

<h1>Regulatory Analysis Form</h1> <p>(Completed by Promulgating Agency)</p> <p>(All Comments submitted on this regulation will appear on IRRC's website)</p>		<p>INDEPENDENT REGULATORY REVIEW COMMISSION</p> <p>MAY 11 2021</p> <p>Independent Regulatory Review Commission</p>
<p>(1) Agency State Board of Education</p>		
<p>(2) Agency Number: 006 Identification Number: 347</p>		<p>IRRC Number: 3303</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 checked="" type="checkbox"/> Proposed Regulation <input type="checkbox"/> Final Regulation <input type="checkbox"/> Final Omitted Regulation</p>		<p><input type="checkbox"/> Emergency Certification Regulation; <input type="checkbox"/> Certification by the Governor <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 proposed regulation makes both substantive and technical revisions to Chapter 4. Substantively, the rulemaking would replace 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 proposed academic standards, presented in Appendix B-1, would take effect on July 1, 2024.</p> <p>Proposed 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 proposed 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 proposed 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 proposed revised standards introduce more complexity and rigor into standards for early grades.

The proposed 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 the 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 proposed 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 is 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 proposed 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 proposed 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 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 proposed 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 proposed rulemaking would 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 the proposed rulemaking, the standards reflected in proposed amendments to 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 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 proposed 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 regulation does not directly affect other regulations, the updated academic standards included in the proposed rulemaking will need to be integrated into relevant coursework of educator preparation programs. Currently, the Board is considering amendments to 22 Pa. Code, Chapter 49 (Certification of Professional Personnel) in proposed rulemaking #6-346 that establish requirements for programs that prepare individuals to become teachers to integrate instruction in Culturally Relevant and Sustaining Education (CR-SE). 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 proposed 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 proposed 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 proposed 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 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 proposed 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, pre-service 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 draft recommendations.

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 Steering Committee and the 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	Vallette	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	Zemal-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.

(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 proposed 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 2019-20, there were approximately 2,983 public schools in 781 school entities in the Commonwealth. Those school entities serve 1.7 million students and employ approximately 149,658 professional staff. Currently, there are 119 educator preparation program that operate in the Commonwealth. The proposed 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 proposed rulemaking establishes a three-year window for school entities to take necessary measures to ensure their instruction is aligned with the proposed updated standards. Educator preparation programs also will need to integrate instruction in the proposed 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 teacher education faculty in the updated standards. Further, the Department will need to undertake a review of the PSSA Science assessment and the Keystone Exam in Biology to align these state assessments with the proposed updated standards. Finally, the Department will need to review the Alternate Eligible Content in Science, that serve to guide instruction for students with the most severe cognitive disabilities, to determine whether updates are necessary to align the AEC with the proposed updated science standards.

Technical amendments presented in the proposed 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 proposed rulemaking. In 2019-20, there were approximately 2,983 public schools in 781 school entities in the commonwealth. Those school entities serve 1.7 million students and employ approximately 149,658 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 updated *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 proposed effective date for updated science standards of July 1, 2024, provides time for school entities to plan for integration of updated standards as part of ongoing curricular review.

The proposed rulemaking would impact the Department by necessitating a review of state assessments aligned with the state's academic standards for science, and further would 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 proposed 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 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 proposed 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 post-secondary 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 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 the *Pennsylvania Technology and Engineering Standards (Grades 6-12)* 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 proposed rulemaking provides the foundation for educators to include every student in high-quality learning experiences, building their scientific, technological, and environmental literacies. The proposed regulations are 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 proposed 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 2020-2021 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. 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 proposed standards 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 proposed 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 proposed standards lay the foundation for students to apply knowledge and skills from known situations to novel contexts. The integrative nature of the proposed 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 proposed 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 in statute could have an adverse effect of causing confusion for students and educators about what requirements 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 proposed regulation will not impose any costs on students. Further, the proposed regulation is not anticipated to impose new costs on programs that train new educators. The proposed updated 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 proposed 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 proposed 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 proposed rulemaking includes a July 1, 2024 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 the 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 proposed rulemaking, since the proposed revised standards were informed by current national standards frameworks in their development and incorporate some elements of the frameworks already referenced by educators.

