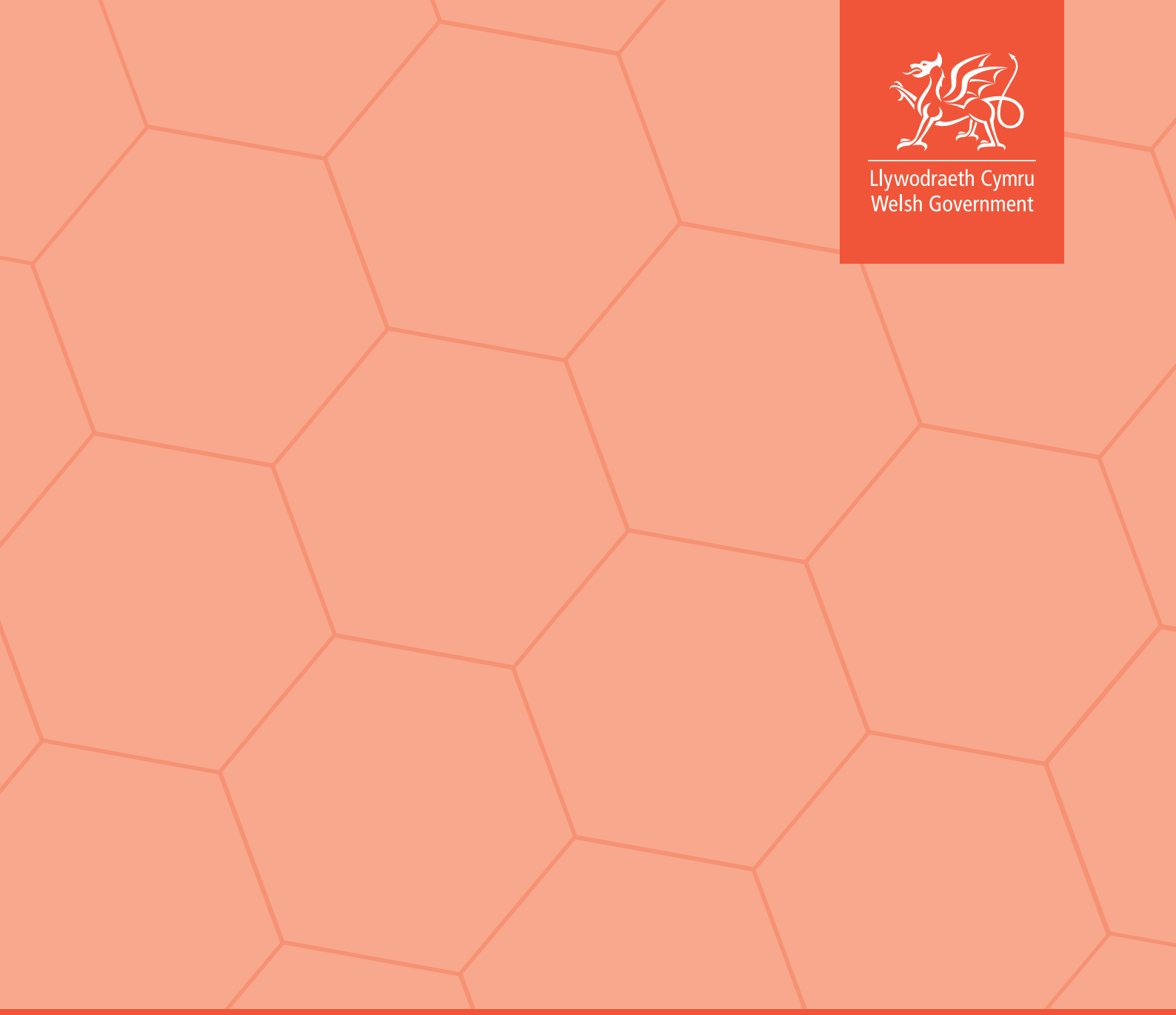

Llywodraeth Cymru
Welsh Government

Exemplification materials at Key Stages 2 and 3 in science

Additional guidance for Level 5

Exemplification materials at Key Stages 2 and 3 in science

Additional guidance for Level 5

Audience

Primary and secondary headteachers and heads of departments of maintained schools; secondary assessment coordinators and teachers at Key Stages 2 and 3; governing bodies of mainstream schools; local authorities; regional consortia; national bodies with an interest in education; tutors in initial teacher training; and others with an interest in continuing professional development.

Overview

The materials consist of examples of learners' work and a written commentary, which exemplify the standards set out in the national curriculum level descriptions. They illustrate how to use level descriptions to make best-fit judgements at the end of Key Stages 2 and 3, and give a justification and explanation for the level awarded.

Action required

To review learning plans and activities, and to prepare to make the required judgements at the end of Key Stages 2 and 3.

Further information

Enquiries about this document should be directed to:
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Additional copies

This document can be accessed from the Welsh Government's website at gov.wales/learning

Related documents

Exemplification materials at Key Stages 2 and 3 in science: Additional guidance for Level 4 (2017); *Exemplification materials at Key Stages 2 and 3 in science: Additional guidance for Level 6* (2017); *Science in the National Curriculum for Wales* (2008); *Science: Guidance for Key Stages 2 and 3* (2009); *Ensuring consistency in teacher assessment: Guidance for Key Stages 2 and 3* (2008); *Making the most of assessment 7–14* (2010)

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Introduction

When teachers make summative judgements in science, the science skills are broken into 14 separate strands covering communication and enquiry skills, including planning, developing and reflecting. This science subject portfolio has been designed to exemplify the standards for each of the 14 science assessment strands that are available on the *Strands in progression from the level descriptions for science Key Stages 2 and 3* (learning.gov.wales/docs/learningwales/publications/140624-science-standards-of-progression-poster-en.pdf).

The materials here include a mixture of full and part investigations, alongside other transient skills that have been captured, e.g. learner–teacher dialogue, individual graphs and examples of learners' research findings. In the process of exemplifying the 14 strands, we have attempted to include a range of enquiry types, e.g. fair testing, classifying and identifying, and using and applying models. However, these materials are not designed to exemplify the full range of enquiry types. More information on science enquiry types are contained with *Science: Guidance for Key Stages 2 and 3* (learning.gov.wales/docs/learningwales/publications/140624-science-in-the-national-curriculum-guidance-en.pdf).

These materials are a collection of samples of work from different learners. They are not designed to present a coherent progression of the work of one learner. However, some of the tasks are used as source material for different skill strands. This demonstrates how one enquiry task may be used to enable teachers to develop multiple science skills. Although it is effective to teach science skills discretely, learners will require opportunities to draw together these skills in whole investigations as they work more independently.

The materials consist of examples of learners' work as well as written commentaries which give justifications and explanations for the level awarded. The audience for this work includes teachers working at Key Stages 2 and 3 and those working within a school to moderate and verify judgements. The examples in this document are for Level 5.

Examples of work will have errors that reflect the level being exemplified and some errors will not have been highlighted by teachers, where that aspect is not the focus of the marking.

Example 1

Subject portfolio:	Science
Task:	CSI – crime scene reflection task
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Review success*

Context

The learner engaged in a number of practical tasks, following the setting of success criteria, to solve the crime. After identifying the suspect, the learner reflected upon her success criteria.

Comments

1. The learner begins to evaluate how far success criteria fully reflect successful outcomes. They comment on the fact that they were able to meet each of their success criteria, but crucially start to reflect on the suitability of these success criteria. The learner starts to realise that the success criteria selected could be improved to reflect real-life situations.

