Energy From the Sun

National Energy Education Development Project

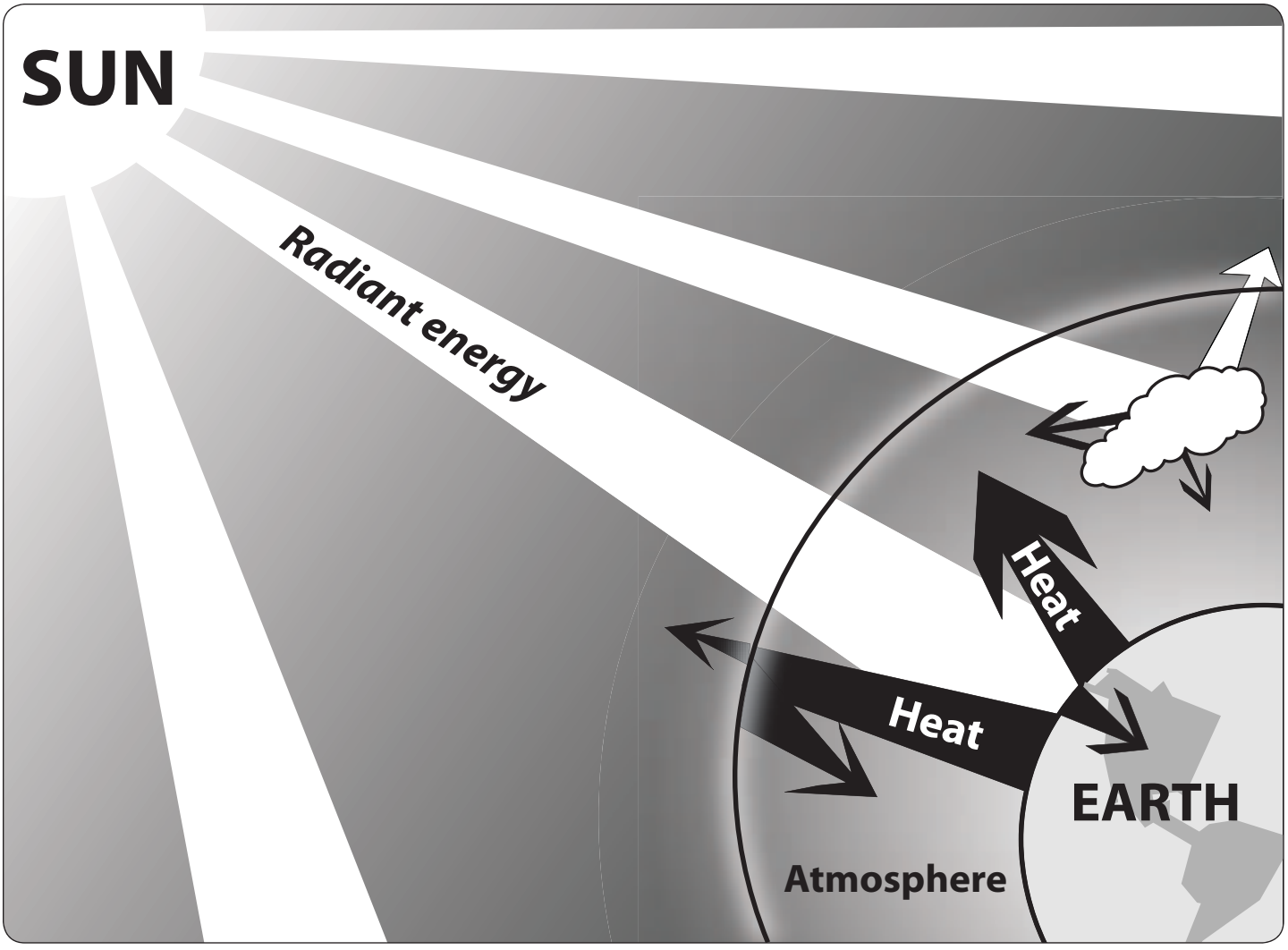
Solar Energy

Our earth gets most of its energy from the sun. We call this energy **solar energy.** *Sol* means sun.

Solar energy travels from the sun to the earth in **rays.** Some are light rays that we can see. Some are rays we can't see, like x-rays. Energy in rays is called **radiant energy**.

The sun is a giant ball of gas. It sends out huge rays of energy every day. Most of the rays go off into space. Only a small part reaches the earth.

When the rays reach the earth, some bounce off clouds back into space—the rays are **reflected**. The earth **absorbs** most of the solar energy and turns it into **heat.** This heat warms the earth and the air around it—the **atmosphere**. Without the sun, we couldn't live on the earth—it would be too cold.



We Use Solar Energy

We use solar energy in many ways. During the day, we use sunlight to see what we are doing and where we are going.

FOOD

Plants use the light from the sun to grow. Plants **absorb** (take in) the solar energy and use it to grow. The plants keep some of the solar energy in their roots, fruits, and leaves. They store it as **chemical energy**. This process is called **photosynthesis**.

The energy stored in plants feeds every living thing on the earth. When we eat plants and food made from plants, we store the energy in our bodies. We use the energy to grow and move. We use it to pump our blood, think, see, hear, taste, smell and feel. We use energy for everything we do.

The energy in the meat that we eat also comes from plants. Animals eat plants to grow. They store the plants' energy in their bodies.

Plants turn the sun's radiant energy into chemical energy.

HEAT

We also use the energy stored in plants to make heat. We burn wood in campfires and fireplaces. Early humans burned wood to provide light, cook food, scare away wild animals, and keep warm.

Solar energy **transforms**, or changes, into heat when it hits objects. That's why we feel warmer in the sun than in the shade. The light from the sun turns into heat when it hits our clothes or our skin. We use the sun's energy to cook food and dry our clothes.

We burn wood to produce heat.

