DETERMINING METALS AND NON-METALS FROM THE PERIODIC TABLE *(MODIFIED FOR ADEED)*

INSTRUCTIONS

Science Concept:

Properties of elements can be determined by their position on the periodic table of elements. Position of elements on the periodic table of elements can also be used to identify elements as metals or non-metals.

Objectives:

The student will:

- perform an experiment to test the structure and properties of an element;
- work as a member of a team;
- observe classroom safety protocols; and
- write a lab report.
- write a lab report.

GLEs Addressed:

Science

[10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

[11] SB1.1 The student demonstrates an understanding of the structure and properties of matter by predicting the properties of an element (i.e., reactivity, metal, non-metal) using the periodic table and verifying the predictions through experimentation.

[10] W4.2.4 The student writes for a variety of purposes and audiences by using research-based information and/or analysis in research projects or extended reports.

Vocabulary:

metal – Any element that usually has a shiny surface (luster), is generally a good conductor of heat and electricity, and can be hammered into thin sheets (malleable), or drawn into wires (ductile). Metals also tend to be solid (not an absolute) in natural form.

nonmetal – An element that lacks the physical and chemical properties of metals. That is, the element is not shiny, not a good conductor, and is not malleable or ductile. Nonmetals tend to be good insulators of heat and electricity; they tend to fracture easily if they are in a solid form; and they come in any phase form (solid, liquid, and gas) at room temperature.

luster – Shiny; has sheen because the object is reflecting light.

conductor – A substance or medium that conducts (serves as a medium for conveying) or transmits heat, light, sound, or an electric charge.

insulator – A material that insulates to prevent the passage of heat, electricity, or sound.

malleable – Capable of being shaped or formed into a thin layer by hammering or pressure.

ductile – Easily drawn into wire by pulling or stretching.

fracture – A break (usually uneven) in a substance.

metalloid – A nonmetallic element, such as arsenic, that has some of the chemical properties of a metal.

semi-conductor – Any of various solid crystalline substances that have and electrical conductivity greater than insulators but less than good conductors.

NOTE: These vocabulary words are for teacher use only.

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INSTRUCTIONS

Materials:

- Chart paper
- Index cards (one per student)
- Wagons (one per group)
- 30 pounds of flour or other material in 10-pound increments (one per group)
- Plastic garbage bags, ropes, bungee cords, other lengths of material for moving flour bags
- Thick dowels to act as rollers
- Ramps
- Vagin, V. (1998). The Enormous Carrot. New York, NY: Scholastic Press.
- Butzow, C. M., and Butzow, J. W. (2000). Science through children's literature: An Integrated Approach. 2nd ed. Englewood, CO: Teacher Ideas Press.
- TEACHER INFORMATION SHEET: "Open Circuit"
- STUDENT INFORMATION SHEET: "Periodic Table"
- STUDENT WORKSHEET: "Push Me Pull You Storyboard"
- STUDENT WORKSHEET: "Move the Bags"
- STUDENT WORKSHEET: "Move the Panda"

Activity Procedure:

Gear Up

Process Skills: communicating, observing, describing and classifying

1. Put on safety gear (apron and goggles) to demonstrate proper usage. (Sodium metal is very dangerous. Read all precautions before handling. Mercury is very poisonous. Read all precautions before handling.)
2. Ask students what they know about elements.
3. Choose one or more of the following elements and demonstrate the element's properties:
   a. Aluminum: Show how aluminum foil can be folded, crushed, re-shaped into a sheet and all the wrinkles can be removed (unlike paper).
   b. Sodium: The teacher should then cut the sodium in half with a knife while it is in the jar. If sodium metal is not available demonstrate how metals are ductile (can be drawn into a wire). Copper wire is a good choice.
   c. Mercury: Show how the mercury moves around in the container.
   d. Lead: Show how the thin lead pipe bends easily.
4. Ask students what they observed. Instruct them to write their observations and any knowledge they have of metals and nonmetals.

