Science

Year 10
Above 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: Global ocean currents
Sample 11	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).

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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 ocean currents (WS10) and explains the structures and processes involved in inheritance and evolution by natural selection (WS9). The student evaluates the evidence for scientific theories (WS6, WS11) and examines how the theory of evolution (WS6) and the Big Bang theory (WS7, WS11) developed over time.

The student demonstrates the ability to develop hypotheses for investigation (WS2, WS3, WS10) and independently designs and improves appropriate methods of investigation (WS2, WS3, WS10), explaining how reliability and fairness were considered (WS2, WS3, WS10) 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). 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).

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.

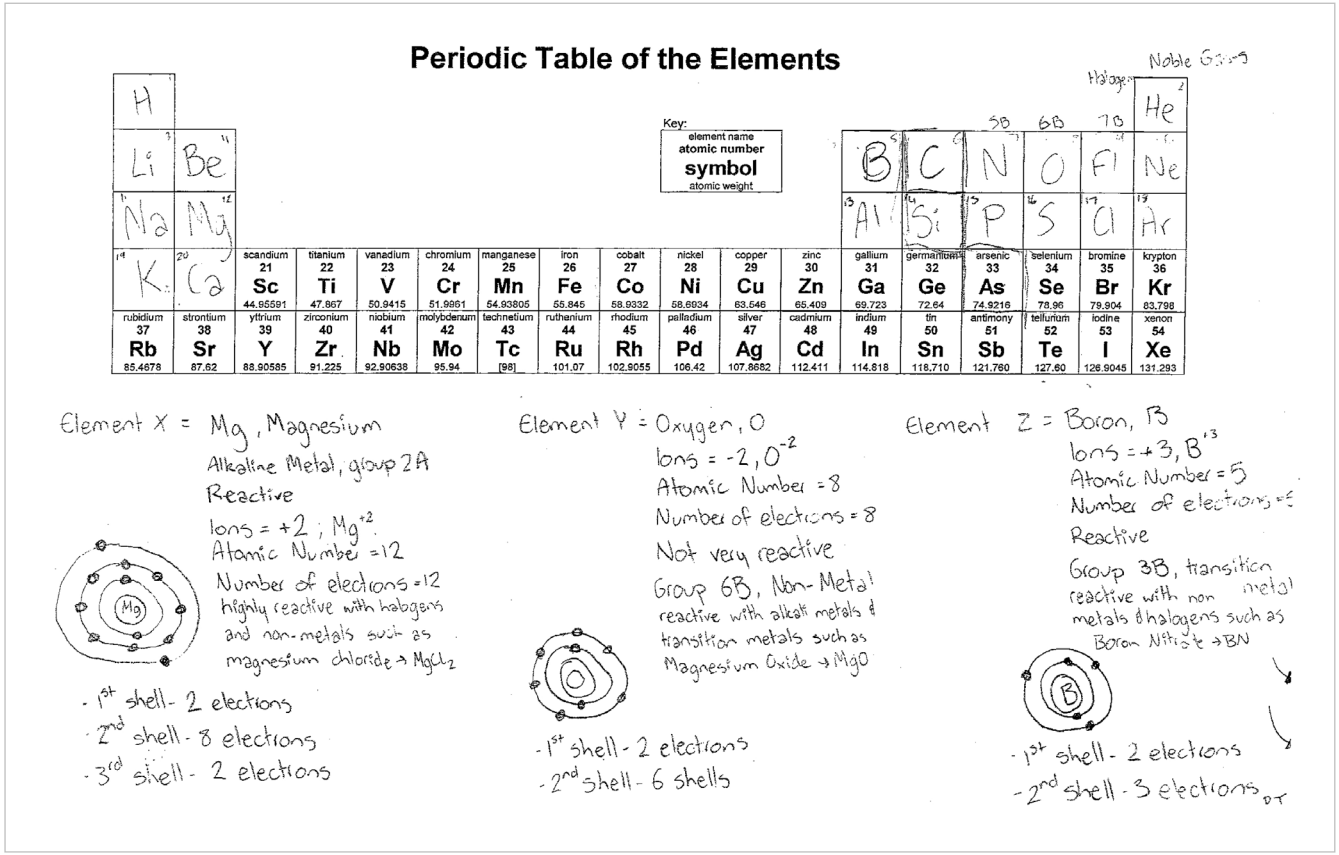
Summary of task

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.

Analyses the position of elements in the periodic table and makes detailed predictions about their reactivity.

Science

Year 10

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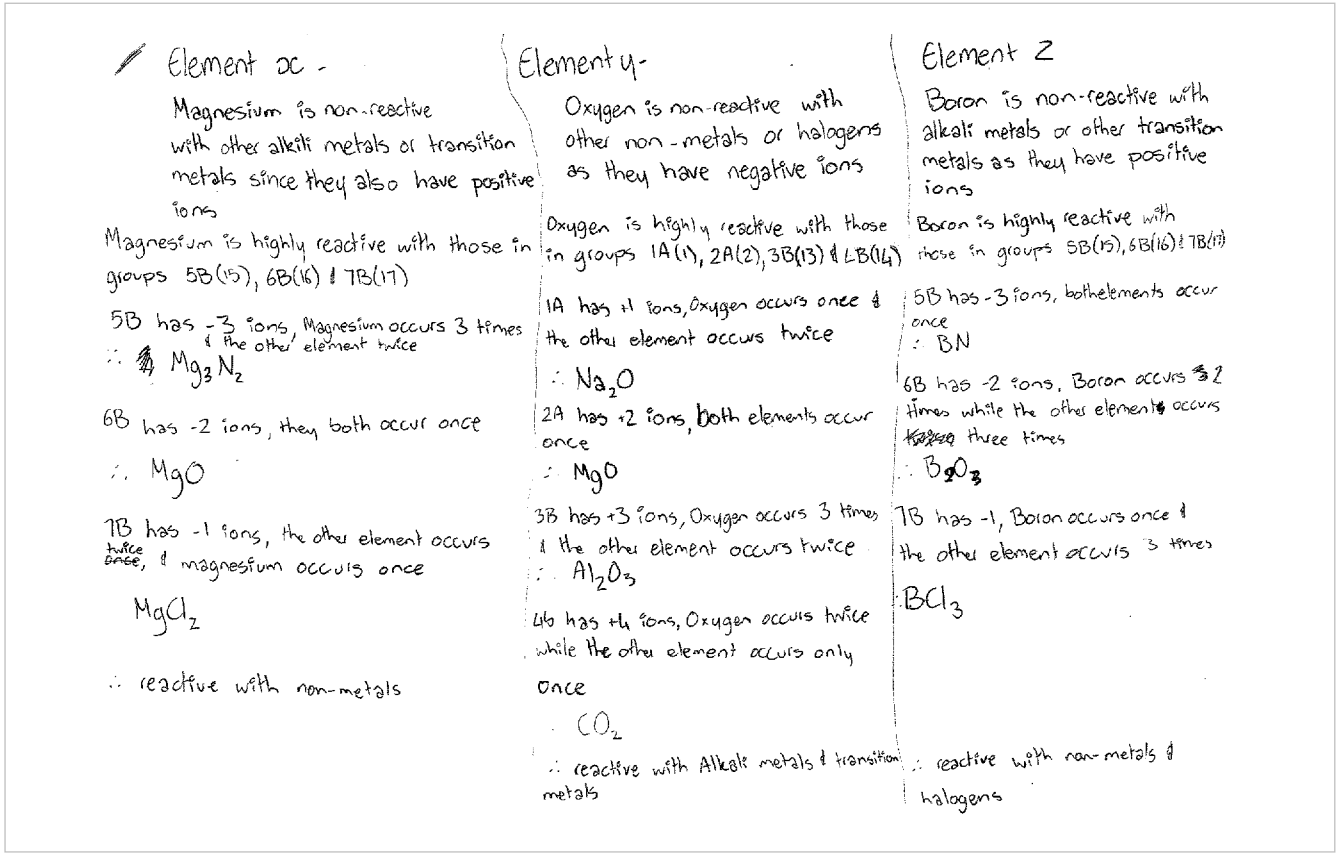
Analysis task: The periodic table



Element x -

Magnesium is non-reactive with other alkali metals or transition metals since they also have positive ions

Magnesium is highly reactive with those in groups 5B(15), 6B(16) & 7B(17)

5B has -3 ions, Magnesium occurs 3 times & the other element twice

∴ Mg_3N_2

6B has -2 ions, they both occur once

∴ MgO

7B has -1 ions, the other element occurs ~~twice~~ once, & magnesium occurs once

$MgCl_2$

∴ reactive with non-metals

Element y -

Oxygen is non-reactive with other non-metals or halogens as they have negative ions

Oxygen is highly reactive with those in groups 1A(1), 2A(2), 3B(13) & 4B(14)

1A has +1 ions, Oxygen occurs once & the other element occurs twice

∴ Na_2O

2A has +2 ions, both elements occur once

∴ MgO

3B has +3 ions, Oxygen occurs 3 times & the other element occurs twice

∴ Al_2O_3

4b has +4 ions, Oxygen occurs twice while the other element occurs only once

∴ CO_2

∴ reactive with Alkali metals & transition metals

Element z

Boron is non-reactive with alkali metals or other transition metals as they have positive ions

Boron is highly reactive with those in groups 5B(15), 6B(16) & 7B(17)

5B has -3 ions, both elements occur once

∴ BN

6B has -2 ions, Boron occurs 2 times while the other element occurs ~~three~~ three times

∴ B_2O_3

7B has -1, Boron occurs once & the other element occurs 3 times

BCl_3

∴ reactive with non-metals & halogens

Annotations

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

Uses the periodic table to determine the formulas of compounds formed by the combination of elements.

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.*
>
> *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 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

Rates of Reaction

Aim:
To determine whether changing the concentration of reactants affects the rate of a chemical reaction.

