**STEAM Subject:** Chemistry
**Lab:** How Small is an Atom?

**Grades:** 5th-8th

**Learning objective:**
Students will be able to gain understanding of scale and proportion of an atom

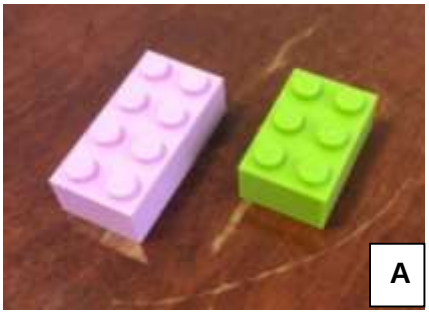
**ENGAGE:**
**Ask students the following questions:**

- What are cupcakes made of? (flour, sugar, water, etc.)
- Do you have any idea what those ingredients are made of? Atoms!

**Introduction:**
Everything is made out of atoms! We can think of atoms as incredibly small, little building blocks that make up everything in the world, even the universe! They come in different types and sizes and when you combine them in different ways, you can create different things! To explain this point, we will do the following activity:

**Activity:**
The following images are also provided on the last pages beneath the instruction guide for easy use.

Using the image A students will:


A

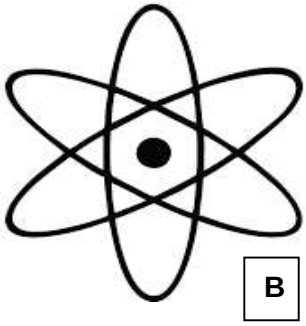
Identify the similarities between these two blocks?

- *Same shape (both are rectangular blocks)*
- *Have the same parts (bumps, smooth areas)*
- *Those parts are found in the same places (the bumps are always on one side - the top)*

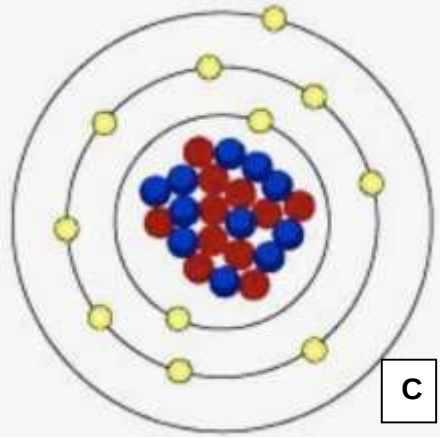
Identify the differences between these two blocks?

- *They are different colors (they look a bit different)*
- *They are different sizes (one is a little bigger)*
- *They have different amounts of the parts they have (one has more bumps than the other)*

Show students the image B


B

Have they ever seen something that looks like this before? This is one way that people like to draw a very simple version of an atom. When we look at atoms, we are going to look at the slightly more detailed image C. This is like if we flattened out the rings from image B and added some details to include their different parts.




Just like with our blocks, all atoms look very similar to image C. They all have the same general shape, they are made out of the same parts (shown here by the red, blue, and yellow dots), and those parts are found in the same places (red and blue in the middle, yellow on the outside rings) *.

However, like our blocks they might have some variations. They can come in different sizes, and they might have different amounts of their different parts (e.g. more of the red dots, less of the yellow dots, etc.)

