Energy in Cells
Photosynthesis and Respiration
7th grade science

Tina Taylor
Introduction
Power Plants in Cells

Grade level: 7th grade science

Target group: 7th grade science class and integrated English Language students

Written material:

Time: 4-6 periods

Content Objectives:
1. Describe the process photosynthesis?
2. Describe the two stages of respiration?

Language Objectives:
1. Write questions and predictions to surveying the text on photosynthesis and respiration.
2. Discuss predictions made to the questions made from surveying the lab.
3. Write observation to photosynthesis lab

Sources:
1. biologycorner.net
2. Prentice Hall Science Explorer
Lesson 1
<table>
<thead>
<tr>
<th>Function</th>
<th>Situation/Topic</th>
<th>Expression</th>
<th>Vocabulary</th>
<th>Grammar</th>
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</thead>
</table>
| 1. Write |                | - _____ is the process in which plants take sunlight and make food.  
  - Plants take in Carbon dioxide _____ and let out _____ ____.  
  - Photosynthesis occurs in the _____. | - Energy  
- Osmosis  
- Oxygen  
- Sugar  
- Carbon dioxide  
- Sunlight  
- Water  
- Photosynthesis  
- Respiration  
- Heterotroph  
- Autotroph  
- Chlorophyll  
- Energy | - verbs  
- nouns  
- Basic chemical equation |
| 2. Discuss | 1. write about the process of photosynthesis | | | |
## Lesson objectives

**Energy in a Cell**

**Grade 7**

<table>
<thead>
<tr>
<th><strong>Level 5</strong></th>
<th><strong>Level 4</strong></th>
<th><strong>Level 3</strong></th>
<th><strong>Level 2</strong></th>
<th><strong>Level 1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read: process of photosynthesis</td>
<td>Complete guided reading that explains the process of photosynthesis. This includes the products and byproducts of each process</td>
<td>Complete guided reading that explains the process of photosynthesis. This includes the products and byproducts of each process, using a vocabulary list for aid in reading</td>
<td>Complete modified reading that explains the process of photosynthesis. Reading will be simplified with just the important information in text.</td>
<td>Read a modified text that has been rewritten with just the important information to read. Teacher has underlined specific information.</td>
</tr>
<tr>
<td>Write: question and predict answers to surveyed paragraph photosynthesis</td>
<td>Write question and prediction to surveyed paragraph.</td>
<td>Write question and prediction to surveyed paragraph. Teacher will model the activity.</td>
<td>Write question and prediction to surveyed paragraph. Teacher will model the activity and sentence frame will be posted on board.</td>
<td>Copy question and predictions.</td>
</tr>
<tr>
<td>Speak: share Question and predictions when they survey the text with the group supporting their reasoning</td>
<td>share Question and predictions when they survey the text with the group supporting their reasoning</td>
<td>Share Question and predictions when they survey the text with the group supporting their reasoning after teacher models the speaking.</td>
<td>Share Question and predictions when they survey the text with the group supporting their reasoning after teacher models the speaking with the aid of sentence starters on the board.</td>
<td>Point to possible predictions in reading when group in group discussion.</td>
</tr>
</tbody>
</table>
Class: 7th grade science
Unit: Energy in a cell
Topic: Photosynthesis and respiration

Content Objectives:
1. Explain how all living things get their energy from the sun.
2. Describe the process of photosynthesis.

Language objectives:
1. Read the text on photosynthesis and respiration.
2. Write the answers to the guiding questions on the readings.
3. Discuss the answers to the text with partners.

Time: 2 days, 2 periods

Activity:
Warm up – 5 minutes –
- Teacher will provide a specimen of a plant and the class pet (if class does not have pet use pictures).
- Teacher will model what a response will look like out loud and on board.
  - The plant needs water to grow.
  - The animal needs ____________.
- Class will make a list of what each needs to live in science journal.
- Teacher and class will discuss what each organism needs for energy.
- Teacher will then explain the lesson and language objectives using warm up as a stepping stone:
  - Teacher will say: So what you are telling me is that plants need (input student answers form warm up) and animals need (input warm up answers) to make energy. Today's objectives are: in put CO and LO

Activity:
1. Teacher will assign reading in photosynthesis text pages 44- 53.
2. Teacher assigns groups according to EL level.
3. Text is modified according to level. (see worksheets)
4. Teacher will introduce reading activity Squeepers
   a. Survey text and write Questions (10 minutes)
      i. Students will look on the assigned paragraph to read.
      ii. Teacher will model the activity by thinking out loud the thought process, having an example for each paragraph on the board.
        1. Teacher will say: The heading of the paragraph #4 is sources of Energy.
        2. Question: Where does energy come from?
        3. Teacher will think out loud: It has sunlight going into a leaf in the diagram.
        4. Question: Why do leaves need sunlight?
<table>
<thead>
<tr>
<th>Question</th>
<th>prediction</th>
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</table>

b. Predicting (5 minute)
   i. Students will predict (on word wall) the answers to the questions they have thought of when surveying the reading.

c. Reading (15 minute)
   i. Students will read modified text in a group and answer the questions through high lighting, or underlining the answers.

d. Respond
   i. Students will discuss the answer to the questions using their predictions they have made and if needed sentence frames
      1. Photosynthesis is ________.
      2. Energy comes from ____________.
      3. The two steps of photosynthesis are ________.

e. Summarize
   i. One student from each group will explain the groups section of the reading.
   ii. Teacher will point out the answers of the questions that agree with the objectives.
   iii. Teacher will provide a starting phrase to guide the students.
      1. The paragraph my group read is about ________
      2. Out paragraph was about ________

f. Close teacher will review the content objectives which the students will indicate how well they met them with a chop of fingers
   i. 1 finger - can’t met objective
   ii. 2 fingers - I can’t meet objective but I made progress towards it
   iii. 3 fingers – I can fully meet the objective

5. Homework – Complete reading of photosynthesis using guided reading questions.

Day 2
Warm up – 5 minutes
- What do plants need to make energy?
- Teacher will have a picture of a plant in sunlight and a plant’s roots absorbing water and a person breathing out.
- Sentence fragment
  o Plants need ____________, ____________, and ____________ to make energy to live
- Students will record answer in journal.
- Teacher will review the language and content objectives.
Activity: 30 minutes
- Teacher will provide interactive notes on photosynthesis and how plants make energy from sunlight. (see slides provided) Teacher will provide diagrams for students.
- During slides teacher will have vocabulary words on the board. As the explanation progresses students are encouraged to point out the vocabulary words on the board and write the definitions, or draw a representation next to the words on the board. (see functional notional chart)
- Through the slide presentation the teacher will ask the class as a whole to provide explanations to questions based off of the reading and guided questions from the guided reading questions provided.
- Questions:
  - What does all life on earth need to make energy?
  - What do plants need to make energy?
  - How many steps are there in photosynthesis?
  - What gas do animals’ people use that plants expel?
  - Would you expect a plant to expel more oxygen on a sunny or cloudy day?
- Teacher will review objectives at the end of the power point.
- Close: 10 minutes
- Students will use graphic organizer to review the steps of photosynthesis.
- Teacher will provide starter sentences for the EL students on the handout. (see handout)
Photosynthesis

Reading Preview

Key Concepts
How does the sun supply living things with the energy they need?

What happens during the process of photosynthesis?

Key Terms
photosynthesis • autotroph
heterotroph • pigment
chlorophyll • stomata

Target Reading Skill
sequencing A sequence is the order in which the steps in a process occur. As you read, create a flowchart that shows the steps in photosynthesis. Put each step in a separate box in the flowchart in the order in which it occurs.

Steps in Photosynthesis

- Sunlight strikes leaf.
- Chlorophyll captures light energy.

Lab zone Discover Activity

Where Does the Energy Come From?

1. Obtain a solar-powered calculator that does not use batteries. Place the calculator in direct light.
2. Cover the solar cells with your finger. Note how your action affects the number display.
3. Uncover the solar cells. What happens to the number display?
4. Now cover all but one of the solar cells. How does that affect the number display?

Think It Over

Inferring From your observations, what can you infer about the energy that powers the calculator?

On a plain in Africa, a herd of zebras peacefully eat the grass. But watch out—the zebras’ grazing will soon be harshly interrupted. A group of lions is about to attack the herd. The lions will kill one of the zebras and eat it.

Both the zebras and the lions use the food they eat to obtain energy. Every living thing needs energy. All cells need energy to carry out their functions, such as making proteins and transporting substances into and out of the cell. The zebra’s meat supplies the lion’s cells with the energy they need, just as the grass provides the zebra’s cells with energy. But plants and certain other organisms, such as algae and some bacteria, obtain their energy in a different way. These organisms use the energy in sunlight to make their own food.
The sun is the source of energy for most living things.

**Figure 1**

*Energy From the Sun*

The sun supplies energy for most living things, directly or indirectly. How does sunlight provide food for the zebra?

**Sources of Energy**

The process by which a cell captures energy in sunlight and uses it to make food is called **photosynthesis** (foh toh SIN thuh sis). The term photosynthesis comes from the Greek words *photo*, which means “light,” and *synthesis*, which means “putting together.”

Nearly all living things obtain energy either directly or indirectly from the energy of sunlight captured during **photosynthesis**. Grass obtains energy directly from sunlight, because it makes its own food during photosynthesis. When the zebra eats the grass, it gets energy that has been stored in the grass. Similarly, the lion obtains energy stored in the zebra. The zebra and lion both obtain the sun’s energy indirectly, from the energy that the grass obtained through photosynthesis.

Plants manufacture their own food through the process of photosynthesis. An organism that makes its own food is called an **autotroph** (AWT oh trahf). An organism that cannot make its own food, including animals such as the zebra and the lion, is called a **heterotroph** (HET ur oh trahf). Many heterotrophs obtain food by eating other organisms. Some heterotrophs, such as fungi, absorb their food from other organisms.

*Reading Checkpoint*

What are autotrophs?

**Figure 2**

*Autotrophs and Heterotrophs*

Grass, which makes its own food during photosynthesis, is an autotroph. Zebras and lions are heterotrophs, because they cannot make their own food.
The Two Stages of Photosynthesis

Photosynthesis is a complex process. During photosynthesis, plants and some other organisms use energy from the sun to convert carbon dioxide and water into oxygen and sugars. The process of photosynthesis is shown in Figure 3. You can think of photosynthesis as taking place in two stages: capturing the sun’s energy and producing sugars. You’re probably familiar with many two-stage processes. To make a cake, for example, the first stage is to combine the ingredients to make the batter. The second stage is to bake the batter. To get the desired result—the cake—both stages must occur in the correct order.

Stage 1: Capturing the Sun’s Energy

The first stage of photosynthesis involves capturing the energy in sunlight. In plants, this energy-capturing process occurs mostly in the leaves. Recall that chloroplasts are green organelles inside plant cells. The green color comes from pigments, colored chemical compounds that absorb light. The main photosynthetic pigment in chloroplasts is chlorophyll.

Chlorophyll functions in a manner similar to that of the solar “cells” in a solar-powered calculator. Solar cells capture the energy in light and use it to power the calculator. Similarly, chlorophyll captures light energy and uses it to power the second stage of photosynthesis.

Stage 1
Chloroplasts in plant cells capture energy from sunlight.

Stage 2
The captured light energy is used to produce sugars and oxygen from water and carbon dioxide.

Carbon dioxide enters the leaf through openings called stomata.

