

The assessments included fourteen tasks related to the *material world* strand of the science curriculum.

Seven tasks were identical or had many common components for year 4 and year 8 students. Four of these are trend tasks (fully described with data for both 1995 and 1999), one is a released task (fully described with data for 1999 only), and two are link tasks (to be used again in 2003 so only partially described here). Three other tasks, including one link task, were attempted only by year 4 students. The remaining four tasks, including a trend task and two link tasks, were attempted only by year 8 students.

The task details and results for trend tasks are presented in the first section, followed by the task details and results for released tasks. The third section contains a little task information and the results for the link tasks. Within each of the three sections, tasks used with both year 4 and year 8 students are presented first, followed by tasks used only with year 4 students and then by tasks used only with year 8 students.

Comparing results for year 4 and year 8 students

Averaged across 38 task components used with both year 4 and year 8 students, 15 percent more year 8 than year 4 students produced correct responses. This indicates that, on average, students have made substantial progress between year 4 and year 8 in the skills assessed by the tasks. Students at both levels were more successful in carrying out experimental procedures and reporting the results than in demonstrating their knowledge or giving explanations of material world phenomena.

Trend results: Comparing 1995 and 1999 results

Four trend tasks involving a total of 23 components were administered to year 4 students in both the 1995 and 1999 assessments. More 1999 than 1995 students succeeded on 13 components, more 1995 than 1999 students succeeded on eight components, and there was no difference on two components. Averaged across the 23 components, two percent more students succeeded in 1999 than in 1995. This difference is not large enough to be regarded as important.

Five trend tasks involving 26 task components were administered to year 8 students in both the 1995 and 1999 assessments. More 1999 than 1995 students succeeded on 15 components, more 1995 than 1999 students succeeded on ten components, and there was no difference on the final component. Averaged across the 26 components, two percent more students succeeded in 1999 than 1995. Again, this difference is not large enough to be important.

Emptying Rate

Trend Task

Approach: Team

Level: Year 4 and year 8

Focus: Plan and conduct an investigation of the flow properties of liquids of different viscosity.

Resources: Video demonstrating the task, basin, 500ml plastic drink bottle with bottom cut off and small hole drilled in cap, tap water, 900ml bottle of detergent, measuring jug, laminated activity card, results sheet, stopwatch.

Questions/instructions:

Set out the supplies ready for the activity.
In this activity your team will be doing an investigation. We will watch a video now that tells you what you are to do.
Play video.

Video Script: Your group is going to work together to do a small investigation. This video will explain what you group is going to do. You will have this equipment to work with: a drink bottle with the bottom cut off and a small hole drilled in the lid; a basin; a measuring jug; tap water; detergent; a stop watch; and a chart for writing down your results.

Your group will need to think how you will organise your investigation so that everyone is helping, and everyone has a job to do.

This is what your team will be investigating: You will be timing how long two different liquids take to empty out of the bottle from each of the 3 different measurement marks. The two liquids are tap water and detergent.

This is what you will do:

1. Plan how your team will do the activity so that everyone has a job to do.
2. Pour water into the bottle up to the measurement mark—like this [demonstrate]. When you are pouring it in, keep the hole in the lid covered with your finger.
3. Use the stop watch to measure how much time it takes the bottle to empty from each mark. You will need to put a fresh lot of water in to time how long it takes from each mark. See how I am letting the water pour into the jug so that it can be used again.
4. Write the results on your group chart.
5. When you have finished doing all of the measurements, look at all of your results on the chart. Test all of the measurements with the plain water first, then test with the detergent.

Before you start, your group needs to plan how it will do the activity so that everyone has a job to do. When you have made up your plan, you will tell your teacher about the plan before you start the investigation.

Here is the equipment that your team will use to do the investigation and a table for you to write your results in. You also have this instruction card that tells you what you are to do.

Read instruction card to team.

Your first instruction is to plan how you will do your experiment. Do this now and when you are ready I will ask you to tell me your plan. Remember you need to plan your activity so everyone has a job to do.

Allow time for discussion and then ask students to explain their plan to you. If the plan does not involve everyone, ask them to go back into discussion to do this, then report back to you.

