



pennsylvania
STATE BOARD OF EDUCATION

April 14, 2022

Honorable Curt Sonney
Majority Chairman
House Education Committee
214 Ryan Office Building
Harrisburg, PA 17120

Honorable Mark Longietti
Minority Chairman
House Education Committee
202 Irvis Office Building
Harrisburg, PA 17120

Dear Chairman Sonney and Chairman Longietti:

Enclosed is a copy of a final-form rulemaking approved by the State Board of Education, (PA Code Cite: 22 Pa. Code Chapter 4 – Academic Standards and Assessment, #006-347) for review by the House Education Committee pursuant to the Regulatory Review Act. The regulation also is being delivered today to the Majority and Minority Chairs of the Senate Education Committee and the Independent Regulatory Review Commission.

The State Board of Education will provide your Committee with any assistance it requires to facilitate a thorough review of this final-form rulemaking. Should you have any questions, please contact me at kamolchano@pa.gov or (717) 346-9449.

Thank you for your consideration.

Sincerely,

Karen Molchanow
Executive Director

cc: Noe Ortega, Secretary of Education
Thomas P. Howell, Esq.
Addie Abelson, Esq.

CDL-1

**FACE SHEET
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<p>Copy below is hereby approved as to form and legality. Attorney General</p> <p>BY: _____ (DEPUTY ATTORNEY GENERAL)</p> <p>_____ DATE OF APPROVAL</p> <p><input type="checkbox"/> Check if applicable Copy not approved. Objections attached.</p>	<p>Copy below is here by certified to be a true and correct copy of a document issued, prescribed or promulgated by:</p> <p><u>State Board of Education</u> (AGENCY)</p> <p>DOCUMENT/FISCAL NOTE NO. <u>6-347</u></p> <p>DATE OF ADOPTION: <u>September 9, 2020</u></p> <p>BY: <u>Karen Holloman</u></p> <p>TITLE <u>Executive Director</u> (EXECUTIVE OFFICER, CHAIRMAN OR SECRETARY)</p>	<p>Copy below is hereby approved as to form and legality. Executive or Independent Agencies.</p> <p>BY: _____ <i>David M. ...</i></p> <p><u>April 13, 2022</u> DATE OF APPROVAL</p> <p>(Chief Counsel, Independent Agency) (Strike inapplicable title)</p> <p><input type="checkbox"/> Check if applicable. No Attorney General approval or objection within 30 days after submission.</p>
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NOTICE OF FINAL RULEMAKING

DEPARTMENT OF EDUCATION
STATE BOARD OF EDUCATION

22 Pa. Code Chapter 4

Academic Standards and Assessment

FINAL RULEMAKING

STATE BOARD OF EDUCATION

[22 PA. CODE CH. 4]

Academic Standards and Assessment

The State Board of Education (Board) amends Chapter 4 (relating to academic standards and assessment) to read as set forth in Annex A. Notice of proposed rulemaking was published at 51 Pa.B. 3103 (June 5, 2021).

Statutory Authority

The Board is acting under the authority of sections 2603-B and 2604-B of the Public School Code of 1949 (24 P.S. §§ 26-2603-B and 26-2604-B).

Purpose

Chapter 4 sets forth requirements for state academic standards, state assessments, and high school graduation for public schools across the Commonwealth, including school districts, area career and technical schools (ACTSs), charter schools, and cyber charter schools. This final rulemaking replaces the academic standards for Science and Technology and Environment and Ecology, as set forth in the current Appendix B, with the updated standards in the new Appendix B-1 and establishes a timeframe for implementation of updated standards. The final rulemaking also makes technical amendments unrelated to academic standards to align other provisions of the Chapter with changes to the Public School Code of 1949 enacted by Act 136 of 2020, Act 158 of 2018, Act 6 of 2017, Act 16 of 2019, and Act 76 of 2019.

Background

Businesses and industries involved in Science, Technology, Engineering, and Mathematics (STEM) are growing in Pennsylvania, driving a demand for skilled and well-educated workers who are prepared to be successful in the 21st century economy. Data from the U.S. Bureau of Labor Statistics shows that STEM-related occupations have remained resilient during the economic crisis ignited by the COVID -19 pandemic. Employment projections from the U.S. Bureau of Labor Statistics further show that STEM occupations are projected to grow by 8% through 2029, with an annual mean salary of \$89,000. This is nearly parallel to the Pennsylvania Workforce Needs Assessment 2016-2026 that shows STEM jobs are predicted to grow at a rate of approximately 9 percent through 2026, and that there are more than 13,000 unfilled computer science and software development jobs. Pennsylvania's scholars need to be equipped with the knowledge, skills, and experiences that prepare them to enter into and be successful in the workforce.

To best prepare students for the STEM economy and the 21st century workforce, the Pennsylvania Department of Education's (Department) work is guided by a vision for equity, innovation, and openness. The Department strives to establish a culture for learning across the Commonwealth that ensures every student can be included in high quality science education. *Pennsylvania's Integrated Standards for Science, Environment, Ecology, Technology, and Engineering (K-5), Pennsylvania's Integrated Standards for Science, Environment and Ecology (6-12), and Pennsylvania's Technology*

and Engineering Standards (6-12) were established on the following foundational principles:

- Every student is capable of science, engineering, technological and environmental literacy.
- Science, engineering, technology, environment and ecology should be explored through an integrated and active learning process.
- Iteration and reflection are a critical component of the learning process.
- Success depends upon the partnerships between educators, students, families, postsecondary providers and institutions, legislators, businesses and industries.

The process for reviewing and revising the state's current Science and Technology & Environment and Ecology standards, which were adopted in 2002, was guided by the Department's vision for learning and grounded in these core principles.

The Board, in September 2019, directed the Department to begin the process of updating Pennsylvania's current Academic Standards for Science and Technology and Academic Standards for Environment and Ecology. Since their adoption in 2002, cognitive science has improved the understanding of how students learn and revealed the requirement for students to have a deeper knowledge of a complex and rapidly changing world. Pennsylvania's science standards must reflect this growing body of research so every student has a rigorous, responsive and just vision for science learning, equipping them with the skills to be successful in career and citizenry.

To begin the review process, the Department, in collaboration with the American Institutes for Research, held 14 stakeholder engagement sessions across Pennsylvania

from February through March 2020 to gather feedback on updating Pennsylvania’s academic standards for science. The stakeholder sessions were held both in person and virtually. More than 951 members of the public provided input at these sessions, including elementary and secondary educators (35 educators from grades PreK-2, 77 educators from grades 3-5, 157 educators from grades 6-8, and 214 educators from grade 9-12), 164 school administrators, 27 Intermediate Unit staff, 88 postsecondary educators, and 131 business and industry representatives. Stakeholder sessions also were attended by student teachers, representatives of community not-for-profit organizations, parents, and students.

In addition to the stakeholder sessions, the Department surveyed stakeholders and further collected data from surveys that organizations, including the Pennsylvania Science Teachers Association, conducted. Stakeholder feedback was captured in a report, *“Science and Technology & Environment and Ecology Standards: A National Landscape Scan and Pennsylvania Stakeholder Feedback,”* that summarized the current research and best practices regarding science, environment, ecology, technology and engineering standards. That report was presented to the Board at a public meeting in May 2020 and, at the same time, was made available to members of the public.

In April 2020, the Department solicited applications from interested members of the public to serve on committees to review and revise the state’s science standards. Applicants were nominated to serve on committees through a multi-reviewer process on the basis of their depth and breadth of expertise in: curriculum and standards development, understanding of the existing standards and current research, equity and access in education and meeting needs of diverse learners, and overall education

experience. Recommendations for individuals to serve on the Science Standards Content Committee and Steering Committee were considered by the Board at a public meeting and the Board approved nominees to serve on the Committees in May 2020.

In June and July of 2020, the committees met to review the initial stakeholder input gathered by the Department, as well as research-based frameworks and guidelines—such as the National Research Council’s (NRC’s) *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012), the North American Association for Environmental Education’s (NAAEE) *K-12 Environmental Education: Guidelines for Excellence* (2019), the Ecological Society of America’s (ESA) *Four-Dimensional Ecology Education (4DEE) framework* (2018), the International Technology and Engineering Educators Association’s (ITEEA) *Standards for Technological and Engineering Literacy (STEL)* (2020), the International Society for Technology in Education’s (*ISTE*) *Standards for Students* (2019), the National Council for Agricultural Education (NCAE) *Agriculture Food and Natural Resources (AFNR) Career Cluster Content Standards* (2015), and other national and international frameworks. Committee members also reviewed relevant information from Pennsylvania-specific documents, such as Pennsylvania’s existing academic standards for Science and Technology and academic standards for Environment and Ecology, to inform the development of recommended revised standards. Committee members collaborated to identify key content within those research-informed frameworks and other key national and international standards in science, environment, ecology, technology, engineering, and agriculture. They sought to identify cross-content connections while adding

sustainability, Pennsylvania Career Ready Skills, and other Pennsylvania-specific contexts.

Over nine full-day convenings, committee members discussed the essential elements of academic standards. Attention to equity and access surfaced as foundational in the development of the standards recommendations. Equity in the context of the standards can be defined as a foundation of knowledge and skills critical for and accessible to all students, as well as “a characteristic of the instructional environment that increases the capacity for everyone to participate in meaningful learning” as described by Windschitl, Thompson, and Braaten in their 2018 publication “*Ambitious Science Teaching*.” This begins with standards that are crafted to allow for the individual and personalized experiences, knowledge, and skills students bring with them to the classroom.

Following recommendations from current research to ensure equitable opportunities exist for all students, committee conversations, and research indicating how students learn best, committee members worked over a series of 30 additional meetings to draft recommendations for revised state science standards. Interspersed throughout the drafting process, a series of focus groups engaged students, educators, and business and industry representatives to garner additional input and feedback on the committees’ work. Special care was made to ensure representatives of small business, along with students and educators from diverse backgrounds, were included in the focus groups. An invitation to provide input was extended to representatives of small businesses to satisfy a standard established in the Regulatory Review Act that requires agencies to solicit ideas and comments from small businesses and to examine the impact of a proposal on such

businesses. The outgrowth of these efforts resulted in a set of recommended standards drafted with an attention to the committees' commitment to equity and inclusivity to open doors to STEM fields for all students. Therefore, these socially mediated practices embedded in the standards provide an equitable on-ramp for all students as they transition their developing and experience-based notions of the scientific world to conceptions that are scientifically-based.

The committees' recommendations for updated standards – reflected in the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)* – were developed in parallel to ensure consistency, coherence, and a cohesive K-12 integrated approach to science education in Pennsylvania.

These recommendations for updated science standards were considered and adopted by the Board at a public meeting on September 9, 2020. Drafts of the proposed standards were posted to the Board's website in advance of the meeting so that members of the public could access the content that was the subject of the Board's deliberations.

In addition to the substantive effort to update the state's academic standards for science, the Board identified a need to review Chapter 4 for consistency with recent changes enacted to the Public School Code of 1949. This review identified five acts of the General Assembly, enacted since the most recent promulgation of Chapter 4 – Act 136 of 2020, Act 158 of 2018, Act 6 of 2017, Act 16 of 2019, and Act 76 of 2019 – that either added new sections or amended existing sections of the Public School Code and

address existing subject matter in Chapter 4. To address inconsistencies between the Public School Code and Chapter 4 resulting from these Acts, the Board undertook an effort to integrate a comprehensive set of technical amendments into its proposed rulemaking to conform Chapter 4 with changes to statute and to create consistency for affected parties. Technical amendments adopted in the Board's proposed rulemaking were maintained in the final-form rulemaking.

Technical amendments were presented at the same time the Board considered substantive amendments to science standards to create efficiency in the rulemaking process. Technical amendments address provisions governing high school graduation requirements, Keystone Exams, compulsory school age, and terminology updates. The Board identified a need to amend requirements related to Keystone Exams and high school graduation requirements to conform to changes enacted by Act 6 of 2017 that scaled back the number of Keystone Exams to be developed and established a new pathway to satisfy graduation requirements for eligible students pursuing career and technical education.

The Board further identified a need to amend requirements established in Chapter 4 related to Keystone Exams and high school graduation requirements to conform to changes enacted by Act 136 of 2020 and Act 158 of 2018. Act 158 put in place broad changes to graduation requirements that were not in concert with the existing provisions of Chapter 4, including creating additional pathways to satisfy state graduation requirements, extending the effective date for the use of Keystone Exams as part of graduation determinations, modifying requirements for administering and participating in both supplemental instruction and project-based assessment, establishing new parameters

for issuing waivers to students who do not meet state graduation requirements, and establishing new reporting requirements related to how students graduate. Act 136 further delayed the use of Keystone Exams as a graduation requirement to the 2022-23 school year.

The breadth of amendments enacted in Act 6 of 2017, Act 158 of 2018, and Act 136 of 2020 necessitated updates to Chapter 4 to ensure that students, parents, educators, and school administrators have a clear understanding of the state's expectations for high school graduation and that Chapter 4 does not with these provisions.

In Act 76 of 2019, the General Assembly adopted comprehensive terminology updates to the Public School Code of 1949 to replace the term "vocational-technical education" with "Career and Technical Education" and to replace the term "Area Vocational-Technical School" with "Area Career and Technical School." The Board identified a need to update the same terminology used throughout Chapter 4 to be parallel with terminology now used in statute.

Finally, Act 16 of 2019 enacted changes to the Public School Code of 1949 that included reducing the compulsory school age from age 8 to age 6. A review of this Act identified a need to update an existing provision of Chapter 4 pertaining to primary education to reflect the lowering of the compulsory school age.

The Board's proposed rulemaking was published in the *Pennsylvania Bulletin* for a 30-day public comment period on June 5, 2021. The Board received and considered comments from educators, environmental organizations, legislators, the Department of Conservation and Natural Resources, county conservation districts, professional

associations, and the public, as well as comments from the Independent Regulatory Review Commission (IRRC). Commentators raised concerns about whether certain content relevant to Environment, Ecology, and Agriculture either was omitted or weakly linked in the proposed new academic standards. Other commentators asked the Board to consider refinements to content addressed elsewhere in the proposed new standards.

The Board's Committee on Academic Standards/Chapter 4 – the Standing Committee of the Board delegated responsibility for preparing revised regulations for recommendation to the Board – met on September 8, 2021 to consider next steps on the proposed rulemaking in response to public comment. To address stakeholder concerns specific to the content of the proposed new standards and to facilitate building consensus surrounding those concerns, the Academic Standards/Chapter 4 Committee determined that it would be prudent to seek additional input from content experts. As such, the Academic Standards/Chapter 4 Committee directed the Department to reconvene the Science Standards Content Committee and Steering Committee, designated through action of the Board in May 2020, to develop additional recommendations for the Committee's consideration. The Academic Standards/Chapter 4 Committee adopted a detailed charge to the Science Standards Content and Steering Committees requesting that those external advisory bodies review and formulate recommendations on how, or whether, all academic content-related concerns raised by stakeholders should be addressed in the proposed new standards.

The Science Standards Content and Steering Committees met extensively throughout the fall of 2021 to consider and respond to the charge presented to them. On December 1, 2021, the Academic Standards/Chapter 4 Committee held a special meeting

to receive recommendations from the Content and Steering Committees on stakeholder concerns related to the academic content of the new proposed standards. Those recommendations were presented in an open public meeting, were made publicly accessible on the Board’s website, and were considered closely by the Board over the next few weeks.

On January 13, 2022, the Board adopted final-form amendments to 22 Pa. Code Chapter 4 as recommended by the Academic Standards/Chapter 4 Committee and the Council of Basic Education. These final-form amendments update the new science standards to reflect the recommendations developed by the Board’s appointed advisory bodies of content experts. In response to stakeholder concerns, the Board has made changes in the final-form regulations to include the addition of a new fifth domain for “Environmental Literacy and Sustainability,” which was added to the standards across all grade levels. That new fifth domain incorporates essential principles of environmental education organized under the following three core ideas: 1) Agricultural and Environmental Systems and Resources, 2) Environmental Literacy Skills, and 3) Sustainability and Stewardship. The final-form rulemaking also makes additional clarifying amendments in response to comments submitted by IRRC.

Need for the rule

Academic standards define what students should know and be able to do at specific grade levels. They establish goals for student learning. Academic standards do not represent a particular curriculum or instructional methodology. Rather, they provide a foundation for the development of local curriculum and serve as guideposts to which local curriculum should be aligned.

As it pertains to the state's academic standards for science, this final-form rulemaking is necessary for three reasons.

First, it is essential to set forth the academic standards that will serve as the substantive underpinning for high-quality instruction and assessment in the Commonwealth. Therefore, the Board is adopting the Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology, and Engineering (Grades K-5), Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12), and the Pennsylvania Technology and Engineering Standards (Grades 6-12) as set forth in Appendix B-1.

Second, this final-form regulation is necessary for the Commonwealth to remain academically and economically competitive with other American public education systems and economies, including those in neighboring states. As of the 2020-21 school year, Pennsylvania's current Science and Technology and Environment and Ecology Standards were 18 years old. Since 2013, science standards have been updated in 44 states across the country according to data compiled by the American Institutes for Research. The final-form updates to Pennsylvania's standards are designed to provide every student in the Commonwealth with the knowledge and skills to be successful in the 21st century global economy.

Third, it is critical that the standards are inclusionary of and accessible for all students and educators in Pennsylvania. The standards have been designed to integrate the knowledge and skills core to the science, technology, engineering, environment, and ecology disciplines while making explicit connections with Math, Language Arts, and the Pennsylvania Career Ready Skills framework. The standards lay the foundation for

students to apply knowledge and skills from known situations to novel contexts. The integrative nature of the standards makes explicit connections for educators and breaks down artificially created content “silos” to inspire connected student learning, preparing them for the workforce.

The final-form rulemaking further is necessary to address inconsistencies between statute and existing provisions of Chapter 4 caused by changes enacted to the Public School Code of 1949 by the General Assembly. Incorporating a comprehensive set of technical amendments to conform Chapter 4 with changes in statute will create alignment across state-level education policies and create consistency for affected stakeholders in understanding expectations.

Provisions of the Final Rulemaking

The final-form rulemaking amends the following provisions in Chapter 4:

Section 4.3. Definitions.

The existing definition of “AVTS–Area Vocational-Technical School” is being replaced with a definition for “ACTS–Area Career and Technical School.” Within the definition, the term “vocational-technical education” is being updated to refer to “career and technical education.” These revisions reflect technical amendments to align the regulation with parallel terminology updates that were made globally throughout the Public School Code of 1949 by Act 76 of 2019. Technical amendments are incorporated throughout relevant sections of the final-form rulemaking to make existing references to AVTSs consistent with final revisions to this definition.

The final-form rulemaking deletes the existing definition for “Vocational-technical education” and replaces it with a new definition for “Career and Technical Education.” No

changes are proposed to the narrative description of the definition as it appears under the existing definition of “Vocational-technical education.” The final amendments only replace the term being defined with the more current language (“career and technical education”) that was incorporated throughout the Public School Code of 1949 by Act 76 of 2019. Technical amendments are incorporated throughout relevant sections of the final-form rulemaking to replace existing references to “vocational-technical education” with “career and technical education,” making language consistent with final revisions to this definition and consistent with terminology now used in statute. This includes updating the terminology used in the existing definitions of “Cooperative vocational-technical education”, “Employment area”, “School entity”, and “School organization”, as well as deleting the existing definition of “Vocational-technical education”.

Section 4.4. General Policies

Cross-references to Section 4.51b(j) (relating to Keystone Exams) were deleted from Section 4.4(e)(1) and Section (4.4)(e)(3). Language in the original cross-reference set forth a schedule for the development of Keystone Exams in English Composition, Civics and Government, Geometry, U.S. History, Algebra II, Chemistry, and World History. However, Act 6 of 2017 amended Section 121(a) of the Public School Code to remove the requirement for the Department to development Keystone Exams in those subjects. Therefore, language in the existing Section 4.51b(j) is being deleted from the regulation for consistency with changes enacted to the Public School Code and, as such, cross-references to that existing subsection are being deleted throughout Section 4.4.

Section 4.11. Purpose of public education.

In Sections 4.11(g)(3) and 4.11(g)(4), the Board is aligning the existing references to academic content areas with the structure of the new science standards established in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii). These revisions are presented to create consistency with the substantive changes to the academic standards in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii).

Section 4.12. Academic standards.

Final amendments to Sections 4.12(a)(1)(i-ii) and 4.12(a)(2)(i-iii) sunset the current academic standards in Science and Technology and Environment and Ecology (published in Chapter 4 as Appendix B) on June 30, 2025, and establish three new sets of academic standards in science that take effect July 1, 2025. New science standards, which will be published in Chapter 4 as Appendix B-1, are organized as follows: Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5), Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12), and Pennsylvania Technology and Engineering Standards (Grades 6-12).

In the Board's proposed rulemaking, current standards were set to sunset on June 30, 2024, and new science standards were to take effect on July 1, 2024. Final amendments to these sections extend the effective date for transitioning to new academic standards to July 1, 2025, to maintain a commitment to providing a three-year window for implementation. The effective date set forth in final amendments establishes an expectation that new science standards will be fully integrated into classroom instruction by the 2025-2026 school year. Final amendments to these sections also include a narrative description of each set of new academic standards.

In Section 4.12(i), the Board is amending the three-year timeframe for reviewing state academic standards and state assessments established in this section. Final revisions set forth that such reviews be conducted no sooner than every five years and no later than every 10 years. Conducting academic standards reviews every three years may not provide school entities adequate time to fully implement updated academic standards and gain experience in delivering instruction under those standards before commencing a review process that may result in additional modifications to those standards. The Board finds a range of five to ten years between reviews to be a more feasible timeframe.

Section 4.21. Elementary education: primary and intermediate levels.

The Board is amending Section 4.21(a) to reflect a change to the compulsory school age enacted by Act 16 of 2019. Act 16 reduced the age at which compulsory school attendance is required in Pennsylvania from age eight (8) to age six (6). Language in this section speaks to the age at which children ordinarily complete a primary school program and currently references age 8. This language is being revised to align with the statutory change that lowered the age for compulsory attendance to age 6, the age at which students now are required to begin attending a primary school program.

Existing requirements in Section 4.21(e) set forth that planned instruction at the primary level shall align with state academic standards. Changes to Sections 4.21(e)(3) and (e)(4) are editorial for consistency with the structure of new academic standards for science established in Section 4.12 (related to academic standards).

Likewise, amendments to Sections 4.21(f)(3) and (f)(4) also are editorial to create consistency with the structure of new academic standards for science. These editorial changes conform planned instruction topics for intermediate grades, set forth in this

section, with the structure of the Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5) established in Section 4.12(a)(1)(ii) (relating to academic standards).

Section 4.22. Middle level education.

Revisions to Sections 4.22(c)(3) and (c)(5) conform the planned instruction topics for middle level education, set forth in these sections, with the structure of the Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5), Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12), and Pennsylvania Technology and Engineering Standards (Grades 6-12) established in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii). These editorial changes create consistency with substantive changes in Section 4.12 (related to academic standards).

Section 4.23. High school education.

Revisions to Sections 4.23(c)(3) and (c)(5) conform the planned instruction topics for high school set forth in these sections with the structure of the Pennsylvania Integrated Standards for Science, Environment, and Ecology (6-12) and the Pennsylvania Technology and Engineering Standards (grades 6-12) established in Section 4.12(a)(2)(ii-iii). These editorial changes are create consistency with substantive changes in Section 4.12 (related to academic standards).

Section 4.24. High school graduation requirements.

In Act 136 of 2020, Act 158 of 2018, and Act 6 of 2017, the General Assembly enacted various changes to state high school graduation requirements. Act 6 established new graduation requirements for students who are defined in statute as “CTE Concentrators.” The graduation pathway for CTE Concentrators and the definition of

students who qualify to use this standard to meet graduation requirements are set forth in Sections 121(c-d) of the Public School Code of 1949 (24 P.S. § 1-121(c-d)).

Act 158 expanded the pathways that may be used to demonstrate readiness for graduation for general education students who are not CTE Concentrators. Act 158 also delayed the effective date for use of the high school-level state assessments – Keystone Exams – as a graduation requirement. Among other changes, Act 158 further established that students cannot be required to participate in a project-based assessment to satisfy graduation requirements, set forth that students who do not demonstrate proficiency on a Keystone Exam may be offered supplemental instruction but shall not be required to participate in such supplemental instruction, and permitted the inclusion of Keystone Exam performance results on student transcripts at the discretion of each school entity.

Act 136 of 2020 further delayed the use of Keystone Exams as a graduation requirement to the 2022-23 school year.

The amendments enacted to the Public School Code by Act 136 of 2020, Act 158 of 2018, and Act 6 of 2017 superseded high school graduation policies established by the Board in Chapter 4. To the extent that the aforementioned amendments are in conflict with the existing regulation, the Board is making technical amendments to conform related provisions of Chapter 4 with the changes enacted by Act 136, Act 158, and Act 6 to provide clarity and consistency between statute and regulation.

Section 4.24(a) (high school graduation requirements). Technical amendments to this section extend the date by which local governing boards must approve, publish, and distribute graduation requirements to no later than the beginning of the 2020-2021 school year. The deadline for this action is being extended for consistency with the date now set

forth for such action in Section 121(c.10) of the Public School Code of 1949 (24 P.S. § 1-121(c.10)).

Section 4.24(b) (high school graduation requirements). In its comments on the Board's proposed rulemaking, IRRC noted that Section 4.24(b) set forth high school graduation requirements through the 2015-16 school year and Section 4.24(c) set forth high school graduation requirements beginning in the 2022-23 school year. IRRC noted that graduation requirements for the 2016-17 through the 2021-22 school years were not specified in the regulation and asked the Board to clarify this section to include the graduation requirements for the omitted years. In response to IRRC's request for clarity, the Board amended Section 4.24(b) to specify that the high school graduation requirements set forth in that section remain in effect through the 2021-22 school year. Consistent with the date established in Act 136 of 2020, graduation requirements that include Keystone Exams will take effect in the 2022-23 school year as reflected in amendments to Section 4.24(c).

Sections 4.24(c) and 4.24(c)(1) (high school graduation requirements). Technical amendments to these sections delay the effective date of the sections to the 2022-23 school year. These revisions create consistency with amendments to Section 121(b)(1) of the Public School Code of 1949 (24 P.S. § 1-121(b)(1)) that states "...the use of Keystone Exams as a graduation requirement or as a benchmark for the need for participation in a project-based assessment shall be delayed until the 2022-2023 school year."

Section 4.24(c)(1)(iii) (high school graduation requirements). Existing Board policy requires students to demonstrate proficiency in the current academic standards for Science and Technology and Environment and Ecology in order to satisfy state high school

graduation requirements. In addition, federal accountability policies require high school students to participate in a uniform state assessment in science, and Pennsylvania's Keystone Exam in Biology has been approved by the U.S. Department of Education to satisfy this requirement. Final amendments to Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii) (related to academic standards) and Appendix B-1 replace the existing science standards cited in this section with new academic standards. Therefore, it is necessary to identify relevant content of the new standards that will be assessed for the purposes of high school graduation and federal accountability. Amendments to this section make clear that future determinations related to high school graduation will be based on a student demonstrating proficiency in the new high school-level Science and Environment and Ecology standards presented in Appendix B-1.

Further, in its comments on the Board's proposed rulemaking, IRRC noted that the new standards contained in Appendix B-1 will not take effect immediately. As such, IRRC requested that the Board add clarity to this section by specifying the respective effective dates when the current science standards in Appendix B will sunset and when the new standards in Appendix B-1 will take effect to ensure that the timetables for compliance are accurately stated. Final amendments to this section specify that, for the purposes of high school graduation, students must demonstrate proficiency in the standards in Appendix B through June 30, 2025, and that, beginning July 1, 2025, students must demonstrate proficiency in the Science, Environment, and Ecology standards in Appendix B-1.

Section 4.24(c)(1)(iii)(A) (high school graduation requirements). Technical amendments to this section recognize that students may meet graduation requirements by attaining proficiency on Keystone Exams or by satisfying requirements of one of the

pathways to graduation established by the General Assembly in Section 121(c) and Section 121(c.1) of the Public School Code of 1949 (24 P.S. §§ 1-121(c) and (c.1)). Technical amendments to this section further remove reference to completion of a project-based assessment as a measure of proficiency to satisfy graduation requirements. Removal of the reference to project-based assessment conforms the regulation with Section 121(c.5) of the Public School Code of 1949 (24 P.S. § 1-121(c.5)) that sets forth in statute that school entities may not be required to offer project-based assessments and that students may not be required to participate in or complete project-based assessments as established in Section 4.51(c) of Chapter 4.

Section 4.24(c)(1)(iii)(B)(I) (high school graduation requirements). Existing language in this section sets forth that validated local assessments used for the purpose of demonstrating graduation requirements must align with Biology-related content in current state academic standards. As the Board is updating the academic standards for science in this final rulemaking, revisions to this section identify the relevant new standards in Section 4.12(a)(2)(ii) (related to academic standards) that contain Biology-related content for alignment with this section.

Further, in its comments on the Board's proposed rulemaking, IRRC identified the need to make a clarifying amendment to Section 4.24(c)(1)(iii)(B)(I) to remove the reference to "Civics and Government". This reference is no longer necessary or relevant as Act 6 of 2017 removed the requirement for the Department to establish Keystone Exams in the academic standards related to Civics and Government. As proficiency in standards related to Civics and Government no longer will be determined through state assessments, it is irrelevant to continue referencing Civics and Government in this section of Chapter 4

that defines how validated local assessments can be used as alternatives to Keystone Exams for the purposes of assessing proficiency for graduation in various academic standards.

Section 4.24(c)(1)(iii)(B)(III) (high school graduation requirements). The existing Sections 4.24(d-f) are being deleted in the final-form rulemaking, necessitating technical updates to the identification of the remaining subsections. As a result, the existing subsection 4.24(g) is relabeled sequentially as subsection 4.24(d). Technical amendments presented in Section 4.24(c)(1)(iii)(B)(III) update the existing cross-reference to refer to the appropriate section as it has been relabeled due to amendments elsewhere in the rulemaking.

Section 4.24(c)(1)(iii)(C) (high school graduation requirements). The use of Advanced (AP) and International Baccalaureate (IB) exams for satisfying high school graduation requirements was addressed by the General Assembly in the graduation pathways established by Act 158. Pathways that include consideration of AP and IB exam scores are reflected in Section 121(c.1) of the Public School Code of 1949 (24 P.S. § 1-121(c.1)). Use of these assessments for making graduation determinations, as defined by the General Assembly, is captured in the statutory reference presented in amendments to Section 4.24(c)(1)(iii)(A) of the final-form rulemaking. Therefore, the Board is deleting Section 4.24(c)(1)(iii)(C) as it does not align with statutory amendments regarding the use of AP and IB exam scores as they pertain to high school graduation determinations and a cross-reference to the appropriate use of these exams as defined in statute is incorporated elsewhere in the rulemaking.

Sections 4.24(d) and 4.24(e) (high school graduation requirements). Act 6 of 2017 removed language from statute directing the development of Keystone Exams in English

composition, algebra II, geometry, United States history, chemistry, civics and government, and world history. Therefore, the Board is deleting these sections from the regulation to conform to changes reflected in Section 121(a) of the Public School Code of 1949 (24 P.S. § 1-121(a)) that eliminate Keystone Exams in these content areas. Further, existing language in Section 4.24(d) and 4.24(e) provides for a student to demonstrate proficiency in academic standards in English Language Arts (Composition) and Civics and Government through a pathway including a Keystone Exam. This pathway is no longer feasible due to the elimination of Keystone Exams in these content areas by Act 6 and, as such, the Board is removing the language from Chapter 4.

Section 4.24(f) (high school graduation requirements). In Act 6 of 2017, the General Assembly established graduation requirements for students pursuing Career and Technical Education that are in conflict with the requirements for such students presented in Section 4.24(f). Amendments to the Public School Code of 1949 established a definition for “CTE Concentrator” to define the population of students eligible to graduate under the pathway for CTE Concentrators set forth in Section 121(c) (24 P.S. § 1-121(c)). Graduation requirements for CTE Concentrators are captured in the statutory reference presented in amendments to Section 4.24(c)(1)(iii)(A) of this final-form rulemaking. Therefore, the Board is deleting Section 4.24(f) as its requirements do not align with statutory amendments regarding graduation measures for students who are CTE Concentrators and a reference to the graduation pathway for such students, as defined by the General Assembly, is incorporated elsewhere in the rulemaking.

Section 4.24(d) (former Section 4.24(g)) (high school graduation requirements). Due to the deletion of existing Sections 4.24(d-f), the existing Section 4.24(g) is being

relabeled as Section 4.24(d) to maintain sequential order of the remaining sections. Amendments to the designation for each section are carried through the end of Section 4.24 to update the remaining sections with appropriate sequential references due to the deletion of existing Sections 4.24(d-f).

Section 4.24(f) (former Section 4.24(i)) (high school graduation requirements). The Board is amending requirements for student transcripts set forth in this section to align with requirements as established in Section 121(c.9) of the Public School Code of 1949 (24 P.S. § 1-121(c.9)). Current language in this section of the regulation requires performance levels attained on Keystone Exams, validated local assessments, or project-based assessments to be recorded on student transcripts. The current language is in conflict with changes enacted by Act 158 of 2018 to the aforementioned section of the School Code that permit, but do not require, performance levels demonstrated in each of the state academic standards, including the highest performance level attained on a Keystone Exam, to be included on a student's transcript. The changes enacted by Act 158 grant discretion to each individual school entity to determine whether or not to present this information on transcripts and how such information may be included.

Section 4.24(h) (former section 4.24(k)) (high school graduation requirements). Act 158 of 2018 established Section 121(c.4) of the Public School Code of 1949 (24 P.S. § 1-121(c.4)) governing supplemental instruction offered to students who do not demonstrate proficiency on a Keystone Exam or locally validated assessment. This statutory provision allows school entities to offer supplemental instruction, but prohibits required participation by students in supplemental instruction. Statutory language governing supplemental instruction further requires that such offerings not intrude on time

for participation in Career and Technical Education programming or instruction related to a student’s career, military, or postsecondary education plans. Existing requirements for supplemental instruction established in Section 4.24(h) are in conflict with the changes enacted by Act 158 as the language of the current regulation requires schools to offer supplemental instruction to students who do not demonstrate proficiency on a Keystone Exam or locally validated assessment and also requires students to participate in supplemental instruction. Therefore, the Board is amending this section to align with changes in statute which set forth that students are not required to participate in supplemental instruction and that schools may, but are not required, to offer supplemental instruction.

Section 4.24(i) (former section 4.24(l)) (high school graduation requirements). Revisions to this section make technical edits to reflect the deletion of the existing Sections 4.24(d) and 4.24(e) as described above. Revisions further align this section with language that addresses student transfers from an out-of-state school in Section 121(c.8) of the Public School Code of 1949 (24 P.S. § 1-121(c.8)). Language in the current regulation that directs determinations of proficiency for out-of-state transfer students to be made “subject to guidance developed by the Secretary” is being removed as a parallel requirement does not exist in the aforementioned statutory provision that addresses such determinations.

Section 4.24(m) (high school graduation requirements). The Board is deleting Section 4.24(m) as the transitions facilitated under it are no longer relevant. As discussed earlier, Act 6 of 2017 removed language from the Public School Code directing the Department to develop Keystone Exams in additional content areas beyond the exams already administered in Literature, Algebra I, and Biology. Sections 4.24(d) and 4.24(e)

are being deleted to conform with that change in statute. Therefore, language in this section that addresses successfully effectuating transitions to the existing requirements of Sections 4.24(d) and 4.24(e) is no longer relevant as Keystone Exams will not be developed in the academic standards identified in those sections. Further, language that addresses transition between Sections 4.24(b) and 4.24(c) is no longer relevant as it addresses requirements for the 2015-2016 and 2016-2017 school years that did not take effect due to delays in the implementation of Keystone Exams as amended in Section 121(b)(1) of the Public School Code of 1949 (24 P.S. § 1-121(b)(1)).

Section 4.24(i) (high school graduation requirements). The Board is adding this new subsection to conform the regulation with Section 121.1 of the Public School Code of 1949 (24 P.S. § 1-121.1). This technical amendment addresses conditions set forth in statute that suspend state requirements for students to take Keystone Exams in any year where the federal government waives testing and accountability and requirements and, alternatively, provides for a student to be deemed proficient for the purposes of meeting the high school graduation requirements set forth in Section 4.24 by demonstrating successful completion of locally-established, grade-based requirements for the academic content areas associated with each Keystone Exam. Final revisions to Section 4.24(i) also reflect a clarifying amendment requested by IRRC to include a citation to the Every Student Succeeds Act following cross-reference to the Elementary and Secondary Education Act.

Section 4.31 (Career and Technical Education). As described in revisions to Section 4.3 (relating to definitions), updated terminology replacing “vocational-technical education” with Career and Technical Education is presented throughout Section 4.31 and other relevant sections of the final-form rulemaking.

Section 4.31(a) (Career and Technical Education). Amendments made earlier in this rulemaking reorganize Section 4.24(g) as Section 4.24(d). Section 4.31(a) includes a technical amendment to refer to the appropriate cross-reference as it is relabeled elsewhere in the final regulation to maintain sequential ordering.

Section 4.51 (State assessment system).

Section 4.51(a)(6) (State assessment system). Section 4.51 sets forth the purpose of the state assessment system and identifies the academic standards through which student proficiency is measured on a state assessment. State assessments aligned with current standards for Science and Technology and Environment and Ecology are administered at three points in a student's educational career – grade 4, grade 8, and following completion of coursework in Biology. Final amendments to Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii) will replace the standards to which these state assessments (the Pennsylvania System of School Assessment in Science and the Keystone Exam in Biology) are aligned. As such, the Board is amending Section 4.51(a)(6) to align state assessments administered in Science with the new science standards established in Appendix B-1 of this rulemaking.

Further, in its comments on the Board's proposed rulemaking, IRRC noted that the new standards contained in Appendix B-1 will not take effect immediately. As such, IRRC requested that the Board add clarity to this section by specifying the dates when state assessments will transition from being aligned to the current science standards in Appendix B to the new standards in Appendix B-1 to ensure that the timetables for compliance are accurately stated. In response to IRRC's request for clarity, final amendments to Section 4.51(a)(6) specify that state assessments in science will be aligned to the standards in Appendix B through June 30, 2025, and that, beginning July 1, 2025, state assessments in

science will be aligned to the standards in Appendix B-1. These timeframes are consistent with the effective date for full implementation of the new standards in Appendix B-1 established in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii) and clarify that updated state assessments aligned with new academic standards will not occur until the end of the implementation period for fully integrating new standards into instruction.

Section 4.51a (Pennsylvania System of School Assessment).

Section 4.51a sets forth requirements for the Pennsylvania System of School Assessment (PSSAs). The PSSAs are state assessments administered in English Language Arts and Mathematics in grades 3 through 8 and in Science at grades 4 and 8.

Section 4.51a(a) directs the Department to develop PSSA exams that are “standards-based and criterion referenced” and delineates the standards in which PSSAs are administered, including the current academic standards in Science and Technology and Environment and Ecology. As noted above, in this final rulemaking the Board is adopting new academic standards for science. Revisions to section 4.51a(a) and its paragraphs align references to academic standards for science with the structure of the new science standards in Appendix B-1 of this rulemaking.

Further, in its comments on the Board’s proposed rulemaking, IRRC noted that the new standards contained in Appendix B-1 will not take effect immediately. As such, IRRC requested that the Board add clarity to Section 4.51a(b) by specifying the dates when the Grade 4 and Grade 8 PSSAs in Science will transition from being aligned to the current science standards in Appendix B to the new standards in Appendix B-1 to ensure that the timetables for compliance are accurately stated. In response to IRRC’s request for clarity, final amendments to Section 4.51a(b) specify that PSSAs in science will be aligned to the

standards in Appendix B through June 30, 2025, and that, beginning July 1, 2025, the PSSAs in science will be aligned to the new standards in Appendix B-1. These timeframes are consistent with the effective date for full implementation of the new standards in Appendix B-1 established in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii) and clarify that updated PSSAs aligned with new academic standards will not occur until the end of the implementation period for fully integrating new standards into instruction.

Final amendments to Section 4.51a(c) are presented for consistency with earlier technical amendments to align references to the current academic standards in Science and Technology and Environment and Ecology with the structure of the new standards in Appendix B-1.

Section 4.51b (Keystone Exams).

Section 4.51b contains requirements for Keystone Exams. The Keystone Exams are high school level state assessments administered in Algebra I, Literature, and Biology. At present, content on these state assessments is aligned to the academic standards for Mathematics, English Language Arts, Science and Technology, and Environment and Ecology.

The Board is making technical amendments to conform Sections 4.51b(a)(1-4) with changes enacted by Act 6 of 2017. Act 6 removed language from Section 121(a) of the Public School Code (24 P.S. § 1-121(a)) that directed the Department to develop Keystone Exams in additional content areas beyond the existing exams for Literature, Algebra I, and Biology. Therefore, provisions in Sections 4.51b(a)(1-4) that direct the Department to develop Keystone Exams in Algebra II, Geometry, composition, American history, world history, and civics and government are in conflict with changes to statute. Revisions to

these sections remove language directing the development of Keystone Exams in content areas that no longer are included in statute and update language for grammatical consistency.

In addition, amendments to Section 4.51b(a)(3) (former Section 4.51b(a)(4)) provide for the Keystone Exam in Biology to be updated to align to the new Pennsylvania Integrated Standards for Science, Environment and Ecology (grades 6-12) contained in Appendix B-1 of this final-form rulemaking. In its comments on the Board's proposed rulemaking, IRRC noted that the new standards contained in Appendix B-1 will not take effect immediately. As such, IRRC requested that the Board add clarity to Section 4.51b(a)(3) by specifying the dates when the Keystone Exam in Biology will transition from being aligned to the current science standards in Appendix B to the new standards in Appendix B-1 to ensure that the timetables for compliance are accurately stated.

In response to IRRC's request for clarity, final amendments to Section 4.51b(a)(3) specify that the Keystone Exam in Biology will be aligned to the standards in Appendix B through June 30, 2025, and that, beginning July 1, 2025, the Keystone Exam in Biology will be aligned to the new standards in Appendix B-1. These timeframes are consistent with the effective date for full implementation of the new standards for grades 6-12 in Appendix B-1 established in Section 4.12(a)(2)(ii-iii).

Later in Section 4.51b(d), the Board is making technical amendments to conform the section with changes enacted by Act 158 of 2018. Through the addition of Section 121(c.4) to the Public School Code of 1949 (24 P.S. § 1-121(c.4)), Act 158 prohibits the required participation of students in supplementary instruction, which is inconsistent with existing language in Section 4.51b(d) that creates conditions regarding eligibility to retake

a Keystone Exam that require successful completion of supplementary instruction as a prerequisite. Act 158 further addressed the matter of Keystone Exam retakes in the addition of Section 121(c.7) to the Public School Code of 1949 (24 P.S. § 1-121(c.7)). Statutory language in that new section permits a student to retake a Keystone Exam only if the student or parent submits a written request. Existing language in Section 4.51b(d) does not specify that requests to retake a Keystone Exam must be submitted in writing. Therefore, revisions are being made to Section 4.51b(d) to align language in the regulation with relevant changes enacted by Act 158 that address supplementary instruction and Keystone Exam retakes.

In Section 4.51b(f), the Board is making technical amendments to conform the section with statutory changes enacted by Act 158 of 2018. As noted above, Act 158 prohibits required participation of students in supplemental instruction, as set forth in Section 121(c.4)(5) of the Public School Code of 1949 (24 P.S. § 1-121(c.4)(5)). Therefore, language regarding the provision of supplemental instruction in this section is being amended to replace the term “shall” with the term “may” to recognize that a student cannot be required to participate in supplemental instruction offerings.

Additional amendments to Section 4.51b(f) are being made to conform with Section 121(c.5) of the Public School Code of 1949 (24 P.S. § 1-121(c.5)) which establishes that no school entities may be required to offer project-based assessments and students may not be required to participate in or complete a project-based assessment. Existing language in Section 4.51b(f) is inconsistent with these statutory changes as it would require a student to complete a project-based assessment if other conditions established in the section are not met. Therefore, the Board is removing language requiring students to complete a

project-based assessments in certain circumstances to align Section 4.51b(f) with provisions governing project-based assessment as they now are set forth by the General Assembly in statute.

A technical amendment to the statutory cross-reference in Section 4.51b(f) also was made in the final rulemaking to make the citation complete.

Sections 4.51b(j-k) are being deleted to conform with changes enacted by Act 6 of 2017 that eliminated language directing the Department to develop Keystone Exams in Algebra II, Geometry, composition, civics and government, world history, U.S. history and chemistry. These sections are no longer relevant as Keystone Exams in these content areas will not be developed.

Section 4.51b(j) (former Section 4.51(b)(1)) is being amended to recognize that the federal Elementary and Secondary Education Act has been reauthorized as the Every Student Succeeds Act (Pub. L. No. 114-95) and that Keystone Exams will continue to serve as the approved high school level accountability system under that Act or its successor federal statute. As requested by IRRC, final amendments to this section remove reference to the No Child Left Behind Act and, for clarity, replace that with reference to its current successor federal statute – the Every Student Succeeds Act.

The Board also is amending Section 4.51b(j) (former Section 4.51(b)(1)) to remove language that speaks to prospective approval of the Algebra I, Literature, and Biology Keystone Exams by the U.S. Department of Education as such approval already has been granted. The section also includes a technical amendment updating the term “AVTSs” to “ACTSs,” consistent with parallel terminology changes that are incorporated throughout the Chapter.

Finally, the citation for Section 4.51b(l), along with citations for Sections 4.51b(k-n), are being relabeled to maintain sequential order of provisions due to the deletion of existing Sections 4.51b(j-k).

Section 4.51c (project-based assessment).

Amendments to Section 4.51c conform the section with changes enacted by Act 6 of 2017 and Act 158 of 2018 and with a technical revision requested by IRRC.

Language in the existing Section 4.51c(a) that directs project-based assessments to be developed in composition and civics and government that are aligned to the modules of the Keystone Exams is being deleted. Act 6 of 2017 eliminated the development of Keystone Exams in composition and civics and government. Thus, developing project-based assessments in those content areas is no longer relevant as there will be no Keystone Exam modules in those content areas to which a project-based assessment could be aligned.

A reference to Section 121(c.5) of the Public School Code of 1949 (24 P.S. § 1-121(c.5)) that governs participation in project-based assessment is being added by the Board for clarity in the permissible use of project-based assessment by school entities and for alignment with statutory changes that do not require districts to administer project-based assessment and that prohibit the required participation of students in project-based assessment.

The Board is deleting Sections 4.51c(b-g) to further conform the regulation with Section 121(c.5) of the Public School Code of 1949 (24 P.S. § 1-121(c.5)). Language in these sections sets forth requirements for the administration of project-based assessment and establishes criteria that may make a student eligible to participate in a project-based assessment, which is in conflict with Section 121(c.5) that does not require school entities

to offer project-based assessments and prohibits required participation of students in project-based assessments.

Finally, as directed by IRRC, the subsection “(a)” designation is being deleted from Section 4.51c in accordance with Section 2.1(e) of the *Pennsylvania Code and Bulletin Style Manual*.

Section 4.51d (waivers).

