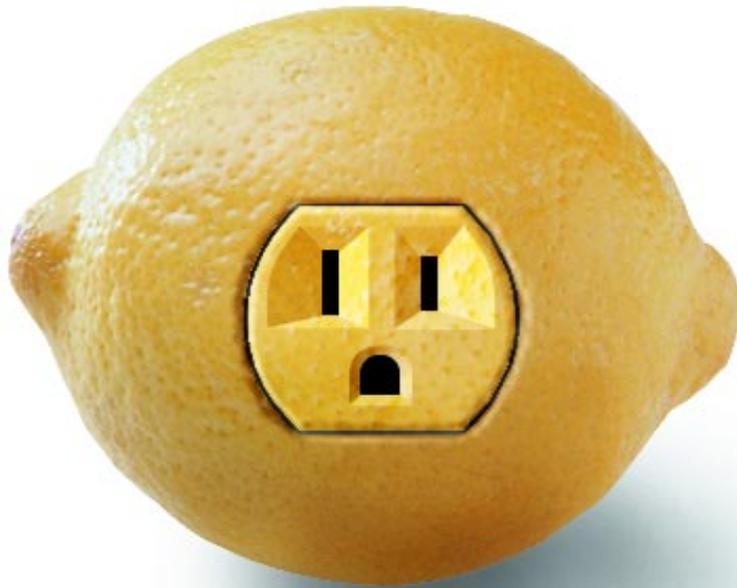


FRUIT “JUICE”



GRADES 3 - 5

FRUIT “JUICE”

SNC - Plant Farley LESSON PLAN

Lesson Title: Fruit “juice”

Lesson Description: Students will apply concepts relating to electrochemistry by constructing a fruit-powered battery. The exercise is designed to compliment/reinforce discussion of concepts regarding electricity and chemistry (e.g., ions, electrolytes, voltage, batteries, etc.).

Grade Level: 6-8 (modify as needed for each grade level)

Subject Area(s): Physical Science

Objectives: Students will:

- construct a battery powered by a citrus fruit.
- observe and measure electrical voltage.
- compare voltage production with different types of fruit.
- analyze and discuss observations and data with other students.
- relate findings to principles of electrochemistry.

Materials:

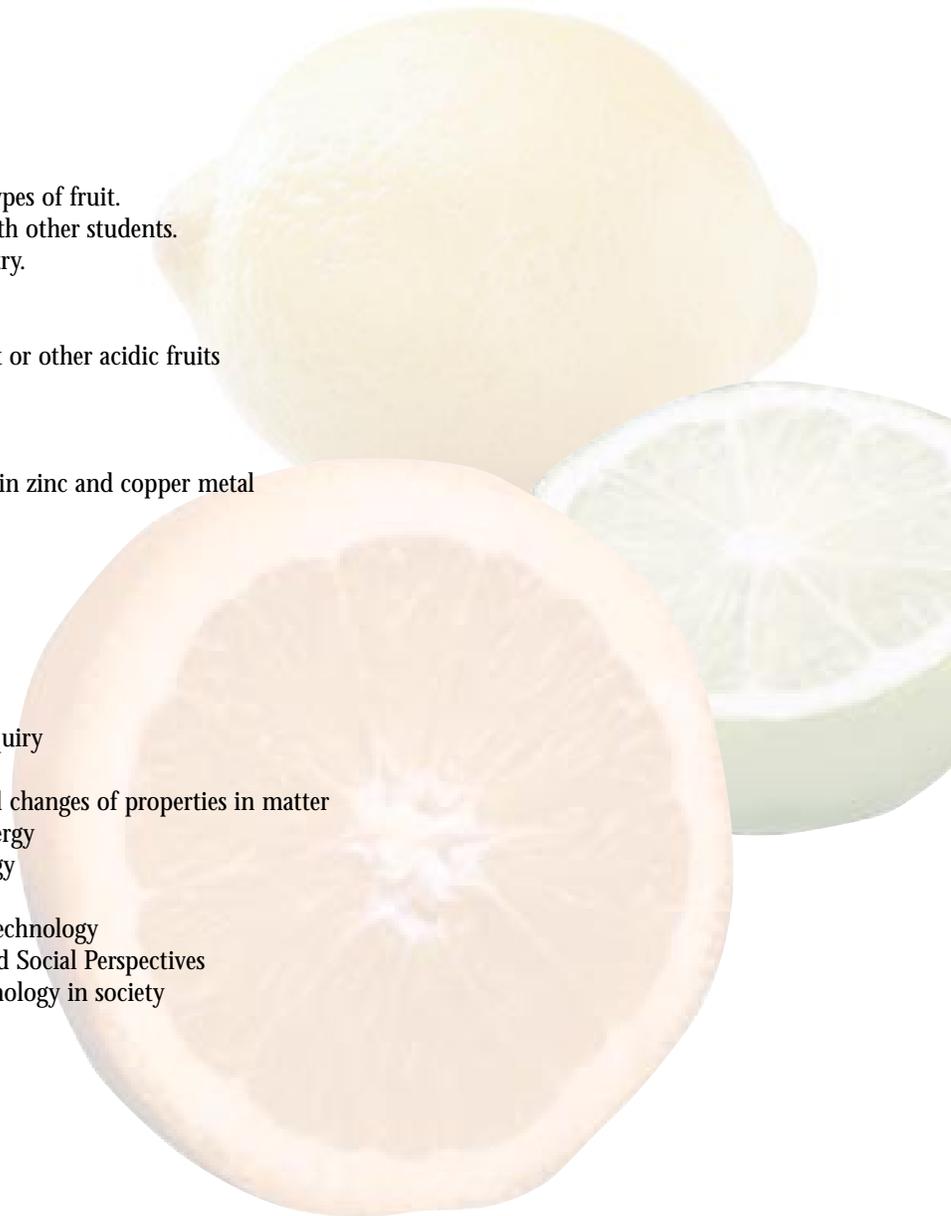
- lemons, limes, oranges, tangerines, grapefruit or other acidic fruits
- alligator clips
- balance or scale
- voltmeters with leads
- small strips (about 3/4 inch x 2 inches) of thin zinc and copper metal
- pencils
- stopwatches (or watches with second hands)
- activity sheets

Correlations (NSES):

- Content Standard A - Science as Inquiry
 - develop abilities to do scientific inquiry
 - develop understandings about scientific inquiry
- Content Standard B - Physical Science
 - develop an understanding of properties and changes of properties in matter
 - develop an understanding of transfer of energy
- Content Standard E - Science and Technology
 - develop abilities in technological design
 - develop understanding about science and technology
- Content Standard F - Science in Personal and Social Perspectives
 - develop understanding of science and technology in society

Curriculum Integration:

- Mathematics (measurements)
- Vocational Education (electricity)



Process Skills:

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

Background Information:

- Main ideas
 - Principles related to electrochemistry such as:
 - the flow of electrons through a conductor is electric current
 - resistance is a measure of how difficult it is for electrons to flow through a conductor
 - electricity flows through ionized solutions called electrolytes
 - uses/operation of a voltmeter
 - additional principles such as voltage, amperes, Ohm's Law, etc. may be discussed if so desired
 - the current produced in this "battery" is the flow electrons through the acidic lemon juice from the Zn to Cu strip
 - Principles related to thermal energy such as friction and heat, kinetic energy, and thermodynamics
- Secondary ideas
 - Energy consumption/production methods

Teacher Activities:

- Assemble/organize all materials needed for activity.
- Check voltmeters to make certain they are working properly and have leads without electrical shorts.
- If you don't have voltmeters you can modify the exercise to power a small LCD clock or thermometer instead.
- Present background material to students.
- Issue instructions on how to use a voltmeter for this exercise.
- Depending on the size of the class, the teacher may wish to divide the class into groups or 2-4 students. Each student in the group should have a specific task in the exercise. For example, one student should be responsible for recording data, another using stopwatch to monitor time, another actually reading voltmeter, etc.
- Issue instructions to students regarding experiment.
- Distribute Activity Sheets to students and give instructions on how to complete them.
- Stress lab safety (hot water bath, etc.)
- Monitor/assist students as needed during exercises.
- After students complete exercises and assemble back into a group, allow students to show their work and describe their observations.
- After students have shared their work, engage students in post-activity discussion. Stress main points of lesson during discussion.

