Kit #87
Energy Studies

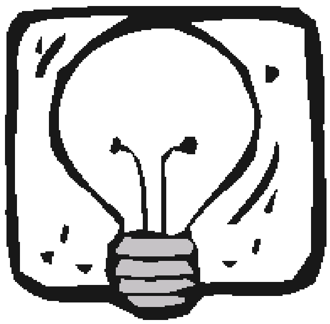
Blackline
Masters

Revised May 2004
Format Revisions March 2016

NAME: ______________________________ DATE: __________________

What is Energy?

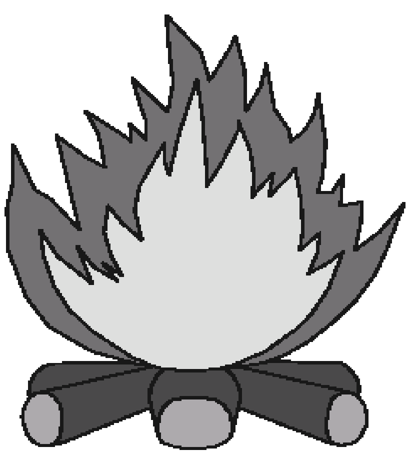
Energy helps us do things. It gives us light. It warms our bodies and homes. It bakes cakes and keeps milk cold. It runs our TVs and our cars. It makes us grow and move and think. Energy is the power to change things. It is the ability to do work.

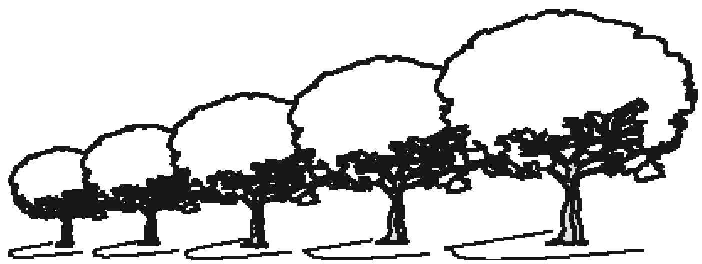


ENERGY IS LIGHT

Light is a type of energy we use all the time. We use it so we can see. We get most of our light from the sun. That's why we stay awake during the day. It saves money. Sunlight is free.

At night, we must make our own light. Usually, we use **electricity** to make light. Flashlights use electricity, too. This electricity comes from batteries.





ENERGY MAKES THINGS GROW

All living things need energy to grow. Plants use light from the sun to grow. Plants change the energy from the sun into sugar and store it in their roots and leaves.

Animals can't change light energy into sugars. Animals, including people, eat plants and use the energy stored in them to grow. Animals can store the energy from plants in their bodies.

ENERGY IS HEAT

We use energy to make heat. The food we eat keeps our bodies warm. Sometimes, when we run or work hard, we get really hot. In the winter, our jackets and blankets hold in our body heat.

We use the energy stored in plants and other things to make heat. We burn wood and natural gas to cook food and warm our houses. Factories burn fuel to make the products they sell. Power plants burn coal to make electricity.

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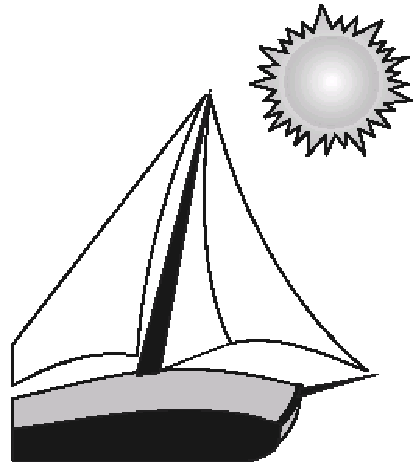
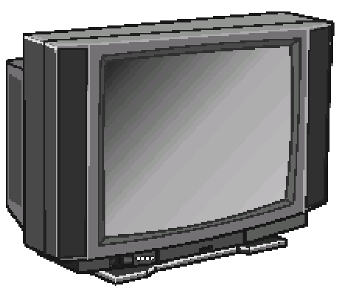


ENERGY MAKES THINGS MOVE

It takes energy to make things move. Cars run on the energy stored in gasoline. Many toys run on the energy stored in batteries. Sail boats are pushed by the energy in the wind.

After a long day, do you ever feel too tired to move? You've run out of energy. You need to eat some food to refuel.



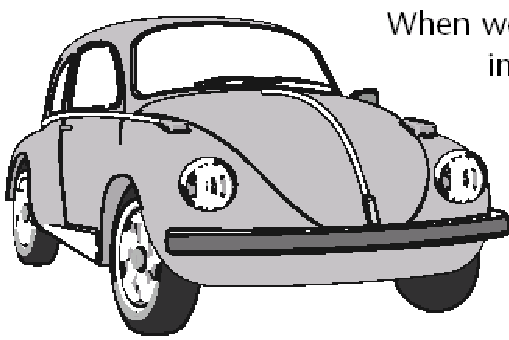
ENERGY RUNS MACHINES

It takes energy to run our TVs, computers and video games—energy in the form of electricity. We use electricity many times every day. It gives us light and heat, it makes things move, and it runs our toys and microwaves. Imagine what your life would be like without electricity.

We make electricity by burning coal, oil, gas, and even trash. We make it from the energy that holds atoms together. We make it with energy from the sun, the wind, and falling water. Sometimes, we use heat from inside the earth to make electricity.

ENERGY DOESN'T DISAPPEAR

There is the same amount of energy today as there was when the world began. When we use energy, we don't use it up. We change it into other forms of energy. When we burn wood, we change its energy into heat and light. When we drive a car, we change the energy in gasoline into heat and motion.



There will always be the same amount of energy in the world. But more and more of it will be changed into heat. Most of that heat will go into the air. It will still be there, but it will be hard to use.