Act 158 of 2018 added Section 121(c.3) to the Public School Code of 1949 (24 P.S. § 1-121(c.3)) that addresses the circumstances in which chief school administrators may grant waivers to demonstrations of proficiency required for high school graduation. Waiver provisions established in Section 4.51d, including those related to the percentage of students who may qualify to receive a waiver, are inconsistent with the waiver requirements now established in statute. As such, the Board is deleting language in Section 4.51d, Sections 4.51d(1)(i-iv), and Section 4.51d(2) to create clarity surrounding waiver requirements by replacing this language with a reference to the waiver requirements established by the General Assembly in Section 121(c.3) to the Public School Code of 1949 (24 P.S. § 1-121(c.3)).

The citation for existing Section 4.51d(3) is being reorganized as Section 4.51d(1) to align with the deletion of the subsections preceding it. Within that section, the Board is incorporating an additional technical amendment to ensure annual reporting on the number of waivers issued to students is conducted in a manner consistent with the reporting requirements for waivers set forth in Section 121(c.11)(6) of the Public School Code of 1949 (24 P.S. § 1-121(c.11)(6)).

The Board also is eliminating Section 4.51d(6) as it refers to action that would occur under paragraph (2) of Section 4.51d and this final-form rulemaking deletes paragraph (2).

Finally, within Section 4.51d, as well as within Sections 4.24, 4.51b, and 4.51c, the Board is making technical corrections to the *Purdon's* citations to sections 121 and 121.1 of the Public School Code of 1949 as directed by IRRC. Throughout those sections, the citations were corrected to include the “1-” formatting that was omitted from each citation.

Appendix B-1. The Board is publishing Appendix B-1 as a new Appendix in the regulation. Appendix B-1 contains three sets of new academic standards for science as follows: *Pennsylvania Integrated Standards for Science, Environment, Ecology, Environment and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and *Pennsylvania Technology and Engineering Standards (Grades 6-12)*.

As described earlier, final amendments to Section 4.12(a)(1)(ii) and Sections 4.12(a)(2)(ii-iii) set forth a July 1, 2025, effective date for the new standards in Appendix B-1. Final amendments to Section 4.12(a)(1)(i) and Section 4.12(a)(2)(i) address the current science standards published in Appendix B and set forth that those standards will no longer be in effect as of June 30, 2025.

The state's current *Academic Standards for Science and Technology* and *Academic Standards for Environment and Ecology*, adopted in 2002 and published as Appendix B within 22 Pa. Code Chapter 4, were organized by topics of what students should know and be able to do by the end of fourth, seventh, tenth and eleventh grades. The new standards contained in Appendix B-1 of the final-form regulation reflect a shift to grade level expectations for kindergarten through fifth grade, allowing for clear learning progressions

by grade in elementary school, and reflect a shift to grade bands for 6-8 and 9-12 allowing for greater flexibility in course design and progression at the middle and high school levels.

The current *Academic Standards for Science and Technology* and *Academic Standards for Environment and Ecology*, adopted in 2002, also were organized into two separate sets of standards. As they pertain to the earliest grades, the new standards presented in Appendix B-1 of the final regulation reflect integration of Environment, Ecology, Science, Technology, and Engineering education for kindergarten through fifth grade. The integration of Science, Environment, Ecology, Technology, and Engineering into one document for kindergarten through fifth grades systemically ensures equity of the content covered at these early grades and enables educators to expose students to the interconnected nature of Science, Environment, Ecology, Technology, and Engineering at the earliest grades. Further, the integration of Science, Environment, Ecology, Technology, and Engineering, along with their application, reflects how these disciplines are practiced in the real world.

The standards contained in Appendix B-1 of the final-form rulemaking also reflect a shift to the integration of Science with Environment and Ecology for grades 6-12, encouraging integration across the Science disciplines while promoting equity by ensuring the Environment and Ecology content is included in Science instruction for all students across all grades.

Finally, the state's current *Academic Standards for Science and Technology* and *Academic Standards for Environment and Ecology*, adopted in 2002, were organized into two separate sets of standards documents with Technology and Engineering integrated across each set of standards. The standards presented in Appendix B-1 of the final-form

rulemaking separate Technology and Engineering standards from the Science, Environment and Ecology standards for grades 6-12. The Board determined to present Technology and Engineering standards for grades 6-12 as a standalone document in order to provide the necessary content depth and breadth for related courses and experiences in middle and high school programs. Further, organizing these standards by grades bands provides flexibility for school districts in high school course offerings that sometimes include mixed grade levels in a course.

The new standards presented in the final-form rulemaking are informed by seminal research in science, technology, environment, and ecology education, such as the National Research Council's *"A Framework for K-12 Science Education, Standards for Technology and Engineering Literacy"* and the Environment and Ecology framework of the North American Association for Environmental Educators. In addition, the final-form regulation considers the Pennsylvania context with clear connections to agriculture, career readiness, and sustainability. The final regulation shifts away from a focus on the regurgitation of disciplinary content to a multi-dimensional approach for teaching and learning that includes cross-content connections such as the understanding of "scale, proportion, and quantity" and "systems and system models", disciplinary core ideas such as "physical sciences" or "life sciences", and practices like "developing and using models" or "analyzing and interpreting data". The final-form regulation sets the conditions for students to work and learn across these multiple dimensions by better preparing students to apply skills and concepts in a novel context and demonstrating knowledge and skills gained through the learning experiences.

Within the framework described above, the Board made numerous amendments to the standards in its final-form rulemaking in response to concerns raised by stakeholders during public comment.

To ensure that new academic standards reflect essential principles of environmental education, as suggested by stakeholders, the Board added a new fifth domain for “Environmental Literacy and Sustainability” to the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Environment and Engineering (Grades K-5)* and to the *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*. This fifth domain incorporates essential principles of environmental education across all grade levels organized under three core ideas: 1) Agricultural and Environmental Systems and Resources, 2) Environmental Literacy Skills, and 3) Sustainability and Stewardship. The addition of this fifth domain is responsive to stakeholder concerns indicating that certain content related to environment, ecology, and agriculture either was omitted or weakly linked in the Board’s proposed standards, and also is responsive to the Pennsylvania Environmental Education Act’s charge to fully integrate environmental education into K-12 education.

Content in this new fifth domain was developed using standards and guidelines from relevant professional organizations, including the National Council for Agriculture, Food, and Natural Resources and North American Association of Environmental Educators, as well as Pennsylvania’s current Environment and Ecology standards, environmental education research, and examples of how other states address environmental literacy and sustainability (including California, Louisiana, Maryland, Virginia, Washington, and Wisconsin).

The *Pennsylvania Integrated Standards for Science, Environment, Ecology Environment and Engineering (Grades K-5)* presented in the Board’s proposed rulemaking included grade band standards for “Environment and Ecology” for grades K-2 and for grades 3-5. The proposed K-2 and 3-5 grade band standards for “Environment and Ecology” each were reorganized in the final-form rulemaking under a new domain for “Environmental Literacy and Sustainability” for consistency with how this domain is presented in standards across all grade levels. In addition, content in the proposed K-2 grade band and in the proposed 3-5 grade band for “Environment and Ecology” also was revised in response to this reorganization to reflect content that stakeholders identified as weakly linked or omitted in the proposed standards, to reduce redundancy, to ensure standards were placed where they are developmentally appropriate for students, and to respond to stakeholder concerns that the proposed standards were not written using three-dimensional language.

A proposed K-2 standard that directed students to “examine and express their own view on environmental issues” was removed in the final-form rulemaking. The standard was determined to be unnecessary as the overarching intent of the new fifth domain for “Environmental Literacy and Sustainability” is to provide instruction for students in environmental literacy. As such, the ability to examine and express their own views on environmental issues is a skill students will develop through instruction provided in other related standards and it is unnecessary to include this as a standalone standard.

A proposed standard in the K-2 grade band for “Environment and Ecology – Decision-Making and Action Skills” that expected students to “determine whether action is needed on selected environmental issues and whether they should be involved” was

removed because it was determined to be more developmentally appropriate for students in grades 3 through 5. In final-form amendments to Appendix B-1, the standard was rewritten and is now reflected in the Grade 3-5 standards for “Environmental Literacy and Sustainability” under the core idea for “Sustainability and Stewardship.” As amended, this Grade 3-5 band standard reads as follows, “Construct an argument to support whether action is needed on a selected environmental issue and propose possible solutions.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Decision-Making and Action Skills” that expected students to “develop an action strategy or design a solution for a specific local environmental issue of their choosing” was determined to be redundant with another proposed K-2 standard. As such, it was removed in final-form amendments to the standards in Appendix B-1.

A proposed standard in the K-2 grade band for “Environment and Ecology – Decision-Making and Action Skills” that expected students to “identify environmental and social consequences of design solutions and civic actions, including their own actions” was rewritten in three-dimensional language as requested by stakeholders. As such, the proposed standard was removed in the Board’s final-form rulemaking and replaced and reorganized with a rewritten standard in the new grades 3-5 domain for “Environmental Literacy and Sustainability.” The rewritten standard is included under the core idea for “Agricultural and Environmental Systems and Resources” as follows, “Make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions.”

The new standard for grades 3-5 referenced above further reflects the combination of standards that were included in the Board’s proposed rulemaking for the 3-5 grade band.

Standards in the proposed rulemaking for “Environment and Ecology – Decision Making and Action Skills,” expected students in grades 3-5 to, “Identify, justify, and clarify their views on environmental issues and alternative ways to address them” and to “Evaluate whether action is needed in specific solutions, using environmental, cultural/social, and economic criteria. They decide whether they should be involved in that action.” A standard in the proposed rulemaking for grades 3-5 in “Environment and Ecology – Personal and Civic Responsibility” expected students to, “Describe the broad environmental, social, and economic consequences of their personal and group actions and, as appropriate, accept responsibility for their actions.” Finally, a standard in the proposed rulemaking for grades 3-5 in “Environment and Ecology – Human Systems” expected students to, “Describe how economic systems and economic decision-making influence natural resource use and management as well as environmental and human well-being.” In the final-form rulemaking, these standards were combined and were revised to use three-dimensional language requested by stakeholders and to strengthen connections to the new “Environmental Literacy and Sustainability” standards for grades 6-12. Concepts included in those proposed standards are reflected in the new final standard for grades 3-5 that expects students to, “Make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions.”

The three proposed standards in the K-2 grade band for “Environment and Ecology – Personal and Civic Responsibility” all were removed in the final-form rulemaking for a lack of clarity and because they were not written in a three-dimensional manner as requested by stakeholders. These proposed standards were replaced with a rewritten standard in the new domain for “Environmental Literacy and Sustainability” for grades 3-

5. The rewritten standard is included under the grades 3-5 core idea for “Sustainability and Stewardship” as follows, “Examine ways you influence your local environment and community by collecting and displaying data.”

The new standard for grades 3-5 referenced above also replaces the the proposed standard for grades 3-5 in “Environment and Ecology – Decision-Making and Action Skills” that expected students to, “Use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.” In the Board’s final-form rulemaking, that proposed standard was edited to reflect three-dimensional language, as requested by stakeholders, and to strengthen connections to the standards presented in the new standards in the “Environmental Literacy and Sustainability” domain for grades 6-12. As referenced in the paragraph above, the revised standard for grades 3-5 now reads, “Examine ways you influence your local environment and community by collecting and displaying data.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Earth’s Physical and Living Systems” that expected students to “describe the characteristics of Earth’s physical systems, including air, water, and land” and to “explain how these systems interact with one another and identify changes in the physical environment over time” was removed in the final-form rulemaking for redundancy. The proposed standard is redundant to the grade 5 standard for “Earth and Space Sciences – Earth’s Systems #1” that expects student to, “Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Earth’s Physical and Living Systems” that expected students to “identify basic similarities and

differences among a wide variety of living organisms” and to “explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them” was removed in the final-form rulemaking in order to present the standard in three-dimensional language, as requested by stakeholders in public comment, and to strengthen its connection to Science and Engineering Practices and Disciplinary Core Ideas. The eliminated proposed standard was replaced with a rewritten standard in the new domain for “Environmental Literacy and Sustainability” for Grades 3-5. The rewritten standard is included under the grades 3-5 core idea for “Agricultural and Environmental Systems and Resources” as follows, “Analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them.”

The new standard for grades 3-5 referenced above also reflects revisions to the proposed standard for grades 3-5 that expected students to, “Explain ways that individual traits and group membership or affiliation influence perceptions of actions toward the environment. The describe how their environmental beliefs and values are shaped by their community and the larger society.” In the Board’s final revisions, this proposed standard was edited to increase the use of three-dimensional language, as requested by stakeholders, and to strengthen connections to the new “Environmental Literacy and Sustainability” standards for grades 6-12. The concepts in that proposed standards now are reflected in the final standard for grades 3-5 that expects students to, “Analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them.”

The two proposed standards in the K-2 grade band for “Environment and Ecology – Human Systems” were removed in the final-form rulemaking to reduce redundancy and to respond to stakeholder concerns that these standards were not written in a three-dimensional manner. These proposed standards were combined and rewritten in three-dimensional language in final-form amendments to the rulemaking. The revised standard is included in the new domain for “Environmental Literacy and Sustainability” for grades K-2 under the core idea for “Agricultural and Environmental Systems and Resources” as follows, “Examine how people from different cultures and communities, including one’s own, interact and express their belief about nature.

A proposed standard in the K-2 grade band for “Environment and Ecology – Environment and Society” that expected students to “identify ways that people depend on, change, and are affected by the environment” was rewritten and the rewritten standard was moved to a new section in the Board’s final-form amendments to Appendix B-1.

The rewritten standard is presented in the new domain for “Environmental Literacy and Sustainability” for Grades 3-5 under the core idea for “Sustainability and Stewardship” as follows, “Critique ways that people depend on and change the environment.” As revised in the final-form rulemaking, the standard continues to include language from the proposed standard that expected students to identify “ways that people depend on and change the environment.” However, language from the proposed standard that also expected students to identify ways that people “are affected by the environment” was not included in the final-form rulemaking because that theme is repeated in other standards. As such, maintaining the language in the revised standard would be redundant. The word “identify” used in the proposed standard also was replaced with the word “critique” in the rewritten

final standard to establish a standard that expects students to demonstrate a higher depth of knowledge. The standard, as rewritten, also responds to stakeholder requests to revise the proposed standards to use three-dimensional language.

The Board revised a proposed standard in the K-2 grade band for “Environment and Ecology – Environment and Society” that expected students to “describe ways people harvest, re-distribute, and use natural resources.” The Board also reorganized where the standard is included in Appendix B-1. The word “describe” in the proposed standard was replaced with the word “categorize” in the Board’s final-form amendments. This revision establishes a standard that expects students to demonstrate a higher depth of knowledge. The revised standard was reorganized as part of the new grades K-2 domain for “Environmental Literacy and Sustainability” under the core idea for “Agricultural and Environmental Systems and Resources.”

The Board made an editorial revision to a proposed standard in the K-2 grade band for “Environment and Ecology – Environment and Society” that expected students to “identify ways that places differ in their physical and human characteristics.” The Board also reorganized where the standard is included in Appendix B-1. The standard was reworded to clarify the meaning of the term “places” as used in the proposed standard. The revised standard reads as follows, “Explain ways that places differ in their physical, their meaning, and their value and/or importance.” The final revised standard is included in the new Grades K-2 domain for “Environmental Literacy and Sustainability” under the core idea for “Environmental Literacy Skills.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Environment and Society” that expected students to “recognize that change is a normal part

of individual and societal life” was removed in the final-form rulemaking and replaced with a rewritten standard in a different section of the final rulemaking. This proposed standard was reworded in response to stakeholder concerns regarding sufficiency of the content of the standards to better reflect the full spectrum of standards in the North American Association for Environmental Education’s (NAAEE) *K-12 Environmental Education: Guidelines for Excellence*. The final revised standard reads as follows, “Investigate how perspectives over the use of resources and the development of technology have changed over time and resulted in conflict over the development of societies and nations.” As revised in the final rulemaking, the standard was reorganized as part of the new grades 3-5 domain for “Environmental Literacy and Sustainability” under the core idea for “Environmental Literacy Skills.”

The new standard for grades 3-5 referenced above also reflects a revision to a standard proposed for grades 3-5 under “Environment and Ecology – Environment and Society.” The standard within that section of the Board’s proposed rulemaking that expected students to, “Explain that human social systems are dynamic and that conflicts sometimes arise over differing and changing viewpoints about the environment and natural resources use and management” was removed from the final-form rulemaking. The proposed standard was edited to increase the use of three-dimensional language, as requested by stakeholders, and to strengthen connections to the new “Environmental Literacy and Sustainability” standards for grades 6-12. As revised in the final-form rulemaking, concepts from the proposed standard now are reflected in the final standard that expects students in grades 3-5 to, “Investigate how perspectives over the use of

resources and the development of technology have changed over time and resulted in conflict over the development of societies and nations.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Skills for Analyzing and Investigating Environmental Issues” that expected students to “identify and investigate issues in their local environment and community” was rewritten in three-dimensional language as requested by stakeholders and reorganized in a different section of the final rulemaking. As such, the proposed standard was removed in the Board’s final-form rulemaking and replaced with a rewritten standard in the new K-2 domain for “Environmental Literacy and Sustainability.” The rewritten standard is included under the core idea for “Environmental Literacy Skills” as follows, “Plan and carry out an investigation to address an issue in their local environment and community.”

A proposed standard in the K-2 grade band for “Environment and Ecology – Skills for Analyzing and Investigating Environmental Issues” that expected students to “use their knowledge of how ecological and human systems are interconnected to describe the environmental and social consequences of local environmental issues” was revised in the final rulemaking to use three-dimensional language as requested by stakeholders. The revised standard also was reorganized in a different section in the final-form rulemaking. The proposed standard was revised as follows, “Develop a model to demonstrate how local environmental issues are connected to larger local environment and human systems.” As reorganized in the final-form rulemaking, the revised standard is included in the new grades 3-5 domain for “Environmental Literacy and Sustainability” under the core idea for “Environmental Literacy Skills.”

The new standard for grades 3-5 referenced above also reflects a revision to the proposed standard for students in grades 3-5 for “Environment and Ecology – Skills for Analyzing and Investigating Environmental Issues” that expected students to, “Demonstrate active listening, tolerance, adaptability, and openness as they work with others to gather a range of perspectives and information.” That proposed standard was edited to increase the use of three-dimensional language, as requested by stakeholders, and to strengthen connections to the new “Environmental Literacy and Sustainability” standards for grades 6-12. As edited, the concepts in the proposed standard are now reflected in the final standard for grades 3-5 that expects students to, “Develop a model to demonstrate how local environmental issues are connected to larger local environment and human systems.”

Two proposed standards in the K-2 grade band for “Environment and Ecology – Skills for Analyzing and Investigating Environmental Issues” that expected students to “develop plans, including possible design solutions, for addressing selected local environmental issues” and to “demonstrate openness and receptivity while listening to and working with others who have perspectives about the environment that are different from their own” were combined with another standard in the final-form rulemaking. As such, those two proposed standards were removed in the final-form rulemaking. This new combined standard is reflected in the final standard within the new grades K-2 domain for “Environmental Literacy and Sustainability” under the core idea for “Environmental Literacy Skills” that reads as follows, “plan and carry out an investigation to address an issue in their local environment and community.”

A standard in the proposed grades 3-5 domain for “Environment and Ecology – Environment and Ecology” under “Earth’s Physical and Living Systems” expected students to, “Describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth’s physical systems.” This standard was removed in the Board’s the final-form rulemaking due to a lack of clarity.

Other standards in the Board’s proposed rulemaking for grades 3-5 were removed from the final-form rulemaking due to a lack of clarity and to revise the standards to use three-dimensional language as requested by stakeholders. These proposed standards were replaced by new standards. The proposed standards for students in grades 3-5 for “Environment and Ecology” that were removed and replaced for these reasons are as follows: proposed standard #4 under Decision-Making and Action Skills; proposed standards #1 and #2 under Personal and Civic Responsibility; proposed standard #2 under Earth’s Physical and Living Systems; proposed standards #2 and #3 under Human Systems; proposed standards #1, #2 and #3 under Environment and Society; and proposed standards #1, #2, and #3 under Skills for Analyzing and Investigating Environmental Issues.

Alternatively, new standards for students in grades 3-5 were included in the final-form rulemaking to enhance clarity, to reflect three-dimensional language as requested by stakeholders, and to establish clear learning progressions relative to standards in the new fifth domain for students in grades 6-12. These standards are included in the new domain for “Environmental Literacy and Sustainability” for grades 3-5 under the core idea for “Sustainability and Stewardship.” The new standards included in the Board’s final-form

rulemaking expect students to, “critique ways that people depend on and change the environment,” “examine ways you influence your local environment and community by collecting and displaying data,” and “construct an argument to support whether action is needed on a selected environmental issue and propose possible solutions.”

In its final-form rulemaking, the Board also amended the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* to include a new domain on “Environmental Literacy and Sustainability” in both the grade band standards for Grades 6-8 and in the grade band standards for Grades 9-12. For consistency with how this domain is presented across all grade levels, the new fifth domain for “Environmental Literacy and Sustainability” for Grades 6-8 and Grades 9-12 also is organized under the following three core ideas: 1) Agricultural and Environmental Systems and Resources, 2) Environmental Literacy Skills, and 3) Sustainability and Stewardship. Adding a fifth domain to the standards for grades 6-12 that addresses content related to the environment, ecology, and agriculture was suggested by multiple stakeholders as a way to satisfy stakeholder concerns surrounding the sufficiency of content in those areas.

In direct response to stakeholder concerns, the new domain added to the standards for grades 6-8 includes standards that expect students to develop models to describe how agricultural and food systems function, including sustainable use of natural resources and the production, processing, and management of food, fiber, and energy. Standards in the new domain also set forth expectations for students in grades 6-8 to analyze and interpret data about how different societies and cultures use and manage natural resources differently, address the roles and functions of watersheds and wetlands, create expectations

for Pennsylvania students to explore how local environmental issues affect our state's human and natural systems, and establish requirements for instruction related to integrated pest management. Further, in response to stakeholder concerns, the final standards for students in grades 6-8 also expect students to receive instruction in how best management practices and environmental laws are designed to achieve environmental sustainability, to design a solution to an environmental issue to gain knowledge related to environmental stewardship, and to construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity.

Standards included in the new "Environmental Literacy and Sustainability" domain for grades 9-12 in the Board's final-form rulemaking also were created in direct response to stakeholder concerns about content that stakeholder identified as either omitted or weakly link in the Board's proposed rulemaking. The standards adopted in the final-form rulemaking expect students at the high school level to receive instruction in agricultural systems to "analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources." They further expect high school students to be able to "apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individual groups, and nations" as they pertain to environment and society. The new standards included in the Board's final-form rulemaking also set forth expectations for high school-level instruction in watersheds and wetlands, for applying research and analytical skills to investigate local, regional or global environmental issues, and for planning and conducting investigations utilizing environmental data about a local environmental issue. The standards in the new "Environmental Literacy and Sustainability" domain for grades 9-12

also require instruction to be provided in integrated pest management. Students in grades 9-12 further are expected to be able to “analyze and evaluate how best management practices and environmental laws achieve sustainability of natural resources,” to “design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being,” and to “analyze and interpret data on a regional environmental condition and its implication on environmental justice and social equity.”

In addition to adding a new fifth domain for “Environmental Literacy and Sustainability” across all grade levels, the Board made other amendments to the standards in its final-form rulemaking that also were responsive to stakeholder concerns.

First, within the Kindergarten standards for Earth and Space Science, the first standard under “Earth’s Systems” was revised. In the Board’s proposed rulemaking, that standard expected students to, “Use observations of local weather conditions to describe patterns over time.” The phrase “and share” was added to the final standard in response to a stakeholder comment that communication is a critical part of three-dimensional learning and, as such, should be reflected in the standard.

Next, the Board made editorial revisions to the grade 3 standard for Life Sciences – Ecosystems: Interactions, Energy, and Dynamics. In its proposed rulemaking, that standard expected students to, “Construct an argument that some animals have physical and behavioral adaptations that help members survive”. A stakeholder raised concern that, as proposed, the standard did not match the title of the section in which it is included and that it already appeared appropriately under the grade 3 standard for Life Sciences – Biological Evolution: Unity and Diversity #2 that addresses evolutionary adaptations. In

response to that stakeholder concern, the standard was revised to read as follows in the final form rulemaking, “Construct an argument that some animals form groups that help members survive.”

The Board also made an editorial revision to the grade 5 standards for Physical Science – Matter and Its Interactions in response to a comment received from a stakeholder. The stakeholder questioned whether standard #5 in that section is not three-dimensional and whether it is too similar to standard #3 within that same section.

As proposed, the grade 5 standard for Physical Science – Matter and Its Interactions #5 questioned by the commentator expected students to, “Interpret and analyze data and observations to make decisions about how to utilize materials based on their- properties.” Standard #3 in that section that expects students to, “Make and communicate observations and measurements to identify materials based on their properties.” The Board disagrees that standard #5 is redundant to standard #3. Rather, standard #5 builds upon other standards. Standard #3 in this section focuses on identifying materials based on their properties, while standard #5 in this section focuses on synthesizing skills, interpreting, and analyzing. To provide clarity between the intent of the two distinct standards, in its final rulemaking the Board removed the phrase “and observations” from standard #5. This final grade five standard now reads as follows, “Interpret and analyze data to make decisions about how to utilize materials based on their properties.”

Finally, following a recommendation from the Science Standards Content Committee and Steering Committee, the Board amended a middle school standard for Life Sciences – Natural Selection and Adaptations. As proposed, this standard within grade 6-8 band of the *Pennsylvania Integrated Standards for Science, Environment, and Ecology*

(Grades 6-12) expected students to, “Analyze displays of pictorial data to compare patterns of similarities in embryological development across multiple species to identify relationships not evident in the fully formed anatomy.” The emphasis of this standard is on inferring general patterns of relatedness among structures of different organisms by comparing the appearance of diagrams or pictures. In addition, the Science Standards Content Committee and Steering Committee advised that the Recapitulation Theory (Biogenetic Principle) is no longer scientifically valid. Furthermore, the standard was found to be written in a manner that overlaps with curricular decisions, and the developmental appropriateness for younger middle school students was questioned.

In response to those considerations, in its final-form rulemaking the Board amended the grade 6-8 standard for Life Sciences – Natural Selection and Adaptations #3 by replacing the term “embryological development” with “anatomical structures.” As amended, the final standard reads as follows, “Analyze displays of pictorial data to compare patterns of similarities in their anatomical structures across multiple species of similar classification levels to identify relationships.”

Affected Parties

The proposed rulemaking would affect public school districts, ACTSs, and charter and cyber charter schools in Pennsylvania and their employees and students, as well as educator preparation programs that prepare new teachers.

Cost and Paperwork Estimates

The final-form regulation will not impose any costs on students. Further, the final-form regulation is not anticipated to impose new costs on programs that train new educators. The updated academic standards will act as a guide for redesigning some courses

educator preparation programs deliver to individuals preparing to become teachers to ensure course content is aligned to current academic standards. This does not impose a new cost for additional coursework. Rather, the impact on educator preparation programs would shift the content of some existing courses, and the Department will provide educator preparation program faculty with access to implementation supports it will make available for updated science standards to support this work.

Further, the Department will update its program framework guidelines for educators in the science, technology, environment, ecology and engineering fields to align with the new standards. Outreach conducted with the Pennsylvania Association of Colleges and Teacher Educators (PAC-TE), which includes educator preparation programs at private colleges and universities, state-related universities, and the Pennsylvania State System of Higher Education (PASSHE), indicated that the final-form rulemaking will not impose a cost on the institutions. Educator preparation program updates occur through two basic means: as a part of faculty expectations or as departmental service. Costs only would be incurred if updates occurred outside of the contract period (PASSHE faculty are 9-month employees), and approval for curriculum updates could take 12-18 months (2-3 semesters) at some institutions. The proposed rulemaking includes a July 1, 2025, effective date for implementation of updated standards which should provide adequate time for educator preparation programs to make any necessary adjustments.

As part of the stakeholder engagement convened by the Department in developing recommended standards updates, science educators were asked to complete a survey that included strategic questions to discern what academic standards K-12 schools utilize when creating their curriculum. The results of the survey indicated that, as of the 2019-20 school

year, approximately 42 percent of respondents in Pennsylvania reported using national frameworks in designing learning experiences, while between 35-37 percent reported having curriculum aligned to national standards and frameworks. This presumably will necessitate fewer or more minor adjustments to curriculum to align with the updated standards in the final-form rulemaking since the revised standards were informed by current national standards frameworks in their development and incorporate some elements of the frameworks already referenced by educators in response to the Department's question.

For the purposes of this rulemaking, school entities are considered local governments. In order to determine a specific estimate of the costs to local governments, the Board sought to determine the cost of implementing updated standards in the remaining school entities in Pennsylvania that did not report that they already are aligning their curriculum to current national standards and frameworks and, thus, would need to revise curriculum. School entities typically engage in curriculum review cycles every five to six years. Thus, the Board anticipates that efforts to implement the updated standards included in the final-form rulemaking will be reflected in school entities' existing budgetary practices for curriculum review and updates, therefore becoming part of a traditional cycle for updating school entity resources. As such, the final-form rulemaking does not add new costs in so much as it refines the focus of current instruction.

At the state level, the Board anticipates that the final-form rulemaking will cost approximately \$17,994,792 in total through Fiscal Year 2026-27 to review and update the PSSA exams in Science, the Keystone Biology exam, the Pennsylvania Standards Aligned System resources, and to provide technical support for school entities. As a result of the

final-form rulemaking, the Department anticipates a need to update the PSSA Science exams, administered in grades 4 and 8, and the Keystone Exam in Biology to align to the update to academic standards in science included in Appendix B-1 of the final-form rulemaking. To support implementation of the revised standards locally, the Department will provide educators with access to state-developed resources through the Standards Aligned System website, professional learning, and on-going support and consultation. The Department will provide technical assistance supports through the expertise of its content advisors and additional professional learning supports through the Statewide System of Support deployed through collaboration with the existing network of regional Intermediate Units.

Through collaboration with the state's 29 Intermediate Units, the Department drives professional learning to support science, technology, environment, and ecology education through the Statewide System of Support. Since 2016, the Department has been driving professional learning to educators and school entities aligned to robust research, practice, and recent guidance outlined by "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas," "Taking Science To School," and "Science Teacher's Learning: Enhancing Opportunities Creating Supportive Contexts." Since 2016, the Department has invested more than \$4.3 million in federal and state funds to enhance educators' and school entities' ability to ensure all learners, especially those who have been historically underserved, are included in science, technology, engineering, and environmental learning experiences. The investment has resulted in the development of an Open Education Resource (OER) STEM Toolkit, provision of research-aligned professional learning for thousands of educators across the commonwealth, and school

entities' building STEM Comprehensive plans. This upfront investment will support school entities in implementing the new standards included in the final-form rulemaking.

Continued annual investments of \$1.8 million in the Statewide System of Support will ensure each Intermediate Unit has a STEM Point of Contact with the expertise to deliver professional learning and technical assistance at no cost to school entities as they build towards implementation of the new *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)*.

In addition to the state-level investments in education infrastructure through the Intermediate Units, the Department employs content advisors who provide curriculum alignment supports for school entities across the commonwealth. The Department has individual content advisors dedicated to science, technology, engineering, environment, and ecology education with the expertise necessary to guide implementation for the field. Support for standards implementation by the Department, including updating, aligning, and designing resources for school entities and educators, can be carried out with the current staff complement of content advisors. The resources developed by the Department will be curated on the Department's Standards Aligned System website for voluntary use by school entities at no cost to the school entities.

Below is an estimate of anticipated costs to the state to implement the final-form rulemaking on an annual basis through Fiscal Year 2026-27:

Fiscal Year 2021-22: The estimated state cost is \$1,827,000, which represents the annual investment in the Pennsylvania Statewide System of Support to deliver professional

learning and technical assistance in Science, Technology, Engineering, and Environment and Ecology education at no cost to educators. Professional learning and technical assistance delivered through this investment is provided through each of the state's 29 Intermediate Units.

Fiscal Year 2022-23: The estimated state cost is \$1,827,000, which represents the investment in the Pennsylvania Statewide System of Support that will support the creation of state-level resources to assist school entities and educators with implementation of the updated state academic standards in science. This investment will be directed toward work to redesign the professional learning and technical assistance made available at no cost to educators through the state's network of Intermediate Units to align with the new standards in the final-form rulemaking.

Fiscal Year 2023-24: The estimated state cost is \$9,258,797, which represents a sustained effort to support state-level resources to assist school entities and educators with implementation of the updated state academic standards in science and new work to revise state assessments administered in Science. Through an investment in the Pennsylvania Statewide System of Support, the state will continue to support efforts to redesign the content of professional learning and technical assistance made available at no cost to educators to align with the needs of school entities in implementing the new standards in the final-form rulemaking. The professional learning and technical assistance will be provided through the state's network of 29 Intermediate Units. The estimated cost also includes work necessary to revise state assessments administered in Science to align with the new standards in Appendix B-1 of the final-form rulemaking. Anticipated costs include aligning the state assessment question bank to reflect the content of the updated science

standards in the regulation and modernizing the testing process towards technology-enhanced items. Updated performance-based academic standards will enable adjustments to state assessments that enable automated scoring.

Fiscal Year 2024-25: The estimated state cost is \$2,891,071, which reflects efforts to continue refining state assessment items and resources for educators to align with the new standards as described above.

Fiscal Year 2025-26: The estimated state cost is \$1,827,000, and estimated savings are \$1,463,076, resulting in an estimated net cost of \$363,924. The estimated cost represents the investment in the Pennsylvania Statewide System of Support to redesign the professional learning and technical assistance available at no cost to educators to align with the needs of school entities in implementing the updated state academic standards in science. The professional learning and technical assistance will be provided by the state's network of 29 Intermediate Units. The estimated savings reflects a shift in assessment practices. The Department anticipates that updated state assessments will be administered for the first time beginning in Fiscal Year 2025-26. Estimated savings are realized through the shift from hand-scored assessments to automated scoring, enabled by adopting updated performance-based standards. This estimate assumes a shift from hand-scored items to technology-enhanced items. Hand-scored items require the time and expertise of several professionals to score individual assessments. Technology-enhanced items do not require the time and expertise of several professionals. It is anticipated that this shift will result in annual savings in future years. Estimated savings are predicated on assumptions to changes in the state assessment design and are contingent on final determinations about the design

of state assessments that will be completed through the Department's work to implement assessments aligned to the new standards.

Fiscal Year 2026-27: The estimated state cost is \$1,827,000, which represents the investment in the Pennsylvania Statewide System of Support to deliver professional learning and technical assistance aligned with the new standards in the final-form rulemaking to educators at no cost. The professional learning and technical assistance will be provided through the state's network of 29 Intermediate Units.

Estimated state costs take into account resources and collaborations, such as federal grants, that will support implementation of the final-form regulation. Through collaborative efforts with the state's network of Intermediate Units, the Department has been working with the Stroud Watershed Research Center, the National Oceanic and Atmospheric Association, the Department of Conservation and Natural Resources, the Department of Environmental Protection, and other collective impact partners through a multi-year federal grant to build a robust network that is delivering professional learning and technical assistance in environmental, ecology, and watershed education to school entities across the commonwealth. The collaboration represents an upfront investment preparing educators and school entities for research-aligned supports and has established a foundation for implementing the new standards included in the final-form rulemaking. This federally grant-funded program will continue through 2022 to support professional development for educators and environmental literacy for scholars across Pennsylvania.

Effective Date

The final-form rulemaking will take effect upon final publication in the *Pennsylvania Bulletin*.

Sunset Date

The Board will review the effectiveness of Chapter 4 every four years in accordance with the Board's policy and practice respecting all of its regulations. Thus, no sunset date is necessary.

Regulatory Review

Under section 5(a) of the Regulatory Review Act (71 P. S. § 745.5(a)), on May 11, 2021, the Board submitted a copy of the notice of proposed rulemaking, published at 51 Pa.B. 3103 (June 5, 2021), and a copy of a Regulatory Analysis Form to IRRC and to the Chairpersons of the House and Senate Committees on Education for review and comment.

Under section 5(c) of the Regulatory Review Act, IRRC and the Committees were provided with copies of the comments received during the public comment period. In preparing the final-form rulemaking, the Board has considered all comments from IRRC and the public.

Under section 5.1(j.2) of the Regulatory Review Act (71 P.S. § 745.5a(j.2)), the final-form rulemaking was deemed approved by the House Committee on **INSERT DATE**, and by the Senate Committee on **INSERT DATE**. Under section 5.1(e) of the Regulatory Review Act, IRRC met on **INSERT DATE**, and approved the final-form rulemaking.

The Office of Attorney General (OAG) approved the final-form rulemaking as to form and legality on **INSERT DATE**.

Contact Person

Persons who require additional information about this final-form rulemaking may submit inquiries to Karen Molchanow, Executive Director, State Board of Education, 333 Market Street, 1st Floor, Harrisburg, PA 17126, ra-stateboardofed@pa.gov.

Findings

The Board finds that:

- (1) Public notice of the intention to adopt this final-form rulemaking was given under sections 201 and 202 of the act of July 31, 1968 (P.L. 769, No. 240) (45 P.S. §§ 1201 and 1202) and the regulations promulgated thereunder, 1 Pa. Code §§ 7.1 and 7.2.
- (2) A public comment period was provided as required by law and all comments were considered.
- (3) This final-form rulemaking does not enlarge the purpose of the proposed rulemaking published at 51 Pa.B. 3103 (June 5, 2021).
- (4) The final-form rulemaking is necessary and appropriate for the administration of the code.

Order

The Board, acting under authorizing statute, orders that:

- (a) The regulations of the Board, 22 Pa. Code Chapter 4, are amended to read as set forth in Annex A.
- (b) The Board shall submit this final-form rulemaking to the Office of General Counsel and the Office of Attorney General for review and approval as required by law.
- (c) The Board shall submit this final-form rulemaking to IRRC and the Legislative Standing Committees as required by law.
- (d) The Board shall certify this final-form rulemaking, as approved for legality and form, and shall deposit it with the Legislative Reference Bureau as required by law.
- (e) The final-form rulemaking shall take effect upon publication in the *Pennsylvania Bulletin*.

KAREN MOLCHANOW,
Executive Director

Annex A
TITLE 22. EDUCATION
PART I. STATE BOARD OF EDUCATION
CHAPTER 4. ACADEMIC STANDARDS AND ASSESSMENT

GENERAL PROVISIONS

§ 4.3. Definitions.

The following words and terms, when used in this chapter, have the following meanings, unless the context clearly indicates otherwise:

[AVTS—Area vocational-technical school] *ACTS—Area Career and Technical School*—A public school that provides **[vocational-technical] career and technical** education to secondary school students, out-of-school youth and adults in a geographical area comprised and operated by one or more school districts and established under sections 1840—1853 of the School Code (24 P. S. §§ 18-1840—18-1853).

Board—The State Board of Education established under sections 2601-B—2606-B of the School Code (24 P.S. §§ 26-2601-B—26-2606-B).

Career and technical education—Programs under public supervision and control which provide an organized process of learning experiences designed to develop integrated academic and occupational skills, knowledge, attitudes, work habits and leadership ability for entry into and advancement within various levels of employment in occupational areas of agriculture, business, marketing and distribution, health, home economics and trade and industry and for participation in postsecondary education and training.

Chief school administrator—The superintendent of a school district, the superintendent of an **[AVTS] ACTS** or the chief executive officer of a charter school.

Cooperative [vocational-technical] career and technical education—A planned method of instruction developed through a signed cooperative arrangement among school representatives, students, parents and employers in the community to provide students with an opportunity to alternate in-school academic and **[vocational-technical] career and technical** instruction in entry-level paid employment in an occupational field, in which the student's total occupational

work experience is planned, coordinated and supervised by the school in close cooperation with the employer.

Employment area—A geographic area where **[vocational-technical] career and technical** education program completers are most likely to be employed.

School entity—A local public education provider (for example, public school district, charter school, cyber charter school, **[AVTS] ACTS** or intermediate unit).

School organization—The organization of a school district’s programs into kindergarten, primary, intermediate level, middle level and high school programs, including programs operated at **[AVTSS] ACTSs**.

Tech-prep program—A combined secondary and postsecondary program which leads to an associate degree or certificate and employment by providing technical preparation in engineering technology, applied science, mechanical, industrial or practical art or trade, agriculture, health or business, including development of competence in mathematics, science and communications through a sequential course of study.

[Vocational-technical education—Programs under public supervision and control which provide an organized process of learning experiences designed to develop integrated academic and occupational skills, knowledge, attitudes, work habits and leadership ability for entry into and advancement within various levels of employment in occupational areas of agriculture, business, marketing and distribution, health, home economics and trade and industry and for participation in postsecondary education and training.]

§ 4.4. General policies.

(e) The Department will provide support to school districts, **[AVTSS] ACTSs** and charter schools, including cyber charter schools, in developing educational programs that enable students to attain academic standards under § 4.12. Department support will include:

- (1) Establishment of a voluntary model curriculum and diagnostic supports aligned with State academic standards in each of the content areas assessed by the Keystone Exams under § 4.51b(i) **and (j)** (relating to Keystone Exams).
- (2) Assistance in the development of effective student tutoring, remediation and extended instructional time programs.

(3) Opportunities for continuing professional education designed to improve instruction in each of the content areas assessed by the Keystone Exams under § 4.51b(i) ~~and (j)~~.

(4) Technical guidance in developing local assessments that meet the requirements of § 4.24(c)(1)(iii)(B) (relating to high school graduation requirements), upon request.

(f) The Department may not, and the Board will not, require school entities to utilize a Statewide curriculum or Statewide reading lists.

ACADEMIC STANDARDS AND PLANNING

§ 4.11. Purpose of public education.

(g) Public schools provide instruction throughout the curriculum so that students may develop knowledge and skills in the following areas:

- (1) English language arts.
- (2) Mathematics.
- (3) Science and **[technology] environment and ecology**.
- (4) **[Environment and ecology] Technology and engineering**.
- (5) Social studies (civics and government, geography, economics and history).
- (6) Arts and humanities.
- (7) Career education and work.
- (8) Health, safety and physical education.
- (9) Family and consumer science.

§ 4.12. Academic standards.

(a) School entities may develop, expand or improve existing academic standards in the following content areas:

(1) **The following apply:**

(i) **Through June 30, 2024 2025:** *Science and technology.* Study of the natural world and facts, principles, theories and laws in the areas of biology, chemistry, physics and earth sciences. Technology is the application of science to enable societal development, including food and fiber production, manufacturing, building, transportation and communication. Science and technology share the use of the senses, science processes, inquiry, investigation, analysis and problem solving strategies. The Pennsylvania Core Standards for Reading in

Science and Technology and the Pennsylvania Core Standards for Writing in Science and Technology will be an appendix to the Commonwealth's academic standards for Science and Technology upon publication in the *Pennsylvania Bulletin*.

(ii) Effective July 1, 2024 2025: Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology, and Engineering (Grades K-5). Guide the elementary-level study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. The integration of these disciplines in the elementary grades highlights the interconnectedness of scientific study and the integral relationship between humans and the environment.

(2) The following apply:

(i) Through June 30, 2024 2025: Environment and ecology. Understanding the components of ecological systems and their interrelationships with social systems and technologies. These components incorporate the disciplines of resource management, agricultural diversity, government and the impact of human actions on natural systems. This interaction leads to the study of watersheds, threatened and endangered species, pest management and the development of laws and regulations.

(ii) Effective July 1, 2024 2025: Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12). Utilize a three-dimensional approach to guide the study of physical sciences, life sciences, and earth and space sciences at the middle and high school levels. The standards highlight the critical intersections of these disciplines with environmental science, ecology, and agriculture. These three-dimensional standards integrate disciplinary core ideas, practices in science and engineering, and crosscutting concepts into coherent learning progressions across the grade bands.

(iii) Effective July 1, 2024 2025: Pennsylvania Technology and Engineering Standards (Grades 6-12). Define the knowledge, skills, and abilities necessary for establishing literacy in technology and engineering literacy. Students develop a practical understanding of how humans are influenced by science and technology. Four core disciplinary standards describe practices in technology and engineering and include specific benchmarks for students in grade bands 6-8 and 9-12.

(3) *Social studies.*

(i) *History.* Study of the record of human experience including important events; interactions of culture, race and ideas; the nature of prejudice; change and continuity in political systems; effects of technology; importance of global-international perspectives; and the integration of geography, economics and civics studies on major developments in the history of the Commonwealth, the United States and the world.

(5) *Career education and work.* Understanding career options in relationship to individual interests, aptitudes and skills including the relationship between changes in society, technology, government and economy and their effect on individuals and careers. Development of knowledge and skill in job-seeking and job-retaining skills and, for students completing **[vocational-technical] career and technical education** programs, the skills to succeed in the occupation for which they are prepared.

(i) **[Every 3 years] No sooner than every 5 years and no later than every ten years**, the Board will review the State academic standards and State assessments under this section to determine if they are appropriate, clear, specific and challenging, and will make revisions as necessary by revising this chapter.

(j) The Department may not expand the collection of student data and, in accordance with section 444 of the Family Educational Rights and Privacy Act of 1974 (20 U.S.C.A. § 1232g), regarding family educational and privacy rights, may not collect personal family data due to the implementation of Pennsylvania Core Standards in Appendix A-2.

CURRICULUM AND INSTRUCTION

§ 4.21. Elementary education: primary and intermediate levels.

(a) The primary program shall ordinarily be completed by children who are approximately **[8] 6** years of age. School districts, including charter schools, shall provide opportunities for individualized rates of learning and social and emotional development that reflect differing rates of development and learning styles of young children.

(e) Planned instruction aligned with academic standards in the following areas shall be provided to every student every year in the primary program. Planned instruction may be provided as separate course or other interdisciplinary activity.

(1) Language arts, integrating reading, writing, phonics, spelling, listening, speaking, literature and grammar, and information management, including library skills.

(2) Mathematics, including problem-solving and computation skills.

(3) Science, **environment** and **[technology education] ecology**, involving active learning experiences for students.

(4) **[Environment and ecology] Technology and engineering** education, involving active learning experiences for students.

(f) Planned instruction in the following areas shall be provided to every student every year in the intermediate level program. Planned instruction may be provided as a separate course or as an instructional unit within another course or other interdisciplinary instructional activity:

(1) Language arts, integrating reading, writing, spelling, listening, speaking, literature and grammar.

(2) Mathematics, including problem-solving and computation skills.

(3) Science, **environment** and **[technology] ecology**, including instruction about agriculture and agricultural science.

(4) **[Environment and ecology, including instruction about agriculture and agricultural science] Technology and Engineering**.

(5) Social studies (civics and government, economics, geography and history).

§ 4.22. Middle level education.

(c) Planned instruction aligned with academic standards in the following areas shall be provided to every student in the middle level program. Planned instruction may be provided as a separate course or as an instructional unit within a course or other interdisciplinary instructional activity:

(1) Language arts, integrating reading, writing, listening, speaking, literature and grammar.

(2) Mathematics, including mathematical reasoning, algebra and problem-solving.

(3) Science, **environment** and **[technology] ecology**, which involves active learning experiences and which may include laboratory experiments **[and]**, instruction in agriculture and agricultural science, **and political and economic aspects of ecology**.

(4) Social studies (civics and government, economics, geography and history, including the history and cultures of the United States, the Commonwealth, and the world).

(5) **[Environment and ecology, including social, political and economic aspects of ecology, and instruction in agriculture and agricultural science] Technology and Engineering**.

(6) Information skills, including access to traditional and electronic information sources, computer use and research.

(7) Health, safety and physical education, including instruction in concepts and skills which affect personal, family and community health and safety, nutrition, physical fitness, movement concepts, motor skill development, safety in physical activity settings, and the prevention of alcohol, chemical and tobacco abuse.

(8) The arts, including art, music, dance and theatre.