Water enters the plant through roots and moves upward to the leaf.
The Photosynthesis Equation The events of photosynthesis can be summed up by the following chemical equation:

\[
\text{light energy} \quad 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \quad \rightarrow \quad \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2
\]

carbon dioxide water a sugar oxygen

Notice that the raw materials—six molecules of carbon dioxide and six molecules of water—are on the left side of the equation. The products—one molecule of a sugar and six molecules of oxygen—are on the right side of the equation. An arrow, which you can read as "yields," connects the raw materials to the products. Light energy, which is necessary for the chemical reaction to occur, is written above the arrow.

What happens to the sugar produced in photosynthesis? Plant cells use some of the sugar for food. The cells break down the sugar molecules to release the energy they contain. This energy can then be used to carry out the plant’s functions. Some sugar molecules are converted into other compounds, such as cellulose. Other sugar molecules may be stored in the plant's cells for later use. When you eat food from plants, such as potatoes or carrots, you are eating the plant's stored energy.

In the photosynthesis equation, what does the arrow mean?

Section 1 Assessment

Target Reading Skill Sequencing Use your flowchart about photosynthesis to help answer Question 2.

Reviewing Key Concepts
1. a. Reviewing Why do living things need energy?
   b. Explaining How do plants obtain energy?
   c. Applying Concepts An insect eats a leaf. Explain how the insect depends on the sun for energy.

2. a. Reviewing What chemical equation sums up the events of photosynthesis?
   b. Comparing and Contrasting What are the substances needed for photosynthesis? What substances are produced during photosynthesis?
   c. Making Generalizations Would you expect a plant to produce more oxygen on a cloudy day or a sunny day? Explain.

Job Qualifications When people apply for jobs, they often must complete a job application form in which they describe their qualifications for a job. Suppose that you are a leaf, and that you are applying for a job in a photosynthesis factory. Write a paragraph in which you summarize your qualifications for the job of photosynthesis. Your paragraph should include the following words: chloroplasts, chlorophyll, light, energy, water, carbon dioxide, and stomata.
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The sun is the source of energy for most living things.

Plants such as grass use energy from the sun to make their own food.

The zebra obtains energy by eating grass.

The lion obtains energy by feeding on the zebra.

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The sun supplies energy for most living things, directly or indirectly. How does sunlight provide food for the zebra?

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Stage 2 The captured light energy is used to produce sugars and oxygen from water and carbon dioxide.

Carbon dioxide enters the leaf through openings called stomata.

Water enters the plant through roots and moves upward to the leaf.
Stage 2: Using Energy to Make Food  In the next stage of photosynthesis, the cell uses the captured energy to produce sugars. The cell needs two raw materials for this stage: water (H₂O) and carbon dioxide (CO₂). In plants, the roots absorb water from the soil. The water then moves up through the plant’s stem to the leaves. Carbon dioxide is one of the gases in the air. Carbon dioxide enters the plant through small openings on the undersides of the leaves called stomata (STOH muh tuh) (singular stoma). Once in the leaves, the water and carbon dioxide move into the chloroplasts.

Inside the chloroplasts, the water and carbon dioxide undergo a complex series of chemical reactions. The reactions are powered by the energy captured in the first stage. These reactions produce chemicals as products. One product is a sugar that has six carbon atoms. Six-carbon sugars have the chemical formula C₆H₁₂O₆. Recall that sugars are a type of carbohydrate. Cells can use the energy in the sugar to carry out important cell functions.

The other product of photosynthesis is oxygen (O₂), which exits the leaf through the stomata. In fact, almost all the oxygen in Earth’s atmosphere was produced by living things through the process of photosynthesis.

Looking at Pigments
You can observe the pigments in a leaf.

1. Cut a strip 5 cm by 20 cm out of a paper coffee filter.
2. Place a leaf on top of the paper strip, about 2 cm from the bottom.
3. Roll the edge of a dime over a section of the leaf, leaving a narrow band of color on the paper strip.
4. Pour rubbing alcohol into a plastic cup to a depth of 1 cm. Stand the paper strip in the cup so the color band is about 1 cm above the alcohol. Hook the other end of the strip over the top of the cup.
5. After 10 minutes, remove the paper strip and let it dry. Observe the strip.
6. Wash your hands.

Inferring. What does the paper strip’s appearance reveal about leaf pigments?
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Photosynthesis (pages 44–48)

Sources of Energy (page 45)

Key Concept: Nearly all living things obtain energy either directly or indirectly from the energy of sunlight captured during photosynthesis.

- Photosynthesis (foh toh sin thuh sis) is what happens when cells take in the energy in sunlight and use it to make food.
- Plants make their own food by photosynthesis. Plants get energy directly from sunlight.
- Animals cannot make their own food. Animals get food by eating plants or by eating other animals that eat plants. So, animals get the sun’s energy indirectly.

Answer the following questions. Use your textbook and the ideas above.

   a. Animals get food.
   b. Plants make food using the sun’s energy.
   c. The sun shines on plants.

2. Look at the picture of the zebra eating grass. Which gets energy indirectly from the sun, the grass or the zebra? ________________

[Image of a zebra eating grass]

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The Two Stages of Photosynthesis
(pages 46–48)

Key Concept: During photosynthesis, plants and some other organisms use energy from the sun to convert carbon dioxide and water into oxygen and sugars.

- In the first stage, or part, of photosynthesis, plants take in the energy in sunlight. Remember, plant cells have special organelles called chloroplasts. Chloroplasts absorb the energy in sunlight.
- In the second stage of photosynthesis, plant cells use the captured energy to make food. To do this, plant cells need water and carbon dioxide.
- Plants get water by absorbing it from the soil with their roots. Carbon dioxide gas enters the leaves through small openings on the leaves.
- Inside the chloroplasts, water and carbon dioxide go through a series of chemical reactions. The energy captured from the sun powers these reactions.
- One product of these chemical reactions is sugar. Plant cells use the energy from some of this sugar to carry out cell activities. Some of this sugar is changed to carbohydrates that make up plant structures. Any unused sugar is stored in the plant for later use.
- The other product of photosynthesis is oxygen. Oxygen goes out of the leaf through the same small openings that carbon dioxide entered the leaf.

Answer the following questions. Use your textbook and the ideas above.

3. Is the following sentence true or false? In the first stage of photosynthesis, plant cells make sugar. _________
4. Draw a line from each event in photosynthesis to the stage of photosynthesis in which it occurs. Stages of photosynthesis may be used more than once.

**Stage of Photosynthesis** | **Event in Photosynthesis**
---|---
first stage | a. series of chemical reactions
second stage | b. oxygen released

5. Fill in the concept map below about photosynthesis.

```
Photosynthesis

raw materials are
Carbon dioxide

products are
Oxygen

a. 

b. 
```
Guided reading
Photosynthesis

1. Define words using your own words and draw a diagram that represents word.
   a. photosynthesis
   b. heterotroph
   c. autotroph
   d. chlorophyll

