

Read About Atoms & Molecules

WHAT IS ATOMIC STRUCTURE?

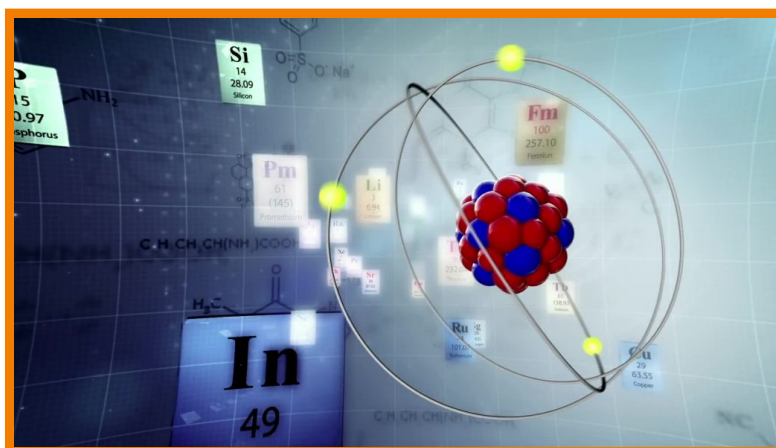
All atoms are made of three smaller particles called protons, neutrons and electrons. The protons and neutrons clump together at the center of an atom and the electrons orbit far away. Atoms can be combined to form molecules through chemical reactions.

To better understand atomic structure...

LET'S BREAK IT DOWN!

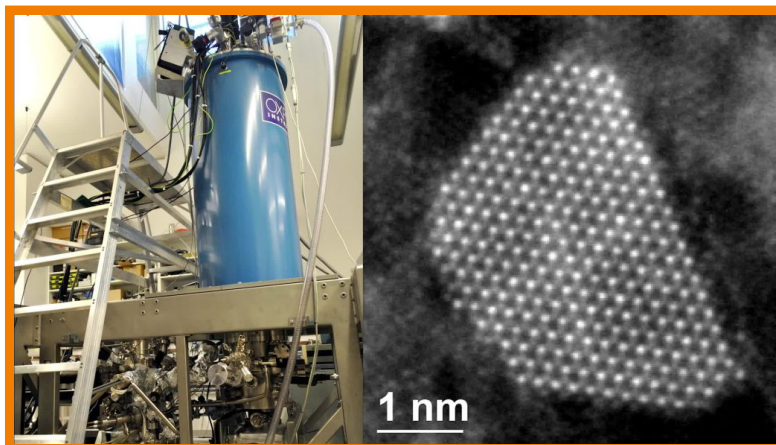
Atomic Structure

The center of the atom, often referred to as the nucleus, is made up of protons and neutrons. The protons are positively charged, while the neutrons don't have a charge. Orbiting around the outside of the atom at a tremendous speed and distance are electrons. Electrons are the smallest of the three subatomic particles and have a negative charge. Empty space is found between the atomic nucleus and electrons.



Microscopic Atoms

Atoms are extremely small. Atoms are more than 10,000 times smaller than the width of a hair. Even a classroom microscope would not be able to see anything close to the size of an atom. A specialized microscope called a Scanning Tunneling Microscope developed in the 1980s can show us individual atoms. If you were to look at some iron filings with a Scanning Tunneling Microscope, you would be able to see tiny spheres of iron atoms.



Identifying Atoms

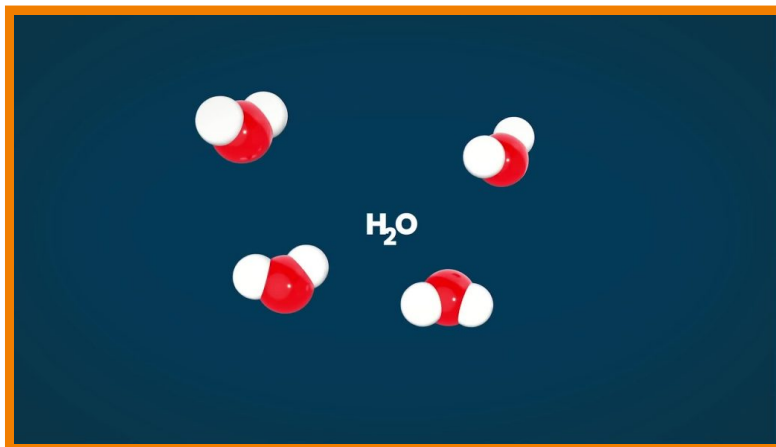
Each element has a certain number of protons, neutrons and electrons. We can find this information by referencing the Periodic Table of Elements. For example, element number 6 on the table is carbon, which is notated by the letter C. The periodic table also shows us that carbon's atomic number is 6. The atomic number tells us how many protons and electrons are present in the element. From this information we know that carbon has 6 protons and 6 electrons.

The Periodic Table

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3 Li lithium	4 Be beryllium															17 Cl chlorine	16 S sulfur	15 P phosphorus	14 Si silicon	13 B boron																																																																													
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11 Na sodium	12 Mg magnesium											11 Zn zinc	10 Cu copper	9 Ni nickel	8 Co cobalt	7 Fe iron	6 Mn manganese	5 Cr chromium	4 V vanadium	3 Ti titanium	2 Sc scandium	1 Ca calcium	1 K potassium																																																																										
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37 Rb rubidium	38 Sr strontium	39 Y yttrium	40 Zr zirconium	41 Nb niobium	42 Mo molybdenum	43 Tc technetium	44 Ru ruthenium	45 Rh rhodium	46 Pd palladium	47 Ag silver	48 Cd cadmium	49 In indium	50 Sn tin	51 Sb antimony	52 Te tellurium	53 I iodine	54 Xe xenon											18																																																																					
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87 Fr francium	88 Ra radium			101 Rf rutherfordium	102 Db dubnium	103 Sg seaborgium	104 Bh bohrium	105 Hs hassium	106 Mt meitnerium	107 Ds darmstadtium	108 Rg roentgenium	109 Cn copernicium	110 Uut ununtrium	111 Fl flerovium	112 Uup ununpentium	113 Lv livermorium	114 Uus ununseptium	115 Uuo ununoctium											18																																																																				
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		89 Ac actinium	90 Th thorium	91 Pa protactinium	92 U uranium	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium											18																																																																						

Elements and Molecules

Elements can be combined to make molecules. Water for example is H₂O. This means that 2 hydrogen atoms are bonded to one oxygen atom. There are endless combinations of atoms that make up all of matter. Some are simple like water, while others are much more complicated such as hemoglobin. A sucrose molecule, what you know as table sugar, is made up of 12 atoms of carbon, 22 atoms of hydrogen, and 11 atoms of oxygen. Sucrose can be written in a shorthand notation like this: C₁₂H₂₂O₁₁.



Careers in Chemistry

The main field of science that studies atoms and molecules is called chemistry. Chemists use their knowledge of atoms to create molecules that can be used as medicines. In order to make molecules, they need to know which ones react together and which order to react them in. Other types of scientists like biochemists study huge molecules made by nature such as proteins and DNA. The production of insulin molecules to treat diabetes was made possible by the work of biochemists.



ATOMS & MOLECULES VOCABULARY

Matter

Anything that has mass and takes up space.

Atom

The basic unit of an element. All matter is made up of atoms.

Proton

A positively charged subatomic particle located at the center of an atom.

Neutron

A subatomic particle with no charge located at the center of an atom.

Electron

A subatomic particle of an atom that is negatively charged and orbits the nucleus extremely fast.

Nucleus

Protons and neutrons clump together at the center of an atom to form the nucleus of an atom.

ATOMS & MOLECULES DISCUSSION QUESTIONS

What would you see if you looked at iron filings with a Scanning Tunneling Microscope?

Since the Scanning Tunneling Microscope is so powerful, you would see tiny spheres which are iron atoms (the smallest possible unit of iron).

Describe the different particles that make up an atom.

An atom is made up of 3 particles; protons, neutrons and electrons. Protons are positively charged and are positioned in the center of an atom. Neutrons are not charged and are also located in the center of an atom. Electrons orbit the center very quickly and are negatively charged.

What are some examples of elements? How do you know they are elements?

Some examples of elements are gold, iron, copper and carbon. Anything on the periodic table is an element. All elements are pure substance made up of only one type of atom.

How can you use the Periodic Table of Elements to help you find information about specific elements?

The Periodic Table of Elements shows the names and abbreviations for each element. It also tells you how many protons, neutrons and electrons each atom has. The atomic number of each element corresponds with how many protons and electrons an element has. We cover more details about the periodic table in our lesson called "The Periodic Table."



How did scientists conclude that most of an atom is empty space?

In 1908, Ernest Rutherford did an experiment where he shot beams of radiation through gold foil which is made up of gold atoms. Most of the radiation went right through the gold foil, while only a tiny fraction of the beams bounced back. This supports the atomic model with most of the mass at the center with electrons orbiting far away from it.

What are some different careers available for people that want to study atoms and molecules?

Scientists in the medical field use molecules on a regular basis to develop new medicines to help fight diseases. Specifically, biomedical scientists may be able to replicate naturally occurring molecules to help people with deficiencies.