Next steps

- To progress to the next level, the learner needs to fully evaluate their success criteria, developing their comments around repeating each test to obtain concordant results and keeping samples free of contamination.

Dydd Iau Ionawr 16

Where my success criteria good?

Scenes of Crime Success Criteria

1. I need to understand what each of the chemical tests on the samples found at the crime scene mean.
2. I need to understand what all the physical evidence at the crime scene means.
3. I need to understand what the chemical tests carried out of the suspects mean
4. I need to understand the physical evidence collected from each of the suspect.
5. I need to identify the suspect who committed the crime and record my findings in a report.

Evaluation

I think I met all of my success criteria. I was able to collect all the chemical evidence from the crime scene and the suspects. From this I was able to work out which suspect or suspects evidence matched that from the crime scene. This allowed me to narrow down the suspects. I then used the physical evidence to identify who I thought committed the crime. I then wrote my conclution in my book and my teacher said I was right.

I am not sure though if my success criteria are right. We only thought of this as a normal practical lesson and not like a real world event. We should consider other things like is the evidence sterile, and did we do it more than once. Some of our class could mess around with the chemicals, mix them up so my report could have been wrong as the samples miss put would would be contaminated.

Example 2

Subject portfolio:	Science
Task:	Science of sound
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Explaining*

Context

The learner was presented with a number of scenarios, such as:

'Mrs Brown is 85 and when walking with her granddaughter she has discovered that she cannot hear the very high-pitched sounds that crickets make. Use your knowledge of sound, the ear, hearing and noise levels to explain the differences in hearing levels of Mrs Brown, her granddaughter and the crickets.'

Comments

1. The learner uses some scientific knowledge, explaining the path sound would take on entering the ear, and what part of the ear is damaged as a result of loud noises. They support their response to the task with a simple model of water waves in a bath.

Next steps

- To progress to the next level the learner needs to recognise that a number of factors could influence the individual's ability to hear, such as infections that could have damaged the ear previously.
- The learner needs to include an abstract model where they recognise sounds are created by vibrations, and that these vibrations cause particles in the air to vibrate, which in turn cause the eardrum and subsequent parts of the inner ear to vibrate.

Dydd Mercher Ionawr 22

Science of Sound Core Task

Mrs Brown

Mrs Brown is 85 and so she wont be able to hear as higher pitch as her granddaughter can. Her hearing has got worse as she grew older and so she cant hear as well as a child or a teenager. Over the years she has heard a lot and these sounds could have damaged her hearing if they were quite loud. Mrs Brown walks out into a field by her house with her granddaughter. Her granddaughter says "listen to those crickets Nan", but Mrs Brown cannot hear them.

Why Mrs Brown cannot hear the crickets!

When a sound is made it travels to your ears. It is a little like making a wave in the bath. If you push the water one end with your hand the wave moves to the other end of the bath. When the sound gets to Mrs Browns ear the sound message does not go all the way and to her brain. Mrs Brown is very old and will have heard a lot of loud sounds and these sounds could have damaged the sensory hair cells in her ear. Normally the sound would go into her ear, past the ear drum, past the bones, past the cochlea and would get to the nerve. This would take the sound message to her brain. Mrs Brown is old and as you get older the inner ear changes. These changes stop the sound message getting the message to the nerve and brain.

Mr Green – School Teacher Rock Star!

Mr Green, our RE teacher plays in a rock band. He is only 31, and is constantly hearing loud noises in the evenings after school. Mr Green always makes us late for the next lesson as he never hears the school bell, although he always tells us he can hear ringing in his ears all through our lessons.

Mr Green has damaged his hearing. He has damaged his hearing as he is always listening to very loud music. This is why he has ringing in his ears and he may have Tinitus. When a sound is made it travels to your ears. It is a little like making a wave in the bath. If you push the water one end with your hand the wave moves to the other end of the bath. If you push it harder the wave hitting the other end of the bath is bigger. When the sound gets to Mr Greens ear the sound message does not go all the way and to his brain. Mr Green has heard a lot of loud sounds and these sounds could have damaged the sensory hair cells in his ear. Normally the sound would go into her ear, past the ear drum, past the bones, past the cochlea and would get to the nerve. But the message is not reaching the nerve when our school bell goes and so Mr Green does not hear it.

Example 3

Subject portfolio:	Science
Task:	Core task – lollies
Illustrative of characteristics mainlyat:	Level 5
Skill assessed:	*Explaining*

Context

The learner was presented with the following scenario.

‘Some primary children were eating ice lollies on a very hot day. One of them dropped their lolly on the ground. Soon there was a puddle of liquid around the stick. When they went back lunchtime, nothing was left except for the stick. Can you explain this?’

Comments

1. The learner uses scientific knowledge and a simple model to explain the changes taking place. Here they confirm the solid lolly changes initially into a liquid and then a gas.
2. The learner explains that evaporation takes place when the liquid is heated and a gas forms, and that a liquid formed when the solid lolly was heated and melted.

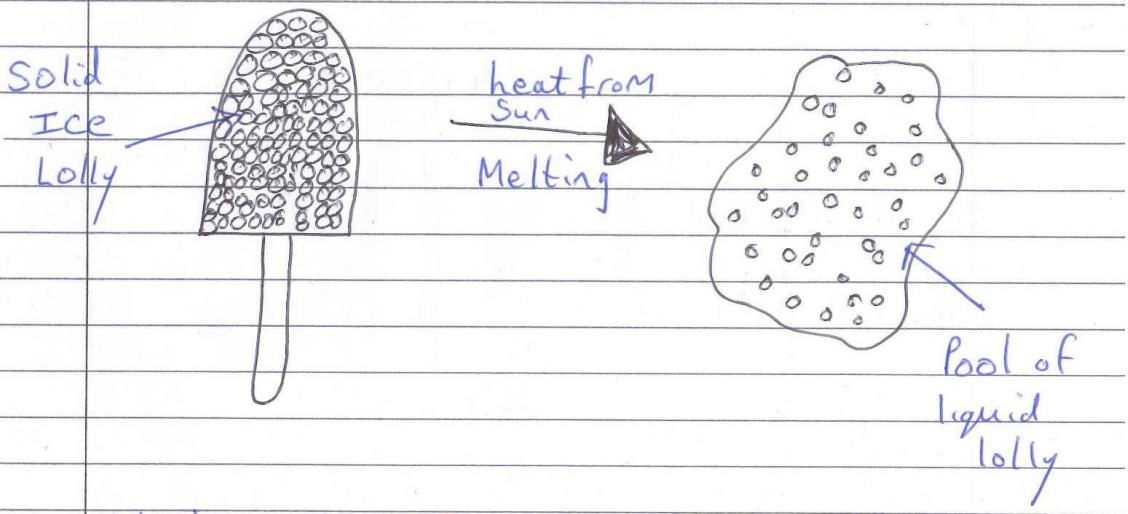
Next steps

- For the learner to progress to the next level they need to include an abstract model. Here the learner could include diagrams of the particles that represent each state and explain the effect of heat on these particles as we move from one state to another.
- The learner also needs to acknowledge that other factors will influence the evaporation of the liquid, such as wind levels on the day.

