Science

Year 10
Satisfactory

WORK SAMPLE PORTFOLIO

Annotated work sample portfolios are provided to support implementation of the Foundation – Year 10 Australian Curriculum.

Each portfolio is an example of evidence of student learning in relation to the achievement standard. Three portfolios are available for each achievement standard, illustrating satisfactory, above satisfactory and below satisfactory student achievement. The set of portfolios assists teachers to make on-balance judgements about the quality of their students' achievement.

Each portfolio comprises a collection of students' work drawn from a range of assessment tasks. There is no pre-determined number of student work samples in a portfolio, nor are they sequenced in any particular order. Each work sample in the portfolio may vary in terms of how much student time was involved in undertaking the task or the degree of support provided by the teacher. The portfolios comprise authentic samples of student work and may contain errors such as spelling mistakes and other inaccuracies. Opinions expressed in student work are those of the student.

The portfolios have been selected, annotated and reviewed by classroom teachers and other curriculum experts. The portfolios will be reviewed over time.

ACARA acknowledges the contribution of Australian teachers in the development of these work sample portfolios.

THIS PORTFOLIO: YEAR 10 SCIENCE

This portfolio provides the following student work samples:

Sample 1	Analysis task: The periodic table
Sample 2	Investigation report: Rates of reaction
Sample 3	Investigation report: Motion down an inclined plane
Sample 4	Worksheet: Objects in motion
Sample 5	Written test: Chemical reactions
Sample 6	Research task: The theory of evolution by natural selection
Sample 7	Research report: The Big Bang theory
Sample 8	Source analysis: Designer babies
Sample 9	Written test: Genetics and evolution
Sample 10	Investigation report: Nutrient cycling
Sample 11	Investigation: Global ocean currents
Sample 12	Cartoon: The development of the Big Bang theory

In this portfolio, the student explains how the periodic table organises elements and uses the periodic table to make predictions about the properties of elements (WS1). The student explains how chemical reactions are used to produce particular products (WS5) and analyses how different factors influence the rate of reaction (WS2).

Science

Year 10
Satisfactory

The student explains the concept of energy conservation, representing energy transfer and transformation within a simple system involving motion down an inclined plane (WS3) and applies relationships between force, mass and acceleration to predict changes in the motion of objects (WS4). The student describes interactions between Earth's spheres in the context of global nutrient cycling (WS10) and global ocean currents (WS11). The student explains the structures and processes involved in inheritance and evolution by natural selection (WS9). The student evaluates the evidence for scientific theories (WS6, WS12) and examines how the theory of evolution (WS6) and the Big Bang theory (WS7, WS12) developed over time.

The student demonstrates the ability to develop hypotheses for investigation (WS2, WS3, WS11) and independently designs and improves appropriate methods of investigation (WS2, WS3, WS11), explaining how reliability and fairness were considered (WS2, WS3, WS11) 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 (WS2, WS3) and evaluates the validity of claims made in secondary sources with reference to current scientific views (WS8, WS10). The student constructs evidence-based arguments and selects appropriate representations and text types to communicate science ideas for specific purposes and to specific audiences (WS2, WS3, WS4, WS5, WS6, WS7, WS8, WS9, WS10, WS11, WS12).

Analysis task: The periodic table

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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.*

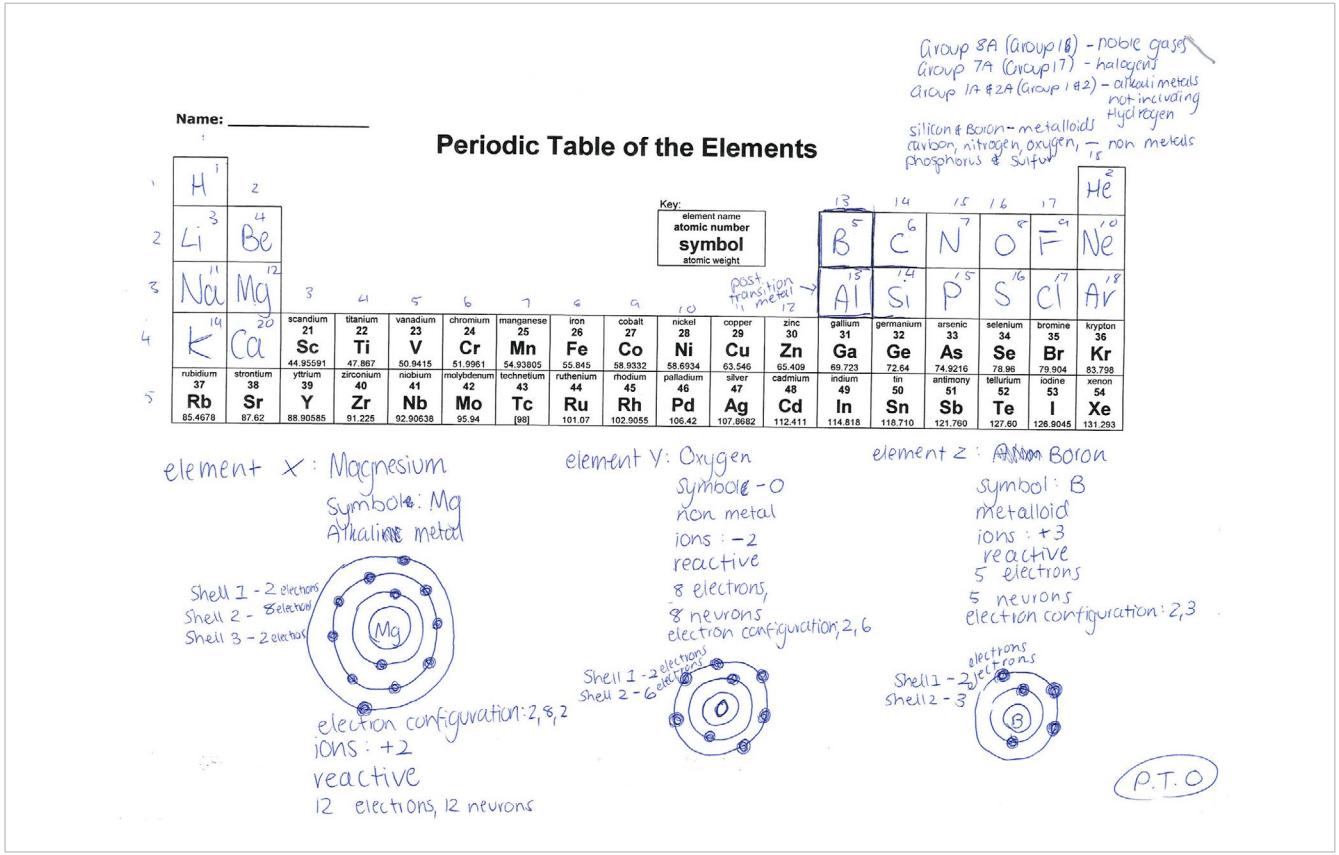
Summary of task

Before undertaking this task, students had examined the organisation of the periodic table of the elements and atomic structure.

Students were provided with a partially complete copy of the periodic table and asked to identify and describe three elements given a description of their position only, for example, 'Element x is found in Row 3, Group 2'. They were also required to explain how the elements might react with alkali metals, transition metals, non-metals and halogens.

Students completed the task in a single lesson of 100 minutes.

Analysis task: The periodic table

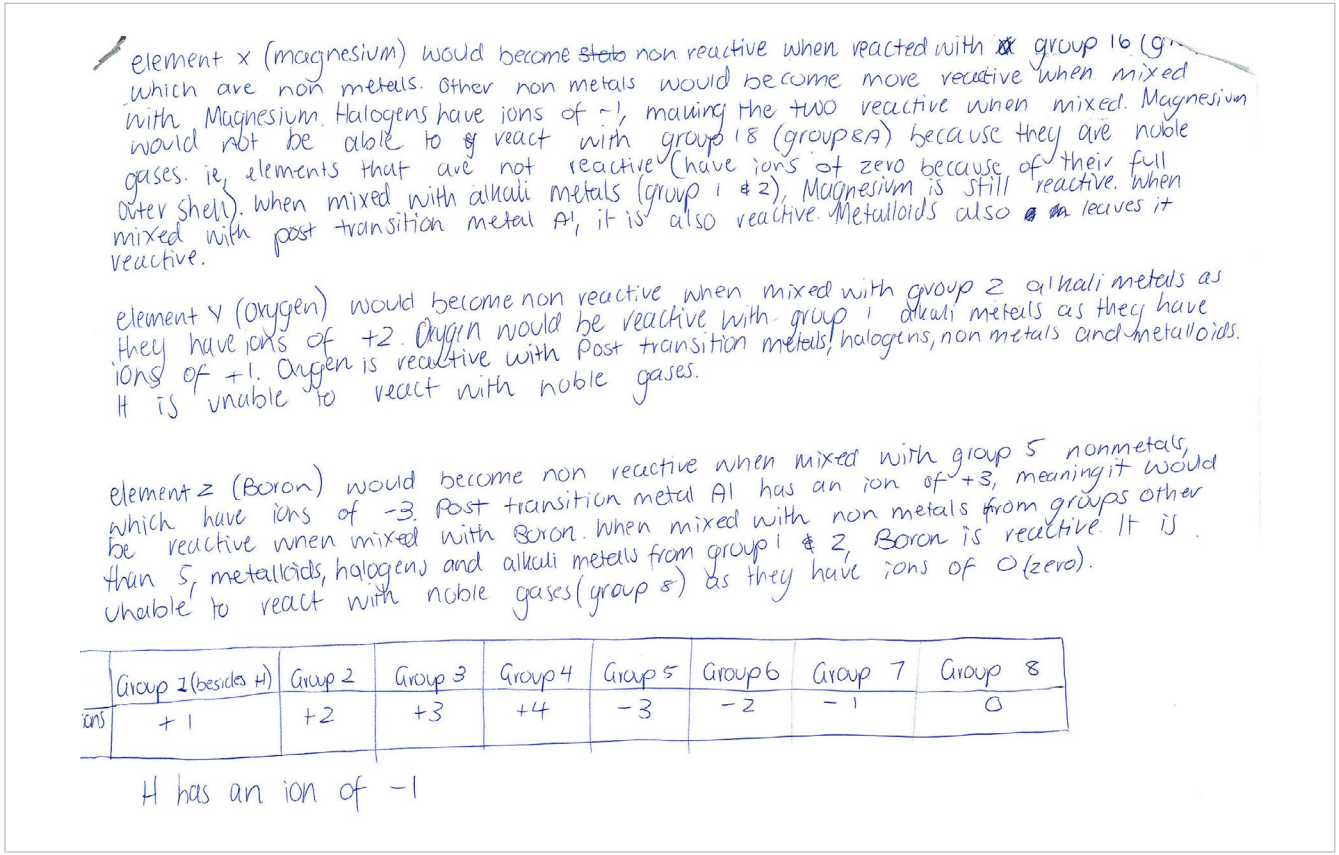


Annotations

Uses the position of elements in the periodic table to determine their atomic structure and electron configuration.

Uses the position of elements in the periodic table to make predictions about their reactivity.

Analysis task: The periodic table



element x (magnesium) would become ~~stato~~ non reactive when reacted with ~~x~~ group 16 (gr... which are non metals. Other non metals would become more reactive when mixed with Magnesium. Halogens have ions of -1, making the two reactive when mixed. Magnesium would not be able to ~~of~~ react with group 18 (group 8A) because they are noble gases. ie, elements that are not reactive (have ions of zero because of their full outer shell). When mixed with alkali metals (group 1 & 2), Magnesium is still reactive. When mixed with post transition metal Al, it is also reactive. Metalloids also ~~a~~ ~~m~~ leaves it reactive.

element Y (Oxygen) would become non reactive when mixed with group 2 alkali metals as they have ions of +2. Oxygen would be reactive with group 1 alkali metals as they have ions of +1. Oxygen is reactive with Post transition metals, halogens, non metals and metalloids. H is unable to react with noble gases.

element z (Boron) would become non reactive when mixed with group 5 nonmetals, which have ions of -3. Post transition metal Al has an ion of +3, meaning it would be reactive when mixed with Boron. When mixed with non metals from groups other than 5, metalloids, halogens and alkali metals from group 1 & 2, Boron is reactive. It is unable to react with noble gases (group 8) as they have ions of 0 (zero).

	Group 1 (besides H)	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
ions	+1	+2	+3	+4	-3	-2	-1	0

H has an ion of -1

Annotations

Identifies the position of different types of elements within the periodic table.

Makes some predictions about how specific elements react with different types of elements within the periodic table.

Investigation report: Rates of reaction

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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 asked to carry out research to identify the factors that affect the rate of a chemical reaction. They selected one factor and designed and performed an experiment to confirm its effect. Students worked in groups of 3-4 and presented their findings individually in the form of an investigation report. A report template was provided as well as opportunities for assistance and feedback in developing the experimental method.

Students were required to complete a risk assessment regarding the use of the 2.0M acetic acid.

Prior to completing the supervised experiment, students were advised of the following safety precautions when handling acetic acid: be careful to avoid skin contact as well as clothing contact and wear safety goggles at all times while handing the acetic acid.

Investigation report: Rates of reaction

Science Report – Rate of Reaction

Aim:

The aim of this experiment is to see how the rate of a chemical reaction can be affected by certain factors like the concentration of the reactant.

Introduction:

A chemical reaction happens when reactants are converted into products. How fast the reactants are converted into products is the rate of a chemical reaction. This is explained by a theory called collision theory. Collision theory says that reactant particles have to collide before they can be converted into products. This means that the rate of a chemical reaction is equal to how many collisions occur in a certain amount of time. The amount of collisions is affected by three factors: the surface area, the concentration and the temperature.

In this experiment we will be testing concentration. Bringing up the concentration means that there is more chance that the reactant particles will collide because there's more of them. A simple way to test this is to conduct a simple test using acetic acid and sodium bicarbonate. We can use the same amount of acetic acid and sodium bicarbonate and add small amounts of water to make the concentration of the acetic acid reactant go down. Carbon dioxide gas is the product in this chemical reaction so we can measure the amount of carbon dioxide that's made over the same time. The rate of the reaction can be worked out using the results.

Hypothesis:

The hypothesis is that the rate of the chemical reaction will decrease when the amount of acetic acid reactant is decreased. The evidence for this is in the collision theory.

Method:

1. A conical flask with a tube in the side and a stopper was collected
2. An ice cream container was filled half way with water and a measuring cylinder was filled with water and placed upside down in the ice cream container.
3. The tube was placed inside the measuring cylinder.
4. 25 mL of acetic acid was placed in a conical flask.
5. 1 g of sodium bicarbonate was placed in the conical flask and the stopper was put on straight away.
6. At the same time the stop watch was started and measurements were taken every 5seconds for 20 seconds.
7. The experiment was repeated two more times.
8. The third time the experiment was repeated with 5 mL of water added to the acid.
9. The experiment was repeated two more times.
10. Then the same thing with 10, 15, 20, 25 mL of water.
11. The equipment was washed and put away and all of the results recorded in a table.

Safety:

We wore lab coats and safety glasses to prevent risk from the acid.

Annotations

Identifies factors that influence rate of reaction, including surface area, concentration and temperature.

Develops a clear and logical hypothesis based on collision theory.

Designs a logical and appropriate investigation method.

Considers reliability by specifying controlled variables and by performing repeated trials.

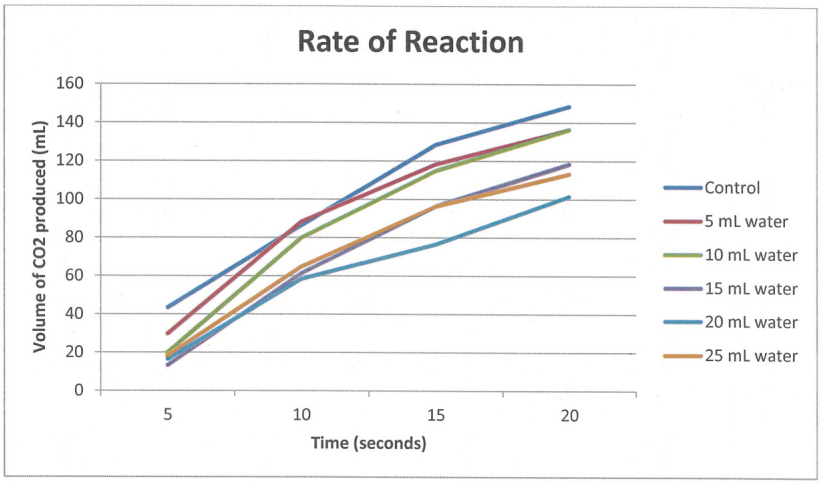
Considers safety precautions by specifying protective clothing and eyewear.

Investigation report: Rates of reaction

Acid with 25 mL of water

Time (seconds)	Volume of CO2 (mL)	Test 2	Test 3	Average
5	5	25	25	18.5
10	65	55	75	65
15	100	85	105	96.5
20	115	100	125	113.5

Graph



Observations

All of the experiments produced large volumes of gas bubbles. The first three happened straight away and the last three took a little while to start. All of the reactions slowed down over the 20 second time limit.

Word equation

Acetic acid + sodium bicarbonate → sodium acetate + carbon dioxide + water

Discussion:

The rate of reaction for the experiments was calculated from the volume of carbon dioxide produced. They show a decrease in both the rate and the amount of CO2 produced. This conforms to the prediction in the hypothesis which stated that the rate of the chemical reaction will decrease when the amount of acetic acid reactant is decreased.

The control with no water added to the acid had the highest average first and last readings. Each test following this one with more water added each time saw the reaction rate decrease. The graph

Annotations

Correctly selects average quantity of CO_2 produced and rate of production as evidence and constructs a line graph to represent trends.

Analyses evidence to identify trends.

Investigation report: Rates of reaction

shows this because each one is less steep and produces less carbon dioxide overall. One problem in the results is in the acid with 25 mL of water test. In this test the reaction rate and amount of carbon dioxide gas produced was recorded as being higher than the acid with 20 mL of water test. This might be because of an error in the timing of the experiment or in measuring the acid and water.

The reasons for the rest of the correct results in the experiment are simple. The collision theory says that bringing up the concentration means that there is more chance that the reactant particles will collide because there's more of them. If the concentration is low, there are less reactant particles or they are spread further apart so the chances of them colliding is less. Our experiment showed this because by adding water to the acid we are making the concentration less and so expect to see the reaction rate get slower which we did. We know that there are two other factors that affect the rate of reaction which are surface area and temperature. We kept the temperature the same and it goes without saying that the surface area was the same because we got the sodium bicarbonate from the same container every time we did the tests. The tests were also done three times each to make them reliable and the average was calculated for each time and used to make the graph.

We were careful when doing the experiment but it is impossible to prevent some errors from happening. The possible errors could have been caused by the measuring scales and stopwatches not being 100% accurate or there may have been contamination in the chemicals used in the tests. Another possible error could have been inaccurate timing of the experiment due to human error in starting and stopping the stopwatch. The last error is to do with the experiment method where the stopper had to be put on straight away after the sodium bicarbonate was added to the conical flask. This might let some gas escape before the stopper is put on and make the results of the volume of carbon dioxide gas produced seem lower than it actually was.

All of these errors can be avoided. The first thing we could do is improve the accuracy of the measuring equipment. We can use digital scales and get the most accurate stopwatches possible to get rid of the timing error. We can also include the reaction time of people starting and stopping the stopwatch. We could use purified water and also pure acetic acid and sodium bicarbonate. The problem with the gas escaping can be fixed by placing the sodium bicarbonate in the conical flask first and adding the acid and water through a stopper with a syringe.

Conclusion:

In conclusion to this experiment we have proved that the concentration of the reactant has an effect on the reaction rate. If the concentration is lower the reaction rate will be slower! This matches with the collision theory and our hypothesis.

Bibliography:

"Collision Theory" http://www.britannica.com/EBchecked/topic/125867/collision-theory

"Rate of Reaction" http://www.chem4kids.com/files/react_rates.html

Annotations

Constructs evidence-based arguments with reference to collected data and collision theory.

Identifies uncertainty (anomalous data) and provides a plausible explanation.

Identifies strategies, including use of digital technologies, to improve the quality of the data.

Annotations (Overview)

The student selects appropriate language and visual representations to communicate observations and ideas within the genre of a scientific report.

Investigation report: Motion down an inclined plane

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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 familiar with designing open-ended investigations. They had previously investigated how the mass of an object affects its speed when travelling down an inclined plane and analysed the results as a class.

Students worked in groups to research, design and perform an investigation to answer the following question: how does the slope of an incline affect the speed of an object moving freely down it? Students were supplied with a toy car and a piece of wood to serve as the incline. They also had access to common laboratory equipment. Students were given a detailed scientific report style guide as well as opportunities to receive feedback on draft submissions. Students submitted an individual scientific report.

Investigation report: Motion down an inclined plane

Introduction:

Research Questions:

The research questions being examined in this investigation is how does the height affect the motion of an object moving freely down an inclined plane?

Aim:

The aim of this investigation is to find the effect of the height of the slope on the motion of a 0.024g car travelling down an inclined plane.

Research and background information:

New construction on roller coasters, theme parks or skate and stunt parks cannot only be improved thrill wise but also safety wise. Even the construction of new roads and disabled or elderly ramps can be improved. To ensure that the construction of new theme parks, ramps, roads and so on many steps need to be followed and taken into account. Gravitational Potential Energy (GPE) is the energy stored in an object as a result of its height above the surface of the earth (Henderson 1996-2012). Kinetic Energy (KE) is thc energy an object possesses due to its movement (Henderson 1996- 2012). By following The Law of Conservation of Energy which states that energy may neither be created nor destroyed in an inclined plan context, GPE can be converted into different forms such as KE (Think Quest date unknown). In a perfect world energy conversation would always be 100% efficient but as other factors add to the equation such as friction which causes heat, energy is not always converted 100% efficiently (Pearson Australia Group). Percentage efficiency is the measure of how efficient the conversion of input energy to output energy is (Pearson Australia Group). In an inclined plane Gravitation and Friction are two factors that affect the motion of an object. When an object is raised above the surface of the earth it has GPE which is the force of gravity pulling it to the centre of the Earth. So the higher an object is off the ground the more GPE it has (Henderson 1996- 2012). Friction on the other hand is the force exerted by a surface as an object moves across it (Henderson 1996- 2012). Friction opposes motion and creates heat through the action of two surfaces being pressed together in an inclined plane. (Henderson1 996-2012). Motion of an object can bc dcpictcd by a graph. Position versus time (P-t) graphs and Velocity versus time (V-t) graphs are two examples of this. On a V-t graph thc accclcration of an object is represented by the slope on a graph (see figure 1) (Henderson 1996- 2012). V-t graphs can also show the distance that an object travels (Henderson 1996- 2012). As seen in figure 1 the shaded

Annotations

Investigation report: Motion down an inclined plane

area or area underneath the line is an objects displacement or distance covered (Henderson 1996-2012). The Information from the drafts can be compared to the results found.

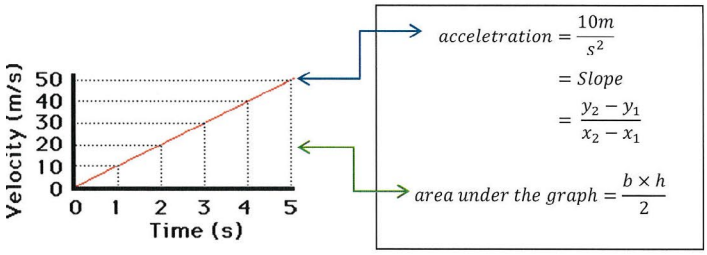


Figure 1: V-t Graph where the slope shows the acceleration (Henderson 1996- 2012).

In Laboratories speed through the measurement of time is generally measured with stop watches. Because of this systematic error must be taken into account. (Pearson Australia Group). Systematic error is when a set of measurements all differ from the actual value by about the same amount (Pearson Australia Group). In the case of human timing, systematic error would be caused by the varying reaction speeds of a person starting and stopping a stopwatch (Pearson Australia Group). This is due to perceived errors in the start and stop of motion (Pearson Australia Group).

Hypothesis:

It was hypothesised that the greater the slope height the greater the speed of the 0.024g car travelling down the (length) inclined plane will be.

Annotations

Develops a clear and logical hypothesis.

Orientation to the Overall Design:

In this experiment the variable that will be measured is the speed in which the car freely travels down the inclined plane. The variable that will be purposely manipulated in this experiment is the height of the inclined plane. To ensure that the results are fair these variables will need to be kept consistent:

Investigation report: Motion down an inclined plane

- The distance that the car travels (1m/100cm)
- The same car from the brand _ and with the weight of _
- Speed will be measured with a Leonay sports timer
- Technique of release is for the car to be released to the count down from three from the timer
- Same person was used timing (same human reaction time)
- Testing was taking inside to reduce the effects of the elements

Equipment:

- Toy Car (0.02g)
- Stop Watch (Leonay Sports timer)
- Retort stand
- Boss head
- Piece of wood (0.25 m wide 1.2m long 0.01m thick Plywood)
- 1m Ruler
- HB Pencil

Method:

1. Make a mark on the wood 1m from the end. This will be the starting line for the car. The end of the wood is the finishing point.
2. Raise the ramp to a height (h) of 0.1m from the bench top (under the mark) using a retort stand and boss head. Add the height to the table. Measure to the underside of the ramp to take the thickness of the ramp at the finish into account.
3. Hold the car lightly with its front on the line. Release the car and start the timer. As the front of the car reaches the finish line stop the timer. Record the results into the table as trial one.
4. Repeat this four more times. Each time adding the results to the table as the next trial.
5. Raise the height of the ramp to 0.2 m and add the new height to the table.
6. Measure the time taken for the car to travel down the incline 5 times. Record each time measurement into the table as new trials.
7. Raise the height of the ramp to 0.3 m and add the new height to the table.
8. Measure the time taken for the car to travel down the incline 5 times. Record each time into the table as new trials
9. Raise the height of the ramp to 0.4 m and add the new height to the table.
10. Measure the time taken for the car to travel down the incline 5 times and record the times into the table as new trials.