Height of liquid	Tap Water	Detergent
9 cm		
6 cm		
3 cm		

	% responses	
	1999 ('95)	1999 ('95)
	year 4	year 8
Planning:		
to measure liquid consistently	8 (0)	16 (10)
to measure flow time accurately	9 (3)	23 (7)
to check consistency through replication	0 (0)	4 (0)
to achieve requested member participation	97 (86)	99 (100)
I will show you how the stopwatch works and then you can start your investigation.		
Demonstrate stopwatch operation then withdraw. Once the investigation activity has been completed and the results recorded on the sheet, remind the group to discuss the results among themselves.		
Allow time.		
Experimentation:		
measured liquid reasonably consistently	92 (66)	100 (97)
measured flow time reasonably accurate	79 (55)	93 (97)
checked consistency through replication	9 (3)	17 (3)
recorded results carefully	91 (73)	96 (93)
Now I would like you to tell me what you found out in your investigation.		
Reporting:		
clear, accurate	5 (0)	21 (17)
moderately clear	56 (56)	59 (62)
Now I want you to think about what the results might be if you used tomato sauce. Discuss it in your team and then write what you think the results might be for tomato sauce on the table in the spare column.		
Allow time.		
Explain to me why you think the measurements would be like that.		
very good discussion	7 (8)	23 (14)
moderate discussion	65 (56)	68 (59)

Commentary:

These results show some improvement from 1995 to 1999, particularly at year 4 level. It is pleasing to see greater use of replication in 1999 at both levels, although the low percentages leave much room for improvement.

Trend Task

Disappearing Water

Approach: Station

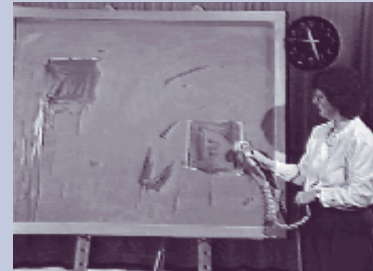
Level: Year 4 and year 8

Focus: Explanation of evaporation and understanding of the water cycle.

Resources: Video showing evaporation with hand fanning and use of a hair dryer.



Two squares were marked on the blackboard. One was dried using fanning (left) one was dried using a hair dryer (right).



Questions/instructions:

In this activity you are going to watch a video clip showing people cleaning a blackboard, then answer some questions about what you saw happening in the video.

Watch the video and then answer these questions. You may replay the video if you need to.

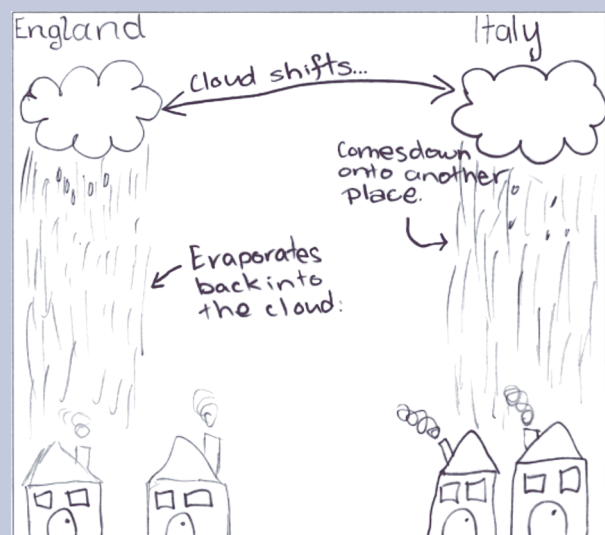
	% responses	
	1999 ('95) year 4	1999 ('95) year 8
1. Why did fanning the wet blackboard help it to dry? fanning moves moist air away from the blackboard to allow more to evaporate mentions wind and/or water vapour and/or evaporation mentions wind or air movement only	0 (0) 5 (4) 64 (45)	3 (2) 18 (13) 60 (60)
2. The hairdrier uses heat as well as fanning. Why did the heat dry the blackboard faster? mentions increased warmth helping evaporation	28 (9)	60 (37)
3. Where does the water go as the blackboard dries? evaporation or equivalent (eg. "into the air")	36 (40)	71 (75)
4. Now think about a puddle on the footpath. Where does the water go when the puddle dries out? both in to the air and the ground into the air/sky into the ground	- - -	7 (5) 66 (63) 16 (13)

5. The water that falls as rain in one place may come from another place that is far away. Explain how this happens. You can draw a diagram with labels to help explain your answer.