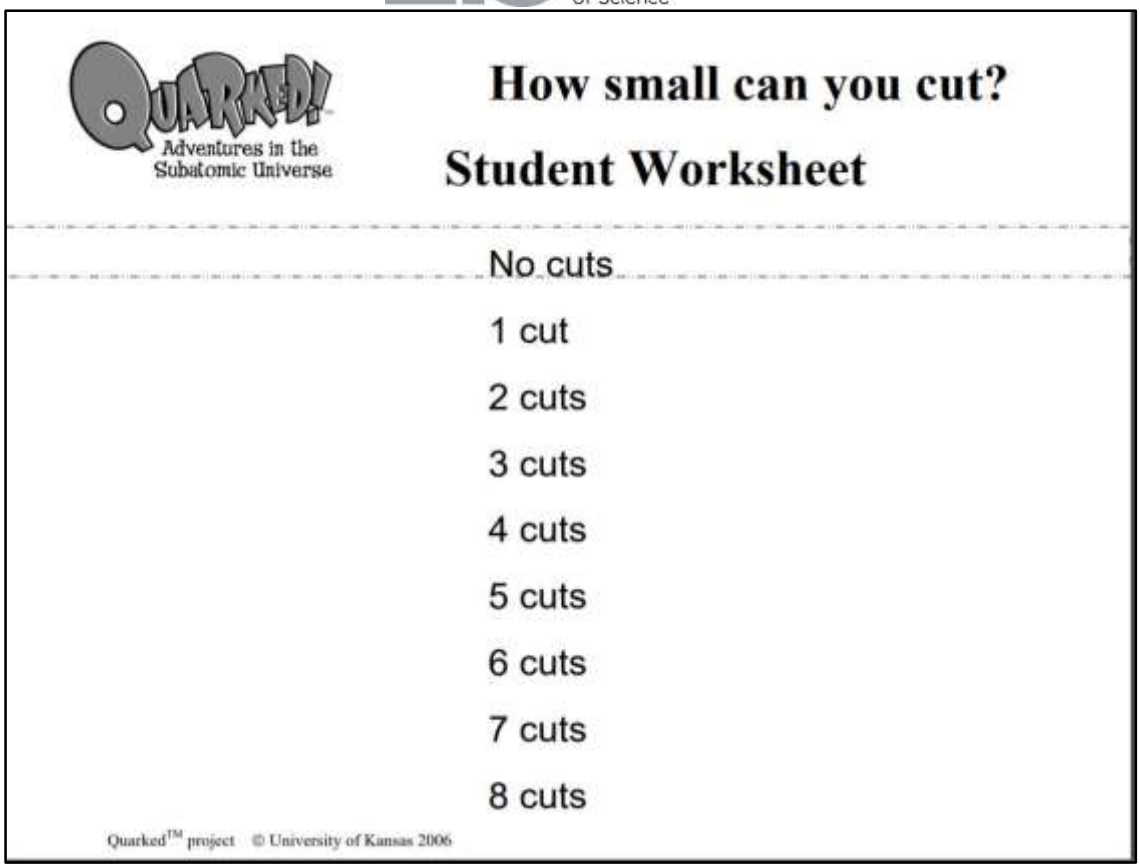
**Note: Atoms are NOT actually made out of red, blue, and yellow dots. Those are just the colors that this image is using to differentiate between the **protons, neutrons, and electrons** which are actually the pieces of an **atom**.* For today's lesson we are focusing on the atom as a whole. Image credit and more information about this shape of atoms found here: https://www.sutori.com/story/maria-mayer--o76ukqwrpuwP6TAxesGPevde

**EXPLORE:**

**Science Question of the Day**
How small is an atom?
Let's start by trying to name the smallest thing we can think of. What are some ideas?
*Everything is made out of atoms including all the super tiny things we just named which means atoms have to be even smaller*!
We are going to do an activity to help us visualize how small an atom is.

**Materials**:

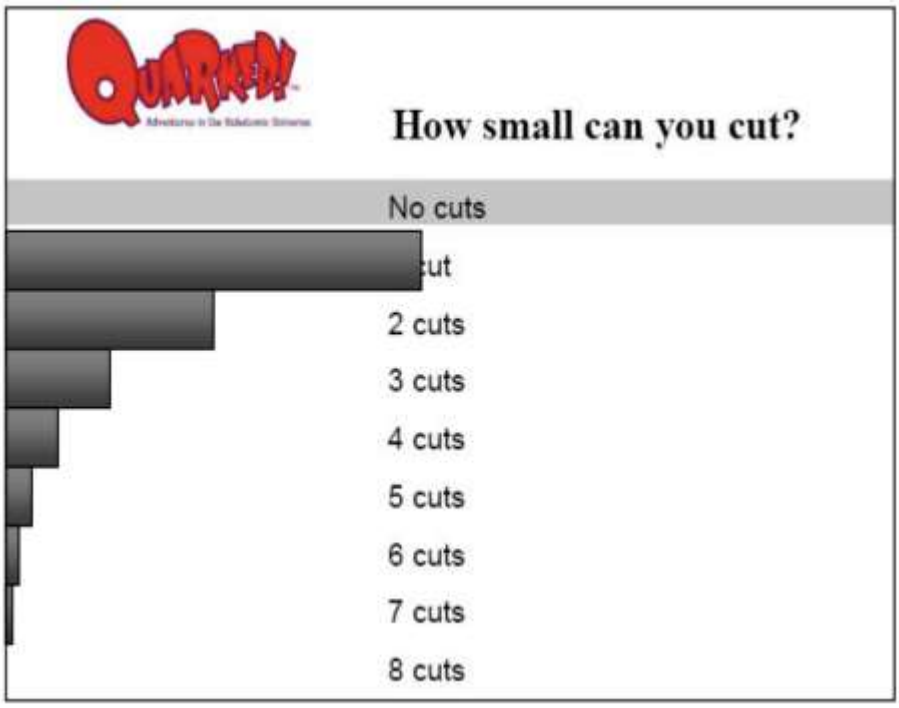
- One “How Small Can You Cut? Worksheet. Link to Worksheet: (Lesson Plan #2: How Do We Know What We Can't See). If you can’t print the worksheet, you may also use one 8.5x11 sheet of paper (white paper is recommended).
- One 11 inches long paper strip (approximately between ¼ inch and ½ inch wide, white paper is not recommended for this strip)
- A pair of scissors
- A glue stick or clear tape
- A ruler




**Directions**

1. Measure how long our strip of paper is. Do we know anything else that looks about this size? (Hint: compare it to your worksheet!).
2. Fold the strip of paper in half to find the center. Cut in the center to cut it in half. Set one half aside for later.
3. Take the other half and glue it onto the worksheet so that the edge of the paper strip lines up with the edge of the worksheet (it should extend half the length of the page. It also will cover up part of the "1 cut" text (on the worksheet), that is fine).
4. Take the half you set aside before and repeat the process. Fold and cut it in half. Set one half aside, and glue the second half to the worksheet with the end of the strip lining up with the edge of the worksheet.
5. Continue repeating and see how small you can cut! Note: eventually, folding it in half will be harder to do than just cutting it in half. At this point skip the folding step. As you continue cutting the strip in half, you will probably reach the point where the paper strip is so thin that it may seem easier to cut it in half the other direction (i.e. if it started ½ inch thick, shortening that to ¼ inch instead of cutting vertically. DO NOT DO THIS. The purpose of this lab is to get a sense of **proportion** as the length of the paper strip gets exponentially smaller. By cutting in a different direction, we will not gain the same understanding of **scale**.
6. Once you have repeated as many times as possible, discuss!

Example:




**EXPLAIN**

- Let's look at our "1 cut" example. Name some other things that are about the same size/length? (hand, grapefruit, phone)
- How about our "2 cut" (finger, apple) and "3 cut" examples (mushroom, paperclip) Were you able to get to 7 cuts? If you managed to cut it in half 7 times it would be the **width** of an ant!
- Now let's imagine we could keep going. If you could make it to 12 cuts it would be the width of a human hair!
- If you could keep cutting it in half over and over again, at 14 cuts it would be the width of a sheet of paper!
- At 18 cuts it would be as small as bacteria! That's **microscopic**!

How many cuts do you think it would take to be the size of an atom? Answer: 31 cuts! Another way to represent this: if you took the kind of atoms that paper is mostly made out of, and you stacked those atoms one on top of another, then you could fit a tower of atoms 650,000 atoms tall into just the width of a piece of paper!

**Review Science Vocabulary**

1. Atom- basic building blocks that make up matter. Everything in the Universe is made of atoms.
2. Scale- the size of one object in relation to another object
3. Proportion- the relative size of parts of a whole (elements within an object)

**More Resources**

- Watch this “zoom in” video. Starting at about the 1min 55sec mark it will zoom in on someone’s eyeball, the blood vessels in the eye, the cells in the blood vessels, etc. until it gets to the size of an atom!
  Cosmic Eye (Original HD Landscape Version)
- Watch Jon Bergmann: Just how small is an atom? | TED Talk

**Evaluate**

- Are we made of atoms? Yes! All matter is made out of atoms!
- What are atoms made out of? There are smaller pieces within atoms called protons, neutrons, and electrons.
- What are those made of? Quarks!
- What are quarks made out of? We don’t know! We still have a lot to learn about atoms and what they’re made of. In fact, we only discovered quarks in the 1960s. This may seem like a long time ago to you, but if you know anyone that’s 80 years old, then you know someone who was alive before humans knew what a quark was!

**Image A: Two Lego/building blocks**

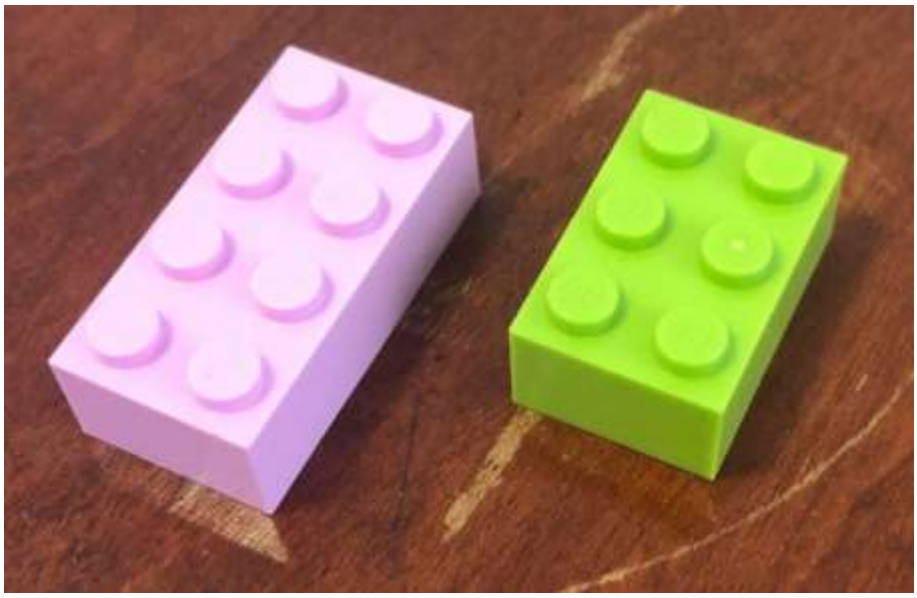


**Image B: Simple image of an atom**

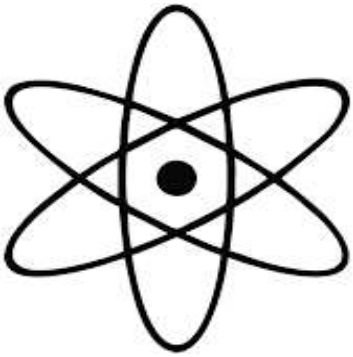
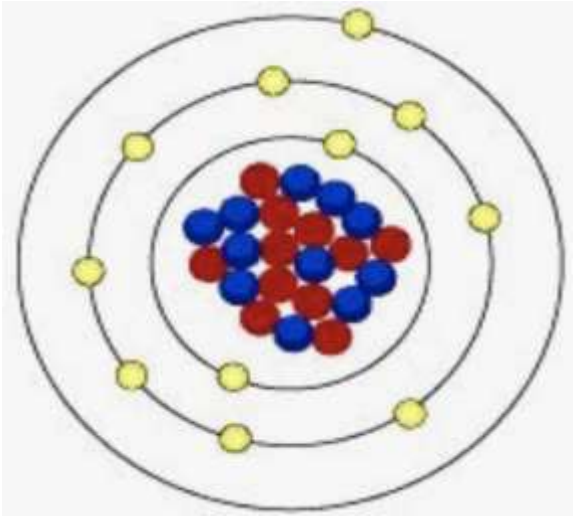


**Image C: Complex image of an atom**



***Source***: *http://www.quarked.org/*

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