



## Grades 9–12

### 3.3.9-12.Q Earth and Space Science: Human Sustainability

**Students who demonstrate understanding can** *create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.*

**Clarifying Statement:** Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.

**Assessment Boundary:** Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
<p><b>Using Mathematics and Computational Thinking</b></p> <p>Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> <li>Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.</li> </ul>	<p><b>Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.</li> </ul>	<p><b>Stability and Change</b></p> <ul style="list-style-type: none"> <li>Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</li> </ul> <hr/> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Modern civilization depends on major technological systems.</li> <li>New technologies can have deep impacts on society and the environment, including some that were not anticipated.</li> </ul> <hr/> <p><b>Connections to Nature of Science</b></p> <p><b>Science is a Human Endeavor</b></p> <ul style="list-style-type: none"> <li>Science is a result of human endeavors, imagination, and creativity.</li> </ul>

**Pennsylvania Context:** Examples of Pennsylvania context include but are not limited to the relationships among Pennsylvania's energy resources, mining, watersheds, agricultural practices, and biodiversity.

**PA Career Ready Skills:** Evaluate how societal conventions may influence the perspectives of individuals.



### Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
<b>Agriculture (AFNR)</b>	CS.04.01.02.b: Analyze and assess sustainability practices that can be applied in AFNR systems (e.g., energy efficiency, recycle/re-use/repurpose, green resources, etc.).
<b>Science, Environmental Literacy and Sustainability (NAEE)</b>	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.
<b>PA Core Standards: ELA</b>	N/A
<b>PA Core Standards and Practices: Math</b>	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics.
<b>PA Standards: Social Studies</b>	6.1.9.B: Identify the origin of resources and analyze the impact on the production of goods and services. Analyze how unlimited wants and limited resources affect decision making.
<b>Educational Technology (ISTE)</b>	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
<b>Technology and Engineering (ITEEA)</b>	STEL-4P: Evaluate ways that technology can impact individuals, society, and the environment.