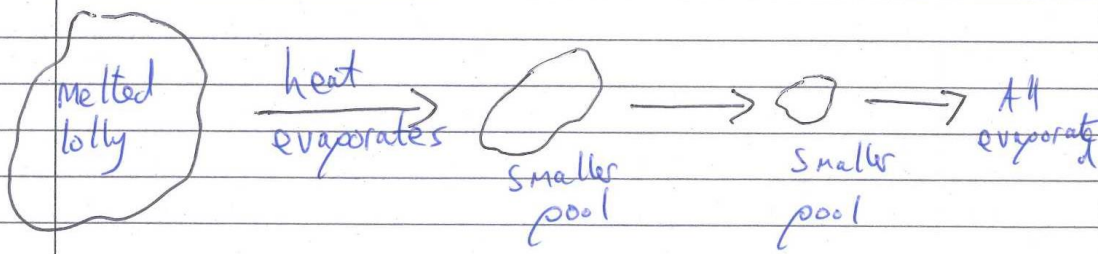
Thursday 3rd April

Core Task

When the ice lolly was dropped on the floor it melted. This is because the lolly soaked up all the heat energy from the Sun.



At the end of break the children went back to class. When they returned to the play ground at lunchtime the ice lolly had gone and only the stick was left on the ground. This is because of evaporation. The Sun heated up the liquid lolly on the ground and the water in this evaporated. It turned into gas and went into the air



Example 4

Subject portfolio:	Science
Task:	How does the surface area of a liquid affect evaporation?
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Communicate findings* *Explaining*

Context

The learner had previously been presented with a task to explain what happens to an ice lolly on a summer's day. Following on from this, learners were asked to consider what things could influence how quickly a liquid evaporates from a container. The learner decided to investigate the link between surface area and rate of evaporation.

Comments

Communicate findings

1. The learner presents their findings in a number of ways: a table of results and a graph. In both of these they correctly use SI units. The learner independently decides to produce a bar chart for their results, which is suitable for the data collected. They then decide to view their results using a line graph, feeling this is more appropriate, which has been produced with inappropriate scales for the independent variable.

Explaining

2. The learner uses their scientific knowledge, and a simple model of change of state to explain their findings. They link the surface area of the container to the amount of heat absorbed from the sun and the rate of evaporation.

Next steps

- For the learner to progress to the next level, they could improve their results table, including all of the data they collected. They would need to produce a graph with an appropriate scale for the independent variable, and attempt to make quantitative definitions. Examples of this could be 'when the surface area was increased tenfold, the time taken to evaporate reduced by 24.8 minutes'.
- The learner uses a simple model, introducing the idea of changes of state, and could develop this with an abstract model. Here they would need to introduce the idea of particles, how they are arranged in a liquid and gas, and the process the particles in a liquid go through when evaporation takes place.
- The learner could add an explanation accounting for any other factors that could influence the rate of evaporation in their investigation.

19th May

Rough Results

Area

Very small	$9cm^2$	= 28 Mins	26 Mins
Small	$24cm^2$	= 22 Mins	24 Mins
Medium	$55cm^2$	= 14 Mins	13.5 Mins
large	$70cm^2$	= 8.5 Mins	8 Mins
Very large	$90cm^2$	= 2.4 Mins	2 Mins

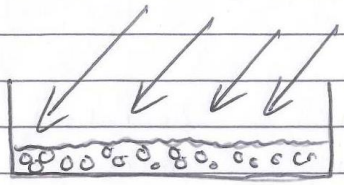
Recording Results

Container Size	Container Area cm^2	Average time to evaporate Minutes
Very Small	9	27
Small	24	23
Medium	55	13.75
large	70	8.25
Very large	90	2.2

Explaining My Results

My results showed that the containers with a large surface area evaporated quickest. The containers with a smaller surface area took a long time to evaporate. I think this because

a larger surface area would get more heat from the sun, or our busen burner.



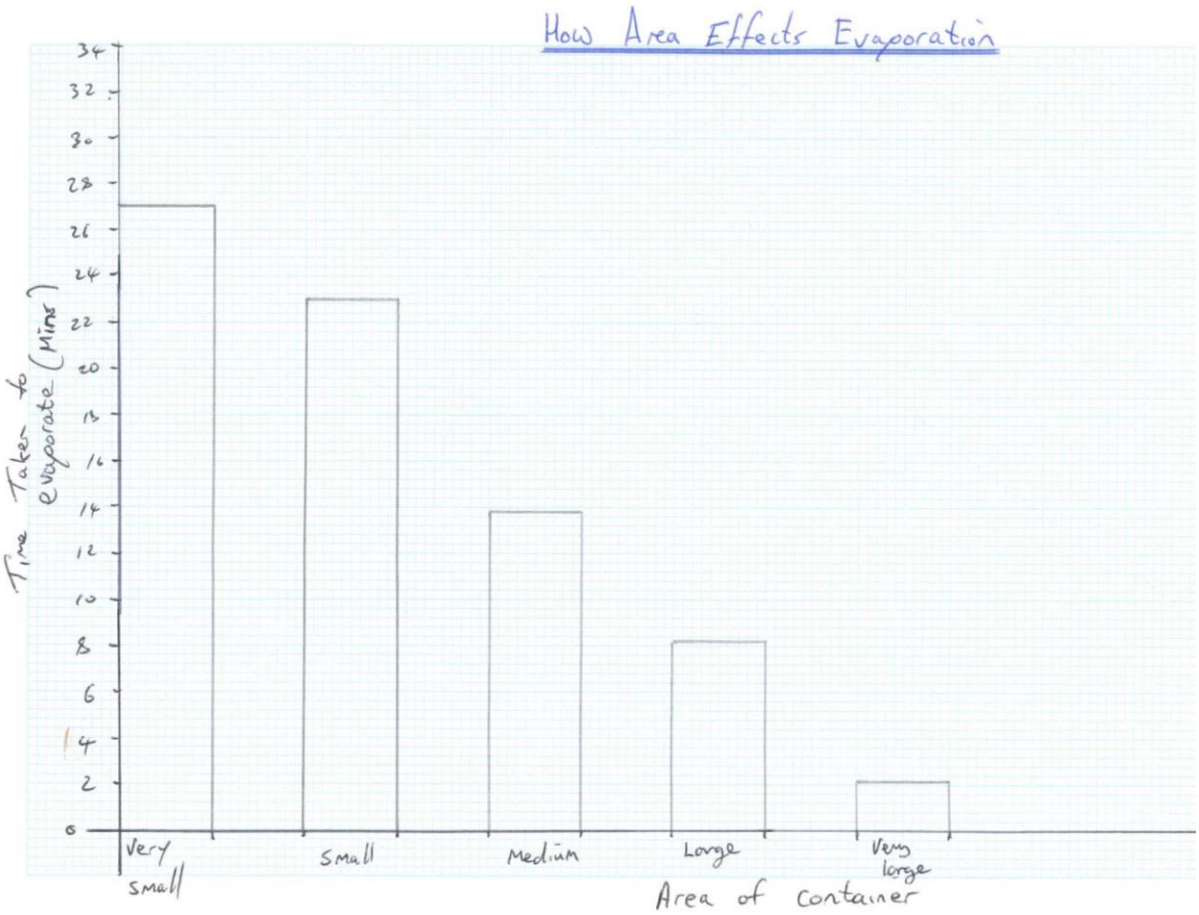
Large surface area getting 4 parts of heat energy

Small surface area getting only 1 part of heat energy

For the water to evaporate and turn into steam it needs heat.

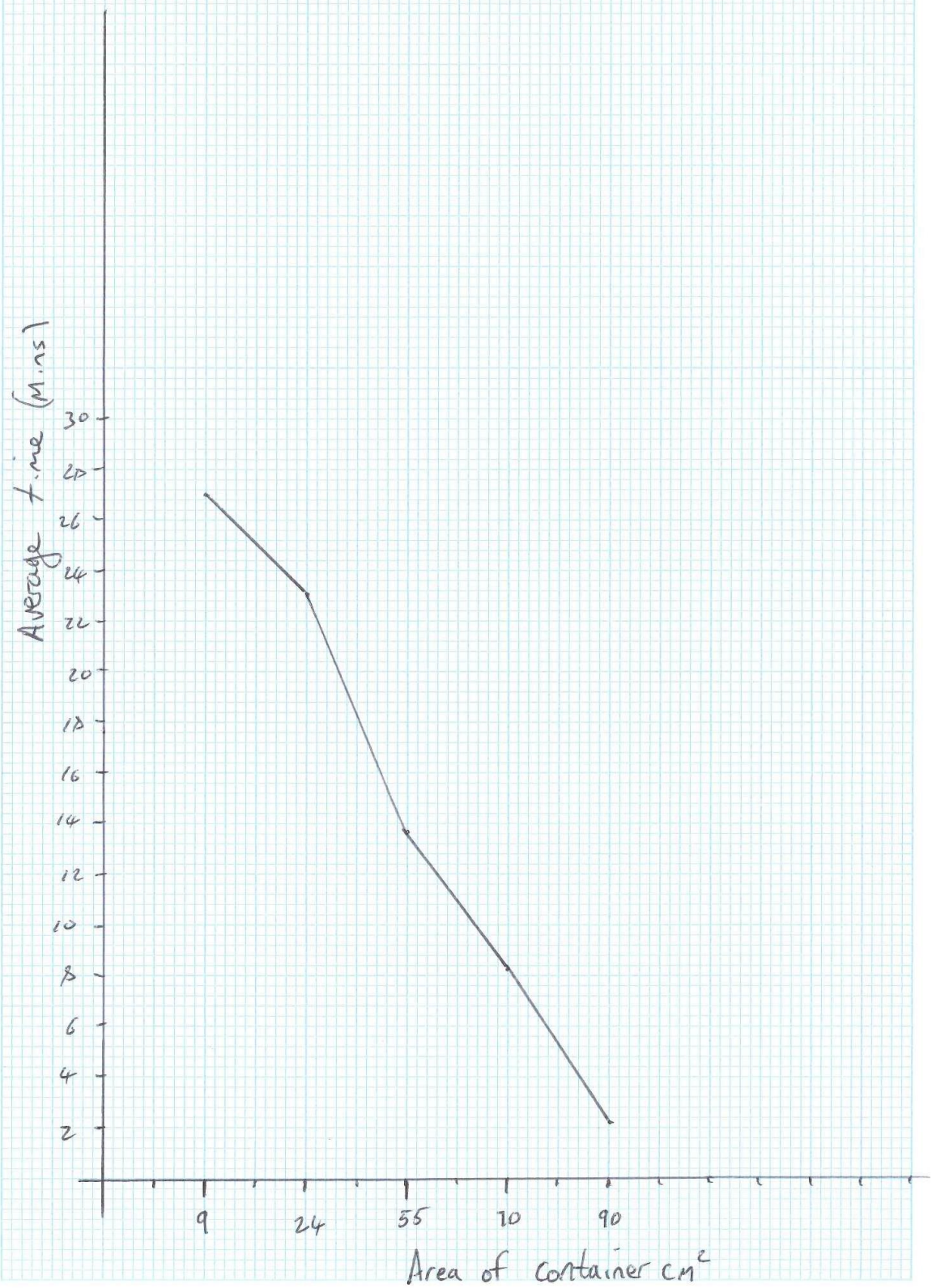
water $\xrightarrow[\text{heat from Bunsen}]{\text{evaporation}}$ Steam

The bigger the area the more heat from the bunsen gets to the water, more water is heated. It evaporates faster


How Area Effects Evaporation
Time Taken to evaporate (Mins)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Very small
Small
Medium
Large
Very large
Area of container

How Area Effects Evaporation

19th May



Example 5

Subject portfolio:	Science
Task:	What happens to the electric current in a series circuit as you add more bulbs?
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Predict*

Context

During a demonstration, the learner observed the brightness of a bulb in a series circuit when the teacher added more batteries to the circuit. The teacher posed the question, “Would anything happen if the number of batteries in the circuit stayed constant but the number of bulbs were changed?” The learners considered this and made a prediction.

Comments

1. The learner makes a simple prediction indicating that the addition of more bulbs will reduce the current. This is characteristic of Level 4. They continue, adding that this reduction in current is a result of increased resistance. They include a simple model to support this, linking resistance to standing on a hosepipe, limiting the amount of water flowing.

Next steps

- For the learner to progress to the next level, they need to develop the model of resistance, e.g. by using the analogy of water flowing through a pipe to model the flow of electrons in a wire.

Wednesday 25th June 2014

Plan an experiment to find out what happens to the electric current in a series circuit as you add more bulbs

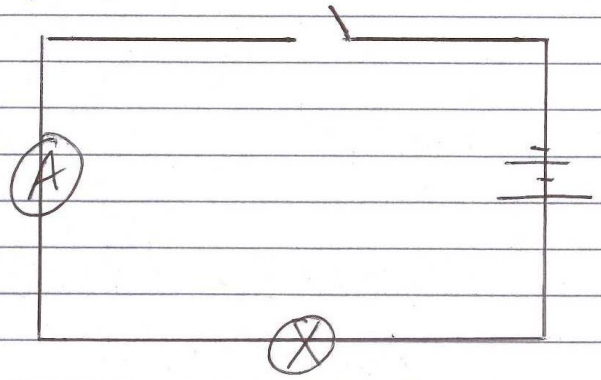
Planning

Equipment:

- Circuit Board
- Ammeter
- Batteries
- Bulbs
- Wires
- Crocodile Clips

Method

1. Gather all equipment
2. Set up your circuit board like this:



3. Take your first current reading and note it down

4. Add another bulb and take your second reading.
5. keep adding bulbs until you get up to 4.
6. Note down all the readings and record the current readings in a table.

Prediction

I think that when you add more bulbs, the current will decrease because the amount of resistance increases. The bulbs will become dimmer. Current is like water flowing in a hose pipe, if you stand on the hose pipe less water comes through because there is more resistance. Adding more bulbs is like standing on the hose.

Example 6

Subject portfolio:	Science
Task:	Is *Euglena* a plant or an animal?
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Conclusions and decisions*

Context

The learners were set the task of producing a diagram of both plant and animal cells, with labelled organelles, and details of their functions. They were then presented with a labelled diagram of *Euglena* and were set the task of explaining whether they thought it was a plant or animal with a justification for their conclusion. During the task, learners were expected to consider the views of their peers before committing to a response they would be happy with.

Comments

1. The learner produces a conclusion that:

    - is consistent with their knowledge of both types of cell, recognising that certain organelles are characteristic of plant and animal cells
    - is informed by their consideration of the views of other learners in the class.

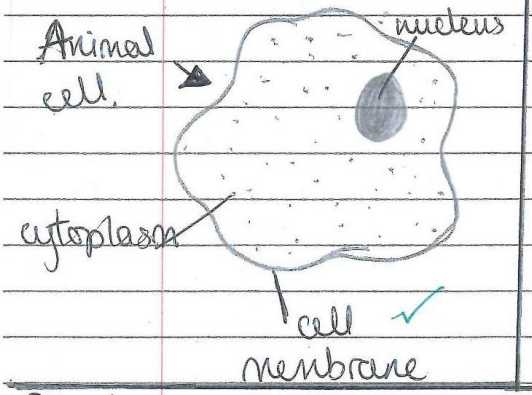
Next steps

- For the learner to progress to the next level they need to consider a wider range of evidence such as researching if all plant cells contain chloroplasts for example, or whether animal cells contain vacuoles.

'Is Euglena a plant or an animal?'

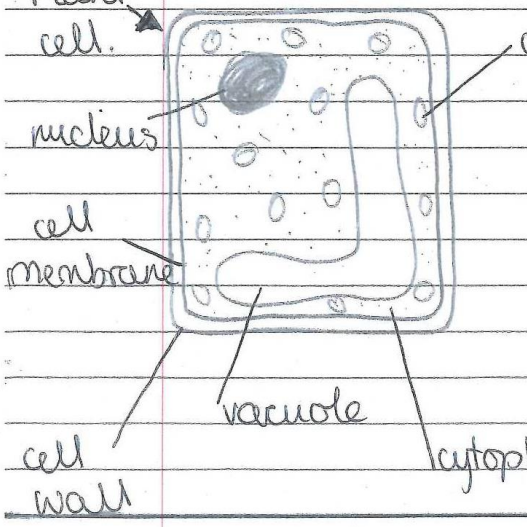
~~A Euglena is neither or both~~
I think that a Euglena is neither a plant or an animal cell because an animal cell doesn't have a chloroplast but a plant cell does. ✓

An animal cell is made up of three main compartments, a nucleus, a cytoplasm and a cell membrane.



components ✓

A plant cell is made up of 6 main compartments, double the amount of an animal cell. The compartments are a nucleus, a cytoplasm, a cell membrane, a cell wall, a vacuole and a chloroplast



A chloroplast is a compartment of a plant cell that uses photosynthesis to feed ~~the plant~~ it. Animal cells do not include chloroplasts because they either hunt or are given their own food. ✓

I don't think that a Euglena is a plant or an animal cell because it doesn't look like either a plant or an animal cell, and is missing some main compartments of both animal and plant cells. ✓

Chloroplast: ~~Here~~ uses photosynthesis to feed the plant cell plant cell

Nucleus: this holds genetic information and plant and animal cell controls the cell.

plant cell
Contractile Vacuole: A space filled with fluid

either
Eyespot: could be somewhere to put an eye.

Flagella: a whip like structure that allows either the cell to move. ✓

organism

You could say that a Euglena is more like a plant cell than an ~~animal~~ plant animal cell because it has ~~more~~ 3/5 components that are included in a plant cell. On the other hand, ~~it~~ a Euglena still has 2/5 components that a found in an animal cell.

I think that a Flagella and an eyespot would be found in an animal cell because a flagella allows it to move and animals are moving all the time. Also, the eyespot could be found in an animal cell because animals have eyes and plants don't.

Example 7

Subject portfolio:	Science
Task:	Investigating pulse rate
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Explaining*

Context

The learner was set the task of explaining to primary school learners why their pulse rate changed when they ran around the playground. To support their explanation, the learner conducted an investigation into their own pulse rate.

Comments

1. The learner produces a conclusion using scientific knowledge to explain their findings. They state that as more exercise is done the pulse rate increases. They continue, explaining that this is because the heart beats faster to deliver more oxygen to the muscles.
2. They include a simple model, likening the heart to a pump in a swimming pool that is used to heat the water up.

Next steps

- For the learner to progress to the next level they need to include more detail in their explanations. It would be expected at this higher level that the learner acknowledge muscle cells would need more energy during exercise. To produce this energy, respiration would need to increase and so the heart responds by beating faster to deliver additional glucose and oxygen. The learner could represent this in a simple word equation.

Rydd Gwener 3 Hydref

Core Task

A table to show heart beats per Minute before and after exercise

	Beats per Minute				
	Try 1	Try 2	Try 3	Try 4	Average
Before exercise	60	54	50	55	54·75
After exercise	136	174	186	165	165·25

For this core task we measured our heart rate 4 times before exercise. It seemed to get lower each time and was hard to find. It might have got lower as I was sitting down and not moving much. We then did some exercise and measured our pulse rates again. After exercise my pulse rate was always higher. This was because the heart beat faster. The heart is a pump that pushes blood around the body. This is like a pump in a swimming pool. When they want the pool to heat up, they turn the pump up and it pushes more hot water into the pool. The heart is like this. During exercise the muscles need more oxygen so the heart beats faster to get it there quickly. The oxygen and food then allow the muscles

to make the extra energy they need for exercise

Example 8

Subject portfolio:	Science
Task:	Life in the stars
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Review findings*

Context

The learner observed the teacher setting off a water-powered rocket with two different volumes of water. From this the learner was asked to suggest an investigation around rockets. The learner decided to investigate the effect of changing the volume of water used to propel the rocket into the air. Learners were required to answer the question 'Will a rocket with more water fly for a longer time?'

Comments

1. The learner identifies and describes the link between the volume of water used and the duration of the rocket's flight.
2. The learner considers the reliability of the results, which is characteristic of Level 6, stating that the results are both repeatable and reproducible.

Next steps

- For the learner to progress to the next level they need to explain the anomalies present in the results table and graph. An explanation for these anomalies could include the difficulty in recording time accurately with a stopwatch when the flying times were so short.

Review Findings

Independant Variable = what we change = the volume of water in the bottle rocket.

Dependant Variable = what we measure = How long the bottle rocket stays in the air.

Independent

The relationship between the two variables is that when you change the volume of water, the time that it will stay in the air will change as well.

On My graph it shows that the more water in the bottle, the longer it will stay in the air up until a certain point (400ml) when the bottle got ~~too~~ heavy and gravity dragged it down.

~~My graph is repeatable~~

I know that my ~~graph~~ experiment is repeatable because I did the experiment three times and they all had similar results. I also know that my ~~graph~~ experiment is reproducable because I talked to other groups and they had similar results to me as well.

