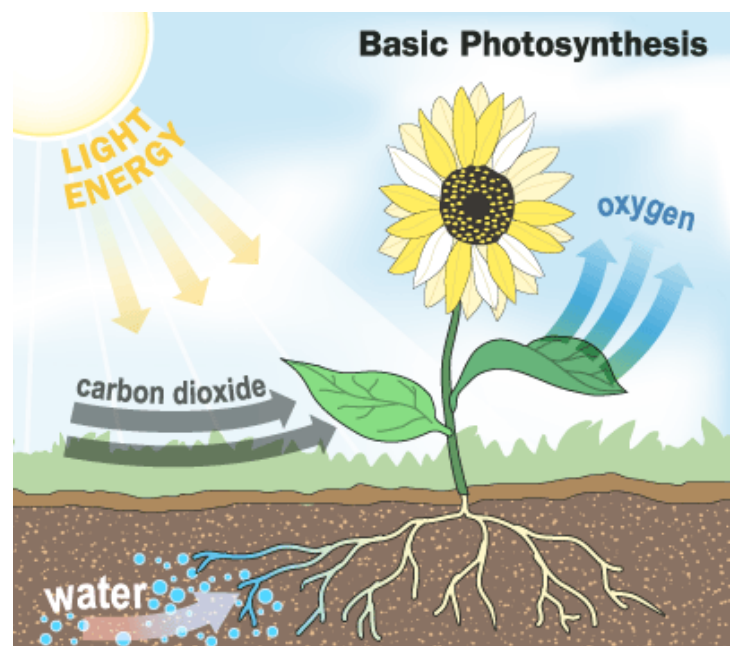


# Nature's Energy



<b><u>Item</u></b>	<b><u>Number of</u></b>
Plant Pigments and Photosynthesis Lab Investigation	1
Radiation's Effects on Plant Growth Kit	1
"What Is Photosynthesis?" DVD, questions and answers	1
"Bill Nye the Science Guy: Respiration Classroom Edition" [Interactive DVD] (1995), questions and answers	1
Enviro battery kit	1
Solar powered Ferris wheel	1
Make Electricity Science Kit	1
Book- <u>One Hundred Years of Public Power; Crawfordsville Electric Light and Power</u>	1
Natural Gas Safety- Vectren	1
Discover Electricity; teachers' and students' edition- Vectren	1
Water calculator	1
Solar hot dog cookers	2



# **Station 6- Nature's Energy**

## **Introduction**

Energy conversions make things happen and nature creates its own energy in a variety of amazing ways. THE main energy source begins with that which pours onto the Earth from the sun. It is so eager to get here and start heating things up that it zips through the 93 million miles of space vacuum between the sun and us in eight and one half minutes. It heats the oceans and landmasses and the air, which makes wind and ocean currents, evaporates water, forms clouds, and drops rain and snow.

Plants absorb energy from the sun, and then use it, along with water and carbon dioxide, to make more of themselves. Animals eat the plants and use the energy that was stored in the plant molecules to breathe, move, stay warm, and to make more of themselves by combining the plant material with water. Then other animals eat the animals that ate the plants.

Over and over again energy is transformed from one form to another. It cannot be created nor destroyed, but converted into endless forms. Energy is everywhere in nature - in the light of the sun, in the wind, in the forest, in falling water, in the food that we eat, inside of us, in the air, and in the substances we find on the ground. Without energy, there is no life. Energy makes everything happen and can be divided into two different types. Stored energy is called potential energy. Energy in motion is called kinetic energy.

<http://www.ftexploring.com/me/photosyn1.html> and <http://www.gp.com/Educationalinnature/energy/>

# Examples of Natural Energy Production

## Photosynthesis and Respiration

Photosynthesis and respiration are opposite and interconnected reactions. The equations are



During the process of photosynthesis, plants take the energy from sunlight and use it to put together large sugar molecules from the raw ingredients  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . During cellular respiration, organisms break down large sugar molecules to use the energy to do work and release the waste products  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .

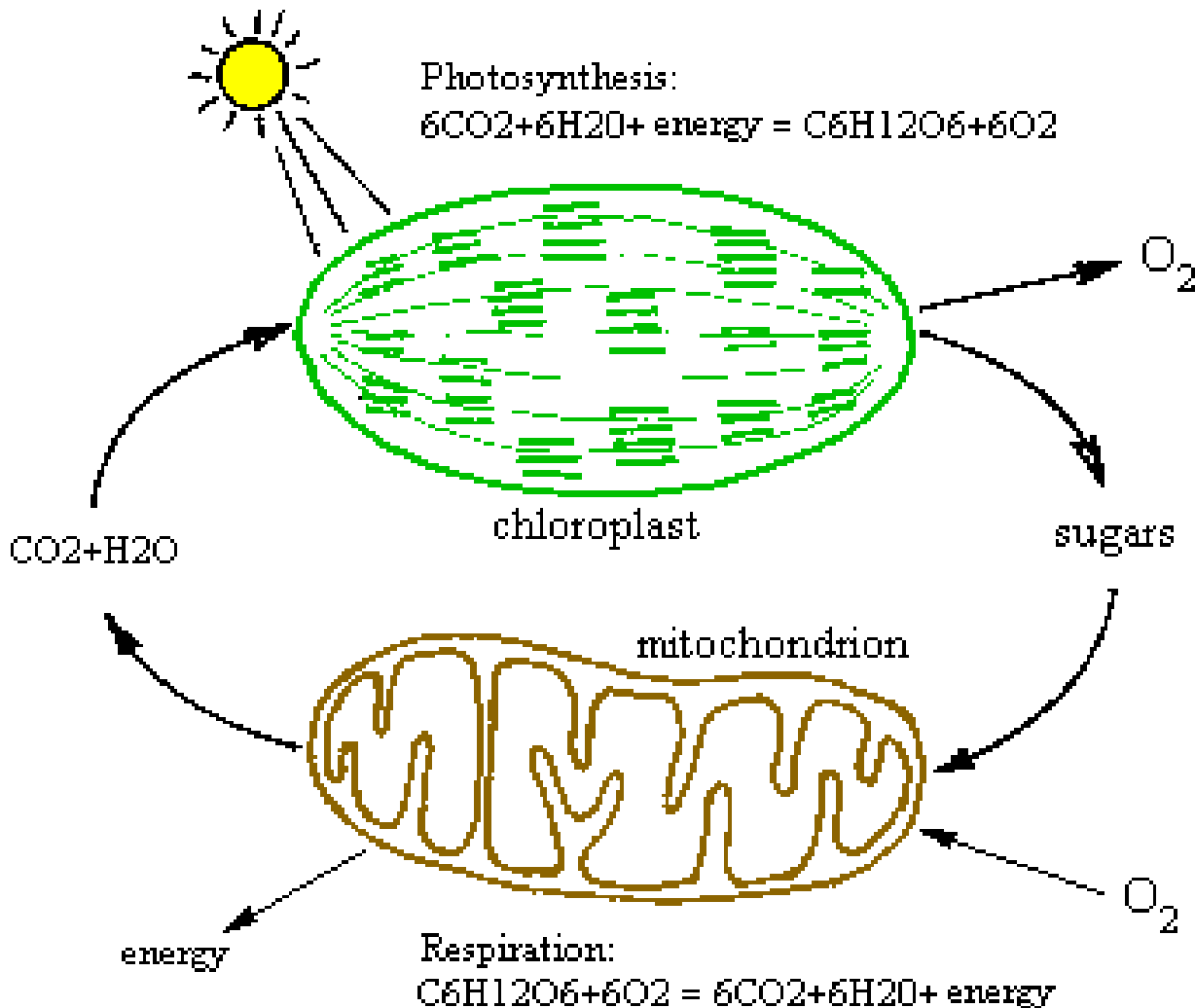
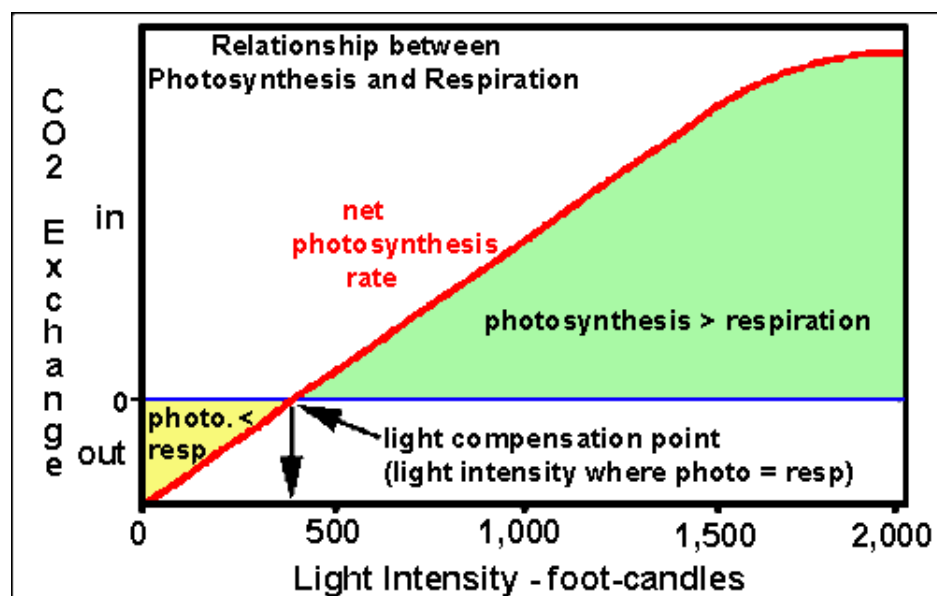


Figure 16 - With the photosynthesis, the solar energy is cumulated by the chloroplasts as sugar molecules. With the glycolysis and the respiration, made by mitochondria, the energy is liberated and supplied to the cell for its biochemical processes.

Photosynthesis is light dependent. A plant typically has chloroplasts within their cells. A straight line of light comes from the sun, a natural source. It hits the surface of a green leaf. Not all light is absorbed because some of the light is reflected off the surface and some light cannot penetrate the surface because it is the wrong wavelength. And not all the light hits the chloroplasts because they are small, and some light rays will miss the chloroplasts all together. It is only the light which hit the chloroplasts which will be used in photosynthesis.

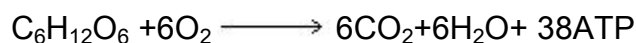
Photosynthesis is not a simple one-way process. Photosynthesis involves two linked reactions: light-dependent and light-independent reactions. The light dependent reaction is the first one - and it is, obviously, reliant on sunlight. The energy from the sunlight and water are converted into ATP (chemical energy) and electron carriers (NADPH). Basically, this process just sets up for the light independent reaction, which happens in the grana of the chloroplast. The light independent reaction takes the energy and electron carriers from the previous reaction and uses them to turn carbon dioxide into glucose. This reaction doesn't need light...but it will cease if it uses up all the chemical energy.

<http://answers.yahoo.com/question/index?qid=20090114024646AAOKTWN>



<http://generalhorticulture.tamu.edu/lectsupl/Light/light.html>

Respiration is defined as the process during which organic compounds break down in order to release energy. The organic compounds that are broken down are called the substrates; the most common is glucose. The general equation for respiration is



Breathing takes in oxygen and gives off carbon dioxide. It is a physical process and part of respiration and is a biochemical and physical process.

Respiration takes place in the following three stages:

1. External Respiration

This is the exchange of gases between the environment and the body. It is also called gaseous exchange.

2. Internal Respiration

This is the exchange of gases between the body spaces or fluids and the cells. It is also called tissue respiration

3. Cellular Respiration

It takes places within the cells of an organism. It helps break down the substates to release energy in the tissues within the cells of the organism.

- Gaseous exchange in plants takes place through the stomata in the leaves, lenticels in the stem and general surface of the roots.

- Gaseous exchange in earthworm takes place through its skin. The skin always remains moist and is in close contact with the blood vessels so that gaseous exchange can take place.
- Gaseous exchange in fish takes place through the gills. The fish uses the oxygen present in water and the carbon dioxide given off is also dissolved in the surrounding water.
- Gaseous exchange in grasshopper takes place through the spiracles, the pores on the body wall. The pores open into a interconnected air tube system that directly takes the oxygen to the tissues and brings the carbon dioxide from them to the outside.
- Gaseous exchange in humans takes place with the help of a pair of lungs. The lungs are situated in the thoracic cavity next to the heart and are connected to the outside with the help of bronchi and trachea.
- The oxygen is transported to the different parts of the body through the circulatory system. The red blood cells in the blood have pigments called haemoglobin which transport oxygen to the tissues. From the tissues, most of the carbon dioxide is transported as bicarbonate ions in the plasma (outside red blood cells) of the blood.
- During cellular respiration glucose undergoes glycolysis forming pyruvic acid. The pyruvic acid then enters into the Krebs's cycle. The products of Krebs's cycle enter into the electron transport system, which liberates energy. The total energy produced during respiration is stored in 38 ATP molecules.
- There are two types of respiration based on the availability of oxygen.
  - Aerobic respiration makes use of oxygen and produces carbon dioxide, water and 38 molecules of ATP.
  - Anaerobic respiration takes place in the absence of oxygen. The products formed may be ethanol (alcohol) and carbon dioxide or only lactic acid. In both the cases, the energy released during anaerobic respiration is only 2 ATPs.
  - Anaerobic respiration is a commercially important process
  - Respiration along with photosynthesis helps to maintain the delicate oxygen-carbon dioxide balance of nature

<http://www.tutorvista.com/content/science/science-ii/respiration/summary.php>

## Solar Radiation

Solar radiation is a general term for the electromagnetic radiation emitted by the sun. Every location on Earth receives sunlight at least part of the year. The amount of solar radiation that reaches any one "spot" on the Earth's surface varies according to these factors:

- Geographic location
- Time of day
- Season
- Local landscape
- Local weather.

