14–16 years

Structured talk: atomic model

ROYAL SOCIETY OF CHEMISTRY

Education
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Learning objectives

1. Apply the nuclear model to describe an element's atoms, isotopes and ions.

2. Develop speaking and listening skills by using the structured talk foundations to help manage your group's discussion.

3. Build a shared understanding of how the model of atomic structure has developed and share this understanding with other groups.

4. Evaluate how successful your group's word bridge is by comparing to the other examples.

Foundations

- **Knowledge:** aim for accuracy when you speak.
- **Reasoning:** when you say something, explain why you're saying it (in other words, justify what you are saying).
- **Community:** listen to others and show respect, even if you don't agree with them.

Speaking

- Take turns when speaking.
- Be prepared to change your mind.
- Clarify, summarise and build on each other's ideas and respect other people's.
- If you disagree, say so politely.
- Invite someone to contribute by asking a question.
- Come to a shared agreement.

Listening

Focus

- Give the speaker your full attention. Face them and give eye contact.
- Do not interrupt.

Accept

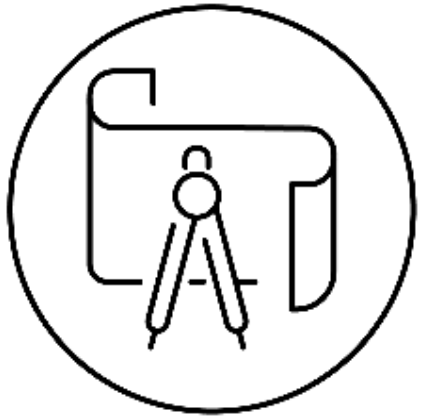
- Nod or smile to show that you understand.
- Listen with interest and respect even if you disagree.

Draw out

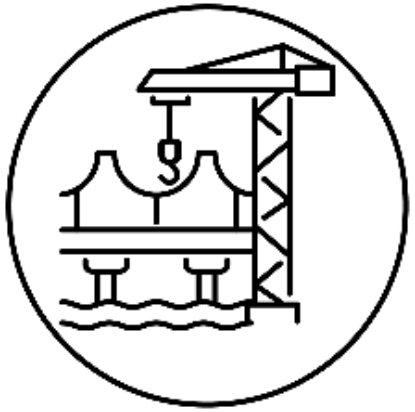
- In response, summarise and seek clarification rather than simply stating your answer or opinion.

Roles

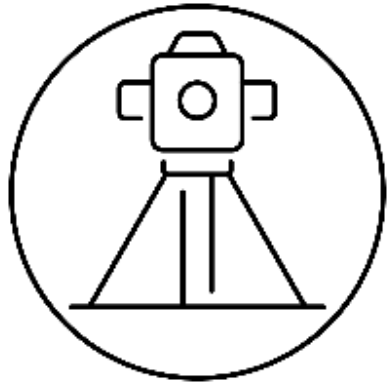
You will have either role A, B or C.



A is the architect.
They start.



B is the bridge builder.
They respond.



C is the civil engineer.
They summarise.

Building word bridges

Start with 30 seconds silent thinking time.

