



## Energy, Plants, and Humans

*More than spinach: Why do we need plants?*



Name: \_\_\_\_\_

**Before you start...  
What do you already know?**

What are three ways you used energy from the sun today?

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How do plants use sunlight?

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How are animals dependent on plants?

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What are the parts inside leaves and plant cells that allow them to make food?

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What are three words you would use to describe botanical gardens?

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What is a cholla cactus?

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# Thought Experiment

Imagine that you wake up tomorrow at 8 am, and it is completely dark. All you can see in the sky are stars. You turn on the news and learn that the sun was extinguished last night.

**Question:** What would happen on Earth if our sun suddenly stopped emitting any energy? How would it change Santa Fe?

**Note:** Light and heat are both forms of energy that can come from the sun.

## Solar Energy on Earth

When people discuss solar energy, they are often talking about solar panels that change sunlight into electricity. However, the Earth depends on solar energy for much more than powering humans' homes and businesses. Solar energy is the foundation of much of life on Earth. In order to survive, all living organisms require energy. They acquire this energy in many ways. Plants convert sunlight into food through a process called **photosynthesis**. After plants capture this energy as food, animals can consume them. Without sunlight humans would be left without food. The sun also heats the surface of the Earth. At night Santa Fe is much cooler than during the day. This is due to the lack of direct solar energy during the night. Without sunlight the Earth would be a cold dead place.

Even driving or heating a home depends on energy that once came from the sun. Gas, coal, and oil are all fossil fuels. Fossil fuels are made from organisms that were once alive. When these organisms died, they were buried and the energy stored in their cells was converted into coal, gas, or oil. When people drive cars or burn oil to heat the water in their homes, they are using solar energy that was stored by plants millions of years ago. Ninety percent of the electricity that provides the light allowing you to read this was paragraph was produced by burning fossil fuels in large power plants here in New Mexico.

What are five ways you used solar energy today?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

## Plant Cells

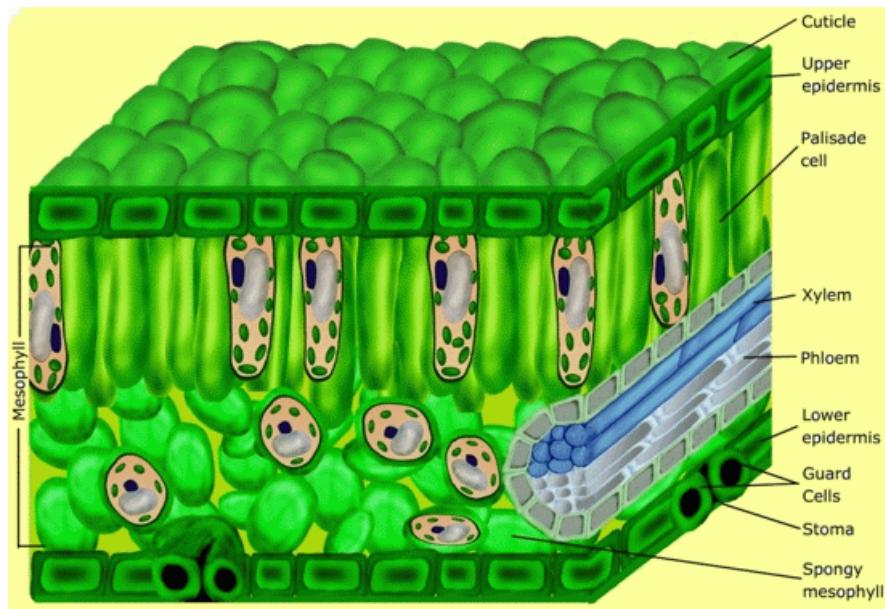
*Imagine...*

If you were hungry you would go lay outside in the sun and your body would make its own food.

