



Science Objectives

- Students will discover that atoms are made up of particles and that the number of particles in an atom affects its properties.
- Students will learn that these particles—protons, neutrons, and electrons—are found in specific locations in the atom.
- Students will learn that neutrons have a neutral charge, protons a positive charge (+), and electrons a negative (–) charge; atoms become unstable with large imbalances between the charges.
- Students will learn that an atom is neutral when there is the same number of protons as electrons; the charge of the atom becomes either positive or negative, depending on the net gain of either electrons (–) or protons (+).
- Students will learn about how atomic number, mass, and net charge are determined.
- Students will learn about the organization of the Periodic Table.

Vocabulary

- matter
- atom
- ion
- Periodic Table of Elements
- proton
- neutron
- electron
- atomic mass
- atomic charge
- atomic number

About the Lesson

- This lesson involves students using TI-Nspire technology to simulate, observe, and manipulate the variables that affect the structure and, therefore, the properties of an atom.
- As a result, students will:
 - Reinforce understanding of the structure of an atom;
 - Understand how changing particles numbers affects atoms
 - Recognize how atomic mass, atomic number, and net charge, are determined;
 - Apply understanding about the atom to the organization of the Periodic Table.

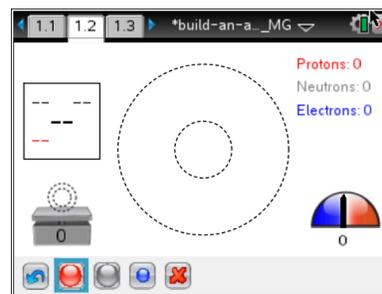


TI-Nspire™ Navigator™

- Send out the *build-an-atom_MG.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to allow students to show how they manipulate variables that effect results.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software
- Periodic Table of Elements (optional)



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

Lesson Files:

Student Activity

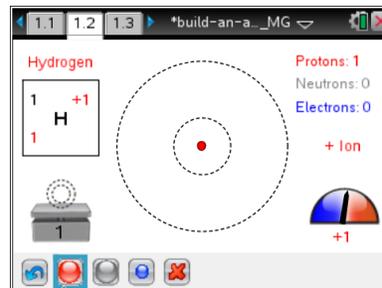
- Build_an_Atom_Student.doc
- Build_an_Atom_Student.pdf
- build-an-atom_MG.tns



Discussion Points and Possible Answers

Move to page 1.2. Students should answer the following questions on their activity sheet.

In this part of the simulation students will change the number of protons, neutrons, and electrons to observe changes in the atom.



1. Direct students to add and take away protons from the atom. Select to add a proton. Select to add a neutron. Select to add an electron. To remove the particle, select the proton, neutron, or electron and then use to remove.
2. Then students reset the simulation. After adding just 1 proton, they will add and take away neutrons. Then they will add and take away electrons. Students do not need to reset between playing with neutrons and playing with electrons. They are to observe the changes in the mass indicator (the scale on the left side) and charge indicator (the meter on the right side).

Tech Tip: To remove particles, use the grab tool to first select and then select to remove the particle.

Q1. What happens to the *mass* of the atom if you add more neutrons? More electrons?

Answer: The mass increases by 1 each time a neutron is added. The mass does not change is more electrons are added.

Q2. What happens to the *charge* of the atom if you add more neutrons? What happens if you have more protons than electrons? Fewer protons than electrons? The same number of protons as electrons?

Answer: The charge does not change if neutrons are added or subtracted. If there are more protons than electrons the charge of the atom is positive; fewer protons than electrons the charge is negative; the same number of protons as electrons the charge is neutral.

3. Students should select the red circle (protons), grey box (neutrons), and blue box (electrons) to see how this affects the information in the element square. They should then determine the function of each of these indicators.



Q3. How is one element changed into an entirely different element?

Answer: When a proton is added, the element changes.

Q4. Which number in the element square represents the atom's mass? How do you know?

Answer: The number in the upper left corner of the element square is the atom's mass. It matches the number on the scale.

Q5. Which numbers of particles are added together to determine atom's mass?

Answer: The mass is determined by adding the number of protons and the number of neutrons.

