

The assessments included twenty-three assessment tasks related to the *physical world* strand of the science curriculum.

Twelve 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), four are released tasks (fully described with data for 1999 only), and four are link tasks (to be used again in 2003 so only partially described here).

Six other tasks, including two trend tasks and two link tasks, were attempted only by year 4 students. The remaining five tasks, including one 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 82 task components used with both year 4 and year 8 students, 12 percent more year 8 than year 4 students produced correct responses. This indicates that, on average, students have made useful progress between year 4 and year 8 in the skills assessed by the tasks. Tasks involving experimentation and observation of phenomena were usually performed very well, but students were often less successful with tasks which required knowledge or explanation. In team experiments, students still placed little emphasis on replication of results (repeating a procedure and the associated observations or measurements to check on the consistency of results). Replication is a very important part of scientific investigation.

Trend results: Comparing 1995 and 1999 results

Six trend tasks involving a total of 45 components were administered to year 4 students in both the 1995 and 1999 assessments. More 1999 than 1995 students succeeded on 22 components, more 1995 than 1999 students succeeded on 17 components, and there was no difference on 6 components. Averaged across the 45 components, one percent more students succeeded in 1999 than in 1995. This difference clearly is not important.

Five trend tasks involving 39 task components were administered to year 8 students in both the 1995 and 1999 assessments. More 1999 than 1995 students succeeded on 12 components, more 1995 than 1999 students succeeded on 20 components, and there was no difference on seven components. Averaged across the six components, one percent fewer students succeeded in 1999 than 1995. Again, this difference clearly is not important.

Dropping Coins

Trend task

Approach: Station

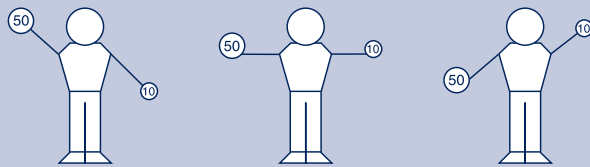
Level: Year 4 and year 8

Focus: Students demonstrate their intuition or prior learning about the effects of gravity on objects of differing mass, then carry out a practical investigation and interpret the outcome.

Resources: 50c coin, 10c coin.

Questions/instructions:

In this activity you will be finding out about how things fall.



1. THINK FIRST — do not try it yet.

You have a 10 cent coin and a 50 cent coin.

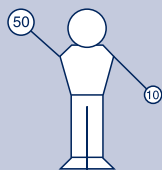
Which picture do you think shows a way to hold the coins before you drop them so they will hit the floor at the same time?

Circle the picture which you think shows the best way.

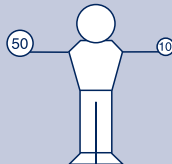
	% responses	
	1999 ('95)	1999 ('95)
	year 4	year 8
✓ same level	76 (65)	49 (43)
50c higher	15 (18)	39 (45)

2. NOW TRY IT.

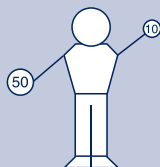
Hold your arms in each of the different ways and drop the coins. Write down which coin hit the floor first.



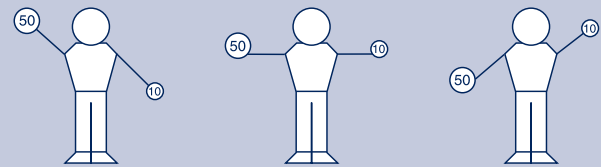
10c first 83 (71) 80 (79)



✓ both together 63 (54) 68 (69)
50c first 22 (22) 17 (17)



50c first 88 (77) 87 (84)



3. Which is the best way to hold your arms so the coins hit the floor at the same time?

Circle the picture which you think shows the best way.

✓ same level 86 (85) 84 (86)

4. What could you do to check your results in question 2?

	% responses	
	1999 ('95)	1999 ('95)
	year 4	year 8
repeat test	50 (51)	61 (58)
have second observer	7 (7)	25 (26)

Commentary:

Surprisingly, about 25 percent more year 4 than year 8 students predicted the result correctly. Year 4 and year 8 students were equally adept at conducting and interpreting the experiments. Results in 1995 and 1999 were very similar for year 8 students, but year 4 students did noticeably better in 1999 than in 1995, on questions 1 & 2.

Trend task

How Does it Work?: Eggtimer

Approach: One to one

Level: Year 4 and year 8

Focus: Explain the operation of measuring instrument and predict the effects of alterations of its components.

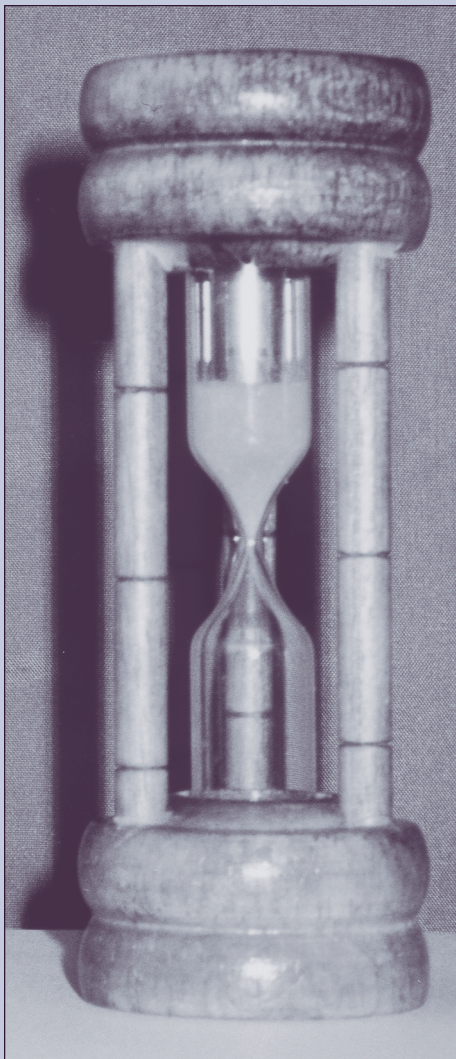
Resources: Household instrument: eggtimer.

