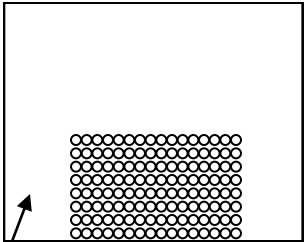
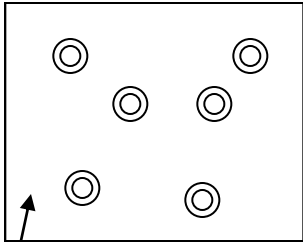
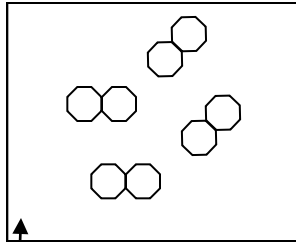





Elements, Compounds, and Mixtures

We spent most of the last unit talking all about the different elements, their histories, and how they work. We learned all about the Periodic Table and what it means to a Chemist. And although the elements of the universe are very important, they really are quite boring to a Chemist. Think about what a boring place the universe would be if only elements existed. There would only be about 100 or so substances in existence. There wouldn't be anything we could see, smell, hear, taste, or touch. Of course we wouldn't be able to any of those things anyway because we certainly wouldn't exist.

What makes the universe a wonderfully complex place is that the elements combine together in a variety of different ways to make new substances and they are what makes the world of Chemistry useful and fun.

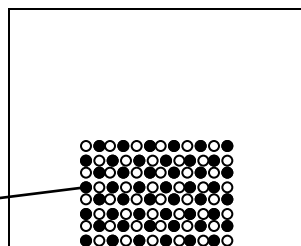
To review, an *element* is one of the basic building blocks of matter. It is one of the 100 or so simplest substances from which more complex substances are made. You know that something is an element if it is listed on the Periodic Table. An element consists of only one type of atom. Each of the diagrams below represents an element:

		
<p>This is representative of a solid element. All the atoms are the same.</p>	<p>This is representative of a gaseous element.</p>	<p>Don't be fooled! Even though the atoms are bonded, there is still only one kind of atom here. It is a diatomic <i>element</i>.</p>
		
	<p>http://www.rpd.net/sciencetips_v3/images/p8a3/P8A3_clip_image016.jpg</p>	<p>http://www-personal.umich.edu/~lpt/oxlabel_files/oxlabel.gif</p>

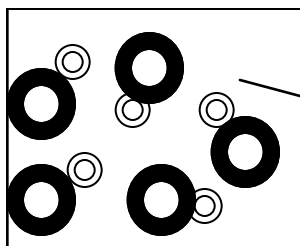
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A **compound** is a new substance made when two or more elements chemically combine. The new compound has properties that are completely different than the elements from which it is made. For instance, hydrogen (H_2) is a colorless, explosive gas. The Hindenberg blimp accident occurred because it was filled with flammable hydrogen. Oxygen (O_2) is also a colorless gas that supports combustion. Oxygen is about 20% of our atmosphere and we need it to breathe. However when hydrogen and oxygen combine you get regular, boring water (H_2O), a compound that has none of the properties of hydrogen or oxygen! It is its own substance, made from hydrogen and oxygen but with its own properties.

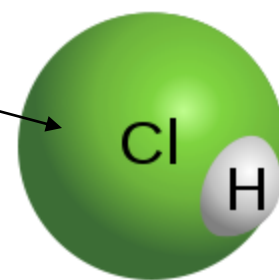
<http://healthyfastingguide.com/wp-content/uploads/2008/03/salt-is-not-needed.jpg>



This is representative of a solid compound. The atoms are bonded but different.



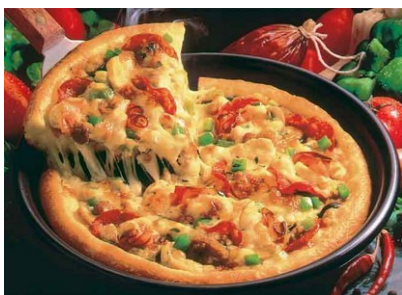
This is representative of a gaseous compound. The different atoms are bonded but all the combinations are the same.



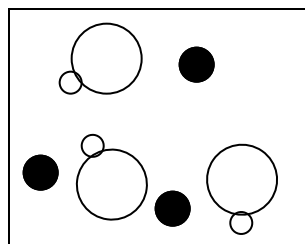
http://upload.wikimedia.org/wikipedia/commons/thumb/8/88/HCl_molecule_model-VdW_surface.svg/150px-HCl_molecule_model-VdW_surface.svg.png

Elements and compounds are known as **Pure substances**. All the atoms in an element are the same. Even though a compound consists of more than one kind of atom, each of the combinations is the same so that substance has the same properties throughout.

