Science

Year 9
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 9 SCIENCE

This portfolio provides the following student work samples:

Sample 1	Investigation report: Chemical change
Sample 2	Research report: Chemical change
Sample 3	Investigation report: Solar oven
Sample 4	Investigation report: Refraction of light
Sample 5	Written test: Changing Earth
Sample 6	Worksheet: Ecosystems
Sample 7	Venn diagram: Control and regulation
Sample 8	Research report: Bionic eye

In this portfolio, the student explains chemical processes with reference to atoms and energy transfers (WS1, WS2) and describes examples of photosynthesis and combustion as important chemical reactions (WS2). The student applies the wave model of energy transfer to explain phenomena (WS3, WS4). The student explains some global features in terms of geological processes and timescales (WS5) and provides a simple analysis of how biological systems function and respond to external changes with reference to interdependencies (WS6, WS7). The student explains how technological factors have influenced scientific developments (WS5) and predicts how future applications of technologies might affect people's lives (WS8).

Science

Year 9

Above satisfactory

The student demonstrates the capacity to design questions that could be investigated using a range of inquiry skills and methods, including the control and accurate measurement of variables and systematic collection of data (WS1, WS3). The student analyses trends in data (WS1, WS3, WS4), identifies relationships between variables and reveals inconsistencies in results, suggesting specific improvements to improve the quality of the evidence (WS1, WS3, WS4). The student uses appropriate language and representations to communicate findings and ideas (WS1, WS2, WS3, WS4, WS5, WS6, WS7, WS8) and designs text to communicate to specific audiences (WS1, WS2).

Investigation report: Chemical change

Year 9 Science achievement standard

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

> *By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They describe models of energy transfer and apply these to explain phenomena. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives.*
>
> *Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.*

Summary of task

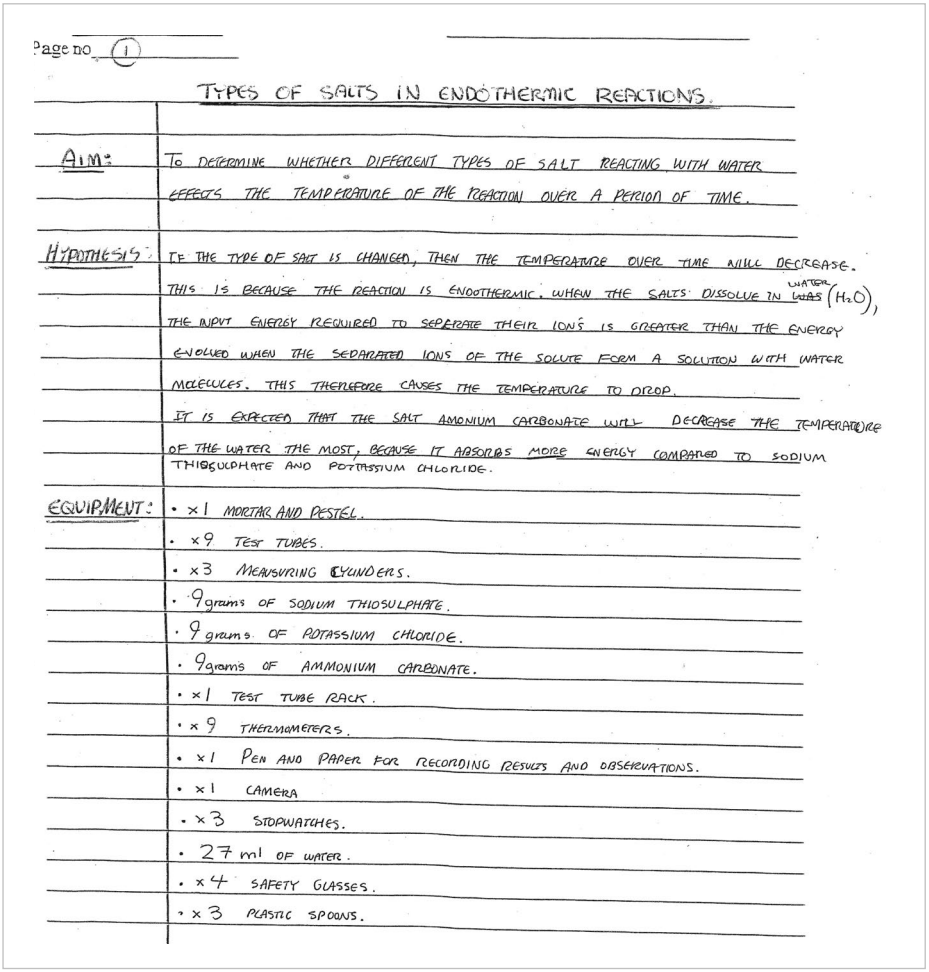
Students had investigated a range of chemical reactions and explored the use of the atomic model to explain and predict chemical processes. Students had been introduced to the classification of endothermic and exothermic reactions and some everyday applications of these.

In this task students were asked to work in groups to investigate the energy changes involved in chemical reactions. A range of chemicals and equipment was provided. Students were required to develop a question, design an appropriate method and select ways to present their data in a scientific report appropriate for an audience of their peers.

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

The practical component of this task was undertaken in three lessons. In the fourth lesson, students completed their written investigation report individually under test conditions. A set of guidelines for writing a practical report was provided.

Investigation report: Chemical change



Page no. 1

TYPES OF SALTS IN ENDOTHERMIC REACTIONS.

AIM: TO DETERMINE WHETHER DIFFERENT TYPES OF SALT REACTING WITH WATER EFFECTS THE TEMPERATURE OF THE REACTION OVER A PERIOD OF TIME.

HYPOTHESIS: IF THE TYPE OF SALT IS CHANGED, THEN THE TEMPERATURE OVER TIME WILL DECREASE. THIS IS BECAUSE THE REACTION IS ENDOTHERMIC. WHEN THE SALTS DISSOLVE IN WATER (H_2O), THE INPUT ENERGY REQUIRED TO SEPERATE THEIR IONS IS GREATER THAN THE ENERGY EVOLVED WHEN THE SEPARATED IONS OF THE SOLUTE FORM A SOLUTION WITH WATER MOLECULES. THIS THEREFORE CAUSES THE TEMPERATURE TO DROP.
IT IS EXPECTED THAT THE SALT AMONIUM CARBONATE WILL DECREASE THE TEMPERATURE OF THE WATER THE MOST, BECAUSE IT ABSORBS MORE ENERGY COMPARED TO SODIUM THIOSULPHATE AND POTTASSIUM CHLORIDE.

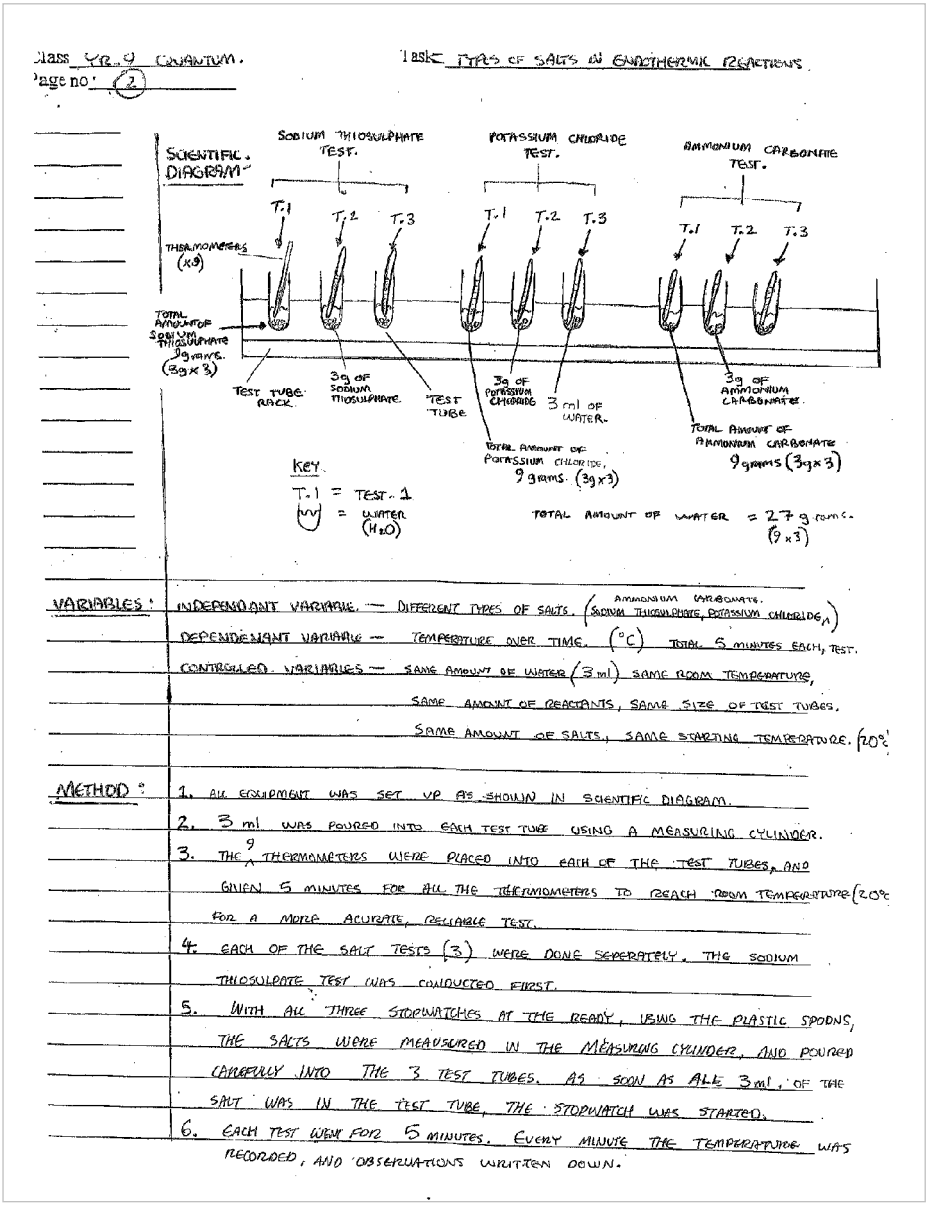
EQUIPMENT:
- x1 MORTAR AND PESTEL.
- x9 TEST TUBES.
- x3 MEASURING CYLINDERS.
- 9 grams OF SODIUM THIOSULPHATE.
- 9 grams OF POTASSIUM CHLORIDE.
- 9 grams OF AMMONIUM CARBONATE.
- x1 TEST TUBE RACK.
- x9 THERMOMETERS.
- x1 PEN AND PAPER FOR RECORDING RESULTS AND OBSERVATIONS.
- x1 CAMERA
- x3 STOPWATCHES.
- 27 ml OF WATER.
- x4 SAFETY GLASSES.
- x3 PLASTIC SPOONS.