Solar energy transforms into to heat when it hits objects.

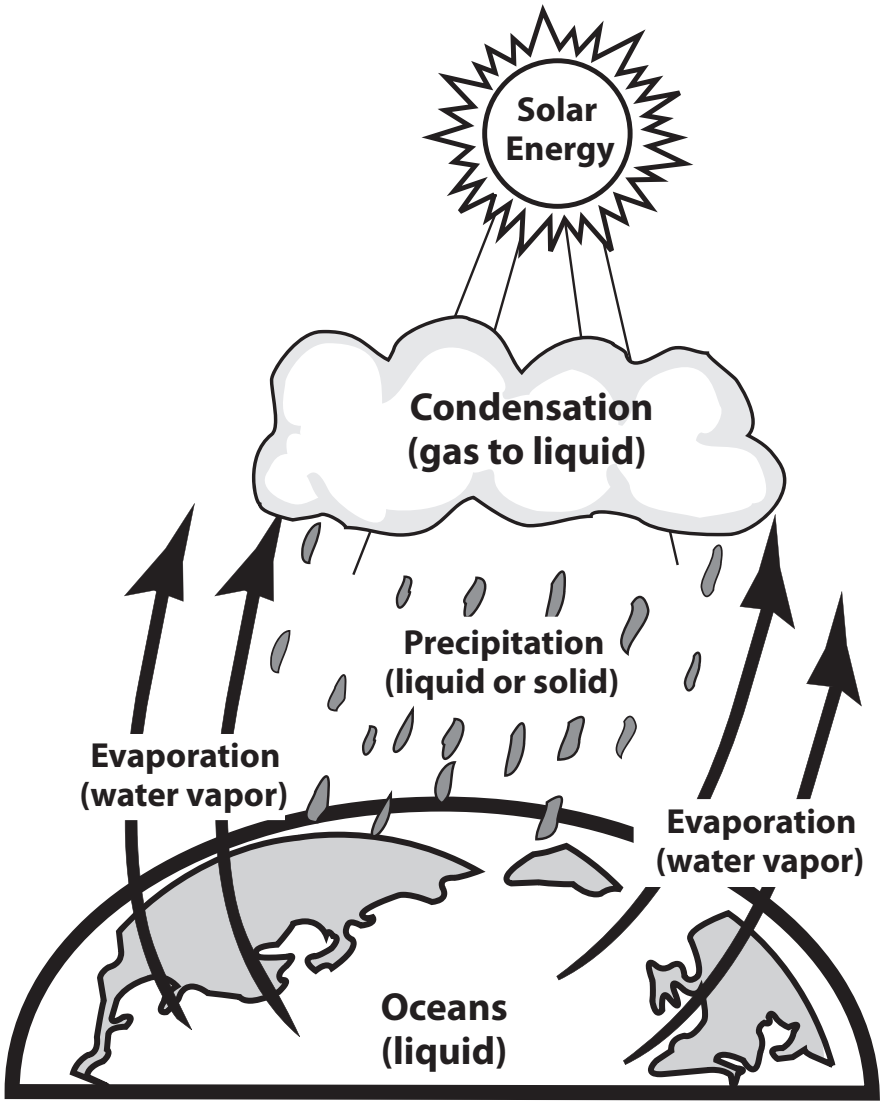
Solar Energy is Important

People, plants, and animals use solar energy for light, heat, and food. Solar energy is also important to nature.

WATER CYCLE

Solar energy powers the **water cycle**. The water cycle is how water moves through the atmosphere and the earth's surface. The sun heats water on the earth. The water **evaporates**—it turns into a gas called **water vapor** and rises into the air to form clouds. The air in the atmosphere is cool. The water vapor **condenses** into liquid water. The water falls from the clouds as **precipitation**—rain, sleet, hail or snow.

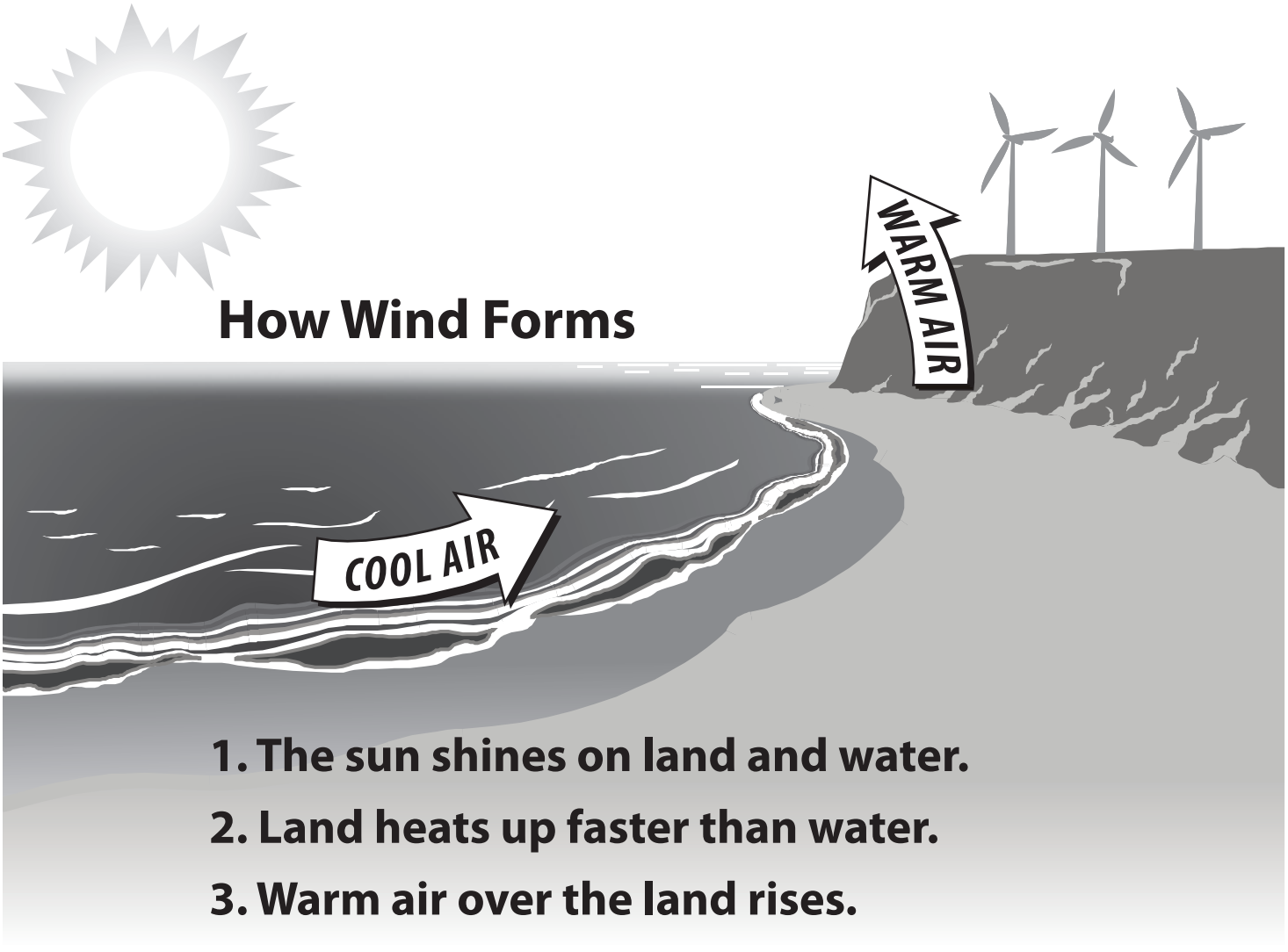
When water falls on high ground, **gravity** pulls it to lower ground. There is energy in the moving water. We can capture that energy with dams and use it to make **electricity**.