Introduction:
A chemical reaction occurs when reactants are chemically changed into products. There are many different types of chemical reactions including synthesis, decomposition, combustion and neutralisation reactions. This experiment will focus on a neutralisation reaction which is between an acid and a base. The acid is acetic acid and the base is sodium bicarbonate. These are also known as the reactants. The products are carbon dioxide, water and sodium acetate as given in the equation below:

Sodium bicarbonate + acetic acid → sodium acetate + water + carbon dioxide

$$NaHCO_3 + CH_3COOH \rightarrow CH_3COONa + H_2O + CO_2$$

The rate of a chemical reaction, or how quickly the reaction occurs, depends on a variety of factors. These include temperature, concentration, surface area and the presence of a catalyst. The effect of these factors on reaction rate can be explained by collision theory. Collision theory states that a chemical reaction takes place when particles of the reactants collide with each other with sufficient energy. The more collisions there are in a given period of time, the faster the reaction will be. Increasing the temperature will cause the reactant particles to have more kinetic energy. This increases the number of collisions between the particles and also means that the particles collide with enough energy to form products. Therefore, the reactants will be changed into products faster and so the reaction rate increases. Lowering the temperature would have the opposite effect. Increasing the concentration of reactants increases the number of reactant particles which increases the chances of them colliding and changing into products so the reaction rate increases. A large surface area is when the reactant particles are smaller which increases the chances of the particles colliding. This increases the reaction rate as well. The last factor is a catalyst which reduces the amount of energy that the reactant particles need to collide with and be converted into products. Because they need less energy, the reactants will be converted into products faster and so the reaction rate will increase.

Hypothesis:
Based on the information above, it can be predicted that decreasing the concentration of a reactant will decrease the reaction rate. In this experiment, if we decrease the concentration of the acetic acid, the rate will decrease. This can be calculated by measuring the volume of carbon dioxide gas produced over a specific period of time.

Method:
Equipment required – acetic acid (2.0 M), sodium bicarbonate, water, plastic container, measuring cylinder, retort stand, conical flask, rubber tubing, rubber stopper, beaker.

Annotations

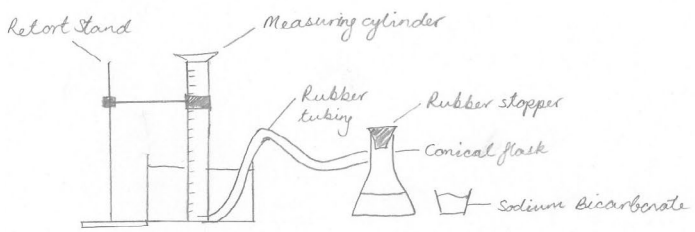
Identifies factors that influence rate of reaction, including surface area, concentration, temperature and catalysts.

Explains how rate of reaction can be increased with reference to energy transfers and collision theory.

Develops a clear and logical hypothesis based on collision theory.

Investigation report: Rates of reaction

Diagram



Method

1. The equipment was set up as shown in the diagram above.
2. 20 mL of acetic acid was measured and placed in the conical flask.
3. A piece of paper was folded and attached to the bottom of the rubber stopper to form a cup shape.
4. 0.5 g of sodium bicarbonate was measured and placed in the paper.
5. The stopper was attached to the conical flask which was being held at an angle to ensure that the sodium bicarbonate was not tipped into the flask.
6. The conical flask was returned to the upright position allowing the sodium bicarbonate to fall into the flask and the stopwatch was started at this time.
7. The volume of gas inside the inverted measuring cylinder was recorded every two seconds for two minutes.
8. The experiment was repeated twice for reliability.
9. Steps 2-8 were repeated using 20 mL of acid and 20 mL of water to give half the concentration.
10. Steps 2-8 were repeated using 20 mL of acid and 60 mL of water to give a quarter of the concentration.
11. The data was recorded, tabulated and graphed.

Risk assessment:
The chemicals used in the experiment are not hazardous. However, care should be taken whenever using acid because it is corrosive. Therefore lab coats and safety glasses were worn to prevent contact with skin and eyes.

Results:

Quantitative results

Table 1 – concentration of reactants

Test	Volume of acid (mL)	Volume of water (mL)	Final Concentration (M)	Mass of sodium bicarbonate (g)
1	20	0	2.0	0.5
2	20	20	1.0	0.5
3	20	60	0.5	0.5

Annotations

Designs a logical and appropriate investigation method, including provision of a scientific diagram.

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

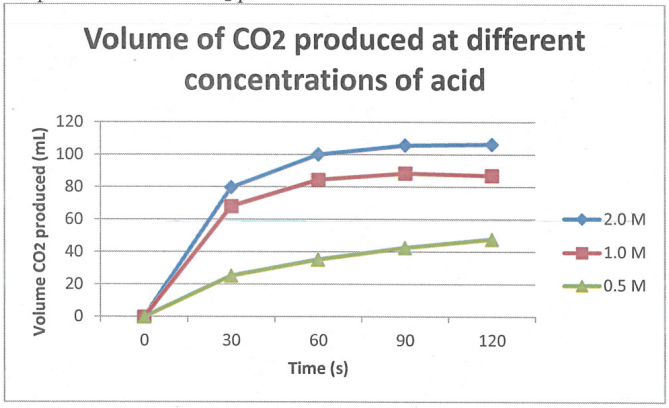
Considers safety precautions by specifying protective clothing and eyewear.

Investigation report: Rates of reaction

Table 2 – volume of CO_2 produced at different concentrations

		Volume of CO_2 produced (mL)											
	Concentration (M)	2.0				1.0				0.5			
	Test	1	2	3	Ave	1	2	3	Ave	1	2	3	Ave
Time (s)	0	0	0	0	0	0	0	0	0	0	0	0	0
	30	63	92	84	79.67	61	75	69	68.33	20	31	25	25.33
	60	97	106	97	100.00	82	89	83	84.67	32	38	36	35.33
	90	106	110	101	105.67	86	93	87	88.67	40	44	44	42.67
	120	107	110	102	106.33	88	95	79	87.33	47	48	49	48.00

Graph 1 – volume of CO_2 produced at different concentrations of acid



Qualitative results

There was a large difference between how vigorously the reactions occurred at different concentrations. The 2.0 M acid was the most vigorous and a large amount of gas bubbles were observed during the reaction. The 0.5 M acid was the least vigorous and produced much less gas bubbles.

Discussion:

The rate of reaction can be determined from the initial slope of the graphs above. The reaction that used the most concentrated acid (2.0 M) has the steepest slope between 0 and 30 seconds which indicates that it produced the most carbon dioxide in that amount of time, giving it the fastest reaction rate. It also produced the most carbon dioxide overall.

The three graphs together show the trend that as the concentration increases the rate of reaction increases. This observation is supported by collision theory which states that reactants with higher concentration react faster because there is a greater chance that the particles will collide and be converted into products.

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 in both average quantity of CO_2 produced and rate of reaction.

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

Investigation report: Rates of reaction

Each test was repeated three times to make sure that the results were reliable. All three results were used to calculate the average however, this was not always correct. Some of the results that were included were outliers which means that they should have either been left out of the calculation or repeated to get a result that was more like the others.

The other factors that affect the rate of reaction were controlled as much as possible in this experiment to make sure that it was valid. They included temperature, surface area and catalysts. The temperature may not have been the same for each test since some of them were performed on different days. The surface area of the sodium bicarbonate reactant was the same for all of the tests as it was a powder. There were no catalysts used in any of the tests.

There were some errors made in the experiment. The main ones were human error in the timing and measurement error of the reactants. These errors could be removed by using technology. Filming the experiments and then analysing start and finishing times of the reaction would get rid of the error in human reaction times. Using electronic balances would have removed the measurement error. A magnetic stirrer could also have been used to make sure that the reactants were combined evenly. Parallax error could be removed by making sure that the measurer's eyes were level with the meniscus of the liquid in the measuring cylinder.

Despite these errors, the experiment produced results that were consistent with the collision theory and so was accurate overall.

Conclusion:
Changing the concentration of acetic acid affects the rate of reaction with sodium bicarbonate. The higher the concentration the faster the rate of reaction.

References
AUS-e-TUTE, n.d., *Chemistry Tutorial : Reaction Rates*,viewed 4 June 2012, http://www.ausetute.com.au/reactrate.html

David N Blauch, 2012, *Chemical Kinetics: Reaction rates*, viewed 4 June 2012, http://www.chm.davidson.edu/vce/kinetics/ReactionRates.html

Jim Clark, 2011, *Understanding Chemistry*, viewed at 4 June 2012, http://www.chemguide.co.uk/physical/basicratesmenu.html

Annotations

Identifies uncertainty in the evidence (outliers in the data, instances where variables may not have been appropriately controlled, measurement error).

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

situation where GPE is converted to KE, the formula would be KE/GPE * 100 = % efficiency (the physics classroom 1996-2012). Percentage efficiency gives us a measure of how much energy is converted and how much is lost to other forms of energy such as heat and sound because of friction. This would be the case in the toy car down an incline plane experiment. Energy cannot be lost and therefore energy conversion must in all circumstances be 100% efficient. This can be represented by the formula KE + all energy losses / GPE = 100%.

1.4 hypothesis

It was hypothesized that if the height of the ramp is increased the velocity of the toy car will increase when that the mass of the vehicle and distance it travelled is kept constant.

1.5 Orientation to overall design

The design characteristics of the experiment to achieve its aim are as follows;

1. The experiment was conducted inside a laboratory under laboratory conditions to achieve consistency in measurement by excluding outside environmental influences such as wind, noise, variable lighting, rain, dust etc
2. Smooth plank was used to minimise variation due to the surface of the incline
3. A wheeled toy car was used to facilitate rolling and to minimise the effect of friction, as seen in figure 1 of appendix
4. A stopwatch was used to measure time rather than simply using a second hand on watch to determine the time estimate

In the conducted experiment the controlled variables were the ramp, the car, the time keeper, the stopwatch and the release method. It was ensured that the same ramp was used in all trials with no changes made to it. The toy car was also kept exactly the same in all cases. The person time keeping and the stopwatch said person used was controlled and kept constant at all times, for every trial. The same person was used in every trial to release the car with the same method being applied always. Reliable results were insured in keeping the controlled variables constant at all times with the same person conducting each given part. This makes the conducted experiment a fair test.

In the conducted experiment the manipulated or independent variable was the height of the ramp, the dependent variable was the variable that was measured and was the time to travel one metre.

Annotations

Develops a clear and logical hypothesis and includes qualifiers particular to the scenario.

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

Investigation report: Motion down an inclined plane

The velocity vs distance was graphed to determine the acceleration and distance covered of the toy car.

The controlled variables were the ramp, car, time keeper, and stopwatch and release method. The ramp was kept exactly the same in all trials at a constant length of one (1) metre. The exact same plastic toy car was used when conducting the trials with the release method of the car constant. The release of the toy car was conducted by the same person every time, releasing the car at the starting position 100cm from the edge of the wood as seen in appendix figure 2. The time keeper and stopwatch used were the same in all cases.