2. Where do all living things get energy either indirectly or directly?

3. How many stages does photosynthesis have and where do they take place?

4. What happens in the first stage of photosynthesis?

5. What happens in the second stage of photosynthesis?

6. Write out the photosynthesis equation.
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raw materials are

Carbon dioxide
  a. __________________

products are

Oxygen
  b. __________________
```
Photosynthesis

1. Explain how all living things get their energy from the sun.
2. Describe the process of photosynthesis.
3. Read text on photosynthesis.
4. Write and discuss questions and predictions on the reading assigned.

Photosynthesis

- Where does all energy come from on Earth?

From the sun

1. Grass gets energy from sun
2. Zebra eats grass
3. Lion eats zebra

Autotroph

- Organism that makes its own food
  - Plants
    - Make food by photosynthesis

Heterotroph

- Organism that can not make food.
- Needs to eat
- Lions – eat animals
- Elephants - eat plants

Photosynthesis

- process that cells capture sunlight and use it to make food
2 stages

1. Sunlight captured in leaves

2. Carbon dioxide and water use sunlight energy to make food

Photosynthesis equation

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]
C13 Energy From the Sun

Sun
Grass
Zebra
Lion
Two Stages of Photosynthesis

Stage 1
- Light
- Chloroplasts

Stage 2
- Carbon dioxide
- Water
- Sugars
- Oxygen
- Stoma
Carbon Dioxide + Water + Light Energy → Sugar + Oxygen
Lesson 2
Class: 7th grade science
Unit: Energy in Cells
Topic: Testing for photosynthesis

Objectives:
1. Prove through experimentation that plant expel carbon dioxide during photosynthesis.

Language objective:
1. Write answers to observations from experiment to test that a plant gives off Carbon Dioxide during photosynthesis.

Time: 2 days
Materials: see lab worksheets
Vocabulary: Blue dye, foil, beaker, stopper, straw, Yellow, blue, test tube, light source
- Teacher will have vocabulary at the front of the room along with corresponding definition, and pictures throughout the lab

Activities:
Warm up - 5 minutes:
- Teacher will blow into a beaker with a blue dye in it.
- **Teacher will then ask the question what changed the color of the blue dye to yellow. Is it the carbon dioxide we breathe out or the oxygen we breathe in?**
  - Yellow = carbon dioxide  blue = oxygen (written on board)
- Students will answer the question in their science journal.
- Teacher will review the objectives at the beginning of class by summarizing what the materials and byproducts are for photosynthesis and how they relate to the colors in the beaker. Teacher will use the equation found in the reading and pictures below each material in equation as show below while explaining that changes dye to oxygen for yellow and carbon dioxide as blue.

\[
6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow C_6\text{H}_{12}\text{O}_6 + 6\text{O}_2
\]

1. Teacher will provide materials and procedure for the lab on photosynthesis.
2. 5 minutes - Students will, in assigned group to read modified procedure of lab. Students will be grouped with El students and Ei helper students
3. 10 minutes - Teacher will then read lab out loud to the students then model the set up of the lab using pictures and answering questions as needed. (see procedure of lab)
4. Teacher will leave model of set up of lab out for students to reference.
5. 20 minutes – students will set up lab as procedure instructs.
a. Teacher will have model available for reference, and guide students through set up. Steps with pictures will be on the board.

6. Close – Students will share the predictions out loud with the class using sentence frames: I predict the liquid will be _______. Blue or red

7. Teacher will ask for a raise of hands who thinks the beakers will stay blue and who thinks it will be clear?

Day 2 -
Warm up – 5 minutes –
- Teacher will have picture of photosynthesis equation on the board and students will write the corresponding materials below the pictures

- Teacher will ask students to explain the content objective of the lab.
  - Teacher will ask what the purpose of the lab is.
  - Teacher will have the sentence starter for students who need it:
    - The purpose of the lab is to prove that ___________ expels
      - Teacher will then ask students: If the plant in the lab goes through photosynthesis what color should the solution in the beaker be yellow or blue?
      - Teacher will use language objectives to explain what the students are supposed to write and answer in the lab.

Activity –
1. 10 minutes – Students will observe and collect data from ongoing lab.
   Teacher will provide visuals on the board and on the lab worksheets for the groups to reference the outcomes. (see lab worksheets)
   a. Teacher will model the observation of the lab by using a chart like the chart on the lab.
   b. Teacher will say: The first test tube looks blue. The teacher will write the observation into the correct section of the lab, and draw a diagram of the test tube for EL 1 and 2.
   c. Teacher will model each test tube in this manner and draw the test tube of each trial.
   d. Teacher will also provide sentence starters for EL 3 and Sentence frames for EL 2. Provided with the experiment.

2. 20 minutes – Students will answer modified questions for the lab using Sentence frames for EL2, sentence starters for EL3 and a vocabulary list for EL 4 found with the respective modified labs. Students will work with the partner assigned EL and EL helper. Teacher will walk around the room guide students through their observations and questions.

3. 10 minutes - Close – Students will share their findings with the class.
   Through teacher questioning by tossing a tennis ball to different groups asking:
a. What color was your test tube #1, blue or yellow?
b. What color was your test tube #2, blue or yellow?
### Lesson 2

**Energy in Cells**

**Grade 7**

<table>
<thead>
<tr>
<th>Level 5</th>
<th>Level 4</th>
<th>Level 3</th>
<th>Level 2</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write: observations and answers to questions in the photosynthesis lab</td>
<td>Write observations and answers to questions in the photosynthesis lab</td>
<td>Write observations and answers to questions in the photosynthesis lab using vocabulary from the board to answer questions</td>
<td>Write observations and answers to questions in the photosynthesis lab using vocabulary using sentence frames for aid.</td>
<td>Draw observations.</td>
</tr>
<tr>
<td>Draw observations.</td>
<td>Draw observations.</td>
<td>Draw observations.</td>
<td>Draw observations and analyze data from lab circling yes or no questions</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Situation/Topic</td>
<td>Expression</td>
<td>Vocabulary</td>
<td>Grammar</td>
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</table>
| Writing  | Writing the observations to photosynthesis lab and answering questions based on photosynthesis lab | The test tube color is _____. Test tube # ____ shoed color change after the 24 hour period. The color change shows that ____ was made. There was a color change because ____ occurred. A plant carries on photosynthesis when there is _____. The ____ variable is _____. | - Blue  
- Yellow  
- 1  
- 2  
- 3  
- Oxygen  
- Carbon dioxide  
- Photosynthesis  
- Light  
- Independent  
- Dependent  
- Controlled  
- Light  
- Color  
- Water  
- plant | - noun |
Evidence of Photosynthesis

Objective: To prove that plants expel oxygen when they go through photosynthesis.

Materials:

- 3 test tubes with caps
- Bromothymol dye solution
- Light source
- Beaker
- Straw
- Foil
Procedure:

1. Place 75ml bromothymol blue into a beaker.

2. Observe color of solution.

3. Introduce Blow into the solution using the straw until the solution turns yellow.

4. Pour the yellow solution into the 3 test tubes, 25ml each.

5. Get a 6cm elodea leaf and place it into one of the test tube and cap it.

6. Get 1 elodea leaves and place leaf in a test tube and cove the entire test tube with foil and cap it.

7. Cap the last test tube with no leaf in it.
8. Place test tubes into a beaker of water and place about 250 cm from a lamp.

9. Let lab sit in lamp light over night.

10. Compare the colors in the different test tubes, and record findings.

11. Clean out test tubes and beaker.

Data:

<table>
<thead>
<tr>
<th>observations of test tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test tube 1, leaf, covered</td>
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<tr>
<th>Start</th>
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</tr>
</tbody>
</table>

Data analysis:

1. Which test tube showed a color change?
2. What does a color change show?

3. From your observations when does a green plant carry on photosynthesis?

**Questions:** (independent variable, dependent variable, controlled variables: see word wall)

4. What is the independent Variable in the investigation? (see word wall for definition)

5. What is the dependent variable in this investigation? (see word wall for definition)

6. What are the controlled variables in this investigation? (see word wall for definition)

**Challenge:**

7. Describe or write the photosynthesis equation.

8. Explain why the plant was producing bubbles when placed near the light source?
Evidence of Photosynthesis

**Objective:** To prove that plants expel oxygen when they go through photosynthesis.

**Materials:**

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<th>Bromothymol dye solution</th>
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<td><img src="image1.png" alt="Image" /></td>
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7. Cap the last test tube with no leaf in it.
8. Place test tubes into a beaker of water and place about 250 cm from a lamp.

9. Let lab sit in lamp light over night.
10. Compare the colors in the different test tubes, and record findings.
11. Clean out test tubes and beaker.

Data: observations of test tubes

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Data analysis:

1. Which test tube showed a color change?

   Test tube ______ changed color.

2. What does a color change show?

   The color change in the test tube shows that ___________ is made.

3. From your observations when does a green plant carry on photosynthesis?

   A plant goes through photosynthesis when _________ is shining.

Questions: (independent variable, dependent variable, controlled variables: see word wall)

4. What is the independent Variable in the investigation? (see word wall for definition)

   The independent variable of the investigation is ________________.

5. What is the dependent variable in this investigation? (see word wall for definition)

   The dependent Variable of the investigation is ________________.

6. What are the controlled variables in this investigation? (see word wall for definition)

   The controlled variables are __________, __________, and each test tube has a cap.

Challenge:

7. Why did we cover the test tubes with stoppers rather than leaving them open?

8. Describe or write the photosynthesis equation.

   __________+__________  $\rightarrow$  _____+_______

9. Explain why the plant was producing bubbles when placed near the light source?

   The bubbles are ____________, a gas made from plants going through photosynthesis.
Evidence of Photosynthesis

Objective: To prove that plants expel oxygen when they go through photosynthesis.

Materials:

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10. Compare the colors in the different test tubes, and record findings.
11. Clean out test tubes and beaker.

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<td></td>
</tr>
</tbody>
</table>

Data analysis:

1. Which test tube showed a color change?

   Test tube _______ changed color.  Answer: 1, 2, or 3
2. What does a color change show?
   The color change in the test tube shows that ___________ is made.
   Answer: oxygen, carbon dioxide

3. From your observations when does a green plant carry on photosynthesis?
   A plant goes through photosynthesis when ___________ is shining.
   Answer: sun is shining, no sun shining

Questions: (independent variable, dependent variable, controlled variables: see word wall)

4. What is the independent Variable in the investigation? (see word wall for definition)
   The independent variable of the investigation is _________________.
   Answer: light, elodea leaf

5. What is the dependent variable in this investigation? (see word wall for definition)
   The dependent Variable of the investigation is _________________.
   Answer: color, time

6. What are the controlled variables in this investigation? (see word wall for definition)
   The controlled variables are __________, __________, and each test tube has a cap.
   Answer: amount of bromothymol blue dye, amount of light, color

Challenge:

7. Describe or write the photosynthesis equation.

   __________+___________  \rightarrow  __________+___________

   Answer: carbon dioxide, oxygen, water food (put into correct order)

8. Explain why the plant was producing bubbles when placed near the light source?

9. The bubbles are _______________, a gas made from plants going through
   photosynthesis. Answer: production of oxygen, Production of Carbon Dioxide
Evidence of Photosynthesis

**Objective:** To prove that plants expel oxygen when they go through photosynthesis.

**Materials:**

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<td><img src="image6.jpg" alt="Foil" /></td>
</tr>
</tbody>
</table>
Procedure:

1. Place 75ml bromothymol blue into a beaker.

![Image of a beaker with solution]

2. Observe color of solution.

3. Introduce Blow into the solution using the straw until the solution turns yellow.

![Image of a person blowing into a beaker]

4. Pour the yellow solution into the 3 test tubes, 25ml each.

![Image of test tubes]

5. Get a 6cm elodea leaf and place it into one of the test tube and cap it.

![Image of an elodea leaf and test tube]

6. Get 1 elodea leaves and place leaf in a test tube and cove the entire test tube with foil and cap it.

![Image of an elodea leaf and test tube with foil]

7. Cap the last test tube with no leaf in it.
8. Place test tubes into a beaker of water and place about 250 cm from a lamp.

9. Let lab sit in lamp light over night.
10. Compare the colors in the different test tubes, and record findings.
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<th>Test tube with no plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>after 24 hr</td>
<td>Start</td>
</tr>
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<td>after 24 hr</td>
<td>after 24 hr</td>
</tr>
</tbody>
</table>

Start after 24 hr after 24 hr after 24 hr
Lesson 3
# Lesson 3

## Energy in Cells

### Grade 7

<table>
<thead>
<tr>
<th>Level 5</th>
<th>Level 4</th>
<th>Level 3</th>