Annotations

Identifies variables that can be controlled to improve the fairness of the test.

Designs a logical and appropriate investigation method.

Considers reliability by specifying controlled variables and by performing repeated trials.

Investigation report: Motion down an inclined plane

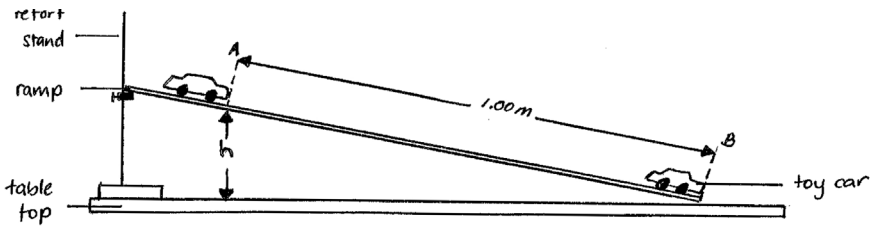


Table 1: Test Results

Height h (m)	Time (sec)					
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
0.1m	1.87	1.8	1.79	1.97	1.91	1.87
0.2m	1.25	1.34	1.34	1.31	1.27	1.04
0.4m	0.81	0.67	0.81	0.87	0.74	0.78
0.5m	0.55	0.43	0.46	0.46	0.6	0.5

$$\text{Average Time} = \frac{\textit{Total times}}{\textit{Number of times taken}}$$

$$= \frac{1.87 + 1.8 + 1.79 + 1.97 + 1.91}{5}$$

$$= \frac{9.34}{5}$$

$$= 1.868$$

$$\approx 1.87s$$

Table 2: Varying units of measurement for different ramp heights of a car freely moving down an inclined plane.

Height h (m)	Mass of car m (kg)	Average time t (s)	Average speed v (av) (m/s)	Final speed v (final) (m/s)	Acceleration A (m/s/s)	Initial GPE (J)	Final KE (J)	% Efficiency
0.1m	0.024kg	1.87	0.53m/s	1.06m/s	0.57m/s/s	0.024	0.013	54.17%
0.2m	0.024kg	1.04	0.96m/s	1.92m/s	1.85m/s/s	0.048	0.044	91.67%

6

Annotations

Constructs an appropriate table to represent data including use of consistent units.

Investigation report: Motion down an inclined plane

$$= \frac{0.013}{0.024} \times 100$$

$$\approx 54.17\%$$

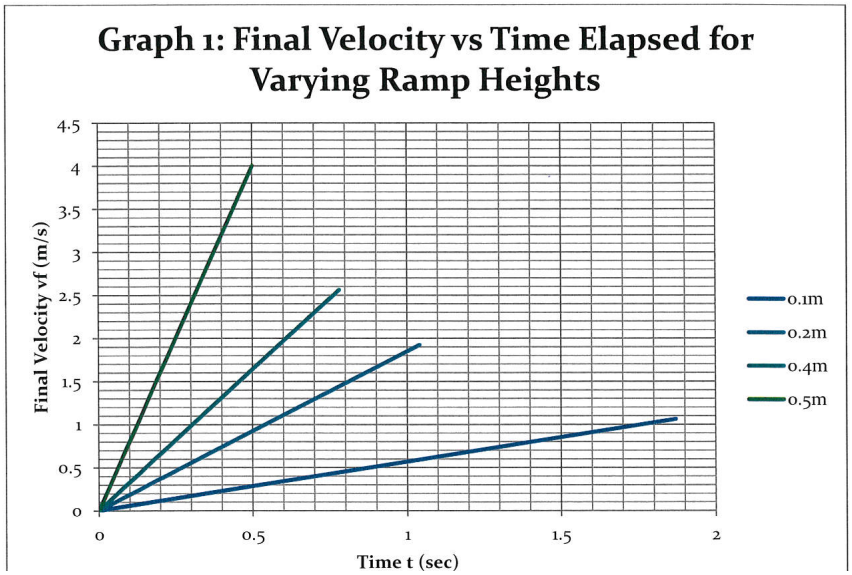
Table 3: Table showing the acceleration and displacement of the results

Height of ramp h (m)	Distance travelled d (m)	Area under each line (V-t graph)	Acceleration A (m/s/s)
0.1m	1m	0.9911	0.57m/s/s
0.2m	1m	0.9984	1.85m/s/s
0.4m	1m	0.9984	3.28m/s/s
0.5m	1m	1	8m/s/s

Area under Graph $= \frac{b \times h}{2}$

$$\frac{1.06 \times 1.87}{2}$$

$$= 0.9911$$



Annotations

Correctly selects final velocity data as evidence and constructs a line graph to represent trends.

Investigation report: Motion down an inclined plane

Discussion and Interpretation of Data

From the results when the height of the inclined plane was 0.1m the final velocity was 1.06m/s. When the height was 0.2m the velocity 1.92m/s. a velocity of 2.56m/s came from a height of 0.4m and finally from a height of 0.5m a velocity result of 4m/s was recorded. A trend that comes from this given data is that as the height of the inclined plane so too did the velocity of the car freely travelling down it. Of the 4 tests taken with a difference of only 0.17s between the five trials, the two most precise were Test 1 (height of 0.1) and 4 (height of 0.5). Test 2 on the other hand (height of 0.2m) was the least accurate with a difference of 0.30 seconds between the trials. Referring to graph 1 the shape or curve of all of the lines on the V-t is moving in a positive direction and speeding up, just like the results said they would.

The energy efficiency results that were calculated from the results of first three tests (height of 0.1m, 0.2m and 0.4m) were all under 100% efficiency. This is because as the car was freely travelling down the inclined plane there was friction caused between the surface of the inclined plan and the car's wheels. Friction creates heat energy, meaning that some of input energy was lost as wasted energy. Therefore the overall output energy was less than 100%. The energy efficiency results in the last test (height of 5.0) exceeded 100% efficiency. This was most likely caused by human error either in the timing of the tests of the releasing of the car. The car may not have had a clean release and was given extra energy from a push.

The design and method used to collect the data for the investigation on how the height of an inclined plane affects the free motion of a 0.024g car, was flawed. This can be seen from the evaluations above. Multiple errors occurred throughout the test, one being the difference in human reaction time for the starting and stopping of the stopwatch. To counter this problem more test could have been taken to ensure that the average time was as accurate as possible. A new method to start and stop the timer could have also been made, such as the same person releasing the car as starting the stopwatch. Finally, the same person to should have always been used for the timing to account for their personal reaction time. The Equipment that was used was also flawed and would have added to the inaccurate results. The inclined plane made of plywood was bowed and not perfectly straight. A smooth sticker at the base of the plane would have reduced the overall friction. A new type of wood should be used next time this test is conducted. The wood should be straight and free of bends and stickers. The toy car also didn't travel straight down the inclined plane; it had a curve and therefore travelled further than it should have. A better car with new wheel would have been sufficient to fix this problem.

9

Annotations

Analyses data to identify trends and considers uncertainty.

Explains conservation of energy within the system with reference to transfers and transformations of energy.

Identifies inconsistencies in findings, suggests possible explanations and identifies strategies to improve the method.

Investigation report: Motion down an inclined plane

To further the results and increase their use and relevance to the real world, changes could be made to the method. One change could be the material that the inclined plane is made out of. If the inclined plane was metal or concrete the friction caused by the plane would change. These materials are also more likely to be found in the real world when compared to plywood. Increased heights of the inclined plane could also be changed to get faster results. That similar to speeds achieved by roller coasters and cars. If the masses of the toy car were also scaled up then results would also be closer to that of objects in the real world, such as cars and shopping trolleys.

Conclusion

From the results when the height of the inclined plane was 0.1m the final velocity was 1.06m/s. When the height was 0.2m the velocity 1.92m/s. a velocity of 2.56m/s came from a height of 0.4m and finally from a height of 0.5m a velocity result of 4m/s was recorded. A trend that comes from this given data is that as the height of the inclined plane so too did the velocity of the car freely travelling down it. The aim of this investigation was to find the effect of the height of the slope on the motion of a 0.024g car travelling down an inclined plane. The information found above can be used to improve thrill and safeness of new roller coasters, theme parks or skate and stunt parks. Even the construction of new roads and disabled or elderly ramps can be improved. It had been hypothesised that the greater the slope height the greater the speed of the 0.024g car travelling down the (length) inclined plane will be. As taken from the results this hypothesis was supported.

Annotations

Provides an analysis of the data to justify conclusions and confirm the hypothesis.

Annotations (Overview)

The student constructs evidence-based arguments and selects appropriate representations to communicate science ideas.

Worksheet: Objects in motion

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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 previously been introduced to concepts and equations of motion. This task required students to complete a series of problems. Approximately 30 minutes was allowed and equations for velocity, average acceleration and force were provided.

Worksheet: Objects in motion

1. During the Olympic 4 x 100 metre relay, the winning team completed the race in 39.2 seconds.

(a) What is the average speed of the runners in metres per second and kilometres per hour?

$v_{av} = d / t = 400 / 39.2 = 10.2\ ms^{-1}$

$v_{av} = 10.2\ ms^{-1} / 3.6 = 2.83\ kmh^{-1}$

(b) The athlete who runs the third leg of the relay reaches his maximum speed of 10.1 ms^{-1} after about 4.40 seconds. Calculate the average acceleration of the athlete.

$a_{av} = \Delta v / t = (10.1 - 0) / 4.40 = 2.3\ ms^{-2}$

(c) The athlete has a mass of 85.0 kg. Determine the approximate force exerted by the athlete.

$F = ma = 85.0 \times 2.30 = 195$

2. A dragster accelerated at 9.00 ms^{-2}.

(a) Calculate its speed after 4.00 s.

$a_{av} = (v - u) / t$

$9.00 = (v - 0) / 4.00$

$v = 9.00 \times 4.00 = 36\ ms^{-1}$

(b) Find the distance it travels in this time.

$d = v_{av} \times t = 36 \times 4 = 144\ m$

(c) A parachute is deployed and the driver applies the brakes, which reduces the dragster's speed to zero in just 2.50 seconds.

(i) Calculate the deceleration of the dragster during this period.

$a_{av} = (v - u) / t = (36 - 0) / 2.5 = 14\ ms^{-2}$

(ii) Determine the stopping distance.

$d = v_{av} \times t = 36 \times 2.5 = 90\ m$

(iii) Calculate the force exerted by the brakes and parachute if the dragster and driver have a total mass of 950 kg.

$F = ma = 950 \times 14 = 13,300$

(iv) If the total mass of the dragster and driver are doubled and the same force is applied, predict its deceleration without the use of calculations. Justify your answer.

If m goes up by 2 and F stays the same then a has to go down by 2. So the acceleration will be half.

Annotations

Uses the force, mass and acceleration relationship to solve problems involving the motion of objects.

Calculates changes in the motion of objects.

Uses the force, mass and acceleration relationship to predict changes in the motion of objects.

Annotations (Overview)

The student selects and uses appropriate representations to solve numerical problems.

Written test: Chemical reactions

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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 completed a written assessment at the end of a unit of work on the periodic table, chemical reactions, reaction rate and energy. The assessment was carried out under closed-book examination conditions.

The work sample includes some of the test material.

Written test: Chemical reactions

12. Write a **word equation** AND a **balanced chemical equation** for each of the following reactions:

a) The combustion of hexane (C_6H_{14}) in oxygen gas:

Word: Hexane + Oxygen → Hexane Oxide + Carbon Oxide

Balanced: $C_6H_{14} + O_3^- \rightarrow C_6H_{14}O_3$

b) The reaction of lead nitrate with potassium iodide:

Word: Lead Iodide + Potassium Nitrate →

Balanced: $Pb^{4-} + I^{1-} \rightarrow K^{1+} + NO_3^-$

$Pb + I_4 \rightarrow KNO_3$

13. Calcium perchlorate is an ionic compound. Its formula is $Ca(ClO_4)_2$. Iron chloride is also an ionic compound. Its formula is $FeCl_3$

a) Write the formula for the **ions** that are present in calcium perchlorate (include their charge).

Ca^{2+}, ClO_4^- $Ca^{2+} + ClO_4^- \rightarrow Ca(ClO_4)_2$

b) Write the formula for the **ions** that are present in iron chloride (include their charge).

$Fe^{3+} + Cl^- \rightarrow FeCl_3$

c) Using this information, write the formula for iron perchlorate

$Fe^{3+} + ClO_4^- \rightarrow Fe(ClO_4)_3$

Annotations

Attempts to construct word and symbolic chemical equations to show how chemical reactions produce particular products.

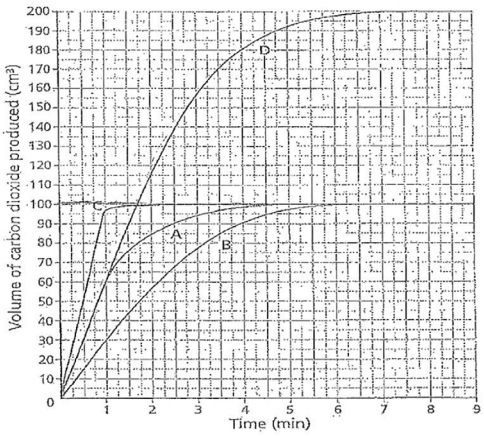
Correctly represents the formulas of ionic compounds.

Written test: Chemical reactions

14. Emma and Luke carried out some reactions using hydrochloric acid and calcium carbonate (marble chips). They did an experiment four times each time changing one variable. The table below gives the conditions they used for each of the experiments:

Reaction	A	B	C	D
Volume of acid (mL)	50	50	50	100
Volume of water added (mL)	0	50	0	0
Temperature (°C)	20	20	60	20

The graph on the next page shows the results:



a) How much carbon dioxide was produced in reaction A?

100cm³

b) Which reaction was the fastest? Why? **Justify** your answer.

Reaction C was the fastest because it has the steepest slope. Which means the reactants in the experiment was reacted at a quicker pace

Annotations

Recognises different rates of reaction from graphical data.

Written test: Chemical reactions

c) Emma and Luke were asked to explain why reactions B and D have different graphs.

Luke said "Obviously there was an error in the measurement. Reaction B should have produced CO_2 at the same rate as reaction D because they both use 100 mL of solution. Acids have water in them anyway so it makes no difference that there is 50 mL of acid and 50 mL of water."

Emma said "Well they have the same volume of solution but it's not the water that reacts with the marble chips, it's the acid. So reaction B really only has half the amount of acid as reaction D so its graph is different."

Evaluate the claims made by these two students using your knowledge of chemical reactions and factors that influence their rate. State who you agree with and why.

I agree with Emma, because for their experiment the reactant is the Hydrochloric acid & not the water. So ~~eva~~ even if they do have the same volume ~~they~~ There is still only half the amount of the reactant in reaction B then there is in D, plus it's much more diluted so the acid molecules don't connect with the marble chips as much Therefore the experiment with only happen half as fast as experiment D.

Annotations

Identifies and explains that the quantity of reactant present influences the rate of reaction.

Annotations (Overview)

The student selects appropriate representations to communicate scientific ideas for a specific purpose.

Research task: The theory of evolution by natural selection

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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.

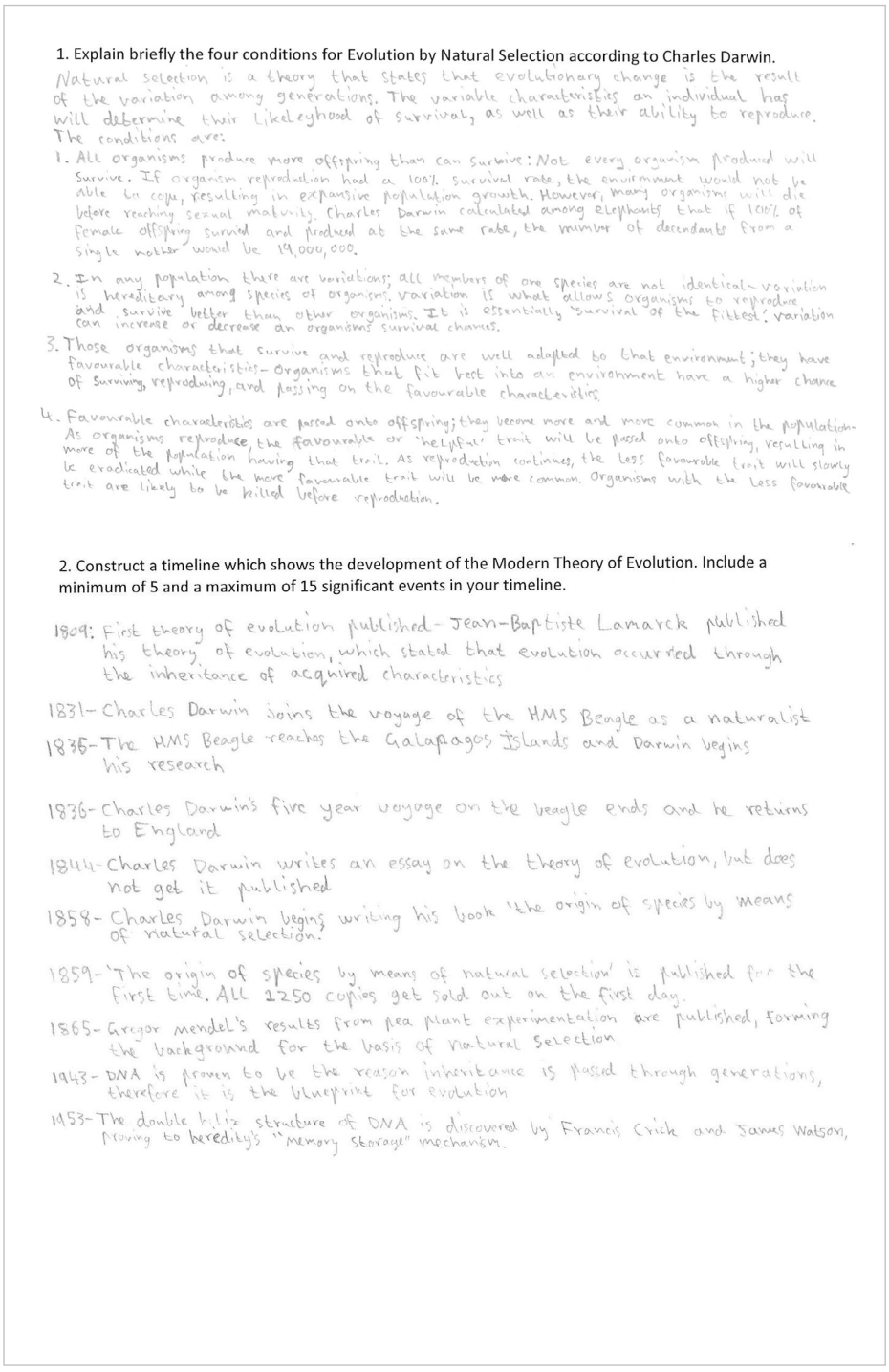
Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital 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 previously completed a unit of work in which early theories of evolution were discussed as well as the theory of evolution by natural selection. In this task, students worked individually to demonstrate their understanding of the theory, its development over time and its evidence base. They investigated how improvements in technology have influenced the development of the theory and researched the contribution of a scientist of their choice to development of the theory.

Students completed a task booklet in response to identified questions. They were required to include a list of sources used in their research.

Research task: The theory of evolution by natural selection



1. Explain briefly the four conditions for Evolution by Natural Selection according to Charles Darwin.

Natural selection is a theory that states that evolutionary change is the result of the variation among generations. The variable characteristics an individual has will determine their likelyhood of survival, as well as their ability to reproduce. The conditions are:

1. All organisms produce more offspring than can survive: Not every organism produced will survive. If organism reproduction had a 100% survival rate, the environment would not be able to cope, resulting in expansive population growth. However, many organisms will die before reaching sexual maturity. Charles Darwin calculated among elephants that if 100% of female offspring survied and produced at the same rate, the number of decendants from a single mother would be 19,000,000.
2. In any population there are variations; all members of one species are not identical- variation is hereditary among species of organism. variation is what allows organisms to reproduce and survive better than other organisms. It is essentially 'survival of the fittest.' variation can increase or decrease an organisms survival chances.
3. Those organisms that survive and reproduce are well adapted to that environment; they have favourable characteristics- Organisms that fit best into an environment have a higher chance of surviving, reproducing, and passing on the favourable characteristics
4. Favourable characteristics are passed onto offspring; they become more and more common in the population. As organisms reproduce, the favourable or 'helpful' trait will be passed onto offspring, resulting in more of the population having that trait. As reproduction continues, the less favourable trait will slowly be eradicated while the more favourable trait will be more common. Organisms with the less favourable trait are likely to be killed before reproduction.

2. Construct a timeline which shows the development of the Modern Theory of Evolution. Include a minimum of 5 and a maximum of 15 significant events in your timeline.

1809: First theory of evolution published- Jean-Baptiste Lamarck published his theory of evolution, which stated that evolution occurred through the inheritance of acquired characteristics

1831- Charles Darwin joins the voyage of the HMS Beagle as a naturalist

1836- The HMS Beagle reaches the Galapagos Islands and Darwin begins his research

1836- Charles Darwin's five year voyage on the beagle ends and he returns to England

1844- Charles Darwin writes an essay on the theory of evolution, but does not get it published

1858- Charles Darwin begins writing his book 'the origin of species by means of natural selection.'

1859- 'The origin of species by means of natural selection' is published for the first time. All 1250 copies get sold out on the first day.

1865- Gregor Mendel's results from pea plant experimentation are published, forming the background for the basis of natural selection.

1943- DNA is proven to be the reason inheritance is passed through generations, therefore it is the blueprint for evolution

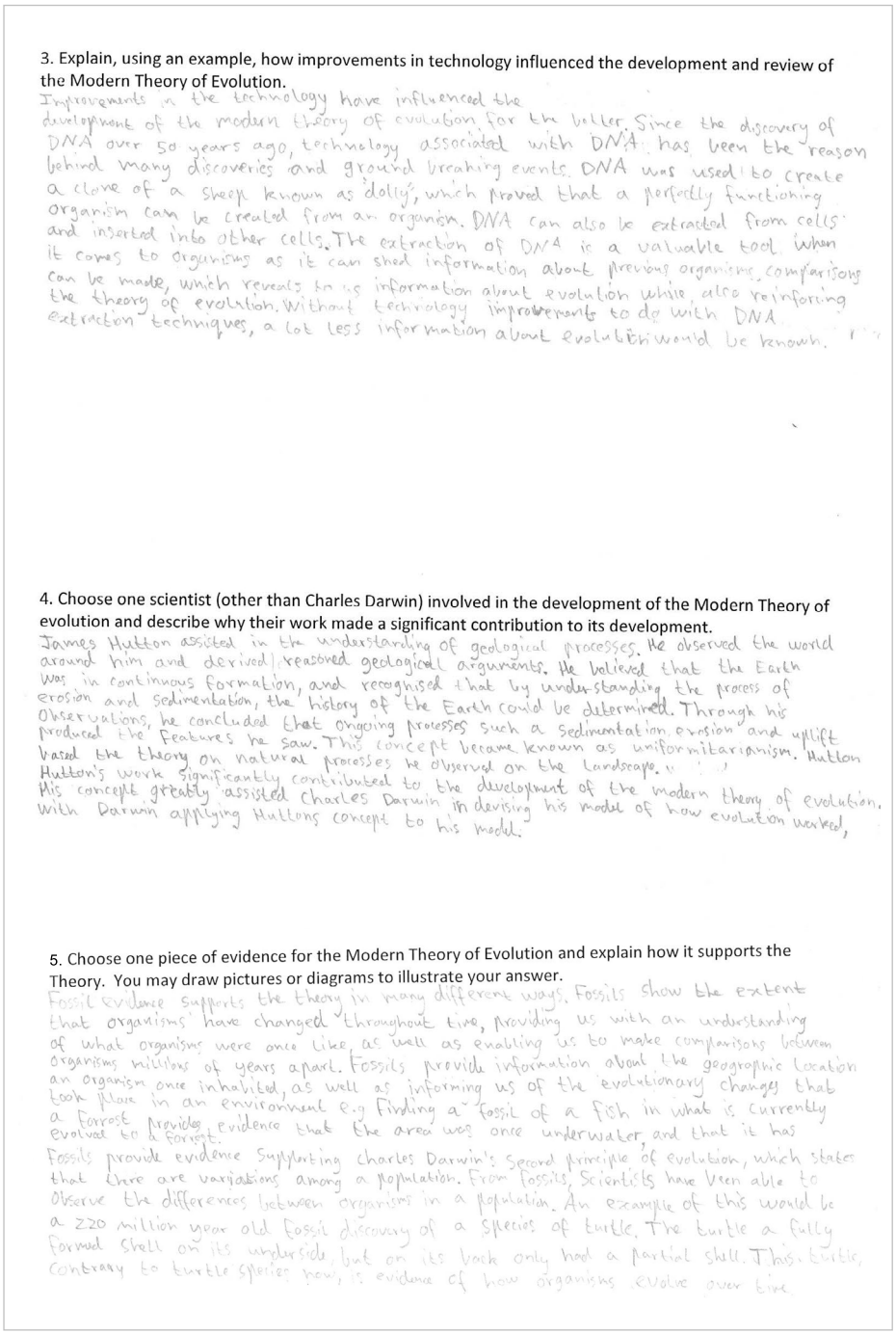
1953- The double helix structure of DNA is discovered by Francis Crick and James Watson, proving to heredity's "memory storage" mechanism.

Annotations

Outlines the processes involved in natural selection.

Selects significant events in the development of the theory of evolution, including alternative theories, key publications and supporting evidence.

Research task: The theory of evolution by natural selection



3. Explain, using an example, how improvements in technology influenced the development and review of the Modern Theory of Evolution.

Improvements in the technology have influenced the development of the modern theory of evolution for the better. Since the discovery of DNA over 50 years ago, technology associated with DNA has been the reason behind many discoveries and ground breaking events. DNA was used to create a clone of a sheep known as 'dolly', which proved that a perfectly functioning organism can be created from an organism. DNA can also be extracted from cells and inserted into other cells. The extraction of DNA is a valuable tool when it comes to organisms as it can shed information about previous organisms, comparisons can be made, which reveals to us information about evolution while also reinforcing the theory of evolution. Without technology improvements to do with DNA extraction techniques, a lot less information about evolution would be known.

4. Choose one scientist (other than Charles Darwin) involved in the development of the Modern Theory of evolution and describe why their work made a significant contribution to its development.

James Hutton assisted in the understanding of geological processes. He observed the world around him and derived/reasoned geological arguments. He believed that the Earth was in continuous formation, and recognised that by understanding the process of erosion and sedimentation, the history of the Earth could be determined. Through his observations, he concluded that ongoing processes such a sedimentation, erosion and uplift produced the features he saw. This concept became known as uniformitarianism. Hutton based the theory on natural processes he observed on the landscape.
Hutton's work significantly contributed to the development of the modern theory of evolution. His concept greatly assisted Charles Darwin in devising his model of how evolution worked, with Darwin applying Huttons concept to his model.

5. Choose one piece of evidence for the Modern Theory of Evolution and explain how it supports the Theory. You may draw pictures or diagrams to illustrate your answer.

Fossil evidence supports the theory in many different ways. Fossils show the extent that organisms have changed throughout time, providing us with an understanding of what organisms were once like as well as enabling us to make comparisons between organisms millions of years apart. Fossils provide information about the geographic location an organism once inhabited, as well as informing us of the evolutionary changes that took place in an environment e.g Finding a fossil of a fish in what is currently a forrest provides evidence that the area was once underwater and that it has evolved to a forrest.
Fossils provide evidence supporting charles Darwin's second principle of evolution, which states that there are variations among a population. From fossils, Scientists have been able to observe the differences between organisms in a population. An example of this would be a 220 million year old fossil discovery of a species of turtle. The turtle a fully formed shell on its underside, but on its back only had a partial shell. This turtle, contrary to turtle species now, is evidence of how organisms evolve over time.

Annotations

Identifies that technologies associated with DNA analysis and manipulation have provided further evidence to support the theory of evolution.

Illustrates how multiple scientists across a range of fields contributed to the development of the theory of evolution by natural selection.

Explains, using examples, how selected evidence supports the theory of evolution by natural selection.

Science

Year 10
Satisfactory

Research task: The theory of evolution by natural selection

6. Based on the evidence that is available, can the Modern Theory of Evolution be accepted as true at this point in time? Explain your answer using one example from the evidence.

Based on the evidence available, the modern theory of evolution can be accepted as true at this point in time. DNA and protein structure is an example of evidence supporting the theory. The human genetic code is 98.5% the same as chimpanzees, providing reason to believe that humans have evolved from chimpanzees due to the genetic similarity shared by both human and chimp. Genetic material is passed from generation to generation, resulting in offspring inheriting characteristics and then passing them on. Throughout the passing of genetic material among generations, certain characteristics that allow an organism to be better suited to its environment will continuously be passed on, resulting in the organism evolving to best suit its environment.

Distribution is another piece of evidence providing reason as to why the Modern Theory of Evolution can be accepted as true. Techtonic Plate Shift gives evidence that all animals were once in the same area. Animals may share certain traits, behavioural and eating patterns despite being separate species and living accross the world from eachother. An example of this would be an ostrich and an emu. Both animals are similar in shape, found in similar environments and have a similar diet, however each specie is located on a seperate continent. Techtonic Plate shift also shows that Australia has been isolated from other land masses for millions of years, giving time for the evolution of major groups of mammals. The shifting of techtonic plates also shows that isolated islands higher proportions of unique species, giving reason to infer that the unique species are the result of evolution.

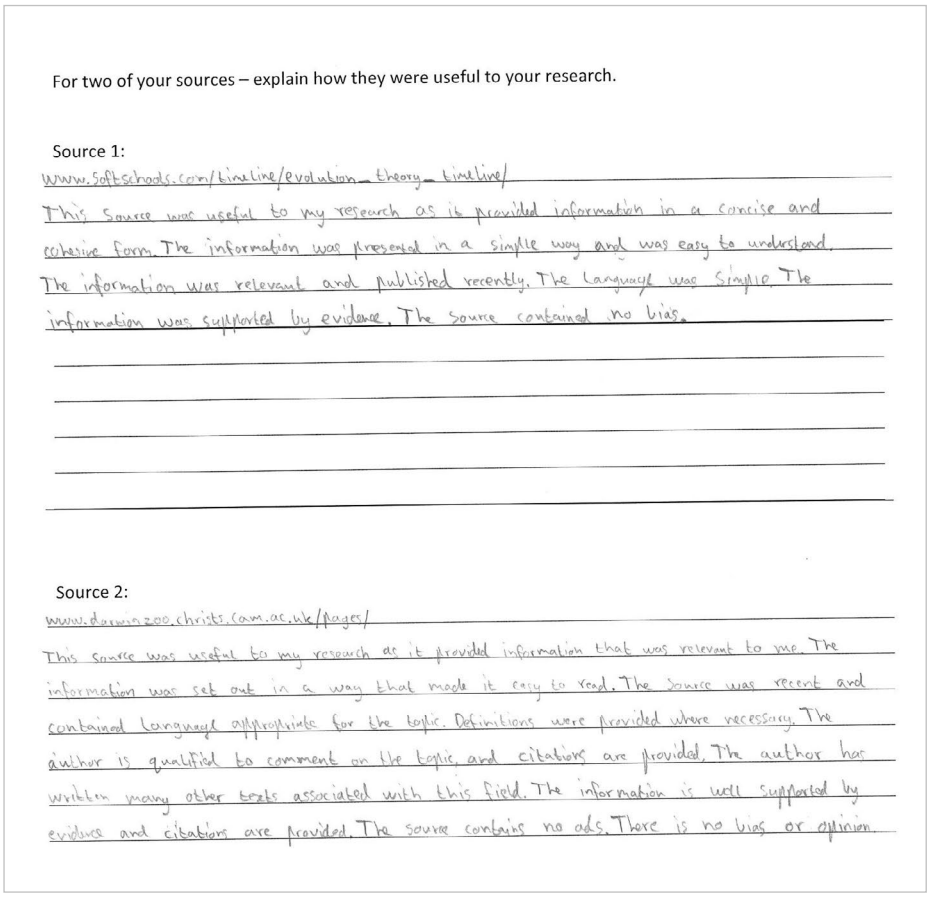
Bibliography:

www.darwin200.christs.cam.ac.uk – Natural selection, 2009, Darwin Christ's College
www.agiweb.org/news/evolution – Darwin's revolutionary theory, 2001, American geological institute
www.necsi.edu/Projects/evolution – How does evolution occur, 2011, necsi
www.softschools.com/timeline/evolution_theory_timeline/ – evolution theory, 2013
atheism.about.com/od/aboutevolution/
whyfiles.org/095evolution/5.html – evolution, 1999
geography.about.com – uniformitarianism
Sci.Waikato.ac.nz/evolution – Darwin and religion
www.bbc.co.uk/schools/gcsebitesize/science

Annotations

States a position and provides a range of evidence to support that position.

Research task: The theory of evolution by natural selection



For two of your sources – explain how they were useful to your research.

Source 1:

www.softschools.com/timeline/evolution_theory_timeline/

This source was useful to my research as it provided information in a concise and cohesive form. The information was presented in a simple way and was easy to understand. The information was relevant and published recently. The language was simple. The information was supported by evidence. The source contained no bias.

Source 2:

www.darwinzoo.christs.cam.ac.uk/pages/

This source was useful to my research as it provided information that was relevant to me. The information was set out in a way that made it easy to read. The source was recent and contained language appropriate for the topic. Definitions were provided where necessary. The author is qualified to comment on the topic, and citations are provided. The author has written many other texts associated with this field. The information is well supported by evidence and citations are provided. The source contains no ads. There is no bias or opinion.

Annotations

Annotations (Overview)

The student uses appropriate language and scientific terms to construct evidence-based arguments and communicate science ideas.

Research report: The Big Bang theory

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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Summary of task

Students were required to undertake research that would enable them to outline the origin of the universe as described by the Big Bang theory. They were also asked to discuss the contributions of scientists in the development of the theory and elaborate on the involvement of Australian scientists.

Students presented their research in the form of a written report. There was no word limit specified. Students were encouraged to provide a reference list of the sources used to gather their information.

Research report: The Big Bang theory

THE BIG BANG THEORY

In this essay I will discuss the Big Bang theory and the people who had large impacts on the theory, eg Albert Einstein, Edwin Hubble, ect. I will discuss all, the evidence with all terms explained. Such as cosmic microwave background radiation, red shift and so on.

The theory of the Big Bang is a theory about the beginnings of the universe,in simple terms the universe at the beginning was a hot dense mass that expanded and cooled rapidly resulting in the universe, the theory also states the universe is still expanding, in the cooling state many components of life formed like protons, neutrons and electrons which later formed many of our elements, the first elements were a mix of hydrogen and helium.

The first observation of evidence for the Big Bang was when Vesto Slipher observed that a spiral galaxy in the distance was moving further and further away. But he did not think much about it at the point 5 years later the Friedmann theory was made by correcting einsteins theory of relativity this was made by Alexander Friedmann. Then Edwin Hubbell's measurements proved Vesto Slipher right. Many people didn't like this change in their knowledge and many rejected it until later on. Soon more and more evidence was found to support the Big Bang theory over the steady state theory(theory where universe always was and always will be and is infinite)

One such piece of evidence is cosmic microwave background radiation, this is thermal radiation left over from the Big Bang, which was discovered by Arno Penzias and Robert Wilson by accident, this discovery was made in 1964 they were later given a Nobel prize for their discoveries. Astrologists can observe this all the time and 1989 NASA launched a cosmic microwave background radiation detector which proved Arnos and Roberts theory correct and gave solid evidence for the Big Bang theory.

Another piece of evidence is cosmological red shift can be seen because the universe is ever expanding and the far away stars emitting light emit red shift light as well because they are moving further away causing the wave lengths to lengthen or move to the redder end of the spectrum. This was first discovered by observing the mechanics of the Doppler effect, which was made by Christian Doppler who was the fist person to explain this theory.

Diagram demonstrating red shift

Annotations

Describes the Big Bang theory of the origin of the universe.

Describes how the Big Bang theory developed over time through the contributions of a number of scientists.

Presents a range of evidence that led to the development of the Big Bang theory and explains how some of this evidence supports the theory.

Research report: The Big Bang theory

Image showing a model of space time

The next piece of evidence is space time where there are 3 dimensions: height, width and length along with time where events occur, this can be used to calculate events and such this theory supports the Big Bang theory by saying the 3 dimensions are expanding whilst the time is staying the same and events are occurring in the ever expanding universe. This was first thought of by mathematicians thinking of it in an expanded geometric point of view.

The universe can be accurately aged due to it is the oldest possible thing ever so we can measure the age by looking at old white dwarf stars and judging the age by that, but there is a better method, scientists can observe the red shift waves given off by very distant stars and planets and therefore get a good reading on the age of the universe which is thought to be around 3.75 billion years old.

