

Lesson Plan - Atoms and Water Molecules

Summary

This lesson and activity will help students understand what atoms and elements are and how they are the building blocks of matter. Students will create a water molecule to demonstrate how atoms and elements build molecules and matter.

Subject Area

Chemical Science/ Oceanography

Grade Level

1-2

Lesson Plan - Atoms and Water Molecules

Key Concepts

- Atoms are the smallest parts or “building blocks” of elements, molecules, and matter.
- The Periodic Table of Elements is all of the atoms and elements (and their properties) currently known to scientists.
- The atoms is made up of three parts: protons, neutrons, and electrons
- Water is made up of 2 Hydrogen atoms and 1 Oxygen atom and has very unique properties.

Objectives

Students will be able to:

- Understand that atoms are the smallest components of elements, molecules, and matter
- Understand that the periodic table of elements is a list of all the atoms/ elements known to scientists
- Name the parts of an atom
- Name two characteristics unique to the water molecule

Lesson Plan - Atoms and Water Molecules

National Science Education Standard or Ocean Literacy Essential Principle	Learning Goals
Unifying Concepts and Processes 1. Systems, order, and organization	Types of organization provide useful ways of thinking about the world.
Unifying Concepts and Processes 2. Evidence, models, and explanation	Models help scientists and engineers understand how things work.
A.1: Abilities necessary to do scientific inquiry	Ask a question about objects, organisms, and events in the environment.
B.1: Properties of objects and materials	1. Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. 2. Materials can exist in different states—solid, liquid, and gas.

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National Science Education Standard or Ocean Literacy Essential Principle

D.1: Properties of earth materials

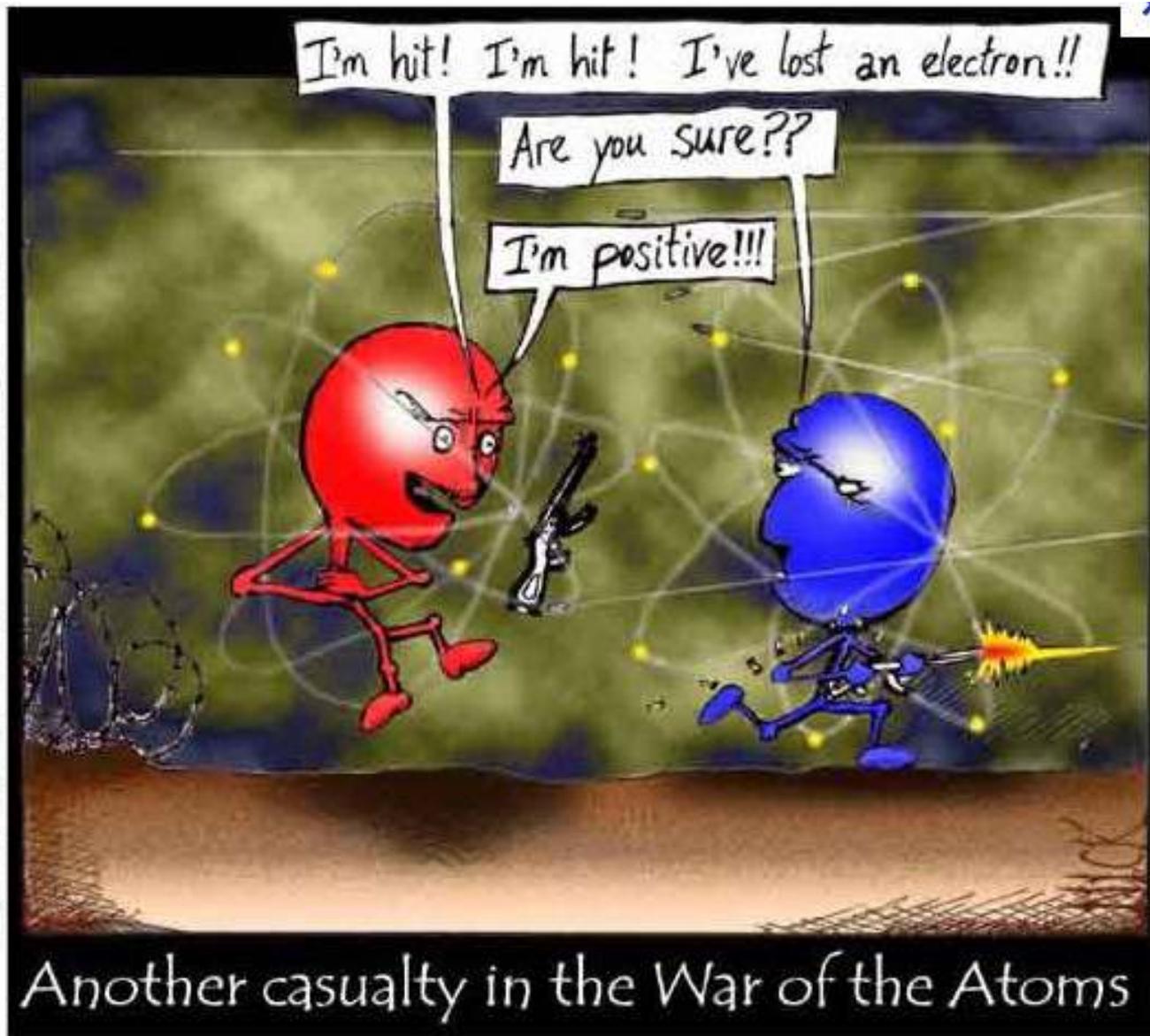
Principle 1 (K-2:A): Earth has one big ocean with many features.

