SHINE BRIGHT

MAKE SOME LIGHT!

GRADES 9 - 12

SOUTHERN COMPANY

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SHINE BRIGHT
SNC - Plant Farley
LESSON PLAN
MAKE SOME LIGHT!

Lesson Title: Shine Bright - Make Some Light!

Lesson Description: After study of basic concepts relating to electricity, students construct and test a light bulb. The exercise involves investigation of circuits, resistance, and energy conversion. Students experiment to determine what type of material produces the most heat, most light and has the longest life. Students are required to plot data on a graph. Teachers may also relate the activity to the work of Thomas Edison.

Grade Level: 9-12

Subject Area(s): Physical Science

Objectives: Students will
- construct a model light bulb
- observe/measure light production
- observe/measure heat production
- observe/measure filament life
- collect and plot data as a graph
- discuss/report findings with other students
- formulate hypotheses related to efficiency of filament materials
- relate findings to basic electrical principles

Materials:
- 6 volt dry cell (lantern battery)
- 1 foot lengths of insulated copper wire
- 250 mL Florence (boiling) flasks
- corks to fit flasks listed above
- cork borer
- thermometers (alcohol based)
- short lengths (~2") of very thin diameter wire of various composition (e.g. aluminum, steel, iron, copper, lead, tin, brass, Nichrome, etc.)
- light meters (camera with built-in light meter will work)
- graph paper
- pencils
- stopwatch
- activity sheets (include with this lesson plan)

Correlations (NSES):
- Content Standard A - Science as Inquiry
  - develop abilities necessary to do science inquiry
  - develop understandings about scientific inquiry
- Content Standard B - Physical Science
  - develop an understanding of the structure and properties of matter
  - develop an understanding of motions and forces
  - develop an understanding of conservation of energy and increase in disorder
  - develop an understanding of interactions of energy and matter

Correlations (NSES) continued:

Content Standard E - Science and Technology
- develop understandings about science and technology

Content Standard G - History and Nature of Science
- develop an understanding of science as a human endeavor
- develop an understanding of the nature of scientific knowledge
- develop an understanding of historical perspectives

• Content Standard F - Science in Personal and Social Perspectives
- develop an understanding of population growth
- develop an understanding of natural resources
- develop an understanding of environmental quality

Curriculum Integration:

• Mathematics (measurement/graphing)
• Vocational Education (electricity)

Process Skills:

• Observation
• Collection of data
• Comparison
• Measurement
• Counting
• Research
• Investigation/experimentation
• Inference
• Analysis of findings/data
• Plotting data
• Interpretation of data
• Construction of model
• Communication of ideas
• Description of findings
• Prediction

Background Information:

• Main ideas
- the flow of electrons through a conductor is electric current
- an electrical circuit is a collection of items (voltage supply, load, conductors) that forms a closed path for the flow of electrons
- the filament in a light bulb acts as a resistor; it offers opposition to the flow of electrons
- different materials differ in the amount of resistance they provide; they also differ in the amount of light and heat generated
- some electrical energy is transformed into thermal and light energy as the current passes through the filament
- different filament materials have different lifetimes as some burn up very quickly
- principles related to conductivity and resistance
- principles related to electricity/current such as voltage, coulomb, ampere, etc.

• Secondary Ideas
- there is a definite relationship between voltage applied and combined heat/light energy
- historical perspectives: Edison's experiments leading to invention of the light bulb
- electrical power consumption of light bulbs
- review of graphing techniques
- review of temperature scales

Teacher Activities:

- Assemble/organize all materials needed for activity
- Present background materials to students
- Divide class into small groups for lab activity (2-4 students per group). Each student in the group should have a specific task in the lab activity. For example, one student should monitor temperature, another collect & plot data, another monitor light intensity, etc.
- Issue instructions to students regarding lab activity. Issue and stress safety information.
- Distribute Activity Sheets to students and issue instructions regarding their completion.
- Monitor/assist students as needed during exercises.
- After completion of lab activities, assemble students and have them share and compare data.
- Complete lesson by stressing main points and relating them to lab activities.