<th>Level 2</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Read:</strong> process of respiration</td>
<td>Complete guided reading that explains the 2-step process of respiration. This includes the products and byproducts of the process</td>
<td>Complete guided reading that explains the 2-step process of respiration. This includes the products and byproducts of the process, using a vocabulary list for aid in reading</td>
<td>Complete modified reading that explains the 2-step process of respiration. Reading will be simplified with just the important information in text.</td>
<td>Read a modified text on respiration that has been rewritten with just the important information to read. Teacher has underlined specific information.</td>
</tr>
<tr>
<td><strong>Write:</strong> question and predict answers to surveyed paragraph on the process of respiration</td>
<td>Write question and prediction to surveyed paragraph on respiration reading.</td>
<td>Write question and prediction to surveyed respiration paragraph. Teacher will model the activity.</td>
<td>Write question and prediction to surveyed respiration paragraph. Teacher will model the activity and sentence frame will be posted on board.</td>
<td>Copy group question and predictions.</td>
</tr>
<tr>
<td><strong>Speak:</strong> Share Question and make predictions when they survey the text with the group. Students will also supporting their reasoning</td>
<td>Share Question and predictions when they survey the text with the group. Students will also supporting their reasoning</td>
<td>Share Question and predictions when they survey the text with the group supporting their reasoning after teacher models the speaking, writing sentence frames on the board.</td>
<td>Share Question and predictions when they survey the text with the group supporting their reasoning after teacher models the speaking with the aid of sentence starters on the board.</td>
<td>share Question and predictions when they survey the text with the group supporting their reasoning after teacher models the speaking with the aid of sentence prompts on the board.</td>
</tr>
<tr>
<td>Function</td>
<td>Situation/Topic</td>
<td>Expression</td>
<td>Vocabulary</td>
<td>Grammar</td>
</tr>
<tr>
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<td>------------</td>
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<td>---------</td>
</tr>
<tr>
<td>Write</td>
<td>Respiration reading</td>
<td>____ is how cells get energy from food</td>
<td>Respiration</td>
<td>verbs</td>
</tr>
<tr>
<td></td>
<td>Discuss questions and predicting the answer to the questions</td>
<td>Respiration takes place in ____ and _____.</td>
<td>Food</td>
<td>nouns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiration takes place in the _____.</td>
<td>Sugar</td>
<td>Basic chemical equation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>____ and ____ are opposite of each other.</td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiration uses ____ and _____.</td>
<td>Mitochondria</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiration gives off ____ and _____.</td>
<td>Cytoplasm</td>
<td></td>
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<td>Oxygen</td>
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<td></td>
<td>Carbon Dioxide</td>
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<td>Water</td>
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<td>Plants</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>animals</td>
<td></td>
</tr>
</tbody>
</table>
Class: 7th grade science
Unit: energy in cells
Topic: respiration
Objectives:
1. Students will be able to explain how animals make energy.
2. Students will be able to explain what the materials are needed for respiration.
3. Students will explain what the byproducts are for respiration.
Language Objectives:
1. Students will read a modified text on respiration.
2. Students will discuss questions and answers they have discovered on the text.
Time: 2 days

Activities:
Warm up – What are the raw materials needed for respiration to occur?
Teacher will show pictures of animals eating and breathing and point out that all animals do these processes.
DAY 1 –
Activity –
1. Teacher will provide a modified text that explains respiration.
2. Teacher and students will use the squeepers activity (as see in previous lessons) to preview the text together as a class before they read.
   a. Survey/question (steps will be posted on the board for students to follow)
      i. Teacher will model the thought process of surveying the introduction to the text and a question along with the survey
      ii. Teacher will say: Looking at the title I would like to know what respiration is? I would also like to know what vigorous exercise has to do with respiration
      iii. Teacher will then assign paragraphs to each table of students.
      iv. Teacher will then ask one of the students to model surveying the text and asking a question.
      v. Teacher will provide guidance as students demonstrate the activity.
      vi. Students will then survey the text with the group and ask questions about what they are surveying.
      vii. Students will write the questions into an organizer such as:

<table>
<thead>
<tr>
<th>Question</th>
<th>prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Predict
   i. Students will predict the answers to the questions as a group.
c. Read
i. Students will read out loud the paragraph assigned to the group. As they read they will underline or highlight the answers to the questions they asked.

d. Respond
i. Students will then discuss in a group their predictions and the answers that they have found.

e. Summarize
i. Student group will then share with the class what they have read. Teacher will provide sentence starters such as:

1. Respiration is ____________________.
2. When people exercise they need more ______.
3. During respiration cells break down _____ and _____ and release the ______ they contain.
4. There are ______ stages of respiration.
5. The equation for respiration is
   a. __________ + __________
6. Photosynthesis and respiration are both processes that make ______.
7. Teacher will then review the vocabulary relevant to the reading with students using diagrams or pictures for each word.
   a. Respiration, cytoplasm, mitochondria, oxygen, carbon dioxide

3. Close: Teacher will provide cut outs of the respiration equation which each student will work in pairs to put into the correct order.

4. Homework – students will read modified text using guided reading questions.

Day 2 –

Warm up- Yeast and balloon activity

1. Teacher will write a question on the board: What is a product of respiration?
2. Students will have a flask half filled with warm water and a teaspoon of sugar.
3. Teacher will explain that yeast is a single celled organism that goes through respiration.
4. Students will add a package of yeast from the super market to the flask of warm water and sugar.
5. Students will then put a balloon over the mouth of the flask and observe. (about 5 minutes)
6. What changes are occurring in the flask?
7. yeast + water

8. Teacher and students will discuss what is happening to the yeast in the flask. Teacher will write the correct answer on the board for students.
9. Students will draw a diagram of what they are observing and what they think is happening to the yeast.

Activity –

1. Teacher will provide an interactive lecture on power point with diagrams and pictures based on the respiration reading. Teacher will pace the lecture according to the students needs. Waiting until the students finish writing to explain the concepts from the slides.
2. Power point (see slide notes) Teacher will provide relevant diagrams for students.
3. **Teacher will ask** relevant questions throughout power point such as:
   a. Why do people eat? Need energy for body
   b. What do people breathe in? Oxygen
   c. Why do we need oxygen? To make energy
   d. What part of the cell does respiration occur in? Mitochondria
8. After power point teacher will then have an activity

Close – White board activity

4. Teacher will ask students to answer 2 questions on the board in their journals.
   a. Warm up questions on the board.
      i. What do animals need to make energy?
      ii. What are the animal byproducts of respiration
      iii. ______ + ______ → ______ + ______

5. Teacher will then have table groups look at each student’s response and pick the best answer. They will then write the answer on the white board provided by the teacher.

6. Teacher will then pick a group to lift the white board and share their response with the class. Group must support the answer. (Teacher should emphasize that it was the group’s response that was incorrect.)

7. Teacher will then pick another group to respond in the same matter. Teacher and students will then discuss correct answer.
Respiration

Reading Preview

Key Concepts
- What events occur during respiration?
- What is fermentation?

Key Terms
- respiration • fermentation

Target Reading Skill

Using Prior Knowledge Your prior knowledge is what you already know before you read about a topic. Before you read, write a definition of respiration in a graphic organizer like the one below. As you read, revise your definition based on what you learn.

What You Know
1. Definition of respiration:

What You Learned
1.

Lab zone Discover Activity

What Is a Product of Respiration?

1. Put on your goggles. Fill two test tubes half full of warm water. Add 5 mL of sugar to one of the test tubes. Put the tubes in a test-tube rack.

2. Add 0.5 mL of dried yeast (a single-celled organism) to each tube. Stir the contents of each tube with a straw. Place a stopper snugly in the top of each tube.

3. Observe any changes that occur in the two test tubes over the next 10 to 15 minutes.

Think It Over
Observing What changes occurred in each test tube? How can you account for any differences that you observed?

You and your friend have been hiking all morning. You look for a flat rock to sit on, so you can eat the lunch you packed. The steepest part of the trail is ahead. You’ll need a lot of energy to get to the top of the mountain. That energy will come from food.

Before food can provide your body with energy, it must pass through your digestive system. There, the food is broken down into small molecules. These small molecules can then pass out of the digestive system and into your bloodstream. Next, the molecules travel through the bloodstream to the cells of your body. Inside the cells, the energy in the molecules is released. In this section, you’ll learn how your body’s cells obtain energy from the food you eat.

Figure 5
Energy
Vigorous exercise, such as hiking, requires a lot of energy.
Energy From Respiration
All organisms need energy to live. The leopard frog uses energy to leap great distances. Although the mushrooms don’t move, they still need energy to grow and reproduce.

What is Respiration?
After you eat a meal, your body converts some of the food into glucose, a type of sugar. Respiration is the process by which cells obtain energy from glucose. During respiration, cells break down simple food molecules such as sugar and release the energy they contain. Because living things need a continuous supply of energy, the cells of all living things carry out respiration continuously. Plant cells, as well as animal cells, respire.

Storing and Releasing Energy Energy stored in cells is something like money you put in a savings account in a bank. When you want to buy something, you withdraw some of the money. Cells store and use energy in a similar way. During photosynthesis, plants capture the energy from sunlight and “save” it in the form of carbohydrates, including sugars and starches. Similarly, when you eat a meal, you add to your body’s energy savings account. When cells need energy, they “withdraw” it by breaking down the carbohydrates in the process of respiration.

Breathing and Respiration The term respiration has two meanings. You have probably used it to mean “breathing,” that is, moving air in and out of your lungs. To avoid confusion, the respiration process that takes place inside cells is sometimes called cellular respiration. The two meanings of the term respiration do point out a connection, however. Breathing brings oxygen, which is usually necessary for cellular respiration, into your lungs.
Two Stages of Respiration. Like photosynthesis, respiration is a two-stage process. The first stage takes place in the cytoplasm of the organism's cells. There, molecules of glucose are broken down into smaller molecules. Oxygen is not involved, and only a small amount of energy is released.

The second stage of respiration takes place in the mitochondria. There, the small molecules are broken down into even smaller molecules. These chemical reactions require oxygen, and they release a great deal of energy. This is why the mitochondria are sometimes called the "powerhouses" of the cell.

Trace the steps in the breakdown of glucose in Figure 7. Note that energy is released in both stages. Two other products of respiration are carbon dioxide and water. These products diffuse out of the cell. In most animals, the carbon dioxide and some water leave the body during exhalation, or breathing out. Thus, when you breathe in, you take in oxygen—a raw material for respiration. When you breathe out, you release carbon dioxide and water—products of respiration.

Respiration Equation. Although respiration occurs in a series of complex steps, the overall process can be summarized in the following equation:

\[ C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy} \]

sugar oxygen carbon dioxide water

Notice that the raw materials for respiration are sugar and oxygen. Plants and other organisms that undergo photosynthesis make their own sugar. The glucose in the cells of animals and other organisms comes from the food they consume. The oxygen used in respiration comes from the air or water surrounding the organism.

Stage 1. In the cytoplasm, glucose is broken down into smaller molecules. A small amount of energy is released.

Stage 2. In the mitochondria, the smaller molecules combine with oxygen to produce water and carbon dioxide. This reaction releases a large amount of energy.

FIGURE 7
Two Stages of Respiration
Respiration, like photosynthesis, takes place in two stages.
Interpreting Diagrams. In which stage of respiration is oxygen used?
**Photosynthesis**
During photosynthesis, plants use carbon dioxide and release oxygen.
\[ 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \]

**Respiration**
During respiration, organisms use oxygen and release carbon dioxide.
\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \]

