

PART B: ELEMENTS

A substance that cannot be broken down into simpler substances by chemical means. An element is composed of atoms that have the same number of protons in their nucleus.



ELEMENTS

Every element has a unique Atomic number (Z). It indicates the total number of protons in the nucleus of the atom. Normal atoms are electrically neutral, same number of \oplus protons as \ominus electrons. So it is also the number of electrons.

Every elements is abbreviated using a unique symbol of one or 2 letters. The first letter is always capitalized and if there is a second letter, it is lower case. Some are based on other languages, for example the symbol Fe is iron from the Latin "ferrium".

ATOMIC NUMBER

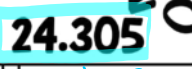


ELEMENT NAME



SYMBOL

Every element has a unique name. Many element names are very old and are based on other languages. Chlorine is named after "khloros," the Greek work for yellowish green. Newly discovered elements are named by the discoverer, but must be approved by an international committee.



ATOMIC MASS

Atomic mass is the mass of the protons and the neutrons in an atom. Every proton and neutron has a mass of 1 AMU. Electrons do NOT count towards the mass because they are so tiny. The mass can be shown with a decimal because it is an average mass of the isotopes of that element.
 (different versions of the same element)

You try:



What element's neutral atom has 17 electrons?
 (also 17 p+)
 chlorine

Atomic Number = 17

How many neutrons are in a lithium atom?
 6.94 / round to 7
 7 - 3 (protons) = 4
 p+ + n0 = mass

Atomic mass Number (A)

What do you think the cube symbol in the upper right means?
 means it is solid at room temp.

- (5)
- (6)
- (9)

Homework

ASSIGNMENT #1: Getting to Know Subatomic Particles pg 9
 + Atomic Structure Worksheet pages 10-11 This assignment is
 to be completed below in the space provided.

HW Oct 10th

Getting to Know Subatomic Particles:

Use your periodic table to complete the table below:

Element	Symbol	Atomic Number (Z)	# of protons	# of electrons	Atomic Mass	Rounded Atomic Mass	# of neutrons (show work)	Period
Oxygen	O	8	8	8	15.999	16	16 - 8 = 8	2
Helium								

~ mass Number (A)

= row

column = "Group"

Element	Symbol	Atomic Number	# of protons	# of electrons	Atomic Mass	Rounded Atomic Mass	# of neutrons (show work)	Period
Oxygen	O	8	8	8	15.999	16	16 - 8 = 8	2
Helium	He	2	2	2	4.00	4	4 - 2 = 2	1
Carbon	C	6	6	6	12.01	12	12 - 6 = 6	2
Aluminum	Al	13	13	13	26.98	27	27 - 13 = 14	3
Calcium	Ca	20	20	20	40.08	40	40 - 20 = 20	4
Sodium	Na	11	11	11	22.99	23	23 - 11 = 12	3
Potassium	K	19	19	19	39.10	39	39 - 19 = 20	4
Nitrogen	N	7	7	7	14.01	14	14 - 7 = 7	2
Silicon	Si	14		28.09	28	28	28 - 14 = 14	3
Iron	Fe	26	26	26	55.85	56	56 - 26 = 30	4
Hydrogen	H	1	1	1.01	1	1	1 - 1 = 0	1
Uranium	U	92	92	92	238.03	238	238 - 92 = 146	7

