The National Strategies
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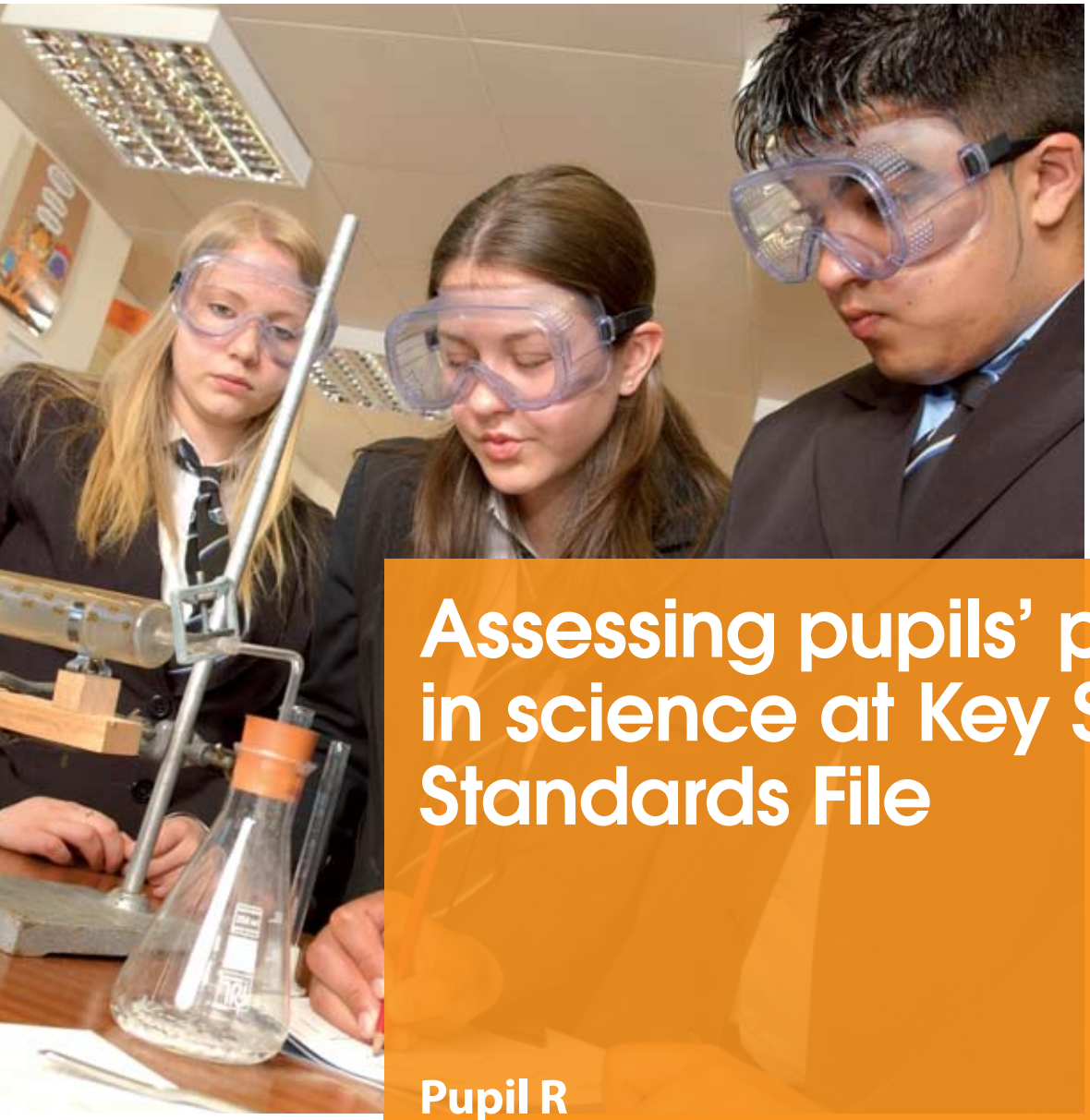

Assessing pupils' progress in science at Key Stage 3: Standards File

Pupil R

department for children, schools and families

QCA Qualifications and Curriculum Authority

Assessing pupils' progress in science at Key Stage 3: Standards File

Pupil R

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Pupil R Year 8 Secure level 4 Science Standards File

Pupil profile

Pupil R is in a class working in the level 3 to level 5 range. She enjoys producing colourful information posters, and the presentation of her work is generally good. She is able to use some abstract ideas in her work but finds handling quantitative data challenging.

The evidence

1. Rock pool food web
2. Making cell models
3. Investigating indigestion remedies
4. Forces on a pram
5. Investigating the stretch of a rubber figure
6. Applications and implications of distillation

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1. Rock pool food web

Assessment focuses

AF1, AF3, AF4

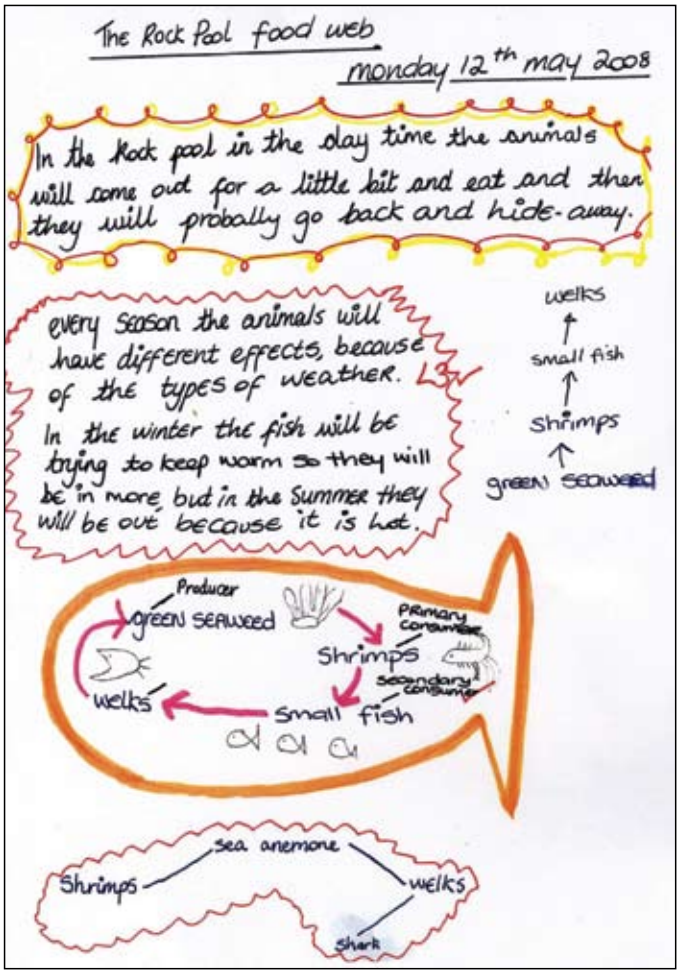
Context

Pupil R lives in a coastal town, and the lesson that produced this work followed a visit to the nearest beach and rock pools. During the visit, the pupils noted as many different kinds of evidence of living things as they could.

The class discussed rock pools as habitats, and the importance of temperature, daylight and the tides. The teacher emphasised the need of every living thing for a source of energy, but without using higher level vocabulary such as 'trophic level'. Pupils were provided with a rock pool food web that identified 'producers', 'primary consumers' and 'secondary consumers', and the class discussed the feeding relationships. They were then asked to identify:

- daily cycles in the lives of organisms in rock pools;
- annual cycles;
- two food chains within the food web.

Pupil R's work



Teacher's notes

AF1

Pupil R demonstrated an understanding of scientific ideas in her depiction of food chains, each of which included four different organisms. The first food chain has been represented twice and, in the diagrammatic version shaped like a fish, there is a minor error in that she has drawn the chain as a cycle. She also included a shark in the second food chain, which is not a typical organism found in a rock pool.

AF3

Pupil R used appropriate scientific vocabulary supplied to her (producer, primary consumer, secondary consumer), recognising these from the food web illustration that was the basis of the work. She also used the correct scientific convention to show the direction of the food chain.

AF4

She showed good and thoughtful observation in the initial beach and rock pool visit, recognising and naming several rock pool species.

Next steps

- Exploring food chains and food webs in other habitats.
- Considering the effect of pollution on ecosystems and the accumulation of toxic materials in food chains.

Assessment commentary

Pupil R describes a food chain involving a number of steps, using correct scientific vocabulary and conventions. It is unclear from her food chain the extent to which she understands the nature of whelks as detritivores.

She makes, and describes directly to her teacher, some clear observations. She offers some links to explain these observations in terms of the animals' behaviour but these explanations are limited.

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2. Making cell models

Assessment focuses

AF1, AF3

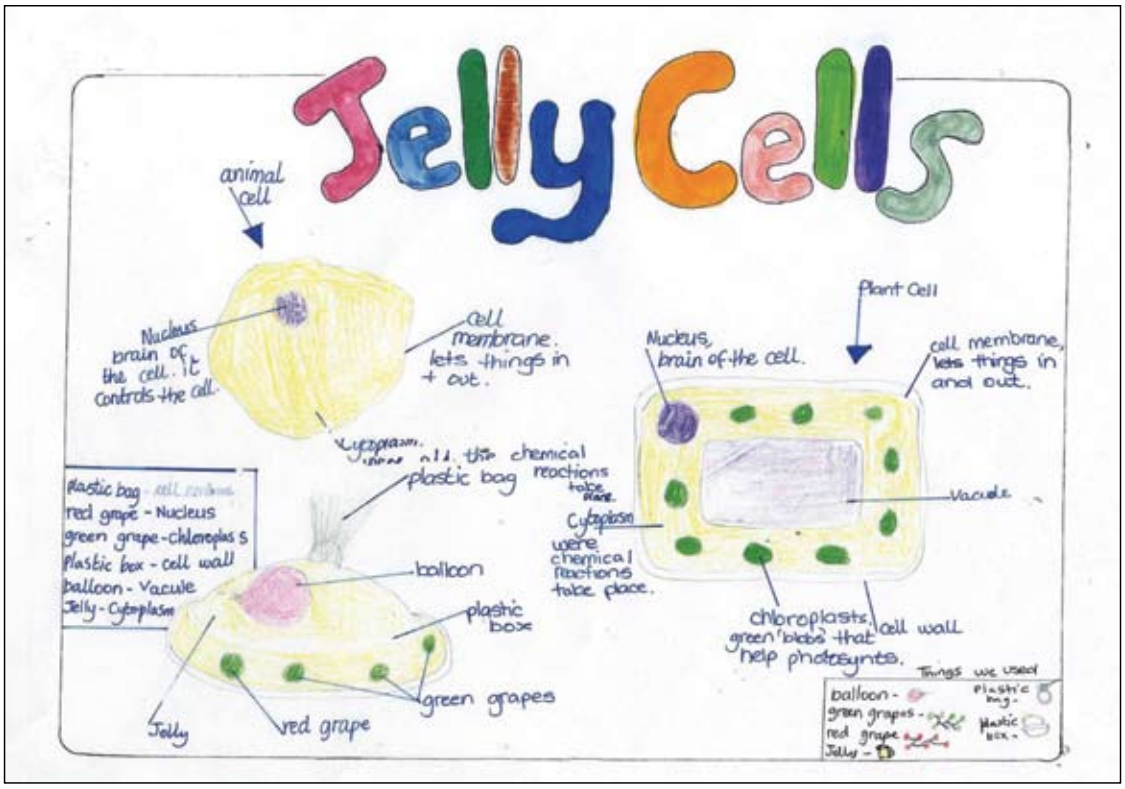
Context

Pupils had previously observed onion cells using microscopes and various images of plant and animal cells from the Wellcome Trust [1](http://medphoto.wellcome.ac.uk/). The teacher made the pupils aware that cells are the complex centres of the processes of life.

