General Biology
Biological Chemistry Lab

Introduction:

All matter, including living things, are made of small particles called atoms. The tables in your classroom, the air in the atmosphere, the water in the oceans, and even the cells in your body are made of these building blocks called atoms. There are 92 different kinds of atoms which occur in nature. Each different kind of atom is called an element. An element cannot be broken into simpler parts by chemical reactions. Each element has unique physical and chemical properties. Examples of elements include oxygen, gold, lead, aluminum and nitrogen. Every single atom of a single type of element shares the same chemical and physical properties.

Atoms react with other atoms to form compounds and molecules. A compound is a substance which is made of 2 or more different kinds of atoms. Water, which is made of 2 hydrogen atoms and 1 oxygen atom is an example of a compound. A molecule is a substance which is made of 2 or more atoms. Two atoms of the same element can sometimes bind together to form a molecule. For example, two atoms of oxygen can form a chemical bond with each other to form an oxygen molecule.

Atoms are made of smaller particles which actually determine the chemical and physical properties of each atom. These subatomic particles include protons, neutrons, and electrons. Protons and neutrons each have a mass equivalent to 1 atomic mass unit. Electrons are so small that there mass is negligible. Protons have a positive charge, electrons have a negative charge, and neutrons are neutral. The information in the periodic table allows us to determine the number of protons, neutrons, and electrons in each different kind of atom.

Materials

Periodic Table of the Elements

Procedure:

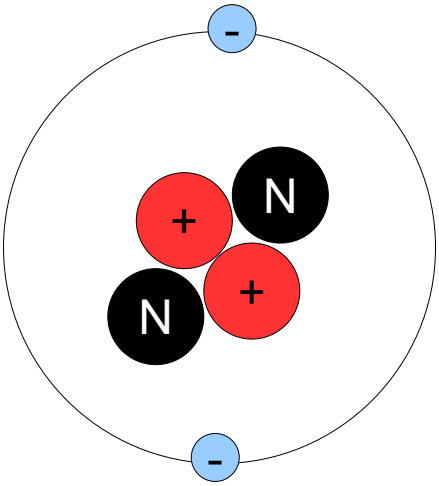
1.1 Subatomic particles

Complete the table below.

Name	**Weight**	**Charge**
Proton	1 AMU	+
Neutron	1 AMU	No charge
electron	0 AMU	-

Use the information presented in class to create a diagram which shows the location of the protons, neutrons, and electrons in an atom of Helium.

Helium

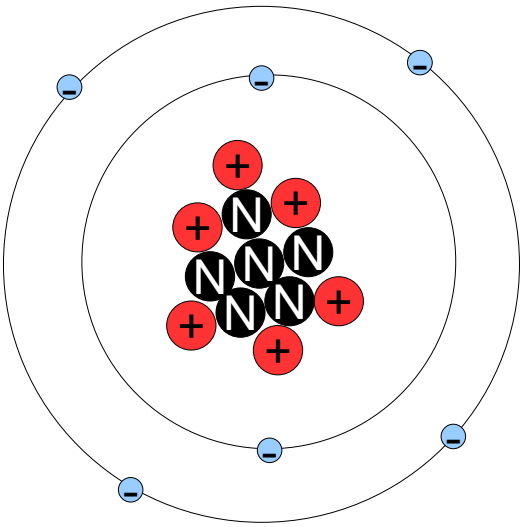


1.2 Electron Orbitals

Electrons revolve around the nucleus is pathways called orbitals or shells. Each orbital or shell will hold a finite number of electrons. The amount of kinetic energy each electron possesses depends on which orbital or shell it is located within. The electrons closest to the nucleus have the least amount of energy. Electrons remain in the orbitals around the nucleus because they are attracted to the positive charges that the protons in the nucleus possess. When filling orbitals with electrons, you must fill the orbital closest to the nucleus with electrons before placing electrons in the next orbital. The shell closest to the nucleus will hold a maximum of 2 electrons. The second and third orbitals will hold a maximum of 8 electrons.

Draw a carbon atom showing the location of the protons, neutrons, and electrons.