Student Activities:

- Listen to background information given by teacher.
- Obtain all materials needed to complete the exercise (refer to Activity Sheet).
- Record preliminary data on Activity Sheets.
- Construct fruit batteries as directed in Activity Sheets.
- Observe results and record data.
- Interpret/analyze data and share it with other students.
- Participate in post-activity discussion.

Evaluation:

- Activity sheets
- Direct observation
- Oral reports from students

Extension/Enrichment:

- Have students utilize different power sources - almost any fruit or vegetable can be used.
- Measure pH of power source fluids and plot pH against voltages produced.
- Construct other types of batteries such as a wet cell or Volta pile.
- Use various electrolyte solutions rather than a fruit or vegetable to supply the voltage.
- Complete an exercise in galvanic deposition or electroplating.
- Vary wire composition and note differences in voltage production.
- Arrange a field trip to a power production facility to see how electricity is produced commercially.

Safety Considerations:

- Caution students not to place metal strips in their mouths.
- Caution students to handle equipment (voltmeters) with care to prevent breakage.
- Exercise caution with the hot water bath; do not use excessively hot water and warn students about the danger of burns.

FRUIT "JUICE"

ACTIVITY SHEET ONE

(READ THIS ENTIRE SHEET BEFORE BEGINNING THE EXERCISE)

Introduction

In this lab activity, you will measure a weak electrical current produced by a common fruit such as a lemon or orange. It is amazing that fruit can generate "Juice" (electric current), but it is true as you will prove in this exercise. Not all lab groups will be using the same fruit. This means that not all groups will have the same results in the experiment. The exercise will require close observation and measurement of temperature and voltage changes over time.

Hopefully, you will be able to see some basic principles of electrochemistry as discussed prior to the laboratory exercise. Follow the directions on this Activity Sheet and record your data carefully and accurately, as you will be called upon to relay your findings to the rest of the class after the lab is completed.

Procedure

Obtain the following materials as directed by your instructor:

- 1 small strip of zinc (Zn) metal
- 1 small strip of copper (Cu) metal
- Thermometer - BE CAREFUL!!!
- A piece of fruit (e.g., lemon, orange, lime, etc.)
- 2 alligator clamps
- Stopwatch (or watch with second hand)
- Voltmeter with leads
- Pencil

Answer the first three questions on Activity Sheet 2. Then proceed as directed below.

- Attach the alligator clips to the leads of the voltmeter.
- Roll your fruit firmly on the lab tabletop to break up some of the tissue inside and create more juice.
- Check the settings on your voltmeter and insert the leads. Check with your teacher if you have questions or are not sure about settings.
- Measure the mass (or weight) of your piece of fruit on the scales and record the data on Activity Sheet Two.
- Insert the two metal strips (one Cu and the other Zn) into the center of your piece of fruit to a depth of about 1 to 1-1/2 inches. The strips should be about 1 inch apart - be careful that the strips do not touch. The two metal strips act as electrodes for your battery. Study Figure 1 to see what your fruit battery should resemble.
- Have one of your lab partners be ready to begin timing with the stopwatch. He/she will start timing the instant you connect the leads to the electrodes.
- Connect the alligator clamps to the two leads. Begin timing, and record the voltage being produced.
- Record all data obtained thus far on Activity Sheet 2.
- Analyze your data and answer the questions on Activity Sheet 2.

