**What is the Universe made of?**

Think about the desk that you are sitting at– what would the desk look like if you were only the size of an atom??? What do you think you would “see” if you were “inside” the desk and looking around?

Use the “internet” to find information on the Bohr model of the atom. In the Bohr model of the atom, where are the protons, neutrons, and electrons of the atom found?? Draw a picture of what an atom looks like (where electrons, protons, and neutrons are located) according to the Bohr model.

What keeps electrons from leaving an atom?

Protons have a positive electrical charge. Electrons have a negative electrical charge. Neutrons have no electrical charge.

Oppositely charged things pull on each other with an attractive force. That is why electrons want to stay in atoms instead of flying away—they are being pulled inwards towards the nucleus of the atom by the positively charged protons. ***But neutrons are neither positive nor negative—they have ZERO electrical charge. Why, then, do neutrons and protons stick together in the nucleus? And if like charges push each other apart, why doesn’t the nucleus fly apart due to the protons pushing each other away???***

It turns out that there is a different kind of force inside of atoms, a force that is unlike any of the forces that we are used to from our day-to-day lives. This force is called the STRONG FORCE, or sometimes the STRONG NUCLEAR FORCE, and it is kind of like the electric force, but one that only works over incredibly short distances—like the width of an atom’s nucleus!!!

Go to a website called the Particle Adventure and read about Fundamental Particles under the Standard Model heading. What does the word “fundamental” mean when talking about the building blocks of matter?

Are electrons, protons, and neutrons “fundamental”? Read the entirety of the section entitled “What is fundamental?” in the Particle Adventure and then fill in the table below.

|  |  |  |
| --- | --- | --- |
| Particle Type: | Is it fundamental? | If no, what is it made of? |
| The electron |  |  |
| The proton |  |  |
| The neutron |  |  |

Just as protons and electrons are pulled towards each other because of an electrical force, quarks stick to each other because of the Strong Force. And believe it or not, if the Strong Force didn’t exist—if quarks didn’t stick together—there wouldn’t be any life on earth. Because without a strong force, there wouldn’t be any atoms, nor would stars like the Sun produce the energy that heats our planet.

A ***fundamental particle*** is best defined as

***The Standard Model*** is a theory that, simply stated, says

Move on to the next section, “What is the World made of?”, and use it to complete the following:

Classify each of the following statements as either true or false.

\_\_\_\_\_\_\_ A quark has mass.

\_\_\_\_\_\_\_ A quark has a measure-able size.

\_\_\_\_\_\_\_ A quark has an electric charge.

\_\_\_\_\_\_\_ A quark has something called “color charge”.

\_\_\_\_\_\_\_ A quark is actually made up of 3 leptons.

\_\_\_\_\_\_\_ A lepton has mass.

\_\_\_\_\_\_\_ A lepton has a measure-able size.

\_\_\_\_\_\_\_ A lepton can have an electric charge of either -1 or 0.

\_\_\_\_\_\_\_ A lepton is made up of 3 quarks.

What is antimatter?

What happens when matter and antimatter meet?

What can you tell me about positrons?

What can you tell me about neutrinos?

Move ahead to the next section of the Particle Adventure, entitled “What holds it together?”

What are the four Fundamental Forces of nature?

What is the difference between a “force” and an “interaction”?

What is a force carrier particle?

If protons have a positive electrical charge, and like charges repel each other, why doesn't the nucleus of an atom just fall apart???

What effect do Weak Interactions have on quarks and leptons?