

The Periodic Table and Bonding



Mad Duck Science Friday Laboratory Notebook

Name:

Team:

Atomic structure

Have you ever wondered what the world around us is made of?

The world around us is made of elements. Elements can either exist alone or bonded to other elements in compounds. All elements have a different atomic structure. What an atom is will be discussed in the next section!

Examples of elements that are pure:

Graphite - Carbon is what pencil lead is made of

Penny – coated in copper

Aluminum foil – made of aluminum



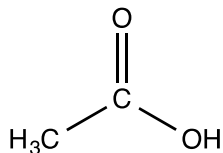
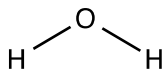
List three elements around you!

Examples of compounds

Water is a compound made of oxygen and hydrogen

Vinegar is composed of carbon oxygen and hydrogen

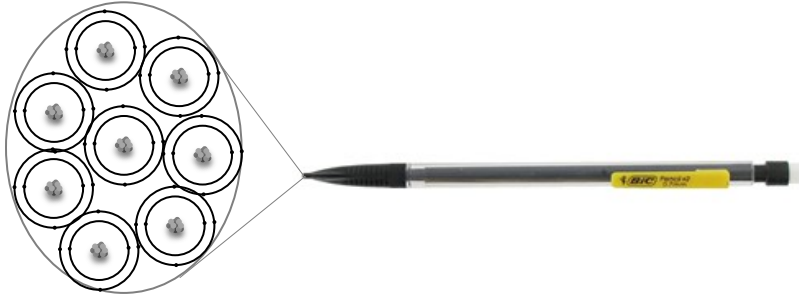
Fools gold or pyrite is made of iron and sulfur



List three compounds around you!

How big is an atom?

A pencil is made of carbon in the form of graphite and about 10,000,000,000,000 carbon atoms can fit on the tip of a piece of 0.7mm pencil lead.

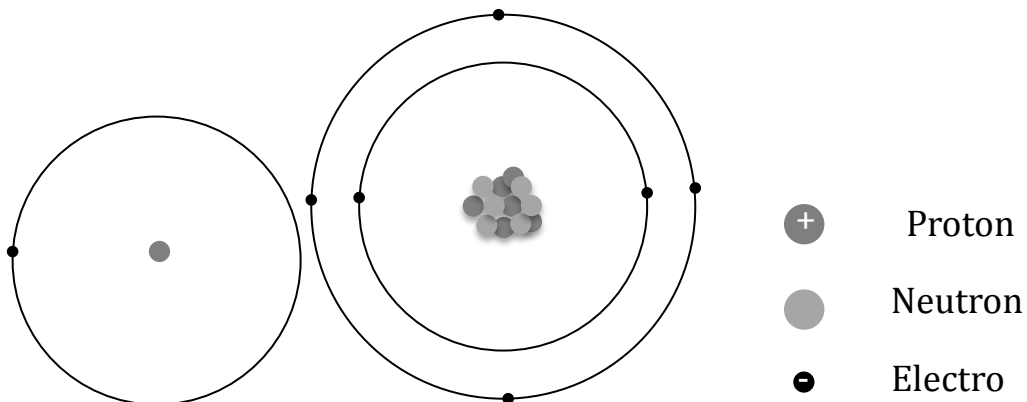


What is an atom?

Atoms are made of even smaller components: protons, neutrons and electrons. Protons and neutrons make up the nucleus of an atom. Electrons are not in the nucleus of the atom but surround the nucleus like a cloud.

- Protons have a +1 charge
- Neutrons do not have a charge
- Electrons have a -1 charge

Below is a hydrogen atom and a carbon atom. The hydrogen atom has a proton and an electron and the carbon atom has 6 protons, 6 neutrons and 6 electrons. The number of protons in the nucleus will determine the element of the atom.



Things to know about charge!

- Opposite charges will attract each other and like charges will repel each other.
- Charge must always be conserved – electrons and protons will not disappear. Electrons can transfer from one atom to another.
- Things can have a partial charge depending on their surroundings. If you hold a negatively charged item next to a neutral item a partial charge will develop. A partial charge is like a migration of charge from one area to another.

If like charges repel each other what do you think the partial charge will be on the neutral object closest to the plastic bag? Draw your prediction below!