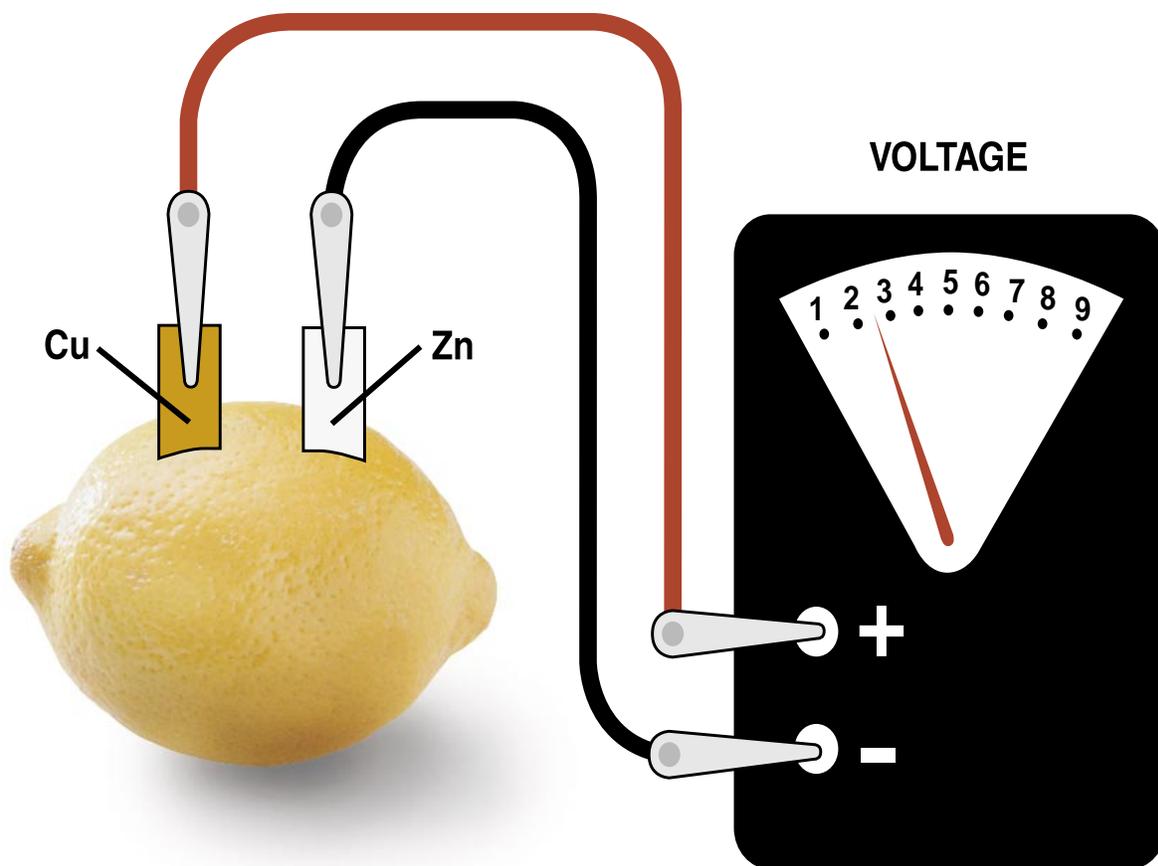


Figure 1

FRUIT “JUICE”

ACTIVITY SHEET TWO

1. Do you think your fruit will produce electric current? If so, how much?
2. Which fruit do you think will produce the highest amount of voltage?
Why?
3. How long do you think your fruit will produce measurable current?
4. Record the type and mass (weight) of your fruit.
Type of fruit:

Mass of fruit:
5. Record the length of time the fruit battery produced current. (Get this data from stopwatch).
6. How much voltage did your fruit produce?

Compare your results with those of others in the class and answer the following questions:

7. What fruit produced the greatest amount of voltage?

8. What fruit produced current for the longest amount of time?

9. Which fruit had the greatest mass (weight)? Is there a correlation between mass, voltage, and length of voltage production? If so, state that correlation.

10. Do you think other fruits or vegetables could produce voltage?
Why or why not?