Following a set of printed instructions, the pupils created a model cell by setting jelly (cytoplasm) inside a plastic bag (cell membrane) that was held inside a plastic box (cell wall). Within the jelly they placed a partly inflated balloon (vacuole), a red grape (nucleus), and green grapes (chloroplasts).

The pupils then created posters to record this work. They copied labelled artworks of plant and animal cells, but made their own drawings of the models. They made their own 'keys', including lists matching parts of their models with parts of a plant cell.

Pupil R's work



Teacher's notes

AF1

The format and ingredients of the model were supplied to the pupil. She successfully used it to describe the

1. Welcome Images. http://images.wellcome.ac.uk

principal parts of a plant cell.

AF3

Pupil R used appropriate scientific language with clear 'keys' and well labelled artwork for her model.

Next steps

- Use of word games to consolidate understanding of specific vocabulary.
- Observation of specialised cells and linking to their function.
- Consideration of the strengths and weaknesses of the jelly model as a representation of a real cell.
- Consideration of issues relating to the use of stem cells.

Assessment commentary

Although a lot of guidance was given in the construction of the physical model and in the provision of labelled diagrams of plant and animal cells, there is much that she contributes herself. The key points for assessment are that she has drawn her own clearly labelled diagram of her model, and has matched the model components with cell components.

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3. Investigating indigestion remedies