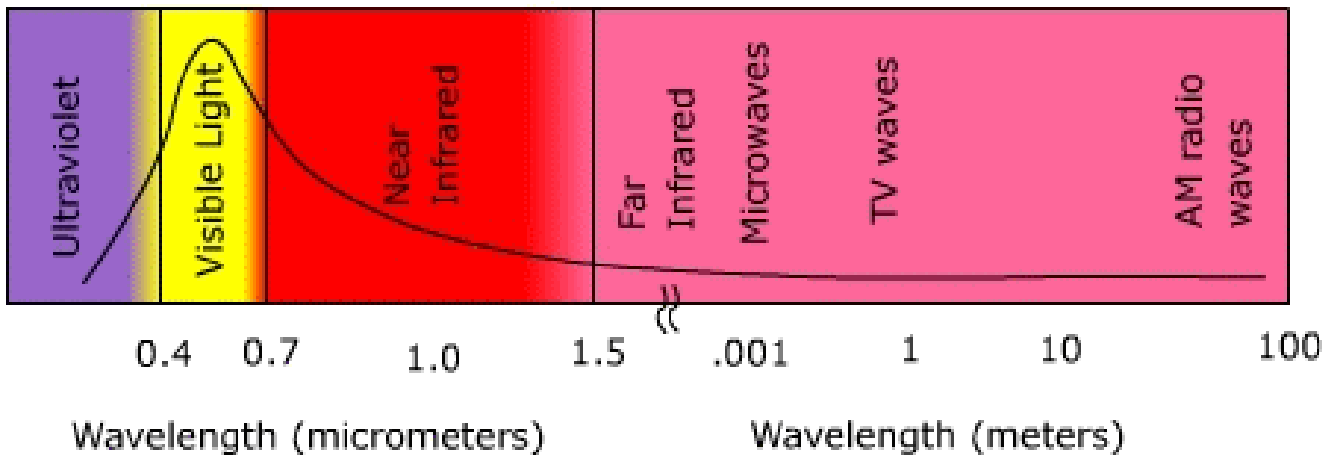
Because the Earth is round, the sun strikes the surface at different angles ranging from 0° (just above the horizon) to 90° (directly overhead). When the sun's rays are vertical, the Earth's surface gets all the energy possible. The more slanted the sun's rays are, the longer they travel through the atmosphere, becoming more scattered and diffuse.

[http://www.energysavers.gov/renewable\\_energy/solar/index.cfm/mytopic=50012](http://www.energysavers.gov/renewable_energy/solar/index.cfm/mytopic=50012)

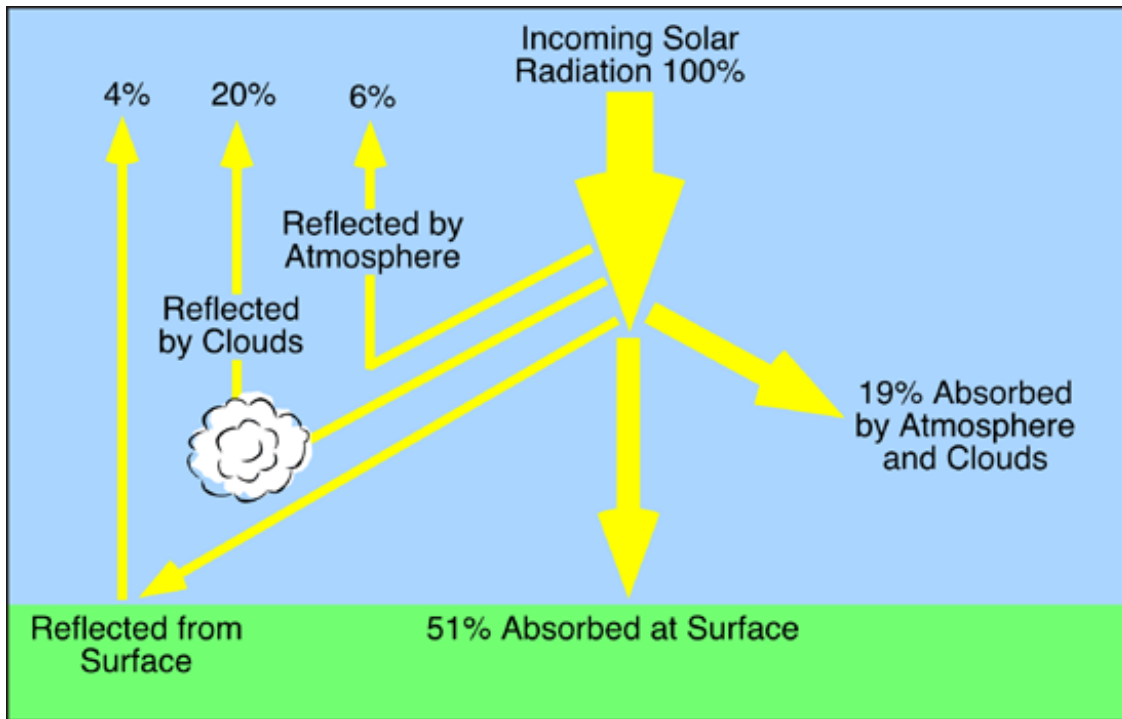
Photosynthesis is light dependent. At low light intensities, this may become the limiting factor - one reason why plants grow better outdoors, rather than in the house

Solar radiation can be trapped by solar panels and used to generate renewable energy. Like leaves, the solar panels are made from materials that can allow it to convert the sun's rays into electrical energy. IT can be measured by instruments such as a pyranometer, a sunshine recorder, cloud cover data taken from existing satellite images, a solar radiation sensor, and a radiometer.