2.0 Method

2.1 Equipment

- Retort stand and Boss head
- Toy car
- Piece of wood (over 1 metre long)
- Ruler
- Stopwatch
- Marker

2.2 Procedure

1. The equipment was collected.
2. Using the marker, a mark was made, 100cm from the end of the wood using the tape measure. This mark was the starting point for the car.
3. The ramp was raised to a starting height of 10cm, using the tape measure, from the bench top using the retort stand and boss head.
4. The car was held at the mark, at the top of the ramp, and then released gently whilst starting the timer. It was ensured that at the top of the ramp, the car was not pushed.
5. When the car reached the bottom of the ramp, the time was recorded in table 1.
6. The previous step was repeated 15 times and recorded in the table.
7. The height was then increased by another 10cm, therefore raising the ramp to a height of 20cm.

Annotations

Designs a logical, appropriate and detailed investigation method.

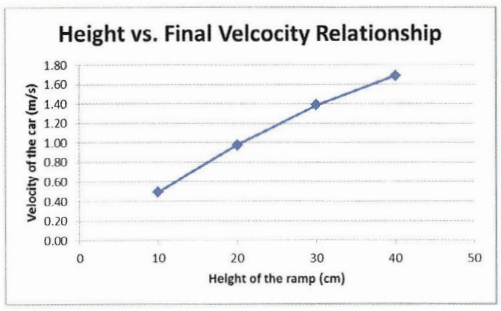
Investigation report: Motion down an inclined plane

8. Once again the car was timed as it travelled the 1m distance. For the 15 trials, the times were recorded in table 1.
9. Once again, the height was raised by 10cm using the tape measure. The ramp was then 30cm.
10. The car was then timed at the 30cm height, recording the 15 trials in the table.
11. Use the tape measure to change the height to a final 40cm height where the times were once again recorded in the table.
12. Calculations were then made using the times recorded from the previous steps. In table 2, the average time, average speed, final speed, acceleration, the initial gravitational potential energy, the final kinetic energy and the percentage efficiency were calculated.

3.0 results

Calculations Table – using information in appendix (raw data table and calculations)

Height (cm)	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)	Kinetic Energy KE (J)	Gradient of line cm	Area under v-t graph m^2	% efficiency
10cm	0.03674	2.0232	0.49	0.99	0.49	0.036	0.018	0.487	1.001	50.00%
20cm		1.0228	0.98	1.96	1.91	0.072	0.070	1.916	1.002	97.22%
30cm		0.7204	1.39	2.78	3.85	0.108	0.142	3.859	1.001	131.48%
40cm		0.592	1.69	3.38	5.71	0.144	0.210	5.709	1.000	145.83%



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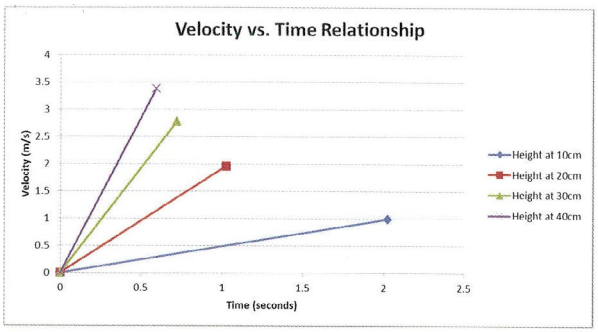
Annotations

Considers reliability by specifying controlled variables and by performing a large number of repeated trials.

Constructs an appropriate table to represent summarised data.

Correctly selects final velocity data as evidence and constructs appropriate graphs to represent the relationship between ramp height and final velocity.

Investigation report: Motion down an inclined plane



4.0 Discussion

4.1 Summaries of results

The task was to investigate the affect that height has on the motion of an object (toy car) moving freely down and incline plane. The results of the experiment are indicated that:

The greater the height of the ramp, the faster the final speed will be.
For a height of 10cm, the final speed was 0.99m/s.
For a height of 20cm, the final speed was 1.96m/s.
For a height of 30cm, the final speed was 2.78m/s.
For a height of 40cm, the final speed was 3.38m/s.

As you can see, the greater the height of the ramp the greater the final speed, average speed, Kinetic energy (KE), initial gravitational potential energy (GPE), Gradient and percentage efficiency as indicated by the calculations. However, the average time decreases as the height increases.

The car released from the greatest height had the greatest speed. The speed of the car is determined by the amount of energy acting upon it. Accordingly, the greater the height the car was released from, the greater the stored gravitational potential energy available to be converted into the kinetic energy of motion, resulting in a greater speed. This is can be seen in our measurements which indicate that the time taken for the car to travel 1 metre from a 10cm height is 2.0232s which results in an average velocity of 0.49m/s. Whereas for a height of 40cm, the time taken for the car to travel 1 metre is 0.592s which results in an average velocity of 1.69m/s.

The data from the 40cm height showed the greatest efficiency at 145.83%. Next was the 30cm height at 131.48% efficiency, followed by the 20cm height at 97.22% efficiency, with the least efficient being the 10cm height at 50% efficiency.

Annotations

Analyses data to identify trends.

Investigation report: Motion down an inclined plane

4.2 Explanations of results

The greater the height the car was released from, the greater the stored gravitational potential energy available to be converted into the kinetic energy of motion, resulting in a greater speed. This is clear in the formula GPE=mgh, where h is height above ground (metres), m is mass (kg) and g is acceleration due to gravity (9.8m/s^2). Accordingly, any increase in height, will lead to an increase in GPE.

The Velocity vs Time graph shows that the speed is changing, the vehicle is travelling in a positive direction and the car that was released from the greatest height changed speed the quickest to reach the fastest final velocity.

The Final velocity vs Height graph shows an expediential curve where the higher that ramps is, the faster the car goes. However, the degree to which the velocity increases with height is diminishing. This appears to be the case of "the law of diminishing returns," that is the velocity return per joule of stored gravitational potential energy invested is diminishing with the height. Given the "Law of conservation of energy" states that energy cannot be created or destroyed only transformed or transferred (the physics classroom 1996-2012), it would be expected in a perfect frictionless environment that the kinetic energy possessed by the car at the bottom of the ramp would be equal to the gravitational potential energy stored in the car at the top of the ramp. This would comply with the formula Ep=Ek. Ep=mgh, Ek=1/2mv^2 where m is mass in kg and v is final velocity in m/s. Furthermore, the mass of the car (m) and acceleration due to gravity (g) remain constant; therefore the final velocity of the car is determined by the only other variable in the equation, height. This is confirmed in the equation:

$$Ep = EK$$
$$mgh = \frac{1}{2}mv^2$$
$$\div m \qquad \div m$$
$$gh = \frac{1}{2}v^2$$
$$9.8 \times h = \frac{1}{2}v^2$$
$$9.8 \times 2 \times h = v^2$$
$$\sqrt{9.8 \times 2 \times h} = v$$

Annotations

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

Investigation report: Motion down an inclined plane

Energy cannot be created or destroyed, therefore energy transformation and/or transfer must be 100% efficient.

The data for the 10cm height indicated a 50% efficiency conversion of Ep to Ek, which appears to be within the expected range. The energy which was not converted to kinetic energy was then transformed to heat and sound energy. The formula which explains this transformation would be gravitational potential energy (Ep) = kinetic energy (Ek) + energy transformed to heat (Eh) + energy transformed to sound (Es). Therefore $Ep = Ek + Eh + Es$.

The data for the 20cm height indicated a 97.22% efficiency conversion of Ep to Ek, which appears to be over the expected range. This efficiency, which is very close to 100%, is unexpected especially given that the car used was a basic model which would be expected to lose more energy than it did to heat and sound. The energy which was not converted to kinetic energy was then transformed to heat and sound energy. A possible reason for this high efficiency could have been due to a slight push at the top of the incline plain which would boost the percentage efficiency.

The data for the 30cm and 40cm heights indicated 131.48% and 145.83% efficiency respectively. Efficiency's over 100% would be impossible to obtain. According to the law of conservation of energy, it is not possible for additional energy to be created from nothing. Therefore, the only way to record efficiency's over 100% is to add kinetic energy by pushing the car at the top of the incline plane, in which case the mathematics of the efficiency's recorded would be in error because the additional energy would not have been measured and included in the calculation. Should this energy have been recorded and included in the calculation then the efficiency would have to be fewer than 100%. An additional way this high efficiency may have been obtain is an error in the measurements, for example timing.

4.3 Critique of design and problem solution

The design method used in the experiment had many associated problems that would make the data inaccurate. These include; the person timing the speed of the car using a stopwatch does not have a perfect reaction time. For example, the average time for 40cm height is just over half a second, which leaves great room for error due to reaction time given that a stopwatch was being used. The ramp was not absolutely straight, causing the car to travel on a slightly curved path, thus increasing the distance compared to the distance measured. The releasing method may have been flawed as Kinetic energy may have been transferred by an inadvertent push at the top of the ramp on the release down the ramp.

Annotations

Identifies inconsistencies in findings with reference to collected evidence and scientific concepts and suggests plausible explanations.

Identifies sources of error that contribute to uncertainty.

Investigation report: Motion down an inclined plane

4.4 Future research

Other investigations that should be conducted with relation to the effect that height and speed have on inclines and which relate to real world situation include:

1. Travelators in buildings which transports people and trollies from one level to another would need to be constructed at an angle so that the coefficient to friction is sufficient to prevent people and trollies from slipping down the travelator. Accordingly, the angle of the incline would determine the length of travelator required.
2. A roller coaster operates under the influence of gravity once it has been mechanically lifted to its starting height. This means that the height of the ramp, which determines the initial potential energy, must be sufficient to ensure that the cart is able to overcome to frictional forces and the upward inclines in order to reach the bottom.
3. Train must often travel over mountain ranges in which case the height is set and pre-determined and cannot be altered. The train tracks would need to be constructed at angles which enable the engine hauling the train to reach the peak as well as ensuring that the train does not "runaway" on its downward journey.

5.0 Conclusion

The aim of the experiment was to gather the relevant data in order to determine how height affects the motion of an object moving freely down an Incline plane. It was anticipated that this data would confirm the hypothesis that if the height of the ramp is increased the velocity of the toy car will increase when that the mass of the vehicle and distance it travelled is kept constant. The data positively indicated that when the height of the incline plane was increased, whilst the mass of the car and distance travelled was kept constant, the speed of the car increased.

This investigation has added to the science community's understanding of the dynamic nature of the relationship that exists between gravitational potential and its conversions to kinetic energy, which in turn enhances the community's understanding of exciting and safe motion on inclines.

Annotations

Provides a thorough 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 within the genre of scientific report.

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

Year 10 Physics: 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?

