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In the early 20th century, the plum pudding model of the atom was replaced by the Rutherford model.

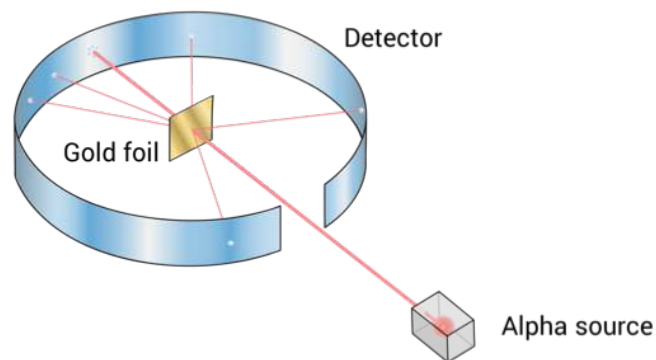
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Describe the plum pudding model of the atom.

An atom is a ball of positive charge [1] which has small negative charges dotted throughout it (like the plums in a Christmas pudding) [1].

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The experimental setup which was used by Rutherford and his team in their alpha scattering experiment was as shown in the below diagram.



Why was it important that the experiment was carried out under vacuum (rather than in air)?

Alpha particles have a very short range in air (of 5 – 10 cm) [1].
If the experiment was carried out in air, the alpha particles would be stopped before they had reached the foil (or detector) [1].

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Describe the main observations from this experiment.

Most of the alpha particles went straight through the foil [1].
A small number were deflected slightly [1].
A very small number (about 1 in 10,000) were deflected through angles of greater than 90° / large angles / 'rebounded' from the foil [1].

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What did Rutherford and his team learn about the structure of the atom from these observations?

That the (volume of the) atom was mostly empty space [1].
That most of the mass in the atom was located in its centre [1].
That there was a very small, positively-charged nucleus in the centre of the atom [1].
That negatively-charged electrons orbit the nucleus [1].
That the radius of the nucleus is around 10,000 times smaller than that of the atom [1].

Any THREE.

0 1 . 5

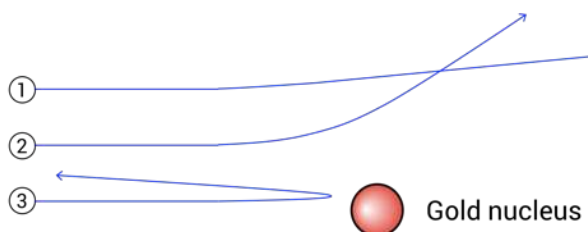
Before Rutherford conducted this experiment, most scientists believed the plum pudding model to be correct. Once they learned about the results of his experiment however, they changed their minds.

How did the results of the Rutherford experiment prove that the plum pudding model was incorrect?

If the plum pudding model had been correct, then the alpha particles which were directed towards the gold foil would have passed straight through it [1] because the positive and negative charges in the atom would have 'cancelled one another out' [1].

0 1 . 6

The below diagram shows the paths of three alpha particles as they approach a gold nucleus. Complete the path of each of the alpha particles to show how their directions change as they travel closer to the gold nucleus.



0 1 . 7

Explain why alpha particle 3 follows the path you have drawn in the above diagram.

Both the alpha particle and the gold nucleus are positively-charged [1]. This means that there will be a force of electrostatic repulsion between them (which is what causes the alpha particle to be pushed away from the gold nucleus) [1].