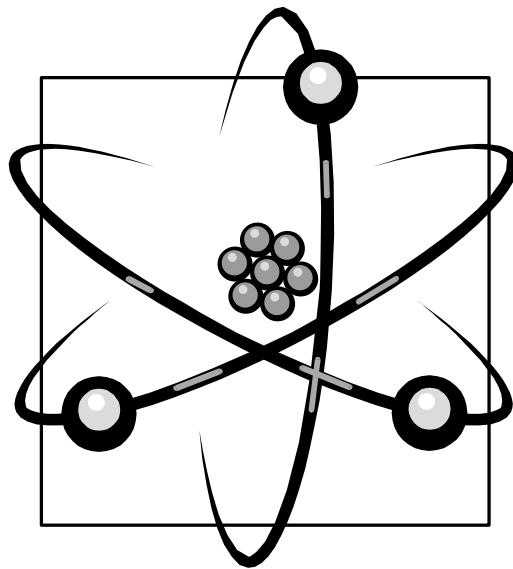
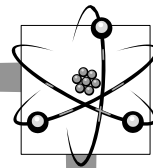


Unit 5: Introduction to the Atom





Vocabulary

Study the vocabulary words and definitions below.

atom the smallest unit of an element that is still that element; the basic building block of matter

attract move toward each other

bond the attraction that holds two or more atoms together

charge a property of an object that causes it to be affected by a magnetic field

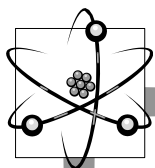
compound a substance formed when two or more elements combine chemically

electron the negatively charged particle of an atom; the electron moves around the center of the atom (nucleus)

element a substance that cannot be broken down into a simpler form by ordinary chemical means

molecule two or more atoms that have a bond of shared electrons

negative charge the charge of an electron



neutral being neither positively nor negatively charged

neutron the neutral particle found in the nucleus of an atom; a neutron has no charge

nucleus the middle part of an atom around which the electron(s) move

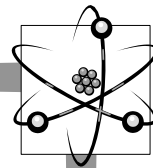
orbit the path(s) that the electron follows around the center of an atom

positive charge the charge of a proton; considered opposite of negative

proton the positively charged particle in the nucleus of an atom

repel push away from

shell the space that electron(s) occupy while in a certain orbit



Introduction

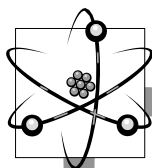
Did you ever wonder what is in air? Have you ever thought about how there are an incredible number of different things in the world? All that you see, touch, and feel is made from tiny units of matter. This unit will introduce you to these unseen building blocks of the universe.

Elements

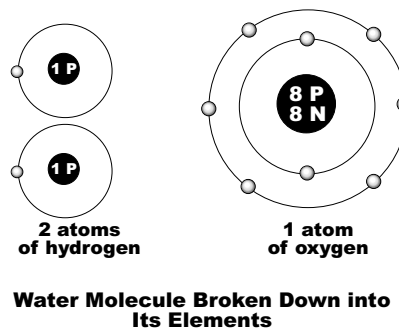
There are thousands and thousands of different substances in the world. Water is a substance. Sugar is a substance. Oxygen is a substance. All of the substances that we know are made of **elements**. The elements are the substances that have unique chemical and physical properties. Elements cannot be broken down into other substances that are unique. Of water, sugar, oxygen, which is the element? One way to find out is through chemistry. If we break down the water, we will get hydrogen and oxygen gas. If we break down the sugar, we get hydrogen, oxygen, and carbon. We cannot use chemistry to break down the oxygen. This means that oxygen is the element. Oxygen is a part of such substances as water, sugar, carbon dioxide, rust, and wood.

Atoms

All substances are made of **atoms**. Atoms are very tiny pieces of matter. An atom is the smallest unit of an element that is still that element. This may sound strange, but what it means is that an atom of gold is still gold. You cannot see that atom of gold. You cannot feel it. Despite this, it still has the physical and chemical properties of gold. Atoms still have all the properties of the element. An atom is the smallest unit of an element that can go through a chemical change. An atom can gain or lose **electrons**, a process which can then change its **charge**. Electrons are negatively charged particles that **orbit** the **nucleus** of an atom. If an atom gains extra electrons, it will become **negatively charged** (-). A loss of electrons will create a **positive charge** (+). There are about 120 different elements. So, there are about 120 different kinds of atoms. These atoms can combine with each other and form many different kinds of substances. One substance made from the combining of atoms is water. Water is made of two atoms of hydrogen and one atom of oxygen. One model for the



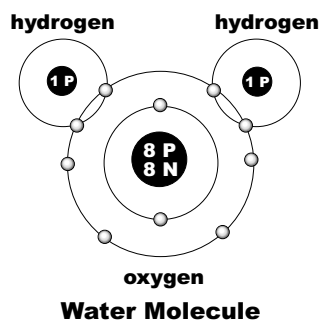
hydrogen atoms is shown here. Hydrogen has one **shell** of electrons. There is only one electron in the shell. The other, larger atom, is a similar model of oxygen. Oxygen has two shells of electrons. The outer shell has six electrons. In the next section we will talk about how these atoms combine. When two or more atoms combine, a chemical change takes place.