row of the periodic table

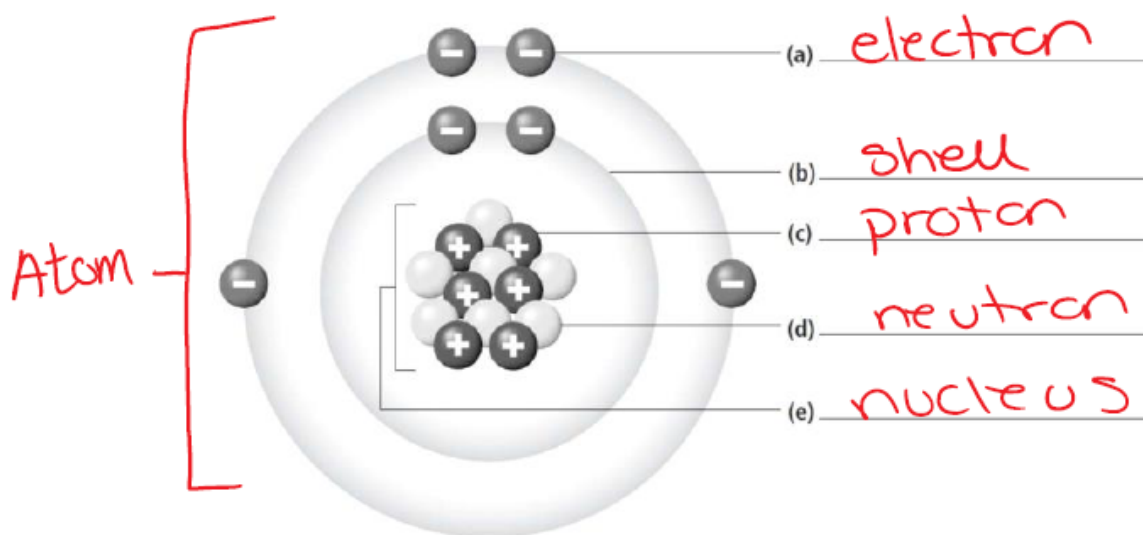
Homework

Atomic structure

Atomic structure

1. Use the vocabulary terms that follow to label the parts of an atom. Place the correct term on the line next to each part of the atom. You will not need to use all the terms.

- atom
- proton
- nucleus
- neutron
- electron
- shell



2. Complete the following table describing the three subatomic particles.

	Proton	Neutron	Electron
electric charge	+1	0	-1
location in the atom	nucleus	nucleus	shell (orbital)

Homework

Complete the table below by referencing a periodic table. The first row has been completed as an example. **KEY**

	Chemical Symbol	Atomic Number	Atomic Mass	Mass Number	Hyphenated Notation of Most Common Isotope	# of protons	# of electrons	# of neutrons (Show work: Mass Number - Atomic #)
Phosphorous	P	15	30.97	31	Phosphorous - 31	15	15	31 - 15 = 16
Aluminum	Al	13	26.98	27	Aluminum - 27	13	13	27 - 13 = 14
Potassium	K	19	39.10	39	Potassium - 39	19	19	39 - 19 = 20
Argon	Ar	18	39.95	40	Argon - 40	18	18	40 - 18 = 22
Lead	Pb	82	207.20	207	Lead - 207	82	82	207 - 82 = 125

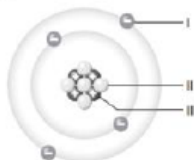
Match each item with the correct statement:

- | | |
|--|-------------|
| ...C... 1. The smallest particle of an element that retains the properties of that element | A. PROTON |
| ...A... 2. A positively charged subatomic particle | B. NUCLEUS |
| ...D... 3. A negatively charged subatomic particle | C. ATOM |
| ...E... 4. A subatomic particle with no charge | D. ELECTRON |
| ...B... 5. The central part of an atom containing protons and neutrons | E. NEUTRON |

Match each item with the correct statement:

- | | |
|--|----------------|
| ...C... 1. Atoms with the same number of protons but different numbers of neutrons | A. ATOMIC MASS |
| ...B... 2. Total number of protons and neutrons in the nucleus | B. MASS NUMBER |
| ...A... 3. The weighted average of the masses of the isotopes of an element | C. ISOTOPE |

Use the following diagram of an atom to answer questions 8 and 9.



8. Which of the following is the structure labelled II in the diagram?
- A. atom
B. proton
C. neutron
D. electron
9. Which of the following exists in energy levels?
- A. I only
B. II only
C. III only
D. II and III only
10. What is the electrical charge of the nucleus of an atom?
- A. neutral charge
B. positive charge
C. negative charge
D. It depends on the element
11. The nucleus of the atom contains which of the following subatomic particles?
- A. electron
B. proton and neutron
C. proton and electron
D. proton, neutron, and electron
- [Handwritten note: electrons in shells]*

The Periodic Table...OF ELEMENTS!