(9) Career education, including exposure to various career options and the educational preparation necessary to achieve those options.

(10) Technology education, emphasizing practical application of academic skills and problem-solving experiences facilitated by technology.

(11) Family and consumer science, including principles of consumer behavior and basic knowledge of child health and child care skills.

(d) This section does not preclude the teaching of other planned instruction designed to achieve a school entity's academic standards.

(e) School entities shall determine the most appropriate way to operate their middle level programs to achieve the purposes under subsection (b) and any additional academic standards as determined by the school entity.

§ 4.23. High school education.

(c) Planned instruction aligned with academic standards in the following areas shall be provided to every student in the high school program. Planned instruction may be provided as a separate course or as an instructional unit within a course or other interdisciplinary instructional activity:

(1) Language arts, integrating reading, writing, listening, speaking, literature and grammar.

(2) Mathematics, including problem-solving, mathematical reasoning, algebra, geometry and concepts of calculus.

(3) Science, **environment** and **[technology] ecology**, including **scientific, social, political and economic aspects of ecology**, participation in hands-on experiments and at least one laboratory science chosen from life sciences, earth and space sciences, chemical sciences, physical sciences and agricultural sciences.

(4) Social studies (civics and government, economics, geography and history, including the history and cultures of the United States, the Commonwealth and the world).

(5) **[Environment and ecology, including scientific, social, political and economic aspects of ecology] Technology and Engineering.**

(6) The arts, including art, music, dance, theatre and humanities.

(7) Use of applications of microcomputers and software, including word processing, database, spreadsheets and telecommunications; and information skills, including access to traditional and electronic information sources, computer use and research.

(8) Health, safety and physical education, including instruction in concepts and skills which affect personal, family and community health and safety, nutrition, physical fitness, movement concepts, motor skill development, safety in physical activity settings, and the prevention of alcohol, chemical and tobacco abuse.

(9) Family and consumer science, including principles of consumer behavior and basic knowledge of child health, child care and early literacy skill development.

(d) The following planned instruction shall be made available to every student in the high school program:

(1) **[Vocational-technical] Career and technical** education under § § 4.3 and 4.31—4.35.

(2) Business education, including courses to assist students in developing business and information technology skills.

(3) World languages under § 4.25 (relating to languages).

(4) Technology education, incorporating technological problem-solving and the impacts of technology on individuals and society.

(e) College-level advanced placement courses may be offered as planned instruction in the high school curriculum.

(f) This section does not preclude the teaching of other planned instruction designed to achieve a school district's, including a charter school's, academic standards.

(g) School districts, including a charter school, shall determine the most appropriate way to operate their high school programs to achieve the purposes under subsection (a) and any additional academic standards as determined by the school entity.

§ 4.24. High school graduation requirements.

(a) *Approval.* High school graduation requirements and revisions to them shall be approved by a school entity's governing board **[by September 2, 2014] no later than the beginning of the 2020-2021 school year**, and a copy of the requirements shall be published and distributed to students, parents and guardians. Copies of the requirements also shall be available in each school building or on each school entity's publicly accessible web site. Changes to high school graduation requirements shall be published and distributed to students, parents and guardians and made available in each school building or on each school entity's publicly accessible web site immediately following approval by the governing board.

(b) *Requirements through the ~~2015-2016~~ 2021-2022 school year.* Each school district, charter school (including a cyber charter school) and **[AVTS] ACTS**, if applicable, shall specify requirements for graduation. Requirements through the ~~2015-2016~~ 2021-2022 school year must include course completion and grades, completion of a culminating project, results of local assessments aligned with the academic standards and a demonstration of proficiency in English Language Arts and Mathematics on either the State assessments administered in grade 11 or 12 or local assessments aligned with academic standards and State assessments under § 4.52 (relating to local assessment system) at the proficient level or better to graduate. The purpose of the culminating project is to assure that students are able to apply, analyze, synthesize and evaluate information and communicate significant knowledge and understanding.

(c) *Requirements beginning in the ~~[2016-2017]~~ 2022-2023 school year.*

(1) *General.* Beginning in the [2016-2017] **2022-2023** school year, each school district, charter school (including a cyber charter school) and [AVTS] **ACTS**, if applicable, shall adopt and implement requirements for high school graduation that, at minimum, include:

(i) Course completion and grades.

(ii) Demonstration of proficiency as determined by the school district, charter school (including a cyber charter school) or [AVTS] **ACTS**, if applicable, in each of the State academic standards not assessed by a State assessment under § 4.51, § 4.51a or § 4.51b (relating to State assessment system; Pennsylvania System of School Assessment; and Keystone Exams).

(iii) Demonstration of proficiency or above in each of the following State academic standards: English Language Arts and Mathematics (Appendix A-2); **THROUGH JUNE 30, 2025, Science and {Technology} and Environment and Ecology {(Appendix B)}, AND, BEGINNING JULY 1, 2025, SCIENCE, ENVIRONMENT AND ECOLOGY (Appendix B-1)**, as determined through any one or a combination of the following:

(A) Completion of secondary level coursework in English Language Arts (Literature), Algebra I and Biology in which a student demonstrates proficiency on the associated Keystone Exam or **[related project-based assessment if § 4.4(d)(4) (relating to general policies) applies] through a pathway established in section 121(c) or section 121(c.1) of the Public School Code of 1949 (24 P.S. §§ 1-121(c) or (c.1)).**

(I) A school district, [AVTS] **ACTS** or charter school, including a cyber charter school, shall allow a student to take a Keystone Exam prior to taking the course associated with the exam's content provided that the student achieved a score of advanced on the most recent associated PSSA assessment administered to the student.

(II) A school district, [AVTS] **ACTS** or charter school, including a cyber charter school, shall allow a student who transfers from another state to take a Keystone Exam prior to taking the course associated with the exam's content, provided that the student achieved a score comparable to the PSSA's advanced performance level on a comparable assessment administered by another state.

(III) A school district, [AVTS] **ACTS** or charter school, including a cyber charter school, may allow a student who scores at the advanced level on a particular Keystone Exam prior to taking the course to be granted course credit for the course without having to complete the course.

(B) Locally approved and administered assessments, which shall be independently and objectively validated once every 6 years. Local assessments may be designed to include a variety of assessment strategies listed in § 4.52(c) and may include the use of one or more Keystone Exams. Except for replacement of individual test items that have a similar level of difficulty, a new validation is required for any material changes to the assessment. Validated local assessments must meet the following standards:

(I) Alignment with the following State academic standards: English Language Arts (Literature and Composition); Mathematics (Algebra I), **AND** Science and [Technology,] Environment and Ecology (Biology)~~, and Civics and Government~~.

(II) Performance level expectations and descriptors that describe the level of performance required to achieve proficiency comparable to that used for the Keystone Exams.

(III) Administration of the local assessment to all students, as a requirement for graduation, except for those exempted by their individualized education program under subsection [(g)] (d), regarding special education students, or gifted individualized education plan as provided in § 16.32 (relating to GIEP).

(IV) Subject to appropriations provided by law, the cost to validate local assessments shall be evenly divided between the school district, [AVTS] ACTS or charter school, including a cyber charter school, and the Department. If the Department does not provide sufficient funding to meet its share, local assessments submitted for validation shall be deemed valid until a new validation is due to the Department.

(V) The Department will establish a list of entities approved to perform independent validations of local assessments in consultation with the Local Assessment Validation Advisory Committee as provided in § 4.52(f).

(VI) School boards shall only approve assessments that have been determined to meet the requirements of this subsection by an approved entity performing the independent validation. If a school district, [AVTS] ACTS or charter school, including a cyber charter school, uses a local assessment that has not been independently validated, the Secretary will direct the school entity to discontinue its use until the local assessment is approved through independent validation by an approved entity.

[(C) Completion of an Advanced Placement exam or International Baccalaureate exam that includes academic content comparable to the appropriate Keystone Exam at a score established by the Secretary to be comparable to the proficient level on the appropriate Keystone Exam.

(d) Requirements beginning in the 2018-2019 school year. Effective with the 2018-2019 school year, requirements in subsection (c)(1)(iii) must include a determination of proficiency in English Language Arts (Composition) (Appendix A-2).

(e) Requirements beginning in the 2019-2020 school year. Effective with the 2019-2020 school year, Civics and Government (Appendix C) is added to the academic standards in subsection (c)(1)(iii). The requirements in subsection (c)(1)(iii) must include a determination of proficiency in Civics and Government.

(f) Career and technical education program students. A student enrolled in a Department-approved career and technical education program may satisfy the requirements of subsections (d) and (e) upon completion of secondary level coursework in English Language Arts (Literature), Algebra I and Biology, in which a student demonstrates proficiency on the associated Keystone Exam, validated local assessment or project-based assessment, and achieves a score of competent or advanced on a Pennsylvania State Skills Assessment required under § 4.31(a) (relating to vocational-technical education).]

[(g)] (d) *Special education students.* Children with disabilities who satisfactorily complete a special education program developed by an Individualized Education Program team under the Individuals with Disabilities Education Act and this part shall be granted and issued a regular high school diploma by the school district of residence, charter school (including cyber charter

school) or [AVTS] **ACTS**, if applicable. This subsection applies if the special education program of a child with a disability does not otherwise meet the requirements of this chapter.

[(h)] **(e)** *Demonstration of proficiency.* For purposes of this section, a student shall be deemed proficient in the State-assessed standards whenever the student demonstrates proficiency through any of the options in subsection (c)(1)(iii), regardless of the student's grade level or age.

[(i)] **Transcripts.** Beginning in the 2003-2004 school year, and through the 2012-2013 school year, PSSA scores in each assessed discipline shall be included on student transcripts. Beginning in the 2016-2017 school year, the performance level demonstrated in each of the academic standards in subsections (c)—(e) shall be included on student transcripts. The information presented on a transcript must include the highest performance level demonstrated by a student on the associated Keystone Exam, validated local assessment or project-based assessment at the time the transcript is produced.]

(f) Transcripts. The performance level demonstrated by a student in each of the state academic standards, including the highest performance level demonstrated by a student on the associated Keystone Exam, may be included on a student's transcript as determined by each school entity.

[(j)] **(g)** *Release of scores.* This section does not allow for the release of individual student PSSA or Keystone Exam scores to the Department or other Commonwealth entities in accordance with § 4.51(f) and (g).

[(k)] **Supplemental instruction.** Beginning in the 2011-2012 school year, a] **(h) Supplemental instruction.** A student who does not demonstrate proficiency on a Keystone Exam or a locally validated assessment specified in subsection (c)], **(d) or (e) shall** may be offered supplemental instructional support by the student's school district, [AVTS] **ACTS** or charter school, including a cyber charter school]. **The supplemental instructional support must be consistent with the student's educational program and assist the student to attain proficiency in the State academic standards]** consistent with section 121(c.4) of the Public School Code of 1949 (24 P. S. § 1-121(c.4)).

[(l)] **(i)** *Out-of-state transfers.* A school district, [AVTS] **ACTS** or charter school, including a cyber charter school, shall determine whether a student who transfers from an out-of-State school having demonstrated proficiency in coursework and assessments aligned with the academic standards assessed by each Keystone Exam may satisfy the requirements of [subsections (c)—(e) subject to guidance developed by the Secretary] subsection (c).

[(m)] **Transition.** To effect successful transition between requirements outlined in subsections (b) and (c) regarding requirements through the 2015-2016 school year and requirements beginning in the 2016-2017 school year, subsection (d) regarding requirements beginning in the 2018-2019 school year and subsection (e) regarding requirements beginning in the 2019-2020 school year, a student who will graduate in the 2016-2017 school year or thereafter, who successfully completes courses with academic content assessed under subsection (c), (d) or (e), regarding requirements beginning in the 2016-2017 school year, 2018-2019 school year and 2019-2020 school year for which both the Keystone Exams and local validated assessments were not available at the time the course was completed, shall be deemed proficient for purposes of this section.]

(j) In any year in which the Federal government has waived the testing and accountability requirements of the Elementary and Secondary Education Act, AS AMENDED BY THE EVERY STUDENT SUCCEEDS ACT (20 U.S.C.A. §§ 6301–7981), a student shall not be required to take a Keystone Exam for the purpose established in this section and shall be deemed proficient for purposes of this section by meeting the requirements set forth in section 121.1 of the Public School Code of 1949 (24 P.S. § 1-121.).

[VOCATIONAL-TECHNICAL] CAREER AND TECHNICAL EDUCATION

§ 4.31. [Vocational-technical education] Career and Technical education.

(a) **[Vocational-technical] Career and technical** education courses shall be developed in the planned instruction format and be accessible to all high school students attending those grades in which **[vocational-technical] career and technical** education courses are offered. All students and their parents or guardians shall be informed of the students' rights to participate in **[vocational-technical] career and technical** education programs and courses and that students with disabilities enrolled in the programs are entitled to services under Chapter 14 (relating to special education services and programs). Students who complete approved **[vocational-technical] career and technical** education programs shall have their occupational competency assessed by completion of the appropriate assessment under the Pennsylvania Skills Certificate Program or by completion of another occupational competency assessment approved by the Department. A student with a disability shall be provided appropriate accommodations when provided for in the student's individualized education program. Students shall also demonstrate proficiency in meeting academic standards as required under § 4.24 (relating to high school graduation requirements), including § 4.12(f) (relating to academic standards) and **[§ 4.24(g)] § 4.24(d)** for students with disabilities with an individualized education program.

(b) **[Vocational-technical] Career and technical** education courses may be taught at **[AVTSS] ACTSS** or other high schools.

(c) **[Vocational-technical] Career and technical** education programs must consist of a series of planned academic and **[vocational-technical] career and technical** education courses that are articulated with one another so that knowledge and skills are taught in a systematic manner. When appropriate, **[vocational-technical] career and technical** education programs must adopt, in program areas for which they are available, industry recognized skills standards and may also include cooperative **[vocational-technical] career and technical** education and participation in **[vocational] career and technical** student organizations to develop leadership skills.

(d) **[Vocational-technical] Career and technical** education courses must include content based upon occupational analysis, clearly stated performance objectives deemed critical to successful employment and assessment of student competencies based upon performance standards.

(e) The record of a student enrolled in a **[vocational-technical] career and technical** education program must include the student's educational and occupational objectives and the results of the assessment of student competencies under subsection (d).

(f) Safety education, consisting of safety practices, accident prevention, occupational health habits and environmental concerns shall be integrated into the instruction and practices in **[vocational-technical] career and technical** education programs.

(g) School districts and **[AVTSs] ACTSs** administering **[vocational-technical] career and technical** education programs shall develop written policies regarding admissions. Course announcements, guidance materials and other communications must convey the philosophy of equal access to students considering enrolling in **[AVTSs] ACTSs** and include a description of admissions policies. The policies must assure that when admissions to **[AVTSs] ACTSs** must be limited, the admissions shall be on a nondiscriminatory basis.

§ 4.32. Standards and reports.

(a) The Secretary is responsible for the promulgation of standards appropriate for implementing § 4.31 (relating to **[vocational-technical] career and technical** education). Present standards, to the extent that they are inconsistent, are superseded by this chapter.

(b) The Secretary will report annually to the Board on the status of **[vocational-technical] career and technical** education programs, including tech-prep and apprenticeship programs. Reports will include numbers and types of programs, numbers of students, post-program status of students, Statewide competency standards and assessment information.

§ 4.33. Advisory committees.

(a) A school district or **[AVTS] ACTS** administering or planning to administer **[vocational-technical] career and technical** education programs shall appoint a local advisory committee. Membership on the committee shall consist of business and industry representatives, public sector employers, agriculture, labor organizations, community organizations, postsecondary education institutions and the general public. The appointed advisory committee shall meet at least once each year and give advice to the board and the administration concerning the program of the school, including its general philosophy, academic and other standards, course offerings, support services, safety requirements and the skill needs of employers. An advisory committee may serve multiple institutions where employment areas overlap.

(b) An administrative committee, composed of chief school administrators representing participating school districts, shall be included in the organization of each **[AVTS] ACTS**. The committee shall advise the **[AVTS] ACTS** board and the administration concerning the educational program and policies of the school.

(c) An occupational advisory committee shall be established for each **[vocational-technical] career and technical** education program or cluster of related programs offered by a school district or **[AVTS] ACTS**. The committee shall be appointed by the board of directors, and a

majority of the members of the committee shall be employees and employers in the occupation for which training is provided. The committee shall meet at least twice each year to advise the board, administration and staff on curriculum, equipment, instructional materials, safety requirements, program evaluation and other related matters and to verify that the programs meet industry standards and, if appropriate, licensing board criteria and that they prepare students with occupation related competencies.

§ 4.34. Programs and equipment.

(a) A satellite **[vocational-technical] career and technical** education program may be operated by an **[AVTS] ACTS** board in conformity with a memorandum of understanding adopted with the participating school district's board of school directors.

(b) Certified guidance personnel in each secondary school and **[AVTS] ACTS** shall be assigned responsibility to provide pupils with **[vocational-technical] career and technical education** guidance services.

(c) Equipment will be deemed appropriate if it is compatible, insofar as practical, to that used in occupations or households for which **[vocational-technical] career and technical** education is provided.

§ 4.35. [AVTSs] ACTSs.

(a) **[AVTS] ACTS** attendance areas shall conform to the plan of the State Board **[for Vocational] of Career and Technical** Education. Boards of school directors may petition the State Board **[for Vocational] of Career and Technical** Education for attendance area assignment or reassignment.

(b) The following provisions apply to the establishment of **[AVTSs] ACTSs**:

(1) Where more than one district constitutes an attendance area, the appropriate intermediate unit may, and upon the request of any school district shall, call for an election by the boards of school directors within the attendance area to determine if an **[AVTS] ACTS** shall be established.

(2) A school district within the attendance area may elect to participate in the establishment of the **[AVTS] ACTS**.

(3) Where a single school district constitutes an attendance area, the board of school directors of that district may establish and operate **[AVTSs] ACTSs** and be considered an **[AVTS] ACTS** board.

(c) The following provisions apply to articles of agreement for the establishment and operation of **[AVTSs] ACTSs**:

(1) The boards of school directors of the school districts electing to participate in the **[AVTS] ACTS** shall enter into a written agreement setting forth rights and obligations of the participating school districts.

(2) No change will be made in the articles of agreement under paragraph (1) without the consent of each participating school district by the affirmative vote of each board of school directors.

(3) No school district may withdraw from the articles of agreement under paragraph (1) without the consent of each participating school district.

ASSESSMENT

§ 4.51. State assessment system.

(a) The State assessment system shall be designed to serve the following purposes:

(1) Provide students, parents, educators and citizens with an understanding of student and school performance consistent with the No Child Left Behind Act of 2001 (Pub. L. No. 107-110, 115 Stat. 1425).

(2) Determine the degree to which school programs enable students to attain proficiency of academic standards under § 4.12 (relating to academic standards).

(3) Provide information to State policymakers, including the General Assembly and the Board, on how effective schools are in promoting and demonstrating student proficiency of academic standards.

(4) Provide information to the general public on school performance.

(5) Provide results to school entities based upon the aggregate performance of all students, for students with an Individualized Education Program (IEP) and for those without an IEP.

(6) Assess student proficiency in the Academic Standards for English Language Arts (Appendix A-2), Mathematics (Appendix A-2), **AND, THROUGH JUNE 30, 2025, Science and ~~{Technology and}~~ Environment and Ecology ~~{(Appendix B)}~~, AND, BEGINNING JULY 1, 2025, SCIENCE, ENVIRONMENT, ECOLOGY and Technology and Engineering (Appendix B-1) and Civics and Government (Appendix C)** for the purpose of determining, in part, a student's eligibility for high school graduation.

(b) The State assessment system must include PSSA assessments and Keystone Exams.

(c) Neither State assessments nor academic standards under § 4.12 may require students to hold or express particular attitudes, values or beliefs.

(d) The Department will make samples of State assessment questions, assessment formats and scoring guides available to the public after each administration of State assessments.

(e) To ensure that information regarding student performance is available to parents and teachers, State assessments developed under this section must include student names.

(f) Individual assessment results shall be used in planning instruction only by parents, teachers, administrators and guidance counselors with a need to know based upon local board policy on testing and in reporting academic progress.

(g) The Department and other Commonwealth entities are prohibited from collecting individual student test scores and may collect only aggregate test scores by school and district.

(h) The Board will authorize the expansion of the State assessment system through a revision of this chapter.

(1) The Board will not include National assessments as part of the State assessment system unless, upon consultation with teachers, counselors and parents representing students who have been identified under Chapter 14 (relating to special education services and programs), the Board determines the assessment is an appropriate means of assessing the academic progress of students identified under Chapter 14, or unless the General Assembly authorizes the use of a National assessment.

(2) Subject to paragraph (3), the Board will not, and the Department may not, be a governing state in any consortium for the development of a National assessment for the purpose of utilization as part of the State assessment system.

(3) The Department may continue to participate in a consortium to develop an alternate assessment to measure the academic progress of students identified under Chapter 14.

(i) The Department will implement provisions for security of the State assessment system, including the following:

(1) Action by a professional employee or commissioned officer that is willfully designed to divulge test questions, falsify student scores or in some other fashion compromise the integrity of the State assessment system as determined by the school district, [AVTS] ACTS or charter school, including a cyber charter school, shall be subject to disciplinary action under the Educator Discipline Act (24 P. S. § § 2070.1a—2070.18c).

(2) Cheating by students or employees other than those covered in paragraph (1) shall be subject to disciplinary action by the school district, [AVTS] ACTS or charter school, including a cyber charter school.

(3) Cheating or breaches of assessment security shall be reported to the Secretary as soon as detected.

(j) The Secretary is authorized to establish guidelines for the administration of the State assessment system.

(k) The Secretary will report each September to the Board and the General Assembly information and pertinent data regarding the State assessment system. The Secretary also will provide each school entity information and pertinent data for the school entity and its students.

(l) Children with disabilities and children with limited English proficiency shall be included in the State assessment system as required by Federal law, with appropriate accommodations when necessary. As appropriate, the Commonwealth will develop guidelines for the participation of children with disabilities in alternate assessments for those children who cannot participate in the

PSSA or Keystone Exams as determined by each child's individualized education program team under the Individuals with Disabilities Education Act and this part.

§ 4.51a. Pennsylvania System of School Assessment.

(a) All PSSA assessments administered in English Language Arts, Mathematics, and Science, **[and Technology and]** Environment **[and]**, Ecology, **Technology and Engineering** will be standards-based and criterion referenced and include essay or open-ended response items in addition to other item formats. The proportion of type of items will vary by grade level. The criteria for judging performance on PSSA assessments are as follows:

(1) Performance on PSSA English Language Arts assessments shall be demonstrated by students' responses to comprehension questions about age-appropriate reading passages, by their written responses to in-depth comprehension questions about the passages and by the quality of their written compositions on a variety of topics and modes of writing.

(2) Performance on PSSA mathematics assessments shall be demonstrated by students' responses to questions about grade-appropriate content and by the quality of their responses to questions that require a written solution to a problem.

(3) Performance on PSSA science assessments shall be demonstrated by students' responses to grade appropriate content and by the quality of their responses to questions that demonstrate knowledge of each category of the standards for science **[and technology and]**, environment **[and]**, ecology, **technology and engineering**.

(4) Performance levels shall be advanced, proficient, basic and below basic. In consultation with educators, students, parents and citizens, the Department will develop and recommend to the Board for its approval specific criteria for advanced, proficient, basic and below basic levels of performance.

(b) The Department will develop or cause to be developed PSSA assessments based on Pennsylvania Core Standards in Mathematics and English Language Arts under § 4.12 (relating to academic standards) and contained in Appendix A-2. **and THROUGH JUNE 30, 2025, THE DEPARTMENT WILL DEVELOP OR CAUSE TO BE DEVELOPED PSSA ASSESSMENTS BASED ON ACADEMIC STANDARDS IN SCIENCE AND TECHNOLOGY AND ENVIRONMENT AND ECOLOGY UNDER § 4.12 AND CONTAINED IN APPENDIX B. BEGINNING JULY 1, 2025, THE DEPARTMENT WILL DEVELOP OR CAUSE TO BE DEVELOPED PSSA ASSESSMENTS BASED ON** academic standards in Science **[and Technology and]**, Environment **[and]**, Ecology, **Technology and Engineering** under § 4.12 and contained in **[Appendix B] Appendix B-1**. In developing PSSA assessments, the Department will consult with educators, students, parents and citizens regarding the specific methods of assessment.

(c) The PSSA assessments shall be administered annually and include assessments of the State academic standards in Mathematics and English Language Arts at grades 3 through 8, and in Science **[and Technology and]**, Environment **[and]**, Ecology, **Technology and Engineering** at grades 4 and 8.

§ 4.51b. Keystone Exams.

(a) The Department will develop or cause to be developed Keystone Exams as provided in this subsection. (This subsection is intended by the Board to be a continuation of § 4.51(f) (relating to State assessment system) as published at 40 Pa.B. 240 (January 9, 2010) and referenced in section 102 of the School Code (24 P. S. § 1-102).)

(1) **[Three assessments] One assessment** aligned with the Mathematics standards, contained in Appendix A-2, that **[assess] assesses** the academic content traditionally included in **an Algebra I, Algebra II and Geometry courses] course.**

(2) **[Two assessments] One assessment** aligned with select English Language Arts standards, contained in Appendix A-2 that **[assess] assesses** academic content traditionally included in **a high school literature [and composition courses] course.**

[(3) Three assessments aligned with select History and Civics and Government standards, contained in Appendix C, that assess content traditionally included in high school level American History, World History and Civics and Government courses.]

[(4) Two assessments] (3) THROUGH JUNE 30, 2025, ONE ASSESSMENT ALIGNED WITH SELECT STANDARDS FOR SCIENCE AND TECHNOLOGY AND ENVIRONMENT AND ECOLOGY, CONTAINED IN APPENDIX B, THAT ASSESSES ACADEMIC CONTENT TRADITIONALLY INCLUDED IN A HIGH SCHOOL LEVEL BIOLOGY COURSE. BEGINNING JULY 1, 2025, ~~One~~ ONE assessment aligned with select standards for Science **[and Technology and]**, Environment and Ecology, contained in **[Appendix B] Appendix B-1**, that **[assess] assesses** academic content traditionally included in **a high school level Biology [and Chemistry courses] course.**

(b) Keystone Exams shall be offered at least three times each year: once each in the fall, spring and summer.

(c) Keystone Exams shall be administered, reviewed and scored so that scores for candidates for graduation are provided to schools no later than 10 calendar days prior to graduation. A school district, **[AVTS] ACTS** or charter school, including a cyber charter school, may request the Department to approve alternative test administration and scoring time frames. The Department will publish guidelines and procedures for approving alternative test administration and scoring time frames on its web site. The guidelines will provide for approval of all requests unless the approval is contrary to standards of test validity and scoring.

(d) A student shall be permitted to retake any Keystone Exam, or Keystone Exam module, in which the student did not score proficient or above at the next available testing date, **so long as the student has participated in a satisfactory manner in supplemental instruction as provided under § 4.24(k) (relating to high school graduation requirements) and subsection (f).** There is not a limit on the number of times a student who did not score proficient on a Keystone Exam is permitted to retake the Keystone Exam or Keystone Exam module. A student who has achieved a score of proficient or advanced on a Keystone Exam **[is not permitted to retake the exam] shall be permitted to retake a Keystone Exam only if the student or parent submits a request in writing to the school entity.**

(e) Each Keystone Exam will be designed in modules that reflect distinct, related academic content that is common to the traditional progression of coursework to allow students who do not score proficient or above to retake those portions of the test in which they did not score proficient or above.

(f) A student taking Keystone Exams, or Keystone Exam modules, who did not score proficient on a Keystone Exam, or Keystone Exam module, **[shall] may** be provided supplemental instruction consistent with the student's educational program by the student's school district, **[AVTS] ACTS** or charter school, including a cyber charter school, **[until the student can demonstrate proficiency in the subject area or the student begins a project-based assessment provided in § 4.51c (relating to project-based assessment)] consistent with section 121(c.4) of the Public School Code OF 1949 (24 P. S. § 1-121(c.4))**.

(g) Performance levels for Keystone Exams shall be set at the advanced, proficient, basic and below basic levels. In consultation with the Performance Level Advisory Committee, the Department will develop and recommend to the Board for its approval performance level descriptors and performance level cut scores for the Keystone Exams and any alternative assessments developed to assess students with disabilities as permitted by the No Child Left Behind Act of 2001 (Pub. L. No. 107-110, 115 Stat. 1425). The Department will use widely-accepted psychometric procedures to establish the cut scores. Cut scores shall be presented at a public meeting of the Board for its review at least 2 weeks prior to scheduled Board action on the cut scores.

(h) The Department will provide guidance to school districts, **[AVTSs] ACTSs** and charter schools, including cyber charter schools, as to the appropriate accommodations school entities shall provide to students with disabilities, students who are gifted and English language learners, when appropriate.

(i) Beginning in the 2012-2013 school year, Keystone Exams in the following subjects will be developed by the Department and made available for use by school districts, **[AVTSs] ACTSs** and charter schools, including cyber charter schools, for the purpose of assessing high school graduation requirements in § 4.24(c)(1)(iii):

Algebra I
Literature
Biology

[(j) Subject to funding appropriated by the General Assembly for development of the exams and related project-based assessments and validation of related local assessments, Keystone Exams in the following subjects will be developed by the Department and made available for use by school districts, AVTSs and charter schools, including cyber charter schools, for the purpose of assessing high school graduation requirements in § 4.24(c)(1)(iii) in accordance with the following schedule:

**School Year 2015-2016 English Composition
School Year 2016-2017 Civics and Government**

(1) During the 2014-2015 school year, school districts, AVTSs and charter schools, including cyber charter schools, shall administer the Keystone Exam in English

Composition for the purpose of gathering data to set performance level cut scores for the exam.

(2) During the 2015-2016 school year, school districts, AVTSs and charter schools, including cyber charter schools, shall administer the Keystone Exam in Civics and Government for the purpose of gathering data to set performance level cut scores for the exam.

(k) Subject to funding appropriated by the General Assembly for development of the exams, Keystone Exams in the following subjects will be developed by the Department and made available for voluntary use by school districts, AVTSs and charter schools, including cyber charter schools, in accordance with the following schedule:

**School Year 2016-2017 Geometry
School Year 2017-2018 U.S. History
School Year 2018-2019 Algebra II
School Year 2019-2020 Chemistry
School Year 2020-2021 World History]**

[(l)] (j) The Department will seek to have the Keystone Exams approved as the high school level single accountability system under the ~~No Child Left Behind Act of 2001~~ EVERY STUDENT SUCCEEDS ACT (PUB. L. NO. 114-95) or its successor Federal statute. [Upon approval by the United States Department of Education, the Algebra I and Literature exams will be used to determine adequate yearly progress at the high school level. The Biology Keystone Exam will be used as the high school level science assessment, which is not a factor in determining adequate yearly progress.] If the Keystone Exams receive approval as the high school level accountability measure, school districts, [AVTSs] ACTSs and charter schools, including cyber charter schools, shall administer the Literature, Algebra I and Biology exams as end-of-course tests in the grade level in which students complete the relevant coursework.

[(m)] (k) The 11th grade PSSA exams in Reading, Writing, Math and Science shall be discontinued upon implementation of the Keystone Exams as the approved assessment system under section 1111(b)(2)(C) of the No Child Left Behind Act of 2001 (20 U.S.C.A. § 6311(b)(2)(C)).

[(n)] (l) At least once every 5 years, the Department will contract with a qualified, independent research organization to perform a validity study of the Keystone Exams using generally accepted education research standards. These studies will determine, at a minimum, the degree to which the Keystone Exams and performance level cut scores are valid for the purposes for which they are used; aligned with State academic standards; aligned with performance levels of other states; internationally benchmarked; and predict college and career success. In addition, all Keystone Exams, performance level descriptors and cut scores will be subject to the best available forms of content, criterion and consequential validation.

[(o)] (m) The Department will establish a State Assessment Validation Advisory Committee (Committee). The Committee will advise the Department on its plans to conduct the validity study and review and provide feedback on its findings.

~~[(p)]~~ **(n)** The Department and the Committee will investigate the use of a certificate based on industry approved standards and performance on an NOCTI exam as an alternative pathway to graduation and will make a report and recommendation to the Board by January 10, 2011.

§ 4.51c. Project-based assessment.

~~(a)~~ The Department will develop a project-based assessment system that is aligned with the modules for the Keystone Exams in Literature, Algebra I, and Biology], **Composition, and Civics and Government for students who are unable to demonstrate proficiency on a Keystone Exam or Keystone Exam module, or if § 4.4(d)(4) (relating to general policies) applies]. School entities may utilize project-based assessments for students consistent with section 121(c.5) of the Public School Code of 1949 (24 P. S. § 1-121(c.5)).**

(b) The project-based assessment system shall be administered by schools and scored by Statewide panels composed of teachers, principals and curriculum specialists assembled by the Department. The Statewide review panels shall score student projects according to scoring protocols and rubrics developed by the Department.

(c) A student in grade 12 who has not demonstrated proficiency on a Keystone Exam or Keystone Exam module may qualify to participate in one or more project-based assessments if the student has met the following conditions:

(1) Has taken the course.

(2) Has met the attendance requirements of the school district, AVTS or charter school, including a cyber charter school.

(3) Has participated in a satisfactory manner in supplemental instructional services consistent with the student's educational program provided by the school district, AVTS or charter school, including a cyber charter school, as provided under § § 4.24(k) and 4.51b(f) (relating to high school graduation requirements; and Keystone Exams).

(d) A student below grade 12 who has not demonstrated proficiency on a Keystone Exam or Keystone Exam module after at least two attempts on the exam or module may qualify to participate in one or more project-based assessments if the student has met the following conditions:

(1) Has taken the course.

(2) Has met the attendance requirements of the school district, AVTS or charter school, including a cyber charter school.

(3) Has participated in a satisfactory manner in supplemental instructional services consistent with the student's educational program provided by the school district, AVTS or charter school, including a cyber charter school, as provided under § § 4.24(k) and 4.51b(f).

(e) A student to whom § 4.4(d)(4) applies may qualify to participate in one or more project-based assessments if the student has met the following conditions:

(1) Has taken the course.

(2) Has met the attendance requirements of the school district, AVTS or charter school, including a cyber charter school.

(f) Successful completion of a project-based assessment aligned to the Keystone Exam or Keystone Exam module on which a student did not demonstrate proficiency shall satisfy the requirements that students achieve proficiency on the Keystone Exams in § 4.24.

(g) A student enrolled in a Department-approved career and technical education program who has not demonstrated proficiency on a Keystone Exam or Keystone Exam module in Biology may qualify to participate in a project-based assessment in Biology if the student has met the following conditions:

(1) Has taken the course.

(2) Has met the attendance requirements of the school district, AVTS or charter school, including a cyber charter school.]

§ 4.51d. Waivers.

A chief school administrator, in his sole discretion, may waive the requirements in § 4.24 (relating to high school graduation requirements) **[on a case-by-case basis for good cause. Waivers may be granted for a student in grade 12 who was not successful in completing a project-based assessment as provided in § 4.51c (relating to project-based assessment), or to accommodate a student who experiences extenuating circumstances (including serious illness, death in immediate family, family emergency, frequent transfers in schools or transfer from an out-of-State school in grade 12).**

(1) Prior to granting a waiver, a chief school administrator shall certify that the student meets the following criteria:

(i) Has met the local requirements of the school district, AVTS or charter school, including a cyber charter school, for graduation, except for demonstration of proficiency of the requirements in § 4.24(c)(1)(iii)(A) for which the waiver is being requested.

(ii) Has not demonstrated proficiency on a Keystone Exam or Keystone Exam module.

(iii) If the student is required to participate in supplemental instruction under § 4.24(k) and § 4.51b(f) (relating to Keystone Exams), has participated in a satisfactory manner in supplemental instructional services consistent with the student's educational program provided by the school district, AVTS or charter school, including a cyber charter school.

(iv) Has not successfully completed a project-based assessment aligned to the Keystone Exam or Keystone Exam module on which the student did not demonstrate proficiency.

(2) If a chief school administrator is considering granting waivers for more than 10% of students in the graduating class of a school district, AVTS or charter school, including a cyber charter school, because the students were not successful in completing a project-based assessment as provided in § 4.51c, the chief school administrator shall submit an action plan for approval by the Secretary no later than 10 calendar days prior to graduation. The action plan must identify improvements the school district, AVTS or

charter school, including a cyber charter school, will implement to each course associated with the Keystone Exam content for which the waivers were granted.] consistent with section 121(c.3) of the Public School Code of 1949 (24 P. S. § 1-121(c.3)).

[(3)] **(1)** The chief school administrator of each school district, [AVTS] **ACTS** and charter school, including a cyber charter school, shall annually report to the Department the number of waivers granted to students in the most recent graduating class **consistent with section 121(c.11)(6) of the Public School Code of 1949 (24 P. S. § 1-121(c.11)(6))**, and the Department will annually report to the Board the number of waivers granted by each school district, [AVTS] **ACTS** and charter school, including a cyber charter school.

[(4)] **(2)** The waiver process described in this section does not confer an individual right on any student.

[(5)] **(3)** The decision of a chief school administrator concerning a waiver request is not an adjudication.

[(6) Disapproval of the action plan required under paragraph (2) does not confer an individual right on any student relative to a waiver determination made by a chief school administrator.]

§ 4.52. Local assessment system.

(e) Children with disabilities shall be included in the local assessment system, with appropriate accommodations, when necessary. As appropriate, the school district, including a charter school, including a cyber charter school, or [AVTS] **ACTS** shall develop guidelines for the participation of children with disabilities in alternate assessments for those children who cannot participate in the local assessment as determined by each child's Individualized Education Program team under the Individuals with Disabilities Education Act and this part.

Appendix B – 1

Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K–5) ¹²

Kindergarten

Earth and Space Sciences

Earth and Human Activity

1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.
3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Earth's Systems

1. Use **AND SHARE** observations of local weather conditions to describe patterns over time.
2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

¹ Across grades K-5, all of the core ideas in Table 1 are covered, but not every discipline or core idea is reflected at every grade.

² The language of the standards is adapted, informed by or taken from the: National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. North American Association for Environmental Education (2019) *K–12 environmental education: Guidelines for excellence*; International Society for Technology in Education Standards. (2019). *ISTE standards for students*; *International Technology and Engineering Educators Association (ITEEA) (2020)*; *NGSS Lead States. (2013). Next generation science standards: For states, by states*; *Standards for technological and engineering literacy: The role of technology and engineering in STEM education. National Council for Agricultural Education. (2015)*; *International Society for Technology in Education. (2019). ISTE Standards for students. Agriculture, food and natural resources (AFNR) career cluster content standards; Pennsylvania State Board of Education. (2002). Academic standards for science and technology; Pennsylvania Department of Education. (2002). Safety guidelines for elementary and technology education teachers; Pennsylvania Department of Education. (n.d.). Pennsylvania career ready skills continuum; Standards for Technological and Engineering Literacy. (2020); Pennsylvania Association for Environmental Educators. (September 2015). Pennsylvania environmental literacy plan Pennsylvania State Board of Education. (2002). Academic standards for environment and ecology. North American Association for Environmental Education. (2014). State environmental literacy plans: 2014 status report.*

Life Science

From Molecules to Organisms: Structures and Processes

1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

Physical Science

Motion and Stability: Forces and Interactions

1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Energy

1. Make observations to determine the effect of sunlight on Earth's surface.
2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.

Grade 1

Earth and Space Sciences

Earth's Place in the Universe

1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.
2. Make observations at different times of year to relate the amount of daylight to the time of year.

Life Science

From Molecules to Organisms: Structures and Processes

1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

Heredity: Inheritance and Variation of Traits

1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.

Physical Science

Waves and Their Applications in Technologies for Information Transfer

1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.
3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.
4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Grade 2

Earth and Space Sciences

Earth's Place in the Universe

1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

Earth's Systems

1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Life Science

Ecosystems: Interactions, Energy, and Dynamics

1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.
2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Biological Evolution: Unity and Diversity

1. Make observations of plants and animals to compare the diversity of life in different habitats.

Matter and its Interactions

1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Grade 3

Earth and Space Sciences

Earth's Systems

1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
2. Obtain and combine information to describe climates in different regions of the world.

Earth and Human Activity

1. Make a claim supported by evidence about the merit of a design solution that reduces the impacts of a weather-related hazard.

Life Science

From Molecules to Organisms: Structures and Processes

1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Ecosystems: Interactions, Energy, and Dynamics

1. Construct an argument that some animals ~~have physical and behavioral adaptations that~~ **FORM GROUPS THAT** help members survive.

Heredity: Inheritance and Variation of Traits

1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
2. Use evidence to support the explanation that traits can be influenced by the environment.

Biological Evolution: Unity and Diversity

1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
4. Make a claim supported by evidence about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Physical Science

Motion and Stability: Forces and Interactions

1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
2. Make and communicate observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

Grade 4

Earth and Space Sciences

Earth's Place in the Universe

1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Earth's Systems

1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
2. Analyze and interpret data from maps to describe patterns of Earth's features.

Earth and Human Activity

1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Life Science

From Molecules to Organisms: Structures and Processes

1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Physical Science

Waves and Their Applications in Technologies for Information Transfer

1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
3. Generate and compare multiple solutions that use patterns to transfer information.

Energy

1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
2. Make and communicate observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Grade 5

Earth and Space Sciences

Earth's Place in the Universe

1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Earth's Systems

1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Earth and Human Activity

1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
2. Generate and design possible solutions to a current environmental issue, threat, or concern.

Life Science

From Molecules to Organisms: Structures and Processes

1. Support an argument that plants get the materials they need for growth chiefly from air and water.

Ecosystems: Interactions, Energy, and Dynamics

1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Physical Science

Matter and Its Interactions

1. Develop a model to describe that matter is made of particles too small to be seen.
2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
3. Make and communicate observations and measurements to identify materials based on their properties.
4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
5. Interpret and analyze data and observations to make decisions about how to utilize materials based on their properties.

Motion and Stability: Forces and Interactions

1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

Energy

1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Standards by Grade Band

Grades K–2: ~~Environment and Ecology~~ ENVIRONMENTAL LITERACY AND SUSTAINABILITY

Decision-Making and Action Skills

- ~~1. Examine and express their own views on environmental issues.~~
- ~~2. Determine whether action is needed on selected environmental issues and whether they should be involved. They describe their reasoning.~~
- ~~3. Develop an action strategy or design solution for a specific local environmental issue of their choosing.~~
- ~~4. Identify environmental and social consequences of design solutions and civic actions, including their own actions.~~

Personal and Civic Responsibility

- ~~1. Describe their basic rights and responsibilities as members of a community and the importance of these rights and responsibilities in promoting environmental quality and community well-being.~~
- ~~2. Describe how they can realistically and meaningfully contribute to their community and environmental quality.~~
- ~~3. Identify ways in which they are responsible for the environmental and social effects of their actions.~~

Earth's Physical and Living Systems

- ~~1. Describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.~~
- ~~2. Identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.~~

Human Systems

- ~~1. Generate examples of how people act, as individuals, as members of a group, and as members of society, toward the environment. They articulate their own beliefs and the beliefs of family and community members about the environment and environmental issues.~~
- ~~2. Identify ways that people express different cultural backgrounds and how these can influence environmental perceptions and activities.~~

AGRICULTURAL AND ENVIRONMENTAL SYSTEMS AND RESOURCES

- 1. EXAMINE HOW PEOPLE FROM DIFFERENT CULTURES AND COMMUNITIES, INCLUDING ONE’S OWN, INTERACT AND EXPRESS THEIR BELIEFS ABOUT NATURE.**

Environment and Society

- ~~1. Identify ways that people depend on, change, and are affected by the environment.~~
- ~~2. Describe~~ **2. CATEGORIZE** ways people harvest, re-distribute, and use natural resources.

ENVIRONMENTAL LITERACY SKILLS

- ~~3. Identify~~ **1. EXPLAIN** ways that places differ in their physical and human characteristics, **THEIR MEANING, AND THEIR VALUE AND/OR IMPORTANCE.**
- ~~4. Recognize that change is a normal part of individual and societal life.~~

Skills for Analyzing and Investigating Environmental Issues

- ~~1. Identify and investigate issues~~ **2. PLAN AND CARRY OUT AN INVESTIGATION TO ADDRESS AN ISSUE** in their local environment and community.
- ~~2. Use their knowledge of how ecological and human systems are interconnected to describe the environmental and social consequences of local environmental issues.~~
- ~~3. Develop plans, including possible design solutions, for addressing selected local environmental issues.~~
- ~~4. Demonstrate openness and receptivity while listening to and working with others who have perspectives about the environment that are different from their own.~~

Grades K–2: Technology and Engineering

Applying, Maintaining, and Assessing Technological Products and Systems

- Analyze how things work.
- Identify and use everyday symbols.
- Describe qualities of everyday products.

Core Concepts of Technology and Engineering

- Illustrate how systems have parts or components that work together to accomplish a goal.
- Safely use tools to complete tasks.
- Explain that materials are selected for use because they possess desirable properties and

characteristics.

4. Develop a plan in order to complete a task.
5. Collaborate effectively as a member of a team.

Design in Technology and Engineering Education

1. Apply design concepts, principles, and processes through play and exploration.
2. Demonstrate that designs have requirements.
3. Explain that design is a response to wants and needs.
4. Discuss that all designs have different characteristics that can be described.
5. Illustrate that there are different solutions to a design and that none are perfect.
6. Demonstrate essential skills of the engineering design process.
7. Apply skills necessary for making in design.

History of Technology

1. Discuss how the way people live and work has changed throughout history because of technology.

Impacts of Technology

1. Explain ways that technology helps with everyday tasks.
2. Illustrate helpful and harmful effects of technology.
3. Compare simple technologies to evaluate their impacts.
4. Select ways to reduce, reuse, and recycle resources in daily life.
5. Design new technologies that could improve their daily lives.

Influence of Society on Technological Development

1. Explain the needs and wants of individuals and societies.
2. Explore how technologies are developed to meet individual and societal needs and wants.
3. Investigate the use of technologies in the home and community.

Integration of Knowledge, Technologies, and Practices

1. Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.
2. Draw connections between technology and human experiences.

Nature and Characteristics of Technology and Engineering

1. Compare the natural world and human-made world.
2. Explain the tools and techniques that people use to help them do things.

3. Demonstrate that creating can be done by anyone.
4. Discuss the roles of scientists, engineers, technologists and others who work with technology.

Grades 3–5: Environment and Ecology ENVIRONMENTAL LITERACY AND SUSTAINABILITY

Decision-Making and Action Skills

1. Identify, justify, and clarify their views on environmental issues and alternative ways to address them.
2. Evaluate whether action is needed in specific situations, using environmental, cultural/social, and economic criteria. They decide whether they should be involved in that action.
3. Use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.
4. Analyze the effects of design solutions, their own civic actions, and actions taken by other individuals and groups. They describe the short and long term effects of these actions and design solutions in terms of environmental, social, and economic consequences.

Personal and Civic Responsibility

1. Explain the rights and responsibilities of community membership and their role in addressing environmental quality and sustainability.
2. Possess a realistic self-confidence in their effectiveness as community members to make changes in their community that address environmental quality and sustainability.
3. Describe the broad environmental, social, and economic consequences of their personal and group actions and as appropriate, accept responsibility for their actions.

Earth's Physical and Living Systems

1. Describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.
2. Describe how living things, including humans, are dependent on their environment and are adapted to live in particular ecosystems under particular environmental conditions. They describe major interactions among organisms and populations of organisms and explain the importance of biodiversity to ecosystem health. They describe how humans affect and are affected by the biosphere.

