

Name: \_\_\_\_\_

## 18.2

## Comparing Atoms



Question: What are atoms and how are they put together?

### 1 Setting up the atom board

Read about how you set up the atom board in your Investigation book.

### 2 The game of atomic challenge

Read about how to play the game of atomic challenge in your Investigation book.

### 3 What did you learn?

a. What particles are found in the nucleus of an atom? What particles are found outside the nucleus?

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b. Name one element which is always radioactive and which has an atomic number less than 50.

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c. What is the atomic number of sodium (Na)?

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d. How many protons does Na have?

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e. How many different isotopes does magnesium (Mg) have?

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f. How many protons, neutrons, and electrons does  $\text{Mg}^{26}$  have?

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g. If an isotope of silicon (Si) has 15 neutrons, what is its mass number?

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h. What do you call an atom where the number of electrons is different from the number of protons?

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i. What is the heaviest element with at least one isotope that is NOT radioactive?

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

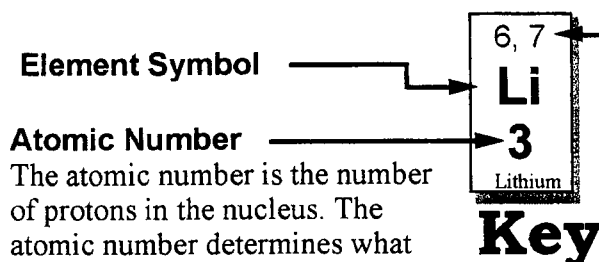
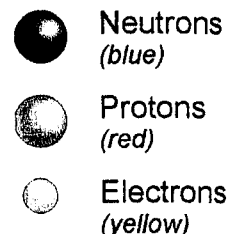
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Question: What are atoms and how are they put together?

In this Investigation, you will:

1. Investigate the structure of the atom.
2. Identify what makes atoms of different elements different from each other.
3. Use spectral analysis to identify the elements present in different light sources.

In this Investigation, you will use the atom board to learn about atomic structure. The marbles will represent the three particles in the atom. Red marbles are protons, blue marbles are neutrons, and yellow marbles are electrons. The position of the marbles on the board shows where the real particles are in the atom. The neutrons and protons are in the nucleus (center) and the electrons are arranged in energy levels around the outside. After you have gained an understanding of atomic structure, and compared atoms of different elements, you will use a technique called spectral analysis to identify the elements present in the different light sources found in your school building.



### Mass Number

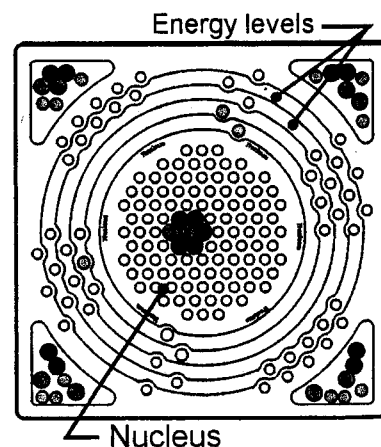
The mass number is the total number of particles (protons plus neutrons) in the nucleus. Atoms with the same number of protons but different mass numbers are called **isotopes**. These numbers are the mass numbers of the stable isotopes. Stable isotopes are not **radioactive**. For example, lithium has two stable isotopes,  $\text{Li}^6$  with three protons and three neutrons, and  $\text{Li}^7$  with three protons and four neutrons.

## 1 Setting up the atom board

1. Each atom board can have four players.
2. Each player should use one of the four pockets at the corners.
3. Each player should start with the following marbles in their pocket.

6 blue marbles (neutrons)  
5 red marbles (protons)  
5 yellow marbles (electrons)

4. The remaining marbles stay in the containers and are the 'bank.' Players may need to trade marbles with the bank later in the game.



## 2 The game of atomic challenge

The first player to run out of marbles wins. The object of the game is to play all your marbles by adding them to the board to make real, stable atoms from the periodic table. After each turn you must correctly identify what atom has been made. For example, you might say "Lithium six" if the marbles you added made an atom with 3 protons (red), 3 neutrons (blue) and 3 electrons (yellow).

Each player takes turns adding up to 5 marbles to the atom. The player must add the marbles according to the rules for building atoms:

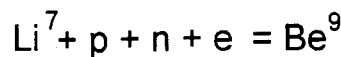
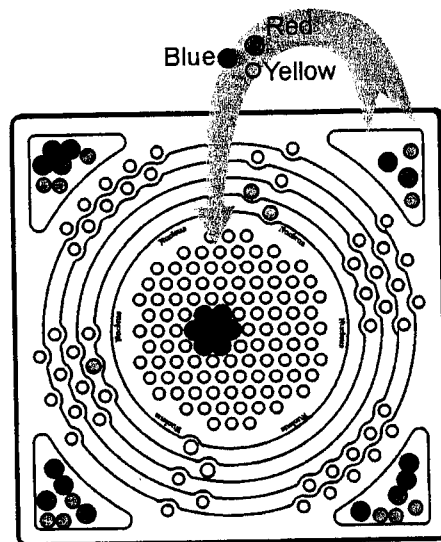
1. The number of protons matches the atomic number (number of red marbles = atomic number)
2. The total number of protons and neutrons equals one of the right mass numbers for that element (number of red + blue = mass number)
3. The number of electrons and protons match (number of red = number of yellow)
4. Protons and neutrons go in the nucleus.
5. Electrons go in the energy levels.

You can add no more than 5 marbles per turn. The 5 can include any mix of colors, such as 2 red, 1 blue, and 2 yellow. You may not always be able to add 5, sometimes you will only be able to add 3 or 4 and still make a real atom. You cannot add more than 5 in one turn.

The periodic table should be carefully consulted by all players to see whether the atom is correct or not. If the atom has been incorrectly built or identified, the offending player must take their marbles back and does not get to try again until the next turn. The next player on the right then takes a turn.

A player can trade marbles with the bank INSTEAD of taking their turn. You can take as many marbles, and of as many colors, as you need, but you must take at least as many total marbles as you put in. For example you can trade 2 yellows for 1 yellow, 1 blue, and 1 red. You put in 2 and took 3, which is OK. You cannot put in 2 and take only 1 back.

### Example of a good move



## 3 What did you learn?

- a. Which particles are found in an atom's nucleus? Which particles are found outside the nucleus?
- b. Name one element that is always radioactive and has an atomic number less than 50.
- c. What is the atomic number of sodium (Na)?
- d. How many protons does Na have?
- e. How many different isotopes does magnesium (Mg) have?
- f. How many protons, neutrons, and electrons does  $\text{Mg}^{26}$  have?
- g. If an isotope of silicon (Si) has 15 neutrons, what is its mass number?
- h. What do you call an atom where the number of electrons is different from the number of protons?
- i. What is the heaviest element with at least one isotope that is NOT radioactive?
- j. What element has atoms with 26 protons in the nucleus?