Questions/instructions:

In this activity I want you to try to explain how a bit of equipment works.

Give the student the eggtimer.

First of all have a look at this.



		% responses	
		1999 ('95)	1999 ('95)
		year 4	year 8
1. What do people use this piece of equipment for?	not marked		
If the student doesn't know, tell them it is used to show when a certain amount of time has passed.			
2. What is this piece of equipment called?	eggtimer	30 (38)	55 (64)
If the student doesn't know tell them it is an eggtimer.			
3. Can you explain how the eggtimer works?			
<i>When you turn it over the sand runs through, taking a fixed amount of time</i>			
	clear and correct	18 (22)	41 (49)
	limited understanding	63 (72)	53 (49)
4. What would happen if:			
• there was more sand?	longer time	65 (64)	87 (87)
• there was a bigger hole in the middle?	shorter time	85 (93)	97 (97)
• the sand had larger grains?	longer time	29 (25)	48 (41)
	might not go through	64 (63)	58 (56)
• the sand was damp?	stick together and not go through	76 (83)	86 (92)
5. How could you change the egg-timer to make the time longer?			
	more sand	59 (53)	77 (71)
	smaller hole	18 (18)	42 (38)
	larger grains	5 (5)	11 (11)

Commentary:

Students in 1999 appeared less familiar with this form of egg timer than the 1995 students. There was, however, no clear difference between the two years in ability to understand the operation of the timer and implications of changes in its components. Year 8 students scored substantially higher than year 4 students on most questions.

How Does it Work?: Thermometer

Trend task

Approach: One to one

Level: Year 4 and year 8

Focus: Explain the operation of measuring instrument and predict the effects of alterations of its components.

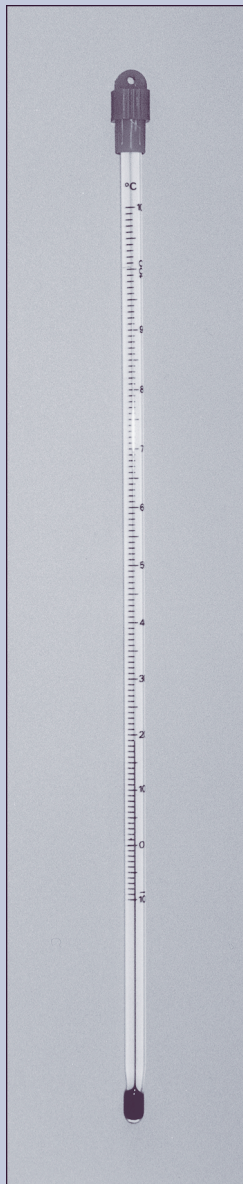
Resources: Scientific instrument: thermometer.

Questions/instructions:

In this activity I want you to try to explain how a bit of equipment works.

Give the student the thermometer.

Now have a look at this.



	% responses	
	1999 ('95) year 4	1999 ('95) year 8
1. What do people use this piece of equipment for? to measure temperature	65 (75)	90 (96)
If the student doesn't know, tell them it is used to find out what the temperature is.		
2. What is this piece of equipment called? thermometer	44 (47)	83 (26)
If the student doesn't know tell them it is a thermometer.		
3. Can you explain how the thermometer works? Rising temperature causes liquid to expand, pushing it along the tubing. clear and correct limited understanding	3 (10) 66 (40)	16 (25) 71 (45)
4. What would happen: • if you put the thermometer in some boiling water? measures 100°C (at sea level) goes to top	8 (8) 57 (66)	29 (29) 43 (55)
• if you put the thermometer in something that is 130°C? breaks goes to top	20 (20) 33 (43)	40 (46) 38 (39)
Point to the appropriate part of the thermometer for the student:		
5. What would happen: • if the hole in the long part of the thermometer was fatter? move less as temperature changed read lower be inaccurate	3 (11) 15 (9) 5 (14)	10 (16) 28 (18) 14 (12)
• if the bulb was made of thicker glass? take longer to register temperature change	7 (20)	29 (46)

Commentary:

Year 8 students performed substantially better than year 4 students. Changes in performance between 1995 and 1999 were mixed, with some improvements and some declines in performance. Overall, there was a small decline in performance.

Trend task

Physical World Questions

Approach: Independent

Level: Year 4 and year 8

Focus: Student knowledge in areas covered by these multiple choice questions.

Resources: None

Questions/instructions:

	% responses	
	1999 ('95) year 4	1999 ('95) year 8
1. A litre of water at a temperature of 30°C is mixed with a litre of water at 50°C. The temperature of the water just after mixing will be about		
a. 20°C	4 (5)	9 (8)
b. 30°C	3 (4)	3 (2)
c. 40°C ✓	11 (14)	20 (21)
d. 50°C	6 (7)	6 (7)
e. 80°C	76 (70)	62 (62)
2. Which makes its own light?		
a. a burning fire ✓	31 (29)	-
b. a red reflector on a bike	14 (15)	-
c. a glass window	6 (5)	-
d. the moon	49 (51)	-

	% responses	
	1999 ('95) year 4	1999 ('95) year 8
3. Blowing or fanning can make a wood fire burn hotter because it		
a. makes the wood hot enough to burn.	21 (18)	3 (4)
b. adds more oxygen needed for burning. ✓	39 (38)	80 (80)
c. gets rid of the smoke more quickly.	12 (10)	5 (3)
d. provides the energy to keep the fire going.	28 (34)	12 (13)

Commentary:

For reasons of economy, a material world question (question 3) has been included here. Results for 1995 students and 1999 students are almost identical. The results for question one are quite remarkable, suggesting that students responded without much thought. Other evidence (see page 30) indicates that they do not really believe warm water mixes with quite hot water to produce very hot water. The responses to question two are also disturbing.

Trend task

Mystery Wires

Approach: Station

Level: Year 4 and year 8

Focus: Use a continuity tester (linked battery and bulb) to test and decide which of 6 wires are connected.

