

11–14 years

# Structured talk: particle model

# Learning objectives

1. Apply the particle model to compare the properties of solids, liquids, and gases.
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 the relative energy, movement and arrangement of particles in different states and share this understanding.
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 are 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

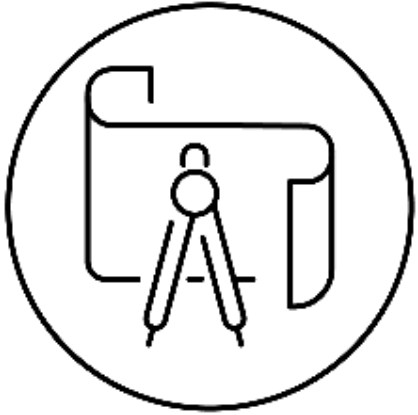
- Nod or smile to show that you understand.
- Listen with interest and respect even if you disagree.

## Draw out

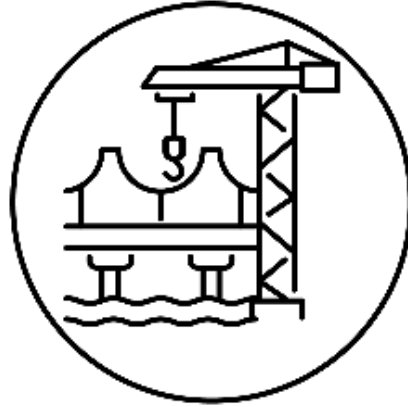
- In response, summarise and seek clarification rather than simply stating your answer or opinion.

# Roles

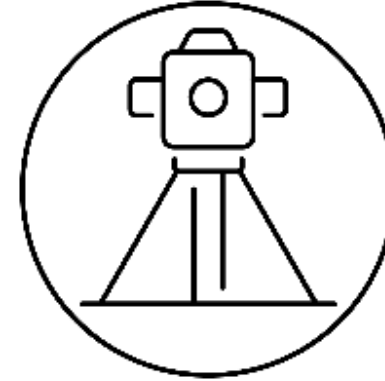
You will have either role A, B or C.



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.

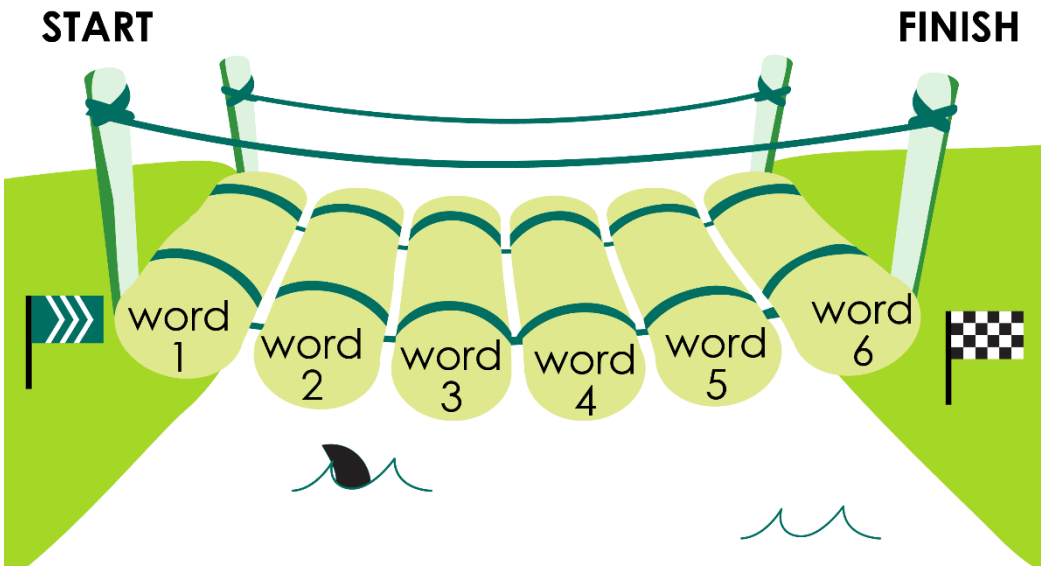
You have 2 minutes to build the best bridge you can.



**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		End
 When particles of matter	Gases expand to fill the container they are in.		 called the gas state
	Link these words		
	Words		
	frequently	collide	
	quickly	spread out	
	energy	move	

# 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 ... '

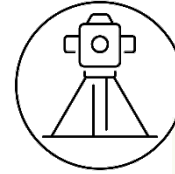
'Considering what I already know about ... , I think that ... '

'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



**Plan**

## **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?







# Worked example

<b>Start</b>  When particles of matter	<b>Fact</b> Gases expand to fill the container they are in.		<b>Finish</b>  called the gas state
	<b>Link these words</b>		
	<b>Words</b>		
	frequently	collide	
	quickly	spread out	
	energy	move	

When particles of matter have enough energy to move quickly, they collide frequently and spread out, which is called the gas state.

