LIGHT BULBS AND THEIR CAPABILITIES

Description:

The main purpose of these activities is to acquaint the students with the light bulbs and their abilities in everyday life. They will understand different kinds of light bulbs along with their physical and mechanical properties.

North Dakota State Standards:

9-10.1.1 Explain how models can be used to illustrate scientific principles
11-12.1.1 Explain how scientists create and use models to address scientific knowledge
8.2.3 Use basic mathematics and statistics to interpret quantitative data
9-10.2.8 Analyze data found in tables, charts, and graphs to formulate conclusions

Schedule:

9:00-9:30	Brief introduction/Cultural introduction
9:30-10:00	Power Point
10:00-11:15	Activity 1
11:15-12:15	Activity 2
12:15-12:45	Lunch
12:45-1:45	Activity 3
1:45-2:45	Activity 4
2:45-3:00	Wrap Up

Activity 1

Build a Solar Car

Lesson Outcome

The student will apply understanding of current electricity to build a solar car and describe its workings.

Rationale / Purpose for Lesson

The students will have background knowledge in different types of renewable energy. They will use their knowledge of solar power to have an idea of how a solar panel can produce energy created from the sun.

The students will incorporate their engineering design skills to build a custom model car.

The students will be given a demonstration of solar energy.

Objectives

Students will know that solar energy is a renewable energy source, and its utilization has numerous benefits for our environment.

The angle at which a solar cell is positioned in relation to the sun affects its power output.

The amount of current produced by a photovoltaic cell is proportional to the amount of the light hitting the cell; therefore, increasing light intensity or increasing the size of the cell itself will increase the power output of the cell.

In order to construct a solar powered system that will work at maximum efficiency, numerous factors pertaining to the design, such as gear ratio and power output, must be considered.

Materials for pulley driven

- 1 - 3”x4” sheet of wood 1/8”x3”x24”
- 1- 4” dowel
- 1 – 3 ¼” dowel
- 1 - motor
- 1 – solar panel
- 2 – 2 ½” pieces of balsa wood 1/4” x 1/4” x 24”
- 1 – pulley use a sliding screen door part
- 1 – motor gear and a guard
- 4 – 1 ½” round pieces of wood for tires
- 4 – 15/16” eye hooks
- 1 – thin rubber band should fit in the middle of loose and tight
- 1 – 3/4” 2 hole strap
- Sand paper
- 1 – glue gun
- 1- glue stick
- 2 - 100 watt bulb
- 2 – 125 watt bulb
- 2 – 250 watt bulb

- 2 – lamp holder
- Exacta Knife
- Ruler
- Stop watch
- 4 – 1” heat shrink

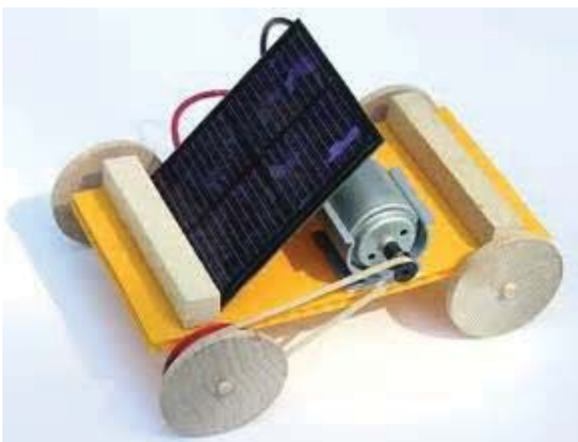
Materials for gear driven

- 1 - 3”x4” sheet of wood 1/8”x3”x24”
- 2 – 3 ¼” dowel
- 1 - motor
- 1 – solar panel
- 2 – 2 ½” pieces of balsa wood 1/4” x 1/4” x 24”
- 1 – gear 1 7/8”
- 1 – motor gear
- 2 – 1 ½” round pieces of wood for tires
- 2 – 2 in round pieces of wood
- 4 – 15/16” eye hooks
- 1 – 3/4” 2 hole strap
- Sand paper
- 1 – glue gun
- 1- glue stick
- 2 - 100 watt bulb
- 2 – 125 watt bulb
- 2 – 250 watt bulb
- 2 – lamp holder
- Exacta Knife
- Ruler
- Stop watch
- 4 – 1” heat shrink