Student Activities:

- Listen carefully to background information issued by teacher.
- Obtain materials needed for exercise.
- Construct light bulb models as directed in activity sheet.
- Observe, record, plot data on graph paper.
- Analyze/interpret data
- Complete activity sheets
- Compare data with that of other groups
- Participate in post-activity discussion

Evaluation:

- Direct observation
- Lab Activity Sheets
- Oral communication from students

Extension/Enrichment:

- Have students use a regulated DC power supply to vary applied voltage
- Apply Ohm's law and note differences in resistance among filament materials
- Substitute heavy-walled flasks for the Florence flasks and pull a vacuum on them to see if filament life is improved or shortened; also if heat or light production is affected
- Replace air in flasks with inert gases such as helium, neon, etc. and record affects

Safety Considerations:

- Use alcohol filled thermometers rather than mercury
- Use high quality borosilicate glass flasks (such as Pyrex) that can withstand heat
- Use only the specified 6 V lantern battery as specified
- Caution students about the heat generated in the filaments - they can cause severe burns if handled. Students should not touch the filaments until they have had a chance to cool.
- Caution students about glass breakage hazards

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ACTIVITY SHEET ONE

MAKE SOME LIGHT!

(READ THIS ENTIRE SHEET BEFORE BEGINNING THE EXERCISE)

Introduction

In this exercise you will build a model light bulb from standard lab glassware and various types of wire. You will monitor light production, temperature and the lifetime of various types of filament materials.

You will record this data and plot it on graph paper to compare the various types of materials you will use as a material for the filament.

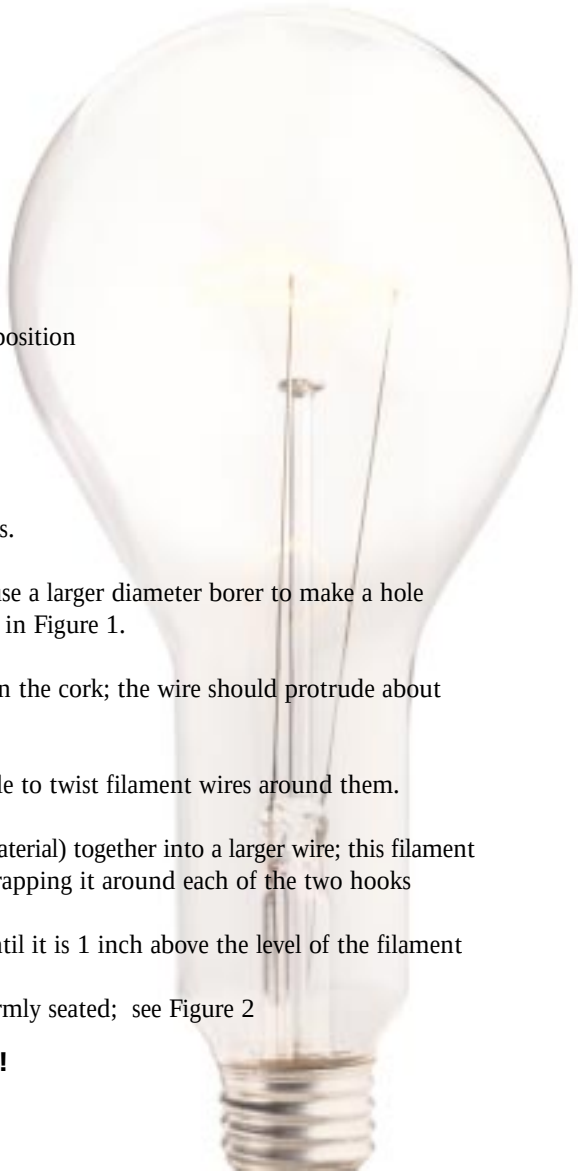
You may find out why Thomas Edison had such a difficult time in discovering what to construct the “original” light bulbs from. Your teacher will ask you to share your findings with the class.

Follow the directions on this Activity Sheet and record your data carefully. If you need help or have questions ask your teacher for assistance.

Procedure

Obtain the following materials as directed by your instructor:

- 250 mL Florence or boiling flask
- cork to fit the flask
- cork borer
- thermometer
- 2 one foot lengths of insulated copper wire
- 6 volt lantern battery
- 3 sets of short lengths of very thin diameter wire, each set of a different composition
- light meter (or camera with built in light meter)
- graph paper
- pencils
- stopwatch



- Remove about an inch of insulation from both ends of the two copper wires.

- Use the smallest diameter cork borer to make two small holes in the cork; use a larger diameter borer to make a hole just big enough for the thermometer; the holes should look like the pattern in Figure 1.

- Pass one end of each insulated copper wire through one of the small holes in the cork; the wire should protrude about two inches.

- Twist the ends of the copper wires into small hooks so that it will be possible to twist filament wires around them.

