ESS 100 (Stapleton)
Structure of Matter (especially water)
Part 1

Name: Key

Periodic Table of the Elements

1																	18
hydrogen 1 H 1.0079	2											13	14	15	16	17	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	3	4	5	6	7	8	9	10	11	12	aluminium 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	selenium 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 ■	lutetium 71 Lu 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 ■	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	darmstadtium 110 Ds [271]	roentgenium 111 Rg [272]	ununbium 112 Uub [277]	ununtrium 113 Uut [284]	ununquadium 114 Uuq [289]	ununpentium 115 Uup [288]	ununhexium 116 Uuh [292]	ununseptium 117 Uus [291]	ununoctium 118 Uuo [294]

■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 [145]	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]

Element: a substance that cannot be chemically broken down into a simpler substance; a type of atom

Atomic Symbol: A two letter symbol representing an element.

Atom: the basic unit of a chemical element; the smallest particle of an element that is still considered to be that element — A circle with a letter in it.

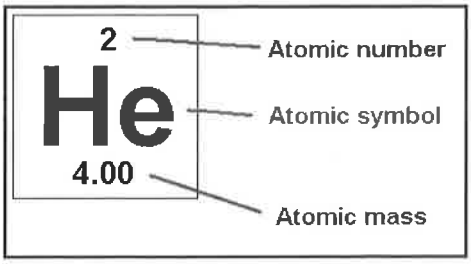
Periodic Table of The Elements: a table organizing all of the known elements by atomic masses and other characteristics.

Molecule: a group of atoms bonded together by sharing electrons (electron sharing is indicated in Mr. Stapleton's drawings by lines connecting atoms)

Chemical Compound: more than one type of element chemically combined

Ion: a charged atom or molecule; charge may be + or -

Ionic Compound: multiple types of atoms held together by opposite charges

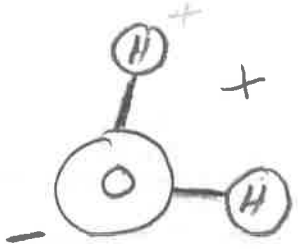


Polar Molecule: A molecule that does not have an overall charge (it is not + or -), but which has one end that is more positive and one end that is more negative.

Non-Polar Molecule: A molecule that does not have a positive and a negative end.

Chemical formula: a shorthand way of listing the numbers of atoms of each element in a compound. The symbol of each element in the substance is followed by the number of atoms of that element.

Draw a water molecule:



1. How many elements are in water? What are they?

2 Oxygen, Hydrogen

2. Is water a molecule? Explain.

Yes. Atoms are connected with lines, meaning they share electrons.

3. Is water a compound? Explain.

Yes. It has more than one element

4. How many atoms are in a water molecule?

3

5. Is water polar or non-polar? Explain. What causes it to be this way?

Polar. The Oxygen has a negative charge, and the hydrogen end has a positive charge.

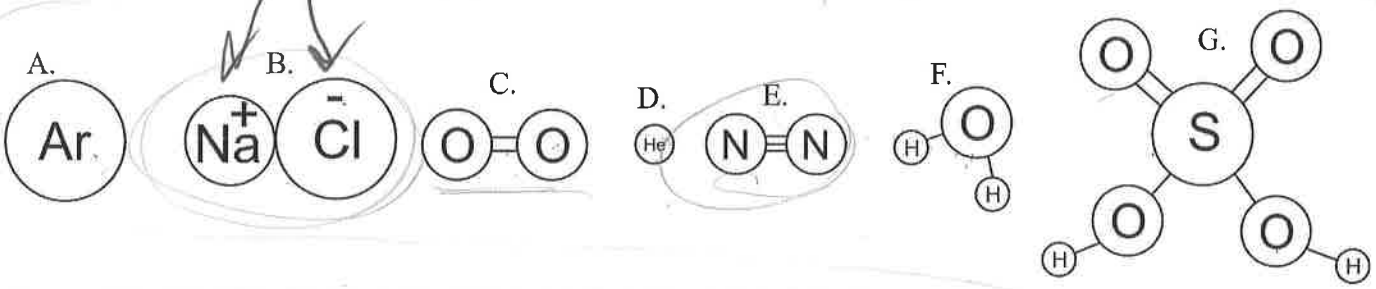
6. What is the chemical formula for water?

H_2O

Vocabulary Practice:

1. How many atoms are shown in the diagrams below? 18 (Circles with symbols)
2. How many elements? 8
3. How many molecules? 4 (C E F G)
4. How many compounds? 3 (B, F, G)
5. How many ions? 2
6. Which lettered items are compounds but not molecules? B
7. Which lettered items are molecules but not compounds? C, E
8. Which items are neither molecules nor compounds? A, D
9. What is the molecular formula for the substance lettered "G?" H_2SO_4
10. Which item is water? F

Ar N
Na H
Cl S
O
He



11. For each of the items above, tell what a chemist might call the item.

A. Argon atom (3rd most common substance in air)

B. Sodium chloride; table salt; NaCl

C. Oxygen; O_2 (2nd most common in air)

D. Helium atom

E. Nitrogen; N_2 (Most common in air)

F. Water; H_2O

G. H_2SO_4; sulfuric acid; battery acid

aluminum
aluminium

States of Matter Simulation:

Open, download, and run the states of matter simulation at this web address:
http://phet.colorado.edu/en/simulation/states-of-matter

1. Click the states of matter buttons to switch back and forth between Solid, Liquid, and Gas. Describe what the particles are doing in each state.

Solid: Touching; vibrating, but not moving around

Liquid: Moving around, but touching

Gas: Flying free, but occasionally bumping into each other

2. The simulation allows you to experiment with Neon, Argon, Oxygen, and Water. Fill in the table for each substance, as it is pictured in the simulation.

Substance	How many atoms make up one particle?	Is it a molecule?	Is it a compound?	What is the chemical formula?
Neon	1	No	No	Ne
Argon	1	No	No	Ar
Oxygen	2	Yes	No	O_2
Water	3	Yes	Yes	H_2O

3. For each substance, rank the densities of different states of matter. 3 = most dense; 1=least dense

Substance	Solid	Liquid	Gas
Neon	3	2	1
Argon	3	2	1
Oxygen	3	2	1
Water	2	3	1

4. Based on your table of densities above, which substance is unique?

Water. It is most dense in liquid form.