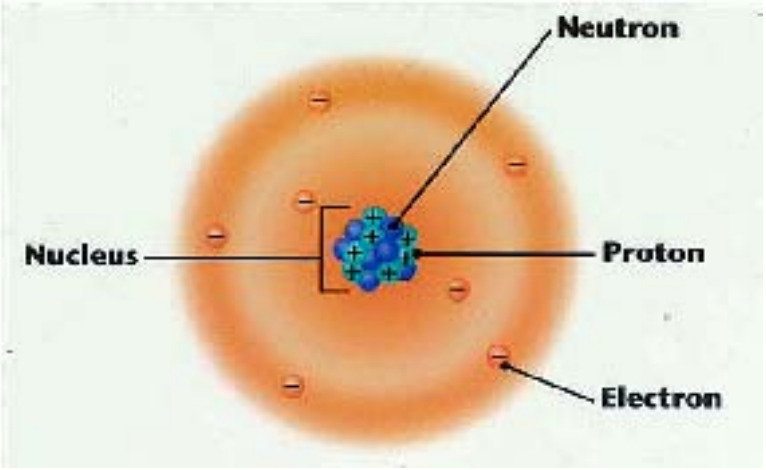
Name: Class Copy
Period: ____ Subject: Int Science

Activity 1 - Beginning the Language

Read

Inside the Atom

In the early 1900s, scientists began to identify the particles that make up atoms (subatomic particles). Below is a picture of the basic parts of the atom.



Every atom has a core called a **nucleus**, where the majority (99.9%, to be exact) of an atom's mass is held. Although the nucleus contains the majority of the mass of the atom, the nucleus is very small compared to the size of the whole atom, because most of the atom is empty space surrounding the nucleus. The nucleus is made up of two smaller particles called **protons** and **neutrons**. The third type of particles that make up the atom, **electrons**, orbit around the nucleus.

Protons:

- Protons are positively charged particles which form part of the nucleus of an atom.
- Every atom of a particular element contains the same number of protons. In fact, the number of protons is unique to each element. Each element has a unique **atomic number**, or a unique number of protons in its nucleus. ***Proton number never changes for any given element.*** For example, oxygen has an atomic number of 8. That tells us that oxygen always has 8 protons.

Neutrons:

- Neutrons are the other particle that make up the nucleus of an atom.
- Neutrons have about the same mass as protons.
- Unlike protons and electrons, however, neutrons carry no electrical charge. Therefore, neutrons are "neutral."
- Atoms of a given element do not always contain the same number of neutrons. Atoms of an element that have a different number of neutrons in the nucleus are called **isotopes** of that element.

Electrons:

- Electrons are negatively charged particles that orbit around the outside of the nucleus.
- The mass of an electron is about 1/2000th of the mass of a proton or a neutron.
- The sharing or exchange of electrons between atoms forms chemical bonds, which is how new molecules and compounds are formed.

Atomic Number:

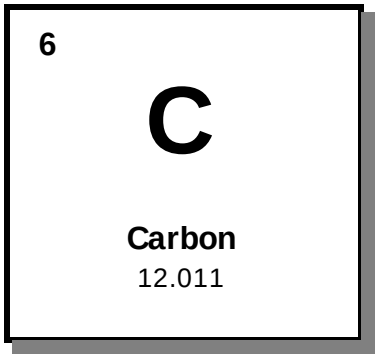
- ***An atom's atomic number tells you how many protons are in that atom's nucleus.*** For example, oxygen has an atomic number of 8, meaning that there are 8 protons in the nucleus of an atom of oxygen. Copper's atomic number is 29, meaning that there are 29 protons in the nucleus of an atom of copper. Later, you'll see how the periodic table conveniently tells you each element's atomic number.

Atomic Mass:

- Because atoms are so small, their masses cannot be measured in grams or milligrams. Instead, scientists have created the **atomic mass unit (amu)** to measure mass of subatomic particles.
- The mass of a proton or a neutron is about 1 amu. The mass of an electron, however, is about 1/2000 amu.
- **To find the atomic mass of an atom, add the number of protons and neutrons in the nucleus.**
- Example: If an atom has 3 protons, 4 neutrons, and 3 electrons, the atomic mass is 7 amu, because you do not count the very small mass of the atom's electrons (1/2000 amu). Only add the number of protons and neutrons (each has a mass of 1 amu) in the nucleus.

Think Inside the Box

On the periodic table, each box represents a different element, and each box contains vital information about the element, including its name, symbol, atomic number, and atomic mass. Different periodic tables may put the numbers in different places, but the example box and instructions below should help you find your way around.