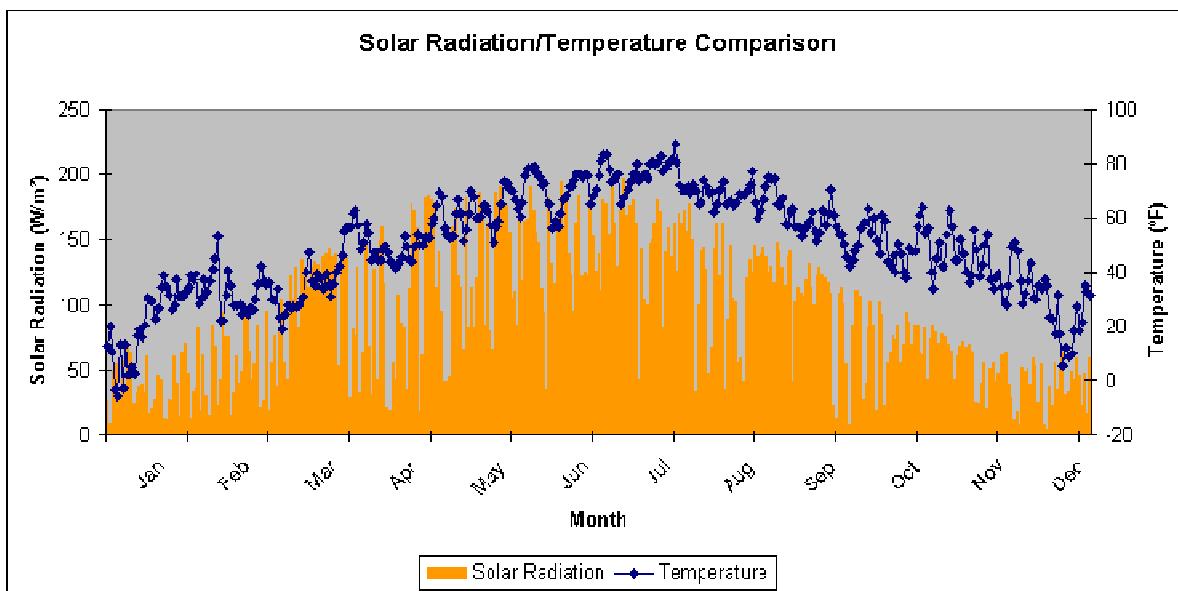
### **Solar Radiation Spectrum**



[http://www.uwsp.edu/geo/faculty/ritter/images/atmosphere/energy/solar\\_radiation\\_spectrum.gif](http://www.uwsp.edu/geo/faculty/ritter/images/atmosphere/energy/solar_radiation_spectrum.gif)



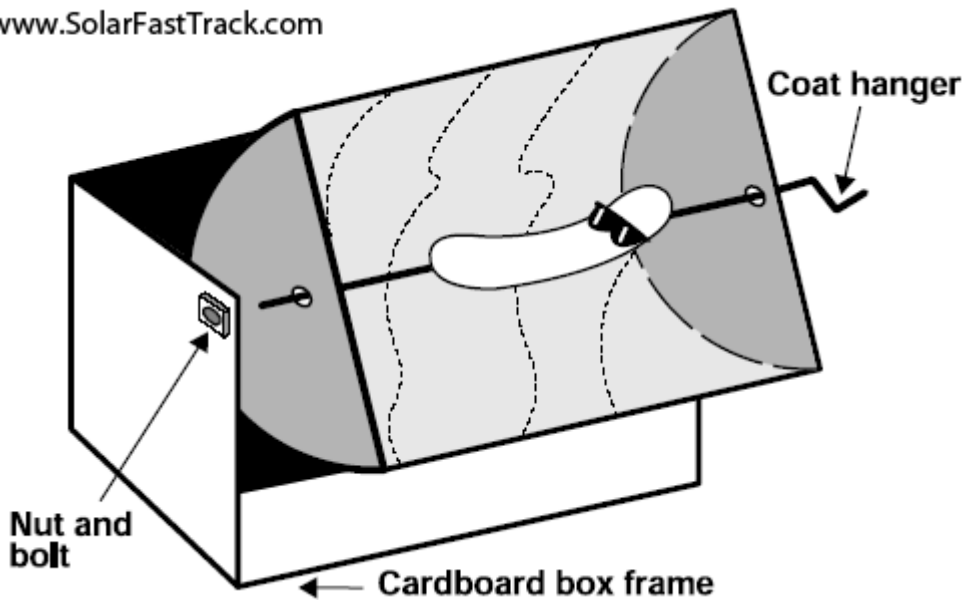
<http://www.physicalgeography.net/fundamentals/images/cascade.GIF>



<http://www-esh.fnal.gov/Weather/SolarRadiation.htm>

### Hot Dog Cookers Activity

Solar hot dog cookers have long been used as science experiments to show how the sun's energy can be utilized in everyday activities. It allows students to see how powerful the sun's rays actually are when they're focused on a single object. These cookers are simple to construct and are a great project for summertime, when the sun is at its brightest and warmest.