Annotations

Designs a clear aim that reflects a question to be investigated.

Develops a plausible hypothesis based on understanding of energy changes in exothermic reaction.

Investigation report: Chemical change



Class YR. 9 QUANTUM. Task: TYPES OF SALTS IN ENDOTHERMIC REACTIONS
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SCIENTIFIC DIAGRAM:

VARIABLES:
INDEPENDENT VARIABLE — DIFFERENT TYPES OF SALTS. (AMMONIUM CARBONATE, SODIUM THIOSULPHATE, POTASSIUM CHLORIDE)
DEPENDENT VARIABLE — TEMPERATURE OVER TIME. (°C) TOTAL 5 MINUTES EACH, TEST.
CONTROLLED VARIABLES — SAME AMOUNT OF WATER (3 ml) SAME ROOM TEMPERATURE,
SAME AMOUNT OF REACTANTS, SAME SIZE OF TEST TUBES,
SAME AMOUNT OF SALTS, SAME STARTING TEMPERATURE. (20°C)

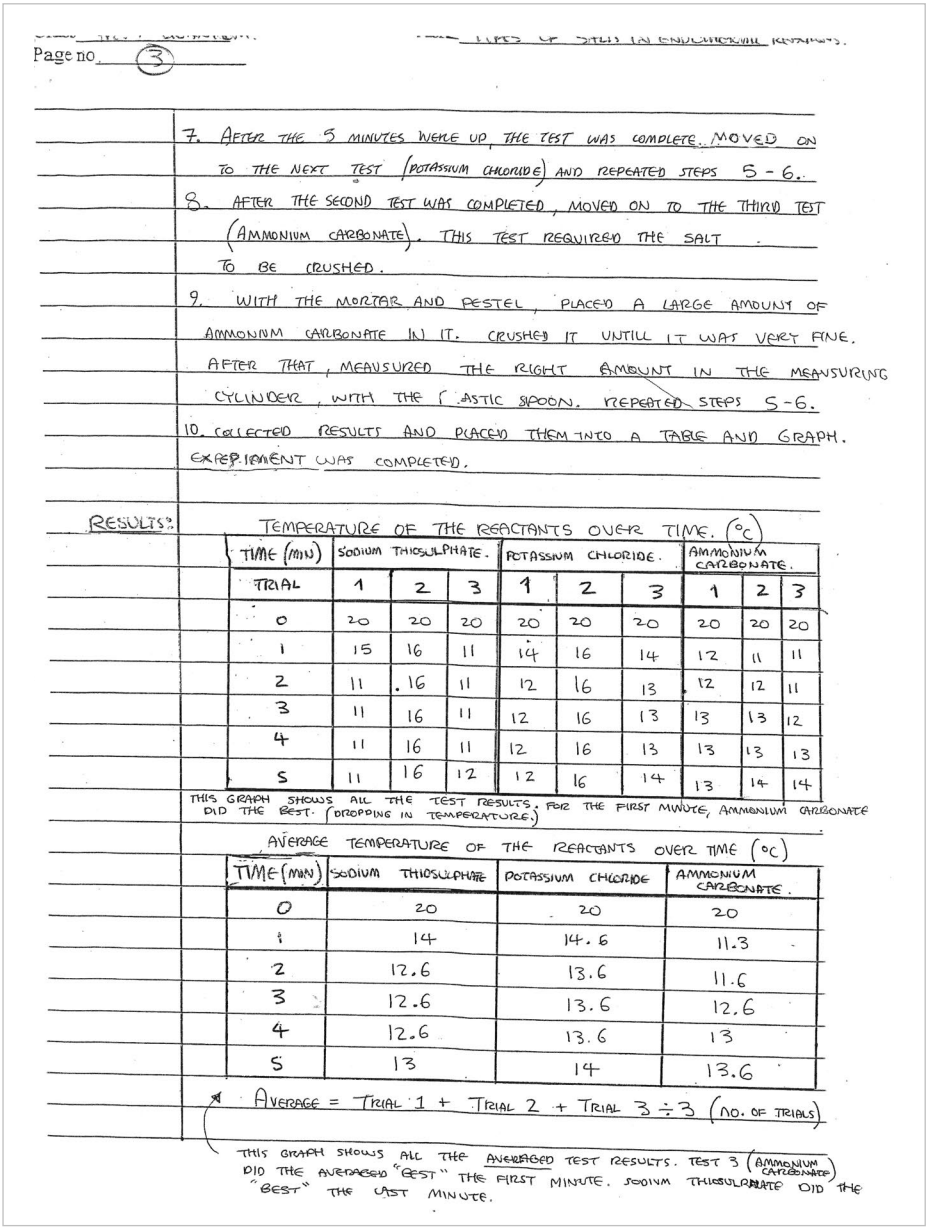
METHOD:
1. ALL EQUIPMENT WAS SET UP AS SHOWN IN SCIENTIFIC DIAGRAM.
2. 3 ml WAS POURED INTO EACH TEST TUBE USING A MEASURING CYLINDER.
3. THE 9 THERMOMETERS WERE PLACED INTO EACH OF THE TEST TUBES, AND GIVEN 5 MINUTES FOR ALL THE THERMOMETERS TO REACH ROOM TEMPERATURE (20°C) FOR A MORE ACURATE, RELIABLE TEST.
4. EACH OF THE SALT TESTS (3) WERE DONE SEPERATELY. THE SODIUM THIOSULPHATE TEST WAS CONDUCTED FIRST.
5. WITH ALL THREE STOPWATCHES AT THE READY, USING THE PLASTIC SPOONS, THE SALTS WERE MEASURED IN THE MEASURING CYLINDER, AND POURED CAREFULLY INTO THE 3 TEST TUBES. AS SOON AS ALL 3 ml OF THE SALT WAS IN THE TEST TUBE, THE STOPWATCH WAS STARTED.
6. EACH TEST WENT FOR 5 MINUTES. EVERY MINUTE THE TEMPERATURE WAS RECORDED, AND OBSERVATIONS WRITTEN DOWN.

Annotations

Identifies independent, dependent and controlled variables.

Designs a clear, logical method to test the hypothesis, including control and measurement of variables.

Investigation report: Chemical change



Page no. 3

7. AFTER THE 5 MINUTES WERE UP, THE TEST WAS COMPLETE. MOVED ON TO THE NEXT TEST (POTASSIUM CHLORIDE) AND REPEATED STEPS 5 - 6.

8. AFTER THE SECOND TEST WAS COMPLETED, MOVED ON TO THE THIRD TEST (AMMONIUM CARBONATE). THIS TEST REQUIRED THE SALT TO BE CRUSHED.

9. WITH THE MORTAR AND PESTEL, PLACED A LARGE AMOUNT OF AMMONIUM CARBONATE IN IT. CRUSHED IT UNTILL IT WAS VERY FINE. AFTER THAT, MEASURED THE RIGHT AMOUNT IN THE MEASURING CYLINDER, WITH THE PLASTIC SPOON. REPEATED STEPS 5-6.

10. COLLECTED RESULTS AND PLACED THEM INTO A TABLE AND GRAPH. EXPERIMENT WAS COMPLETED.

RESULTS:

TEMPERATURE OF THE REACTANTS OVER TIME. (°C)

TIME (MIN)	SODIUM THIOSULPHATE.			POTASSIUM CHLORIDE.			AMMONIUM CARBONATE.		
TRIAL	1	2	3	1	2	3	1	2	3
0	20	20	20	20	20	20	20	20	20
1	15	16	11	14	16	14	12	11	11
2	11	16	11	12	16	13	12	12	11
3	11	16	11	12	16	13	13	13	12
4	11	16	11	12	16	13	13	13	13
5	11	16	12	12	16	14	13	14	14

THIS GRAPH SHOWS ALL THE TEST RESULTS. FOR THE FIRST MINUTE, AMMONIUM CARBONATE DID THE BEST. (DROPPING IN TEMPERATURE.)

AVERAGE TEMPERATURE OF THE REACTANTS OVER TIME (°C)

TIME (MIN)	SODIUM THIOSULPHATE	POTASSIUM CHLORIDE	AMMONIUM CARBONATE
0	20	20	20
1	14	14.6	11.3
2	12.6	13.6	11.6
3	12.6	13.6	12.6
4	12.6	13.6	13
5	13	14	13.6

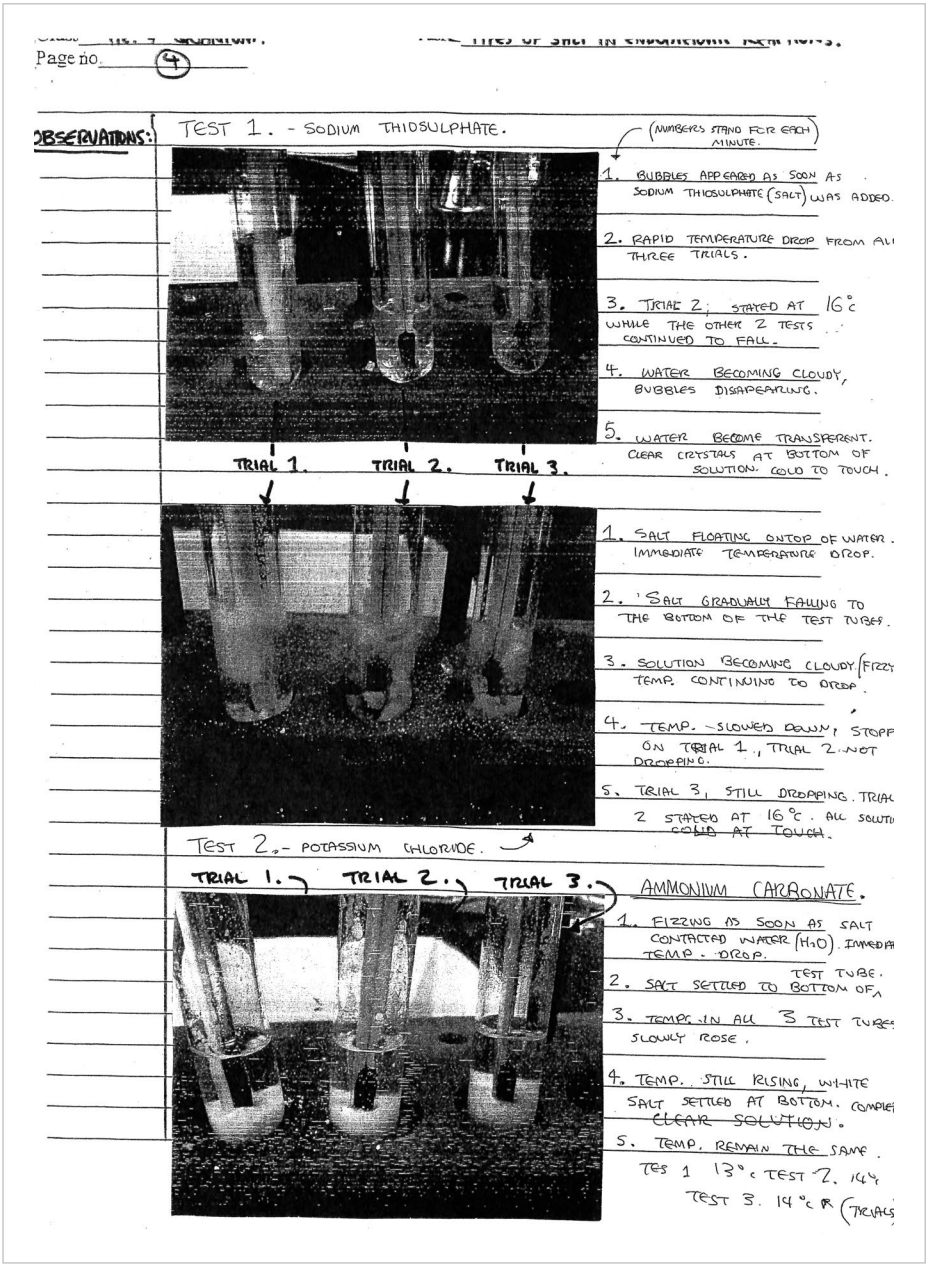
AVERAGE = TRIAL 1 + TRIAL 2 + TRIAL 3 ÷ 3 (NO. OF TRIALS)

THIS GRAPH SHOWS ALL THE AVERAGED TEST RESULTS. TEST 3 (AMMONIUM CARBONATE) DID THE AVERAGED "BEST" THE FIRST MINUTE. SODIUM THIOSULPHATE DID THE "BEST" THE LAST MINUTE.

Annotations

Systematically collects and records quantitative data (time and temperature).

Investigation report: Chemical change



Page no. 4

OBSERVATIONS: TEST 1. - SODIUM THIOSULPHATE. (NUMBERS STAND FOR EACH MINUTE.

1. BUBBLES APPEARED AS SOON AS SODIUM THIOSULPHATE (SALT) WAS ADDED.
2. RAPID TEMPERATURE DROP FROM ALL THREE TRIALS.
3. TRIAL 2; STATED AT 16°C WHILE THE OTHER 2 TESTS CONTINUED TO FALL.
4. WATER BECOMING CLOUDY, BUBBLES DISAPEARING.
5. WATER BECOME TRANSPERENT. CLEAR CRYSTALS AT BOTTOM OF SOLUTION. COLD TO TOUCH.

TRIAL 1. TRIAL 2. TRIAL 3.

1. SALT FLOATING ONTOP OF WATER. IMMEDIATE TEMPERATURE DROP.
2. SALT GRADUALLY FALLING TO THE BOTTOM OF THE TEST TUBES.
3. SOLUTION BECOMING CLOUDY (FIZZY TEMP. CONTINUING TO DROP.
4. TEMP. SLOWED DOWN, STOPP ON TRIAL 1, TRIAL 2 NOT DROPPING.
5. TRIAL 3, STILL DROPPING. TRIAL 2 STATED AT 16°C. ALL SOLUTI COLD AT TOUCH.

TEST 2. - POTASSIUM CHLORIDE.

TRIAL 1. TRIAL 2. TRIAL 3.

AMMONIUM CARBONATE.

1. FIZZING AS SOON AS SALT CONTACTED WATER (H_2O). IMMEDIA TEMP. DROP.
2. SALT SETTLED TO BOTTOM OF TEST TUBE.
3. TEMP. IN ALL 3 TEST TUBES SLOWLY ROSE.
4. TEMP. STILL RISING, WHITE SALT SETTLED AT BOTTOM. COMPLE CLEAR SOLUTION.
5. TEMP. REMAIN THE SAME.

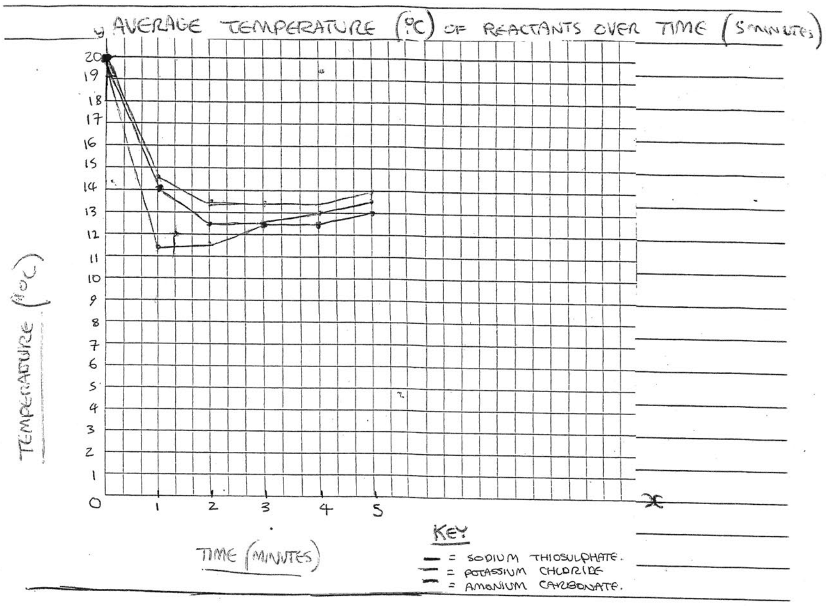
TES 1 13°C TEST 2. 14° TEST 3. 14°C (TRIALS

Annotations

Systematically collects and records qualitative data (observed reaction).

Investigation report: Chemical change

Class YR. 7 QUANTUM   Task TYPES OF SALTS IN ENDOTHERMIC REACTIONS.
Page no (3)

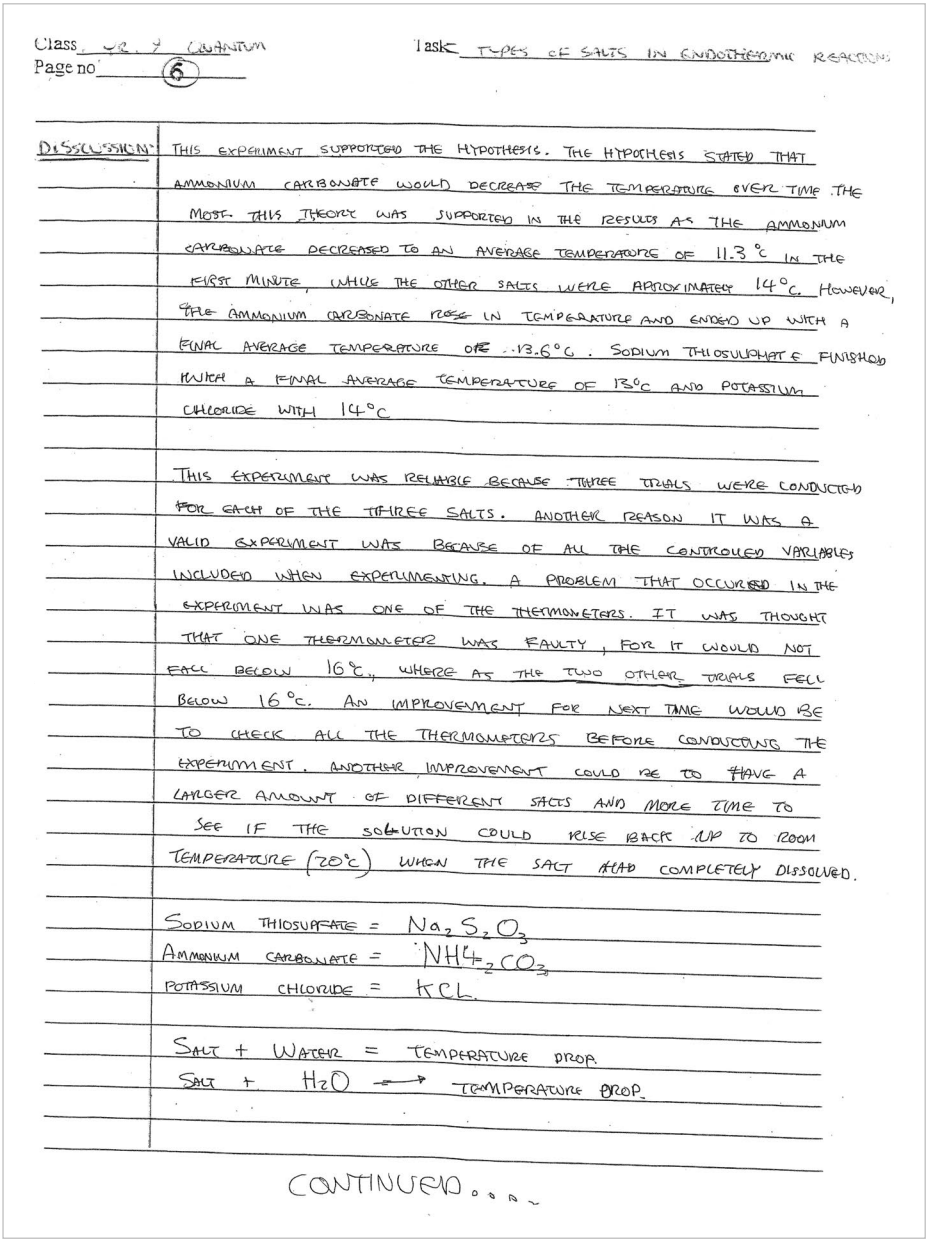


- AS SHOWN ON THE GRAPH, THE TEMPERATURE OF AMMONIUM CARBONATE MIXED WITH WATER HAS HAD THE LARGEST TEMPERATURE CHANGE, IT HAS DECREASE BY 8.7°C. BUT, AFTER THE FIRST MINUTE, THE TEMPERATURE STARTED RISING AGAIN. AT THE END OF THE TEST (5 minutes) IT WAS AT 13.6 °C. SODIUM THIOSULPHATE WAS THE SECOND SLOWEST OUT OF ALL OF THE THREE TESTS, BUT WAS THE LOWEST TEMPERAUTURE AFTER FIVE MINUTES. POTASSIUM CHLORIDE DECREASED THE SLOWEST AND HAD THE HIGHEST AND MOST CONSISTENT TEMPERATURE.

Annotations

Uses graphing conventions to construct a line graph which clearly represents the relationship between temperature and time for dissolved salts.

Investigation report: Chemical change



Class YR. 7 CHEMISTRY Task TYPES OF SALTS IN ENDOTHERMIC REACTIONS
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DISCUSSION: THIS EXPERIMENT SUPPORTED THE HYPOTHESIS. THE HYPOTHESIS STATED THAT AMMONIUM CARBONATE WOULD DECREASE THE TEMPERATURE OVER TIME THE MOST. THIS THEORY WAS SUPPORTED IN THE RESULTS AS THE AMMONIUM CARBONATE DECREASED TO AN AVERAGE TEMPERATURE OF 11.3 °C IN THE FIRST MINUTE, WHILE THE OTHER SALTS WERE APPROXIMATELY 14 °C. HOWEVER, THE AMMONIUM CARBONATE ROSE IN TEMPERATURE AND ENDED UP WITH A FINAL AVERAGE TEMPERATURE OF 13.6 °C. SODIUM THIOSULPHATE FINISHED WITH A FINAL AVERAGE TEMPERATURE OF 13°C AND POTASSIUM CHLORIDE WITH 14 °C

THIS EXPERIMENT WAS RELIABLE BECAUSE THREE TRIALS WERE CONDUCTED FOR EACH OF THE THREE SALTS. ANOTHER REASON IT WAS A VALID EXPERIMENT WAS BECAUSE OF ALL THE CONTROLLED VARIABLES INCLUDED WHEN EXPERIMENTING. A PROBLEM THAT OCCURRED IN THE EXPERIMENT WAS ONE OF THE THERMOMETERS. IT WAS THOUGHT THAT ONE THERMOMETER WAS FAULTY, FOR IT WOULD NOT FALL BELOW 16 °C, WHERE AS THE TWO OTHER TRIALS FELL BELOW 16 °C. AN IMPROVEMENT FOR NEXT TIME WOULD BE TO CHECK ALL THE THERMOMETERS BEFORE CONDUCTING THE EXPERIMENT. ANOTHER IMPROVEMENT COULD BE TO HAVE A LARGER AMOUNT OF DIFFERENT SALTS AND MORE TIME TO SEE IF THE SOLUTION COULD RISE BACK UP TO ROOM TEMPERATURE (20°C) WHEN THE SALT HAD COMPLETELY DISSOLVED.

SODIUM THIOSULFATE = $Na_2S_2O_3$
AMMONIUM CARBONATE = $NH4_2CO_3$
POTASSIUM CHLORIDE = KCL.

SALT + WATER = TEMPERATURE DROP.
SALT + H_2O → TEMPERATURE DROP.

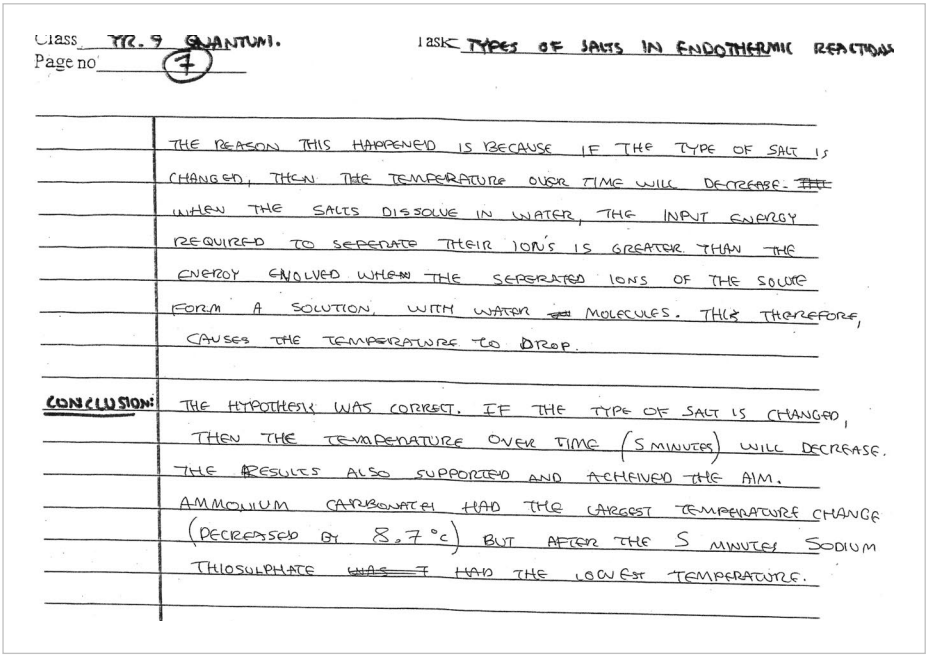
CONTINUED....

Annotations

Analyses evidence to identify the relationship between type of salt and temperature change.

Provides a thorough analysis of the method to justify the reliability and accuracy of the data.

Investigation report: Chemical change



Class YR. 9 QUANTUM. Task TYPES OF SALTS IN ENDOTHERMIC REACTIONS
Page no 7

THE REASON THIS HAPPENED IS BECAUSE IF THE TYPE OF SALT IS CHANGED, THEN THE TEMPERATURE OVER TIME WILL DECREASE. ~~THE~~ WHEN THE SALTS DISSOLVE IN WATER, THE INPUT ENERGY REQUIRED TO SEPERATE THEIR IONS IS GREATER THAN THE ENERGY EVOLVED WHEN THE SEPERATED IONS OF THE SOLUTE FORM A SOLUTION WITH WATER ~~THE~~ MOLECULES. THIS THEREFORE, CAUSES THE TEMPERATURE TO DROP.

CONCLUSION: THE HYPOTHESIS WAS CORRECT. IF THE TYPE OF SALT IS CHANGED, THEN THE TEMPERATURE OVER TIME (5 MINUTES) WILL DECREASE. THE RESULTS ALSO SUPPORTED AND ACHEIVED THE AIM. AMMONIUM CARBONATE HAD THE LARGEST TEMPERATURE CHANGE (DECREASED BY 8.7 °c) BUT AFTER THE 5 MINUTES SODIUM THIOSULPHATE ~~WAS~~ I HAD THE LOWEST TEMPERATURE.

Annotations

Uses evidence to justify conclusions.

Annotations (Overview)

The student uses language and representations to communicate science ideas to a specific audience.

Research report: Chemical change

Year 9 Science achievement standard

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

> *By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They describe models of energy transfer and apply these to explain phenomena. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives.*
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> *Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.*

Summary of task

Students had been introduced to the atomic model and the ways in which this could be used to explain chemical structures and processes. They had investigated a variety of chemical reactions and classified them as endothermic or exothermic, linking this to energy transfers and transformations.

In this task, students were asked to research how chemical changes impact on society and develop a report suitable for a general public audience. Students were given two weeks to complete the task outside of class time.

Research report: Chemical change

Chemical change, also called a chemical reaction, occurs when two substances react to form an entirely new substance. This product has a different set of properties from the reactants. For a chemical change to occur, the bonds of the reactants need to be broken, and then new bonds are formed between the atoms in the reaction to form new compounds. A chemical change can be either endothermic or exothermic – that is, it either takes in heat from the environment and converts it to chemical energy or transfers heat to the environment after converting chemical energy into heat energy. Chemical changes can be both natural and man-made. Natural chemical changes include photosynthesis, combustion and oxidation. Man-made chemical changes include saponification in wet chemical fire extinguishers, combustion in fireworks and engines, and batteries. A physical change occurs when a substance takes on a new form but is still the same substance. This is the case for changes of state. H_2O can be found as a solid (ice), a liquid (water) or a gas (steam). When in each of these three states the H_2O still consists of H_2O molecules and so changing from one state to another is a physical change, not a chemical change. Unlike a chemical change, a physical change does not create a new substance and is easily reversed.