Resources: Continuity tester (linked battery and bulb with alligator clips), cardboard with 6 wires sticking out. (blue and grey wires connected internally, red, cream and yellow wires all connected internally)

Questions/instructions:

In this activity you will be finding out how the wires are connected inside the cardboard.

1. Check that everything on the board is working by touching the 2 loose alligator clips together.

The bulb will go if everything is working. If the bulb does not go, tell the teacher now.

Inside the cardboard some of the wires are joined to other wires. Each wire might be joined to 1 other, 2 others, or no others.

Use the board with the battery and bulb to find out which wires are connected.

2. Draw lines on the diagram below to show which wires are connected.

	% responses	
	1999 ('95) year 4	1999 ('95) year 8
green wire not connected to any other	78 (76)	84 (85)
blue and grey wires connected to each other only	59 (51)	69 (71)
red, yellow and cream wires all connected to each other and no others	50 (44)	65 (68)

Commentary:

Year 8 students did better than year 4 students, particularly on the more complex components of the task. There was little difference in performance from 1995 to 1999 for year 8 students, but a small improvement for year 4 students.

Water Mix

Trend task

Approach: One to one

Level: Year 4

Focus: Use a thermometer to record water temperatures and mix hot and cold water to achieve a specified temperature range.

Resources: Thermometer, 3 glasses, cold water, hot water (around 50–55°C), note paper.

Questions/instructions:

Pour about 4 cm of cold water into one glass, and about 4 cm of hot water into another.

In this activity you are going to use a thermometer to measure the temperature of some cold water and some hot water. After that, I am going to ask you to mix cold water and hot water together to get a different water temperature.

1. First I want you to measure the temperature of the COLD water in this glass.

Have you used a thermometer before?

If the student says “yes” then allow them to proceed.

If the student says “no”

Prompt: Can you figure out how it works?

If the student cannot figure it out, show them how to use it, demonstrating with the cold water, then ask the student to repeat that measurement.

Fold open the recording book to the results sheet and give to student.

Now write the measurement on your results sheet.

Check the actual temperature and make a private note.

Record alongside the student’s record after the student has finished, so that they do not see the teachers’ measurements.

cold water temperature accurately recorded 78 (86)

2. Now measure the temperature of the HOT water, and write the measurement on your results sheet.

accurately recorded 75 (89)

3. Now I want you to think about how you could mix together some of the cold water and some of the hot water to make water that is at a different temperature. I want you to try to mix the water so that it is between 30°C and 35°C.

Water mix	Teacher measurements here	
Results sheet		
Temperature of the COLD water	<input type="text"/>	<input type="text"/>
Temperature of the HOT water	<input type="text"/>	<input type="text"/>
Temperature of the MIXED water	<input type="text"/>	<input type="text"/>

Try to do that now. Mix together some of the cold water and some of the hot water so that you will have water at a temperature between 30° and 35°C.

Allow time for the student to do the mixing.

mixed water: between 30°C and 35°C 73 (74)
between 24°C–29°C or 36°C–42°C 19 (24)

4. Now write down the temperature of your water on your results sheet.

Check the actual temperature and record this and your earlier measurement alongside the student’s record.

recorded accurately 83 (89)

% responses
1999 ('95)
year 4

% responses
1999 ('95)
year 4

Commentary:

The 1999 students were somewhat less able than the 1995 students to measure temperatures.

Trend task

Truck Track

Approach: Team

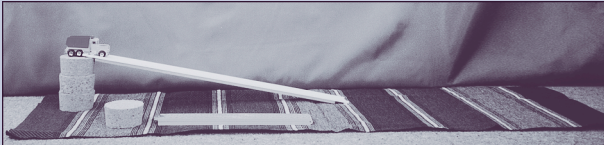
Level: Year 4

Focus: Plan, carry out and report results for an experiment involving a toy truck launched down a ramp with varying slope. Extrapolate results, check and interpret.

Resources: Toy truck, track, cloth, 5 corks (1 hidden), 1 metre folding ruler, instruction card.

Questions/instructions:

Set up the cloth and track on a level surface, with the far end of the track raised on three corks. Place the 4th cork nearby, and the ruler (folded) alongside the cloth. Keep the 5th cork out of sight.



In this activity you are going to find out how the slope of this ramp affects how far the truck will travel on the cloth after it rolls down the ramp. You will need to use the ruler to measure how far the truck goes. You will use one, two, three or four corks under the end of the track, to make the slope more steep or less steep. At the moment there are three corks under the track, so it is quite steep. For each slope, you should make measurements with the truck going forward and other measurements with the truck going backward. Perhaps it will make a difference whether it is going forward or backward. Let me show you once how the truck goes.

Show the truck going down the ramp once, forwards. Then pick up the truck and hold it while you give the next instructions, and while the team does its planning.

You are to work as a team, and try to make sure that everyone helps. First, you should plan how you will do the experiment. Think about what things you will need to keep the same. Think about how you will do the measurements. Sort out who is going to do the measurements and who will do the other jobs. Everyone should have a job. You may want to change jobs half way through, so you each try two jobs.

Plan your experiment now, and tell me when you have finished your planning.

Planning to achieve:

	<i>% responses</i> 1999 ('95) year 4
consistent set-up and release of truck	11 (0)
accurate measurement of travel	29 (27)
check on consistency by replicating	0 (0)
requested member participation	96 (90)

Instruction card

- Your task is to find out:
 - how the slope of the ramp affects how far the truck travels
 - whether the truck goes further forwards or backwards.
- Think about how you will do the experiment.
 - What will you keep the same?
 - How will you do the measurements?
- You are to work as a team and make sure that everyone helps.
- Record your measurements on the results sheet.

Results

Number of corks	Distance going forwards	Distance going backwards
1		
2		
3		
4		
5		

After they have finished planning, give the group the truck and results sheet.

Here is the truck, and a sheet to record your results on. You can do your experiment now. Tell me when you have finished and recorded all your results.