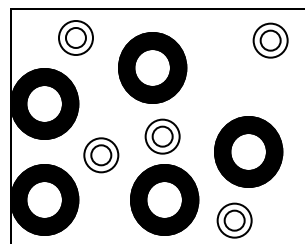
Elements and compounds can often be put in the same place but retain their own properties and identities. This is called a **mixture**. In a mixture, you don't get a new substance but rather two or more substances that are physically mixed together. For instance, you can put salt in water and the salt will dissolve. However, the salt is still there and the water is still there and you haven't created anything new. There are two types of mixtures: **homogenous** and **heterogenous**. Homogenous mixtures are the same throughout the sample. Any sample you take from the mixture will be pretty much just like any other sample you take. Salt water, air, and pancake syrup are good examples. Heterogenous mixtures are ones that are different throughout. A sample taken from a heterogenous mixture will most likely be different from another sample taken. Trail mix and pizza are good examples of this; every bite is different!



<http://studentwork.rutgers.edu/SEOTY/logo/pizza.jpg>



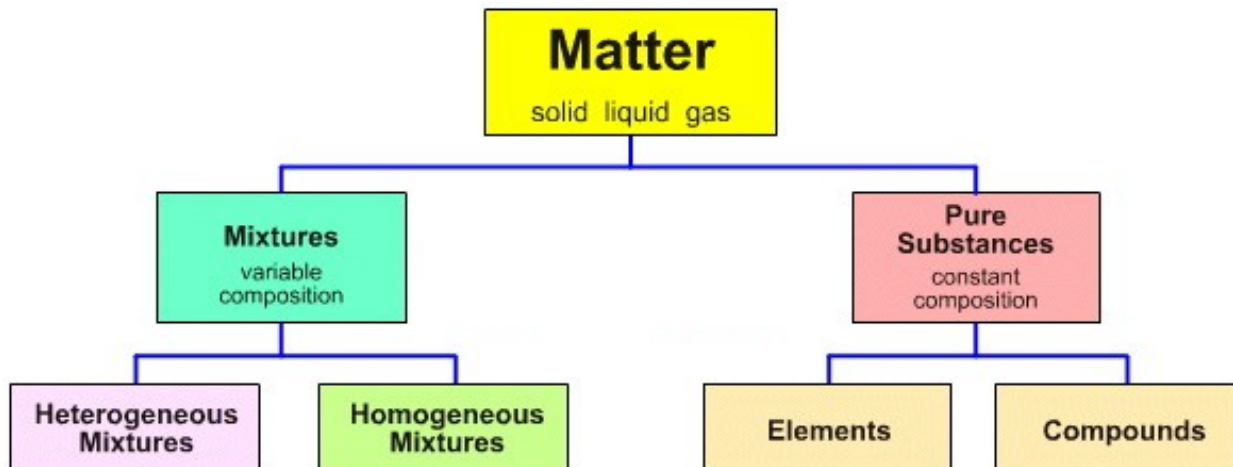
This is representative of a mixture of an element and a compound.



This is representative of a mixture of elements.



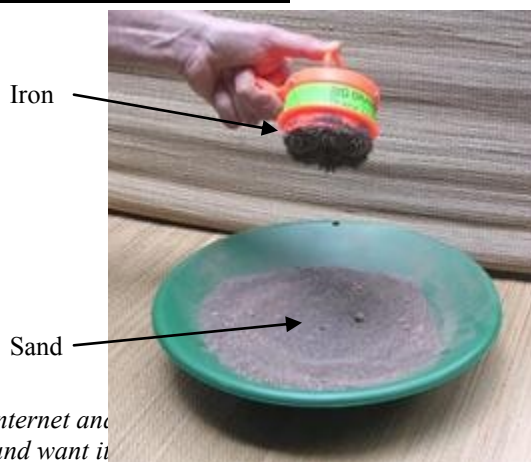
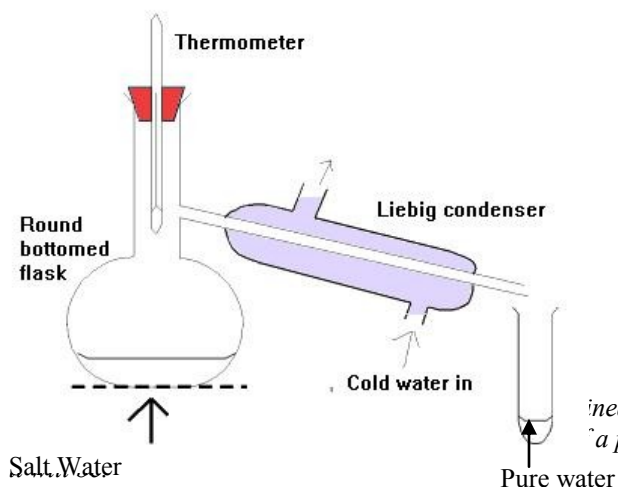
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Separations