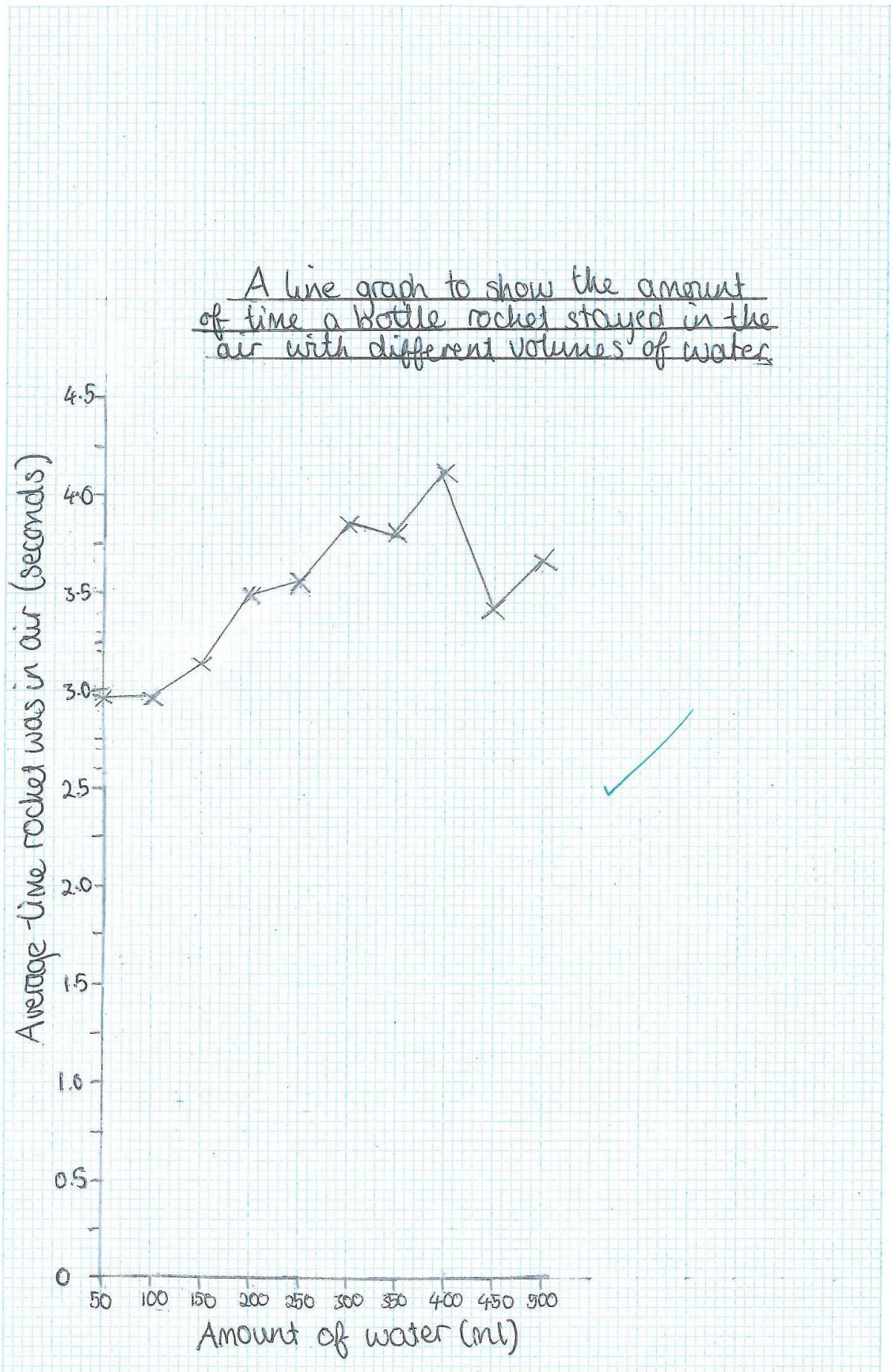
Other factors that could have effected the results were weather, buildings, area, whether the ground slopes and the person pumping the air into the rocket.

My prediction was correct as the amount of water that stayed in the air the longest was 400ml, a middle amount.

Prediction

I predict that there will be an optimum amount of water in the bottle rocket which will make the rocket stay in the air the longest. The rocket will go up in the air because of Newton's third law When object A (ground) exerts a force on object B (rocket), object B will exert the opposite force on object A, making the bottle fly up in the sky.

Amount of water (ml)	Try 1 (seconds)	Try 2 (seconds)	Try 3 (seconds)	Average (seconds)
50	3.00	2.89	2.98	2.96
100	2.94	2.92	3.02	2.96
150	3.19	3.11	3.12	3.14
200	3.15	3.60	3.72	3.49
250	3.25	3.48	3.92	3.55
300	3.72	3.84	3.99	3.85
350	3.45	3.96	4.01	3.81
400	3.36	4.56	4.45	4.12
450	3.24	3.58	3.61	3.41
500	3.84	3.61	3.52	3.66


A line graph to show the amount of time a bottle rocket stayed in the air with different volumes of water.
Average time rocket was in air (seconds)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
50
100
150
200
250
300
350
400
450
500
Amount of water (ml)

Example 9

Subject portfolio:	Science
Task:	How the height of a ramp affects the speed of a bob sleigh.
Illustrative of characteristics mainly at:	Level 5
Skill assessed:	*Methods and strategies* *Fair testing*

Context

The learner watched a clip of the film *Cool Runnings* and became involved in a class discussion around what affects the speed of a bobsleigh travelling down a track. The learner then decided to investigate how the height and steepness of a ramp affected speed.

Comments

Methods and strategies

1. The learner produces a plan that enables another person to carry out the investigation. The diagram indicates where the bobsleigh is to be placed, and the learner's comments inform the reader when to stop timing (when the bobsleigh reaches the bottom of the ramp). Points 1–6 in the plan model a Level 5 plan for methods and strategies.
2. Even though the learner does not state the stopwatch was used to time how long it takes for the bobsleigh to travel down the ramp, the inclusion of a diagram indicating that this is the case is sufficient at this level.
3. The learner's table of results also provides evidence that they planned a systematic approach to their investigation.

Fair testing

4. The learner identifies the independent variable and also the range of the independent variable, which is characteristic of Level 6.
5. The learner identifies the dependent variable and the variables they need to control.

Next steps

Methods and strategies

- For the learner to progress to the next level, they need to suggest an alternative method, or extension, to this investigation. An example could be the use of light gates to record the time the bobsleigh takes to move between two points.

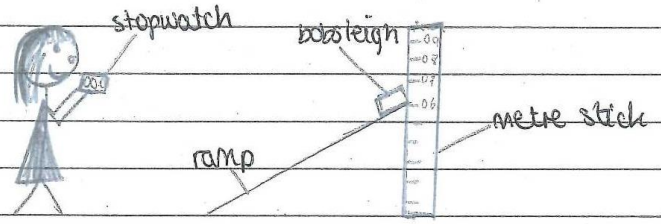
Fair testing

- For the learner to progress to the next level they need to explain how they will control variables that they need to control. For example, the learner could indicate that the length of the ramp will be kept the same, and controlled by using a metre stick, and the mass of the bobsleigh would be controlled by using the same bobsleigh for each run.

Planning

1. Collect your equipment:
   - bobsleigh
   - ramp
   - stopwatch
   - metre stick

2. Set up the apparatus as shown in the diagram:



3. Lift one end of the ramp at 0.6 metres on the metre stick and time how long it takes the bobsleigh to get to the bottom.

4. Repeat step 3 for 0.7, 0.8, 0.9, 1.0 metres.

5. Repeat the experiment 3 times to make sure it is repeatable. This means that you can repeat it and get similar results.

6. Record the results in a results table.

7. Calculate the average speed, Gravitational Potential energy and kinetic energy.

8. Check your results with other groups to make sure your results are reproducable. This means that the experiment can be done by other groups and they can get similar results to you.

I can justify that my method is accurate because I used a metre stick to measure height and a stopwatch to measure time. This means I have accurately measured the height and time that it takes for the bobsleigh to go down the ramp.

Prediction

I predict that as you increase the height of the ramp, the speed of the bobsleigh will increase because if it's got more GPE, then there will be more energy to transfer into kinetic energy and the speed will increase. If you increase the height in the GPE equation = MGH, the whole number will increase, meaning there will be more energy to transfer into kE. Also, if you increase the velocity^2 in $kE = \frac{1}{2}MV^2$, the number will increase, meaning more energy and if you decrease the time in $S = D/T$, the bobsleigh will go faster because it will be less time to get down a certain distance. The bobsleigh might go a bit slower because of friction acting against the bobsleigh and the ramp.

Fair testing

IV: The independant variable is the height of the ramp in metres. The heights I will use are 0.6, 0.7, 0.8, 0.9 and 1.0 metres.

DV: The dependant variable is the time taken for the bobsleigh to get from the top of the ramp to the bottom in seconds.

CV: The control variables are the:

- Bobsleigh
- ramp
- Distance of ramp
- Mass of bobsleigh.

To control the IV (time) I will use a stopwatch and to control the DV (height) I will use a metre stick.

Monitor progress

I have changed my method from the lower heights 0.1, 0.2, 0.3, 0.4 and 0.5 metres to the higher heights 0.6, 0.7, 0.8, 0.9, and 1.0 metres because when the ramp was at a lower slope, the bobsleigh didn't move at the lower heights.

