Name: Class Copy
Period: ____ Subject: Int Science

Activity 3 - Letters to Words

Read

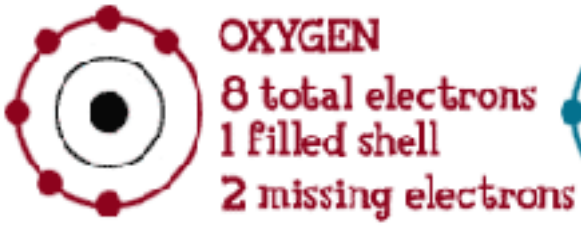
Ionic Bonds

You must first learn why atoms bond together. We use a concept called "Happy Atoms." We figure most atoms want to be happy, just like you. The idea behind Happy Atoms is that atomic shells like to be full. That's it. If you are an atom and you have a shell, you want your shell to be full. Some atoms have too many electrons (one or two extra). These atoms like to give up their electrons. Some atoms are really close to having a full shell. Those atoms go around looking for other atoms who want to give up an electron.

Let's take a look at some examples.

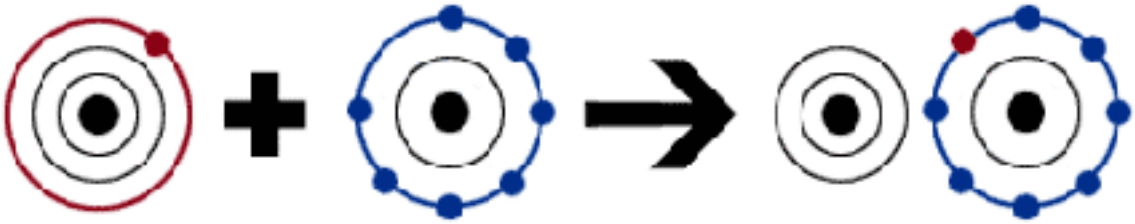
We should start with the atoms with atomic numbers between 1 and 18. There is a 2-8-8 rule for these elements. The first shell is filled with 2 electrons, the second is filled with 8 electrons, and the third is filled with 8. You can see that sodium (Na) and magnesium (Mg) have a couple of extra electrons. They, like all atoms, want to be happy. They have two possibilities: (1) They can try to get eight electrons to fill up their third shell. Or (2) they give up a few electrons and have a filled second shell. For them it's easier to give up a few electrons.

What a coincidence! Many other atoms are interested in gaining a few extra electrons.



Oxygen (O) and fluorine (F) are two good examples. Each of those elements is looking for a couple of electrons to make a filled shell. They have one filled shell with two electrons but their second shell wants to have eight. There are a couple of ways they can get the electrons. (1) They can share electrons, making a covalent bond. Or (2) they can just borrow them, and make an ionic bond (also called electrovalent bond).

So we've got a sodium (Na) atom that has an extra electron. We've also got a fluorine (F) atom that is looking for one.



They wind up working together and both wind up happy! Sodium (Na) gives up its extra electron. The sodium (Na) has a full second shell and the fluorine (F) has a full second shell. Two happy atoms! That's one way things are able to bond together. They can give up or share electrons. The two elements have created an electrovalent bond.

Covalent Bonds

A covalent compound is a compound in which the atoms that are bonded share electrons rather than transfer electrons from one to the other. While ionic compounds are usually formed when metals bond to nonmetals, covalent compounds are formed when two nonmetals bond to each other.

The big question that students frequently have is, "Why do elements share electrons? After all, wouldn't atoms rather grab electrons outright? That's what happens when ionic compounds are formed."

The reason that nonmetals have to share electrons with each other has to do with electronegativity. Recall that electronegativity is a measure of how much an element pulls electrons away from other elements it is bonded to. Metals generally have very low electronegativities (they don't much want to grab electrons) while nonmetals have high electronegativities (they really want to grab electrons). The reason for this trend is the octet rule, which says that all elements want to have the same number of electrons as the nearest noble gas, because noble gases are unusually stable. When metals bond to nonmetals, ionic compounds are formed because the metal atoms don't want electrons and easily give them to nonmetals that do want electrons.

It's a different story when two nonmetals bond with each other. Instead of having one element give electrons to another, we run into a case where we have two elements that have roughly the same electronegativity. As a result, neither element can steal electrons from the other. As a result, if either of them are going to be like the nearest noble gas, they'll have to share electrons rather than transfer them. Keep in mind, also, even if one non-metal ***could*** steal electrons from the other non-metal, this would only allow one of the two non-metals to complete its shell of electrons. The other would still have an incorrect number of electrons for a complete shell.

Is it possible to predict whether bonds are covalent or not? A good rule of thumb is that bonds between non-metals (remember that hydrogen is considered a non-metal) are usually covalent bonds. For example, the carbon dioxide (CO_2) molecules you exhale are bonded together covalently.

Questions – Activity 3 Read

Ionic Bonds:

1. What does it mean when we say an atom is "happy"?
2. What does an atom want to do if it's missing just one electron (it has seven electrons in its outer shell)?
3. What does an atom want to do if it has an "extra" electron (it has just one electron in its outer shell)?
4. What is the atom called after it gives up or grabs an extra electron (hint: this is why it's called an ***ion***ic bond)?
5. When one atom gives up an electron and the other atom takes an electron, why are the two ions attracted to each other?

Covalent Bonds:

6. What do atoms in a covalent bond do rather than transfering electrons?
7. What two types of atoms tend to bond together in a covalent bond (metal/metal, metal/nonmetal, nonmetal/nonmetal)?
8. What two types of atoms tend to bond together in an ionic bond?
9. Why would an ionic bond ***not*** work for two nonmetals? (Use an example like two oxygen atoms and explain what would happen)
10. Which family of elements tends to not form ***any*** bonds (ionic or covalent)? Why doesn't this family of elements form bonds?