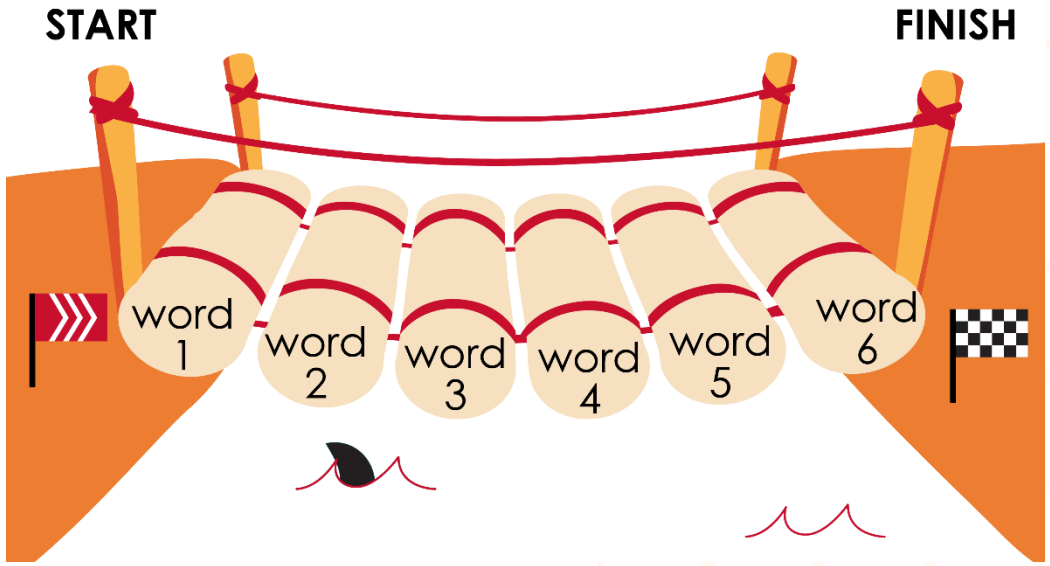
You have 2 minutes to build the best bridge you can.

A starts the discussion trying to correctly use as many words from the word bridge table as they can.

B responds, either reinforces (agrees with), or fixes (disagrees with) the bridge started by A.

Lastly, **C summarises** the bridge constructed by A and B, seeks their agreement and feeds back to the class.

Build the bridge. Get from the start to the finish by linking all the given words.

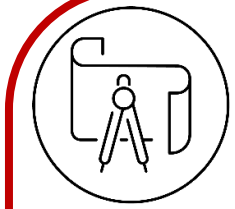


Start	Fact	Finish
The relative atomic mass (A_r) of an element is	Carbon-12 is the international standard for measuring the relative atomic mass of other elements.	mass of a carbon-12 atom.

Link these words

Words	
average	abundances
mass	isotopes
atom	compared

Sentence starters



A is the architect. They start:

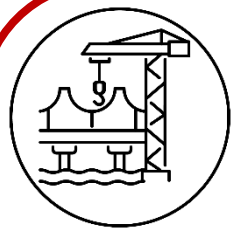
‘I know that … and it’s relevant to this discussion because … ’

‘I think that … ’

‘I am not sure about … but I think … ’

‘Before I begin, remind me what … means?’

‘Can you please help me to start?’



B is the bridge builder. They respond:

‘Linking to that I would add … ’

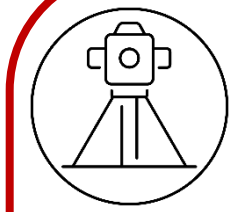
‘Considering what I already know about … I think that ... ’

‘I would suggest that we change that because of … ’

‘Can you explain why you said that?’

‘Have you thought of … ?’

‘That’s brilliant because … ’



C is the civil engineer. They summarise:

‘I think you said … ’

‘Can you just explain … ?’

‘What was your reasoning when you said … ?’

