Atomic structure

Student activity • class activity

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The question

How do atomic number and mass number determine the particles in a neutral atom?

Use labelled particle counters and supplied atom data to connect proton, neutron and electron counts. This is a desk model, not an experiment observing atoms. All listed species are neutral atoms; ion calculations are outside this activity. The drawings are not to scale.

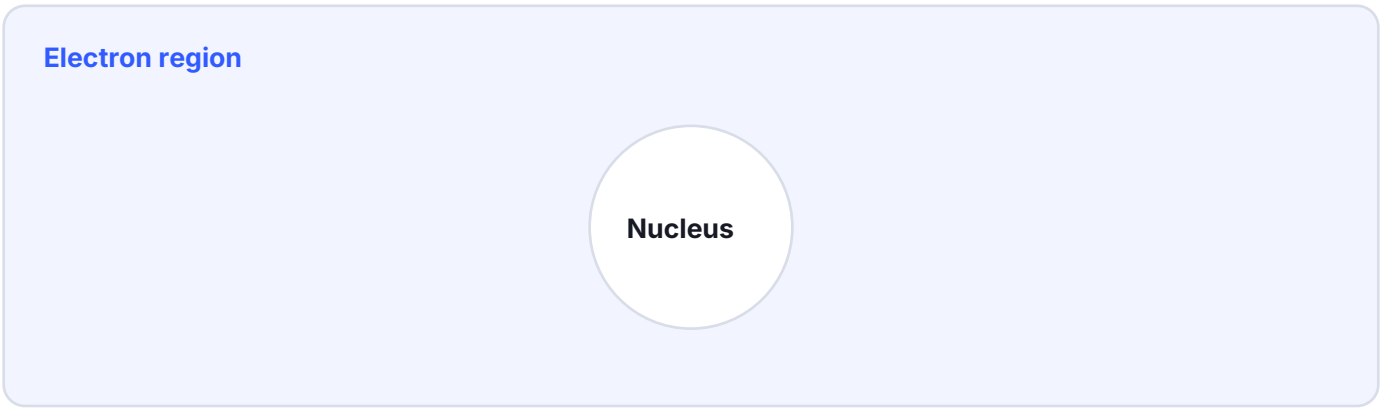
Equipment

- Student booklet, periodic table, pencil and eraser
- Per pair: 12 counters labelled p, 12 labelled n and 12 labelled e, or pre-cut paper tokens
- Paper mat labelled nucleus / electron region; ruler

Desk activity only. Keep small counters out of mouths and off the floor. Use pre-cut paper tokens if needed. No chemicals, heating, radiation sources or glassware are required.

Course coverage: 1.14–1.16: atoms, molecules, subatomic particles, atomic number and mass number.

Two-region model mat • not to scale



Place labelled tokens in the appropriate region. This mat does not show shells, real sizes, distances or paths.

Method and reasoning

Read the whole sequence before starting

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1. Read the particle reference table. Identify which particles are in the nucleus and which occupy the surrounding electron region.

2. Use atomic number Z to find protons. For a neutral atom, use the same number of electrons. Find neutrons by subtracting Z from mass number A.

3. Complete the supplied atom table before building a model. Show one worked subtraction beside the table.

4. Use counters to model carbon-12: Z = 6 and A = 12. Put the correct particles in each region and label the totals. This model shows particle counts and locations, not real sizes or electron trajectories.

5. Change only the neutron count to represent carbon-13. Compare the element identity and mass number. Leave a detailed isotope calculation for Lesson 9.

6. Use two labelled atom circles and a joining line to represent a hydrogen molecule. Explain why one molecule can contain more than one atom but only one element.

7. Exchange your table with a partner. Check proton count, neutral charge and the sum of protons plus neutrons. Correct errors with a written explanation.

Cleanup

- Count and return the tokens. Keep the completed particle table and labelled drawing. Recycle unwanted paper pieces.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Particle	Location	Relative mass	Relative charge
Proton	Nucleus	1	+1
Neutron	Nucleus	1	0
Electron	Electron region	about 1/1836	−1

Z = number of protons. A = protons + neutrons. For a neutral atom, electrons = protons. Use the supplied A values, not a rounded periodic-table average.

Neutral atom	Z	A	Protons	Neutrons	Electrons
Hydrogen-1	1	1			
Helium-4	2	4			
Carbon-12	6	12			
Carbon-13	6	13			
Sodium-23	11	23			

Draw your carbon-12 model with labelled particle counts and regions.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Define atomic number and mass number.

2. Explain why a neutral carbon-12 atom has six electrons.

3. Compare carbon-12 and carbon-13: what changes and what stays the same?

4. Why are electrons not included in mass number?

5. Describe one difference between an atom and a molecule.

6. Give two limitations of the counter model.