Phoenixville Area School District Understanding by Design (UbD) Science Template

Grade Level &/or HS Subject: Environmental Science Unit Name: Atmospheric Science

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">Overarching NGSS & PA Standards:

HS-ESS2-4
Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes.

HS-ESS2-6
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Ask questions and/or define problems
Develop and/or use models
Plan and/or carry out investigations
Analyze and interpret data using computational thinking
Obtain, evaluate, and communicate information (supported by evidence)
Construct explanations and design solutions</td></tr>
<tr><td colspan="2">Meaning-Making</td></tr>
<tr><td>Students will understand that…

Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth’s orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.

Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...

How do Earth’s major systems interact?

What regulates weather and climate?</td></tr>
<tr><td colspan="2">Knowledge and Skills Acquisition</td></tr>
<tr><td>UNDERSTANDINGS
Students will know…

ESS1.B: Earth and the Solar System
-Cyclical changes in the shape of Earth’s orbit around the sun, together with changes in the tilt of the planet’s axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.

ESS2.A: Earth Materials and Systems
-The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean</td><td>Students will be skilled at…

• Identifying and describing components of a model
• Identifying and describing relationships
• Making connections
• Developing a model
• Organizing data
• Interpreting data</td></tr>
</table>

Which branch(es) of science apply: **LS PS** **E&SS**	circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ESS2.D: Weather and Climate -The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. -Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. -Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.	
	KEY VOCABULARY weather, climate, ozone, aerosols, troposphere, stratosphere, mesosphere, thermosphere, environmental lapse rate, revolution, rotation, Tropic of Cancer, Tropic of Capricorn, inclination of the axis, convection, radiation, albedo, latent heat, saturation, relative humidity, dew-point temperature	

Stage 2 – Evidence		
Evaluative Criteria	***Assessment Evidence***	
Project Rubrics Labs Quizzes Tests	PERFORMANCE TASK(S): HS-ESS2-4 • From the given model, students identify and describe the components of the model relevant for their mechanistic descriptions. Given models include at least one factor that affects the input of energy, at least one factor that affects the output of energy, and at least one factor that affects the storage and redistribution of energy. Factors are derived from the following list: o Changes in Earth's orbit and the orientation of its axis o Changes in the sun's energy output o Configuration of continents resulting from tectonic activity o Ocean circulation o Atmospheric composition o Atmospheric circulation o Volcanic activity o Glaciation o Changes in extent or type of vegetation cover	Differentiation Considerations:

	○ Human activities • From the given model, students identify the relevant different time scales on which the factors operate • Students identify and describe the relationships between components of the given model, and organize the factors from the given model into three groups: ○ Those that affect the input of energy ○ Those that affect the output of energy ○ Those that affect the storage and redistribution of energy • Students describe* the relationships between components of the model as either causal or correlational. • Students use the given model to provide a mechanistic account of the relationship between energy flow in Earth's systems and changes in climate, including: ○ The specific cause and effect relationships between the factors and the effect on energy flow into and out of Earth's systems ○ The net effect of all the competing factors in changing the climate. HS-ESS2-6 • Students use evidence to develop a model in which they: ○ Identify the relative concentrations of carbon present in the hydrosphere, atmosphere, geosphere, and biosphere; and ○ Represent carbon cycling from one sphere to another. • In the model, students represent and describe* the following relationships between components of the system, including: ○ The biogeochemical cycles that occur as carbon flows from one sphere to another ○ The relative amount of and the rate at which carbon is transferred between spheres ○ The capture of carbon dioxide by plants; and ○ The increase in carbon dioxide concentration in the atmosphere due to human activity and the effect on climate. • Students use the model to explicitly identify the conservation of matter as carbon cycles through various components of Earth's systems. • Students identify the limitations of the model in accounting for all of Earth's carbon.	

Question Accuracy Project Rubrics	OTHER EVIDENCE: Optional • Project • Labs • Unit Test	Differentiation Considerations: