Science

WORK SAMPLE PORTFOLIOS

These work sample portfolios have been designed to illustrate satisfactory achievement in the relevant aspects of the achievement standard.

The December 2011 work sample portfolios are a resource to support planning and implementation of the Foundation to Year 10 Australian Curriculum in English, Mathematics, Science and History during 2012. They comprise collections of different students' work annotated to highlight evidence of student learning of different aspects of the achievement standard.

The work samples vary in terms of how much time was available to complete the task or the degree of scaffolding provided by the teacher.

There is no pre-determined number of samples required in a portfolio nor are the work samples sequenced in any particular order. These initial work sample portfolios do not constitute a complete set of work samples - they provide evidence of most (but not necessarily all) aspects of the achievement standard.

As the Australian Curriculum in English, Mathematics, Science and History is implemented by schools in 2012, the work sample portfolios will be reviewed and enhanced by drawing on classroom practice and will reflect a more systematic collection of evidence from teaching and learning programs.

THIS PORTFOLIO – YEAR 10 SCIENCE

This portfolio comprises a number of work samples drawn from a range of assessment tasks, namely:

Sample 1	Research summary – The periodic table
Sample 2	Investigation report – Energy conservation
Sample 3	Data analysis – Acceleration
Sample 4	Investigation report – Nutrient cycling
Sample 5	Text response – Human genome
Sample 6	Cartoon – Evolution
Sample 7	Investigation Report – Cut flower preservatives
Sample 8	Investigation Report – Reaction rates

In this portfolio, the student explains how the periodic table organises elements (WS1), and how different factors influence the rate of reaction (WS8). The student explains the concept of energy conservation, representing energy transfer and transformation within a simple pendulum system (WS2) and applies relationships between force, mass and acceleration to predict changes in the motion of objects (WS3). The student describes interactions between Earth's spheres in the context of global nutrient cycling (WS4) and examines the evidence for the theory of evolution by natural selection as an explanation of the diversity of life on Earth (WS6). The student explains the processes that underpin heredity (WS5) and evolution (WS6) and considers how the periodic table, a key model in chemistry, developed over time (WS1).

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The student demonstrates the ability to develop questions and hypotheses for investigation (WS7) and independently designs and improves appropriate methods of investigation (WS3, WS7, WS8), explaining how reliability and fairness were considered (WS2, WS3, WS7, WS8) and identifying where digital technologies could improve the quality of the data (WS2, WS3). The student analyses data, selects evidence and justifies conclusions with reference to areas of uncertainty (WS3, WS7, WS8) and evaluates the validity of claims made in secondary sources with reference to current scientific views (WS4, WS5). The student constructs evidence based arguments (WS4, WS7) and selects appropriate representations and text types to communicate science ideas for specific purposes and to specific audiences (WS4, WS6, WS7).

The following aspects of the achievement standard are not evident in this portfolio:

- *use the periodic table to make predictions about the properties of elements*
- *explain how chemical reactions are used to produce particular products*
- *explain how they considered safety and ethical actions in their methods*
- *identify alternative explanations for findings*
- *evaluate claims with reference to the quality of methodology and the evidence cited.*

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Work sample 1:
Research summary – The periodic table

Relevant parts of the achievement standard

By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.

Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.

Summary of task

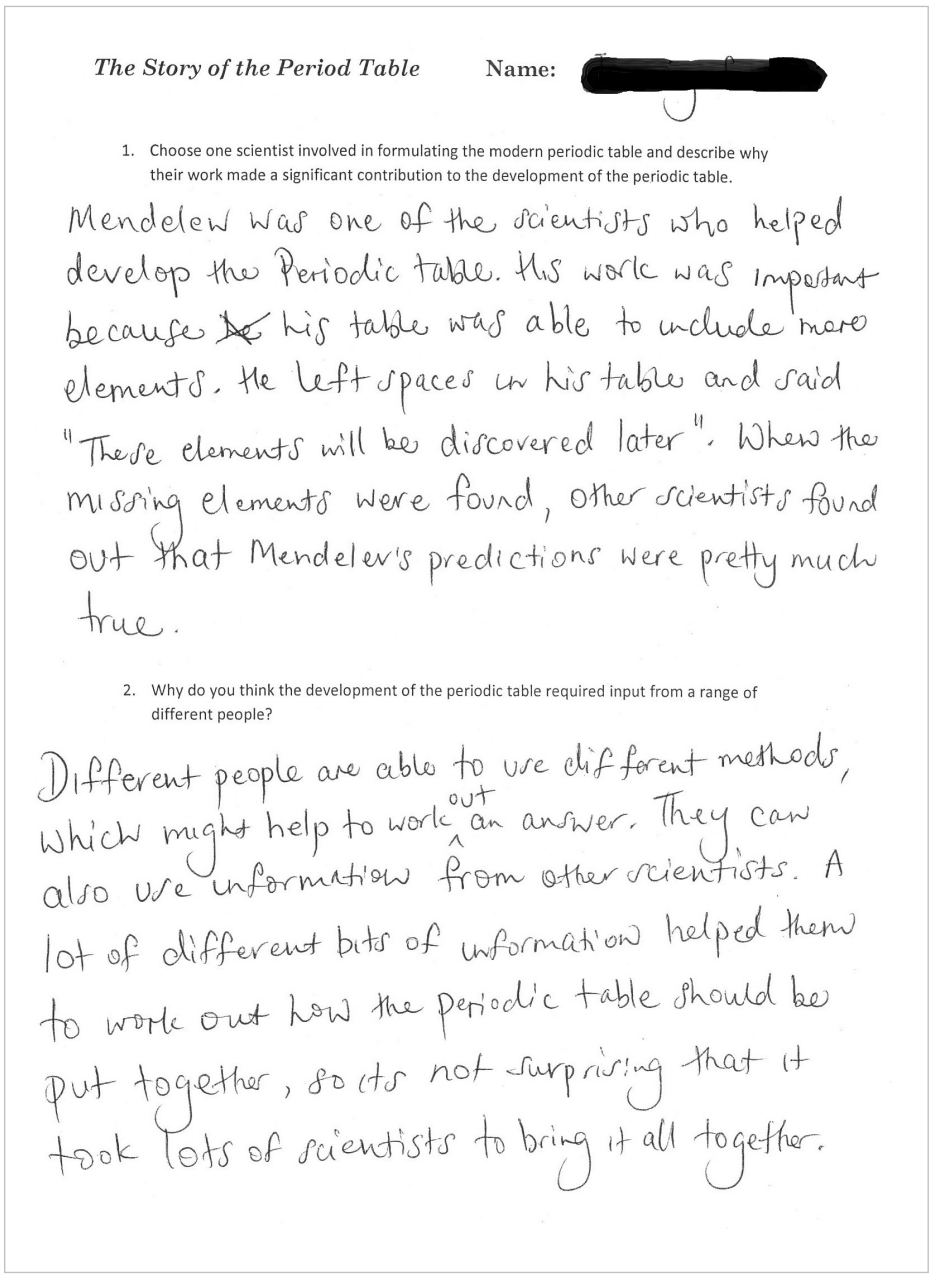
Students had been given a research task on the periodic table, with the following key inquiry questions:

- Why do we need to organise elements?
- How have different models of the periodic table developed over time?
- Which scientists have made major contributions to the development of the periodic table?
- Is the periodic table likely to change in the future?

Students were then set an in-class assignment, taken under test conditions where a range of questions based on their assignments were asked. Answers to the first four questions are shown here.

Science

Work sample 1:
Research summary – The periodic table



The Story of the Period Table Name: [redacted]

1. Choose one scientist involved in formulating the modern periodic table and describe why their work made a significant contribution to the development of the periodic table.

Mendelew was one of the scientists who helped develop the Periodic table. His work was important because ~~he~~ his table was able to include more elements. He left spaces in his table and said "These elements will be discovered later". When the missing elements were found, other scientists found out that Mendelev's predictions were pretty much true.

2. Why do you think the development of the periodic table required input from a range of different people?

Different people are able to use different methods, which might help to work out an answer. They can also use information from other scientists. A lot of different bits of information helped them to work out how the periodic table should be put together, so it's not surprising that it took lots of scientists to bring it all together.

Annotations

Identifies that the model of the periodic table proposed by Mendelee allowed for the discovery of new elements in the future.

Identifies that models change when new information is available, i.e. that the missing elements were found.

Describes, in simple terms, that scientists might work in different ways and that a discovery may depend on a range of sources of information.

Science

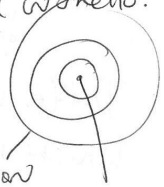
Work sample 1:
Research summary – The periodic table

3. How did improvements in technology influence the development of the periodic table?

Chemists discovered better techniques for separating elements. This meant that gradually, more elements were discovered. Also, when X-rays were discovered these were used to find out more about the structure of atoms and this info was used to check the position of atoms in the Periodic table.

4. Briefly describe information we now have about atoms that was not available to earlier scientists who were identifying patterns and trends within early versions of the period table. What trends could they see, compared to what we now know?

We now know more about atoms of each element. We know their atomic mass and how many electrons, protons and neutrons they have.
We know that electrons are organised in shells.



Trends Mendeleev and co. could see	Trends we can see
• groups with similar properties (columns) • increasing atomic weight across rows	• increasing atomic number across the row (how many protons in each atom) • electron shells say how many in each row • groups with similar properties

The big difference is what we now know about protons and electron shells.

Annotations

Identifies that developments in technology can lead to the revision of previous assumptions on the basis of new evidence.

Identifies that the periodic table organises elements in accordance with the electronic structure of the atom and the properties of elements.

Acknowledgment
ACARA acknowledges the contribution of trial school teachers and students for providing the tasks and work samples. The annotations are referenced to the Australian Curriculum achievement standards.

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Work sample 2:
Investigation report – Energy conservation

Relevant parts of the achievement standard

By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.

Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.

Summary of task

Students were part way through a unit on motion. They had encountered the ideas of acceleration, including acceleration due to gravity. They were familiar with the concepts of kinetic energy and gravitational potential energy.

Students were asked to independently conduct an investigation to consider energy changes involved in a swinging pendulum. They were provided with the method and the formula to calculate gravitational potential energy (GPE) and were asked to:

- draw a diagram showing how the energy of the pendulum changes as it swings
- calculate the GPE of the pendulum at the start of the experiment; after one swing; after 10 swings
- explain their results with reference to the Law of Conservation of Energy
- discuss the efficiency of the pendulum
- identify sources of uncertainty and suggest improvements.

Students completed the experiment in class and then developed a final draft of the report out of class time.

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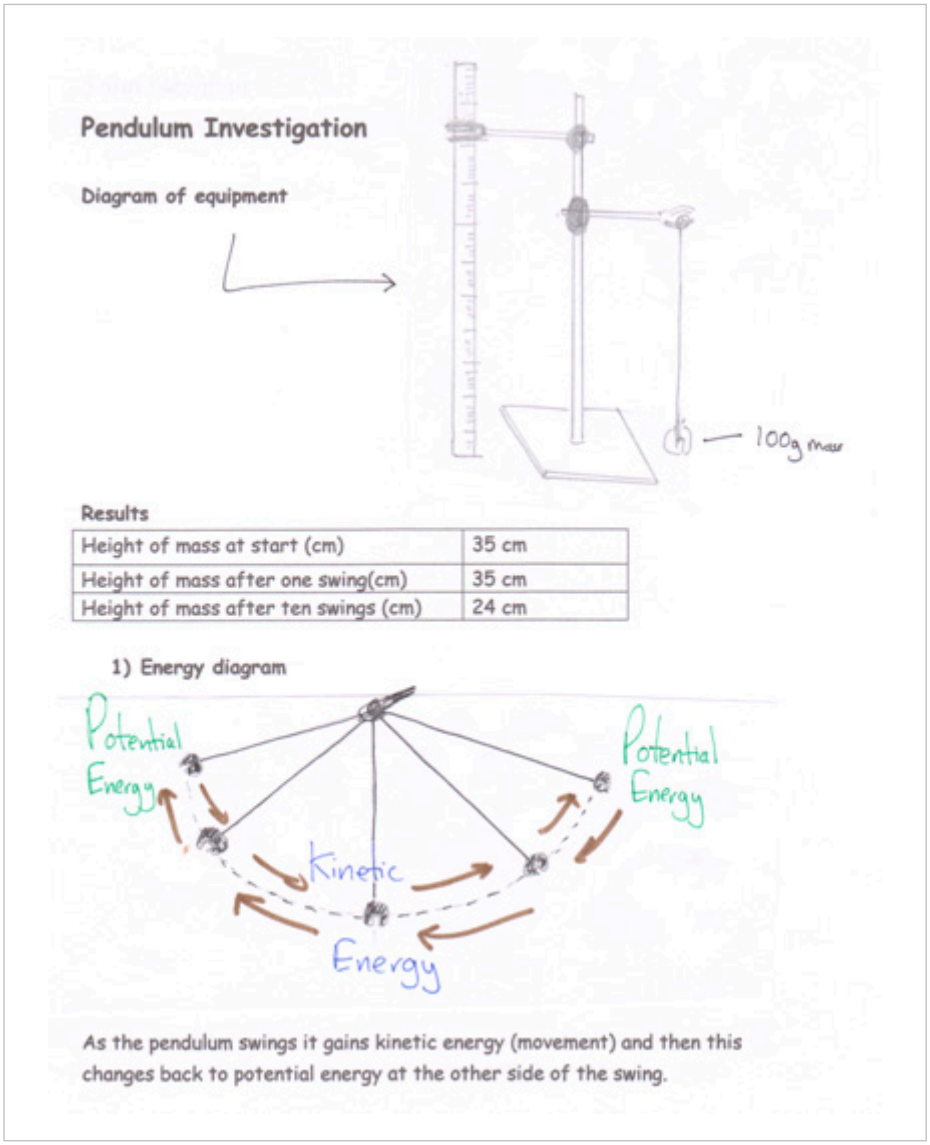
Work sample 2:
Investigation report – Energy conservation



Pendulum Investigation

Diagram of equipment

Results

Height of mass at start (cm)	35 cm
Height of mass after one swing(cm)	35 cm
Height of mass after ten swings (cm)	24 cm

1) Energy diagram

As the pendulum swings it gains kinetic energy (movement) and then this changes back to potential energy at the other side of the swing.

Annotations

Represents the energy transformations occurring through an annotated diagram.

Science

Work sample 2:
Investigation report – Energy conservation

2) Potential energy calculation

At start of the experiment GPE = 0.1 × 0.35 × 9.8 = 0.343 J

After one swing GPE = 0.1 × 0.35 × 9.8 = 0.343 J

After 10 swings GPE = 0.1 × 0.35 × 9.8 = 0.235

3) The law of conservation of energy says that energy cannot be created or lost. When the pendulum swings back to the starting place, it has the same amount of potential energy as it had at the start, so the energy has been conserved. However when left to swing for ten times, it is losing energy. Because of the law of conservation of energy, this energy must be being converted into other forms of energy such a heat, and some sound. This might be because here is some friction where the strng is tied around the clamp.

4) The pendulum is not very efficient because out of the 0.343 Joules of energy at the start, only 0.235 Joules remains after 10 swings. This means that 0.108 Joules of energy have been wasted.

5) Our way of measuring the height of the mass was not very accurate as it was hard to judge exactly how high the mass was as it did not always line up nicely with the ruler.
One way to improve this would be to video the experiment, and then you could pause the video to get more exact reading. We should also have repeated the tests at least three times and calculated an average reading. This would have made the results more accurate.

Annotations

Explains that while the potential energy of the system decreases over time, the energy of the system is conserved because energy is transformed to other forms of energy.

Explains data with reference to the Law of Conservation of Energy.

Identifies uncertainty and error arising through the experimental method and suggests ways to improve the validity and reliability of their findings, including use of video technology to improve accuracy of measurement.

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Work sample 3:
Data analysis – Acceleration

Relevant parts of the achievement standard

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Summary of task

Students were investigating forces and acceleration. They had previously used ticker tape timers to measure the motion of objects travelling down ramps and had encountered the concept of acceleration and Newton's first law of motion.

Students were asked to analyse a set of data and reflect on the method used to generate that data. They were provided with information about the investigation method and a table of experimental data. They were required to complete the following:

1. provide a set of summary statistics to represent the results
2. represent the summary statistics graphically
3. describe the relationship in the data.

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They were then asked to use the results and their knowledge and understanding of forces and motion to complete the following:

1. Identify possible errors in the experimental method.
2. Explain why the last reading was not able to be recorded.
3. Suggest another method for measuring the speed of the trolley and identify advantages and disadvantages to this method.
4. Explain how consistent the results of the experiment are with Newton's second law.
5. Predict the speed of a trolley being accelerated by the 1.0N force after 5 seconds.
6. Explain what would happen to the acceleration of the trolley if the accelerating force was kept the same but the mass of the trolley was increased.

Students completed the task as an independent homework task.

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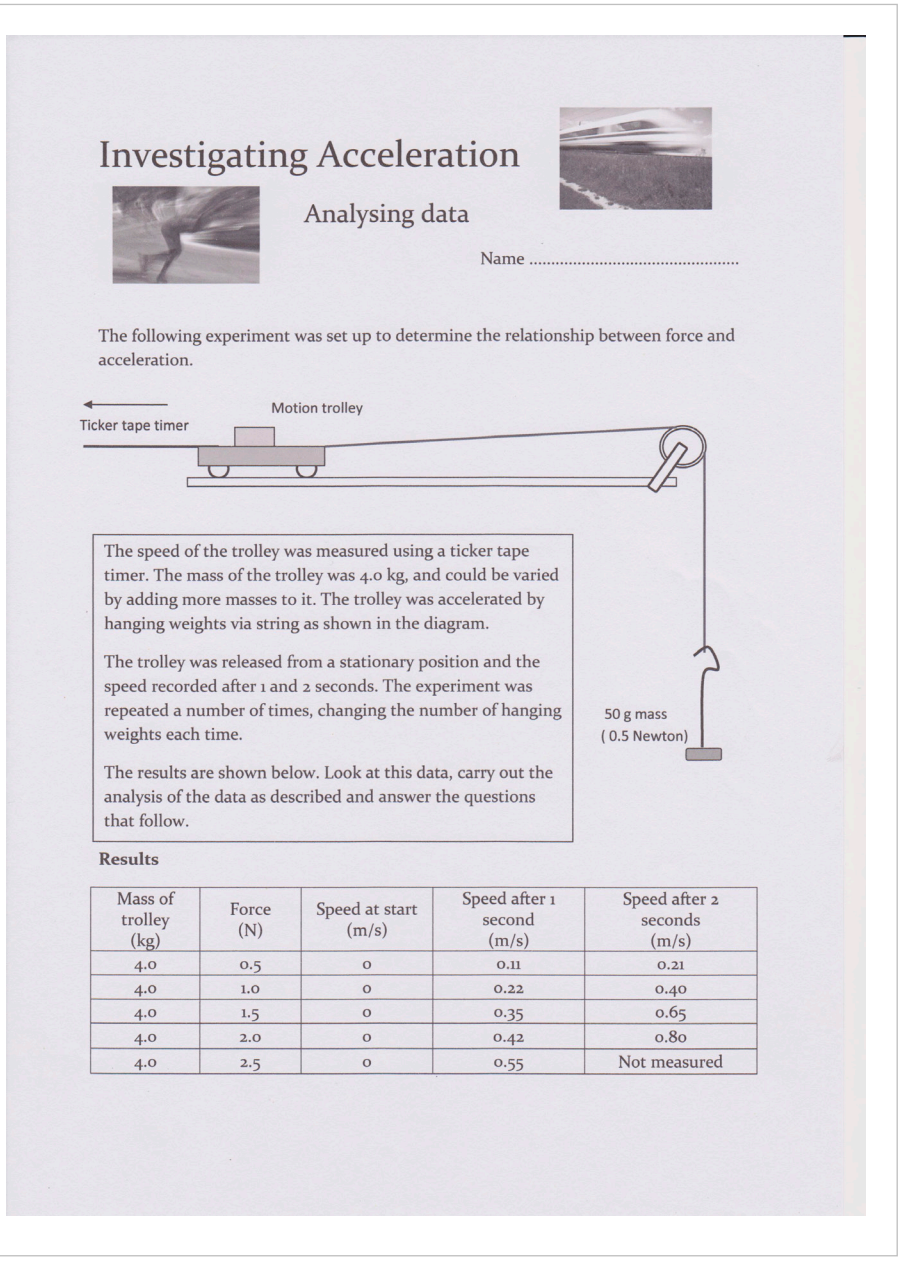
Work sample 3:
Data analysis – Acceleration



Investigating Acceleration

Analysing data

Name .....

The following experiment was set up to determine the relationship between force and acceleration.

The speed of the trolley was measured using a ticker tape timer. The mass of the trolley was 4.0 kg, and could be varied by adding more masses to it. The trolley was accelerated by hanging weights via string as shown in the diagram.

The trolley was released from a stationary position and the speed recorded after 1 and 2 seconds. The experiment was repeated a number of times, changing the number of hanging weights each time.

The results are shown below. Look at this data, carry out the analysis of the data as described and answer the questions that follow.

Results

Mass of trolley (kg)	Force (N)	Speed at start (m/s)	Speed after 1 second (m/s)	Speed after 2 seconds (m/s)
4.0	0.5	0	0.11	0.21
4.0	1.0	0	0.22	0.40
4.0	1.5	0	0.35	0.65
4.0	2.0	0	0.42	0.80
4.0	2.5	0	0.55	Not measured

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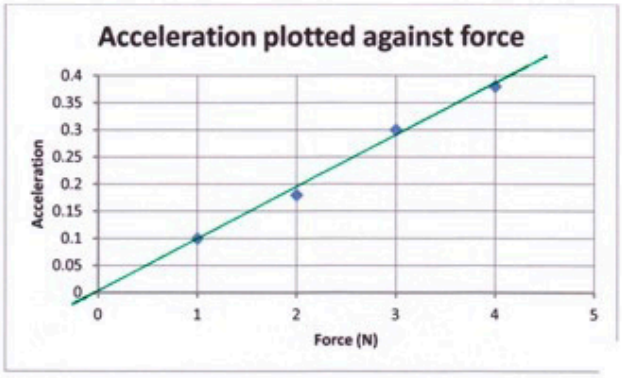
Work sample 3:
Data analysis – Acceleration

Investigating Acceleration by [redacted]

1. Results

Force (N)	Acceleration (m/s/s)
1.0	0.10
2.0	0.18
3.0	0.30
4.0	0.38
5.0	-

2. Graph



3. As the force increases, the acceleration increases in the same proportion. (in other words if you double the force you double the acceleration)

Evaluation

1. Possible errors:

- The ticker tape timer might not be that accurate
- None of the results were repeated, which should have been done

Annotations

Correctly calculates the acceleration between 1-2 seconds.

Represents the data in an appropriate graph.

Draws line of best fit, which correctly goes through the axis.

Recognises that there is a proportional relationship between force and acceleration.

Suggests some possible sources of error.

Science

Work sample 3:
Data analysis – Acceleration

2. The last reading might not have been able to be recorded as the trolley might have been going too fast. Or the falling weights might have hit the floor before two seconds was up.

3. A better way to measure the speed of the trolley would have been using light gates connected to a computer. This would have been much quicker, as the computer would have produced an accurate reading straight away without having to cut up and measure lots of strips of ticker tape paper. A problem would be knowing where to set up the light gate to measure the speed.

4. If we take one of the readings, with the force of 1 Newton, according to Newtons law (**f = m × a**), it says that 1 Newton = 4.0 kg × 0.22 m/s/s. 4.0 × 0.22 actually equals 0.88. This is fairly close to 1, but not exactly. This might be because of things happening in the experiment, such as the masses not being exact, or friction in the pulley and on the surface of the desk which will effect the results.

Predictions

1. I think the speed of the trolley being pulled by the 1 Newton force will be about 0.5 m/s. This is because the acceleration is about 0.1, so after five seconds the speed will have increased by 0.1 m/s each second.

2. If the mass of the trolley was increased, the acceleration will be slower because more force would be needed to get the trolley to move faster. (This could be tested by placing more weights on the trolley in this experiment)

Annotations

Suggests appropriate reasons why the last reading was not able to be recorded, including using knowledge of the method of the experiment.

Suggests using digital technologies to improve the accuracy of the results.

Comments on the experimental data in relation to Newton's Law using just one set of data.

Provides appropriate suggestions for why the data does not fit the law exactly (for example, the effect of friction).

Makes a justified prediction for the motion of the trolley based on an understanding of the concept of acceleration.

Makes a qualitative prediction for the motion of the trolley based on the relationship between force, mass and acceleration.

Acknowledgment
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Science

Work sample 4:
Investigation report – Nutrient cycling

Relevant parts of the achievement standard

By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.

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Summary of task

Students were working on an integrated unit looking at a topic issue – dredging in Port Phillip Bay. They had explored the arguments for and against dredging and were linking their investigations to studies of global nutrient cycling and interactions between the Earth's spheres.

Students were asked to research the ways in which two nutrient cycles occurred with reference to the bay ecosystem and to use this understanding to assess claims made in the media. Students worked in pairs to research the topic over two class lessons and then drafted individual investigation reports over a further 50 minute lesson, completing the final copy at home.

Science

Work sample 4:
Investigation report – Nutrient cycling

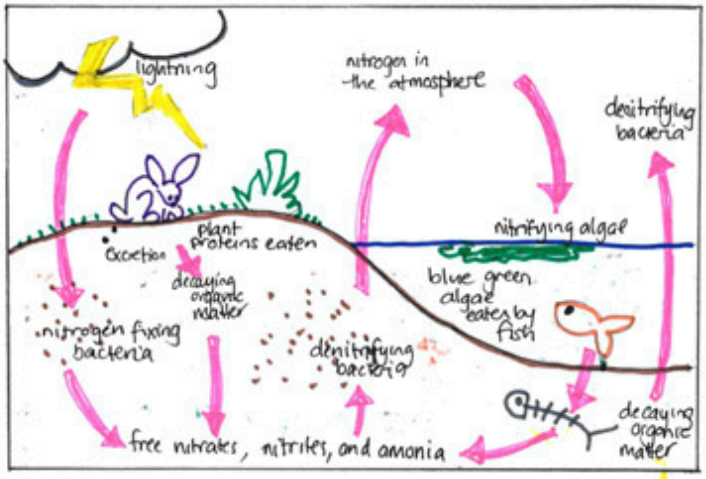
Dredging and the Nitrogen Cycle in Port Phillip Bay

Background

Nitrogen and phosphorus are two main nutrients that are in Port Phillip Bay.

Nitrogen is essential to plant and animal growth. It is used to make proteins, which are the building blocks of all cells. Nitrogenis mostly as nitrogen gas in the atmosphere and also occurs in the tissues of living and dead organisms. Some bacteria and blue-green algae can extract nitrogen gas from the atmosphere and transform it to organic nitrogen in a process called nitrogen fixation. Lightning can also fix nitrogen.

The Nitrogen Cycle



Phosphorus is an essential nutrient for plants and animals. It is part of DNA, bones and teeth. Phosphorus can be found in water, soil and sediments. It is not found in the air as a gas, but can be found in the air as small gas particles. Phosphorus is mostly found in rock formations and ocean sediments. Phosphorus salts are released from rocks through weathering and get dissolved in soil water then absorbed by plants.

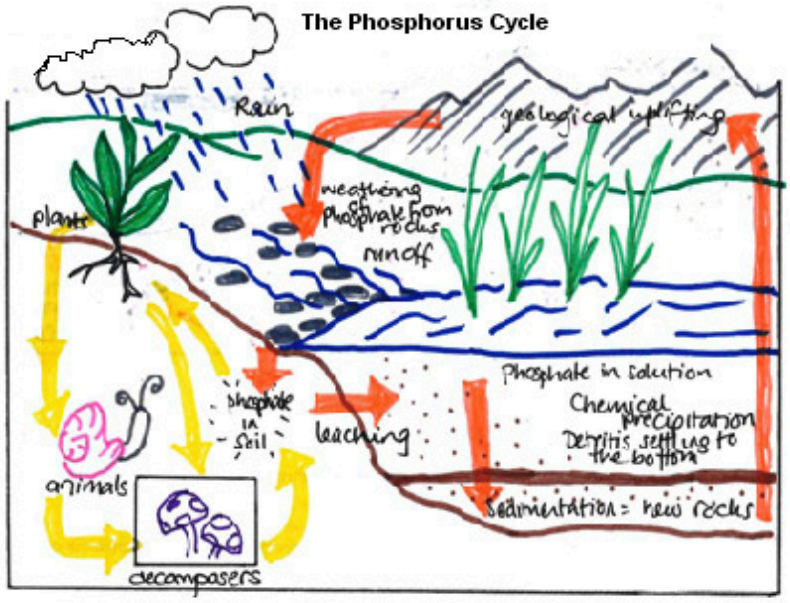
Annotations

Identifies that the nitrogen cycle involves interactions between the atmosphere, hydrosphere and biosphere.

Identifies that the phosphorus cycle involves interactions between the hydrosphere, atmosphere, lithosphere and biosphere.

Science

Work sample 4:
Investigation report – Nutrient cycling



Effect of dredging on the nitrogen and phosphorus cycles

The newspaper article said that the Acting Premier said that "Nitrogen levels had not been affected by trial dredging and that "the biggest impact of nitrogen in the bay was due to storm water".

The article I read said that the main causes of the Bay's poor water quality and aquatic habitat loss are elevated levels of nitrogen and phosphorus and that lots more of these nutrients are entering the bay. So the bay is being polluted from the land.

Too much phosphorus and nitrogen cause rapid growth of algae called algal blooms. These block the light so that the aquatic plants can't do photosynthesis. Also there is less oxygen in the water, so fish and other animals will die.

The big question, is, will digging up the sediments at the bottom of the bay cause more phosphors and nitrogen to be in the water? I think that it will, because there is nitrogen and phosphate in the sediments and if you dig up the sediments then more will end up in the water, faster than it usually would. This might cause too many nutrients in the water which might cause algal blooms and so lots of other marine animals and plants will die.

So I think that even though there is pollution coming from other places as well, dredging will still cause a change in the nitrogen and phosphorus levels in the bay.

Bibliography

- Thwaites denies bay claims' by Mathew Murphy August 30 2005 (The Age)
- Chesapeake Bay Program www.chesapeakebay.net

Annotations

Identifies that the phosphorus cycle involves interactions between the atmosphere, hydrosphere, lithosphere and biosphere.

Evaluates a claim from a secondary source with reference to scientific understanding.

Attempts to reference citations.

Constructs an argument with reference to research evidence.

Annotations (Overview)

In this work sample, the student selects appropriate representations to communicate science ideas.

Acknowledgment
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Science

Work sample 5:
Text response – Human genome

Relevant parts of the achievement standard

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Summary of task

Students had studied a unit on genetics and had explored the Human Genome Project. They had been introduced to concepts of DNA, genes and processes of DNA replication.

Students were asked to complete an independent in-class short response to a cartoon highlighting one aspect of the Human Genome Project. They could select from one of three cartoons. They were required to complete the following:

- describe the cartoon, with reference to the view of science being expressed
- evaluate whether this view of the science is valid and provide evidence for your view, including an explanation of what a genome is and why each individual's genome is unique.

The student selected a cartoon that shows a criminal being removed from a murder scene. He is protesting to police, "My genome made me do it!"

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Work sample 5:
Text response – Human genome

Human Genome Cartoon Task Name: [redacted]

Instructions

1. Select one of the attached cartoons
2. Describe the cartoon, with reference to the view of science being expressed
3. Evaluate whether this view of the science is valid and provide evidence for your view, including an explanation of
   - what a genome is
   - how each individual's genetic make up is unique
   - what genes do

Cartoon B shows a man being dragged away from the scene of a crime by two police men. It looks like he might have shot someone because there's a body on the ground with a gun beside it and other police men are standing around it. The man is saying "My genome made me do it!"

This cartoon is not giving valid science. It is saying that your genome makes you do stuff. Lots of people think that your genes control every little thing about you, like what you do, but this isn't true. That's why people say nature vs nuture - because you learn things as you grow up and what you do is a decision not nature.

Also, the cartoon is saying like everybody's genome is different but actually a genome is for a whole species - it's like a map of all the genes that species has. So saying that your genome made you do it doesn't mean anything cos we all have the same genome as humans.

Our genome is all our genetic information - all of our genes. Genes are made out of DNA. Every single one of our cells has a copy of our genetic code.

Everyone has their own unique genetic makeup except for clones and identical twins. This is because everyone has two copies for every gene. One gene comes from the mother and one comes from the father. In the sperm and in the egg. That's why you look a bit like your parents but not exactly the same.

Genes provide information for cells to make proteins. And the proteins basically do all the jobs in the cells. So genes are like the recipe to make all things we need for our body to grow and function.

Annotations

Evaluates the validity of secondary sources (i.e. cartoon) from a scientific perspective.

References currently held scientific views to support their evaluation.

Provides a simple overview of the role of genes in heredity and the processes by which heritable information is transmitted.

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Work sample 6:
Cartoon – Evolution

Relevant parts of the achievement standard

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Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.

Summary of task

Students were researching the evidence for the theory of evolution. They had watched a video in class and collated notes.

They were asked to devise a short text to engage a student audience, outlining at least two significant pieces of evidence for the theory and providing a brief overview of the main ideas of the theory.

Science

Work sample 6:
Cartoon – Evolution

Annotations

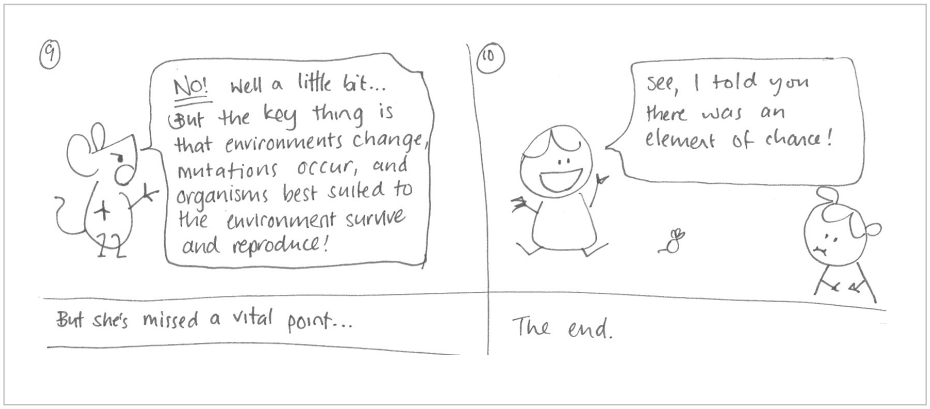
Constructs a text that has characters providing a simple evaluation of the evidence for the theory of evolution by natural selection.

Provides a simple outline of the theory of evolution by natural selection.

Identifies two significant pieces of evidence that support the theory, i.e. evidence from the fossil record and comparative anatomy.

Science

Work sample 6:
Cartoon – Evolution



Annotations

Emphasises the role of adaptation in the evolution of species over time.

Annotations (Overview)

In this work sample, the student selects appropriate representations and an appropriate text type to fit the purpose of engaging a student audience.

Acknowledgment
ACARA acknowledges the contribution of trial school teachers and students for providing the tasks and work samples. The annotations are referenced to the Australian Curriculum achievement standards.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Relevant parts of the achievement standard

By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.

Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.

Summary of task

Students have practised a variety of science inquiry skills: they have identified problems, described strategies to solve problems, developed hypotheses and collected data. They have written reports as experimental records that include an aim, method, results and conclusion.

Students were asked to independently select and research a topic. They were required to develop a hypothesis and plan a controlled investigation to test it. They were required to present their findings in an appropriate form for sharing with the scientific community.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Student Research Project - Cut Flower Preservatives

Year 10

Aim

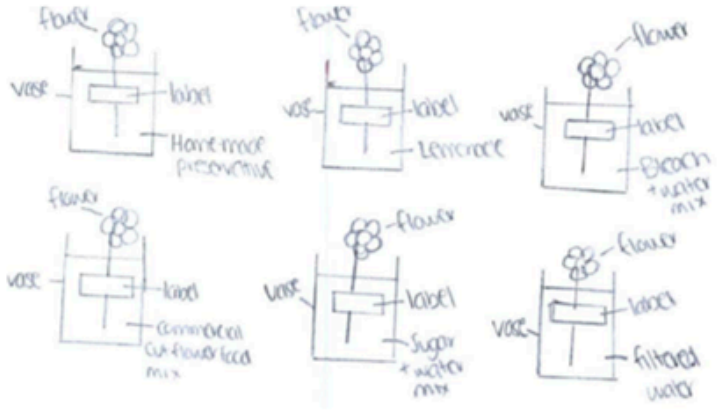
To observe which type of cut flower preservative has the best effect on keeping the flowers fresher for longer.

Hypothesis

That the commercial cut flower preservative will have the longest lasting effect on keeping the flowers fresh.

Equipment

- 6 identical glass jars/vases (200ml at least)
- 6 roses
- 1 packet of Branch Cut Flower Food
- 150 ml of lemonade
- 1 teaspoon of sugar
- 1 teaspoon of lemon/lime juice
- 1 teaspoon of bleach
- Measuring cup
- 6 labels
- Rule scissors
- 750ml of water



Annotations

Develops a question and hypothesis.

Selects appropriate equipment to conduct the investigation.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Method

1) Collect all equipment
2) Sterilize all jars/vases
3) Fill 1 vase with 150ml of filtered water and label
4) Fill 1 vase with 150ml of lemonade and label
5) Mix 2g of Brand Cut Flower Food with 150ml water and pour into a vase and label
6) Mix 1 teaspoon sugar with 150ml and pour into a vase and label
7) Mix half a teaspoon bleach with 150ml water and pour into vase and label
8) Mix 1 teaspoon sugar, half a teaspoon bleach and 2 teaspoons lemon/lime juice in 300 ml lukewarm water. Pour 150 ml into a vase and label.
9) Cut flower stems to 16cm at a diagonal and remove all foliage
10) Place a flower in each of the bases
11) Mark liquid levels
12) Count petal amount
13) Photograph all flowers
14) Record all observations and amount of petals dropped at regular intervals
15) Repeat experiment

Independent Variable

The type of cut flower preservative

Dependent Variable

The amount of petals dropped over a period of 5 days

Controlled Variables

- Length of flower stems
- Amount of liquid
- Size of vase
- Starting condition of the roses
- Regular observations and photographs
- Type of flower
- Surrounding conditions
- Amount of sunlight
- Protection from interference
- Protection from ants or insects

Annotations

Designs an appropriate method of investigation.

Identifies independent, dependent and controlled variables to ensure fairness.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Results

Amount of Petals Dropped (Tests 1 and 2)

Preservative	Day 1	Day 2	Day 3	Day 4	Day 5	Total	Total average
Home-made	0	2	4	3	4	12	10
	0	2	3	2	1	8	
Commercial	0	0	0	1	1	2	2
	0	0	1	1	0	2	
Lemonade	0	0	24	14	4	42	33.5
	0	4	12	5	4	25	
Bleach and water	0	5	7	6	3	21	15.5
	0	3	2	2	3	10	
Sugar and water	0	1	2	2	3	8	8
	0	1	3	2	2	8	
Filtered water	0	0	0	3	2	5	6
	0	1	1	3	2	7	

Observations:
Day 1, test 1

Preservative:	Observations
Commercial	Looks healthy and alive
Home-made	Looks healthy and alive
Lemonade	Looks healthy and alive
Bleach and water	Looks healthy and alive
Sugar and water	Looks healthy and alive
Filtered water	Looks healthy and alive

Day 2, test 1

Preservative:	Observations:
Commercial	The rose looks as fresh and healthy as it did yesterday, but it has opened up more and the petals have spread slightly.
Home-made	The rose has petals that are already slightly wilted. It has lost one petal.
Lemonade	This rose is looking healthy and bright.
Bleach and water	It has lost 5 petals and looks a bit limp.
Sugar and water	It has lost one petal but looks healthy and strong.
Filtered water	This rose is doing well, it hasn't lost any petals but has opened up more.

Annotations

Collects and represents data in appropriate tables, including summary statistics.

Includes both quantitative and qualitative data.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Day 3, test 1

Preservative:	Observations:
Commercial	The rose is still looking healthy and looks better off than the others look so far.
Home-made	This rose has lost 5 petals today. It still looks strong and alive.
Lemonade	This rose lost 24 petals today, which surprised me, it looks quite unhealthy.
Bleach and water	Today this rose lost 7 petals, its colour is changing and it looks much darker.
Sugar and water	This rose lost 2 petals. It still looks strong and healthy.
Filtered water	This rose has not lost any petals yet, it looks quite similar to when I first set it up, except that some of the petals closest to the centre have curled slightly.

Day 4, test 1

Preservative:	Observations:
Commercial	Lost its first petal today but is still looking happy and alive.
Home-made	It lost 3 petals today, it is starting to curl and its colour is darkening
Lemonade	It lost 14 petals today. There is not much of this flower left. I wonder if it does not like the sugar levels of the drink, because they are quite high.
Bleach and water	This rose lost 6 petals today. It is turning a very dark maroon.
Sugar and water	It has lost 2 petals today, it still looks alive and well.
Filtered water	This rose lost 3 petals today and is fading.

Day 5, test 1

Preservative:	Observations:
Commercial	This rose lost one petal today but still looks very healthy. Some of the petals closest to the centre have shriveled slightly.
Home-made	It lost 4 petals today, and is starting to look a bit limp.
Lemonade	This rose only lost 4 petals today; it looks quite sad
	and old.
Bleach and water	The rose lost 3 petals. It is fading slightly
Sugar and water	This rose lost 3 petals today, it is starting to lose it colour and curl.
Filtered water	This rose lost 2 petals today, it has faded more but is still holding its shape

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Day 1, test 2

Preservative:	Observations:
Commercial	Looks healthy and alive
Home-made	Looks healthy and alive
Lemonade	Looks healthy and alive
Bleach and water	Looks healthy and alive
Sugar and water	Looks healthy and alive
Filtered water	Looks healthy and alive

Day 2, test 1

Preservative:	Observations:
Commercial	This one hasn't changed since yesterday
Home-made	This rose has lost 2 petals, but otherwise still looks as it did yesterday.
Lemonade	The rose has lost 2 petals and has curled slightly at the centre petals
Bleach and water	This rose has lost 3 petals and has darkened.
Sugar and water	This rose lost 1 petal but otherwise still looks the same
Filtered water	The rose has lost one petal and has faded slightly

Day 3, test 1

Preservative:	Observations:
Commercial	The rose lost its first petal, its petals have spread
Home-made	This rose lost 3 petals today, its centre petals are shrivelling
Lemonade	This rose dropped 12 petals today it doesn't look very healthy
Bleach and water	This rose has lost 2 petals today. Its colour is darkening
Sugar and water	The rose dropped 3 petals today, its petals have spread out
Filtered water	This rose is losing its colour and has dropped one petal.

Day 4, test 2

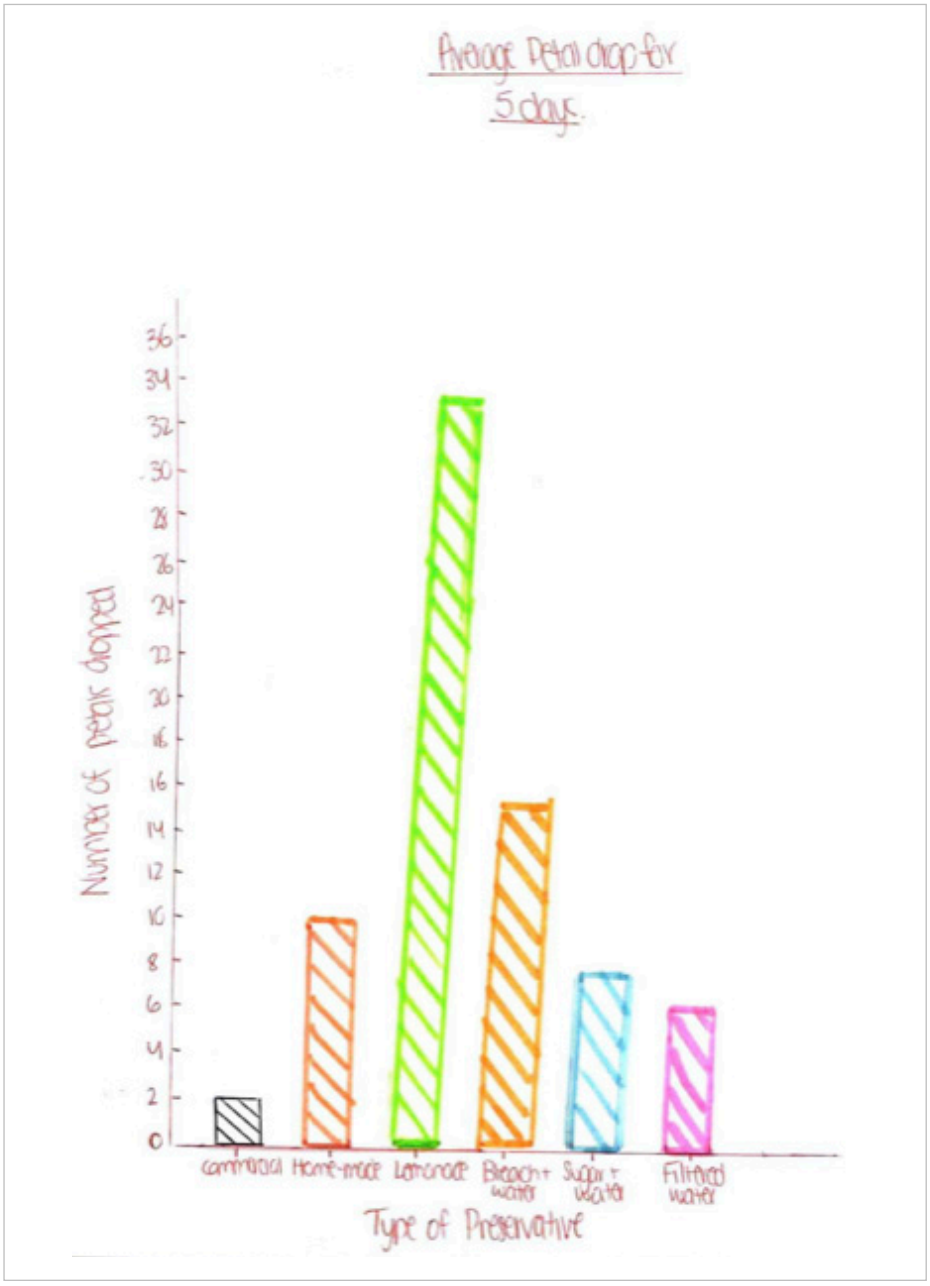
Preservative:	Observations:
Commercial	The rose lost 1 petal today but still looks the best so far.
Home-made	This rose lost 2 petals today and is beginning to lose its colour
Lemonade	The rose lost 5 petals today. It looks quite bad
Bleach and water	This rose lost 2 petals today and is shrivelling
Sugar and water	The rose lost 2 petals and its colour is lightening
Filtered water	This rose lost 3 petals today, its colour has lightened considerably

Day 5, test 2

Preservative:	Observations:
Commercial	It didn't lose any petals today and is still looking quite fresh compared to the others
Home-made	The rose lost 1 petal today and its petals are all curling.
Lemonade	This one lost 4 petals today. There aren't many left to lose.
Bleach and water	This rose lost 3 petals today. Its colour has darkened considerably
Sugar and water	This rose has lost 2 petals today. Its colour has lightened
Filtered water	This one lost 2 petals. It hasn't changed from yesterday apart from the petal drop.

Science

Work Sample 7:
Investigation report – Cut flower preservatives



Annotations

Represents evidence (summary statistics) in an appropriate graph.

Science

Work Sample 7:
Investigation report – Cut flower preservatives

Discussions

The results indicate that the commercial cut flower preservative kept the roses from falling apart with the best result. There is no apparent pattern in the reuslts, but the roses tended to lose the most amounts of petals towards the middle of the experiment and then not as many at the conclusion. The experiment would have to be repeated many times before a definite conclusion could be resolved, so I do not think my reuslts were completely reliable. The experimental Designo f this project was good; it had a good structure and followed the guildelines well.

During the experimental process, I encountered a few problems. These were:

- The availability of flowers-when I decided what I was going to bse my project on I thought I had all the equipment I needed and did not realise that the flowers I needed were not as available as I thought. I was able to resolve this problem without too much difficluty, but it was a minor setback.
- I had limited access to the internet as our internet line had been ruined by a sotrm
- I had trouble deciding what graphs to use and knowing if they were the right ones.

To imporve my experiment I would need to do more background research on graphs and roses. I would also need to repeat the experiment many times to get a more reliable result.

It would be interesting to see what would happen if I placed the flowers in other types of liquids such as alchol or aspirin solution.

Conclusion

It seems that the commercial cut flower preservative had the best result on keeping the roses fresher for longer. According to my results, myhypthesis was correct.

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Annotations

Identifies sources of uncertainty – the need for a greater number of trials.

Interprets evidence to construct a conclusion.

Cites references.

Annotations (Overview)

In this work sample, the student selects appropriate representations and an appropriate text type (scientific report) to communicate science ideas for specific purposes.

Acknowledgment

ACARA acknowledges the contribution of the Board of Studies, New South Wales for providing the tasks and work samples. The annotations are referenced to the Australian Curriculum achievement standards.

Science

Work sample 8:
Investigation report – Reaction rates

Relevant parts of the achievement standard

By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.

Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.

Summary of task

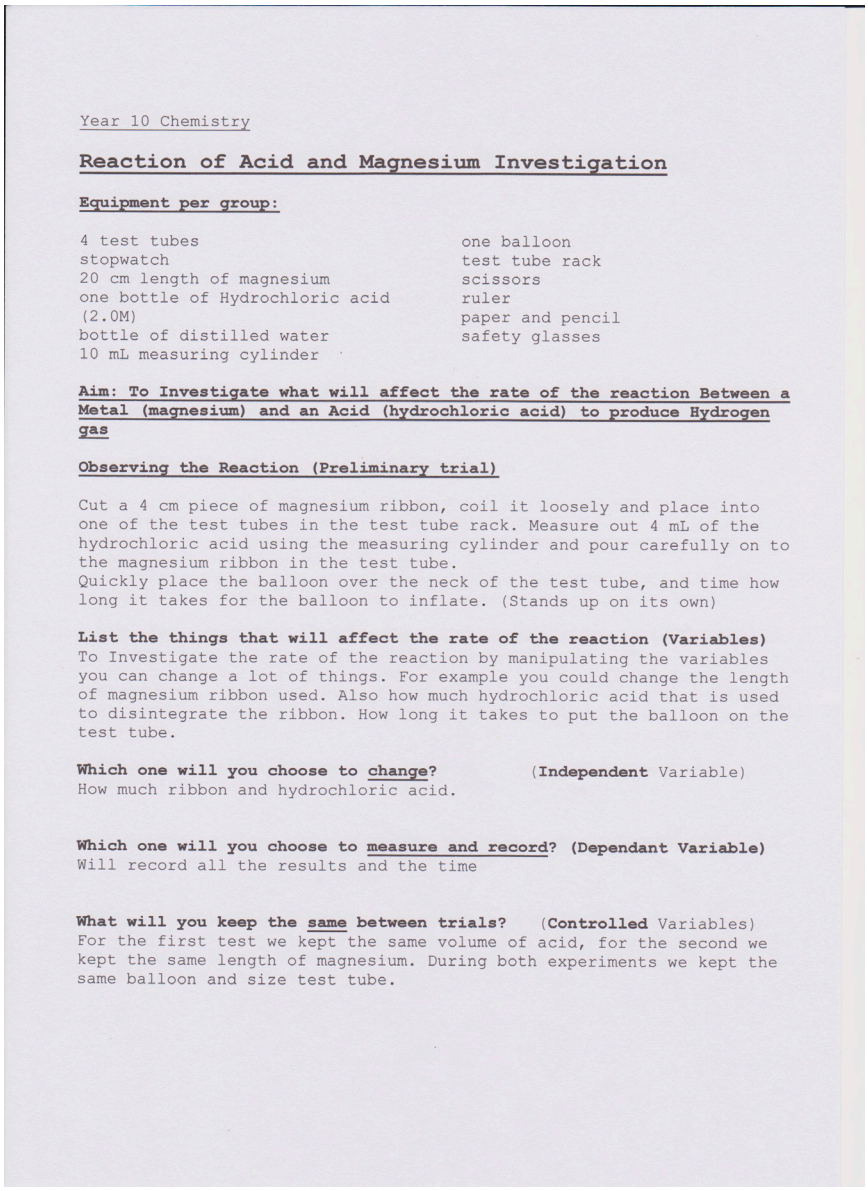
Students were asked to investigate factors that affected the rate of the reaction between hydrochloric acid and magnesium ribbon. They were able to chose the variable(s) to investigate. They were shown the basic set up for the experiment and were provided with a digital template for their planning and report.

Students were advised of the following safety precautions when handling hydrochloric acid: be careful to avoid skin contact as well as clothing contact; wear safety goggles at all times while handling the hydrochloric acid.

Students worked in groups but were required to produce their own report of their experiment.

Science

Work sample 8:
Investigation report – Reaction rates



Year 10 Chemistry

Reaction of Acid and Magnesium Investigation

Equipment per group:

4 test tubes	one balloon
stopwatch	test tube rack
20 cm length of magnesium	scissors
one bottle of Hydrochloric acid (2.0M)	ruler
	paper and pencil
bottle of distilled water	safety glasses
10 mL measuring cylinder	

Aim: To Investigate what will affect the rate of the reaction Between a Metal (magnesium) and an Acid (hydrochloric acid) to produce Hydrogen gas

Observing the Reaction (Preliminary trial)

Cut a 4 cm piece of magnesium ribbon, coil it loosely and place into one of the test tubes in the test tube rack. Measure out 4 mL of the hydrochloric acid using the measuring cylinder and pour carefully on to the magnesium ribbon in the test tube.
Quickly place the balloon over the neck of the test tube, and time how long it takes for the balloon to inflate. (Stands up on its own)

List the things that will affect the rate of the reaction (Variables)
To Investigate the rate of the reaction by manipulating the variables you can change a lot of things. For example you could change the length of magnesium ribbon used. Also how much hydrochloric acid that is used to disintegrate the ribbon. How long it takes to put the balloon on the test tube.

Which one will you choose to change? (**Independent** Variable)
How much ribbon and hydrochloric acid.

Which one will you choose to measure and record? (Dependant Variable)
Will record all the results and the time

What will you keep the same between trials? (**Controlled** Variables)
For the first test we kept the same volume of acid, for the second we kept the same length of magnesium. During both experiments we kept the same balloon and size test tube.

Annotations

Identifies variables to investigate.

Describes how to control variables to ensure fairness.

Science

Work sample 8:
Investigation report – Reaction rates

Hypothesis: *predict what will happen to the rate of the reaction as you change your variable*

I predict that the more hydrochloric acid used and the less ribbon the quicker the balloon will inflate because there are more acid particles to attack the magnesium strip resulting in the magnesium dissolving faster.

Materials: List what you will need to conduct your investigation.

- 3 test tubes
- A test tube rack
- A roll of magnesium ribbon
- Hydrochloric acid
- Stop watch
- A balloon
- A measuring cylinder

Describe your experimental set-up and explain how you will collect your data.

To start the experiment we first needed to collect all our materials. Using a ruler we cut our needed size of the magnesium ribbon and placed the first piece at the bottom of the first test tube. We then using the pipet in the hydrochloric acid jar squeezed the right amount of acid into the measuring cylinder and then poured it into the test tube with the ribbon whilst someone started the stop watch and the other placed the balloon on top of the test tube. We followed this procedure with every piece of ribbon.

Did you carry out any preliminary trails of your procedure to see if your planned method of data collection would work?

We did carry out preliminary trials to get the feel of the experiment and see how we can change it to different our results in the preliminary tests.

Were there any problems?

We did have one problem that the size of the ribbon was so tall even when it was coiled so the hydrochloric acid did not reach taking it longer to dissolve.

What changes did you make to fix the problems?

We coiled the magnesium ribbon even more and then added more hydrochloric acid.

How are you going to make sure that it is a fair test?

By making sure we use the same balloon, measure the right amount hydrochloric acid and by using the same procedure for each test.

Annotations

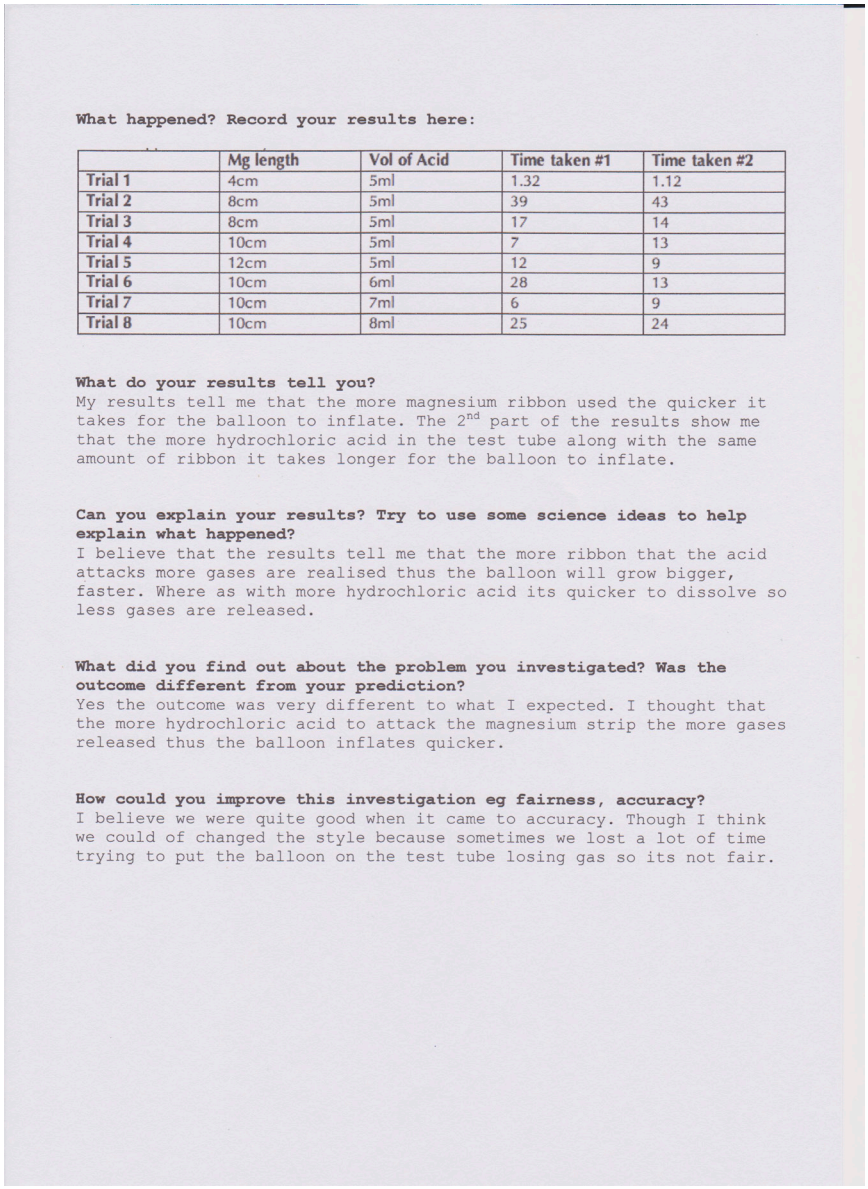
Uses knowledge of reaction rates to make and justify a prediction.

Plans and conducts the experiment effectively.

Identifies problems with the experiment during preliminary trials and makes changes to the method.

Science

Work sample 8:
Investigation report – Reaction rates



What happened? Record your results here:

	Mg length	Vol of Acid	Time taken #1	Time taken #2
Trial 1	4cm	5ml	1.32	1.12
Trial 2	8cm	5ml	39	43
Trial 3	8cm	5ml	17	14
Trial 4	10cm	5ml	7	13
Trial 5	12cm	5ml	12	9
Trial 6	10cm	6ml	28	13
Trial 7	10cm	7ml	6	9
Trial 8	10cm	8ml	25	24

What do your results tell you?
My results tell me that the more magnesium ribbon used the quicker it takes for the balloon to inflate. The 2nd part of the results show me that the more hydrochloric acid in the test tube along with the same amount of ribbon it takes longer for the balloon to inflate.

Can you explain your results? Try to use some science ideas to help explain what happened?
I believe that the results tell me that the more ribbon that the acid attacks more gases are realised thus the balloon will grow bigger, faster. Where as with more hydrochloric acid its quicker to dissolve so less gases are released.

What did you find out about the problem you investigated? Was the outcome different from your prediction?
Yes the outcome was very different to what I expected. I thought that the more hydrochloric acid to attack the magnesium strip the more gases released thus the balloon inflates quicker.

How could you improve this investigation eg fairness, accuracy?
I believe we were quite good when it came to accuracy. Though I think we could of changed the style because sometimes we lost a lot of time trying to put the balloon on the test tube losing gas so its not fair.

Annotations

Record measurements in a table with correct unit.

Conducts two replicates for each trial.

Tests two different variables in the experiment.

Proposes brief explanations for the results based on prior knowledge.

Refers findings back to prediction and suggest an explanation.

Attempts to consider the accuracy of the experiment with reference to areas of uncertainty.

Acknowledgment
ACARA acknowledges the contribution of trial school teachers and students for providing the tasks and work samples. The annotations are referenced to the Australian Curriculum achievement standards.