

Matter and Energy in Plants

Reflect

Imagine if you were hungry and all you had to do to eat was step into the sunshine, dig your toes into the soil, and breathe. Wouldn't it make life easy if you could make your own food?

That is basically the process green plants use to get the nutrition they need to grow. Green plants make their own food with the air, water, and sunshine they get from their surroundings.



How do green plants make their own food?

Plants are able to produce their own food through the process of **photosynthesis**. The name means “made from light.” Water is absorbed by the roots and is carried up through the stems. Carbon dioxide is taken in through openings in the leaves. Leaves absorb sunlight. When plants take in water and carbon dioxide, through the process of photosynthesis, the absorbed light energy changes to chemical energy and is stored as sugar for the plant to use. Oxygen is produced as a waste product and released from the leaves back into the air.

photosynthesis: the process used by plants to change light energy into chemical energy for food.



Plants are called *producers* because they can make their own food. Plants use the chemical energy in this food to grow and reproduce. Some plants, like fruits and vegetables, store the chemical energy. When you eat an apple or an ear of corn, the stored chemical energy is passed along to you. Any organism that eats plants is called a *consumer* because they can't make their own food and must consume a producer.

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Do plants really need dirt?

While we generally see plants in soil, and the plants do get nutrients from minerals in the dirt, plants can grow quite well without soil. Yes, plants can grow with just water and air.

Horticulture is an area of science that deals with plant cultivation. There is a branch of horticulture called **hydroponics** in which plants are grown without soil. Hydroponics include growing plants in a substance that has no nutrients (like rocks or sand) and providing the plants the nutrients they need through the nutrient-rich water. Sometimes the plants are just grown with the nutrient-rich water and nothing else.

The use of hydroponics can be traced back to the 1600s. An advantage of hydroponics is that it provides a fresh food supply in areas where land is scarce, like in big cities.



Watermelons being grown using hydroponics. Mesh slings help to support the weight of the fruit.

hydroponics: growing plants without soil; usually by providing a nutrient-rich water.

Windowfarms is a hydroponic gardening organization that focuses on urban areas. Started by Britta Riley in 2009, Windowfarms is indoor gardening year-round using natural light and the climate-control of your living space. Riley's first hydroponic garden was in the windows of her fourth floor Brooklyn, NY apartment. Today, there are 40,000 registered users, supplying city-dwellers with fresh foods such as greens, herbs, and small vegetables.



A hydroponic herb garden on a patio.

Hydroponic gardening isn't limited to apartments and small patios. Birds Eye, an American company that is known for frozen foods, started investigating in hydroponic farming in 2013 as a way to guarantee year-round food supplies.



Lettuce being grown hydroponically in a greenhouse.

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Aquaponics takes hydroponics to the next level by raising fish and other aquatic organisms, such as snails, crayfish, and shrimp, in the water supply and then pumping the fish water through the hydroponics system and then back to the fish tank. The waste products of the fish become the nutrients and fertilizers in the water for the plants.



The fish are raised as a food source in tanks like this.



The nutrient-rich water is pumped from the fish tank through the plant containers then recycled back to the fish tanks.

Look Out!

Epiphytes, sometimes called air plants, grow on other plants like trees and gather their nutrition from the air and rain.

Mosses, orchids, and bromeliads are examples of epiphytes.



What Do You Think?



What if plants could actually clean the soil? What if toxic materials and heavy metals could be removed from water and soil using plants? It may sound like futuristic science fiction but it is a reality. The process is called *phytoremediation*. Phytoremediation uses plants like sunflowers, pigweed, mustard plants, and Alpine pennycress to absorb and store the unwanted and toxic materials in their roots. Sometimes the plants can change the chemicals they absorb in to something less harmful. Phytoremediation is very environmentally friendly and less expensive than other methods of cleaning soil.

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Try Now

Now it is your turn to create your very own hydroponics system! This is a great, simple, and cheap hydroponics hands-on activity for you to do with your classmates or at home.

Materials:

Two-liter bottle (1)
Growing medium (2-3 cups)
Water (3-4 cups)
Washcloth cut into 1 inch wide strips
Aluminum foil (2 sheets)
Nutrients (1 quart)
Seeds (1 packet)
Sharpie (1)
Scissors (1)

Instructional Steps:

1. Using your Sharpie, draw a line around the circumference of the two-liter bottle near the top of the bottle where the curved sides stop and it goes into the straight sides of the bottle (about one-third of the way down from where the cap goes).
2. Using your scissors, carefully cut your bottle around the line you drew. Try to make sure to keep the cut as straight as possible. Take off the top section you just cut off, flip it upside down, and carefully place it into the bottom half of your soda bottle. (The spout should be facing down towards the bottom of the bottle.)
3. You will prep your water by adding nutrients to it. Be sure to read the package label on the nutrients to see how much to add to your 3–4 cups of water.
4. Pour your water into the bottle until it reaches the point where the bottle cap would normally go.
5. Carefully remove the top half of the soda bottle. You will take two of your washcloth strips (about 1 inch wide) and twist them together. It will look like a long rope. This is going to be the wick of your hydroponics system. Carefully push your wick through the spout of the bottle until about two-thirds of it is hanging out. Put the top half of the soda bottle back into its resting place inside the bottom half of the soda bottle. Your wick should drag the bottom of the bottle.
6. Fill the whole top portion of your soda bottle with your growing medium. Be sure to read the package to see if you need to add any extra water to it.
7. Pour your packet of seeds into the palm of your hand. Using one finger, pick up 4–5 seeds at one time. Read the directions on your seed packet to see how far down you need to plant them in your growing medium. Create a small pocket in your growing medium to plant your seeds, and then carefully cover your seeds so they are in a dark environment.
8. Wrap your aluminum foil around the outside of your soda bottle to ensure the health of your plant.

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What Do You Think?

What Do You Know?

Use the words from the bank to complete the sentences below.

WORD BANK			
aquaponics	carbon dioxide	consumers	
epiphytes	horticulture	hydroponics	
oxygen	photosynthesis	phytoremediation	producer

1. The process green plants use to make food is _____.
2. Leaves take in _____ from the air.
3. An organism that can make its own food is called a _____.
4. The study of plant cultivation is called _____.
5. Organisms that cannot make their own food are called _____.
6. The process using plants to clean soil and water is _____.
7. Growing plants without soil in nutrient-rich water is _____.
8. Leaves release _____ into the air.
9. Raising aquatic organisms and cycling the nutrient-rich water from their ponds to plants is called _____.
10. _____ are organisms that are also called air plants.

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Connecting With Your Child

A Hydroponic Garden at Home

To help your child learn more about the environment, discuss having a hydroponic garden at your home.

Here are some questions to discuss with your child:

- What do plants need to make their own food?
- Where do they get these things from?
- Should the hydroponic garden be in the house or outside on a patio or deck?
- What direction should the garden face?
- What equipment will be needed?
- What should we grow in the garden?





Content Connections Video

Name: _____ Date: _____ Group: _____

Parts of a Plant

1. Plants are special because of what unique ability? (Pause 0:18)

2. Plants start life as a _____ that develops _____. (Pause 0:30)

3. Describe the root's job, or function. (Pause 0:46)

4. Shoots grow into strong stems. What are they in search of? (Pause 1:17)

5. Describe the stem's job, or function. (Pause 1:37)

6. What is the process through which leaves make food for the plant? (Pause 1:54)

7. What part of the plant is needed for reproduction to make new plants? (Pause 2:23)



Content Connections Video

8. Label the parts of a plant.





Content Connections Video

Name: _____ Date: _____ Group: _____

Parts of a Plant—Did You Know?

1. What part do plants use to make food during photosynthesis? (Pause 0:14)

2. Do all plants make their own food? (Pause 0:27)

3. Describe how the plant in the video gets food if it cannot make it itself. (Pause 0:55)



Independent Practice

Name: _____ Date: _____ Group: _____

Part I: That's a Lie!

Directions: Each statement below contains something that makes it untrue. Rewrite it to make it accurate and explain the change needed.

1. Plants get all the materials they need to grow from the soil.

New Statement: _____

Reasoning: _____

2. Plants only grow in warm weather environments.

New Statement: _____

Reasoning: _____



Independent Practice

Name: _____ Date: _____ Group: _____

Part II: Riddle

Directions: Use the clues to fill in the missing words. Then match the numbers under the letters to find the answer to the riddle.

- A single, self-contained living thing. O _____
12 6
- The two main things plants need to grow are A _____ & _____.
4 8 1
- Green plants make their own _____ D.
9
- Anything that has mass and volume. M _____
7 3
- To increase in size, amount, or increasing complexity. G _____
5 2
- The matter that makes up something. M _____
11 10

How do plants obtain what they need to grow?

1	2	3	4	5	5	1	6	7	B	6	5	4	B	1	2	3	
8	7	1	3	4	9	4	5	M	1	2	3	6	5	I	10		
7	12	D	1	2	3	10	3	7	V	3	6	7	B	6	5	4	B
1	2	3	6	U	12	10	11	G	2	1	7	12	D	7	11	4	



Concept Attainment Quiz

Name: _____ Date: _____ Group: _____

I. Vocabulary Matching

_____ An organism with the ability to make its own food	A. Materials
_____ Anything that has volume and mass	B. Growth
_____ The matter from which a thing is or can be made	C. Matter
_____ To increase in size	D. Producer

II. Identification

Use the word bank to fill in the blanks below.

Structures Air Energy Grow Water

1. Plants use the _____ from sunlight, along with carbon dioxide and water, to create food.
2. Plants have several _____ that are different from animals, and they play an important role in their survival.
3. _____ and _____ are two of the most important requirements a plant needs in order to _____.