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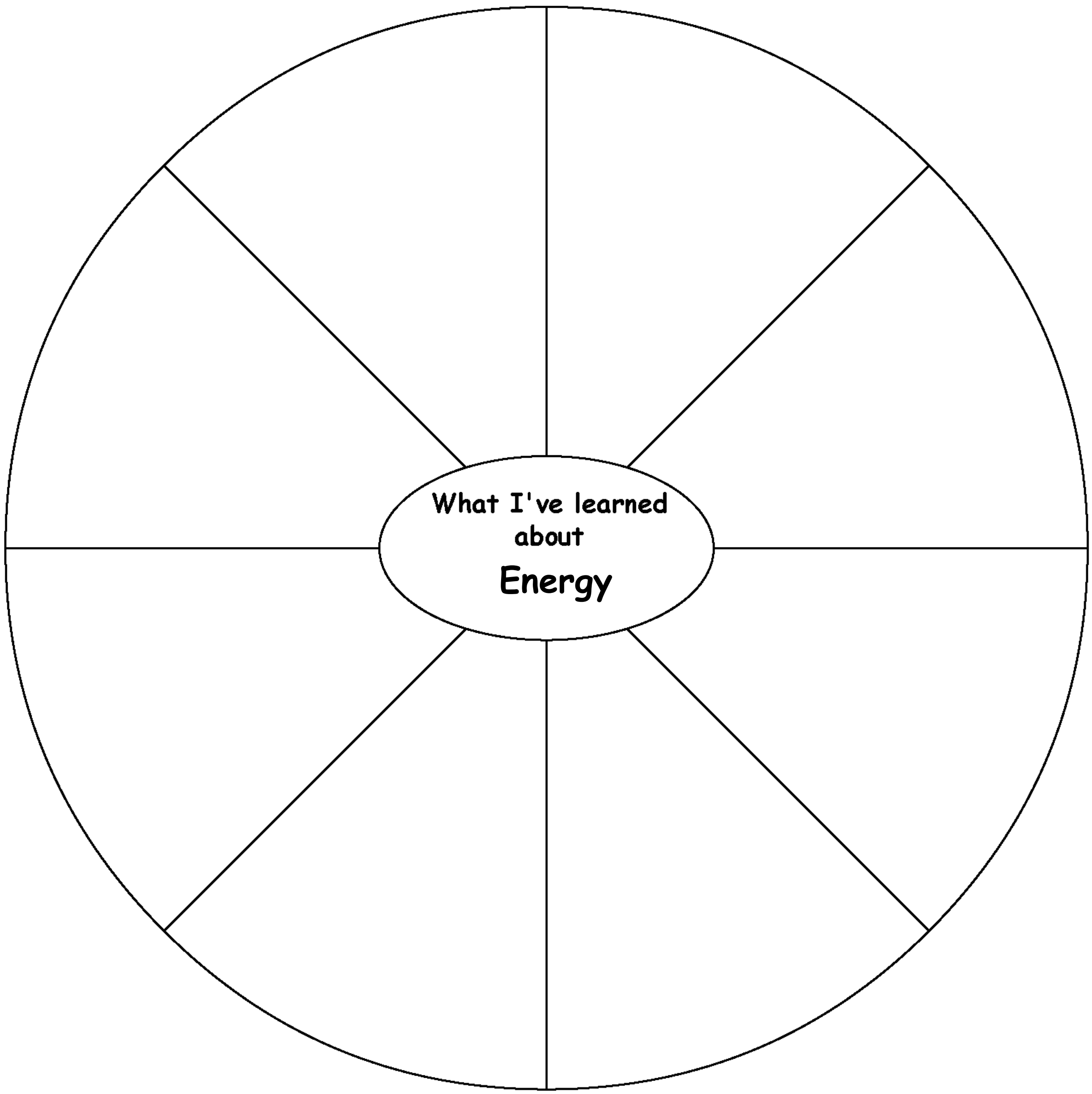
Activity 2

Energy Review Wheel: Try to think of 8 things that you have learned about energy. Write them in the spaces between the lines of the wheel.



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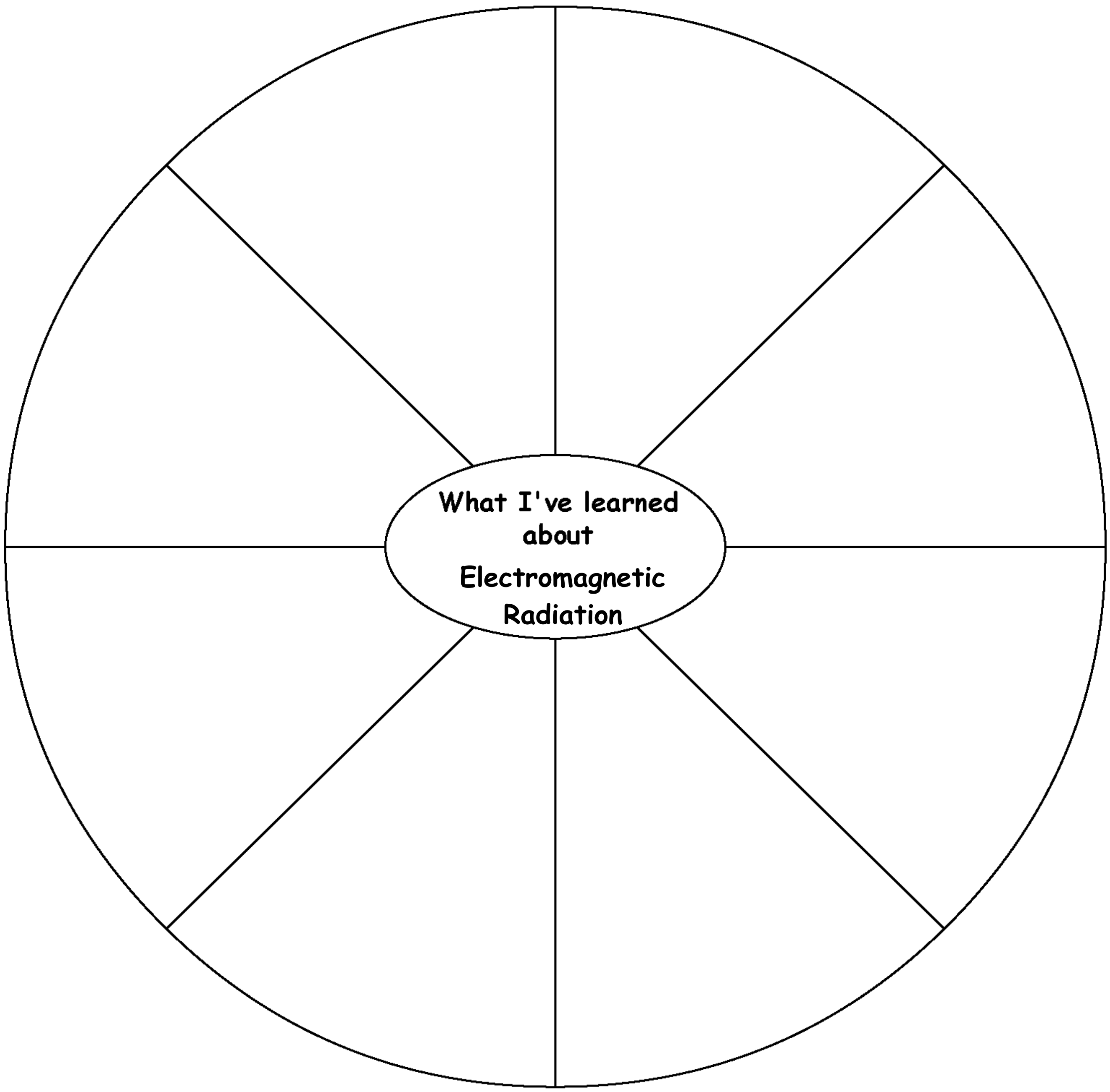
Electromagnetic Radiation Review Wheel: Try to think of 8 things that you have learned about ER. Write them in the spaces between the lines of the wheel.