Includes all three aspects:

water evaporation from source,
cloud movement,
rain falling elsewhere

	% responses	
	1999 ('95) year 4	1999 ('95) year 8
	-	30(30)



Commentary:

Overall, the changes in performance between 1995 and 1999 were inconsistent and small. Year 8 students performed substantially better than year 4 students.

Rods

Trend Task

Approach: One to one

Level: Year 4 and year 8

Focus: Predict and investigate the heat conductivity of different materials, and explain practical applications.

Resources: 5 rods, picture of saucepan, , timer, mug, paper towel, water (boiling), electric jug

<i>Questions/instructions:</i>	% responses		<i>After 2 minutes of feel tests:</i>	% responses	
	1999 ('95) year 4	1999 ('95) year 8		1999 ('95) year 4	1999 ('95) year 8
In this activity you are going to find out and tell me about how quickly different materials let heat through them.			6. Now lift each rod out of the water and place them on the table in order, from the one that let the heat through most quickly, to the one that let it through least quickly. Be careful to lift them out with a paper towel so that you don't burn your fingers.		
Show student the rods as you name them.			Observations:		
1. Here are 5 rods. They are made of wood, perspex, copper, steel and aluminium.			copper first	80 (90)	86 (89)
I am going to put them into this cup then pour in boiling water. Then I will get you to touch the end of each rod to find out how much heat they are letting through.			aluminium second	71 (79)	77 (83)
2. But before we start, can you tell me which rod you think will let the heat move through most quickly?			steel third	81 (81)	84 (86)
Prediction for first:			perspex fourth	65 (61)	70 (67)
copper	10 (32)	28 (34)	wood fifth	68 (61)	71 (69)
aluminium	10 (27)	20 (22)			
steel	15 (15)	21 (19)	7. Materials that let the heat travel through easily are called good conductors . Which rods were good conductors of heat?		
perspex	28 (15)	14 (14)	copper	92 (95)	97 (97)
wood	38 (11)	17 (11)	aluminium	87 (87)	93 (93)
3. Why do you think that rod will let the heat through most quickly?			steel	54 (52)	49 (37)
not marked					
4. Now let's do the experiment.			8. When toffee is made, the ingredients are made very hot, a lot hotter than water. If we had spoons made out of each of these materials, which spoon would be the best for stirring the very hot toffee mixture?		
I am going to pour boiling water into the mug, and I want you to test each rod. When you test the rods, touch them like this:			wood and/or perspex	4 (3)	3 (7)
Demonstrate how the rods should be touched — before the boiling water is added. Demonstrate use of timer.			wood	41 (35)	58 (56)
I will get you to check them every 30 seconds, for two minutes.			perspex	14 (16)	12 (11)
With the rods already in the mug, pour boiling water into the mug, and get ready to time the 30 sec intervals. Repeat the following instruction 4 times (every 30 seconds).			copper	26 (27)	15 (11)
5. Feel each rod now, and tell me what you notice.			9. Why would you use that material?		
			not good conductor of heat	56 (60)	69 (85)
			Show student the picture of a saucepan.		
			The saucepan in this picture is made of stainless steel. It has a copper bottom, and a plastic handle.		
			10. Why do you think it has a copper bottom?		
			conducts heat well	75 (70)	91 (93)
			11. Why do you think it has a plastic handle?		
			conducts heat poorly	91 (92)	96 (95)

Commentary:

Both year 4 and year 8 students conducted and interpreted the experiment quite well. Year 8 students showed better initial knowledge of the rod materials, and were better able to explain the practical applications. There was no marked change in performance between 1995 and 1999.

Trend Task

Candles in Jars

Approach: One to one

Level: Year 4 and year 8

Focus: Predict and explain the effect on burning of different environmental conditions.

Resources: Video, picture.

Questions/instructions:

In this activity you will be predicting what will happen to three candles.

You are going to watch a video clip of three candles in three different jars. The three candles are all the same size. The big jar and one of the little jars will have lids put on them at the same time. We will watch the video now.



Play the video clip. Stop the video when cued.

Before we finish watching the video, I want you to tell me the order that you think the candles will go out.