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

$v_{av} = 10.2\ ms^{-1} \times 3.6 = 36.7\ kmh^{-1}$

(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.

$a_{av} = \Delta v / t = (10.1 - 0) / 4.40 = 2.30\ ms^{-2}$

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

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

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

(a) Calculate its speed after 4.00 s.

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

$9.00 = (v - 0) / 4.00$

$v = 9.00 \times 4.00 = 36.0\ ms^{-1}$

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

$d = ut + \frac{1}{2}a_{av}t^2 = 0 + \frac{1}{2}(9.00 \times 4^2) = 72.0\ m$

(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.

$a_{av} = (v - u) / t = (0 - 36.0) / 2.50 = -14.4\ ms^{-2}$

(ii) Determine the stopping distance.

$d = \frac{1}{2}(u + v) \times t = \frac{1}{2}(36.0 + 0) \times 2.50 = 45.0\ m$

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

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

(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 the mass is doubled and force remains the same then the acceleration must halve according to Newton's second law F = ma. This means that the deceleration will be half the value and it will take longer to stop.

Annotations

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

Calculates changes in the motion of objects and provides detailed solutions.

Applies the force, mass and acceleration relationship to justify predictions to changes in the motion of objects.

Annotations (Overview)

The student selects and uses appropriate representations to correctly solve numerical problems showing detailed solutions.

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.

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 → water + carbon dioxide

Balanced: $2C_6H_{14} + 19O_2 \rightarrow 14H_2O + 12CO_2$

b) The reaction of lead nitrate with potassium iodide:

Word: lead nitrate + potassium iodide → potassium nitrate + lead iodide

Balanced: $Pb(NO_3)_2 + 2KI \rightarrow 2KNO_3 + PbI_2$

13. Calcium perchlorate is an ionic compound. Its formula is $Ca(ClO_4)_2$. Iron chloride in 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^-

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

Fe^{+3} Cl^-

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

$Fe(ClO_4)_3$

Annotations

Constructs word equations and balanced chemical equations to show how chemical reactions produce particular products.

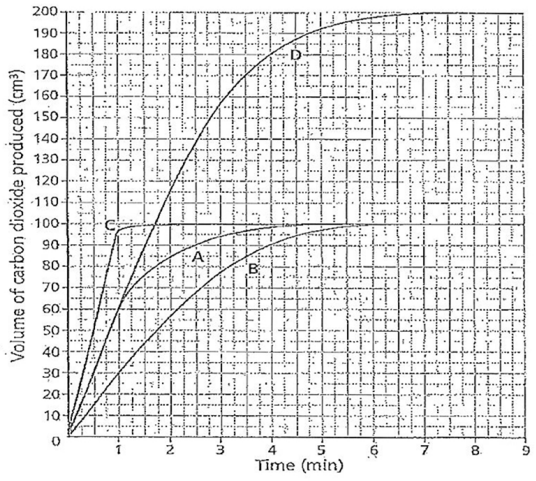
Correctly represents the formulas of ionic compounds.

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 shows the results:



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

100cm^3

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

The fastest reaction was 'Reaction C' as the reaction was completed first. Also, at the start of the reactions you can see that 'C' had the greatest gradient.

Annotations

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.

Using my scientific knowledge of chemical reactions, I agree with Emma. As water does not react with the marble chips, it means that 'D' has a greater concentration (100mL) of ~~base~~ acid reacting with the marble chips in comparison to 'B' only having 50mL of acid. Greater concentration means that there are more particles closer together; increasing the chance of particles colliding, particles colliding with enough energy to make a change and particles colliding at the right angles to make a change. This is ~~the~~ the particle theory and is why Emma is correct in saying Reactions 'B' and 'D' should have different graphs.

Annotations

Recognises and explains different rates of reaction from graphical data.

Uses the particle model to clearly explain how concentration influences reaction rate.

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.*
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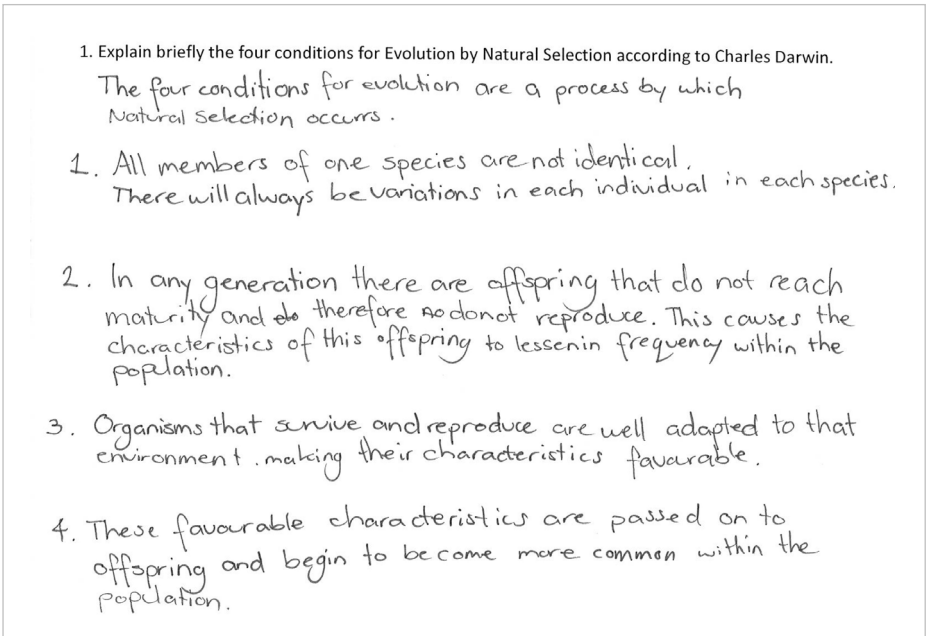
> *Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital 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 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.

The four conditions for evolution are a process by which Natural Selection occurs.

1. All members of one species are not identical. There will always be variations in each individual in each species.

2. In any generation there are offspring that do not reach maturity and ~~do~~ therefore ~~no~~ do not reproduce. This causes the characteristics of this offspring to lessen in frequency within the population.

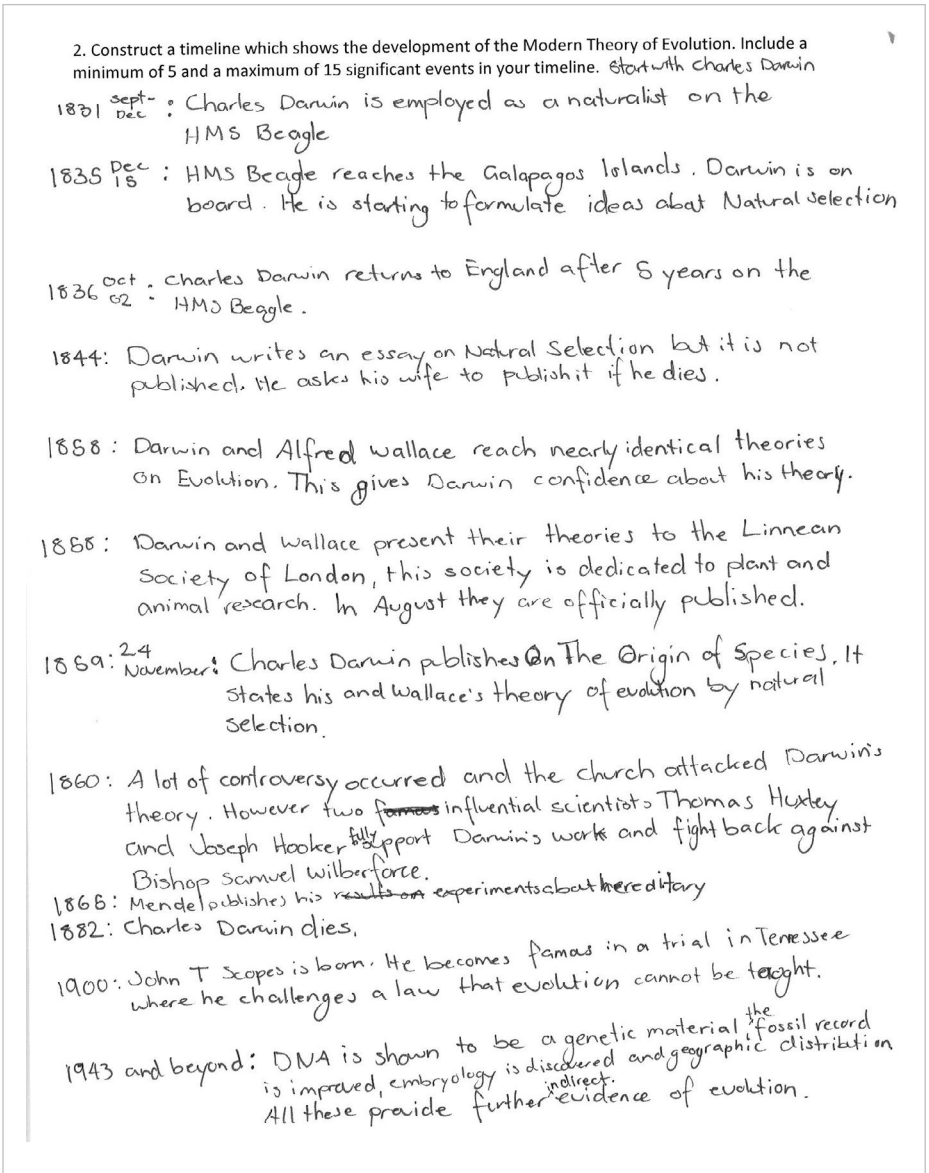
3. Organisms that survive and reproduce are well adapted to that environment, making their characteristics favourable.

4. These favourable characteristics are passed on to offspring and begin to become more common within the population.

Annotations

Outlines the processes involved in natural selection.

Research task: The theory of evolution by natural selection



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. start with charles Darwin

1831 sept-Dec : Charles Darwin is employed as a naturalist on the HMS Beagle

1835 Dec 15 : HMS Beagle reaches the Galapagos Islands. Darwin is on board. He is starting to formulate ideas abat Natural selection

1836 Oct 02 : charles Darwin returns to England after 5 years on the HMS Beagle.

1844: Darwin writes an essay on Natural Selection but it is not published. He asks his wife to publish it if he dies.

1858 : Darwin and Alfred Wallace reach nearly identical theories on Evolution. This gives Darwin confidence about his theory.

1858 : Darwin and Wallace present their theories to the Linnean Society of London, this society is dedicated to plant and animal research. In August they are officially published.