Chemical changes are used in everyday life to address specific problems and issues. Chemical fire extinguishers, cars and the use of aluminium oxidation are all ways that humans manipulate chemical reactions to suit our needs. In a wet chemical fire extinguisher, the chemical in the fire extinguisher, usually potassium acetate, potassium citrate or potassium carbonate, reacts with fat in a chemical reaction called saponification. It creates a layer of soap on top of the fat and thus smothers the fuel preventing re-ignition, as the fuel requires oxygen to combust. Saponification is also an endothermic reaction, and as such takes in heat from the surrounding environment, cooling the fuel down even further, which also prevents re-ignition. In this way saponification is used in everyday life to combat the problem of oil or fat fires, which is not possible without wet chemical fire extinguishers. We also use combustion for transportation, allowing us to travel faster than we might otherwise do. Combustion requires a fuel, oxygen and heat. In a car engine, a fuel is compressed and then ignited. This produces a vast amount of energy and this energy is used to move the car. Ships are made out of metal because they are stronger than when made out of wood and are also easier to fabricate. However, this presents the problem of oxidation, as ships spend a large period of time in contact with oxygen in water. To address this problem some ships are made out of aluminium. Aluminium oxidises very quickly, and forms a hard, smooth layer. This prevents the aluminium from oxidising further and so solves the problem.

Annotations

Explains chemical processes in terms of the breaking and forming of bonds between atoms.

Explains energy transfer and transformation in exothermic and endothermic chemical reactions.

Describes the differences between chemical changes and physical changes.

Describes examples of chemical reactions that are important for society, including saponification, combustion and oxidation.

Research report: Chemical change

The way aluminium oxidises is a great advantage when building ships. It can also be used to great effect as a coating for steel to prevent corrosion. This coated steel can be used for water heaters, corrugated roofing, drying ovens, home and industrial incinerators, furnaces, kiln walls and small appliances.[1] This is because the aluminium oxidises in such a way that it forms a protective coating on top of the aluminium to prevent any further oxidation. However, because aluminium oxidation is such an aggressive reaction, in that it happens very quickly, if one were to rub off the layer of aluminium oxide than the aluminium that is exposed would immediately react with the oxygen in the air. If this happened continually over a number of months, than the aluminium would eventually corrode all the way through. This would create holes in the aluminium, and as such is a disadvantage of the reaction between oxygen and aluminium.

The oxidation of aluminium has economic and social implications. As aluminium is lightweight and malleable as well as the way in which it oxidises, it is very easy to construct boats out of it because one can make thin light sheets from it and use these to build the boat. This means it is much cheaper and practical to make small boats out of aluminium than another substance. When a small boat is made from aluminium, it is light and so uses less fuel, making it more economic because one does not have to buy lots of fuel. As such, there are many more small boats on the ocean for pleasure and social activities. Small recreational boats are comparatively cheap to build and run, and so social and recreational activities involving boats are more easily accessible to the public. The oxidation of aluminium contributes to the social usage of boats as it prevents the entire substance from corroding and thus is very practical for people to use for a social activity.

Chemical changes impact society quite heavily. We use them for safety in fire extinguishers, travel in cars and portable electricity in batteries. Oxidation particularly impacts society in the making of boats as due thought must be given to which material one should make them out of.

[1] *Look No Further For the World's Best Source of Aluminized Steel,* (2012) [online] Available at: http://www.atlassteel.com/products/aluminizedsteel.aspx (accessed 20.05.2012)

3

Annotations

Applies knowledge of chemical reactions and energy transfer and transformation to explain in detail the positive and negative social and economic implications of saponification, combustion and oxidation reactions.

Annotations (Overview)

The student uses appropriate language and representations to communicate findings and ideas to a specific audience.

Investigation report: Solar oven

Year 9 Science achievement standard

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

> *By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They describe models of energy transfer and apply these to explain phenomena. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives.*
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> *Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.*

Summary of task

Students had completed a number of tasks to develop their science inquiry skills. They had been exploring sustainable energy use and simple technologies that could be used as alternatives to electric appliances.

Students were asked to research solar ovens and how they work. They were then required to design and build their own solar oven and test its performance. A template was provided which students used to document their procedure and findings. Students were required to explain trends and patterns in their data and to complete an evaluation of their investigation.

Students were warned that handling the solar ovens when hot could cause burns, so protective clothing should be worn. They were provided with welder's gloves to protect their hands when taking temperature measurements.

Investigation report: Solar oven

INVESTIGATION: MAKE A SOLAR OVEN

Aim: Investigate the factor(s) that can affect how well a solar oven performs.

WHAT TO DO:

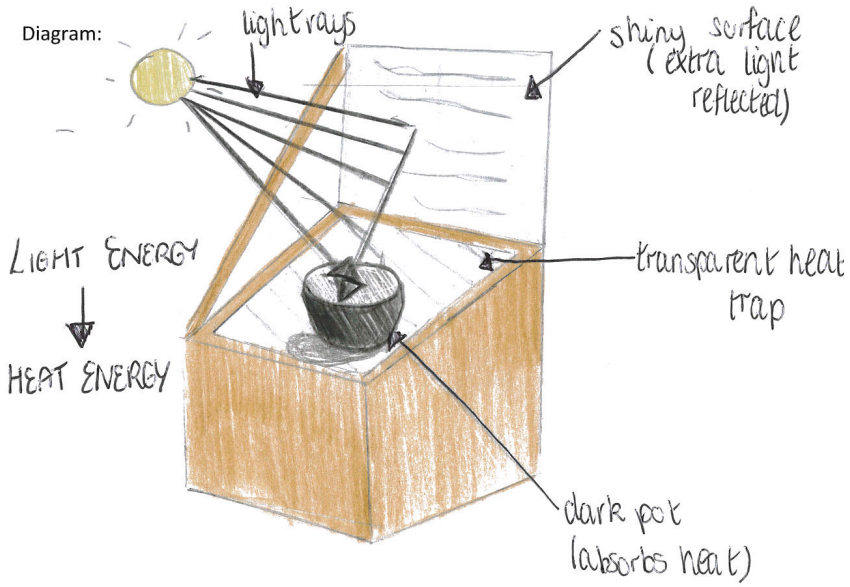
1) 'WHAT IS A SOLAR OVEN'?

A solar oven is a device which uses sunlight as its energy source. It uses no electricity, costs nothing to run and it is fuelled by the sun and its light.

2) WITH A DIAGRAM EXPLAIN HOW A SOLAR OVEN WORKS.

A solar oven cooks by turning light rays from the sun into heat. The dark pot absorbs heat and converts sunlight into heat energy, the transparent heat trap seals the air and the temperature rises, the reflectors increase the amount of light (heat), the food would start to cook, the insulated box keeps the heat in and the temperature can be regulated by adjusting the amount of light the oven gets.

Diagram:



Annotations

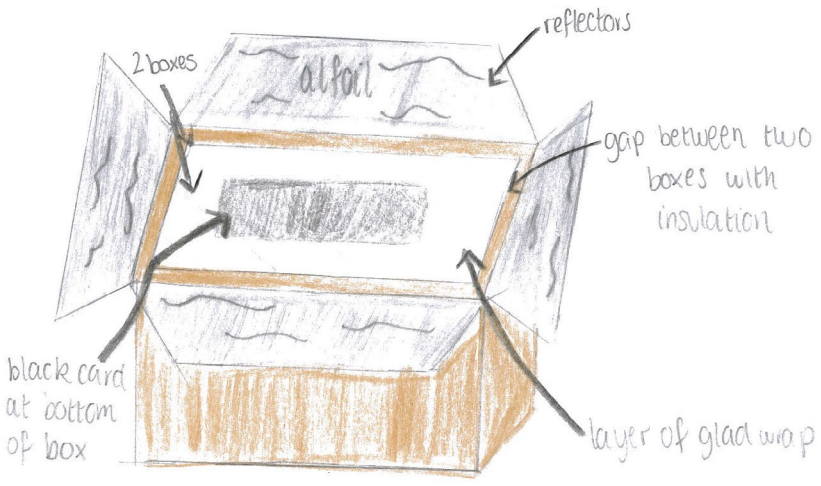
Investigation report: Solar oven

3) MY SOLAR OVEN!!

-DESIGN A SOLAR OVEN THAT YOU CAN MAKE IN 2 OR 3 LESSONS
-WITH A LABELLED DIAGRAM (SHOWING THE MATERIALS USED), EXPLAIN THE CHOICE IN THESE MATERIALS AND HOW YOUR SOLAR OVEN WORKS.
-NOW BUILD YOUR SOLAR OVEN AND TEST IT

- Two boxes: with insulation between them to retain heat
- Black card on the inside of the inner box: absorbs heat
- Glad wrap on the top of the box: prevents heat from escaping
- Alfoil reflectors: reflects extra sunlight
- The reflectors are at the same angle to keep the test fair

Labelled Diagram:



Annotations

Investigation report: Solar oven

INVESTIGATE:

HOW CAN I IMPROVE THE PERFORMANCE OF MY SOLAR OVEN?

Phase one: Planning

What is the problem you are investigating?

The problem is: *How can I improve my performance of my solar oven?*

What do you know about this topic from personal experience and from science?

From personal experience and science, we know:

- The more reflectors, the more heat will be produced- this will decrease the amount of time required to cook food
- A transparent sheet (eg. glad wrap) will let sun in, but retains heat
- The more heat we can manage to trap, the quicker the food will cook

What variables may affect the phenomenon you are investigating?

The variables may include: The number of reflectors, angle of reflectors, amount of glad wrap and the amount of sunlight.

Annotations

Investigation report: Solar oven

Which of the variables are you going to investigate as your independent variable (this is the variable you will change to see what effect it has on the dependent variable)?

The variable our group has chosen to investigate as our independent variable is the amount of reflectors added to our solar oven.

