



**Grades 9–12**

**3.2.9-12.S Physical Science: Energy**

**Students who demonstrate understanding can** *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.*

**Clarifying Statement:** Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.

**Assessment Boundary:** Assessment is limited to systems containing two objects.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
<p><b>Developing and Using Models</b></p> <p>Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> <li>Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.</li> </ul>	<p><b>PS3.C: Relationship Between Energy and Forces</b></p> <ul style="list-style-type: none"> <li>When two objects interacting through a field change relative position, the energy stored in the field is changed.</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</li> </ul>

**Pennsylvania Context:** N/A

**PA Career Ready Skills:** Advocate for oneself in education, employment, and within the community.

**Connections to Other Standards Content and Practices**

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.01.02.02.b: Analyze how technology is used in AFNR systems to maximize productivity.
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.A. Earth's physical systems: Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large-scale and long-term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.



Standard Source	Possible Connections to Other Standard(s) or Practice(s)
<p><b>PA Core Standards: ELA</b></p>	<p>CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.</p> <p>CC.3.5.11-12.G: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>CC.3.6.9-10.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p> <p>CC.3.6.11-12.G: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p> <p>CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.</p>
<p><b>PA Core Standards and Practices: Math</b></p>	<p>MP.2: Reason abstractly and quantitatively.</p> <p>CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables.</p> <p>CC.2.4.HS.B.4: Recognize and evaluate random processes underlying statistical experiments.</p> <p>CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.</p>
<p><b>PA Standards: Social Studies</b></p>	<p>N/A</p>
<p><b>Educational Technology (ISTE)</b></p>	<p>1.6. Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.</p>
<p><b>Technology and Engineering (ITEEA)</b></p>	<p>STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.</p>