1859: 24 November: Charles Darwin publishes On The Origin of Species, It states his and Wallace's theory of evolution by natural selection.

1860: A lot of controversy occurred and the church attacked Darwin's theory. However two ~~famous~~ influential scientists Thomas Huxley and Joseph Hooker fully support Darwin's work and fight back against Bishop Samuel Wilberforce.

1865: Mendel publishes his ~~results on~~ experiments about hereditary

1882: Charles Darwin dies.

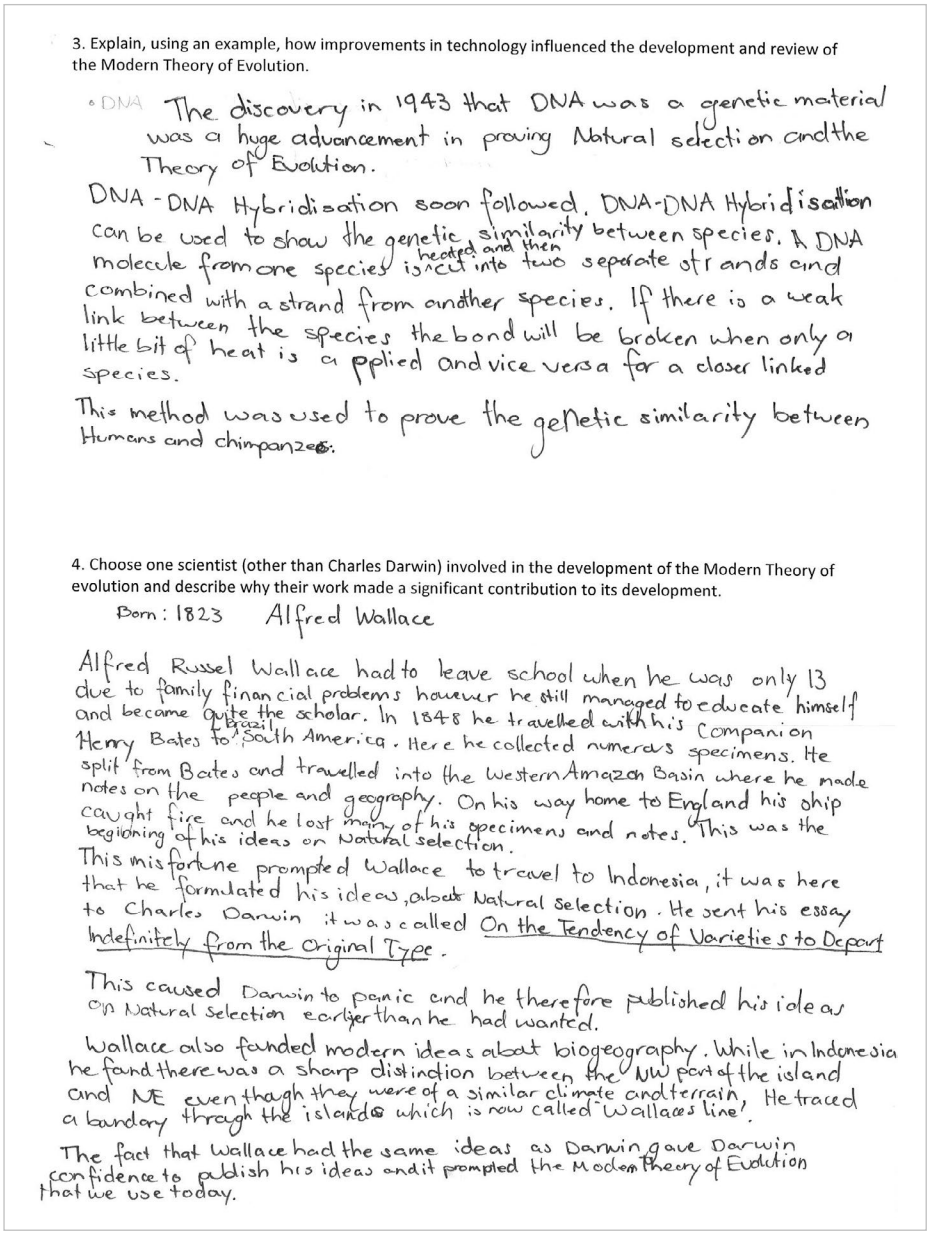
1900: John T Scopes is born. He becomes famous in a trial in Tennessee where he challenges a law that evolution cannot be taught.

1943 and beyond: DNA is shown to be a genetic material, the fossil record is improved, embryology is discovered and geographic distribution is improved. All these provide further indirect evidence of evolution.

Annotations

Selects significant events in the development of the theory of evolution, including key publications, peer review events and discovery of further 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.

DNA The discovery in 1943 that DNA was a genetic material was a huge advancement in proving Natural selection and the Theory of Evolution.

DNA - DNA Hybridisation soon followed. DNA-DNA Hybridisation can be used to show the genetic similarity between species. A DNA molecule from one species is heated and then cut into two separate strands and combined with a strand from another species. If there is a weak link between the species the bond will be broken when only a little bit of heat is applied and vice versa for a closer linked species.

This method was used to prove the genetic similarity between Humans and chimpanzees.

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.

Born: 1823 Alfred Wallace

Alfred Russel Wallace had to leave school when he was only 13 due to family financial problems however he still managed to educate himself and became quite the scholar. In 1848 he travelled with his Companion Henry Bates to Brazil South America. Here he collected numerous specimens. He split from Bates and travelled into the Western Amazon Basin where he made notes on the people and geography. On his way home to England his ship caught fire and he lost many of his specimens and notes. This was the beginning of his ideas on Natural selection.

This misfortune prompted Wallace to travel to Indonesia, it was here that he formulated his ideas about Natural selection. He sent his essay to Charles Darwin it was called On the Tendency of Varieties to Depart Indefinitely from the Original Type.

This caused Darwin to panic and he therefore published his ideas on Natural selection earlier than he had wanted.

Wallace also founded modern ideas about biogeography. While in Indonesia he found there was a sharp distinction between the NW part of the island and NE even though they were of a similar climate and terrain, He traced a boundary through the islands which is now called Wallaces line.

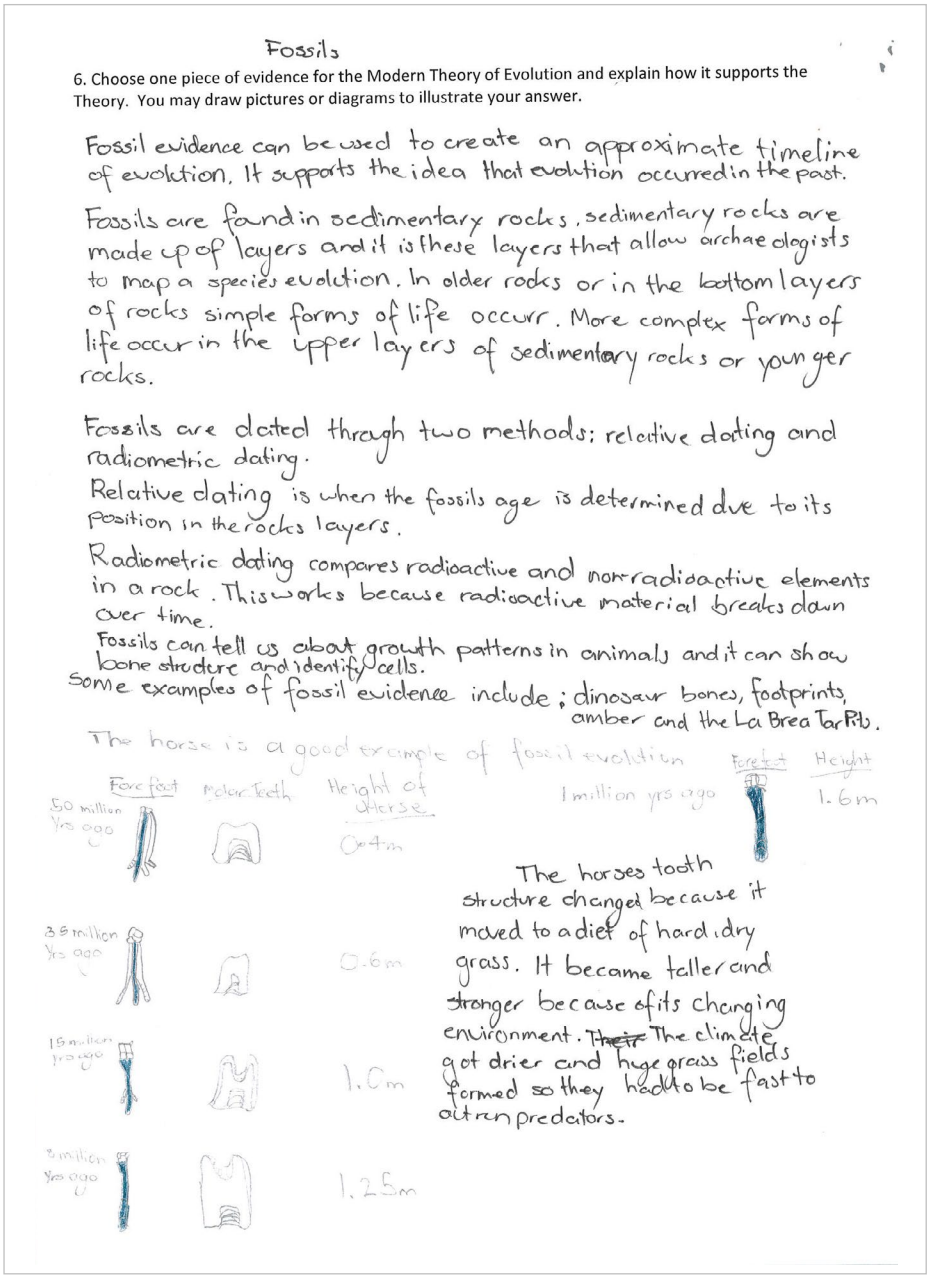
The fact that Wallace had the same ideas as Darwin gave Darwin confidence to publish his ideas and it prompted the Modern Theory of Evolution that we use today.

Annotations

Explains the significance of DNA hybridisation in provision of evidence to support the theory of evolution.

Explains how interactions between scientists contributed to the development of a scientific theory.

Research task: The theory of evolution by natural selection



Fossils

6. 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 can be used to create an approximate timeline of evolution. It supports the idea that evolution occurred in the past.

Fossils are found in sedimentary rocks, sedimentary rocks are made up of layers and it is these layers that allow archaeologists to map a species evolution. In older rocks or in the bottom layers of rocks simple forms of life occur. More complex forms of life occur in the upper layers of sedimentary rocks or younger rocks.

Fossils are dated through two methods; relative dating and radiometric dating.
Relative dating is when the fossils age is determined due to its position in the rocks layers.
Radiometric dating compares radioactive and non-radioactive elements in a rock. This works because radioactive material breaks down over time.
Fossils can tell us about growth patterns in animals and it can show bone structure and identify cells.
Some examples of fossil evidence include; dinosaur bones, footprints, amber and the La Brea Tar Pits.

The horse is a good example of fossil evolution

Fore foot | Molar teeth | Height of horse

50 million yrs ago — 0.4m

35 million yrs ago — 0.6m

15 million yrs ago — 1.0m

3 million yrs ago — 1.25m

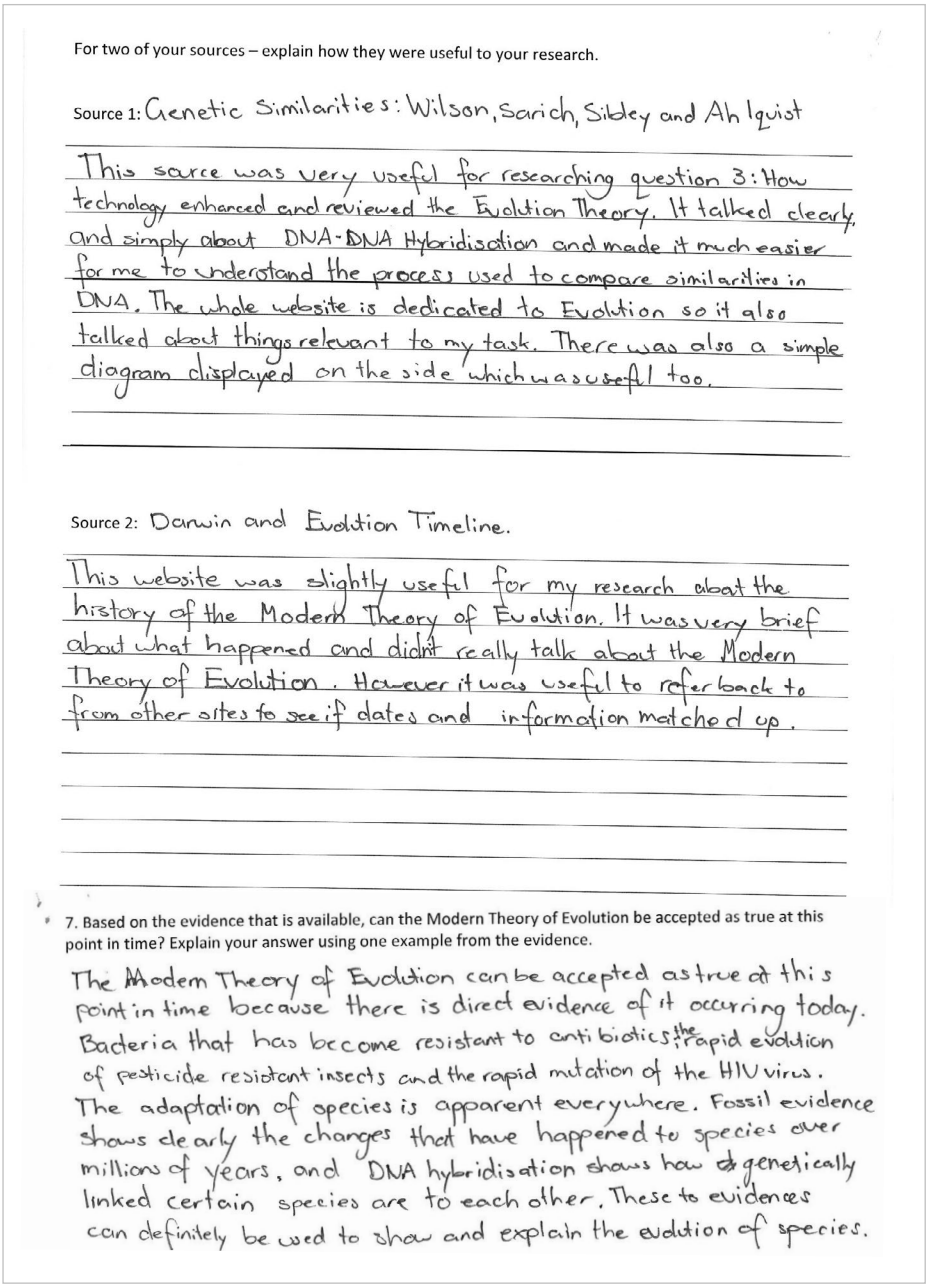
1 million yrs ago — Fore foot | Height — 1.6m

The horses tooth structure changed because it moved to a diet of hard dry grass. It became taller and stronger because of its changing environment. ~~Their~~ The climate got drier and huge grass fields formed so they had to be fast to outrun predators.

Annotations

Explains, using examples, how selected evidence is gathered and interpreted to support the theory of evolution.

Research task: The theory of evolution by natural selection



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

Source 1: Genetic Similarities: Wilson, Sarich, Sibley and Ahlquist

This source was very useful for researching question 3: How technology enhanced and reviewed the Evolution Theory. It talked clearly and simply about DNA-DNA Hybridisation and made it much easier for me to understand the process used to compare similarities in DNA. The whole website is dedicated to Evolution so it also talked about things relevant to my task. There was also a simple diagram displayed on the side which was useful too.

Source 2: Darwin and Evolution Timeline.

This website was slightly useful for my research about the history of the Modern Theory of Evolution. It was very brief about what happened and didn't really talk about the Modern Theory of Evolution. However it was useful to refer back to from other sites to see if dates and information matched up.

7. 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.

The Modern Theory of Evolution can be accepted as true at this point in time because there is direct evidence of it occurring today. Bacteria that has become resistant to antibiotics, the rapid evolution of pesticide resistant insects and the rapid mutation of the HIV virus. The adaptation of species is apparent everywhere. Fossil evidence shows clearly the changes that have happened to species over millions of years, and DNA hybridisation shows how genetically linked certain species are to each other. These to evidences can definitely be used to show and explain the evolution of species.

Annotations

Constructs an evidence-based argument for accepting the Modern Theory of Evolution, using relevant examples.

Annotations (Overview)

The student uses appropriate language, scientific terms and diagrams 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.

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 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

Year 10
Science assignment: Where did we come from?

Discoveries in our astronomy and our physics have shown that our Universe may have possibly had a beginning. There are numerous theories and pieces of evidence that can possibly explain, that one moment there may have been nothing, and during and after that moment there was something; our universe. 'The Big Bang Theory' is a theory to explain what happened during and after that moment, of how our universe came about.

The Big Bang Theory

The 1929 discovery by Edwin Hubble, gave us an understanding that our universe is in fact expanding at an enormous speed. Hubble also noted that galaxies outside our own Milky Way were all moving away from us. This came to the conclusion that there must have been an instant time, when the Universe itself was contained in a single point in space, and a violent event which came to be named the Big Bang.

Because our Universe is known to be expanding all the time, it makes the Big Bang theory seem more realistic, due to the fact that when an explosion does occur it grows and expands. Evidence of our universe expanding is when the term 'redshift' occurs. Redshift happens when light is seen coming from an object that is moving away in a proportionally increased in wavelength, or shifted to the red end of the spectrum. This evidence is familiar in changes with pitches of sounds, with frequency of sound waves. When an object moves towards an observer, it has a decrease in wave length and is called 'blueshift', because of the colour of the light observed.

With these two particular theories in our knowledge, we can basically say, that the Universe itself does possibly have an age, due to the fact that we have identified that the Universe is expanding, and it may be expanding due to a cause or event, possibly being the Big Bang.

The Cosmic Microwave Background Radiation

The Cosmic Microwave Background Radiation, also known as CMB, is one of the most carefully examined pieces of evidence for the Big Bang. I964, two young radio astronomers, Arno Penzias and Robert Wilson, accidently discovered the CMB. They did this by using a well calibrated horn antenna. This determined that radiation was diffuse, emanated uniformly from all directions of the sky. Although, it wasn't considered a satisfying explanation. However, it came to the attention through Robert Dicke and Jim Peebles that this Background Radiation had in fact been predicted years earlier in 1948 by Gery Gamwow, Ralph Alpher, and Robert Herman, therefore, evidence or theory as such, wasn't just discovered once.

Basically, this Cosmic Microwave Background Radiation is a faint glow of light that fills the universe, falling on Earth from every direction with nearly uniform intensity. It is said to be the afterglow of the Big Bang, meaning it is the residual heat of creation, streaming through space these last 14 billion years, like the heat from a sun warmed rock, reradiated at night. CMB is said to be the oldest light we can see, the farthest back both in time and space can see. This theory relates back to the Big Bang, since it states that light set out on its journey more than 14 billion years ago, and is a relic

Annotations

Provides a clear explanation for the Big Bang theory of the origin of the universe.

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

Research report: The Big Bang theory

of the Universe's infancy. The time when it was not the cold black place it is now, but was in fact a firestorm of radiation and elementary particles. As the Universe keeps expanding, the wave length of the light has stretched with it into the microwave part of the electromagnetic spectrum, and CMB has cooled to its present day temperature.

As the theory states that this light is a faint glow and a residual heat from the Big Bang, travelling through our universe, it would have had to begin its journey from something or somewhere. If it did originate from the Big Bang itself, then it is a way that we can determine the age of our Universe, since this light is an aged light.

Gravitational Waves

Gravitational waves are the ripples in space-time which carry energy and angular momentum at the speed of light. Predicted by Albert Einstein's General Theory of relativity, there has been to date only indirect evidence for their existence. Weisberg and Taylor observed energy loss from binary pulsars, which gave the proof of existence for gravity waves. Gravity wave detectors constitute 'ears' which allow us to 'hear' for the first time the 'sounds' produced by the universe. This can relate back to the Big Bang, as the gravity waves ripple the space-time.

Like the CMB theory, these gravitational waves are a radiating through our Universe. This could mean that these gravitational waves of energy and angular momentum have been caused by something, possibly again the Big bang. As the Universe keeps expanding, these gravitational waves may keep expanding and travelling along with it.