Learning Goals

Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways

Ocean water has unique properties.

STRANGE MATTER
by nick d. kim strange-matter.com



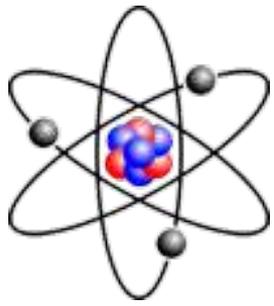


Think of making molecules from atoms like building words with letters.

- We sort letters into two groups:



“I just don’t get that guy. Sometimes he sits with us, sometimes he doesn’t!”



Think of making matter from molecules and atoms like building sentences with words and letters.



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KAMAGURKA

Before we build a molecule from atoms, we will build a sentence from letters and words!

Solve the sentence puzzle using the word clues from your class.

W b w a ?

 2 3 5 4 1

Solve the word puzzle by putting the correct letters from the sentence above in the numbered spaces below.

_____ r
1 2 3 4 5

All matter is made from atoms!

- The word "atom" comes from the Greek word *indivisible*
- *When we say the Pledge of Allegiance, we say “...one nation under God, **INDIVISIBLE**, with liberty and justice for all.”*



What we really mean is that it can't be divided or separated into smaller parts.

The “alphabet” for atoms is the Periodic Table

Periodic Table of the Elements © www.elementsdatabase.com

1 H																	2 He														
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne														
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar														
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr														
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe														
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn														
87 Fr	88 Ra	89 Ac	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Unn																						
																		58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
																		90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Legend:

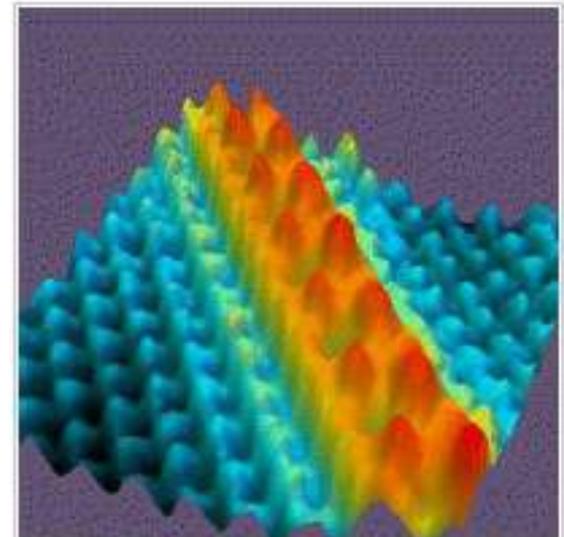
- hydrogen
- alkali metals
- alkali earth metals
- transition metals
- poor metals
- nonmetals
- noble gases
- rare earth metals

There are 26 letters in the alphabet.