Procedure for pulley driven

1. Take the 2 pieces of balsa wood and glue one on each end of the sheet of wood.
2. Screw the 2 eye screws on each end under the sheet wood.
3. Put the dowels through the eye screws.
4. Then put 2 of the round pieces of wood on the front and put the two round pieces with the pulley in the middle on the back.

5. Glue the heat shrink on the outside of the eye screws it will act as a shaft.
6. Now put the motor close to the edge wear the side the pulley is on and glue the strap that hold the motor.
7. Glue the solar panel to the front piece balsa wood at a slant it will rest on the motor.
8. Now hook the rubber band to the pulley and to the gear on the motor.



9. Finally use the heat lamp to drive the solar car.
10. Test each bulb with the car record the time it takes to reach the finish line. The finish line should be 2 meters long.
11. Then have a race use the bracket below if there are not enough teams then research smaller brackets.
12. Share your results with the class

Procedure for gear driven

1. Take the 2 pieces of balsa wood and glue one on each end of the sheet of wood.
2. Screw the 2 eye screws on each end under the sheet wood.
3. Put the dowels through the eye screws.

4. Then put 2 of the round pieces of wood on the front and put the two 2” round pieces with the gear in the middle on the back.
5. Glue the heat shrink on the outside of the eye screws it will act as a shaft.
6. Now put the motor close to the edge wear the gear is located and glue the strap that hold the motor.
7. Glue the solar panel to the front piece balsa wood at a slant it will rest on the motor.
8. Finally use the heat lamp to drive the solar car.
9. Test each bulb with the car record the time it takes to reach the finish line. The finish line should be 2 meters long.
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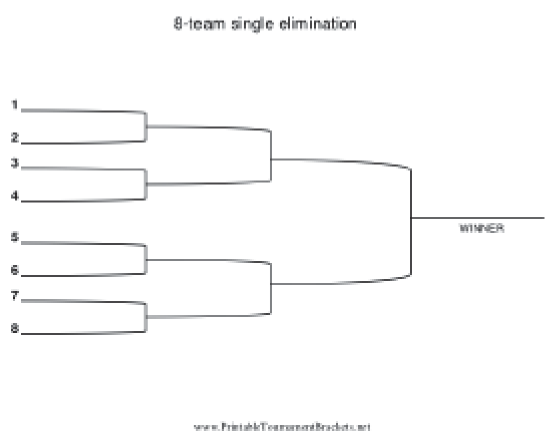


Activity 2

Circuits and the Flow of Electricity

Lesson Outcome

The student will apply understanding of current electricity to design a circuit and describe its workings.

Rationale / Purpose for Lesson

To understand current electricity, many vocabulary words must be introduced. The first part of this lesson uses a hands-on, problem-solving activity that helps students define the vocabulary terms and demonstrate the terms’ relationships. After gaining foundational understanding, students create their own circuits.

Materials Required

- 12 – 1” smooth foam balls
- 12 – 2” smooth foam balls
- Copies of “Making Circuits” handout (below)
- 1 Circuit Kit for each group. Circuit Kits contain 1-D Cell battery, two strips of black tape, 2 - light bulbs, 2 sockets for the light bulbs (or E-10 light bulb bases), and 4 pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire.

Introduction

- Ask two student volunteers to go to the front of the classroom. Assign one student the role of “the battery” and the other student the role of “the light bulb.” It may be helpful to have each student stand by the chalkboard with a picture of his or her role (the battery or light bulb) nearby.
- Ask the students, “How can the battery give energy to the light bulb in order to create light?”
- Have “the battery” toss the balls to the light bulb. Now the light bulb has been supplied energy to generate light.