Plastic Bag Neutral



Activity 1

Exploring Charge

Take a strip of plastic bag and run the material through your fingers a few times

Hold the strip of plastic bag next to a variety of objects. In the table below write your observations.

Your hand which you ran the plastic bag through	
A table	
A chair	
Another strip of plastic bag	

The plastic bag after you run it through your fingers becomes negatively charged. What does this mean?

What is the charge of your hand?

What is the charge of the table and chair?

Activity 2: Digging Deeper: Atomic Structure

Definitions: Can you fill in these definitions?

Element:

Atom:

Electron:

Proton:

Orbital:

Energy Level/Shell:

Lewis Diagram:

Ionic Bond:

Covalent Bond:

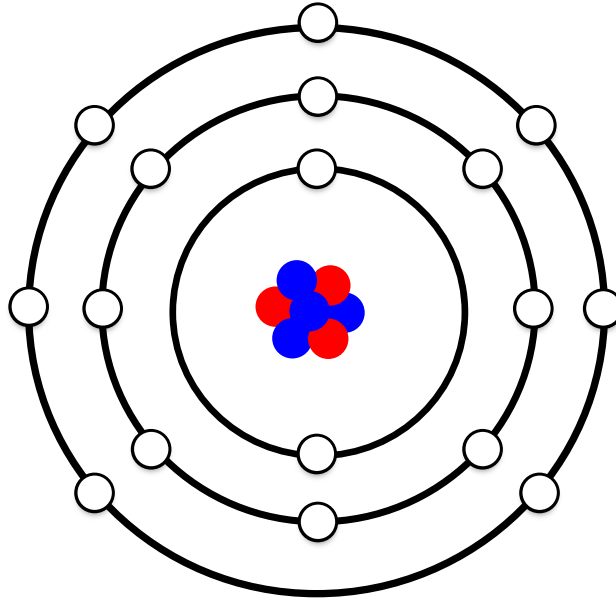
The Periodic Table:

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 * lanthanum 57 La 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]						
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * * actinium 89 Ac [227]	luthetium 103 Lr [262]	rutherfordium 104 Rf [261]	bohrium 105 Db [262]	seaborgium 106 Sg [261]	bohrium 107 Bh [264]	hassium 108 Hs [265]	meitnerium 109 Mt [269]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	unbibium 112 Uub [277]	unseptadium 114 Uuq [289]										

* Lanthanide series	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [143]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
* Actinide series	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

Structure of the atom:

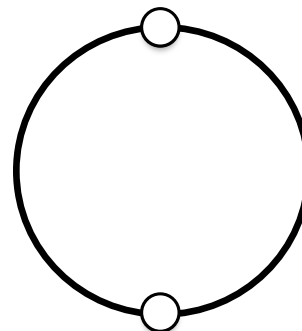
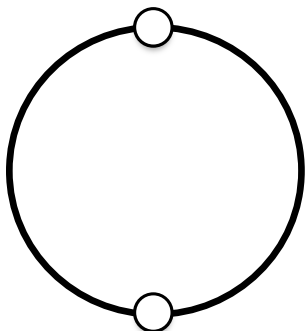
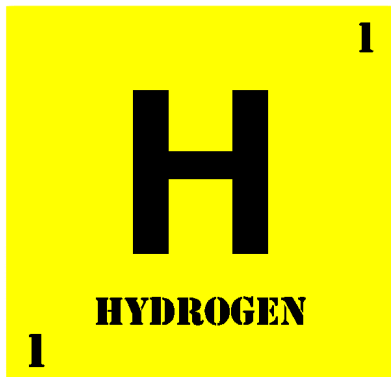
This is a Bohr diagram of the atom:



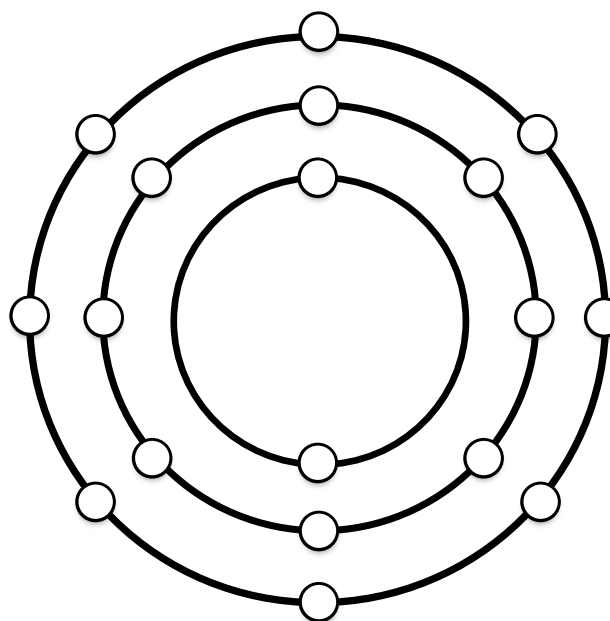
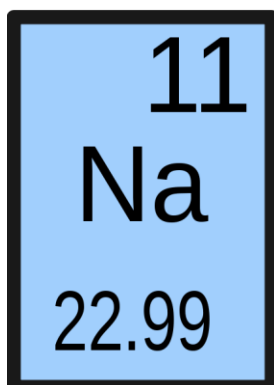
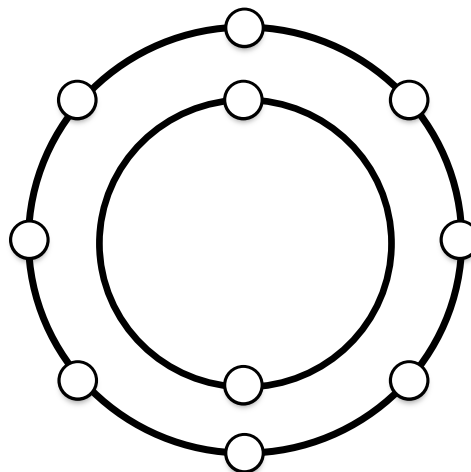
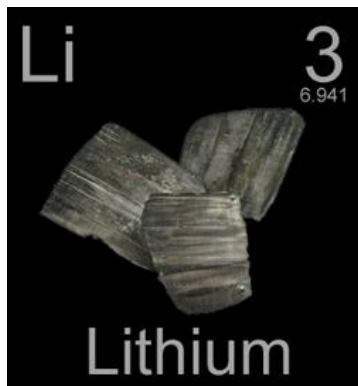
Protons are located in the nucleus with the neutrons
Electrons are located around the nucleus

This picture is not complete though, since there are missing electrons. Let's fill in the missing electrons for the first two elements:

Place the correct number of protons and electrons in the model:



What about the first column or family of the table?
What do these look like?

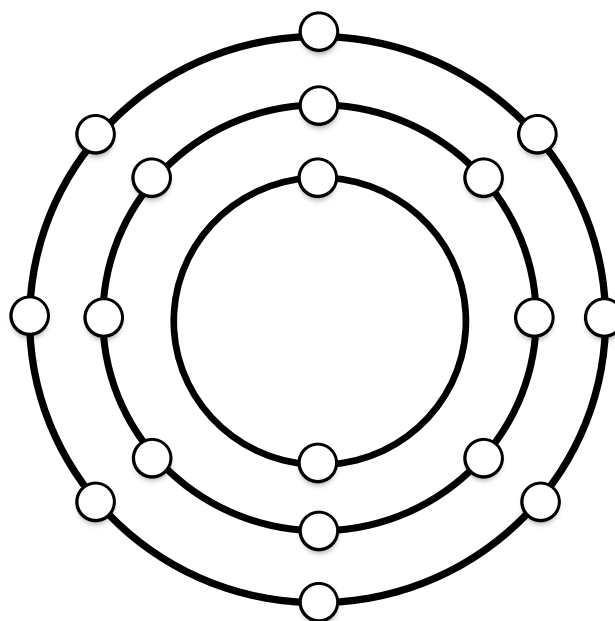
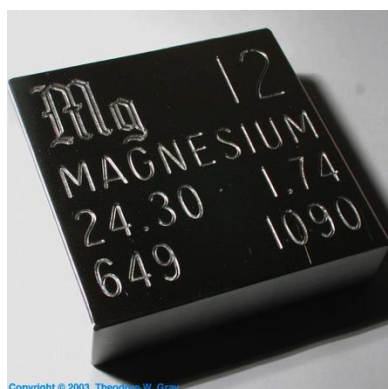
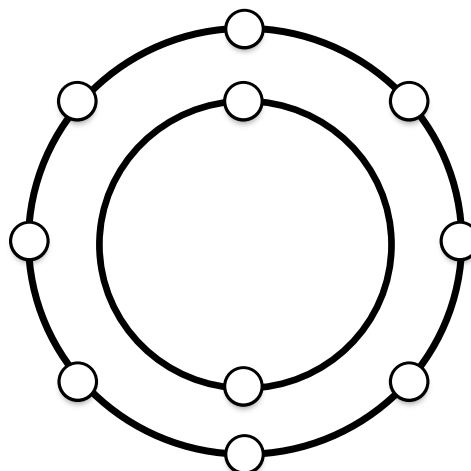
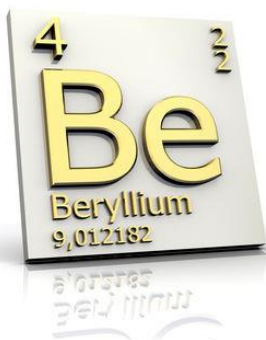