Australian international gravitational observatory

A large observatory/centre for space is located in Gingin and is run through the university of Australia. It's current project is to create a telescope/ technology that can detect gravitational waves, it is predicted that they will start the building of the project soon in about 1-4 years, they will begin building this project on the site of the observatory in Gingin. They wanted to start this project in pursuit of Einstein's theory of gravitational waves. Many different countries have pledged millions into this project and currently had a budget of over 140 million and this is expected to increase to roughly 200 million.

REFERENCES
Websites:
http://imagine.gsfc.nasa.gov/docs/features/exhibit/map_age.html
http://en.wikipedia.org/wiki/Age_of_the_universe
http://en.wikipedia.org/wiki/Big_Bang
http://www.big-bang-theory.com/
http://en.wikipedia.org/wiki/Redshift
http://en.wikipedia.org/wiki/Spacetime
http://en.wikipedia.org/wiki/AIGO
IMAGES:
Figure 1 explaining red shift http://en.wikipedia.org/wiki/File:Redshift_blueshift.svg
Figure 2 showing a model of space time http://en.wikipedia.org/wiki/Spacetime

Annotations

Acknowledges the role of Australian science in gathering evidence related to the origin of the universe.

Annotations (Overview)

The student constructs evidence-based arguments and selects appropriate representations of science ideas for an explanatory essay.

Source analysis: Designer babies

Year 10 Science achievement standard

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Summary of task

Students read an article published by an online news source outlining the practices of an American fertility clinic. They were then required to analyse the article for its relevance, credibility and bias. Students were provided with prompts and clues to assist in this process. A single 50-minute lesson was allowed for completion of the task.

Source analysis: Designer babies

The Task:

- Read and analyse the source attached for relevance, credibility and bias. You should identify elements by **annotating** the articles to show indicators of relevance, bias and credibility. You s try to use a number of different indicators to demonstrate clear understanding of these terms
- Answer the questions below:

1. Describe the intended audience for "'Designer baby row over US clinic." based on the annotat you have made.

This article aims at couples who think they want to have a go at altering their baby's appearance or sex selection. The clinic offers a range of services that might appeal to couples. Parents are said that they have the chance to select eye and hair colour for their offspring and is permeated with "I would not say this is a dangerous road". The other intended audience is for couples wishing to seek both medical and cosmetic reasons at the clinic. Patients who have genetic screening for abnormal chromosome conditions in their embryos are welcomed for cosmetic selection.

2. Do you think the article is credible? Support your answer using specific examples from your annotations of the article.

The article is credible in my opinion as it gives the person's name and the organization. Dr [redacted] was a pioneer in the 1970's and now runs the [redacted] Fertility Institute. Dr [redacted] has given much detail about designer babies and the services his clinic offers. He has said that "I would not say this is a dangerous road. It's an uncharted road", however this is not very reliable and trustworthy information. Dr [redacted] is a UK fertility expert and a member of the Royal College of Obstetricians and Gynaecologists' ethics committee, has disagreed with the positive selection. "Turning babies into commodities that you buy off the shelf" she said.

3. Do you think the article is biased? Support your answer using specific examples from your annotations of the article.

I don't think this article is biased as the title as the title does not agree with anything although the qualified people have given their opinions based

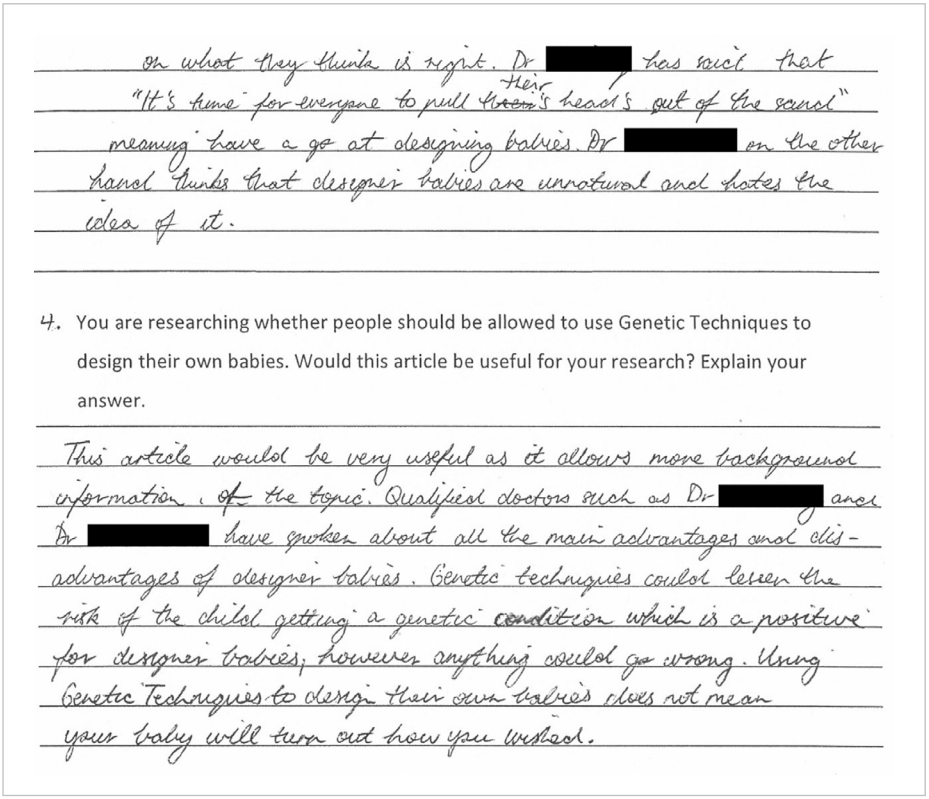
Annotations

Analyses the language of the article and makes a plausible inference about audience and purpose.

Evaluates the credibility of the article by considering the qualifications of those offering opinions.

Makes a judgement that the article is unbiased because it reports a range of perspectives on the issue.

Source analysis: Designer babies



on what they think is right. Dr [redacted] has said that "It's time for everyone to pull their head's out of the sand" meaning have a go at designing babies. Dr [redacted] on the other hand thinks that designer babies are unnatural and hates the idea of it.

4. You are researching whether people should be allowed to use Genetic Techniques to design their own babies. Would this article be useful for your research? Explain your answer.

This article would be very useful as it allows more background information of the topic. Qualified doctors such as Dr [redacted] and Dr [redacted] have spoken about all the main advantages and disadvantages of designer babies. Genetic techniques could lessen the risk of the child getting a genetic condition which is a positive for designer babies, however anything could go wrong. Using Genetic Techniques to design their own babies does not mean your baby will turn out how you wished.

Annotations

Considers the reliability of the scientific views when evaluating the suitability of the article to inform research.

Annotations (Overview)

The student constructs arguments and selects representations to communicate science ideas.

Written test: Genetics and evolution

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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 completed a unit on genetics and heredity. They had investigated processes of inheritance and the structure and function of DNA, chromosomes and genes. They had used Punnett squares and pedigree charts to investigate and predict patterns of inheritance and explored the difference between phenotype and genotype.

The students were required to complete an end-of-unit written test. The task was completed under closed-book conditions. The time allowed was 90 minutes. A selection of the test items has been included.

Written test: Genetics and evolution

SECTION A: Multiple Choice: Circle the most correct answer. (**1 Mark** for each Question)

1. Animals that use sexual reproduction
   - A. inherit their chromosomes from one parent
   - (B) gets exactly half their chromosomes from each parent
   - C. get their father genes if they are a boy, their mother's if they are a girl
   - D. rely on mutation for variation within the species

2. A chromosome is
   - (A) A strand of DNA containing many genes
   - B. A strand of DNA containing one gene
   - C. Half of the genetic code for an organism
   - D. something that is used to coat bumper bars

3. A normal human cell has
   - A. 92 chromosomes
   - B. 23 chromosomes
   - C. 1 chromosomes
   - (D) 46 chromosomes

4. The gene for brown colour in eyes (B) is dominant over the gene for blue eye colour (b). If a person has blue eyes then their genotype must be:
   - A. BB
   - B. BB or bb
   - C. Bb
   - (D) bb

5. The pair of chromosome that determines if a baby is a boy is:
   - (A) XY
   - B. XX
   - C. YY
   - D. XO

6. In sheep, white coat colour (W) is dominant over black coat colour (w). If Mr and Mrs Baa are both white sheep, could they produce a black sheep?
   - A. Yes, if one of the parents is heterozygous.
   - (B) No, one of the parents would have to be black to have a black offspring.
   - C. Yes, if both of the parents are heterozygous.
   - D. Yes, if one of the "grandparents" was a black sheep.

Annotations

Responses to most multiple-choice questions demonstrate an understanding of structures and processes associated with heredity and genetics.

Written test: Genetics and evolution

7. A biology student wants to examine gamete formation. **Select** the most suitable prepared slide for her to examine.

A. Human skin
B. Rat testes
C. Early developing embryo
D. Human bone marrow

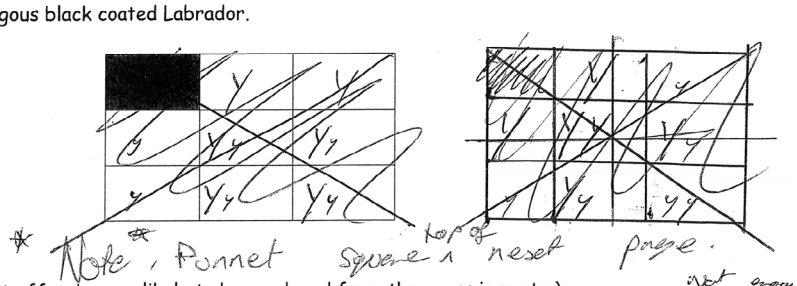
SECTION B: Short Answers

12. **Explain** why variation is necessary before natural selection can occur.

Variation is very important because natural selection can occur because a wide variety of species needs to be assessed to see who is best Suit for the environment.

13. Y represents the allele for a yellow coat and y represents the allele for a black coat.

a) Complete the punnett square of a cross between a homozygous yellow-coated Labrador and a homozygous black coated Labrador.



Note, Punnet Square on next page.

b) What offspring are likely to be produced from the cross in part a)

GENOTYPE		PHENOTYPE	
[illegible] %	[illegible]	%	
Yy %	100%	100 %	yellow coated.
[illegible] %	[illegible]	%	

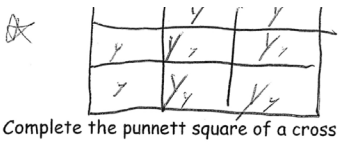
Punnet Square next page.

Annotations

Shows some understanding of the relationship between variation and natural selection.

Uses Punnett squares to predict the likely offspring from both homozygous and heterozygous parents.

Written test: Genetics and evolution



c) Complete the punnett square of a cross between two heterozygous Labradors.

	Y	y
Y	YY	Yy
y	Yy	yy

d) What offspring are likely to be produced from the cross in c)

GENOTYPE		PHENOTYPE	
YY	% 25%	75	% yellow coat
yy	% 25%	25	% black coat
Yy	% 50%		%

14b) **List** and **explain** 2 things which are different between Mitosis and Meiosis

1. Mitosis is the reproduction of normal cells. eg. Stem cells.
" Mitosis produces 2 daughter cells.
2. Meiosis is the reproduction of sex cells.
" Meiosis produces 4 daughter cells.

Annotations

Identifies two differences between mitosis and meiosis.

Written test: Genetics and evolution

The following information relates to Q 20

The Spiro was a very simple, single-celled organism that once lived in a freshwater lake. It was so simple that it did not have to rely on meeting the opposite sex in order to reproduce. Baby Spiros, identical to their parents, budded off directly from their parent cell.

The main competition for the Spiros in the lake was from another simple organism, called a Hiro, which looked very similar to the Spiro and had very similar requirements. There was, however, one major difference: Hiros reproduced sexually and therefore, females had to find a male to mate with.

The lake was fed by an inland river system and although it usually contained some water, water levels fluctuated with seasons.

At first the Spiros out-competed the Hiros and there were many more Spiros than Hiros. Later on, however, it was the Hiros that flourished, while the Spiros numbers declined.

20. Reflect on the above information and **hypothesise** why the Hiros may have eventually out-competed the Spiros.

Although the Hiros had to find another mate to make with they could produce more offspring than the Spiros. The Spiros are exactly the same as each other but the Hiros could produce different offspring.

Annotations

Identifies a difference between the rate of asexual and sexual reproduction.

Annotations (Overview)

The student constructs evidence-based arguments and correctly uses a range of representations to communicate science ideas.

Investigation report: Nutrient cycling

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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 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 cycling and interactions between 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.