AGRICULTURAL AND ENVIRONMENTAL SYSTEMS AND RESOURCES

1. ANALYZE HOW LIVING ORGANISMS, INCLUDING HUMANS, AFFECT THE ENVIRONMENT IN WHICH THEY LIVE, AND HOW THEIR ENVIRONMENT AFFECTS THEM.

Human Systems

1. Explain ways that individual traits and group membership or affiliation influence perceptions

of and actions toward the environment. They describe how their environmental beliefs and values are shaped by their community and the larger society. They compare their beliefs and values to those held by others in their community.

- ~~2. Describe examples of the interconnection between cultural perspectives and the environment.~~
- ~~3. Describe how political systems at varying scales account for, manage, and affect natural resources and environmental quality.~~
- ~~4. Describe how economic systems and economic decision-making influence natural resource use and management as well as environmental and human well-being.~~

2. MAKE A CLAIM ABOUT THE ENVIRONMENTAL AND SOCIAL IMPACTS OF DESIGN SOLUTIONS AND CIVIC ACTIONS, INCLUDING THEIR OWN ACTIONS.

Environment and Society ENVIRONMENTAL LITERACY SKILLS

- ~~1. Describe human-caused changes that affect the immediate environment as well as other places, other people, and future times.~~
- ~~2. Explain that uneven geographic distribution of natural resources influences their use and perceived value.~~
- ~~3. Describe the meaning of “place” both close to home and around the world.~~
- ~~4. Explain that human social systems are dynamic and that conflicts sometimes arise over differing and changing viewpoints about the environment and natural resource use and management.~~

1. INVESTIGATE HOW PERSPECTIVES OVER THE USE OF RESOURCES AND THE DEVELOPMENT OF TECHNOLOGY HAVE CHANGED OVER TIME AND RESULTED IN CONFLICT OVER THE DEVELOPMENT OF SOCIETIES AND NATIONS.

Skills for Analyzing and Investigating Environmental Issues

- ~~1. Use primary and secondary sources of information and apply research and analytical skills to investigate environmental issues, beginning in their own community and region.~~
- ~~2. Apply their knowledge of ecological and human processes and systems to describe the short- and long-term consequences of selected environmental issues on sustainability.~~
- ~~3. Identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.~~
- ~~4. Demonstrate active listening, tolerance, adaptability, and openness as they work with others to gather a range of perspectives and information.~~

2. DEVELOP A MODEL TO DEMONSTRATE HOW LOCAL ENVIRONMENTAL ISSUES ARE CONNECTED TO LARGER LOCAL ENVIRONMENT AND HUMAN SYSTEMS.

SUSTAINABILITY AND STEWARDSHIP

- 1. CRITIQUE WAYS THAT PEOPLE DEPEND ON AND CHANGE THE ENVIRONMENT.**
- 2. EXAMINE WAYS YOU INFLUENCE YOUR LOCAL ENVIRONMENT AND COMMUNITY BY COLLECTING AND DISPLAYING DATA.**
- 3. CONSTRUCT AN ARGUMENT TO SUPPORT WHETHER ACTION IS NEEDED ON A SELECTED ENVIRONMENTAL ISSUE AND PROPOSE POSSIBLE SOLUTIONS.**

Grades 3–5: Technology and Engineering

Applying, Maintaining, and Assessing Technological Products and Systems

1. Follow directions to complete a technological task.
2. Use appropriate symbols, numbers and words to communicate key ideas about technological products and systems.
3. Identify why a product or system is not working properly.
4. Examine information to assess the trade-offs of using a product or system.

Core Concepts of Technology and Engineering

1. Describe how a subsystem is a system that operates as a part of another larger system.
2. Illustrate how, when parts of a system are missing, it may not work as planned.
3. Identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.
4. Describe the properties of different materials.
5. Demonstrate how tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.
6. Describe requirements of designing or making a product or system.
7. Create a new product that improves someone's life.

Design in Technology and Engineering Education

1. Illustrate that there are multiple approaches to design.
2. Demonstrate essential skills of the engineering design process.
3. Evaluate designs based on criteria, constraints, and standards.
4. Interpret how good design improves the human condition.
5. Apply universal principles and elements of design.
6. Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.

7. Practice successful design skills.
8. Apply tools, techniques, and materials in a safe manner as part of the design process.

History of Technology

1. Create representations of the tools people made, how they cultivated to provide food, made clothing, and built shelters to protect themselves.

Impacts of Technology

1. Describe the helpful and harmful effects of technology.
2. Judge technologies to determine the best one to use to complete a given task or meet a need.
3. Classify resources used to create technologies as either renewable or nonrenewable.
4. Explain why responsible use of technology requires sustainable management of resources.
5. Predict how certain aspects of their daily lives would be different without given technologies.

Influence of Society on Technological Development

1. Determine factors that influence changes in a society's technological systems or infrastructure.
2. Explain how technologies are developed or adapted when individual or societal needs and wants change.

Integration of Knowledge, Technologies, and Practices

1. Demonstrate how simple technologies are often combined to form more complex systems.
2. Explain how various relationships can exist between technology and engineering and other content areas.

Nature and Characteristics of Technology and Engineering

1. Compare how things found in nature differ from things that are human-made, noting differences and similarities in how they are produced and used.
2. Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.
3. Differentiate between the role of scientists, engineers, technologists, and others in creating and maintaining technological systems.
4. Design solutions by safely using tools, materials, and skills.
5. Explain how solutions to problems are shaped by economic, political, and cultural forces.

Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6–12)

Standards for Grades 6–8³⁴

Physical Science

Structure and Properties of Matter

1. Develop models to describe the atomic composition of simple molecules and extended structures
2. Gather and make sense of information to describe how synthetic materials come from natural resources and impact society.
3. Develop a model that predicts and describes changes in the particle motion, temperature and state of a pure substance when thermal energy is added or removed.

Chemical Reactions

1. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
2. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
3. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

Forces and Interactions

1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.*

³ The asterisk (*) indicates that the Performance Expectation is integrating Engineering Design.

⁴ The language of the standards is adapted, informed by or taken from the: National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. North American Association for Environmental Education (2019) *K–12 environmental education: Guidelines for excellence*; International Society for Technology in Education Standards. (2019). *ISTE standards for students*; International Technology and Engineering Educators Association (ITEEA) (2020); NGSS Lead States. (2013). *Next generation science standards: For states, by states*; Standards for technological and engineering literacy: *The role of technology and engineering in STEM education*. National Council for Agricultural Education. (2015); International Society for Technology in Education. (2019). *ISTE Standards for students. Agriculture, food and natural resources (AFNR) career cluster content standards*; Pennsylvania State Board of Education. (2002). *Academic standards for science and technology*; Pennsylvania Department of Education. (2002). *Safety guidelines for elementary and technology education teachers*; Pennsylvania Department of Education. (n.d.). *Pennsylvania career ready skills continuum*; Standards for Technological and Engineering Literacy. (2020); Pennsylvania Association for Environmental Educators. (September 2015). *Pennsylvania environmental literacy plan* Pennsylvania State Board of Education. (2002). *Academic standards for environment and ecology*. North American Association for Environmental Education. (2014). *State environmental literacy plans: 2014 status report*.

2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

Energy

1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.
1. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
2. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*
3. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
4. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Waves and Electromagnetic Radiation

1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
2. Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.
3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Life Science

Structure, Function, and Information Processing

1. Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.
2. Develop and use a model to describe the function of a cell as a whole and the ways that parts of cells contribute to the function.

3. Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
4. Gather and synthesize information about how sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Matter and Energy in Organisms and Ecosystems

1. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
2. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
3. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
4. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
5. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Interdependent Relationships in Ecosystems

1. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
2. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

Growth, Development, and Reproduction of Organisms

1. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.
2. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
3. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
4. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Natural Selection and Adaptations

1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
2. Apply scientific ideas to construct an explanation for anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
3. Analyze displays of pictorial data to compare patterns of similarities in ~~embryological development~~ **ANATOMICAL STRUCTURES** across multiple species to identify relationships not evident in the fully formed anatomy.
4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
5. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Earth and Space Science

Space Systems

1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
2. Develop and use a model to describe the role of gravity in the motion within galaxies and the solar system.
3. Analyze and interpret data to determine scale properties of objects in the solar system.

History of Earth

1. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.

Earth's Systems

1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
2. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
3. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Weather and Climate

1. Collect data to provide evidence for how the motion and complex interactions of air masses result in changes in weather conditions.
2. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
3. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Human Impacts

1. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
2. Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.*
3. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

Engineering, Technology, and Applications of Science

Engineering Design (Define Problems, Develop Solutions and Improve Designs)

1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

ENVIRONMENTAL LITERACY AND SUSTAINABILITY

AGRICULTURAL AND ENVIRONMENTAL SYSTEMS AND RESOURCES

AGRICULTURAL SYSTEMS

1. **DEVELOP A MODEL TO DESCRIBE HOW AGRICULTURAL AND FOOD SYSTEMS FUNCTION, INCLUDING THE SUSTAINABLE USE OF NATURAL RESOURCES AND THE PRODUCTION, PROCESSING, AND MANAGEMENT OF FOOD, FIBER, AND ENERGY.**

ENVIRONMENT & SOCIETY

1. ANALYZE AND INTERPRET DATA ABOUT HOW DIFFERENT SOCIETIES (ECONOMIC AND SOCIAL SYSTEMS) AND CULTURES USE AND MANAGE NATURAL RESOURCES DIFFERENTLY.

WATERSHEDS AND WETLANDS

1. DEVELOP A MODEL TO DESCRIBE HOW WATERSHEDS AND WETLANDS FUNCTION AS SYSTEMS, INCLUDING THE ROLES AND FUNCTIONS THEY SERVE.

ENVIRONMENTAL LITERACY SKILLS

INVESTIGATING ENVIRONMENTAL ISSUES

1. GATHER, READ, AND SYNTHESIZE INFORMATION FROM MULTIPLE SOURCES TO INVESTIGATE HOW PENNSYLVANIA ENVIRONMENTAL ISSUES AFFECT PENNSYLVANIA'S HUMAN AND NATURAL SYSTEMS.

ENVIRONMENTAL EXPERIENCES

1. COLLECT, ANALYZE, AND INTERPRET ENVIRONMENTAL DATA TO DESCRIBE A LOCAL ENVIRONMENT.

EVALUATING SOLUTIONS

1. OBTAIN AND COMMUNICATE INFORMATION ON HOW INTEGRATED PEST MANAGEMENT COULD IMPROVE INDOOR AND OUTDOOR ENVIRONMENTS.

SUSTAINABILITY AND STEWARDSHIP

ENVIRONMENTAL SUSTAINABILITY

1. OBTAIN AND COMMUNICATE INFORMATION TO DESCRIBE HOW BEST MANAGEMENT PRACTICES AND ENVIRONMENTAL LAWS ARE DESIGNED TO ACHIEVE ENVIRONMENTAL SUSTAINABILITY.

ENVIRONMENTAL STEWARDSHIP

1. DESIGN A SOLUTION TO AN ENVIRONMENTAL ISSUE IN WHICH INDIVIDUALS AND SOCIETIES CAN ENGAGE AS STEWARDS OF THE ENVIRONMENT.

ENVIRONMENTAL JUSTICE

1. CONSTRUCT AN EXPLANATION THAT DESCRIBES REGIONAL ENVIRONMENTAL CONDITIONS AND THEIR IMPLICATIONS ON ENVIRONMENTAL JUSTICE AND SOCIAL EQUITY.

Standards for Grades 9–12^{5 6}

Physical Science

Structure and Properties of Matter

1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
2. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
3. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
4. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

Chemical Reactions

1. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
2. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
3. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
4. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*

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5. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Forces and Interactions

1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
3. Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.*
4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Energy

1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
3. Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy.*
4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Waves and Electromagnetic Radiation

1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
2. Evaluate questions about the advantages of using digital transmission and storage of information.

3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model and that for some situations one model is more useful than the other.
4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

Life Science

Structure and Function

1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Matter and Energy in Organisms and Ecosystems

1. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
2. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
3. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
4. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
5. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
6. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Interdependent Relationships in Ecosystems

1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
3. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
4. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
5. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
6. Create or revise a simulation to test a solution to mitigate the adverse impacts of human activity on biodiversity.*

Inheritance and Variation of Traits

1. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
2. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
3. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
4. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Natural Selection and Evolution

1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Earth and Space Science

Space Systems

1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.
2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, the motion of distant galaxies, and the composition of matter in the universe.
3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.
4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

History of Earth

1. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
2. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
3. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Earth's Systems

1. Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.
2. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
3. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
4. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
5. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Weather and Climate

1. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
2. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Human Sustainability

1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
4. Evaluate or refine a technological solution that reduces the impact of human activities on natural systems.*
5. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity

Engineering, Technology, and Applications of Science

Engineering Design (Define Problems, Develop Solutions and Improve Designs)

1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

ENVIRONMENTAL LITERACY AND SUSTAINABILITY

AGRICULTURAL AND ENVIRONMENTAL SYSTEMS AND RESOURCES

AGRICULTURAL SYSTEMS

1. **ANALYZE AND INTERPRET HOW ISSUES, TRENDS, TECHNOLOGIES, AND POLICIES IMPACT AGRICULTURAL, FOOD, AND ENVIRONMENTAL SYSTEMS AND RESOURCES.**

ENVIRONMENT AND SOCIETY

1. **APPLY RESEARCH AND ANALYTICAL SKILLS TO EVALUATE THE CONDITIONS AND MOTIVATIONS THAT LEAD TO CONFLICT, COOPERATION, AND CHANGE AMONG INDIVIDUALS, GROUPS, AND**

NATIONS.

WATERSHEDS AND WETLANDS

1. ANALYZE AND INTERPRET HOW ISSUES, TRENDS, TECHNOLOGIES, AND POLICIES IMPACT WATERSHEDS AND WATER RESOURCES.

ENVIRONMENTAL LITERACY SKILLS

INVESTIGATING ENVIRONMENTAL ISSUES

1. APPLY RESEARCH AND ANALYTICAL SKILLS TO SYSTEMATICALLY INVESTIGATE ENVIRONMENTAL ISSUES RANGING FROM LOCAL ISSUES TO THOSE THAT ARE REGIONAL OR GLOBAL IN SCOPE.

ENVIRONMENTAL EXPERIENCES

1. PLAN AND CONDUCT AN INVESTIGATION UTILIZING ENVIRONMENTAL DATA ABOUT A LOCAL ENVIRONMENTAL ISSUE.

EVALUATING SOLUTIONS

1. EVALUATE AND COMMUNICATE THE EFFECT OF INTEGRATED PEST MANAGEMENT PRACTICES ON INDOOR AND OUTDOOR ENVIRONMENTS.

SUSTAINABILITY AND STEWARDSHIP

ENVIRONMENTAL SUSTAINABILITY

1. ANALYZE AND EVALUATE HOW BEST MANAGEMENT PRACTICES AND ENVIRONMENTAL LAWS ACHIEVE SUSTAINABILITY OF NATURAL RESOURCES.

ENVIRONMENTAL STEWARDSHIP

1. DESIGN AND EVALUATE SOLUTIONS IN WHICH INDIVIDUALS AND SOCIETIES CAN PROMOTE STEWARDSHIP IN ENVIRONMENTAL QUALITY AND COMMUNITY WELL-BEING.

ENVIRONMENTAL JUSTICE

1. ANALYZE AND INTERPRET DATA ON A REGIONAL ENVIRONMENTAL CONDITION AND ITS IMPLICATIONS ON ENVIRONMENTAL JUSTICE AND SOCIAL EQUITY.

Technology and Engineering Academic Standards⁷

Grades 6–8

Nature and Characteristics of Technology and Engineering

1. Consider historical factors that have contributed to the development of technologies and human progress.
2. Engage in a research and development process to simulate how inventions and innovations have evolved through systematic tests and refinements.
3. Differentiate between inputs, processes, outputs, and feedback in technological systems.
4. Demonstrate how systems thinking involves considering relationships between every part, as well as how the systems interact with the environment in which it is used.
5. Create an open-loop system that has no feedback path and requires human intervention.
6. Create a closed-loop system that has a feedback path and requires no human intervention.
7. Predict outcomes of a future product or system at the beginning of the design process.
8. Apply informed problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.
9. Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.
10. Compare how different technologies involve different sets of processes.

Integration of Knowledge, Technologies, and Practices

1. Compare, contrast, and identify overlap between the contributions of science, technology, engineering, and mathematics in the development of technological systems.
2. Analyze how different technological systems often interact with economic, environmental, and social systems.
3. Adapt and apply an existing product, system, or process to solve a problem in a different setting.
4. Demonstrate how knowledge gained from other content areas affects the development of technological products and systems.

⁷ The language of the standards is adapted, informed or from the: *International Technology and Engineering Educators Association (ITEEA). (2020). Standards for technological and engineering literacy: The role of technology and engineering in STEM education. Pennsylvania State Board of Education. (2002). Academic standards for science and technology; Pennsylvania Department of Education. (2002). Safety guidelines for elementary and technology education teachers; Pennsylvania Department of Education. (n.d.). Pennsylvania career ready skills continuum.*

Applying, Maintaining, Assessing and Evaluating Technological Products and Systems

1. Examine the ways that technology can have both positive and negative effects at the same time.
2. Analyze how the creation and use of technologies consumes renewable, non-renewable, and inexhaustible resources; creates waste; and may contribute to environmental challenges.
3. Consider the impacts of a proposed or existing technology and devise strategies for reducing, reusing, and recycling waste caused by its creation.
4. Analyze examples of technologies that have changed the way people think, interact, live, and communicate.
5. Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected.
6. Analyze how an invention or innovation was influenced by the context and circumstances in which it is developed.
7. Evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors.
8. Research information from various sources to use and maintain technological products or systems.
9. Use tools, materials, and machines to safely diagnose, adjust, and repair systems.
10. Use devices to control technological systems.
11. Design methods to gather data about technological systems.
12. Interpret the accuracy of information collected.
13. Use instruments to gather data on the performance of everyday products.

Design Thinking in Technology and Engineering Education

1. Apply a technology and engineering design thinking process.
2. Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.
3. Illustrate the benefits and opportunities associated with different approaches to design.
4. Create solutions to problems by identifying and applying human factors in design.
5. Evaluate and assess the strengths and weaknesses of various design solutions given established principles and elements of design.
6. Refine design solutions to address criteria and constraints.
7. Defend decisions related to a design problem.

Grades 9–12

Nature and Characteristics of Technology & Engineering

1. Evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history.
2. Relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.
3. Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.
4. Analyze how the Industrial Revolution resulted in the development of mass production, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.
5. Investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.
6. Analyze the rate of technological and engineering development and predict future diffusion and adoption of new innovations and technologies.
7. Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.
8. Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.
9. Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.
10. Use project management tools, strategies, and processes in planning, organizing, and controlling work.
11. Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.

Integration of Knowledge, Technologies, and Practices

1. Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system.
2. Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.
3. Analyze how technology transfer occurs when a user applies an existing innovation developed for one function for a different purpose.
4. Evaluate how technology enhances opportunities for new products and services through globalization.

5. Connect technological and engineering progress to the advancement of other areas of knowledge and vice versa.

Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems

1. Develop a solution to a technological problem that has the least negative environmental and social impact.
2. Develop a device or system for the marketplace.
3. Evaluate ways that technology and engineering can impact individuals, society, and the environment.
4. Critique whether existing or proposed technologies use resources sustainably.
5. Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal.
6. Evaluate a technological innovation that arose from a specific society's unique need or want.
7. Evaluate how technology and engineering advancements alter human health and capabilities.
8. Evaluate a technological innovation that was met with societal resistance impacting its development.
9. Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.
10. Synthesize data and analyze trends to make decisions about technological products, systems, or processes.
11. Interpret laws, regulations, policies, and other factors that impact the development and use of technology.

Design Thinking in Technology and Engineering Education

1. Apply a broad range of design skills to a design thinking process.
2. Implement and critique principles, elements, and factors of design.
3. Evaluate and define the purpose of a design.
4. Conduct research to inform intentional inventions and innovations that address specific needs and wants.
5. Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
6. Implement the best possible solution to a design using an explicit process.
7. Apply principles of human-centered design.
8. Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.

9. Use a design thinking process to design an appropriate technology for use in a different culture.
10. Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.
11. Recognize and explain how their community and the world around them informs technological development and engineering design.
12. Safely apply an appropriate range of making skills to a design thinking process.

<h2 style="margin: 0;">Regulatory Analysis Form</h2> <p style="margin: 0;">(Completed by Promulgating Agency)</p>		<p><i>INDEPENDENT REGULATORY REVIEW COMMISSION</i></p>
<p>(All Comments submitted on this regulation will appear on IRRC's website)</p>		
<p>(1) Agency State Board of Education</p>		<p>IRRC Number:</p>
<p>(2) Agency Number: 006 Identification Number: 347</p>		
<p>(3) PA Code Cite: 22 Pa. Code Chapter 4</p>		
<p>(4) Short Title: Academic Standards and Assessment</p>		
<p>(5) Agency Contacts (List Telephone Number and Email Address):</p> <p>Primary Contact: Karen Molchanow, Executive Director, State Board of Education, (717) 787-3787, ra-stateboardofed@pa.gov</p> <p>Secondary Contact:</p>		
<p>(6) Type of Rulemaking (check applicable box):</p> <p><input type="checkbox"/> Proposed Regulation</p> <p><input checked="" type="checkbox"/> Final Regulation</p> <p><input type="checkbox"/> Final Omitted Regulation</p>		<p><input type="checkbox"/> Emergency Certification Regulation;</p> <p><input type="checkbox"/> Certification by the Governor</p> <p><input type="checkbox"/> Certification by the Attorney General</p>
<p>(7) Briefly explain the regulation in clear and nontechnical language. (100 words or less)</p> <p>The final-form regulation makes both substantive and technical revisions to Chapter 4. Substantively, the rulemaking replaces the Commonwealth's current <i>Academic Standards for Science and Technology</i> (2002) and <i>Academic Standards for Environment and Ecology</i> (2002) with the <i>Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)</i>, <i>Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)</i>, and <i>Pennsylvania Technology and Engineering Academic Standards (Grades 6-12)</i>. The new academic standards, presented in Appendix B-1, will take effect on July 1, 2025.</p> <p>Final-form amendments also make technical revisions to conform certain provisions of the regulation with statutory changes enacted by the General Assembly to high school graduation requirements, compulsory school age, and terminology replacing references to "vocational-technical education" with "Career and Technical Education."</p>		
<p>(8) State the statutory authority for the regulation. Include <u>specific</u> statutory citation.</p> <p>The State Board of Education (Board) is acting under the authority of Sections 2603-B and 2604-B of the Public School Code of 1949 (24 P.S. §§ 26-2603-B and 26-2604-B).</p>		

(9) Is the regulation mandated by any federal or state law or court order, or federal regulation? Are there any relevant state or federal court decisions? If yes, cite the specific law, case or regulation as well as, any deadlines for action.

The regulation is not mandated by federal law, court order, or federal regulation. However, while not mandated by state law, provisions within the final-form rulemaking are being amended to conform with changes enacted by the General Assembly to the Public School Code of 1949. These changes are reflected in technical amendments to align Chapter 4 with revisions to high school graduation requirements enacted by Act 136 of 2020, Act 158 of 2018, and Act 6 of 2017, to align the Chapter with terminology updates enacted by Act 76 of 2019 that globally replaced references to “vocational-technical education” with “career and technical education” and “Area Vocational Technical School” with “Area Career and Technical School,” and to align a provision of Chapter 4 with a change enacted by Act 16 of 2019 that lowered the compulsory school age to six.

(10) State why the regulation is needed. Explain the compelling public interest that justifies the regulation. Describe who will benefit from the regulation. Quantify the benefits as completely as possible and approximate the number of people who will benefit.

Academic standards define what students should know and be able to do at specific grade levels. They establish goals for student learning. Academic standards do not represent a particular curriculum or instructional methodology. Rather, they provide a foundation for the development of local curriculum and serve as guideposts to which local curriculum should be aligned.

Innovative and research-based academic standards in the areas of science, environment and ecology, and technology and engineering education are critical to preparing Pennsylvania’s 1.7 million public school students for success in the 21st century economy. Both for Pennsylvania’s economic vitality and civic strength, it is essential to strive for all students to be scientifically, technologically, environmentally, and engineering literate. Students who possess these literacies will be best prepared for college and careers.

Since the adoption of the state’s current science and technology and environment and ecology academic standards in 2002, there have been significant innovations in cognitive science and educational research. In *“Taking Science to School,”* the National Research Council (NRC) outlined the importance of the transition in science education from memorizing facts to “productive participation in scientific discourse and practices” which, the NRC concluded, “is what is necessary to make sense of the natural and the designed worlds.” Given this, the Board saw a need to update the state’s academic standards for science to ensure that our standards are in line with contemporary research on learning and teaching science. Accordingly, the revised standards emphasize practices and skills development, setting students up for the highest-quality instruction possible, and for learning experiences that more closely mirror the practices and skills used outside of school and in the workforce.

Since the adoption of our current science standards in 2002, cognitive science has shown that young children from pre-kindergarten through third grade are naturally curious and capable of more sophisticated science reasoning. In light of this research, the revised standards introduce more complexity and rigor into standards for early grades.

The revised standards are innovative in their focus on equity and making connections to students’ lived experiences. They were consciously developed to expand access to high-quality learning in science, technology, engineering, environment, and ecology education for students who have historically had less access and fewer opportunities in these fields. As the foundation for what all students should know and

be able to do, academic standards establish common goals for student learning and, as such, drive a focus on equity as school entities develop high-quality learning experiences to support all students in meeting the standards. Again, the proposed standards updates are based on newly-available research. Following its “*Taking Science to School*” report, the NRC released the seminal document “*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.” This research report articulates a new vision for science education by explicitly centering equity as a core component of science education, along with identifying science and engineering practices that are critical for students’ understanding of the natural and designed worlds. More recently, The National Academies released a report, “*English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives*,” which reframed the importance of a learners’ cultural and linguistic assets as positive resources to be part of instruction and assessment in the kindergarten through twelfth grade experience.

A key consideration of the revised standards is that the standards should enable all students to explore and prepare for high-growth careers in scientific, environmental, agricultural, technological, and engineering fields consistently and from an early age. According to the Pennsylvania Workforce Needs Assessment 2016-2026, STEM (science, technology, engineering, and math) jobs are predicted to grow at a rate of approximately 9 percent through 2026, and there are more than 13,000 unfilled computer science and software development jobs. This is nearly parallel to employment projections from the U.S. Bureau of Labor Statistics which further show that STEM occupations are projected to grow by 8% through 2029, with an annual mean salary of \$89,000. This jobs outlook demonstrates the sense of urgency Pennsylvania must foster to create pathways for equitable access to STEM experiences. In the last three years, Pennsylvania has developed several initiatives to improve equitable access to STEM and computer science experiences, such as PAsmart, grassroots STEM Ecosystems, and establishing a STEM point of contact in each Intermediate Unit who provide regional support services to school entities at no cost. While these efforts address acute local and regional needs, a review of the state academic standards was imperative to ensure that all students, regardless of their access to particular investments or initiatives, are gaining the knowledge and skills necessary to thrive in the future workforce.

Since 2002, 44 states and the District of Columbia have updated science standards to align with seminal documents including the NRC’s “*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.” This final-form rulemaking leverages Pennsylvania’s recent investments and leadership in STEM education, learns from the journey of 44 other states, and draws upon the most recent research on science education to design an innovative set of standards preparing Pennsylvania learners to be creators and leaders in the 21st century economy.

Outside of the need to update the state’s academic standards for science, the regulation further is necessary to clarify the state’s expectations for high school graduation and to align with other recent changes to state statutes. The General Assembly enacted significant revisions to high school graduation requirements through amendments to the Public School Code of 1949. These statutory changes are not consistent with existing language governing high school graduation in Chapter 4 and supersede the graduation policies set forth in regulation. With this final-form rulemaking, the Board is seeking to create consistency between statute and regulation to provide clarity to students and educators on the state’s expectations for graduation by cleaning up language in Chapter 4 that no longer accurately reflects the state’s graduation policy as set forth in statute. The Board is seeking to provide further clarity between statute and regulation by conforming the regulation with other changes to the Public School Code related to compulsory school age and the terminology used to refer to Career and Technical Education. These clarifications are presented in technical amendments throughout the rulemaking.

(11) Are there any provisions that are more stringent than federal standards? If yes, identify the specific provisions and the compelling Pennsylvania interest that demands stronger regulations.

No.

(12) How does this regulation compare with those of the other states? How will this affect Pennsylvania's ability to compete with other states?

As 20 states and the District of Columbia have adopted the Next Generation Science Standards (NGSS) and another 24 states have adopted standards based on the same framework, the final-form rulemaking will bring Pennsylvania's academic standards for science in line with those of other states that stress skills such as: communication, inquiry, collaboration, flexibility, and problem-solving. While standards adopted by other states, including the NGSS, were reviewed in the development of this final rulemaking, the new standards reflected in Appendix B-1 of Chapter 4 represent learning goals crafted by Pennsylvania educators and content experts.

National and regional data suggest that Pennsylvania needs to have a STEM-ready workforce to compete in the global economy. According to the Pennsylvania Workforce Needs Assessment 2016-2026, there will be nearly 600,000 new and replacement jobs in Pennsylvania through 2026, with STEM jobs growing at approximately 9 percent, and there are more than 13,000 unfilled computer science and software development jobs. This jobs outlook demonstrates the sense of urgency Pennsylvania must foster to create pathways for equitable access to STEM experiences and to ensure that all students are learning the knowledge and skills necessary for future careers. Thus, the final-form rulemaking is intended to position the Commonwealth to retain current businesses in the STEM fields and to compete to attract new STEM-related industries by preparing our future workforce with the skills and competencies necessary to support growth in these industries.

(13) Will the regulation affect any other regulations of the promulgating agency or other state agencies? If yes, explain and provide specific citations.

Although this final-form rulemaking does not directly affect other regulations, the updated academic standards included in Appendix B-1 of Chapter 4 will need to be integrated into relevant coursework of educator preparation programs. In a separate rulemaking, the Board approved final-form amendments to 22 Pa. Code, Chapter 49 (Certification of Professional Personnel) that establish requirements for programs that prepare individuals to become teachers to integrate instruction in Culturally Relevant and Sustaining Education (CR-SE) (*see regulation #6-346*). In identifying the competencies and associated standards for CR-SE, as the Department of Education (Department) is directed to do under Chapter 49, the Department should consider how the academic standards in this proposed rulemaking will be delivered under the lens of CR-SE.

Further, while not a regulation, the final-form rulemaking could necessitate a review of Pennsylvania's Learning Standards for Early Childhood, developed by the state's Office of Child Development and Early Learning (OCDEL), to ensure alignment with the new Standards for Integrated Science, Technology, Engineering, Environment, and Ecology (Grades K-5). Cross-agency awareness of this potential impact was facilitated by including OCDEL representation on the Steering Committee that oversaw development of recommendations for updated science standards.

Finally, while not directly reflected in the final-form rulemaking, adoption of new academic standards in science will require action by the Department to review the Alternate Eligible Content (AEC) standards in science and to determine whether updates are necessary to align the AEC in Science with the new science standards adopted by the Board. Currently, the Board has approved AEC in English Language Arts, Mathematics, and Science that reflect modified content aligned to the state’s existing academic standards to make instruction in those content areas accessible to students with the most significant cognitive disabilities. The AEC standards represent a reduction in the breadth, depth, and level of complexity of the state’s academic standards to reflect eligible content that is appropriate for students with the most significant cognitive disabilities while still ensuring access to the general education curriculum. The Pennsylvania Alternate System of Assessment (PASA) – state assessments administered to students with the most significant cognitive disabilities – are aligned to the AEC. Any future updates to the AEC standards that may result from the final-form rulemaking would be presented to the Board at a public meeting for review and an opportunity for public comment.

(14) Describe the communications with and solicitation of input from the public, any advisory council/group, small businesses and groups representing small businesses in the development and drafting of the regulation. List the specific persons and/or groups who were involved. (“Small business” is defined in Section 3 of the Regulatory Review Act, Act 76 of 2012.)

The Department hosted 14 face-to-face and virtual stakeholder engagement meetings across 12 counties over the course of four weeks from late February to mid-March 2020. The purpose of the meetings was to gather feedback directly from individual stakeholders across the Commonwealth about their vision for Pennsylvania’s updated science standards. All stakeholder engagement sessions were led and facilitated by researchers and technical assistance experts from the American Institutes for Research (AIR). Staff from the Department and the Berks County Intermediate Unit (BCIU) also attended each face-to-face and virtual stakeholder session. The Department engaged BCIU as the lead to support efforts to update the state’s academic standards in science. BCIU engaged stakeholders in providing feedback on the development and implementation of updated standards, convened, and facilitated Committees to incorporate stakeholder feedback into standards recommendations, and collaborated with the Department, Intermediate Units, and school entities on building capacity for implementation.

A total of 951 stakeholders attended the engagement meetings (feedback was collected from 934 stakeholders; 17 stakeholders requested to be ‘silent observers’ during the sessions). Teachers, including special education and English Learner educators, higher education faculty, preservice teachers, students, librarians, business leaders, community members, school and district leaders, Intermediate Unit staff, and environmental and agricultural organization representatives were among the wide range of stakeholders who provided feedback in these engagement sessions. An invitation to deliver stakeholder feedback also was extended to the Pennsylvania Chapter of the National Federation of Independent Business to provide an opportunity for representatives of small businesses to have a voice in the development of the rulemaking.

A detailed chart that identifies the sectors represented at each stakeholder convening is available in Appendix G of a summary report of stakeholder feedback prepared by AIR. That report can be found on the Department’s website at the following URL: <https://www.education.pa.gov/Documents/Teachers-Administrators/Curriculum/Science%20Education/PA%20Landscape%20Report.pdf>.

In April 2020, the Department began its next phase of stakeholder engagement by soliciting applications from interested members of the public to serve on committees to review and revise the standards. Applicants were nominated to serve on these committees through a multi-reviewer process on the basis of their depth

and breadth of expertise in: curriculum and standards development, understanding of the existing science standards and current research, equity and access in education and meeting the needs of diverse learners, and overall education experience. Nominations for individuals to serve on the Science Standards Steering Committee and the Science Standards Content Committee tasked with drafting recommended updates to the standards were approved at a public meeting of the Board in May 2020. An opportunity for public comment on the nominations was made available at the meeting prior to Board approval of the committees' membership. Below is a list of individuals who served on each Committee:

Steering Committee Members

First Name	Last Name	District/Organization
Jean M.	Devlin	PA Dept. of Conservation and Natural Resources, Bureau of Forestry
Dr. Kathleen	Hill	Pennsylvania State University
Dr. Nikole	Hollins-Sims	Pennsylvania Technical Training and Assistance Network
Tanner	Huffman	Advancing Excellence in P12 Engineering Education
Len	Litowitz	Millersville University of Pennsylvania
Jesse	Maine	Titusville Area School District
Dr. Scott	McDonald	Pennsylvania State University
Gilbert L.	Myers	Pennsylvania Department of Environmental Protection
Jolie	Phillips	PA Dept. of Education, Office of Child Development and Early Learning
Jeff	Remington	Palmyra Area School District
Carl	Richardson	Pennsylvania Fish and Boat Commission
Dr. Christine Anne	Royce	Shippensburg University of Pennsylvania
Dr. Scott J.	Sheely	Pennsylvania Commission for Agricultural Education
Ben	Smith	Lincoln Intermediate Unit 12
Andrew	Walton	Upper Moreland School District
Dr. Darryl N.	Williams	The Franklin Institute
Dr. Carla	Zemba-Saul	Pennsylvania State University

Content Committee Members

First Name	Last Name	District/Organization
Jason	Ambler	Derry Township School District
Lauren	Beal	Lancaster-Lebanon Intermediate Unit 13
Shubhada	Bhamre	Plum Borough School District
Kathleen K.	Blouch	Lebanon Valley College
Sharon	Brusic	Millersville University of Pennsylvania
Jennifer	Cleary	School District of Lancaster
Jacqueline	Clymer	Quakertown Community School District
Charlene	Crawford	Abington School District
Nanette	Dietrich	Millersville University of Pennsylvania
Dr. Jane	Dmochowski	University of Pennsylvania
Michele	Dubaich	Greenwood High School, Millerstown
Timothy	Dzurko	State College Area School District
Katherine	Engelhardt	Mechanicsburg Area School District
Dr. Colleen	Epler-Ruths	Shikellamy High School
Dr. Jaunine	Fouché	Milton Hershey School
Alison	Francis	Fox Chapel Area School District

Joshua	Fuller	East Stroudsburg Area School District
Edith L.	Gallagher	Franklin and Marshall College, School District of Lancaster
Lydia	Hallman	Kennett Consolidated School District
Bobby	Hughes	Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR)
David	Johnson	Wyndcroft School
Jason	Karcheski	Eastern Lancaster County School District
Kelly	Kemmerle	U.S. Fish and Wildlife Service, John Heinz National Wildlife Refuge
Dr. Steve	Kerlin	Stroud Water Research Center
Carrie	Lankford	Red Lion Area School District
Lori	Lauver	Sylvan Heights Science Charter School
Dr. Peter R.	Licon	Elizabethtown College
Dr. Tyler	Love	Pennsylvania State University, Harrisburg
Travis G.	Martin	Bellwood-Antis School District
Gina	Mason	Palmyra Area School District
Brienne	May	Franklin Regional School District
Amy	McDowell	Indiana School District
Diane	McGaffic	Midwestern Intermediate Unit IV
Jeanmarie	McGinley	Pennsbury School District
Molly	Miller	Penn Manor School District
Darren	Myzak	Pine-Richland School District
Justin	Ogline	Bishop McCort Catholic High School
Kara	Olewiler	Conewago Valley School District
Jessica	Papariello	Fox Chapel Area School District
Dr. Nancy	Peter	Philadelphia Education Fund
Jason	Petula	Millersville University of Pennsylvania
Brian	Pifer	Northeast Bradford School District
Tarrea R.	Potter	Chesapeake Bay Foundation
Jeff	Remington	Palmyra Area School District
Darla	Romberger	Cumberland Valley School District
Adam	Serfass	Conrad Weiser Area School District
Ben	Smith	Lincoln Intermediate Unit 12
Nancy	Stahlschmidt	Intermediate Unit 1
Brian	Suter	Neshaminy School District
Dr. Rebecca (Becky)	Thomas	Slippery Rock University of Pennsylvania
Joanne M.	Trombley	West Chester Area School District
Mike	Ulderich	California University of Pennsylvania
Douglas	Valette	Unionville Chadds Ford School District
Pete	Vreeland	Upper Merion Area School District
Steve	Wasiesky	Millcreek Township School District
Eric	Wilson	Red Lion Area School District
Dr. Pat	Woods	Susquenita School District
Dr. Carla	Zembal-Saul	Pennsylvania State University
Beth	Zigmont	Great Valley School District
Rick	Zilla	Greenville Area School District

Recommendations for updating Pennsylvania’s science standards were presented by the Department at the September 9, 2020, public meeting of the Board’s Committee on Academic Standards/Chapter 4. At the same time, the Committee considered draft proposed amendments to Chapter 4 that included language necessary to implement revised standards and unrelated technical amendments to other parts of the Chapter. Both the draft proposed amendments to Chapter 4 and the recommendations for updated science standards were posted to the Board’s website in advance of the meeting for access by interested stakeholders, and an opportunity for public comment on the draft documents was made available at the Committee meeting.

The proposed rulemaking approved by the Committee also was considered at a public meeting of the Council of Basic Education on September 9, 2020, at which time an additional opportunity for public comment on the rulemaking was made available. Another opportunity for public comment was offered at the September 9, 2020, meeting of the Board prior to the Board’s adoption of the proposed rulemaking.

The proposed rulemaking then was published in the *Pennsylvania Bulletin* on June 5, 2021, for a 30-day public comment period. That publication invited comments from interested persons and individuals affiliated with small businesses. The Board received more than 2,200 comments on its proposed rulemaking.

In response to concerns raised by stakeholders during public comment, the Board’s Committee on Academic Standards/Chapter 4 held a public meeting on September 8, 2021, to discuss next steps in consideration of the proposed rulemaking. At that meeting, the Committee directed the Department to reconvene the Science Standards Content Committee and Steering Committee – previously appointed advisory bodies comprised of subject matter experts – to develop additional recommendations for the Board’s consideration. The Committee on Academic Standards/Chapter 4 adopted a charge to those advisory bodies that identified stakeholder concerns specific to the academic content of the proposed new standards and directed those advisory bodies to develop recommendations on whether and how those concerns should be addressed in the new standards. Members of the public were provided with an opportunity to address the Committee on Academic Standards/Chapter 4 during its September 8, 2021, meeting prior to its adoption of a charge to the Content and Steering Committees.

The Content and Steering Committees met extensively throughout the fall of 2021 to develop additional recommendations in response to the charge presented to them by the Academic Standards/Chapter 4 Committee. The Committees held five meetings on October 5, October 18, October 27, November 1, and November 17. In addition, smaller working groups of those Committee members focused on standards for grades K-5 and on standards for grades 6-12 held 26 additional meetings on the following dates in the fall of 2021: October 12 (K-5 & 6-12 groups); October 13 (K-5 & 6-12 groups); October 14 (K-5 & 6-12 groups); October 19 (6-12 group); October 20 (K-5 group); October 26 (K-5 group); October 28 (K-5 group); October 29 (6-12 group); November 2 (6-12 group); November 8 (6-12 group); November 9 (6-12 group); November 10 (K-5 & 6-12 groups); November 11 (K-5 group); November 12 (K-5 group); November 16 (6-12 group); November 18 (K-5 & 6-12 group); November 19 (K-5 & 6-12 group); November 29; and November 30.

As some members of the Content Committee and Steering Committee were not able to attend meetings in the fall, the recommendations were sent out to all Committee members through a Google form for feedback and/or approval at two different points in time (November 5-8, 2021 and November 22-24, 2021) in order to gather feedback on each recommendation from all Committee members and to reach consensus among all Committee members.

On December 1, 2021, the Committee on Academic Standards/Chapter 4 held a special meeting to receive the recommendations developed by the Science Standards Content and Steering Committees related to specific academic content concerns raised by stakeholders. An opportunity for public comment was made available during the Committee meeting, and a copy of the recommendations presented to the Committee was posted on the Board's website prior to the meeting for public access.

The Committee on Academic Standards/Chapter 4 met again on January 12, 2022, to consider final-form amendments to Chapter 4. For transparency, a copy of the draft final amendments to Chapter 4 again were posted to the Board's website prior to the Committee meeting for public access. An opportunity for public comment also was made available during the Committee meeting.

Following approval of final-form amendments by the Academic Standards/Chapter 4 Committee, the final-form amendments to Chapter 4 were considered by the Board's Council of Basic Education at a public meeting on January 13, 2022. Interested members of the public were given an opportunity to address the Council prior to the Council taking action on the rulemaking.

Final-form amendments to Chapter 4 then were considered by the Board later on January 13, 2022. Again, an opportunity for public comment before the Board was made available prior to Board action on the regulation.

(15) Identify the types and number of persons, businesses, small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012) and organizations, which will be affected by the regulation. How are they affected?

The final-form regulation will affect students enrolled in public school entities, school districts, public school employees, area career and technical schools, charter schools, cyber charter schools, educator preparation programs, and the Department. In 2020-21, there were approximately 2,974 public schools in 788 school entities in the Commonwealth. Those school entities serve 1.7 million students and employ approximately 151,858 professional staff. Currently, there are 119 educator preparation programs that operate in the Commonwealth. The final-form regulation will not affect small businesses.

The adoption of the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)* will guide school entities in developing a rigorous curriculum that will create a cohesive K-12 integrated approach to science education in Pennsylvania and prepare students to succeed in the global economy. The final-form rulemaking establishes a three-year window for school entities to take necessary measures to ensure their instruction is aligned with the updated standards. Educator preparation programs also will need to integrate instruction in the updated standards into the coursework they deliver to individuals studying to become teachers.

To support this, the Department will need to update the instructional resources made available to educators through the Standards Aligned System portal to reflect materials aligned with the new standards and will need to support professional development opportunities for both current educators and educator preparation faculty in the updated standards. Further, the Department will need to undertake a review of the PSSA Science assessments and the Keystone Exam in Biology to align these state assessments with the updated standards. Finally, the Department will need to review the Alternate Eligible Content in Science that serves to guide instruction for students with the most severe cognitive disabilities to determine whether updates are necessary to align the AEC with the new science standards in Board's final-form rulemaking.

Technical amendments presented in the final-form rulemaking to conform the Chapter with statute will affect school entities and students by creating consistency and clarity in the state's expectations for high school graduation and by creating consistency in language used in provisions governing career and technical education across both statute and regulation.

(16) List the persons, groups or entities, including small businesses, that will be required to comply with the regulation. Approximate the number that will be required to comply.

Students enrolled in public school entities, school districts, area career and technical schools, charter schools, cyber charter schools, public school employees, and the Department will be required to comply with the final-form rulemaking. In 2020-21, there were approximately 2,974 public schools in 788 school entities in the commonwealth. Those school entities serve 1.7 million students and employ approximately 151,858 professional staff.

(17) Identify the financial, economic and social impact of the regulation on individuals, small businesses, businesses and labor communities and other public and private organizations. Evaluate the benefits expected as a result of the regulation.

Although school districts, area career and technical schools, charter schools, and cyber charter schools may incur a cost to implement the new *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)*, the anticipated efforts related to implementation are expected to be combined with curricular and professional development costs educational entities generally would incur during a regular curricular review cycle. Further, the effective date for updated science standards of July 1, 2025, provides time for school entities to plan for integration of updated standards as part of ongoing curricular review.

The final-form rulemaking will impact the Department by necessitating a review of the state assessments administered in science (the PSSA in Science in grades 4 and 8 and the Keystone Exam in Biology) to ensure the assessments are aligned with relevant content in the updated academic standards. The final-form rulemaking further will impact the Department by necessitating updates to the resources and materials the Department makes available to support school entities in delivering instruction aligned to our academic standards.

The final-form rulemaking is not anticipated to have a fiscal impact on small businesses or individuals.

Academic standards have a broad social and economic impact in that they establish goals for what all students should know and be able to do not just as students but as members of society, members of the citizenry, and participants in the economy. Changes in science, technology, and the environment since the state's current science standards were adopted in 2002 have transformed life as we know it. The extent to which Pennsylvania's 1.7 million students are literate in these areas can determine issues of social, financial and economic impact for the commonwealth ranging from sustainable land management to the growth of science and technology industries in the commonwealth, to whether Pennsylvania is a net-importer or net-exporter of talent in scientific careers. The distribution of these literacies across student demographics can impact socioeconomic equality, since the final-form regulations pertain to academic areas that prepare students for some of the fastest growing high-growth, high-wage careers in Pennsylvania.

Educators use standards to develop students’ scientific, environmental, and technological literacy. “Literacy” requires more than possessing knowledge; literacy requires being able to apply knowledge. A scientifically, technologically, and environmentally literate person can apply the knowledge, concepts, skills, processes, and practices of those fields to real-life situations. This includes engaging in scientific inquiry and applying science concepts and processes to make decisions for oneself, participating in civic and cultural affairs, and contributing to society and the economy through one’s work. To achieve the goal of literacy, Pennsylvania needs innovative standards based upon the most current and robust research and practice.