What is the same about H, Li, and Na?

What is a Valence electron?

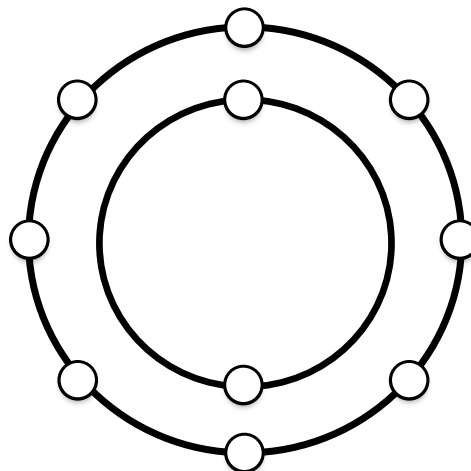
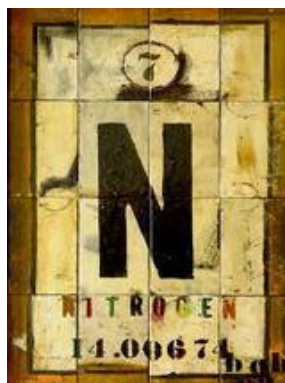
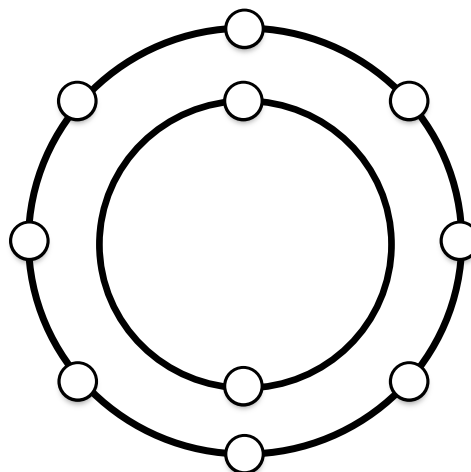
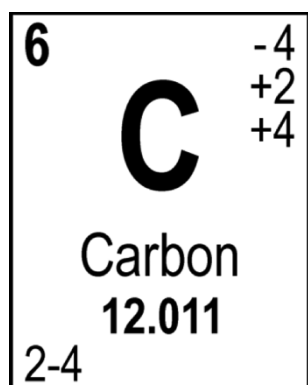
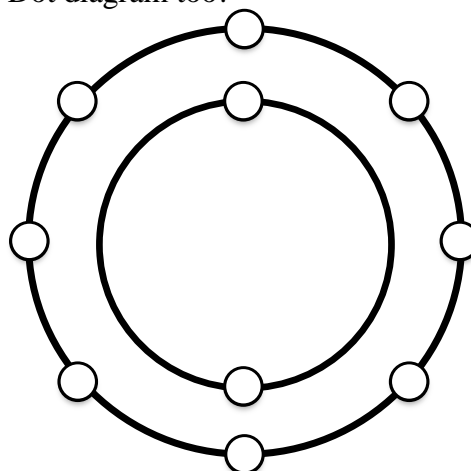
Can you draw the Lewis Dot Diagram?