There are about 115 elements in the language of chemistry. It changes as we make discoveries!

Atoms make up elements--the building blocks of matter

- The building blocks are too small to see, even with a light microscope.
- In 1981, the **Scanning Tunneling Microscope** was invented. It uses electric currents to 'see' atoms.



STM image (7 nm x 7 nm) of a single zigzag chain of cesium atoms (red) on a gallium-arsenide surface (blue)
Photo courtesy National Institute of Standards and Technology (NIST)

The atom is made up of 3 parts

- **1) Proton**

- Protons have a **POSITIVE** charge.

- **2) Neutron**

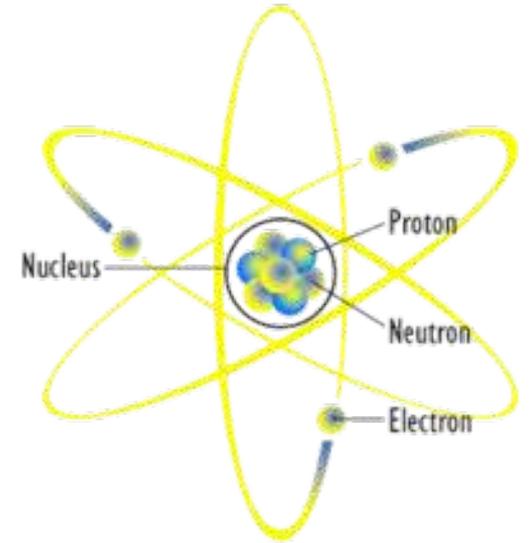
- Neutrons have **NO** charge.

- **3) Electron**

- Electrons have a **NEGATIVE** charge.

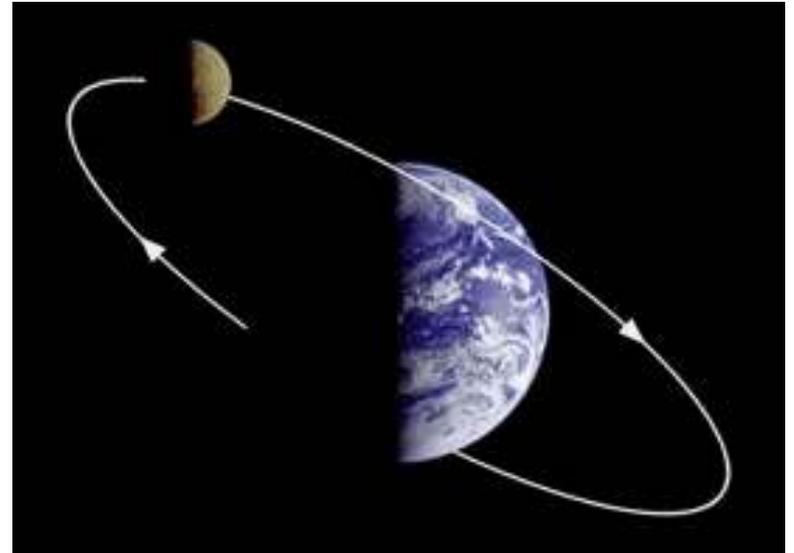
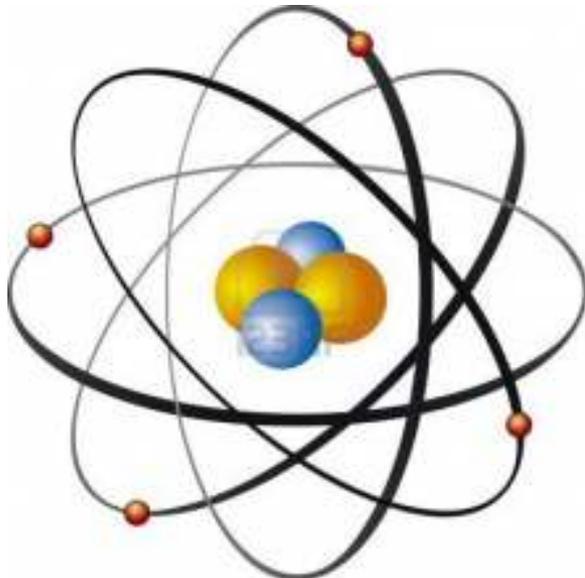
- Electrons are by far the smallest. We do not yet have the technology to measure their mass and size.

