Atoms, nuclei and isotope notation

Student activity • observation and reasoning

YEAR 11 / LESSON 91 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How can one element have atoms with different masses?

Build paper particle models and interpret nuclear notation without confusing an isotope with an ion.

Equipment

- Booklet, pencil and reusable paper particle labels

Paper models only. No radioactive materials, samples or radiation apparatus are used.

Course coverage: Shared Physics / Double Award: 7.2–7.3. Atomic structure, proton number, nucleon number and isotopes.

Plan, model or apparatus sketch

Draw a labelled particle, nuclear-symbol or detector model appropriate to the task.

Method and reasoning

Read the whole sequence before starting

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1. Draw a nucleus containing protons and neutrons, with electrons outside it. State each particle's charge and approximate relative mass.

2. Label atomic number Z as the proton count and mass number A as protons plus neutrons. Write neutron count = A − Z.

3. For carbon-12 and carbon-14, both with Z = 6, calculate protons, neutrons and electrons in neutral atoms. Use the same proton count in both models.

4. Repeat for chlorine-35 and chlorine-37 with Z = 17. Explain why these are isotopes of the same element despite different neutron counts.

5. Compare neutral sodium-23 with a sodium ion formed by losing one electron. With Z = 11, show that ion formation changes electrons but does not change the nucleus.

6. Write one isotope using the conventional element symbol with A at upper left and Z at lower left. Check the placement and distinguish nuclear changes from changes to electron number.

Cleanup

- Collect reusable labels and retain nuclear diagrams.

Record your evidence

Blank spaces are for your own work

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Reference and task data

A and Z are whole-number counts, not relative atomic mass averages. Neutral atoms have equal proton and electron numbers. The simple drawing is not to scale and does not show literal electron paths.

Atom / ion	Protons	Neutrons	Electrons
Carbon-12			
Carbon-14			
Chlorine-35			
Chlorine-37			
Sodium-23 ion, +1			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What does Z count?

2. What does A count?

3. Find neutrons in carbon-14.

4. Why are carbon-12 and carbon-14 isotopes?

5. Find electrons in a sodium ion with charge +1.

6. Does losing an electron change the element?