

Atoms: Changing Ideas

Trace how evidence led scientists to revise atomic models.

PS.2.a "our understanding of atoms has developed over time;"

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each observation or experiment, circle the model change it caused, and number the changes in time order.

Evidence Changes the Model

- ① People have wondered what matter is made of for centuries. Around 400 BCE, the Greek thinker Democritus proposed that matter could be divided only until tiny pieces remained. He called these pieces atomos, meaning "uncuttable." His idea was based on reasoning, not experiments. Much later, in the early 1800s, John Dalton used evidence from chemical reactions. He argued that each element is made of its own kind of atom and that atoms combine in whole-number ratios.
- ② Dalton pictured atoms as solid spheres, but later experiments showed that atoms have smaller parts. In 1897, J. J. Thomson studied cathode rays and found negatively charged particles, now called electrons. This result meant atoms were not indivisible. In 1911, Ernest Rutherford directed alpha particles at thin gold foil. Most passed through, but a few bounced back or changed direction sharply. He concluded that an atom is mostly empty space with a tiny, dense, positively charged nucleus.
- ③ Rutherford's model did not explain how electrons are arranged or why atoms produce particular light colors. In 1913, Niels Bohr proposed that electrons occupy set energy levels around the nucleus. Later evidence showed that electrons do not travel in simple circular paths. The modern model describes electrons as likely to be found in regions called electron clouds. Scientists revise models when new observations or experiments explain results that an older model could not explain. A model can improve without being the final answer.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 How did Democritus’s approach to atoms differ from Dalton’s approach?

2 What discovery from cathode-ray experiments showed that atoms were not indivisible?

3 What gold-foil result led Rutherford to conclude that atoms are mostly empty space?

4 How is the modern electron-cloud model different from Bohr’s model?

3 YOUR TURN _____ Your own words

Create a three-row evidence trail for an imaginary investigation of an unseen object. In each row, give a model claim, a new observation, and a revised model that follows from the observation.

MODEL CLAIM	NEW OBSERVATION	REVISED MODEL

PART 1 • READ AND MARK

Underline each observation or experiment, circle the model change it caused, and number the changes in time order. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	How did Democritus's approach to atoms differ from Dalton's approach?	Democritus used reasoning rather than experiments. Dalton used evidence from chemical reactions.
2	What discovery from cathode-ray experiments showed that atoms were not indivisible?	Thomson found negatively charged particles, now called electrons, inside atoms.
3	What gold-foil result led Rutherford to conclude that atoms are mostly empty space?	Most alpha particles passed through the thin gold foil, while only a few bounced back or changed direction sharply.
4	How is the modern electron-cloud model different from Bohr's model?	Bohr proposed set energy levels around the nucleus. The modern model says electrons are likely to be found in regions called electron clouds, not simple circular paths.

PART 3 • YOUR TURN (SAMPLE ANSWER)

MODEL CLAIM	NEW OBSERVATION	REVISED MODEL
The sealed box contains one smooth ball.	Shaking it makes two different tapping sounds.	The box may contain two objects.
The box may contain two loose objects.	When tilted, one object stops at the center.	One object may be held in place by a divider.
A divider holds one object in place.	A magnet attracts the fixed object through the box.	The fixed object is likely magnetic.

Accept equivalent descriptions of the evidence and resulting model changes. For the open response, each revision should be logically connected to the observation in the same row.