Investigation report: Nutrient cycling

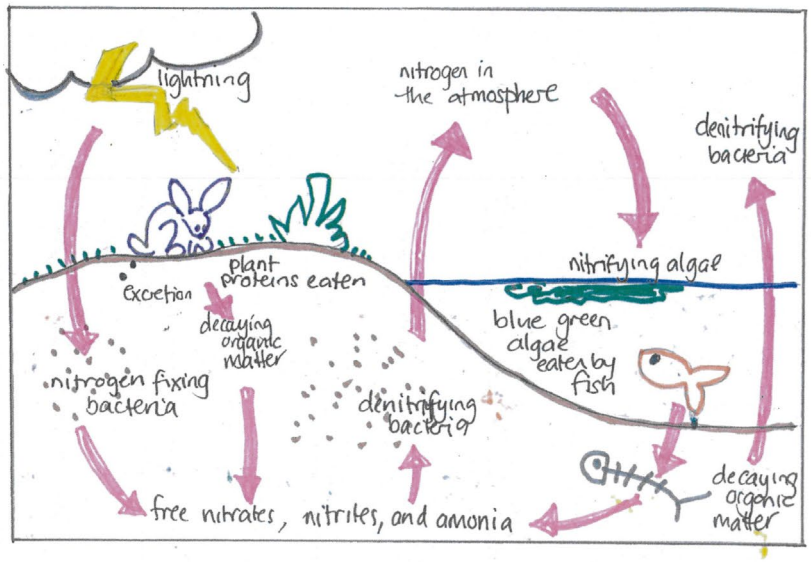
Dredging and the Nitrogen Cycle in Port Phillip Bay

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

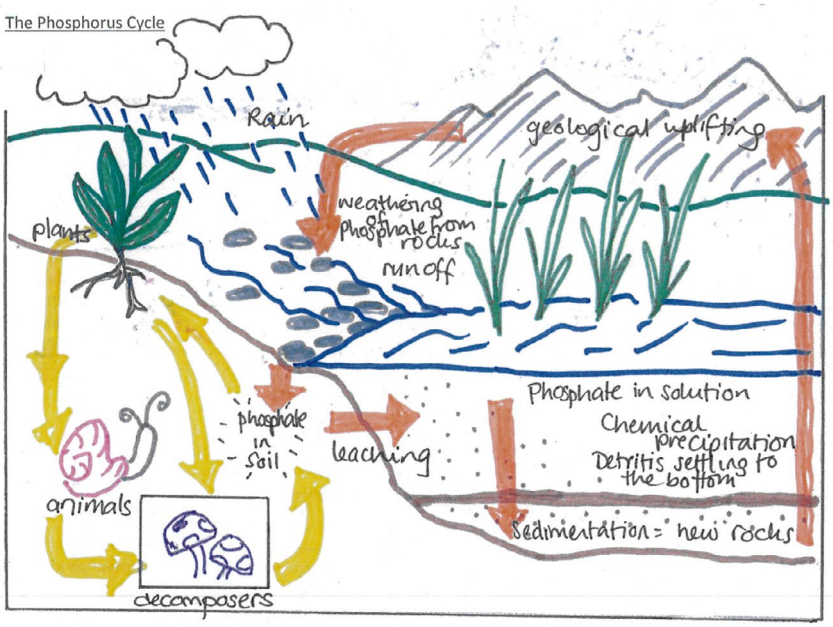


Phosphorus is an essential nutrient for plants and animals. It is part of DNA, bones and teeth. Phosphorus can be found in water, soil and sediments. It is not found in the air as a gas, but can be found in the air as small gas particles. Phosphorus is mostly found in rock formations and ocean sediments.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

Annotations

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

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 Matthew 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)

The student selects appropriate representations to communicate science ideas.

Investigation: Global ocean currents

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *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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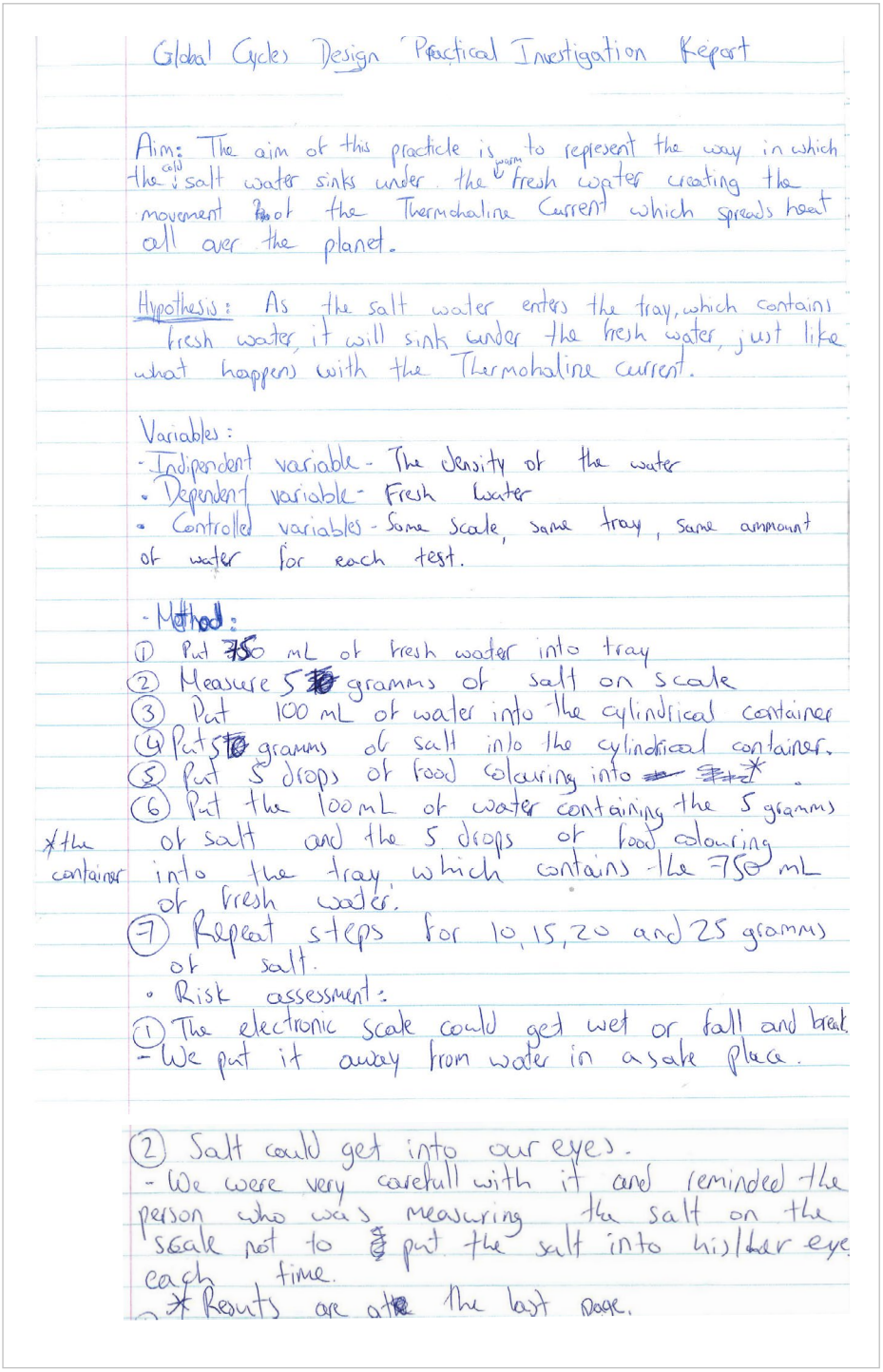
Summary of task

Students were completing a unit of work on global cycles. They had explored and discussed the ways in which global cycles involve interactions between the atmosphere, hydrosphere, geosphere and biosphere. For this task, they were required to investigate the role of water density in the processes that underpin ocean currents. They were required to design and conduct an investigation that explored an analogy for current formation, and to present their findings in a report, including responding to a set of theory questions as part of their discussion.

Investigation: Global ocean currents



Global Cycles Design Practical Investigation Report

Aim: The aim of this practicle is to represent the way in which the cold salt water sinks under the warm fresh water creating the movement of the Thermohaline Current which spreads heat all over the planet.

Hypothesis: As the salt water enters the tray, which contains fresh water, it will sink under the fresh water, just like what happens with the Thermohaline current.

Variables:
- Independent variable - The density of the water
- Dependent variable - Fresh water
- Controlled variables - Same scale, same tray, same ammount of water for each test.

- Method:
① Put 750 mL of fresh water into tray
② Measure 5 gramms of salt on scale
③ Put 100 mL of water into the cylindrical container
④ Put 5 gramms of salt into the cylindrical container.
⑤ Put 5 drops of food colouring into *
⑥ Put the 100mL of water containing the 5 gramms of salt and the 5 drops of food colouring into the tray which contains the 750 mL of fresh water.
⑦ Repeat steps for 10, 15, 20 and 25 gramms of salt.

*the container

- Risk assessment:
① The electronic scale could get wet or fall and break - We put it away from water in a safe place.

② Salt could get into our eyes.
- We were very carefull with it and reminded the person who was measuring the salt on the scale not to put the salt into his/her eye each time.

* Results are at the last page.

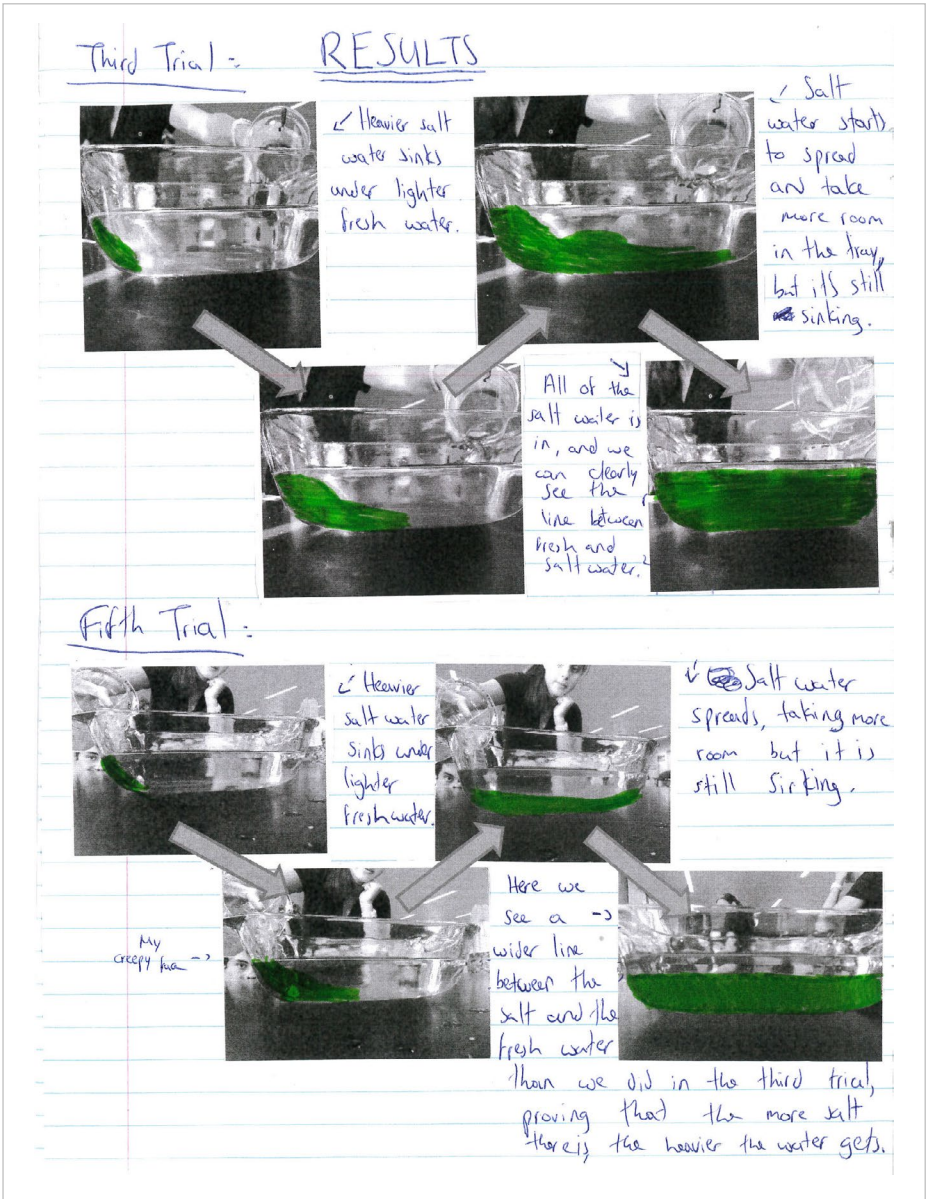
Annotations

Develops a hypothesis based on science knowledge.

Identifies variables and designs an appropriate method to ensure the investigation is fair and reliable.

