

Outreach Pre-lab Preparation

<http://outreach.chem.ucsb.edu>

Grade Level: 5

Standards:

1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept, students know:
 - a. during chemical reactions, the atoms in the reactants rearrange to form products with different properties.
 - b. all matter is made of atoms, which may combine to form molecules.
 - c. metals have properties in common, such as electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), gold (Au), are pure elements while others, such as steel and brass, are composed of a combination of elemental metals.
 - d. each element is made of one kind of atom. These elements are organized in the Periodic Table by their chemical properties.
 - g. properties of solid, liquid, and gaseous substances, such as sugar (C₆H₁₂O₆), water (H₂O) helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).

Objectives:

- Students participate in exciting hands-on standards based activities in the chemistry lab at UCSB
- Students work with university students
- Students see that the university is a place for them
- Inspire and motivate students to work harder in school so they will be prepared to apply and attend a university

Background: Students will learn significantly more if they come to the lab prepared.

Pre-Lab Activities: The 5th grade Lesson Plans for the following activities are posted on our K-12 website: <http://outreach.chem.ucsb.edu>

- Mystery Powders Lesson Plan
- VIDEO and VIDEO QUIZZES: All about Properties of Matter, Physical Science for Children: Schlessinger Science Library <http://www.libraryvideo.com/ssl/default.asp>
- Introduction to Density Activities Lesson Plans
- Eco-Peanuts Lesson Plan
- Introduction to Chemical Reactions (Lesson Plans posted are adapted from the Teachers guide to Chemical Reactions (GEMS))

Program Director: Petra van Koppen Ph.D. Email: vankoppen@chem.ucsb.edu

Background Concepts:

ACTIVITY TO INTRODUCE THE PERIODIC TABLE: Link between creating materials from elements and words from alphabet letters: Greeks also thought that there were four basic elements, earth, wind, fire and water. We now know that matter is composed of over a hundred different elements. You could have students do the following exercise. Give them the following letters and ask them to make as many words as they can for 3 to 5 minutes.

A S T E R O H I C W

Ask students if they had more time, how many words could they make with all 26 letters. Then introduce the periodic table and tell them that scientists use these elements to make new materials. Even, we ourselves are made up of these elements. There are rules on how to combine elements to make materials just like there are rules to make words from the alphabet.

PERIODIC TALE BINGO: To review elements in the periodic table, play the bingo game posted on our website. **VIDEO AND QUIZ:** Show the Bill Nye Video called Atoms. The quiz is posted on our website.

Air - a mixture of gases: It helps for the students in your class to know what is in the air: the different types of gases, primarily N_2 , O_2 , CO_2 , and H_2O . What vital gas do we breathe in and what waste gas do we breathe out? They need to know that there are different types of gases, liquids, and solids.

Densities of gases: You can bring in a balloon filled with Helium gas and ask students why the balloon rises. If you blow up a balloon with air, why doesn't it rise? Using the periodic table students compare the mass of Helium to the mass of molecules in the air: N_2 , O_2 , CO_2 , H_2O .

Molecular Motion: You can also ask why a balloon pops when you blow up a balloon to it full extent and put it out in the sun. What are the molecules doing inside the balloon? You can talk about how the molecules move at high speeds at room temperature, about **1000 miles per hour!** The molecules collide with the inside walls of the balloon, creating pressure. When the balloon is placed out in the sun, the increase in temperature will increase the speed of the molecules inside the balloon, which increases the number of collisions of the gas particles with the inside wall of the balloon and creates more pressure inside the balloon. Too much pressure will cause the balloon to pop.

Historical Connection: Have you discussed how over 2000 years ago the Greeks proposed that all matter is made of something uncuttable, and so small that it was invisible? The Greeks called this uncuttable unit of matter "atomos" or what we call atoms. The Greeks did not do experiments so they never proved atoms existed. We'll do experiments with your students to show atoms and molecules exist.

Alloy: We will also show how the Alchemists tried to change cheap metals into gold. Students will plate zinc metal onto copper pennies and heat the pennies to make brass pennies but they look like gold. Brass is an alloy composed primarily of copper and zinc.

Atomic Structure: If you have time, introduce students to the basic composition of atoms. In the center of every atom there is a nucleus. Inside the nucleus are protons and neutrons. The electrons surround the nucleus. Protons have a +1 charge and electron have a -1 charge. Opposite charges attract. Electrons are attracted to protons. Some atoms would like more electrons and other atoms would like fewer electrons. Atoms combine to make molecules by sharing electrons. I will do a fun demonstration that shows electrons moving within atoms.

Concepts (continued)

- 1) All matter is made of atoms; atoms combine to form molecules.
- 2) Metals may appear to be similar in their appearance, but have different masses and densities. Gases also have different masses and densities.
- 3) Chemical reactions involve the reorganization of atoms – changes in the way they are bound together. The products may have substantially different properties compared to the reactants.



In this reaction, a soft silver metal, sodium, Na(s), reacts with toxic green chlorine gas, Cl₂(g), to make ordinary table salt, sodium chloride, NaCl (s), a white crystalline solid that we use to flavor and preserve food. Sodium metal can be cut with a knife - it is quite soft at room temperature.

Ask your students if they know of another way that we can obtain sodium chloride salt? Can we obtain from NaCl from sea water? How? Evaporation of water will leave the salt behind.

- 4) A metal alloy is a substance that contains a mixture of elements and has metallic properties. Brass is copper mixed with zinc.

Vocabulary

Periodic table: The arrangement of elements in order of increasing atomic number, with elements having similar properties placed in vertical columns.

Element: A pure chemical substance that contains only one kind of atom.

Atom: The smallest particle of a chemical element. An atom is defined by its atomic number; that is, by the number of protons in its nucleus.

Molecule: A group of two or more atoms bound together.

Matter: Anything that occupies space and has mass.

Mass: A measure of the amount of material in an object.

Volume: The amount of space that a sample occupies.

Density: The ratio of an object's mass to its volume.

Substance: A form of matter that has a fixed composition and distinct properties; all substances are either elements or compounds.

Compound: A substance consisting of atoms of two or more elements in a definite ratio.

Chemical reaction: A process in which one or more substances are converted into other substances.

Physical change: Change in matter from one state to another, without forming new substances

Condensation: The formation of a liquid or a solid from a gas.

Resources: **Wikipedia is a great resource** to help us understand concepts, see relevant diagrams, definitions, links to vocabulary, and applications to life, materials and our environment. For example, for a definition of “element” see http://en.wikipedia.org/wiki/Chemical_element When the Wikipedia level is too high, you can **search Google** to access relevant K-12 websites.