**Comparing Photosynthesis and Respiration**
Can you notice anything familiar about the equation for respiration? You are quite right if you said it is the opposite of the equation for photosynthesis. This is an important point. During photosynthesis, carbon dioxide and water are used to produce sugars and oxygen. During respiration, the sugar glucose and oxygen are used to produce carbon dioxide and water. Photosynthesis and respiration can be thought of as opposite processes.

Together, these two processes form a cycle that keeps the levels of oxygen and carbon dioxide fairly constant in Earth's atmosphere. As you can see in Figure 8, living things use both gases over and over again.

Which process—photosynthesis or respiration—produces water?

**Fermentation**
Some cells are able to obtain energy from food without using oxygen. For example, some single-celled organisms live where there is no oxygen, such as deep in the ocean or in the mud of lakes or swamps. These organisms obtain their energy through fermentation, an energy-releasing process that does not require oxygen. Fermentation provides energy for cells without using oxygen. The amount of energy released from each sugar molecule during fermentation, however, is much lower than the amount released during respiration.
Alcoholic Fermentation  One type of fermentation occurs when yeast and some other single-celled organisms break down sugars. This process is sometimes called alcoholic fermentation because alcohol is one of the products. The other products are carbon dioxide and a small amount of energy.

The products of alcoholic fermentation are important to bakers and brewers. The carbon dioxide produced by yeast creates air pockets in bread dough, causing it to rise. Carbon dioxide is also the source of bubbles in alcoholic drinks such as beer and sparkling wine.

Lactic Acid Fermentation  Another type of fermentation takes place at times in your body. You’ve probably felt its effects. Think of a time when you ran as fast as you could for as long as you could. Your leg muscles were pushing hard against the ground, and you were breathing quickly.

No matter how hard you breathed, your muscle cells used up the oxygen faster than it could be replaced. Because your cells lacked oxygen, fermentation occurred. The fermentation supplied your cells with energy. One product of this type of fermentation is an acid known as lactic acid. When lactic acid builds up, you feel a painful sensation in your muscles. Your muscles feel weak and sore.

Target Reading Skill
Using Prior Knowledge  Review your graphic organizer about respiration. List two things that you learned about respiration.

Reviewing Key Concepts
1. a. Reviewing  What happens during respiration?
   b. Reviewing  What is the equation for respiration?
   c. Comparing and Contrasting  Compare the equations for respiration and photosynthesis.
   d. Relating Cause and Effect  Explain why cellular respiration adds carbon dioxide to the atmosphere, but photosynthesis does not.

2. a. Identifying  What is the process in which cells obtain energy without using oxygen?
   b. Inferring  How would athletes be affected if this process could not take place?
   c. Predicting  Is this process more likely to occur during a short run or a long walk? Explain your answer.

Lab Activity
Make Bread  With an adult family member, follow a recipe in a cookbook to make a loaf of bread using yeast. Explain to your family what causes the dough to rise. After you bake the bread, observe a slice and look for evidence that fermentation occurred.
Reading Preview

Key Concepts
- What events occur during respiration?
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Key Terms
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Storing and Releasing Energy Energy stored in cells is something like money you put in a savings account in a bank. When you want to buy something, you withdraw some of the money. Cells store and use energy in a similar way. During photosynthesis, plants capture the energy from sunlight and "save" it in the form of carbohydrates, including sugars and starches. Similarly, when you eat a meal, you add to your body's energy savings account. When cells need energy, they "withdraw" it by breaking down the carbohydrates in the process of respiration.

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Lab Skills Activity
Predicting
During the winter months, some animals go into a state called hibernation. During hibernation, an animal does not eat and its body activities are greatly reduced. Predict what will happen to an animal's rate of cellular respiration when the animal goes into hibernation. Explain your prediction.
The Two Stages of Respiration Like photosynthesis, respiration is a two-stage process. The first stage takes place in the cytoplasm of the organism's cells. There, molecules of glucose are broken down into smaller molecules. Oxygen is not involved, and only a small amount of energy is released.

The second stage of respiration takes place in the mitochondria. There, the small molecules are broken down into even smaller molecules. These chemical reactions require oxygen, and they release a great deal of energy. This is why the mitochondria are sometimes called the "powerhouses" of the cell.

Trace the steps in the breakdown of glucose in Figure 7. Note that energy is released in both stages. Two other products of respiration are carbon dioxide and water. These products diffuse out of the cell. In most animals, the carbon dioxide and some water leave the body during exhalation, or breathing out. Thus, when you breathe in, you take in oxygen—a raw material for respiration. When you breathe out, you release carbon dioxide and water—products of respiration.

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\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{energy} \]

sugar        oxygen         carbon dioxide         water

Notice that the raw materials for respiration are sugar and oxygen. Plants and other organisms that undergo photosynthesis make their own sugar. The glucose in the cells of animals and other organisms comes from the food they consume. The oxygen used in respiration comes from the air or water surrounding the organism.

**Stage 1** In the cytoplasm, glucose is broken down into smaller molecules. A small amount of energy is released.

**Stage 2** In the mitochondria, the smaller molecules combine with oxygen to produce water and carbon dioxide. This reaction releases a large amount of energy.
**Photosynthesis**
During photosynthesis, plants use carbon dioxide and release oxygen.

\[6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2\]

**Respiration**
During respiration, organisms use oxygen and release carbon dioxide.

\[\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 6 \text{ H}_2\text{O}\]

**FIGURE 8**
Photosynthesis and Respiration
You can think of photosynthesis and respiration as opposite processes.

Comparing and Contrasting: Which process uses oxygen? Which uses carbon dioxide?

**Comparing Photosynthesis and Respiration**
Can you notice anything familiar about the equation for respiration? You are quite right if you said it is the opposite of the equation for photosynthesis. This is an important point. During photosynthesis, carbon dioxide and water are used to produce sugars and oxygen. During respiration, the sugar glucose and oxygen are used to produce carbon dioxide and water. Photosynthesis and respiration can be thought of as opposite processes.

Together, these two processes form a cycle that keeps the levels of oxygen and carbon dioxide fairly constant in Earth's atmosphere. As you can see in Figure 8, living things use both gases over and over again.

Which process—photosynthesis or respiration—produces water?

**Fermentation**

Some cells are able to obtain energy from food without using oxygen. For example, some single-celled organisms live where there is no oxygen, such as deep in the ocean or in the mud of lakes or swamps. These organisms obtain their energy through fermentation, an energy-releasing process that does not require oxygen. Fermentation provides energy for cells without using oxygen. The amount of energy released from each sugar molecule during fermentation, however, is much lower than the amount released during respiration.
**Alcoholic Fermentation** One type of fermentation occurs when yeast and some other single-celled organisms break down sugars. This process is sometimes called alcoholic fermentation because alcohol is one of the products. The other products are carbon dioxide and a small amount of energy.

The products of alcoholic fermentation are important to bakers and brewers. The carbon dioxide produced by yeast creates air pockets in bread dough, causing it to rise. Carbon dioxide is also the source of bubbles in alcoholic drinks such as beer and sparkling wine.

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---

**Section 2 Assessment**

**Target Reading Skill**

Using Prior Knowledge: Review your graphic organizer about respiration. List two things that you learned about respiration.

**Reviewing Key Concepts**

1. **Reviewing** What happens during respiration?
2. **Reviewing** What is the equation for respiration?
3. **Comparing and Contrasting** Compare the equations for respiration and photosynthesis.
4. **Relating Cause and Effect** Explain why cellular respiration adds carbon dioxide to the atmosphere, but photosynthesis does not.

---

**Lab zone At-Home Activity**

Make Bread: With an adult family member, follow a recipe in a cookbook to make a loaf of bread using yeast. Explain to your family what causes the dough to rise. After you bake the bread, observe a slice and look for evidence that fermentation occurred.
Guided reading questions
Respiration

1. Draw a picture for each word and write a definition in your own words.
   a. Respiration
   b. Mitochondria
   c. Oxygen
   d. Carbon Dioxide

2. Why do organisms need to eat?

3. What happens during respiration?

4. How is energy stored in the cell?

5. Why do organisms need to breathe and how is oxygen used in respiration?

6. How many stages are there in respiration and where do they take place?

7. Write the materials needed for respiration?

8. What are the products of respiration?

9. How are photosynthesis and respiration related to each other?
Respiration (pages 49-53)

What Is Respiration? (pages 50-52)

Key Concept: During respiration, cells break down simple food molecules such as sugar and release the energy they contain.

- **Respiration** is how cells get energy from sugar.
- Respiration takes place in both plant cells and animal cells. Respiration happens all the time because cells always need energy. Respiration has two stages.
- The first stage of respiration takes place in the cytoplasm of the cell. There, sugar from food is broken down into smaller particles. Just a little energy is released.
- The second stage of respiration takes place in the mitochondria. There, the small sugar particles from the cytoplasm are broken down into even smaller particles. These chemical reactions must have oxygen to take place. Oxygen comes from the air you breath.
- A lot of energy is released during the second stage of respiration. Carbon dioxide and water are also made. They are given off as wastes.
- Photosynthesis and respiration are the opposite of each other. Photosynthesis uses carbon dioxide, water, and energy and makes oxygen and sugar. Respiration uses sugar and oxygen and gives off carbon dioxide, water, and energy.
- Together, photosynthesis and respiration form a cycle that keeps the levels of oxygen and carbon dioxide about the same in Earth’s atmosphere.
Cell Processes and Energy • Adapted Reading and Study

Answer the following questions. Use your textbook and the ideas on page 23.

1. Is the following sentence true or false? Respiration takes place only in animal cells. ________

2. Draw a line from each event in respiration to the stage of respiration in which it takes place. Stages of respiration may be used more than once.

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<td>d. must have oxygen</td>
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3. Fill in the cycle diagram about photosynthesis and respiration.

Photosynthesis

Plants produce oxygen.

Respiration

Organisms use

Plants use

b. ________

Organisms produce carbon dioxide.
Respiration (pages 49–53)

What Is Respiration? (pages 50–52)

Key Concept: During respiration, cells break down simple food molecules such as sugar and release the energy they contain.

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Plants use

Respiration

Organisms use

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a. ____________________
Respiration (pages 49–53)

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Photosynthesis

- Plants produce oxygen.
- Plants use
  - b. __________

Respiration

- Organisms use
  - a. __________
- Organisms produce carbon dioxide.
Respiration

1. Explain what happens during the process of respiration.
2. Write the notes on the process of respiration.

To get energy

- **Respiration** – the process in which organisms obtain energy from glucose

  \[ \text{Cellular Respiration} \quad \text{cell food} + \text{oxygen} \rightarrow \text{energy} + \text{carbon dioxide} \]

2 stages- Energy released in both stages

1. Food is eaten broken down into small molecules
2. Broken down into even smaller pieces

Respiration equation

**Cellular Respiration**

\[ \text{cell food} + \text{oxygen} \rightarrow \text{energy} + \text{carbon dioxide} \]

Comparing photosynthesis and respiration

**Photosynthesis**

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \]

**Respiration**

\[ \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \]
Oxygen cycle

Animal and plants need each other
Cellular Respiration

cell food + oxygen → energy + carbon dioxide
Two Stages of Respiration

Stage 1
- Glucose
- Smaller molecules
- Energy
- Cytoplasm

Stage 2
- Smaller molecules
- Energy
- Oxygen
- Mitochondrion
- Water
- Carbon dioxide
Comparing Photosynthesis and Respiration

Photosynthesis:

\[ 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow C_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \]

Respiration:

\[ C_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \]
Oxygen + Sugar → Carbon Dioxide + Water + Energy

Cut out for equation
Checklists
Write the page numbers and any other identifying features to identify those parts of your lessons that employ the following strategies.

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<td>V. Engage at Appropriate Language Proficiency Levels</td>
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<tr>
<td>V.A. Use questions appropriate for language proficiency levels in conversations, activities, and assessments</td>
<td>18.6</td>
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<tr>
<td>VI. Give Students Voice</td>
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<td>VI.A. Challenge students to produce extended talk</td>
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<tr>
<td>VI.B. Model Language for Oral and Written Production</td>
<td>18.6</td>
<td>31.33</td>
<td>8.10</td>
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<tr>
<td>VI.C. Use Group/Pr. Work to Elicit Student Talk; Students as Researchers</td>
<td>18.6</td>
<td>31-35</td>
<td>8.10</td>
</tr>
</tbody>
</table>
Original Lessons
In your peer's lesson, find evidence of:

- meaningful activities
- activation—or provision—of background knowledge
- provision of key vocabulary in a meaningful way
- the teacher making the instruction comprehensible
- teaching/modeling learning strategies
- use of questioning strategies
- opportunities for interaction
- language support for ELLs at different levels of language development
- assessment and evaluation
Power Plants in Cells

Grade level: 7th grade science

Target group: Sheltered science class

Written material:

Time: 4-6 periods

Objectives:
1. Explain how all living things get their energy from the sun.
2. What happens during the process of photosynthesis?
3. What happens during the two stages of respiration?

Sources:
1. biologycorner.net
2. Prentice Hall Science Explorer
Power Plants in Cells

Grade level: 7th grade science

Target group: Sheltered science class

Written material:

Time: 4-6 periods

Content Objectives:
1. Describe the process photosynthesis.
2. Describe the two stages of respiration.

Language Objectives:
1. Read the adapted text on photosynthesis and respiration.
2. Answer questions through writing about the process of photosynthesis and respiration.
3. Discuss the Answers that they have written on the guided questions.

Sources:
1. biologycorner.net
2. Prentice Hall Science Explorer

Tina: Your design is strong and you could exploit it much more if you incorporated more meaningful activities to your lesson. Think of ways to make this lesson more hands on and of ideas to make the input more comprehensible. Design your materials (modified readings, & handouts) and provide with improved lesson at the end. Keep improving your lesson.
## Lesson Objectives

**Energy in a Cell**

**Grade 7**

<table>
<thead>
<tr>
<th>Level 5</th>
<th>Level 4</th>
<th>Level 3</th>
<th>Level 2</th>
<th>Level 1</th>
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<tbody>
<tr>
<td>Read: process of <em>respiration</em> and photosynthesis</td>
<td>Complete guided reading that explains the process of photosynthesis and respiration. This includes the products and byproducts of each process</td>
<td>Complete guided reading that explains the process of photosynthesis and respiration. This includes the products and byproducts of each process, using a vocabulary list for aid in reading</td>
<td>Complete guided reading that explains the process of photosynthesis and respiration. Reading will have the important information highlighted in order to guide the students</td>
<td>Read a diagram of the process of respiration and one of the processes of photosynthesis.</td>
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<tr>
<td>Write: answers to guiding questions on respiration and photosynthesis</td>
<td>Answer the guiding question based on the respiration and photosynthesis text</td>
<td>Answer the guiding questions on respiration and photosynthesis using the text, give and vocabulary list</td>
<td>Answer the guiding questions on respiration and photosynthesis using the highlighted text used for reading and sentence frames for answers</td>
<td>Fill in the diagram explaining the processes of respiration and photosynthesis</td>
</tr>
<tr>
<td>Speak: share the answers to the guiding questions with the partner</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written using sentence prompts for modification.</td>
<td>Complete a guiding diagram on respiration and photosynthesis filling in sections using the diagram from the reading.</td>
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</tbody>
</table>

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*Very nice!*
<table>
<thead>
<tr>
<th>Function</th>
<th>Situation/Topic</th>
<th>Expression</th>
<th>Vocabulary</th>
<th>Grammar</th>
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<tr>
<td>1. Write</td>
<td>1. Experiment Respiration</td>
<td>if yeast cells go through _______ and make Carbon Dioxide then the balloon will increase in size each minute.</td>
<td>Energy</td>
<td>- verbs</td>
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<td>2. Experiment Photosynthesis</td>
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<td>Osmosis</td>
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<td>1. Process of respiration</td>
<td>if plants make carbon dioxide when they go through _______. Then the water will go from being blue to clear.</td>
<td>Oxygen</td>
<td>- nouns</td>
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<td>2. Process of photosynthesis</td>
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<td>Carbon dioxide</td>
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<td>Plants take in Carbon dioxide _______ and let out _______ and water out.</td>
<td>Sunlight</td>
<td>- Basic chemical equation</td>
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<td>Animals breathe in _______ and eat food to make _______.</td>
<td>Water</td>
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<td>Photosynthesis</td>
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<td></td>
<td>Respiration</td>
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<td>2. Discuss</td>
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<td>Hypothesis</td>
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<td>Dependent variable</td>
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<td>Conclusion</td>
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nice!
Class: 7th grade science
Unit: Energy in a cell
Topic: Photosynthesis and respiration

Content Objectives:
1. Describe the process of photosynthesis.
2. Describe the two stages of respiration.

Language Objectives:
1. Read the text on photosynthesis and respiration.
2. Write the answers to the guiding questions on the readings.
3. Discuss the answers to the guiding questions with a partner.

Time: 2 days, 2 periods

Activity:

Warm up – 5 minutes – Where do animals and plants get energy from

Day 1
1. Teacher will assign reading in text on photosynthesis.
2. Students will finish reading using guided reading questions.
3. Students will then, in groups compare their answers and discuss them in their groups.
4. Using the guiding questions from the reading. Teacher and students will then take notes on photosynthesis and respiration using diagrams and visuals.
5. Homework – Complete worksheets on respiration and photosynthesis.

Day 2

Warm up – What do plants need for photosynthesis?
1. Teacher will provide reading on respiration with guided questions to highlight important information.
2. Students will complete the reading and questions and share their answers in groups.
3. Teacher and students will then provide notes from guided questions.

Day 3

Warm up – What is the relationship between respiration and photosynthesis?
4. Teacher will provide group work consisting of a worksheet comparing photosynthesis to respiration. The worksheet also shows the relationship between the two processes. Students will complete the worksheet using the readings and homework.
5. Teacher and students will then share and fill out comparison worksheet together on the overhead projector.

Here's a good place for questioning strategies.
Photosynthesis

Reading Preview

Key Concepts

1. How does the sun supply living things with the energy they need?
2. What happens during the process of photosynthesis?

Key Terms

photosynthesis • autotroph
eterotroph • pigment
chlorophyll • stomata

Forget Reading Skill

Sequencing A sequence is the order in which the steps in a process occur. As you read, create a flowchart that shows the steps in photosynthesis. Put each step in a separate box in the flowchart in order in which it occurs.

Steps in Photosynthesis

Sunlight strikes leaf.

Chlorophyll captures light energy.

1. Obtain a solar-powered calculator that does not use batteries. Place the calculator in direct light.
2. Cover the solar cells with your finger. Note how your action affects the number display.
3. Uncover the solar cells. What happens to the number display?
4. Now cover all but one of the solar cells. How does that affect the number display?

Think It Over

Inferring From your observations, what can you infer about the energy that powers the calculator?

On a plain in Africa, a herd of zebras peacefully eat the grass. But watch out—the zebras' grazing will soon be harshly interrupted. A group of lions is about to attack the herd. The lions will kill one of the zebras and eat it.

Both the zebras and the lions use the food they eat to obtain energy. Every living thing needs energy. All cells need energy to carry out their functions, such as making proteins and transporting substances into and out of the cell. The zebra's meat supplies the lion's cells with the energy they need, just as the grass provides the zebra's cells with energy. But plants and certain other organisms, such as algae and some bacteria, obtain their energy in a different way. These organisms use the energy in sunlight to make their own food.
The sun is the source of energy for most living things.

**Figure 1**
Energy From the Sun
The sun supplies energy for most living things, directly or indirectly.

Relating Cause and Effect: How does sunlight provide food for the zebra?

**Sources of Energy**
The process by which a cell captures energy in sunlight and uses it to make food is called **photosynthesis** (foh toh SIN thuh sis). The term *photosynthesis* comes from the Greek words *photo*, which means "light," and *synthesis*, which means "putting together."

Nearly all living things obtain energy either directly or indirectly from the energy of sunlight captured during **photosynthesis**. Grass obtains energy directly from sunlight, because it makes its own food during photosynthesis. When the zebra eats the grass, it gets energy that has been stored in the grass. Similarly, the lion obtains energy stored in the zebra. The zebra and lion both obtain the sun's energy indirectly, from the energy that the grass obtained through photosynthesis.

Plants manufacture their own food through the process of photosynthesis. An organism that makes its own food is called an **autotroph** (AWT oh trahf). An organism that cannot make its own food, including animals such as the zebra and the lion, is called a **heterotroph** (HET ur oh trahf). Many heterotrophs obtain food by eating other organisms. Some heterotrophs, such as fungi, absorb their food from other organisms.

**Reading Checkpoint**
What are autotrophs?

**Figure 2**
Autotrophs and Heterotrophs
Grass, which makes its own food during photosynthesis, is an autotroph. Zebras and lions are heterotrophs, because they cannot make their own food.
**The Two Stages of Photosynthesis**

Photosynthesis is a complex process. During photosynthesis, plants and some other organisms use energy from the sun to convert carbon dioxide and water into oxygen and sugars. The process of photosynthesis is shown in Figure 3. You can think of photosynthesis as taking place in two stages: capturing the sun’s energy and producing sugars. You’re probably familiar with many two-stage processes. To make a cake, for example, the first stage is to combine the ingredients to make the batter. The second stage is to bake the batter. To get the desired result—the cake—both stages must occur in the correct order.

**Stage 1: Capturing the Sun’s Energy** The first stage of photosynthesis involves capturing the energy in sunlight. In plants, this energy-capturing process occurs mostly in the leaves. Recall that chloroplasts are green organelles inside plant cells. The green color comes from pigments, colored chemical compounds that absorb light. The main photosynthetic pigment in chloroplasts is chlorophyll.

Chlorophyll functions in a manner similar to that of the solar “cells” in a solar-powered calculator. Solar cells capture the energy in light and use it to power the calculator. Similarly, chlorophyll captures light energy and uses it to power the second stage of photosynthesis.

**Stage 1**
Chloroplasts in plant cells capture energy from sunlight.

**Stage 2**
The captured light energy is used to produce sugars and oxygen from water and carbon dioxide.

- **Carbon dioxide** enters the leaf through openings called stomata.
- **Water** enters the plant through roots and moves upward to the leaf.
Stage 2: Using Energy to Make Food  In the next stage of photosynthesis, the cell uses the captured energy to produce sugars. The cell needs two raw materials for this stage: water (H₂O) and carbon dioxide (CO₂). In plants, the roots absorb water from the soil. The water then moves up through the plant's stem to the leaves. Carbon dioxide is one of the gases in the air. Carbon dioxide enters the plant through small openings on the undersides of the leaves called stomata (STOH muh tuh) (singular stoma). Once in the leaves, the water and carbon dioxide move into the chloroplasts.

Inside the chloroplasts, the water and carbon dioxide undergo a complex series of chemical reactions. The reactions are powered by the energy captured in the first stage. These reactions produce chemicals as products. One product is a sugar that has six carbon atoms. Six-carbon sugars have the chemical formula C₆H₁₂O₆. Recall that sugars are a type of carbohydrate. Cells can use the energy in the sugar to carry out important cell functions.

The other product of photosynthesis is oxygen (O₂), which exits the leaf through the stomata. In fact, almost all the oxygen in Earth's atmosphere was produced by living things through the process of photosynthesis.

Looking at Pigments

You can observe the pigments in a leaf.

1. Cut a strip 5 cm by 20 cm out of a paper coffee filter.
2. Place a leaf on top of the paper strip, about 2 cm from the bottom.
3. Roll the edge of a dime over a section of the leaf, leaving a narrow band of color on the paper strip.
4. Pour rubbing alcohol into a plastic cup to a depth of 1 cm. Stand the paper strip in the cup so the color band is about 1 cm above the alcohol. Hook the other end of the strip over the top of the cup.
5. After 10 minutes, remove the paper strip and let it dry. Observe the strip.
6. Wash your hands.

Inferring: What does the paper strip's appearance reveal about leaf pigments?
The Photosynthesis Equation  The events of photosynthesis can be summed up by the following chemical equation:

$$6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \xrightarrow{\text{light energy}} \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$$