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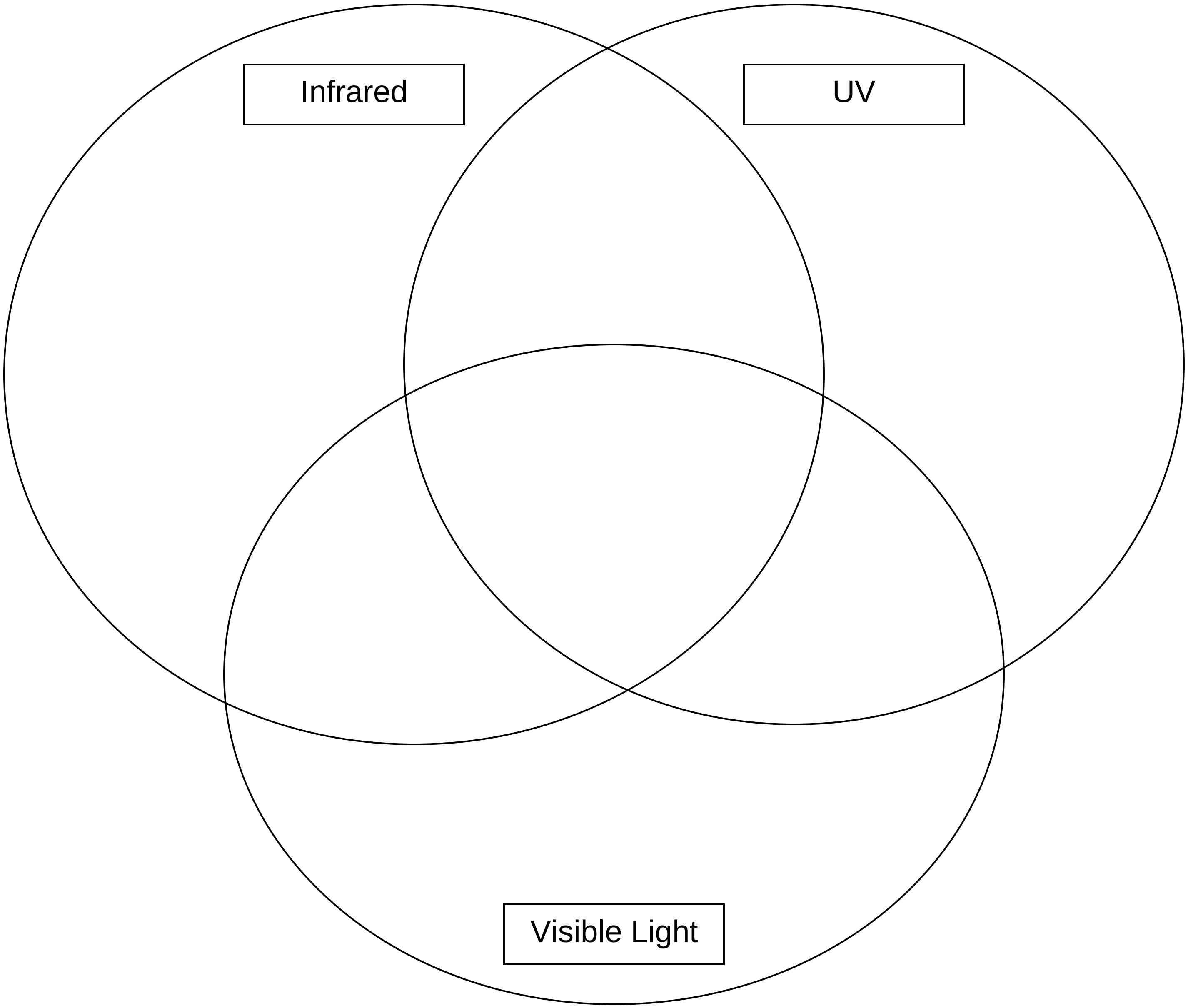
Electromagnetic Energy: Visible Light – Infrared – Ultraviolet Radiation Venn Diagram



Cut and Paste each of these statements into the Venn diagram.
Electromagnetic Energy
People can see it.
People can feel it.
People cannot see it.
Given off by the Sun.
Rainbow colors
Heat energy
High energy, short waves
Use sun block to protect skin from.

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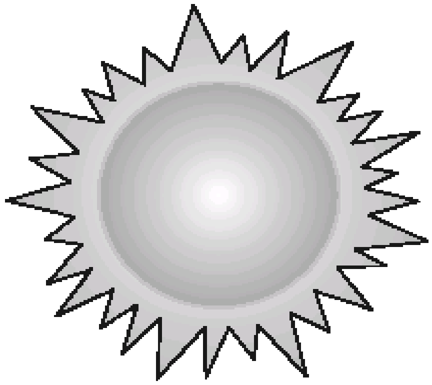
What is Solar Energy?

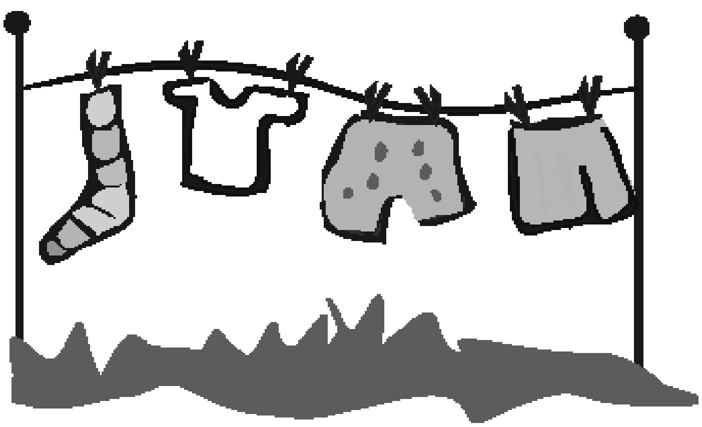


We get most of our energy from the sun. We call it **solar energy**. It travels from the sun to the earth in rays. Some are light rays that we can see. Some rays we can't see, like x-rays.

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

WE DEPEND ON SOLAR ENERGY

We use solar energy in many ways. All day, we use sunlight to see what we're doing and where we're going.