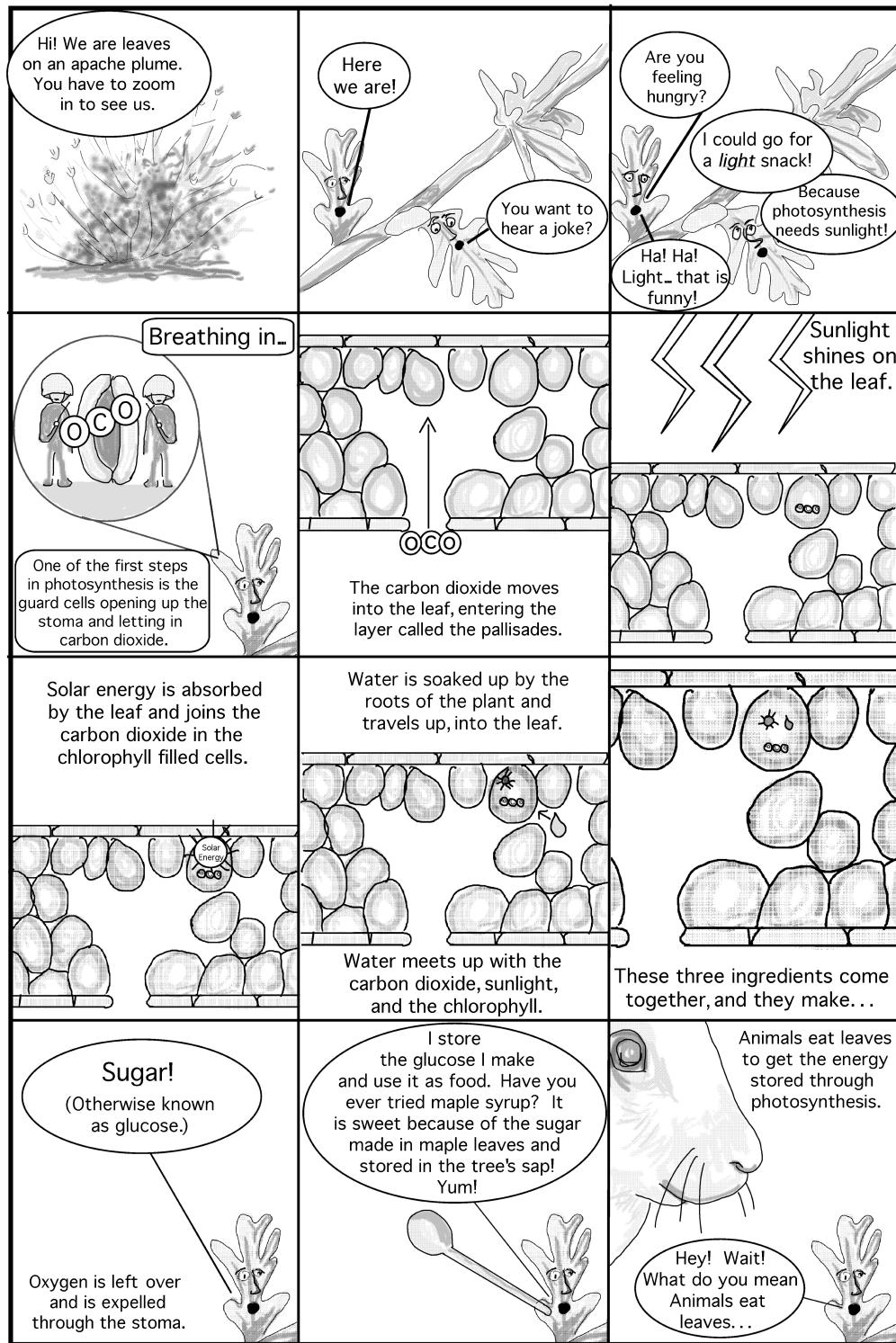
*How do plants make their own food?*

Plants are incredible **organisms** that are able to make, store, and utilize their own food. This food is the basis of most of the life that exists on Earth. **Multi-cellular** organisms are made of smaller parts that have specialized purposes. In the human body, the lungs serve a different purpose than a heart or brain. Plants are also filled with specialized components. The roots of plants store energy and gather minerals, water, and nutrition from the soil. Plant stems or trunks carry water and nutrients to and from the roots and leaves. Leaves produce food from solar energy.

Inside of a leaf there are many specialized cells. Each cell has a different duty. The **epidermis** is the “skin” of the leaf. It protects the organs inside. **Xylem** and **phloem** carry water, food, and nutrients to and from the leaves. **Guard cells** allow the leaf to breathe, opening and closing an opening called the stoma. **Palisade** cells and the **spongy mesophyll** are filled with **chloroplasts**. Chloroplasts produce food through photosynthesis.



