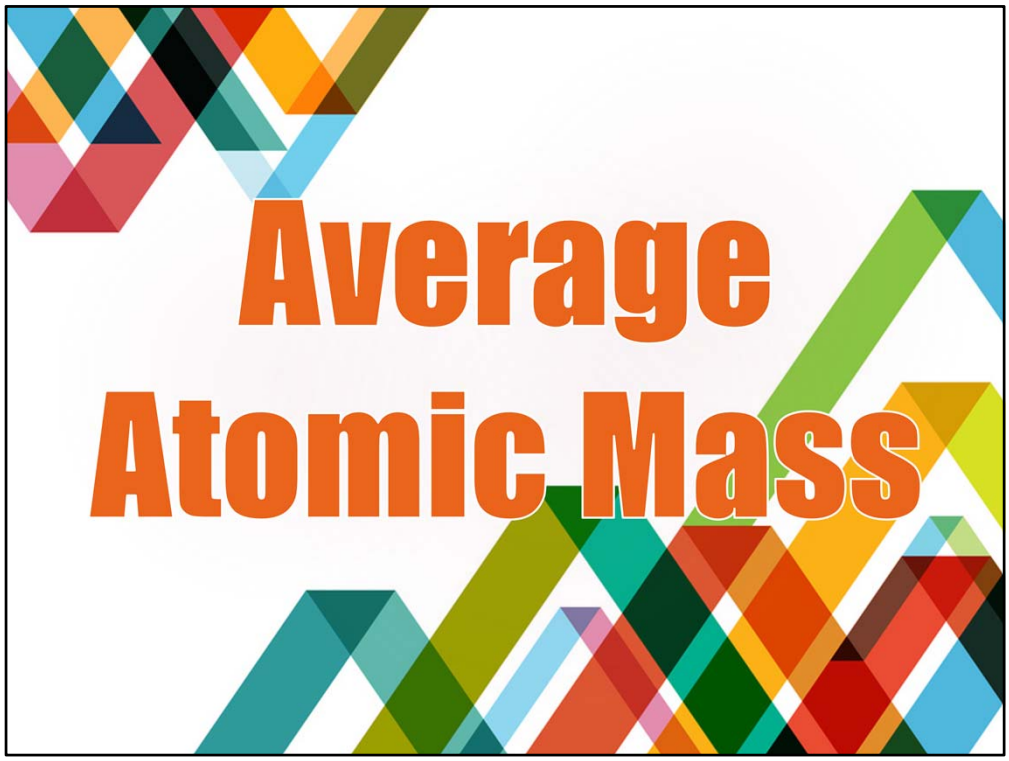
Module 2: Atomic Structure and the History of Atomic Theory

Topic 6 Content: Average Atomic Mass and Abundance



Average Atomic Mass

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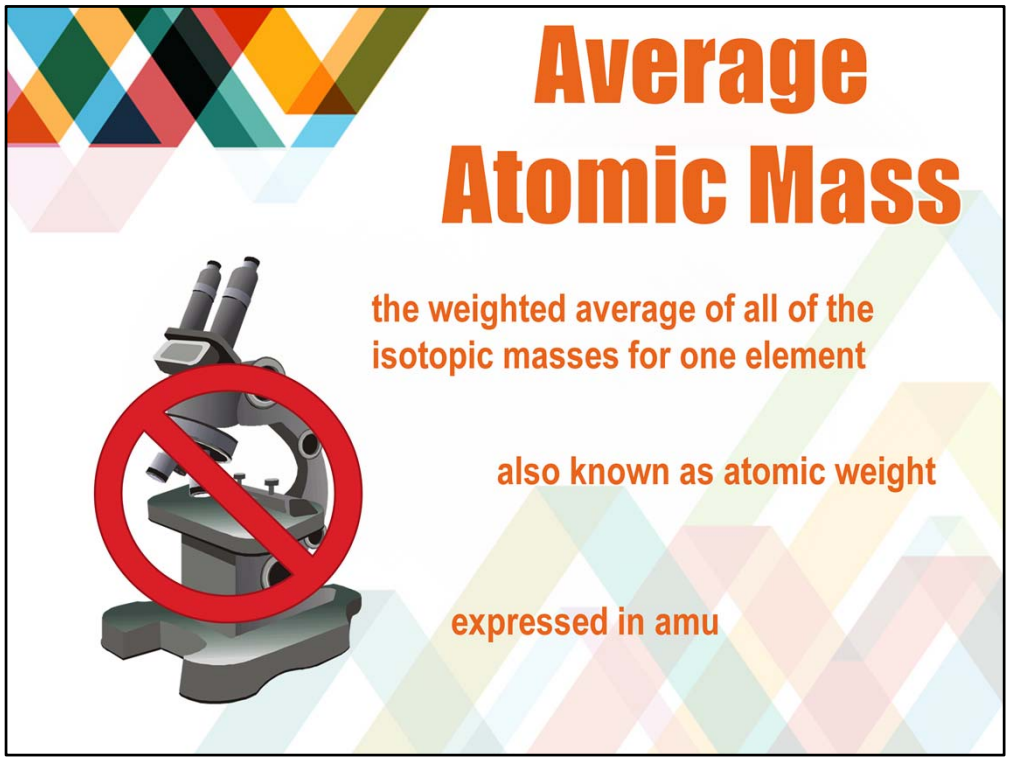

Atoms are extremely small and difficult to study without extremely advanced and expensive equipment. Because of this, scientists often recognize standardized characteristics for atoms of the same element. One of these characteristics is average atomic mass. The average atomic mass is the weighted average of all of the isotopic masses for one element. It is also known as atomic weight, and the average atomic mass is expressed in atomic mass units, or amu.

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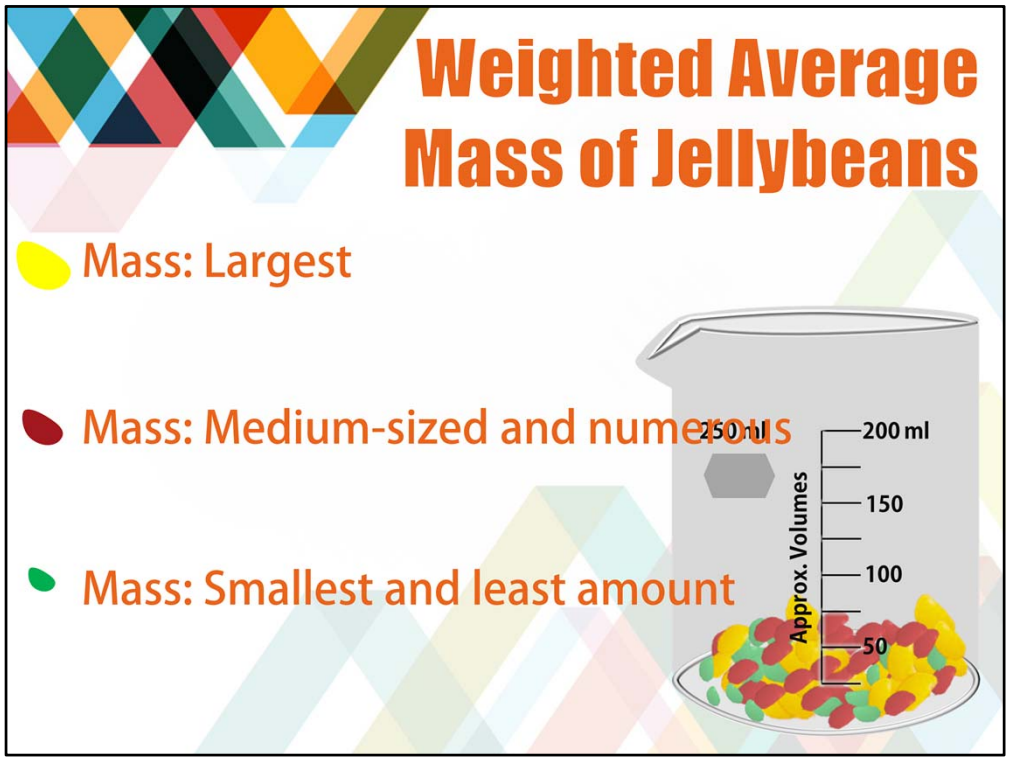

How do scientists calculate the average atomic mass of the different elements? Pretend that jellybeans are an element and each individual jellybean represents an atom. Imagine that your instructor asked you to calculate the average atomic mass of this element using these jellybeans in a beaker. How would you solve this problem? You may notice that the jellybeans shown here do not appear to be uniform in size, mass, color, or quantity, even though they are all jellybeans. The yellow jellybeans are the largest, the red jellybeans are medium-sized and are numerous, and the green jellybeans are the smallest and are outnumbered by both the yellow and red jellybeans.

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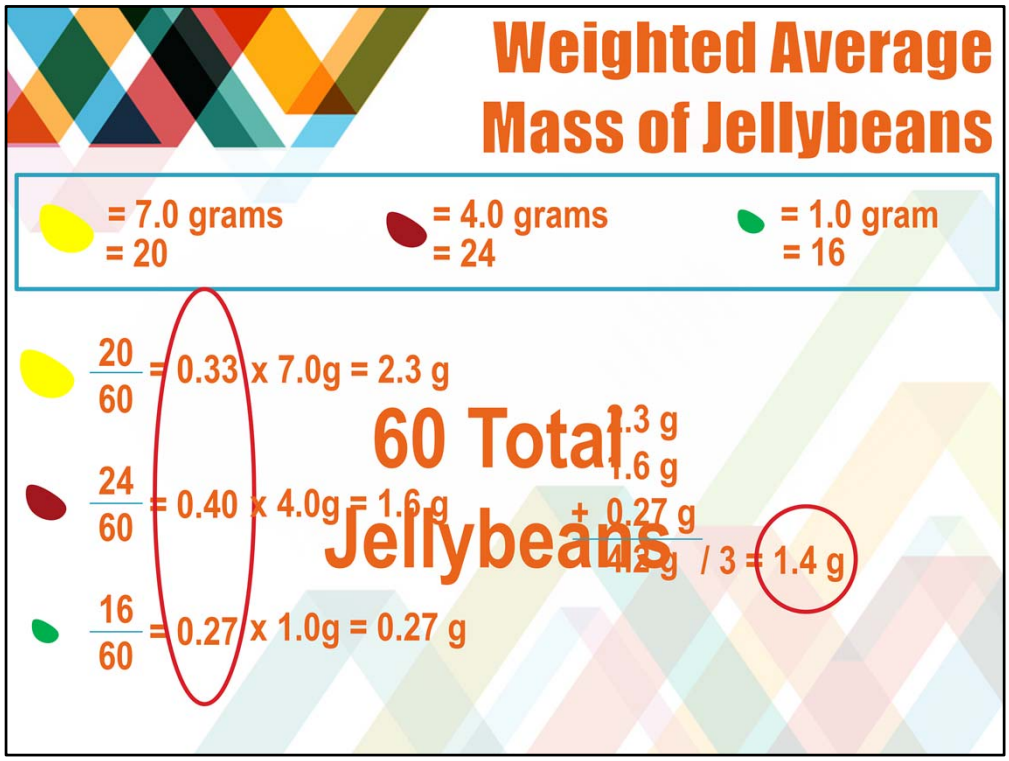

Even though each color of jellybean in the beaker is different from the others, the solution to this problem is not difficult. First, you will need to measure the mass of one of each colored jellybean. You find that a yellow jellybean has a mass of 7.0 grams, a red jellybean has a mass of 4.0 grams, and a green jellybean has a mass of 1.0 gram.

In order to find the relative abundance, you will need to count the total number of jellybeans in the beaker. Once completed, you find that there are a total of sixty jellybeans. Then, you will need to count each color of jellybean. In this example, there are 20 yellow jellybeans, 24 red jellybeans, and 16 green jellybeans. Next, to find relative abundance of each color jellybean divide the total of each colored jellybean by the total number of jellybeans. Once you have found the relative abundance, multiply each colored jellybean's relative abundance by its mass. Finally, to find the weighted average mass, you take the sum of these three calculations and divide by three.

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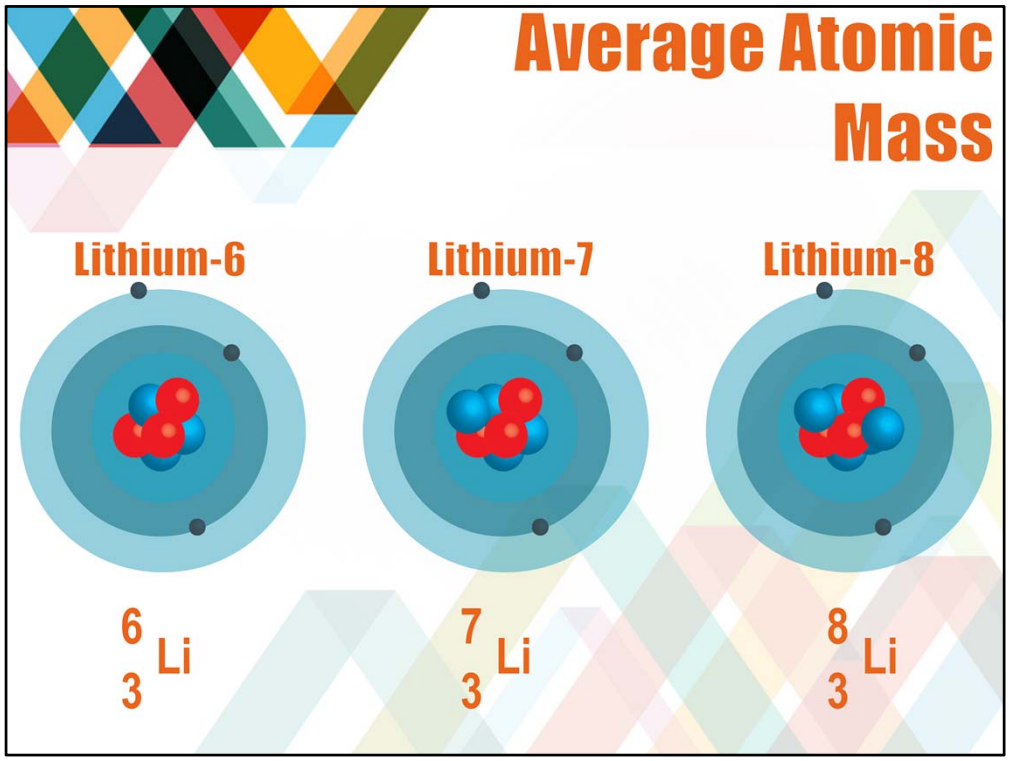

This calculation mirrors the way in which scientists calculate the average atomic mass number that is found with each element on the periodic table of elements. Like the jellybeans, atoms of the same element can have different masses because there are isotopes of that element. Isotopes have a different number of neutrons in their nuclei, so the mass of each isotope of an element will vary, as shown here in these isotopes of lithium.

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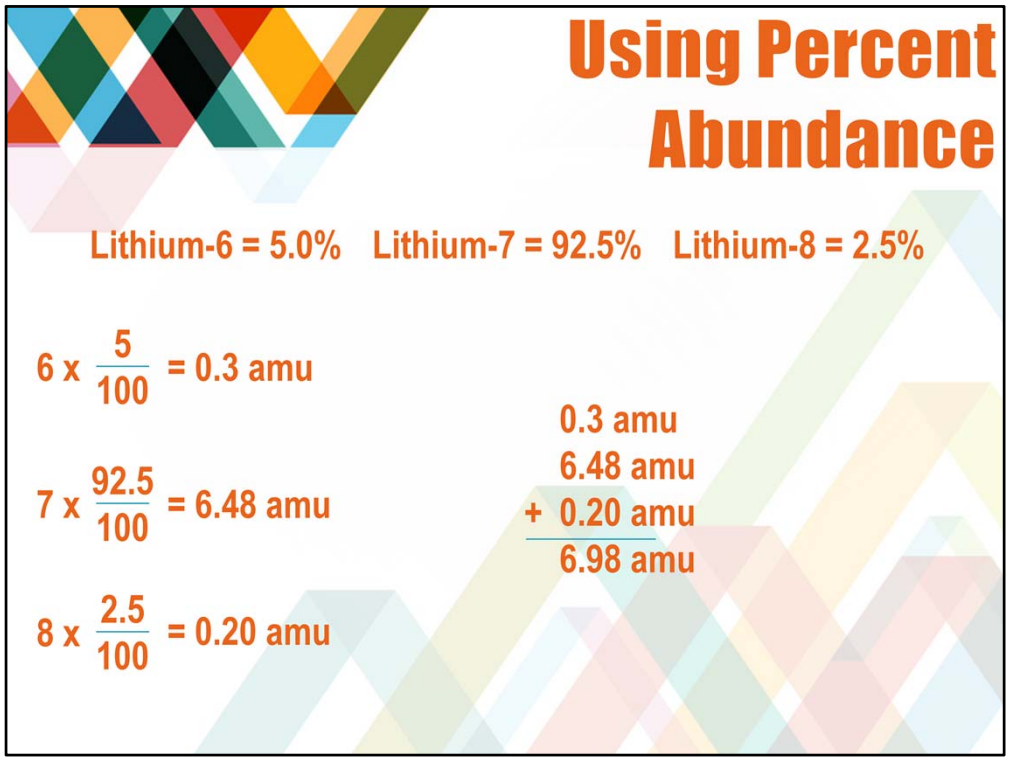

When scientists calculate the average atomic mass of lithium, they considered the abundance of each isotope. In this example, lithium-6 has an abundance of 5%, lithium-7 has an abundance of 92.5%, and lithium-8 has an abundance of 2.5%. When these percentages are divided by one hundred, multiplied by the individual isotopes' atomic mass, and then these three figures are summed, you can find the total average atomic mass of these three isotopes, which is 6.98 amu.