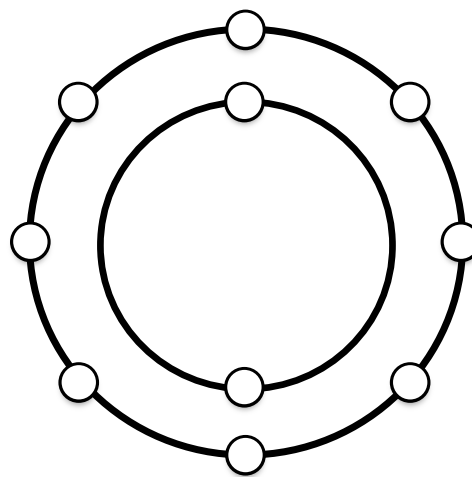
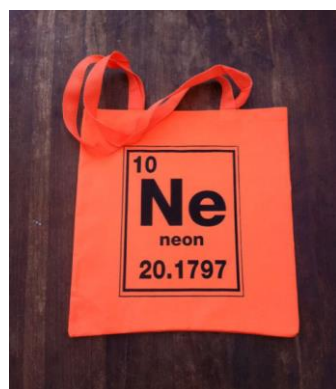
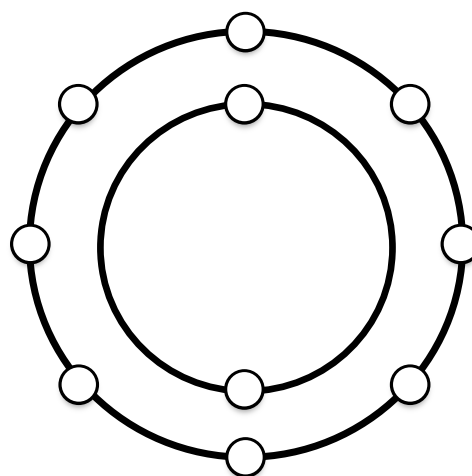
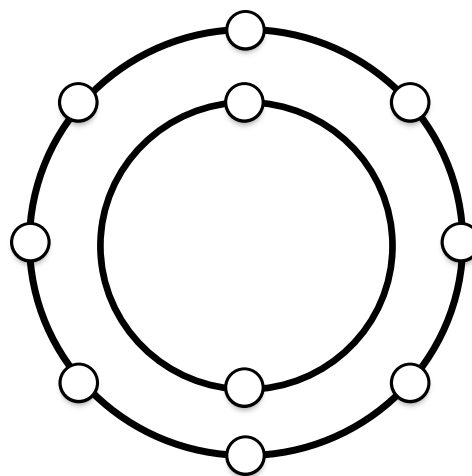
How about the next family?



What is the Lewis Dot structure?

How about the rest of the families? Draw the Lewis Dot diagram too!





Atoms like to have 8 electrons. This behavior is called the octet rule!
 Knowing this, which families do you think will react with each other?

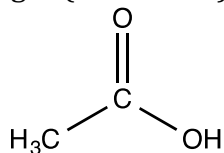
Activity 3 - Understanding Chemical Reactions

Reactions involve the breaking and forming of new bonds. There are two components to a reaction: the reactants are the starting material and products are the ending material. In this next experiment you are going to perform some chemical reactions!

Lets look at baking soda and vinegar!



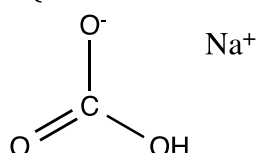
Vinegar (acetic acid)



Are these elements or compounds?



Baking Soda (sodium bicarbonate)



What elements are these made of?

Count up the atoms of each type

Which compounds are covalently bound or ionically bound?

Put a small scoop of baking soda into a Dixie cup
Add 1 mL of vinegar

What observations can you make when you mix baking soda with vinegar?

We know what the reactants are but what are the products?

This type of reaction is called a metathesis reaction. This is where the positively charged species and negatively charged species of each component of the reaction switch places with each other like shown below.



Use the paper elements provided which make up the products to determine what they are!

Do these products agree with your observations? Label each of the products a solid, liquid or gas!

Lets try another metathesis reaction!

