NAVIGATING® NUCLEAR
Energizing Our World

Classroom Activity

Topic
Amazing Atoms

OBJECTIVES

Students will:

- Understand that the world is composed of matter, and matter is composed of atoms.
- Describe key characteristics of an atom.
- Illustrate and explain unique qualities of different atoms.

Overview

This activity will introduce students to the concept of an atom. After watching a short video to help grasp just how small an atom is, the class will simulate an atom's structure as they take on the role of neutrons, protons, and electrons. They will then be led to understand that there are different kinds of atoms, and that these different atoms contribute to everything around us. Students will ultimately apply what they have learned as they create Atom Trading Cards for hydrogen, oxygen, carbon, and uranium that illustrate each atom's "superpowers."

Grade Band

Elementary, primarily grades 3–5

Instructional Delivery Method

This activity is presented as an in-classroom experience, but it can also be easily completed at home. A suggested modification is included for virtual instruction.

Timing

60 minutes

NGSS Standards

Next Generation Science Standards	English Language Arts Standards
Matter and Its Interactions: • 5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen. • Disciplinary Core Idea: ○ PS1.A: Structure and Properties of Matter: Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)	**Speaking and Listening:** • CCSS.ELA-LITERACY.CCRA.SL.5: Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

Materials & Equipment

- A device with the ability to project video, for the teacher
- Video for grades 3–4: How Small is Nano?
  Video for grade 5: How Small is an Atom?
- The Atom Song video (for virtual instruction only)
- **Nametag handout**, 10 copies cut out in advance (for in-person instruction only)
- Elementary periodic table of elements, to display
- **All About Atoms handout**, one per student
- **Atom Superstar handout**, one per student
- Coloring materials, at least three different colors per student
- Scissors, for the class to share

Activity

1. Two-Minute Brainstorm: Begin by telling students that everything around them—their desks, their pencils, their paper, their water bottles, the water *in* their water bottles, the air they breathe into their bodies, and even their own bodies—is made up of matter. Matter is anything that has mass and takes up space!

   Then challenge students to brainstorm the very smallest things—or pieces of matter—that they can think of. Keep a list on the board as students share.

2. Ask students to show you with their facial expressions if it surprises them to learn that the pieces of matter they just brainstormed can be broken down into even smaller pieces or particles.*

3. Explain that all matter, including ourselves, is made up of tiny building blocks called atoms. Because atoms are so tiny, we can only see them under a very strong microscope.
4. Play one of the following videos to explain just how small an atom is. As students watch, encourage them to think of how they would explain the size of an atom to a peer.
    - Video for grades 3–4: How Small is Nano?

      Note: At 1 minute 52 seconds, it may be helpful to pause quickly and explain that a molecule is two or more atoms joined tightly together.
    - Video for grade 5: How Small is an Atom? (Stop at 1 minute 14 seconds)

    When the video is complete, invite a few students to share their explanations.
5. Then ask the class, "Based on what you have learned so far about the size of atoms, about how many atoms do you think make up one human body?" Write the following answers on the board, and then encourage students to raise their hand when you read the answer that they believe is correct.
    - ○ 70 atoms
    - ○ 700 atoms
    - ○ 7,000 atoms
    - ● 7,000,000,000,000,000,000,000,000,000 atoms: This answer, pronounced "seven octillion", is **correct!**

    Note: For more advanced students, you could also incorporate the Fermi questions as a strategy to help students think about, estimate, calculate and understand the size of an atom.
6. Next, lead students to an outdoor or indoor area with plenty of open space.*

***Virtual Instruction Note:**

If you are completing this lesson virtually, skip Steps 6–11. Replace these steps with the following instruction, and then continue with Step 12.

- Tell students that there are over 100 different kinds of atoms that make up everything around us. While each type of atom is a little different, they also have many similarities.
- Play The Atom Song video and ask students to listen for characteristics that all atoms share.
- When the video is complete, explain:
    - All atoms are the same because they each have protons, neutrons, and electrons.
    - Atoms are different because they can have a *different* number of protons, neutrons, and/or electrons. When an atom has a *different* number of protons than other atoms, it also has a different name! For instance, an atom called nitrogen has 7 protons as well as 7 neutrons and 7 electrons. An atom called helium, on the other hand, has 2 protons as well as 2 neutrons and 2 electrons.
    - Different atoms help create the many different materials and substances that we have all around us!
- Wrap up by challenging students to use materials in their home, such as pebbles, beads, beans, etc., to make a model of an atom based on what they learned and then share their creation by taking a picture of their creation!

7. Ask the class to look around and share everything they see that is made up of atoms. Accept any and all answers.
8. Go on to explain that there are over 100 different kinds of atoms! However, every kind of atom has a few important things in common:
    - First, in the middle of every atom is a nucleus. Walk in a circle in the middle of the open space, and ask students to pretend that this is a blown-up nucleus.
    - Explain that an atom's nucleus is made up of particles called protons and neutrons.
        - Pass out seven proton nametags to students and instruct them to stand close together in the nucleus.
        - Then pass out seven neutron nametags to students, and instruct the neutrons to squeeze in with the protons so they form a compact circular group.
    - Explain that the nucleus, or center of an atom, is made up of protons and neutrons that are close together like this!
    - Go on to explain that around the nucleus spins a third particle called electrons.
        - Pass out electron nametags to all of the remaining students.
        - Guide the first student in walking around the nucleus, the second student in walking in a slightly different path around the nucleus (avoiding the first student), and so on… until all students are circling the nucleus in different patterns.
        - Explain that electrons orbit around the nucleus of an atom.
9. Then instruct students to take a seat right where they are.
10. Ask the class if they remember about how many different kinds of atoms there are. Remind students that there are over 100 different kinds of atoms, and different atoms help form different things around us!

    Explain that the main difference between these different kinds of atoms is that each one has a different number of protons. They may also have a different number of neutrons and electrons, but it's the number of protons that make them different!
    - Tell the class that one type of atom is called nitrogen. Nitrogen has seven protons (instruct the seven students with proton nametags to stand back up), seven neutrons (instruct the seven students with neutron nametags to stand back up) and seven electrons (instruct seven students with electron nametags to begin walking around the nucleus).
    - Then ask everyone to sit down in their spots, and explain that another type of atom is called helium. Helium has two protons (tap on the shoulders of two protons and ask them to stand up); two neutrons (tap on the shoulders of two neutrons and ask them to stand up); and two electrons (tap on the shoulders of two electrons and ask them to begin walking around the nucleus).
11. Tell students that while these differences may seem small, it is because of their differences that we have so many different things on Earth!
12. Then bring students back to the classroom. Explain that for the rest of class they are going to create Atom Trading Cards (like baseball cards, character cards, popular card trading games, etc.) for a few different atoms so they can better understand some of the differences between them!

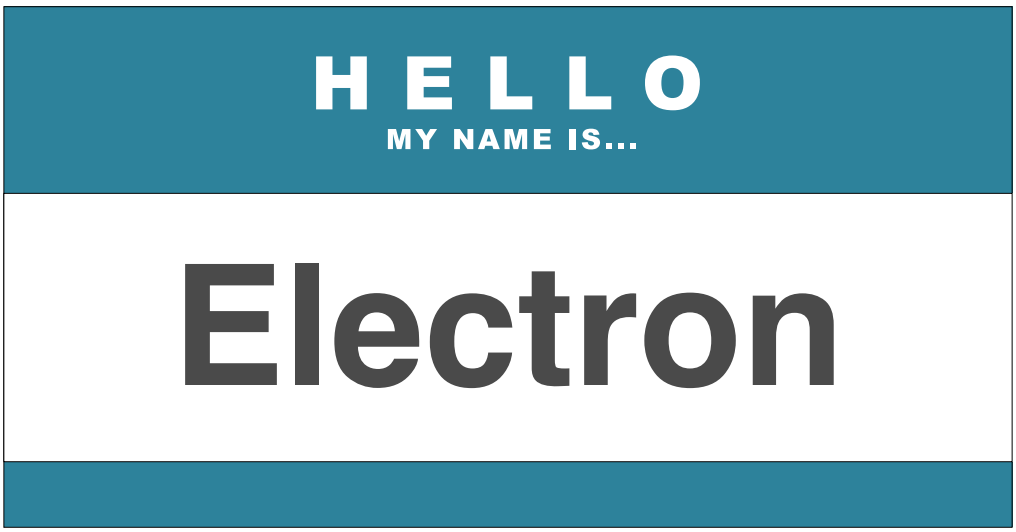
The US Patent and Trademark Office has created a series of inventor trading cards to introduce a diverse group of inventors and innovators to students. Check them out!

https://www.uspto.gov/kids/cards.html

13. Pass out one **All About Atoms handout** and one **Atom Superstar handout** to each student. Also be sure students' coloring supplies are accessible.
14. Explain that students will use the information on the **All About Atoms handout** to help them create their Atom Superstar Cards. For each Atom Superstar Card, they will:
    - Draw the atom's protons, neutrons, and electrons
    - Develop a picture, symbol, or slogan that describes the atom's superpowers and/or how it is unique
15. To kick off, instruct each student to choose three different colors for protons, neutrons, and electrons, and color in the corresponding circles on the top of the **Atom Superstar handout**.
16. Then complete the first card (Hydrogen) together as a class by following these steps:
    - Demonstrate how to use the **All About Atoms handout** to learn how many protons (1), neutrons (0), and electrons (1) hydrogen has. Then instruct students to draw these on the hydrogen atom card using the colors they selected. Guide students in drawing the protons and neutrons in the center of the atom, and the electrons anywhere in the shaded areas around the nucleus. Explain that we don't know exactly where the electrons will appear, but a 2D model like this makes it easier to show all the parts included in a real 3D atom!
    - Next, use the **All About Atoms handout** to learn what hydrogen is famous for. Explain that in the banner on the bottom of the Hydrogen Superstar card, students should draw a picture, create a symbol, *or* write a slogan or name that explains one or all of these "superpowers." Brainstorm a few ideas together, and then give students a couple minutes to complete their card.
17. For the time remaining in class, instruct students to work individually or in pairs on their final three cards.* Before they do, explain that they'll notice that the remaining atoms have more than one energy level (which look like shaded rings), because they have more electrons! Students should draw their electrons in all of the different energy levels.

    * For younger students, you may find it helpful to continue working together on each card, as you did with hydrogen.
18. As the end of the class session approaches, encourage students to cut out their cards and then share them with each other to see which superpowers each student chose to highlight.
19. Wrap up by reminding students that these are just a few examples of the atoms that make up our world. If time allows, you can display and share the elementary periodic table of elements and demonstrate all of the different atoms that exist. From forming water (you could even draw or model how 2 hydrogens pair up with one oxygen to make water), to helping us breathe, and creating electricity, all atoms have their own superpowers!


HELLO
MY NAME IS...
Proton


HELLO
MY NAME IS...
Electron

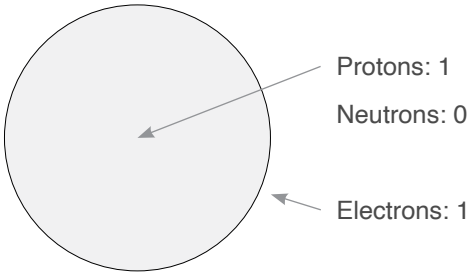

HELLO
MY NAME IS...
Neutron

Name: _____

STUDENT HANDOUT

"All About Atoms" Handout

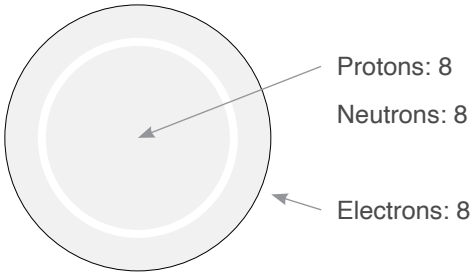
Hydrogen



Famous for:

- Helps form water
- Helps form stars
- Helps form Jupiter
- Found in more things on Earth than any other kind of atom!

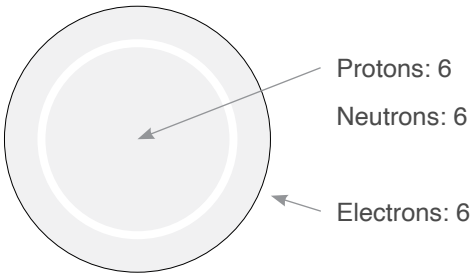
Oxygen



Famous for:

- Is an important part of the air we breathe
- Found in water, the Earth's crust, and the Earth's atmosphere!

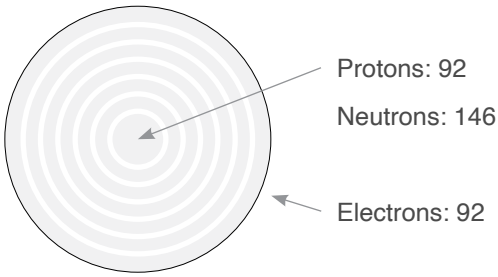
Carbon



Famous for:

- Found in diamonds
- Found in graphite (which is what pencils write with)
- Most of the world's carbon is stored in rocks at the bottom of the ocean!

Uranium



Famous for:

- Found in the Earth
- Can be used to create electricity!

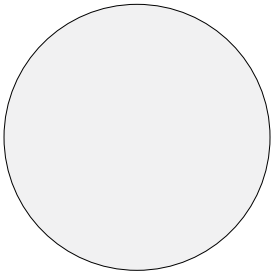
Name: _____

STUDENT HANDOUT

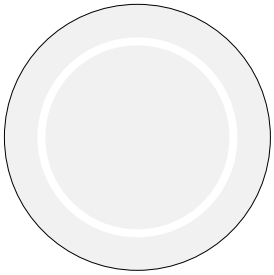
Atom Superstar Handout

◯ = Proton ◯ = Neutron ◯ = Electron

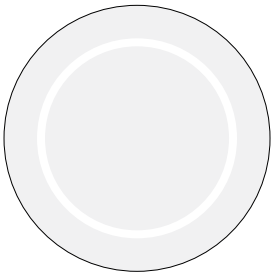
Hydrogen



Oxygen



Carbon



Uranium