Wizards of Wright

Lesson: Building Atoms

Background Info for Wizards:	Students will begin the lesson reviewing what they already know about Matter and States of Matter. We will then move into the concept that all matter is made up of atoms and when you break apart an atom, you release the subatomic particles (protons, neutrons, and electrons) that make up the structure of the atom. These subatomic particles are the basis of quantum science. In this lesson, students will gain an understanding of atomic structure, quantum science, and practice building elements based on their atomic structure.
Materials:	1 Atom Model poster 2 donut magnets for demonstration 1 plastic grocery bags (for each group) - Cut 2 strips of plastic bag for demonstration purposes. each group will need scissors 1 ruler (for each group) 1 Static Electricity worksheet per group 2 laminated periodic tables (for each group) 3 element cards (for each group) 1 atomic model kit (for each group) - 3 trays - tube - baggie of white pom poms - baggie of red pom poms - baggie of black pom poms Building Atomic Models worksheets (1per student)
Lesson Time: ***70 minutes***	Introduction: 5 minutes Guided Lesson #1: 5 minutes Guided Lesson #2: 10 minutes Student Activity #1: 20 minutes Guided Lesson #3: 5 minutes Student Activity #2: 20 minutes Conclusion: 5 minutes

Learning Targets:	Students will understand the structure of an atom. Students will learn that quantum science is science at the subatomic level. Students will practice using the periodic table. Students will practice building elements based on their atomic structure
Introduction for Students: 5 minutes	**Say to the students:** Let's begin by reviewing some things that you already know. **Ask the students:** What is matter? - Anything that has mass and takes up space. What are the 3 forms of matter? - Solid, liquid and gas. What happens to make matter a solid, liquid, or gas? In other words, what's the biggest difference in these 3 phases or states? - The molecules in a solid are tightly packed together, and they can't move around, so the solid keeps its' shape. - The molecules in a liquid aren't as tightly packed, with room to move around, allowing the liquid to change shape based on the container it is poured into. - The molecules in a gas aren't packed together at all, giving them ample room for movement, meaning that gas can fill any space and any shape, and spread out. **Say to the students:** Since you already know that matter is made up of molecules. Let's go even smaller! **Ask the students:** Does anyone know what molecules are made up of? Yes! Atoms. **Say to the students:** We think of atoms as being the smallest particle that makes up all forms of matter. Scientists can now break apart atoms and use what is called the "subatomic particles" found inside the atom! Before we go any further, let's define the word subatomic. The prefix "sub" means *beneath*. But it also means *smaller than*. So, subatomic means smaller than an atom.

	Ask the students: Does anyone know what the three parts are that make up an atom? - protons, neutrons, and electrons **Say to the students:** When we use these subatomic particles for science, we call that quantum science. Quantum is a word that means *a small unit*, so of course when we study or work with quantum science, we are studying or working with the smallest units. Specifically, quantum science is the study of matter at a tiny level, which helps us understand the world around us better. Because of Quantum Science, there are countless inventions that make human life easier. For example, paper thin solar panels, super tiny microchips in your iPhones, more efficient medications, and stain resistant materials are all a result of studying and manipulating the subatomic particles. Today, we will learn more about these subatomic particles, the atoms that they create and their place on the Periodic Table.
Guided Lesson #1: 5 minutes	Hold up the poster of an atom and name each of the parts. Hang it on the board if you can. **Say to the students:** You've already told me that the three parts of an atom are the protons, neutrons, and electrons. Let's make sure we can identify them. Two of the subatomic particles are in the center of the atom. **Ask the students:** Which labels are pointing to the particles in the center? Does anyone know what this symbol tells us? - The protons and the neutrons are in the center. - The plus sign on the protons tells us it has a positive charge. That leaves this particle, on the outside of the atom. **Ask the students:** Which one is this? Does anyone know what this symbol tells us? - It is the electron. - The minus sign tells us the electron has a negative charge. There's one more area of the atom, that we haven't discussed yet. The center, where the protons and neutrons are, is called the nucleus.
Guided Lesson #2: 10 minutes	**Ask the students:** Who can tell me what you already know about static electricity? - Have several students either try to explain it or give examples of when they have experienced it.

	Say to the students: Let me explain it a little further. *(Use their answers from above to infer what they may not know or understand. The information below can help fill in any of the blanks.)* **Say to the students:** All atoms want an even number of electrons, so electrons tend to jump to other atoms if there is space for them. Sometimes when this happens, we call it static electricity. **Ask the students:** Have you ever been "shocked" by a doorknob? **Say to the students:** Static electricity is a form of electricity that doesn't flow like the electricity that charges your phone. When an uneven number of protons and electrons build up in the atoms that make up your skin and the atoms that make up the doorknob they want to even out (or become neutral). When you touch the doorknob, they do just that. The electrons jump from your skin to the doorknob at such an intense rate that it causes a "shock." **Say to the students:** Static electricity is the buildup of an electrical charge on the surface of an object. It's called "static" because the charges remain in one area rather than moving or "flowing" to another area. **Say to the students:** As we mentioned, static electricity can even build up on us. For example, when we rub our feet on the carpet and then zap something when we touch it. That is static electricity that we have built up on the surface of our skin and then discharging it onto another object. - We see it when our hair gets charged and sticks straight up. - We see it (and feel it) when our pant legs keep sticking to our legs. This is all static electricity that has built up on the surface of an object. **Say to the students:** (Pull out 2 donut or bar magnets to demonstrate.) Think for a moment about what you've learned about magnets. Magnets have opposite poles. **Ask the students:** - When we face the opposite poles towards each other, what happens? (opposites attract) - When we face the matching poles towards each other, what happens? (matching repels) **Say to the students:** Items with different charges (positive and negative) will attract, while items with similar charges (positive and positive) will push away from each other. Sort of like a magnet.

	Say to the students: Now, let's move that thinking to atoms. There are times when an electron moves from one atom to another. When this happens, some atoms end up with a positive charge, and then some are negatively charged. **Ask the students:** When a positively charged atom meets up with a negatively charged atom, what do you think happens? Will they attract or repel each other? - Right, they will attract because opposite charges are attracted to one another. What would cause 2 atoms to repel each other? - Correct, if they had the same charge. **Say to the students:** So, how do we get a static charge? A static charge is formed when two surfaces touch each other, and the electrons move from one object to another. One object will have a positive charge and the other a negative charge. Rubbing the items quickly, like when you rub a balloon fast over something or your feet on the carpet, will build up a large charge. When your skin is charged with static electricity and you touch something metal, like a door handle, the metal is very conductive and will quickly discharge the static electricity, creating a zap or small spark.
Student Activity #1: 20 minutes	**(Students will be working in small groups for this activity. Groups should be 3-4 students. Ask the teacher if the groups have already been created. If not, wait while he or she does this.)** Students will need their own scissors. Pass out 1 Static Electricity worksheet, 1 plastic grocery bag, and 1 ruler per group. **Say to the students:** We are going to do a static electricity experiment. As a group, cut your paper bag into strips (2 for each of you) around 2cm wide and 20cm long. It does not have to be precise. - Give the groups a few minutes to complete this task. **Say to the students:** We are going to follow the static electricity worksheet together. - What does the first box say? Right, we need a charged bag strip and charged skin. Your skin is almost always charged, so we need to charge a bag strip. - Each person should take one bag strip and lay it flat on the desk. Rub your hand back and forth across the strip at least 2-3 times

	to charge your plastic strip. (Demonstrate with your strip of plastic bag.) - This causes an uneven charge on the plastic. Now hold your charged plastic near the skin on your arm. What is happening? Is it attracting or repelling? Attracting! Great! - I'll give you a moment to fill in the 2nd box of the chart on your sheet, and then we'll move on to the second task. - Okay, the second task says we need a charged bag strip and the neutral desk. **Ask the students:** Are there any suggestions on how we should accomplish this? - Have the students recharge the bag, if necessary. - Have them do it on a desk that they will not use for the test, so that the desk remains neutral. **Say to the students:** Now hold your charged plastic near the skin on your desk. What is happening? Is it attracting or repelling? Attracting! Great! I'll give you a moment to fill in the 2nd box of the second row on your sheet, and then we'll move on to the third task. **Say to the students:** The third task says we need two charged bag strips. - Have the students recharge the first bag, if necessary. - Have them charge their second bag. **Say to the students:** Now hold your both of the strips near each other. What is happening? Is it attracting or repelling? Yes, it is repelling. Collect the materials, and then discuss with students the information to complete their worksheets. Give them a few minutes to do that before moving on.
Guided Lesson #3: 5 minutes	**Say to the students:** We have just observed how charged atoms interact with each other. Let's get ready to build a few atom models and the subatomic particles that make them. Pass out 2 laminated periodic tables to each group. **Ask students:** Who can tell me what this is called, and what kind of information we can find on it?

	- the periodic table - a listing of the elements - the elements name and abbreviation (*Some of the abbreviations are easy to remember, like H for hydrogen. Some are a bit harder like Fe for iron or Au for gold. For gold the "Au" comes from the Latin word for gold "aurum".)* - how many protons they have in the nucleus - how many electrons they have in the inner and outer shell **Say to the students:** Find the element Sodium on your Periodic Table. Sodium is represented as Na in the third row (from the Latin natron). - The atomic number is listed in the top left corner of the Sodium box. What is Sodium's atomic number? (11) - The atomic number represents the number of protons found in the atom's nucleus.
Student Activity #2: 20 minutes	**(Students will be working in small groups for this activity. Groups should be 3-4 students. Ask the teacher if the groups have already been created. If not, wait while he or she does this.)** Pass out 3 element cards and 1 atomic model kit to each group. (There are duplicates of the element cards, so make sure that each group gets 3 different element cards.) Pass out 1 Building Atomic Models worksheet to each student. **Say to the students:** Your group will recreate the atomic model on the 3 element cards you received. Let's do a sample together using the element Boron. We'll need to put these pieces together first. *Show the students first how to build their model using the tube with lid as your nucleus and the 3 dishes as your electron orbital field.* **Say to the students:** Find the element Boron on your Periodic Table. Boron is represented as a capital B in the second row. Boron is a mineral that our body needs for strong bones. - To build our model, we need to first find the atomic number for Boron. The atomic number is listed in the top left corner of the Boron box. What is Boron's atomic number? Great, it is 5. - The atomic number represents the number of protons found in the atom's nucleus. - The protons and electrons are always equal. So, if Boron has 5 protons, how many electrons will it have? Right, 5.

	- The red pom poms represent the protons and the black pom poms represent the electrons. - *Place 5 red pom poms into the nucleus tube and place 5 electrons in the outer shells.* **Say to the students:** The innermost shell is filled first. This shell can contain a maximum of two electrons. The second shell can hold a maximum of eight electrons. When this is filled, electrons go into the third shell, which also holds a maximum of eight electrons. **Say to the students:** Which subatomic particle is missing from this model of the element Boron? Right, the neutrons. - Now we need to figure out how many neutrons Boron has. - To do this, let us look at the atomic mass of Boron. - What do you think the atomic mass of an element is? Correct, the atomic mass is the mass of the element itself. - To find the atomic mass, we need to look at the number below the element's symbol B. What is that number? Yes, it is 10.811. - We'll round that to the nearest whole number, so it is easier to work with. So, 10.811 will be rounded 11. - To find the number of neutrons in Boron, we need to subtract the atomic number from the atomic mass. So, what would our subtraction problem be? Right, 11-5. - Boron has 6 neutrons. The white pom poms represent the neutrons, so we will put 6 white pom poms into the nucleus tube with the 5 red protons. **Say to the students:** Now, as a group, you will recreate the atomic models for the 3 elements that you have cards for. Please fill out your worksheet as you go along. I will come around and answer any questions that you might have. Have the students separate their pom poms into their correct baggies before collecting activity items.
Conclusion: 5 minutes	Check for understanding by asking the following questions: - What can you tell me about matter? - What can you tell me about atoms? - What are the subatomic particles of an atom? - What kind of charges do protons, electrons and neutrons have? - What information is found on the periodic table?

	- How do you calculate the number of protons, neutrons, and electrons found in an element?

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