Within saying this, the Big Bang Theory hasn't been just backed up by one person, being Edwin Hubble. Many other theories by Einstein, Penzias, Wilson and many others can relate their theories and Evidence for the Big Bang. Stephen Hawking states that there is no big gap in the scientific account of the Big Bang. That laws of physics can explain, how a universe of space, time and matter could emerge spontaneously, as a natural process. As a theory is put out, scientists can build on the theory, as there can always be more that can be discovered. Einstein's Theory of Relativity proposed that our Universe has 4 dimensions, the first three being what we know as space, and the fourth being space-time, (a dimension where time and space are inextricably linked). The Steady State Theory proposed by Herman Bond, Thomas Gold, and Fred Hoyle in 1948, suggested the Universe has always existed and always will, and looks essentially the same from every spot at every time (applying only to the Universe on large scales), This rose a lot of questions among scientists. The Steady State Theory had no way to explain the left over radiation possibly relating to the Big Bang, coming from the CMB theory. To that, the theory slowly faded, as the Big Bang displayed more evidence of our aging expanding Universe.

All these theories and more developed by people over history can give us an understanding on how to determine the age of our Universe. Each discovery, whether big or small, helps in the process of how it all started. If we hadn't come to discover these theories, even if they were proved wrong, or still remain as fact today, we wouldn't know what we know today about our Universe. If Edwin Hubble hadn't discovered that our Universe is expanding, years ago, we wouldn't be able to measure the expansion rate of the Universe that extrapolates back to the Big Bang, which can determine the possible age of our Universe.

Annotations

Analyses how theories are developed and reviewed over time as new evidence becomes available.

Research report: The Big Bang theory

One man by the name of Brain Schmidt, an Australian, won the Nobel Prize for physics. This was for the discovery that the Universe is expanding at an accelerated rate through observation of a distant supernovae. This turned the accepted scientific theory on its head. Schmidt says that the Universe will become infinitely big due to a mysterious force that he calls 'dark energy'. He also states that in the distant past, 5 billion years ago, the Universe was actually expanding slower than it is now. He and his team detected these supernovae at a distance more than 5 billion light years, estimating their age, subtracting their signals from the vast quantity of digital data in order to record their luminosity. This built on the Edwin's Hubble's theory that the Universe is expanding, but they went that further step and provided a theory that our Universe may be speeding up and slowing down, along with the a new 'dark energy'.

If you relate back to the Big Bang Theory, radiations, lights and gravity waves, would have all had to come from something, that something possibly being an event that created our Universe. If these radiations, lights and gravity waves are all travelling through space, then it must have had a cause for it to travel. The same goes with the whole Universe itself, something causing it to expand. If you were to reverse it from expanding, say travel back in time, so it would contract to where it began, it would have had to come from something smaller, something that would cause that expansion to happen, a time where the time began.

As we still try to compare and determine more theories, we won't really know if the Big Bang is true or not, with as much evidence as we do have, it's still hard to give an exact answer. As time does go on, and our knowledge grows, and our technologies improve, maybe one day we will find the answer we have been looking for.

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Annotations

Acknowledges the discovery of recent evidence by an Australian scientist that prompted further review and modification of the Big Bang theory.

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

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 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 shou 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 annotations you have made.

The audience this article is aimed at is people with little or no background information on the topic. It clearly explains words that the reader may not know, such as 'preimplantation genetic diagnosis' as to unsure the reader understands what they are reading. In ~~some~~ one part they talk about [redacted] of Comment on Repoductive ~~Ethic~~ Ethics', That is the part I had most difficult understanding as I was not sure what she worked as or whether ~~it~~ her opinion was relevant to the topic. I would have found it easier/better if they had explained what her job consisted of.

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

The article is written using a lot of information from Dr [redacted]. As Dr [redacted] both runs the [redacted] fertility institute and was a pioneer of IVF, he is a credible source to use due to his obvious knowledge on the topic. It is also written using opinions from Dr [redacted] who is a UK fertility expert and a member of the Royal College of Obstetricians and Gynaecologists' ethics committee, therefore has knowledge on the topic and is fit to release her negative opinions on designer babies.

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

The article is and is not biased in different ways. It is biased because Dr [redacted] clearly gives his

Annotations

Analyses the language of the article in detail to make a defensible inference about audience and purpose.

Questions the purpose of a citation when the person's qualifications are not clearly provided.

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

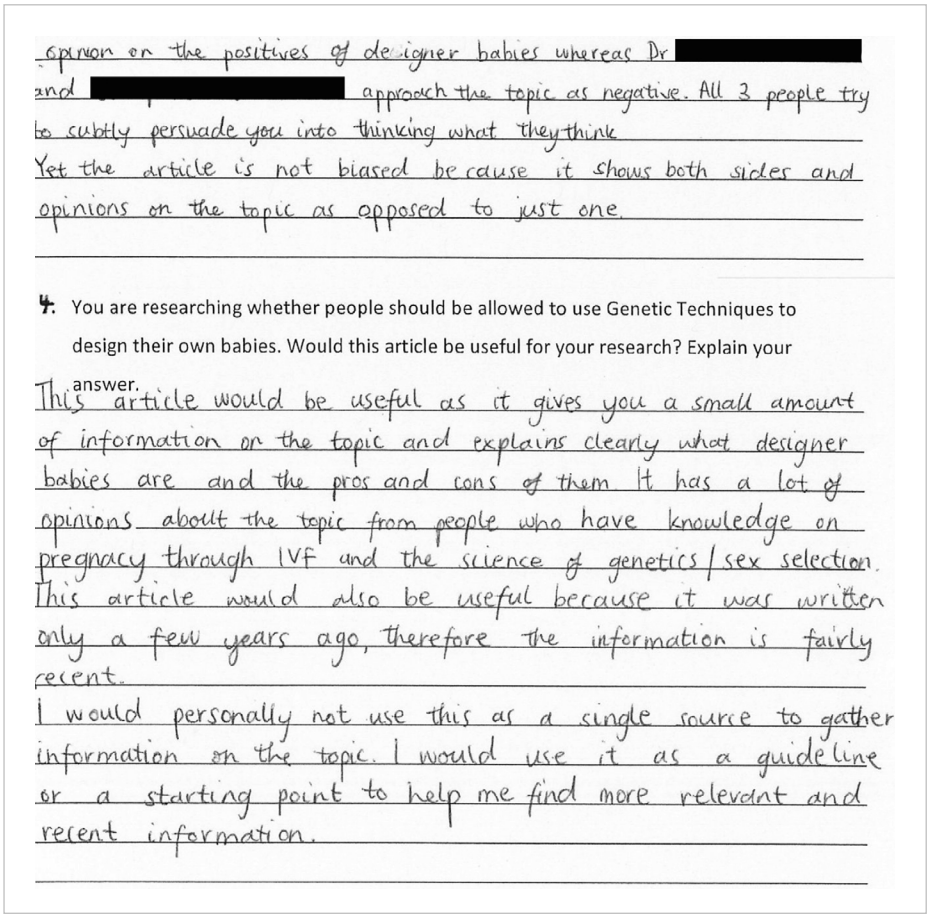
Evaluates the bias of each respondent and the article overall with reference to balance of views presented.

Science

Year 10

Above satisfactory

Source analysis: Designer babies



opinion on the positives of designer babies whereas Dr [redacted] and [redacted] approach the topic as negative. All 3 people try to subtly persuade you into thinking what they think. Yet the article is not biased because it shows both sides and opinions on the topic as opposed to just one.

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 useful as it gives you a small amount of information on the topic and explains clearly what designer babies are and the pros and cons of them. It has a lot of opinions about the topic from people who have knowledge on pregnacy through IVF and the science of genetics / sex selection. This article would also be useful because it was written only a few years ago, therefore the information is fairly recent.

I would personally not use this as a single source to gather information on the topic. I would use it as a guideline or a starting point to help me find more relevant and recent information.

Annotations

Considers the purpose, audience, reliability and validity of the article when evaluating the suitability of the article for research.

Annotations (Overview)

The student constructs evidence-based 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

Correctly identifies answers to 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.

An ~~organism~~ organism can only pass on the genes that it has. If all the organisms of a species are the same they will pass on the same genes. Variation is necessary so that the genes that give a species the best chance of survival can be selected and passed on.

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.

	Y	Y
y	Yy	Yy
y	Yy	Yy

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

GENOTYPE	PHENOTYPE
100 % Yy	100 % Yellow coat
%	%
%	%

Annotations

Explains 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	
25 %	YY	75 %	Yellow coat
50 %	Yy	25 %	Black coat
25 %	yy	%	

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

1. Mitosis involves only one round of cell division and produces two daughter cells and meiosis involves two rounds and produces four daughter cells.
2. The number of chromosomes in the daughter cells produced by mitosis is the same as in the parent cell, but in meiosis the daughter cells have half the number of chromosomes as the parent cell.

Annotations

Identifies two differences between mitosis and meiosis.

Science

Year 10

Above satisfactory

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.

The information tells us that spiros reproduce asexually and hiros reproduce sexually. Asexual reproduction is fast which is why there were more spiros than hiros at first. This is because they don't need to search for a mate to reproduce. However there is no variation in the species because the offspring are the same as the parents. This means that if one of the spiros gets a disease and dies then they all might die. The hiros take longer to reproduce since the females have to find a mate to mate with. However there will be variation in the species because of this and so they are likely to survive in the long run. Th is especially important for the inland river environment since the changing conditions will favour a species with variation which will be the h

Annotations

Explains the success of sexually reproducing species in the given scenario with reference to the relative advantages of sexual and asexual reproduction in a changing environment.

Annotations (Overview)

The student constructs evidence-based arguments and correctly uses a range of 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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> *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 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

Aim: To see how salinity affects the density of water.

Hypothesis: The water with the highest salt concentration will sink the lowest and be the densest.

Variables

Independent: The independent variable is the amount of salt in ratio to the amount of water; the salt concentration.

Dependent: The dependent variable is measured in annotated still photographs from a video.

Controlled Variables: The variables that will be kept the same are the volume of fresh tap water poured into the oven dish, all the water has the same temperature, the oven dish is the same, and the beakers are the same, the measuring electronic scales and the amount of water being added to the base water.

Equipment

- Pyrex Oven dish
- Coloured food dye
- 2X 250 mL beakers
- Spoon
- Camera or ipod
- Electronic scale
- Paper towel
- Stirring rod
- Salt

In this practical we are investigating the effect of salinity on the density of water. We chose to do 5 trials measuring the salt in ratio to fresh tap water and mixing it together to create salt water. We used 50mL of water each time, making the ratio of salt water to fresh water 20:1. For each trial we doubled the ratio starting at 1:2, 1:4, 1:8, 1:16, and 1:32.