Assessment focuses

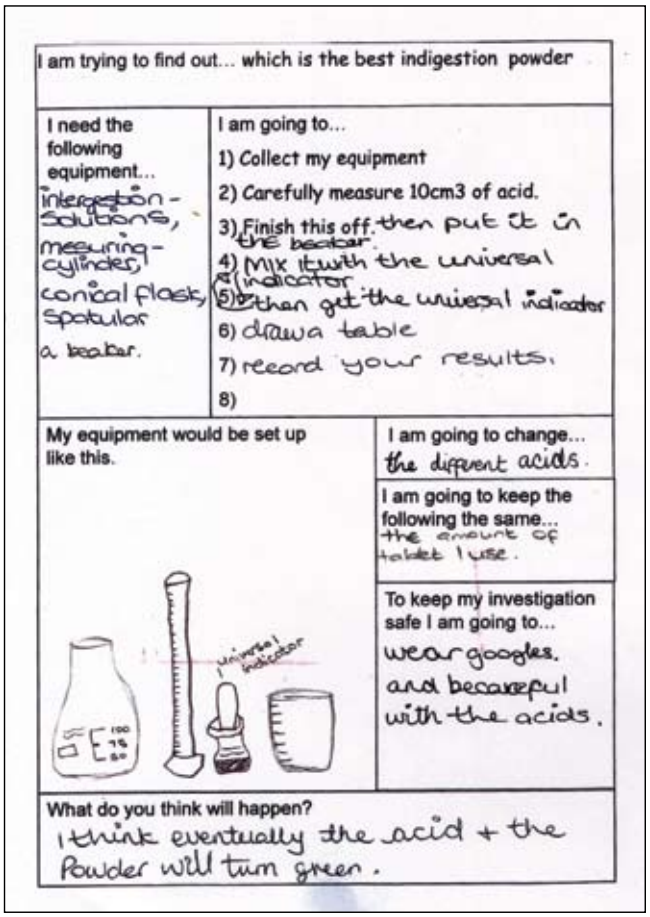
AF2, AF3, AF4, AF5

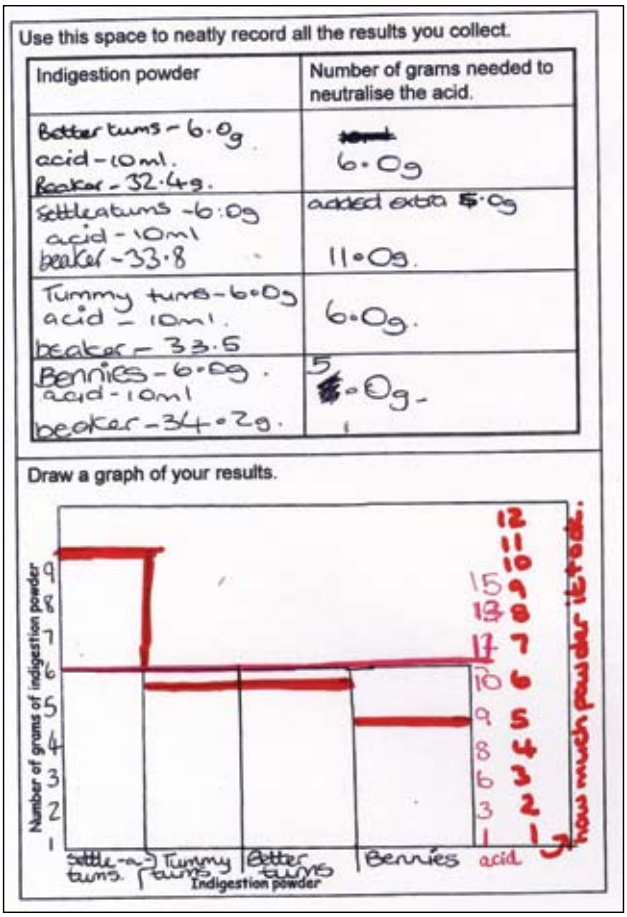
Context

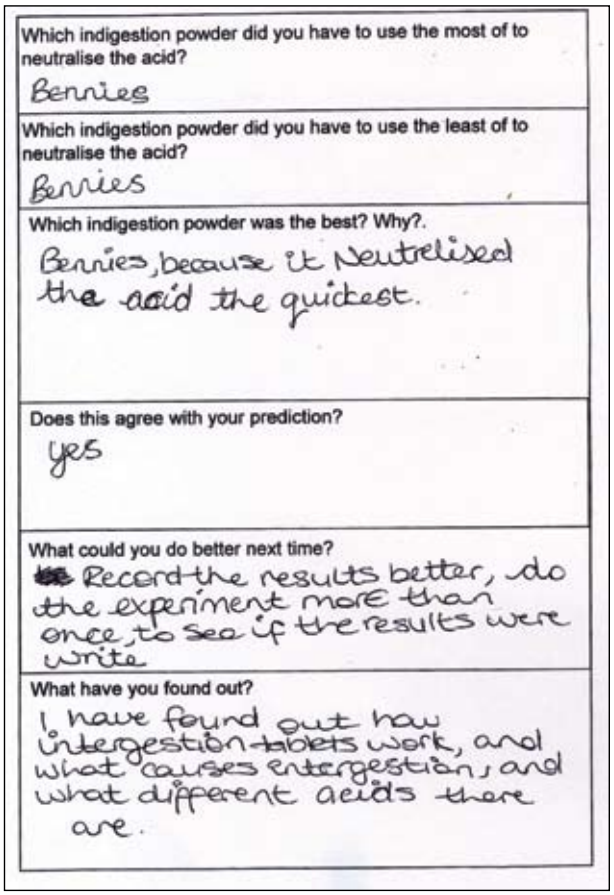
The class discussed naturally occurring acids, having found out that the stomach produces acid to aid in the digestion of food. The class considered the effect of excess acid and acid reflux as causes of indigestion and heartburn.

Pupil R carried out an investigation that required her to compare four indigestion remedies, carrying out the practical activity in a group of three. The remedies were white powders prepared in school, and named accordingly. She recorded her work, independently from other pupils, in a template provided.

Pupil R's work







Which indigestion powder did you have to use the most of to neutralise the acid?
Berries

Which indigestion powder did you have to use the least of to neutralise the acid?
Berries

Which indigestion powder was the best? Why?.
Berries, because it Neutrelised the acid the quickest.

Does this agree with your prediction?
yes

What could you do better next time?
Record the results better, do the experiment more than once, to see if the results were write

What have you found out?
I have found out how intergestion tablets work, and what causes intergestion, and what different acids there are.

Teacher's notes

AF2

During a brief one-to-one discussion, Pupil R made it clear that she recognised the use of indigestion tablets as an application of a scientific idea, stating that, "they make the acid in your stomach more neutral."

AF3

Pupil R recorded her measurements in a table, listing the masses of indigestion remedies needed to neutralise the acid. She included unnecessary information on volumes of acid. She showed her results as a bar chart, though not all values were shown correctly. There is additional information (the multiple y-axes) that creates some confusion. She used some scientific conventions in the form of units. She used appropriate scientific language to communicate the process she followed, although she omitted some important information. There is no mention in her description of her procedure when adding the indigestion powder or of how she measured the amounts added.

AF4

Pupil R made a selection from the equipment provided and she also recognised the need to use the same quantity of acid each time, thus working with the concept of a fair test. However, she stated that she would change "the different acids" and would keep the "amount of tablet" the same in each case, which is not what she actually did. She made some accurate measurements when carrying out the practical work. She also made her own initial suggestions during a discussion about controlling risk, and acted on these.

AF5

Pupil R's report of the outcome of her measurements lacked clarity. She described 'Bennies' as the powder which she needed both most and least. Her statement that Bennies were best is consistent with her results, although she stated that it neutralised the acid "the quickest". She recognised that her recording of results could have been improved. She correctly suggested that repetition of measurements would provide a check of the results.

Next steps

- Further investigations to allow opportunities to control variables.
- Straight-forward data exercises, using secondary data to reach valid conclusions.
- Developing the use of the pH scale to measure strength of acids.

Assessment commentary

Pupil R attempts to represent data in the form of a bar chart but confuses it by including unnecessary information, which suggests some uncertainty in working with quantitative data.

There is sufficient evidence to indicate achievement at level 4 in her work on fair testing, on the use of equipment, on observations and on controlling risk. She draws straightforward conclusions about the data and identifies the evidence used for her conclusions. Her suggestion for improvements to her working method is a simple statement that the teacher could develop through further discussion.