WIND

Solar energy makes the winds that blow over the earth. The sun shines down on the earth. Some parts of the surface heat up faster than others. Land, for example, usually heats more quickly than water. The air over the land gets warm. The warm air rises. The cooler air over the water moves in where the warm air was. This moving air is **wind**.

Wind turbines can capture the wind's energy. The wind turbines turn the energy in moving air into **electricity**. The wind pushes against the blades of the turbine and they begin to spin. A **generator** inside the turbine changes the motion into electricity.

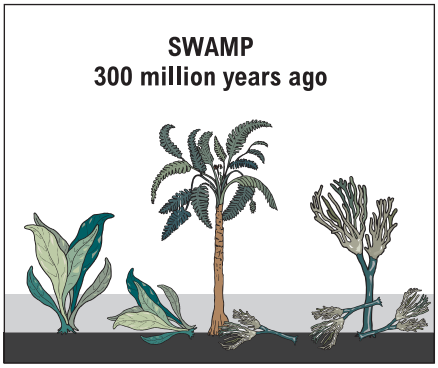


FOSSIL FUELS

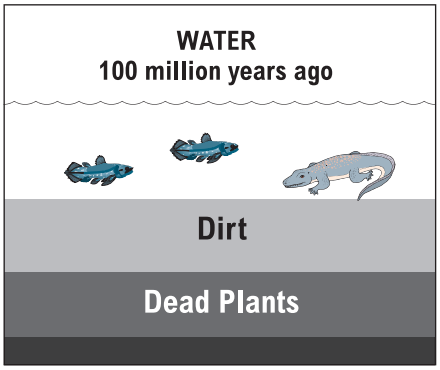
Coal, oil, and natural gas are called **fossil fuels**, because they were made from prehistoric plants and animals. The energy in the plants and animals came from the sun.

We use the energy in fossil fuels to cook our food, warm our homes, run our cars, and make electricity. Most of the energy we use today comes from fossil fuels.

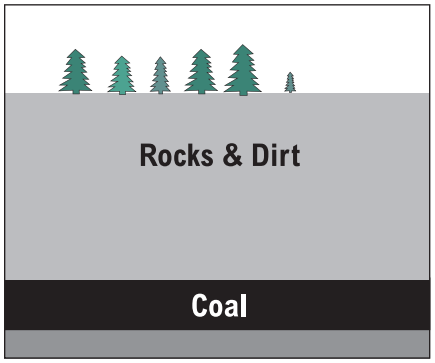
HOW COAL WAS FORMED



Before the dinosaurs, many giant plants died in swamps.

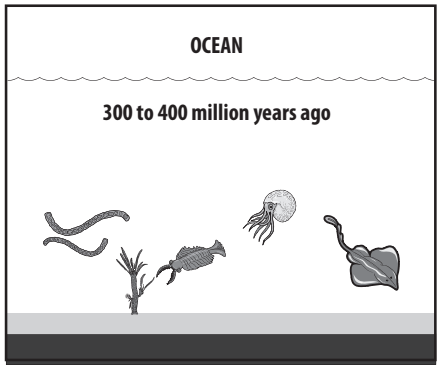


Over millions of years, the plants were buried under water and dirt.

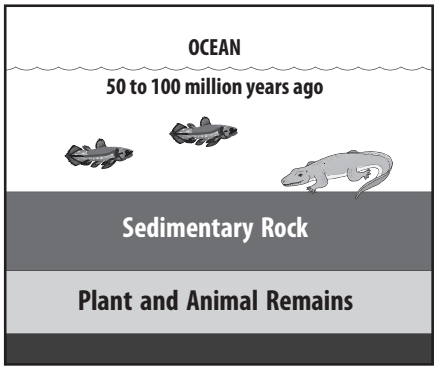


Heat and pressure turned the dead plants into coal.

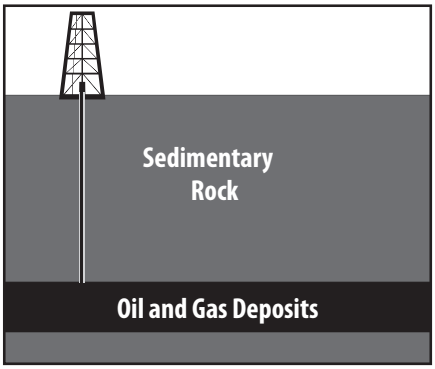
HOW OIL AND NATURAL GAS WERE FORMED



Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of sedimentary rock.



Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.



Today, we drill down through layers of sedimentary rock to reach the rock formations that contain oil and gas deposits.

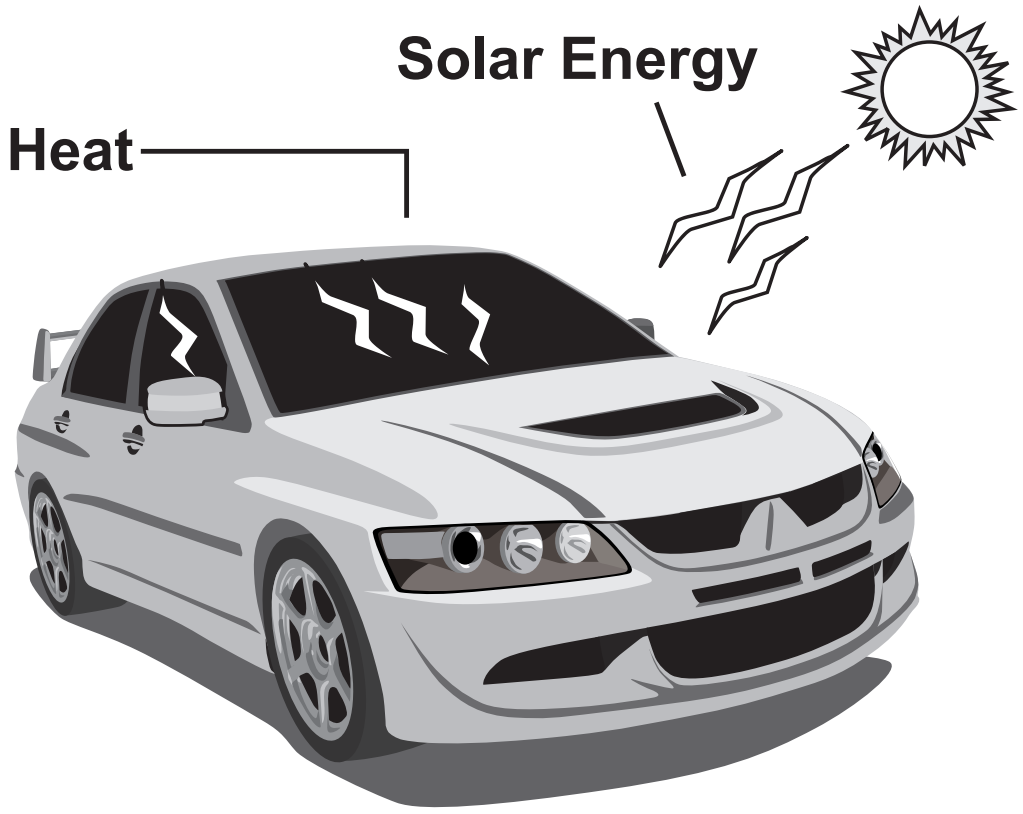
Solar Energy is Renewable

Solar energy is free and clean. Solar energy is **renewable**. We will not run out of it. The sun will keep making energy for millions of years.

Why don't we use the sun for all our energy needs? We don't have the technology to do it yet. The hard part is capturing the sun's energy. Only a little bit reaches any one place. On a cloudy day, most of the solar energy never reaches the ground at all.

We Can Capture Solar Energy

Lots of people put **solar collectors** on their roofs. Solar collectors capture the energy from the sun and turn it into heat. People heat their houses and their water using the captured solar energy. A closed car on a sunny day is a solar collector.



On a sunny day, a closed car is a solar collector. Solar energy passes through the glass, hits the inside of the car and changes into heat. The heat gets trapped inside.

Solar Energy Can Make Electricity

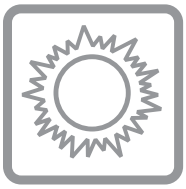
Photovoltaic (PV) cells turn the sun's energy into electricity. *Photo* means light and *volt* is a measure of electricity. PV cells are made of a piece of **silicon**, the main ingredient in sand. Each side of the silicon has a different **chemical** added. When **radiant energy** from the sun hits the PV cell, the sides of the silicon work together to change the energy into electricity.

Some toys and calculators use small PV cells instead of batteries. Big PV cells can make enough electricity for a house. They are expensive, but good for houses far away from power lines.

Some schools are adding PV cells to their roofs. The electricity helps lower the amount of money schools must pay for energy.

Today, solar energy provides only a tiny bit of the electricity we use. In the future, it could be a major source of energy. Scientists are looking for new ways to capture and use solar energy.

People put solar panels on their roofs to generate electricity.



Solar Energy Vocabulary

Fill in the blanks with the words in the box at the bottom of the page. Use each word only once.

1. Solar comes from the word _____, which means sun.
2. The word _____ means light.
3. _____ is a measure of electricity.
4. _____ is energy that travels in rays.
5. Plants _____ , or take in, radiant energy.
6. White and shiny objects _____ radiant energy.
7. A _____ takes in solar energy and turns it into heat.
8. Solar energy is called a _____ energy source, because it will always be there.
9. A _____ cell turns light into electricity.
10. Plants take in solar energy and store it in their leaves and roots as _____.

reflect **absorb** **chemical energy** **photo** **volt** **sol**
renewable **photovoltaic** **solar collector** **radiant energy**


Water and Wind Vocabulary

Fill in the blanks with the words in the box at the bottom of the page. Use each word only once.

1. Water as a gas is called _____.
2. Rain and snow are called _____.
3. The air around the earth is the _____.
4. When water turns into a gas, it _____.
5. Near the shore, the air over _____ heats up faster than air over the water.
6. A _____ is a machine that captures the energy in moving air.
7. Warm air _____ into the atmosphere.
8. Moving air is called _____.
9. _____ moves water from high to low ground.
10. Wind turbines and hydropower dams turn the energy in moving air and moving water into _____.

evaporates **rises** **water vapor** **precipitation** **gravity**
wind turbine **electricity** **land** **atmosphere** **wind**

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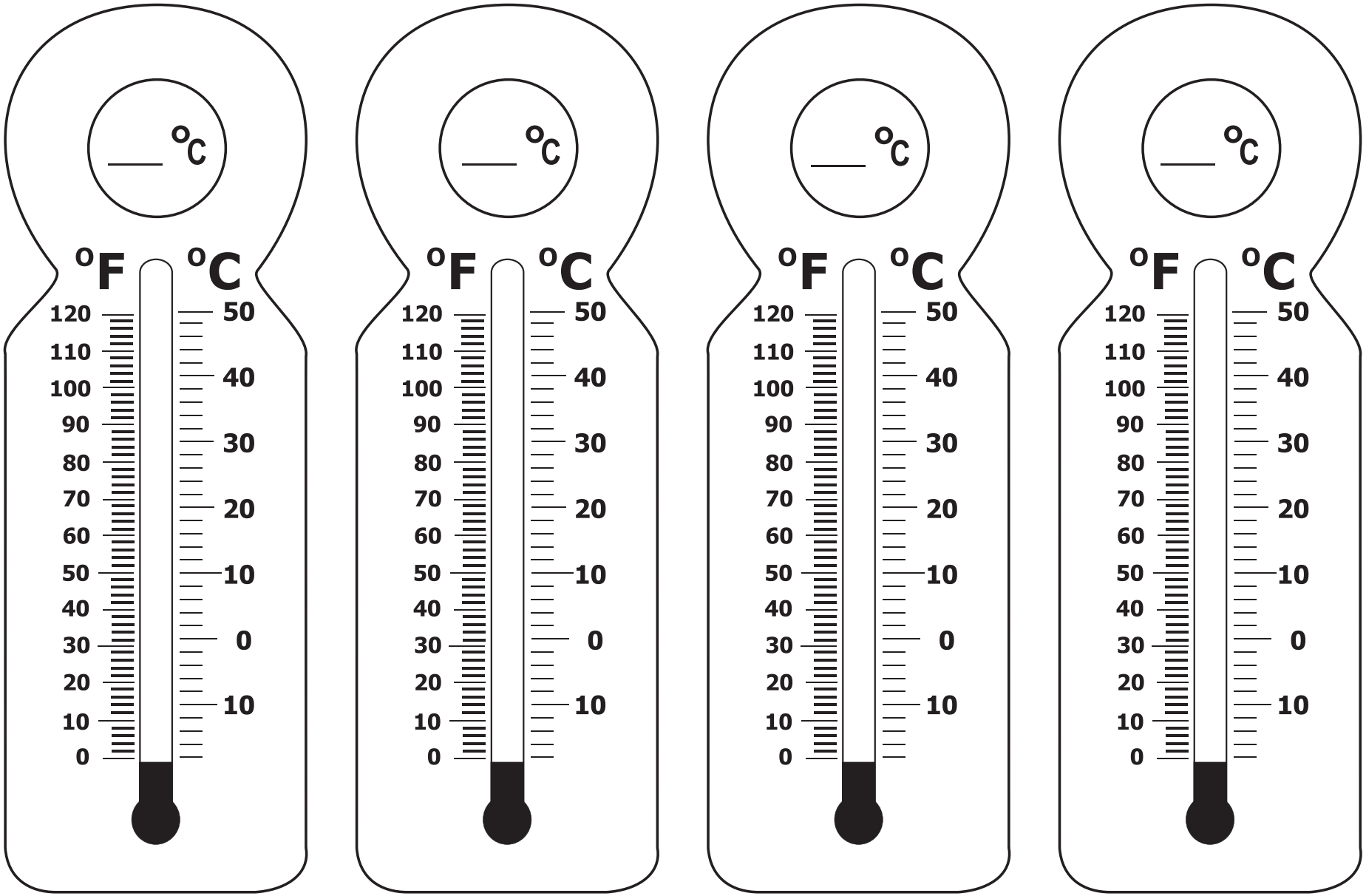
Freezing Water 32°F

Body Temperature 98-99°F

Warm Summer Day 80°F

Very Cold Winter Day 10°F



Solar to Heat

When radiant energy hits objects, some of the energy is reflected and some is absorbed and changed into heat. Some colors absorb more radiant energy than others.

Step 1: Put three thermometers in a sunny place.

Step 2: Cover the bulb of one with black paper. Cover the bulb of one with white paper.

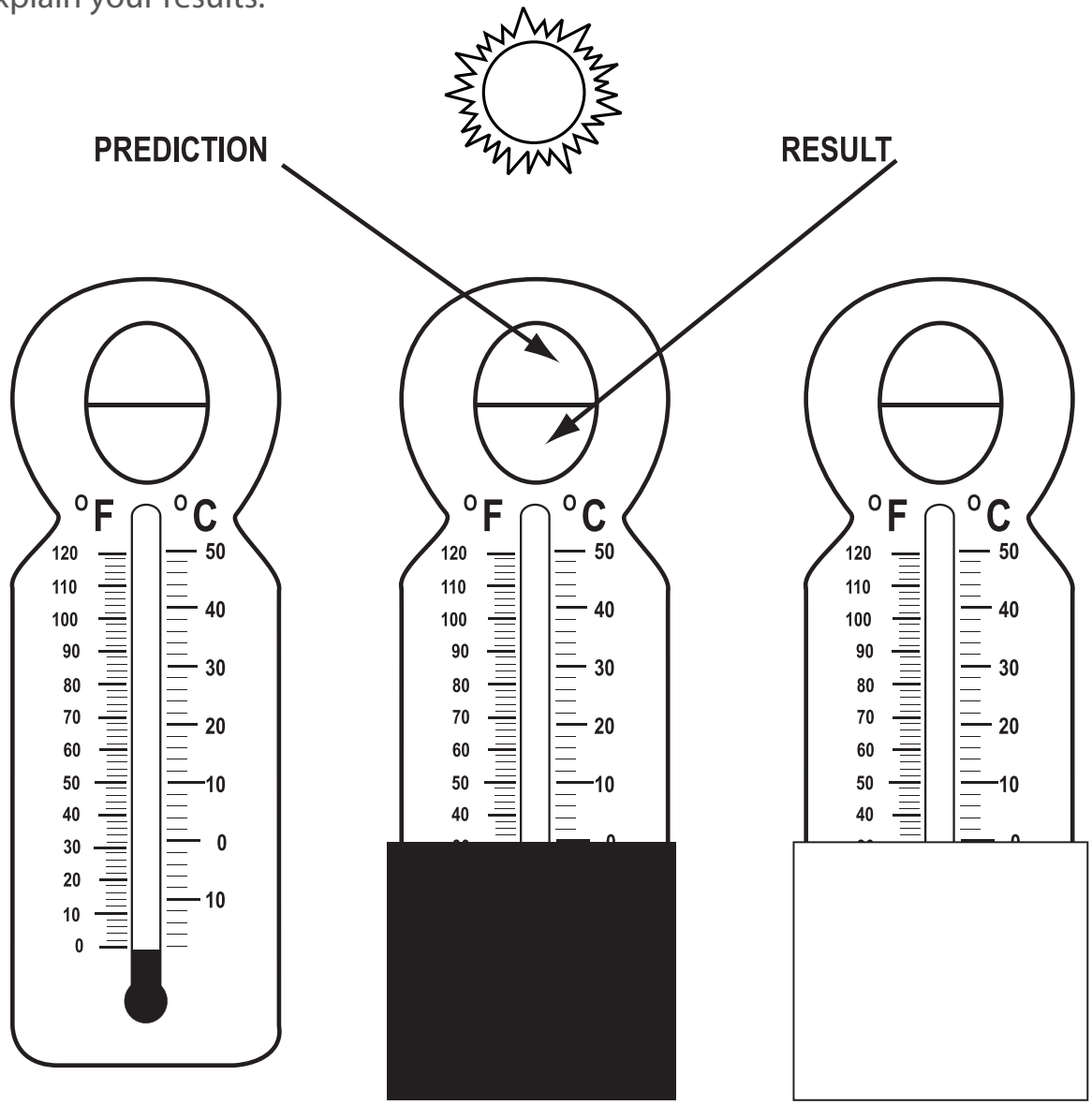
Step 3: Predict which thermometer will get hottest. Number them 1-3, with 1 as the hottest.

Step 4: Observe the thermometers for three minutes.

Step 5: Record your results by coloring the tubes of the thermometers.

Step 6: Look at the results and number the thermometers 1-3 with 1 as the hottest.

Step 7: Explain your results.



Radiometer

A radiometer has four vanes. One side of each vane is white; the other side is black. When radiant energy hits the vanes of the radiometer, they begin to spin. One side of the vanes gets hotter than the other. The air near the hotter side of the vanes gets hotter and pushes against the vanes. The radiometer changes radiant energy to heat, then to motion.

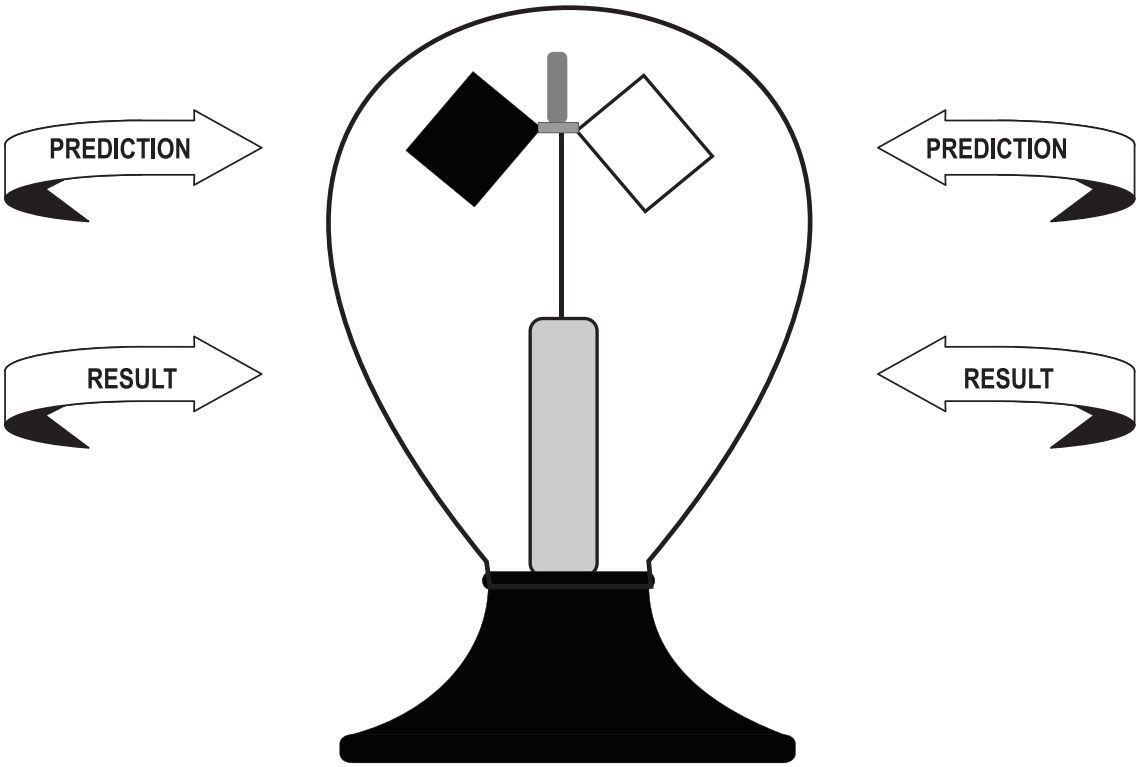
Step 1: Predict which way you think the radiometer vanes will spin. Color the PREDICTION ARROW that shows the direction you think the vanes will spin.

