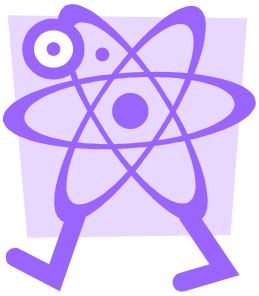
Atomic Musical Chairs
Lesson Plan and Answer Key



Objectives:

Students will be able to…

1. Identify the different parts of an atom.
2. Determine the atomic number, atomic mass, & the # of protons, neutrons and electrons for each atom.
3. Realize that electrons are not static, but always moving.
4. Know the relationship between the number of electrons to the type of atom.
5. Differentiate between ions and isotopes.
6. Recognize that atoms have a numeric relationship in the periodic table.
7. Understand the connection between energy levels and valence electrons to the shape of periodic table.

Materials:

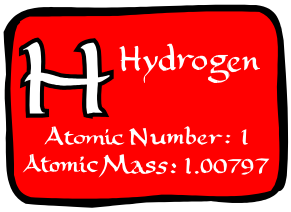
- 40 balls of two colors (18 one color = protons, 22 another color = neutrons, ex. Tennis balls, rubber balls, wiffle balls, golf balls, Nerf balls, etc…)
- 2 Small Round Laundry Baskets (1 for the nucleus, 1 to store unused balls)
- 10 – 18 Chairs
- Periodic Tables
- Music

Opener (ask class):

- What do we know about the periodic table?
- How is one atom different from another?
- What do we know about the number of electrons?
- What do we know about electron orbitals?

Explain:

1. Display periodic tables in easy to see locations or have half your students as electrons and the other half holding periodic tables, then switch roles.
2. Arrange chairs in concentric circles with rings of 2, 8, & 8. The laundry basket is the "nucleus" at the center.
3. Parts of the Atom:
    a. The nucleus holds the protons and neutrons. The number of protons = the atomic number. Ex. Hydrogen has an atomic number of 1, place one tennis ball in the nucleus. Protons have a positive (+) charge.
    b. The number of neutrons = {the atomic mass of the atom – the atomic number}. Hydrogen has an atomic mass of 1 *(round*

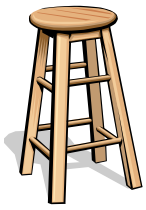


the atomic mass to the nearest whole number) and an atomic number of 1. Therefore 1 – 1 = 0. There are no neutrons in Hydrogen. Sometimes the # of neutrons and the # of protons are the same, sometimes they are not. Neutrons have no charge and are considered neutral.

c. Each circle is an energy level for electrons. The number of electrons = the atomic number. The atomic number of Hydrogen is 1, therefore it has 1 electron. Electrons have a negative (-) charge.
d. Notice there are two chairs in the first level, eight in the next? Each energy level has a certain amount of space for the electrons to move in.
e. We will add one color ball for the protons, the other color for the neutrons for each atom. We will fill in each atom one electron at a time. Each student will be an electron.

Start Activity:

1. Have students line up or stand in a circle around the outside of the atom. Have half the students hold a periodic table or have periodic tables that are easy to see and access.
2. The first element is Hydrogen, have the students tell you how many balls to throw into the nucleus. *(ex. 1 tennis ball for proton, no rubber balls for neutrons)*
3. Ask the students, "How many electrons should enter the atom?" *(just 1)*
4. The first student on line should enter the atom and take a seat in the first energy level.
5. At this point, you can turn on the music; the electron should walk around until you turn off the music, then take a seat. Why? *(Electrons are always moving, when the music stops, it is just where they are at that moment in time, it's not a permanent position.) You can turn the music on and off again a couple of times for fun and have the elelctron seated when the music stops.*

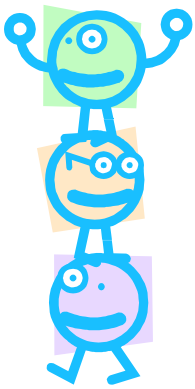


6. Have the student that was the electron step out of the atom and to the end of the line.
7. Now try Helium. Ask, "How many protons?" *(2)* "What is the Atomic Mass?" *(4)* "How many Neutrons?" *(4-2=2)* "How many Electrons?" *(2)*