You can often tell whether something is an element, compound, or mixture by how easy it would be to separate it into its parts. Elements are impossible to separate unless you have a nuclear reactor or particle collider. Since most high school chemistry labs don't have those, we'll just go with elements are impossible to separate. Compounds can be separated but it's probably going to take some work. You need a chemical reaction to take place in order to separate a compound. Salt can be turned back into explosive sodium and poisonous chlorine but it's going to require some energy and expertise to do it. Water can be decomposed back into hydrogen and oxygen but it requires electricity, heat, or some other way to induce a chemical reaction.. So, compounds can be separated but only by difficult, chemical means. Mixtures on the other hand are relatively easy to separate. A simple mixture of salt water can be separated by simply waiting and doing literally nothing. Eventually, the water will evaporate off, leaving the salt behind. To speed the process up you can heat the water to boiling and even capture that water as steam, cool it, and condense it. If you have a mixture of iron filings and sand, all you need to separate it out is a magnet. The iron attaches itself to the magnet and presto, you have separated a mixture. Mixtures are relatively easy to separate and should require only physical means and not a chemical reaction.

Elements	Impossible to separate
Compounds	Difficult to separate; a chemical reaction is needed
Mixtures	Easy to separate; only physical reaction is needed



Types of Reactions

As stated above, the only way to separate a compound is by using a **Chemical Reaction or a Chemical Change**. During a chemical reaction, the elements or compounds involved get rearranged to make a new substance. You can tell if something is a chemical reaction if you get “new stuff” out of it. There is often energy involved in chemical reactions that also make it obvious. Exploding dynamite and digesting food are good examples of chemical reactions.

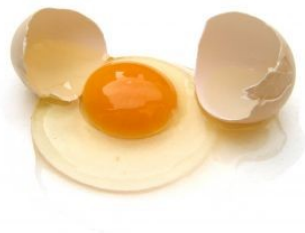
Physical Reactions or Physical Changes are ones where the change you make does not result in a new substance. In a physical reaction you have the “same stuff”. Tearing paper is a physical reaction; you have smaller pieces but you still have paper. Freezing water into ice is a physical reaction; although now a solid, it is still H₂O.

Cracking an egg is a physical reaction as is scrambling it. But cooking it into the final product is a chemical reaction. Splitting wood is a physical reaction but when that wood is burned in the campfire it is a chemical reaction.

Physical Changes
= Same Stuff

Chemical Changes
= New Stuff

http://urbanchickens.org/files/images/cracked_egg.jpg



http://mos-savi.files.wordpress.com/2008/05/2458_scrambled_eggs_4_full.jpg

<http://pro.corbis.com/images/CB025231.jpg?size=572&uid={1F435E23-650C-44E4-AAE0-0BEEE247180D}>



<http://pro.corbis.com/images/CB025231.jpg?size=572&uid={1F435E23-650C-44E4-AAE0-0BEEE247180D}>

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Questions

1. What is the basic building block of matter to a chemist?
2. What is formed when two or more elements are chemically combined?
3. Define a mixture.
4. What would each of the following be classified, an element, compound, homogenous mixture, heterogenous mixture:
 - A. Air
 - B. H_2O
 - C. Garden soil
 - D. Iron
 - E. U
 - F. Carbon dioxide
 - G. Kool-aid
5. Which of the above substances in question #4 are considered to be Pure Substances?
6. Which of the above substances in question #4 would be impossible to separate?
7. Describe how you could separate a mixture of sand and water.
8. Describe how you could separate a mixture of sand and salt (This one requires a few steps. Be creative!)
9. How can you separate out the hydrogen and oxygen from water?
10. Could you use a magnet to get the iron out of a sand/ iron mixture? Why or why not.
11. Could you use a magnet to get the iron out of a pile of iron oxide (Fe_2O_3 , rust)? Why or why not.
12. Describe each of the changes listed below as either a physical change or a chemical change:
 - A. Boiling water
 - B. Burning gasoline
 - C. Rotting vegetables
 - D. Cutting hair
 - E. Crushing ice
 - F. Melting wax
 - G. Burning a candle
13. Describe each of the diagrams below as either:
 - Element
 - Compound
 - Mixture of elements
 - Mixture of compounds
 - Mixture of elements and compounds