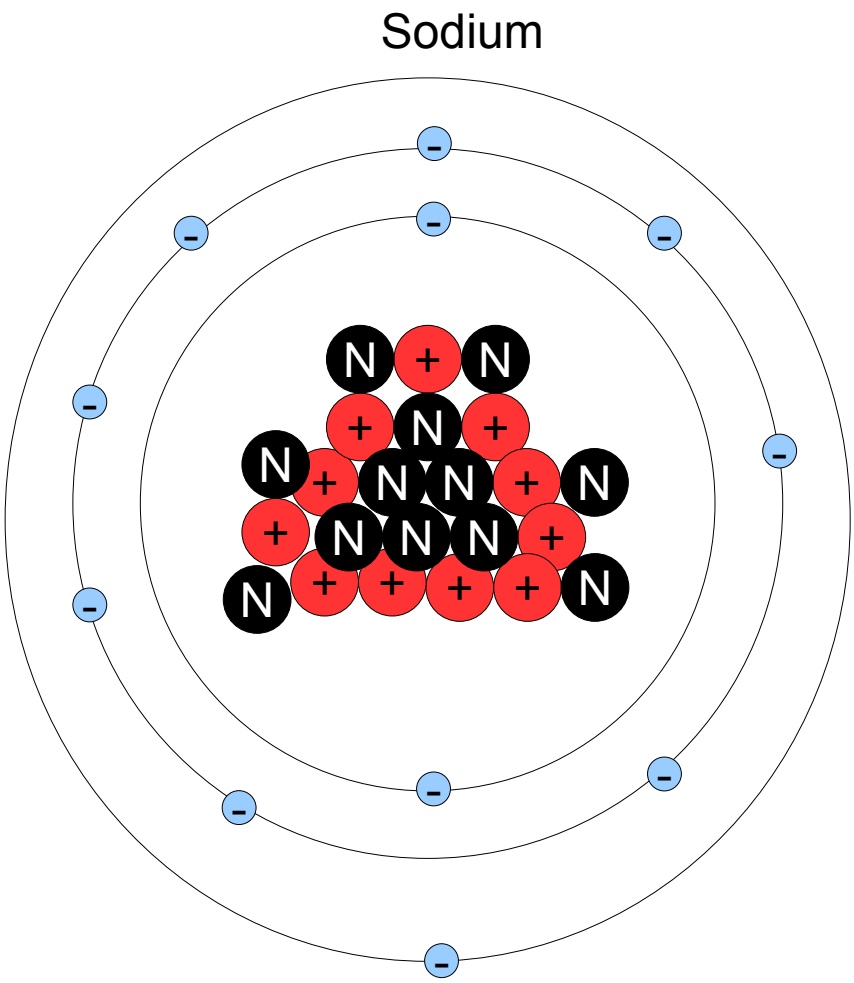
Carbon



How many electrons must the carbon atom gain to fill its outermost shell?

Four more electrons.

Draw a sodium atom, showing the location of the protons, neutrons, and electrons.



How many electrons must this atom lose in order for its outermost shell to be stable?

One.

The number of protons that an atom has determines the kind of atomthat that atom is. All carbon atoms have 6 protons, all helium atoms have two protons. The number of neutrons that an atom has may vary. For example, if you had drawn the sodium atom in the previous example with 11 neutrons, it would still be a sodium atom. The

number of protons in an atom is called the atomic number of that atom because the number of protons determines the kind of atom.

The mass of an atom is determined by the mass of its protons plus the mass of its neutrons. The mass of an atom is called the atomic mass.

What is the atomic mass of a Carbon atom?

12

What is the atomic mass of a Sodium atom?

23

1.3 The Periodic Table

Each element has been named and given a one or two letter symbol. The first letter of a chemical symbol is always capitalized, and the second letter is always in the lower case. The element's name, symbol, atomic number, and atomic mass can be found in the Periodic Table of the Elements. The Periodic table arranges elements in a fashion which allows a chemist to easily determine reactivity, physical properties, and chemical properties of various elements.

Use the periodic table to answer the following questions.

What is the symbol for lead? Pb

What element has the symbol Ca? Calcium

What is the atomic number for oxygen? 8

What is the atomic mass of gold? 197

What is the chemical symbol for potassium? K

What is the atomic number of phosphorus? 15

What is the atomic mass of oxygen? 16

What element has the chemical symbol S? Sulfur

How many electrons does a nitrogen atom have? 7

1.4 Ions

Atoms which gain or lose electrons are called ions. Ions are indicated by a + or – following the chemical symbol. Anions are ions which have a negative charge and

cations are ions which have a positive charge. Ions with opposite charges are attracted to each other to form chemical bonds called ionic bonds. These bonds are easily broken when the compound is placed in a solution of water.

Complete the following table.

Name	Symbol	# protons	# neutrons	# electrons	Atomic mass
Sodium atom	Na	11	12	11	23
Sodium ion	Na+	11	12	10	23
Chlorine atom	Cl	17	18	17	35
Chlorine ion	Cl-	17	18	18	35
Sodium chloride	NaCl	28	30	28	58
Carbon 12 atom	C	6	6	6	12
Carbon 14 atom	C	6	8	6	14
Calcium atom	Ca	20	20	20	40
Calcium Ion	Ca+2	20	20	22	40
Oxygen molecule	O2	16	16	16	32
Sulfur atom	S	16	16	16	32
Sulfide ion	S-2	16	16	14	32