Part I: Build an Atom PhET Simulation

Activity

Procedure

An atom is electrically neutral. If an atom gains or loses electrons, it will obtain a charge and become an **ion**. To determine the electrical charge of an atom or ion, simply count the number of positive protons and the number of negative electrons, and then add these two numbers together. For example, the hydrogen atom has one positive proton and one negative electron, resulting in (+1) + (-1) = 0. The helium atom has two positive protons and two negative electrons, resulting in (+2) + (-2) = 0.

1. On a computer or smartphone, search for “build an atom phet.”
2. Click the first link.
3. Click the play button.
4. Explore the “Build an Atom” simulation for a few minutes.
5. Using “Build an Atom,” play with the parts of atoms to discover the following: What parts go in the center of the atom? What is the center called?
6. Fill in the table to identify three examples.
7. Everything around us is made up of different elements. The air has oxygen and nitrogen. Plants and people have lots of carbon. Helium is in balloons. Hydrogen is in water. Play until you discover a rule for what determines the name of the **element** you build. What did you find determines the element? Test your idea by identifying the element for the three cases. Write down the information you use to determine the element in your lab journal.
8. Now make the number of protons and electrons unequal. Play until you discover some good rules about the **charge** of your atom or ion. What is a rule for making:
   - a neutral atom that has no charge?
   - a positive ion that has a positive charge?
   - a negative ion that has a negative charge?

9. Write about how you used the tools in the simulation to help you decide whether the atom had a positive, negative, or zero charge. (There is a box on the lower right of the screen that will state the current charge.)
10. Use the table on Page 3 to identify three examples of atoms and ions (one neutral with zero extra charges, one with a positive charge, and one with a negative charge) that show your rules **for charge** work and include a drawing of your atom. All your examples should also have a stable nucleus.

Part I: Build an Atom PhET Simulation, continued

11. Now make the number of protons and electrons unequal. Play until you discover some good rules about the **charge** of your atom or ion. What is a rule for making:
    - a neutral atom that has no charge?
    - a positive ion that has a positive charge?
    - a negative ion that has a negative charge?
12. Write about how you used the tools in the simulation to help you decide whether the atom had a positive, negative, or zero charge. (A box on the lower right of the screen will state the current charge.)
13. Use the table on Page 3 to identify three examples of atoms and ions (one neutral with zero extra charge, one with a positive charge, and one with a negative charge) that show your rules **for charge** work and include a drawing of your atom. All your examples should also have a stable nucleus.
14. Play until you discover some good rules about the **mass** of your atom or ion. What is a rule for determining the mass?
15. Using all your rules, figure out what changes for each of these modifications to an atom or ion. Use this table and make predictions, then test your ideas with the simulation. If you have new ideas, rewrite your rules.
16. Design a positive ion with a charge of +2. **Include a drawing.**
    - What element is your ion?
    - What mass is your ion?
    - Is the nucleus of your ion stable or unstable?
17. Design a neutral, stable atom with a mass of eight. **Include a drawing.**
    - What element is your atom?_____
    - What is the charge of your atom?_____
18. What does the tool called **Symbol** tell you about what parts are in an atom or ion? What rules can you use to tell how many protons, neutrons, and electrons make up an atom or ion?

Reflection

Make sure you know working definitions for the following terms: nucleus, proton, neutron, electron, atom, ion, charge, neutral, atomic mass, and element.

Games

Play the games to check your understanding of these concepts.

Part II: Isotopes

Analyze and answer question one in Part II of the Student Journal, and then read the paragraph below.

All atoms of the same element are similar, but not necessarily identical. There can be different masses of atoms for the same element. For example, carbon has six protons in each atom. In fact, every carbon atom contains six protons in the nucleus. Those six protons are what makes the atom of carbon have carbon properties, though different atoms of carbon could contain different numbers of neutrons. Carbon could have six, seven, or eight neutrons, and these carbons are named carbon-12, carbon-13, or carbon-14, respectively. Atoms of the same element with the same number of protons but a different number of neutrons are called **isotopes**.

In order to determine the average atomic mass of elements on the periodic table, scientists have taken into account the relative abundance of the isotopes of the element, using what is called a weighted average. In the example of carbon above, carbon-12 makes up 98.93% of all carbons, carbon-13 is 1.07%, and carbon-14 is found in trace amounts. What this means for the weighted average is that the mass will lean heavily towards carbon-12 mass. On the periodic table, the average atomic mass is 12.01.

Finish Part II of your Student Journal.