Academic standards that are research-based, comparable with recently-developed standards in most states, and innovative in their connections with the Pennsylvania context can help meet economic needs to grow and sustain Pennsylvania as a leader in scientific, high-tech, and environmental fields. According to the Pennsylvania Department of Labor and Industry, STEM-related businesses and occupations are growing in Pennsylvania, and they want skilled and well-educated workers who are prepared for the 21st century economy. The Pennsylvania-specific facts sheet produced by Code.org estimates 58 percent of new jobs in Pennsylvania will require STEM and computer science related skills like problem solving, data analytics, computational thinking, and project management, while the U.S. Department of Labor estimates 8 of the fastest growing occupations in Pennsylvania, like data scientists and engineers, will require those same skills. With growing opportunity in STEM-related occupations, and only 30 percent of postsecondary degrees awarded in STEM-related fields, it is essential to set the conditions necessary to engage more scholars in science, technology, engineering, and environmental learning. Academic standards rooted in modern skills, knowledge, and practices equip students to be successful in a science and technology-driven, global economy.

Academic standards that are accessible to all students and designed with equitable opportunities for implementation in mind have the potential to be society-transforming by giving communities of low socioeconomic status the educational foundation for economic success. The *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)* included in Appendix B-1 of this final-form rulemaking will ensure educators design experiences that ignite productive participation in scientific discourse and practices building a student’s scientific, environmental and technological literacy. These standards were developed intentionally to attend to issues of equitable access and inclusion in science, technology, engineering, and environmental education in order to build a literate citizenry. Vulnerable and historically underserved students often are not included in or lack access to high-quality science, technology, engineering, and environmental education. According to the Education Commission of the States, only 9 percent of engineering degrees in 2018 were awarded to historically underserved minority students, and, when reviewing the ACT scores for STEM college readiness, female students and students of color score lower on the exam when compared to their white, male peers. The final-form rulemaking provides the foundation for educators to include every student in high-quality learning experiences, building their scientific, technological, and environmental literacies. The final-form regulation was designed in the context of a world of accelerated technological, scientific, and environmental change to prepare students to be the drivers of future change.

(18) Explain how the benefits of the regulation outweigh any cost and adverse effects.

The final-form rulemaking is necessary for the commonwealth to remain academically and economically competitive with other American public education systems and economies, including those in neighboring states.

As of the 2021-2022 school year, Pennsylvania’s current Science and Technology and Environment and Ecology standards were 19 years old. Since 2013, science standards have been updated in 44 states across the country according to data compiled by the American Institutes for Research. Not acting to update our science standards could place the commonwealth at a disadvantage given that the overwhelming majority of states already have adopted new science standards aligned to more current research in science instruction. The new standards adopted by the Board are designed to provide every student in the commonwealth with the knowledge and skills to be successful in the 21st century global economy. Furthermore, it is critical that the standards are inclusionary of and accessible for all students and educators in Pennsylvania.

The new standards have been designed to integrate the knowledge and skills core to the science, technology, engineering, environment, and ecology disciplines and will make explicit connections with Math, Language Arts, and the Pennsylvania Career Ready Skills framework through related implementation resources. The standards lay the foundation for students to apply knowledge and skills from known situations to novel contexts. The integrative nature of the standards makes explicit connections for educators and breaks down artificially created content “silos” to inspire connected student learning, preparing students for the workforce.

Outside provisions of the final-form rulemaking that address science standards, technical amendments that conform the regulation to statute will benefit both educators and students by creating consistency in expectations and terminology used across state policy. Not conforming the regulation to changes enacted in statute could have an adverse effect by causing confusion for students and educators about what expectations must be satisfied in order to meet state graduation requirements given the current discrepancies between how this issue is addressed in statute and in Chapter 4.

(19) Provide a specific estimate of the costs and/or savings to the **regulated community** associated with compliance, including any legal, accounting or consulting procedures which may be required. Explain how the dollar estimates were derived.

The final-form regulation will not impose any costs on students. Further, the final-form regulation is not anticipated to impose new costs on educator preparation programs. The updated academic standards will act as a guide for redesigning some courses educator preparation programs deliver to individuals preparing to become teachers to ensure course content is aligned to current academic standards.

This does not impose a new cost for additional coursework. Rather, the impact on educator preparation programs would shift the content of some existing courses, and the Department will provide educator preparation program faculty with access to implementation supports it will make available for updated science standards (that are addressed in response to question 21) to support this work.

Further, the Department will update its program framework guidelines for educators in the science, technology, environment, ecology, and engineering fields to align with the new academic standards. Outreach conducted with the Pennsylvania Association of Colleges and Teacher Educators (PAC-TE), which includes educator preparation programs at private colleges and universities, state-related universities, and the Pennsylvania State System of Higher Education (PASSHE), indicated that the final-form rulemaking will not impose a cost on the institutions. Educator preparation program updates occur through two basic means: as a part of faculty expectations or as a departmental service, which is reflected in faculty promotion criteria and generally includes teaching, scholarship, and service to the department. Costs only would be incurred if updates occurred outside of the contract period (PASSHE faculty are 9-month employees), and approval for curriculum updates could take 12-18 months (2-3 semesters) at some institutions. The final-form rulemaking includes a July 1, 2025, effective date for implementation of updated standards which should provide adequate time for educator preparation programs to make any necessary adjustments.

(20) Provide a specific estimate of the costs and/or savings to the **local governments** associated with compliance, including any legal, accounting or consulting procedures which may be required. Explain how the dollar estimates were derived.

As part of the Department's stakeholder engagement sessions, science educators were asked to complete a survey that included strategic questions to discern what academic standards K-12 schools were utilizing when creating their curriculum. The results of the survey indicated that, as of the 2019-20 school year, approximately 42 percent of respondents in Pennsylvania reported using national frameworks in designing learning experience, while between 35-37 percent reported having curriculum aligned to national standards and frameworks. This presumably will necessitate fewer or more minor adjustments to curriculum to align with the updated standards in the final-form rulemaking since the revised standards were informed by current national standards frameworks in their development and incorporate some elements of the frameworks already referenced by educators in their response to the Department's question about what standards they utilize when creating curriculum.

For the purposes of this rulemaking, school entities are considered local governments. In order to determine a specific estimate of the costs to local governments, the Board sought to determine the cost of implementing updated standards in the remaining school entities in Pennsylvania that did not report that they already are aligning their curriculum to current national standards and frameworks and, thus, would need to revise curriculum. School entities typically engage in curriculum review cycles every five to six years. Thus, the Board anticipates that efforts to implement the updated standards included in the final-form rulemaking will be reflected in school entities' existing budgetary practices for curriculum review and updates, therefore becoming part of a traditional cycle for updating school entity resources. As such, the final-form rulemaking does not add new costs in so much as it refines the focus of current instruction.

(21) Provide a specific estimate of the costs and/or savings to the **state government** associated with the implementation of the regulation, including any legal, accounting, or consulting procedures which may be required. Explain how the dollar estimates were derived.

The final-form regulation will cost the state approximately \$17,994,792 in total through Fiscal Year 2026-27 to review and update the Pennsylvania System of School Assessment (PSSA) exams in Science, the Keystone Biology exam, the Pennsylvania Standards Aligned System (SAS) resources, and to provide technical support for school entities. As a result of the rulemaking, the Department anticipates a need to update the PSSA Science exams, administered in grades 4 and 8, and the Keystone Exam in Biology to align to the new academic standards in science. To support implementation of the revised standards locally, the

Department will provide educators with access to state-developed resources through the SAS website, professional learning, and ongoing support and consultation. The Department will provide technical assistance supports through the expertise of its content advisors and additional professional learning supports through the Statewide System of Support deployed through collaboration with the existing network of regional Intermediate Units.

Through collaboration with the state's 29 Intermediate Units, the Department determines the professional learning delivered to school entities in support of science, technology, environment, and ecology education through the Statewide System of Support. In doing so, the Department gathers input from Intermediate Units, educators, and school administrators on needs and opportunities and, through its Intermediate Unit partners, supports efforts to design, direct, and deliver professional learning to the field to meet identified needs. Since 2016, the Department has been providing professional learning to educators and school entities aligned to robust research, practice, and recent guidance outlined by "*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*," "*Taking Science To School*," and "*Science Teacher's Learning: Enhancing Opportunities Creating Supportive Contexts*." Since 2016, the Department has invested more than \$4.3 million in federal and state funds to enhance educators' and school entities' ability to ensure all learners, especially those who have been historically underserved, are included in science, technology, engineering, and environmental learning experiences. The investment has resulted in the development of an Open Education Resource (OER) STEM Toolkit, provision of research-aligned professional learning for thousands of educators across the commonwealth, and school entities' building STEM Comprehensive plans. This upfront investment will establish the foundation for school entities to begin implementing the new standards included in these final regulations.

The Department will continue to support annual investments of \$1.8 million in the Statewide System of Support for STEM professional learning and technical assistance to support implementation of the updated science standards. The Statewide System of Support is funded by a matrix of Teacher Professional Development dollars and federal funds that are attributed to the Department as a result of its state share to implement regulations. The final-form regulations will require shifts in instruction, alignment of curricular assets, and familiarization with the regulations at the local level. The Department will redefine the STEM deliverables within the Statewide Systems of Support to align with the implementation requirements of the final-form regulations. The continued investment will ensure each Intermediate Unit has a STEM Point of Contact with the expertise to deliver free professional learning and technical assistance to help school entities as they build towards implementation of the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and the *Pennsylvania Technology and Engineering Standards (Grades 6-12)*.

In addition to the investments in education infrastructure through the Intermediate Units, the Department employs content advisors who provide curriculum alignment supports for school entities across the commonwealth. The Department has individual content advisors dedicated to science, technology, engineering, environment, and ecology education with the expertise necessary to guide implementation for the field. Support for standards implementation by the Department, including updating, aligning, and designing resources for school entities and educators, can be carried out with the current staff complement of content advisors. The resources developed by the Department will be curated on the Department's SAS website for voluntary use by school entities at no cost to the school entities.

Below is an estimate of anticipated costs to the state on an annual basis through Fiscal Year 2026-27:

Fiscal Year 2021-22: The estimated state cost is \$1,827,000, which represents the annual investment in the Pennsylvania Statewide System of Support to deliver professional learning and technical assistance in Science, Technology, Engineering, and Environment and Ecology education at no cost to educators. Professional learning and technical assistance delivered through this investment is provided by each of the state's 29 Intermediate Units.

Fiscal Year 2022-23: The estimated state cost is \$1,827,000, which represents the investment in the Pennsylvania Statewide System of Support that will support the creation of state-level resources to assist school entities and educators with implementation of the updated state academic standards in science. This investment will be directed toward work to redesign the professional learning and technical assistance made available at no cost to educators through the state's network of Intermediate Units to align with the new standards in the final-form rulemaking.

Fiscal Year 2023-24: The estimated state cost is \$9,258,797, which represents a sustained effort to support state-level resources to assist school entities and educators with implementation of the updated state academic standards in science and new work to revise state assessments administered in science. Through an investment in the Pennsylvania Statewide System of Support, the state will continue to support efforts to redesign the content of professional learning and technical assistance made available at no cost to educators to align with the needs of school entities in implementing the new standards in the final-form rulemaking. The professional learning and technical assistance will be provided through the state's network of 29 Intermediate Units. The estimated cost also includes work necessary to revise state assessments administered in science to align with the new standards in Appendix B-1 of the final-form rulemaking. Anticipated costs include aligning the state assessment question bank to reflect the content of the updated science standards in the regulation and modernizing the testing process towards technology-enhanced items. Updated performance-based academic standards will enable adjustments to state assessments that enable automated scoring.

Fiscal Year 2024-25: The estimated state cost is \$2,891,071, which reflects efforts to continue refining state assessment items and resources for educators to align with the new standards as described above.

Fiscal Year 2025-26: The estimated state cost is \$1,827,000, and estimated savings are \$1,463,076, resulting in an estimated net cost of \$363,924. The estimated cost represents the investment in the Pennsylvania Statewide System of Support to redesign the professional learning and technical assistance available at no cost to educators to align with the needs of school entities in implementing the updated state academic standards in science. The professional learning and technical assistance will be provided by the state's network of 29 Intermediate Units. The estimated savings reflects a shift in assessment practices. The Department anticipates that updated state assessments will be administered for the first time beginning in Fiscal Year 2025-26. Estimated savings are realized through the shift from hand-scored assessments to automated scoring, enabled by adopting updated performance-based standards. This estimate assumes a shift from hand-scored items to technology-enhanced items. Hand-scored items require the time and expertise of several professionals to score individual assessments. Technology-enhanced items do not require the time and expertise of several professionals. It is anticipated that this shift will result in annual savings in future years. Estimated savings are predicated on assumptions to changes in the state assessment design and are contingent on final determinations about the design of state assessments that will be completed through the Department's work to implement assessments aligned to the new standards.

Fiscal Year 2026-27: The estimated state cost is \$1,827,000, which represents the investment in the Pennsylvania Statewide System of Support to deliver professional learning and technical assistance aligned

with the new standards in the final-form rulemaking to educators at no cost. The professional learning and technical assistance will be provided through the state’s network of 29 Intermediate Units.

Estimated state costs take into account resources and collaborations, such as federal grants, that will support implementation of the final-form regulation. Through collaborative efforts with the state’s network of Intermediate Units, the Department has been working with the Stroud Watershed Research Center, the National Oceanic and Atmospheric Association, the Department of Conservation and Natural Resources, the Department of Environmental Protection, and other collective impact partners through a multi-year federal grant to build a robust network that is delivering professional learning and technical assistance in environmental, ecology, and watershed education to school entities across the commonwealth. The collaboration has been an upfront investment preparing educators and school entities for research-aligned supports and has established a foundation for implementing the final-form regulation. This federally grant-funded program will continue through 2022 to support professional development for educators and environmental literacy for scholars across Pennsylvania.

(22) For each of the groups and entities identified in items (19)-(21) above, submit a statement of legal, accounting or consulting procedures and additional reporting, recordkeeping or other paperwork, including copies of forms or reports, which will be required for implementation of the regulation and an explanation of measures which have been taken to minimize these requirements.

The final-form regulation does not contain any new legal, accounting or consulting procedures, or new requirements for reporting and recordkeeping, or other paperwork.

(22a) Are forms required for implementation of the regulation?

No, there are no forms required for implementation of the final-form regulation.

(22b) If forms are required for implementation of the regulation, **attach copies of the forms here**. If your agency uses electronic forms, provide links to each form or a detailed description of the information required to be reported. **Failure to attach forms, provide links, or provide a detailed description of the information to be reported will constitute a faulty delivery of the regulation.**

As noted above in the response to question 22a, no forms are required for implementation of the regulation.

(23) In the table below, provide an estimate of the fiscal savings and costs associated with implementation and compliance for the regulated community, local government, and state government for the current year and five subsequent years.

	Current Fiscal Year 21-22	FY +1 Year 22-23	FY +2 Year 23-24	FY +3 Year 24-25	FY +4 Year 25-26	FY +5 Year 26-27
SAVINGS:	\$	\$	\$	\$	\$	\$
Regulated Community	\$0	\$0	\$0	\$0	\$0	\$0
Local Government	\$0	\$0	\$0	\$0	\$0	\$0
State Government	\$0	\$0	\$0	\$0	\$1,463,076	\$0
Total Savings	\$0	\$0	\$0	\$0	\$1,463,076	\$0

COSTS:						
Regulated Community	\$0	\$0	\$0	\$0	\$0	\$0
Local Government	\$0	\$0	\$0	\$0	\$0	\$0
State Government	\$1,827,000	\$1,827,000	\$9,258,797	\$2,891,071	\$1,827,00	\$1,827,00
Total Costs	\$1,827,000	\$1,827,000	\$9,258,797	\$2,891,071	\$1,827,00	\$1,827,00
REVENUE LOSSES:						
Regulated Community	\$0	\$0	\$0	\$0	\$0	\$0
Local Government	\$0	\$0	\$0	\$0	\$0	\$0
State Government	\$0	\$0	\$0	\$0	\$0	\$0
Total Revenue Losses	\$0	\$0	\$0	\$0	\$0	\$0

(23a) Provide the past three year expenditure history for programs affected by the regulation.

Program	FY -3 18-19	FY -2 19-20	FY -1 20-21	Current FY 21-22
PA Assessment	\$49,446,000	\$50,490,000	\$41,540,000	\$45,265,000
Teacher Professional Development	\$5,309,000	\$5,309,000	\$5,044,000	\$5,044,000
General Government Operations (Department of Education)	\$26,947,000	\$28,323,000	\$25,359,000	\$29,981,000
Basic Education Funding	\$6,095,079,000	\$6,742,838,000	\$6,794,489,000	\$7,066,773,000

(24) For any regulation that may have an adverse impact on small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012), provide an economic impact statement that includes the following:

- (a) An identification and estimate of the number of small businesses subject to the regulation.
- (b) The projected reporting, recordkeeping and other administrative costs required for compliance with the proposed regulation, including the type of professional skills necessary for preparation of the report or record.
- (c) A statement of probable effect on impacted small businesses.
- (d) A description of any less intrusive or less costly alternative methods of achieving the purpose of the proposed regulation.

The final-form regulation will not have an adverse impact on small business.

(25) List any special provisions which have been developed to meet the particular needs of affected groups or persons including, but not limited to, minorities, the elderly, small businesses, and farmers.

While not reflected directly in the final-form rulemaking, adoption of new academic standards in science will require future action by the Department to review the Alternate Eligible Content (AEC) standards in science to determine whether updates are necessary to align the AEC in Science with the new science standards adopted by the Board. The AEC standards represent a reduction in the breadth, depth, and level of complexity of the state’s academic standards to reflect eligible content that is appropriate for students with the most severe cognitive disabilities while still ensuring access to the general education curriculum. Any future updates to the AEC standards that may result from this final-form rulemaking would be presented to the Board at a public meeting for review and an opportunity for public comment.

In addition, intentional consideration was given to agricultural education in the development of recommendations for updated science standards. The committees that developed recommendations for updated science standards reviewed the most recent research on agricultural education from the Council for Agricultural Education. The Council’s Agriculture, Food, and Natural Resources Standards were cross-walked against the updated science standards to identify gaps and opportunities, ensuring that Pennsylvania students are exposed to agricultural education throughout their K-12 experience and prepared to explore careers in agriculture.

The final-form rulemaking further has the potential to increase the number of vulnerable and historically underserved students engaging in high quality STEM learning. The foundational research, including “*A Framework for K-12 Science Education*” and “*English Language Learners in STEM Subjects*”, used to develop recommendations for updated science standards established a clear focus on equity. An essential component of the research is the vision that every learner is capable of engaging in science, technology, engineering, environment, and ecology education. The final-form regulation will guide educators to attend to students’ interests, identities, and lived experiences as assets, helping develop a student’s sense of belonging as a capable knower and doer of science, technology, engineering, and environmental learning.

In developing recommendations for updated science standards, a focus group of students was convened to provide feedback. Students shared that environmental education, technology, and engineering courses, where they are offered, often appear as elective courses for students in the upper grades, limiting access to those courses to a certain number of students and inherently excluding others. Students excluded from such courses simply may have other interests, but they are more likely to be students deemed in need of academic remediation, English learners, students with disabilities, students placed in programs outside of the school because of involvement with the juvenile justice system, and otherwise interested students who are not counseled or advised to enroll—and in each case given, more likely to be students of color. This final rulemaking aims to afford all students experiences in all of the content areas included in the new standards at increasingly early ages and consistently throughout their kindergarten to twelfth grade academic careers. The cognitive sciences and research guidance on science education is clear that an increased dose of science, technology, engineering, and environmental education at an early age increases the likelihood of students pursuing these types of experiences later in school and into their careers. The integration of content areas beginning at the elementary level may help mitigate some inequities such as disparate resources across school entities, and disparate academic opportunities for students of color, by providing more “on ramps” to exploring science, environment and ecology, and technology and engineering in universal science courses.

(26) Include a description of any alternative regulatory provisions which have been considered and rejected and a statement that the least burdensome acceptable alternative has been selected.

The committees that developed recommendations for updated science standards considered several elements regarding the structure of the standards. Among those, a determination had to be made as to how the standards would be organized. The committees discussed whether the standards should address each grade level (e.g. separate standards for Kindergarten, 1, 2, 3, 4, 5, etc.) or should address grade bands (e.g. establish standards for K-2, standards for 3-5, etc.). The committees sought to provide the opportunity in grades K-5 to empower every grade level to provide science instruction. This recommendation was consistent with the National Research Council's "A Framework for K-12 Science Education" which recommends grade level standards for K-5 to establish strong foundational learning progressions. The cognitive science research, review of the structure of other states' science standards, and Pennsylvania stakeholder feedback indicated that grade level standards would ensure more students are included in science and are building skills toward scientific, environmental, and technological literacy.

The committees that developed recommendations for updated science standards also considered generating grade bands for standards in grades 6-8 and 9-12. They reviewed the structure of other states' standards and the current research on science education and found that grade banded standards were the recommended structure. The committees also discussed the design of Pennsylvania school entities and determined that grade banded standards for 6-8 and 9-12 provide school entities more flexibility for course structure and progression.

A second structural element considered by the committees was whether to integrate technology, environment and ecology standards into one integrated document or to keep the structure of the current standards adopted in 2002, in which the Environment and Ecology standards are a stand-alone set of academic standards. The committees that developed recommendations for updated standards considered the value of integration into one set of standards. The committees unanimously agreed that environment, ecology, and sustainability education are critical for students to understand the designed and natural worlds. The majority of committee members indicated a preference to integrate technology, environment and ecology with the science standards, and the committees outlined the following justifications for integrating the standards:

- Artificial silos between the life sciences, earth sciences, environmental sciences, and ecological sciences created by the structure of the current academic standards adopted in 2002 need to be broken so educators provide fuller access and inclusion to environmental and ecological education for every student.
- Artificial silos between disciplines in the K-12 system created by the structure of the state's current science standards do not model the careers in the life, earth, environment, and ecological sciences, where disciplines are integrated fluidly to best prepare students for a science-driven economy. Artificial barriers should not be created by the structure of the standards.
- If we are to attend to equitable inclusion of every student in science, technology, environment, and ecology education it is critical to have the structure of the standards documents combined, especially for the K-5 level where educators are generalists. A combined structure will provide educators the accessibility to deliver instruction to every student.

The committees that developed recommendations for updated science standards also generated crosswalks to conduct a gap analysis between Pennsylvania's current science standards adopted in 2002 and more current resources on practices in science education outlined in the NRC's *A Framework for K-12 Science Education* (2012), the International Technology and Engineering Educators Association's (ITEEA) *Standards for Technological and Engineering Literacy (STEL)* (2020), and the North American Association for Environmental Education's (NAAEE) *K-12 Environmental Education: Guidelines for Excellence* (2019). The committees agreed that for Pennsylvania's educators and students to have the most innovative set of standards, it would be necessary to complete a gap analysis and use this information to inform their recommendations. The result of the gap analysis continued to enrich the focus on equity and to elevate the

Pennsylvania context in the standards, ensuring students' and teachers' lived experiences in Pennsylvania become an asset-based feature for the implementation of the final-form rulemaking.

All of the considerations reviewed by the committees in developing recommendations for updated science standards were framed by the commitment to equitable access and inclusion of all of Pennsylvania's 1.7 million students to high-quality learning. The final-form regulations will ensure every student can build the skills and knowledge to become scientifically, technologically and environmentally literate, preparing them to be creators in the STEM-driven economy and to be part of a productive citizenry.

(27) In conducting a regulatory flexibility analysis, explain whether regulatory methods were considered that will minimize any adverse impact on small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012), including:

- a) The establishment of less stringent compliance or reporting requirements for small businesses;
- b) The establishment of less stringent schedules or deadlines for compliance or reporting requirements for small businesses;
- c) The consolidation or simplification of compliance or reporting requirements for small businesses;
- d) The establishment of performance standards for small businesses to replace design or operational standards required in the regulation; and
- e) The exemption of small businesses from all or any part of the requirements contained in the regulation.

Small businesses are not part of the regulated community affected by the final-form rulemaking.

(28) If data is the basis for this regulation, please provide a description of the data, explain in detail how the data was obtained, and how it meets the acceptability standard for empirical, replicable and testable data that is supported by documentation, statistics, reports, studies or research. Please submit data or supporting materials with the regulatory package. If the material exceeds 50 pages, please provide it in a searchable electronic format or provide a list of citations and internet links that, where possible, can be accessed in a searchable format in lieu of the actual material. If other data was considered but not used, please explain why that data was determined not to be acceptable.

The standards revision process and subsequent draft standards relied on data from a variety of sources. Which data to use, from which sources, and how to incorporate them, were determined by the following foundational principles:

- Every student is capable of science, engineering, technological and environmental literacy.
- Science, engineering, technology, environment, and ecology should be explored through an integrated and active learning process.
- Iteration and reflection are a critical component of the learning process.
- Success depends upon the partnerships between educators, students, families, postsecondary providers and institutions, legislators, businesses, and industries.

Guided by these principles, the process incorporated: significant input from the stakeholders who will use and be impacted by the academic standards, outreach to historically underrepresented groups, cycles of iteration between committees and between committees and stakeholders, and recent research on learning. Below is a summary of the publicly available information that was reviewed as part of this process.

The Board, in September 2019, directed the Department to begin the process of updating Pennsylvania’s existing academic standards for Science and Technology (2002) and Academic Standards for Environment and Ecology (2002) to align them with current research and best practices. From February through March 2020, 14 stakeholder engagement sessions were held across the state. The stakeholder sessions were held both in person and virtually. Of the more than 960 members of the public who provided input at these sessions, most were elementary and secondary educators, school administrators, postsecondary educators, student teachers, business and industry representatives, community not-for-profit organization representatives, students and parents. In addition to the stakeholder sessions, the Department released a survey and collected data from additional surveys by organizations like the Pennsylvania Science Teacher Association. The stakeholder feedback was captured in a report produced for the Department by the American Institutes for Research, “*Science and Technology & Environment and Ecology Standards: A National Landscape Scan and Pennsylvania Stakeholder Feedback*,” that summarized the current research and best practices regarding science, environment, ecology, technology, and engineering standards. That report can be accessed online here: <https://www.education.pa.gov/Documents/Teachers-Administrators/Curriculum/Science%20Education/PA%20Landscape%20Report.pdf>.

In April 2020, the Department solicited applications from interested members of the public to serve on committees to review and revise the standards, and membership of the committees subsequently was approved by the Board. In June and July of 2020, the committees met to review the stakeholder input referenced above as well as other research-based frameworks and guidelines on science education – such as the National Research Council’s (NRC) *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012), the North American Association for Environmental Education’s (NAAEE) *K–12 Environmental Education: Guidelines for Excellence* (2019), the Ecological Society of America’s (ESA) *Four-Dimensional Ecology Education (4DEE) framework* (2018), the International Technology and Engineering Educators Association’s (ITEEA) *Standards for Technological and Engineering Literacy (STEL)* (2020), the International Society for Technology in Education’s (*ISTE Standards for Students*) (2019), the National Council for Agricultural Education (NCAE) *Agriculture Food and Natural Resources (AFNR) Career Cluster Content Standards* (2015), and other national and international frameworks. Committee members also conducted close reads to share relevant information from Pennsylvania-specific documents, such as Pennsylvania’s *Academic Standards for Science and Technology* (2002), the *Academic Standards for Environment and Ecology* (2002), the Pennsylvania Environmental Literacy Plan, and the 22 Pa. Code Chapter 4 Academic Standards and Assessment. In total, Content Committee and Steering Committee members reviewed over 30 research-based frameworks, guidelines, and Pennsylvania-specific documents. Committee members collaborated to identify key content within those research-informed frameworks and other key national and international standards in science, environment, ecology, technology, engineering, and agriculture. They sought to identify cross-content connections while adding sustainability, Pennsylvania Career Ready Skills, and other Pennsylvania-specific contexts.

All documents reviewed by the committee are available on publicly accessible websites as indicated below:

“*A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*,” National Research Council, 2012: <https://www.nap.edu/read/13165/chapter/1>

“*Taking Science to School: Learning and Teaching Science in Grades K -8*”, National Research Council (2007): <https://www.nap.edu/catalog/11625/taking-science-to-school-learning-and-teaching-science-in-grades>

“*Science Teachers’ Learning: Enhancing Opportunities, Creating Supporting Contexts*”, National Academies of Sciences, Engineering and Medicine, (2015): <https://www.nap.edu/catalog/21836/science-teachers-learning-enhancing-opportunities-creating-supportive-contexts>

“*K–12 Environmental Education: Guidelines for Excellence*,” North American Association for Environmental Education, 2019: https://cdn.naaee.org/sites/default/files/eeoproducts/files/k-12_ee.lr_.pdf

“*Four-Dimensional Ecology Education (4DEE) Framework*,” Ecological Society of America, 2018: <https://www.esa.org/4DEE/>

“*Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education*,” International Technology and Engineering Educators Association, (2020): <https://www.iteea.org/File.aspx?id=177416&v=90d1fc43>

“*ISTE Standards for Students*,” International Society for Technology in Education, (2019): <https://www.iste.org/standards/for-students>

“*Agriculture Food and Natural Resources (AFNR) Career Cluster Content Standards*,” National Council for Agricultural Education, (2015): <https://thecouncil.ffa.org/afnr/>

“*English Language Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives*,” National Academies of Science Engineering and Medicine, (2018) <https://www.nap.edu/catalog/25182/english-learners-in-stem-subjects-transforming-classrooms-schools-and-lives>

In developing the proposed rulemaking, the Board and the Department also reviewed the following publicly available reports produced by Commonwealth entities on Pennsylvania’s workforce projections:

Pennsylvania Workforce Needs Assessment 2016-2026 (Executive Memo of Key Findings from Pennsylvania’s State System’s Workforce Needs Assessment 2016-2026): <https://www.passhe.edu/SystemData/Documents/Pennsylvania-Workforce-Needs-Assessment-Memo.pdf>

Additional data on the Pennsylvania Workforce Needs Assessment 2016-2026 was reviewed on the state’s webpage titled “What is PASmart” that can be accessed at the following URL: <https://www.pasmart.gov/what-is-pasmart/>

Fulfilling High School Graduation Requirements with Computer Science Coursework, Pennsylvania Department of Education, January 2017 <https://www.education.pa.gov/Documents/K-12/Computer%20Science%20Guidance.pdf>

The Board and the Department also reviewed additional data on workforce needs in STEM fields as presented by Code.org in “Support K-12 Computer Science Education in Pennsylvania” accessible at the following URL: <https://code.org/advocacy/state-facts/PA.pdf>.

(29) Include a schedule for review of the regulation including:

- | | |
|---|-----------------------------------|
| A. The length of the public comment period: | 30 days (for proposed rulemaking) |
| B. The date or dates on which any public meetings or hearings will be held: | N/A |
| C. The expected date of delivery of the final-form regulation: | April 2022 |
| D. The expected effective date of the final-form regulation: | July 2022 |
| E. The expected date by which compliance with the final-form regulation will be required: | July 1, 2025 |
| F. The expected date by which required permits, licenses or other approvals must be obtained: | _____ N/A _____ |

(30) Describe the plan developed for evaluating the continuing effectiveness of the regulations after its implementation.

The State Board will review Chapter 4 on a regular basis in accordance with the Board's policy and practice respecting all its regulations. Further, in the final-form rulemaking, the Board is establishing a revised timeframe for future reviews of academic standards that would require such reviews to occur no sooner than five years, but no later than 10 years, from the adoption of standards.

In addition, the Board receives regular reports from the Secretary of Education and Deputy Secretary for Elementary and Secondary Education at the six public meetings it is statutorily required to convene annually. These reports provide a timely means to keep the Board informed about the Department's implementation of final-form amendments to Chapter 4, their effectiveness, and feedback the Department is receiving from schools within the Commonwealth.

RESPONSE TO COMMENTS
22 PA CODE CHAPTER 4

Regulation #6-347

Academic Standards and Assessment

The State Board of Education published proposed regulations in the *Pennsylvania Bulletin* on June 5, 2021 (51 Pa.B. 3103), initiating a formal 30-day public comment period. During this period, individuals and organizations submitted 2,207 comments to the Board.

This document provides a summary of the comments received and the Board's response to the comments.

I. Record of Comment

The following individuals and organizations provided comment to the Board during the 30-day public comment period:

Laura Branby, Dr. Marc Peipoch, Dr. Steve Kerlin, Dr. Donna Queeney, Dr. Lucy McClain, David Wise, PA Association of Conservation Districts, Dr. Sanford Leuba, Allegheny County Conservation District, Lawrence County Conservation District, Carrie Chaitt, Scott Donnelly, Shannon Wehinger, Luke Vanatta, Addison Salus, Nick Kerlin, Crawford County Conservation District, Mike Redding, Montgomery County Conservation District, Gina D'Aquila, Andrea Redinger, Laura Jackson, Potter County Conservation District, Bernard Brown, Lawrence Olsavsky, Alexa Sarussi, Elizabeth Jarrard, Erie SD BELONG Project, Clearfield County Conservation District, Cortney Murphy, Frances Demillion, Amy Allison, Juliann Sepesy, Inner-City Neighborhood Art House, Columbia County Conservation District, Wyoming County Conservation District, Veronica Mortier, Chris Greco, Dr. Maria Wheeler-Dubas, Anna Herman, Shannon Maurer, Ed Ulmer, John P. Sartor, Rebecca Finch, Barton Thompson, Pittsburgh Parks Conservancy, David Himes, Elizabeth Gallagher, Westmoreland Conservation District, McKean

County Conservation District, Greg Schubert, Sheila Snider, Richard Monaghan, Wendy Kedzierski, Monroe County Conservation District, Eric French, Berks Agriculture Resource Network, Lauren Schricker, Keith Niedermeier, Michelle Niedermeier, Martha Napolitan, Watershed Alliance of Adams County, Jessica Hickman Fresch, Kim Carnahan, Zach Muhl, Gary Popiolkowski, Mark Winiesdorffer, Hilary Schenker, Kimberly Witt, Juan Llarena, Charles Brill, Deanna McPeak, Linda Bescrypt, Annie Regan, Melvin Sheets, Lela Betts, Ray Verna, Bruce Kiesel, Brian Brown, Glenn Moyer, Adam Goren, Diana Hulboy, Marina Krempasky, Richard Tregidgo, Rev. David Wesley Brown, David Gunyuzlu, Zuleikha Erbedinger-Bjork, Robin Paur, Mary Jean Cunningham, Julio Paz y Mino, Char Esser, Mandy Tshibangu, Bert Whitehair, Tim Miller, Liz Robinson, Lisa Plotkin, Jean Wiant, Isabel Melvin, James Curtis, Darlene Dech, Diedra Heitzman, Michael Babitch, Rob Sackett, Matthew Mehalik, Shelley Schwartz, Veronica Liebert, Donna Curtis, Jessica Bellwoar, Allison Haas, Jane Hickman, Greta Aul, Lisa Holman, Meredith Stone, Susan Markowitz, Brian Moore, Joel Grace, Amanda Cichon, Vaughn Miller, Dr. Marion M. Kyde, Lisa Ketrick, Carrie Swank, Christoph Stannik, Jack Leiss, Steven Greenspan, Richard Dikant, Susan Murawski, Clifford Johnston, Char Magaro, Dianna Holland, Adam Eyring, Richard Schwartz, Phyllis Blumberg, Victoria Foster, Dennis Keller, Silvia Babicz, Margee Kooistra, Phyllis Gardener, Robert D. Missimer, Jr., Martha Black, Michelle Dugan, Martha Christine, Karen Guarino Spanton, Josh Hantman, Yvonne Paranick, Nancy Bergey, Kim Kantorik, Pamela Haines, Joan Russo, Martha Morgan, Dianne Klein, Bridget Harris, Daniel Aunkst, Steve Olshevski, Ronald Gulla, Virginia Hildebrand, Matthew Franck, Carol Oneill, Al Ferrucci, Richard Johnson, Bonnie Winter, Martha Raak, Richard Whiteford, Anne Young, Diane DiFante, Norma Dunkelberger, Kenneth Bickel, Alexa Manning, Paul Metzloff, Kathleen Miller, Tracey Ash, Laurent Hahn, Gwen Stadler, Patrick Smith, Carol Armstrong, Rachel Davis, Elizabeth Beatty, David Zanardelli, Kathryn Morrow, Kate Potter, Green County Conservation District, Melinda Robinson-Paquette, PA Forest Products Association, Glenn Frantz, Bob Moyer, John Woodward, Barbara Hogan, Kathleen Geist, Diane Bastian, David Zabriskie, Karen Kirchoerfer, Patricia Hartigan, Laura Neiman, Keith Atherholt, Sarah Thompson, Nancy Iannuzzelli, Donald Lancaster, Michelle Dougherty, Kathryn Stevens, Adam Cotchen, Christine Koehler, Frances Moorman, Susan Babbitt, Tascha Babitch, Jill Turco, Mary More, Kay Reinfried, Robert Cooke Jr., Elizabeth Terry, Michael Lombardi, Alicia Weiss, Sheila Erlbaum, Joseph Gross, Barry Cutler, Linda

Schmidt, Kathy Ober, Leann Turley, Margaret Goodman, Richard Fox, Michele Hensey, Trina Gribble, Heather Nelson, Robert Sagely, Patricia Finley, Lloyd Brown, Scott Trees, Barbara Litt, Thomas Graves, Paula Kensinger, Laura Horowitz, Barbara Knickerbocker, Bucks Environmental Action, Deidre DeVine, Catherine Scott, Betty Schulz, Scott Shepler, Steven Lachman, Donna Carswell, Clarence Brommer, Bob Steininger, Michael St. Jean, Betsy Delisle, Marlene Knight, Edward Esler, Garry Armstrong, Nicole Gallo, Martina Jacobs, Gail Richert, Susan Porter, Walter Goodman, Deneice Oroszvary, James Serene, Jen Danner, Melissa G. DelMonego, Bruce Ludwig, Olivia D'Andrea, Jennifer Prince, Jane Seidel, Laura Fake, Julia Nakhleh, Alisa Apgar, Dr. Erica Husser, McKean County Conservation District, Michelle Feldman, Emma Wu, William Licopoli, Francine Locke, Mitch Chanin, Darla J. Romberger, Dianna K. Jarema, Lee Wisdom, Timothy Carpenter, Albert Morales, Karen Vernisi, SaraBeth Fulton, Douglas Brown, Maureen Lewis, Duong Nguyen, Hadley Littell, Raylene Russell, Doreen Jamison, Virginia Nurk, Daniel A. Lynch, Daniel Lynch, Valerie Fry, Suzi Bloom, Chelsea Trainor, Katherine Ranck, Barbara Sheinmel, Hannah Ryan, The Pennsylvania Forestry Association, Chris Mitchell, Joanne Fox, Abha Saini, Mark Weakland, The Institute for Earth Science Research and Education, Gettysburg College, Cam Koons, Wes Miller, Dr. Becky Thomas, Mary Ellen Noonan, Holly Spallone, Luzerne Conservation District, Eric & Andrea Gimbal, Dr. David Twining, Brandon Witmer, Rodger Waldman, Sara Fern Fitzsimmons, Brian M. Wargo, Miriam Lindauer, Gail Nordlof, Keystone Wood Products Association, Millbrook Marsh Nature Center, Stephanie Letourneau, Dr. Kristine Danowski, PA Farm Bureau, KD Davenport, Lauri Moon, Pittsburgh Food Policy Council, Lucy Karlsson, Kelyn Klein, Lynn Kohler, Jessie Snyder, Mary Wirth, Megan Vala, Jeremy L. Deysher, Penn State Earth System Science Center, Bruce Williamson, Jacki Richey, Tamarack Wildlife Center, Dr. Mariam Mahmud, Adam Fabie, Angela Biederman, bwoodsdc@gmail.com, Katherine Kutchins, Mr. & Mrs. James Snyder, Steve Schueth, Serena Sabbara, Jennifer Rankin, Roth Woods, Janice Cyrill, Lindsay Mugglestone, Karylee Feldman, Clinton Burdette, Sarah Kim, Doris Berger, natashakaluza@hotmail.com, Chad Jenkins, Ed Kuszajewski, Pawiter Parhar, Linda Savidge, Judith Peter, Jeffrey Bains, Liza Hamoy, Andrea Schneider, Will Hicks, Fred Granlund, Cammy Colton, Elizabeth Chouldjian, karenl3623@gmail.com, Wallis Goss, Pen Doubleday, Tanya Field, Kristin Crage, Grace Thomson, Emma Houseman, Allyce Spindler, Sargelk@hotmail.com, Robin Mayforth, David Longacre, Glory Arroyos, Theresa Lehman,

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In addition, the Board received comments from the Independent Regulatory Review Commission (IRRC). *See* 51 Pa.B. 5324 (August 21, 2021).

II. Comment and Response

In this section, the Board responds to specific questions and concerns raised by the public during the 30-day public comment period, as well as by IRRC in its August 5, 2021, comments (State Board of Education # 6-347, IRRC #3303). Comments and responses are grouped by topic.

SUPPORT FOR NEW ACADEMIC STANDARDS

Comment: Commentators expressed support for the new science standards included in Appendix B-1 of the Board’s proposed rulemaking and said the process for developing new standards was rooted in research and best practices. Commentators stated that the updated standards streamline the breadth of content and integrate Science, Technology, Engineering and Mathematics (STEM) practices in coherent sets of standards that will clearly inform curriculum development and teacher instruction. Commentators further stated that the new standards will allow students to delve deeper into content, participate in scientific discovery, and develop scientific skills and engineering practices necessary for 21st century scientific literacy rather than focusing on recall of discrete facts. Stakeholders said the new standards focus on what students can do with what they know as opposed to recalling knowledge in an isolated fashion and expressed strong support for that focus on skill-building and understanding scientific processes.

Response: The updated standards included in both the Board’s proposed and final-form rulemakings were informed by current research and best practice in science education. Documents that were relied upon in the development of new standards are identified in both the Preamble and the Regulatory Analysis Form for this rulemaking package. The Board acknowledges and appreciates stakeholder support for the adoption of these new academic standards.

REACHING CONSENSUS

Comment: Some commentators stated that the process of developing updated academic standards requires time for additional conversation. IRRC noted that comments were received from legislators, the Department of Conservation and Natural Resources (DCNR), the Conservation and Natural Resources Advisory Committee, members of the Science Standards Content and Steering Committees, educators, county conservation districts, environmental organizations, professional associations, and the public. In those comment, stakeholders called for additional standards to address content in the Environment, Ecology, and Agriculture.

Legislators asked the Board to provide members of the Content Committee and Steering Committee with additional time to work on the standards. Likewise, some members of the Science Standards Content Committee stated that they were unable to continue contributing to the standards drafting process when that work extended into the fall of 2020 due to professional conflicts and that the process of bringing draft standards to fruition felt rushed. One member of the Content Committee stated that the Committee needed more time to address gaps in the proposed standards for grades 6-12. The commentator identified a particular need to create a domain for environment and ecology within the 6-12 standards similar to the domain included in the proposed standards for elementary school. Agricultural science teachers requested continued conversation with content experts.

Given these concerns presented by stakeholders, IRRC drew attention to Section 2(a) of the Regulatory Review Act that states, “To the greatest extent possible, this act is intended to encourage the resolution of objections to a regulation and the reaching of a consensus among the

commission, the standing committees, interested parties and the agency.” 71 P.S. § 745.2(a). IRRC urged the Board to seek input from all parties as it developed a final-form regulation as a means of reaching consensus. IRRC suggested that the Board consider publishing an Advance Notice of Final Rulemaking should it determine that revisions to the academic standards are necessary.

Response: After reviewing and considering public comment, the Board agreed that additional efforts should be made to reach consensus around the content of proposed new science standards. The Board’s Committee on Academic Standards/Chapter 4 (Chapter 4 Committee), which was delegated responsibility for preparing revised regulations for recommendation to the Board, held a public meeting on September 8, 2021, to discuss next steps on the proposed standards in response to public comment. An electronic communication announcing the meeting agenda was sent to all stakeholders who submitted comment on the Board’s proposed rulemaking. The Chapter 4 Committee recognized that the overwhelming majority of public comment pertained to the academic content of the proposed new standards. As such, the Chapter 4 Committee determined that it would be most prudent to consult with content experts in reviewing and building consensus around how to address the content-related concerns raised by stakeholders.

Therefore, as suggested by members of the General Assembly in their comments to the Board, the Chapter 4 Committee directed the Department to reconvene the Science Standards Content Committee and Steering Committee to develop additional recommendations for the Board’s consideration. Individuals named to serve on these advisory bodies previously were selected for their content expertise, with consideration to ensuring representation across grade spans; geographic regions; urban, rural, and suburban communities; institutions (Intermediate

Units, out-of-school learning providers, colleges and universities, school districts, charter schools, career and technical centers, etc.); types of educators (school teachers, informal educators, school administrators, curriculum experts, postsecondary education, professional learning providers, etc.); and races, ethnicities, and genders reflective of the learners in the Commonwealth.

Content Committee and Steering Committee members also were evaluated based on their depth and breadth of expertise in overall education experience, understanding of the existing standards and current research, equity and access in education and meeting needs of diverse learners, and curriculum and standards development. Further, the Content and Steering Committees were comprised of individuals who hold expertise across numerous scientific disciplines, including multiple individuals who directly represent the communities that expressed concern with the sufficiency of content related to the Environment, Ecology, and Agriculture. Among the Content and Steering Committees members were representatives from: DCNR, the Pennsylvania Department of Environmental Protection, the Pennsylvania Commission for Agricultural Education, the U.S. Fish and Wildlife Service, the Stroud Water Research Center, and the Chesapeake Bay Foundation.

The Chapter 4 Committee set forth a detailed charge to the Content and Steering Committees to review and formulate recommendations on how, or whether, all academic content-related concerns raised by stakeholders should be addressed in amendments to the Board's proposed new standards. A copy of the charge outlining the issues to be considered by the Content and Steering Committees was posted on the Board's website for public access prior to the Chapter 4 Committee's September 8, 2021, public meeting. Members of the public were

provided with an opportunity to address the Chapter 4 Committee during that meeting prior to its adoption of a charge to the Content and Steering Committees.

The Content and Steering Committees met extensively throughout the fall of 2021 to develop additional recommendations in response to the charge presented to them. The Content Committee and Steering Committee held five meetings on October 5, October 18, October 27, November 1, and November 17. Each meeting was over two hours in length. In addition, Content Committee working groups of those Committee members focused on standards for grades K-5 and on standards for grades 6-12 held 26 additional meetings on the following dates in the fall of 2021: October 12 (K-5 & 6-12 Content Committee working groups); October 13 (K-5 & 6-12 Content Committee working groups); October 14 (K-5 & 6-12 Content Committee working groups); October 19 (6-12 Content Committee working group); October 20 (K-5 Content Committee working group); October 26 (K-5 Content Committee working group); October 28 (K-5 Content Committee working group); October 29 (6-12 Content Committee working group); November 2 (6-12 Content Committee working group); November 8 (6-12 Content Committee working group); November 9 (6-12 Content Committee working group); November 10 (K-5 & 6-12 Content Committee working groups); November 11 (K-5 Content Committee working group); November 12 (K-5 Content Committee working group); November 16 (6-12 Content Committee working group); November 18 (K-5 & 6-12 Content Committee working groups); November 19 (K-5 & 6-12 Content Committee working groups); November 29 (Content Committees); and November 30 (Content Committees). All meetings were open to all members of both the Content and Steering Committees.

As some members of the Content Committee and Steering Committee were not able to attend meetings in the fall, their draft recommendations were sent out to all Committee members

through a Google form for feedback and/or approval at two different points in time (November 5-8, 2021, and November 22-24, 2021) in order to gather feedback on each recommendation from all Committee members and to build consensus among all Committee members.