Sunlight turns into heat when it hits things. Without the sun, we couldn't live on the earth—it would be too cold. We use the sun's energy to heat water and dry clothes.

Plants use the light from the sun to grow. Plants take the energy in light and store it in their roots and leaves. That energy feeds every living thing on earth. We can also burn plants to make heat.

THE SUN'S ENERGY IS IN MANY THINGS

The energy from the sun makes rain fall and wind blow. We can capture that energy with dams and windmills.

Coal, oil and natural gas were made from prehistoric plants and animals. The energy in them came from the sun. We use that energy to cook our food, warm our houses, run our cars, and make electricity.

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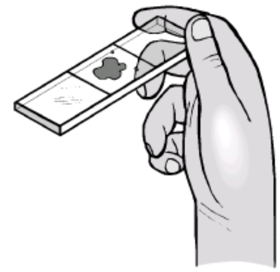
Activity 5B: A Closer Look At Plant Cells



Materials: microscope, plastic knife, slide, Iodine sol., cover slip

Directions:

1) Cut 1cm of onion (no skin) on a hard surface.
2) Using a small plastic knife, cut a tiny, tiny piece of onion from the edge. It may seem more like juice than onion.
3) Scrap this onto the center of the glass microscope slide.
4) Place a drop of iodine on this onion/juice.
5) Place a small cover slip over the top of the onion and iodine. The iodine should stain the onion cells.
6) Allow the slide to sit for a few seconds.
7) Place the slide under the microscope. Focus using the lowest magnification (smallest lens).
8) Using colored pencils, draw what you observe.
9) Increase the magnification and focus. Draw your observation again.
10) Try to label as many cell parts as possible. Make notes regarding what you have learned about plant cells.

Magnification _________

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Magnification __________

Notes:

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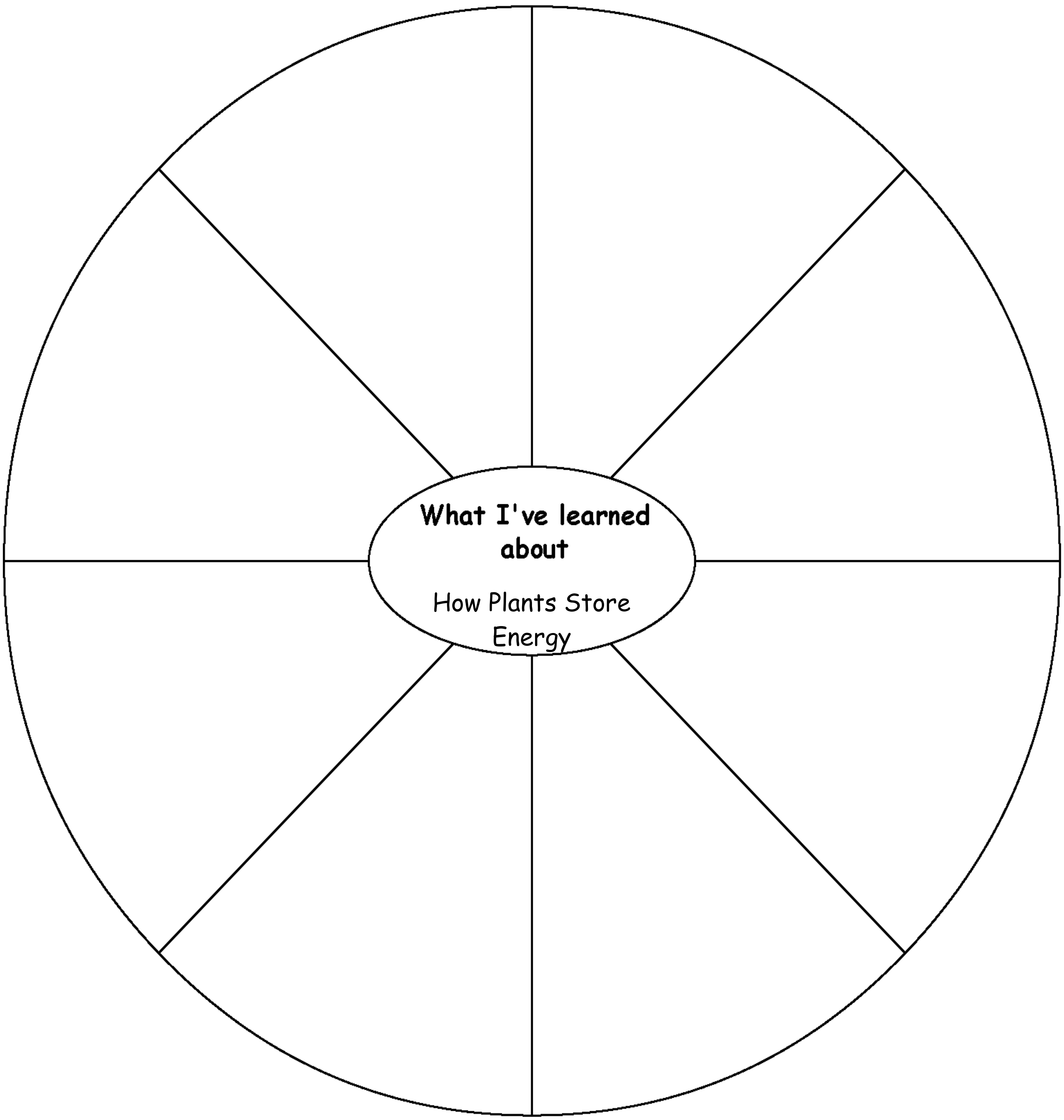
Plants Store Energy Wheel Review:

Try to think of 8 things that you have learned about plants as energy sources. Write them in the spaces between the lines of the wheel.



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The Peppy Peanut Caloric Calculation

Energy content is the amount of heat produced by the burning of 1 gram of a substance, and is measured in joules per gram (J/g) or calories. One calorie equals 4.184 joules.

How much energy is in a peanut? Find out by using this equation.

Heat Value (Cal.), Q = ^T C m_s + L m_b

^T = change in temperature is the difference between the starting and ending temperatures of the water.

Starting temperature of the water = ___________°C
Ending temperature of the water = 100 °C (boiling temperature of water)

C = *specific heat, in this case of water which is 1 (calorie)

m_s = **mass of the water you start with**

L = latent heat of vaporization of water is the energy needed to boil the water, L= 540 calories per gram of water

m_b = **mass of the water boiled away**

(*Specific heat of a substance is amount of heat required to change the temperature of one gram of a substance one degree Celsius. The specific heat of water is 1 calorie or 4.184 joules)

Example:
Let's say that by burning a peanut you raised the temperature of 10 ml (equal to 10 g) of 20°C water to boiling (100 °C). This boiled away 2 ml (equal to 2 g) of water.
What is the caloric value of the energy released?