Procedures

- Once “the battery” has thrown all of the balls to “the light bulb” the supply of energy to the light bulb is exhausted and no more light can be generated.
- “How can the light bulb be lit for a longer period of time?”
- “How could the light bulb give off light that is brighter?”
- Distribute the “Making Circuits” handouts and provide each group of three or four students with a Circuit Kit. Allow students time to complete the activities on the handout.
- Have students show their completed working circuits to the class.
- Ask students to explain the circuits by tracing the flow of energy from the battery through the course of the circuit. Have them either present this explanation or write it.

- “Will the light bulbs in the parallel circuit or the series circuit burn brighter?”
- Have students test their predictions.
- Were the predictions correct?

- Explain the results of the test.

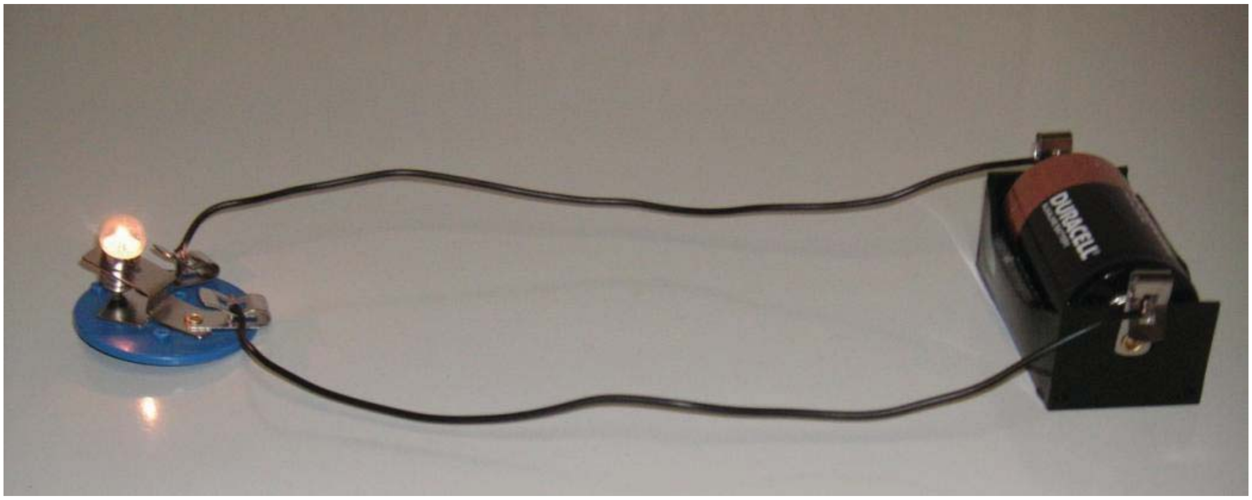
- Now start building the following circuits and answer the following questions:
    - A. Simple circuit with single light bulb:

      1. Using two wires connect one end of each wire to the light bulb base.

      2. Connect the other end of each wire to the battery, unless this has already been done for you.

      3. Record what happens. Does the light bulb light up? Where does the energy flow? Describe and illustrate the flow of electrical current from the battery through the wires and to the bulb.

      4. Using your circuit, demonstrate how switches must work to turn lights on and off. Draw a diagram of what the circuit would look like if the switch was in the “off” position.