# Photosynthesis



## **The Sun and Me**

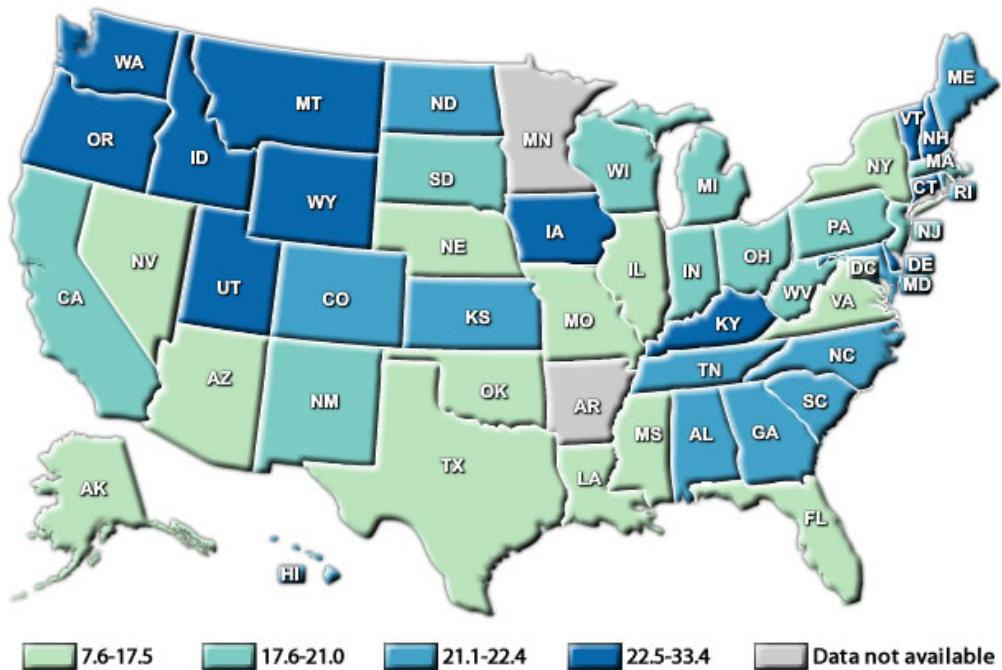
Humans depend on energy from the sun. Create a comic describing how humans use solar energy. It can be funny or just informative. You must include at least three ways that humans use this energy


## The Sun on My Skin

Sunlight is important to life on Earth in many ways, as you have seen. Sun helps feed people and animals, heats the Earth's surface, and even helps the skin produce Vitamin D. However, the sun can also have a harmful effect on you. Have you ever had sunburn? Sunburn is caused by energy from the sun damaging the cells that make up your skin. The same energy that allows plants to photosynthesize, called **UV or ultraviolet light**, burns your skin. Your skin cells try to protect themselves by producing **melanin**, a dark pigment that people think of as a tan. UV rays are strong enough that they can travel through clouds, clothes, and even the outer layers of skin. The sun can even damage lower layers of newly growing skin cells.

Too much direct exposure to UV light can have negative consequences, including temporary and permanent damage to your skin. Sunburns are classified as first and second degree burns. **First-degree burns** damage the outer layers of skin. These burns will turn red, feel tender and sensitive, and can peel after 3-5 days. Second-degree burns are more severe. **Second-degree burns** can result in blistering and swollen skin. This indicates deep damage that can take longer to heal and could even produce scars. If individuals have repeated exposure to harmful UV light, one long-term result could be **skin cancer**. This occurs when skin cells are so damaged by UV light that they no longer grow in a normal way. About 60,000 people were diagnosed with skin cancer in the United States in 2010, according the Center for Disease Control. Nearly 10,000 individuals in the US died of skin cancer that year. Although sunlight can be damaging, there are many things you can do to protect yourself.

## 2010 CDC Map, Skin Cancer Rates per 100,000 People



<http://www.cdc.gov/cancer/skin/statistics/state.htm> Note: Melanoma is much more common among non-Hispanic whites than people of other races and ethnicities. More than 9 out of 10 cases of melanoma are diagnosed in non-Hispanic whites. Differences in state populations are responsible for much of the variation in melanoma rates between states. To see melanoma tables and maps of rates by state, separated by racial and ethnic groups, see [CDC WONDER](#).

The National Institute for Health (NIH) risk factors include:

- Infants and children are very sensitive to the burning effects of the sun.
- People with fair skin are more likely to get sunburn, but even dark and black skin can burn and should be protected.
- The sun's rays are strongest during the hours of 10 a.m. to 4 p.m. The sun's rays are also stronger at higher altitudes and lower latitudes
- Reflection off water, sand, or snow can make the sun's burning rays stronger.
- Sun lamps can cause severe sunburn.

To protect yourself the NIH recommends that you:

- Use a broad spectrum sunscreen and lip balm that protects from both UVB and UVA of SPF 30 or higher.
- Apply a generous amount of sunscreen to fully cover exposed skin every 2 hours. Even on cloudy days over 80% of UV light reaches the ground.
- Apply sunscreen after swimming or sweating and even when it is cloudy.
- Wear a hat and other protective clothing. Light-colored clothing reflects the sun.
- Stay out of the sun when the sun's rays are strongest, 10 a.m. and 4 p.m.
- Wear sunglasses with UV protection.

From: [www.nlm.nih.gov/medlineplus/ency/article/003227.htm](http://www.nlm.nih.gov/medlineplus/ency/article/003227.htm)

To learn more watch: [www.nlm.nih.gov/medlineplus/ency/anatomyvideos/000125.htm](http://www.nlm.nih.gov/medlineplus/ency/anatomyvideos/000125.htm)

## **Learning at the Botanical Garden**

### **Food Web**

Draw and label the web we created today.



What was the impact of changing the producers on the consumers?

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Why was the sun important in this model?

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What will you remember from this activity?

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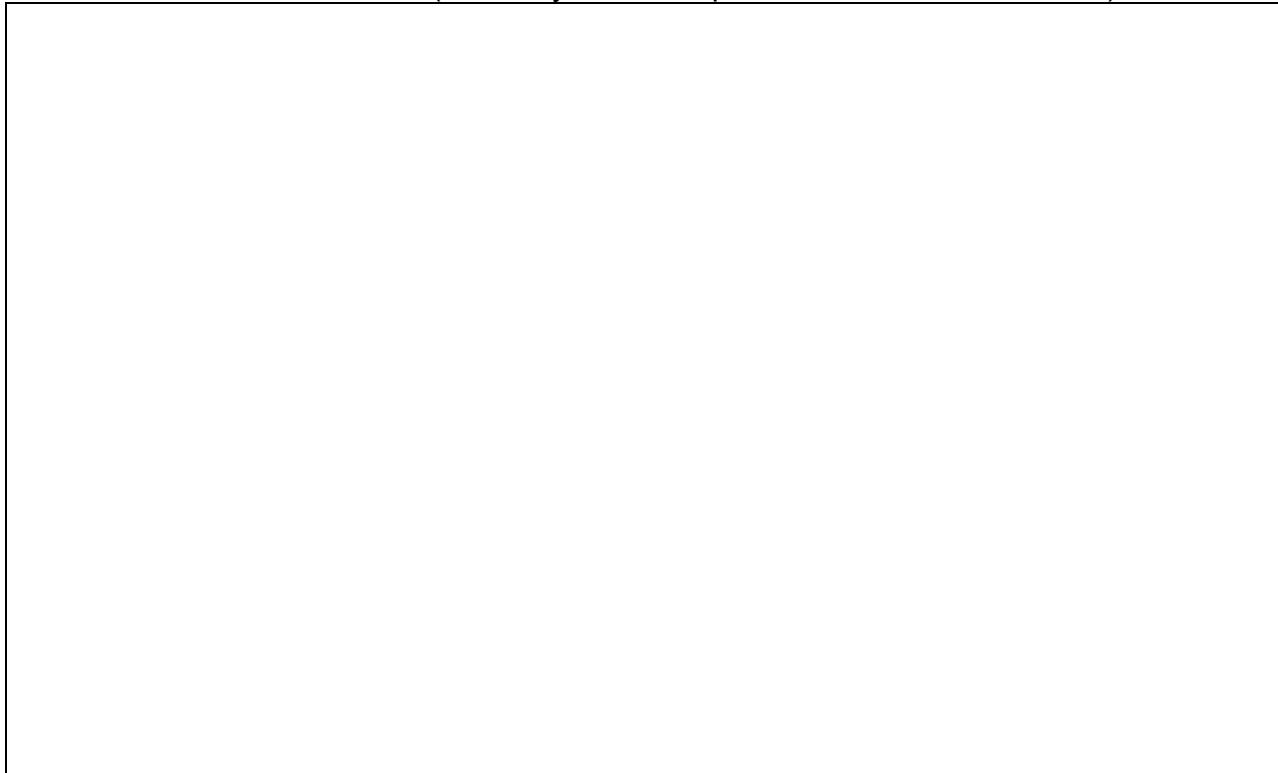
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## **Learning at the Botanical Garden**