Q = (100 – 20)(1)(10) + 540(2) = (80)(1)(10) + 1080 = 800 +1080 = 1880 calories

This looks like way too much but remember that **a food calorie and a science calorie are different. One food calorie is about 1,000 physicist calories**. So in terms of food calories this would be about 1.88 calories a peanut.

YOUR PEANUT CALCULATION:

Q = (100 -)(1)( ) + 540 ( ) = ____________ calories

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Density Review

Density Review Activity 1

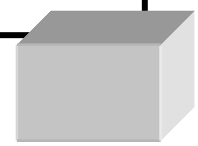
Formulas:

Volume = Length x Width x Height or V = L x W x H

Units for Volume = cm^3

Density = Mass divided by Volume or D = M/V

Units for Density = g/cm^3



Problem: How do you measure the density of a regularly shaped object?

____

____

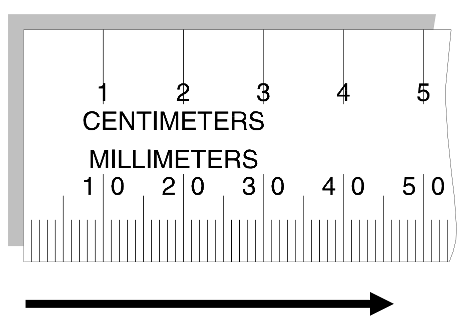
Procedure:

1) Select a regularly shaped object.

2) Measure the mass of the object. Round off to the nearest gram.

3) Measure the length, width, and height of the object. Record this data to a tenth of a centimeter.

(The arrow would be 4.6 cm long)



4) Calculate the volume using **V= L x W x H** **Units will be cm^3**

5) Calculate the density of the object. **D=M/V** **Units will be g/cm^3**

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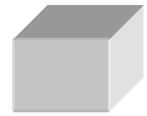
Density Review Activity 1 Data Sheet:



Regularly shaped object	Measurement (include units)	Formula used
MASS		
Length		
Width		
Height		
VOLUME		
DENSITY		

Show Your Work:

VOLUME:

DENSITY:

Thought question: Is the density more, less, or the same as you expected?

____

____

The density of water is 1. Would your object float or sink in water? Why or why not?

____

____

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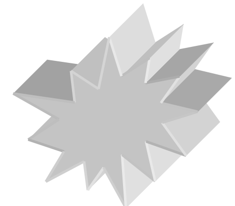
Density Review



Density Review Activity 2

Problem: How do you measure the density of an <u>irregularly shaped object</u>?
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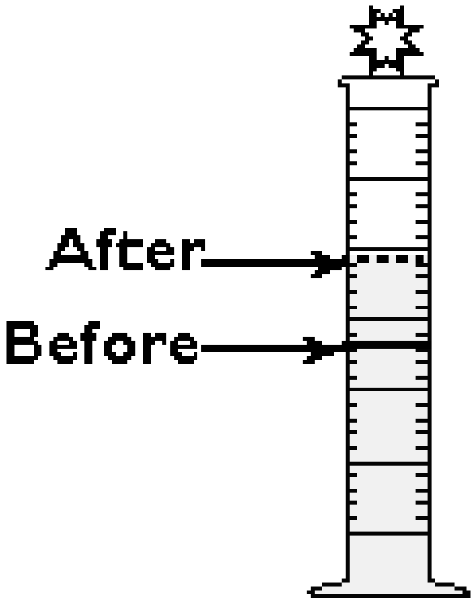
Procedure: (see the "Density Review Activity 2 Data Sheet")



1) Select the irregularly shaped object

2) Measure the mass of the object. Round off to the nearest gram.

3) Measure the volume of the object. Record the measure to the nearest milliliter (ml).

How do you do this?
(Hint: Think "water displacement" method.)

4) To calculate density:
Remember the formula is D **= M/V**

Density = Mass divided by volume

5) Substitute the values into the formula and calculate the value.

The units will be g/ml. These are OK units for density.

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Density Review Activity 2 Data Sheet:

Irregularly shaped object	Measurement (include units)	Formula used
MASS		
VOLUME		
DENSITY		

Show Your Work:

Volume: Ending level of water in graduated cylinder: __________ml
Beginning level of water in graduated cylinder: __________ml
Difference in levels of water: __________ml

The amount of water displaced is equal to the volume of the object.
Therefore the volume of the object is equal to: ____________

Density:

Questions:

A) Think about how you would find the volume for a regularly shaped object. How would you find the volume of an irregularly shaped object?
What are the two possible units that can be used to find the value for volume?

___________________ ___________________

B) What are the two possible units that can be used for density?

___________________ ___________________

C) Would this object float or sink? ____

D) So far you have found the density of two objects. How could knowing the density of an object be important?

____

____

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Density Review

Density Review Activity 3

Problem: There are 2 objects. One object is smaller than the other object. Both objects are made from the same material. Are their densities the same or different?

Write your hypothesis. (What do you think?)

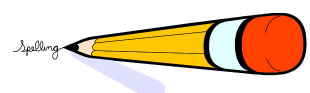
____

____

____

How do you prove or disprove your hypothesis? Answer: Collect some data.

How do I do this?



- Decide what data you will need to collect.
- Make a data table for your data.
- Label an area where you will show your math work.
- Collect your data.
- Do your calculations.
- Write your conclusion. (Did you prove or disprove your hypothesis.)

Plan first then collect your data.

