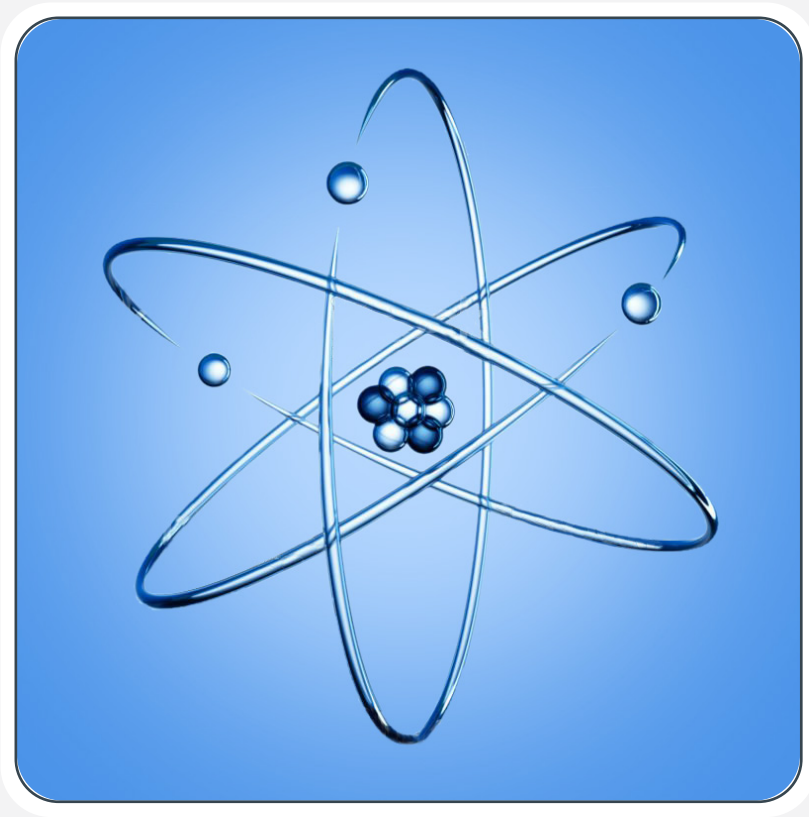# STEM Sims™

Making Atoms

Making Atoms

**Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.**

Atoms are the building blocks that make up all matter in the universe. Take the following brief quiz to see how much you already know about atoms. See the bottom of page 4 to check your answers.

1.   The origin of the term "atom" came from the Greek word meaning:
    a.   ball.
    b.   tiny.
    c.   undivided.
    d.   top.

2.   About what percentage of an atom is empty space?
    a.   10%
    b.   25%
    c.   50%
    d.   99.9%

3.   What is the average diameter of a typical atom?
    a.   1/10,000,000,000 meter
    b.   1/100,000,000 meter
    c.   1/1,000,000 meter
    d.   1/100,000 meter

4.   All the following help hold the particles that make up an atom together except:
    a.   the weak nuclear force.
    b.   the strong nuclear force.
    c.   an electrostatic force.
    d.   gravity.

5.   Hydrogen atoms make up about what percentage of the total atoms in the Milky Way galaxy?
    a.   15%
    b.   55%
    c.   75%
    d.   99.9%
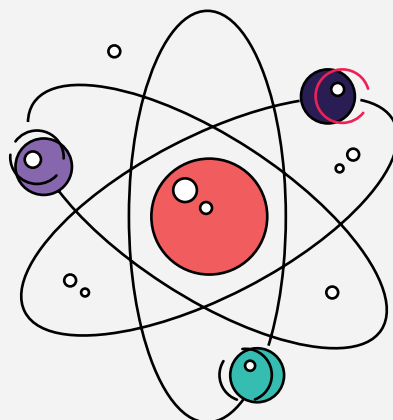
How Many Atoms Thick?

Aluminum foil is found in most kitchens in the world. There are a variety of uses of the foil, including heating foods, preserving foods, and making fun figures. Can you find out how many atoms thick are in a typical piece of aluminum foil? Get started now with your investigation.

Materials
1 piece 15 cm by 20 cm of aluminum foil
Centimeter ruler   Scissor   Calculator

Procedure

1. Use the ruler to measure a piece of aluminum foil 15 cm by 20 cm.
2. Carefully use the scissors to cut out the piece of aluminum foil.
3. Calculate the area of the piece of aluminum foil using the formula:

$$\textbf{Area = Length × Width}$$

Record this value in Table 1.

4. The mass of one square centimeter of aluminum foil is 0.0060 grams. Use this information and the area of the piece of foil to find the mass of the piece of foil. Record this value in Table 1.
5. Aluminum foil has a density of 2.700 g/cm³. Use this information and the following formula to find the thickness of the piece of foil. Record this value in Table 1.

$$\textbf{Thickness = Mass/(Area × Density)}$$

6. The diameter of one aluminum atom is about $1.48 × 10^{-8}$ cm. Use this information and the thickness of the aluminum foil to calculate how many atoms thick are in your piece of foil. Record this value in Table 1.

Table 1. Aluminum Foil Data

Measurement	Value
Aluminum Foil Area (cm²)	
Mass Aluminum Foil (g)	
Thickness of Aluminum Foil (cm)	
Number of Aluminum Atoms Thick	

Questions

1. Did your answer of how many atoms are in a typical piece of aluminum foil's thickness surprise you? Provide a reason to support your response.

2. Calculate how many total atoms are in the 15 cm by 20 cm piece of aluminum foil.

Making Atoms

How Old Is It?

One of the most perplexing questions facing scientists who study the environment of the past is: "How old is this object?" Since the past can help guide people in the future, the ability to time stamp objects is critical to these studies. Carbon isotopes can help determine the age of things that were alive at some point in the past.

Living organisms update carbon mainly in the form of carbon-12 from the atmosphere. Since plants take in carbon dioxide from the air to make carbon-based food and all animals either eat plants or animals that eat plants, all living things consume carbon-12. However, the isotopes carbon-13 and carbon-14 are also present in the atmosphere and can enter the food chain through plants.

Once a living organism dies, the organism no longer takes in any of these three isotopes of carbon. The small part of carbon-14 that was in the organism starts undergoing nuclear decay and turning into a different element, nitrogen-14. This process is known as beta decay. To determine the age of an organism, scientists calculate the ratio of carbon-14 and carbon-12 in a currently alive organism to the ratio of carbon-14 and carbon-12 present in the organism they are trying to date. The older the organism, the smaller the concentration of the current amount of carbon-14 relative to the amount of carbon-14 in a living organism.

Radioactive decay of Carbon-14
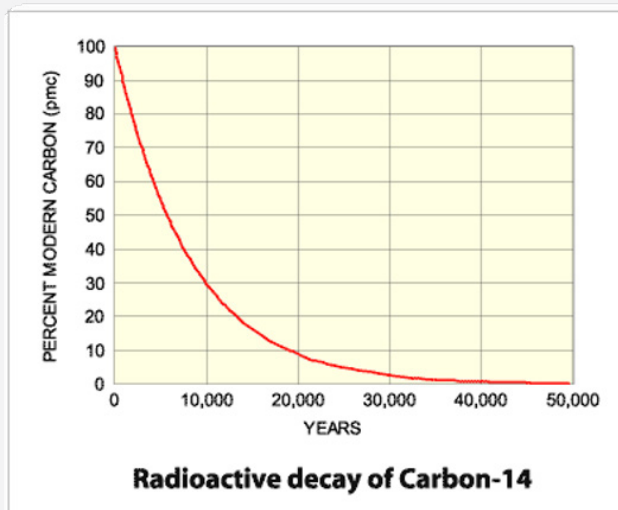
The half-life of carbon-14 is about 5,700 years. This means that after 5,700 about one-half of the mass of carbon-14 that was present in the living organism will have decayed into nitrogen-14. A limitation of carbon-14 dating is that the process is only valid up to about 60,000 years. Organisms older than that must be dated using a different isotope.

**Please visit our site for more helpful information:
STEMsims.com**