### **Santa Fe Cholla**

This is the Santa Fe Cholla. (You may use this space to either write or draw.)



The Latin name is \_\_\_\_\_

I think that this plant has thorns because \_\_\_\_\_

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Where do you think that photosynthesis happens in the cholla? Why do you see that makes you say that?

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Which of the cholla you potted today do you think will grow the fastest? Why?

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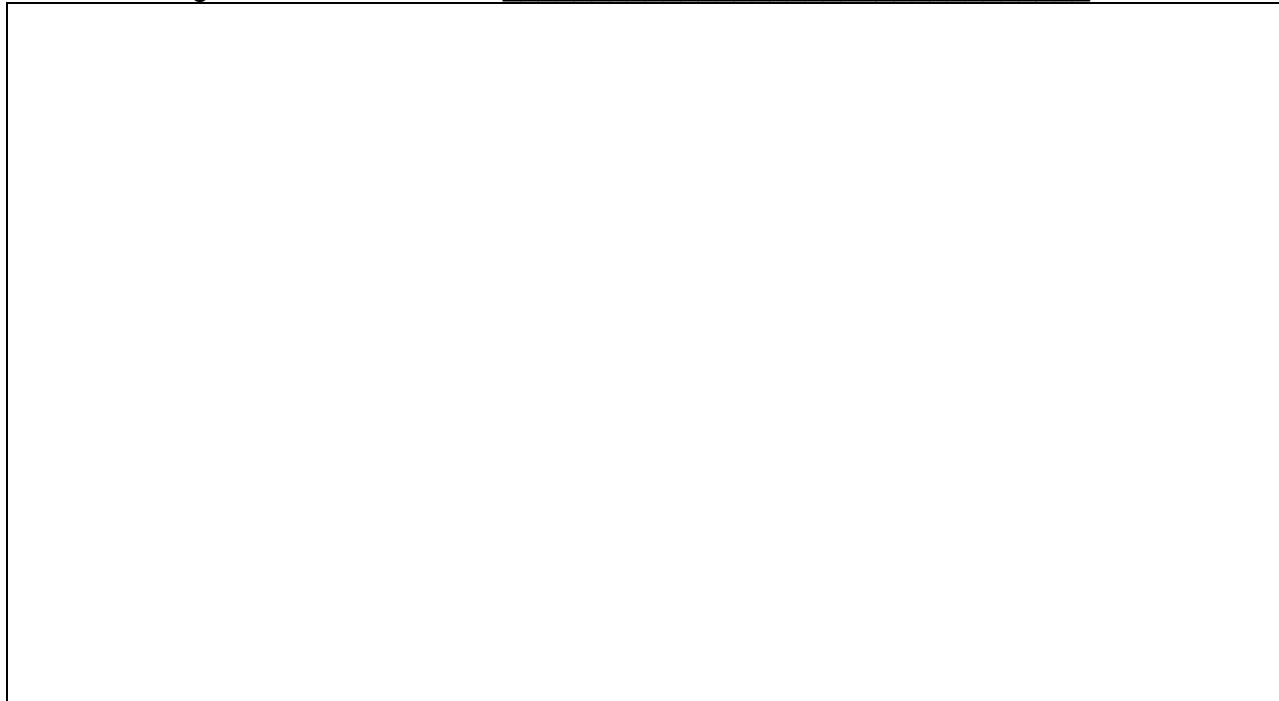
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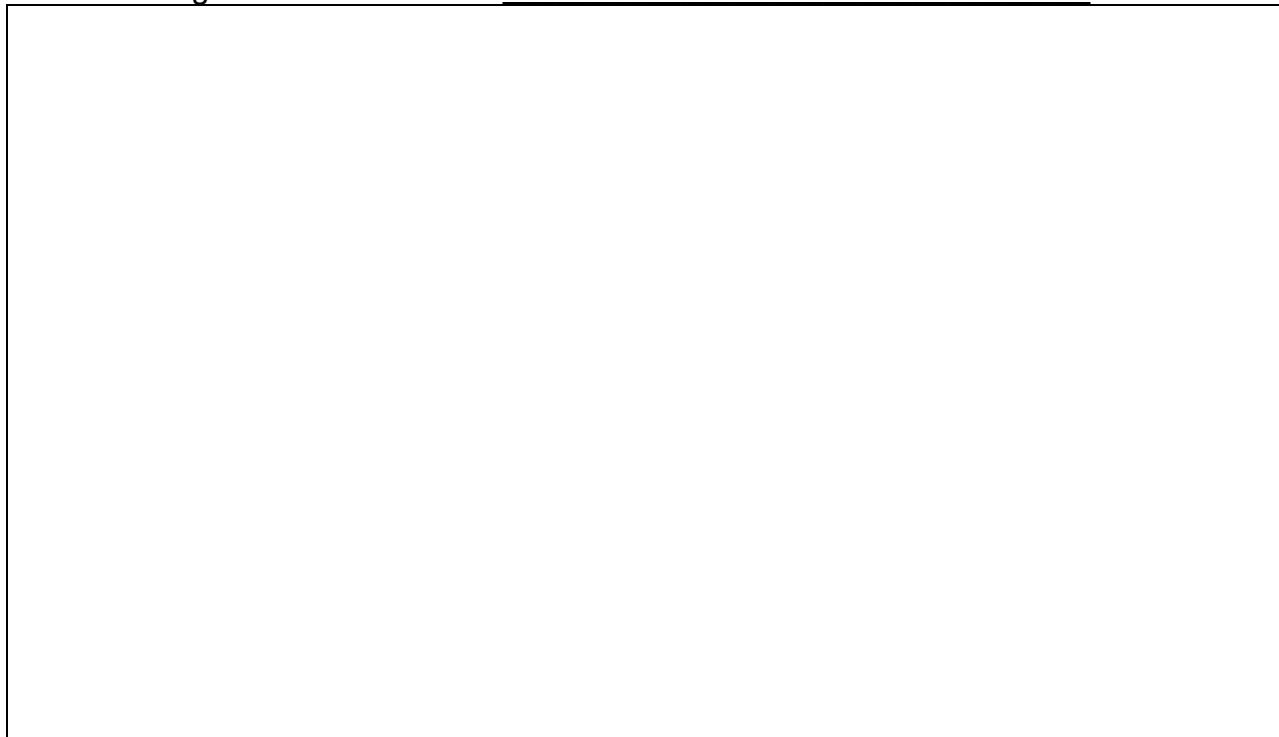
## **Learning at the Botanical Garden**