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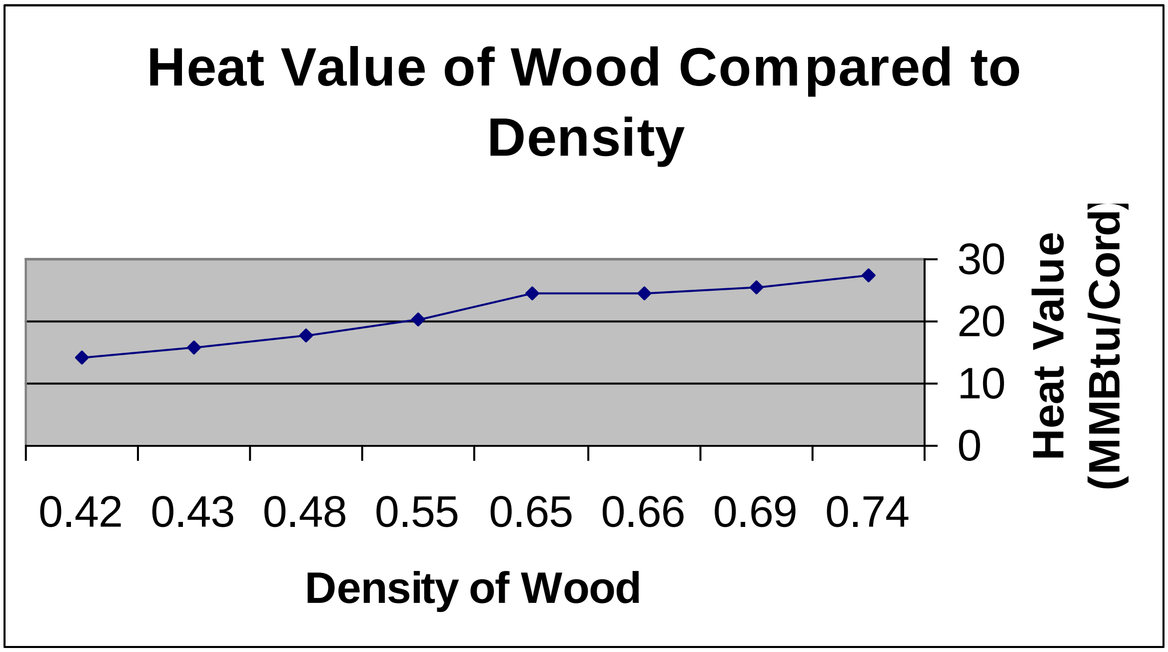
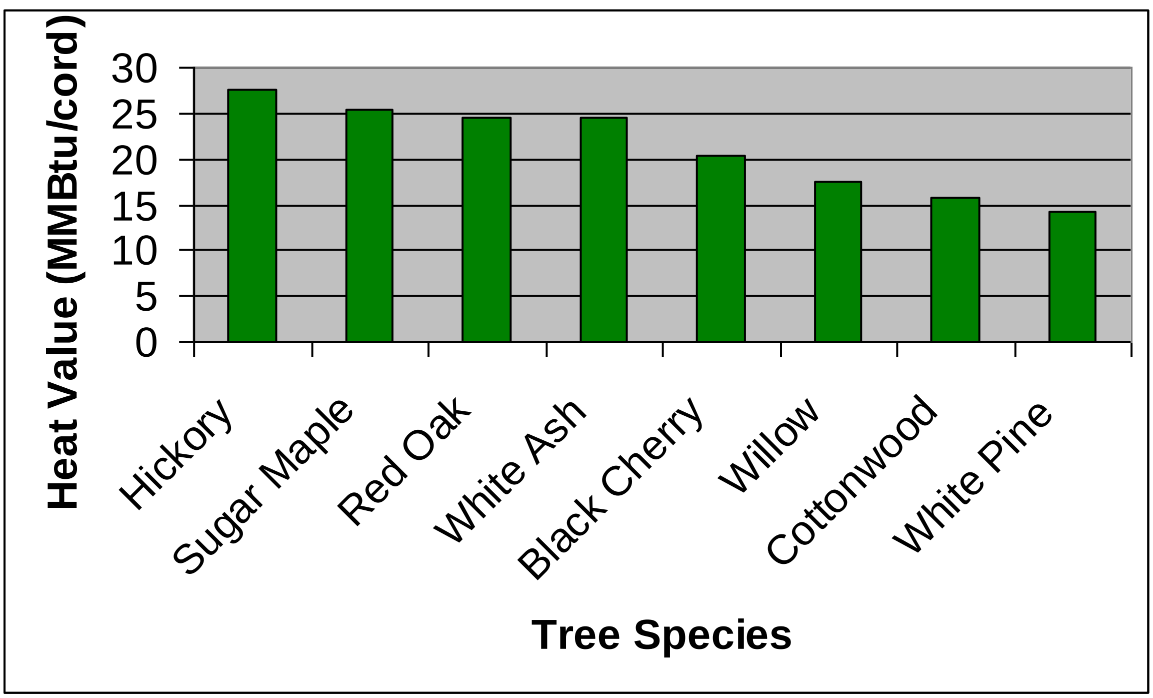
How can we use density of wood to help us estimate the wood's heat value?

Investigation 2:

Reference Graphs for Density and Heat Value of species of Trees/Shrubs





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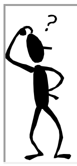
Experiment Plan sheet for ____

What are you thinking?

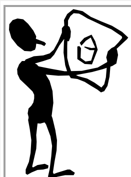


What do you want to find out? (Can be a question.)

What do you think will happen?

Why do you think it will happen?

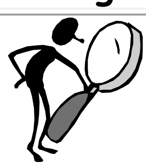
How are you going to explore your question?



What are you going to do? (use added paper for your plan)

What will be different for each test. (variable)	What will be kept the same for each test. (controls)

Observing and measuring.



What are you are going to measure / observe?

Do you have questions about what you are going to do?

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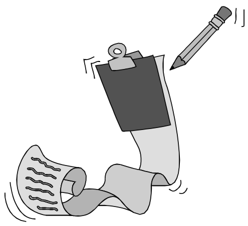
For the record …

How are you going to record your observations?

Are going to use a data table? What are you going to measure and write down?



If you are going to use a data table, draw it here.

When you have your results, write a conclusion statement. A conclusion statement tells if what you thought would happen actually happened and why you think it did or did not.

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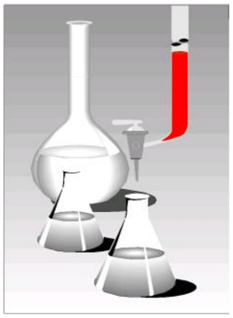


Warming Experiment #1
Clear or Opaque?

Problem: If I place the two similar containers in front of a light source, will they heat up the same if one is clear and one is opaque?

Hypothesis: If you have one container with a construction paper liner and one is clear, will they heat the same or differently? Think of a hypothesis about how you think the containers will heat up.

I think that ________________________________

____

____

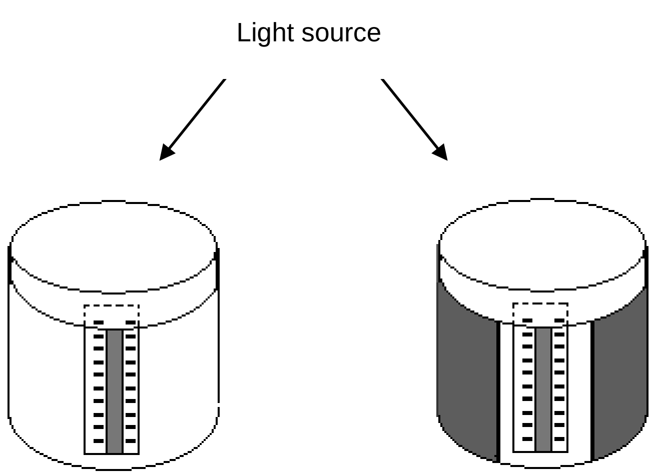
Procedure: (Read before you start.)