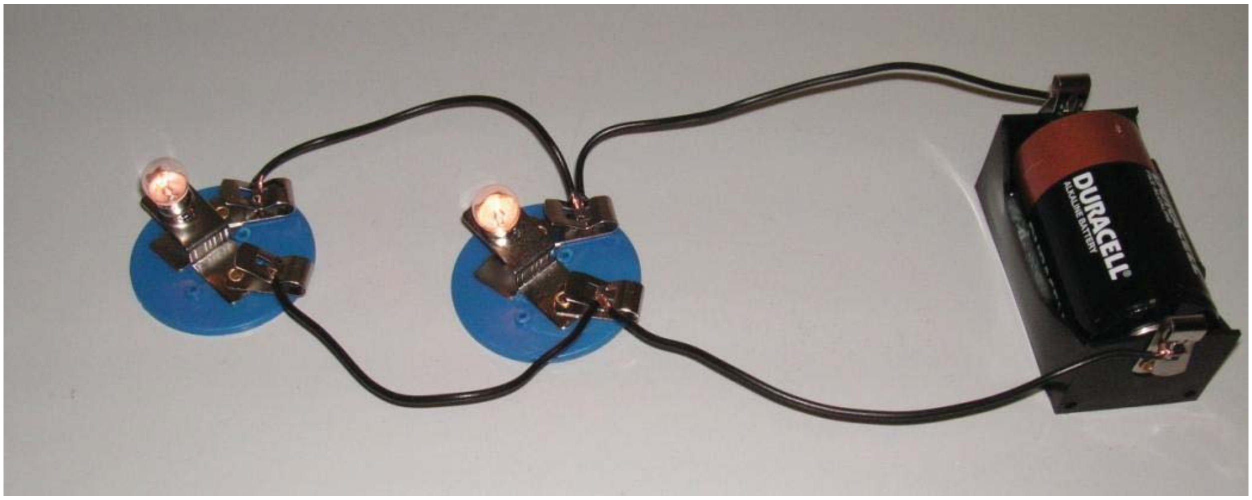


- B. Parallel circuits:

Parallel circuits are circuits in which electrical current from the battery flows with equal voltage into two or more bulbs. In this type of circuit, electricity can flow through more than one path.

1. To make a parallel circuit, you will need two more pieces of wire, an additional light bulb and socket. Connect one end of the two new wires to the new light bulb. Connect the other ends of the two new wires to the first light bulb (that is still attached to the battery.

2. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?

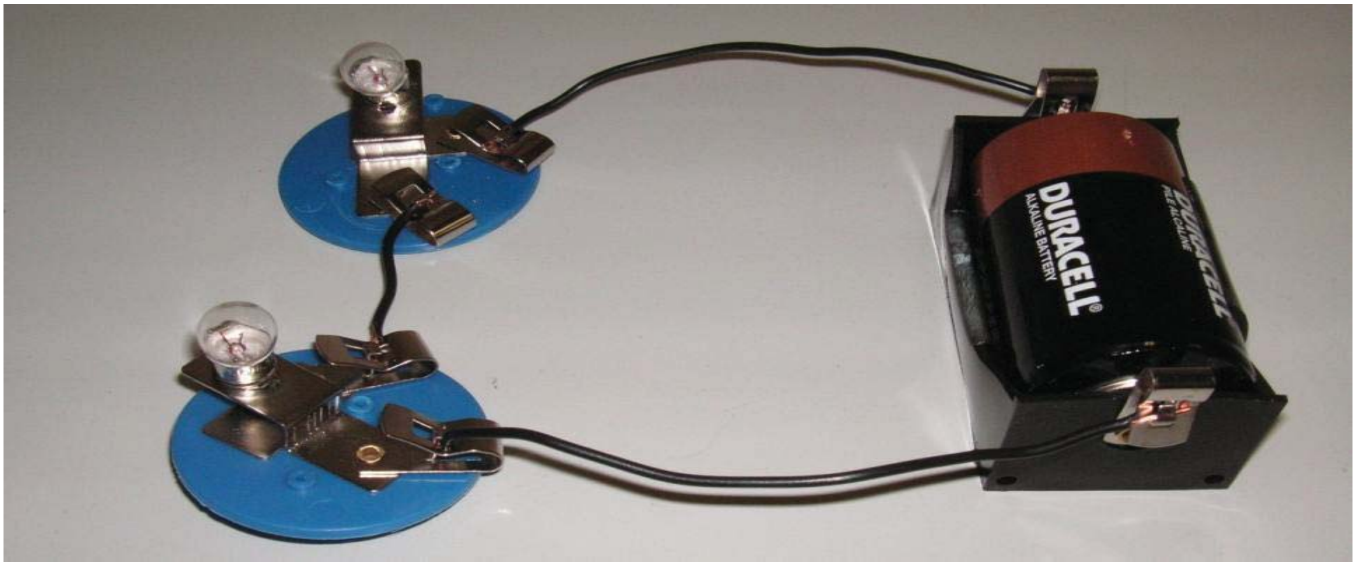


- C. Series circuits:

Series circuits are circuits in which electrical current from the battery flows through one bulb and then through another bulb. Electricity in this type of circuit can only flow in one path.