- Most atoms have a neutral charge because the number of protons and electrons are the same.



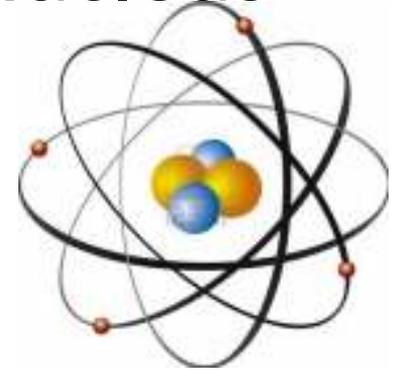
Electrons orbit the nucleus like the moon orbits Earth

- The place where electrons are found are called orbitals.
- In each orbital, there can only be a certain number of electrons.
- The negative charge of electrons is attracted to the positive charge of the protons.
- This is why we say 'opposites attract'!



Protons and neutrons are in the nucleus

- Protons and neutrons are about the same size.
- They are in the 'middle' of the atom, or the nucleus.
We will put our protons (goldfish) and neutrons (gummies) in our nucleus (plastic egg)

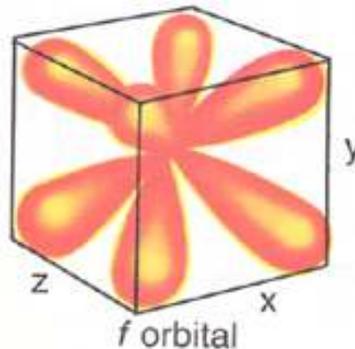
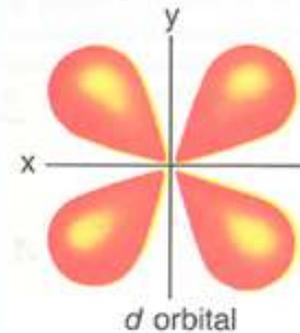
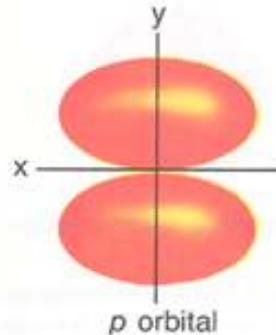
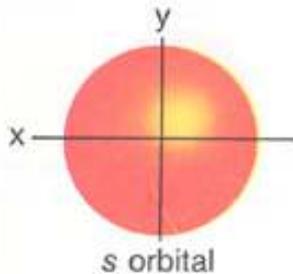


- When the number of protons and neutrons is equal, the nucleus is stable—it stays the way it is.
- When there is more of one than the other, the atom tries to make the numbers the same by getting rid of the extra parts.

Electrons

- Around the nucleus some electrons are further out than others.
- The further away the electron is from the nucleus, the weaker the pull of the nucleus on it. This is why bigger atoms, with more electrons, react more easily with other atoms.

Orbitals



The number of Protons and Electrons determine the kind of element.

Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18														
1	H Hydrogen 1.008	Period 1																														
2	He Helium 4.003	Period 2																														
3	Li Lithium 6.941	Be Beryllium 9.012	Period 3														Ar Argon 39.948															
4	Na Sodium 22.990	Mg Magnesium 24.305	Al Aluminum 26.982	Si Silicon 28.086	P Phosphorus 30.974	S Sulfur 32.065	Cl Chlorine 35.453	Ar Argon 39.948	K Potassium 39.098	Ca Calcium 40.078	Sc Scandium 44.956	Ti Titanium 47.887	V Vanadium 50.942	Cr Chromium 51.996	Mn Manganese 54.938	Fe Iron 55.845	Ni Nickel 58.693	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.64	As Arsenic 74.922	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.798							
5	Rb Rubidium 85.468	Sr Strontium 87.62	Y Yttrium 88.906	Zr Zirconium 91.224	Nb Niobium 92.906	Mo Molybdenum 95.94	Tc Technetium [98]	Ru Ruthenium 101.07	Rh Rhodium 102.91	Pd Palladium 106.42	Ag Silver 107.87	Cd Cadmium 112.41	In Indium 114.82	Sn Tin 118.71	Sb Antimony 121.76	Te Tellurium 127.6	I Iodine 126.91	Xe Xenon 131.29														
6	Cs Cesium 132.91	Ba Barium 137.33	La Lanthanum 138.91	Ce Cerium 140.12	Pr Praseodymium 140.91	Nd Neodymium 144.24	Pm Promethium [145]	Sm Samarium 150.36	Eu Europium 151.96	Gd Gadolinium 157.25	Tb Terbium 158.93	Dy Dysprosium 162.50	Ho Holmium 164.93	Er Erbium 167.26	Tm Thulium 168.93	Yb Ytterbium 173.05	Lu Lutetium 174.97	Hf Hafnium 178.49	Ta Tantalum 180.95	W Tungsten 183.84	Re Rhenium 186.21	Os Osmium 190.23	Ir Iridium 192.22	Pt Platinum 195.08	Au Gold 196.97	Hg Mercury 200.59	Tl Thallium 204.38	Pb Lead 207.2	Bi Bismuth 208.98	Po Polonium [209]	At Astatine [210]	Rn Radon [222]
7	Fr Francium [223]	Ra Radium [226]	Period 7														Rg Roentgenium [288]															

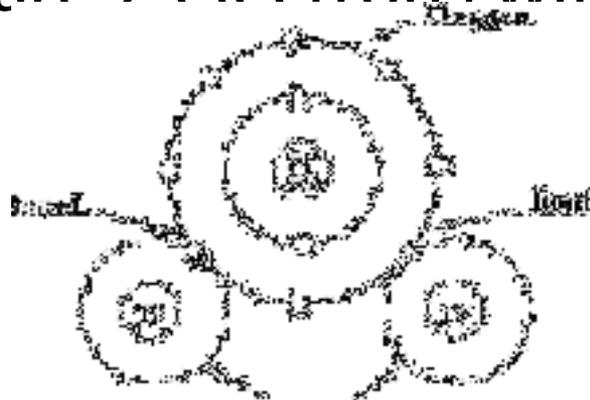
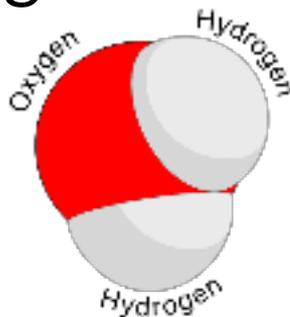
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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Water is the most amazing molecule!

- Hydrogen is the only element without a neutron. It has 1 proton and 1 electron.
- Oxygen has 8 protons, 8 neutrons and 8 electrons.
- Hydrogen and oxygen form water when 2 Hydrogen atoms share 2 electrons with 1 Oxygen atom.



Only water...H₂O

- Water in its solid state is less dense than its liquid state.
 - Solid ice floats on liquid water!
- Water expands when it turns solid.
 - Most molecules shrink together or compress.
- Ice is less dense than liquid water because of the way the atoms line up and bond together!





GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

Activity

Mostly Edible Water Molecule

Step by Step: Let's make a water molecule

Materials

- Plastic Easter eggs
- Small (smaller than the plastic eggs) plastic spheres (similar to those found in prize machines)
- Play dough or modeling clay
- Toothpicks
- Goldfish crackers
- Raisins

Step by Step: Let's make a water molecule

1. Put 1 goldfish (proton) in the first small sphere and close.



2. Put 1 goldfish in the second small sphere and close.

These are your Hydrogen atoms without their electrons.



3. Put 8 goldfish and 8 gummies (neutrons) in your plastic egg.
Close it carefully. This is your Oxygen atom without its electrons.



4. Attach one raisin (electron) to the end of a broken toothpick.



5. Do this again for the other 7 raisins and toothpicks.

These are the electrons in the outer orbital (6 for oxygen and 1 for each hydrogen).



6. Use Play Dough to stick 6 toothpicks with raisins to the outside of the plastic egg.



7. Stick the remaining two toothpicks with raisins on the Hydrogen atoms.



8. Try your best to attach the two Hydrogen spheres to the plastic egg. Use more Play Dough if you need.
In a water molecule, each Hydrogen atom shares its only electron with an Oxygen atom.





GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

Acknowledgements

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