On December 1, 2021, the Chapter 4 Committee held a special meeting to receive the recommendations developed by the Science Standards Content and Steering Committees related to specific academic content concerns raised by stakeholders. An electronic notice about the meeting was sent to all stakeholders who submitted comment on the Board's proposed rulemaking, and an opportunity for public comment was made available during the Committee meeting. Further, a copy of the recommendations developed by the Content Committee and Steering Committee was posted on the Board's website prior to the meeting for public access.

The Chapter 4 Committee met again on January 12, 2022, to consider final-form amendments to Chapter 4. For transparency, a copy of the draft final amendments to Chapter 4 again were posted to the Board's website prior to the Committee meeting for public access, and an electronic notice with the agenda for the meeting was sent to all stakeholders who submitted comment on the Board's proposed rulemaking. An opportunity for public comment was made available during the Committee meeting.

Following approval of final-form amendments by the Chapter 4 Committee, the final-form amendments to Chapter 4 were considered by the Board's Council of Basic Education at a public meeting on January 13, 2022. Interested members of the public were given an opportunity to address the Council prior to the Council taking action on the rulemaking.

Final-form amendments to Chapter 4 then were considered by the Board later on January 13, 2022. Again, an opportunity for public comment before the Board was made available prior to Board action on the regulation.

Since the close of the public comment period on its proposed rulemaking, the Board has made efforts to reach consensus around the proposed *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*, *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)*, and *Pennsylvania Technology and Engineering Academic Standards (Grades 6-12)* by reengaging content experts and providing additional time for them to deliberate on the standards, transparently providing public access to recommendations for additional revisions to the standards as informed by content experts, creating multiple opportunity to address the Board at public meetings prior to adoption of a final rulemaking, and making a draft copy of a final-form rulemaking accessible on its website prior to convening a vote on a final rulemaking.

ACADEMIC STANDARDS: CONTENT AND STRUCTURE

Comment: Commentators recommended that the Board adopt the Next Generation Science Standards (NGSS) as opposed to the proposed science standards included in Appendix B-1 of the Board’s proposed rulemaking.

Response: The external Committees of content experts that developed recommended standards updates that were adopted in the Board’s proposed rulemaking used the National Research Council’s report “*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*” to inform the structure of the standards. The NGSS does not include

content such as agriculture, watersheds, and wetlands that stakeholders identified as important for inclusion in Pennsylvania’s new standards. As such, the Board sought to create its own set of Pennsylvania-specific standards as opposed to adopting the NGSS.

Comment: Commentator expressed support for the new science standards included in Appendix B-1 of the Board’s proposed rulemaking and suggested that the standards be reorganized as follows: 1) science standards for all grade bands, 2) environment and ecology standards for all grade bands, and 3) technology and engineering standards for all grade bands. Commentator stated that presenting the standards in three different documents is potentially confusing as the science standards are written to match the performance expectations in the Next Generation Science Standards and the other standards are not. Other commentators felt organizing standards by grade bands was problematic and expressed support for organizing the standards by grade level to ensure the standards are grounded in research on disciplinary learning and reflect appropriate learning progressions.

Response: The grade-specific standards for K–5 in the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)* reflected in the final-form rulemaking allow for a clear learning progression in elementary school. Standards in the new domain for “Environmental Literacy and Sustainability,” along with the Technology and Engineering standards, are presented in grade bands to reflect the National Research Council (NRC) Framework structure for engineering, technology, and applications of science as well as the North American Association for Environmental Education Guidelines for Excellence. Aligning curriculum to the standards that are grade banded is a matter of local control in Pennsylvania. To support this work, the Department will update its voluntary model curriculum. The Department also will develop resources for the field on learning progressions aligned to the new standards.

The committees that developed recommendations for updated science standards considered several elements regarding the structure of the standards. Among those, a determination had to be made as to how the standards would be organized. The committees discussed whether the standards should address each grade level (e.g. separate standards for Kindergarten, 1, 2, 3, 4, 5, etc.) or should address grade bands (e.g. establish standards for K-2, standards for 3-5, etc.). The committees sought to provide the opportunity in grades K-5 to empower every grade level to provide science instruction. This recommendation was consistent with the National Research Council's "*A Framework for K-12 Science Education*" which recommends grade level standards for K-5 to establish strong foundational learning progressions. The cognitive science research, review of the structure of other states' science standards, and Pennsylvania stakeholder feedback indicated that grade level standards would ensure more elementary students are included in science and are building skills toward scientific, environmental, and technological literacy.

The committees that developed recommendations for updated science standards also considered generating grade bands for standards in grades 6-8 and 9-12. They reviewed the structure of other states' standards and the current research on science education and found that grade banded standards were the recommended structure. The committees also discussed the design of Pennsylvania school entities and determined that grade banded standards for grades 6-8 and grades 9-12 provide school entities more flexibility for course structure and progression.

Further, the *Pennsylvania Technology and Engineering Standards (Grades 6-12)* reflected in the final-form rulemaking were separated in a standalone document to provide the necessary content depth and breadth for courses and experiences in middle and high school programs. The Board agreed with the determination of the expert advisors that served on the

Science Standards Content and Steering Committees that organizing these standards by grade bands is appropriate and, as such, maintained the grade band approach in its final-form rulemaking. Using 9-12 grade band standards for Technology and Engineering provides the most flexibility for school districts for high school elective courses, which often include mixed grade levels in courses.

Comment: IRRC noted that some commentators opposed integrating the current Environment and Ecology standards into broader science standards and expressed support for maintaining them as a separate set of standards. Other commentators stated that environmental education is fundamentally interdisciplinary and that an integrated, interdisciplinary approach is the most effective way to teach it.

Response: The Board agree that environmental education is fundamentally interdisciplinary and, as such, supports the integration of the current standards for Science and Technology and Environment and Ecology. This matter was considered by the Science Standards Content Committee and Steering Committee when developing recommended standards updates for the Board’s consideration. Reports were produced for each set of recommended updated standards and were published at the time the recommendations were presented to the Board in September of 2020. Those report address the rationale for supporting integrated sets of standards.

Excerpts for the report on the recommended integrated standards for grades K-5 state that, “The interconnectedness of the world and its impact on science, environment, ecology, technology, and engineering has never been more prominent.” The report further states that, “Presenting the standards for science, environment, ecology, technology, and engineering together in a single document provides content support in these areas to elementary teachers and makes the standards

more accessible when developing innovative STEM curricula that integrate related content.” The report goes on to state that, “Integrating science, environment, ecology, technology, and engineering in the science standards encourages integrated teaching across these disciplines. Incorporating environment and ecology standards in a systematic way promotes equity by ensuring that the environment, ecology, technology, and engineering are well covered in science courses across grades K-5.” The same rationale for integrating the standards was included in the Content and Steering Committee’s report for recommended updates on integrated standards in grades 6-12. Those reports are publicly accessible on the Department’s website at <https://www.education.pa.gov/Teachers%20-%20Administrators/Curriculum/Science/Pages/Science-Standards.aspx>.

The Board agrees with the reasoning presented in these reports and supports maintaining an integrated approach to new science standards in its final-form rulemaking. Artificial silos between the life sciences, earth sciences, environmental sciences, and ecological sciences created by the structure of the current academic standards adopted in 2002 need to be broken so educators provide fuller access and inclusion to environmental and ecological education for every student. Further, artificial silos between disciplines in the K-12 system created by the structure of the state’s current science standards do not model the careers in the life, earth, environment, and ecological sciences, where disciplines are integrated fluidly to best prepare students for a science-driven economy. Artificial barriers should not be created by the structure of the standards. Further, if we are to attend to equitable inclusion of every student in science, technology, environment, and ecology education it is critical to have the structure of the standards documents combined, especially for the K-5 level where educators are generalists. A combined structure will provide educators the accessibility to deliver instruction to every student.

Comment: IRRC noted that multiple commentators expressed concern the certain content related to the Environment, Ecology, and Agriculture was either weakly linked or omitted from the proposed standards. Specifically, commentators identified a need to include content in the following areas: watersheds and wetlands; renewable and nonrenewable resources; environmental health; agriculture and society; integrated pest management; ecosystems and their interactions; threatened, endangered and extinct species; humans and the environment; and environmental laws and regulations. Some commentators also identified a need to address the following topics from the North American Association for Environmental Education guidelines: human systems, decisions; decision-making and action skills; and personal and civic responsibility.

Related comments urged the Board to add Environment and Ecology standards to reinforce the connections between humans and the natural world in terms of: systems thinking; human health; diversity; equity and inclusion; direct experience; expanding environmental science and ecology principles across disciplines; critical and creative thinking; and sustainability. IRRC noted that other commentators suggested adding standards addressing climate change, alternative energy sources, Pennsylvania-specific standards focused on the environment and ecosystems, and environmental literacy.

Specifically, IRRC noted that commentators called for the *Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12)* to be revised to include Environment, Ecology, and Agriculture as a separate fifth domain with associated performance expectations to provide a level of specificity and application that makes the standards meaningful and effective. IRRC asked the Board to explain how the proposed academic standards in Appendix B-1 adequately integrate standards for Science, Environment, Ecology, Technology, Engineering,

and Agriculture and how students will achieve competency under these standards to be properly prepared for the 21st century workforce.

Response: In response to stakeholder concerns about the sufficiency of content within the proposed standards, the Board took efforts outlined earlier in this document to reengage content experts to develop additional recommendations in response to those concerns. Recommendations developed from those additional deliberations were considered and, ultimately, adopted by the Board in its final rulemaking.

To ensure that new academic standards in Appendix B-1 reflect essential principles of environmental education, as suggested by stakeholders, the Board added a new fifth domain for “Environmental Literacy and Sustainability” to the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology, and Engineering (Grades K-5)* and to the *Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12)*. This fifth domain incorporates essential principles of environmental education across all grade levels and is organized under three core ideas: 1) Agricultural and Environmental Systems and Resources, 2) Environmental Literacy Skills, and 3) Sustainability and Stewardship. The addition of this fifth domain is directly responsive to stakeholder concerns indicating that certain content related to environment, ecology, and agriculture was either omitted or weakly linked in the standards in the Board’s proposed rulemaking. The addition of this new fifth domain also is responsive to the Pennsylvania Environmental Education Act’s charge to fully integrate environmental education into K-12 education.

Content in this new fifth domain was developed using standards and guidelines from relevant professional organizations, including the National Council for Agriculture, Food, and Natural Resources and the North American Association of Environmental Educators, as well as

Pennsylvania’s current Environment and Ecology standards, environmental education research, and examples of how other states address environmental literacy and sustainability (including California, Louisiana, Maryland, Virginia, Washington, and Wisconsin).

The *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology, and Engineering (Grades K-5)* contained in the Board’s proposed rulemaking included K-2 and 3-5 grade band standards for “Environment and Ecology.” The proposed K-2 and 3-5 grade band standards for “Environment and Ecology” were reorganized in the final-form rulemaking under the new domain for “Environmental Literacy and Sustainability” for consistency with how this domain is presented in standards across all grade levels. In addition, content in the proposed K-2 and 3-5 grade band standards for “Environment and Ecology” also was amended in response to this reorganization to reflect content that stakeholders identified as weakly linked or omitted in the proposed standards, to reduce redundancy, to ensure standards were placed where they are developmentally appropriate for students, and to respond to stakeholder concerns that the proposed standards were not written using three-dimensional language.

While a new domain was added across all grade levels, in public comment stakeholder input focused specifically on the need to add a fifth domain to the standards for grades 6-12 to address certain content at those upper grade levels. A new domain for “Environmental Literacy and Sustainability” was added for the 6-8 and 9-12 grade bands in the Board’s final-form amendments to Appendix B-1.

In direct response to stakeholder concerns, the new domain for grades 6-8 include standards that expect students to develop models to describe how agricultural and food systems function, including sustainable use of natural resources and the production, processing, and management of food, fiber, and energy. Standards in the new domain also set forth expectations for students in

grades 6-8 to analyze and interpret data about how different societies and cultures use and manage natural resources differently, address the roles and functions of watersheds and wetlands, create expectations for Pennsylvania students to explore how local environmental issues affect our state's human and natural systems, and establish requirements for instruction related to integrated pest management. Further, in response to stakeholder concerns, new standards for students in grades 6-8 also expect students to receive instruction in how best management practices and environmental laws are designed to achieve environmental sustainability, to design a solution to an environmental issue to gain knowledge related to environmental stewardship, and to construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity.

New standards included in the “Environmental Literacy and Sustainability” domain for grades 9-12 also were created in direct response to stakeholder concerns about content that was either omitted or weakly link in the Board’s proposed rulemaking. These standards expect students at the high school level to receive instruction in agricultural systems in order to “analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources.” They further expect high school students to be able to “apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individual groups, and nations” as they pertain to environment and society. The new standards included in the Board’s final-form rulemaking also set forth expectations for high school-level instruction in watersheds and wetlands, for applying research and analytical skills to investigate local, regional or global environmental issues, and for planning and conducting investigations utilizing environmental data about a local environmental issue. The standards in the new “Environmental Literacy and Sustainability” domain for grades 9-12 also

require instruction to be provided in integrated pest management. Students further are expected to be able to “analyze and evaluate how best management practices and environmental laws achieve sustainability of natural resources,” to “design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being,” and to “analyze and interpret data on a regional environmental condition and its implication on environmental justice and social equity.”

The addition of this fifth domain, organized around three core ideas, creates consistency for instruction in Environmental Literacy and Sustainability across all grade levels. Standards in the new fifth domain in the 6-8 and 9-12 grade bands are directly responsive to academic content that stakeholders identified as either weakly omitted or missing from the proposed integrated standards for grades 6-12. As noted by a commentator, educational and workforce pipelines are reinforced through strong environmental connections and learning in the classroom, supporting sectors including forestry, conservation science, agriculture, clean energy, hydrology, geology, climate science, engineering, park and recreation management, biology, sociology, political science, wildlife management, ecology, and more. The Board believes the addition of the new fifth domain across all grade levels will further strengthen these workforce connections.

The Board also considered comments from stakeholders on whether the new standards should emphasize the major role that human activities play in causing the rise in global temperature, similar to how the Next Generation Science Standards add a clarifying statement in its related middle school standard on factors that have caused the rise in global temperatures over the past century to recognize that these factors include human activities. The Board also considered whether climate change should be more explicitly addressed in content at all grade levels and within all scientific disciplines as suggested by a commentator.

The Board agrees with the findings of the Content and Steering Committees that “the intention of the standards is not to prescribe conclusions but to build students’ capacity to engage in investigating issues, analyzing various scientific research and data, and developing informed conclusions.” As such, the standards set forth expectations for instruction focused on scientific processes that will provide students with multiple opportunities to investigate all major factors, including natural processes, human and other activities, as well as potential solutions to those factors. Further, the Board finds that the proposed performance expectations explicitly and implicitly address climate science at all grade levels with related core ideas revisited throughout grade levels to build a deeper understanding. This is reflected through the inclusion of foundational ideas in science, environment, and ecology that require students to learn deeply about several core ideas, including the disciplinary core ideas underlying climate change as laid out in the National Research Council’s report “*A Framework for K-12 Science Education.*”

Some commentators suggested including other content within the new academic standards, such as integrating Meaningful Watershed Educational Experiences (MWEEs) that reinforce the importance and interconnection between our water cycles and systems and offer hands-on, learner-centered experiences for students, ensuring equitable access to the outdoors and meaningful environmental education experiences for BIPOC youth and those living in environmental justice and underserved communities, creating meaningful direct outdoor experiences for special needs learners that stimulate various senses, and offering outdoor exploratory learning through visual, auditory, and tactile stimuli. The Board recognizes that these and other suggestions offered by stakeholders represent strategies for delivering instruction to students in the new standards and, as such, they more appropriately fall into curriculum development and do not belong in the standards themselves.

The Board will make the Department aware of the suggestions that were presented by stakeholders in public comment for review and consideration as it develops implementation supports in delivering instruction aligned to the new standards. Specifically, the Environmental Education Act directs the Department to provide support to educators related to environmental education and to maintain an Advisory Council on Environmental Education to advise and assist it in carrying out this work. The Department should review these stakeholder suggestions that pertain to how instruction in the new standards may be delivered with its Advisory Council on Environmental Education and incorporate relevant recommendations into the implementation supports developed for educators.

Other commentators stated that Pennsylvania’s Environmental Rights Amendment, set forth in Article 1, Section 27 of the state constitution, also should be included in the new standards. The new high school level standards expect students to “analyze and evaluate how best management practices and environmental laws achieve sustainability of natural resources.” While environmental laws are referenced in the standards, the Board finds that the intention of the standards is not to prescribe curriculum and that including a reference to Pennsylvania’s Environmental Rights Amendment would fall under the scope of curriculum. The Board recognizes the importance of Pennsylvania’s Environmental Rights Amendment and will direct the Department to include references to it in the implementation resources that will be developed for the field to support how to interpret, teach, and assess the performance expectations in the standards. The Department further should consult with the statutorily-required Advisory Committee on Environmental Education in the development of curriculum supports related to Pennsylvania’s Environment Rights Amendment.

Comment: Some commentators expressed concern that proposed standards related to environment and ecology were too vague for teachers, not grade appropriate, not written using three-dimensional language, and more appropriately belong in social science standards.

Response: As addressed above, proposed standards related to environment and ecology have been reorganized in the final-form rulemaking under a new domain for “Environmental Literacy and Sustainability” that is designed to vertically align across all grade levels K-12. Those revisions also included amendments to the language of the performance expectations to rewrite the standards using three-dimensional language as requested by stakeholders. Related Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas will be developed in the implementation resources that will be made available to the field by the Department. To address the connections between standards presented in this new domain and the social sciences, the implementation resources developed by the Department also will highlight relevant connections between these standards and the social sciences.

To address stakeholder concerns about whether the environment and ecology standards included in the proposed standards for grades K-5 were grade appropriate, standards in the new “Environmental Literacy and Sustainability” domain within the integrated standards for grades K-5 were assigned to the K-2 or 3-5 grade bands. The organization of those grades bands was informed by the North American Association of Environmental Educators’ publication “*K-12 Environmental Education: Guidelines for Excellence.*”

Comment: IRRC noted that some commentators asserted that the policies in Section 2 of the Environmental Education Act stating the duties of the Board for environment and ecology curriculum and the Department for formal environmental education are not met in the proposed standards. 35 P.S. § 7522.

Response: The Declaration of Policy in Section 2(2) of the Environmental Education Act notes that the Board has adopted environment and ecology standards that identify the concepts and understanding that students in kindergarten through grade 12 must attain at each grade level. While the Act makes reference to the standards adopted by the Board in 2002, the Act does not direct or require any specific action on the part of the Board, nor does it direct or require the environment and ecology standards to be structured in a certain manner. The Board believes the new standards in Appendix B-1 of its final rulemaking meet the intent of the Environmental Education Act to fully integrate environmental education in K-12 education.

The Environmental Education Act creates responsibilities for the Department related to formal environmental education. However, those responsibilities are separate and distinct from the role and responsibilities of the Board. The Department will continue to carry out its responsibilities under the Act as it works in tandem with the Advisory Committee on Environmental Education, created in the Act, to develop supports for the implementation of the new standards in Appendix B-1 of this final rulemaking.

Comment: Commentators stated that content from the Family and Consumer Sciences Standards (standard 11.3 on Food Science and Nutrition) and content from the Standards for Health, Safety, and Physical Education (standard 10.1 on Concepts of Health) which is very apropos to agriculture is missing from the new standards in the Board's proposed rulemaking.

Response: The Family and Consumer Sciences standards and Health, Safety, and Physical Education standards referenced by commentators were not reflected in the Board's proposed rulemaking because no changes are being made to those standards. The only academic standards that are being modified in the current rulemaking are the current standards for Science and

Technology and the standards for Environment and Ecology. Therefore, commentators can rest assured that the standards apropos to agriculture with which they expressed concern will remain in place.

Comment: IRRC noted that some commentators stated that there was not an attempt to crosswalk the standards for Science, Environment, and Ecology for grades 6-12 to the National Agriculture, Food, and Natural Resources standards to provide clarity and guidance to agricultural science teachers. Commentators further asserted that there was no attempt to incorporate by footnote or other reference the Agriculture, Food, and Natural Resources (AFNR) Standards that are a reference point for many agriculture educators.

Response: The AFNR standards were relied upon as a resource by the Science Standards Content Committee and Steering Committee in the development of recommended new standards for the Board’s consideration. The first page of both the proposed standards in Appendix B-1 of the Board’s proposed rulemaking and the final standards in Appendix B-1 of the Board’s final-form rulemaking includes a footnote that reads, “The language of the standards is adapted, informed by or taken from the...” and goes on to cite the resources that were utilized in developing new academic standards. The AFNR standards are included in that footnote.

Comment: Commentators noted the direct connection between agricultural practices and STEM, including conservation practices related to food production, research, and technology that supports animal nutrition and modern farm equipment, and the need for clean water and production soil. However, commentators stated that portions of the Environment and Ecology standards adopted in 2002 related to agriculture content (Section 4.4 on Agriculture and Society and Section 4.5) appear to be missing from the proposed new standards. Commentators stated that the related

standards for students in kindergarten through fifth grade should be explored in greater detail with input from subject matter experts to ensure elementary-level students possess a general understanding of agriculture and food in the early years.

Response: The Board recognizes the important role that agriculture plays in supporting Pennsylvania’s workforce and economy. The Board directed the Science Standards Content Committee and Steering Committee to review agriculture-related content that stakeholders identified as lacking in the Board’s proposed standards. The Board agrees with the Committees’ findings that the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)* include standards related to agricultural concepts both across the K-2 and 3-5 grade bands.

For example, standards for Grade 1 expect students to “make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.” Standards for Grade 2 expect students to “plan and conduct an investigation to determine if plants need sunlight and water to grow.” Additional standards for Grade 2 expect students to “make observations of plants and animals to compare the diversity of life in different habitats.” In Grade 3, students are expected to “analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.” Grade 3 students also are expected to “make a claim supported by evidence about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.”

In Grade 4, the standards expect students to “construct an argument that plants and animal have internal and external structures that function to support survival, growth, behavior, and

reproduction.” Students in Grade 5 are expected to “support an argument that plants get the materials they need for growth chiefly from air and water.” Finally, standards in the K-2 grade band provide for instruction in ways people harvest, re-distribute, and use natural resources.

The Board finds that there is evidence of agriculture-related content through the standards for grades K-5 in Appendix B-1.

Comment: Commentators stated that there is no demarcation in the proposed standards for when agriculture and food-related content shifts from the general knowledge that creates healthy people, wise consumers, and people who are environmentally aware to more specific knowledge that would be required of people preparing for agriculture and food career pathways. In particular, commentators noted efforts to shift perspective on the stereotype that jobs in agriculture are only in production agriculture and to highlight connections between STEM and the availability of quality careers in agriculture such as plant scientists and large animal veterinarians. Commentators said the proposed standards should fully identify those career options given the importance of agriculture in Pennsylvania.

Response: The academic standards in Chapter 4 are intended to reflect general education requirements for what all students should know and be able to do at specific grade levels. The standards in Chapter 4 are not intended to include content that falls outside of general educational requirements and identifies competencies specific to various career pathways. Standards related to the specific knowledge and skills that are required of students preparing for agriculture and food career pathways are developed under other offices within the Department.

Programs of Study (POS) that lead students into a career pathway that aligns secondary Career and Technical Education (CTE) courses to a postsecondary program leading to an

industry-recognized credential, certificate, or associate degree are identified through the Bureau of Career and Technical Education (BCTE). Pennsylvania offers 42 POS across thirteen career clusters. POS incorporate elements of secondary and postsecondary education and include coherent and rigorous content aligned with challenging academic standards and relevant career and technical content in a coordinated, non-duplicative progression of courses that prepare students to succeed in postsecondary education. This includes the opportunity for secondary education students to earn postsecondary education credits through statewide or local articulation agreements with participating postsecondary institutions leading to a postsecondary credential.

Available POS include programs specific to careers in food and agriculture, including Agricultural Mechanization, Applied Horticulture, Baking and Pastry Arts, Biotechnology, Institutional Food Worker, and Veterinary/Animal Health Technology. Each POS was established through a committee including statewide representation from business and industry, instructors from secondary and postsecondary education, and other interested parties, such as the Workforce Investment Board (WIB). Every three years, the task lists for each POS are reviewed by a committee that includes representation from business and industry, instructors from secondary and postsecondary education, and other interested parties.

Other Career and Technical Education offerings develop student potential for success in entering and advancing through careers in a given career area. This includes career and technical agricultural education that refers to the form of career and technical education which develops student potential for success in entering and advancing through careers in the food, agriculture and natural resources sciences, such as production agriculture, animal science, agribusiness management and marketing, agricultural research, energy systems, agricultural mechanics and engineering, biotechnology, food science, processing and retailing, banking, agricultural

education, forestry, horticulture, landscape contracting, nursery and floriculture production, retail garden center management, leadership and career development, management, economics and marketing, natural resource management, plant and soil science, power and systems technology, rural-urban interfacing and other related fields.

Under 22 Pa. Code § 339.4, the Secretary of Education approves CTE programs prior to operation. Each program submitted for approval must provide a scope and sequence which displays secondary level college preparatory academic and technical course taking sequence, along with the postsecondary course offerings, dual enrollment, and articulated credits. In 2013, the Department initiated the opportunity for districts, charter schools, and career and technical centers (CTC) to develop career pathways. As defined in 22 Pa. Code § 339.22(a)(1)(ii)(B), career pathways are a plan designed to provide basic information and skills for a number of closely related occupations and to develop basic competencies in a variety of jobs within an occupational field, including careers related to agriculture as delineated in the paragraph above. The Department has approved 1,479 POS and 22 Career Pathways.

The Board encourages stakeholders to engage with BCTE in the development of standards for POS and career pathways aligned to careers in food and agriculture as these career-specific standards are developed outside of the standards promulgated by the Board. Further, in resources developed by the Department to support implementation of new academic standards, the Department should identify connections between content in the final standards in Appendix B-1 and related careers in agriculture to make explicit connections for educators.

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* for Grades 6-8 in Weather and Climate expects students to, “Ask questions to clarify evidence of the factors that have caused the rise in global

temperatures over the past century.” Commentator questioned whether the standard should be limited to looking at rising temperatures only of the last century and whether framing the standard to consider this timeframe reflects confirmation bias.

Response: The Board disagrees with the commentator that the proposed standard reflects confirmation bias. Students are expected to rely on all available scientific research to investigate the rise in global temperatures over the past century. Research includes that from the United States Global Change Research Program, the Intergovernmental Panel on Climate Change, the American Geophysical Union, the National Oceanic and Atmospheric Administration, and the United States Geological Survey.

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* for Grades 6-8 in Human Impacts expects students to, “Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.” Commentator questioned whether the standard reflects an assumption that man is causing temperature increases and that man can somehow create a system to mitigate our current climate and whether there are other causes of which students should be made aware.

Response: The Board does not support formulating academic standards based on assumptions. Relative to the proposed standard that is the subject of the commentator’s question, students should be expected to rely on current scientific research to analyze and interpret data on natural hazards (such as hurricanes, earthquakes, floods, and severe weather).

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* for Grades 6-8 in Human Impacts expects

students to, “Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.” Commentator questioned whether the standard ignores improvements over recent years in air and water cleanliness and that the Earth heals itself. Commentator asserted that the environmental movement has always been an anti-capitalism movement and that minimizing impact on human is codeword for “control” and government know what is better for you.

Response: The Board disagrees with the commentator’s assumption that current advances will be ignored. As proposed, the standard expects students to “apply scientific principles to design a method...” as a means for students to demonstrate Science and Engineering practices, not as a means to assert control.

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* for Grades 6-8 in Human Impacts expects students to, “Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth’s systems.” Commentator questioned whether the standard is more pertinent to politics and the unfair distribution of natural resources.

Response: The Board will direct the Department to provide further clarity on implementation of this standard in the resources that will be developed to support the field in delivering instruction. In those resources, the Department should include examples of evidence that may be considered relevant to this standard, including grade-appropriate databases on human population and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). The Department also may provide example of impacts, including changes to the

appearance, composition, and structure of Earth's systems as well as the rates at which they change.

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment and Ecology (Grades 6-12)* for Grades 9-12 in Weather and Climate expects students to, "Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate." Commentator questioned whether the standard is an attack on fossil fuels.

Response: The Board disagrees with the commentator's assumption that the standard is an attack on the fossil fuel industry. As advised by the Science Standards Content and Steering Committees, the standard encompasses all interactions and all energy flows into, out of, and among Earth's systems, including dynamic systems modeling, energy flow, thermodynamics, and system feedback loops.

Comment: Commentator noted that the proposed *Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12)* for Grades 9-12 in Earth's Systems expects students to, "Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems." Commentator questioned whether the standard more appropriately belongs in social studies due to the lack of scientific evidence that supports the theory that man's activity is significantly changing temperatures or climate on Earth.

Response: As advised by the Science Standards Content and Steering Committees, this standard encompasses all interactions among Earth's systems, including dynamic systems modeling, energy flow, thermodynamics, and system feedback loops. As such, the Board find the

standard appropriate for inclusion in the final *Pennsylvania Integrated Standards for Science, Environment, and Ecology (Grades 6-12)*.

Comment: Within the standards for Kindergarten, commentator suggested that the first standard under “Earth’s Systems” should be revised to include students sharing with each other as a critical part of three-dimensional learning and communication.

Response: The Board agrees with the commentator. In the Board’s proposed rulemaking, the first Kindergarten standard under “Earth’s Systems” expected students to, “Use observations of local weather conditions to describe patterns over time.” The phrase “and share” was added to this standard in the Board’s final rulemaking in response to the stakeholder’s comment that communication is a critical part of three-dimensional learning and, as such, should be reflected in the standard.

Comment: Commentator stated that the Grade 3 standard for Life Sciences – Ecosystems: Interactions, Energy, and Dynamics does not match the title of the section in which it is included and already appeared appropriately under the Grade 3 standard for Life Sciences – Biological Evolution: Unity and Diversity #2 that addresses evolutionary adaptations.

Response: In its proposed rulemaking, the Grade 3 standard for Life Sciences – Ecosystems: Interactions, Energy, and Dynamics expected students to, “Construct an argument that some animals have physical and behavioral adaptations that help members survive”. The Board agrees with the stakeholder’s concern that, as proposed, this standard does not match the title of the section in which it is included and could be interpreted as duplicative to the standard that already appropriately appears under the Grade 3 standard for Life Sciences – Biological Evolution: Unity and Diversity #2 that addresses evolutionary adaptations. In response, the Board made editorial revisions in its final-form rulemaking to clarify the Grade 3 standard for Life

Sciences – Ecosystems: Interactions, Energy, and Dynamics in a manner that matches the title of the section under which it falls. The standard was revised to read as follows, “Construct an argument that some animals form groups that help members survive.”

Comment: Commentator identified standards at three different grade levels that the commentator asserted ask students to complete two practices in one standard. To reconcile this, the commentator suggested removing the reference to communication from each proposed standard. The standards identified for revision by the commentator are: Grade 3 standard for Physical Science – Motion and Stability, #2, Grade 4 standard for Physical Science – Energy #2, and Grade 5 standard for Physical Science – Matter and Its Interactions #3.

Response: As proposed, the Grade 3 standard for Physical Science – Motion and Stability identified by the commentator expects students to, “Make and communicate observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.” The proposed Grade 4 standard for Physical Science – Energy identified by the commentator expects students to, “Make and communication observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.” And, the proposed Grade 5 standard for Physical Science – Matter and Its Interactions identified by the commentator expects students to, “Make and communicate observations and measurements to identify materials based on their properties.”

The Board disagrees with the commentator that communication should be removed from these standards because its inclusion asks students to complete two practices in one standard. Science and engineering practices work together and, as such, the practices should not be treated as standalone. While there may be foci practices, there can be multiple that are occurring.

According to Bell et al. (2012), “the eight practices do not operate in isolation. Rather, they tend to unfold sequentially, and even overlap. For example, the practice of “asking questions” may lead to the practice of “modeling” or “planning and carrying out an investigation,” which in turn may lead to “analyzing and interpreting data.” The practice of “mathematical and computational thinking” may include some aspects of “analyzing and interpreting data.” Just as it is important for students to carry out each of the individual practices, it is important for them to see the connections among the eight practices (Achieve, p. 3, Appendix F: Science and Engineering Practices NGSS). (See also, Bell, P., Bricker, L., Tzou, Carrie, Lee., T., and Van Horne, K. (2012) <http://fspsscience.pbworks.com/w/file/fetch/67877369/Obtaining%20and%20Communicating%20Information.pdf>. Exploring the science framework; Engaging learners in science practices related to obtaining, evaluating, and communicating information. Science Scope, 36(3), 18–22).

Comment: Within the Grade 5 standards for Earth and Space Sciences – Earth’s Place in the Universe, commentator suggested that the first standard in that section should be rephrased to replace “compared to” with “and” to reflect the intention of the standard to focus on patterns more than just our star.

Response: As proposed, the Grade 5 standard in question by the commentator expects students to, “Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.” The Board disagrees with the commentator’s suggestion that the standard should be rephrased to replace the phrase “compared to” with “and” to reflect the intention of the standard to focus on patterns more than just our star. The Science Standard Content Committee and Steering Committee reviewed the standard in the context of current research and found that, as proposed, comparisons to the sun are appropriate in

fifth grade according to the performance expectations that were developed using elements from the National Research Council’s publication “*A Framework for K-12 Science Education*”.

Comment: Within the Grade 5 standards for Earth and Space Sciences – Earth and Human Activity, commentator questioned whether the second standard in that section should be removed due to a lack of three dimensionality, lack of clarity, addition of a standard without removing another, and lack of vertical coherence.

Response: As proposed, the Grade 5 standard questioned by the commentator expects students to, “Generate and design possible solutions to a current environmental issue, threat, or concern.” The Board disagrees with the commentator that this standard should be removed. The Board believes the standard helps strengthen vertical coherence of existing proposed standards, as well as strengthening vertical coherence to the new fifth domain for Environmental Literacy and Sustainability that was added to the standards for grades 6-12 in the final-form rulemaking.

Three-dimensionality of this standard will be reflected in the implementation resources the Department is preparing for use by the field through the following connections: Crosscutting Concepts (Stability and Change, Cause and Effect); Disciplinary Core Ideas (Human Impacts, Technology and Engineering); Science and Engineering Practices (Designing Solutions, Obtaining, Evaluating, and Communicating Information). Further, the terms “generate and design” can be encompassed within the engineering design process and appropriate clarification of this also will be made in implementation resources the Department will prepare to support educators in delivering instruction in this standard.

Comment: Within the Grade 5 standards for Physical Science – Matter and Its Interactions, commentator stated that the fifth standard in that section is not three-dimensional and is similar to

the third standard within that same section. As such, the commentator suggested that the standard should be removed due to a lack of three-dimensionality, lack of clarity, the addition of a standard without removing another, a lack of coherence, and similarity to another standard.

Response: As proposed, the Grade 5 standard for Physical Science – Matter and Its Interactions identified by the commentator expects students to, “Interpret and analyze data and observations to make decisions about how to utilize materials based on their properties.” The Board disagrees with the commentator that the standard is redundant to the third standard in that section that expects students to, “Make and communicate observations and measurements to identify materials based on their properties.” Rather, the standard builds upon other standards. Standard #3 in this section focuses on identifying materials based on their properties, while standard #5 in this section focuses on synthesizing skills, interpreting, and analyzing. To provide clarity between the intent of the two distinct standards, in its final rulemaking the Board removed the phrase “and observations” from standard #5. The final Grade five standard identified by the commentator now reads as follows, “Interpret and analyze data to make decisions about how to utilize materials based on their properties.”

Comment: Commentator questioned whether the proposed new standards in Appendix B-1 include sufficient content on simple machines, compound machines, or mechanical advantage.

Response: The question presented by the commentator falls under the scope of curriculum. The intention of the standards is not to prescribe curriculum, including simple machines, compound machine, or mechanical advantage. Determining the sufficiency of such content is a curricular decision that falls to local school entities.

Comment: Commentator questioned whether “Applied Science” should be added as a ninth crosscutting concept reflecting how applied, multidisciplinary, real-world projects can be used to show how core sciences work together.

Response: The Board disagrees with the commentator’s suggestion as applied science already is reflected in the updated standards in Appendix B-1. Applied Science is included in the new academic standards for *Pennsylvania Technology and Engineering Standards (Grades 6-12)*. For grades K-5, applied science is included in the technology and engineering standards that are incorporated into the *Pennsylvania Integrated Standards for Science, Environment, Ecology, Technology and Engineering (Grades K-5)*.

Comment: Commentator requested that new science standards require, not merely suggest, the use of community-based institutions to address real-world projects and enhance understanding on how communities and professionals work together to address problems and the actions required for teamwork and outreach and communication critical to project development. Commentator further requested that the rulemaking incorporate a standard or metric to track and monitor progress in the use of outside organizations.

Response: The Board disagrees with the commentator’s suggestions. The new academic standards included in Appendix B-1 of the Board’s final rulemaking, as well as the existing academic standards in Chapter 4, define what students should know and be able to do at different grade levels. The standards do not dictate a particular curriculum or method of delivering instruction in the standards. How instruction is delivered, including the use of outside organizations as resource experts, is at the discretion of school administrators and classroom teachers.

Comment: Commentator opposed including “intelligent design” in science curriculum, a concept that the commentator identified as a religious belief that belongs in comparative religious class and not in science class.

Response: Neither the Board’s proposed or final-form rulemaking include “intelligent design” in the new science standards contained in Appendix B-1.

DISCIPLINARY CORE IDEAS, CROSS-CUTTING CONCEPTS, AND SCIENCE AND ENGINEERING PRACTICES

Comment: Commentators expressed concern that the standards in Appendix B-1 of the Board’s proposed rulemaking do not include Disciplinary Core Ideas (DCIs), Cross-Cutting Concepts (CCCs), and Science and Engineering Practices (SEPs) that underline the performance expectations set forth in the standards. Commentators noted that the DCIs, CCCs, and SEPs weave together the performance expectations in the standards to provide context for educators on the level of knowledge and achievement necessary to attain the standard. Commentators further suggested that language should be included to reflect an explicit goal on getting students competent in appropriately applying the CCCs and SEPs to the DCIs, language should clarify how each performance expectation reflects the related CCC, SEP and DCI, and examples illustrating how DCIs, CCC, and SEPs can be applied to Pennsylvania-specific situations, environmental and ecological issues, and engineering and technological tasks should be included.

Response: The Board agrees with commentators that DCIs, CCCs, and SEPs provide important context to support educators in implementing the state’s new science standards. The DCIs, CCCs, and SCIs were not included in the standards in Appendix B-1 of the Board’s

proposed or final-form rulemaking because they are not part of the academic content of the standards themselves. Thus, as a matter of legal construct, the Board determined not to include them within Chapter 4. However, the Department is committed to fully developing DCIs, CCCs, and SEPs as a supportive resource for educators as they work to align curriculum and deliver instruction under the new standards. Below is an example of how the DCIs, CCCs, and SEPs requested by stakeholders will be organized under Foundation Boxes for each new standard in the implementation resources to be developed by the Department. The Board will hold the Department accountable for ensuring that this resource requested by stakeholders is finalized for use by the field in a timely manner.

Domain Physical Science		
Core Idea Motion and Stability: Forces and Interactions		
Performance Expectation (PE): Students who demonstrate understanding can: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.		
Clarifying Statements Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.		
Assessment Boundary Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.		
Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)

<p>Planning and Carrying Out Investigations</p> <p>Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> • With guidance, plan and conduct an investigation in collaboration with peers. <p>Analyzing and Interpreting Data</p> <p>Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> • Analyze data from tests of an object or tool to determine if it works as intended. <hr/> <p><i>Connections to the Nature of Science</i></p> <p>Scientific Investigations Use a Variety of Methods</p> <ul style="list-style-type: none"> • Scientists use different ways to study the world. 	<p>PS2.A: Forces and Motion</p> <ul style="list-style-type: none"> • Pushes and pulls can have different strengths and directions. • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. <p>PS2.B: Types of Interactions</p> <ul style="list-style-type: none"> • When objects touch or collide, they push on one another and can change motion. <p>PS3.C: Relationship Between Energy and Forces</p> <ul style="list-style-type: none"> • A bigger push or pull makes things speed up or slow down more quickly. <i>(secondary)</i> 	<p>Cause and Effect</p> <ul style="list-style-type: none"> • Simple tests can be designed to gather evidence to support or refute student ideas about causes.
<p align="center">PA Connections: PA Context and PA Career Ready Skills</p> <p align="center">Distinguish among a set of short-term, mid-range, and long-term goals.</p>		
<p align="center">Connections to Other Standards Content and Domains</p>		

<p>Agriculture (Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards)</p> <p>CS.01.02.01.a. Research technologies used in AFNR systems.</p>	<p>Educational Technology (ISTE Standards for Students)</p> <p>1.1 Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.</p>	<p>ELA (PA Core Standards: ELA)</p> <p>CC.1.2.K.A: With prompting and support, identify the main idea and retell key details of text.</p> <p>CC.1.4.K.V: Participate in individual or shared research projects on a topic of interest.</p> <p>CC.1.5.K.C: Ask and answer questions in order to seek help, get information, or clarify something that is not understood</p>	<p>Environment (NAAEE Guidelines for Excellence)</p> <p>Strand 1.A. Designing investigations: Learners design simple environmental investigations.</p>	<p>Math (PA Core Standards: Math)</p> <p>MP.2: Reason abstractly and quantitatively.</p> <p>CC.2.4.K.A.1: Describe and compare attributes of length, area, weight, and capacity of everyday objects.</p>	<p>PA Social Studies Standards</p> <p>5.4 K.B: Identify how students can work together.</p>	<p>Technology and Engineering (ITEEA)</p> <p>STEL-2D. Develop a plan in order to complete a task.</p>
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TIMEFRAME FOR REVIEWING ACADEMIC STANDARDS

Comment: Under subsection 4.12(i) of the Board’s proposed rulemaking, the Board will review academic standards and assessments to determine if they are appropriate, clear, specific and challenging no sooner than every five year and no later than every 10 years. IRRC noted that a commentator stated that Pennsylvania’s science standards must be updated more frequently than every 10 years because science and technology progress so rapidly that many topics are outdated by the time they reach the K-12 curriculum. The commentator recommended that the state’s science standards be updated no later than every five years. IRRC asked the Board to explain why it believes a 10-year review period is appropriate and reasonable.

Response: Section 4.12(i) addresses timeframes for reviewing state academic standards to determine if they are appropriate, clear, specific, and challenging. Language in this section applies to all academic standards established in 22 Pa. Code Chapter 4 and is not specific only to the academic standards for science. In its final amendments to Section 4.12(i), the Board is amending the current three-year timeframe for reviewing state academic standards to require these reviews be conducted no sooner than every five years and no later than every 10 years.

The Board disagrees with the commentator that it is necessary to establish a review cycle for science standards that would require the standards to be updated no later than every five-years. School entities need adequate time to train staff and update curriculum to fully implement new academic standards and to gain experience in delivering instruction under those standards before commencing a review that may result in modifications to the standards. Further, when standards that are measured by state assessments are updated, such as science standards, the Department needs adequate time to align related state assessments to the new standards. The Board assessed these needs and, in its final rulemaking, is providing a three-year implementation window to provide school entities and the Department with adequate time for fully integrating new standards into instruction and transitioning to aligned state assessments. Taking into account the timeframe for implementation, requiring science standards to be updated no later than every five years as suggested by the commentator would compel the Board to prepare updates to the Chapter after only two years of full implementation of the new standards and state assessments.

The Board finds a range of five to ten years between reviews to be more appropriate and reasonable given the time needed for implementation of new standards by both the field and the Department, particularly for standards that are aligned to state assessments. Conducting reviews

of academic standards within this range will allow school entities to gain experience with new standards before inviting discussion about potentially modifying them, while retaining flexibility for the Board to address identified concerns at the five-year mark if necessary.

HIGH SCHOOL GRADUATION REQUIREMENTS

Comment: The Board's proposed rulemaking included technical amendments to conform the regulation with changes to state high school graduation requirements enacted by the General Assembly in the Public School Code of 1949. IRRC noted that subsection 4.24(b) of the Board's proposed rulemaking sets forth high school graduation requirements through the 2015-2016 school year and that subsection 4.24(c) sets forth high school graduation requirements that will begin in the 2022-2023 school year. IRRC further noted that graduation requirements for the 2016-2017 school year through the 2021-2022 school year were not stated in Section 4.24 of the proposed rulemaking. For purposes of the regulatory record, IRRC asked the Board to clarify that section to include the high school graduation requirements for the omitted years.

Response: The Board agrees with IRRC's request to add clarity to subsection 4.24(b) by including the high school graduation requirements for the 2016-2017 school year through the 2021-2022 school year for purposes of the regulatory record. In its final-form rulemaking, subsection 4.24(b) was amended to address high school graduation requirements through the 2021-2022 school year.

Subsection 4.24(b) addresses state graduation requirements that predate the use of Keystone Exams as part of graduation requirements and reflects the requirements used to determine a student's eligibility to graduate up until the time that Keystone Exams are used as

part of such determinations. In the Board’s proposed rulemaking, subsection 4.24(b) addressed requirements through the 2015-2016 school year only. As such, the regulation did not address how graduation determinations were made from the 2016-2017 school year to present.

Act 136 of 2020 delayed the use of Keystone Exams as a graduation requirement until the 2022-2023 school year, and graduation requirements consistent with that effective date established in Act 136 are reflected in subsection 4.24(c). Therefore, the state graduation requirements set forth in subsection 4.24(b) will remain in effect through the 2021-2022 school year.

Comment: IRRC noted that subsection 4.24(c)(1)(iii) of the Board’s proposed rulemaking required school districts, charter schools, cyber charter schools, and areas career and technical schools to adopt and implement requirements for high school graduation that demonstrate proficiency with the Science, Environment, and Ecology standards in Appendix B-1 beginning in the 2022-2023 school year. However, IRRC noted that Appendix B-1 will not be effective until July 1, 2024, and that the current academic standards in Appendix B will remain in effect until it sunsets on June 30, 2024. To ensure that the timetables for compliance are accurately stated in the rulemaking, IRRC asked the Board to revise subsection 4.24(c)(1)(iii) to reference Appendices B and B-1, along with their respective effective dates.

Response: The Board agrees with IRRC’s request to add clarity to subsection 4.24(c)(1)(iii) by incorporating the relevant effective dates for the current Science and Technology and Environment and Ecology standards in Appendix B and the new Integrated Standards for Science, Environment and Ecology in Appendix B-1, respectively. Final-form amendments to Section 4.24(c)(1)(iii) clarify that students must demonstrate proficiency in the

current academic standards set forth in Appendix B through June 30, 2025, and that, beginning July 1, 2025, students must demonstrate proficiency in the standards set forth in Appendix B-1 to satisfy state graduation requirements.

IRRC's comments to the Board referenced updating this subsection to reflect an effective date in 2024, as initially proposed by the Board. However, in its final-form rulemaking, the Board amended subsections 4.12(a)(2)(i-iii) to change the effective date for the new academic standards in Appendix B-1 from July 1, 2024 to July 1, 2025, and to change the sunset date for the current standards in Appendix B from June 30, 2024 to June 30, 2025, in order to provide school entities with a three-year window for implementation of the new standards. Therefore, clarifying amendments reflect the effective date established in the final rulemaking.

Comment: Commentator stated that the weakening of project-based assessments removes some potential training for future scientists and environmentalists. Commentator requested that the Board not weaken project-based assessments and keep students involved in learning opportunities outside of the classroom.

