STEM Activity

Grade Level: 9th Grade - 12th Grade

Element, Mixture, Compounds?

Homogeneous and heterogeneous mixtures - do you know the difference?

For more information and an instructional video, visit www.teachengineering.org/activities/view/uoh_sep_mixtures_activity1

Materials:

- **Set of bolts, nuts and washers**
- **Plastic dishes**
- **Tape and marker [number the dishes]**
- **Data table (see next page)**

- **Four elements:**
  - **Aluminum (one small sheet of foil)**
  - **Copper (small piece of wire or tubing)**
  - **Iron (filings or a magnet)**
  - **Carbon (a pure carbon pencil or graphite)**

- **Compounds:**
  - **Water, or H2O (-100mL)**
  - **Table salt, or NaCl (-10g)**
  - **Baking soda, or NaHCO3 (-10g)**
  - **Eggshell or a seashell, or CaCO3**

- **Mixture [homogenous and heterogenous]:**
  - **Inflated Ziploc bag (as an example of air)**
  - **Bottle of coke or other soda will work**
  - **Salad dressing (vinaigrette-based works best)**
  - **Salt water**

Introduction:

- **Understand the three types of matter:**
  - **Elements:** All matter is made of elements that are fundamental substances that cannot be broken down by chemical means. An element is a substance that can not be further reduced as to simpler substances by ordinary processes. In essence, an element is a substance consisting of one type of atom.
  - **Compounds:** A compound is a pure substance composed of two or more different atoms chemically bonded to one another. That means that it can not be separated into its constituents by mechanical or physical means and only can be destroyed by chemical means.
  - **Mixtures:** A mixture is a material containing two or more elements or compounds that are in close contact and are mixed in any proportion. For example, air, sea water, crude oil, etc. The constituents of a mixture can be separated by physical means like filtration, evaporation, sublimation and magnetic separation. The constituents of a mixture retain their original set of properties. Further, mixtures can be classified to homogeneous and heterogeneous mixtures. A homogeneous mixture has the same uniform appearance and composition throughout its mass. For example, sugar or salt dissolved in water, alcohol in water, etc. A heterogeneous mixture consists of visibly different substances or phases. The three phases or states of matter are gas, liquid and solid. A heterogeneous mixture does not have a uniform composition throughout its mass.
- **Define pure and impure materials**
- **Give some examples of elements, mixtures, and compounds.**
- **Explain how chemical engineers use these terms when solving problems related to water purification and distillation of crude oil.**
- **Explain what material and mechanical engineers use these terms regarding creating new composite materials.**

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From www.teachengineering.org

INTRODUCTION:

- Prepare nine plastic dishes of bolts, nuts and washers as described below. Place them on a table (called Table A). Indicate the dish numbers in some way, such as with tape and a marker.
- Place the examples of elements, compounds, and mixtures on another table (called Table B) and label them. You may also label the compounds with their specific chemical formula (for example, table salt would be NaCl).
- The sets of washers, bolts and nuts can be used to convey the concept of elements, mixtures and compounds. If you think of each washer, bolt and nut as an individual atom, then the contents of dishes 1, 2 and 3 are elements because they are all the same atom and that can not be further reduced as to simpler substances. The contents of dishes 4, 5 and 6 are compound because they show one substance composed of two or more different atoms chemically bonded to one another, and the contents of dishes 7, 8 and 9 are mixtures because they are materials containing two or more elements or compounds and are mixed in any proportion.
- Go through the Data Table and compare and contrast the different items. Categorize the materials in each dish as element, homogenous mixture, heterogeneous mixture, or compound, recording this in your data table.

DISH #	ELEMENT	HOMOGENEOUS MIXTURE	HETEROGENOUS MIXTURE	COMPOUND
1 (4 WASHERS)				
2 (4 BOLTS)				
3 (4 NUTS)				
4 (1 NUT WITH 1 BOLT - 4 SETS)				
5 (2 NUTS WITH 1 BOLT - 4 SETS)				
6 (1 NUT, 1 BOLT, AND 1 WASHER - 4 SETS)				
7 (1 WASHER, 1 NUT, + DISH 5 + DISH 6)				
8 (2 WASHERS, 2 NUTS, 2 BOLTS)				
9 (TWO SETS OF DISH 5 + ONE SET OF DISH 4				