

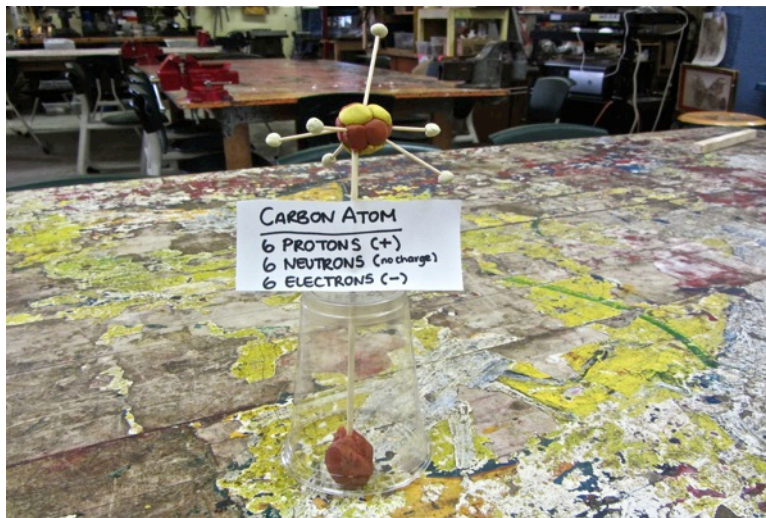
Building Atoms

Category: Matter

Type: Atom

Materials List:

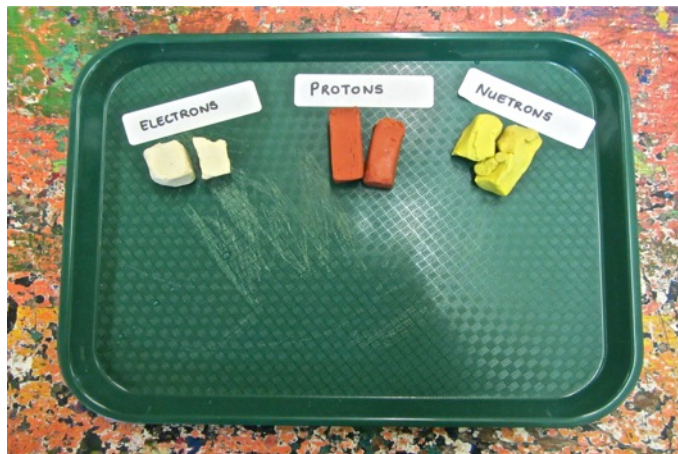
3	Blocks of different colored clay
	Toothpicks
1	Skewer
1	Plastic cup
1	Sheet of paper and Marker
	Periodic Table



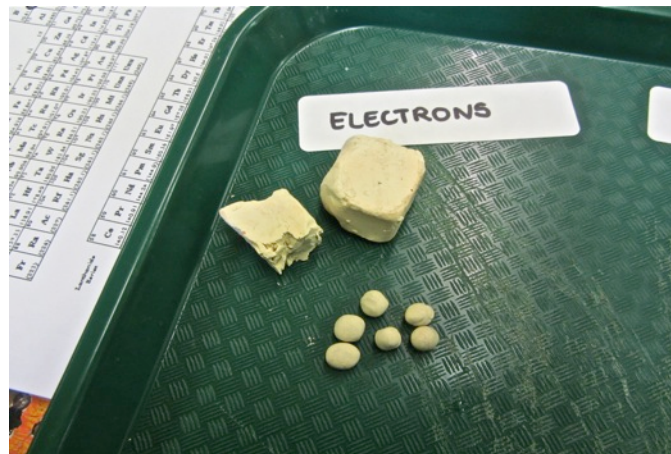
Team

Decide one of the first 20 elements that you would like to create

How To:



Decide which color clay will represent electrons, protons and neutrons.



Roll pea-sized balls to represent electrons.



To build protons and neutrons, roll balls that are twice the size of the electrons.

THE PERIODIC TABLE

1 H 1.00794																
3 Li 6.941	4 Be 9.0122															
11 Na 22.99	12 Mg 24.305															
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.693							
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (97.91)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42							
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08							

Looking at the periodic table, identify which element your team will be building. Remember to stick to the first 20 elements.



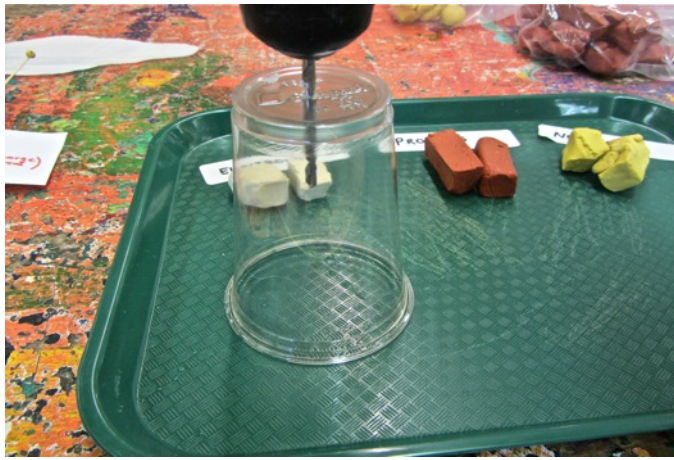
Begin building your electrons, neutrons, and protons.



Push the electron onto one end of the toothpick.



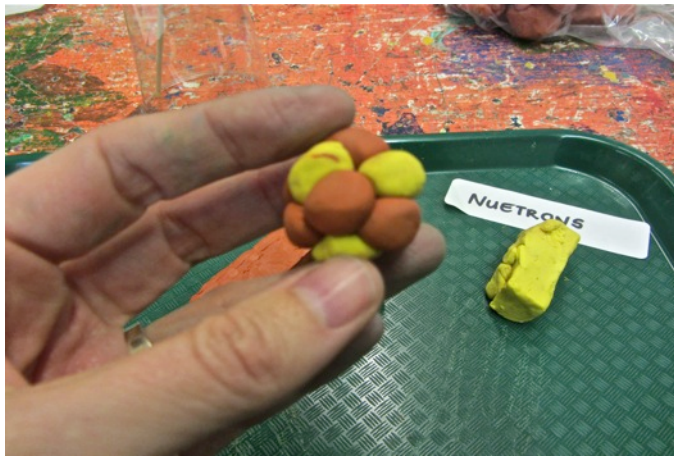
Push a proton onto the other end. .



To support the model, turn a cup upside down and poke a hole through the bottom.



Stick the skewer through the hole in the cup and into a large piece of clay to keep it upright.



Arrange all of the necessary protons and neutrons into a ball to build the atom's nucleus.



Place the nucleus on top of the skewer.



Using a mix of long and short toothpicks arrange the electrons around the nucleus.



Make a label for your atom. Include the name of the element, number of electrons, protons and neutrons. Attach the label to your display.

Hints for success:

- The protons and neutrons might have to be pressed together hard so that they stick to each other. Try and keep the overall shape spherical.
- If you want to make the model more accurate, make the electrons tiny specs of clay and the protons and neutrons much larger. Then use bamboo skewers instead of toothpicks, since the average distance between a nucleus and its electrons is actually much, much greater than shown in this model.

Concepts Involved:

- Atoms are made up of electrons, protons and neutrons.
- Electrons are negatively charged, protons are positively charged and neutrons have no charge.
- In the periodic table, elements are organized based on their atomic masses. This also gives information on some of their properties.
- Using the atomic mass and atomic numbers, the numbers of electrons, protons and neutrons in an atom can be determined.

Elaboration:

Atoms can be described as building blocks; we are made up of billions and billions of atoms. Atoms themselves are made up of electrons, protons and neutrons. The center part of an atom is a dense nucleus that's made up of the positively charged protons and electrically neutral neutrons. A cloud of the negatively charged electrons surrounds the nucleus.

The electrons in this activity are around half the size of the protons and neutrons. In reality, electrons are much smaller and around 2000 times lighter than protons and neutrons. They are moving constantly and a cloud is a good way to visualize them. That's one limitation in these models – they're static and don't represent the constant movement of an atom's particles. Electrons are attracted to the positively charged protons. This means that for every electron in a neutral atom, there is one proton.

An element is a pure substance in its simplest form consisting of only one type of atom. There are over 120 known elements, both natural and man-made. Only the first 98 elements are known to occur naturally on Earth and these include, hydrogen, helium, gold, silver and copper. Humans are made of billions of atoms but only 40 elements!

The periodic table is an important tool in chemistry. The periodic table lists 118 elements and recognizes several more unnamed ones. They are organized based on atomic number, which also gives information on how the electrons are arranged and how they will react with other. The standard form of the table is comprised of a large grid of elements, positioned above a double row of elements. Each square of the periodic table houses an element, and contains information about it. Here is an example:

1 H 1.008	6 C 12.001
-----------------	------------------

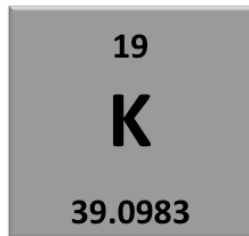
Hydrogen (H) and Carbon (C) as they appear on the periodic table.

There are three main parts in each element's squares. One or two letters represent the name of each element, and the first letter is always capitalized. For some elements one or two letters from the element's common name are used, such as C for carbon, while others are based on their Latin names such as Au for gold. The number above the name is the atomic number which tells us how many and protons are in an atom of the element. Atoms are neutrally charged, so for every positively charged proton in an atom there is a negatively charged electron. For example, the atomic number for carbon is 6, meaning that it has 6 protons and 6 electrons. The number below the element name is the atomic mass, also known as atomic weight. It represents the number of protons and neutrons in the nucleus of the atom. In carbon it is 12.001. The number 12.001 is not an even 12 because protons and neutrons are not exactly the same mass, and also because sometimes a bit of mass is lost in the process of binding. This is all very complicated, but you can always round the atomic mass number to its nearest integer value to find the total number of protons and neutrons in the standard, most prevalent atom of the element. There may be other forms of the atom called isotopes which are the same element but with different numbers of neutrons, and thus atomic masses. This difference in the number of neutrons was one of the challenges to early scientists trying to figure out the periodic table.

To calculate out how many neutrons there are, we need to look at both numbers. The formula to use is:

$$\textit{atomic mass} - \textit{atomic number} = \textit{number of neutrons}$$

In the case of carbon this is $12 - 6 = 6$, which tells us that in carbon there are 6 electrons, 6 protons and 6 neutrons. Let's look at another element, potassium (K).



It's atomic number is 19, meaning there are 19 electrons and 19 protons in the atom. Using the formula above to calculate the number of neutrons in the nucleus, it tells us that there are 20 neutrons in potassium ($39 - 19 = 20$).

