

Promoting the Use of Educational Technology in Learning and Teaching in Science (S1-3) Learning and Teaching Resources

Photosynthesis

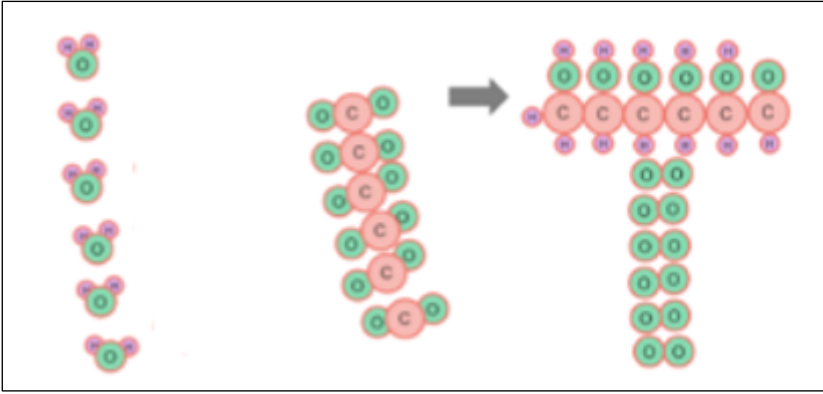


Part A: Background and connections	
Topic	Photosynthesis
Relevant theme, topic and learning focus	Matter transformation and conservation in photosynthesis
Prior knowledge	<ul style="list-style-type: none"> Photosynthesis is the process that plants make their own food Matter is made up of particles (specifically different atoms)
Previous and subsequent learning activities	<p><u>Previous learning activity:</u></p> <ul style="list-style-type: none"> Discuss the characteristics plants as living things and direct student attention to nutrition. <p><u>Subsequent learning activity:</u></p> <p>Discuss student design on the experiment that aims to collect and test for the gas produced in photosynthesis and conduct the experiment with revised design.</p>

Part B: Details of the learning activity	
Description	<p>This learning activity involves the use of a technological platform, <i>DragGame</i>, to support students' understanding of the chemical reactions in photosynthesis at the sub-microscopic level and reasoning about matter transformation and conservation.</p> <p>Students are invited to suggest what plants need to grow. They are then grouped to perform fair tests on different factors they suggested. After developing a consensus that carbon dioxide and sunlight are essential factors for photosynthesis with class discussion, teacher suggests water as another essential factor and introduces photosynthetic products, which are simplified as glucose.</p> <p>Students develop explanations of how matter is rearranged and conserved in the carbon-transforming processes of photosynthesis by creating linkages between their observations in the practical work and their constructed particle diagrams</p>
Learning objectives	<p><i>After the lessons, students should be able to:</i></p> <p><u>Knowledge</u></p> <ul style="list-style-type: none"> state that carbon dioxide, water and light are essential factors for photosynthesis explain the formation of photosynthetic products in terms of rearrangement of atoms of the carbon dioxide and water write the word (and chemical) equation of photosynthesis realise that the number of atoms is conserved in photosynthesis <p><u>Skills</u></p> <p>conduct fair test to identify essential factors for photosynthesis</p>

Segment time	100 minutes
Materials	<p>Student Worksheet</p> <p>1 tablet computer per student (or pair/trios of students)</p> <p><i>DragGame</i> activity, available at: https://draggame.e-learning.hk/zh-hant/templates/281/view/</p> <p>Assignment Task sheet</p>