Here is a picture of the three candles in their jars.

small with lid first,
large with lid second,
small open last

Give student the picture of the candle in the jar. Wait for student response.

Now let's look and see what happens.

Play the rest of the video.

1. Can you explain to me why the candles went out in this order?

mentions oxygen 10 (16) 43 (45)

mentions air 42 (54) 42 (47)

mentions how amount of air is related to size of closed jar 31 (42) 77 (80)

% responses
1999 ('95) 1999 ('95)
year 4 year 8

20 (32) 63 (71)

Commentary:

About 40 percent more year 8 than year 4 students succeeded with this task. The 1999 year 4 students showed less knowledge and understanding than their 1995 counterparts, but there was a smaller decline for year 8 students.

Trend Task

Chemical Muddle

Approach: Station

Level: Year 8 only

Focus: Given information about chemical properties of three substances, identify samples of the substances.

Resources: Jars of icing sugar, cornflour, cream of tartar, 3 clean teaspoons, 3 spatulas, 3 small beakers, water in measuring jug, 3 pieces of blue litmus paper, paper towels.

Questions/instructions:

The label has been left off three jars in the kitchen. You are to try and find out what is in each jar.

You have three jars.

In one jar is cornflour.

In one jar is icing sugar.

In one jar is cream of tartar.

You need to test to find out which substance is in each jar.

Do not taste the unknown substances.

Here are three clues to help you:

1. Cream of tartar is an acid.
2. Acids turn blue litmus paper pink.
3. Cornflour does not dissolve in water.

You will need to test each substance to find out what it is.

1. Put half a teaspoon of each substance into separate beakers. Use a clean spoon each time. Add about 2 cms of water and stir well with a spatula.

The substance in jar A is —

The substance in jar B is —

The substance in jar C is —

Number correct: 3 58 (53)

2 0 (1)

1 27 (37)

0 15 (9)

% responses
1999 ('95) 1999 ('95)
year 8

Commentary:

Students particularly enjoyed this task. The 1999 and 1995 year 8 students had very similar levels of success with this task.

Sugar Solutions

Approach: One to one

Level: Year 4 and year 8

Focus: Investigate solubility rate of different forms of sugar, using a fair test, and explain results.

Resources: Timer, packet of raw sugar, packet of coffee sugar, 2 100ml beakers, 2 stirrers, water in a jug.

Questions/instructions:

Set out equipment on table so that it is visible to student.

In this activity you are going to do an experiment to find out which type of sugar dissolves faster. You should try to make your experiment so that it is a fair test.



- | | |
|---|---|
| 1. What do you think we mean in science by a "fair test"? | % responses |
| <i>you keep all features the same except the variable you are trying to find out about</i> | y4 y8 |
| <i>on the right track, but vague</i> | 7 28 |
| <i>on the right track, but vague</i> | 37 55 |
| Let's begin. Here are packets of two different types of sugar. Carefully tip one packet of sugar into each beaker. Don't add the water yet. Each packet has the same amount of sugar. | |
| 2. What can you tell me about the sugars. How are they different? | not marked |
| 3. Which of these two sugars do you think will dissolve faster? | raw sugar 82 81 |
| Why do you say that? | smaller crystals dissolve faster 78 78 |

You need to do an experiment to find out which sugar will dissolve faster. These are the things that you will need for your experiment.

% responses
y4 y8

Point to equipment.

Remember that your experiment needs to be a fair test.

4. First of all tell me how you plan to do your experiment so that it is a fair test.

What would you do first?

What would you do next?

Experiment plan:

- | | |
|--|--------------|
| <i>use same amount of water</i> | 49 69 |
| <i>start timing as soon as water added (both beakers)</i> | 34 55 |
| <i>stir both beakers similarly (schedule & method)</i> | 32 51 |
| <i>carefully observe and time until last crystals dissolve</i> | 31 47 |

You can do your experiment now. The results sheet is for you to record how long it took for each type of sugar to dissolve.

Open recording book to results sheet and give it and pen to student, then allow time.