8. Throw in new balls until you have 2 proton balls and 2 neutron balls. Have the next 2 students enter as electrons.
9. At this point, you can turn on the music; the electrons should walk around until you turn off the music, then take a seat. *You can turn the music on and off again a couple of times for fun and have the electrons seated when the music stops.*
10. Have these two electrons leave and then continue with Lithium. Ask again how many protons, atomic mass, neutrons, and electrons there are. Throw in the correct number of colored balls. Then ask the students, "Where will the 3rd electron go?" *(Next energy level)* "Why?" *(No more room in first energy level)* Have the next 3 students enter as electrons.
11. At this point, you can turn on the music; the electrons should walk around until you turn off the music, then take a seat. *You can turn the music on and off again a couple of times for fun and have the electrons seated when the music stops.*

12. When the electrons have stopped and are seated, ask: "What did you notice about the outer electron's orbit compared to the inner electron's orbit?" *(The electron now has a larger orbit compared to the inner orbit, has more room to travel, can be found in more than 2 spots, etc….)*
13. For Lithium, talk about how "lonely" the outer electron is and have him/her leave for a moment. Ask, "What is the atom now called?" *(Lithium Ion)* "What is its charge?" *(+)* "Is it still Lithium?" *(Yes)* "Why?" *(still same number of protons and neutrons) (Bonding with another atom will take away the electron in the outer shell; can mention Ionic Bonding since it is a metal.)*
14. Continue with Beryllium and Boron.
15. Repeat the same steps for Carbon, but at the end before you do Nitrogen, throw in two extra neutrons. Ask, "What is the atom called now? *(Carbon Isotope)* "What is its charge?" *(has same charge, adding neutrons does not change the charge because it is neutral)* "Is it still Carbon?" *(yes)* "Why?" *(still same number of protons. You might mention radio-carbon dating using C_{12} and C_{14}).*
16. Continue with Nitrogen and Oxygen.
17. Repeat steps with Fluorine, then when the electrons are seated, ask "How does the group feel with its empty chair?" Wait for responses, then add: "Somehow incomplete?" "How can the group fill the chair?" *(Bonding with another atom will put another electron in the outer shell, can mention Ionic or Covalent Bonding since it is a non-metal)* "Is it still Fluorine?" *(Still same atom, same number of protons and neutrons)* "What is the charge?" *(-, because it takes on another electron, becoming more -)*
18. At Neon ask, "How do its properties relate to its electron state?" Discuss the special number of 8 for atoms. *(Outer shell is full, therefore stable, octet rule)*
19. Compare the periods of the periodic table to the rings of chairs.

For Fun:



- Depending on time, you can stop at Neon and do more the next day as a review. Instead of going in order, after you have completed the basic idea and the students have gotten a hang of it, you can pick elements at random from Hydrogen to Argon and see how quickly they can do it. Keep them on their toes!

- You can also break the class into two teams and have them compete against each other. You can have one team go at a time and figure out how many protons and neutrons to put into the basket as well as how many electrons need to be in the energy levels. You can play music and the team has to be done before the music stops. (If you have 28 kids, you can do 2 teams of 14 and do the elements $Hydrogen_1$ to $Silicon_{14}$.)

Extensions:

- Discuss radioactivity by having the nucleus shoot out particles.
- Have an outside force (electricity) knock out an electron from its energy level. Have it emit a photon (ping-pong ball) as it drops back in.
- Discuss why groups have the same chemical properties.
- Lead into ionic bonding.

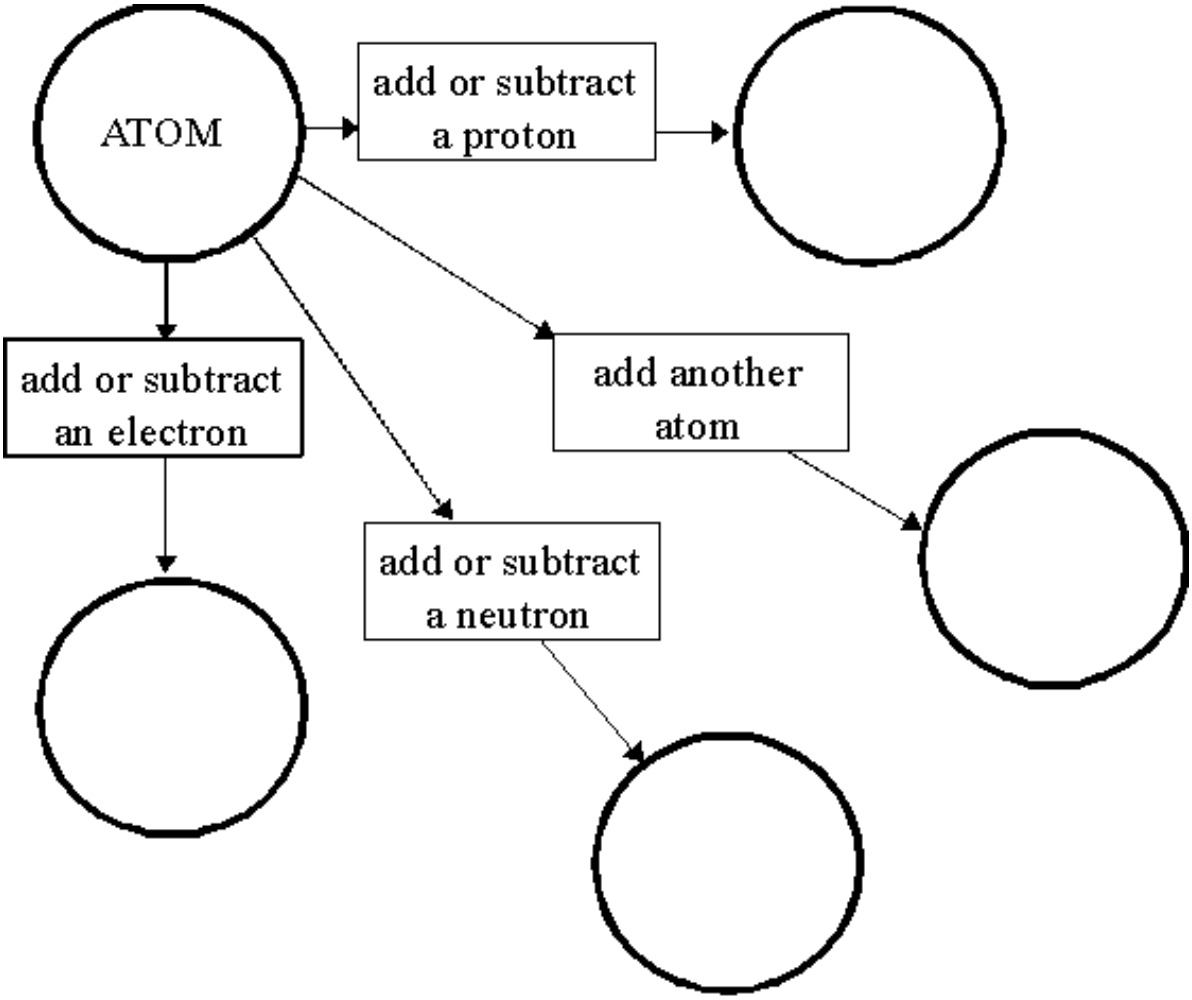
Assessment:

As you go through the exercise, ask what kind of atom is next, the number of protons, neutrons and electrons. Ask if or how an atom might ionize and what its charge will be.

Closure Activity:

- Before end of class, ask for questions. What did we learn?
- What is the electron state of Lithium, Fluorine, Chlorine, Sodium, Potassium, Oxygen, etc.? How will they ionize?
- How do the energy levels relate to the periods?
- Why did we keep changing seats?
- How does Carbon, for example, relate to Nitrogen? Etc…

Sample Diagram for the Board:



Fill in each circle with one of the following:

new element
ion
isotope
molecule

Answer Key:

How many protons and neutrons are placed into to the laundry basket (nucleus), as well as how many electrons are needed for the energy levels.

Atomic # = # Protons = # Electrons

(Atomic Mass – # Protons) = # Neutrons

Element	Atomic Mass	Protons	Neutrons	Electrons
Hydrogen	1	1	0	1
Helium	4	2	2	2
Lithium	7	3	4	3
Beryllium	9	4	5	4
Boron	11	5	6	5
Carbon	12	6	6	6
Nitrogen	14	7	7	7
Oxygen	16	8	8	8
Fluorine	19	9	10	9
Neon	20	10	10	10
Sodium	23	11	12	11
Magnesium	24	12	12	12
Aluminum	27	13	14	13
Silicon	28	14	14	14
Phosphorus	31	15	16	15
Sulfur	32	16	16	16
Chlorine	35	17	18	17
Argon	40	18	22	18

Sample of Classroom Set up with 18 Chairs and 1 Basket: