

Rutherford Atom screen

Atom view

Observe the behavior of alpha particles as they travel through a thin layer of atoms.

The screenshot shows the Rutherford Atom simulation interface. On the left, there are two view options: a Rutherford atom model (selected) and a Plum Pudding atom model. Below them is an alpha particle source. The main area shows several Rutherford atoms with alpha particles (represented by purple lines) passing through them. Some particles pass straight through, while others are deflected. A scale bar indicates 6.0×10^{-10} m (atomic scale). On the right, there is a control panel with a legend, an alpha particle energy slider, a 'Traces' checkbox (checked), and atom composition sliders for Protons (79) and Neutrons (118). At the bottom, there are navigation buttons for 'Rutherford Atom', 'Plum Pudding Atom', a home button, and the PhET logo.

SELECT atomic or nuclear view.

TURN ON the alpha particle source.

VIEW alpha particle behavior.

IDENTIFY key components of the model.

TURN ON traces to see alpha particle trajectories.

Nucleus view

Explore what causes an alpha particle to be deflected when it approaches the nucleus of an atom.

The screenshot shows the Rutherford Atom simulation interface in nucleus view. On the left, the Plum Pudding atom model is selected. The main area shows a single nucleus (a cluster of red and blue spheres) with alpha particles (represented by orange spheres) passing through. Some particles are deflected. A scale bar indicates 1.5×10^{-13} m (nuclear scale). The control panel on the right is the same as in the Atom view, but the legend now includes Proton and Neutron symbols. The alpha particle energy slider is positioned higher than in the Atom view. The navigation buttons at the bottom are the same.

PAUSE the sim or use the step forward function to analyze alpha particle behavior.

INCREASE or decrease the energy of the alpha particles.

CHANGE the composition of the nucleus.

Plum Pudding Screen

Explore the expected behavior of alpha particles based on the Plum Pudding model of an atom, which suggested that an atom was composed of substance with a diffuse positive charge embedded with negatively charged electrons.

VIEW alpha particle behavior predicted by Rutherford.

IDENTIFY parts of the Plum Pudding model.

COMPARE the scale of the views shown in each screen.

CHANGE the background color of the sim for projection.

Model Simplifications

- The default number of protons and neutrons is set to match the most common isotope of gold.
- On the Rutherford Atom screen, the nucleus view shows only a small fraction of the area of the atom. The number of alpha particle deflections is greater than what is observed experimentally.
- The atom view on the Rutherford Atom screen is designed to help students see that most alpha particles pass through the thin layer of atoms without being deflected. However, the number of alpha particles that deflect in the simulation is greater than what is observed experimentally.
- On the Plum Pudding screen, the diffuse positive charge is shown as an amorphous red blob. The red color was used to indicate the positive charge. Electrons are distributed evenly throughout the atom, causing most parts of the atom to have no charge. Therefore, no alpha particle deflection is observed. For computational simplicity, we chose not to show deflections due to the small inhomogeneity of charge distribution.
- Alpha particles are modeled as two protons and two neutrons on both the Rutherford Atom and Plum Pudding screens for consistency, despite the fact that protons and neutrons are not part of the Plum Pudding model of the atom.

Suggestions for Use

Sample Challenge Prompts

- Identify factors that change the deflection of alpha particles. Explain why these factors impact alpha particle deflection.
- Describe the behavior of alpha particles in the Plum Pudding atom screen. Why would you expect to see alpha particles behave this way?
- Describe two important outcomes of Rutherford's experiment and explain how this data was used to develop a new atomic model.
- Calculate the ratio of deflection angles for alpha particles that approach at different angles and check that it matches the Rutherford scattering formula.

See all activities for Rutherford Scattering [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).