### How It Cooks a Hot Dog

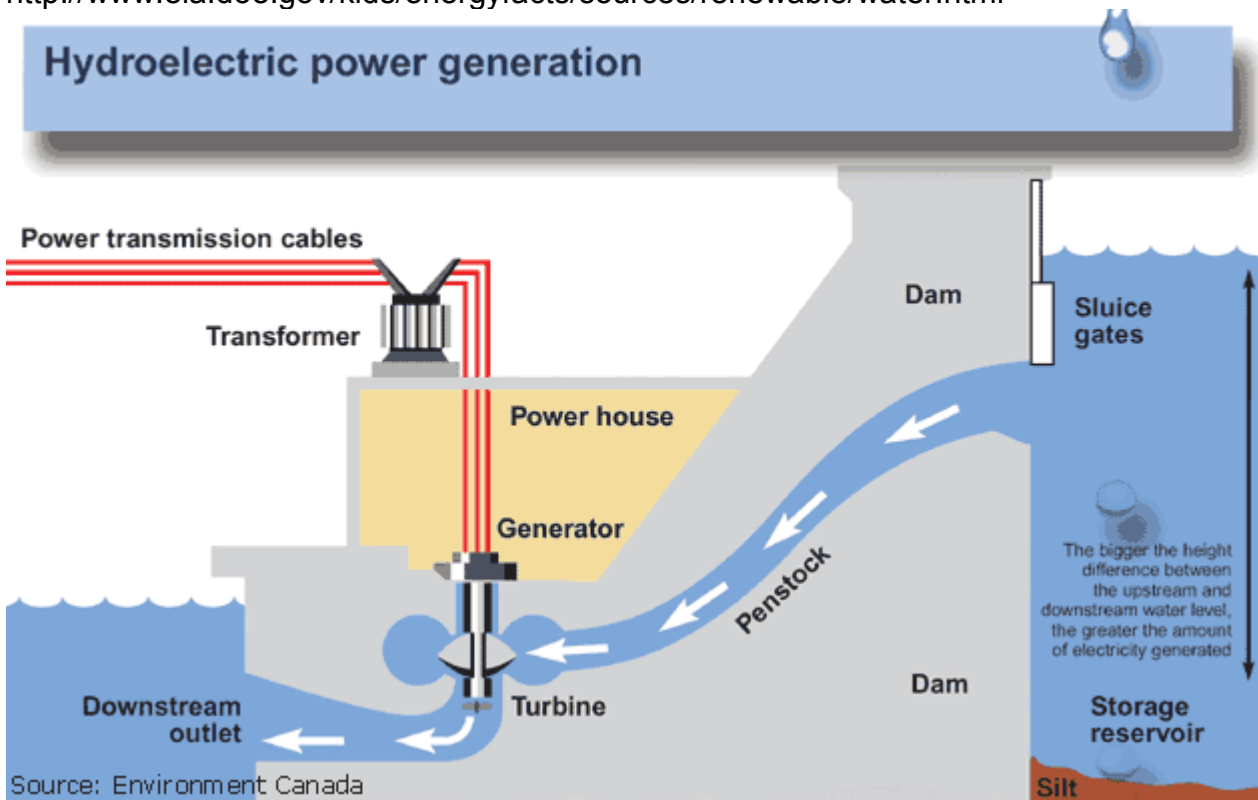
1. Solar hot dog cookers work by redirecting the sun's rays in a narrow band of heat onto the hot dog. The sun hits the foil and skims down to the deepest point in the curve. Once it reaches that point, it forms into a solid beam and is directed onto the hot dog suspended above. The heat and intensity of the concentrated rays cooks the hot dog as it rotates. Because the rays aren't as hot as a flame, cooking the hot dog in this manner takes about twice the amount of time as cooking it over a campfire or on a grill. However, it is an excellent demonstration of how solar energy works.

## Movement of Water

Of the renewable energy sources that generate electricity, hydropower is the most often used. It accounted for 6 percent of total U.S. electricity generation and 71 percent of generation from renewables in 2007. It is one of the oldest sources of energy and was used thousands of years ago to turn a paddle wheel for purposes such as grinding grain. Our nation's first industrial use of hydropower to generate electricity occurred in 1880, when 16 brush-arc lamps were powered using a water turbine at the Wolverine Chair Factory in Grand Rapids, Michigan. The first U.S. hydroelectric power plant opened on the Fox River near Appleton, Wisconsin, on September 30, 1882. Until that time, coal was the only fuel used to produce electricity. Because the source of hydropower is water, hydroelectric power plants must be located on a water source. Therefore, it wasn't until the technology to transmit electricity over long distances was developed that hydropower became widely used.

Hydroelectric power stems from the process of using water's energy as it flows from higher to lower elevation, rotating turbines to create electricity.

<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/water.html>



[http://www.daviddarling.info/images/hydroelectric\\_power\\_plant.gif](http://www.daviddarling.info/images/hydroelectric_power_plant.gif)

## Instructions for generating your own hydropower apparatus

Taken directly from [http://ase.org/uploaded\\_files/educatorlessonplans/hydropower.pdf](http://ase.org/uploaded_files/educatorlessonplans/hydropower.pdf)

### Objectives

The student will do the following:

- 1 Build a water wheel.
- 2 Build a simple galvanometer.
3. Build a simple hydropower generator
4. Detect the electricity generated
- 5 Demonstrate how waterpower is converted to electricity.

### Subjects:

Advanced General Science, Physical Science, Physics

**Time:**

1-2 class periods if working in groups of four; 2-3 class periods if working in groups of two

**Materials:**

(for each group) compass, 2 alligator clips (optional), small spool magnetic wire (#28 or finer, insulated), 2 cardboard or masonite rectangles (about 5" x7"), glue, (2) 1-inch nails, (2) 3-inch nails, 1-inch bar magnet, (2) 1-1/2"x4" metal strips cut from tin can, electrical tape, germanium diode (for example, type 1N34A), soldering iron (optional), solder (optional), 3x5" wood block, round tinker toy. (8) 3" tinker toy spokes, 8 small paper cups, student sheets (included)

**Background Information**

The model hydropower generator made in this activity works much like hydropower plants for generating electricity. When the propeller (water wheel or turbine) spins, the magnet whizzing past the nail head generates a tiny amount of alternating current (AC) in the coil wound around the nail. The small germanium diode connected across the two nail terminals converts the AC into DC (direct current). The galvanometer will indicate that a small current has been produced by the generator.

