



# SCIENCE OF ENERGY

JILL WILLIAMS

## CHEMICAL ENERGY

<b>Time Frame:</b>	<b>Standards:</b>
45-60 minutes	8-9.PS.1.2.1 Use observations and data as evidence on which to base scientific explanations. 8-9.PS.1.6.3 Use appropriate technology and math to make investigations. 8-9.PS.2.3.2 Classify energy as potential and/or kinetic and as energy contained in a field. 7.S.1.6.3 Evaluate data in order to form conclusions.
<b>Objectives:</b>	
Experiment on how to use chemical reactions to produce radiant energy and electricity.	
<b>Background Information:</b>	
<p>Light sticks are filled with hydrogen peroxide. Inside the light stick is a glass container or ampule. The ampule contains an ester. An ester is a organic compound formed from an acid and an alcohol with the elimination of water. When the ampule is broken and the two chemicals are mixed, they produce light. This is because the new chemicals formed when the ester and hydrogen peroxide mixed release energy they didn't need as light. When a light stick is put in hot water, some of the heat energy is absorbed and makes the chemicals react faster, produces more light and lasts a shorter time then at room temperature. Cold water takes some of the heat energy from the light stick and slows down the reaction. It produces less light and lasts longer than at room temperature.</p> <p>With the apple experiment, Zinc and copper react to the acid in the apple but in different ways. They create an electrical imbalance which results in an electrical charge from the zinc nail to the copper wire. You have created an apple battery. When the nail and copper wire are touching there is a short circuit, the electrons flow directly and don't create a current. If you have two copper wires there is no current because both are electron acceptors. If you have two zinc nails there is no current. It is because both are electron donors and there is no electron acceptor. Tin can be either an electron donor or an electron acceptor depending on which other metal it is paired with.</p> <p>Information taken from The Need Project's 2008 Science of Energy <a href="http://www.need.org/">http://www.need.org/</a></p>	
<b>Materials:</b>	
<ul style="list-style-type: none"><li>◆ 1 small zinc nail per station</li><li>◆ 1 large zinc nail per station</li><li>◆ Pair of Alligator clips per station</li></ul>	

**Energy for Educators**

Bringing Energy into the Classroom

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- ◆ 1 thin copper wire per station
- ◆ 1 thick copper wire per station
- ◆ 1 tin wire per station
- ◆ 1 large apple per station
- ◆ 1 meter per station
- ◆ 1 cup of cold water (for demonstration)
- ◆ 1 cup of hot water (for demonstration)
- ◆ 2 light sticks (for demonstration)

### Procedure:

1. Give students background on chemical energy. What is it and what is it used for?
2. Start demonstration with the light sticks. This might be better in a darker classroom.
3. Before turning out the lights, show the students a whole unbroken light stick. Give explanation of why it glows. Break one light stick and turn out the lights. Put it in the hot water and ask the students what is happening? Is there a difference from before? Put the light stick in cold water. Is there a difference now? Which one was brighter? Which one was dimmer?
4. Now that the students have seen radiant energy, tell them chemical reactions can produce electricity.
5. Divide the students into groups and assign each one a station. Pass out the lab sheets and student worksheets (if desired, examples below).
6. Students do the activity. When they are finished discuss with them their conclusions. What was the best combination in the apple to get the most electricity?