Response: Act 158 of 2018 amended Section 121(c.5) of the Public School Code of 1949 (24 P.S. § 1-121(c.5)) to address the use of project-based assessments for the purposes of demonstrating academic proficiencies for high school graduation. Section 121(c.5) of the Public School Code states that no school entity may be required to offer project-based assessments and that no student may be required to participate in or complete project-based assessments as they pertain to Section 4.51c of the Board's existing regulations, which addresses the use of project-based assessments as an alternative to Keystone Exams. These changes in statute are in conflict with the use of and requirements for participation in project-based assessment in Section 4.51c of

the Board's existing regulations. Therefore, in its final-form rulemaking the Board is amending Section 4.51c to conform with language regarding project-based assessments as it now appears in statute. Amending Section 4.51c to address project-based assessments in a different manner as suggested by the commentator would create inconsistency with provisions of the Public School Code governing the use of project-based assessments that supersede the Board's regulations.

Comment: Commentator suggested that state assessments used for the purpose of demonstrating graduation requirements should align with an interdisciplinary science assessment, including life, physical, and earth sciences. Commentator expressed concern that when only Biology is assessed, Biology will receive a disproportionate amount of attention, funding, and administrative scrutiny, and other key content areas will be ignored.

Response: Section 121 of the Public School Code establishes high school graduation requirements that include the use of three state assessments – the Keystone Exams administered in Algebra I, Literature, and Biology. Act 6 of 2017 amended subsection 121(a) of the Public School Code to limit the development of Keystone Exams to those three subject areas and removed language that previously directed the Department to develop additional Keystone Exams in English composition, Algebra II, geometry, U.S. History, chemistry, civics and government, and world history. Therefore, revising the state science assessment used for purpose of demonstrating graduation requirements to include content beyond Biology would require a change in statute and cannot be accomplished by the Board through amendments to Chapter 4.

STATE ASSESSMENT SYSTEM

Comment: IRRC noted that, under subsection 4.51(a)(6), the state assessment system shall be designed to assess student proficiency in Science, Environment, Ecology, Technology and Engineering as set forth in Appendix B-1. However, IRRC noted that Appendix B-1 will not take effect until July 1, 2024. To ensure that the timetables for compliance by schools are accurately stated in the rulemaking, IRRC requested that the Board revise subsection 4.51(a)(6). IRRC further requested that the Board make parallel revisions to similar language in sections 4.51a(b) 4.51b(a)(3) (relating to Pennsylvania System of School Assessment; and Keystone Exams) to reference Appendices B and B-1, along with their respective effective dates, or explain why it is unnecessary to do so.

Response: The Board agrees with IRRC's request to add clarity to the rulemaking by referencing both Appendix B and Appendix B-1, along with their respective effective dates, in Sections 4.51(a)(6), 4.51a(b), and 4.51b(a)(3). In its final rulemaking, each of the aforementioned sections was amended to clarify that the standards in Appendix B are applicable through June 30, 2025, and that the new standards in Appendix B-1 take effect on July 1, 2025. These amendments make clear that the Pennsylvania System of School Assessment (PSSAs) in Science (administered in grades 4 and 8) and the Keystone Exam in Biology will be aligned to the new academic standards in Appendix B-1 and that updated aligned assessments will not be administered until the new standards fully take effect. Thus, state science assessments aligned to the new standards will be administered for the first time in the 2025-26 school year.

IRRC's comments to the Board referenced updating these sections to reflect an effective date in 2024, as initially proposed by the Board. However, in its final-form rulemaking, the Board amended subsections 4.12(a)(1)(i-ii) and subsections 4.12(a)(2)(i-iii) to change the effective date for the new academic standards in Appendix B-1 from July 1, 2024 to July 1, 2025, and to change the sunset date for the current standards in Appendix B from June 30, 2024 to June 30, 2025, in order to provide school entities with a three-year window for implementation of the new standards. Therefore, clarifying amendments reflect the effective date established in the final rulemaking.

Comment: Commentators requested that the Board consider moving the elementary science PSSA from 4th grade to 5th grade due to the grade bands in the proposed new standards for grades 3-5. One commentator stated that, under the updated standards, the 4th grade PSSA would sit in the middle of a cognitively developed grade band and may unintentionally cause school districts to omit certain science standards in 5th grade that are outside the tested year.

Response: The Board will share the commentators' suggestion with the Department for consideration in a future rulemaking. Section 4.51a(c) of Chapter 4 establishes that the PSSA in Science shall be administered in grade 4 and in grade 8. Revisions to the grades in which the Science PSSA is administered were not included in the Board's proposed rulemaking. The Board believes such a change is significant enough that it would substantively expand the scope of the final-form rulemaking and, thus, must be informed by an opportunity for public comment by affected stakeholders. As such, the Board did not include the commentator's suggested revision in its final-form rulemaking.

Comment: Commentator expressed support for the new standards included in the Board's proposed rulemaking and suggested that state assessments methods should be revised to highlight student skills instead of level 1 knowledge recall. Commentator stated that providing students with novel phenomena in which they can apply their skills (i.e. Asking Questions, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computation Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, and Obtaining, Evaluating, and Communicating Information) are imperative to highlight the most important components of science as a process instead of a knowledge base. Commentator further stated that such a change has the ability to reduce costs for the state as a less exhaustive assessment method is necessary to evaluate student proficiency.

Response: The Board will share the commentator's suggestion with the Department for its consideration. Section 4.51a(a) establishes the item types that are reflected on state assessments administered in grades 3 through 8 – the PSSAs – to include essay or open-ended response items, in addition to other item formats. Section 4.51a(a) further establishes that the proportion of item types will vary by grade level. Similar language for the Keystone Exams is not included in Chapter 4.

Revisions to state assessment methods were not included in the Board's proposed rulemaking and, thus, were not subject to an opportunity for public comment by affected stakeholders. Therefore, the Board did not include the commentator's suggested revision in its final-form rulemaking.

However, the revisions to state assessment methods proposed by the commentator may be matters that the Department has the discretion to address outside of the regulatory process. Section 4.51a(a) allows the use of “other item formats” on the PSSAs and Section 4.51a(b) directs the Department to develop the PSSAs and to “consult with educators, students, parents, and citizens regarding the specific methods of assessment”. Further, the Board’s regulations do not address specific item types for inclusion on the Keystone Exams and Section 121(a) of the Public School Code simply directs the Department to develop and implement Keystone Exams, but does not specify how the exams should be structured. In determining whether to incorporate the commentator’s suggestions into state assessments, the Department and the Board will need to consider whether such changes would comply with requirements established in federal law that require the use of a uniform assessment for all students and with similar requirements established in Section 290.1 of the Public School Code that require state testing to provide a uniform evaluation of each school district.

IMPLEMENTATION

Comment: IRRC noted that Appendix B will sunset on June 30, 2024 and asked whether the Board will reserve the appendix at that time.

Response: The Board will take action to place Appendix B in reserve when it sunsets. In its final-form rulemaking, the Board amended subsections 4.12(a)(1)(i-ii) and subsections 4.12(a)(2)(i-iii) to change the effective date for the new academic standards in Appendix B-1 from July 1, 2024 to July 1, 2025, and to change the sunset date for the current standards in

Appendix B from June 30, 2024 to June 30, 2025. Thus, the Board will act to place Appendix B in reserve at the time it will sunset on June 30, 2025.

Comment: Commentator expressed gratitude for the Board’s acknowledgement that financial support for professional development is critical for successful implementation of new standards. However, commentator stated that approximately \$27,000 per county will not cover the professional development gaps that educators will have with this paradigm shift. Commentator requested that the state consider funding to train and financially support coaches to help with implementation in every county.

Response: The fiscal analysis for the Board’s proposed rulemaking reflects a sustained annual investment of \$1,827,000 in the Pennsylvania Statewide System of Support to deliver professional learning and technical assistance in Science, Technology, Engineering, and Environment and Ecology education at no cost to educators. It does not reflect a one-time infusion of \$27,000 per county to support implementation. Professional learning and technical assistance delivered through the investment in the Pennsylvania Statewide System of Support is provided on a regional basis by each of the state’s 29 Intermediate Units (I.U.s) through a train the trainer model. Each I.U. will have a STEM Point of Contact with the expertise to deliver professional learning and technical assistance at no cost to school entities. Thus, the investment in the state’s network of I.U.s is intended to provide a return on investment by building capacity to support implementation in each school entity.

Since 2016, the Department has been driving professional learning to educators and school entities aligned to robust research, practice, and recent guidance outlined by “*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*,”

“Taking Science To School,” and *“Science Teacher’s Learning: Enhancing Opportunities Creating Supportive Contexts.”* Since 2016, the Department has invested more than \$4.3 million in federal and state funds to enhance educators’ and school entities’ ability to ensure all learners, especially those who have been historically underserved, are included in science, technology, engineering, and environmental learning experiences. The investment has resulted in the development of an Open Education Resource (OER) STEM Toolkit, provision of research-aligned professional learning for thousands of educators across the commonwealth, and school entities’ building STEM Comprehensive plans. This upfront investment will support school entities in implementing the new standards included in the final-form rulemaking.

In addition to the state-level investments in education infrastructure through the I.U.s, the Department employs content advisors who provide curriculum alignment supports for school entities across the commonwealth. The Department has individual content advisors dedicated to science, technology, engineering, environment, and ecology education with the expertise necessary to guide implementation for the field.

Further, as part of the stakeholder engagement convened by the Department in developing recommended standards updates, science educators were asked to complete a survey that included strategic questions to discern what academic standards K-12 schools utilize when creating their curriculum. The results of the survey indicated that, as of the 2019-20 school year, approximately 42 percent of respondents in Pennsylvania reported using national frameworks in designing learning experiences, while between 35-37 percent reported having curriculum aligned to national standards and frameworks. Presumably, professional learning needs for implementation of new science standards may not be as great on a statewide basis as the standards in the Board’s final-form rulemaking were informed by current national standards

frameworks that some science educators indicated they already utilize and the Department's upfront investment in related professional development has made inroads in preparing Pennsylvania teachers to work with the new standards adopted by the Board.

Comment: Commentator expressed concern that someone new to STEM may not understand the design concept of the proposed new standards and said workshops and trainings are needed, not only for science teachers but for teachers in grades one through eight as well.

Response: The Department will make professional learning supports available to all educators to support implementation of updated science standards. These supports will not be limited to secondary level science teachers and will include teachers in grades K-8.

Comment: Commentator expressed concern that the proposed standards will become another state mandate that politicians will use as evidence of their support for public education but that the mandate will be unfunded or underfunded. Commentator stated that implementation of the proposed new standards will require professional development and that professional development days are part of collective bargaining and much of that time is already spent covering other state mandates. Commentator stated that lawmakers must fully fund this initiative fairly based on the number of pupils in a district, with special consideration to the number of economically disadvantaged students, special education students, and students who are English learners. Commentator further stated that funding should not be based on the current school funding formula or on grants that require paperwork.

Response: Implementation supports for new academic standards are addressed earlier in this section on stakeholder concerns related to implementation. The Department intends to make supports available both through the state's network of Intermediate Units and through the content

advisors that serve as part of the Department's current staff complement. Access to these supports will not be based on grants that require paperwork. Further, the final-form rulemaking provides a three-year window for implementation by districts to provide time that may be necessary for allocating professional development days to professional learning needs related to the new standards.

Further, as noted above, as part of the Department's stakeholder engagement sessions, science educators were asked to complete a survey that included strategic questions to discern what academic standards K-12 schools were utilizing when creating their curriculum. The results of the survey indicated that, as of the 2019-20 school year, approximately 42 percent of respondents in Pennsylvania reported using national frameworks in designing learning experience, while between 35-37 percent reported having curriculum aligned to national standards and frameworks. This presumably will necessitate fewer or more minor adjustments to curriculum to align with the updated standards in the final-form rulemaking since the revised standards were informed by current national standards frameworks in their development and incorporate some elements of the frameworks already referenced by educators in their response to the Department's question.

School entities typically engage in curriculum review cycles every five to six years. Thus, the Board anticipates that efforts to implement the updated standards included in the final-form rulemaking will be reflected in school entities' existing budgetary practices for curriculum review and updates, therefore becoming part of a traditional cycle for updating school entity resources. As such, the final-form rulemaking does not add new costs in so much as it refines the focus of current instruction.

In addition, decisions related to school funding formulas lie with the General Assembly, not with the Board. Comments pertaining to state funding formulas for education were shared with the House and Senate Committees on Education for their review. The Board further notes that, while the commentator suggested funding for standards implementation should not be based on the current funding formula, the factors that the commentator suggested should be taken into account are considered as part of the state's existing funding formula (number of pupils in a district and number of economically disadvantaged, special education, and English language learner students).

Comment: Commentator expressed support for extending the review cycle of standards from every 3 years to every 5-10 years to provide a better framework for strategically updating and implementing academic standards. Commentator further expressed appreciation for the dedication to research-based practices to improve the content of the standards. However, the commentator requested the additional use of data-driven metrics to evaluate the effectiveness of equity of implementation that goes beyond data from standardized testing.

Response: The Board will share the commentator's suggestions with the Department for consideration as plans for implementation of the new standards are developed, executed, and monitored.

MISCELLANEOUS CLARITY IDENTIFIED BY IRRC

Comment: IRRC noted that the response to Regulatory Analysis Form (RAF) Question #29 regarding the effective date of the final-form rulemaking should be updated.

Response: The Board updated the response to RAF Question #29 in the RAF that accompanied the final-form rulemaking package to include an effective date of July 2022.

Comment: IRRC noted that Sections 4.24(c)(1)(iii)(B)(I) and 4.51(a)(6) include “Civics and Government,” which are no longer included in the Keystone Exams. IRRC asked whether reference to these academic standards should be deleted.

Response: IRRC is correct that references to the academic standards for “Civics and Government” in Sections 4.24(c)(1)(iii)(B)(I) and 4.51(a)(6) should be deleted as a Keystone Exam in that content area no longer will be developed by the Department. The Board deleted the reference to “Civics and Government” in the aforementioned sections in its final-form rulemaking. This correction conforms those sections of the regulation with change to the Public School Code of 1949 made by Act 6 of 2017 which eliminated the development of a Keystone Exam in Civics and Government.

Comment: IRRC noted that the U.S.C.A. citation should be added following cross-reference to the Elementary and Secondary Education Act of 1965 in Section 4.24(j).

Response: The Board added the requested citation to Section 4.24(j) in its amendments to the final-form rulemaking.

Comment: IRRC requested that the Board review cross-references to Section 4.51b to ensure citations reflect renumbering.

Response: In preparation of its final-form rulemaking, the Board reviewed cross-references to Section 4.51b and made two amendments to ensure citations reflect renumbering. Within Section 4.4 (relating to general policies), the Board removed cross-references to Section

4.51b(j) from both subsections 4.4(e)(1) and 4.4(e)(3). Section 4.51b(j), as renumbered in the Board’s final-form rulemaking, no longer cites to the subsection that was the subject of the cross-reference in subsections 4.4(e)(1) and 4.4(e)(3) of the existing provisions of Chapter 4.

However, even if Section 4.51b(j) was not renumbered in the final-form rulemaking, the cross-references to Section 4.51b(j) within Sections 4.4(e)(1) and (e)(3) should be removed as the existing cross-reference referred to a provision that addressed Keystone Exams in English Composition and Civics and Government. As Keystone Exams in English Composition and Civics and Government no longer will be developed, the existing cross-reference is irrelevant.

Comment: IRRC suggested that the Board consider clarifying Section 4.51b(j) by specifically citing the Every Student Succeeds Act (Pub. L. No. 114-95) as the successor federal statute to the No Child Left Behind Act of 2001 (Pub L. No. 107-110).

Response: In its final-form rulemaking, the Board removed the reference to the No Child Left Behind Act in Section 4.51b(j). The Board replaced that reference with a specific citation to the Every Student Succeeds Act (Pub. L. No. 114-95).

Comment: IRRC noted that Section 4.51c should be corrected by deleting the subsection “(a)” designation in accordance with Section 2.1(e) of the *Pennsylvania Code and Bulletin Style Manual*.

Response: The Board made the technical formatting correction requested by IRRC by deleting the subsection “(a)” designation from Section 4.51c in the final-form rulemaking. The section now complies with Section 2.1(e) of the *Pennsylvania Code and Bulletin Style Manual* by not including a subsection designation as all other existing subsections of Section 4.51c are being deleted from the Chapter in the final-form rulemaking.

Comment: IRRC requested that the Board correct the *Purdon's* citations to sections 121 and 121.1 of the Public School Code of 1949 (24 P.S. §§ 1-121 and 1-121.1) in Sections 4.24, 4.51b, 4.51c, and 4.51d.

Response: In its amendments to the final-form rulemaking, the Board made the technical correction requested by IRRC to add the missing “1-” to the *Purdon's* citations to sections 121 and 121.1 of the Public School Code of 1949 (24 P.S. §§ 1-121 and 1-121.1) in Subsections 4.24, 4.51b, 4.51c, and 4.51d.

OTHER MISCELLANEOUS COMMENTS

Comment: Commentator stated that updated standards should reflect science and not be biased by political or religious considerations. Commentator concluded that science class should emphasize theoretical and practical areas of science as they are understood by the scientific community.

Response: The Board agrees that updated science standards should not be biased by political or religious considerations. In formulating new science standards, the Board convened external committees of content experts to advise the Board on updating the state's science standards. These content experts were selected on the basis of their depth and breadth of expertise in: curriculum and standards development, understanding of the existing science standards and current research, equity and access in education and meeting the needs of diverse learners, and overall education experience. The content experts engaged by the Board collaborated to identify key content within research-informed frameworks from multiple associations of professionals in various scientific disciplines and other key national and

international standards in science. The research-informed frameworks that served as a starting point for the development of Pennsylvania’s new science standards are identified in the Preamble and delineated in question #28 of the Regulatory Analysis Form for the final-form rulemaking.

Comment: Notice of proposed rulemaking was published in the *Pennsylvania Bulletin* on June 5, 2021 (51 Pa.B. 3103). Commentator expressed concern with the following language from that publication: “Interested persons and individuals affiliated with small businesses are invited to submit written comments, questions, suggestions, commendations, concerns or objections regarding this proposed rulemaking to...”. Commentator suggested that the reference to small businesses created confusion that comments are being sought only from individuals associated with small businesses and stated a belief that some people will not offer public comment because they are not affiliated with such a business. Commentator requested that the Board remedy this error and allow for another 30-day public comment period.

Response: The Regulatory Review Act (RRA) requires flexibility for small businesses to be considered as part of the rulemaking process and requires state agencies to solicit the ideas and comments of small businesses in order to assess the impact of a proposed rulemaking on small businesses. Notice of proposed rulemaking specifically invited comment from individuals affiliated with small businesses in recognition of the requirement to engage small businesses established in the RRA. That invitation to provide comment did not exclude others from submitting comments as the statement in the Board’s Notice of Proposed Rulemaking invited both “interested persons *and* individuals affiliated with small businesses” to share comments with the Board. (*emphasis added*) In total, the Board received comments on its proposed rulemaking from 2,207 individuals and organizations. Given the volume of comment received, the Board disagrees with the commentators’ assertion that another 30-day public comment period

is necessary because language included in the Notice of Proposed Rulemaking published on June 5, 2021, may serve as a deterrent to participate in the opportunity to offer public comment.

Comment: Commentator suggested editorial revisions to the language of the preamble in the Board’s Notice of Proposed Rulemaking published in the *Pennsylvania Bulletin* on June 5, 2021 (51 Pa.B. 3103). Commentator suggested that the following two sentences should be revised to include the language emphasized in bold:

“Every student is capable of **several aspects** of science, engineering, technological and environmental literacy.”

“Science, engineering, technology, environment and ecology should be explored through **a variety of** integrated and active learning processes.”

Response: The language referenced by the commentator cites part of the vision statement, including foundational principles, upon which new science standards were established. This vision statement and the foundational beliefs referenced within it were used in the work of the Content Committee and Steering Committee in developing recommended updates to state science standards. As such, the Board disagrees with commentator that the language published in the *Pennsylvania Bulletin* should be updated as doing so would modify the vision statement that served as a foundation for the development of new standards. Further, the Board asserts that it is implied that students should be capable of “several aspects” of science, engineering, technological and environmental literacy as the academic standards themselves set forth “several aspects” of those domains in which students are to attain proficiency.

COMMENTS OUTSIDE THE SCOPE OF THE RULEMAKING

Comment: The ARC of Pennsylvania requested that the Board consider amending the following sections of Chapter 4 to add language as described below:

Section 4.13 (Strategic Plans): Add the sentence, “Special education plans shall be developed in alignment with the foundation and principles of the district’s strategic plan.”

Section 4.31(a) (Career and Technical Education): Add the sentence, “Assessment of occupational competency for students with significant disabilities may include assessment of competency to complete specific aspects and tasks within a specific occupational course of study.”

Response: The ARC of Pennsylvania submitted comments requesting amendments to sections of Chapter 4 that were not addressed in the Board’s proposed rulemaking. As such, the ARC’s request falls outside the scope of what the Board can address in its final-form rulemaking as the requested amendments would substantively expand the scope of the rulemaking.

**Commonwealth of Pennsylvania
 State Board of Education
 22 PA Code Chapter 4
 Regulation 006-347
 Published in PA Bulletin
 June 5, 2021
 List of Commentators**

1	Laura	Branby	Creek Connections, Allegheny College		PA
2	Allegheny County Conservation District			Pittsburgh	PA
3	Carrie	Chaitt	Upper Darby School District	Drexel Hill	PA
4	Crawford County Conservation District			Meadville	PA
5	Scott	Donnelly	Carnegie Elementary		PA
6	Nick	Kerlin	Retired, former PA Bureau of State Parks employee	State College	PA
7	Steve	Kerlin	Stroud Water Research Center		PA
8	Lawrence County Conservation District			New Castle	PA
9	Sanford	Leuba	University of Pittsburgh	Pittsburgh	PA
10	Lucy	McClain	Shaver's Creek Environmental Center, The Pennsylvania State University	Petersburg	PA
11	Marc	Peipoch	Stroud Water Research Center	Avondale	PA
12	Donna	Queenev			PA
13	Mike	Redding			
14	Addison	Salus			
15	Pennsylvania Association of Conservation Districts			Harrisburg	PA
16	Luke	Vanatta			
17	Shannon	Wehinger			

18	David	Wise	Stroud Water Research Center	Avondale	PA
19	Pennsylvania Science Curriculum Council (PASCC)				PA
20	Laura	Jackson	Retired biology and environmental science teacher at Bedford High School		PA
21	Bernard	Brown		Philadelphia	PA
22	Potter County Conservation District				PA
23	Lawrence	Olsavsky			
24	Alexa	Sarussi	Shaver's Creek Environmental Center, The Pennsylvania State University		PA
25	Elizabeth	Jarrard	Retired science teacher	Coudersport	PA
26	Doreen	Petri	BELONG (Becoming Empowered by Living Our Natural Gifts) Project Manager, Erie School District	Erie	PA
27	Clearfield County Conservation District			Clearfield	PA
28	Cortney	Murphy			
29	Frances	DeMillion			
30	Amy	Allison			
31	Juliann	Sepesy	Technical Environmental Permitting Specialist		
32	Pat	Lupo	Benedictine Sisters		PA
33	Columbia County Conservation District			Bloomsburg	PA
34	Wyoming County Conservation District			Tunkhannock	PA
35	Veronica	Mortier			

36	Chris	Greco	AP Bio, Advanced Bio & Anatomy teacher, Saegertown High School, Penncrest School District		PA
37	Maria	Wheeler-Dubas			
38	Anna	Herman	Agriculture, Food & Natural Resources Management Educator		
39	Shannon	Maurer	Forge Road Elementary School, Fourth Grade, Palmyra Area School District	Palmyra	PA
40	Ed	Ulmer	Chemistry/BioMedical Technology/PA Nature, Wilson School District		PA
41	John	Sartor	Gilmore & Associates, Inc.	Trappe	PA
42	Rebecca	Finch	Molecular Biology Teacher, Seneca Valley School District	Harmony	PA
43	Jennifer	Schnakenberg	Pittsburgh Parks Conservancy	Pittsburgh	PA
44	Barty	Thompson		Mohnton	PA
45	David	Himes		Allegheny County	PA
46	Elizabeth	Gallagher		Beaver	PA
47	Westmoreland Conservation District			Greensburg	PA
48	Jody	Groshek	McKean County Conservation District	Smethport	PA
49	Sheila	Snider	Retired elementary teacher & current director of an environmental center		
50	Michelle	Niedermeier		Philadelphia	PA

51	Keith	Niedermeier		Philadelphia	PA
52	Lauren	Schricker	Pennsylvania Master Naturalist volunteer		PA
53	Courtney	Shober	B.A.R.N. Ag Project Coordinator		PA
54	G. Eric	French	Eisler Landscapes	Prospect	PA
55	Monroe County Conservation District			Stroudsburg	PA
56	Jessica	Hickman Fresch		Pittsburgh	PA
57	Wendy	Kedzierski		Meadville	PA
58	Watershed Alliance of Adams County			Gettysburg	PA
59	Richard	Monaghan	Teacher, Eastern York Middle School	Wrightsville	PA
60	Greg	Schubert	High School Teacher, Fox Chapel Area School District		PA
61	Martha	Napolitan	Pennsylvania State Naturalist	Phoenixville	PA
62	Bruce	Kiesel		Southampton	PA
63	Ray	Verna		Philadelphia	PA
64	Charles	Brill		Philadelphia	PA
65	Juan	Llarena		Erie	PA
66	Lela	Betts		Glenside	PA
67	Kimberly	Witt		Quakertown	PA
68	Hilary	Schenker		Pittsburgh	PA
69	Mark	Winiesdorffer		Tionesta	PA
70	Melvin	Sheets		New Brighton	PA
71	Gary	Popiolkowski	Former middle school science teacher		
72	Zachary	Muhl	Allegheny Mountain Hardwood Flooring	Emlenton	PA
73	Kimberly	Carnahan	Retired English teacher		PA
74	Annie	Regan		Gibsonia	PA
75	Linda	Bescript		Langhorne	PA
76	Deanna	McPeak		Gibsonia	PA
77	Char	Esser		Villanova	PA

78	Mandy	Tshibangu		Devon	PA
79	Julio	Paz y Mino		Havertown	PA
80	Mary Jean	Cunningham		Philadelphia	PA
81	Robin	Paur		Center Valley	PA
82	Zuleikha	Erbeldinger-Bjork		Pittsburgh	PA
83	Rev. David Wesley	Brown		Philadelphia	PA
84	David	Gunyuzlu		Kennett Square	PA
85	Marina Renee	Krempasky		Peckville	PA
86	Richard	Tregidgo		Holtwood	PA
87	Donna	Curtis		Kennett Square	PA
88	Jessica	Bellwoar		Philadelphia	PA
89	Shelley	Schwartz		Mount Joy	PA
90	Veronica	Liebert		Drexel Hill	PA
91	Adam	Goren		Erdenheim	PA
92	Diana	Hulboy		Philadelphia	PA
93	Brian	Brown		Lewisburg	PA
94	Glenn	Moyer		Souderton	PA
95	Bert	Whitehair		Lake City	PA
96	Rob	Sackett		Erie	PA
97	Matthew	Mehalik		Gibsonia	PA
98	Diedra	Heitzman		Kimberton	PA
99	Michael	Babitch			PA
100	Darlene	Dech		Sewickley	PA
101	James	Curtis		Port Matilda	PA
102	Jean	Wiant		Glenolden	PA
103	Isabel	Melvin		Wynnewood	PA
104	Liz	Robinson		Philadelphia	PA
105	Phyllis	Blumberg		Bala Cynwyd	PA
106	Richard	Schwartz		Hazleton	PA
107	Lisa	Plotkin		Hershey	PA
108	Carrie	Swank		Reading	PA
109	Tim	Miller		Philadelphia	PA
110	Lisa	Ketrick		Hummelstown	PA
111	Marion	Kyde		Ottsville	PA
112	Vaughn	Miller		Wind Gap	PA
113	Dianna	Holland		Philadelphia	PA
114	Adam	Eyring		Philadelphia	PA
115	Clifford	Johnston		Morrisdale	PA
116	Char	Magaro		Enola	PA

117	Richard	Dikant		Stroudsburg	PA
118	Susan	Murawski		North East	PA
119	Jack	Leiss		Pittsburgh	PA
120	Steven	Greenspan		Philadelphia	PA
121	Silvia	Babicz		Northampton	PA
122	Christoph	Stannik		Doylestown	PA
123	Elizabeth	Beatty		Enola	PA
124	Rachel	Davis		Media	PA
125	Victoria	Foster		Hummelstown	PA
126	Dennis	Keller		Middletown	PA
127	Joan	Russo		Hawley	PA
128	Martha	Morgan		Philadelphia	PA
129	Pamela	Haines		Philadelphia	PA
130	Kim	Kantorik		Acme	PA
131	Yvonne	Paranick		Cranberry	PA
132	Nancy	Bergey		New Wilmington	PA
133	Patrick	Smith		Hanover Township	PA
134	Carol	Armstrong		Malvern	PA
135	Laurent	Hahn		Philadelphia	PA
136	Gwen	Stadler		Nazareth	PA
137	Kathleen	Miller		Wilkes Barre	PA
138	Tracey	Ash		Enola	PA
139	Paul	Metzloff		Pottstown	PA
140	Alexa	Manning		Dowington	PA
141	Norma	Dunkelberger		Elizabethtown	PA
142	Kenneth	Bickel		Pittsburgh	PA
143	Patricia	Hartigan		Glenshaw	PA
144	Jill	Turco		Philadelphia	PA
145	Tascha	Babitch		Portland	OR
146	Diane	DiFante		West Decatur	PA
147	David	Zabriskie		Hawley	PA
148	Karen	Kirchdoerfer		Orefield	PA
149	Diane	Bastian		Liberty	PA
150	Kathleen	Geist		West Point	PA
151	Barbara	Hogan		Landenberg	PA
152	John	Woodward		New Stanton	PA
153	Bob	Moyer		Harleysville	PA
154	Glenn	Frantz		Paoli	PA
155	Frances	Moorman		State College	PA

156	Susan	Babbitt		Philadelphia	PA
157	Adam	Cotchen		Johnstown	PA
158	Christine	Koehler		Vineland	NJ
159	Michelle	Dougherty		Philadelphia	PA
160	Kathryn	Stevens		Pittsburgh	PA
161	Nancy	Iannuzzelli		Marcus Hook	PA
162	Donald	Lancaster		Indiana	PA
163	Sarah	Thompson		Long Pond	PA
164	Keith	Atherholt	Lewis Lumber Products, Inc.	Picture Rocks	PA
165	Laura	Neiman		Damascus	PA
166	Melinda	Robinson- Paquette		Riegelsville	PA
167	Matt	Gabler	Pennsylvania Forest Products Association	Harrisburg	PA
168	Kate	Potter		Allentown	PA
169	Green County Conservation District			Waynesburg	PA
170	David	Zanardelli		Eighty Four	PA
171	Kathryn	Morrow		State College	PA
172	Karen	Guarino Spanton		Philadelphia	PA
173	Josh	Hantman		Philadelphia	PA
174	Michelle	Dugan		Upper Darby	PA
175	Martha	Christine		Bethlehem	PA
176	Robert	Missimer		Clearwater	FL
177	Martha	Black		Middletown	PA
178	Phyllis	Gardener		State College	PA
179	Margee	Kooistra		Mechanicsburg	PA
180	Anne	Young		Revere	PA
181	Richard	Whiteford		West Chester	PA
182	Martha	Raak		Pittsburgh	PA
183	Bonnie	Winter		Shrewsbury	PA
184	Al	Ferrucci		Pittsburgh	PA
185	Richard	Johnson		Curwensville	PA
186	Matthew	Franck		Highland Park	NJ
187	Carol	ONeill		Warriors Mark	PA
188	Ronald	Gulla		Canonsburg	PA
189	Virginia	Hildebrand		Mountain Top	PA

190	Steve	Olshevski		Philadelphia	PA
191	Daniel	Aunkst		Watsontown	PA
192	Bridget	Harris		Pittsburgh	PA
193	Dianne	Klein		Honesdale	PA
194	Amanda	Cichon		Media	PA
195	Brian	Moore		Philadelphia	PA
196	Joel	Grace		Pittsburgh	PA
197	Meredith	Stone		Philadelphia	PA
198	Susan	Markowitz		Doylestown	PA
199	Greta	Aul		Lancaster	PA
200	Lisa	Holman		Pittsburgh	PA
201	Allison	Haas		Port Matilda	PA
202	Jane	Hickman			
203	Leann	Turley		West Decatur	PA
204	Kathy	Ober		Pittsburgh	PA
205	Linda	Schmidt		Pittsburgh	PA
206	Barry	Cutler		Springfield	PA
207	Joseph	Gross		Franklin	PA
208	Sheila	Erlbaum		Philadelphia	PA
209	Alicia	Weiss		Lansdale	PA
210	Miichael	Lombardi		Levittown	PA
211	Elizabeth	Terry		Mechanicsburg	PA
212	Robert	Cooke		Mount Joy	PA
213	Kay	Reinfried		Lititz	PA
214	Mary	More		Flourtown	PA
215	Jill	Turco		Philadelphia	PA
216	Edward	Esler		Lansdowne	PA
217	Barbara	Knickerbocker		West Chester	PA
218	Laura	Horowitz		Pittsburgh	PA
219	Michael	St. Jean		Milford	PA
220	Thomas	Graves		Holtwood	PA
221	Paula	Kensinger	Retired teacher	Altoona	PA
222	Bob	Steininger		Phoenixville	PA
223	Barbara	Litt		Pittsburgh	PA
224	Scott	Trees		Aliquippa	PA
225	Lloyd	Brown		Devon	PA
226	Patricia	Finley		Ardmore	PA
227	Heather	Nelson		Douglassville	PA
228	Robert	Sagely		Blairsville	PA
229	Clarence	Brommer		Bethlehem	PA

230	Donna	Carswell		Huntingdon Valley	PA
231	Steven	Lachman		State College	PA
232	Scott	Shepler		Harrisburg	PA
233	Betty	Schulz		Hazleton	PA
234	Catherine	Scott		Philadelphia	PA
235	Deirdre	DeVine		Philadelphia	PA
236	Bucks Environmental Action			Feasterville	PA
237	Garry	Armstrong		West Middletown	PA
238	Trina	Gribble		Harrisburg	PA
239	Richard	Fox		Harrisburg	PA
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241	Margaret	Goodman		Pacific Grove	CA
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245	SaraBeth	Fulton	Agriculture Educator, Big Spring School District		PA
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249	Jennifer	Prince	Pennsylvania Master Naturalist volunteer		PA
250	Bruce	Ludwig	Pennsylvania Master Naturalist	Bryn Mawr	PA
251	Olivia	D'Andrea		Blue Bell	PA
252	Melissa	DelMonego		Chester Springs	PA
253	Jen	Danner		Nazareth	PA
254	Deneice	Oroszvary		Yardley	PA
255	James	Serene		State College	PA
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258	Martina	Jacobs		Pittsburgh	PA

259	Gail	Richert		Lancaster	PA
260	Nicole	Gallo		West Chester	PA
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262	Lee	Wisdom		Downingtown	PA
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267	Francine	Locke		Philadelphia	PA
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270	McKean County Conservation District			Smethport	PA
271	Michelle	Feldman		Philadelphia	PA
272	Erica	Husser	Penns Valley Area School District	Spring Mills	PA
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275	Karen	Vernisi		Wayne	PA
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302	Barbara	Sheinmel		New Hope	PA

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650	The Arc of Pennsylvania			Lemoyne	PA
651	Marlene	Adams	Pennsylvania Master Naturalist volunteer	Christiana	PA
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653	Elizabeth	Brensinger		New Tripoli	PA
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655	Green Amendments for the Generations; American Impact Capital Foundation; Delaware Riverkeeper Network; Berks Gas				PA

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1115	Karen	Berger		Montrose	CA
1116	Clayton	Mumaw		Wilmington	DE
1117	Kimberly	Kauffman		Sacramento	CA
1118	Sharon	Budde		Concord	CA
1119	Garry	Kramchak		Houston	TX
1120	Noah	Haydon		Daly City	CA
1121	Martin	Marcus		San Diego	CA
1122	Becky	Alkire		Wilton	CA
1123	Carla	Hasegawa- Ahrendt		Schaumburg	IL
1124	Grace	Mason		San Jacinto	CA
1125	Phyllis	Tholin		Evanston	IL
1126	Marilyn	Price		Mill Valley	CA
1127	tiapearson@gmail.com			Wahiawa	HI
1128	Susan	VonSchmacht		Watsonville	CA
1129	jptrugger@gmail.com			Chula Vista	CA
1130	Charity	Moschopoulos		Annandale	VA
1131	Claudia	Monahan		La Quinta	CA
1132	William	Insley		Ruston	WA
1133	J. Barry	Gurdin		San Francisco	CA
1134	Willoe	Traver		Mpls	MN
1135	Ben	Ruwe		Felton	CA
1136	Cynthia	Brooks-Fetty		Leoti	KS
1137	Allan	Campbell		San Jose	CA
1138	Amy	Cannata		Chicago	IL
1139	Erin	Suyehara		Torrance	CA
1140	Christine	Hayes		Upland	CA
1141	Monica	Montalvo		Chandler	AZ
1142	Jill	B.		San Francisco	CA
1143	Holly	Hall		Temecula	CA
1144	Carmen	Nichols		Chandler	AZ
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1146	Laura	Huddlestone		Seattle	WA

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1149	Claire	Chambers		Oakdale	CA
1150	Isabel	Cervera		Salisbury Rowan County	NC
1151	Hank	Williams		Big Sky	MT
1152	James	Stratman		Denver	CO
1153	Warren	Woodge		East Northport	NY
1154	Dana	Baldwin		Dix Hills	NY
1155	Jason	Husby		Minneapolis	MN
1156	Ali	VanZee		Fort Bragg	CA
1157	Laura	LaVertu		Alexandria	VA
1158	Marianna	Mejia Contact		Soquel	CA
1159	Madeline	Amalphy		Gaithersburg	MD
1160	Victoria	Shih		Plano	TX
1161	Leon	VanSteen		San Francisco	CA
1162	Judith	King		Vero Beach	FL
1163	Stacie	Charlebois		Sebastopol	CA
1164	Aaron	Adelman		Address in Arabic script	
1165	David	Warner		Richmond	VA
1166	Shelley	Wehberg		Houston	TX
1167	Jim	Carnal		Bakersfield	CA
1168	Amanda	Levesque		Asheville	NC
1169	Diane	Quinlivan		Thornton	CO
1170	Jeisele1@mindspring.com			Tucson	AZ
1171	Tina	Brenza		Goleta	CA
1172	Ken	Gunther		Jupiter	FL
1173	B	Walker		Kingsland	TX
1174	Donald	Shaw		Syracuse	NY
1175	Anne	Charbonneau		Las Vegas	NV
1176	Kimberly	Bouchard- Shapiro		Durham	CT
1177	Robin	Alderfer		Norristown	PA
1178	Gloria	Edmund		Taman Bukit Indah, Ampang, Selangor 68000	

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1180	Karin	Rettig		Hemet	CA
1181	Wendy	Niemeyer		Waterloo	IA
1182	Jack	Polonka		Peekskill	NY
1183	Eme	Okang		Big Qua., Calabar Municipality 540211 (appears to be in Nigeria)	
1184	P.	Sturm		Reno	NV
1185	Michelle	Kofler		South Deerfield	MA
1186	Anibal Verri	Pinheiro		Ponta de Areia, Sao Luis, 65077- 357 (appears to be in Brazil)	
1187	Juanita	Romero		Forth Worth	TX
1188	Melanie.odette@yahoo.com			Salisbury	MD
1189	Michael	Lewis		Muncie	IN
1190	patriciaruggles@yahoo.com			Florham Park	NJ
1191	Sheena Furnace			Boston	MA
1192	peterboothlee@hotmail.com			San Francisco	CA
1193	Lori	Levine		Laurel	MD
1194	Katherine	Griffin		Greeley	TX
1195	Krystal	Krause		Williamsville	NY
1196	Mara	Wooten		Pittsboro	NC
1197	Bonnie	Gorman		Quincy	MA
1198	alancitron@hotmail.com			Manchester Center	VT
1199	Ray	Derrickson		Raleigh	NC
1200	Edward	Kocjancic	President, E.S. Kocjancic, Inc.	Kane	PA
1201	Judith	Campsey			

1202	Candace	Davis		Carbondale	IL
1203	Aline	Rosenzweig		Houston	TX
1204	Angie	Greco		Columbus	GA
1205	Raymond	Intemann		Cliffside Pk	NJ
1206	Les	Roberts		Serafina	NM
1207	Stephen	Krokowski		West Memphis	AR
1208	Joan	Arnold		Rudolph	WI
1209	Gertrude	Battaly		White Plains	NY
1210	Kathryn	Dittemore		Chicago	IL
1211	Ellen	Ingber		Millburn	NJ
1212	Brian	Close		Charleston	SC
1213	AnnMarie	Address		Newark	DE
1214	Hector	Pol		Seminole	FL
1215	Sylvia	Watson		Maple Hts	OH
1216	Mark	Gowan		Plano	TX
1217	Denise	Brown		Rockaway Park	NY
1218	Karyn	Barry		Waltham	MA
1219	Delgado_barbara@yahoo.com			Miami	FL
1220	idahoblue@hotmail.com			Kansas City	MO
1221	Allison	Alberts		Green Lane	PA
1222	Artwork23@verizon.net			Camarillo	CA
1223	Lindasue19020@yahoo.com			Bristol	PA
1224	Rachael	Pappano		Mattawamkeag	ME
1225	Laurie	Denis		Salem	MA
1226	Alex	Stavis		New York	NY
1227	Bob	Schulof		Brooklyn	NY
1228	Dorrine	Marshall		Irvine	CA
1229	Cara	Schmidt		Yellville	AR
1230	Nick	Hood		Clemmons	NC
1231	Tony	Moureilles		Plymouth	MA
1232	Christine	King		Southampton	MA
1233	Max	Salt		Coventry	RI
1234	Judith	Hazelton		Bennington	VT
1235	Erin	Foley-Collins		Hazlet	NJ
1236	Beatrice.langefors@gmail.com			Snowmass Village	CO

1237	A.L.	Steiner		Cornwallville	NY
1238	Virginia	Jones		Kalamazoo	MI
1239	Kathie	Westman		Gibsonia	PA
1240	Mara	Beldavs		Shorewood	WI
1241	Joan	Murtagh		Takoma Park	MD
1242	Jeff	Kulp		Raleigh	NC
1243	Joan	Argo		Blauvelt	NY
1244	Michael	Heinsohn		Columbia Heights	MN
1245	Michelle	Graves		Farmington	MO
1246	Rodney	Hill		Grass Valley	CA
1247	Lee	Jenkinson		Santa Clarita	CA
1248	Beverly	Thomas		Montgomery	NY
1249	Kathleen	Davis		Clinton	MI
1250	Janet	Dingle		Philadelphia	PA
1251	Damian	Kreske		Gaithersburg	MD
1252	Patricia	Kortjohn		Wyckoff	NJ
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1254	Lynette	Lenz		Mt. Airy	MD
1255	Aidan.leitch@gmail.com			Chappaqua	NY
1256	Angelo	Sturino		Harwood Heights	IL
1257	Arshad	Ameen		Memphis	TN
1258	Sharon	Paltin		Laytonville	CA
1259	Brian.Ainsley@gmail.com			Altamonte Springs	FL
1260	Marianne	Rowe		Pacific Grove	CA
1261	Eleanor	Gomez		Cloverdale	CA
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1263	Lois Ann	Griffiths		Harrisburg	PA
1264	Debra	Ryan		Berlin	MD
1265	Nancy	Treffry		Aromas	CA
1266	Felicity	Devlin		Tacoma	WA
1267	Nancy	Niemeir		Tucson	AZ
1268	Bruce	Cratty		Akron	OH
1269	Amr	Salah		Zahraa Nasr City, Cairo 11765 (appears to be in Egypt)	

1270	craigleenew@gmail.com			Guthrie	OK
1271	Elizabeth	Preza		El Paso	TX
1272	Patricia	Ramsey		Nicholasville	KY
1273	Yvonne	Christison		Stevens Point	WI
1274	Kristin	Smith		Omaha	NE
1275	Sharon	Parker		Santa Cruz	CA
1276	Thomas	Clayton		Wendell	NC
1277	Paul	Martin		Los Angeles	CA
1278	Amanda	Salvner		Ann Arbor	MI
1279	Care4animals@hotmail.co.uk			Altadena	CA
1280	Margaret	Woodard		Calverton	NY
1281	Stacey	Pierce		Camden	NJ
1282	Patty	Christoffeerson		Burlingame	CA
1283	Dawn	Dulac		San Diego	CA
1284	Darren	Don		Redwood City	CA
1285	Brianna	Duarte		Long Beach	CA
1286	Natalie	Clark		Little Rock	AR
1287	Mary	McKinney		Cardington	OH
1288	Brett	O'Sullivan		Lafayette	CO
1289	Kendall	Post		Oakland	CA
1290	Inger	Acking		Berkeley	CA
1291	Jacob	Huskey		Santa Cruz	CA
1292	Louis	Cangemi		Los Angeles	CA
1293	Jkl881@hotmail.com			Warwick	RI
1294	Jane	Spini		Arcata	CA
1295	Hurdle1600@aol.com			Toano	VA
1296	Joseph	Palmer		Holland	PA
1297	Melissa	Williams		Sacramento	CA
1298	Stephanie	Zaientz		Glen Oaks	NY
1299	Susan	Harmon		Bellingham	WA
1300	Julia	Sheppard		Atlanta	GA
1301	dlcouncilman@hotmail.com			St. Louis Park	MN
1302	Karla	Devine		Manhattan Beach	CA
1303	Linda	Mellen		Newport Beach	CA
1304	Lu	Roth		Columbus	OH

1305	Edward	Spevak		St. Louis	MO
1306	Nick	Galante		Tavares	FL
1307	prairieroots@yahoo.com			Columbus	OH
1308	Lois	Dunn		Layton	UT
1309	Wendy	Chou		San Mateo	CA
1310	Jessica	Mitchell-Shihabi		Antelope	CA
1311	Margaret	Cifaldi		Las Vegas	NV
1312	Nan	Stevenson		Shoreview	MN
1313	Heath	Post		Lansing	MI
1314	Kitty	Cobb		Malvern	PA
1315	F	Bean		Romney	WV
1316	janwachholz@gmail.com			Woodinville	WA
1317	A G	Hansen		Crestwood	TX
1318	Justin	McCallister		Salem	OR
1319	Kyle	Jones		Rochester	NY
1320	Bernard	Johnson		Austin	TX
1321	Dave	Desjardins		Blue Ridge Summit	PA
1322	Greg	Romashko		Madison	WI
1323	Joseph	Pilapil		Barangay Dayhagan, Ormoc City, 6541 (appears to be in the Philippines)	
1324	Karen	Orourke		Canoga	CA
1325	Kavita	Rao		Brickfields, Kuala Lumpur (appears to be in Malaysia)	
1326	Janet	Weil		Portland	OR
1327	Kirsten	Wolner		Henderson	NV
1328	Tanya	Salof		Rosemead	CA
1329	Sharon	Noll		Tucson	AZ
1330	Tiffany	Marsh		Midway	KY
1331	Aarushrr77gmail.com			Boonton	NJ
1332	Brian and Rita Cohen			Las Vegas	NV