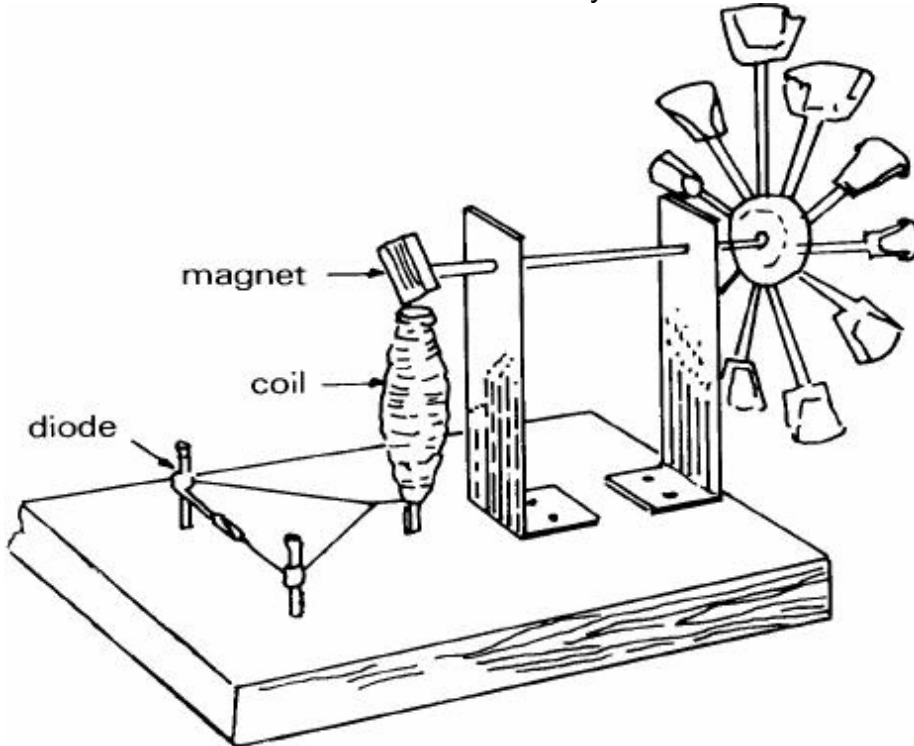
**Procedure**

- I The day before the activity is to be done, introduce it to the class
  - A Define and describe a turbine A turbine is a device that has a central drive shaft fitted with curved vanes or blades that cause it to whirl when force is exerted upon it by water, steam, or gas. A water wheel is a simpler, less efficient predecessor of a turbine, it can use only water. Modern turbines were developed from early water wheels.
  - B. Define and describe a galvanometer. A galvanometer is an instrument that measures minute electric currents. It is made of a compass wound with magnetic wire. As current is passed through the wire, the compass needle will be deflected toward the east-west axis.
  - C. Define generator. A generator is a machine that converts mechanical energy into electrical energy.
  - D. Define hydrogenerator. A hydrogenerator is a machine that converts the mechanical energy of waterpower into electrical energy.
- II. Give each student a copy of "GENERATE YOUR OWN HYDROPOWER" (included). Assign the building of a water wheel (turbine) as homework. (You may choose to have the students build these in class.)
- III. Explain the activity, then carefully supervise the students' work. The directions must be followed closely.
- IV Continue with the follow-up below

**Follow-Up**

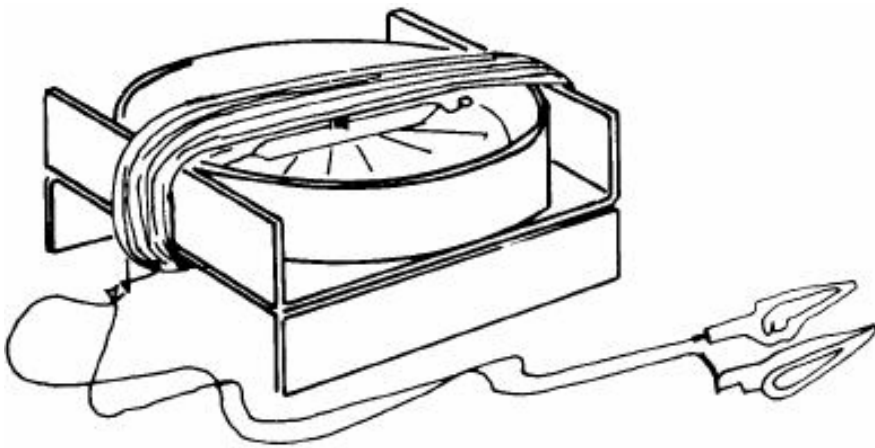
- I Ask the students these questions
  - A. Describe how the apparatus used in this activity qualifies as a generator.
  - B. How do you know electricity is being generated?
  - C. What type of electricity (AC or DC) does your generator produce? (AC)
  - D What type of electricity does a galvanometer detect? (DC)
  - E. What feature of the galvanometer you built allows it to detect the current produced? (the diode)
  - F If your generator did not produce detectable current, what are some possible explanations? How can you test your hypotheses?
- II Extension: The following are suggestions for building upon this activity. Some are especially appropriate as enrichment.
  - A. Different types of water wheels may be built and their effectiveness tested. Check reference books for other designs.

- B Change certain variables and repeat the exercise. Compare the results when the water's velocity is changed, when suspended solids (like silt) are added to the water, or when the water's temperature is changed.
- C. Build a model town complete with tiny electric lights. (Perhaps a model train set town models could be used) Check to see if the hydrogenerator will supply enough electricity for the model town. How must the system be modified to make this work?



### **Diagram 1: Hydropower Generator**

1. Build a hydropower generator (See Diagram 1).
  - a. Wrap 1,000 turns of magnetic wire around one of the large nails. The coil should be 2 inches long, measured from the head end. Leave a few inches of wire for the connections. Twist them so they will not unwind.
  - b. Drive this nail into the center of the wooden block.
  - c. Drive in the 2 smaller nails. (Refer to the diagram for their placement).
  - d. Scrape the enamel insulation off the ends of the coil wires.
  - e. Wrap the ends around the heads of the 2 nails.
  - f. Hook the diode across the nails and make all connections secure. (Soldering is optional)
  - g. Fix the bar magnet on the head of the other large nail. The magnet should be centered on the head of the nail. If using glue, give it plenty of time to set. This nail will be the water wheel shaft.
  - h. Support the shaft with the 2 tin can strips. Fold them in half lengthwise for added stiffness. Bend out about 3/4 of an inch at the ends for the base. Nail them to the wooden block in line with the large nail.
  - i. Decide how high the shaft holes should be. Locate the holes so the magnet end of the shaft is close to the upright nail head but so that the shaft is not prevented from spinning freely. Make the holes for the shaft.
  - j. Insert the shaft in the supports until the magnet is directly over the nail head. Two collars of electrical tape (applied to the shaft just inside the supports) will keep the shaft in place.
  - k. Using the tinker toys and paper cups, construct the water wheel. Cut the cups as shown in the diagram and glue the bottoms to the spokes.
  - l. Fit the water wheel onto the shaft, making sure that the wheel fits snugly on the nail.



### **Diagram 2: Galvanometer**

#### **2 Build a galvanometer (See Diagram 2)**

- a Build a base for the compass by folding the ends of each of 2 squares of stiff cardboard and stacking them back-to-back as shown in the diagram.
- b Place a compass on the base and wind magnetic wire around the north-south axis, making about 100 turns
- c. After winding the coils of wire, twist the free ends a few times to prevent unwinding.
- d. Connect the free ends to the two alligator clips. (This step is optional. You may connect the wires directly to the nails where the diode is located on the hydropower generator apparatus.)
- e. The galvanometer is now complete. Whenever electricity flows through the coil, the compass needle will be deflected toward the east-west axis.

#### **3 Test the hydrogenerator.**

- a. Connect the galvanometers alligator clips (Or wire if not using alligator clips) to the 2 nail terminals.
- b. Keep the compass about a foot away from the magnet.
- c. Line the galvano meter compass needle up with the coil.
- d. Hold the water wheel at the edge of the sink and run a stream of water over the wheel. As the wheel turns, it will power the generator. A small current will be detected by the galvanometer. When the shaft turns, the compass needle will be deflected. This demonstrates that electricity is being produced by the hydrogenerator.