After they have finished experimenting:

What did you find out in your experiment?

Prompts: How does the slope affect how far the truck goes? Does it make any difference whether the truck travels backwards or forwards? [If they think it does, ask "Can you figure out why?"]

Could you have done anything to make your results more accurate? What?

Experimentation:

good consistency in release of truck	72 (73)
good accuracy in measurement	54 (43)
included replication consistently	6 (3)
completed all combinations of slope and truck orientations	81 (73)
recorded results accurately	35 (30)

Reporting:

clear and accurate	42 (43)
rather "fuzzy"	48 (47)
very unclear or inaccurate	10 (10)

What do you think would happen with five corks? Make a prediction and tell me why you think that.

After discussion, give them the 5th cork:

Test with this fifth cork, and see if you were right.

Predictions & discussions: very good	32 (28)
moderate	55 (62)
poor	13 (10)

Commentary:

Teams of students in both 1995 and 1999 showed quite limited ability to anticipate issues during planning. Replication was almost non-existent — a serious fault in scientific investigations. Measurement and recording of results were other weaknesses. Overall, there is evidence of some improvement between 1995 and 1999.

Ball Bounce

Trend task

Approach: Team

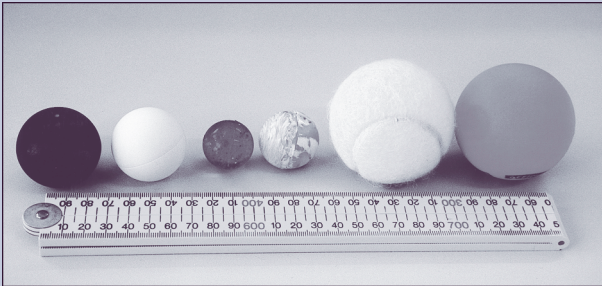
Level: Year 8

Focus: Plan, carry out and report results for an experiment involving measuring the bounciness of balls. Extrapolate results, check and interpret.

Resources: Tennis ball (yellow), small rubber ball, rubber ball (mottled), soft foam ball (pink), table tennis ball (white), squash ball (black), 1 metre folding ruler, activity card, results sheet.

Questions/instructions:

Get out 5 balls, keeping the black ball separate. Soon I will give you these five different balls.



Your task is to work out a way to compare how bouncy the different balls are. You should take some measurements for each ball, so that you can use numbers to say how bouncy the balls are. Some of the balls bounce almost the same. You will have to measure carefully to put them in the right order, from least bouncy to most bouncy. You are to do your experiments on top of the table, in front of the camera. You are to work as a team, and try to make sure that everyone helps.

Activity card

- Your task is to find a way to compare how bouncy the different balls are.
- Think about how you will do the experiment.
 - What will you keep the same?
 - What will you measure?
 - How will you use numbers to say how bouncy the balls are?
- You are to work as a team, and try to make sure that everyone helps.
- Record your measurements on the results sheet.

First, you should plan how you will do the experiment. Think about what things you will need to keep the same. Think about what you will need to measure. Think about how you will use numbers to say how bouncy each ball is. Sort out who is going to do the measurements and who will do the other jobs. Everyone should have a job. Here is your main tool.

Give the students the ruler.

Plan your experiment now, and tell me when you have finished your planning.

Planning to achieve:

consistent height and release of balls	73 (73)
accurate measurement of bounce	68 (73)
check on consistency by replicating	5 (13)
requested member participation	94 (77)

% responses
1999 ('95)
year 8

After they have finished planning give the group the 5 balls — excluding the black squash ball.

Here are the five balls, and a sheet to record numbers for how bouncy each ball is. You can do your experiment now. Tell me when you have finished and recorded all your results.

Results sheet

Yellow tennis ball	
White table tennis ball	
Small ball	
Soft pink ball	
Mottled ball	

After they have finished experimenting:

What did you find out in your experiment? Put the balls in order, from most bouncy to least bouncy.

Are you sure that you have the two least bouncy balls in the right order? Show me by trying the balls again.

Record order of balls on their results sheet from 1 (most) to 5 (least).

Experimentation:

good consistency in release of balls	56 (67)
good accuracy in measurement	33 (37)
included replication consistently	19 (20)
recorded results accurately	52 (40)

Reporting:

clear and accurate	49 (46)
rather "fuzzy"	42 (46)
very unclear or inaccurate	9 (7)

Here is another ball.

Give the students the black ball.

How high do you think this one will bounce? Make a prediction and tell me why you think that.

Predictions and discussions:

very good	33 (37)
moderate	56 (52)
poor	11 (11)

After discussion:

Test the ball and see if you were right.

% responses
1999 ('95)
year 8

Commentary:

Apart from replication, most teams of students included important issues in their planning for the experiment. Only 20 percent checked their measurements by replication. Measurements and recording were also not done particularly well. Overall, the results for 1995 and 1999 are very similar, despite some fluctuations on individual factors.

Dead Mouse

Approach: One to one

Level: Year 4 and year 8

Focus: Identify and explain the application of a lever to shift a heavy object, and choose a suitable arrangement from three options.

Resources: Video

Questions/instructions:

Note: Do not allow student to see recording book until Question 3.

This activity starts with a video about a woman who has a problem at home. Let's watch the video.

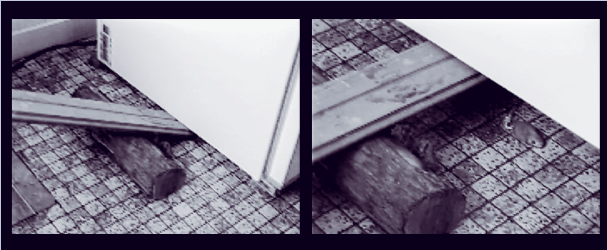
Play video clip one.



- In the video the woman discovered a dead mouse under the fridge. It's a big old fridge that doesn't have wheels. The fridge is too heavy for her to lift by herself and there's nobody around to help her. What could she use to help her lift the fridge?

not marked

Play video clip two.



- The woman used two pieces of wood to lift the fridge. Explain to me how the wood helped her lift it.

Prompt: Why was it easier when she used the pieces of wood?

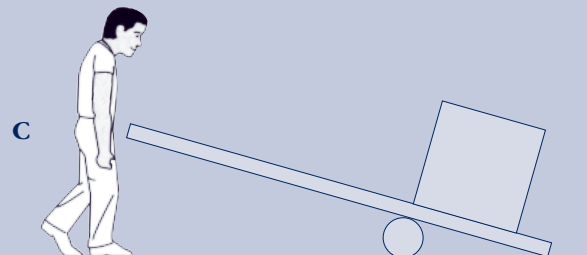
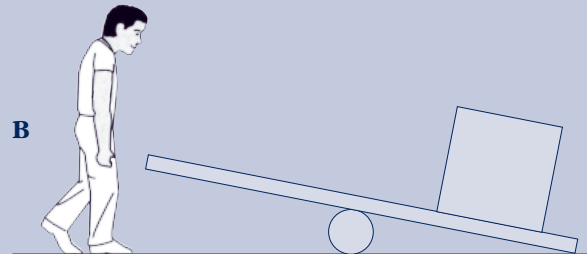
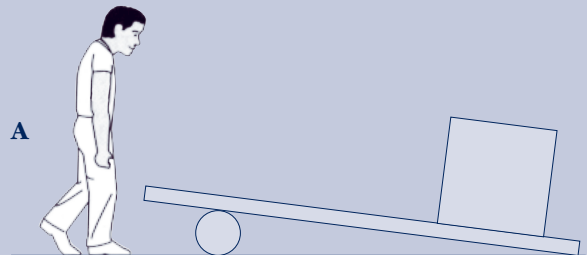
*small force at long end can exert
bigger force at shorter end:*

clear and adequately full explanation	3	21
on right track but vague	38	46

% responses
y4 y8

Show the student the last page of the recording book.

- Here are some pictures that show pieces of wood being used to lift a heavy box. Which picture shows the best way to lift the heavy box?



- Why is that the best way to lift the weight?

clearly understood principle of the ratio of two lever arms	3	14
dealt only with part of lever person was touching (longer = better)	13	19

% responses
y4 y8

picture: A	7	2
B	48	57
C	45	41

Commentary:

Questions three and four proved not very satisfactory, because picture C showed the heavy object so far onto the lever and close to the fulcrum that it would have needed to be lifted directly. For this reason some well-informed students chose picture B. Overall, the results show useful progress between year 4 and year 8.

Flowing Electricity

Approach: One to one

Level: Year 4 and year 8

Focus: Exploring knowledge about the electrical conductivity of different materials, and skills in using a simple electrical circuit to check conductivity.

Resources: Conductivity checker —circuit board, bulb, battery and leads; materials— spoon, key, iceblock stick, foil muffin dish, foil paper, plastic car, plastic ruler.

Questions/instructions:

Set up table with circuit board and other supplies.



In this activity you will be finding out what materials electricity can flow through.

1. Before we begin to test some of the materials I want to know what you think. Which of the materials on the table could electricity flow through?

% responses
y4 y8

Predictions:

Tick in the box what you think will happen.					
Lets electricity flow through?	yes	no	maybe	y4	y8
spoon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	70	85
ruler	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	70	78
iceblock stick	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	77	83
plastic car	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	68	80
key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	78	85
foil muffin dish	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	64	66
foil paper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	64	74

Before we test the objects let's check the circuit board and see if the bulb will work.

Check the circuit board with the student.

Now let's test the objects. Join an alligator clip to each end of the object. Make sure the alligator clips don't touch each other.

2. Test each object to find out if they let electricity flow through them. Tell me and I'll record your answer.

Fold open the recording book for the student to see.

Measurements:

Tick the boxes to show what happened.			<i>% responses</i>	
Lets electricity flow through?	yes	no	y4	y8
spoon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	100	100
ruler	<input type="checkbox"/>	<input checked="" type="checkbox"/>	98	98
iceblock stick	<input type="checkbox"/>	<input checked="" type="checkbox"/>	99	99
plastic car	<input type="checkbox"/>	<input checked="" type="checkbox"/>	98	99
key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	97	96
foil muffin dish	<input checked="" type="checkbox"/>	<input type="checkbox"/>	97	99
foil paper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	98	99

3. See if you can tell me the name of something else that electricity can flow through.

What is it made of?

identified a conductor 85 89

4. Now try to think of something that electricity can't flow through.

What is it made of?

identified a non-conductor 95 97

5. Electricity can travel through some things but not others. Try to tell me what is special about things that electricity can travel through.

used term "conductors" or "conducts" 2 13

suggested metals conduct 48 63

identified that in these materials electrons can move freely to carry electricity 0 2

Commentary:

Both year 4 and year 8 students were reasonably knowledgeable about the electrical conductivity of different materials. About eight percent more year 8 students answered correctly, on average. Almost all student tested materials successfully.

String Ping

Approach: One to one

Level: Year 4 and year 8

Focus: Predict, demonstrate and report the influence of the length and tension of a vibrating string on the sound produced.

Resources: Spoon with piece of string attached, video showing how to use this apparatus to make sounds.

Questions/instructions:

Put the spoon and string on the table.

In this activity you are going to use a spoon and a piece of string to make different sounds. Let's watch the video to see what to do.

Play video.

Before you try the activity I will ask you some questions.

- | | | |
|--|-------------|----|
| 1. What might happen to the sound when the length of the string is changed? | % responses | |
| | y4 | y8 |
| <i>Prompt: How might the length of the string change the sound?</i> | | |
| longer string → lower pitch | 19 | 34 |
| length affects pitch in unspecified way | 30 | 28 |
| 2. What might happen to the sound when the tightness of the string is changed? | | |
| <i>Prompt: In what way might the sound change?</i> | | |
| no sound at all when string is loose | 39 | 40 |
| tighter string → higher pitch | 10 | 20 |
| tightness affects pitch in unspecified way | 11 | 13 |

Let's try these things. Start by holding the spoon to your ear. What happens when you make the string shorter and then longer?