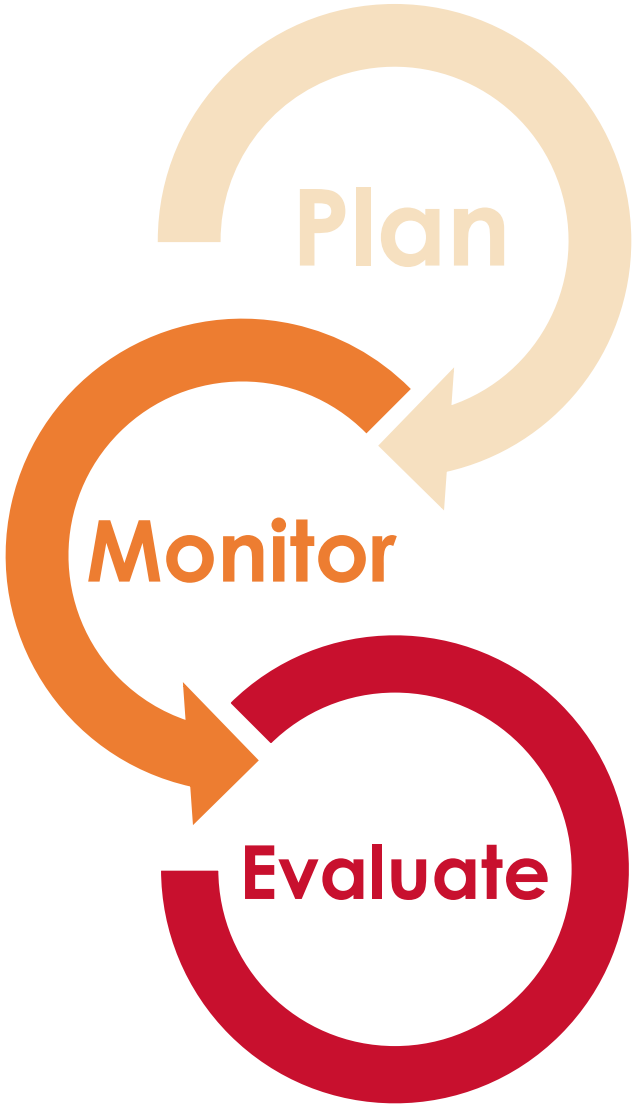
‘Have I got that right?’

‘I’m not sure about … ’

‘Do we all agree?’

‘Our final answer is … ’

Ask yourself these questions



Before doing the task:

What do I see or hear that helps me understand?

What are some steps I can take to figure this out?

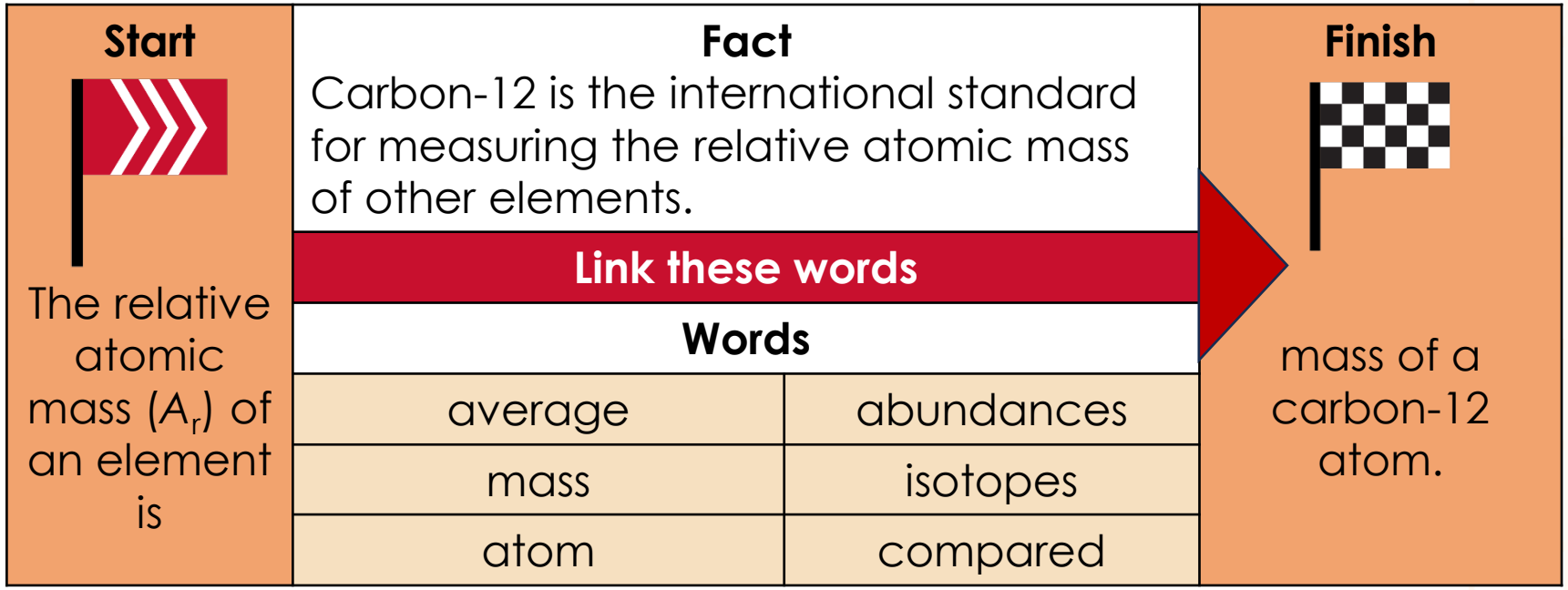
During the task:

How can I tell if I'm doing a good job?

After doing the task:

How do I feel about this task? Why?

Word bridge example

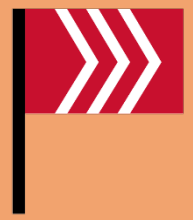


The relative atomic mass (A_r) of an element is the average mass of an atom of that element, taking abundances of isotopes into account, compared to the mass of a carbon-12 atom.

Word bridge 1

Talk in your three to build the word bridge, from the start to the finish. Link the words and use the fact to help you. Keep to your speaking role – either A, B or C.

Start



Atoms of an element always have the

Fact

The number of electrons in an atom is equal to the number of protons in its nucleus.

Link these words

Words

different numbers	protons
same	neutrons
number	atomic number

Finish

different relative atomic masses.

Word bridge 1 – sample answer

Atoms of an element always have the same atomic number (the number of protons), but can have different numbers of neutrons and so different relative atomic masses.

Fix the bridge

Start with 30 seconds silent thinking time.

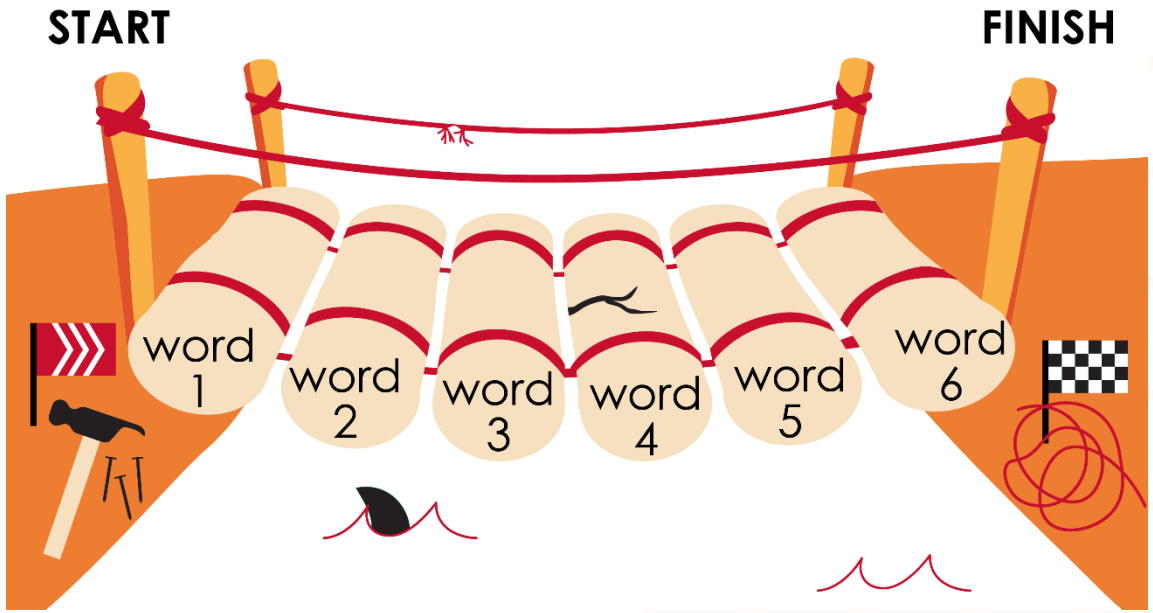
You have 2 minutes to fix a wrong statement, or to unpick and clarify a challenging statement.

A starts the discussion by making a suggestion.

B responds to the comment and if they disagree, they explain why.

A responds to B by clarifying their point before adding to it.

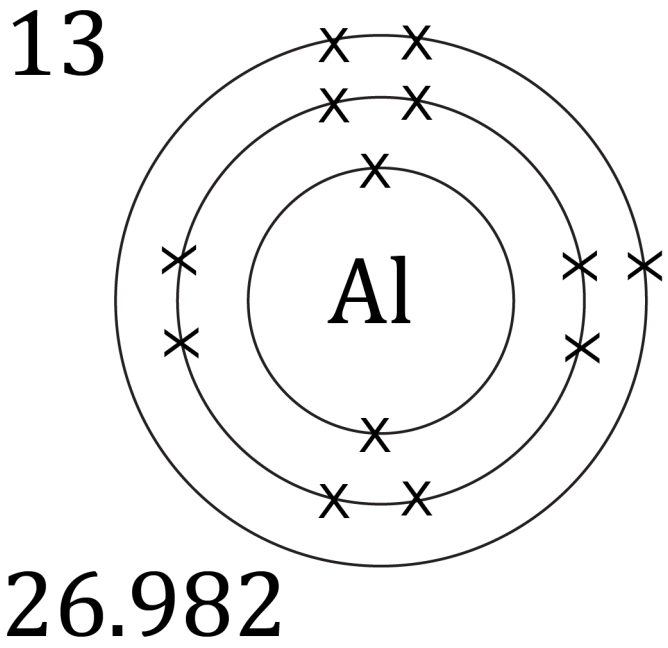
Lastly, **C summarises** the ideas of A and B, seeks their agreement and feeds back to the class.



Fix the bridge 1

Can you unpick and clarify this challenging statement?

Atoms have no charge.



Fix the bridge 1 – sample answer

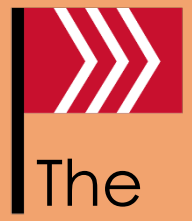
Atoms are made up of three types of subatomic particles. Protons have a positive charge, electrons have a negative charge and neutrons are neutral.

The number of positive protons and negative electrons is the same so atoms have no overall electrical charge, they are neutral.

Word bridge 2

Talk in your three to build the word bridge, from the start to the finish. Link the words and use the fact to help you. Keep to your speaking role – either A, B or C.

Start



The nuclear model describes an atom as having

Fact

Most of an atom is empty space.

Link these words

Words

dense	nucleus
positively charged	protons and neutrons
negatively charged	electrons

Finish

called shells or energy levels.

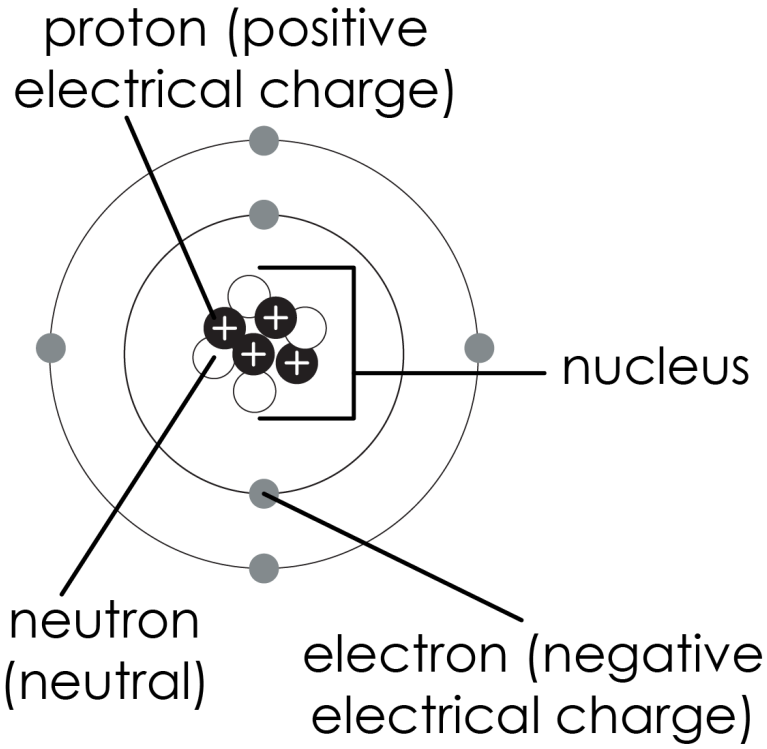
Word bridge 2 – sample answer

The nuclear model describes an atom as having a dense, positively charged nucleus containing protons and neutrons, with negatively charged electrons in surrounding regions called shells or energy levels.

Fix the bridge 2

There is something wrong with the statement below, can you fix it?

The relative mass of the atom shown is 12.



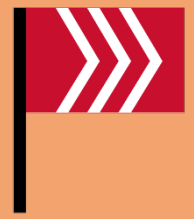
Fix the bridge 2 – sample answer

There are 12 subatomic particles shown in the image, 4 protons, 4 neutrons and 4 electrons. The relative mass of this atom is 8 because electrons have negligible influence on the mass of an atom.

Word bridge 3

Talk in your three to build the word bridge, from the start to the end. Link the words and use the fact to help you. Keep to your speaking role – either A, B or C.

Start



Atoms form positive ions when

Fact

Atoms are neutral particles with equal numbers of protons and electrons, while ions are charged particles.

Link these words

Words

negative	electron
gain	electron
lose	atoms

Finish

but the number of protons remains the same.

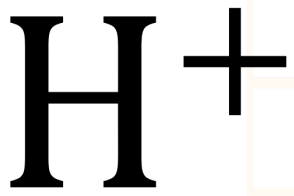
Word bridge 3 – sample answer

Atoms form positive ions when they lose an electron, and atoms form a negative ion when they gain an electron, but the number of protons remains the same.

Fix the bridge 3

There is something wrong with the statement below, can you fix it?

A positive hydrogen ion forms when a hydrogen atom gains a proton.



Fix the bridge 3 – sample answer

Ions are created when an atom or molecule gains or loses electrons, altering the balance between positive protons and negative electrons. The number of protons in an ion remains unchanged, as it determines the identity of the element. If a hydrogen atom gained a proton, it would become a helium atom.

Word bridge 4

Talk in your three to build the word bridge, from the start to the finish. Link the words and use the fact to help you. Keep to your speaking role – either A, B or C.

Start

Isotopes of an element are

Fact

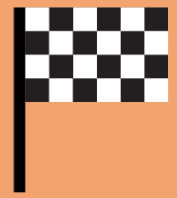
Isotopes are variants of the same element with different atomic masses.

Link these words

Words

same number	protons
different numbers	neutrons
atoms	nucleus

Finish



but have the same chemical properties.

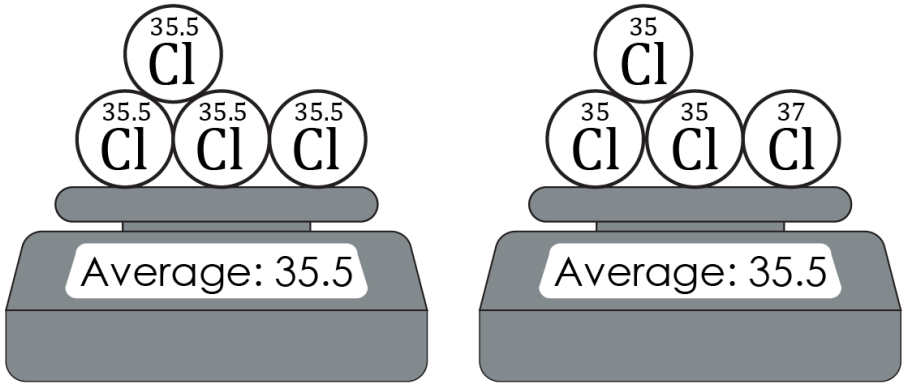
Word bridge 4 – sample answer

Isotopes of an element are atoms with the same number of protons and different numbers of neutrons in the nucleus but have the same chemical properties.

Fix the bridge 4

Can your group find an answer to the question below? Debate the question and agree a response.

If protons and neutrons have a relative mass of 1, why is the relative atomic mass of chlorine 35.5?



hypothetically in reality

Fix the bridge 4 – sample answer

The relative atomic mass of an element is a weighted average of the masses of the atoms of the isotopes. Chlorine has two isotopes: ^{35}Cl and ^{37}Cl, but the relative atomic mass of chlorine is not 36. In any sample of chlorine, 75% of the atoms are ^{35}Cl and the remaining 25 % are ^{37}Cl.

Word bridge 5

Talk in your three to build the word bridge, from the start to the finish. Link the words and use the fact to help you. Keep to your speaking role – either A, B or C.

Start

In the plum pudding model the atom is

Fact

Rutherford's gold foil experiment led to the rejection of the plum pudding model in favour of the nuclear model.

Link these words

Words

positive charge	negative electrons
rebounded	alpha particles
pass straight through	deflected

End

the atom's positive charge is concentrated in a tiny, dense nucleus.

Word bridge 5 – sample answer

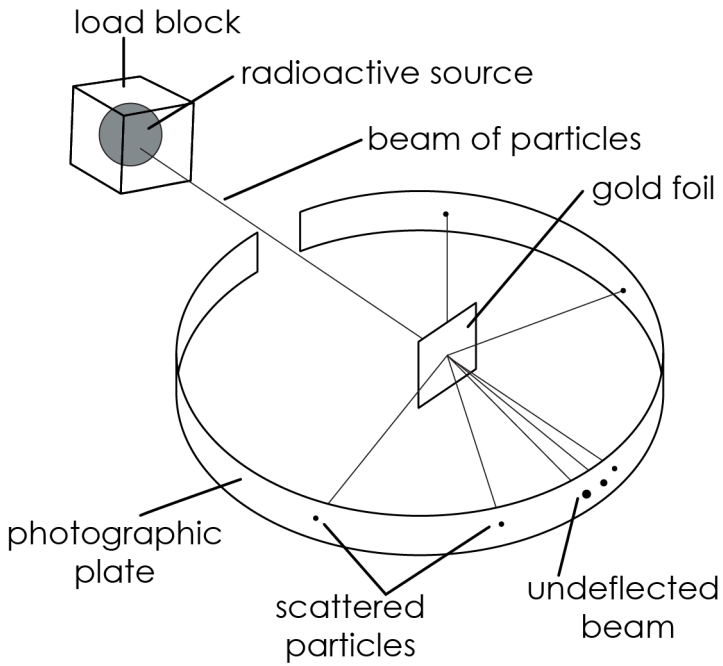
In the plum pudding model the atom is a ball of positive charge with negative electrons embedded in it. Alpha particles were expected to pass straight through, but some were deflected and others rebounded which suggests that the atom's positive charge is concentrated in a tiny, dense nucleus.

Fix the bridge 5

Can your group find an answer to the question below? Debate the question and agree a response.

Alpha particles are highly energetic, have a +2 charge, and are massive compared to electrons.

Why did Rutherford expect the alpha particles to pass straight through gold atoms?



Fix the bridge 5 – sample answer

The plum pudding model of the atom was in use when Rutherford carried out his gold foil experiment. In this model, the positive charge is evenly spread throughout the whole atom with negative electrons embedded in it.

Rutherford expected the highly energetic, positively charged alpha particles to pass straight through the gold atoms because the positive charge would not be dense enough to cause significant deflection.

Reflection

- How do you feel about this task? Why?
- Did everyone keep to the speaking and listening rules?
- How did you find roles A, B and/or C?
- What went well and what was difficult?
- What have you learnt doing this structured talk, that you can use next time you talk about chemistry?

Acknowledgements

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