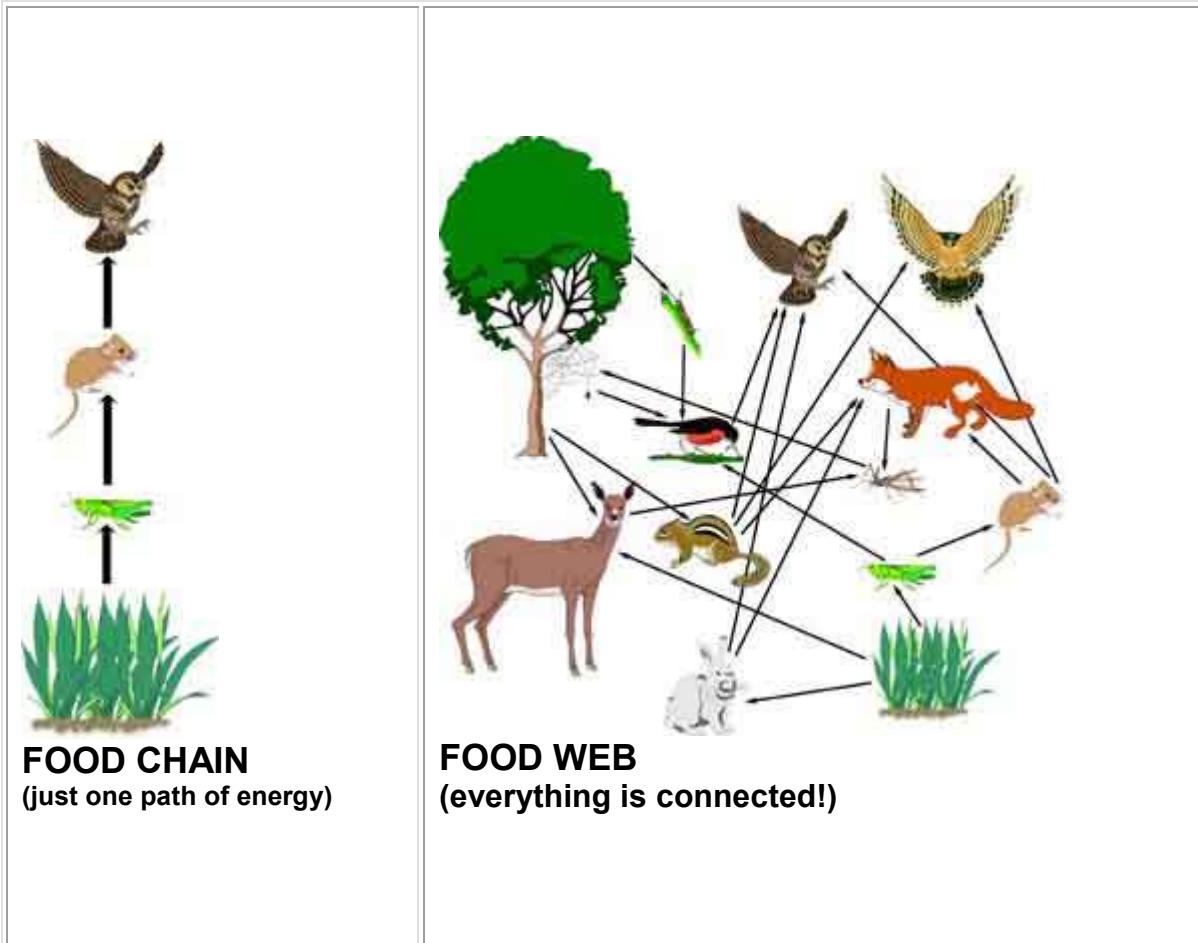
Source: Tennessee Valley Authority, Energy Sourcebook: High School Unit

## Food Webs

A food web is much more complex than a food chain. Food chains follow a single path as animals eat each other. Food webs show how different paths interconnect plants and animals. A food web is actually several food chains joined together. Because most organisms depend on more than one species for food, food webs are more accurate models than food chains.

Organisms can be classified as producers, first, second, or third order consumers, or decomposers. Another way to classify a consumer is by what it eats. Herbivores eat only plants, carnivores eat only meat, and omnivores eat both plants and meat.

### FOOD WEBS



[http://www.sciencebob.com/questions/q-food\\_chain\\_web.php](http://www.sciencebob.com/questions/q-food_chain_web.php) FOOD CHAINS follow just one path of energy as animals

## **Examples of foods that conduct electricity**

Foods that contain a lot of water in them, like fruits, vegetables, and meat, conduct electricity the best. It is harder to get dry foods or foods that are high in fat, such as butter or milk chocolate, to conduct electricity.

### How can you tell which foods conduct electricity?

An electrochemical battery stores chemical energy that changes into electrical energy that runs electronic equipment. There is a chemical reaction within the food that causes the electrons to move. The electromotive force within foods, such as potatoes, is the ability it carries to move electric current. In an electrochemical cell, such as the potato battery, the copper wire makes the electrons move in the potato, causing energy to move into the clock.

The official scientific name for the chemical reaction is "redox reaction." The process starts when one side of the battery loses electrons. This happens in the zinc nail, which forms the anode, or positive part of the circuit. The zinc in the nail reacts with phosphoric acid in the potato (or other food such as a lemon), releasing electrons. The zinc electron loses 2 electrons while the copper in the wire reacts with the phosphoric acid to release hydrogen ions, which gain the electrons. This is the negative half of the circuit, or the cathode, which thereby gains the electrons.

[http://www.ehow.com/how-does\\_4569403\\_potato-clock-work.html](http://www.ehow.com/how-does_4569403_potato-clock-work.html)

Watch this video for a demonstration of how a lemon battery works.

<http://www.teachersdomain.org/resource/phy03.sci.phys.mfw.zlemon/>

### **Activity suggestions before visiting the Nature Park**

- Have students brainstorm ways that nature makes its own energy
- Study any of the topics listed in the “Introduction” section
- Have students make posters explaining their findings
- Have students complete any of the activities with the materials contained in the Station Kit

### **Activity suggestions during your visit to the Nature Park**

- Have students create food webs and food chains using the existing nature.
- If the students have built a water turbine, allow them to test this out using different water flows of Sugar Creek
- Have students study which plants favor more sun or less sun (solar radiation).
- Have students test plants they think might make the battery work.
- Have students take solar radiation readings

### **Activity suggestions after visiting the Nature Park**

- Study any of the topics listed in the “Introduction” section
- Have students make posters explaining their findings
- Have students complete any of the activities with the materials contained in the Station Kit

### **Resources in the Station Kit**

Plant Pigments and Photosynthesis Lab Investigation

Radiation’s Effects on Plant Growth Kit

“What Is Photosynthesis?” DVD, questions and answers

“Bill Nye the Science Guy: Respiration Classroom Edition” [Interactive DVD] (1995), questions and answers

Solar powered Ferris wheel

Enviro battery kit

Make Electricity Science Kit

Book- One Hundred Years of Public Power; Crawfordsville Electric Light and Power

Natural Gas Safety- Vectren

Discover Electricity; teachers’ and students’ edition- Vectren

Water calculator

2 solar hot dog cookers

## On Line Resources

### Photosynthesis and Respiration

<http://bioenergy.asu.edu/photosyn/study.html>  
[http://www.globalchange.umich.edu/globalchange1/current/lectures/klings/energyflow/PSN\\_primer.html](http://www.globalchange.umich.edu/globalchange1/current/lectures/klings/energyflow/PSN_primer.html)  
[www.science-class.net/PowerPoints/PandR.ppt](http://www.science-class.net/PowerPoints/PandR.ppt)  
[http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html#\\_and](http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html#_and)  
[http://www.nclark.net/photosynthesis\\_webquest.doc](http://www.nclark.net/photosynthesis_webquest.doc)  
<http://www.johnkyrk.com/photosynthesis.html>  
<http://videos.howstuffworks.com/hsw/12580-the-science-of-life-cellular-respiration-video.htm>  
<http://www.copernicusproject.ucr.edu/ssi/HSBiologyResources.htm> (you need to arrow down to find the cellular respiration section)  
[http://www.ehow.com/video\\_4984772\\_what-cellular-respiration.html](http://www.ehow.com/video_4984772_what-cellular-respiration.html)  
<http://www.qcc.cuny.edu/biologicalsciences/Faculty/DMeyer/respiration.html>

### Solar Radiation

<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/solar.html>  
<http://www.energyquest.ca.gov/story/chapter15.html>  
<http://www.howstuffworks.com/solar-cell.htm>  
<http://www.wisageek.com/how-do-solar-panels-work.htm>  
[http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/energy/nature\\_of\\_electromagnetic\\_radiation.html](http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/energy/nature_of_electromagnetic_radiation.html)  
[http://www.oksolar.com/technical/daiy\\_solar\\_radiation.html](http://www.oksolar.com/technical/daiy_solar_radiation.html)

### Movement of Water

<http://ga.water.usgs.gov/edu/hyhowworks.html>  
<http://www.howstuffworks.com/hydropower-plant.htm>  
<http://www.webmutations.com/energy/reports/present/rephydro.html>  
<http://www.tvakids.com/electricity/hydro.htm>  
<http://library.thinkquest.org/2763/Electricity/Generating/Renewable/Water.html>  
<http://www.re-energy.ca/pdf/hydroelectric-generator.pdf>

### Food Webs and foods that produce energy

[http://www.gould.edu.au/foodwebs/kids\\_web.htm](http://www.gould.edu.au/foodwebs/kids_web.htm)  
<http://www.vtaide.com/png/foodchains.htm>  
[http://www.picadome.fcps.net/lab/currl/food\\_chain/default.htm](http://www.picadome.fcps.net/lab/currl/food_chain/default.htm)  
<http://www.miniscience.com/projects/PotatoElectricity/>  
[http://www.ecokids.ca/pub/eco\\_info/topics/frogs/chain\\_reaction/index.cfm](http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/index.cfm)  
<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/F/FoodChains.html>  
<http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm>

## Bill Nye the Science Guy: Respiration

- 1) When you breathe what does the diaphragm do? And the lungs?
- 2) What are other things oxygen does?
- 3) About how much surface area do your lungs have?
- 4) Which lung is bigger?
- 5) How many parts is the right lung divided into?
- 6) When a cell takes in oxygen what is released?

## Bill Nye the Science Guy: Respiration ANSWERS

- 1) When you breathe what does the diaphragm do? **Go down.**  
And the lungs? **Fill up.**
- 2) What are other things oxygen does?  
**Iron rust, makes candles burn.**
- 3) About how much surface area do your lungs have?  
**A tennis court**
- 4) Which lung is bigger? **Right**
- 5) How many parts is the right lung divided into? **3**  
And the left? **2**
- 6) When a cell takes in oxygen what is released? **Energy**

## What is Photosynthesis?

- 1) What is an autotroph?
- 2) What one way to explain what photosynthesis is?
- 3) The electrical current causes \_\_\_\_\_ to split into \_\_\_\_\_ and \_\_\_\_\_.
- 4) What is stage one of photosynthesis?
- 5) What is carbon fixation known as?
- 6)  $C_6H_{12}O_6$  is the chemical formula for what?
- 7) When plants combine a simple sugar with nitrogen, phosphorus or sulfur, what can it make?
- 8) Carbohydrates can be stored in what?
- 9) What does xylem do?
- 10) What is one thing that can happen when transpiration occurs?
- 11) What are 2 things that are factors affecting the rate of photosynthesis?

### Review Questions

- 1)
- 2)
- 3)
- 4)
- 5)

## Answers

- 1) What is an autotroph?
  - a. **It makes its own food.**
- 2) What one way to explain what photosynthesis is?
  - a. **The process which makes its own food**
  - b. **Photo=light, synthesis=putting together**
- 3) The electrical current causes water to split into hydrogen and oxygen.
- 4) What is stage one of photosynthesis?
  - a. **Light reactions**
  - b. **absorption of light energy**
- 5) What is carbon fixation known as?
  - a. **Dark reactions**
- 6)  $C_6H_{12}O_6$  is the chemical formula for what?
  - a. **Simple sugar: glucose**
- 7) When plants combine a simple sugar with nitrogen, phosphorus or sulfur, what can it make?
  - a. **Starch, fat, protein, vitamins,**
- 8) Carbohydrates can be stored in what?
  - a. **The fruit, stem or roots.**
- 9) What does xylem do?
  - a. **Transports water and minerals**
- 10) What is one thing that can happen when transpiration occurs?
  - a. **Exchange of gases**
  - b. **Intake of carbon dioxide**
  - c. **Release of oxygen**
- 11) What are 2 things that are factors affecting the rate of photosynthesis?
  - a. **Light intensity**
  - b. **Carbon dioxide concentrations**
  - c. **temperature**

## Review Questions

- 1) What are the green organelles found in palisade cells? **Chloroplasts**
- 2) What is the primary light absorbing pigment in the process of photosynthesis?  
**Chlorophyll**
- 3) What are the cell's two high energy chemicals? **ATP and NADPH**
- 4) What essential component of earth's atmosphere is provided by the planet's plant life?  
**Oxygen**
- 5) In which regions are there plants that have developed special adaptations for photosynthesis? **Tropical and desert**