1) Place a thermometer in each container.
2) Cut a rectangle shaped piece of construction paper and use it to line one of the containers.
3) Leave an open area in the back so that you can read the thermometer. Place a cover on each container.
4) Make sure the cans receive the same amount of light by placing them equal distance from the light source.
5) Create a data table to place your data on.
6) Turn on the light source.
7) Record the temperatures every two minutes for 16 minutes.

Materials:
*two thermometers
*2 clear containers (medium size)
*two covers
*Light source
*stop watch or second hand

Vocabulary:
***opaque**
*Radiation
*Absorption
*Reflection
*Radiator
*Hypothesis

Part B: Turn off the light source but do not touch the containers. Continue recording the temperatures every two minutes for the next 16 minutes.



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Clear or Opaque Lab #1 continued

Data: You are recording the temperature of two different containers. You will do this every 2 minutes for a total of 16 minutes.

Data Table:

1) Construct a **graph** of your data. Attach the graph to this worksheet.

2) **Conclusion:** Look at your data and graph. Write a conclusion about your hypothesis. (Was your hypothesis right or wrong, how do you know this?)

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3) In this activity there were different forms of energy. What forms of energy were in this activity? Was energy radiated, absorbed or reflected?

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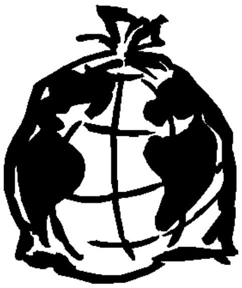

Warming Experiment #2
Lid on or Off?

Materials:
* 2 clear plastic containers with lids per lab team
* 2 thermometers
* 6 cups of dirt/soil
* data recording chart
* graph paper per student
* colored pencils

Vocabulary:
Convection
Energy
Hypothesis
Scientific method
Temperature

Writing an hypothesis:

1) What is your prediction about the outcome for each container?

2) Explain your thoughts from your predictions.

Problem: If I place two similar containers in front of a light source, will they heat up the same if one has a cover on and one does not have a cover on?

Hypothesis: How do you think the containers will heat up?

I think that ______________________________________

____

Procedure:
Read through the activity before you start. Make a table for your data.

Container 1: Lid off
1) Use one of the empty, clean, clear containers provided.
2) Keep the lid off of the container.
3) Place the thermometer in the container so that it is easy to read.
4) Make sure that the thermometer is at room temperature and then record your first temperature on your chart.
5) Label this temperature as the starting point.
6) Place the container in the light.
7) You will be recording the temperature 3 times a day for several days.

Container 2: Lid on
1) Use one of the empty, clean, clear containers provided.
2) Place the thermometer inside so that it is easy to read. (Make sure it is at room temperature.)
3) Put the cover back on tightly.
4) Record your first temperature on your chart. Label this temperature as the starting point.
5) Place the container in the light (near the first container).
6) You will be recording the temperature 3 times a day for several days.

Data Collection: You will be recording the temperature of two different containers. You will be recording the temperature three times a day for 3 to 5 days.

Data table: You will need to make a table for your data.

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Lid On or Lid Off Lab #2 continued

1) Construct a **graph** of your data. Attach the graph to this worksheet. (Reminder: Be sure to label the axis, and include units of measure.)

2) **Conclusion:** Look at your data and graph. Write a conclusion about your hypothesis. (Was your hypothesis right or wrong, how do you know this?)

____

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____

____

____

3) Where did the energy come from to cause the temperatures to change?

____

____

4) Think about your experiences with closed up places and open places. How would the temperature in a closed up place compare to an open place? Give an example.

____

____

____

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Warming Experiment #3
Moist or Dry?

Problem: I have a clear container that light can pass through. The container has a cover on it. Is the amount of heating affected by having moisture trapped in the container?

Hypothesis: (Write your answer to the question.)

____

____

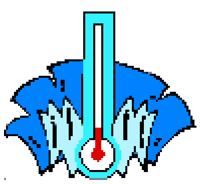
Materials:
* 2 clear plastic containers with lids per lab team
* 2 thermometers
* 6 cups of dirt/soil
* data recording chart
* graph paper per student
* colored pencils

Vocabulary:
Energy
Hypothesis
Scientific method
Temperature

Writing an hypothesis:

1) What is your prediction about the outcome for each container?

2) Explain your thoughts from your predictions.



Procedure:
Read through the procedure before you start.

Container 1: Dry Container
Set up an experimental control.
1) Use one of the empty, clean, clear containers provided.
2) Add 3 heaping tablespoons of dirt to the bottom of the container.
3) Place the thermometer on top of the soil in a manner that allows you to easily read the scale. Make sure that the thermometer is at room temperature.
4) Record your first temperature on your chart. Label this temperature as the starting point.
5) Place the lid on the container.

Container 2: Moist Container
1) Use one of the empty, clean, clear containers provided.
2) Add 3 heaping tablespoons of dirt to the bottom of the container.
3) Add 3 tablespoons of water.
4) Place the thermometer on top of the soil so that you can easily read the scale with the lid on.
5) Give the thermometer time to settle at a temperature (about 2 – 3 minutes). Label this temperature as the starting point.
6) Place the lid on the container.

Data Collection: You will be recording the temperature of two different containers. You will be recording the temperature three times a day for 3 to 5 days.

Data table: You will need to make a table for your data.

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Dry and Moist Containers Lab #3 continued

1) Construct a **graph** of your data. Attach the graph to this worksheet. (Reminder: Be sure to label the axis, and include units of measure.)

2) **Conclusion:** Look at your data and graph. Write a conclusion about your hypothesis. (Was your hypothesis right or wrong, how do you know this?)

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3) Where did the energy come from to cause the temperatures to change?

____

____

4) Think about your experience with a place with a lot of moisture in the air. Now think about that place when it is dry. How did the temperature in moist place compare to the dry place? Give an example.

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Winning Ways of Willow

Inquiring about **CO_2 in our environment.**

What is a "closed loop system"?
What is an "open loop system?"

Materials: _____ CO_2 closure loop diagram for willow

_____ 100 1g markers (cut out from 1g Markers Sheet)

Directions:
Look at the "**Biomass and CO_2 Cycle**".
The diagram shows the cycle of growing and using Willow as a biomass fuel source. It also shows how much CO_2 is given off by each part of the cycle.

1) Every marker will equal 1 gram of CO_2. Cut the markers out and put them in a pile.

2) The diagram is a cycle; there isn't a beginning or ending point. You have to jump in somewhere. A "Start" spot has been labeled for you.