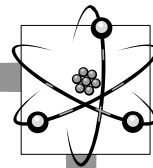
Molecules

A **molecule** is formed when atoms share electrons. In chemical reactions, only electrons are involved. This is because only electrons are on the outside of the atoms. Because its electrons are shared, a molecule is always made of two or more atoms.

Look at the diagram of a water molecule on the left. It has two hydrogen atoms and one oxygen atom. Notice where the electrons are in the diagram of the water molecule. Each hydrogen atom has its own electron, but each now shares an electron with oxygen. Oxygen has six electrons in its outer shell. Oxygen now shares electrons with the hydrogen atoms. Because these three atoms are sharing electrons, they form a molecule. Water is the substance made of molecules that have two hydrogen atoms and one oxygen atom.



Some molecules are not made of different types of atoms. For instance, the element chlorine is often seen as a molecule. In this case, two atoms of chlorine share electrons. Even though chlorine is often a molecule, it is still an element. Why is this? If you broke the **bonds** between the water, you would have two gases (hydrogen and oxygen) which are very different from water. If you broke the bonds between chlorine atoms, you would still have chlorine. Chlorine is just one of the elements that commonly form molecules. In fact, both oxygen and hydrogen atoms will form molecules when not bonded to other atoms. Now that you know what a molecule is, the next section will discuss **compounds**.



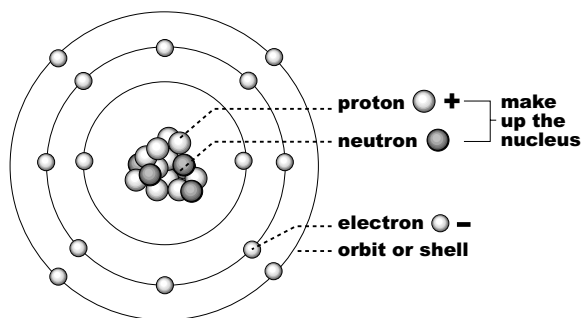
Compounds

A compound has two or more atoms of different kinds. Oxygen, remember, is an element. Its molecules are made of two atoms of oxygen. Water, however, is a compound. Its molecules are made of two atoms of hydrogen and one atom of oxygen. The behavior of molecules is determined by the forces holding the molecules together. The molecules in matter help explain the differences between solids, liquids, and gases. In a solid, the molecules are very close together. They cannot move around very easily. The molecules in a liquid are further apart and can move easily. In a gas, the molecules are very far apart. They can move freely. That's why the molecules of a gas always can fill a container.

When matter changes phase, the distance between the molecules changes. Gaining heat usually causes the molecules to move apart. This may cause melting. Freezing, which is a loss of heat energy, causes the molecules to slow down and move closer together.

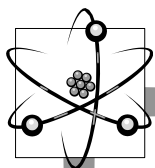
Inside the Atom

It is hard to imagine anything as small as an atom, but atoms are made of even smaller parts. Except for hydrogen, atoms have **protons**, **neutrons**, and **electrons**. (Hydrogen is made only of a proton and an electron.) The middle part of an atom is called the nucleus. It is made of protons and neutrons. Around the nucleus are electrons. Electrons move around the center of the atom. The paths they follow are called orbits. Orbits group together at certain distances from the nucleus. Then the orbits are grouped together, and this is known as a shell.



Parts of the Atom

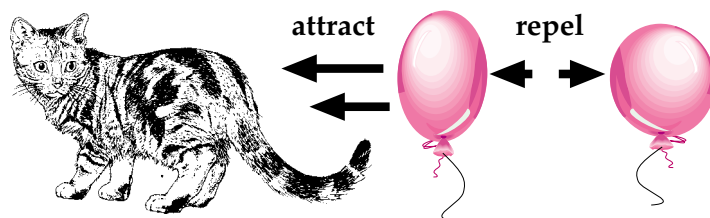
Each part of the atom is important. The proton has a positive charge. In math or science, a positive is shown with a plus (+) sign. A neutron has no charge. (Neutron sounds almost like **neutral**.) The electron that orbits



around the center of the atom has a negative charge. Negative is shown by a minus (-) sign. The electrons are the part of the atom that react chemically with other atoms.

We said that a proton has a positive charge, a neutron has no charge, and an electron has a negative charge. What do we mean by the word “charge”? It stands for an electrical charge. Things that have the same charge push each other away or **repel**, but things that have different charges will move toward each other or **attract**. The forces that push and pull objects based on their charges are known as electrical forces. These electrical forces are often described by the phrase, “Opposites attract, likes repel.”

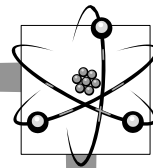
Usually matter is neutral. It has no charge. In an atom, the number of electrons (-) equals the number of protons (+). It is possible for an electron (-) to be added to an atom. Rub two balloons filled with air on a piece of fur or wood. The atoms in the balloons pick up an extra electron atom from the fur. They now have a negative (-) charge. Place the balloons next to each other. They will move away from each other. Remember, two negatives (-) will push away from or repel each other. What about the fur? It has lost electrons. Now it has a positive (+) charge. Rub a balloon on the fur. The balloon is negative (-) and the fur is positive (+). The balloon should move toward the fur.



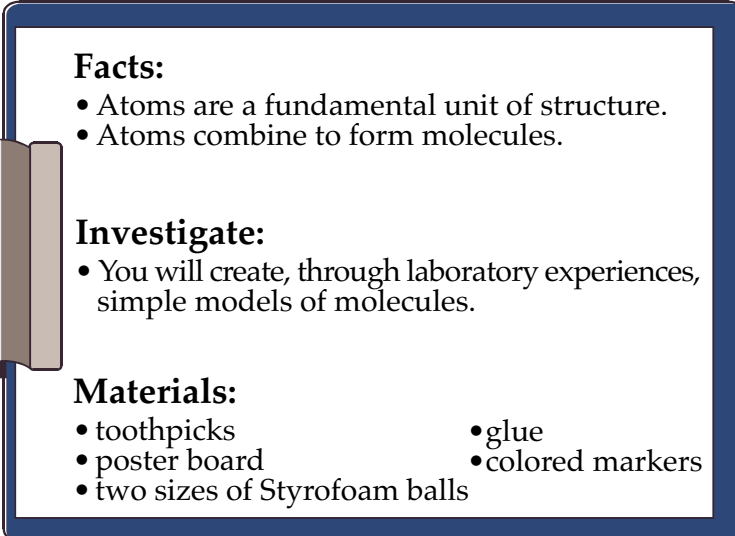
Opposites attract, likes repel.

Summary

We have learned some important facts about atoms. We know that they are the smallest unit of an element that is still the element. Elements are made of only one kind of atom. We know they form molecules when they share electrons. We also know they combine with other atoms to make compounds. Atoms have smaller parts called neutrons, protons, and electrons. We learned that same or like charges move away from each other. Different or unlike charges move toward each other.



Lab Activity



Facts:

- Atoms are a fundamental unit of structure.
- Atoms combine to form molecules.

Investigate:

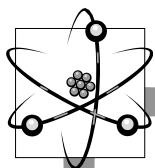
- You will create, through laboratory experiences, simple models of molecules.

Materials:

- toothpicks
- poster board
- two sizes of Styrofoam balls
- glue
- colored markers

Oxygen Molecule

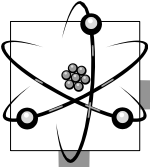
1. We are going to build a model of an oxygen molecule. An oxygen molecule has two oxygen atoms.
2. Pick up two large Styrofoam balls. Each one stands for an atom of oxygen.
3. Label each ball with an O for oxygen. Remember that the O is the symbol for oxygen.
4. Place a toothpick in one of the O atoms. Connect the other O atom to the end of the toothpick.
 - a. How many atoms are connected? _____
 - b. Are the atoms the same? _____
 - c. You have just made a model of a molecule of _____ .