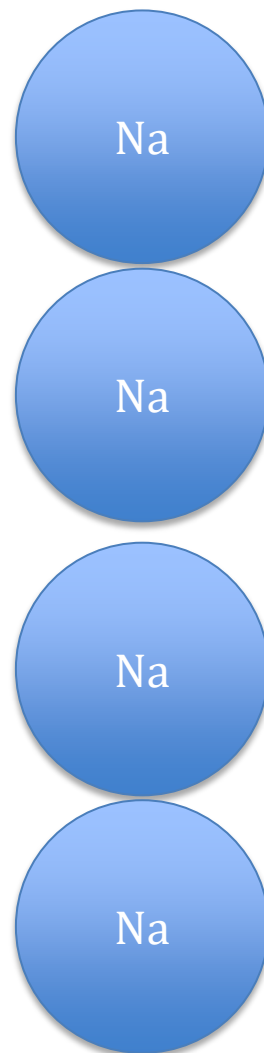
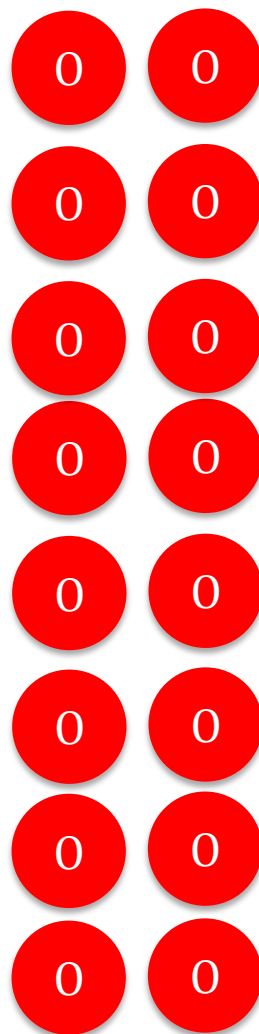
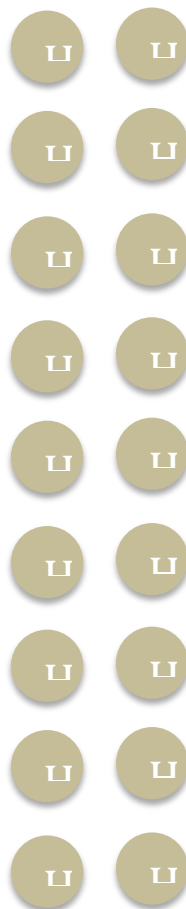
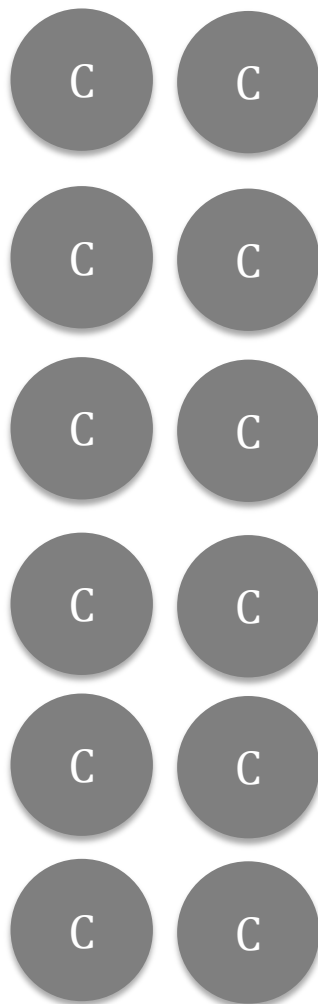
This time we are going to mix baking soda dissolved into water with calcium chloride dissolved into water.