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4. Forces on a pram

Assessment focuses

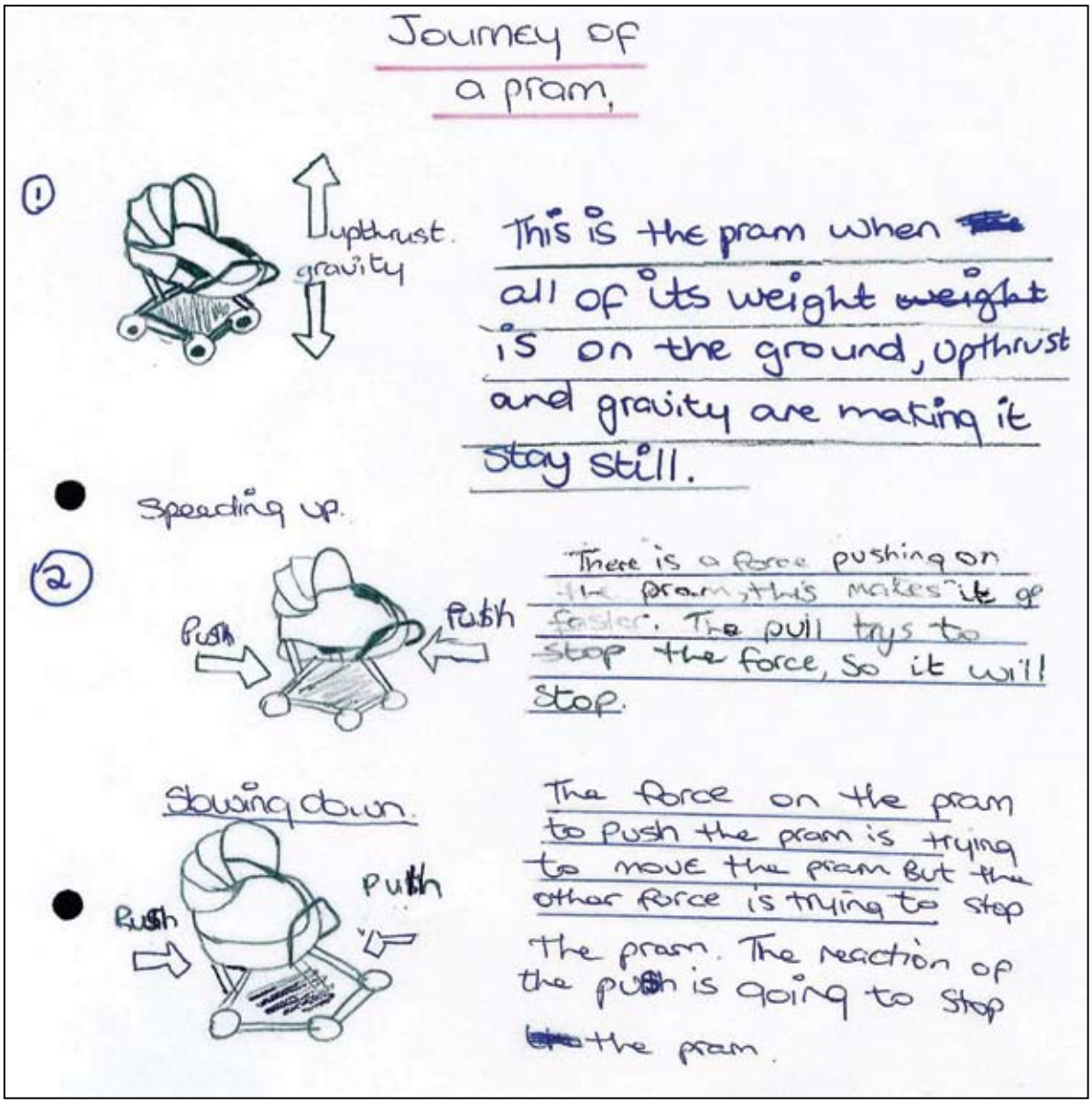
AF1, AF3

Context

The class was working on balanced and unbalanced forces, and predicting the motion of various objects. Pupil R was given three labelled diagrams showing pairs of forces acting on a pram. The first diagram showed equal and opposite vertical forces. The second diagram was titled 'speeding up' and showed a forwards force that was greater than the backward force. The third diagram was titled 'slowing down' and showed a backwards force greater than the forwards force.

The teacher asked Pupil R to make copies of the diagrams and add text to explain what would happen.

Pupil R's work



Teacher's notes

AF1

The pupil's statement for the first diagram was valid, and, although she made no mention of balanced and unbalanced forces, she successfully used scientific ideas to describe a simple process.

For the second diagram, the pupil explained that the two forces have opposite effects, but did not bring these together to provide an explanation of their combined effect. She described the simple process due to each force, but did not progress to the more abstract ideas about the combined effect.

In the third case, the pupil did consider a combined effect, and correctly recognised that the result was a tendency to stop moving.

AF3

The pupil used the arrow convention to represent forces, but was not yet able to clearly distinguish between pushing and pulling forces, or between forces of different magnitudes.

Next steps

- Further work in a variety of contexts using arrows to represent forces, emphasising the conventional significance of the direction and sizes of the arrows.

Assessment commentary

Pupil R has begun to use arrows to represent forces and describe what these mean. There is little evidence to indicate attention to the proportion of the arrows. The relationship between the diagrams and the explanations also shows some confusion. Pupil R's work with models is seen here to be at a simple rather than an abstract level.

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5. Investigating the stretch of a rubber figure

Assessment focuses

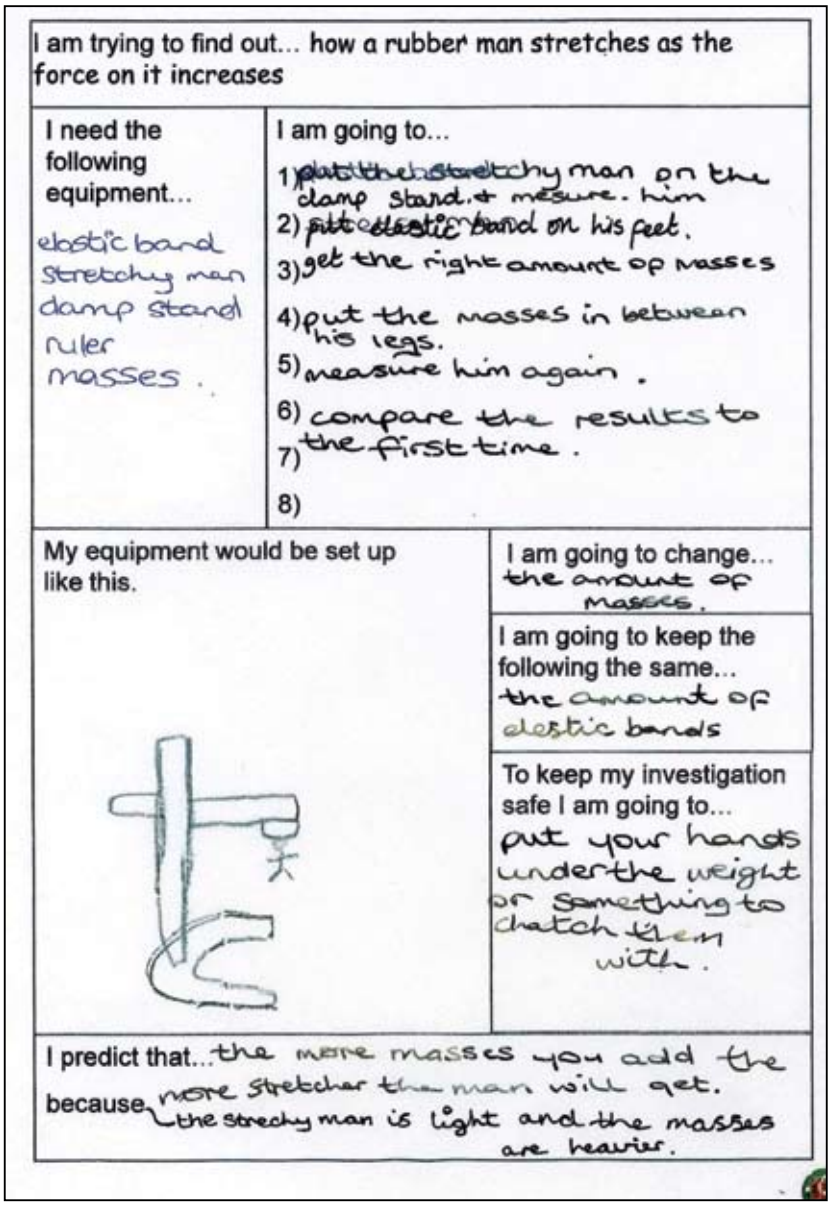
AF3, AF4, AF5

Context

The class did some introductory work on the effects of opposing forces in changing motion. They then moved on to discussing the idea that opposing forces can also produce changes in shape.

Pupil R worked with templates for the planning, drawing conclusions and evaluation stages of the work. She was also given a form with a grid on which to complete her results, and this form imposed a requirement for repetition of measurements. The focus of the activity was the development of independence in plotting graphs. The graph here was produced at her second attempt.

Pupil R's work



I am trying to find out... how a rubber man stretches as the force on it increases

I need the following equipment...
elastic band
stretchy man
clamp stand
ruler
masses.

I am going to...
1) put the stretchy man on the clamp stand. measure. him
2) put elastic band on his feet.
3) get the right amount of masses
4) put the masses in between his legs.
5) measure him again.
6) compare the results to
7) the first time.
8)

My equipment would be set up like this.

I am going to change...
the amount of masses.

I am going to keep the following the same...
the amount of elastic bands

To keep my investigation safe I am going to...
put your hands under the weight or something to catch them with.

I predict that... the more masses you add the more stretcher the man will get.
because the stretchy man is light and the masses are heavier.

Use this space to neatly record all the results you collect.

Force (N)	Length (cm)	Force (N)	Length (cm)
0	4cm (stretchy)	0	5cm.
1 newton	7½ cm.	1 newton	7 cm
2 newtons	12 cm.	2 newton	15 cm
3 newtons	17 cm	3 newton	22cm
4 newtons	19 cm	4 newton	27 cm
5 newtons	24 cm	5 newton	34 cm
6 newtons	32 cm	6 newton	40 cm
7 newtons	41 cm	7 newton	42 cm
8 newtons	45 cm.	8 newton	48cm.

My graph shows me that as I add more force to the stretchy man...

stretches bigger-(longer)

Does this match your prediction? If not what did you find out?

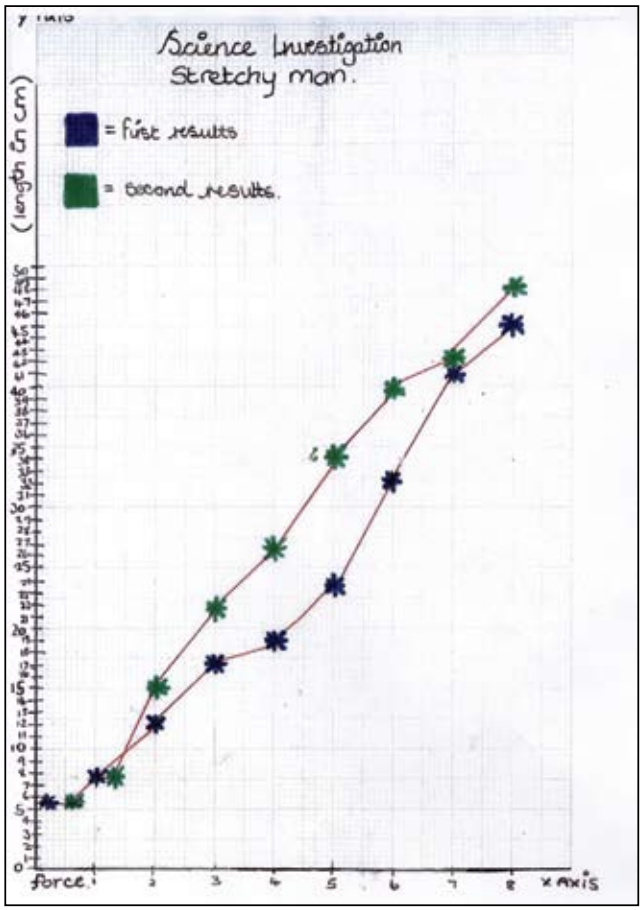
My prediction was right.

Are there any results that don't match the pattern? What might have happened?

yes, I might of measured it slightly fling off.

What could you do to make your experiment better?

I could use more masses. I could tie the elastic band tighter to the mans feet so the band would not fling off. I could try to measure it more accurate.



Teacher's notes

AF3

Pupil R recorded her results clearly in the table. She produced clear line graphs on her second attempt, following some feedback.

AF4

She followed the requirement of the table grid to make two complete sets of measurements with a suitable range. She also made a sensible comment about safety.

AF5

Pupil R drew a valid conclusion from the measurements and their representation in her graph. She recognised that the results did not have a perfect simplicity but followed an overall pattern. She also recognised that using more masses would make her experiment better, but did not explain why.

Next steps

- Work on force diagrams for the stretchy man under different loads, stressing the importance of arrow lengths to represent forces of different magnitudes.
- Further graph drawing exercises involving producing lines of best fit.

Assessment commentary

Pupil R records results using tables and graphs, and this graph shows very considerable progress from her bar chart produced in Task 3. The results show a range of measurements obtained through repetition, although she does not give a reason for this repetition. She provides appropriate conclusions based on the results. There has been some attempt to evaluate and improve upon the working method but with little detail.

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6. Applications and implications of distillation

Assessment focus

AF2

Context

The class had been working on mixtures and separation techniques, and had carried out a distillation activity to obtain water from a solution. They then looked at images of some industrial distillation systems, and related these to commercially available products.

This activity was done near the end of the topic. The class looked at biofuels, alcohol and petrol as products of distillation and pupils had acquired information and various images through research.

The table provided a basis for class discussion about the difference between social and economic impacts of these distillation products. Pupils talked again about the ideas in small groups and completed the tables. They then wrote a letter to a fictitious newspaper to explain the impacts of one of these distillation products.

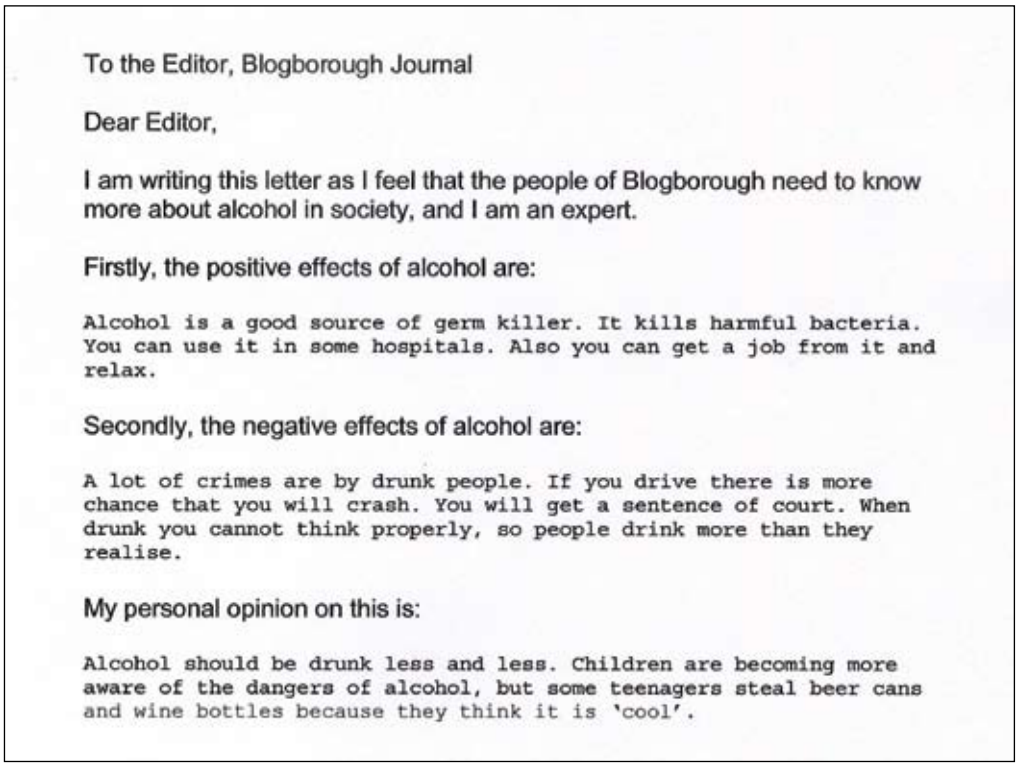
Pupil R's work

Is the process of distillation a good thing for society?

Three things that can be made available using the process of distillation are biofuels, alcohol and petrol.

What are the social and economic advantages and disadvantages of these distillation products?

Product of distillation	Advantages	Social or economic?	Disadvantages	Social or economic?
Biofuels	Biodiesel is renewable – we can grow the crops it is made from again and again.	Economic because we can keep growing crops for fuel	You have to use up lots of land to grow the crops for making the fuel. It uses up land that could be used for growing food.	Economic because it affects poor peoples food.
Alcohol	Can be used to kill germs and harmful bacteria	Social because when alcohol is used to clean things it kills bactaeria.	Half of all violent crimes are carried out by drunken adults.	Social – because of violence
Petrol	Allows people to drive and ambulances to reach casualties	Social because it helps to get people to areas of danger by using fast transport.	It is non-renewable and it is running out.	Social and economic. Social because it affects humans using transport.



To the Editor, Blogborough Journal

Dear Editor,

I am writing this letter as I feel that the people of Blogborough need to know more about alcohol in society, and I am an expert.

Firstly, the positive effects of alcohol are:

Alcohol is a good source of germ killer. It kills harmful bacteria. You can use it in some hospitals. Also you can get a job from it and relax.

Secondly, the negative effects of alcohol are:

A lot of crimes are by drunk people. If you drive there is more chance that you will crash. You will get a sentence of court. When drunk you cannot think properly, so people drink more than they realise.

My personal opinion on this is:

Alcohol should be drunk less and less. Children are becoming more aware of the dangers of alcohol, but some teenagers steal beer cans and wine bottles because they think it is 'cool'.