Allow time.



- | | | |
|---|-------------|----|
| 3. What did you notice about the sound as the length of the string was changed? | % responses | |
| | y4 | y8 |
| <i>Prompt: Why do you think the sound was different?</i> | | |
| longer string → lower pitch | 28 | 53 |
| length affects pitch in unspecified way | 28 | 21 |

Prompt: Why do you think the sound was different?

longer string → lower pitch

length affects pitch in unspecified way

Now try making the string looser and the tighter.

Allow time.



- | | | |
|--|-------------|----|
| 4. What did you notice about the sound as the tightness of the string was changed? | % responses | |
| | y4 | y8 |
| <i>Prompt: Why do you think the sound was different?</i> | | |
| no sound at all when string is loose | 68 | 65 |
| tighter string → higher pitch | 11 | 22 |
| tightness affects pitch in unspecified way | 9 | 9 |

Prompt: Why do you think the sound was different?

no sound at all when string is loose

tighter string → higher pitch

tightness affects pitch in unspecified way

Commentary:

There were two difficulties with this task. Holding a spoon alongside an ear was seen as inappropriate by a few Māori children, and the video demonstration showed the string loose for the start of question 4. These limit the usefulness of the results, but year 8 students clearly understood the key relationship somewhat better than year 4 students.

Marbles in Water

Approach: One to one

Level: Year 4 and year 8

Focus: Account for the rise in water level in a container when an object or objects are added, in terms of water being displaced.

Resources: 100ml jug, water, 1 small marble, water, 2 large marbles.

<i>Questions/instructions:</i>	<i>% responses</i>			<i>% responses</i>	
	<i>y4</i>	<i>y8</i>		<i>y4</i>	<i>y8</i>
In this activity you are going to do an experiment with some water in a jug and some marbles.			4. Why do you say that?		
			no water added or removed (just displaced)	38	61
Give student equipment. Pour 80mls of water into the jug.			5. If you were to put one more large marble into the jug what would happen to the water?		
Here's the jug. You can see that it has 80mls of water in it.			increase by about 15ml	13	15
Show student 80ml level mark.			increase (unspecified)	80	82
1. What might happen to the water if you put one large marble into the jug?			6. What about the little marble? What do you think will happen when you put it into the water?		
water level would increase	83	95	increase smaller amount	41	51
Now put one large marble into the water. Watch what happens to the water.			7. You can try it out. What do you notice?		
2. Read the scale on the side of the jug. What is the level of the water on the scale now?			not scored		
reads increase of about 15mls	83	83	8. What would happen if you took out all the marbles?		
3. Is there more, less or the same amount of water in the jug compared with before?			return to original level	90	89
same amount	32	66	go down	9	10

Commentary:

Both year 4 and year 8 students were generally able to predict the rises and falls in water level as marbles were added or removed. In question 3, year 8 students were much more aware that the amount of water did not change when marbles were added, but the results of question 8 suggest that year 4 students understood that removal of all objects would restore the original water level.

Travelling Trucks

Approach: One to one

Level: Year 4

Focus: Sort magnetic and non-magnetic objects based on prior experience and practical investigation and try to generalise.

Resources: Toy truck, magnet, bag of objects.

Questions/instructions:

Some of the things in this bag are attracted to the magnet. When they are put in the truck, the truck can be pulled along with the magnet.



1. First I want you to look at all the things in the bag and put them into two groups. In one group put the things you think will be attracted to the magnet. In the other group put the things you think will not be attracted to the magnet.

% responses
y4

Give student the bag of objects. Allow time.

	Prediction	Observation	
wood	no		98
iron bolt	yes		97
plastic	no		91
steel key	yes		97
aluminium key	no		9
rubber	no		92
steel wool	yes		47
aluminium foil	no		54
stone	no		89

Now you can try the things and see what happens.

2. Put each of the things in the back of the truck and see if the magnet can tow the truck along.

Give student the magnet. Allow time.

% responses
y4

	Prediction	Observation	
wood		no	99
iron bolt		yes	98
plastic		no	98
steel key		yes	97
aluminium key		no	95
rubber		no	99
steel wool		yes	94
aluminium foil		no	98
stone		no	98

3. Now I want you to think of one more thing that would be attracted to the magnet.

Tell me what it is and what it is made of.

Prompt: What kind of metal?

new magnetic object identified 76

4. Now I want you to think of one more thing that would not be attracted to the magnet. Tell me what it is and what it is made of.

new non-magnetic object identified 89

5. Some things attract to magnets and some things don't. I want you to try to tell me a rule which explains what kind of things are attracted to magnets.

not marked

Commentary:

Year 4 students were very successful in testing the objects. In their earlier predictions, the steel wool and the aluminium objects produced the least successful predictions.

Mixing Colour

Approach: Station

Level: Year 4

Focus: Using the primary colours plus black and white, investigate and report on paint mixtures needed to generate four specified new colours and shades.

Resources: Mixing paper, water in cup, 5 tubes of paint, sponge, brush.

Questions/instructions:

Note: Students should be supplied with a damp sponge in the plastic cup.

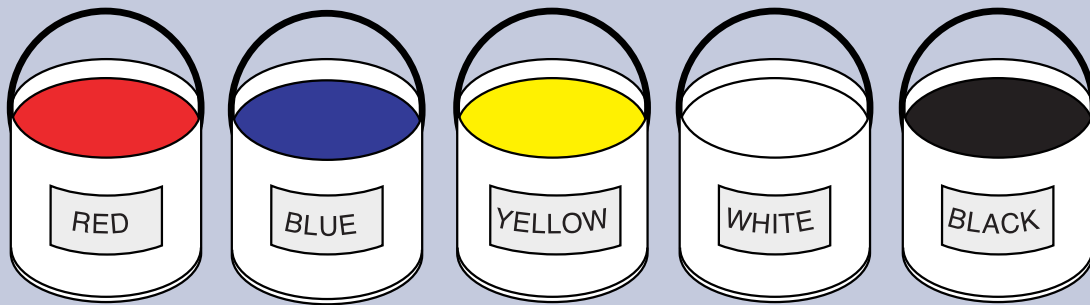
Do not provide the student with water – YOU keep the water to clean the brush etc., when necessary.