Recording my results

Height (m)	Mass (kg)	Time taken for bobsleigh to move down the ramp (s)				Speed (m/s)	KE (J)	GPE (J)
		Try 1	Try 2	Try 3	Average			
0.6	0.5	0.66	1.19	1.26	1.02	1 ÷ 1.02 = 0.98	0.24	2.94
0.7	0.5	0.70	1.03	0.59	0.77	1 ÷ 0.77 = 1.30	0.42	3.43
0.8	0.5	0.51	0.66	0.58	0.58	1 ÷ 0.58 = 1.72	0.74	3.92
0.9	0.5	0.58	0.45	0.43	0.49	1 ÷ 0.49 = 2.04	1.04	4.41
1.0	0.5	0.26	0.36	0.51	0.38	1 ÷ 0.38 = 2.63	1.73	4.90

Example 10

Subject portfolio:	Science
Task:	Photosynthesis fact sheet
Illustrative of characteristics at:	Level 5
Skill assessed:	*Find evidence, information and ideas*

Context

As part of a topic on plants, learners were asked to find out relevant information and ideas about photosynthesis. Before learners began to compile their fact sheet, they were challenged to discuss what type of success criteria might be appropriate. In the example here, the learner worked independently to gather information from a science website, a range of books and their class notes. The learner presented their findings using text and diagrams. The teacher used these tasks to consider whether the learner could *find and use relevant evidence, information and ideas.*

Comments

1. The learner works independently to find and use relevant evidence, information and ideas. They use scientific information to explain what they have found out and understand.
2. During a discussion with the teacher, the learner explains the concept of photosynthesis, including key scientific vocabulary (e.g. 'membrane' and 'oxygen').

   Teacher: Explain what happens to the sunlight that gets trapped in the chloroplast.
   Learner: The cell uses the energy to make sugar. The energy ends up inside the sugar.

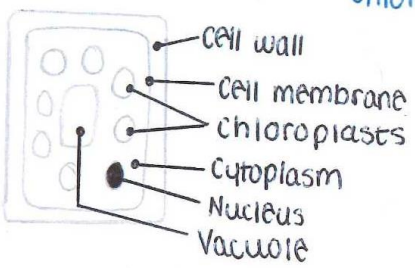
Next steps

- The learner could be encouraged to link their findings to dissimilar but familiar situations, e.g. the use of additional light sources in some greenhouses.
- They could consider using a tabulated format to provide a more systematic layout for their fact file.

PHOTOSYNTHESIS

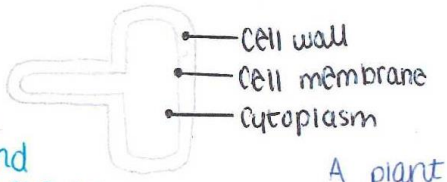
Photosynthesis is the process of a plant using light energy and chlorophyll to turn carbon dioxide and water into glucose and oxegyn.

Water + carbon Dioxide $\xrightarrow[\text{chlorophyll}]{\text{light energy}}$ Glucose + oxegyn



Palisade cell

In the chloroplasts there is chloropyll and this is exactly where photosynthesis happens.



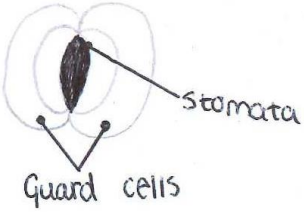
Root hair cell

The root hair cell makes up the roots and has adapted to move to collect the maximum ammount of water.

A plant makes glucose, which can then be stored as starch. When the plant can't photosynthesize, (winter + night) it uses the starch in respiration to survive.

Guard cell and stomata

The stomata are tiny holes on the underside of the leaf that let CO_2 in and O_2 out. The guard cells surround these and can open and control gas movement.



The plant gets its light energy from the SUN

Example 11

Subject portfolio:	Science
Task:	Creating success criteria for a photosynthesis fact sheet
Illustrative of characteristics at:	Level 5
Skill assessed:	*Determine success criteria*

Context

Prior to this task, learners were taught how to identify different types of success criteria. This included discussions on success criteria for science enquiry process skills (e.g. creating scientific plans and presenting data) and outcome success criteria (e.g. what makes an effective circuit or burglar alarm?). During the following lessons, learners were challenged to discuss what type of success criteria might be appropriate when producing a scientific fact sheet about photosynthesis. Learners were asked to find key facts and ideas associated with photosynthesis then choose a way of communicating their findings to the rest of the class. The example here is taken from the work of one learner.

Comments

1. In the example, the learner has typed out their own success criteria using a blank template provided by the teacher.
2. The learner identifies the success criteria that will help them create a good-quality scientific fact sheet, which are:

    - produce a labelled diagram that helps explain the main processes to somebody who is not an expert
    - include a word equation to simplify the chemical reaction
    - include the following scientific words: carbon dioxide, glucose, water, oxygen, photosynthesis and respiration.

3. Throughout the activity, the teacher draws learners' attention back to their initial success criteria to help them assess the quality of their work.

Next steps

- The learner could justify why it is important to include the key scientific vocabulary they listed in the third bullet point.

Creating success criteria for a photosynthesis fact sheet

***Objective**: To identify the success criteria for an effective scientific fact sheet.*

You now need to identify and explain your success criteria for this task:

Our success criteria

1. *Produce a labelled diagram that helps explain the main processes more simply to somebody who is not an expert.*
2. *Include a word equation to simplify the chemical reaction.*
3. *Include the following scientific words: carbon dioxide, glucose, water, oxygen, photosynthesis and respiration.*

Example 12

Subject portfolio:	Science
Task:	How does the intensity of light a plant receives affect the speed of photosynthesis?
Illustrative of characteristics at:	Level 5
Skill assessed:	*Observe and measure*

Context

The learner has produced an independent plan to investigate how light levels affect the speed of photosynthesis. The learner shared ideas within a small group, then produced a method. The learner's work illustrates a number of characteristics, including the identification of variables, measuring and graphing skills. The teacher used this task to focus on the assessment of *observe and measure* skills.

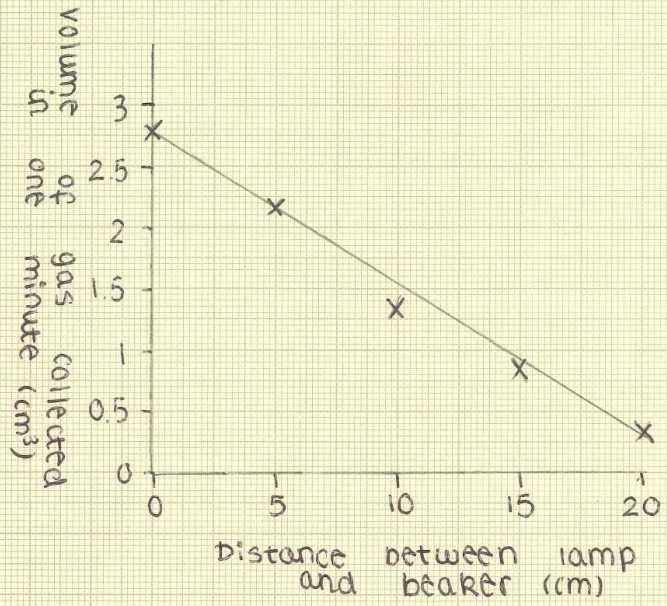
Comments

1. When planning their method, the learner shows the ability to select the measuring equipment that allows them to record the volume of gas generated, e.g. a measuring cylinder with cm^3 scale. During discussions, the learner explains that the volume of gas is likely to be small, so a measuring cylinder with a scale up to $10cm^3$ would be appropriate.

Next steps

- The learner could be challenged to evaluate their plan with particular reference to the method of collecting the gas. They could be encouraged to consider if a gas syringe would be a more effective way of collecting the gas.

Hypothesis - The intensity of light a plant recieves affects photosynthesis



✓✓

Select measuring instruments that allow them to make a series of accurate measurements

✓✓

Use a line graph to describe relationships between two continuous variables. Identify bias and start to consider reliability.

- What does the graph show?

The graph shows that the further from the beaker the lamp is, less oxygen is produced. This is because the plant can use more of the sun's energy to photosynthesize if it is nearer and produces more oxygen.

Example 13

Subject portfolio:	Science
Task:	Making zinc sulphate
Illustrative of characteristics at:	Level 5
Skill assessed:	*Monitor progress*

Context

In this task the learners investigated the production of zinc sulphate salt. During the practical task, the learner produced a plan to show how to produce zinc sulphate salt. During the activity, the learner made several amendments to his plan, including recognising the need to revise the method to take account of the nature of the reactant and the volume of liquids required. Although there are many skill strands evident in this task, the teacher focused on assessing the learner's ability to *monitor progress* and *communicate findings.*

Comments

1. The *monitor progress* skill strand refers to the skill of reviewing the scientific process during an investigation. This may involve an awareness that the learner needs to change or alter aspects of the enquiry they are undertaking, e.g. swapping equipment, identifying additional control variables or increasing the number of repeat measurements to improve reliability.
2. In this example, the learner identifies the need to change the reactants and volume of acid to allow the reaction to take place and produce the salt. The learner makes the edits (circled, and in purple pen) after they are challenged to check their work during the practical activity.

Next steps

- The learner could be encouraged to explain why they changed the volume of acid and reactant.

Gwaith Dosbarth 19.06.16

Making Zinc Sulfate

L.O. Use our knowledge of making salts to plan how you could make the salt Zinc Sulfate.

Success Criteria:
- Step by step method for the reaction.
- Justification for each process carried out.

Method -

1. First use a measuring cylinder to measure out 45cm³ of sulfuric acid.
2. Pour the ~~45cm³~~ 20cm³ of sulfuric acid into a beaker.
3. Then add the ~~zinc~~ zinc oxide to the sulfuric acid - use a ~~stirring~~ rod for this, as a spatula may make it corrode.
4. So now repeat step 3 until you see a reaction. Make sure you stir the bottom of the beaker well.
5. Now take a conical ~~glass~~ flask and fold filter paper into the funnel and pour in the zinc and sulfuric acid mixture.
6. Wait for the liquid to be at the bottom of the conical flask. There should be leftover exess in your filter paper, but should leave you with zinc sulfate. and water in the flask.

Example 14

Subject portfolio:	Science
Task:	Variation
Illustrative of characteristics at:	Level 5
Skill assessed:	*Evaluate learning*

Context

The class had been learning about inherited and environmental variation. Learners were asked to evaluate a number of human characteristics to decide whether they are affected by inheritance or environment. They were then challenged to consider the most appropriate way of sorting and displaying these characteristics. Learners worked in groups to share ideas and consider solutions. The evidence here is the work of one learner.

Comments

1. The learner uses various thinking strategies and graphic tools to help organise their ideas and present their findings.
2. At the start of this task, the learner considers several ways of organising ideas and presenting findings and chooses a line as the best method for displaying the 'mostly inherited' and 'mostly environmental' characteristics because it allows them to order the characteristics by influence.
3. The learner goes on to explain that a Venn diagram could be used as an alternative and 'better' thinking strategy (tool) for this task as Venn diagrams have an overlapping section that allows shared characteristics to be identified.

Next steps

- The learner could be encouraged to evaluate the limitations of the Venn diagram when explaining the relative influence of the environment on some of the characteristics.

Cameron – 9B

Characteristics of Human Variation

Our group brainstormed and listed these human characteristics:

foot length, cholesterol, height, IQ, sporting ability, nose shape, body mass.

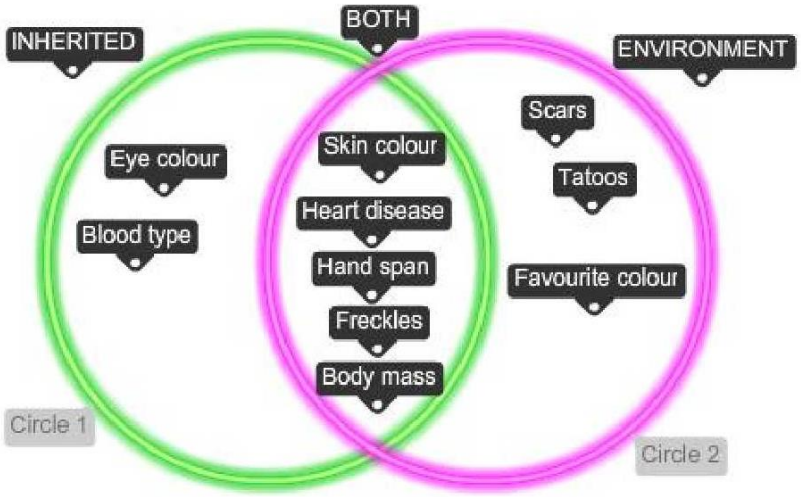
Sorting human characteristics – method 1

We've decided to use a line as it helped us organise our ideas and show which characteristics are influenced more by inheritance and environment.

Mostly inherited ←				→ **Mostly environmental**		
Nose shape	**Height**	**Foot length**	**IQ**	**Sporting ability**	**Body mass**	**Cholesterol**

Sorting human characteristics – method 2

We then chose to use a Venn diagram as another way of sorting these human characteristics. We used an online Venn diagram template.



Conclusion

The brainstorming at the start of the lesson was useful for our group. We listed the human characteristics then chose to use a line to sort them. This was useful, but then we realised that Venn diagram is better because it will let us sort all similar characteristics into sections, e.g. environment, inherited or both. Using a line doesn't let us show these groups clearly.

Example 15

Subject portfolio:	Science
Task:	Photosynthesis – growing tomatoes in winter
Illustrative of characteristics at:	Level 5
Skill assessed:	*Link learning*

Context

Following a series of lessons on plant growth, learners investigated the role of light in photosynthesis. The learner planned and carried out an activity to investigate how light levels affect the rate of photosynthesis. In the activity, the learner measured how the volume of gas generated during photosynthesis varied as a source of light was placed at different distances away from the plant.

Comments

1. During a discussion with the teacher, the learner draws links between the science they learned during their photosynthesis investigation and the growth of grass during summer months: 'We have to cut the grass more often in the summer because there is more daylight during the day and the grass grows more quickly.'
2. The learner also uses correct scientific terminology, e.g. 'photosynthesis' and 'light source'.

Next steps

- The learner could be challenged to use their findings to explain how photosynthesis may be affected when plants grow under water.

Photosynthesis – growing tomatoes in winter

Background
In the 'Photosynthesis' fact file poster, the pupil investigated how light affects the rate of photosynthesis in plants. The teacher asked the pupils to consider how the science they have learned is relevant to growing tomatoes out of season.

Teacher: What would be the best conditions in which to grow tomatoes?

Pupil: I think tomatoes will grow better in a greenhouse in the summer.

Teacher: That's fine for the summer, but how can we encourage better growth during the dark winter months?

Pupil: It would be better to use lights in the winter, because we saw that photosynthesis will be better if the light source is nearer the plant.

Teacher: Can you think of any other examples of that?

Pupil: We have to cut the grass more often in the summer because there is more daylight during the day and the grass grows more quickly.