Part C: Implementation	
<p>Engagement (Whole class; individual work) (10 minutes)</p>	<p>Students are asked to define if plants are living things using the seven characteristics that they have previously learned in groups.</p> <p>The teacher directs students' attention to nutrition and introduces photosynthesis as the process that plants make their own food. Students are asked to suggest what plants need to grow and write them on the blackboard.</p>
<p>Exploration (60 minutes) (Group work)</p>	<p>The teacher then groups the ideas and assigns students to conduct fair tests on different factors they suggested in groups.</p> <p>Students are asked to identify the independent variable, dependent variable and control variable. The teacher then introduces the procedures for testing if the photosynthetic product is present and discuss the rationale behind the procedures with students. Students are asked to record their observations by taking pictures and justify if the factor under study is essential for photosynthesis.</p> <p>After that, they share their results with the class and the teacher guides the class to develop a consensus on the teacher develops consensus with the class that carbon dioxide and sunlight are essential factors for photosynthesis.</p>
<p>Explanation (20 minutes)</p>	<p>The teacher simplifies the photosynthetic products as glucose and introduces the particle diagram of glucose. Students are asked to suggest the symbols for carbon dioxide and water based on their prior knowledge. The teacher then introduces the particle diagrams of carbon dioxide and water.</p> <p>The teacher asks students <i>how</i> carbon dioxide and water transform into glucose. Students are asked to use the <i>DragGame</i> activity to represent how the raw materials (i.e., carbon dioxide and water) transform into glucose.</p> <p>**The DragGame activity is designed for student to make sense with matter transformation and conservation. Its intended purpose is NOT for representing glucose as the primary photosynthetic product and glucose always exists in non-cyclic form.</p> <p>Students first share their particle diagrams and then discuss difficult <i>DragGame</i> particle diagrams assigned in a group. Students</p> <p>(1) compare the assigned diagram with their diagram and evaluate which</p>

	<p>diagram better represents what happens at the particle level for explaining how matter transforms.</p> <p>(2) give reason for their choice.</p> <p>The teacher jots down key ideas from each group and press students to explain key ideas:</p> <ul style="list-style-type: none"> - the raw materials should be carbon dioxide and water particles instead of separate carbon, oxygen and hydrogen atoms. - The number of the atoms remains unchanged because the atoms of the products originate from the raw materials. - The atoms of the raw materials split, rearrange, and combine to form the product. - Energy and matter cannot interchange. <p>The teacher directs students to a <i>DragGame</i> diagram showing the formation of oxygen and asks student what can be predicted from the diagram. Students are also asked to try construct a chemical equation for the matter transformation in photosynthesis.</p> 
<p>Summary and preparation for the next lesson (15 minutes)</p>	<p>The teacher invites students to summarise the key ideas about matter transformation and conservation in photosynthesis and highlight the use of the diagram in predicting the formation of oxygen.</p> <p>The teacher assigns Assignment Task Sheet (Appendix 2) as a take-home assignment that asks students to suggest ways to collect and test for the gas produced in photosynthesis.</p>

<p style="text-align: center;">Part D: Extensions</p>	
<p>Possible adaptations / extensions / modifications</p>	<p>After the learning activity, teachers can discuss with students the role of sunlight with the students as the energy need to split the atoms of the raw materials.</p>
<p>Assessment</p> <p>On-the-fly formative assessment</p>	<p>Teachers can conduct on-the-fly formative assessments by making strategic adjustment in instruction based on students' generated diagrams in the <i>DragGame</i> activity. The following shows some possible student responses:</p> <ul style="list-style-type: none"> - Raw materials: raw materials exist as atoms - No. of atoms: the number of atoms is not conserved. Some are created or some disappear.

Notes to teachers for effective implementation

- Teachers should create an open and warm classroom environment for students to expose their ideas and share their thoughts publicly.
- Teachers can use any instant collaborative editor (e.g., Google doc) to collect results from the group practical work.
- Teachers can ask students to clarify their *Drag Game* drawings and elaborate on their thought and reasoning using dialogic moves (e.g., *Say more, Press for reasoning*).
- Teachers can repeat, acknowledge and revoice students' ideas and invite other students to comment on their ideas using dialogic moves (e.g., *Revoice, Agree/disagree, Add on*).
- Teachers can try to make use of and refer to student ideas when guiding the class to build a class consensus when building explanations so that students think that their ideas are valued by the teacher.
- Teachers can ask about the role of sunlight in photosynthesis and briefly the idea of energy transformation to enhance connection of ideas between different units within the junior science curriculum although it is not the major objective of this lesson.