Inside the Atom

Use particle counts and positions to build atomic models.

FB.2.1 "Develop and use simple atomic models to describe the components of elements (e.g., relative position, charges of protons, neutrons, and electrons)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline statements that tell you where particles belong, circle statements about particle charges, and number the two rules for counting neutrons and electrons.

What a Pencil Mark Can Tell Us

1. A pencil mark looks like a flat gray streak, but its graphite is built from carbon atoms. An atom is far too small to see with a classroom microscope, so scientists use models to show where its parts are. In a simple model, protons and neutrons sit together in a tiny central nucleus. Electrons occupy the space around that nucleus, often shown as dots on circles. A proton has a positive charge, an electron has a negative charge, and a neutron has no charge. These drawings show particle positions, not tiny planets following fixed tracks.

2. A model can also help you count particles. The atomic number gives the number of protons, which identifies an element. Carbon has atomic number 6, while sodium has atomic number 11. A mass number counts the protons and neutrons together in one atom. The name carbon-12 means a carbon atom with mass number 12; carbon-14 has mass number 14. Sodium-23 has mass number 23. To find neutrons, subtract the atomic number from the mass number. A neutral atom has the same number of electrons as protons, so its positive and negative charges balance.

3. Atoms of one element do not always have the same mass number. Such atoms are called isotopes: they share a proton count but have different neutron counts. Electrons can change, too. When a neutral sodium atom loses one electron, it becomes Na^+, an ion with one positive charge. Its nucleus stays the same, so it is still sodium. A model of an ion must show the electron count separately from the proton count. In a sketch, changing a neutron changes the nucleus, while changing an electron changes the dots outside it. That difference matters when comparing models.

2 ANSWER WITH EVIDENCE

Use the passage

1. Build a particle-count model of a neutral carbon-12 atom. How many protons and neutrons go in its nucleus, and how many electrons go outside?

2. If you change a carbon-12 model to carbon-14, which particles must you add, how many, and where do they go?

3. For a neutral sodium-23 atom, give the numbers of protons, neutrons, and electrons. Where does each kind of particle belong?

4. A neutral sodium-23 atom loses one electron. How many protons and electrons does its new model show, where are they, and why is the ion positive?

3 YOUR TURN

Your own words

Draw a simple model of a neutral oxygen-16 atom. Oxygen has atomic number 8. Label the particle counts and charges in the nucleus and outside it, then write one sentence explaining why your model has no overall charge.

ANSWER KEY

Inside the Atom

PART 1 · READ AND MARK

Underline statements that tell you where particles belong, circle statements about particle charges, and number the two rules for counting neutrons and electrons. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Build a particle-count model of a neutral carbon-12 atom. How many protons and neutrons go in its nucleus, and how many electrons go outside?	**The nucleus has 6 protons and 6 neutrons; 6 electrons are outside it.**
2	If you change a carbon-12 model to carbon-14, which particles must you add, how many, and where do they go?	**Add 2 neutrons to the nucleus. The proton and electron counts stay the same.**
3	For a neutral sodium-23 atom, give the numbers of protons, neutrons, and electrons. Where does each kind of particle belong?	**The nucleus has 11 protons and 12 neutrons; 11 electrons are outside it.**
4	A neutral sodium-23 atom loses one electron. How many protons and electrons does its new model show, where are they, and why is the ion positive?	**It has 11 protons in the nucleus and 10 electrons outside. It is positive because it has one more proton than electron.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The sketch shows a nucleus labeled "8 protons, positive; 8 neutrons, no charge" and 8 dots outside it labeled "8 electrons, negative." The eight positive proton charges balance the eight negative electron charges, so the atom has no overall charge.

Accept any clear arrangement of electrons outside the nucleus; circles in a sketch need not represent fixed paths. The oxygen model must show 8 protons, 8 neutrons, and 8 electrons.