carbon dioxide  water  a sugar  oxygen

Notice that the raw materials—six molecules of carbon dioxide and six molecules of water—are on the left side of the equation. The products—one molecule of a sugar and six molecules of oxygen—are on the right side of the equation. An arrow, which you can read as “yields,” connects the raw materials to the products. Light energy, which is necessary for the chemical reaction to occur, is written above the arrow.

What happens to the sugar produced in photosynthesis? Plant cells use some of the sugar for food. The cells break down the sugar molecules to release the energy they contain. This energy can then be used to carry out the plant’s functions. Some sugar molecules are converted into other compounds, such as cellulose. Other sugar molecules may be stored in the plant’s cells for later use. When you eat food from plants, such as potatoes or carrots, you are eating the plant’s stored energy.

**Section 1 Assessment**

**Target Reading Skill Sequencing**  Use your flowchart about photosynthesis to help answer Question 2.

**Reviewing Key Concepts**

1. **a. Reviewing** Why do living things need energy?
   
   **b. Explaining** How do plants obtain energy?

2. **a. Reviewing** What chemical equation sums up the events of photosynthesis?

   **b. Comparing and Contrasting** What are the substances needed for photosynthesis? What substances are produced during photosynthesis?

   **c. Making Generalizations** Would you expect a plant to produce more oxygen on a cloudy day or a sunny day? Explain.

**Writing in Science**

**Job Qualifications**  When people apply for jobs, they often must complete a job application form in which they describe their qualifications for a job. Suppose that you are a leaf, and that you are applying for a job in a photosynthesis factory. Write a paragraph in which you summarize your qualifications for the job of photosynthesis. Your paragraph should include the following words: chloroplasts, chlorophyll, light, energy, water, carbon dioxide, and stomata.
Photosynthesis

Reading Preview

Key Concepts
How does the sun supply living things with the energy they need?
What happens during the process of photosynthesis?

Key Terms
photosynthesis • autotroph
heterotroph • pigment
chlorophyll • stomata

Target Reading Skill
sequencing A sequence is the order in which the steps in a process occur. As you read, create a flowchart that shows the steps in photosynthesis. Put each step in a separate box in the flowchart in the order in which it occurs.

Steps in Photosynthesis
Sunlight strikes leaf.

Chlorophyll captures light energy.

On a plain in Africa, a herd of zebras peacefully eat the grass. But watch out—the zebras' grazing will soon be harshly interrupted. A group of lions is about to attack the herd. The lions will kill one of the zebras and eat it.

Both the zebras and the lions use the food they eat to obtain energy. Every living thing needs energy. All cells need energy to carry out their functions, such as making proteins and transporting substances into and out of the cell. The zebra's meat supplies the lion's cells with the energy they need, just as the grass provides the zebra's cells with energy. But plants and certain other organisms, such as algae and some bacteria, obtain their energy in a different way. These organisms use the energy in sunlight to make their own food.
The Two Stages of Photosynthesis

Photosynthesis is a complex process. During photosynthesis, plants and some other organisms use energy from the sun to convert carbon dioxide and water into oxygen and sugars. The process of photosynthesis is shown in Figure 3. You can think of photosynthesis as taking place in two stages: capturing the sun's energy and producing sugars. You're probably familiar with many two-stage processes. To make a cake, for example, the first stage is to combine the ingredients to make the batter. The second stage is to bake the batter. To get the desired result—the cake—both stages must occur in the correct order.

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Stage 1
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Stage 2
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Carbon dioxide enters the leaf through openings called stomata.

Water enters the plant through roots and moves upward to the leaf.
The Photosynthesis Equation The events of photosynthesis can be summed up by the following chemical equation:

\[ 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \]

carbon dioxide \hspace{2cm} \text{water} \hspace{2cm} \text{a sugar} \hspace{2cm} \text{oxygen}

Notice that the raw materials—six molecules of carbon dioxide and six molecules of water—are on the left side of the equation. The products—one molecule of a sugar and six molecules of oxygen—are on the right side of the equation. An arrow, which you can read as “yields,” connects the raw materials to the products. Light energy, which is necessary for the chemical reaction to occur, is written above the arrow.

What happens to the sugar produced in photosynthesis? Plant cells use some of the sugar for food. The cells break down the sugar molecules to release the energy they contain. This energy can then be used to carry out the plant’s functions. Some sugar molecules are converted into other compounds, such as cellulose. Other sugar molecules may be stored in the plant’s cells for later use. When you eat food from plants, such as potatoes or carrots, you are eating the plant’s stored energy.

In the photosynthesis equation, what does the arrow mean?

Section 1 Assessment

Target Reading Skill Sequencing Use your flowchart about photosynthesis to help answer Question 2.

Reviewing Key Concepts
1. a. Reviewing Why do living things need energy?
   b. Explaining How do plants obtain energy?
   c. Applying Concepts An insect eats a leaf. Explain how the insect depends on the sun for energy.
2. a. Reviewing What chemical equation sums up the events of photosynthesis?
   b. Comparing and Contrasting What are the substances needed for photosynthesis? What substances are produced during photosynthesis?
   c. Making Generalizations Would you expect a plant to produce more oxygen on a cloudy day or a sunny day? Explain.

Job Qualifications When people apply for jobs, they often must complete a job application form in which they describe their qualifications for a job. Suppose that you are a leaf, and that you are applying for a job in a photosynthesis factory. Write a paragraph in which you summarize your qualifications for the job of photosynthesis. Your paragraph should include the following words: chloroplasts, chlorophyll, light, energy, water, carbon dioxide, and stomata.
Respiration

Reading Preview
Key Concepts
• What events occur during respiration?
• What is fermentation?

Key Terms
• respiration • fermentation

Target Reading Skill
Using Prior Knowledge Your prior knowledge is what you already know before you read about a topic. Before you read, write a definition of respiration in a graphic organizer like the one below. As you read, revise your definition based on what you learn.

<table>
<thead>
<tr>
<th>What You Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Definition of respiration:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What You Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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</table>

Lab Zone Discover Activity

What Is a Product of Respiration?
1. Put on your goggles. Fill two test tubes half full of warm water. Add 5 mL of sugar to one of the test tubes. Put the tubes in a test-tube rack.
2. Add 0.5 mL of dried yeast (a single-celled organism) to each tube. Stir the contents of each tube with a straw. Place a stopper snugly in the top of each tube.
3. Observe any changes that occur in the two test tubes over the next 10 to 15 minutes.

Think It Over
Observing What changes occurred in each test tube? How can you account for any differences that you observed?

You and your friend have been hiking all morning. You look for a flat rock to sit on, so you can eat the lunch you packed. The steepest part of the trail is ahead. You'll need a lot of energy to get to the top of the mountain. That energy will come from food.

Before food can provide your body with energy, it must pass through your digestive system. There, the food is broken down into small molecules. These small molecules can then pass out of the digestive system and into your bloodstream. Next, the molecules travel through the bloodstream to the cells of your body. Inside the cells, the energy in the molecules is released. In this section, you'll learn how your body's cells obtain energy from the food you eat.

Figure 5
Energy
Vigorous exercise, such as hiking, requires a lot of energy.
The Two Stages of Respiration Like photosynthesis, respiration is a two-stage process. The first stage takes place in the cytoplasm of the organism's cells. There, molecules of glucose are broken down into smaller molecules. Oxygen is not involved, and only a small amount of energy is released.

The second stage of respiration takes place in the mitochondria. There, the small molecules are broken down into even smaller molecules. These chemical reactions require oxygen, and they release a great deal of energy. This is why the mitochondria are sometimes called the "powerhouses" of the cell.

Trace the steps in the breakdown of glucose in Figure 7. Note that energy is released in both stages. Two other products of respiration are carbon dioxide and water. These products diffuse out of the cell. In most animals, the carbon dioxide and some water leave the body during exhalation, or breathing out. Thus, when you breathe in, you take in oxygen—a raw material for respiration. When you breathe out, you release carbon dioxide and water—products of respiration.

The Respiration Equation Although respiration occurs in a series of complex steps, the overall process can be summarized in the following equation:

\[
\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}
\]

Notice that the raw materials for respiration are sugar and oxygen. Plants and other organisms that undergo photosynthesis make their own sugar. The glucose in the cells of animals and other organisms comes from the food they consume. The oxygen used in respiration comes from the air or water surrounding the organism.

Stage 1 In the cytoplasm, glucose is broken down into smaller molecules. A small amount of energy is released.

Stage 2 In the mitochondria, the smaller molecules combine with oxygen to produce water and carbon dioxide. This reaction releases a large amount of energy.

FIGURE 7
Two Stages of Respiration
Respiration, like photosynthesis, takes place in two stages.

Interpreting Diagrams In which stage of respiration is oxygen used?
Alcoholic Fermentation One type of fermentation occurs when yeast and some other single-celled organisms break down sugars. This process is sometimes called alcoholic fermentation because alcohol is one of the products. The other products are carbon dioxide and a small amount of energy.

The products of alcoholic fermentation are important to bakers and brewers. The carbon dioxide produced by yeast creates air pockets in bread dough, causing it to rise. Carbon dioxide is also the source of bubbles in alcoholic drinks such as beer and sparkling wine.

Lactic Acid Fermentation Another type of fermentation takes place at times in your body. You’ve probably felt its effects. Think of a time when you ran as fast as you could for as long as you could. Your leg muscles were pushing hard against the ground, and you were breathing quickly.

No matter how hard you breathed, your muscle cells used up the oxygen faster than it could be replaced. Because your cells lacked oxygen, fermentation occurred. The fermentation supplied your cells with energy. One product of this type of fermentation is an acid known as lactic acid. When lactic acid builds up, you feel a painful sensation in your muscles. Your muscles feel weak and sore.

Which kind of fermentation is important to bakers?

Section 2 Assessment

Target Reading Skill
Using Prior Knowledge Review your graphic organizer about respiration. List two things that you learned about respiration.

Reviewing Key Concepts
1. a. Reviewing What happens during respiration?
   b. Reviewing What is the equation for respiration?
   c. Comparing and Contrasting Compare the equations for respiration and photosynthesis.
   d. Relating Cause and Effect Explain why cellular respiration adds carbon dioxide to the atmosphere, but photosynthesis does not.

2. a. Identifying What is the process in which cells obtain energy without using oxygen?
   b. Inferring How would athletes be affected if this process could not take place?
   c. Predicting Is this process more likely to occur during a short run or a long walk? Explain your answer.

Lab zone At-Home Activity

Make Bread With an adult family member, follow a recipe in a cookbook to make a loaf of bread using yeast. Explain to your family what causes the dough to rise. After you bake the bread, observe a slice and look for evidence that fermentation occurred.
Class: 7th grade science  
Unit: respiration, photosynthesis  
Topic: Testing for photosynthesis

Objectives:
1. Prove through experimentation that plant use photosynthesis to create energy.

Language objective:
1. Design an experiment to test that a plant gives off Carbon Dioxide during photosynthesis.

Time: 2 days

Activities:

Warm up - 5 minutes - What are the raw materials needed for plants to photosynthesize?

Day 1 -
1. Teacher will provide materials and procedure for the lab on photosynthesis.
2. Students will be assigned group to read procedure of lab. Students will be grouped with El students and El helper.
3. Teacher will then read lab out loud to the students then model the set up of the lab using pictures and answering questions as needed.
4. Students will set up lab as procedure instructs.
   a. Teacher will have model available for reference, and guide students through set up.
5. Close - Students will share hypothesis out loud with the class.

Warm up - 5 minutes - What are the byproducts of photosynthesis?

Day 2 -
1. Students will observe and collect data from ongoing lab. Teacher will provide visuals on the board for the students to reference the outcomes.
2. Students will answer lab questions with group. Teacher will guide students through their observations and questions.
3. Close - Students will share their findings with the class.
Evidence of Photosynthesis

Background Information: PHOTOSYNTHESES is the process during which a plant's chlorophyll traps light energy and sugars are produced. In plants, photosynthesis occurs only in cells with chloroplasts. The chemical reaction for photosynthesis is:

\[
\text{CO}_2 + \text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2
\]

Green plants use energy from light to combine carbon dioxide and water to make food. Light energy is converted to chemical energy and is stored in the food that is made by green plants. The light used in photosynthesis is absorbed by a green pigment called chlorophyll. Each food-making cell in a plant leaf contains chlorophyll in small cells called chloroplasts. In chloroplasts, light energy causes water drawn from the soil to split into molecules of hydrogen and oxygen. In a series of chemical reactions, the hydrogen combines with carbon dioxide from the air, forming a simple sugar. Oxygen from the water molecules is given off in the process. From sugar, along with nutrients from the soil, green plants can make starch, fat, protein, vitamins, and other complex compounds necessary for life. Photosynthesis supplies the chemical energy needed to produce these compounds.

When a person exhales, carbon dioxide is released. Bromothymol blue solution, BTB, can indicate the presence of carbon dioxide in the water. When little or no carbon dioxide is present, BTB will show a blue color. Depending upon the amount of carbon dioxide, BTB will change to green or yellow. Yellow indicates more carbon dioxide.
<table>
<thead>
<tr>
<th>Level 5</th>
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<td>Design an experiment using the scientific process to test if plants use carbon Dioxide and expel oxygen</td>
<td>Design an experiment using the scientific process to test if plants use carbon Dioxide and expel oxygen using a template to write the lab procedure</td>
<td>Design an experiment using the scientific process to test if plants use carbon Dioxide and expel oxygen using a template with helping sentences to guide them through the scientific process</td>
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<td>Write: will interpret data from photosynthesis experiment and write their finding in lab report form</td>
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<td>Write a conclusion based on the data collected from the photosynthesis experiment using a lab report template that has guiding sentence starters in each section</td>
<td>Draw their observations and using a sentence bank copy the appropriate description of their observations</td>
</tr>
</tbody>
</table>

**Lesson 2**

**Energy in Cells**

**Grade 7**

- **Level 5**: Design an experiment that tests if plants go through photosynthesis.
- **Level 4**: Design an experiment using the scientific process to test if plants use carbon Dioxide and expel oxygen.
- **Level 3**: Design an experiment using the scientific process to test if plants use carbon Dioxide and expel oxygen using a template to write the lab procedure.
- **Level 2**: Using diagram of procedure for designing an experiment students will write in appropriate procedure that they picked from a sentence bank (in sequence).
- **Level 1**: Student will cut and paste in order the diagrams depicting the procedure and draw their for the experiment.

**Notes:**

- There are hand-written notes on the page.
- The word "I didn't see this in lesson" is written in the margin.
Materials:

<table>
<thead>
<tr>
<th>3 test tubes with caps</th>
<th>Bromothymol Blue solution</th>
<th>Light source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaker</td>
<td>Straw</td>
<td>Foil</td>
</tr>
</tbody>
</table>

Procedure:

1. Place 75 ml of bromothymol blue in a beaker.
2. Observe the color of the solution.
3. Introduce carbon dioxide into the solution. Use a straw from to slowly blow carbon dioxide from your lungs into the solution until it just turns yellow.
4. Pour the solution into three screw cap test tubes, dividing it evenly.
5. Get one 6 cm piece of Elodea, place it in one of the tubes, and cap it.
6. Get two 6 cm pieces of Elodea, place it in a second tube completely covered with foil (to prevent light from reaching the solution & Elodea), and cap it. In both of these test tubes, be sure the plant is completely submerged in the solution.
7. Cap the test tube that has no plant in it.
8. Place the test tubes into a beaker of water and put the beaker about 250 cm from a lamp.
9. Allow the plants to sit undisturbed for overnight.
10. Compare the colors of the solutions by removing the plants and holding the tubes in front of a white background. Record the final colors of all three tubes.
11. After all measurements have been completed, rinse out your glassware.
Data:

<table>
<thead>
<tr>
<th></th>
<th>Observations of Test Tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Tube 1</td>
<td></td>
</tr>
<tr>
<td>BTB Solution &amp; Elodea; Uncovered</td>
<td>Start</td>
</tr>
<tr>
<td>Test Tube 2</td>
<td></td>
</tr>
<tr>
<td>BTB Solution &amp; Elodea; Covered</td>
<td>Start</td>
</tr>
<tr>
<td>Test Tube 3</td>
<td></td>
</tr>
<tr>
<td>BTB Solution; Uncovered</td>
<td>Start</td>
</tr>
</tbody>
</table>

Data Analysis:
1. Which test tube(s) showed a color change in this investigation?

2. What does a color change indicate in this investigation?

Questions:
1. What is the independent variable in this investigation?

2. What is the dependent variable in this investigation?
2. How does this investigation show that plants give off oxygen during photosynthesis? Use evidence from the investigation to support your answer.

3. Write a short paragraph explaining the results of this investigation. Provide evidence from the investigation to support what you say.
3. What are some controlled variables in this investigation?

4. What color is the water in all three test tubes at the start of the activity?

5. What does this color tell us?

6. After sitting overnight, did any of the test tubes change color? Which one(s)?

7. For each tube that changed color, why do you think there was a color change?
8. From your observations, when does a green plant carry on photosynthesis? Explain your thinking.

9. Challenge: Why did we cover the test tubes with stoppers rather than leave them open?

10. Describe the photosynthesis equation in words.

Conclusions:
1. Explain why the plant was producing bubbles when placed near the light source.
**Observations:** Draw the observations in the correct test tube.

<table>
<thead>
<tr>
<th>Test tube #1</th>
<th>Test tube #2</th>
<th>Test tube #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue solution leaf uncovered</td>
<td>Blue solution leaf covered</td>
<td>Blue solution</td>
</tr>
</tbody>
</table>

![Leaf diagrams]

---

Include word bank on fill in the blank sentence.
Problem: Scientific Question

Hypothesis: 
IF

then

Materials:

Procedure: (Instructions on how to do the Lab)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.
Reflection:
Errors made:
Mistakes that were made in the experiment are ...

What would you change in your experiment?
To make the experiment better, I would ...

Pose a question based on what you have learned.

Title: 

Name: 

Class: 

Problem: 

Hypothesis: 
IF

Materials: 

Procedure: 

1. 

2. 

3. 

4. 

5. 

6. 

7. 

8. 

9. 

10.
Reflection:
Errors made:
What would you change in your experiment?:
Pose a question based on what you have learned.
Cell Processes and Energy  •  Guided Reading and Study

7. Circle the letter of each product of photosynthesis.
   a. water
   b. carbon dioxide
   c. oxygen
   d. sugars

8. Is the following sentence true or false? Photosynthesis produces the carbon dioxide that most living things need to survive. __________________________

The Photosynthesis Equation

9. Write the chemical equation for the process of photosynthesis.

   __________________________

10. What word does the arrow in the chemical equation stand for?

11. Circle the letter of each raw material of photosynthesis.
    a. carbon dioxide
    b. glucose
    c. water
    d. oxygen

12. Circle the letter of each sentence that is true about the products of photosynthesis.
    a. Plant cells use the sugar for food.
    b. Some of the sugar is made into other compounds, such as cellulose.
    c. Some of the sugar is stored in the plant's cells for later use.
    d. Extra sugar molecules pass out of the plant through the stomata.

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Class: 7th grade science
Unit: Respiration, Photosynthesis
Topic: respiration photosynthesis

Objectives:
1. Students will be able to explain their observations of respiration occurring in yeast.

Time: 2 days

Activities:
Warm up – What are the raw materials needed for respiration to occur?
DAY 1 –
1. As students complete the warm up have a lab working at the front of the room. Use the working lab to introduce the lab they will be completing in the next 2 days.
2. Teacher will provide materials to complete respiration lab.
3. 5 minutes – Students will read over procedure on lab in assigned group EL’s with each other. And non EL’s with each other. Each group will draw what they think the lab set up looks like.
4. 5 minutes – Teacher will read procedure aloud in class and model set up in lab.
5. As teacher reads and models the procedure she will place basic instructions on the board with pictures of each step and material used in the procedure. (pictures seen below)
6. 20 minutes – Students will set up lab with the entire set up except the yeast in soda bottle using the instructions pictures and models for reference.
7. Students will take set up label with group name and place on back table.
8. 10 minutes – Teacher and students will review procedure for the next class using the pictures and model for reference.

Warm up – 5 minutes - What are the byproducts of respiration?
Day 2 –
1. 30 minutes – Students will collect prep material and begin lab on respiration. Students will measure the diameter of balloons every 2 minutes for 20 minutes.
2. 10 – Students will answer the questions as a group that follow after data collection.
3. Teacher will guide students through the lab and questions that follow using modified questions with pictures to guide them.
   a. Modified questions
      i. Explanations of the line graph using color to coordinate what goes on the X and Y axis.
      ii. Explain if the temperature increases as the time increases
      iii. Does the Diameter of the balloon increase with the time?
      iv. Pictures are also included in questions.
      v. What is the gas that filled the balloon?

4. Close – Groups will share their findings of the lab by each entering a slip with the respiration equation on the card with the equation or a picture on the card. Teacher can evaluate if the groups completed the labs objectives.

Pictures to be used for modeling procedure:
Yeast Respiration

The graph illustrates the change in circumference (in cm) over time for different groups of yeast respiration experiments. The x-axis represents the time checked (Start, 1/2 hour, 1 hour, 1 1/2 hour), while the y-axis shows the circumference in cm. The graph compares the growth profiles of five groups: Group A, Group B, Group C, Group D, and Group E.
Rapid Rise Yeast

Highly Active

Up to 50% less rising time

Net WT. 1/4 OZ (7g)

Fleischmann's Active Dry

[Image of yeast packet with two scoops showing the product]
Lesson objectives

Energy in a Cell

Grade 7

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<tr>
<td>Read: process of respiration and photosynthesis</td>
<td>Complete guided reading that explains the process of photosynthesis and respiration. This includes the products and byproducts of each process</td>
<td>Complete guided reading that explains the process of photosynthesis and respiration. This includes the products and byproducts of each process, using a vocabulary list for aid in reading</td>
<td>Read a diagram of the process of respiration and one of the processes of photosynthesis.</td>
<td>Read the diagram of photosynthesis and respiration which depicts the processes in picture form using a picture dictionary for modification.</td>
</tr>
<tr>
<td>Write: answers to guiding questions on respiration and photosynthesis</td>
<td>Answer the guiding question based on the respiration and photosynthesis text</td>
<td>Answer the guiding questions on respiration and photosynthesis using the text given and vocabulary list</td>
<td>Answer the guiding questions on respiration and photosynthesis using the highlighted text used for reading and sentence frames for answers</td>
<td>Fill in the diagram explaining the processes of respiration and photosynthesis</td>
</tr>
<tr>
<td>Speak: share the answers to the guiding questions with the partner</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written</td>
<td>Students will explain the answer to the guiding questions to their partners and if needed correct what they have written using sentence prompts with words to be filled in</td>
<td>Students will share their answer with a partner using list of basic words and sentences prompts with words to be filled in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Students will share their answers on the diagram with their partners using gestures and pointing at their answers</td>
</tr>
</tbody>
</table>
Lesson 2

Energy in Cells

Grade 7

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Lesson 3

Energy in Cells

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<tbody>
<tr>
<td>Write: Design an experiment that tests if plants go through respiration</td>
<td>Design an experiment using the scientific process that observes the byproducts of respiration</td>
<td>Design an experiment using the scientific process to test for the byproducts of respiration using a template to write the lab procedure</td>
<td>Design an experiment using the scientific process to test for the byproducts of respiration using a template with helping sentences to guide them through the scientific process</td>
<td>Using diagram of procedure for designing an experiment to test for the byproducts of respiration. Students will write in appropriate procedure that they picked from a sentence bank</td>
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<tr>
<td>Write: I will interpret data from respiration experiment and write their finding in lab report form</td>
<td>Write a conclusion based on the data collected from the respiration experiment</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student will cut and paste in order the diagrams depicting the procedure for the respiration experiment and draw their for the experiment</td>
</tr>
</tbody>
</table>

Comment: Are you sure these are the PIs for lesson 3? I am confused! You submitted Lesson 2 last week (Testing for Photosynthesis), which has these same objectives. Please clarify.

Comment: Is your expectation for the students to write up the design of their experiment? I would image so, right?

Comment: Ok, this is all good!

Comment: Very nice and appropriate modifications! Don't forget to provide the materials that have all these supports for the different levels of ELLs.