

Learning Guide E – Classifying Substances

Review:

What information does each block of your Periodic Table contain?

What does it mean for something to be periodic?

Who first organized the Periodic Table of Elements?

What happens across the rows?

What are the rows called?

What do the columns have in common?

What are the columns called?

What is the smallest and largest element in the 5th period?

What is the smallest and largest alkali metal?

What is the smallest and largest halogen?

What is the smallest and largest noble gas?

What is the smallest and largest alkaline earth metal?

What is the smallest and largest nonmetal?

What is the smallest and largest transition metal?

What is the smallest and largest inner transition metal?

What is the smallest main group metal?

Which would you expect to have properties similar to sulfur?

phosphorus selenium chlorine oxygen

Which would you expect to have properties similar to strontium?

calcium rubidium yttrium barium

Give the atomic numbers and masses of the following elements:

antimony

tellurium

iodine

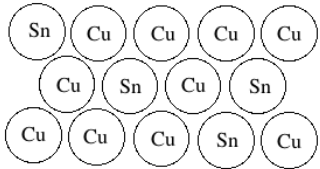
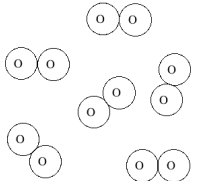
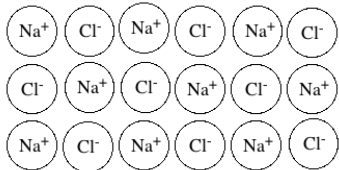
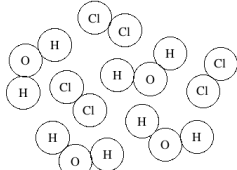
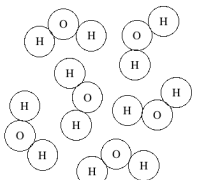
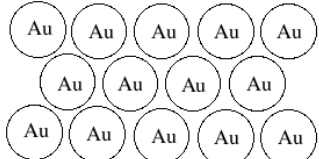
xenon

Which is better to use to organize the Periodic Table, mass or atomic number?

Introduction

Now that we have talked about atoms, elements, and the Periodic Table, we are ready to discuss how atoms are combined to make the actual substances that we see around us.

Each of the following boxes represents the atoms found in one of the substances below. See if you can match them up.

What differences and similarities can you find between the identity and arrangements of these atoms?

Pure elements

Which of the examples above are pure elements?

How could you recognize other examples of pure elements?

What difference do you see between these examples?

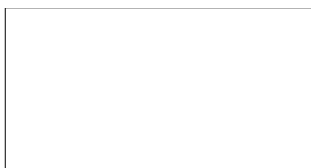
What other elements would have individual atoms like gold?

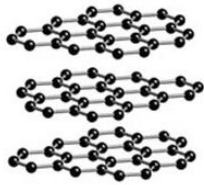


These atoms are not held together by chemical bonds.

Which would have molecules like oxygen?

elements with diatomic molecules:





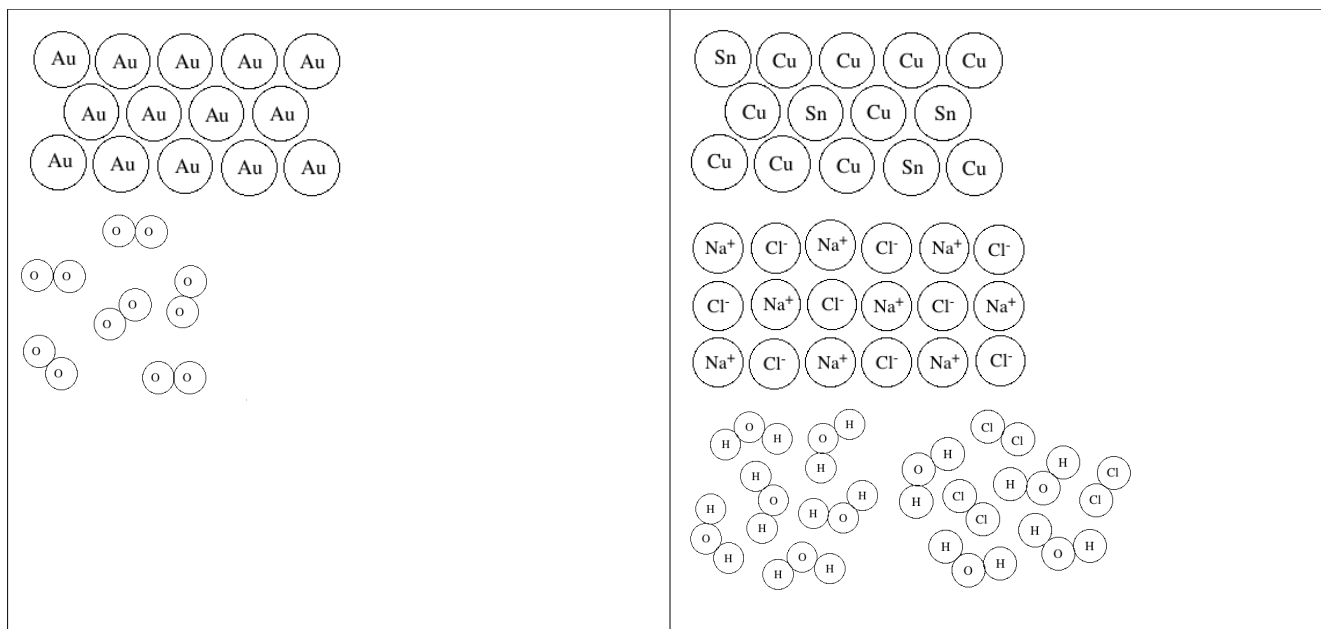
How can you find these on the Periodic Table of Elements?

The image displays a large grid of 100 squares, organized into 10 rows and 10 columns. Below this main grid, there is a smaller grid consisting of 10 squares arranged in 2 rows and 5 columns.

complex molecules:

Compounds and mixtures

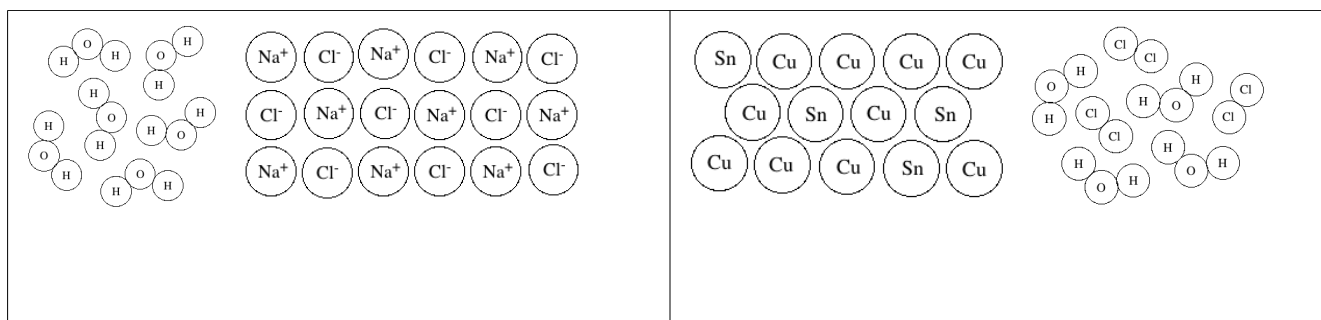
What is the difference between the examples on the left and on the right?



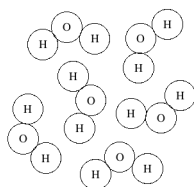
Which of these are pure elements, and which are not?

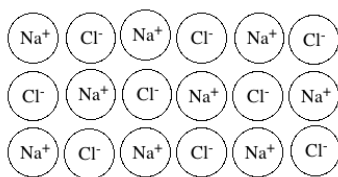
mercury orange juice cheese vitamin C aluminum foil baking soda

What is the difference between these examples on the left and on the right?



Compounds always have the same ratio of elements. We can show this using a formula.





Are these atoms held together by chemical bonds?

water:

table salt:

How can you tell which compounds will have covalent bonds, and which will have ionic bonds?

water (H_2O):

table salt (NaCl):

Which of the following are ionic, and which are covalent?

rust (Fe_2O_3):

vitamin C ($\text{C}_6\text{H}_8\text{O}_6$):

baking soda (NaHCO_3):

sugar ($\text{C}_{11}\text{H}_{22}\text{O}_{11}$):

Mixtures, on the other hand, do not have a set ratio of elements.

What is bronze made of?

Can it have more or less tin and still be bronze?

Are the atoms arranged in any order?

Are the atoms connected by chemical bonds?

What are mixtures of metals called?

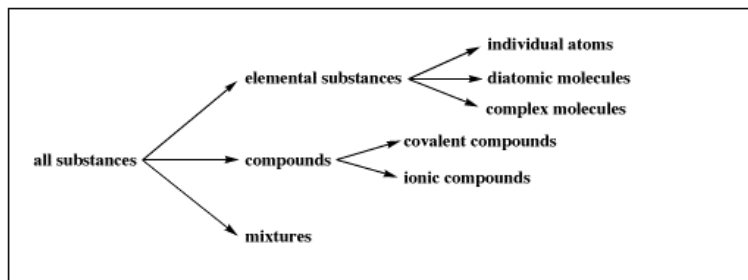
What does chlorinated water contain?

Can you have more or less chlorine?

Are the atoms connected by chemical bonds?

Are the molecules in any particular arrangement?

Summing up



Here is one way to represent how all of these categories are related:

Pure elements:

- only one kind of atom

- may be individual atoms or held together by chemical bonds

Compounds:

- two or more elements

- atoms are bound together by chemical bonds

- have a formula (fixed ratio of elements)

Covalent compounds:

- contain only nonmetals

- atoms are joined together by covalent bonds

- form molecules

Ionic compounds:

- contain a metal and one or more nonmetals

- atoms are held together by ionic bonds

- form ions (not molecules)

Mixtures:

- two or more elements

- not all atoms held together by chemical bonds

- don't have a formula (any ratio of elements possible)

Remember our analogy with the Legos?

Identify the kind of substance represented by the following Legos.

Make up a letter combination for each of the following types of substances. Use vowels to represent nonmetals, and consonants for metals.

pure element - individual atoms

sesesesese

pure element - diatomic molecules

oo oo oo oo oo

pure element - complex molecules

iai xo iai iai xo xo iai

covalent compound

k k k k k k k k k

ionic compound

iai iai iai iai iai

mixture – alloy

aaaaa aaaaa

mixture other than an alloy

r m r m m r m r r m

Draw pictures to represent the atoms of each of the following substances.

brass (copper and zinc)	bromine	carbon monoxide (CO)
potassium chloride (Kcl)	silver	helium and oxygen