Explore

Process Skills: observing, classifying, communicating, predicting, and inferring

5. Divide the class into small groups (two to four students per group).
6. Distribute five metals to each group (make sure they are clearly labeled). Elements should be the same for each group and should not be the same as those that were observed in the gear up section.
7. Explain that each group will perform an investigation and collect observations for the group of elements that they have been given.
8. If any of the elements have safety precautions (i.e., students cannot remove the element from the container because it is toxic or students need to wash their hands after they touch it), instruct students to list the safety precautions in their journals.
9. Instruct students to write the element name and/or symbol and describe the characteristics of each element in their journal.
10. Suggest the use of an open circuit to test the conductivity of each element. Demonstrate how an open circuit is used (see TEACHER INFORMATION SHEET: "Open Circuit").

11. Demonstrate the use of a hammer on an element to test malleability. Make a hammer available for student testing. Remind students not to use hammers on elements inside containers, or on other objects.

Experiment (two interrelated parts)

Process Skills: observing, classifying, communicating, measuring, predicting, inferring, identifying variables, manipulating variables, experimenting, and hypothesizing

12. Explain that each group should devise a way to test their elements to see if they are metals are nonmetals and to see how all of the metals (including the ones they have already observed) and nonmetals relate to one another on the periodic chart.
13. Students should develop and record the following:
    a. The experiment objective (what their job is as a scientist).
    b. An if/then hypothesis that completes at least the first part of the objective of the lab.
    c. A method of data collection: what variables (if any) are they going to test or control, a procedure for testing the variables and/or hypothesis, how are they collecting data, how are they recording data, etc.
    d. A list of safety issues with the elements being studied.
    e. Any data collected and observations made.
    f. Any mistakes or errors in the hypothesis. If any are noted, groups should devise a new experiment and try again.

Interpret

Process Skills: classifying, communicating, predicting, inferring, interpreting data, defining, and drawing conclusions

14. Help groups do the following:
    a. Determine if results nullified their hypothesis (or hypotheses if more than one) and explain why.
    b. Explain what some of the problems were for this type of lab (i.e., safety issues make it hard to do conductivity tests).
    c. Compare their predictions (metal or nonmetal for the various elements) with actual identification of the elements.
    d. Explain why predictions may not match results.
    e. Determine other ways to test each element to find out if it is a metal or nonmetal.
15. Plot all of the information on a periodic table. For instance, groups may want to circle the metals (including the ones used in the previous sections of the lesson) and draw an X through the nonmetals.
16. Determine if there is a trend to the data and compare it to the real stair step trend in the periodic table of elements.
17. List five or six other metallic elements not used during this lab. This is to verify that students understand the periodic trend.

Apply/Assess

Process Skills: communicating

18. Ask students to individually complete a formal lab report. This report should include all of the data in the experiment and interpret sections above. The report should also be typed (if possible), checked for spelling and grammar errors, and organized as neatly as possible.

Extension Idea

Process Skills: classifying, communicating, predicting, inferring, interpreting data, and drawing conclusions

Talk about metalloids and semiconductors. Ask how the characteristics of metals and nonmetals determine their use.

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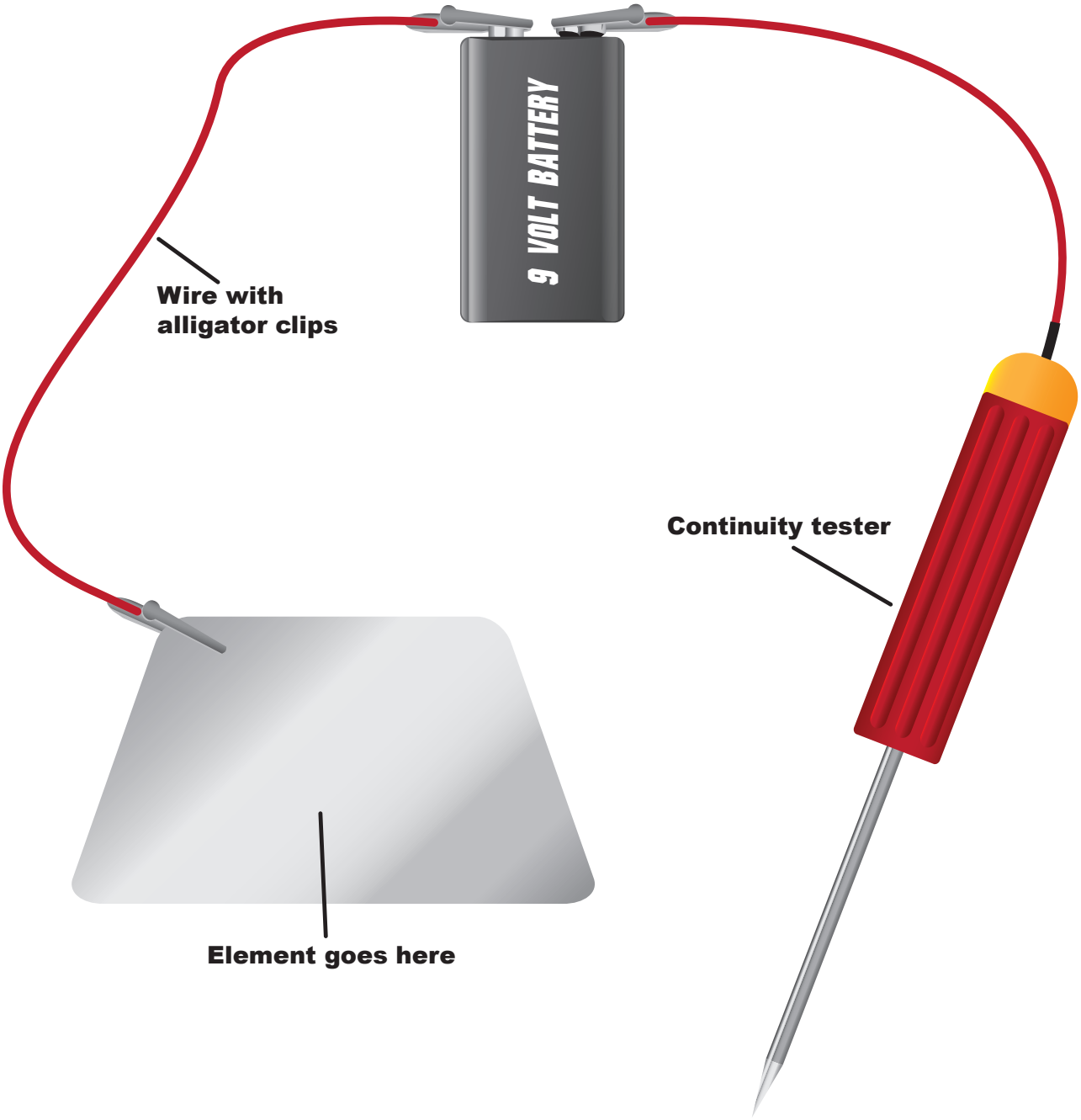
Extension Idea(s):

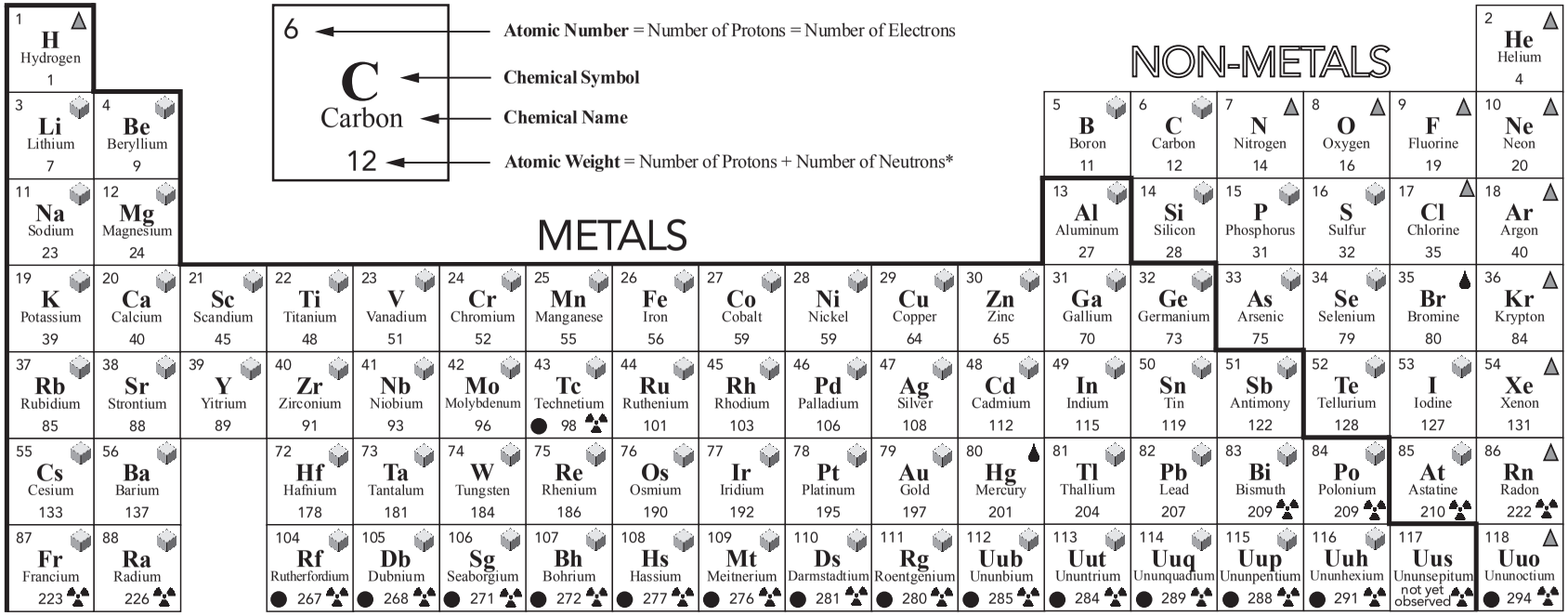
1. Read *The Enormous Carrot* to the class and discuss.
2. Conduct various kinds of tug-of-war contests with varying weights/team sides.

Assessment Task:

On STUDENT WORKSHEET: "Push Me Pull You Storyboard," write at least two simple questions you have about


9 VOLT BATTERY
Wire with alligator clips
Continuity tester
Element goes here

The Periodic Table of Elements



KEY

- = **Solid** at room temperature
- = **Liquid** at room temperature
- = **Gas** at room temperature
- = **Radioactive**
- = **Artificially Made**

*The atomic weights listed on this Table of Elements have been rounded to the nearest whole number. As a result, this chart actually displays the mass number of a specific isotope for each element. An element's complete, unrounded atomic weight can be found on the It's Elemental web site: http://education/jlab.org/itselemental/index.html

Modified from: http://education.jlab.org.

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RUBRIC

Objective	GLE	Emergent	Developing	Proficient	Advanced
The student writes a lab report.	[10] W4.2.4	The lab report is not double-spaced, has poor grammar and/ or spelling, and lacks a format or logical organization.	The lab report is double-spaced, has acceptable grammar and/or spelling, but lacks format or logical organization.	The lab report is double space, has acceptable grammar and/or spelling, and is formatted with a logical organization, but not all three.	The lab report is double space, has acceptable grammar and/or spelling, and is formatted with a logical organization.
The student participates as a team member and complies with all classroom safety protocols.	[10-11] SA1.1	The student does not observe safety protocols and does not work as a team member.	The student observes safety protocols, but does not work as a team member.	The student observes safety protocols, and sometimes works as a team member.	The student observes safety protocols and always works as a team member.
The student performs an experiment to test the structure and properties of an element.	[10] SB1.1	The student does not perform the experiment.	The student performs the experiment, but does not collect data accurately.	The student follows the experiment and collects data accurately.	The student performs the experiment, collects data accurately, and suggests other ways the experiment could have been performed.