How will the independent variable be changed in the experiment?

We will change the independent variable by starting with one reflector and adding more on after three trials have been completed for each. We will finish with four reflectors, one on each side of the box, to see how much the temperature increased and if it improved the performance of the solar oven.

What is the dependent variable (i.e. the variable that responds to changes in the independent variable)?

The dependent variable is how hot the oven gets.

How will you measure the dependent variable?

A thermometer will be placed in a cup of water inside the oven. We will check the temperature change after 3 minutes.

What question are you investigating?

The question we have chosen to investigate is: *How does the number of reflectors affect the temperature of the oven?*

Predict what you think will happen. Explain why.

We think that the more reflectors added, the hotter the water will get. This is because during our research, the reflectors were used on solar ovens to increase the amount of light that reaches the oven. This light energy would then turn into heat energy, due to the way we will construct our box.

Annotations

Identifies the independent variable and how it will be changed.

Identifies the dependent variable and how it will be measured.

Develops a question that can be investigated.

Investigation report: Solar oven

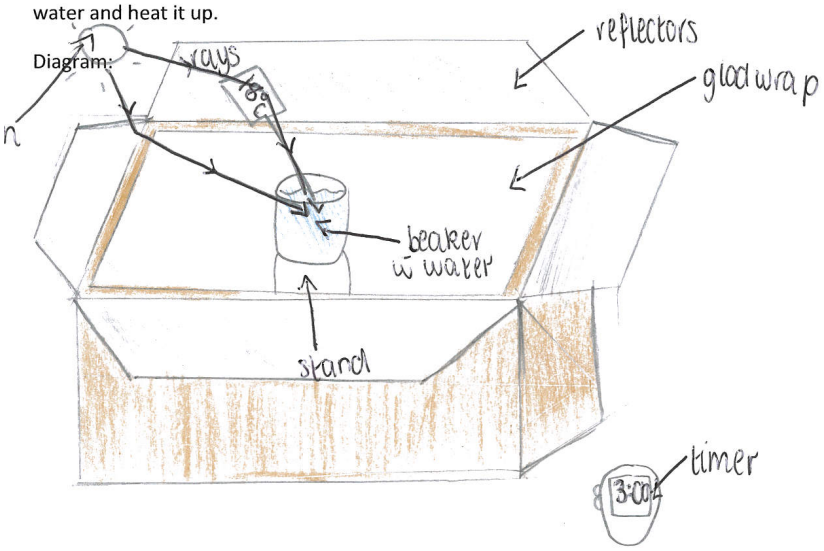
The amount of glad wrap, amount of sunlight, angle of reflectors, amount of water, insulation, same container, type of thermometer are all of the variables that we will control.

Describe your experimental set-up using a labelled diagram and explain how you will collect your data.

- Put a cup of water in solar oven with thermometer
- Measure temperature of the water (before it is heated)
- Position oven, then start timing
- After 3 minutes record temperature
- Let oven and cup cool

The sunlight will bounce off the reflector(s) and hit the cooking area. Then the glad wrap will trap the heat and the black card will absorb it. This heat energy will then reach the cup of water and heat it up.

Diagram:



Are there any safety precautions?
Yes there are. They include:

- Don't pick up the cup before it has cooled down
- Don't look directly at the light source
- Don't touch the hot foil on the reflectors.

Annotations

Identifies a range of variables to be controlled in the investigation.

Describes a method which provides opportunities to control and measure variables.

Describes how safety issues have been considered.

Investigation report: Solar oven

TEMPERATURE OF WATER BEFORE TRIAL 10 DEGREES

NUMBER OF REFLECTORS	TRIAL ONE	TRAIL TWO	TRIAL THREE	AVERAGE TEMPERATURE
ONE	16 DEGREES	16 DEGREES	15 DEGREES	15.6 DEGREES
TWO	17 DEGREES	17 DEGREES	17 DEGREES	17 DEGREES
THREE	19 DEGREES	18 DEGREES	18 DEGREES	18.3 DEGREES

How did you make sure your data were accurate?

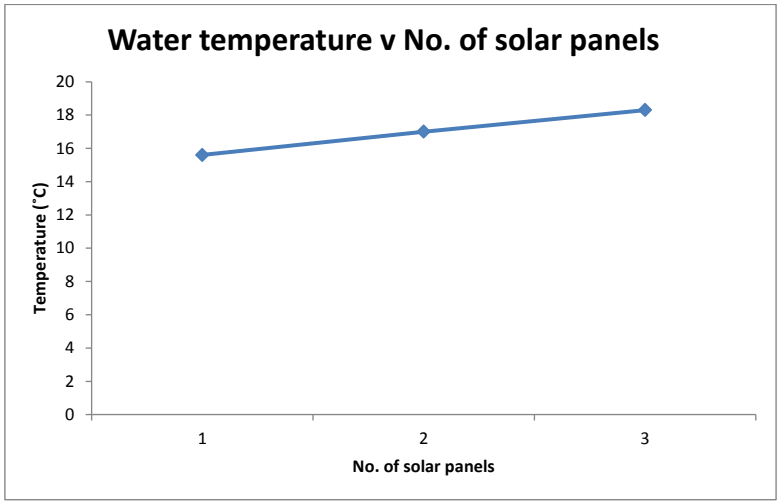
We did three trials which were 3 minutes long for each number of reflectors there were, after we had finished the trials we added up all 3 of the degrees that we got for that one set of reflectors, then divided it by 3 (because there were 3 trials) and got the average temperature. By doing our data this way were can make sure that it is accurate and fair which means others can use our results. There were also no outliers to remove because they were all similar in the final result.

Annotations

Systematically collects and records data.

Considers outliers when collating data as evidence.

Investigation report: Solar oven



Analyse your data. Are there any patterns or trends in your data? What is the relationship between the variables you have investigated? Is the hypothesis supported by the data?

The data shows that as the number of reflectors increased so did the temperature of the water inside the oven. This means that there is a positive relationship between the independent and the dependent variables which can be seen in the graph. The data supports our hypothesis which was that the more reflectors are added the hotter the water will get.

Using science concepts explain the patterns, trends or relationships you have identified in your data. What is your conclusion?

The relationship in the data is because of the way the solar oven is designed. The reflectors direct the sun's rays into the oven which causes the water to be heated through heat energy travelling as radiation. The more reflectors there are the more sunlight will be directed into the oven and so the hotter the water will become.

The pattern in the data suggests that if the surface area of the reflective surface of the solar oven is increased, more sunlight will be reflected into the interior of the solar oven box. This means that the temperature rises to a greater point in a shorter period of time.

Annotations

Uses an appropriate graph to display findings.

Analyses evidence to clearly identify and justify the relationship between number of reflectors and temperature of the water.

Investigation report: Solar oven

Phase Four: Evaluating

1. The main sources of experimental error were probably the way we measured our results. Since we only heated the oven for two minutes, I don't believe the light actually had enough time to take effect on the temperature in the oven. That was the main error, but some of our variables could have also been controlled better. For example, the glad wrap had a few holes in it, which meant that heat could escape. The reflectors were also sometimes moved slightly, so that the angle that they were reflecting the light differed in some tests. We were also unsure of how to read the thermometer.

2. I am fairly confident with our conclusion (that the number of reflectors affects the heat of the solar oven) because there is a clear 'pattern' in the data collected. However I think there were a few aspects of our experiment which could have definitely been considered and improved, which would have ruled out any uncertainty about our conclusion. The results we got were the ones that were predicted.

3. The design of the experiment could have been improved in that we weren't sure of our thermometer. A longer time frame could also be applied to each trial to ensure that the light had proper time to take effect, especially because we were heating up water. A more secure layer of glad wrap over the lid without any holes would probably improve our experiment design. A stronger light source would have also helped.

4. In this investigation, we learned that it is very important to know you're equipment well. Also that controlling variables is vital to getting accurate data and measurements.

Annotations

Evaluates the method in detail to identify probable sources of error and suggests feasible actions to improve the quality of data.

Annotations (Overview)

The student uses appropriate language and representations to communicate findings and ideas.

Investigation report: Refraction of light

Year 9 Science achievement standard

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

> *By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They describe models of energy transfer and apply these to explain phenomena. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives.*
>
> *Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.*

Summary of task

Students had been introduced to the wave model of light, and investigated reflection, refraction and total internal reflection phenomena, including constructing representations to indicate the transfer of energy.

Students were asked to complete an investigation to collect quantitative data to support the law of refraction. They were required to relate their findings to their knowledge of light waves and energy transfer and connect them to everyday phenomena.

Students were warned that the use of light boxes presented a low risk of electrocution and burns and they were required to follow appropriate procedures to ensure the light boxes were set up away from water sources and not handled when they became hot.

Two 50-minute lessons were allocated to the investigation. Students completed the report independently outside of class time.

Investigation report: Refraction of light

Variables

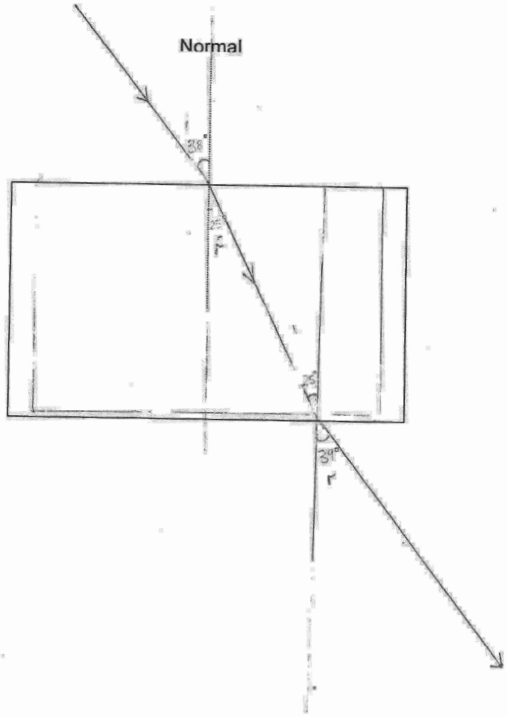
Independent: The independent variable is the angle of incidence.

Dependent: The dependent variable is the angle of refraction.

Controlled to ensure a fair test: The controlled variables are the same number of volts used for the light, the same block was used each time, the same ray box was used and the same amount of lighting was present each time. Another controlled variable was that the same side of the light box was used.

Results

Diagram 1



Annotations

Identifies the independent, dependent and controlled variables in the investigation.

Represents the movement of light through a more dense medium, including the normal and angles of incidence and refraction.

Investigation report: Refraction of light

Table

Test		Trial 1	Trial 2	Trail 3
Light entering glass from air	Angle of incidence	38°	15°	52°
	Angle of refraction	25°	11°	30°
Light entering air from glass	Angle of incidence	25°	13°	32°
	Angle of refraction	39°	12°	53°

Discussion

Does the light bend towards or away from the normal as it enters the glass block?
The light bends towards the normal as it enters the glass block.

Which way does it bend as it leaves?
The light bends away from the normal as it leaves the glass block.

Complete the following statement – As light travels from a less dense medium to a more dense medium it bends towards the normal, as it travels from a more dense medium to a more dense one it bends away from the normal.

Did your findings reflect you hypothesis? Explain
The findings supported the hypothesis because as the light entered a more dense medium it bent towards the normal. Then when the light entered a less dense medium it bent away from the normal.

What can you determine from your table of results? (What results were similar?)
The table of results determine that the angle of incidence when the light entered the glass from the air was similar to the angle of refraction when the light entered the air from the glass. The angle of refraction when the light entered glass from air was similar to the angle of incidence when the light entered the air from glass.

Annotations

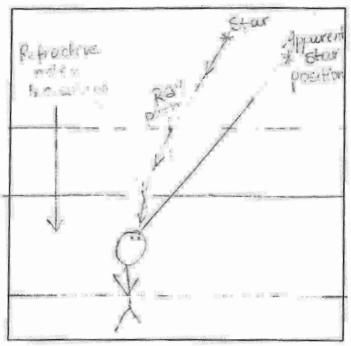
Collates data in a provided table.

Describes the movement of light through a more dense medium with reference to the normal.

Analyses experimental data to clearly identify the relationship between angles of incidence and refraction for light entering and leaving a more dense medium.

Investigation report: Refraction of light

Explain in detail the effect refraction has on either spear fishing, the bending of a pencil in water, the twinkling of the stars or the variation in the size of the sun (midday compared to sunrise and sunset).



the many layers of the atmosphere vary in density. When a ray of light from a star strikes one of the layers of the atmosphere, the light refracts. This keeps happening as the ray of light passes through all the layers of the atmosphere. To the humans eye, standing on earth, the refracted light makes the stars look like they're twinkling.

What errors occurred and explain how they affected your results.

During this experiment when drawing the diagrams the light box moved slightly altering the results. This affected the angle measurements. Another error that occured was that the width of the ~~light~~ ray of light ~~is~~ was wider than the width of the pencil. This meant that the measurements were not exact and that the angle measurements were affected.

Conclusion

In conclusion the aim of the experiment was to investigate how a light beam refracts through a transparent block and to determine the law of refraction. The hypothesis was supported. It was found that: as the light enters a more dense medium it bends towards the normal and as it enters a less dense medium it bends away from the normal. The angle of incidence as the light enters a more dense medium and the angle of refraction as the light enters a less dense medium are similar. The angle of refraction as the light enters a more dense medium and the angle of incidence as the light enters a less dense medium are similar.

Annotations

Applies knowledge of the wave model of light to explain the effects of atmospheric refraction on the observation of a star.

Identifies probable sources of inaccuracy that would impact on findings.

Annotations (Overview)

The student uses appropriate language and representations to communicate findings and ideas.

Written test: Changing Earth

Year 9 Science achievement standard

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

> *By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They describe models of energy transfer and apply these to explain phenomena. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives.*
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Summary of task

Students had completed a unit on plate tectonics and changes to Earth's crust. They had investigated the development of the theory of plate tectonics and the evidence that supports the theory. They had analysed a range of landforms and earthquake and volcanic events to identify the contributing plate movements.

Students were required to complete a unit test following completion of the unit. They had 90 minutes to complete the test in closed book test conditions. The work sample includes a selection of the test items.

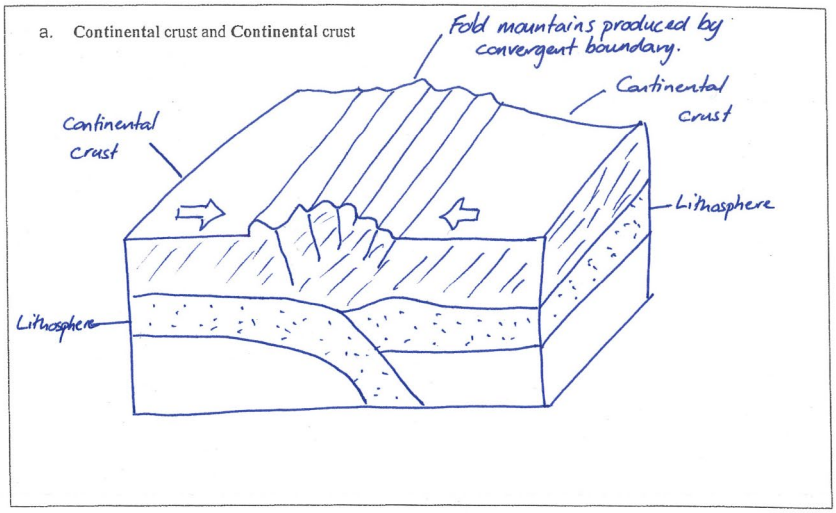
Written test: Changing Earth

PART 2 – MEDIUM DIFFICULTY QUESTIONS

4. a) In the boxes below **illustrate** a convergent boundary between:

   i) Continental and continental crust. (Box 'A')
   ii) Oceanic and oceanic crust. (Box 'B')

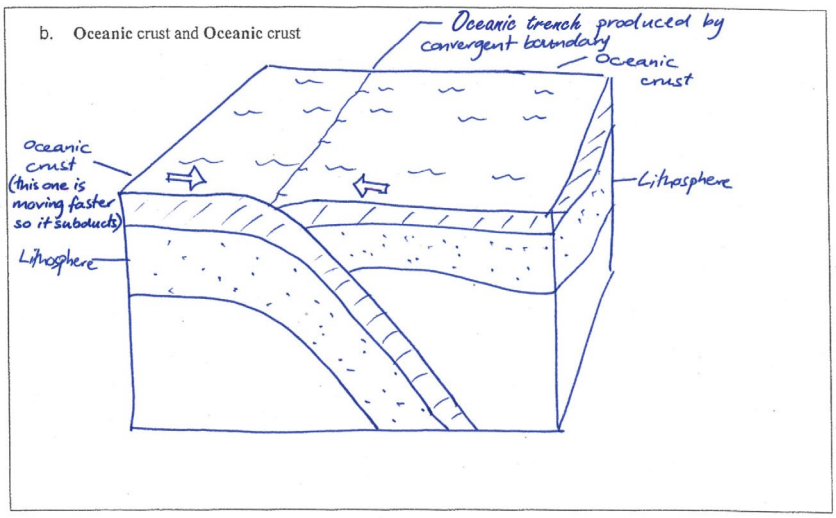
In your illustration, be sure to **identify** the direction that each plate is moving **and** name the landform that each boundary produces.



Annotations

Illustrates in detail that the collision between two areas of continental crust results in mountain building.

Written test: Changing Earth



b) **Explain** why a convergent boundary between a continental plate and an oceanic plate always produces a volcanic island and a deep ocean trench.

At the convergent boundary between a continental plate and an oceanic plate ~~causes the~~ the continental oceanic plate always is subducted underneath the continental plate because it is more dense. This creates an oceanic trench on the ocean floor because its subducted under the continental plate. Some of the oceanic plate melts and forms magma which rises up to the surface and creates a volcanic island at the plates where the 2 plates meet.

Annotations

Illustrates in detail that an oceanic trench forms when oceanic plates converge.

Accurately explains the result of converging continental and oceanic plates with reference to subduction resulting from differences in plate density.

Written test: Changing Earth

8. In 1912, a scientist called Alfred Wegener suggested a hypothesis called continental drift. Wegener's continental drift hypothesis states that "*all the continents used to form a single land mass, called Pangea, before breaking apart and 'drifting' into their current positions*". Despite the evidence Wegener had collected, his theory was rejected by the scientific community. However, in light of new evidence the scientific community have revised Wegener's hypothesis and incorporated it into the theory of plate tectonics.

Justify the following statement: "Without modern technology, Wegener's theory of continental drift would never have been accepted by the scientific community". In your justification make sure to:

a) **Identify** one piece of technology that provided new evidence in support of Wegener's theory of continental drift
b) **Explain** one (1) new piece of evidence that has been collected that supports Wegener's theory of continental drift
c) **Explain how** this evidence **supports and extends** Wegener's original theory

Satellite technology has provided new evidence to support Wegener's theory of continental drift. It can be used to measure the speed of continental plate movement. The fastest rate of movement is about 2.5cm per year. In order to work this out the satellites show the position of the continents by taking images and transmitting them to Earth. Scientists can look at the images and see how the position of the continents have changed. Without this evidence it was impossible to completely prove that the continents were moving or how much they moved. Wegner originally said that the continents moved as fast as 250 cm per year which is maybe why people and scientists found it so hard to believe him. Wegener made some other mistakes as well for example about how the plates move. Therefore the technology has helped to support wegener's original theory and provide some corrections to make his theory stronger.

Annotations

Explains in detail how satellite technology has provided new evidence to support continental drift theory.

Annotations (Overview)

The student uses appropriate language and representations to communicate ideas and findings.

Worksheet: Ecosystems

Year 9 Science achievement standard

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

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Summary of task

Students had completed a unit on ecosystems, including conducting field work in their local heathland and completing a case study on the Biosphere 2 experiment. They had investigated how matter and energy move through an ecosystem, and the different ways this can be represented.

This task was a revision exercise undertaken at the end of the unit. Students worked individually, with no access to resources, other than the Wetland Food Web diagram. They were given 40 minutes to complete the task. A recommended word count was given for the first question as a guide to the level of depth required by students in their answers.

Science

Year 9

Above satisfactory

Worksheet: Ecosystems

1. Explain what the "Wetland Food Web" diagram shows. (50-100 words)

The "Wetland Food Web" diagram shows how water, nutrients and energy are transferred through the ecosystem. It does this through arrows that link the producers, consumers and decomposers. The diagram shows the sun which allows the producers to perform photosynthesis. It also shows ~~decomp~~ ~~dec~~ decomposers and the order of the consumers, for example first order consumers eat the producers.

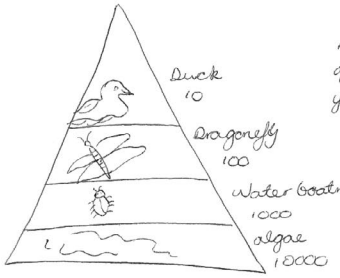
2. A pollution leak into the creek that occurred above this wetland caused the water quality to decrease; all the water boatman died and the mosquitos bred excessively. Predict the possible effects of these changes on the other living things in the wetland.

The water boatman is the only food source of the diving beetle so they will probably die as well. The water boatman are the only animal that eat the reeds. Therefore if all the water boatman die the amount of reeds will increase. They may even crowd out the other water plants and algae, especially if the water gets shallower. This could ~~had~~ have flow on effects for the second order consumers if mosquito numbers increase, there could be changes in the population size of all consumers in the food web.

3. Explain how oxygen and carbon are cycled in this system.

The carbon and oxygen cycle begins with producers when they perform photosynthesis. The carbon and oxygen are absorbed as carbon dioxide and water are converted to oxygen and glucose. Consumers breathe in the oxygen and eat the glucose. They breathe out carbon dioxide and the cycle repeats itself. When consumers die, the carbon and oxygen that makes up their bodies is released by decomposers and they go back into the cycle.

4. Choose one food chain that contains 3 consumers and draw a biomass pyramid. Briefly explain what the biomass pyramid represents.



The food pyramid represents the estimated number and mass ~~of animals~~ at each step of a food chain. The numbers decrease as you move up the pyramid. This is because energy and matter is lost through a food chain as it is converted to heat and other types of energy. There are less big animals at the top of the pyramid since there wouldn't be enough energy and matter to support large numbers.

Annotations

Provides a detailed explanation of a food web in terms of feeding relationships, energy transfer and flows of water and nutrients.

Accurately describes the effects of pollution on specific populations in a wetland in terms of interdependencies.

Explains in detail how oxygen and carbon are cycled through a food web by producers and consumers.

Illustrates that a biomass pyramid shows the relative numbers of organisms in a food chain and provides an explanation in terms of energy and matter.

Annotations (Overview)

The student uses appropriate language and representations to communicate science ideas.

Venn diagram: Control and regulation

Year 9 Science achievement standard

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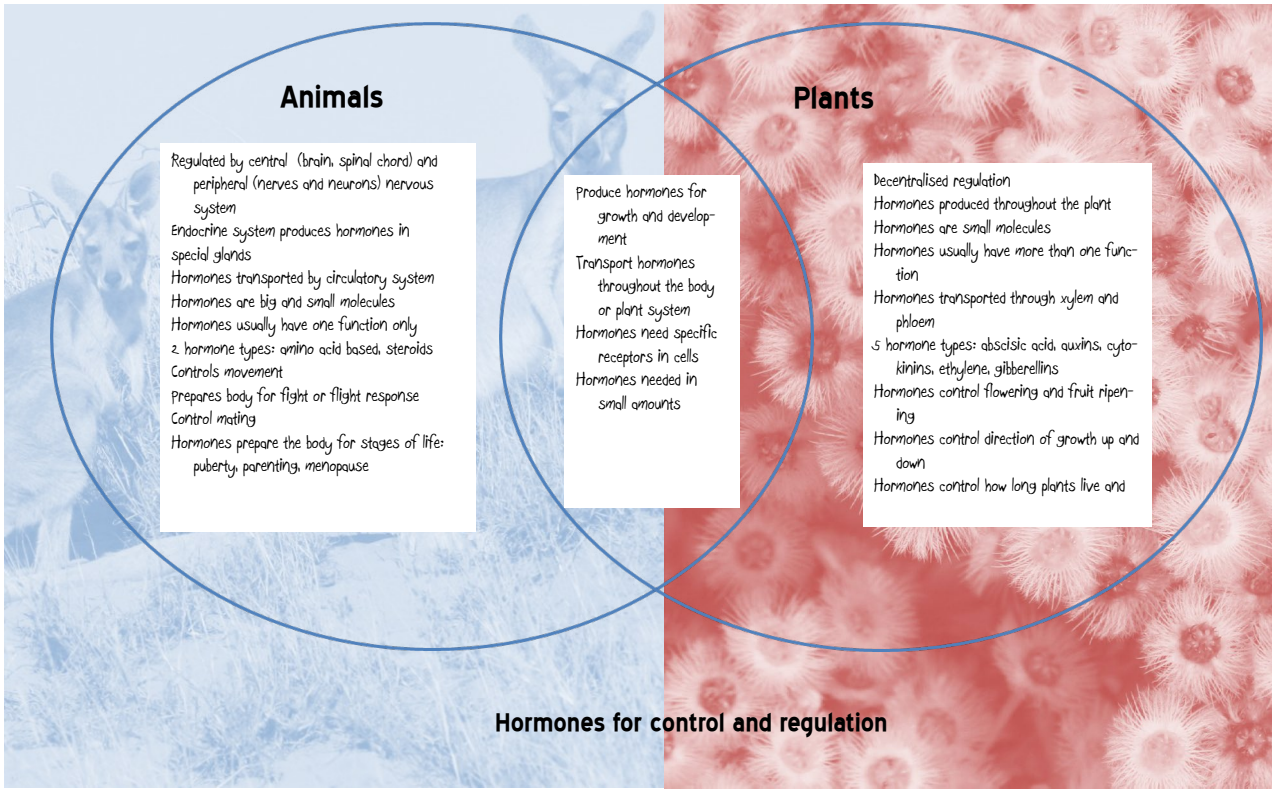
Summary of task

Students had studied the human nervous and endocrine systems, particularly the role of the central nervous system, the peripheral nervous system and hormones. They had not explored any aspects of plant responses to environmental change.

Students were asked to research how plants use hormones to respond to their environment and to construct a Venn diagram to show the similarities and differences between the plant and animal mechanisms for control and regulation of systems. They completed their research in pairs over one class lesson and constructed the Venn diagram summary as a homework task.

Venn diagram: Control and regulation



Annotations

Provides a detailed analysis of similarities and differences in animal and plant mechanisms for growth, development and response to environmental change.

Describes the role of hormones in plant and animal growth, development and response to environmental change.

Describes the interdependencies between systems, organs, tissues, cells and specific chemicals (hormones).

Annotations (Overview)

The student uses appropriate language and representations to communicate findings and ideas.

Research report: Bionic eye

Year 9 Science achievement standard

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

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Summary of task

Students had been studying energy transfer in the context of sound, light and electricity. They had considered how the structure of the eye enables light waves to be detected and how eyes work, including how information is passed on to our brains.

Students were asked to research how bionic eyes have been developed in Australia, provide a brief description of how bionic eyes work, and how they might impact people's lives. They were asked to produce a brief report on their findings. They were provided with one 50-minute lesson to begin their research and were required to complete the task at home.

Research report: Bionic eye

What is a bionic eye and how does it work?

A bionic eye is a device that is able to help people with vision loss to see. A microchip implant is inserted on the retina at the back of the eye. A miniature video camera is connected to a pair of glasses that the person wears and sends images to the implant. The implant converts the images into electrical impulses which are carried along the optic nerve to the brain. Therefore light energy is transformed into electrical energy

A person with a bionic eye can't see things the same way that someone with normal eyes can. A bionic eye helps people to detect light and then they need to be trained to use it to put together a picture of what they are looking at.

The more electrodes are in the implant the more detail a person will be able to see. The implants that are being tested have about 100 electrodes and the best ones have more than 1000. To put it in perspective a cochlear implant (bionic ear) only needs 15 electrodes which means that the bionic eye is much more complicated.

How have bionic eyes been developed in Australia?

The first bionic eye implant in Australia was done this year. It was a year earlier than expected but was still only a research prototype as it only had 24 electrodes. The company that developed the bionic eye, Bionic Vision Australia, has been working on it since 2009. Many of the people who work for the company also helped to develop the cochlear implant in Australia.

How might bionic eyes affect people's lives?

A bionic eye can restore some vision to people who have lost their sight. It can't be used for people who are completely blind though because some live cells on the retina are needed and so is an optic nerve. Its best use is for people who have an eye disease or who lose their sight because of old age.

The bionic eye will impact on people who are dependent on others to do things for them because they can't see. With a 100 electrode implant people will be able to see large objects like buildings. They might also be able to see cars. With a 1000 electrode implant people will be able to recognise faces and read large print.

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"Microchip success for bionic eye" http://www.monash.edu.au/news/show/microchip-success-for-bionic-eye

Annotations

Explains in detail how the bionic eye works with reference to energy transformations.

Outlines the involvement of Australian scientists in the development of the bionic eye.

Identifies the limitations of the technology.

Identifies people who may benefit from the development of the bionic eye, and the extent of the benefit.

Explains, using examples, how future developments of this technology may benefit people using bionic eyes.

Annotations (Overview)

The student uses appropriate language and representations to communicate science ideas.