# 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.

<div>Start</div> <div></div> <div>The states of matter</div>	<div>Fact</div> <div>All matter is made up of tiny particles known as atoms.</div> <div>Link these words</div> <div>Words</div> <table><tr><td>solid</td><td>arranged</td></tr><tr><td>liquid</td><td>move</td></tr><tr><td>gas</td><td>energy</td></tr></table>	solid	arranged	liquid	move	gas	energy	<div>Finish</div> <div></div> <div>changing state</div>
solid	arranged							
liquid	move							
gas	energy							

# Word bridge 1 – sample answer

The states of matter are solid, liquid and gas. If the energy of the particles in a solid increases, the particles move about more and become arranged differently. This is called changing state.

# Fix the bridge

Start with 30 seconds silent thinking time.

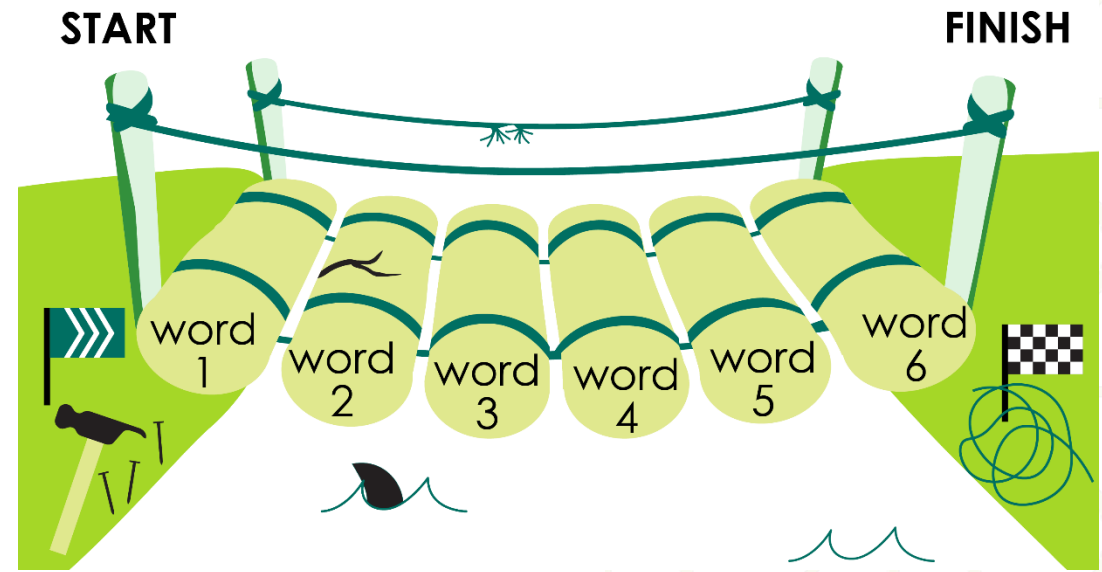
You have 2 minutes to fix a wrong statement, or to unpick and clarify a challenging statement.

**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

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

**The bubbles in boiling water are filled with air.**







# Fix the bridge 1 – sample answer

When water is heated it changes state, so the bubbles are filled with steam not air.



# 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	Fact		Finish
  Increasing the temperature	The collisions of particles with the walls of a container is called gas pressure.		  the pressure exerted on the container
	Link these words		
	Words		
	collide	particle	
	volume	move	
		energy	

## Word bridge 2 – sample answer

Increasing the temperature means every particle has more energy to move throughout the volume of the container. The particles collide with each other and the walls of the container more frequently which then increases the pressure exerted on the container.