- The periodic table is made up of elements
 - An element is a pure substance that cannot be changed into anything simpler (if contains only 1 kind of atom)
- Every element has its own unique name and symbol

Element	Symbol	Element	Symbol
Actinium	Ac	Mercury	Hg
Aluminium	Al	Molybdenum	Mo
Americium	Am	Neodymium	Nd
Antimony	Sb	Neon	Ne
Argon	Ar	Nepthunium	Np
Arsenic	As	Nickel	Ni
Astatine	At	Niobium	Nb
Barium	Ba	Nitrogen	N
Berhelium	Bk	Nobelium	No
Beryllium	Be	Osmium	Os
Bismuth	Bi	Oxygen	O
Boron	B	Palladium	Pd
Bromine	Br	Phosphorus	P
Cadmium	Cd	Platinum	Pt
Calcium	Ca	Plutonium	Pu
Californium	Cf	Polonium	Po
Carbon	C	Potassium	K
Cerium	Ce	Praseodymium	Pr
Cesium	Cs	Protactinium	Pa
Chlorine	Cl	Radium	Ra
Chromium	Cr	Radon	Rn
Cobalt	Co	Rhenium	Re
Copper	Cu	Rhodium	Rh
Curium	Cm	Rubidium	Rb
Dubnium	Db	Ruthenium	Ru
Dysprosium	Dy	Rutherfordium	Rf
Einsteinium	Es	Samarium	Sm
Erbium	Er	Scandium	Sc
Europtium	Eu	Selenium	Se
Fermium	Fm	Silicon	Si
Fluorine	F	Silver	Ag
Francium	Fr	Sodium	Na
Gadolinium	Gd	Strontium	Sr
Gallium	Ga	Sulphur	S
Germanium	Ge	Tantalum	Ta
Gold	Au	Technetium	Tc
Hafnium	Hf	Tellurium	Te
Helium	He	Terbium	Tb
Holmium	Ho	Thallium	Tl
Hydrogen	H	Thorium	Th
Indium	In	Tin	Tm
Iodine	I	Titanium	Ti
Iridium	Ir	Tungsten	W
Iron	Fe	Uranium	U
Krypton	Kr	Vanadium	V
Lanthanum	La	Xenon	Xe
Lawrencium	Lr	Ytterbium	Yb
Lead	Pb	Yttrium	Y
Lithium	Li	Zinc	Zn
Lutetium	Lu	Zirconium	Zr
Magnesium	Mg		
Manganese	Mn		
Mendelevium	Md		

Examine the list of elements to the left. Note the different ways in which they were named. Add three examples to each of the following:

A. The symbol of some elements is just the first letter (*always capitalized*).

O - oxygen
I - iodine
S - sulfur or sulphur

B. When the first letter had already been used, the first and second letter was used (*second letter always lowercase*).

Al - Aluminium
Fr - Francium
Ba - Barium

C. When the first and second letters had been used, the first and the third were used (*third letter always lowercase*).

Db = Dubnium
Sm = Samarium
Zn = Zinc

D. Some elements were named before English became the language of science, so their symbols derive from their Latin names.

Fe = Iron = "Ferrum"
K = Potassium = "Kalium"
Ag = Silver = "Argentum"
Pb = Lead = "Plumbum"

PRACTICE

Can you find an element name that is related to a country/continent?

Indium
Americium
Polonium
Californium
Francium
Scandium

How about an element name related to a famous scientist?

Curium
Einsteinium
Mendelevium
Rutherfordium

CONFUSING ELEMENT SYMBOLS EXPLAINED

Most of the chemical symbols for elements in the periodic table make perfect sense; there are a small selection, however, that seem to bear no relation to their element's name. Here's a look at these rogue symbols, along with explanations of the reasons behind them.

GRAPHIC KEY	Na	SODIUM - NATRUM	K	POTASSIUM - KALIUM	Fe	IRON - FERRUM	
ELEMENT ATOMIC NO.	11		19		26		
ELEMENT NAMES	Sodium's Latin name, 'natrum', derives from the Greek 'natrion' (a name for sodium carbonate). Its original source is likely to be the Arabic work 'natrun'. A number of modern languages still call the element natrium instead of sodium.		'Kali' is potassium's Latin name, and derives from the Arabic 'al qali', meaning 'alkaline ash' (the ashes left over when plant material is burned). As with sodium, a number of modern languages still refer to potassium as kalium.		Iron's Latin name, 'ferrum', simply means 'iron' or 'ward', and is possibly of Semitic origin. The element is known by a myriad of various names in different languages, with some sources suggesting there are over 200 different names for it.		
ELEMENT SYMBOL	Na		K		Fe		
Cu	COPPER - CUPRUM	Ag	SILVER - ARGENTUM	Sn	TIN - STANNUM	Sb	ANTIMONY - STIBIUM
	Copper's Latin name was 'cuprum', which itself comes from 'Cyprus', which is the Greek name for Cyprus. The island of Cyprus was famous for its copper reserves. The name was eventually simplified to 'cuprum'.		The Latin name for silver, 'argentum', is thought to derive originally from Indo-European, likely referring to the metal's shininess. The country Argentina is named after silver, and is the only country to be named after a chemical element.		Tin's Latin name, 'stannum', may be derived from the Indo-European 'stag' (shipping) because tin melts at a low temperature. There's also speculation it could be derived from the Cornish 'stann' due to Cornwall's famous tin mines.		The Latin 'stibium' derives from the Greek word 'stibi', meaning eye paint, referring to antimony's use as an ancient eye cosmetic. This is in turn likely derived from Arabic or Egyptian. Few countries refer to antimony as stibium today.
W	TUNGSTEN - WOLFRAM	Au	GOLD - AURUM	Hg	MERCURY - HYDRARGYRUM	Pb	LEAD - PLUMBUM
	Wolfram was named after the mineral it was found in, wolframite. This is from the German 'wolf rauen' or 'wolf's foam', referring to the amount of tin 'water' by the metal during its extraction. Wolfram is still used in several languages.		The Latin name for gold was 'aurum', meaning 'yellow', derived from the word 'aurus' (beaver). The name 'gold', used in Germanic languages, means 'yellow, shining metal'; many other European languages use derivatives of aurum.		Mercury's original Latin name was actually 'argentum vivum' (living silver), but Latin later borrowed from the Greek 'hydrargyros' (liquid silver) to give 'hydrargyrum'. The original English name for the element was 'quicksilver'.		Lead's Latin name, 'plumbum', likely originally derives from a language predating Ancient Greek. This Latin name is also the source of the English words 'plumbing' and 'plumber', due to the historic use of lead in water pipes.

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On Earth about 90 elements occur naturally (ex. carbon, silver, oxygen). There are many elements that do not occur naturally but are synthesized (made) in Labs (usually radioactive and short-lived).

As you've seen each element has a unique name and symbol. The symbol is usually 1 or 2 letters. The first letter is always CAPITAL and the remaining letters if there are any are ALWAYS lowercase. The names and symbols of the elements are accepted and used by scientists all over the world. Many element names come from Latin words, others are named for countries or to honour scientists of note.

About 80% of the elements found in the periodic table are metals.

- Metals**
- hard, shiny
 - solids (except mercury)
 - malleable, ductile
 - conduct heat + electricity

- Non-Metals**
- gases, or brittle solids (break/crack easily.)
 - dull or opaque
 - poor conductors
 - soft / brittle

PRACTICE

Write the symbol for the following elements.

Oxygen O	Hydrogen H	Chlorine Cl	Potassium K
Phosphorus P	Iodine I	Magnesium Mg	Nitrogen N
Fluorine F	Manganese Mn	Iron Fe	Carbon C
Copper Cu	Calcium Ca	Zinc Zn	Cobalt Co
Sodium Na	Molybdenum Mo	Sulphur S	Mercury Hg

PRACTICE

Write the name of the following elements.

