

## HS-LS2-5

Students who demonstrate understanding can:

**HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> 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).</p> <ul style="list-style-type: none"> <li>Develop a model based on evidence to illustrate the relationships between systems or components of a system.</li> </ul>	<p><b>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</b></p> <ul style="list-style-type: none"> <li>Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.</li> </ul> <p><b>PS3.D: Energy in Chemical Processes</b></p> <ul style="list-style-type: none"> <li>The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. <i>(secondary)</i></li> </ul>	<p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter and information flows — within and between systems at different scales.</li> </ul>

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

1	Components of the model	<p>a Students use evidence to develop a model in which they identify and describe* the relevant components, including:</p> <p>i. The inputs and outputs of photosynthesis;</p> <p>ii. The inputs and outputs of cellular respiration; and</p> <p>iii. The biosphere, atmosphere, hydrosphere, and geosphere.</p>
2	Relationships	<p>a Students describe* relationships between components of their model, including:</p> <p>i. The exchange of carbon (through carbon-containing compounds) between organisms and the environment; and</p> <p>ii. The role of storing carbon in organisms (in the form of carbon-containing compounds) as part of the carbon cycle.</p>
3	Connections	<p>a Students describe* the contribution of photosynthesis and cellular respiration to the exchange of carbon within and among the biosphere, atmosphere, hydrosphere, and geosphere in their model.</p> <p>b Students make a distinction between the model's simulation and the actual cycling of carbon via photosynthesis and cellular respiration.</p>