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 proposed 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 proposed 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 proposed regulation will cost the state approximately \$17,994,792 in total through Fiscal Year 2025-26 to review and update the Pennsylvania System of School Assessment (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 proposed 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 proposed updates to our 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 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 determines the professional learning delivered to LEAs 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 over the last four years will establish the foundation for school entities to begin implementing the new standards included in the proposed 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 proposed updated science standards. The Statewide System of Supports 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 proposed regulations will require shifts in instruction, alignment of curricular assets, and familiarization with the proposed 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 proposed 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 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 on an annual basis through Fiscal Year 2025-26:

Fiscal Year 2020-21: 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 2021-22: 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 proposed updates to the state's 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 standards in the proposed rulemaking.

Fiscal Year 2022-23: 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 proposed updates to the state's 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 proposed 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 proposed new standards. Anticipated costs include aligning the state assessment question bank to reflect the content of the updated science standards in the proposed 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 2023-24: 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 proposed new standards as described above.

Fiscal Year 2024-25: 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 proposed updates to the state's academic standards in science. The professional learning and technical assistance will be provided by the 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 2024-25. 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.

Fiscal Year 2025-26: 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 proposed 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 proposed 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 proposed 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 proposed 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 proposed 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 20-21	FY +1 Year 21-22	FY +2 Year 22-23	FY +3 Year 23-24	FY +4 Year 24-25	FY +5 Year 25-26
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	\$1,827,000	\$1,827,000
Total Costs	\$1,827,000	\$1,827,000	\$9,258,797	\$2,891,071	\$1,827,000	\$1,827,000
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 17-18	FY -2 18-19	FY -1 19-20	Current FY 20-21
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PA Assessment	\$49,446,000	\$49,446,000	\$50,490,000	41,540,000
Teacher Professional Development	\$5,959,000	\$5,309,000	\$5,309,000	\$5,044,000
General Government Operations (Department of Education)	\$25,971,000	\$26,947,000	\$28,323,000	\$25,359,000
Basic Education Funding	\$5,995,079,000	\$6,095,079,000	\$6,742,838,000	\$6,805,954,000

(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 proposed 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 proposed 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 and to determine whether updates are necessary to align the AEC in Science with the new science standards proposed 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 serve cognitive disabilities while still ensuring access to the general education curriculum. Any future updates to the AEC standards that may result from the proposed 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 in the proposed rulemaking to identify gaps and opportunities, ensuring that Pennsylvania student are exposed to agricultural education throughout their K-12 experience and prepared to explore careers in agriculture.

The proposed 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 proposed 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 update 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. The proposed regulation would aim to afford all students experiences in all of the content areas included in the new standards in the proposed rulemaking 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 career. 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 the 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 proposed 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 proposed 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 proposed 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 would 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/eeepro/products/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

- B. The date or dates on which any public meetings or hearings will be held: May 5-6, 2021
 July 14-15, 2021

- C. The expected date of delivery of the final-form regulation: July 2021

- D. The expected effective date of the final-form regulation: July 2021

E. The expected date by which compliance with the final-form regulation will be required:

___ July 2024 ___

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 proposed rulemaking, the Board is seeking to establish a revised timeframe for future reviews of academic standards that would require such reviews to occur no soon 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 proposed amendments to Chapter 4, their effectiveness, and feedback the Department is receiving from schools within the Commonwealth.

CDL-1

FACE SHEET
FOR FILING DOCUMENTS
WITH THE LEGISLATIVE REFERENCE BUREAU

(Pursuant to Commonwealth Documents Law)

RECEIVED
MAY 11 2021
Independent Regulatory
Review Commission

DO NOT WRITE IN THIS SPACE

<p>Copy below is hereby approved as to form and legality. Attorney General</p> <p>Amy M. Elliott <small>Digitally signed by Amy M. Elliott DN: cn=Amy M. Elliott, o=Pennsylvania Office of Attorney General, email=amy.elliott@attorneygeneral.gov, ou=PA Date: 2021.04.28 15:21:19 -0400</small></p> <p>BY: <u>Amy M. Elliott</u> (DEPUTY ATTORNEY GENERAL)</p> <p><u>4/28/2021</u> 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 Moldanow</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><u>Alanna C. Koltash</u></p> <p>BY: _____</p> <p><u>3/8/2021</u> DATE OF APPROVAL</p> <p><u>Deputy General Counsel</u> (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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PROPOSED RULEMAKING
COMMONWEALTH OF PENNSYLVANIA
STATE BOARD OF EDUCATION
22 Pa. Code Chapter 4
Academic Standards and Assessment

PROPOSED RULEMAKING

STATE BOARD OF EDUCATION

[22 PA. CODE CH. 4]

Academic Standards and Assessment

The State Board of Education (Board) proposes to amend Chapter 4 (relating to academic standards and assessment) to read as set forth in Annex A. 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, 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 proposed rulemaking seeks to update the academic standards in Science and Technology and Environment and Ecology, as set forth in the current Appendix B, and to establish a timeframe for implementation of updated standards presented in Appendix B-1. Finally, the proposed rulemaking also seeks to make technical amendments unrelated to science standards to align other provisions of the Chapter with changes to the Public School Code of 1949 enacted by 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. Of the more than 951 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, representatives of community not-for-profit organizations, parents and students.

In addition to the stakeholder sessions, the Department released a survey and collected data from additional surveys by organizations like the Pennsylvania Science Teachers Association. 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 committees 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, the committees met to review the stakeholder input 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 and coherence. The organization and presentation of the standards are similar to create 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 virtual public meeting in September 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 four acts of the General Assembly – 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 School Code that address existing subject matter in Chapter 4. To address inconsistencies between the School Code and Chapter 4 resulting from these Acts, the Board undertook an effort to integrate a comprehensive set of technical amendments into the proposed rulemaking to conform Chapter 4 with changes to statute and to create consistency for affected parties.

Technical amendments are being presented at the same time the Board considers substantive amendments to science standards to create efficiency in the rulemaking process. In considering these technical amendments in September 2020 at the same time it approved proposed updates to science standards, the Board sought to maintain transparency and accessibility for members of the public by posting language of draft technical amendments to Chapter 4 on its website in advance of the meeting.

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 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. The breadth of amendments

enacted in Act 158 necessitates 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 these affected parties are not accessing information in Chapter 4 that is in conflict with statute.

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.

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 proposed 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 proposing 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 proposed 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 proposed 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 proposed 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 proposed standards lay the foundation for students to apply knowledge and skills from known situations to novel contexts. The integrative nature of the proposed standards makes

explicit connections for educators and breaks down artificially created content “silos” to inspire connected student learning, preparing them for the workforce.

The proposed 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 Proposed Rulemaking

The proposed rulemaking would amend 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 proposed 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 proposed rulemaking to make existing references to AVTSs consistent with proposed revisions to this definition.

Section 4.3 (definitions). The proposed 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 proposed 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 proposed rulemaking to replace existing references to “vocational-technical education” with “career and technical education,” making language consistent with proposed revisions to this definition and consistent with terminology now used in statute.

Sections 4.11(g)(3) and 4.11(g)(4) (purpose of public education). The Board is proposing to align references to academic content areas in these sections with the structure of the proposed new science standards in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii). These revisions are necessary to create consistency with the substantive changes proposed in Sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii).

Sections 4.12(a)(1)(i-ii) and 4.12(a)(2)(i-iii) (academic standards). The Board is proposing to sunset the current academic standards in Science and Technology and in Environment and Ecology (published in Chapter 4 as Appendix B) on June 30, 2024. The Board further is proposing to establish three new sets of academic standards in science that would take effect July 1, 2024, 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). Amendments to these sections also include a narrative description for each set of proposed new standards. As reflected later in the Annex, proposed new standards would be published in Chapter 4 as Appendix B-1.

Section 4.12(i). (academic standards). The Board is proposing to amend the three-year timeframe for reviewing state academic standards and state assessments established in this section. Proposed 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 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(a). (Elementary education: primary and intermediate levels). The Board is proposing to amend this section 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.

Sections 4.21(e)(3) and (e)(4). (Elementary education: primary and intermediate levels). Existing requirements in Section 4.21(e) set forth that planned instruction at the primary level shall align with state academic standards. Changes to this section are editorial to be consistent with substantive changes in Section 4.12 that set forth proposed revisions to academic standards.

Sections 4.21(f)(3) and (f)(4). (Elementary education: primary and intermediate levels). The Board is proposing to 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) as proposed in section 4.12(a)(1)(ii). Changes to this section are editorial for consistency with substantive changes in Section 4.12.

Sections 4.22(c)(3) and (c)(5). (Middle level education). The Board is proposing to 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) as proposed in section 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii). These changes are editorial for consistency with substantive changes in Section 4.12.

Sections 4.23(c)(3) and (c)(5). (High school education). The Board is proposing to 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) as proposed in section 4.12(a)(2)(ii-iii). These changes are editorial for consistency with substantive changes in Section 4.12.

Section 4.24 (high school graduation requirements).

In Act 158 of 2018 and in 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.

The amendments enacted to the Public School Code by Act 158 and Act 6 supersede high school graduation policies established by the Board in Chapter 4. To the extent that the aforementioned amendments are in conflict with the Board’s existing graduation policies, the Board is proposing technical amendments to conform related provisions of Chapter 4 with the changes enacted by 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)).

Sections 4.24(c) and 4.24(c)(1) (high school graduation requirements). The Board is proposing to delay the effective date of these sections to the 2022-2023 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 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. As the Board is proposing to update the existing science standards cited in this section in revisions proposed in sections 4.12(a)(1)(ii) and 4.12(a)(2)(ii-iii), it is necessary to identify relevant content of the proposed new standards that would be assessed for the purposes of 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 proposed high school-level Science and Environment and Ecology standards presented in the proposed 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 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 states. As the Board is proposing to update its science standards, revisions to this section identify the relevant new standards proposed in Section 4.12(a)(2)(ii) that contain Biology-related content for alignment with this section.

Section 4.24(c)(1)(iii)(B)(III) (high school graduation requirements). The proposed deletion of Sections 4.24(d-f) necessitated 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 proposed amendments to Section 4.24(c)(1)(iii)(A) of the proposed rulemaking. Therefore, the Board is proposing to delete this section 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 reference to the appropriate use of these exams as defined in statute is incorporated elsewhere in the proposed 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 proposing to delete 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 Exams. This

pathway is no longer possible due to the elimination of Keystone Exams in these content areas by Act 6 and, as such, the Board is proposing to remove 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 this section of Chapter 4. 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 the proposed rulemaking. Therefore, the Board is proposing to delete this section 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 proposed rulemaking.

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

Section 4.24(f) (former Section 4.24(i)) (high school graduation requirements). The Board is proposing to amend 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 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 proposing to amend 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) (high school graduation requirements). Revisions to this section make technical edits to reflect the proposed deletion of the existing Sections 4.24(d) and 4.24(e) as described above. Proposed revisions further align the 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 directing 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 proposing to delete this section as the transitions facilitated under it are no longer relevant. As discussed earlier, Act 6 of 2017 removed language directing Keystone Exams to be developed in additional content areas beyond the exams already administered in Literature, Algebra I, and Biology. Sections 4.24(d) and 4.24(e) are proposed for deletion 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 proposing to add 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.

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 proposed rulemaking.

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

Section 4.51(a)(6) (State assessment system). This section 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. The Board is proposing to update the standards to which these state assessments are aligned, as proposed in Section 4.12(a)(1)(ii) and Sections 4.12(a)(2)(ii-iii). As such, amendments to Section 4.51(a)(6) would align state assessments administered in Science with the new science standards proposed in Appendix B-1 of this rulemaking.

Section 4.51a (Pennsylvania System of School Assessment). This section directs the Department of Education to develop exams used as part of the Pennsylvania System of School Assessment (PSSA) based on academic standards identified in the section, including our current academic standards in Science and Technology and Environment and Ecology. Pennsylvania currently administers the PSSA in Science in grade 4 and in grade 8, as required in this section of Chapter 4. As noted above, in this proposed rulemaking the Board is seeking to adopt new academic standards for science. Proposed revisions to section 4.51a(a) and its paragraphs align references to academic standards for science with the structure of the new proposed standards and add reference to the new science standards proposed in Appendix B-1 of this rulemaking.

Section 4.51a(a)(3) (Pennsylvania System of School Assessment). Proposed revisions to section 4.51a(a)(3) align references to academic standards for science with the structure of the new proposed standards, consistent with language presented in the proposed amendment to Section 4.51a.

Sections 4.51b(a)(1-4) (Keystone Exams). The Board is proposing to make technical amendments to conform this section 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 of Education to develop Keystone Exams in additional content areas beyond the existing exams for Literature, Algebra I, and Biology. Therefore, provisions in Section 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. Proposed 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. Finally, an amendment to Section 4.51b(a)(3) proposed to update the academic standards to which the Keystone Biology exam is aligned to refer to the new Pennsylvania Integrated Standards for Science, Environment and Ecology (grades 6-12) as contained in Appendix B-1 of the proposed rulemaking.

Section 4.51b(d) (Keystone Exams). The Board is proposing technical amendments to conform this section with changed 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 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. Section 4.51b(d) does not specify that requests to retake a Keystone Exam must be submitted in writing. Therefore, revisions are being proposed 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.

Section 4.51b(f) (Keystone Exams). The Board is proposing technical amendments to conform Section 4.51b(f) 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 this section are being proposed 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. Section 4.51b(f) now 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. The Board is proposing to remove language requiring students to complete a project-based assessments in certain circumstances and to align Section 4.51b(f) with provisions governing project-based assessment as they now are set forth by the General Assembly in statute.

Sections 4.51b(j-k) (Keystone Exams). The Board is proposing to delete Sections 4.51b(j-k) to conform with changes enacted by Act 6 of 2017 that eliminated language directing the development of 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)) (Keystone Exams). The Board is proposing to amend Section 4.51b(j) to recognize that the federal No Child Left Behind Act of 2001 (NCLB) has been reauthorized and that Keystone Exams will continue to serve as the approved high school level accountability system required under the Every Student Succeeds Act, NCLB's successor federal statute. The Board also is proposing 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 proposed deletion of Sections 4.51b(j-k).

Section 4.51c (project-based assessment). Proposed amendments to Section 4.51c conform the section with changes enacted by Act 6 of 2017 and Act 158 of 2018. Section 4.51c(a) deletes language that directs project-based assessments to be developed in composition and civics and government that are aligned to the modules of the Keystone Exams. 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 no longer is relevant as there will be no Keystone Exam modules in those content areas to which a project-based assessment would 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 proposing to delete 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.

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 established in statute. As such, the Board is proposing to delete language in Section 4.51d, Sections 4.51d(1)(i-iv), and Section 4.51d(2) and create clarity surrounding waiver requirements by replacing this language with a reference to 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 Section 45.1d(3) is being reorganized as Section 45.1d(1) to align with the proposed deletion of the subsections preceding it. Within this section, the Board is proposing to incorporate 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)).

Finally, the Board is proposing to eliminate Section 45.1d(6) as it refers to action that would occur under paragraph (2) of Section 45.1d and the proposed rulemaking proposes the deletion of paragraph (2).

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

As described earlier, amendments to Section 4.12(a)(1)(ii) and Sections 4.12(a)(2)(ii-iii) set forth a July 1, 2024, effective date for the proposed standards in Appendix B-1. Proposed 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 would sunset on June 30, 2024.

The state's current *Academic Standards for Science and Technology* and *Academic Standards for Environment and Ecology*, adopted in 2002, 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 standards contained in Appendix B-1 of the proposed regulation requires a shift to grade level expectations for kindergarten through fifth grade, allowing for clear learning progressions by grade in elementary school, and require 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 the proposed regulation requires integration of Environment, Ecology, Science, Engineering, and Technology education for kindergarten through fifth grade. The integration of Science, Technology, Engineering, Environment, and Ecology 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, Technology, Engineering, Environment, and Ecology at the earliest grades. Further, the integration of Science, Technology, Engineering, Environment, and Ecology, along with their application, reflects how these disciplines are practiced in the real world.

The standards contained in Appendix B-1 of the proposed 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 proposed rulemaking separate Technology and Engineering standards from the Science, Environment and Ecology standards for grades 6-12.

The new standards presented in the proposed 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 proposed regulation considers the Pennsylvania context with clear connections to agriculture, career readiness, and sustainability. The proposed 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 proposed 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.

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 proposed regulation will not impose any costs on students. Further, the proposed regulation is not anticipated to impose new costs on programs that train new educators. The proposed updated 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 proposed 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 proposed 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, 2024 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 the 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 proposed rulemaking, since the proposed revised standards

were informed by current national standards frameworks in their development and incorporate some elements of the frameworks already referenced by educators.

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 proposed 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 proposed 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 proposed rulemaking will cost approximately \$17,994,792 in total through Fiscal Year 2025-26 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 proposed 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 proposed updates to our 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 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 over the last four years will support school entities in implementing the new standards included in the proposed 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 *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 proposed rulemaking on an annual basis through Fiscal Year 2025-26:

Fiscal Year 2020-21: The estimated state cost is \$1,827,000, which represents the annual investment in the Pennsylvania Statewide System of Support deployed through Intermediate Units to provide professional learning to educators.

Fiscal Year 2021-22: The estimated state cost is \$1,827,000, which represents the annual investment in the Pennsylvania Statewide System of Support deployed through Intermediate Units to provide professional learning to educators.

Fiscal Year 2022-23: The estimated state cost is \$9,258,797, which reflects a flat annual investment in the Pennsylvania Statewide System of Support to provide professional learning for educators, work to revise state assessments, and efforts to revise the state resource system for educators to align resource content with the proposed new standards. Anticipated costs include aligning the state assessment question bank to reflect the content of the updated science standards in the proposed 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 2023-24: The estimated state cost is \$2,891,071, which reflects efforts to continue refining state assessment items and resources for educators.

Fiscal Year 2024-25: 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 reflects an annual investment in the Pennsylvania Statewide System of Support to provide professional learning for educators. 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 2024-25. Estimated savings are realized through a 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.

Fiscal Year 2025-26: The estimated state cost is \$1,827,000, which reflects a flat annual investment in the Pennsylvania Statewide System of Support to provide professional learning for educators.

Estimated state costs take into account resources and collaborations, such as federal grants, that will support implementation of the proposed 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 presented in the proposed 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 proposed rulemaking would become effective upon final publication in the *Pennsylvania Bulletin*.

Sunset Date

The Board will review the effectiveness of Chapter 4 every 4 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 this proposed rulemaking and a copy of a Regulatory Analysis Form to the Independent Regulatory Review Commission (IRRC) and to the Chairpersons of the House and Senate Committees on Education. A copy of this material is available to the public upon request.

Under section 5(g) of the Regulatory Review Act, IRRC may convey any comments, recommendations or objections to the proposed rulemaking within 30 days of the close of the public comment period. The comments, recommendations or objections must specify the regulatory review criteria that have not been met. The Regulatory Review Act specifies detailed procedures for review, prior to final publication of the rulemaking, by the Board, the General Assembly and the Governor of comments, recommendations or objections raised.

Public Comments and Contact Person

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 Karen Molchanow, Executive Director, State Board of Education, 333 Market Street, Harrisburg, PA 17126, ra-stateboardofed@pa.gov. Comments must be submitted to Board within 30 days of publication of this notice of proposed rulemaking in the *Pennsylvania Bulletin*.

Persons with disabilities needing an alternative means of providing public comment may make arrangements by calling the Board at (717) 787-3787 or through the

Pennsylvania AT&T Relay Service at (800) 654-5984 (TDD) or (800) 654-5988 (voice users) to discuss how the Board may accommodate their needs.

**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).

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**.

[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) Through June 30, 2024:

(i) 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: 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) Through June 30, 2024:

- (i) *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: 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: 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.

(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.

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.]

(4) Technology and Engineering.

§ 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.]~~

(5) 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.

§ 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.]

(5) 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.

§ 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 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 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); Science and **[Technology]** and 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. §§ 121(c), (c.1)).**

(1) 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), 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)] (f) 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.] 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)]~~ *(h) Supplemental instruction.* **Beginning in the 2011-2012 school year, a** 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. § 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].~~

(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, 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. § 121.).

[VOCATIONAL-TECHNICAL] CAREER AND TECHNICAL EDUCATION

§ 4.31. [Vocational-technical] Career and Technical [e]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)] (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.

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), Science and **[Technology and]** Environment and 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 academic standards in Science, ~~[and Technology and]~~ Environment, ~~[and]~~ Ecology, Technology and Engineering under § 4.12 and contained in 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) (3) [Two assessments] One assessment aligned with select standards for Science, [and Technology and] Environment and Ecology, contained in 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.**

(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)] (i) 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 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. § 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. § 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. § 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 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 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

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.

Environment and Society

1. Identify ways that people depend on, change, and are affected by the environment.
2. Describe ways people harvest, re-distribute, and use natural resources.
3. Identify ways that places differ in their physical and human characteristics.
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 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

1. Analyze how things work.
2. Identify and use everyday symbols.
3. Describe qualities of everyday products.

Core Concepts of Technology and Engineering

1. Illustrate how systems have parts or components that work together to accomplish a goal.
2. Safely use tools to complete tasks.
3. 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

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.

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.

Environment and Society

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.

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.

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 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.

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.*

⁵ The asterisk (*) indicates that the Performance Expectation is integrating Engineering Design.