Considers safety and appropriate use of equipment.

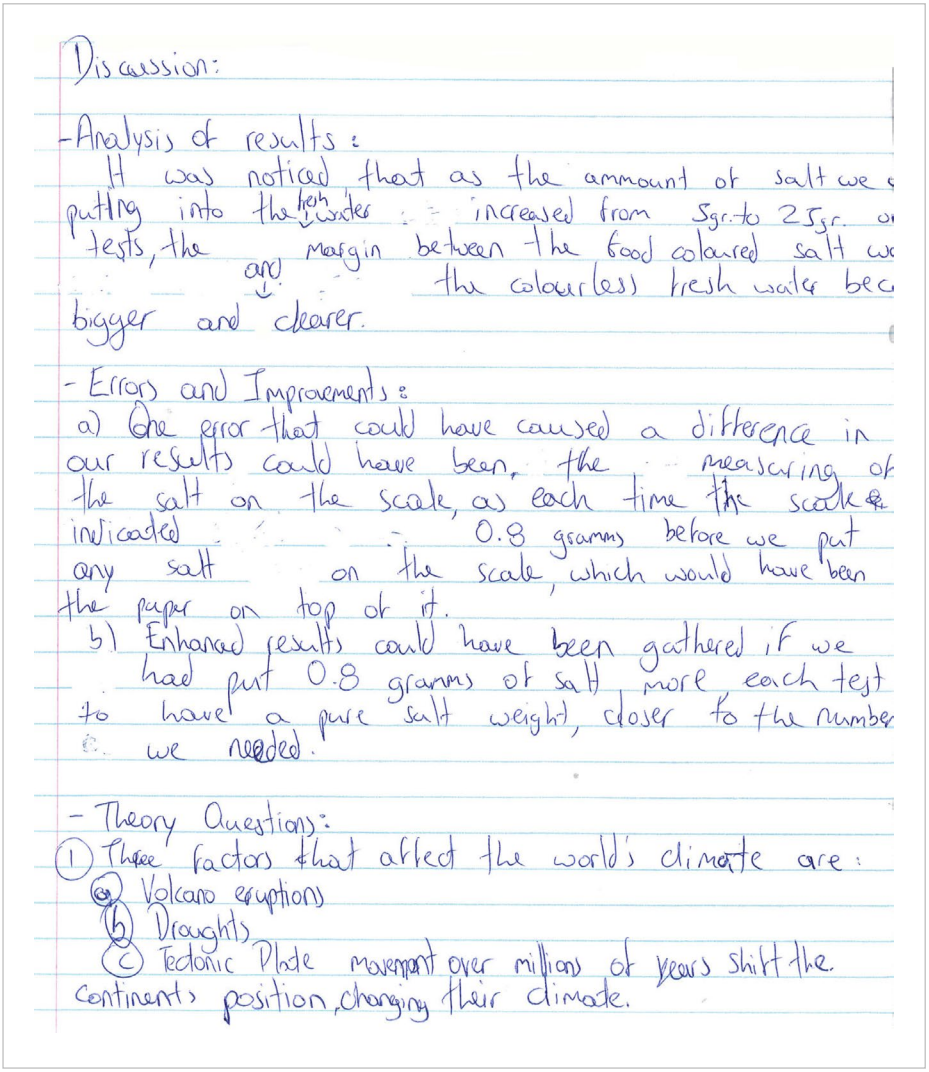
Investigation: Global ocean currents



Annotations

Communicates results for two trials through annotated photographs showing a time series.

Investigation: Global ocean currents



Discussion:

-Analysis of results:
It was noticed that as the amount of salt we ~~s~~ putting into the fresh water increased from 5gr. to 25gr. o~~n~~ tests, the margin between the food coloured salt wa~~ter~~ and the colourless fresh water bec~~ame~~ bigger and clearer.

- Errors and Improvements:
a) One error that could have caused a difference in our results could have been, the measuring of the salt on the scale, as each time the scale ~~was~~ indicated 0.8 grams before we put any salt on the scale, which would have been the paper on top of it.
b) Enhanced results could have been gathered if we had put 0.8 grams of salt more each test to have a pure salt weight, closer to the number we needed.

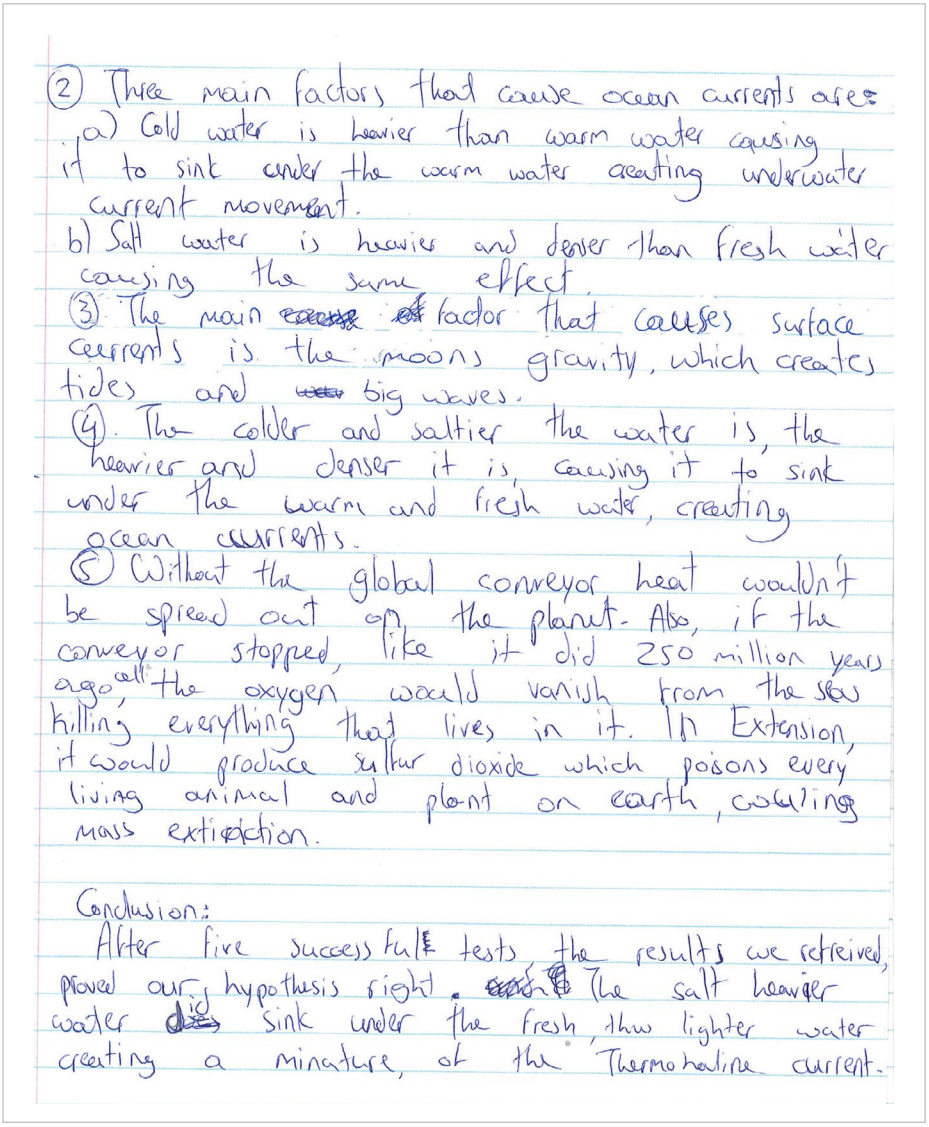
- Theory Questions:
(1) Three factors that affect the world's climate are:
(a) Volcano eruptions
(b) Draughts,
(c) Tectonic Plate movement over millions of years shift the continents position, changing their climate.

Annotations

Describes the trend observed.

Identifies sources of error and proposes an improvement to increase reliability.

Investigation: Global ocean currents



(2) Three main factors that cause ocean currents are:
a) Cold water is heavier than warm water causing it to sink under the warm water creating underwater current movement.
b) Salt water is heavier and denser than fresh water causing the same effect.
(3) The main ~~reason~~ ~~of~~ factor that causes surface currents is the moons gravity, which creates tides and ~~wave~~ big waves.
(4) The colder and saltier the water is, the heavier and denser it is, causing it to sink under the warm and fresh water, creating ocean currents.
(5) Without the global conveyor heat wouldn't be spread out on the planet. Also, if the conveyor stopped, like it did 250 million years ago, all the oxygen would vanish from the sea killing everything that lives in it. In Extension, it would produce sulfur dioxide which poisons every living animal and plant on earth, causing mass extinction.

Conclusion:
After five successful tests the results we retrieved, proved our hypothesis right. ~~The~~ The salt heavier water ~~does~~ did sink under the fresh, thus lighter water creating a minature of the Thermohaline current.

Annotations

Describes some factors that contribute to global ocean currents.

Identifies possible consequences for the biosphere and atmosphere if the global cycle is disrupted.

Draws an evidence-based conclusion and links the investigation to a mechanism underpinning a global cycle, thermohaline circulation.

Annotations (Overview)

The student selects appropriate representations and language to communicate science ideas, methods and results within a scientific report.

Cartoon: The development of the Big Bang theory

Year 10 Science achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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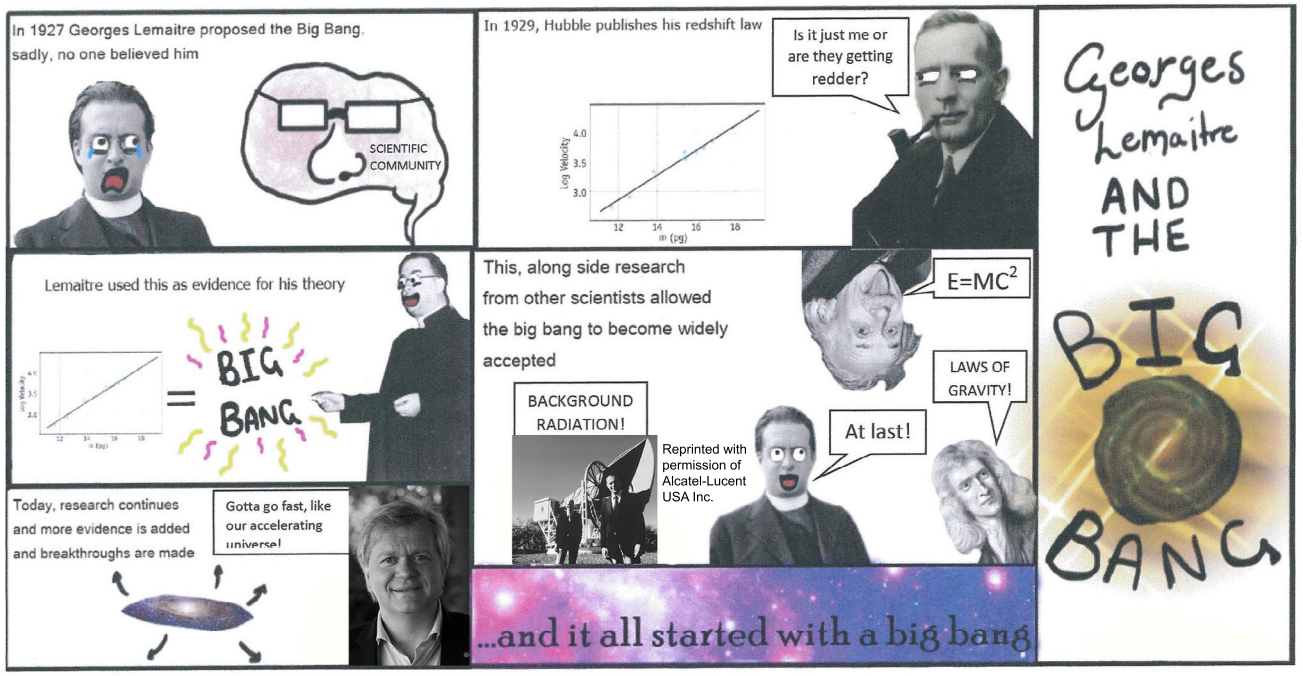
Summary of task

Students had previously completed a unit of work exploring the Big Bang theory. In this task, students worked individually to construct a cartoon that provided a one-page summary for their peers of the role of different scientists in the development of the Big Bang theory. They were specifically required to consider the audience for the cartoon and how to communicate science ideas to this audience.

Science

Year 10
Satisfactory

Cartoon: The development of the Big Bang theory



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Annotations

Examines how the Big Bang theory has developed over time.

Illustrates the role of further research and evidence in acceptance of a scientific theory.

Annotations (Overview)

The student uses popular culture references and a multimedia text to communicate scientific ideas in a way that is concise, visually appealing and engaging for their peers.