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

# **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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# **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").

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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.

# INSTRUCTIONS

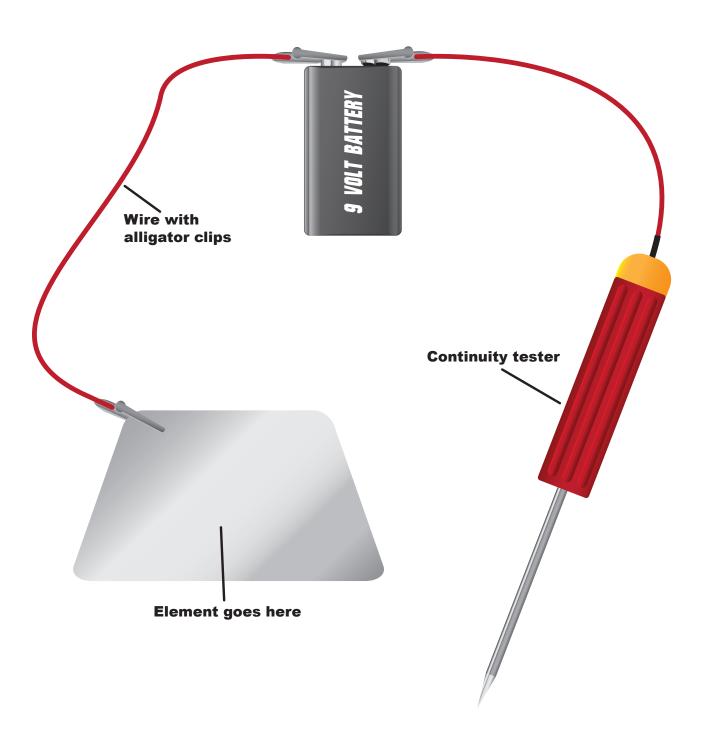
# DETERMINING METALS AND NON-METALS FROM THE PERIODIC TABLE

# **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



Lu Lutetium

# The Periodic Table of Elements

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	9 F Fluorine 19	17 CI Chlorine 35	35 Br Bromine 80	53 L I lodine 127	85 At At Astatine 210 🕏	Unusepitum
MIS	8 <b>O</b> 9 Oxygen Fi	16 S Sulfur 32	<b>→</b>	52 <b>Te</b> Tellurium Ic	4 Po Polonium 209	Uuh Ununhexium Ununsepitum not yet in observed
NON-METALS	Nitrogen Ox	P sphorus	AS rsenic 75	Sb imony 122	3i muth 09	113
	Carbon 12	Si ilicon 28	renium 73	<b>"</b> H H 19	• <b>b</b> • o7	114 (C) 110 (C
Z	B 6 6 711	13 (14 Al Al Aluminum S 27	<b>3a</b> € 1	Findium 115	TI 82 Thallium L 204 2	Uut Ununtrium Ununtrium Unungt
	5 B	13 Alu	31 B		00	
			30 <b>Zn</b> er Zinc 65	48 Cd Cadmium 112	Hg Mercury 201	112
f Electrons	Neutrons*			Ag Silver 108	Au Gold 197	Rg Roentgenium
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	4 Be Beryllium	12 W Magnesium 24	Calcium Calcium	38 Sr Strontium 88	56 Ba Barium 137	88 <b>Ra</b> Radium 226 <b>*</b>
Hydrogen 1	Lithium	Na Sodium 23	19 K Potassium 39	37 <b>Rb</b> Rubidium 85	CS Cesium 133	Francium 223

70 Yb	Yiterbiun 173		102 No	m Nobelium
69 Tm	Thilium 169		101 <b>Md</b>	Mendeleviu 258
$H_0$ 68 $\oplus$ 69 $\oplus$ 70	Erbium 167		100 Fm	Fermium 257
♥ 67 W	Holmium 165		99 <b>ES</b>	Einsteinium  252
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63 Eu	Europium 152		Pu Am Cm	Americium 243
62 Sm	Samarium 150		94 Pu	Plutonium 244
61 Pm	Promethium 145		% Np €%	Neptunium 237
r 60 61 62 62 FM 82 82	Neodymium 144		<b>→</b> Ω	Uranium 238
	Praseodymium 141		91 😝 92	horium Protactinium 232 22
58 Ce 59	Cerium 1		⇒ Th	Thorium 232
57 <b>Ca</b>	Lanthanum 139		89 Ac	Actinium 227
KEY	Solid at room temperature	qua at 100m temperature	= Gas at 100m temperature	= 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.

# **DETERMINING METALS AND NON-METALS FROM THE PERIODIC TABLE**

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