1333	Rachael	Chan		San Marino	CA
1334	Penny	Gregorio		Albany	GA
1335	Joline	Barth		Jacksonville	FL
1336	Debra	Abbott		North Garden	VA
1337	Eric	Simpson		Cincinnati	OH
1338	Geraldine	Card-Derr		Exeter	CA
1339	Russell	Novkov		Madison	WI
1340	Jim	Loveland		Gulfport	FL
1341	Florence	Buckley		Philadelphia	PA
1342	Donald	Mackler		Blacksburg	VA
1343	Segooch3@yahoo.com			Rocklin	CA
1344	Tuan	Nguyen		Lithia	FL
1345	Deborah	Cerreta		West Babylon	NY
1346	Rpershing1@gmail.com		Science teacher	Chapel Hill	NC
1347	Ryan	Joyce		Aspinwall	PA
1348	Janet	Moser		Baldwin	NY
1349	Eric	Manas		Blue Bell	PA
1350	Carrie	Luce		Gladstone	MO
1351	Brenda	Peterson		Fargo	ND
1352	Charles.dineen@wmich.edu			Lawton	MI
1353	Paul	Williams		King	NC
1354	Bruce	Gardner		Dallas	TX
1355	Rhonda	Babb		Hatfield	PA
1356	Anne	P		Apalachicola	FL
1357	Katherine	Nelson		Kent	WA
1358	W.L.	Boucher		Brighton	CO
1359	Karen	Rubino		Huntington Station	NY
1360	Vaishali	Ketkar	Parent & small business owner	Audubon	PA
1361	Rebecca	Flowers		Drexel Hill	PA
1362	Rachel	Camp		Philadelphia	PA
1363	Dana	Kolesar		Media	PA
1364	Meghan	Winch		Philadelphia	PA
1365	Valentina	Van Dijk		Noordwolde, Friesland 8391 KH (appears to be in the Netherlands)	

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1368	cliffblaker@gmail.com			Tenafly	NJ
1369	Debra	Greenberg		Lewisville	TX
1370	Jennifer	R		Whitestone	NY
1371	Shawn	Jones-Bunn		Avila Beach	CA
1372	Jane	Heumann		Berywn	PA
1373	Christopher	Ware		Fremont	CA
1374	Molly	Braverman		Philadelphia	PA
1375	Karin	Garg		Lafayette Hill	PA
1376	fwilliams@tiscall.co.za			Blackstone	MA
1377	Ashish	Wadkar		Lafayette Hill	PA
1378	Michelle	Suquet		Lafayette Hill	PA
1379	Angus	Macdonald		Elkwood	VA
1380	Paula	Andreozzi		Rancho Mirage	CA
1381	Maeve	Zeleniak		Philadelphia	PA
1382	Jameson	Gilpatrick		Langhorne	PA
1383	Charles	Caldronney		Arlington	VA
1384	Ajanderson_1992@yahoo.com			Aurora	CO
1385	George	Hartman		Louisville	CO
1386	Aurora	Dizel		Havertown	PA
1387	Susan	Albow		Jersey City	NJ
1388	Jennifer	Scott		Fort Myers Beach	FL
1389	Walter	Bilderback		Philadelphia	PA
1390	Christopher	Braak		Abington	PA
1391	Donna	Hayden		Havertown	PA
1392	Brianna	Hallinan		Broomfield	CO
1393	Michael	Etkins		Lafayette Hill	PA
1394	Felipe	Diaz		San Francisco	CA
1395	Kaitlin	Fitch		Troy	NY
1396	Lisa	Schwartz		Wynnewood	PA
1397	Jennie	Eisenhower		Paoli	PA
1398	Eliza	Whitney		Ardmore	PA
1399	Ellen	Bailey		Ardmore	PA
1400	Della	Hamlin		Joplin	MO
1401	Steven and Jane	Heumann		Berywn	PA
1402	Sharon	Rothe		Rockaway	NJ
1403	Sarah	Tarlow		Wynnewood	PA

1404	Katherine	Ridella		Plymouth Meeting	PA
1405	Shirley	Mccarthy		Branford	CT
1406	Jennifer	Bradford		Spring Valley	CA
1407	Deborah	Frame		Trinidad	CA
1408	Ken	Gibb		Zephyr Cove	NV
1409	Mary	Romanek		Santa Monica	CA
1410	Margherita	Abe		Philadelphia	PA
1411	Christina	Alger		Palmyra	VA
1412	Lindsay	Blade		Croydon	PA
1413	Maggie	Kalabakas		Nice, Provence-Alpes-Cote d'Azur 06000 (appears to be in France)	
1414	Karen	Curry		Pullman	WA
1415	Meg	Oldman		Latrobe	PA
1416	Michael	Madden		New City	NY
1417	Lois	Klepin		Chula Vista	CA
1418	Barbara	Brandom		Pittsburgh	PA
1419	Doris	Loud		Millerton	PA
1420	Cheryl	Hanks-Hicks		Eugene	OR
1421	Victoria	Oltarsh		Nyack	NY
1422	Carolyn	Barcomb		Media	PA
1423	Joanne	Lilliendahl		Philadelphia	PA
1424	Angelina	Saucedo		Montebello	CA
1425	Beatrice	Zovich		Philadelphia	PA
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1432	Bronwen	Hartranft		Lancaster	PA
1433	Linda	Howie		Woodland Hills	CA
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1438	Kate	Adams		Graniteville	VT
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1440	Mel	Marcus		Long Beach	CA
1441	Lexi	Loch		Portland	OR
1442	Amber	Eby		San Francisco	CA
1443	Paula	Lepore		Berwick	ME
1444	Home	Manviller		Roseville	CA
1445	Montgomery County Conservation District			Collegeville	PA
1446	Gina	D'Aquila	7 th & 8 th Grade Science, York City School District		PA
1447	Jonathan	Fantazier		Pittsburgh	PA
1448	Matthew	Greenstone		Altoona	PA
1449	Tarrea	Potter		Alexandria	PA
1450	Ira	Silverman		West Grove	PA
1451	Barbara	Langan		Huntingdon	PA
1452	HL	Campbell		New Cumberland	PA
1453	Frank	Muto		Cheswick	PA
1454	Denise	Moy		Selinsgrove	PA
1455	Julia	Meredith		Pittsburgh	PA
1456	Maurice	Samuels		Pittsburgh	PA
1457	Sarah	Brooks		Pittsburgh	PA
1458	Trisha	Salvia		Mechanicsburg	PA
1459	Claudia	Silvia		Kennett Square	PA
1460	Amy	Goldstein		Doylestown	PA
1461	Jenifer	McMurray		Harmony	PA
1462	William	Jackson		Lebanon	PA
1463	Renee	Berg		Huntingdon	PA
1464	Dean	DeNicola		Slippery Rock	PA
1465	Shirley	Dodson		Swarthmore	PA
1466	Jacob	Fox		York	PA
1467	Heather	Drzal		Kennett Square	PA
1468	Jan	Milburn		Ligonier	PA

1469	David	Casker		Johnstown	PA
1470	Christopher	Daly		Bryn Mawr	PA
1471	Michelle	Przybylowski			PA
1472	Margaret	Pattishall		Hershey	PA
1473	Peggy	Hartzell		Glenmoore	PA
1474	Marguerite	Chandler		Newtown	PA
1475	Rena	DeArment		Camp Hill	PA
1476	Mark	Ott		Howard	PA
1477	R	Davis		Harrisburg	PA
1478	Liana	Krissoff		Pittsburgh	PA
1479	Olivia	Hipolit		Jefferson Hills	PA
1480	Casey	Taljan		Pittsburgh	PA
1481	Robert	Mulvihill		Pittsburgh	PA
1482	Briana	Mihok		Gibsonia	PA
1483	Richard	Piacentini		Pittsburgh	PA
1484	Meghan	Amayo		Pittsburgh	PA
1485	Alison	Patterson		Pittsburgh	PA
1486	Susan	Roth		Pittsburgh	PA
1487	Rachel	Suppok		Pittsburgh	PA
1488	Lourdes	Castellanos		Pittsburgh	PA
1489	Stephen	Hirtle		Murrysville	PA
1490	Sara	Deegan		Greensburg	PA
1491	Joseph	Brosky		Johnstown	PA
1492	Jason	Miller		Pittsburgh	PA
1493	Julie	Murphy		Rices Landing	PA
1494	Juliana	Ribar		Monroeville	PA
1495	Contenta	Schoenman		Gibsonia	PA
1496	Breanna	Black		Mount Oliver	PA
1497	Heather	Flayer		Pittsburgh	PA
1498	Kimberly	Payne		Pittsburgh	PA
1499	Casper	Wong		Pittsburgh	PA
1500	Michelle	Doyon		Scottdale	PA
1501	Sue	Myers		Oakdale	PA
1502	Lisa	Whitenack		Meadville	PA
1503	Dana	Driscoll		Penn Run	PA
1504	Kylie	Wirebach		Robesonia	PA
1505	Kelley	Gregg		Pittsburgh	PA
1506	Scott	Strasser		Erie	PA
1507	Barbara	King		Pittsburgh	PA
1508	Annie	Maloney		Saegertown	PA
1509	Heath	Brown		Ohiopyle	PA

1510	Amelia	Crowley		Meadville	PA
1511	Emily	Bucks		Palmyra	PA
1512	Amy	Baer		Monroeville	PA
1513	Doug	Mason		Jonestown	PA
1514	W Craig	Stevens		Kennett Square	PA
1515	Tim	Herman		Hershey	PA
1516	Sherrie	Moyer		Bainbridge	PA
1517	Sean	Ryan		Chalfont	PA
1518	Marilyn	Coleman		Swissvale	PA
1519	Philip	Baker		Manchester	PA
1520	Catherine	Raymond		Penn Valley	PA
1521	Dorothy	Talley		Media	PA
1522	Renee	Myers		East Greenville	PA
1523	Janice	Baker		Blue Bell	PA
1524	Ann Marie	Meyer		Warfordsburg	PA
1525	Kim	Wilson			PA
1526	Denise	Flohr		Mount Joy	PA
1527	Shannon	Bearman		Haverford	PA
1528	Susanne	Schneider		Lancaster	PA
1529	Judy	Tiberi		Butler	PA
1530	Jennifer	Bohn		Melrose Park	PA
1531	Andrew	Wadsworth		Reading	PA
1532	Ann	Woodward		Reading	PA
1533	Susan	Fritz		Elizabethtown	PA
1534	Arlene	Taylor		Harrisburg	PA
1535	Glenn	Gawinowicz		Oreland	PA
1536	Melodie	Anderson-Smith		Fayetteville	PA
1537	Robert	Fowler		Hummelstown	PA
1538	Wm	Scott		Mansfield	PA
1539	Margie	Hall		Lititz	PA
1540	Thomas	Swimley		Elkland	PA
1541	Kimberly	Seeger		Kittanning	PA
1542	Jennifer	Shirk		Strasburg	PA
1543	Donald	Meserole		Marietta	PA
1544	Melinda	Shirk		Hanover	PA
1545	Kelly	Matthews		Manheim	PA
1546	Stan	Shinko		Wilkes-Barre	PA

1547	Michael	Hord		Harrisburg	PA
1548	Sally	Sims		Wester Chester	PA
1549	Susanne	Groenendaal		State College	PA
1550	Robert	Young		Wynnewood	PA
1551	Mike	Peale		Aston	PA
1552	Laura	Sokolovic		Pittsburgh	PA
1553	Tim	Ivers		Wexford	PA
1554	Christina	Penrose		Philadelphia	PA
1555	Tali	MacArthur		Lewisburg	PA
1556	Jessica	Spencer		Westfield	PA
1557	Mara	Wolfgang		Philadelphia	PA
1558	Tawnya	Farris		Pittsburgh	PA
1559	Priscilla	Mattison		Bryn Mawr	PA
1560	Elizabeth	LeFever		Philadelphia	PA
1561	James	Coffey		Green Lane	PA
1562	Michael	Lombardi		Levittown	PA
1563	Breanna	Hirosky		Cambridge Springs	PA
1564	Carol	Masden		Mifflinburg	PA
1565	Nina	Hamilton		Pittsburgh	PA
1566	Helen	Lawman		West Chester	PA
1567	Ann-Marie	Christopher		Pittsburgh	PA
1568	Steven	Hoke		Harrisburg	PA
1569	David	Laverne		Dickson City	PA
1570	Robin	Devaney		Middletown	PA
1571	James	Little		Murrysville	PA
1572	Jeff	Hearn		Hatboro	PA
1573	Allen	Moyer		Elizabethtow n	PA
1574	Helene	Rosen		Ivyland	PA
1575	RoseMaria	Root		New Oxford	PA
1576	Frank	Evelhoch II		Mechanicsbu rg	PA
1577	Philip	Witmer		Wayne	PA
1578	Donna	Smith		Havertown	PA
1579	Chrissy	Creamer		Berwyn	PA
1580	Sharon	Belson		Brookhaven	PA
1581	Marci	Mowery		Camp Hill	PA
1582	Sharon	Wushensky		Kennett Square	PA
1583	Tu	Packard		Media	PA

1584	Paul	Hagedorn		Philadelphia	PA
1585	Katharine	Kindall		Bellefonte	PA
1586	William	Ridgeway		Scranton	PA
1587	Joanne	Jeffers			PA
1588	Susan	Thompson		Audubon	PA
1589	Lori	Muller		Hamburg	PA
1590	Christina	Baldwin		Enola	PA
1591	Lori	Szymanik		Ulysses	PA
1592	Dolores	Fifer		Pittsburgh	PA
1593	Emily	Shosh		Coudersport	PA
1594	Donald	Horn		Shippensburg	PA
1595	Suzanne	Webster Roberson		Downingtown	PA
1596	Mary	Heston		Sabinsville	PA
1597	Molly	O'Brien		Berwyn	PA
1598	Dina	Taucher		Halifax	PA
1599	William	Anderson		Narberth	PA
1600	Harold	Arbo		Douglassville	PA
1601	John	Parker		Landsdale	PA
1602	Deb	Latsha		Lewisberry	PA
1603	Marian Liza	Mientus		Mount Pleasant	PA
1604	Mary	Pulanco		Bethlehem	PA
1605	Lauren	Shaffer		Lancaster	PA
1606	James	Chandler		West Grove	PA
1607	Amy	Felton		New Cumberland	PA
1608	David	Fiedler		Bensalem	PA
1609	Emily	Pitner		Washington	PA
1610	Sue	Busch		Newtown	PA
1611	Christi	Hadden		Carlisle	PA
1612	Maria	Zmurkewycz		Elkins Park	PA
1613	Roy	Siefert		Middlebury Center	PA
1614	Thomas	Deihl		Stroudsburg	PA
1615	Justin	Kozak		Bellefonte	PA
1616	Mady	Hart		Dalton	PA
1617	David	Imgrund		Carlisle	PA
1618	Kelly	Riley		Hatfield	PA
1619	Gina	LoBiondo		Havertown	PA
1620	Bruce	Leiby		Chester	PA

1621	Michael	Thomas		Hastings	PA
1622	Charles	Spiroff			PA
1623	Edward	Thornton		Swarthmore	PA
1624	William	Clifford		Harrisburg	PA
1625	Janet	Galib		West Chester	PA
1626	Alexander	Eustis		Phoenixville	PA
1627	Kaye	Wentling		Monroeville	PA
1628	Valeri	Fornagiel		Wellsboro	PA
1629	Maurice	Samuels		Pittsburgh	PA
1630	Sara	Gambone		Lancaster	PA
1631	Susie	Toman		Apollo	PA
1632	Chris	Ferrier		Kennett Square	PA
1633	Steve	York		Downingtown	PA
1634	Carolyn	Stermer		McConnellsburg	PA
1635	Anne	W		State College	PA
1636	Will	Willis		Mercersburg	PA
1637	Thomas	Nelson		Downingtown	PA
1638	Judith	Gallagher		Stahlstown	PA
1639	Brandon	Alan		Marietta	PA
1640	Robert	Cooke Jr.		Mount Joy	PA
1641	Shari	Johnson		Wyncote	PA
1642	Erica	Tomlinson		Wellsboro	PA
1643	Maria	Truskey		Harrisburg	PA
1644	Kerry	Helfner		New Tripoli	PA
1645	Chris	Fitzgerald		Mechanicsburg	PA
1646	Bobby	Hughes		Ashley	PA
1647	Margaret	Reiter		Saylorsburg	PA
1648	Veronica	Harris		Eagleville	PA
1649	Sam	Gibson		Spring Grove	PA
1650	Kelly	Thompson		Carlisle	PA
1651	Miyah	Moore		Palmyra	PA
1652	Aidan	Mahaffey		Palmyra	PA
1653	Barbara	Koffler		Uniontown	PA
1654	Michael	Lawrence		Verona	PA
1655	Chris	Firestone		Galeton	PA
1656	Sharon	Fitzgerald		Mechanicsburg	PA

1657	Nancy Lyn	Coter		Avondale	PA
1658	Hope	Smith		Harveys Lake	PA
1659	Taunja	Beck		Lancaster	PA
1660	Christopher	Tracey		Pittsburgh	PA
1661	Robin	D'Anna		Towanda	PA
1662	Candice	Muench		Nanticoke	PA
1663	Sara	Gemind		Lancaster	PA
1664	DianeChristin	Esser		Erie	PA
1665	Keith	R		Manchester	PA
1666	Patti	Griest		Harmony	PA
1667	Kerstin	Isaacs		Ambler	PA
1668	Cristy	Sweeney		Hanover	PA
1669	Janet	Sredy		Elizabeth	PA
1670	Chris	Lundberg		Meadville	PA
1671	Pam	Digel		Bradford	PA
1672	Lynn	Schuster		Shiloh	PA
1673	Elizabeth	Guldan		Erie	PA
1674	Stacey	Widenhofer		Fombell	PA
1675	Jackie	Baker		Hallstead	PA
1676	Jared	Byrnes		Holtwood	PA
1677	Deborah	Pixton		Gibsonia	PA
1678	Hannah	Spencer		Melcroft	PA
1679	Daniel	Szetela		Hanover	PA
1680	Carolyn	Raasch		West Decatur	PA
1681	Kellie	Tinna		Mehoopany	PA
1682	Kelly	Kruper		Jones Mills	PA
1683	Rachel	Van Orden		Annville	PA
1684	Timothy	LaGasse		Glenside	PA
1685	Shanae	McDevitt		Newtown Square	PA
1686	Emma	Hamrick		Waterford	PA
1687	Joseph	Toner		Media	PA
1688	Alex	Burka		Philadelphia	PA
1689	Kathleen	Gipson		Horsham	PA
1690	William	Goodenow		Lewisburg	PA
1691	Alyssa	Nees		Bethel Park	PA
1692	Adam	Kapp		West Chester	PA
1693	Kate	Wettergreen		Wexford	PA
1694	Jon-Paul	Jaworski		Eagleville	PA
1695	Tara	Muenz		Downingtown	PA

1696	Amy	Baschnagel		Gibsonia	PA
1697	Fran	DeMillion		Kennett Square	PA
1698	Valerie	Alexander		McConnellsburg	PA
1699	Lili	Geiser		Champion	PA
1670	Peggy	Lonett		Cranberry Town	PA
1671	Kimberly	Mehler		Jenkintown	PA
1672	Memphis	LaBella		Philadelphia	PA
1673	Linda	Kaulius		Champion	PA
1674	Edna	Patterson		Downingtown	PA
1675	Jim	Wylie		West Chester	PA
1676	Ellen	Schultz		Oreland	PA
1677	Sheila	Knerr		Chalfont	PA
1678	Brenda	Sieglitz		Columbia	PA
1679	Bill	Chain		Carlisle	PA
1680	Maria	Sanchez		Jenkintown	PA
1681	Nancy	DiMattia		Havertown	PA
1682	Taylor	Robbins		Scottsdale	PA
1683	Christopher	Grainer		McKeesport	PA
1684	William	Jackson		Lebanon	PA
1685	Sara	Thompson		Pittsburgh	PA
1686	Alessandra	Fischer		Pittsburgh	PA
1687	Susan	Boser		Beaver	PA
1688	Ethan	Park		Todd	PA
1689	Cindy	Murdough		Robesonia	PA
1690	Kristin	Stoltzfus		Robesonia	PA
1691	Maria	Zarod		Trafford	PA
1692	Holly	Latterman		Pittsburgh	PA
1693	Todd	Garcia-Bish		Butler	PA
1694	Rebecca	Urban		Manheim	PA
1695	Dawn	White		Glenmoore	PA
1696	Jessica	Stewart		Slippery Rock	PA
1697	Jon	Levin		Emmaus	PA
1698	Susan	Stein		Wynnewood	PA
1699	Isabella	Petitta		Cranberry Town	PA
1700	Beatrice	Kappeler		Harmony	PA
1701	Carla	Ruddock		Indian Head	PA
1702	Nancy	Green		Philadelphia	PA

1703	Katharine	Richardson		Landenberg	PA
1704	Miranda	Smith		Northern Cambrai	PA
1705	Gregory	Wilson		Media	PA
1706	Tess	Melchior		Barto	PA
1707	Laura	Guertin		Chester	PA
1708	Kimberly	Reese		Havertown	PA
1709	Kayleigh	O'Keefe		Philadelphia	PA
1710	Amanda	Smith		State College	PA
1711	Barbara	Beck		Quakertown	PA
1712	Thomas	Wilson		West Chester	PA
1713	James	Kofskie		Bloomsburg	PA
1714	Heather	Wayne		Grove City	PA
1715	Amy	Goldstein		Doylestown	PA
1716	Alicia	Martin		Melcroft	PA
1717	Stacey	Magda		Acme	PA
1718	Tony	Boyle		Andreas	PA
1719	Annette	Boyle		Andreas	PA
1720	Brenda	Wilson		Media	PA
1721	Denise	Stek		Pottstown	PA
1722	Amy	Lignelli		Pottstown	PA
1723	Gary	Dean		Strasburg	PA
1724	Lauren	Kauffman		Phoenixville	PA
1725	Sam	Navarino		Phoenixville	PA
1726	Colin	Kauffman		Phoenixville	PA
1727	Laura	Gandia		Norristown	PA
1728	Kelsey	Feeg		Oley	PA
1729	Elisa	Tyler		Philadelphia	PA
1730	Don	Ranck		Gordonville	PA
1731	Daniel	Dayton		Bensalem	PA
1732	Danielle	Wilson		Murrysville	PA
1733	Julia	Knight		Harrisburg	PA
1734	Leigh	Altadonna		Wyncote	PA
1735	Katie	Zalewski		Latrobe	PA
1736	Paula	Kauffman- Oberly		Bethel Park	PA
1737	Doug	Lapp		Cochranville	PA
1738	Richard	McNutt			PA
1739	Marni	Swartz		Rebersburg	PA
1740	Laura	Fox		Ellwood City	PA
1741	Alicia	Sprow		Shillington	PA
1742	John	Stolz		Glenshaw	PA

1743	David	Deaville		West Chester	PA
1744	Theresa	Cinicola		Andreas	PA
1745	Sheila	Hinkley		Denver	PA
1746	Fay	Wright		Bala Cynwyd	PA
1747	Brian	Wagner		Nazareth	PA
1748	Cynthia	Anstey		Doylestown	PA
1749	Valerie	Stone		Gettysburg	PA
1750	Hannah	Evans		Edinboro	PA
1751	Russ	Collins		Palmyra	PA
1752	Cynthia	Stunkard		Kutzown	PA
1753	Doris	Fiorentino		Lansdale	PA
1754	Nicole	Judge		Shillington	PA
1755	Regina	Wheeland		Liberty	PA
1756	Victoria	Laubach		Chester Springs	PA
1757	Amy	Niehouse		Windber	PA
1758	Leslie	Wessner		Pittsburgh	PA
1759	Richard	Coons		York	PA
1760	Kathryn	Grauert		Reading	PA
1761	Donna	Delany		Chester Springs	PA
1762	Mandy	Santiago		Media	PA
1763	Raymond	Lawler		Alexandria	PA
1764	Heather	Stoy		Wernersville	PA
1765	Chris	Stoy		Wernersville	PA
1766	Claire	Mickletz		Landenberg	PA
1767	R Bruce	Cooper		Cranberry Town	PA
1768	Collin	Shephard		Warren	PA
1769	Tim	Herd		State College	PA
1770	Bill	Mettler		Wyncote	PA
1771	Dustin	Thodde		Wyncote	PA
1772	Kevin	Willis		Jefferson	PA
1773	Mark	Harris		Horsham	PA
1774	William G.	Erat		Jenkintown	PA
1775	Cakky	Evans		Jenkintown	PA
1776	Paul	Ortuba		Mansfield	PA
1777	Daniel	Mink		Lancaster	PA
1778	Terry	O'Connor		Clearfield	PA
1779	Jamie	Arenburg		Hummelstown	PA
1780	Thomas	Anderson			PA

1781	Brian	Mangan		Nescopeck	PA
1782	Diane	Wilson		Harrisburg	PA
1783	Mark	Skevofilax		Dallas	PA
1784	Mary Lou	Benton		York	PA
1785	Jordy	Albert		York	PA
1786	Dorothy	Li Calzi		Philadelphia	PA
1787	Nancy	Adams		Exton	PA
1788	Michelle	Alvare		Havertown	PA
1789	David	Hathazy			PA
1790	Wayne	Hanley		Cochranville	PA
1791	Donna	Ingenito		Mount Joy	PA
1792	Marie	Martin		Media	PA
1793	Loree	Schuster		Philadelphia	PA
1794	Williams	Mulrennan		Atlasburg	PA
1795	Shirley	Barnes		Mechanicsbu rg	PA
1796	Paul	Smith		Downingtow n	PA
1797	Kim	Kane		Lititz	PA
1798	Bettina	Wilkinson		Valencia	PA
1799	Darren	Strain		Brookhaven	PA
1800	Robert	Jehn		Cochranton	PA
1801	Rodney	Stark			PA
1802	Susan	Paolucci		Winfield	PA
1803	Glenn	Black		Gettysburg	PA
1804	Michael	Schnierle		Mechanicsbu rg	PA
1805	Erich	Freimuth, Jr.		Wayne	PA
1806	Linda	Ricci		Warminster	PA
1807	Regina	Brooks		Pittsburgh	PA
1808	Brinton	Culp		Lititz	PA
1809	Tiffany	Deal		Red Lion	PA
1810	John	Nantz		Hummelstow n	PA
1811	Craig	Way		Pottstown	PA
1812	Deborah	Shepard		Philadelphia	PA
1813	Dona	Cuppett		Telford	PA
1814	Donna	Bookheimer		Douglassville	PA
1815	Randy	Blasdell		Columbia	PA
1816	Beatrice	Broughton		Avondale	PA
1817	David	Hrobuchak		Harrisburg	PA
1818	Peter	Luborsky		Phoenixville	PA

1819	Steven	Zimmerman		Pine Grove	PA
1820	Thomas	Herr		Lancaster	PA
1821	Linda	Freimark		Elkins Park	PA
1822	Patricia	Rossi		Levittown	PA
1823	Judith	Bohler		Ephrata	PA
1824	Curt	Wilbern		Harrisburg	PA
1825	Jennifer	Loch		Factoryville	PA
1826	Elise	Davies		Waynesboro	PA
1827	Jady	Conroy		New Cumberland	PA
1828	Ruth	Kuch		Lincoln University	PA
1829	Robert	Depew		Newtown	PA
1830	Nancy	Juskowich		Waynesburg	PA
1831	Susan	Faust			PA
1832	Ryan	OMeara		Hanover	PA
1833	Susan	Kohn		Phoenixville	PA
1834	Virginia	Rivers		Bryn Mawr	PA
1835	Linda	Addis		Hermitage	PA
1836	Cathy	Martin		Palmyra	PA
1837	Judy	Scriptunas		Chambersbur g	PA
1838	Fred	Hixson		Derry	PA
1839	Jeffrey	Donnelly		Philadelphia	PA
1840	William	Bader		Bethlehem	PA
1841	Robert	Smith		East York	PA
1842	Bob	Roach		Pittsburgh	PA
1843	Angie	Weisel		Camp Hill	PA
1844	John	Cosgrove		Easton	PA
1845	Sam	Gibson		Spring Grove	PA
1846	William E	Hoffman, Jr.		Souderton	PA
1847	Johanna	Hantel		Malvern	PA
1848	Betsy	Thompson		Coraopolis	PA
1849	Melvin	Armolt		Chambersbur g	PA
1850	Alan	Peterson		Willow Street	PA
1851	Larry	Hall		Ottsville	PA
1852	Glenn	Schlippert		Goldsboro	PA
1853	Zoe	Warner		Malvern	PA
1854	Jennifer	Wooten		Cochranville	PA
1855	Debra	Orben			PA

1856	Maryanne	Tobin		Philadelphia	PA
1857	Mike	Jackson		Everett	PA
1858	Todd	Waymon		Newtown	PA
1859	Kelly	O'Neill		Harrisburg	PA
1860	George	Hart		Landenberg	PA
1861	Ahren	Ream		Kutztown	PA
1862	Patrick	McLoughlin		Gibsonia	PA
1863	Anne	Jackson		Birdsboro	PA
1864	Phyllis	Terwilliger		York	PA
1865	Stanley	Pohlit		Sinking Spring	PA
1866	Susan	Wilmerding		Haverford	PA
1867	Luana	Goodwin		Philadelphia	PA
1868	Harry	Hochheiser		Pittsburgh	PA
1869	William	Wekselman		Pittsburgh	PA
1870	Ed	Hyde		Pittsburgh	PA
1871	Patricia	Greiss		Carlisle	PA
1872	Frank	Ayers		Altoona	PA
1873	Desiree	Fox		New Cumberland	PA
1874	Adam	Myers		Thomasville	PA
1875	Dennis	Hartenstine		Birdsboro	PA
1876	Meg	Clevenstine		Altoona	PA
1877	Karyn	Hyland		Pittsburgh	PA
1878	Tabassam	Shah		Clarion	PA
1879	Renee	Kline		Douglassville	PA
1880	Kathy	Long		Hamburg	PA
1881	Elizabeth	Seltzer		Media	PA
1882	Wilson	Bradburn		Mechanicsburg	PA
1883	Randall	Tenor		Mechanicsburg	PA
1884	Pat	Griffey			PA
1885	Elizabeth	Rishel		Lititz	PA
1886	Hilary	Thomas		Harrisburg	PA
1887	Linnea	Homa		Freedom	PA
1888	Stan	Warfield		Brookhaven	PA
1889	Erin	Reilly		Lafayette Hill	PA
1890	Paul	Komishock, Jr.		Wilkes-Barre	PA
1891	Max	Bader		Munhall	PA
1892	Emily	Whitney		Pittsburgh	PA
1893	Shelly	Lear		Washington	PA

1894	Teresa	Clifton		Pittsburgh	PA
1895	Simone	Marcus		Pittsburgh	PA
1896	Rachelle	DeMunck		Ambridge	PA
1897	Vivienne	Sebelle		Pittsburgh	PA
1898	Emma	Oxford		Pittsburgh	PA
1899	Courtney	Centner		Pittsburgh	PA
1900	Richard	Webb		Pittsburgh	PA
1901	Lillian	Cannon		Pittsburgh	PA
1902	Gary	Geisinger		Pulaski	PA
1903	Lisa	Mazzocchi		State College	PA
1904	Nicole	Cimabue		Pittsburgh	PA
1905	Katherine	Miller		Pittsburgh	PA
1906	Lindsay	Surmacz		Pittsburgh	PA
1907	Kate	Jacques		Pittsburgh	PA
1908	Charles	Wilson		Pittsburgh	PA
1909	Stephen	McHugh		Pittsburgh	PA
1910	Gary	Marcink		Freedom	PA
1911	Rayden	Sorock		Pittsburgh	PA
1912	Stephen	Christian-Michaels		Pittsburgh	PA
1913	Suzanne	Lisanti		Pittsburgh	PA
1914	Kathy	Nevling		Greensburg	PA
1915	Melissa	Strobel		Greensburg	PA
1916	Colleen	Yeany		Cheswick	PA
1917	Stephanie	Kubik		Canonsburg	PA
1918	Sara	Anderson		Johnstown	PA
1919	Katelyn	Haas-Conrad		Pittsburgh	PA
1920	Daniel	Weaver		Somerset	PA
1921	Gabrielle	Snyder		Pittsburgh	PA
1922	Gretchen	Kreizenbeck		Pittsburgh	PA
1923	Sarah	Walker		Perryopolis	PA
1924	Madeleine	Umstead		Morrisville	PA
1925	Janet	Pritchard		Bethel Park	PA
1926	Jessica	Winter		Pittsburgh	PA
1927	Lauren	Skiba		Irwin	PA
1928	Kelly	Lennon			PA
1929	Rebecca	Mahbubani		Pittsburgh	PA
1930	Laura	Knouff		Pittsburgh	PA
1931	Jessica	Sahi		Clairton	PA
1932	Rosemary	Hegemann		Pittsburgh	PA
1933	Mary	Motz		Sewickley	PA
1934	Shelley	Crannell		Pittsburgh	PA

1935	Andrew	Minton		Pittsburgh	PA
1936	Julie	Polakoski-Rennie		Pittsburgh	PA
1937	Justin	Lennon			PA
1938	Ilaina	Anderson		Pittsburgh	PA
1939	Shannon	Franklin		Coraopolis	PA
1940	James	Snow		Pittsburgh	PA
1941	Patty	Glass		New Cumberland	PA
1942	Joe	Reiss		Pittsburgh	PA
1943	Mark	Chrisman		Greensburg	PA
1944	George	Frank		Pittsburgh	PA
1945	Dan	Garfinkel		Presto	PA
1946	Emily	Weiss		Pittsburgh	PA
1947	Anne	Toland		Wexford	PA
1948	William	Van Meter		Pittsburgh	PA
1949	Alyssa	Parke		Pittsburgh	PA
1950	Martin	Rafanan		Pittsburgh	PA
1951	Andrew	McElwaine		Glenshaw	PA
1952	Kathleen	Burgard		Pittsburgh	PA
1953	Natalie	Escourt		Wexford	PA
1954	Louisa	Dieck		Greensburg	PA
1955	Bridgett	Duerring		Gibsonia	PA
1956	Betty	Reefer		Greensburg	PA
1957	Sheri	Francis		Bethel Park	PA
1958	Alexandra	Gruskos		Pittsburgh	PA
1959	Adam	Ignasky		McKeesport	PA
1960	Jillian	Sinko		Pittsburgh	PA
1961	Kathleen	Martino		Pittsburgh	PA
1962	Gayle	Temple		Irwin	PA
1963	Autumn	Kacian		Pittsburgh	PA
1964	Michelle	Allworth			PA
1965	Jean	Schulte-Tosh		Pittsburgh	PA
1966	Jay	Griffin		Pittsburgh	PA
1967	Edward	Keiser		Cranberry Township	PA
1968	George	Bent		Monroeville	PA
1969	Dick	Jennings		Pittsburgh	PA
1970	Jennifer	Miller		Boalsburg	PA
1971	Kenneth	Yonek		Canonsburg	PA
1972	Scotti	Burnsworth		New Brighton	PA

1973	Chris	Shomo		Pittsburgh	PA
1974	Trudy	Fryer		Strattanville	PA
1975	Jennifer	Freeman		Pittsburgh	PA
1976	Kelly	Rieger		Gibsonia	PA
1977	Virginia	Bell		Pittsburgh	PA
1978	Diane	Dunleavy		Bethel Park	PA
1979	Judy	Bonnaure		Noblestown	PA
1980	Jessica	Gamet		Coraopolis	PA
1981	Elizabeth	Glowczewski		Pittsburgh	PA
1982	Matthew	Pribis		Butler	PA
1983	Gary	Sorock		Pittsburgh	PA
1984	Peggy	Smith		Indiana	PA
1985	Katherine	Jordan		Pittsburgh	PA
1986	Leah	Hoechstetter		Pittsburgh	PA
1987	Randi	Heikes		Pittsburgh	PA
1988	Mary	Bellman		State College	PA
1989	Gabriel	DeFelippis		Pittsburgh	PA
1990	Kristine	Haig		Bethel Park	PA
1991	Alexandra	Wilson		Pittsburgh	PA
1992	Jennifer	Cooper		Pittsburgh	PA
1993	Geoffrey	Spear		Pittsburgh	PA
1994	Ann H	Crimaldi		Allentown	PA
1995	Alden	Merchant		Pittsburgh	PA
1996	Andy	Baxter		Glenshaw	PA
1997	Carolyn	Savikas		Pittsburgh	PA
1998	Kate	Ledford		Pittsburgh	PA
1999	Mel	Packer		Pittsburgh	PA
2000	Katherine	Mangan		Bradford Woods	PA
2001	Christine	Salitrik		Pittsburgh	PA
2002	Mike	Busse		Pittsburgh	PA
2003	Georgia	Field		Pittsburgh	PA
2004	Karen	Hanley		Irwin	PA
2005	Chandra	Colaresi		Pittsburgh	PA
2006	Beatrice	Schulte		Midland	PA
2007	Erin	Copeland		Pittsburgh	PA
2008	Erin	Woods		Sewickley	PA
2009	Susan	Gaertner		Pittsburgh	PA
2010	Lisa	Bloomfield		Pittsburgh	PA
2011	Michael	Coblentz		Pittsburgh	PA
2012	Tracy	Longo		Beaver	PA
2013	Audrey	Sykes		Pittsburgh	PA

2014	Janet	Bench		Pittsburgh	PA
2015	Felipe	Gomez		Pittsburgh	PA
2016	Ellie	Kruger		Pittsburgh	PA
2017	Carisa	Griffin		Pittsburgh	PA
2018	Shelbey	Tharpe		Pittsburgh	PA
2019	Mary	Kelly		Pittsburgh	PA
2020	Diane	Mottiqua		Pittsburgh	PA
2021	Elizabeth	Cassedy		Pittsburgh	PA
2022	Denise	Stack		Gibsonia	PA
2023	Stacy	Koch		York	PA
2024	Kara	Smith		Pittsburgh	PA
2025	Sarah	Simmons		Pittsburgh	PA
2026	Angela	Mazza		Pittsburgh	PA
2027	John	Franco		Pittsburgh	PA
2028	Marie	Ambrose		Pittsburgh	PA
2029	Jess	Hobaugh		Pittsburgh	PA
2030	Melanie	Meade		Clairton	PA
2031	Eileen	Lovell		Pittsburgh	PA
2032	Marilyn	Spohn		Pittsburgh	PA
2033	Elisabeth	Duran		Irwin	PA
2034	Catherine	Ravella		Pittsburgh	PA
2035	James	Conley		Pittsburgh	PA
2036	John	Helter		Pittsburgh	PA
2037	Sarah	Anderson		Greensburg	PA
2038	Morgen	Kelly		Oakmont	PA
2039	Celeste	Farison		Pleasant Hills	PA
2040	Krista	Cooke		Cheswick	PA
2041	Marcie	Milletary		Pittsburgh	PA
2042	Judith	Sullivan		Pittsburgh	PA
2043	Karen	Rondestvedt		Pittsburgh	PA
2044	Lily	Ridilla		Latrobe	PA
2045	Harriett	Weis		Pittsburgh	PA
2046	Sarah	Lapenta-H		Pittsburgh	PA
2047	Annie	Kern		Pittsburgh	PA
2048	Andrea	Cipriani		Pittsburgh	PA
2049	Jean Ann	Straitwell		Pittsburgh	PA
2050	Rachell	Youngman		Pittsburgh	PA
2051	Roberto	Canizares		Gibsonia	PA
2052	Elizabeth	Pitts		Pittsburgh	PA
2053	Debbie	Gallo		Pittsburgh	PA
2054	Laurie	Moraca		Carnegie	PA
2055	Richard	Headley		Pittsburgh	PA

2056	Howard	Jernigan		Pittsburgh	PA
2057	Joe	Wyzkoski		Pittsburgh	PA
2058	Sarada	Sangameswaran		Pittsburgh	PA
2059	Lex	Smith		Pittsburgh	PA
2060	Chris	Kuznicki		Pittsburgh	PA
2061	Lucas	Fellers		Gibsonia	PA
2062	Chad	Schwartz		Slatington	PA
2063	Barbara	Pontello		Sewickley	PA
2064	Pamela	Kavelman		Pittsburgh	PA
2065	Emily	Ferraro		Mars	PA
2066	Mitch	ONeill		Harrison City	PA
2067	Marilyn	Burke		Pittsburgh	PA
2068	Carrie	Lubawy		Pittsburgh	PA
2069	Rana	Tonti		McMurray	PA
2070	Amy	Zierath		Pittsburgh	PA
2071	D	Cooper		Cranberry Township	PA
2072	Jennifer	Riegler		Mars	PA
2073	Chriss	O'Lare		Pittsburgh	PA
2074	Jessica	Teodori		Pittsburgh	PA
2075	Judith	Mihok		Coraopolis	PA
2076	Nicholas	Genger-Boeldt		Pittsburgh	PA
2077	Cheryl	Strauss		Pittsburgh	PA
2078	Glenn	Brynes		Pittsburgh	PA
2079	Jennifer	Murray		Oakdale	PA
2080	Tara	Gainfort		Pittsburgh	PA
2081	Nicole	Payne		Tarentum	PA
2082	Colleen	Vermillion		Pittsburgh	PA
2083	Amy	Whitsel		Wexford	PA
2084	Sue	Heilman		Export	PA
2085	Fred	Pfeil		Dunleavy	PA
2086	Jennifer	Eaves		Zelienople	PA
2087	Steph	Moraca		Bridgeville	PA
2088	Katrina	Brown		Sewickley	PA
2089	Leida	Milazzo		Johnstown	PA
2090	Chris	More		Bangor	PA
2091	Barry	Tessier		Pittsburgh	PA
2092	Wren	Holquist		Erie	PA
2093	Karen	Clapper		Hermitage	PA
2094	Bill	Payne		Tarentum	PA
2095	Jennifer	Novelli		Pittsburgh	PA

2096	Jennifer	Newton		Irwin	PA
2097	Linda	Sanders		Pittsburgh	PA
2098	Andrianna	Thompson		Lower Burrell	PA
2099	Erin	Morey		Pittsburgh	PA
2100	H. Ronald	Fray		Bridgeville	PA
2101	Joanne	Greenwald		Elizabeth	PA
2102	Jamie	Hudzik		Pittsburgh	PA
2103	Leslie	Fisher		Pittsburgh	PA
2104	Ivan	Russell		Pittsburgh	PA
2105	Wanda	Petersen		Tarentum	PA
2106	Matt	Trudeau		Pittsburgh	PA
2107	Toni	Black		Pittsburgh	PA
2108	Irene	Biler		Pittsburgh	PA
2109	David	Kostilnik		Gibsonia	PA
2110	Jocelyn	Johnston		Pittsburgh	PA
2111	Lori	Maxeiner		Meadville	PA
2112	Ellen	Maginnis		Pittsburgh	PA
2113	Kimberly	Murray		Oakmont	PA
2114	Gail	Heller		Pittsburgh	PA
2115	Emily	Abendroth		Philadelphia	PA
2116	Karen	Billingsley		Pittsburgh	PA
2117	Amy	Kleissas		McKees Rocks	PA
2118	Jennifer	Kessner		Meadville	PA
2119	Sean	Ferguson		Pittsburgh	PA
2120	Jennifer	Degelman		Pittsburgh	PA
2121	Shawn	Davis		Slippery Rock	PA
2122	Elisabeth	Aupke		Pittsburgh	PA
2123	Michelle	Lisak		Zelienople	PA
2124	Abigail	Watkins		Meadville	PA
2125	Nichole	Dahlen		Pittsburgh	PA
2126	Michelle	Simon		Pittsburgh	PA
2127	Nicholas	Hessert		Williamsport	PA
2128	Mary	Spicer		Meadville	PA
2129	Autumn	Vogel		Meadville	PA
2130	Zachary	Stankiewicz		Pittsburgh	PA
2131	Taylor	Hinton		Meadville	PA
2132	Elisa	Becze		Beaver	PA
2133	Jenn	Nastasi		Sewickley	PA
2134	Kerry	Hall		Williamsport	PA
2135	Jessica	Sakal		Meadville	PA
2136	Lynne V	Kearns		Canonsburg	PA

2137	Martin	Seltman		Pittsburgh	PA
2138	Timothy	Church		Union City	PA
2139	Gretchen	Myers		Meadville	PA
2140	Carole	Elias		New Kensington	PA
2141	Georgann	Kovacovsky		New Bethlehem	PA
2142	Kristina	Pavlick		Williamsport	PA
2143	Gretchen	McMichael		Zelienople	PA
2144	Kenneth	Maglietta		Claysville	PA
2145	Alta	Dezort		Normalville	PA
2146	Alexis	Hart		Meadville	PA
2147	Michele	Knoll		Pittsburgh	PA
2148	Barbara	Desiderio		Acme	PA
2149	Alan	Oley		Hampton Township	PA
2150	Ellen	Berne		Pittsburgh	PA
2151	Katy	Watkins		Pittsburgh	PA
2152	Lisa	Edwards		Pittsburgh	PA
2153	Keri	Fadden		Meadville	PA
2154	Rachel	Simon		Pittsburgh	PA
2155	Scott	Bortree		Ohio pyle	PA
2156	Tamra	Schiappa		Grove City	PA
2157	Joan	Gordon		Pittsburgh	PA
2158	Miki	Beard		Pittsburgh	PA
2159	Janet	Seltman		Pittsburgh	PA
2160	Michael	Michalojko		New Castle	PA
2161	Janet	Popeleski		Pittsburgh	PA
2162	Alyssa	Pysola		Pittsburgh	PA
2163	Anna	Werle		Pittsburgh	PA
2164	Olivia	Vanistendael		Venetia	PA
2165	Madeline	Koss		Ebensburg	PA
2166	Kristin	Pardini		Pittsburgh	PA
2167	Heather	Li		Hampton Township	PA
2168	Angie	Grubb		Dover	PA
2169	Monica	Smedley		Wall	PA
2170	Brennan	Paden		Mifflintown	PA
2171	Margaret	Lubawy		Pittsburgh	PA
2172	Elisabeth	Healey		Pittsburgh	PA
2173	Lily	Fields		Lititz	PA
2174	Krystal	Leung		Palmyra	PA

2175	Janet	Hessert		Williamsport	PA
2176	Bethany	Kristich		Annville	PA
2177	Michaela	Wolf		Palmyra	PA
2178	Laurel	Husk		Telford	PA
2179	Denise	Bonk		Philadelphia	PA
2180	Tyquan	Reddick		Harrisburg	PA
2181	Katie	Hollen		Palmyra	PA
2182	Taylor	Slusser		Palmyra	PA
2183	Anna	McDougall		Pittsburgh	PA
2184	Marcia	Morton		Pittsburgh	PA
2185	Kelly	LaFaver		Fredericksburg	PA
2186	Jeff	LaFaver		Fredericksburg	PA
2187	Ava	Kristich		Palmyra	PA
2188	Charles	Li		Hampton Township	PA
2189	Nancy	Heastings		Pittsburgh	PA
2190	Gretchen	Brown		Harmony	PA
2191	Janice	Kropczynski		North Versailles	PA
2192	McKayla	Cox		Sewickley	PA
2193	Melody	Munitz		State College	PA
2194	Kristen	Paul		Hampton Township	PA
2195	Margaret	Nikolajski		Glenshaw	PA
2196	Kaitlyn	Snyder		Lebanon	PA
2197	Robert	Ellis		Philadelphia	PA
2198	Ruth	Stickle		Homestead	PA
2199	Judi	Mangan		Pittsburgh	PA
2200	Victoria	Brown		Lenhartsville	PA
2201	Steve	Brown		Bethlehem	PA
2202	Jennifer	Hartigan		Hatboro	PA
2203	Jan	Milburn		Ligonier	PA
2204	Kim	Mares		Schwenksville	PA
2205	Ashley	Phillips		Pittsburgh	PA
2206	Iliana	DiNicola		Pittsburgh	PA
2207	Matthew	Gribble		Springdale	PA