# Bay Area Scientists in Schools Lesson Plan

(Formerly Community in the Classroom)

**Lesson Name** Properties of Metals

**Presenter(s)** Melanie Chiu, Andy Tsai, Peter Marsden , Van

**Grade Level** 5

**Standards Connection(s):**

- Separate mixtures and identify compounds using their chemical and physical properties
- Properties of common molecules
- Common properties of salts (NaCl)
- All matter is made of atoms

**Abstract:** *Your opportunity to tell teachers and kids what's going to be fun and interesting about your visit!*

- We will learn about many of the common properties of metals. We will then use those properties to identify metals and separate them from other stuff.

**Vocabulary/Definitions:** *3 – 6 important (new) words*

- Periodic table: A chart that displays and organizes all elements that makes up our world.
- Metals: One of the two major categories of the periodic table. They are characterized by the ability to readily form ions and conduct electricity.
- Conductivity: The ability to transfer electricity or heat.
- Alloy: A mixture of different metals. They often have properties that are different from any of the metals they are made of.
- Magnetism: A property that some materials possess that allows it to attract or repel other materials.

**Materials:**

*What you'll bring with you*
*What students should have ready (pencils, paper, scissors)*

- We will bring:
  - All equipment needed for the 4 demo stations and the group demonstration.
- We will need:
  - 5 large tables (~4'x3' or larger!) to set up the demos on (4 demos and 1 group demonstration). Have four tables spread out evenly around the perimeter of the room with the fifth table set up centrally in the room.
  - Each student should have a pencil

**Classroom Set-up:** *Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed*

We will need to split up the class into four groups. Each group will have 7 minutes at each of the 4 demo stations. The groups will rotate at the end of 7 minutes. There will be a final demonstration to the whole class.

# Classroom Visit

**1. Personal Introduction:** ____2_____ **Minutes**

*Who are you? What do you want to share with students and why? How will you connect this with students' interests?*

- We are graduate students in chemistry from the University of California - Berkeley. [Each of us introduces ourselves]. We will be talking about metals. Though you use metals everyday in your life, there are many interesting things about them that you may not be aware of. For example, what makes a metal a metal? What properties do metals have in common and what properties make each of those metals different from each other? We will learn some of the answers to those questions and more!

**Topic Introduction:** _____10____ **Minutes**

*Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?*

- Ask the class to lists some metals they use very day.
- Touch on the fact that all matter is made of only just a little over 100 elements. Perhaps relate to how all words are made from just 26 letters.
- Explain how the periodic table (like the alphabet) lists and organizes these elements.
- Explain the two (technically three) basic categories of the periodic table (i.e. metals and non-metals). Perhaps relate back on how the alphabet is split into consonants and vowels.
- Explain what we will be doing and learning today (i.e. modules and how they will help us identify properties of metals. Then how we will use those properties to identify metals from non-metals).
- Each student will have a "lab notebook" where they will write down their observations. Each module will have a corresponding page in the lab notebook that will ask the student pertinent questions pertaining to that module.
- Give a quick overview of modules
    - Module A: Magnetism and Breakfast Cereal – You can separate iron in cereal from other metals and non-metals
    - Module B: Conductivity of Metals – Metals conduct electricity
    - Module C: Alloys – Some metals are made from a combinations of other metals. These mixtures are called alloys.
    - Module D: Metal Plating – You can turn pennies silver and then gold by plating a layer of zinc on them and then heating them under a small flame.
- Explain that each of the four groups will rotate though the four stations. A bell or other signal will indicate when to rotate to the next module.

**2. Learning Experience(s):** _____38____ **Minutes**

*Demonstrations, hands-on activities, images, games, discussion, writing, measuring… What will you do, what will kids do? Describe in order, including instructions to kids.*

I. Module A: Magnetism and Breakfast Cereal (7 min)
    a. <u>Main Idea</u>: Some metals have special properties such as magnetism that we can use to identify some metals (namely iron).
    b. <u>Materials</u>:

a. Container of iron-fortified cereal like “Total”
b. Plastic cup
c. Container of water
d. Small baggies to mix in
e. Small bar magnets.
f. Various metallic and non-metallic objects

c. Activity: In groups of two, the students will put crushed up cereal and water in a ziplock bag. The bag will then be squished and shaken to form a thin paste. The paste will be transferred to a beaker (or clear plastic cup) and a magnet will be held against the wall. The cereal will be gently stirred. Iron fillings will be localized around the magnet. To show that not all metals are magnetic, the students will also try to use the magnet to pick up various metals and non-metals (Copper, iron, plastic, etc0

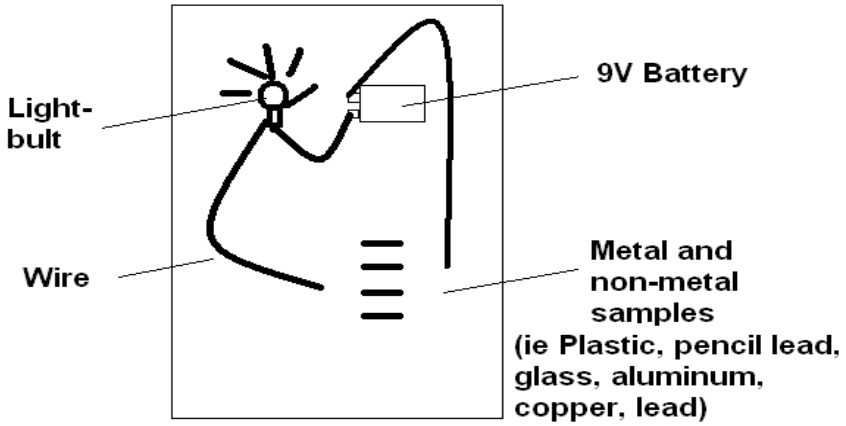
d. Conclusion: Iron is attracted to magnets and we can use that property to separate that metal from other metals and non-metals in the cereal.

II. Module B: Conductivity of Metals (7 min)

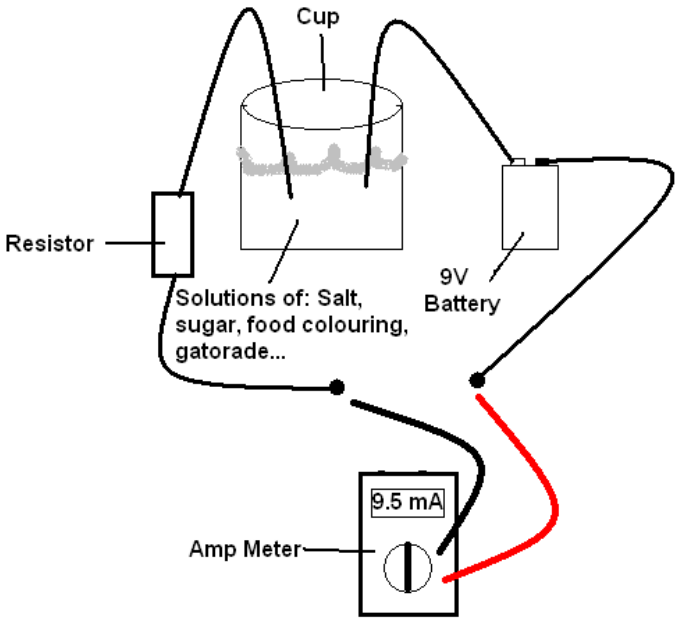
a. Main Idea: A large majority of metals conduct electricity. Sometimes, you can tell if the thing you are dissolving has a metal in it if the solution can conduct electricity.

b. Materials (part 1):

A setup like below:




c. Materials (part 2):
a. Plastic cups
b. Distilled water
c. Sugar
d. Salt
e. Gatorade
f. Food coloring
g. Amp meter




d. Activity: The students play with how different materials (copper wire, iron rod, graphite, glass, plastic) conduct

electricity (part 1). Then (part 2) they dissolve sugar, salt, food coloring, and Gatorade into pure water. Then test if the solution conducts electricity using an amp meter.

e. Conclusion: Most metals conduct electricity but not everything that conducts electricity are necessarily metals (i.e. pencil lead is not a metal but it still conducts electricity!). Some metals dissolve in water. When they do (this may be hard to explain), these metal atoms are able to pass electrons to each other and thus conduct electricity.