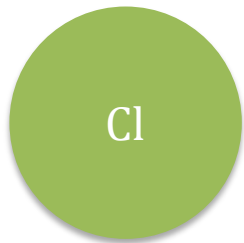
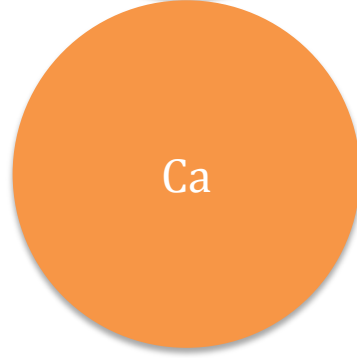
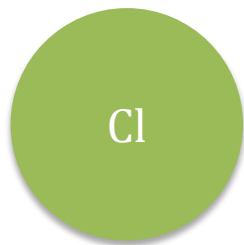
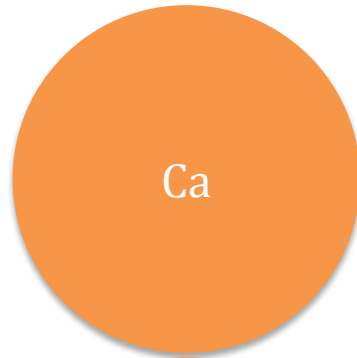
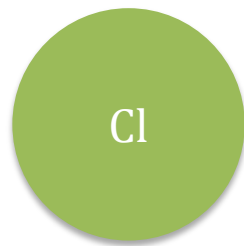
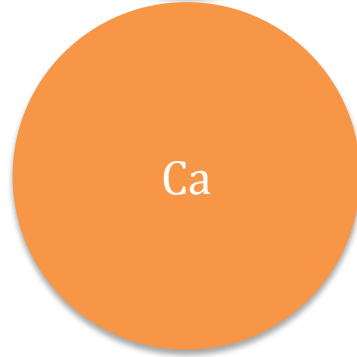
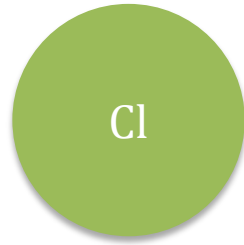
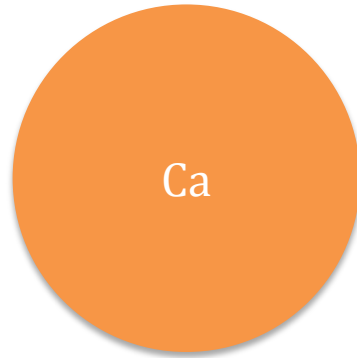
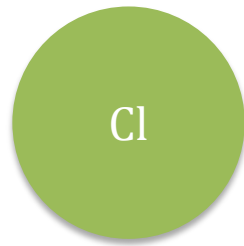
Pour the baking soda solution into the calcium chloride solution..

What are your observations?

Did a chemical reaction occur?

Now lets determine the products of the reaction using the paper elements you can cut out below! Do these products match your observations? Label each of the products a solid, liquid or gas!





Activity 4 – Alien Periodic Table!

Procedure

1. Place the elements in their proper place in the Alien periodic table outline. Remember, same laws of reactivity apply throughout the universe.

Elements:

A	B	C	D	E	F	G	H	I	J	K
L	M	N	O	P	Q	R	S	T	U	V
W	X	Y	Z	#	+	*	\$			

2. There are 34 spots on the Martian periodic table but 4 of the elements have not been discovered yet so those spots should be filled with a question mark.

Hint: Before you are finished, go back over all properties again to be sure your table works for all of them.

After finishing, place the correct atomic number for each element in the block.

Properties of Martian Elements:

1. The metal with the largest atomic radius is X.
2. The smallest element in the most reactive nonmetal group is I.
3. The noble gases are B, L, W, and J.
 - a. B has the smallest mass
 - b. W has the largest mass
 - c. L is in period 2
4. The least massive of all elements is A
5. All of the following elements have 3 energy levels. The number given is the number of valence electrons.

\$	1	Z	2	Y	3
H	4	M	5	O	6
K	7				

6. Element H has 14 protons
7. G has 7 electrons
8. C has an atomic mass of 5 and forms the compound CI.
9. Q has only 1 valence electron but has 4 energy levels
10. The E family is made up of E, Y, R and + in order of increasing mass.
11. *is the most massive of all discovered elements and is radioactive.
12. P is in period 5 and usually creates a +2 ion.
13. D is in period 2 and has the formula DI_2 for one of its salts
14. F is like the Earth element carbon and is in the same family as H, T, and *.
15. The Martian universal solvent, which is like Earth's most important liquid, has the formula A_2N .
16. Here are a few compounds that typically form:

AV #I₂ DU FA₄ #U #3S₂

Alien Periodic Table

+1							0
	+2	+3	+4	-3	-2	-1	

Element List:

A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P
Q	R	S	T	U	V	W	X
Y	Z	#	+	*	\$		