



Grades 9–12

3.3.9-12.R Earth and Space Science: Human Sustainability

Students who demonstrate understanding can *evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

Clarifying Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).

Assessment Boundary: N/A

| Science and Engineering Practices (SEP) | Disciplinary Core Ideas (DCI) | Crosscutting Concepts (CCC) |
|---|--|--|
| Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. <ul style="list-style-type: none"> Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | Human Impacts on Earth Systems <ul style="list-style-type: none"> Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. Developing Possible Solutions <ul style="list-style-type: none"> When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. | Stability and Change <ul style="list-style-type: none"> Feedback (negative or positive) can stabilize or destabilize a system. <hr/> Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World <ul style="list-style-type: none"> Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology. |

Pennsylvania Context: N/A

PA Career Ready Skills: Evaluate a situation to identify skills and strategies to prevent and resolve conflicts.



Connections to Other Standards Content and Practices

| Standard Source | Possible Connections to Other Standard(s) or Practice(s) |
|---|--|
| Agriculture (AFNR) | CS.04.01.01.c: Devise strategies for stewarding natural resources at home and within community. |
| Science, Environmental Literacy and Sustainability (NAAEE) | 9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 2.3.A. Human-environment interactions: Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences. |
| PA Core Standards: ELA | CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CC.3.5.11-12.H: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. |
| PA Core Standards and Practices: Math | MP.2: Reason abstractly and quantitatively. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. |
| PA Standards: Social Studies | 7.4.12.B: Analyze the global effects of human activity on the physical systems. |
| Educational Technology (ISTE) | 1.4. Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. |
| Technology and Engineering (ITEEA) | STEL-7Y: Optimize a design by addressing desired qualities within criteria and constraints. |