

Program Summary

Read + annotate

Plants play an important role in the survival of every living thing. In fact, they are responsible for our very existence! Computer wizard Anna and her lab partner, Jack, find out what makes plants so unique — the amazing process of making food and oxygen from sunlight. They discover that life was very different when bacteria and algae first captured the energy of the sun nearly 3.5 billion years ago. In those days, Earth did not have what you'd call a pleasant atmosphere because there was little oxygen in the air. The chemical process of photosynthesis enriched the atmosphere and eventually led to the evolution of oxygen-breathing creatures.

To find out more about this process of photosynthesis, Anna studies the layers of a leaf with a microscope. She sees small openings in the outer leaf layer called stomata and learns how guard cells surrounding the stomata control the exchange of oxygen and carbon dioxide between the plant and the environment. She sees how photosynthesis begins when chloroplasts in the mesophyll trap sunlight. Found primarily in the palisade layer of mesophyll cells, chloroplasts contain a green pigment called chlorophyll that absorbs light and transforms it into chemical energy. It is then stored in an energy-rich molecule called ATP. Jack discovers how water is sucked up by the plant's roots and carried through the stem to the plant's leaves. There the water is split into its component parts and oxygen is released.

Jack and Anna learn that in the second part of photosynthesis the carbon dioxide that is taken in through stomata is separated into carbon and oxygen. These elements combine with hydrogen and ATP from the first step of photosynthesis to create sugars in a process known as the Calvin Cycle. It is these sugar molecules that living things use to carry out basic life processes such as growth by breaking the sugar molecules apart in a chemical process called respiration. In a classic hands-on experiment, students investigate whether or not a plant needs light to make food.

Vocabulary Read definitions

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

- photosynthesis** — The process by which green plants use light energy from the sun to make their own food out of carbon dioxide and water.
- algae** — The primitive photosynthetic plant like organisms from which green plants have evolved.
- bacteria** — Tiny single-celled organisms, some of which are capable of photosynthesis. It is thought that bacteria were the first organisms capable of photosynthesis.
- oxygen (O₂)** — A gas that is released by plants as a by-product of photosynthesis and is required for the survival of all living things.
- epidermis** — The protective outer layer of leaf cells including the guard cells surrounding the stomata.
- stomata (singular: stoma)** — Small openings or pores found on the underside of a leaf that allow carbon dioxide to enter the leaf as well as the release of oxygen and water vapor. (Continued)

Draw a diagram for each of the

PHOTOSYNTHESIS

1 mesophyll — The middle layers of leaf tissue.

8 palisade layer — The upper layer of mesophyll containing cells that are filled with chloroplasts and carry on most of the photosynthesis in a leaf.

9 chloroplast — The specialized structure found in plant cells where photosynthesis takes place.

10 chlorophyll — The green pigment found in chloroplasts that absorbs sunlight used in the first step of photosynthesis.

11 ATP (adenosine triphosphate) — The energy-rich molecules created with light energy during the first stage of photosynthesis and used to make sugar during the second stage of photosynthesis.

12 hydrogen (H₂) — A light, colorless, odorless gas that is one of the main building blocks of sugars.

13 guard cells — Cells that control the exchange of gases between the leaf and the surrounding atmosphere by regulating the opening and closing of stomata.

14 transpiration — The evaporation of water from a plant through stomata.

15 carbon (C) — A nonmetallic element that is one of the main building blocks of sugars.

16 glucose (C₆H₁₂O₆) — A simple sugar formed during the process of photosynthesis.

17 Calvin Cycle — The light-independent steps of photosynthesis in which carbon is linked to hydrogen and oxygen to make sugars.

19 carbon dioxide (CO₂) — A colorless gas that is given off by animal respiration and the decay of animal and vegetable matter, and is absorbed from the air by plants during photosynthesis.

19 respiration — The process in which sugar and oxygen are broken down into carbon dioxide and water, releasing energy that plants can use for growth. Respiration is the opposite of photosynthesis.

20 starch — A complex compound made from chains of sugar molecules.

21 pigment — Chemical compounds which reflect certain colors of visible light and absorb others.

22 carnivores — Animals that eat other animals.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About..." for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

- Why are plants green?
- What is photosynthesis?
- What do plants need to make food?

After the class has completed their "Everything We Think We Know About..." list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

Answer circled

1 What is the scientific term that means "putting things together with light?"

2 How did photosynthetic bacteria begin to change the Earth 3.5 billion years ago?

3 What was the Earth's atmosphere like before photosynthesis?

4 What are the raw materials plants need to make food?

5 What is the outer layer of a leaf called? What is its function?

6 What are stomata? Where are stomata located?

7 Where is the mesophyll located?

8 What structures are found primarily in the palisade layer of the mesophyll?

9 Where does the process of photosynthesis take place?

10 How do chloroplasts set plants apart from other living things?

11 Explain the role that sunlight plays in photosynthesis.

12 Why do some leaves change color in the autumn?

13 Explain how water contributes to photosynthesis.

14 How do guard cells regulate the exchange of gases between a leaf and the air?

15 What is transpiration?

16 What occurs during the second stage of photosynthesis?

17 What happens to carbon dioxide in the second step of photosynthesis?

18 Why are carnivores ultimately dependent on plants for their survival?

19 What three elements are the basic building blocks of sugars?

20 What does a plant use sugars for?

21 How does a plant store sugars?

22 How does photosynthesis affect life on Earth?

Follow-up Discussion

Research indicates that students will retain their previous misconception about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have you students re-examine the facts/beliefs they put on their "Everything We Think We Know About..." list. It might also be helpful to review the list by marking each entry with a "+", "o", or "*" to show which facts were correct and which were incorrect.

Thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics:

- Discuss the color changes in ripening fruit and autumn leaves. Have students explain what is happening to the green chlorophyll.
- Ask students to explain how some trees survive through cold winters without leaves. (Continued)