Sometimes people mix colours to make other colours.

You have 5 colours of paints.

You are going to try to make 4 new colours.

You need to think about which paints to mix together for each colour.



1. Try to make the colours named in the circles. Mix paints in the circles on your mixing paper.

2. On the answer sheet write down the names of the colours you mixed together to make the colours in the cans.

to make green: blue and yellow only	76
to make orange: red and yellow only	80
to make pink: red and white only	88
to make dark blue: blue and black only	59

% responses
y4

Mixing Paper

Mix paint inside the circles.

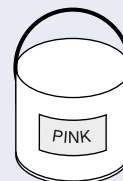
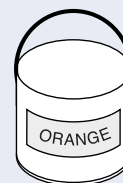
Use **small** amounts of paint.



Recording Sheet

Write the names of the colours you mixed together to make the colours in the cans.

Write the colours in the cans.



Commentary:

More than three quarters of the year 4 students succeeded with the first three colour blends. Dark blue proved more challenging.

Wonderful Water

Approach: Independent

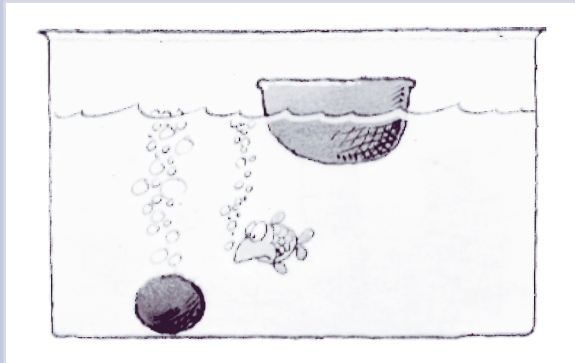
Level: Year 8

Focus: Explain buoyancy and flotation in three situations.

Resources: None

Questions/instructions:

Look at the pictures then answer the questions.



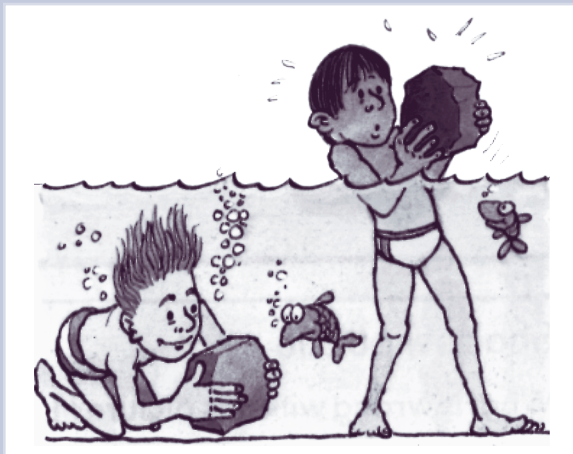
1. Imagine that you have a ball of plasticine. You put it in water and it sinks. Then you shape it into a boat. Now it floats. Why did the ball of plasticine sink but the boat float?

- | | |
|--|----|
| boat shape displaces enough water to hold weight of plasticine | 0 |
| more spread out so it floats/ water holds it up there | 8 |
| because there is air inside it. | 26 |



3. Someone holds the ball at the bottom. Why does it jump out of the water when they let it go?

- | | |
|--|----|
| Under the water: | |
| ball weighs less than the water displaced | 2 |
| air in the ball makes it rise | 33 |
| Above the water: | |
| ball moves upward because of inertia | 0 |
| ball is going fast when it reaches the surface | 3 |



2. Why do things feel lighter when you pick them up under water?

- | | |
|--|----|
| some of the weight is supported by the water displaced | 5 |
| because water is less dense than air | 3 |
| there is less or no gravity under water | 22 |

Commentary:

The concepts involved in these situations were beyond the reach or experience of almost all year 8 students.

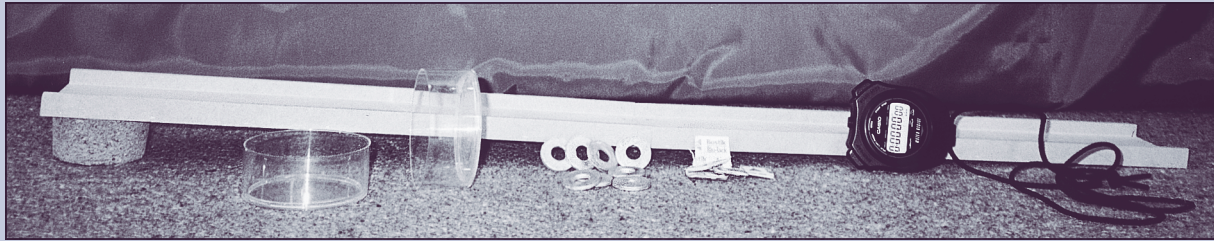
Wheel Race

Approach: Team

Level: Year 8 only

Focus: Co-operatively plan, carry out and report on an experiment involving the effects of mass and rotational inertia on the acceleration of a wheel.

Resources: 2 wheel cases, 8 washers, 2cm blutak, test track, cork, red pen, blue pen, large paper (for planning), stop watch, instruction card.



Questions/instructions:

I want you to imagine that you are a team of scientists who design wheels. You are to experiment and conduct tests with different kinds of wheels to find one that will gain speed most easily. You will need to think about the weight of the wheels. You also need to think about how you can arrange the washers inside the wheels. The washers act as weights. To help you with your work, you have two containers that can act as wheels, 8 washers that can be used as weights in the wheels, some blutak for joining and arranging washers in the wheels, a cork and a test track for checking the speed of the wheels that you design. A stop watch is also available if you want to use it.

