



# Environmental Science - Unit 1 - Earth as a System

## Unit Focus

Students will uncover the dynamic interaction between the Earth's four spheres and how the process of each sphere allow Earth to be a naturally self-sustaining system. Students will explore the transfer of energy and recycling of matter as they explore the biogeochemical cycles and how they function within and between Earth's spheres. Students will begin to participate in citizen scientist data collection that will continue throughout the course, as they gather baseline data to inform their understanding of natural cycles and man-made disturbances to the environment. Throughout the unit, students will develop a model of Earth's natural processes that support sustainability and use this model to explain the science of Earth's systems to a mock Congressional Panel.

## Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
<p><b>NGSS/NSTA Science &amp; Engineering Practices</b> NGSS Science &amp; Engineering Practices: 9-12</p> <ul style="list-style-type: none"> <li>Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (SE.9-12.2.3)</li> <li>Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. (SE.9-12.2.6)</li> </ul> <p><b>Next Generation Science Standards (DCI)</b> Science: 11</p> <ul style="list-style-type: none"> <li>As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (LS1.9.C3)</li> </ul> <p>Science: 9</p> <ul style="list-style-type: none"> <li>Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (ESS2.9.A1)</li> <li>The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (ESS2.9.E1)</li> </ul> <p><b>Next Generation Science Standards (content standards)</b> High School Earth and Space Sciences: 9 - 12</p>	<p><i>Students will be able to independently use their learning to...</i>  <b>T1</b> Use the scientific process to generate evidence that addresses the original questions.  <b>T2</b> Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.</p>	
	Meaning	
	Understanding(s)	Essential Question(s)
	<p><i>Students will understand that...</i>  <b>U1</b> Natural feedback mechanisms allow the Earth to continually recycle matter and transfer energy.  <b>U2</b> Disseminating credible scientific knowledge can help to inform decision and actions.  <b>U3</b> Photosynthesis and cellular respiration are key components of the global carbon cycle.  <b>U4</b> Only a fraction of the energy consumed at the lower trophic levels of a food web is transferred up, resulting in fewer organisms at higher levels.</p>	<p><i>Students will keep considering...</i>  <b>Q1</b> Why is the Earth considered a sustainable system?  <b>Q2</b> How can I explain complex concepts in a format that can be used to inform others?</p>
	Acquisition of Knowledge and Skill	
	Knowledge	Skill(s)
	<p><i>Students will know...</i>  <b>K1</b> The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide and water into sugars and released oxygen.</p>	<p><i>Students will be skilled at...</i>  <b>S1</b> Use a model to represent the various feedback mechanisms that allow Earth to be a self-sustaining system.</p>

## Stage 1: Desired Results - Key Understandings

- Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. (HSESS2-6)

High School Life Sciences: 9 - 12

- Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (HS-LS1-5)
- Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (HS-LS2-5)

### Madison Public Schools Profile of a Graduate

- Product Creation: Effectively use a medium to communicate important information. (POG.3.2)

**K2** Photosynthesis and cellular respiration provide most of the energy for life processes.

**K3** The biogeochemical cycles (carbon, hydrologic, nitrogen) all work to maintain the Earth's self-sustaining system by recycling matter.

**K4** The four sphere of Earth (atmosphere, biosphere, geosphere, and hydrosphere) are interdependent and allow the Earth to be a self-sustaining system.

**K5** The energy from the sun is transferred through the four spheres of Earth and, ultimately, out into the universe as entropy.

**S2** Accurately explain how the processes on Earth interact and depend on each other.