

## Building an Atom

### Learning Outcomes in Focus

#### Contextual strand: CW 3

Students should be able to describe and model the structure of the atom in terms of the nucleus, protons, neutrons and electrons; comparing mass and charge of protons, neutrons and electrons.

**DESCRIBE:** Develop a detailed picture or image of, for example, a structure or process; using words or diagrams where appropriate; produce a plan, simulation or model.

#### Nature of science: NoS 1

Students should be able to **appreciate** how scientists work and how scientific ideas are modified over time.

### Learning Intentions

Students will learn to:

1. Describe where sub-atomic particles are located in the atom and how the mass and charge of the different particles compare.
2. Begin to develop a practical understanding of the limitations of models.

### Prior Learning

Students need have no prior knowledge of atomic structure but should

- Understand that elements are made up of atoms
- Understand the concept of mass

### Teacher Information

You will find the simulation needed for the following activity at

<https://phet.colorado.edu/en/simulation/build-an-atom>

## Student Activity Sheet

Open the pHet “[Build an Atom](#)” simulation. Try the different buttons and then set up the simulation as shown in the diagram.

File Help

Build Atom Game

Protons:  
Neutrons:  
Electrons:

Element

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						

Symbol

Mass Number

Net Charge

Model:  
 Orbits  
 Cloud

Show element name  
 Show neutral/ion  
 Show stable/unstable

Reset All

Protons  
Neutrons  
Electrons

These should all be clicked so they are red.

These are the three things that are inside an atom. They are called SUB ATOMIC PARTICLES.

We are going to use the simulation to find out

- Where the different sub-atomic particles are found in the atom
- Whether the sub-atomic particles have a charge
- Whether the mass of the sub-atomic particles contribute significantly to the mass of the atom.

1. Using the simulation drag protons, neutrons and electrons into the atom. Use these words to complete the table:

PROTONS	NEUTRONS	ELECTRONS
		These particles are always found in rings around the outside of the atom.
		These particles are found in the centre ( <b>the nucleus</b> ) of the atom.

2. Press 'Reset All'. Following the table below, place the indicated number of *neutrons* in the atom and fill in the table after each addition. Mass is indicated on the electronic balance. Charge can be positive or negative.

Number of neutrons	Mass number reading	Net charge reading
1		
2		
3		
4		

Look at your results and discuss in your group the answer to the following questions:

- What happens to the *mass* number reading when you add a neutron? What do you think will happen when you add another neutron? Check your answer.
- What happens to the *charge* when you add a neutron? What do you think will happen to the charge when you add another neutron? Does a neutron have any effect on the charge?

3. Reset. Place the indicated number of protons in the atom and fill in the table after each addition.

Number of protons	Mass number reading	Net charge reading
1		
2		
3		
4		

Look at your results and discuss in your group the answer to the following questions:

- What happens to the *mass* number reading when you add a proton? What do you think will be the mass number reading if you add another proton? Use the simulation to try.
- What happens to the *charge* when you add a proton? What do you think the charge will be if you add another proton? Does a proton have a charge?

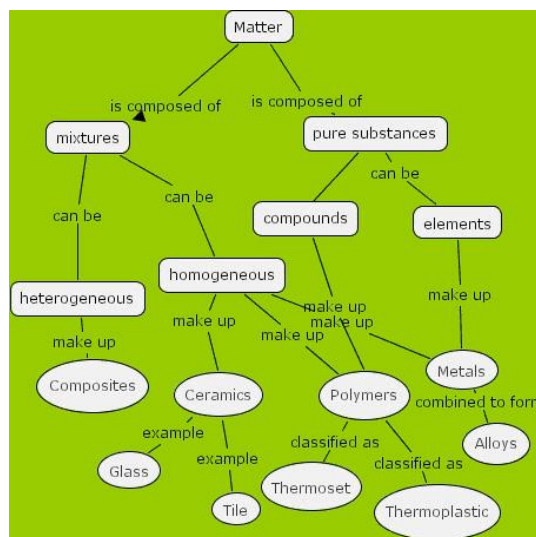
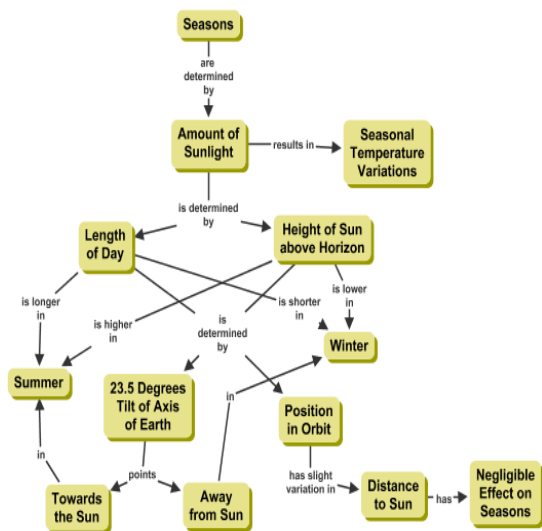
4. Reset. Place the indicated number of electrons in the atom and fill in the table after each addition.

Number of electrons	Mass number reading	Net charge reading
1		
2		
3		
4		

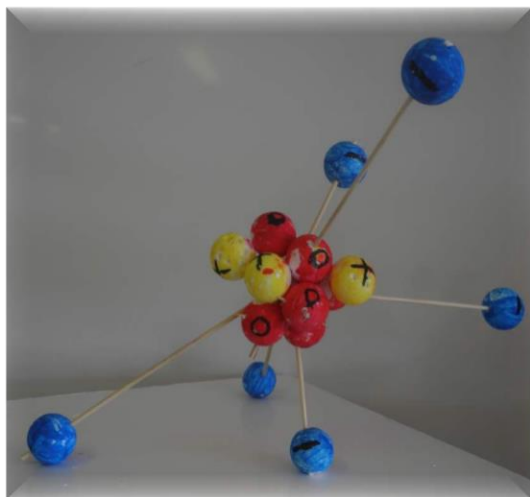
Look at your results and discuss in your group the answer to the following questions:

- What happens to the *mass* number reading when you add an electron? What do you think will happen to the mass number if you add another electron? Check using the simulation.
- What happens to the *charge* when you add an electron? What do you think will happen if you add another electron? Check your answer. Does an electron have a charge?

By working with the simulation, you should have found out about the mass, charge and location of the subatomic particles in an atom. Using the words **mass and charge** as well as the words in the envelope provided, develop a concept map on a large sheet of paper showing what you have learned. Unsure what a concept map is? Two examples are shown below:



**Possible Extension activity:** Use your concept map to help you as you discuss the following question in your group.



A student was asked to develop a model of the atom and they presented the model shown in the picture. Discuss the following:

1. Does the model allow you to identify which colour represents each of the three sub atomic particles? Be prepared to justify your answer.
2. Can you identify ways that the model could be improved to better represent the **mass** of the sub-atomic particles?

## Student Resources

Cut up the following and place in envelope for each group

<b>SHELLS</b>	<b>ELECTRONS</b>
<b>NUCLEUS</b>	<b>NEUTRONS</b>
<b>PROTONS</b>	<b>SUB-ATOMIC PARTICLES</b>
<b>ATOM</b>	