1. Rearrange the position of the wires and light bulbs in your circuit to create a series circuit. You will need three pieces of wire connect one end of the wire the battery is attached to at the end of the first light bulb. Connect one end of the second piece of wire to the first light bulb and the other end of the wire to the second light bulb. Connect the other end of the piece of wire attached to the battery to the second light bulb.

2. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?



Student Data Collection Sheet

A. Simple circuit with single light bulb:

Does the light bulb light?

Where does the energy flow?

Describe and illustrate the flow of electrical current from the battery through the wires and to the bulb.

Using your circuit, demonstrate how switches must work to turn lights on and off. Draw a diagram of what the circuit would look like if the switch was in the “off” position.

B. Parallel circuits:

Record what happens with this type of circuit.

Do both light bulbs light?

What happens if one light bulb is unscrewed from its socket? Why?

C. Series circuits:

Record what happens with this type of circuit.

Do both light bulbs light?

What happens if one light bulb is unscrewed from its socket? Why?

Activity 3

Conductors and Insulators

Lesson Outcome

The student will identify conductors and insulators by using a simple circuit to test the conductivity of various materials.

Rationale / Purpose for Lesson

This activity provides an opportunity to use the circuit to understand the nature of electricity. By testing common objects, students will discover both conductors and insulators of electricity. The knowledge of conductors and insulators can be extended to discussion on the travels of electricity and electric safety. Finally, this hands-on lesson allows students to use the scientific process to hypothesize, test, and compare results.

Materials

- Circuits made from the “Circuits and the Flow of Electricity” lesson plan.
- 2 paper fasteners or binder clips for each circuit being used.
- Classroom samples of conductors and insulators (i.e. Metal paper clips, metal pens, aluminum foil, coins, keys, rubber bands, erasers, glass bottles, etc.). Make sure to have enough materials for each student group to test at least 6 objects.
- Copies of “Testing for Conductivity” instruction sheet (below).

Introduction

- Have students consider the circuit.
- How is the light bulb able to receive power from the battery?
- How does the energy move from the battery to the light bulb?
- Discuss the terms conductor and insulator so students understand that conductors carry electricity from one point to another and insulators stop the flow of electricity.
- Have students come up with a class definition for the terms conductor and insulator and post within the classroom.
- Have the students brainstorm ideas of how the circuit could be used to test materials for their conductivity.

Procedures

- Select one conductor and one insulator from the classroom samples (such as a key and a rubber band as shown in the pictures.) Following procedures in Step 4 of the "Test for Conductivity" sheet show how the circuit can be used to test for conductivity. Demonstrate what happens to the light bulb when both the conductor and insulator become a part of the circuit.

- Have groups of 3 or 4 students select at least 6 objects from the collection of classroom samples.

- Distribute the "Testing for Conductivity" worksheet to each group and have students follow the testing instructions.

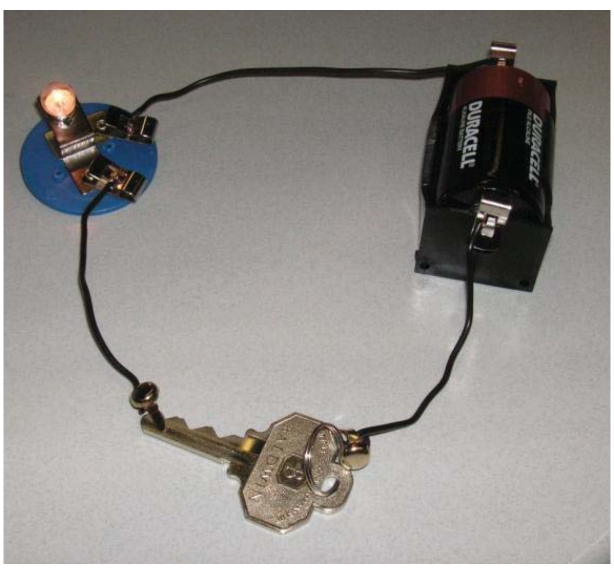
- Have students discuss and compare their observations with other student groups.