⁶ 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*.

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.

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.



pennsylvania
STATE BOARD OF EDUCATION

May 11, 2021

Mr. David Sumner
Executive Director
Independent Regulatory Review Commission
14th Floor, 333 Market Street
Harrisburg, PA 17101

Dear Mr. Sumner:

Attached is a copy of a proposed regulation 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 Commission pursuant to the Regulatory Review Act. The regulation also is being delivered today to the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin* and to the House and Senate Committees on Education.

The State Board of Education will provide the Commission with any assistance it requires to facilitate a thorough review of these proposed regulations.

Thank you for your consideration.

Sincerely,

Karen Molchanow
Executive Director

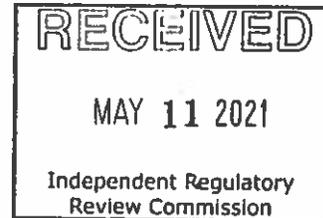
cc: Noe Ortega, Acting Secretary of Education
Thomas P. Howell, Esq.
Marisa Lehr, Esq.

Jones, Stephanie

From: Urban, Cynthia <curban@pasen.gov>
Sent: Tuesday, May 11, 2021 9:31 AM
To: Jones, Stephanie; Martin, Senator Scott
Subject: RE: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

Received. Thank you.

Cindy Urban
Executive Director
Senate Education Committee | Chairman, Senator Scott Martin
Room 351 Main Capitol
Phone: (717) 787-6535
www.SenatorScottMartinPA.com
Facebook: @SenatorScottMartinPA
Twitter: @SenatorMartinPA



From: Jones, Stephanie <stephajone@pa.gov>
Sent: Tuesday, May 11, 2021 8:40 AM
To: Urban, Cynthia <curban@pasen.gov>; Martin, Senator Scott <smartin@pasen.gov>
Subject: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)
Importance: High

Ⓢ CAUTION : External Email Ⓢ

Dear Cindy,

Attached, please find a copy of a proposed regulation approved by the State Board of Education (PA Code Cite: 22 Pa. Code Chapter 4 - Academic Standards and Assessment, #006-347). By way of this message, the Board is electronically delivering the proposed regulation for review by the Senate Education Committee pursuant to the Regulatory Review Act. Please reply to this message with a written (email) confirmation that the regulation has been received.

Regards,
Karen Molchanow

Karen Molchanow
Executive Director, State Board of Education
333 Market Street, 1st Floor, Harrisburg, PA 17126
phone: (717) 787-3787; fax: (717) 787-7306

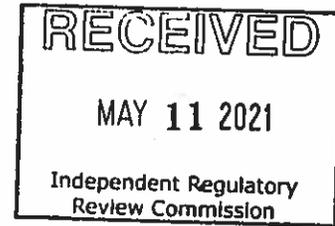
Jones, Stephanie

From: Griffin, Ardie <Ardie.Griffin@pasenate.com>
Sent: Tuesday, May 11, 2021 8:53 AM
To: Jones, Stephanie; Williams, Senator Lindsey
Subject: RE: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

Confirmed.

Thanks Karen!

Ardie Griffin | Legislative Director | Executive Director, Education
Office of Senator Lindsey M. Williams, District 38



From: Jones, Stephanie <stephajone@pa.gov>
Sent: Tuesday, May 11, 2021 8:41 AM
To: Griffin, Ardie <Ardie.Griffin@pasenate.com>; Williams, Senator Lindsey <Lindsey.Williams@pasenate.com>
Subject: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)
Importance: High

■ EXTERNAL EMAIL ■

Dear Ardie,

Attached, please find a copy of a proposed regulation approved by the State Board of Education (PA Code Cite: 22 Pa. Code Chapter 4 - Academic Standards and Assessment, #006-347). By way of this message, the Board is electronically delivering the proposed regulation for review by the Senate Education Committee pursuant to the Regulatory Review Act. Please reply to this message with a written (email) confirmation that the regulation has been received.

Regards,
Karen Molchanow

Karen Molchanow
Executive Director, State Board of Education
333 Market Street, 1st Floor, Harrisburg, PA 17126
phone: (717) 787-3787; fax: (717) 787-7306

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Jones, Stephanie

From: Christine Crone <Ccrone@pahousegop.com>
Sent: Tuesday, May 11, 2021 9:06 AM
To: Jones, Stephanie; Christine Seitz; Curt Sonney
Subject: RE: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

Received, thank you.