Teacher's notes

AF2

Pupil R was able to recognise several applications of products of distillation. She could describe some simple positive and negative consequences of the process and began to distinguish between different kinds of impact, differentiating consistently between those which were 'social' and 'economic'.

Next steps

- Consideration of other issues such as those which are specifically ethical or moral.
- Activity to differentiate clearly between opinion and scientific evidence.

Assessment commentary

Student R makes some considered social and economical judgements about the use of distillation and some of its products. She also weighs up positive and negative factors of these products and their uses.

Assessment summary

AF1 Thinking scientifically

Pupil R is confident in using simple models and scientific ideas when describing simple processes and phenomena. She shows some evidence of moving towards using abstract ideas (such as in the work on food webs), but this is not always shown clearly (as in the case of the work on forces on a pram). She is working at high level 4 for AF1.

AF2 Understanding the applications and implications of science

The action of indigestion tablets is recognised as an application of a specific scientific idea, and positive and negative consequences of distillation are well explored, indicative of level 4. Pupil R distinguishes well between social and economic issues and this aspect of her work is at level 5, so that a judgement for AF2 overall places her at high level 4.

AF3 Communicating and collaborating in science

Some of Pupil R's work shows very good presentation, although this is not yet consistent, as shown by her success in plotting data in the second investigation compared with the first. She uses scientific language appropriately and uses some scientific and mathematical conventions well. For AF3 she is working, on balance, at a secure level 4.

AF4 Using investigative approaches

Pupil R selects appropriate equipment from an available range, and makes sets of observations and measurements. Some of her measurements are not well presented and on their own would indicate level 3, while others suggest work moving on to level 5. She is able to make, and act on, suggestions to control obvious risk. Again, a balanced judgement is needed, placing her work currently at secure level 4.

AF5 Working critically with evidence

Pupil R identifies some straightforward patterns in data and draws straightforward conclusions. There are some suggestions of improvements to working methods. Her work for AF5 is at low level 4.

Overall assessment judgement

Although Pupil R at times makes significant advances into level 5, there is other work in which she displays progress only to high level 3. She is clearly making significant progress through level 4, albeit significantly more so in some areas than others. An overall judgement places her progress at secure level 4.

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APP science assessment guidelines: levels 4 and 5

Name……

	AF1 – Thinking scientifically	AF2 – Understanding the applications and implications of science	AF3 – Communicating and collaborating in science	AF4 – Using investigative approaches	AF5 – Working critically with evidence
Level 5	**Across a range of contexts and practical situations pupils:** ● Use abstract ideas or models or more than one step when describing processes or phenomena ● Explain processes or phenomena, suggest solutions to problems or answer questions by drawing on abstract ideas or models ● Recognise scientific questions that do not yet have definitive answers ● Identify the use of evidence and creative thinking by scientists in the development of scientific ideas ☐	**Across a range of contexts and practical situations pupils:** ● Describe different viewpoints a range of people may have about scientific or technological developments ● Indicate how scientific or technological developments may affect different groups of people in different ways ● Identify ethical or moral issues linked to scientific or technological developments ● Link applications of science or technology to their underpinning scientific ideas ☐	**Across a range of contexts and practical situations pupils:** ● Distinguish between opinion and scientific evidence in contexts related to science, and use evidence rather than opinion to support or challenge scientific arguments ● Decide on the most appropriate formats to present sets of scientific data, such as using line graphs for continuous variables ● Use appropriate scientific and mathematical conventions and terminology to communicate abstract ideas ● Suggest how collaborative approaches to specific experiments or investigations may improve the evidence collected ☐	**Across a range of contexts and practical situations pupils:** ● Recognise significant variables in investigations, selecting the most suitable to investigate ● Explain why particular pieces of equipment or information sources are appropriate for the questions or ideas under investigation ● Repeat sets of observations or measurements where appropriate, selecting suitable ranges and intervals ● Make, and act on, suggestions to control obvious risks to themselves and others ☐	**Across a range of contexts and practical situations pupils:** ● Interpret data in a variety of formats, recognising obvious inconsistencies ● Provide straightforward explanations for differences in repeated observations or measurements ● Draw valid conclusions that utilise more than one piece of supporting evidence, including numerical data and line graphs ● Evaluate the effectiveness of their working methods, making practical suggestions for improving them ☐
Level 4	**Across a range of contexts and practical situations pupils:** ● Use scientific ideas when describing simple processes or phenomena ● Use simple models to describe scientific ideas ● Identify scientific evidence that is being used to support or refute ideas or arguments ☑	**Across a range of contexts and practical situations pupils:** ● Describe some simple positive and negative consequences of scientific and technological developments ● Recognise applications of specific scientific ideas ● Identify aspects of science used within particular jobs or roles ☑	**Across a range of contexts and practical situations pupils:** ● Select appropriate ways of presenting scientific data ● Use appropriate scientific forms of language to communicate scientific ideas, processes or phenomena ● Use scientific and mathematical conventions when communicating information or ideas ☑	**Across a range of contexts and practical situations pupils:** ● Decide when it is appropriate to carry out fair tests in investigations ● Select appropriate equipment or information sources to address specific questions or ideas under investigation ● Make sets of observations or measurements, identifying the ranges and intervals used ● Identify possible risks to themselves and others ☑	**Across a range of contexts and practical situations pupils:** ● Identify patterns in data presented in various formats, including line graphs ● Draw straightforward conclusions from data presented in various formats ● Identify scientific evidence they have used in drawing conclusions ● Suggest improvements to their working methods, giving reasons ☑
BL	☐	☐	☐	☐	☐
IE	☐	☐	☐	☐	☐

Key: BL-Below Level IE-Insufficient Evidence

Overall assessment (tick one box only) Low 4 ☐ Secure 4 ☑ High 4 ☐ Low 5 ☐ Secure 5 ☐ High 5 ☐

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