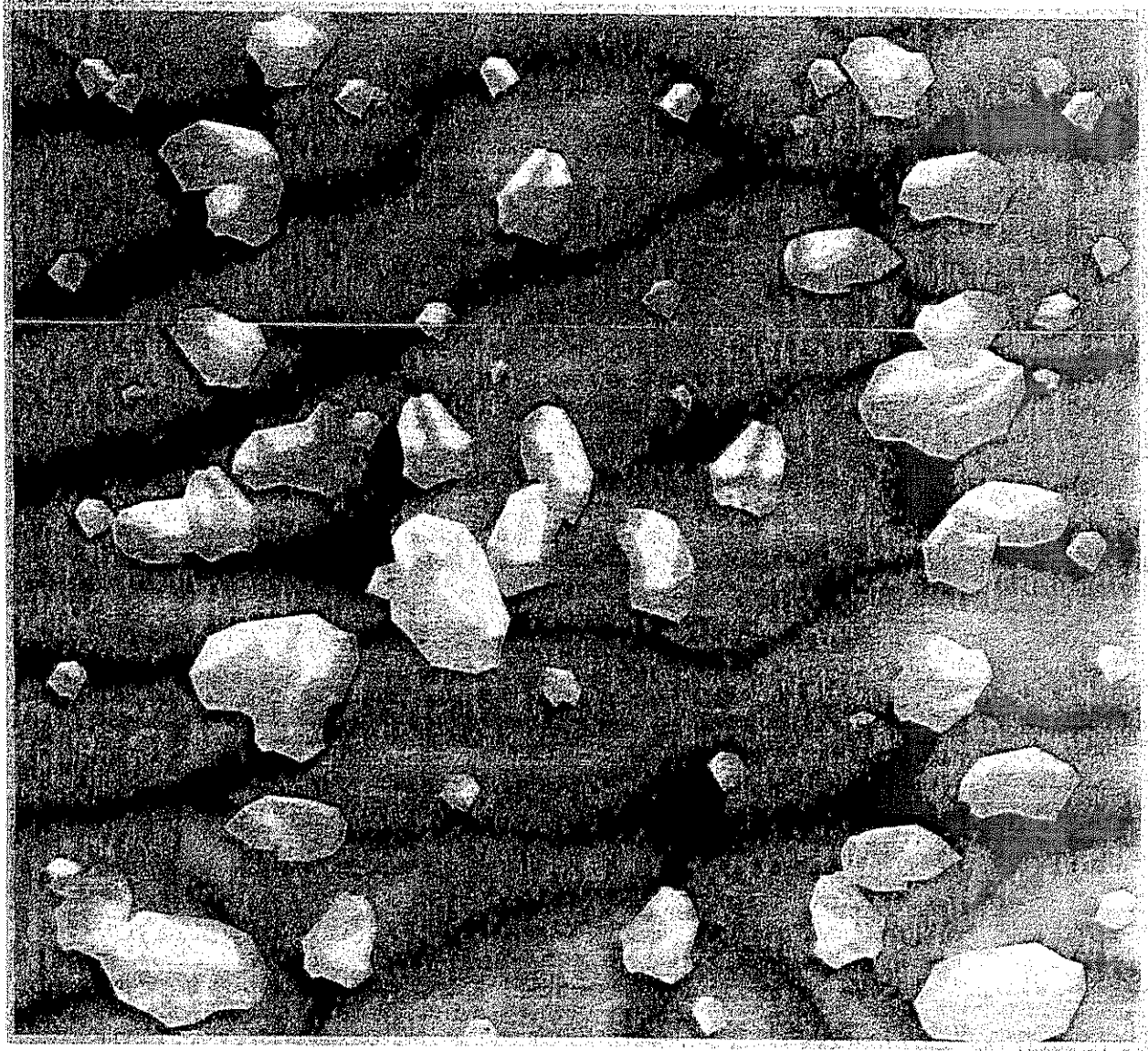


# What are atoms?



**KEY TERM**

**atom:** smallest particle of a type of matter that has all of the same characteristics as that type of matter

# LESSON | What are atoms?

9

What is the smallest thing you can think of? A single grain of sand? A particle of dust?

Now try to imagine something so small that you would need millions of them to make one grain of sand! Imagine something so small that you cannot see it—not even with the most powerful microscope.

There is something that small: the **atom**. All matter is made up of atoms. All solids, liquids, and gases are made up of these tiny particles.

Atoms are matter. One atom takes up space—very, very, very little space. An atom also has mass—very, very, very little mass.

How small is the atom? Atoms are so small that in just one drop of water, there are about six sextillion atoms.

That's 6,000,000,000,000,000,000 atoms!!!

If you tried to count to six sextillion, it would take you about one hundred trillion years—if you counted fast!

The idea of the atom is far from new. Many years ago, before there were any "real" scientists, there were philosophers [fi-LAHS-uh-furz]—people who did mental "investigations." They worked with ideas. Over 2,000 years ago, a Greek philosopher named Democritus [di-MAHK-ruh-tus] had the idea that all matter was made up of tiny parts. He believed that these parts could not be divided or destroyed. He named them *atoms*. In Greek, *atomos* means "indivisible" [in-di-VIS-uh-bul].

Democritus could not prove his idea. He couldn't even test it. So, it remained just an idea for many years. Today, scientists have proven that many of Democritus's ideas were correct. Every day more and more is discovered about the atom.

## LARGE NUMBERS AND SMALL THINGS



Figure A

Suppose each of those atoms were a drop of water. How much water would that be? It would be six sextillion drops of water.

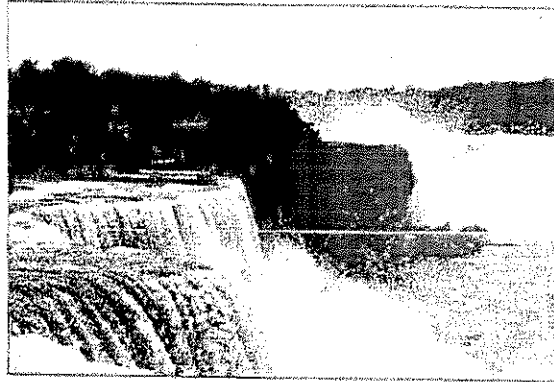


Figure B

That's more water than all the water that passes over Niagara Falls in 2,000 years.



Figure C

That's enough water to fill about six billion Empire State Buildings—or cover the entire United States, including Alaska and Hawaii, with water 31.4 meters (103 feet) deep.

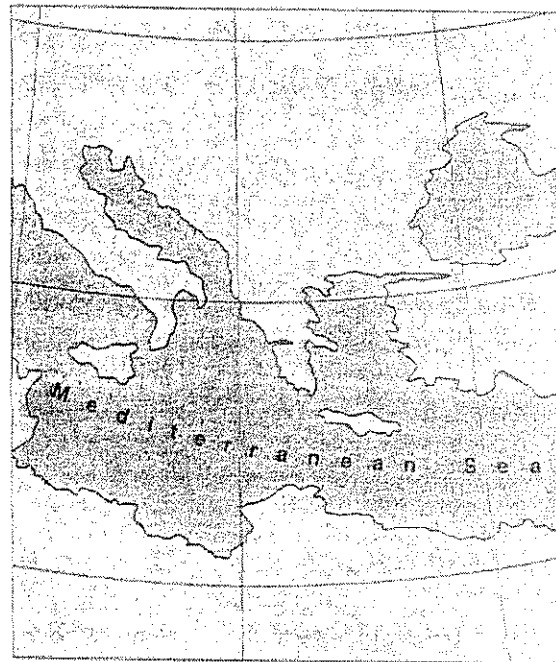


Figure D

That's almost twice as much water as there is in the Mediterranean Sea.

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

- \_\_\_\_\_ 1. An atom is very large.
- \_\_\_\_\_ 2. Democritus named the atom.
- \_\_\_\_\_ 3. Solids are made of atoms.
- \_\_\_\_\_ 4. Liquids are made of atoms.
- \_\_\_\_\_ 5. Gases are not made of atoms.

### MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

Column A	Column B
_____ 1. Democritus	a) a very small particle
_____ 2. matter	b) Greek philosopher who named the atom
_____ 3. philosophers	c) made up of atoms
_____ 4. atomos	d) people who did mental investigations
_____ 5. atom	e) Greek word for "indivisible"

### WHICH IS SMALLEST? WHICH IS LARGEST?

Each group of words or terms below can be arranged by size. Write them in the correct order in the spaces below each group.

1. a piece of dust

an atom

an elephant

\_\_\_\_\_ smallest

\_\_\_\_\_ largest

2. the tip of a pin

a dime

an atom

\_\_\_\_\_ smallest

\_\_\_\_\_ largest

1. an atom

a rock

a pebble

\_\_\_\_\_ smallest

\_\_\_\_\_ largest

## MODERN ATOMIC THEORY



Figure E John Dalton

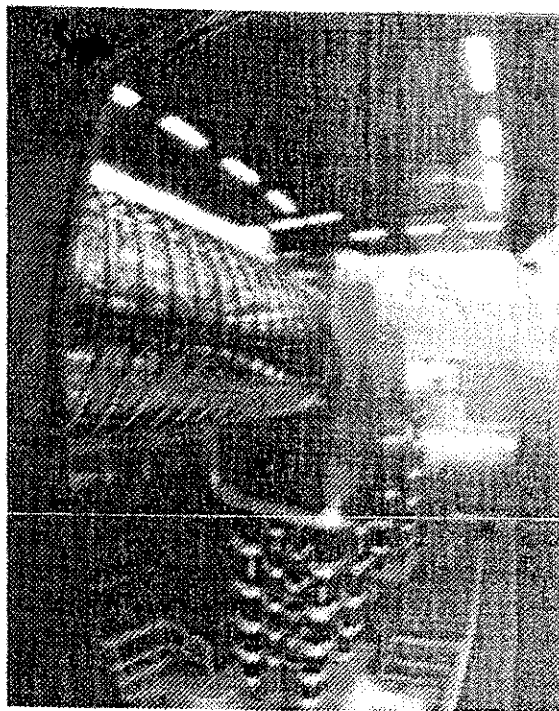


Figure F Synchrotron—one of the complicated pieces of equipment used to study the atom

In the early 1800s, an English chemist named John Dalton described his ideas about matter. Dalton's ideas were based on many scientific experiments and observations. The ideas formed a theory that led to our modern atomic theory.

You may wonder how we could know anything about a particle of matter that is too small to see and almost too small to measure. Scientists have learned how to study atoms. They study atoms by studying how matter behaves. They use very complicated equipment. However, you can learn about atoms by studying what scientists have learned.

The present atomic theory states:

1. All elements are made up of tiny particles called atoms.
2. Atoms of a given element are alike.
3. Atoms of different elements are different.
4. Chemical changes take place when atoms link up with, or separate from, one another.
5. Atoms are not created or destroyed by chemical change.

Democritus was on the right track over 2,000 years ago. However, one important part of his idea has been proven wrong. Atoms *are* divisible. In fact, the "splitting" of the atom is the basis for nuclear [NEW-klee-ur] or atomic, energy.

1. How do scientists study atoms when they are too small to be seen? \_\_\_\_\_
2. How can we learn about atoms? \_\_\_\_\_

## FILL IN THE BLANK

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Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some answers may be used more than once.

alike  
created  
different  
Democritus

John Dalton  
six sextillion  
small  
2,000

atoms  
indivisible  
destroyed

1. The atom was first thought of by a man named \_\_\_\_\_ more than \_\_\_\_\_ years ago.
2. In Greek, the word *atomos* means \_\_\_\_\_.
3. Matter that is indivisible cannot be \_\_\_\_\_.
4. An English chemist named \_\_\_\_\_ presented a modern atomic theory.
5. All elements are made of \_\_\_\_\_.
6. Atoms of a given element are all \_\_\_\_\_.
7. Atoms can not be \_\_\_\_\_ or \_\_\_\_\_ by chemical change.
8. Atoms of \_\_\_\_\_ elements are different.
9. Atoms are so \_\_\_\_\_ that we can not see them.
10. There are about \_\_\_\_\_ atoms in a drop of water.

## REACHING OUT

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Why did it take 2,000 years for scientists to confirm some of Democritus's ideas about atoms.

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