- | | |
|--|------------------------|
| 5. What did your experiment show? Which sugar dissolved faster? | raw sugar 85 90 |
| 6. Why do you think this happened? <i>Why did sugar dissolve faster than the other sugar?</i> | not marked |
| 7. If you were to do this experiment again, is there anything that you would do to make it a better fair test? | not marked |

Commentary:

Year 4 and year 8 students were equally capable at predicting the result of the experiment and the associate reasons, but year 8 students were better at understanding and designing a fair test.

Powders Year 4

Approach: Team

Level: Year 4

Focus: Using physical and chemical evidence to identify different powders and account for the identifications made.

Resources: Teaspoon of four powders in sample cups labelled A, B, C, & D. Two hand lenses, 2 eye droppers, 16 spatulas, bottle of water, bottle of vinegar, 2 sample cups labelled “water”, “vinegar”, 16 sheets A⁵ black paper, instruction card, recording sheet, teaspoon (for teacher).

Questions/instructions:

Before team arrives, put a teaspoon of each powder into labelled sample cups. Put about 20mls water and vinegar into labelled sample cups. Put an eyedropper in each beaker.

In most homes you will find different kinds of powders. Powders are used for many different purposes. We usually know what the powders are by the labels on their packets or containers. Imagine what it would be like if a whole lot of powders were in containers that looked the same, and they didn't have name labels. It could be hard to know which one was which.

I have 4 containers with different powders that are found around most homes. The labels don't say what they are. They only say A, B, C, D.

I want your team to find out as much as you can about each of the powders. You have black paper for putting the powders on so that you can study them more easily. You also have spatulas, hand lenses and two eyedroppers. Use one eyedropper for the water and one for the vinegar. You can use any methods except one: you must not taste the powders.

I am going to give you one powder at a time. I want you to find out as much as you can about each powder then I will write down what you found out.

Show students the results sheet.

A	Powder A is	
	Reasons:	
What we discovered about the powders.		
B	Powder B is	
	Reasons:	
What we discovered about		
C	Powder C is	
	Reasons:	
What we discovered about		
D	Powder D is	
	Reasons:	
What we discovered about		

TEAM INSTRUCTIONS

- Do this activity as a team so that **everyone** is taking part.
- Talk about what you will do to examine each powder.
- Design a chart for showing the properties of each powder.
- Try to find at least 3 properties for each powder, and show them on your chart.
- After you have examined each powder, write down what you think it is.

You have black paper for putting powders on so that you can examine them more easily. You also have spatulas, tweezers, and lenses, eye droppers for putting water with the substances, and some empty beakers.

DO NOT TASTE ANY POWDER

This instruction card reminds you what to do.

Place instructions card in front of students, and read it to them.

You can start by examining powder A. Here is the container with powder A in it. Try to find out as much as you can about the powder.

Give students powder A. Allow about 3 minutes.

Tell me what you think powder A is and why you think it is that.

Prompt students to give detailed descriptions of powders.

I want you to tell me everything that you have found out about powder A. I'll write your ideas down.

% responses
y4

Repeat for powders B, C, D

Powder A	identified baking soda	76
	key tests: bubbles with vinegar	89
	relevant observations: 2	33
		1 39
Powder B	identified lemon drink	27
	relevant observations: 2	54
		1 32
Powder C	identified flour	90
	key tests: sticky, gluey when wet	83
	relevant observations: 2	47
		1 48
Powder D	identified washing powder	86
	key tests: slippery, soapy when wet	36
	relevant observations: 2	50
		1 39

Commentary

Students greatly enjoyed this task and enjoyed good success at identifying the powders and explaining why.

Balancing Balloons

Approach: One to one

Level: Year 4

Focus: Understanding that air has mass, takes up space, and is more dense when compressed.

Resources: Video showing steps of the experiment.

Questions/instructions:

This activity starts with a video. The video shows an experiment with balloons placed on a balance.



Show video clip 1, 2 uninflated balloons on balance.