### **Leaf Anatomy and Dissection**

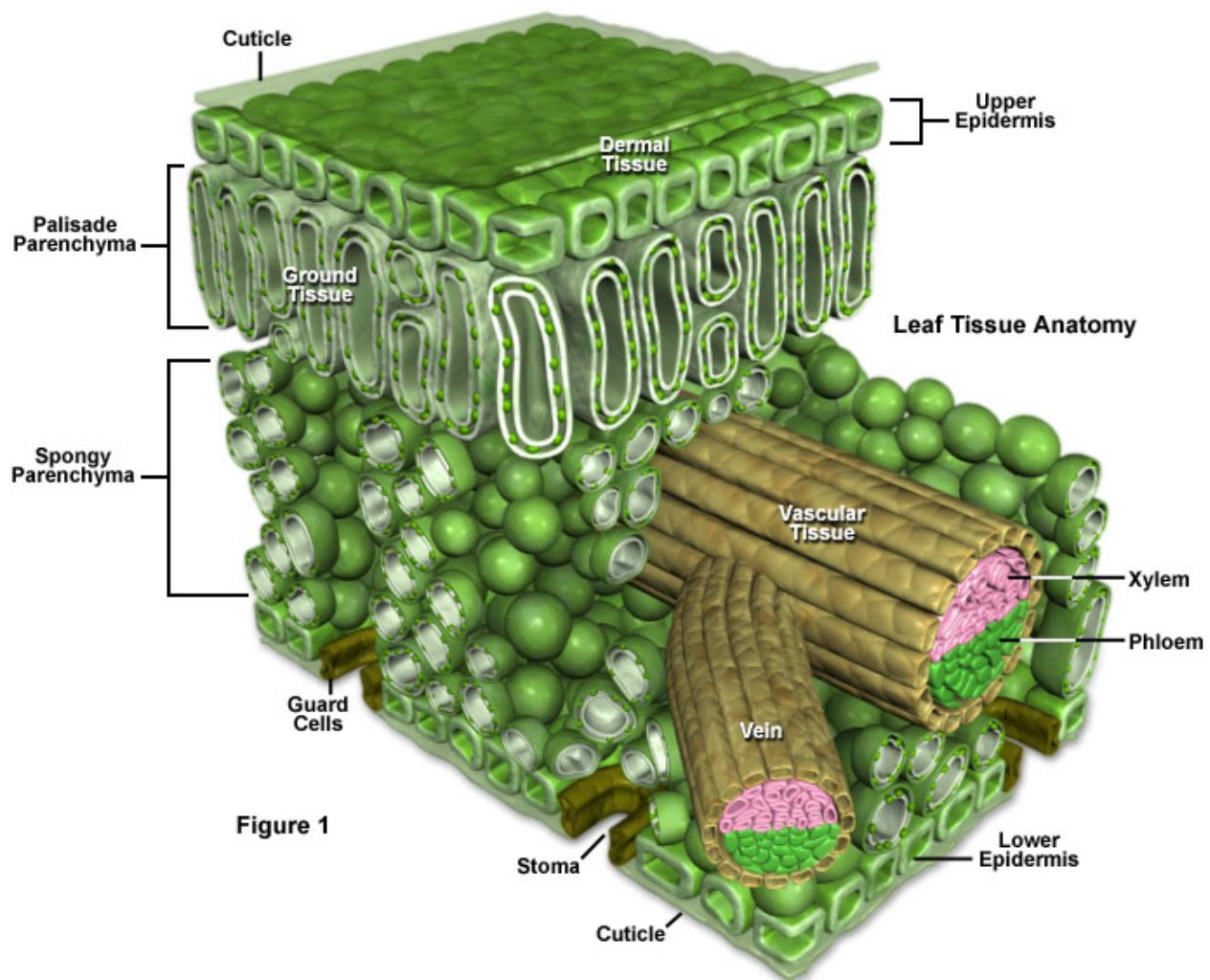
This is a diagram of the leaf of the \_\_\_\_\_.



This is a diagram of the leaf of the \_\_\_\_\_.