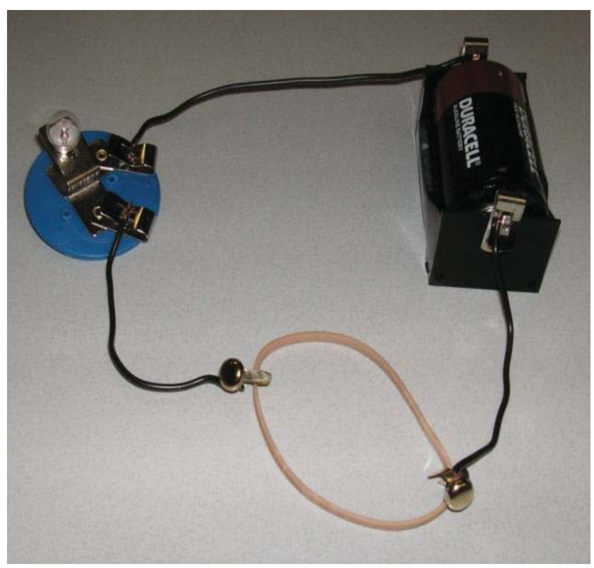
- Have each group write a definition for "conductor" and "insulator."

- Discuss the importance or use of conductors and insulators in daily life.

Conductors

Insulators





Testing for Conductivity

What will make the light bulb light up?

Directions

1. Select 6 objects from the gathered "Classroom Samples"

2. On the chart below, write the names of each object.

3. Predict whether the object is a conductor or insulator. Record your predictions.

4. Use your simple circuit to construct a conductivity tester.

    a. Your simple circuit should have two pieces of wire – one end of each piece of wire should be attached to the battery, the other end of each piece of wire should be attached to the light bulb.

    b. Remove the wire from the bottom of the battery; leave it connected to the light bulb. Wrap a paper fastener around the loose end of this wire.

    c. Attach a third piece of wire to the bottom of the battery. Wrap a paper fastener around the loose end of this wire.

5. Test your objects. One at a time, place each object between the paper fasteners, making sure they touch and have a good connection.

6. What happens to the light bulb when each object is introduced to the circuit? Record your observations for each object.

Predictions and Observations

Object Name	**Prediction**	**Results**

Activity 4

Investigating Light bulbs

Rationale / Purpose for Lesson

Through a scientific investigation, the students compare features and costs of two types of light bulbs. This lesson helps the learners understand how energy efficiency choices can impact their family energy costs and reduce the amount of energy consumed.

Lesson Outcome

- Complete a lab activity comparing 2-3 light bulbs.
- Compare the appearance, cost, and brightness of incandescent, compact fluorescent and led light bulbs.
- Calculate the costs of each type of light bulb (cost to buy and cost to use).
- Brainstorm the environmental benefits of using one type of light bulb.
- Discuss ways to encourage others to use one type of light bulb.

Materials

- Search news headlines related to the price of electricity on the Internet
- Student copies of Lights Light Up Your Life Data Sheet
- Graph paper
- Each lab group (or one per class for a demonstration) needs the following supplies:
- Calculator
- Light meter (if available)
- 3 thermometers
- Compact fluorescent light bulb with power rating (Watts) stamped on the side
- Incandescent light bulb with power rating (Watts) stamped on the top
- LED light bulb
- Two standard lamps
- Tape measure, yard stick, or meter stick

Lights Light Up Your Life Data Sheet

Purpose: Compare CFL to incandescent light bulbs and LED

Research: Read and record facts from outside experts about the differences between the two or three types of bulbs. Compare the bulbs in cost, light output, temperature, energy use, and value.