III. Module C: Alloys (7 min)

a. Main Idea: Many metals we use in everyday life are actually made of combination of metals. These mixtures of metals are called alloys. Alloys are often used get new properties that are desirable but not found in the pure metals themselves (i.e. stainless steel won't rust). Bronze is stronger than either of its component parts (tin and copper).

b. Materials:

   a. Two decks of cards:
      i. Blue deck (alloy cards)
      ii. Red deck (element cards)
   b. The yellow deck consists of 8 "alloy" cards. These cards list an alloy and its two main elemental constituents.
   c. The blue deck consists of 16 element cards (i.e. each of the two elements from the 12 alloys listed in the blue deck).

| | | |
|---|---|---|
| **Steel** = Iron + Chromium | **Cast Iron** = Iron + Carbon | **Brass** = Zinc + Copper |
| **Bronze** = Copper + Tin | **Sterling Silver** = Copper + Silver | **White Gold** = Silver + Gold |
| **Solder** = Lead + Tin | **Pewter** = Copper + Lead | |

**Yellow Deck**

| | | | | |
|---|---|---|---|---|
| Lead | Copper | Copper | Copper | Silver |
| Tin | Lead | Tin | Silver | Gold |

| | | |
|---|---|---|
| Iron | Iron | Zinc |
| Chromium | Carbon | Copper |

**Blue Deck**

c. Activity: All 16 cards in the blue deck are placed face down while 3 yellow cards are placed faced up. In groups of ~4, each student takes turns flipping over two blue cards. The goal is to try to get two blue cards that match the elements listed on any of the 3 alloy cards. When there is a match, that student gets a point, takes the 3 cards, and a new yellow card replaces the one that was won.
d. Conclusion: There are many, many types of alloys and many of them are around you.

IV. Module D: Metal Plating (7 min)
a. Main Idea: Pennies are composed of 98% Zinc and are covered with a thin layer of Copper. The process of covering the penny in copper is sometimes referred to as "plating". Though plating can be carried out in a variety of ways, one of those ways is to heat a mixture of water, lye (a.k.a. Sodium Hydroxide), and a metal (i.e. Copper), which will cause a thin layer of that metal to coat the metal object in that mixture (i.e. the Zinc penny)
b. Materials:

a. Zinc dust
b. Lye (a.k.a. Sodium hydroxide)
c. A glass beaker
d. Pennies
e. A hand-held torch

c. Activity: Plate pennies in Zinc. This is done by heating a mixture of Zinc and sodium hydroxide in water along with a few pennies, which then turn silver (they look like dimes now!). This layer of Zinc can then react with oxygen and turn gold by holding the silver pennies in the flame of a hand-held torch for a few seconds.
d. Conclusions: You can completely change the appearance of objects simply by coating them in a thin layer of a metal.

V. Final dramatic conclusion: (14 min)
a. Main Idea: Some metals are reactive meaning that they undergo chemical changes under certain circumstances. For example, many types of fireworks will ignite (or catch on fire) when it gets hot enough. This is why fireworks are so bright.
b. Activity: Burn a small strip of magnesium (responsible for the "white" in fireworks). Make sure the room is brightly lit. We will also spray solutions of various salts into a flame. The metal ions in the salts will glow all colors of the rainbow in the flame.
c. Conclusions: Metals can do more than fry an egg. Some metals can react and do cool stuff under the right circumstances.

**3. Wrap-up: Sharing Experiences and Building Connections _____8_____ Minutes**

*Putting the pieces together – how will students share learning, interpret experience, build vocabulary?*

- Review each module and summarize what we learned.
- Review what are some properties of metals

**4. Close: _____2_____ Minutes**

*How can kids learn more? Thanks and good-bye! Clean-up.*\

- To learn more about metals visit: http://www.chem4kids.com/files/elem_metal.html
- To learn more about chemistry visit: http://library.thinkquest.org/J001539/

(All links are included in the lab notebook)

**TOTAL _60_____ Minutes**

# Follow-up – After Presentation

Which was your favorite station and why? What did you learn? Was there anything you were unclear of about the station?

Periodic Table of Videos: **http://www.periodicvideos.com/**

## Reading Connections:

**Metals (Material Matters)** by Carol Baldwin This book tells you everything you need to know about the huge group of materials known as metals. There are loads of photos and facts to help you fully understand the topic and find answers quickly. You don't have to be a professor to understand this science book!

**Metals (Chemicals in Action) 2nd Edition** by Chris Oxlade. What makes a metal a metal? How are metals used at home and in industry? What processes are used to get metals from the Earth? This title explores what metals are like, how they are mixed with each other to form alloys, and how they are used to make everything from paper clips to skyscrapers. You will also find several experiments that can be done at home.