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## Developing the atomic model

### Specification references:

- C1.1.3 Scientific models of the atom
- WS 1.1, 1.2

### Aims

In this activity, you will consider why ideas and models in science often improve over time by exploring how ideas about atoms have changed.

### Learning outcomes

After completing this activity, you should be able to:

- describe how and why the atomic model has changed over time
- know that scientific theories are revised or replaced by new ones in light of new evidence.

### Setting the scene

Our ideas about atoms have changed a lot over time. In this activity, you will consider how and why scientific ideas change by exploring some of the key developments in our understanding of atoms.

### Task

Draw a timeline to show how ideas about atoms have changed from the ancient Greeks to the developments suggested by Bohr. Include diagrams of the atomic models on your timeline.

Some key ideas to be included are shown below. Use these in your timeline and add any further information you know for each idea. Note these developments are not in order.

- Rutherford used the experimental work of two of his students, Geiger and Marsden, to develop the nuclear model in which most of the mass is concentrated in the nucleus, with electrons in shells orbiting the nucleus.
- Thomson carried out experiments that led to the discovery of electrons and proved that atoms could be split.
- Bohr discovered that electrons in atoms could only travel along certain 'shells'.
- Dalton developed understanding of atomic theory and came up with theories about what made up different elements. He determined that atoms were tiny particles, like hard spheres that couldn't be split, which made up elements.
- James Chadwick devised an experiment that showed the existence of neutrons.
- Greek philosopher Democritus claimed atoms could not be split.

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#### Student follow up

1 Suggest why models, such as that of the atom, are useful in science.

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2 Why have ideas about atoms changed over time?

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3 We now know that atoms contain three types of subatomic particle. Suggest why this would have surprised earlier scientists who first studied atoms.

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4 Name the three sub-atomic particles and outline where each is found within an atom.

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5 In the early 1800s John Dalton used symbols to represent atoms. Each element had a different symbol. The symbols for oxygen, hydrogen and carbon are shown below.



oxygen



hydrogen



carbon

Use these symbols to draw molecules of oxygen (O<sub>2</sub>), water (H<sub>2</sub>O), and carbon dioxide (CO<sub>2</sub>).

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6 Between 1897 and 1906, Thomson carried out a number of experiments and discovered electrons. Thomson used his discovery to devise his plum pudding model of the atom. Outline the main ideas of the plum pudding model.

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7 Which, if any, of Dalton's ideas about the atom do we no longer believe to be correct? Explain your answer.

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8 Two of Ernest Rutherford's students, Geiger and Marsden, carried out an experiment that helped to disprove the plum pudding model. They fired positively charged alpha particles at a thin layer of gold atoms. Most of the alpha particles travelled straight through but a few were deflected and a tiny number of alpha particles were deflected back towards the source.

a Explain why most of the alpha particles passed straight through the thin layer of gold atoms.

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b Explain why a tiny number of alpha particles were deflected back towards the source.

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