

HS-LS1-5

Students who demonstrate understanding can:

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]

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 worlds.

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

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.

Crosscutting Concepts

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

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

1	Components of the model								
a	From the given model, students identify and describe the components of the model relevant for illustrating that photosynthesis transforms light energy into stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen, including: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>i.</td> <td>Energy in the form of light;</td> </tr> <tr> <td>ii.</td> <td>Breaking of chemical bonds to absorb energy;</td> </tr> <tr> <td>iii.</td> <td>Formation of chemical bonds to release energy; and</td> </tr> <tr> <td>iv.</td> <td>Matter in the form of carbon dioxide, water, sugar, and oxygen.</td> </tr> </table>	i.	Energy in the form of light;	ii.	Breaking of chemical bonds to absorb energy;	iii.	Formation of chemical bonds to release energy; and	iv.	Matter in the form of carbon dioxide, water, sugar, and oxygen.
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2	Relationships								
a	Students identify the following relationship between components of the given model: Sugar and oxygen are produced by carbon dioxide and water by the process of photosynthesis.								
3	Connections								
c	Students use the given model to illustrate: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>i.</td> <td>The transfer of matter and flow of energy between the organism and its environment during photosynthesis; and</td> </tr> <tr> <td>ii.</td> <td>Photosynthesis as resulting in the storage of energy in the difference between the energies of the chemical bonds of the inputs (carbon dioxide and water) and outputs (sugar and oxygen).</td> </tr> </table>	i.	The transfer of matter and flow of energy between the organism and its environment during photosynthesis; and	ii.	Photosynthesis as resulting in the storage of energy in the difference between the energies of the chemical bonds of the inputs (carbon dioxide and water) and outputs (sugar and oxygen).				
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