% responses
y4

- | | | |
|--|------------------------------------|----|
| 1. What happened when the balloons were put on the balance? | stay balanced | 91 |
| 2. Why did that happen? | both weigh the same | 64 |
| 3. If one of the balloons on the balance is blown up and the other one isn't, what do you think will happen? | | |
| | ✓ blown up one will tip scale down | 59 |
| | they will still balance | 4 |
| | blown up one will rise | 32 |

- | | | |
|--|---|---------------------------------|
| 4. Why do you say that? | not marked | <i>% responses</i>
y4 |
| Show video clip 2, one balloon inflated one not. | | |
| 5. What happened when the balloon that was blown up was put on one end of the balance? | blown up one tips scale down | 98 |
| 6. Why did the balance go down on one side? | compressed air is denser than less compressed air | 1 |
| | air has weight | 46 |
| 7. What does this experiment tell us about air? | | |
| | under greater pressure, air is condensed (more weight in same volume) | 2 |
| | air has weight / takes up space | 57 |

Commentary:

The proper explanation for the key feature of this task was beyond the knowledge of almost all of the year 4 students. However, many students made good predictions and gave partial explanations.

Changes

Approach: Team

Level: Year 8

Focus: Developing and presenting explanations for two temperature related phenomena: the changes in the state of water and the rate of diffusion of dye in water.

Resources: Video showing ice turning to steam and red dye diffusing in hot and cold water, 2 team instruction cards.

Questions/instructions:

In this activity your team is going to try to explain changes that happen to substances. We'll begin by watching two video clips.

Play video.

I want you to work out good explanations for these changes. You'll start off working in pairs, then work as one team. [Names, students 1 and 2] will work on an explanation for the clip about ice, water and steam. [Names, students 3 and 4] will work on an explanation for the coloured water. Here are the instructions for what you are to do.

Place instructions cards for all students to see, then read them to the team.

I'll give you a few minutes to work out your explanations in your pairs, then we will work as a whole team.

Allow time for discussion in pairs, the bring students together for team discussion.

I want each pair to tell the others their explanations. The others should listen carefully, then comment on the explanation so that the whole team agrees on the best possible explanation. After you have had time to do that, I will ask you to tell me your explanations.



Teacher withdraws and allows time for team discussions.

Now I would like [names, students 1 and 2] to tell me the team's explanation for what happened with the ice, water and steam. After that I want [names, students 3 and 4] to tell me the team's explanation for what happened with the coloured water. Make your explanations nice and clear so that I can fully understand your reasons.

Ice → water → steam:

- | | |
|--|---------------------------------|
| | <i>% responses</i>
y8 |
| refer to heat melting ice | 71 |
| refers to heat making water boil | 37 |
| explains that ice becomes water as it melts | 67 |
| explains that water becomes steam as it boils | 75 |
| refers to phase changes or different forms of water (solid, liquid, gas) | 36 |
| refers to extra heat required at phase changes (latent heat) | 20 |
| Dye spreading in cold and hot water: | |
| observes that dye spreads faster in hot water | 88 |
| explains spread due to faster, stronger currents (convection) | 17 |
| explains spread due to faster molecular motion (diffusion) | 21 |

Commentary:

Most of the year 8 student teams identified the phenomena presented on videotape. Fewer succeeded in explaining these phenomena.

Link Tasks 17-20

LINK TASK 17

Approach: One to one
Level: Year 4 and year 8
Focus: Evaporation
Resources: Video

		% responses	
		y4	y8
Explanation:	clear	37	48
	vague	47	36
Explanation		28	54
Problem solving:	clear	54	79
	vague	22	31

LINK TASK 18

Approach: One to one
Level: Year 4 and year 8
Focus: Properties of air
Resources: Not revealed

		% responses	
		y4	y8
	prediction	20	46
	observation	46	74
	explanation	44	73
	explanation	7	10

LINK TASK 19

Approach: Team
Level: Year 4 only
Focus: Classification
Resources: Not revealed

		% responses	
		y4	
Grouping:	13-15	12	
	10-12	56	
	7-9	27	
	0-6	5	
Labelling:	6-10	12	
	4-5	73	
	2-3	15	
	0-1	0	

LINK TASK 20

Approach: Station
Level: Year 8
Focus: Chemical tests
Resources: Not revealed

		% responses	
		y8	
Component:	1	73	
	2	69	
	3	78	
	4	87	
	5	70	
	6	38	
	7	5	
	8	45	

LINK TASK 21

Approach: Team
Level: Year 8
Focus: Chemical identification
Resources: Not revealed

		% responses	
		y8	
Total score:	16-18	15	
	13-15	25	
	10-12	28	
	7-9	18	
	4-6	11	
	0-3	3	