Form a hypothesis that you can test in the lab, comparing the two or three types of bulbs and determining one of the bulbs as a better choice for a particular reason.

- Which light bulb will generate the most heat? The most light?

- Which light bulb will use less energy? Last longer? Cost less to operate?

Design an experiment to test your hypothesis. Record data collected. Use the following lab activity.

Screw an incandescent light bulb into one of the light sockets, and screw a compact florescent light bulb into the other light socket also screw the LED light bulb into a light socket if asked to test. With the power off**,** compare and contrast the two light bulbs. How are they the same and how are they different?
Record your observations:

Place your sockets 24 inches (61 cm) apart. **With the power off,** place a thermometer five centimeters away from each light bulb. Read and record the temperature of the air around the light bulbs.
Incandescent _____________ Fluorescent _______________ LED________________

Turn on the power to the light bulbs. Describe each light bulb again. Do not touch the light bulbs. Record your observations:

Place a thermometer five centimeters from each light bulb. Measure and record the temperature of the air around each light bulb every minute for seven minutes.

Time (minutes)	Temperature around Incandescent light bulb (in Fahrenheit or centigrade)	Temperature around Compact Fluorescent light bulb (in Fahrenheit or centigrade)	Temperature around LED light bulb (in Fahrenheit or centigrade)
0 (from step 2, above)			
1			
2			
3			
4			
5			
6			
7			

Plot the data from the table above on graph paper. Place *time* on the x-axis and *temperature* on the y-axis. Write TWO observations below.

Using a light meter, measure the light given off by each type of light bulb. Record the level of emitted light in 1-foot (30cm) intervals, from 1 foot (30 cm) to 12 feet (3.6 m). Record the data on the table below.

Distance from light bulb	Incandescent bulb level	Compact Fluorescent bulb level	LED bulb level
1 foot (30 cm)			
2 feet (60 cm)			
3 feet (91cm)			
4 feet (1.2 m)			
5 feet (1.5 m)			
6 feet (1.8 m)			
7 feet (2.1 m)			
8 feet (2.4 m)			
9 feet (2.7 m)			
10 feet (3.0 m)			
11 feet (3.4 m)			
12 feet (3.6 m)			

Plot the data from the table above on graph paper. Place *distance* on the x-axis and *light level* on the y-axis. Compare your two graphs. Write TWO observations below.

Record the price of each light bulb below.
Incandescent _____________ Fluorescent _______________LED________________

Determine the amount of electrical energy (kilowatt-hours) used by each light bulb in one hour. Multiply the light bulb's power rating (Watts) by .001 (or divide by 1,000). A power rating is printed on the top or stem of the bulb. Record the kilowatt-hours below.
Incandescent _____________ Fluorescent _______________LED________________

Figure out the amount of energy each of the light bulbs would consume if they were left on for 10 hours. Use the kilowatt-hours from above in this equation to figure it out: kilowatt-hours x number of hours = amount of energy used.
Incandescent _____________ Fluorescent _______________LED_________________

Figure out how much the amount of electricity from costs determined above. Use the price per kilowatt-hour your teacher obtained or use $0.07 per kilowatt-hour. What is the daily cost (10 hours) to operate each light bulb?
Incandescent _____________ Fluorescent _______________LED__________________

Answer the questions below:
1. Which light bulb generated the most heat?

2. Which light bulb generated the most light?

3. Which light bulb used the most energy?

4. Which light bulb costs less to operate?

5. Which light bulb costs more to operate?

6. How much energy and money can you save each year by replacing one incandescent light bulb with one compact fluorescent light bulb?

7. How long would it take for energy savings from the fluorescent light bulb to cover the additional cost of the bulb? (You will need to know the cost of each light bulb.)

8. After this lab, which light bulb will you choose to have in your house and why?

9. In your opinion, should the government pass a law requiring the use of compact fluorescent light bulbs? Why or why not?

Organize your notes and write a conclusion and recommendation. How does this support or disprove your hypothesis?