Christine M. Crone
Administrative Assistant II
Representative Curt Sonney
Education Committee Chairman
214 Ryan Office Building
PO Box 202004
Harrisburg PA 17120-2004
(717) 783-9087 ph.
ccrone@pahousegop.com



From: Jones, Stephanie <stephajone@pa.gov>
Sent: Tuesday, May 11, 2021 8:30 AM
To: Christine Seitz <Cseitz@pahousegop.com>; Curt Sonney <Csonney@pahousegop.com>
Cc: Christine Crone <Ccrone@pahousegop.com>
Subject: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)
Importance: High

Dear Christine,

Attached, please find a copy of a proposed regulation approved by the State Board of Education (PA Code Cite: 22 Pa. Code Chapter 4 - Academic Standards and Assessment, #006-347). By way of this message, the Board is electronically delivering the proposed regulation for review by the House Education Committee pursuant to the Regulatory Review Act. Please reply to this message with a written (email) confirmation that the regulation has been received.

Regards,
Karen Molchanow

Karen Molchanow
Executive Director, State Board of Education
333 Market Street, 1st Floor, Harrisburg, PA 17126
phone: (717) 787-3787; fax: (717) 787-7306

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Jones, Stephanie

From: Dixon, Erin <EDixon@pahouse.net>
Sent: Tuesday, May 11, 2021 9:23 AM
To: Jones, Stephanie; Longietti, Mark
Cc: Miller, Marlana M.
Subject: Re: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

Thank you, we received the regulations.

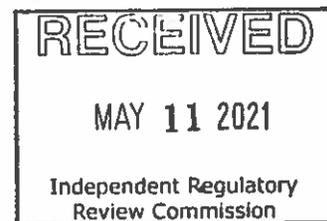
From: Jones, Stephanie <stephajone@pa.gov>
Sent: Tuesday, May 11, 2021 8:31 AM
To: Dixon, Erin <EDixon@pahouse.net>; Longietti, Mark <MLongiet@pahouse.net>
Cc: Miller, Marlana M. <MMiller@pahouse.net>
Subject: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

Dear Erin,

Attached, please find a copy of a proposed regulation approved by the State Board of Education (PA Code Cite: 22 Pa. Code Chapter 4 - Academic Standards and Assessment, #006-347). By way of this message, the Board is electronically delivering the proposed regulation for review by the House Education Committee pursuant to the Regulatory Review Act. Please reply to this message with a written (email) confirmation that the regulation has been received.

Regards,
Karen Molchanow

Karen Molchanow
Executive Director, State Board of Education
333 Market Street, 1st Floor, Harrisburg, PA 17126
phone: (717) 787-3787; fax: (717) 787-7306



Jones, Stephanie

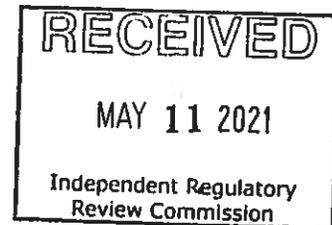
From: Bulletin <bulletin@palrb.us>
Sent: Tuesday, May 11, 2021 8:58 AM
To: Jones, Stephanie
Subject: [External] RE: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)

ATTENTION: This email message is from an external sender. Do not open links or attachments from unknown sources. To report suspicious email, forward the message as an attachment to CWOPA_SPAM@pa.gov.

Good Morning:

Thank you for sending this Proposed Rulemaking. Someone from our office will contact you regarding publication in the *Pennsylvania Bulletin*. Have a nice day.

Corinne Marut
Editorial Assistant
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From: Jones, Stephanie <stephajone@pa.gov>
Sent: Tuesday, May 11, 2021 8:47 AM
To: Bulletin <bulletin@palrb.us>
Subject: Delivery of Proposed Regulation #6-347 (22 Pa. Code Chapter 4 - Academic Standards and Assessment)
Importance: High

Dear Ms. Phelps,

Attached, please find a copy of a proposed regulation approved by the State Board of Education (PA Code Cite: 22 Pa. Code Chapter 4 - Academic Standards and Assessment, #006-347). By way of this message, the Board is electronically delivering the proposed regulation to the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin*. Please reply to this message with a written (email) confirmation that the regulation has been received.

Regards,
Karen Molchanow

Karen Molchanow
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