Show students each of the supplies, but don't give them out yet.

So that everyone takes part in the reporting, I'm going to ask [name students 1 and 2] to report to me on what you did, later I'll ask [name students 3 and 4] to tell me your results and the best way to make a wheel that gains speed most easily. You can have a couple of minutes now to talk about what you will say in your explanations to me. This card describes the three things your team is asked to do.

Place the card for all students to see, then read it to the team.

Give the planning sheet and the blue pen to the students. Teacher withdraws, and allows students time to plan their explanations.



Wheel Race

Team Instructions

Your job is to design a wheel that will gain speed most easily. You will use very small bits of blutak to join and arrange the washers in the wheels. Follow steps 1-5

1. Work together as a team so the **everyone** is taking part.
2. **Talk about how** you will do your experiment. Agree on a plan.
3. **Write down your plan** and the planning sheet. Use a blue pen.
— Tell your plan to the teacher —
4. **Try out your plan** and do the experiment. If you make changes to the plan, use the **red pen**.
5. Talk about your results:
 - a. How good was your plan?
Are there ways that it could be improved?
 - b. What is the best way to make a wheel that gains speed most easily?

[Name students 1 and 2] I want you to tell me the plan of your experiment. The others can help with the explanations if that would be helpful.

Allow time.

Planning:

to try different arrangements of washers to achieve consistent set up and release of wheel on ramp to achieve accurate measurement of speed/time to check consistency by replication to involve all students

Report on planning:

clear, accurate, full reasonably clear, accurate

% responses
y8

y8

44

7

19

4

56

9

54

You have 10 minutes to work through your experiment. If you make changes, use the red pen to write these down on your planning sheet. After that I will ask you to report to me on what you did, to tell me your results, and to explain what is the best way to make a wheel that gains speed most easily. Use all of your time well, so that you get the best results.

Give students the equipment. Take in the blue pen and give students the red pen. Allow 10 minutes for the experiment.

[Name students 3 and 4]: I want you to tell me your results and to explain the best way to make a wheel that is fast at picking up speed. The others can help with the explanations if that would be helpful.

Experimentation:

tried several different arrangements of washers systematically set up and released wheel consistently measured speed/time carefully included replication of most/all trials high participation

Report on experiments:

clear, accurate, full reasonably clear and accurate

% responses

y8

31

25

25

22

60

2

24

Commentary:

The apparatus for this task was not easy to use, which perhaps accounts for the modest proportions of teams who achieved high standards in the different aspects of experimentation. Important aspects were often not considered in the planning.

Link Tasks 9-12

LINK TASK 9

Approach: One to one
Level: Year 4 and year 8
Focus: Motion
Resources: Not revealed

	% responses	
	y4	y8
observation	85	96
explanation	30	56
observation	95	87
explanation	16	30
observation	97	98
explanation	28	51
observation	38	38
explanation	56	82

Commentary:

Students were generally more successful with observations than with explanation. Year 8 students were much more successful than year 4 students with explanations.

LINK TASK 10

Approach: One to one
Level: Year 4 and year 8
Focus: Sound
Resources: Not revealed

	% responses	
	y4	y8
observation	47	74
explanation	88	96
prediction	46	62
observation	36	52
explanation	31	49
explanation	47	67

LINK TASK 11

Approach: One to one
Level: Year 4 and year 8
Focus: Magnetism
Resources: Not revealed

	% responses	
	y4	y8
prediction	27	64
prediction	48	73
observation	98	98
observation	99	99
generalisation	85	87
observation	60	70
prediction	31	28

LINK TASK 12

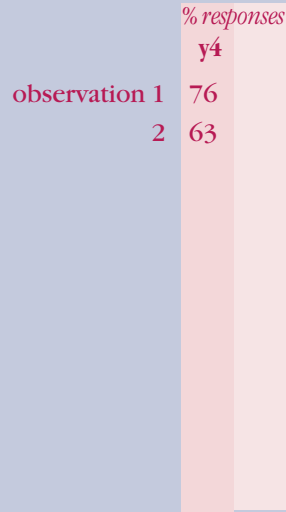
Approach: One to one
Level: Year 4 and year 8
Focus: Electricity
Resources: Not revealed

	% responses	
	y4	y8
practical task	63	79
explanation	23	33
explanation	33	41
explanation	2	5
explanation	58	55
explanation	30	43

Link tasks 13-16

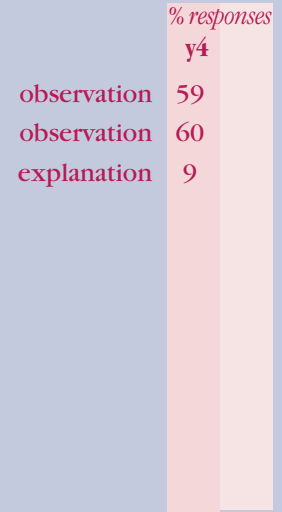
LINK TASK 13

Approach: Station
Level: Year 4
Focus: Electricity
Resources: Not revealed



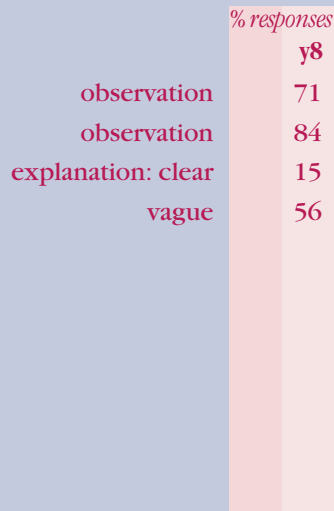
LINK TASK 14

Approach: One to one
Level: Year 4
Focus: Light
Resources: Not revealed



LINK TASK 15

Approach: Station
Level: Year 8
Focus: Motion
Resources: Not revealed



LINK TASK 16

Approach: One to one
Level: Year 8
Focus: Motion
Resources: Not revealed

