

12A Atomic Structure

What is inside an atom?

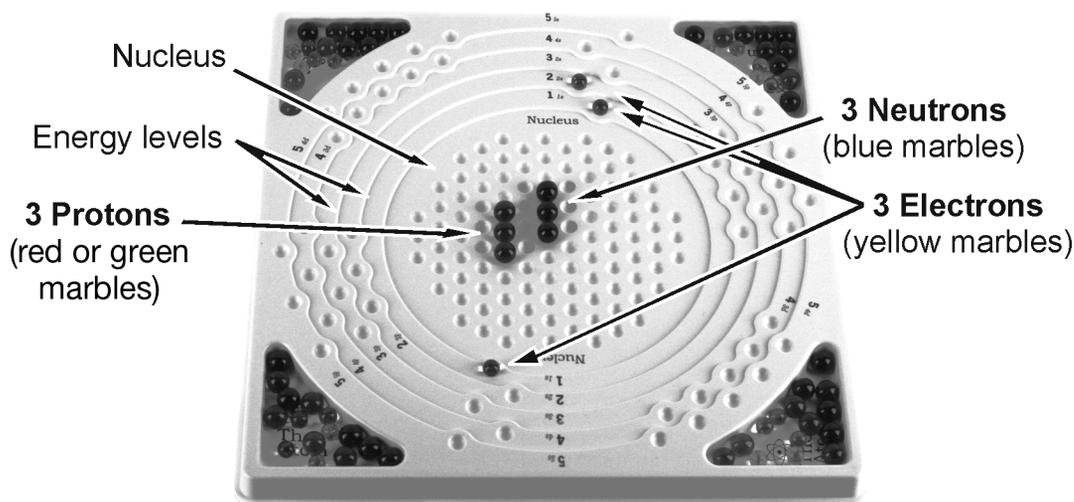
We once believed that atoms were the smallest units of matter. Then it was discovered that there are even smaller particles inside atoms! The structure of the atom explains why nearly all the properties of matter we experience are what they are. This investigation will lead you through some challenging and fun games that illustrate how atoms are built from protons, neutrons, and electrons.

Materials

- Atom Building Game

1 Modeling an atom

In the atom game, colored marbles represent the three kinds of particles. Red or green marbles are protons, blue marbles are neutrons, and yellow marbles are electrons.



- Build the atom above using three red or green, three blue, and three yellow marbles.
- Fill in the blanks in the empty periodic table box for the atom you constructed.

2 Thinking about the atom

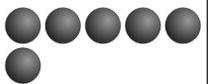
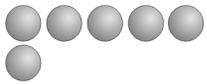
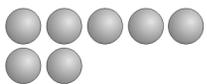
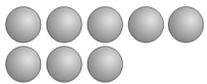
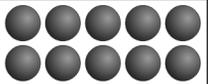
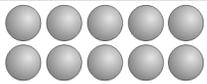
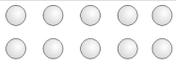
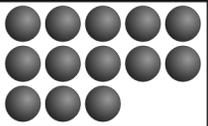
- What is the number below the element symbol called? What does this number(s) tell you about the the atom?

- b. What is the number(s) above the element symbol called? What does this number tell you about the atom?

- c. Why do some elements have more than one number above the symbol? What are the variations in this number called?

3 Making atoms

Build the six atoms shown on the chart, and fill in the missing information. Protons and neutrons go in the middle of the board. Electrons go on the outside and fill up the holes from the lowest row to the highest.

	Element	Atomic number	Mass number	Protons	Neutrons	Electrons
3a						
3b						
3c						
3d		8				
3e						
3f			27			

4 Stop and think

- a. Two of the atoms you made are the same element. What is different about them?

- b. One of the atoms has just enough electrons to completely fill the first two rows. Which atom is this? Where on the periodic table is it found?

- c. Which atom has an atomic number of 8?

- d. Which atom has a mass number of 13?

- e. One atom is found in a lightweight, silvery metal used in airplanes. Which atom is it?

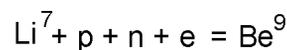
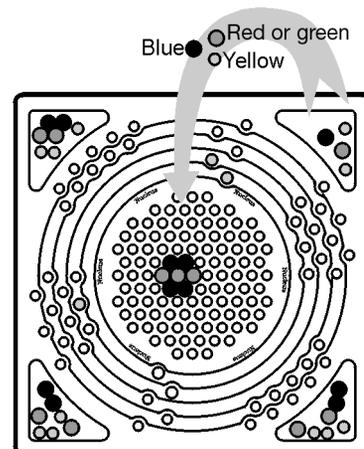
- f. One atom represents an element that makes up about 21 percent of the air you breathe. You could not live without this element.

5 The game of atomic challenge

Each player takes a turn adding protons, neutrons, and electrons to the atom to build heavier and heavier elements. The winner is the first player to run out of marbles.

- Each player should start with six blue (neutrons), five red or green (protons), and five yellow marbles (electrons).
- Each player takes turns adding one to five marbles, but not more than five. The marbles may include any mixture of electrons, protons, and neutrons. For example: you can add one blue, one red or green, and one yellow marble in a turn. That makes three total marbles, which is less than five.
- Marbles played in a turn are added to the marbles already in the atom.
- Only atoms in which the electrons, protons, and neutrons match one of the naturally occurring elements on the periodic table are allowed. If you add marbles that

Example of a good move



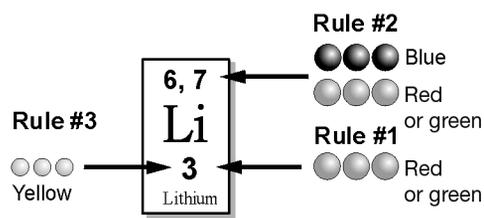
make an atom NOT on the periodic table, you have to take your marbles back and try again.

The Three Rules

Rule #1: The number of protons matches the atomic number

Rule #2: The total number of protons and neutrons equals a stable mass number

Rule #3: The number of electrons matches the number of protons



5. A player may trade marbles with the bank instead of taking a turn. Players can take as many marbles, and of as many colors, as they need but must take at least as many total marbles as they put in. For example, a player can trade two yellows for one blue and two reds.

6 Stop and think

Atoms that are not shown on the periodic table may exist in nature, but they are radioactive and unstable. For example, carbon-14 is unstable and is not listed, but carbon-12 and carbon-13 are stable and so *are* listed.

- a. What four elements make up almost all of the mass in the human body?

- b. How many stable isotopes does oxygen have?

- c. Find one element on the chart that has no stable isotopes.

- d. What element has atoms with 26 protons in the nucleus?

- e. On most periodic tables, a single atomic mass is listed instead of the mass numbers for all the stable isotopes. How is this mass related to the different isotopes?