Step 2: Put the radiometer in bright sunlight or under an overhead projector.

Step 3: Observe the radiometer.

Step 4: Record your results. Color the RESULT ARROW that shows the direction the vanes are spinning.

Step 5: Explain your results.



Sun Paper

Radiant energy can cause chemical changes when it hits objects. Some changes are fast and some are slow. Radiant energy will slowly change the color of construction paper. It will quickly change the color of NaturePrint® Paper. The colors change because the radiant energy makes a chemical change in the paper.

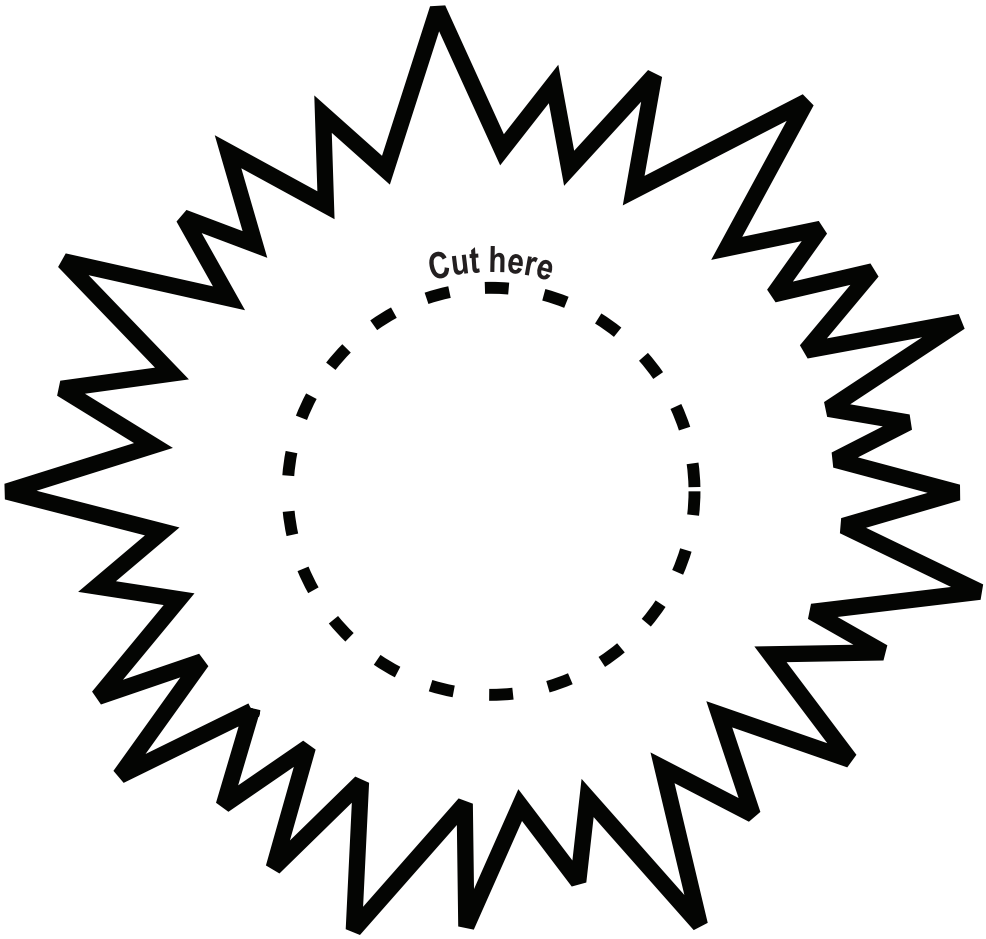
Step 1: Using white paper, cut out two drawings of the sun like in the picture below.

Step 2: Place one drawing on a piece of red construction paper, tape one edge of the drawing to the paper, and put it in the sun.

Step 3: Place the other drawing on a piece of NaturePrint® paper and put it in the sun for two minutes. Remove the drawing and soak the NaturePrint® paper in water for one minute away from the sun. Dry flat. Hang on the wall as a decoration.

Step 4: Observe the red construction paper every hour for four hours. How long does it take for the color to begin to change?

Step 5: Explain your results.



Solar Balloon

Radiant energy often turns into heat when it hits objects. Black objects absorb more radiant energy than white objects. When air gets hotter, it rises. A solar balloon works because the black plastic absorbs radiant energy and turns it into heat. The air inside gets hotter.

Step 1: On a very sunny day, take the solar balloon outside and tie one end closed with a piece of string. Open the other end and walk into the wind until it fills with air. When the balloon is filled with air, tie off the other end with string.

Step 2: Tie long pieces of string to both ends. Have two people hold the ends of the string and place the balloon in the sun.

Step 3: Observe the balloon.

Step 4: Explain your observations.

Solar Oven

A solar oven has shiny foil on its inside walls that reflect radiant energy into the middle of the oven. The bottom of the oven is dark to absorb energy. When the radiant energy hits food in the oven, it changes into heat. A solar oven gets hot enough to cook foods, even in the winter. You can cover the solar oven with clear plastic wrap to hold in the heat.

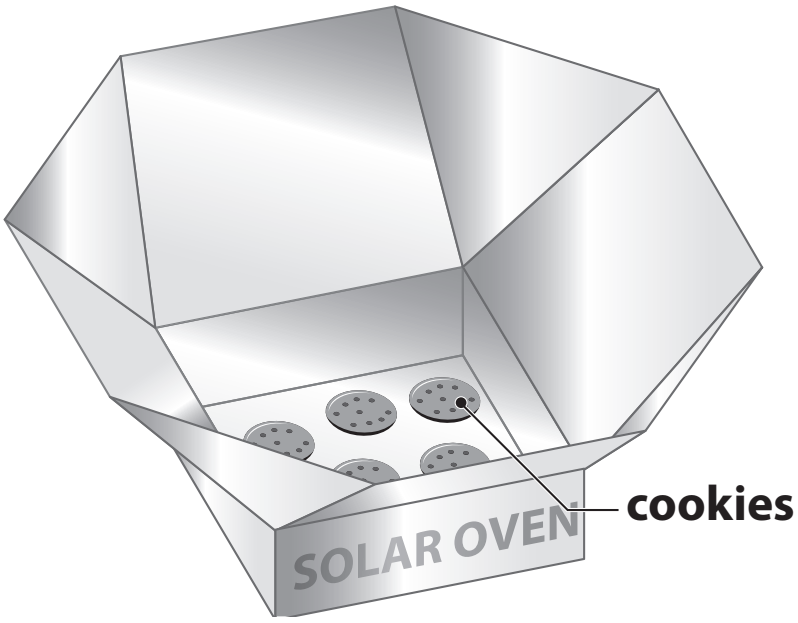
Step 1: On a very sunny day, take the solar oven outside and put it in a sunny place.

Step 2: Place food in the oven.

Step 3: Observe how long it takes to cook the food.

Hints For Cooking With a Solar Oven

1. Use black metal pans and dark brown glass dishes.
2. Don't add water when cooking vegetables. Use a pan with a lid and they will cook in their own juices.
3. To bake potatoes, rub with oil and put in a dark pot with a lid.
4. Bake bread in dark glass dishes with lids.
5. Use packaged chocolate chip cookie dough on a dark pan.
6. Food won't burn in a solar oven. It might lose too much water if you cook it too long.



Solar House

A photovoltaic (PV) cell changes radiant energy into electricity. Electricity can run a motor to make motion and make light. A solar collector absorbs radiant energy and turns it into heat. A solar collector can heat water. A water storage tank painted black can store hot water and keep it hot by absorbing radiant energy.

Step 1: Use a cardboard box to make a house with big windows and a door in the front.

Step 2: Use clear transparency film to cover the windows.

Step 3: Use black construction paper to make a round water storage tank. Attach it to the side of the house with tape.

Step 4: Make two holes in the top of the box like in the drawing. Each hole should be about one centimeter (1 cm) in diameter.

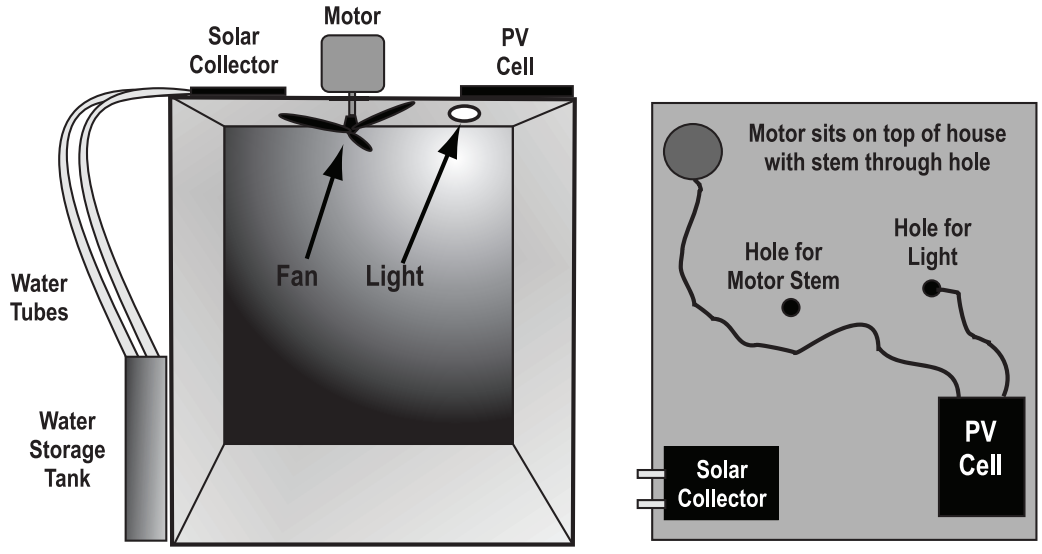
Step 5: Place the solar collector on top of the house as shown in the drawing. Put the tubing from the solar collector into the water storage tank.

Step 6: Place the PV cell on top of the house. Insert the light through the hole as shown in the diagram. Put the stem of the motor through the hole for the motor stem.

Step 7: Put a tiny bit of clay into the hole of the fan and push it onto the stem of the motor that is sticking through the ceiling.

Step 8: On a sunny day, place the house in the sun with the front facing south.

Step 9: Observe the light shine and the fan turn as the PV cell turns radiant energy from the sun into electricity. The solar collector shows how a real solar house could heat and store water. It doesn't really work.



Front View of House

Top View of House

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