Atomic Number:

The whole number (no decimals) is the **atomic number**. Every element has its own unique atomic number. The atomic number tells how many protons are in one atom of that element. Since no two elements have the same atomic number, no two elements have the same number of protons.

Symbol:

The large letter is the element's **symbol**, and usually just below that is the element's name. Each element has its own unique symbol and name. It is often very useful to memorize symbols and names for elements, especially the more commonly used elements.

Atomic Mass:

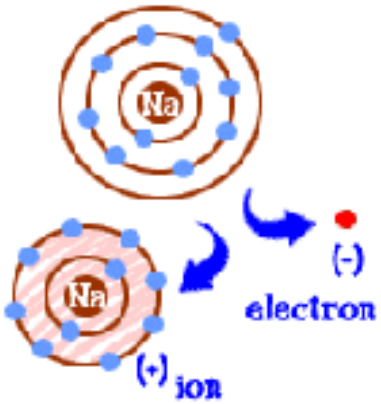
The number with the extra decimal places is the element's **atomic mass**. The atomic mass is the mass in atomic mass units for all possible isotopes of that element. The atomic mass essentially gives you an estimate of how massive one atom of that element is.

Ions and Isotopes

Ions:

We've talked about ions before. Now it's time to get down to basics. ***Ions** are atoms with either extra electrons or missing electrons.* An atom with no extra or missing electrons is called a "neutral atom". In a neutral atom, the number of electrons is the same as the number of protons (the atomic number).

So, why would an atom ever have extra or missing electrons? The electrons in atoms are arranged in layers or "**orbitals**". Atoms like to have complete layers, so if they're missing an electron or two in their outer layer, they may grab extra electrons from some other atom. Or if they have an extra electron or two in their outer layer, they may give those electrons to another atom trying to complete its outer layer.

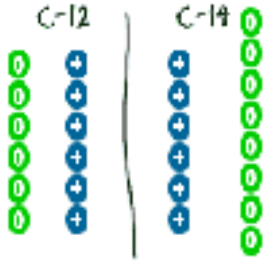


What do you do if you are a sodium (Na) atom? You have eleven electrons, one extra on the outside layer or **shell**. You need to find another element who will take that electron away from you. Bring in chlorine (Cl) which is only missing one electron from its outer layer. Chlorine will take that electron away and leave sodium with 10 electrons inside of two filled shells. Sodium is now a happy atom and has become a sodium ion (Na^+) with one less electron than its atomic number. Since it now has more protons than electrons, sodium is a positive ion.

Chlorine is also a "happy" atom since it needed one more electron to fill its outer layer. However, this does give chlorine one more electron than its atomic number, so like sodium, chlorine has also become an ion (Cl^-) except chlorine is a negative ion since it has more electrons than protons.

Isotopes:

We have already learned that ions are atoms that are either missing or have extra electrons. What if an atom is missing a neutron or has an extra neutron? That type of atom is called an **isotope**. An atom is still the same element if it is missing an electron. The same goes for isotopes. They are still the same element. They are just a little different from every other atom of the same element.



For example, there are a lot of carbon atoms in the universe. The most common ones are carbon-12. Those atoms have 6 neutrons. Some straggler atoms don't have 6 neutrons. Those odd ones may have 7 or even 8 neutrons. As you learn more chemistry, you will probably hear about carbon-14. Carbon-14 has 8 neutrons (2 extra). Carbon-14 is one isotope of carbon.

If you look at a periodic table you may notice that the atomic mass of an element is rarely a whole number. That's because of the isotopes. Atomic masses are calculated by figuring out how many atoms of each isotope exist in the universe. There are a lot of carbon-12, a couple carbon-13, and a few carbon-14 atoms. Averaging the masses, you get a number that is a little bit higher than 12 (the atomic mass for carbon is 12.011). Not knowing which carbon isotope(s) a given sample might contain, you should always use the average (atomic) mass for carbon.

Questions – Activity 1 Read

Inside the Atom:

1. What are the three basic particles which make up an atom?
2. Which subatomic particles make up the nucleus of the atom?
3. Which subatomic particle has a negative charge?
4. Which subatomic particle has much less mass than the others?

Think Inside the Box:

5. What does the large letter (or sometimes 2 or 3 letters) in each box of the periodic table mean or stand for?
6. What are the two numbers found in each box of the periodic table?
7. How can you find the number of protons for an element on the periodic table?
8. How do you calculate the mass of an atom?

Ions and Isotopes:

9. Describe what an ion is.
10. What is the "happy atom" idea about?
11. Which subatomic particle is involved with ions?
12. Describe what an isotope is?
13. Which subatomic particle is involved in isotopes?