## Fix the bridge 2

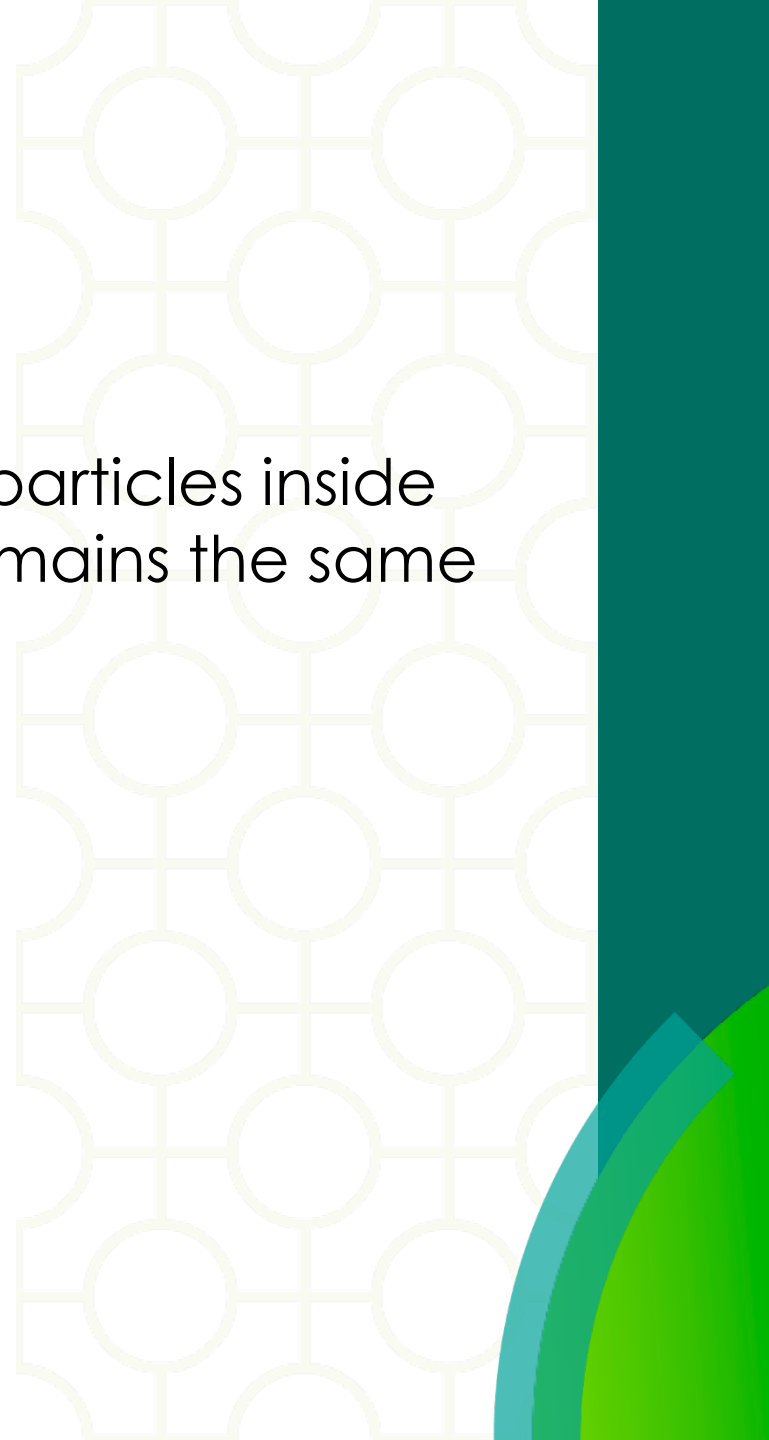
There is something wrong with the statement below, can you fix it?

**The air pressure inside an inflated balloon is higher than outside the balloon.**





## Fix the bridge 2 – sample answer

Pumping air into the balloon increases the number of particles inside but because the material stretches, the air pressure remains the same inside and outside.



# Word bridge 3

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.

<div>Start</div> <div></div> <div>Melting</div>	<div>Fact</div> <div>Particles of matter attract each other.</div>		<div>Finish</div> <div></div> <div>solid to liquid</div>
	Link these words		
	Words		
	overcome	vibrate	
	temperature	heated	
	energy	attraction	

## Word bridge 3 – sample answer

Melting occurs when particles in a solid are heated and gain energy. The particles vibrate more and overcome some of the forces of attraction that were holding them in the regular arrangement of a solid. The temperature will not rise until all the particles have enough energy to move from solid to liquid.

## Fix the bridge 3

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

**The forces of attraction between particles get stronger as steam condenses into water.**





## Fix the bridge 3 – sample answer

The forces of attraction remain the same, it is the lower energy of the particles that causes water vapour/steam to condense into liquid.



# 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.

<div>Start</div> <div></div> <div>In the gas state</div>	<div>Fact</div> <div>Particles of matter are constantly in motion.</div>		<div>Finish</div> <div></div> <div>random arrangement</div>
	Link these words		
	Words		
	straight	distance	
	move	collide	
	energy		

## Word bridge 4 – sample answer

In the gas state the particles have high energy and move over large distances in straight lines. If the particles collide with other particles or the wall of a container, they will change direction resulting in a random arrangement.



## Fix the bridge 4

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

**In a glass of water, the liquid particles can only move if the glass is moved, For example, when the glass is knocked over the water spills out.**





## Fix the bridge 4 – sample answer

The water particles are moving all the time which is why tea or ink will spread out even in cold water. The glass particles are also moving, they vibrate about a fixed point whereas the liquid particles can move past each other and flow out of the glass.

ALSO NOTE: the particles are water molecules or water particles. There is no such thing as liquid particles, just the particle arrangement of a liquid state.

# 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.

<div>Start</div> <div></div> <div>Some solids</div>	<div>Fact</div> <div>As temperature increases, particles of matter move faster.</div>		<div>Finish</div> <div></div> <div>a gas state</div>
	Link these words		
	Words		
	attraction	heated	
	forces	liquid	
	sublime	weaker	

## Word bridge 5 – sample answer

Some solids are made of particles with weaker forces of attraction between them. When these solids are heated they do not melt into a liquid but sublime straight into a gas state.

## Fix the bridge 5

Can you unpick and clarify this challenging statement?

**Particles in a hot liquid are hotter than particles in a cold liquid.**



## Fix the bridge 5 – sample answer

The particles in a hot liquid have more energy and move more than the particles in a cold liquid.

NOTE: temperature is a measure of average kinetic energy of the particles (how much the particles are moving on average).



# 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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