### Assessment:

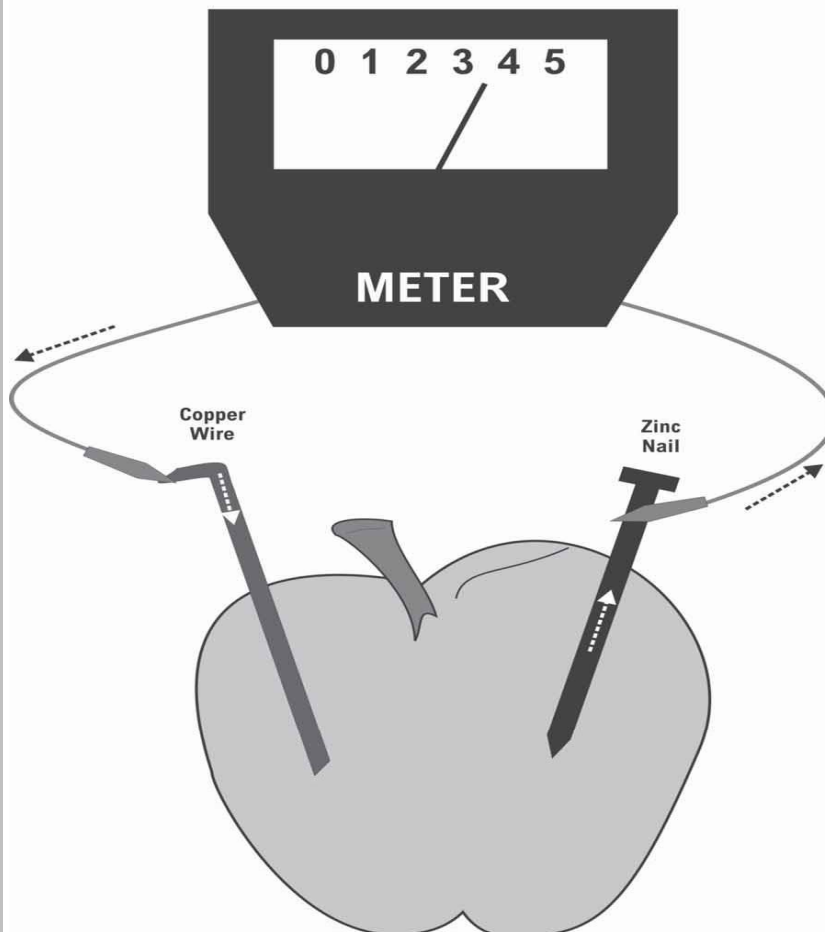
Completion of worksheets  
Participation in discussion

### Additional Content:

#### PROCEDURE - PART TWO: APPLE BATTERY: CHEMICAL TO ELECTRICAL

- Insert the large zinc nail and thick copper wire into the apple about 1 cm. Attach one clip to the copper wire and the red (+) terminal of the meter. Attach the other clip to the zinc nail and the black (-) terminal. Point out the needle on the meter shows current.
- Push the nail and wire 4 cm into the apple and point out the meter reading.
- Pull the copper wire out part way, then reverse the arrangement, observing the meter.
- Push the nail and wire into the apple so that the ends are touching. Point out that there is no current and explain a short circuit.
- Insert the thin copper wire and compare the meter readings of the two copper wires.
- Attach the two copper wires to the meter and explain why there is no current.
- Insert the tin wire into the apple, along with the copper and zinc, making sure none of the ends touch. Explore the different combinations of metals and explain.

### APPLE BATTERY





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### STATION FIVE WORKSHEET

HYPOTHESIS: How is a lightstick affected by thermal energy?

PROCEDURE: Activate the lightstick, heat and cool it, and observe.

OBSERVATIONS:

HYPOTHESIS: What variables affect the ability of an apple battery to produce electricity?

PROCEDURE: Place several different metals in an apple and connect them in a circuit in different configurations to a meter that measures electric current. Observe.

OBSERVATIONS:

QUESTIONS: Define electrical energy: \_\_\_\_\_

\_\_\_\_\_

A lightstick converts \_\_\_\_\_ to \_\_\_\_\_.

How does heat affect the chemical reaction in a lightstick?

\_\_\_\_\_

What variables affected the amount of electrical current produced by the apple battery? \_\_\_\_\_

\_\_\_\_\_

No current was produced by the apple battery under what circumstances?

\_\_\_\_\_

REFLECTIONS ON CHEMICAL ENERGY:

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### References:

Lesson taken from The Need Project's 2008 Science of Energy <http://www.need.org/>

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