Annotations

Develops an appropriate hypothesis.

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

Investigation: Global ocean currents

Ratio	Fresh Water (mL)	Salt (g)
1:2	50	25
1:4	50	12.5
1:8	50	6.25
1:16	50	3.125
1:32	50	1.6

Method

1. Fill the oven dish with 1000mL (1L) of fresh tap water
2. Measure out 25g of salt into a 250 mL beaker using the electronic scales
3. Pour 50mL of fresh water into the beaker containing the salt
4. Stir the salt water mixture well, until all the salt has dissolved, then add 3 drops of food dye into the water
5. Pour the dyed salt water into the oven dish full of fresh water. Pour it from the edge of the oven dish so that it flows down one side.
6. Record the results by taking a video showing the dye being poured into the oven dish
7. Rinse the beaker
8. Repeat steps 1 till 7 for each of the different ratios

Annotations

Investigation: Global ocean currents

Results

Picture 1

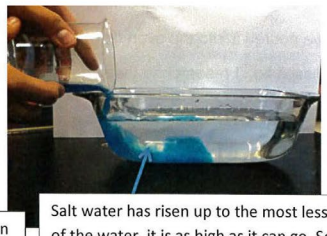
Fresh water

Picture 2

The salt water is rising slightly because the salt was not fully dissolved so there was uneven levels of salt in the water.

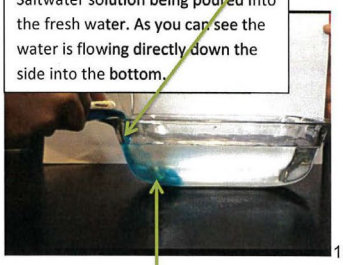
Saltwater with a very small salt concentration being poured into the oven dish.

1:2

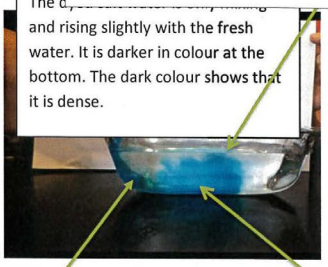


Salt water has risen up to the most less dense part of the water, it is as high as it can go. So the density is equal to that of fresh water in that part.

Saltwater solution being poured into the fresh water. As you can see the water is flowing directly down the side into the bottom.



1:32



and rising slightly with the fresh water. It is darker in colour at the bottom. The dark colour shows that it is dense.

Picture 3

Water colour is slightly paler because it is less dense.

Picture 4

The water still flows straight down but when it levels out it starts to mix with the fresh water.

The water is mixing with the fresh water giving it a much paler colour compared to the other test.

Discussion

From the observations of photographs it can be seen that any concentration of salt water when added to fresh water will sink to the bottom. However the difference that the salt concentrations create is the speed that the salt water sinks and the density of the water. As show in picture 2 the blue water stays at the bottom and does not really mix with the other water because it has a very high concentration of salt to water meaning it is denser. In picture 4 however you can clearly see how the blue water has mixed more with the fresh water because the concentration is significantly less (23.4g less).

Errors and Improvements

Annotations

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

Describes observed trends with reference to speed of water movement and amount of diffusion.

Investigation: Global ocean currents

An error which occurred during our experiment was that the salt was not fully dissolved when we poured it into the oven dish of water, as it was quite hard to see when it was fully dissolved. I researched the saturation point of salt water and found that it is 100mL to 35g of salt. Therefore this means that in 50 mL of water the most amount of salt that will dissolve is 17.5 g. which means that the ratio of 1:2 was too much salt for the water to hold and this is why it didn't dissolve properly. An improvement that can be made for that is to start at a ratio of 1:4 however I still think it is good to see how dense the water is at the highest saturation point so I left the ratio of 1:2 in.

Another error was that we started at the very beginning with a saline solution in the oven dish to replicate the ocean water and then we poured a higher concentration of salt water into the saline solution. This didn't work because the base salt water made the results not as reliable because the water mixed together.

We also were using too much of the saltwater solution in ratio to the oven dish water this made the results unclear as well so we decreased the amount of water we poured in from 100mL to 50mL and we increased the volume of water in the oven dish from 800mL to 1000mL. Another minor improvement was that we poured the saltwater into the fresh water from the side of the dish instead of in the middle which we had initially done.

Theory Questions

1. Three factors that affect the world's climate are gases in the atmosphere, ocean currents and the surface of the earth. The surface of the earth affects the climate because of the amount of sun's rays it can absorb. In darker green areas like forests it absorbs lots of sunlight creating a warmer climate whereas in snowy areas the sunlight is reflected because of the brighter surface, creating a colder climate. Ocean currents carry heat around the Earth, the currents take the warm water from near the equator and take it to colder places further away from the equator. The warm water also has warm air. The gases in the atmosphere are called the greenhouse effect and absorb thermal energy from the sun and Earth's surface; it keeps the Earth's temperature fluctuations in a specific range.

Annotations

Identifies significant sources of error and suggests improvements that would increase the reliability of the investigation.

Identifies a flaw in the analogy design but justifies the approach taken.

Describes the interactions between the atmosphere, geosphere, biosphere and hydrosphere that affect global ocean currents.

Investigation: Global ocean currents

2. The main factors that cause ocean currents are density in sea water, the topography of the sea floor, the energy of the sun and the rotation of the Earth. The energy of the sun affects ocean currents because it heats the water the closer it is to the equator causing a change in density. It also causes evaporation which means there is a higher concentration of salt in the water thus affecting the density again. The topography of the sea floor affects the ocean currents for obvious reasons; if there is something in the way or a deep crevice the water has to go there and fill it up or avoid it.
3. The main cause of surface currents is wind and the rotation of the earth. Gyres are created by the rotation of the Earth. These are surface currents which extend to around 400m below sea level and travel in a clockwise direction in the Northern Hemisphere and in the Southern Hemisphere an anti-clockwise direction.
4. Temperature affects deep ocean currents because it alters the density of the water. When the water is cold it will sink deeper and when the water is hot it will rise to the surface. Salinity effects the deep ocean currents in a similar way, when there is more salt in the water it will become denser sinking to the bottom. The salinity and temperature changes when it is cold and ice forms or when the water is close to the equator and water evaporates and warms.
5. The global conveyor belt is so important in regards to the earth's climate because it moves warm and cold air and water throughout the world causing change in seasons and keeping the fluctuations in weather to a minimum.

In conclusion, the aim of this practical was to see how salinity affects the density of water. The hypothesis stated that the water with the highest salt concentration will sink the lowest and be the densest. This was proved to be correct by the photographs which clearly showed that the highest concentration of salt water sunk the lowest ad stayed the lowest. This practical can be related back to ocean currents especially the deep ocean Thermohaline current. When ice forms in the North Atlantic Ocean it creates a higher salt concentration in the water which means that the water sinks deeper. When it reaches the Indian and Pacific Oceans it is brought to the surface by the process of upwelling. This process continues in an endless cycle.

Annotations

Analyses the investigation results, draws an evidence-based conclusion and links the investigation to the processes involved in 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.

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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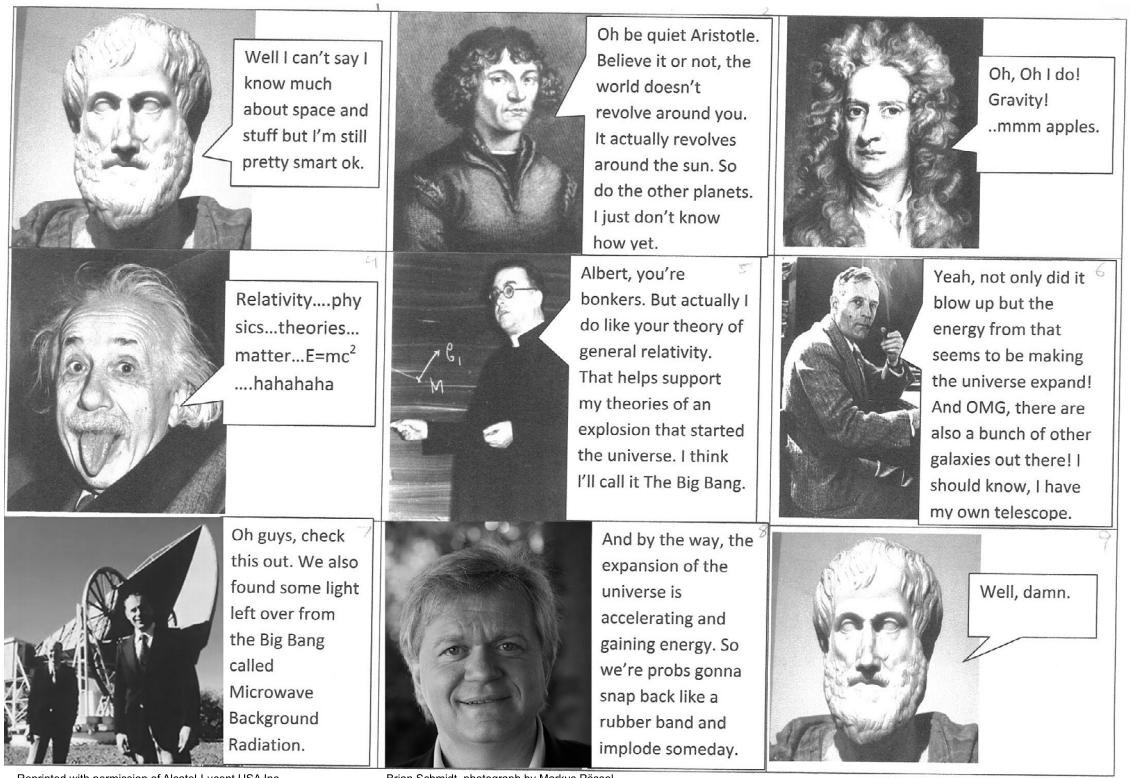
Summary of task

Students 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
Above satisfactory

Cartoon: The development of the Big Bang theory



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Brian Schmidt, photograph by Markus Pössel, 2012 Used under Creative Commons licence: CC BY-SA 3.0 http://creativecommons.org/licenses/by-sa/3.0/deed.en

Annotations

Summarises the contribution of a range of scientists to the development of the Big Bang theory over time.

Identifies the evidence that prompted each scientist to review ideas about the origin of the universe.

Identifies the contribution of contemporary research to the body of evidence supporting the theory.

Annotations (Overview)

The student uses humour and peer-appropriate language in a multimedia text to communicate scientific ideas in a way that is concise, visually appealing and engaging for their peers.