5. Glue the molecule to a piece of poster board.
6. Label your model "Molecule of Oxygen."

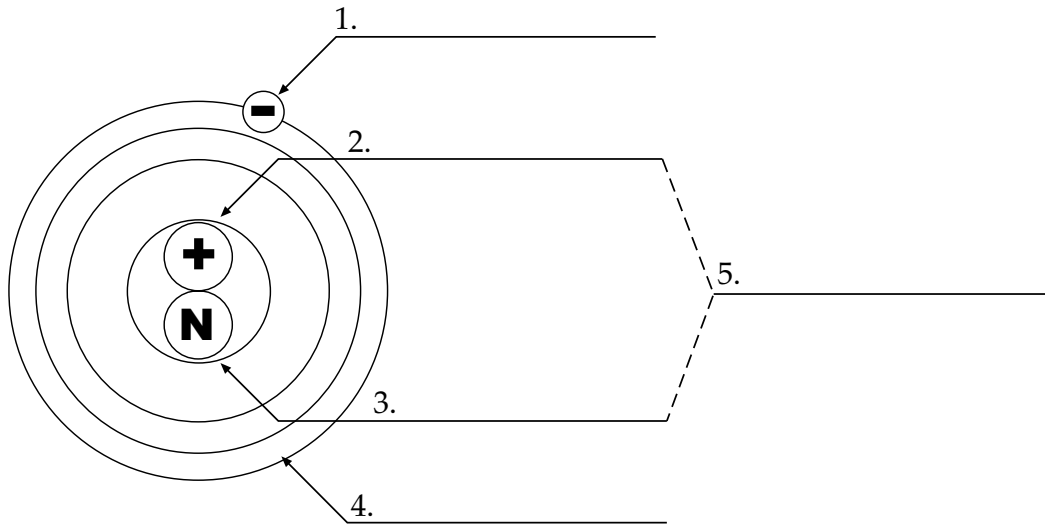
Water Molecule

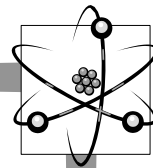
1. Now we are going to create a model of a molecule of water.
Is water an element or a compound? _____
2. Since compounds are made from two or more different elements, we will need to use different kinds of balls in our model.
3. Choose one larger ball and label it with an O for oxygen.
4. Choose two smaller balls. Label each with an H for hydrogen.
5. Use toothpicks to connect an H atom to each side of the O atom.
How many atoms are in the molecule of water? _____
6. Glue the model to a piece of poster board.
7. Label your model "Molecule of Water."



Practice

Label the parts of the **atom** in the diagram below.

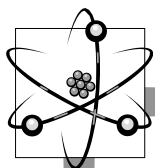




Practice

The symbol \oplus represents **protons**. The symbol \ominus represents **electrons**. Write what would happen if the two charges were placed near each other. Use the terms: **repel** (push away) or **attract** (move toward each other).

- | | | | |
|-------|----|-----------|-----------|
| _____ | 1. | \oplus | \oplus |
| _____ | 2. | \ominus | \ominus |
| _____ | 3. | \ominus | \oplus |
| _____ | 4. | \oplus | \ominus |

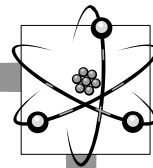


Practice

Use the list above each section to complete the statements in that section. One or more terms will be used more than once.

apart	electrons	nucleus	together
atom	forces	orbit	
distance	molecule	phase	

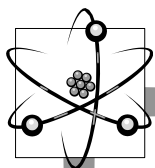
1. An _____ is the smallest unit of an element that is still that element.
2. A _____ is two or more atoms that share electrons in a bond.
3. When matter changes phase, the _____ between the molecules changes.
4. The behavior of these molecules is determined by the _____ that hold them together.
5. Heat usually causes molecules to move _____ .
6. Freezing usually causes the molecules to slow down and move _____ .
7. Changes in _____ , like melting, are caused by gaining or losing energy.
8. Except for hydrogen, atoms are made of protons, neutrons, and _____ .



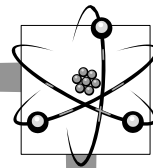
9. The middle part of the atom is the _____ .
10. _____ move around the center of the atom.
11. The path that the electrons follow is called an _____ .

attract	neutral	positive	toward
away	no	repel	
negative	one	shell	

12. The space that electron(s) occupy while in a certain orbit is called a _____ .
13. The proton has a _____ charge.
14. The electron has a _____ charge.
15. The neutron has _____ charge.
16. _____ means no charge.
17. If two positive charges were placed near each other, they would _____ . (repel or attract)
18. If two negative charges were placed near each other, they would _____ . (repel or attract)
19. If a negative charge was placed near a positive charge, they would _____ . (repel or attract)



20. Like charges move _____ from each other.
21. Opposite charges move _____ each other.
22. Elements are made of only _____ kind of atom.

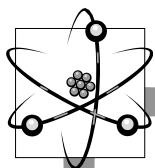


Practice

Use the list below to write the correct term for each definition on the line provided.

atom	electron	neutron	proton
bond	element	nucleus	shell
charge	molecule	orbit	
compound	negative charge	positive charge	

- _____ 1. the charge of an electron
- _____ 2. the charge of a proton
- _____ 3. the smallest unit of an element that is still that element
- _____ 4. two or more atoms that have a bond of shared electrons
- _____ 5. a property of an object that causes it to be affected by a magnetic field
- _____ 6. the positively charged particle in the nucleus of an atom
- _____ 7. the space that electron(s) occupy while in a certain orbit
- _____ 8. the path that the electron follows around the center of an atom
- _____ 9. the middle part of an atom
- _____ 10. the neutral particle found in the nucleus of an atom; has no charge
- _____ 11. the negatively charged particle of an atom



- _____ 12. the attraction that holds two or more atoms together
- _____ 13. when two or more elements combine chemically
- _____ 14. a substance that cannot be broken down into a simpler form by ordinary chemical means