## Plant Leaf Cell

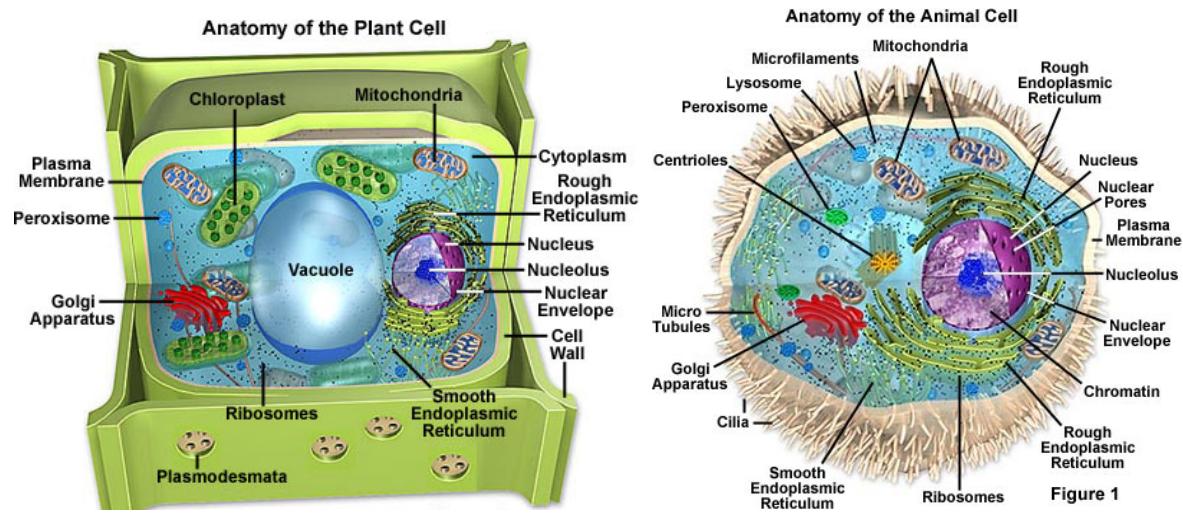


## My Plant Cell

Today you will be making a model of plant cell. Look at the diagram on page 11, as well as the drawing on page 13, to remind you of what is inside of plant cell. Your teacher has materials to represent the different organelles. Think about the purpose of each organelle and choose the model material accordingly. Use this chart to record what materials you chose for each part of the anatomy.

Anatomy	Purpose	Represented by _____ in my model...
Cell wall	Protect the cell and contain organelles	
Chloroplast	Green organelle in which photosynthesis occurs	
Mitochondria	Organelles where energy for the cell is made by burning glucose. It is the cell's "power plant."	
Vacuole	Storage area in the cell	
Cytoplasm	Jelly like substance that fills the cell	
Nucleus	Processes information and holds DNA	
Ribosome	Makes proteins in the cell	
Golgi Apparatus	Like a shipping center for the cell, sending chemicals and proteins out to the body	
Peroxisome	Tiny organelle that help seeds germinate	
Rough and smooth endoplasmic reticulum	Network of "sacks" that make and process chemical compounds	
Chloroplast filled with Chlorophyll	Green organelle that makes glucose, the food of the plant	

## Compare and Contrast



How do you think a plant cell is different than the cells in your body? (Remember, you have “animal cells.”)

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How do you think that they are similar?

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# Photosynthesis

## Cellular Respiration

Plants make food for their own use in the future. The glucose is stored in leaves, roots, stems, fruit, and seeds. It is used daily to fuel cells and is stored for the night or times like the winter, during which the plant might not be able to make more food. When animals or people eat, we are using the energy from the sun that was turned into food. When we eat food and our cells use the food or when plants use the glucose they make, the process is called cellular respiration. It is the opposite of photosynthesis. Instead of using carbon dioxide and water to make glucose and oxygen, the cells break apart glucose and oxygen to make carbon dioxide and water. This releases energy into our cells, allowing us to grow, move, and live.

## Elements

Elements are the basic building blocks of everything around us. Photosynthesis and cellular respiration reorganize these components. Carbon dioxide ( $\text{CO}_2$ ) is made of one carbon and two oxygen. Water ( $\text{H}_2\text{O}$ ) has two hydrogen and one oxygen. Glucose is a more complicated molecule ( $\text{C}_6\text{H}_{12}\text{O}_6$ ). Oxygen is just made of two oxygen. When glucose is being made there is no gain or loss of elements. If you start with six carbon, you have to end with six carbon.

## Challenge:

Can you make this equation balance? Remember that there need to be the same number of each element before and after photosynthesis occurs.



Use manipulatives to solve this challenge. Start with the glucose.

## **What do you know now?**

What are three ways you used energy from the sun today?

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## Glossary

Carbon dioxide \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Cell wall \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Chloroplast \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Consumers \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Cytoplasm \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Endoplasmic Reticulum, rough and smooth \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Epidermis \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

First-Degree Burn \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Glucose \_\_\_\_\_

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Golgi apparatus \_\_\_\_\_

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Guard cells \_\_\_\_\_

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Mitochondria \_\_\_\_\_

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Multi-cellular \_\_\_\_\_

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Nucleus \_\_\_\_\_

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Organelle \_\_\_\_\_

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Organism \_\_\_\_\_

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Oxygen \_\_\_\_\_

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Palisade \_\_\_\_\_

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Phloem \_\_\_\_\_

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Photosynthesis \_\_\_\_\_

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Producers \_\_\_\_\_

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Second-Degree Burn \_\_\_\_\_

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Skin Cancer \_\_\_\_\_

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Solar \_\_\_\_\_

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Spongy mesophyll \_\_\_\_\_

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Sunburn \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Ultraviolet Light \_\_\_\_\_  
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Vacuole \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Water \_\_\_\_\_  
\_\_\_\_\_  
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Xylem \_\_\_\_\_  
\_\_\_\_\_  
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