- Form a bulb filament by twisting the set of four thin wires (all of the same material) together into a larger wire; this filament should now be stretched across the gap between the two copper wires by wrapping it around each of the two hooks

- Moisten the thermometer and pass it through the larger hole in the cork until it is 1 inch above the level of the filament

- Place the cork/wire/thermometer apparatus into the flask; make sure it is firmly seated; see Figure 2

Procedure (continued)

- Before connecting the copper wires to the battery, make sure that you have someone to man a stopwatch, monitor temperature by observing the thermometer, and using the light meter (or camera) to measure maximum light intensity; some filament materials may only last a few seconds so BE READY when you connect the battery

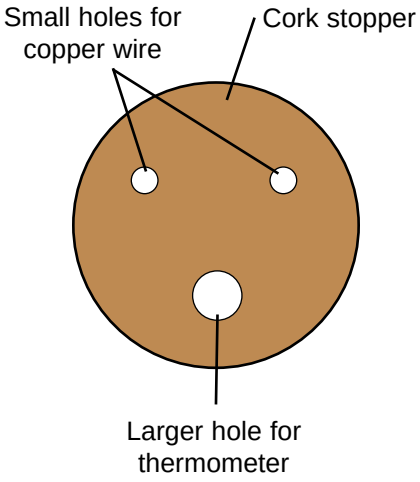
- Connect ends of copper wires to 6 volt lantern battery and monitor carefully; record all data on Table 1

- Repeat experiment by using two other materials as filaments - BE CAREFUL AS THE USED FILAMENTS WILL BE VERY HOT!! DO NOT TOUCH HOT FILAMENTS - GIVE THEM TIME TO COOL

- After repeating the experiment with other filament materials; analyze and compare your data; then complete the questions on Activity Sheet 2

- If at any point during the exercise you encounter difficulties or have questions, ask you teacher for assistance

Figure 1



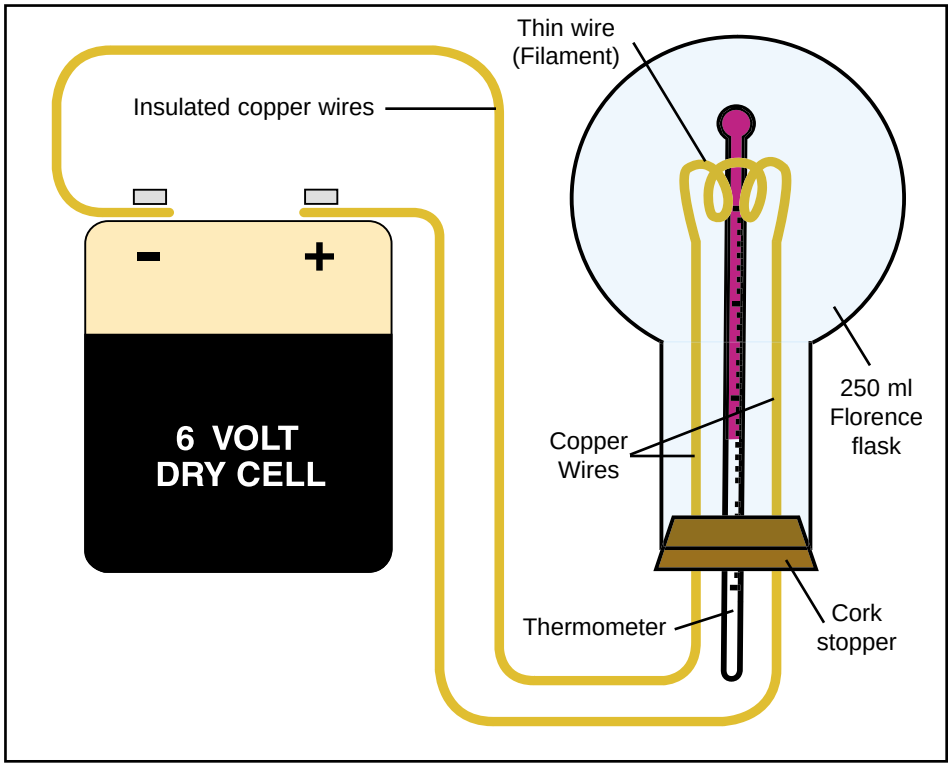


Figure 2

Table 1

FILAMENT COMPOSITION	BURN or GLOW?	MAX TEMP PRODUCED	MAX LIGHT PRODUCED	FILAMENT LIFE in SECONDS

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ACTIVITY SHEET TWO

MAKE SOME LIGHT!

After completing your experiment and plotting your data on graph paper, analyze the results and complete the questions on this sheet.

1. Did all of your filaments produce light? Did they blow or burn?

2. Which filament material produced the most light? Which produced the most heat?

3. Which filament material lasted the longest?

4. Which filament material do you think was the most efficient? Why?

5. How could one change the experiment to produce more light? How could one alter the experiment to increase the life of the filament?

6. Did you find a relationship between heat production and filament life? If so, what is that relationship? Did you find a relationship between heat and light production? If so, what is the relationship?