Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

HS-ESS2-6

Students who demonstrate understanding can:

HS-ESS2-6. **Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.** [Clarification Statement: 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.]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences 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 world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.

Crosscutting Concepts

Energy and Matter

- The total amount of energy and matter in closed systems is conserved.

Observable features of the student performance by the end of the course:

1	Components of the model		
	a	Students use evidence to develop a model in which they:	
		i.	Identify the relative concentrations of carbon present in the hydrosphere, atmosphere, geosphere and biosphere; and
		ii.	Represent carbon cycling from one sphere to another.
2	Relationships		
	a	In the model, students represent and describe* the following relationships between components of the system, including:	
		i.	The biogeochemical cycles that occur as carbon flows from one sphere to another;
		ii.	The relative amount of and the rate at which carbon is transferred between spheres;
		iii.	The capture of carbon dioxide by plants; and
		iv.	The increase in carbon dioxide concentration in the atmosphere due to human activity and the effect on climate.
3	Connections		
	a	Students use the model to explicitly identify the conservation of matter as carbon cycles through various components of Earth's systems.	
	b	Students identify the limitations of the model in accounting for all of Earth's carbon.	