

PhET Name	Build an atom
PhET Simulation Link	https://phet.colorado.edu/en/simulations/build-an-atom
Topic Covered using the Simulation	Structure of an Atom Protons and Element Identity Atomic Number Neutrons and Mass Mass Number Electrons and Atomic Charge Neutral Atoms Formation of Ions Isotopes Atomic Symbol / Notation Relationship among Subatomic Particles
Class	9
Learning Focus	Identify protons, neutrons and electrons as subatomic particles. 1. Understand that the number of protons determines the element. 2. Relate atomic number to the number of protons. 3. Understand the role of neutrons in determining atomic mass. 4. Relate mass number to the sum of protons and neutrons. 5. Understand how electrons determine the charge of an atom. 6. Recognise that a neutral atom has equal numbers of protons and electrons. 7. Understand how gaining or losing electrons forms ions. 8. Identify isotopes as atoms having the same number of protons but different numbers of neutrons. 9. Connect subatomic particles with atomic/isotopic notation. 10. Investigate how changing protons, neutrons or electrons affects an atom.

Task 1: Explore the Subatomic Particles

Open **Build an Atom** → **Atom**.

Build an atom using protons, neutrons and electrons.

Add one particle at a time.

Observe what changes when you add or remove each type of particle.

Open **Build an Atom** → **Symbol**

Build an atom and record its number of protons and neutrons.

Change the number of neutrons without changing the protons.
Observe the mass number.

Test this with at least three different combinations.

Build a neutral atom.
Add one electron.
Remove one electron.
Continue changing the number of electrons.
Observe the charge each time.

Task 2: Formation of Ions

1. Open **PhET – Build an Atom**.
2. Build a neutral atom.
3. Note the number of **protons and electrons**.
4. Add one electron.
5. Observe the change in charge.
6. Remove one electron.
7. Observe the charge again.

Choose any element between 1 to 10 atomic number

Focus: What happens when an atom **gains or loses electrons**?

1. Formation of a Cation

1. Build a neutral atom .
2. Remove one electron.
3. Observe the charge.
4. Compare the number of protons and electrons before and after.

Complete:

Loss of electron → _____ ion → _____ charge

2. Formation of an Anion

1. Build a neutral atom.
2. Add one electron.
3. Observe the charge.
4. Compare the number of protons and electrons.

Complete:

Gain of electron → _____ ion → _____ charge

3. Discover the Rule

Explore different atoms by adding or removing electrons.

Record:

Change in Electrons	Resulting Ion Charge	
Loses 1 electron	_____	_____
Gains 1 electron	_____	_____
Loses 2 electrons	_____	_____
Gains 2 electrons	_____	_____

Use your observations to complete:

An atom becomes a **cation** when it _____ electrons.

An atom becomes an **anion** when it _____ electrons.

During ionisation, the number of _____ does not change; the number of _____ changes.

Misconception

1. Misconception — “The number of electrons determines the element.”

Challenge:

Build an atom and keep the number of protons constant. Change the number of electrons.

Does the element change?

Does the charge change?

What evidence does the simulation provide?

2. Misconception — “Adding neutrons creates a new element.”

Challenge:

Build an element with a fixed number of protons. Add and remove neutrons.

Does the element name change?

What changes?

What remains constant?

3. Misconception — “Atomic number is the total number of protons and neutrons.”

Challenge:

Construct three atoms and compare their proton number, neutron number and atomic number.

Question:

“If an atom has 8 protons and 10 neutrons, what is its atomic number? What is its mass number?”

4. Misconception — “Mass number is the number of protons only.”

Challenge:

Keep the number of protons constant and increase the number of neutrons.

What happens to the mass number?

Does the atomic number change?

Classroom rectification: Students formulate:

Mass number = Protons + Neutrons

5. Misconception — “A charged atom has gained or lost protons.”

Challenge:

Start with a neutral atom. Change only the number of electrons.

What happens to the charge?

Does the element change?

Do the number of protons change?

Classroom rectification: Ask students to use simulation evidence to explain that **ions are formed by gaining or losing electrons.**

6. Misconception — “A neutral atom has no charged particles.”

Challenge:

Build a neutral atom and examine the numbers of protons and electrons.

Question:

“If the atom contains positively and negatively charged particles, why is its overall charge zero?”

Learning focus: Students understand **charge balance**, rather than associating “neutral” with “no charge particles.”

7. Misconception — “Changing any subatomic particle changes the element.”

Challenge:

Perform three experiments:

1. Change only protons.
2. Change only neutrons.
3. Change only electrons.

Record what changes in each case.

Question : Complete the rule:

Changing protons changes _____.

Changing neutrons changes _____.

Changing electrons changes _____.

This is an excellent **diagnostic task** because students must distinguish **element identity**, **isotope formation** and **ion formation**.