Q6. Which number in the element square represents the atom's charge? How do you know?

Answer: The number in the upper right corner of the element square is the atom's charge. It matches the number below the charge meter.

Q7. Which numbers of particles are added together to determine the atom's charge?

Answer: The charge is determined by adding the number of protons and the number of electrons.

Q8. The third number in the square is the atomic number of the element. How do you get that number?

Answer: The atomic number is the number of protons.

4. Students should use the Reset button  and select the red proton button once. Then they should add two neutrons, resulting in an unstable atom.

Q9. What can you do to make the atom stable again?

Answer: Take away a neutron or add a proton.



Q10. In general, when does an atom become unstable? Why do you think this is so?

Answer: An atom becomes unstable when there is an unequal number of protons and electrons. This happens because the protons (+) in the nucleus and the electrons (-) are no longer in balance with one another.

5. Students should use the Reset button and then select the red proton button once. Then they should keep the name of the element as hydrogen but change the atom from an ion (charged particle) to neutral.

Q11. What did you do to neutralize the hydrogen atom?

Answer: Added 1 electron so that there is an equal number of protons (one) and electrons (one).

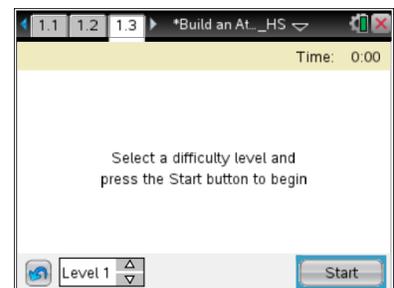
6. Students should use the Reset button and select the red proton button twice (adding two protons) to show a helium atom. They should then follow the same directions as step 5 above to neutralize this atom.

Q12. What did you do to neutralize the helium atom? Is there a general rule for neutralizing an atom?

Answer: Add 2 electrons so that there is an equal number of protons (one) and electrons (one). In general, add or take away electrons so that the number of protons and electrons are equal.

Move to page 1.3.

- Students should begin the game by setting the level to 1. They should then use the up and down arrows to adjust particle numbers. The goal is to the atomic mass, atomic number, and charge of each atom.
- Student should then press Check. If their answer is incorrect, they will get another attempt to get it right. If their answer is correct, they should press Next for the next problem.
- At the end of Level 1, they should view their score and time.
- Students can press  for a new game at any time and adjust the level to play again.





Q11. Did you discover anything else about how the numbers of particles affects the atom in Round 2? Explain.

Answer: The number of neutrons is not always equal to the number of protons in some atoms, yet they still remain neutral. This is because neutrons are neutral and do not affect the net charge.

Extension

11. Provide students with a Periodic Table of Elements.

Q12. Is any of the information in the element squares similar to the element squares in this simulation? If so, how are they the same and how are they different?

Answer: In many of the Periodic Tables the atomic number is usually represented. Mass is many times in the same location as the one in this simulation. However, the net charge is usually represented differently.

Q13. What additional information can be found in element squares in the Periodic Tables you found through your research?

Answer: Periodic Tables sometimes contain information such as the number of electrons in each shell level.

Q14. What information about the atom of each element changes moving left to right along the rows (periods)?

Answer: Elements are listed in ascending order by atomic number in the rows (periods). The number of electrons in the outer shell also changes when moving from left to right. Metallic properties of elements also change from left to right.

Q15. How do you think a tool such as the Periodic Table of Elements makes the study atoms of elements easier?

Answer: The way the elements are arranged and color coded in the Periodic Table makes it easier to study how they are alike and how they are different.



TI-Nspire Navigator Opportunities

Allow students to volunteer to be the Live Presenter and demonstrate how to adjust the protons, electrons, and neutrons. Use Quick Poll to check for understanding during the course of the activity.

Wrap Up

When students are finished with the activity, collect students' worksheets.

Assessment

- Formative assessment will consist of questions embedded in the student worksheet. Analyze questions in the student worksheet with the students. Teacher can also collect scores that students earned in the “game” portion of the activity.
- Summative assessment will consist of questions/problems on the chapter test.