As Arsenic	Rn Radon	Pb Lead	Al Aluminium
Cu Copper	K Potassium	Ba Barium	Ag Silver
He Helium	Pu Plutonium	Ne Neon	Sr Strontium
Si Silicon	Am Americium	U Uranium	Au Gold
Sn Tin	Ra Radium	Pt Platinum	Ge Germanium

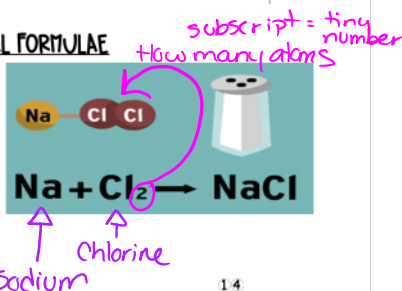
THINKING AHEAD ABOUT COMPOUNDS & CHEMICAL FORMULAE

As you know a compound is a pure substance that is made up of 2+ or more different types of atoms.

These different types of atoms come from different types of elements.

Elements combine to form COMPOUNDS.

something that we will look at later in this course.



Homework

ASSIGNMENT #2: Chemical Formula Practice page 15

This assignment is to be completed below in the space provided.

1. For each of the following molecules, identify the kind of atoms and the number of each. The first one is done for you.

Chemical Formula	Kinds and Number of Atoms in Each Molecule
CaCO_3	1 atom calcium, 1 atom carbon, 3 atoms oxygen
AgBr	1 atom of silver, 1 atom Br
PbS_2	1 atom lead, 2 atoms S
MgCl_2	
Al_2O_3	
PbCl_4	
Fe_2O_3	
AlP	
NH_4OH	
NaHSO_4	
PbSO_3	

compound
silver →
more than 1 type of atom

COMPOUNDS

2. Each particle of the following contains the atoms listed. Write the formula of each compound. The first one is done for you.

- One copper atom and one sulphur atom
CuS
- One nitrogen and three hydrogen atoms
 NH_3
- Two hydrogen and one sulphur atom
 H_2S
- One hydrogen, one nitrogen and three oxygen atoms
- Two potassium, one carbon and three oxygen atoms
- Two aluminium and three oxygen atoms
- One iron, one phosphorus and four oxygen atoms
- One nitrogen, four hydrogen, one carbon and three oxygen atoms
- One potassium, one chlorine and three oxygen atoms
- Six carbons, twelve hydrogen and 6 oxygen atoms
- One carbon, three hydrogen, one oxygen and one hydrogen

1. For each of the following molecules, identify the kind of atoms and the number of each. The first one is done for you.

Chemical Formula	Kinds and Number of Atoms in Each Molecule
CaCO_3	1 atom calcium, 1 atom carbon, 3 atoms oxygen
AgBr	1 silver, 1 bromine
PbS_2	1 lead, 2 sulphur
MgCl_2	1 magnesium, 2 chlorine
Al_2O_3	2 aluminium, 3 oxygen
PbCl_4	1 lead, 4 chlorine
Fe_2O_3	2 iron, 3 oxygen
AlP	1 aluminium, 1 phosphorus
NH_4OH	1 nitrogen, 4 hydrogen, 1 oxygen, 1 hydrogen
NaHSO_4	1 sodium, 1 hydrogen, 1 sulphur, 4 oxygen
PbSO_3	1 lead, 1 sulphur, 3 oxygen

2. Each particle of the following contains the atoms listed. Write the formula of each compound. The first one is done for you.

- One copper atom and one sulphur atom
CuS
- One nitrogen and three hydrogen atoms
 NH_3
- Two hydrogen and one sulphur atom
 H_2S
- One hydrogen, one nitrogen and three oxygen atoms
 HNO_3
- Two potassium, one carbon and three oxygen atoms
 K_2CO_3
- Two aluminium and three oxygen atoms
 Al_2O_3
- One iron, one phosphorus and four oxygen atoms
 FePO_4
- One nitrogen, four hydrogen, one carbon and three oxygen atoms
 NH_4CO_3
- One potassium, one chlorine and three oxygen atoms
 KClO_3
- Six carbons, twelve hydrogen and 6 oxygen atoms
 $\text{C}_6\text{H}_{12}\text{O}_6$
- One carbon, three hydrogen, one oxygen and one hydrogen
 CH_3OH

Science 9 Thanksgiving Long Weekend Homework:

- Assignment #1
- Assignment #2
- Make sure you scan + email your lab to Miss Z if you forgot to hand it in today!