3) Place the number of markers that equals the amount of CO_2 given off to the atmosphere at each part of the cycle.
   How many did you place on the willows? __________
   How many did you place on the truck? __________
   How many did you place above the power plant? __________
   How many did you place below the power plant? __________

4) What is the total number of markers needed to use the willow as a fuel? ______

   What are the total grams of CO_2 given off to use willow as a fuel? _______

   Look for were this number would go on the diagram. Write it in.

(Move all the markers to the area of "Total CO_2 given off …")

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5) Move in the cycle by moving the markers to the space near "CO_2 used by the Willows to grow..."

What are the total grams of CO_2 taken in by the willow to grow? _______

Look for were this number would go on the diagram. Write it in.

6) Using the markers that are now at the left side of the cycle as your supply, go through the cycle again.

Does the number of markers used change? _________

Does the total amount of CO_2 in the loop change? ________

What is the total amount of CO_2 that moves through the loop? ______

A system is a series of parts that have a cause/effect relationship.

To define a system as open or closed you first have to decide what is moving through the system. In your system CO_2 is the focus of the diagram.

In a Closed-Loop system the amount given off by the parts of the system has to equal the amount taken in. The same quantities of matter move within the parts of the system. There is not any extra that is needed from an outside source. There is not any extra given off to be used outside the system.

In an Open-Loop the movement through the system is open to outside input and output.

Does "Biomass and CO_2 **Cycle**" diagram show an open- or closed-loop system?

____

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Winning Ways of Willow, PART 2

Look at the **cycle titled, "Fossil Fuel and CO_2 Cycle"**.
The diagram shows the cycle of using fossil fuel as a fuel source.
It also shows how much CO_2 is given off by each part of the cycle.

1) Every marker will equal 1 gram of CO_2. Cut the markers out and put them in a pile.

2) On the diagram, a "Start" spot has been labeled for you.

3) Place the number of markers that equals the amount of CO_2 given off to the atmosphere at each part of the cycle.
   How many did you place on the fossil fuel? ___________
   How many did you place on the truck? ___________
   How many did you place above the power plant? ___________
   How many did you place below the power plant? ___________

4) What is the total number of markers needed to use the fossil fuel as a fuel?

   ____

   What are the total grams of CO_2 given off to the air to use fossil fuel as a fuel?

   ____

   Look for were this number would go on the diagram. Write it in.

   (Move all the markers to the area of "Total CO_2 **given off …")**

5) If this is a Closed-Loop System where would you need to move the markers (CO_2) to continue the cycle? ____

6) Is this an open- or closed-loop system? Why do you think this?

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____

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Markers for CO_2 Cycle

1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g
1g	1g	1g	1g	1g	1g	1g	1g	1g	1g

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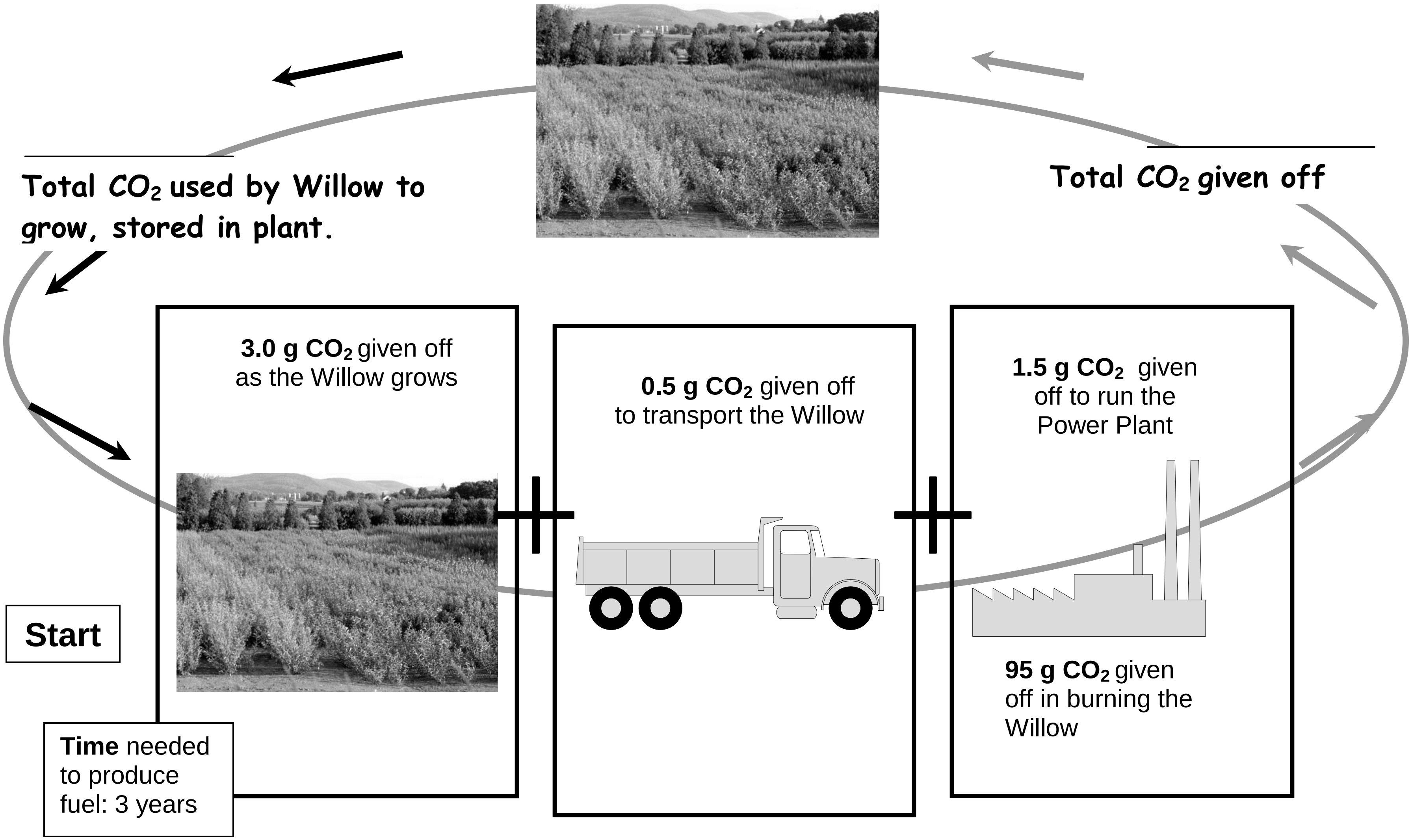
"Biomass and CO_2 Cycle"



This diagram shows the place of Willow in a Carbon Dioxide Closed Loop Cycle. This means the carbon dioxide moves through the parts of the cycle, but the amount in the cycle stays the same.

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“Fossil Fuel and CO_2 Cycle”