For CSC Students Away Tuesday-Wednesday:

Tuesday: Part C: The Periodic Table Notes pg 20-28

- Assignment #3 + Assignment #4 (all)

Wednesday: Part D: The Bohr Model Notes pg 30-32

Part E: Valence Electrons Notes pg 33-34

- Assignment #5 pg 36-37



ACTIVITY:

Elements and the Periodic Table

Activity 1: Comparing Properties of Elements

An **element** is a substance that cannot be broken down into simpler substances by heating it or causing it to react with other chemicals. The smallest unit of an element is a tiny particle called an **atom**. Each different element has a unique atom. Everything around you is made from incredibly small atoms of one or more of these elements.



A pure sample of an element contains many atoms of the same type. For example, the millions of iron atoms that make up a piece of iron metal are of the same type and have the characteristics of iron. Iron atoms, however, are very different from atoms of other elements, such as gold or oxygen. All elements have unique properties. It is atoms of an element that determine its properties.

Most elements are rarely found in pure form. Atoms of different elements tend to combine chemically, or react, with each other. Scientists say these elements are reactive. When elements react, they can form substances called compounds. One familiar compound is water, a combination of two hydrogen atoms and one oxygen atom.



Challenge: How can elements be grouped based on their physical and chemical properties and how are they related to compounds?

Materials: Element Cards, Element Family Cards

Part A: Classifying Elements

- With your partners, spread the Element Cards out on a table. Each card provides information about an element. Two categories might be unfamiliar, reactivity (how likely the element is to react chemically with other elements) and number of bonds to hydrogen (the number of hydrogen atoms that usually combine chemically with this element).

1. With your partners, spread the Element Cards out on a table. Each card provides information about an element. Two categories might be unfamiliar, reactivity (how likely the element is to react chemically with other elements) and number of bonds to hydrogen (the number of hydrogen atoms that usually combine chemically with this element).

2. Examine the information on each card carefully, noting similarities and differences among elements.

3. Working together, sort the elements into at least three groups. Each group of elements should have at least two similar properties.

16

4. List the groups you have made and the common features of each group. Be sure to record all of the elements in each group.

Group	Elements in Group	Common Features of the Group
1		
2		
3		
4 (if needed)		

Part B: Comparing Classification Systems

5. Your group will receive four Element Family Cards. Each card describes a group of elements called a family. Based on the information on the Family Cards, place each element under a Family Card.

6. Arrange the elements in each family in order from lowest atomic mass at the top to highest atomic mass at the bottom. Place the column on a half sheet of coloured paper.

7. Line up the four columns of elements to form a table, so that the elements are in columns and rows. Use the atomic masses of the elements to decide on an order for the columns.

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**STUDENT ANSWERS
TO THIS ACTIVITY
WILL VARY... (IN
CLASS ACTIVITY)**

8. Record your new classification system, complete with:

- Family names
- Similar properties within each family
- Elements in each family in order of increasing atomic mass

Family Name									
Similar Properties									
Elements + atomic mass	Element	Mass	Element	Mass	Element	Mass	Element	Mass	Mass

Analysis:

1. Which of the properties listed on the Element Cards are:
 - a. Physical properties?

 - b. Chemical properties?

2. How did your first classification system compare to the second classification with the Element Family Cards?

**STUDENT ANSWERS
TO THIS ACTIVITY
WILL VARY... (IN
CLASS ACTIVITY)**

3. In what ways could grouping elements help scientists understand their properties?

4. Use the table of elements you constructed in step 8 above to find the family or families of elements that are:

- a. Not usually reactive:

- b. Highly reactive:

- c. All metals:

- d. All solids:

- e. All gases:

5. The element strontium (Sr) has properties that make it belong in the Alkaline Earth Metals family, directly below calcium (Ca) on your table of elements. Design an Element Card for strontium that shows its symbol, name and the properties you predict it will have: