Supporting the writing of conclusions

The following materials are from the Literacy in science unit

Handout 3.11

Teacher guidance sheet 1: Writing conclusions

The structure of a conclusion will vary slightly depending on the context, but will follow the main stages as illustrated with three different skills.

Considering evidence

observations and measurements of phenomena

Skill 1

Describing relationships by looking at tables, graphs, series of observations and measurements and writing generalisations; identifying anomalous results.

Skill 2

Drawing concluding remarks that are consistent with the evidence and answer the original enquiry. Conclusions may be drawn from patterns or directly from observations and measurements.

Skill 3

Relating conclusions to scientific knowledge and understanding either by explaining conclusions in the light of pupils' developing scientific ideas or using the findings to suggest a hypothesis for testing.

- Pupils need to be taught to describe relationships, using comparative adjectives, when appropriate, to make generalisations.
- Pupils need to be taught to draw concluding remarks that relate back to the enquiry question and are consistent with the evidence. They may need to relate their conclusion to a prediction made.
- Pupils need to be taught how to use their scientific knowledge and understanding to support their conclusions or suggest further ideas to test.

Handout 3.12

Teacher guidance sheet 2: Writing conclusions

Text type	Purpose	Language features
Conclusion **Examples** • *What affects the strength of an electromagnet?* • *How are plants adapted to suit their environment?*	• To present an analysis and interpretation that is consistent with the evidence.	**Text** Generally has three parts: • One section describes any patterns in the results as generalisations, e.g. *the larger the number of coils the stronger the electromagnet. Also the larger the current… .* • Another summarises these as a concluding remark which relates directly back to the enquiry question, e.g. *the factors that affect the strength of an electromagnet are… .* • In the third section, attempts are made to explain the remark in terms of scientific understanding or relate back to any prediction made, e.g. *the reasons for this are that when electricity flows through a wire it produces a magnetic field… . I predicted that… .* It may suggest further ideas to test. **Sentence** • Active voice, often first person. • Connectives help to describe patterns using comparative adjectives, e.g. *longer, hotter, heavier.* • Connectives used to establish cause and effect, e.g. *because, since, therefore, as a result… .* Also relate to evidence, e.g. *this shows that, I know this because… .* **Word** • Process words and concept words dominate.

Handout 3.18

Pupils' work: What makes a good conclusion?

Commentary

This handout contains the written conclusions provided by each group on flipcharts in the Year 9 video clip *Writing conclusions*. They have been typed, but contain original spellings, phrases and paragraphing.

Group 1

The cooler the water the longer the salt takes to dissolve. The hotter the water the faster the salt dissolves.

We conclude that the greater the termpurature, the faster the salt dissolves.

When the water heats up the water particles move faster. This ables the salt to dissolve quicker. So this means that the cooler the temerature of the water the slower the water particles move around so they don't collide as much. The warmer the water the faster the water particles move so they collide into the salt particles more often dissolving the salt faster.

Group 2

How does the temperature effect solubility of SALT?

We found out the hotter the water, the quicker the salt dissolved and the cooler the water, the longer it took the salt to dissolve.

The cooler the water particals, the slower the salt particals move. The hotter the water particals, the faster the salt particals move.

The heat of the water effects how fast or slow the salt particals collide and dissolve.

Group 3

How does temperature effect the solubility of salt

The graph shows that the cooler the temperature the longer it takes for the salt to dissolve. The higher the temperature the shorter amount of time is taken.

From this we conclude that the higher the temperature the less time it takes to dissolve.

When the water is hotter the particles move faster so the salt dissolves quicker. When the water is cooler the particles move slower so the salt dissolves slower.

Group 4

HOW DOES THE TEMPERATURE AFFECT THE SPEED OF WHICH SALT DISSOLVED?

In this experiment we found out that the cooler the water the more time it took the salt to dissolve, the warmer the water the less time it took the salt to dissolve.

We conclude that the warmer the water the quicker the salt dissolves.

When the water is cool the particles move slowly and when the water is warm the water particles move faster and when they bump into the salt, the salt dissolves making a solution.

Handout 3.19

Pupil sheet A

Experiment: What happens when acid is put on rock?

When pupils were investigating rocks they were asked to find out what happened when dilute acids were placed on the minerals that made up the rocks. Here is a set of their results.

Results

Mineral salt	Acid added	Observation
Calcium sulphate	Hydrochloric acid	No reaction seen
Sodium silicate	Sulphuric acid	No reaction seen
Calcium carbonate	Hydrochloric acid	Fizzes a lot, bubbles and gas
Iron chloride	Nitric acid	No reaction seen
Sodium carbonate	Sulphuric acid	Fizzing, bubbles
Aluminium sulphate	Hydrochloric acid	No apparent reaction
Copper sulphide	Hydrochloric acid	No reaction seen
Sodium sulphate	Sulphuric acid	No reaction seen
Copper carbonate	Sulphuric acid	Fizzing, bubbles, blue colour seen
Iron sulphate	Nitric acid	No reaction seen
Zinc carbonate	Nitric acid	Fizzing, bubbles seen
Iron carbonate	Hydrochloric acid	Fizzing, bubbles seen

Handout 3.20

Pupil sheet B: Examples of conclusions

Example 1

My results show me that some rocks fizz and some do not when acid is added. Hydrochloric acid made calcium carbonate fizz, sulphuric acid made sodium carbonate fizz and copper carbonate made hydrochloric acid fizz. Fizzing also happened between zinc carbonate and nitric acid and iron carbonate and hydrochloric acid. None of the other rocks fizzed. The reason for this is that there is a reaction between some types of minerals that might be in rocks and acids. You could use this as a test for some minerals, but you could not tell which is which. The bubbles mean that a gas is made in the reaction. The gases I know about are hydrogen, oxygen and carbon dioxide, it could be one of these, but I would need to test them.

Example 2

My results show me that fizzing only occurs with those minerals that contain carbonate. The results also show that it doesn't matter what type of acid you use.

I conclude that carbonates react with acids to produce a fizz. You could use acids to test whether rocks contain carbonates or not.

The fizz means that a gas is given off. This gas is probably carbon dioxide, because it comes from a carbonate and the names are similar. I could test and be sure by seeing if the gas turns limewater milky.

Handout 3.21

Pupil guidance sheet: Writing conclusions

Step 1: Describe the patterns

- Describe patterns or trends in graphs or data.
- Phrases to use:
  - comparative adjectives such as *longer, heavier, hotter*
    e.g. *The brighter the light the faster the plant photosynthesises.*
  - *as the… so the…*
    e.g. *As the number of batteries increases so the current increases.*
- You may need to comment on how good the pattern is, e.g.
  This is a good pattern because… or *The pattern is not very strong.*

Step 2: Make a concluding remark

- Answer the original enquiry question.
- Phrases to use:
  - *To conclude…, I conclude that…* (relate to original question or question and prediction)
  - *The experiment shows that…, In general…, This means that…*

Step 3: Explain the conclusion

- Use the science you know or can find out to explain your conclusion. Say if this leads to another experiment.
- Phrases to use:
  - *This can be explained by…, As I predicted…, This is because…, The reason for this is…, To be sure I will need to test…*
- Aim to:
  - use paragraphs;
  - use the present tense;
  - use scientific words accurately.

Handout 3.22

Teacher guidance sheet: Writing conclusions

Pupils need to see examples of conclusions and discuss the merits of each.

They need to build a picture of what the structure of a conclusion looks like and how paragraphs help to organise the text.

They need to know how to describe patterns, draw concluding remarks and explain their observations in the light of scientific knowledge and understanding.

Pupil sheet B provides two examples of conclusions. You can use these to discuss how to write conclusions with pupils.

A suggested approach

- Ask pupils to work in pairs.
- Provide each pair with a set of results (pupil sheet A).
- Ask them to think about what conclusions they might draw from the results.
- Provide each pair with the two conclusions (pupil sheet B).
- Ask pupils to annotate each (using different colours) to show what is good about each and what is bad.
- Invite discussion about the merits of each.

Some points to make

Example 1 has a better conclusion than example 2.

Example 1 strengths:

- starts by stating what the results show;
- uses scientific terms correctly;
- attempts to summarise with *The reason for this is... .*

Example 1 weaknesses:

- no description of a pattern, merely repeats results although is partially selective (separates carbonates from others);
- no paragraphs, so difficult to follow sequence;
- no clear generalisation or concluding remark;
- because no pattern was identified (i.e. carbonates produce fizz), it was difficult to explain using scientific understanding.

Example 2 strengths:

- clear structure demarcated with paragraphs;
- clearly identifies pattern in results, generalises by referring to carbonates;
- makes a concluding remark and identifies significance (*You could use acids to…*);
- explanation uses appropriate scientific understanding, good speculation about name of gas.

Handout 3.29

Teacher guidance sheet: Argument

Text type	Purpose	Language features
Argument **Examples** • *Provide the evidence to support the view that we see because light enters our eyes.* • *Provide the evidence for a spinning Earth.* • *What causes day?* • *What are the possible causes of global warming?*	• To analyse evidence and present a view that is consistent with it. • To analyse conflicting views on the basis of evidence. • To develop the skills of considering evidence.	**Text** • Text usually starts with a statement of an idea or a particular point of view, e.g. *We see because light enters the eye* or *Seeing because light enters the eye makes more sense,* or *The spinning Earth causes day and night.* • Presenting a case, which sets out the evidence, follows this. It may include diagrams to aid clarity. **Sentence** • Sentences contain connectives that show formal logic, e.g. *this shows..., my reasons are..., because... , therefore..., the evidence for this is...* • There may be reference to a model or analogy, e.g. *it is like...* • Counter-arguments may be set up to be demolished. *Some people think that... another point of view is... but the evidence shows...* • Active voice, often first person. • Present tense. **Word** • Process words and concept words are important here.

Handout 3.30

Pupil sheet: Arguments for seeing because light enters the eyes

We need light to see things. Some people believe we see because light bounces off things and enters our eyes, others because light leaves our eyes, striking an object, so helping us see.

Argument 1

We must see because light enters the eye. We need light to see by, otherwise we would be able to see in the dark because light could come out of your eyes.

Argument 2

Seeing because light enters the eye makes more sense. We can't see when there is no light at all. If something was coming out of our eyes, we should always be able to see even in the pitch black. Another reason for believing this is that if you are standing outside looking into a dark room you cannot easily see things. If, however, light is let into the room from a window you can see things in it. This is because the light bounces off objects into your eye.

From 'Enhancing the quality of argument in school science', by Osborne et al., School Science Review *(published by ASE), June 2001, pp. 63–70.*

Handout 3.31

Pupil guidance sheet: Constructing arguments

My argument

- My idea is…
- My reasons are that…
- Arguments against my idea might be that…
- I would convince somebody that does not believe me by…
- The evidence I would use to convince them is that…

From 'Enhancing the quality of argument in school science', by Osborne et al., School Science Review *(published by ASE), June 2001, pp. 63–70.*

Handout 3.32

Teacher guidance sheet: Supporting the writing of argument

Constructing arguments helps pupils to explore ideas and evidence and make a case based on evidence. Arguments may also analyse conflicting points of view. It is important to avoid opinion and to encourage pupils to support their views with evidence.

Structure

Constructing a good argument is not a simple task.

Start by writing an opening statement about an idea or point of view, e.g. *My idea is… , I believe that… , There are different views about… .*

Follow this by presenting the evidence that supports this view or the conflicting views. In the case of conflicting views, make a judgement about the balance of the evidence and then summarise.

A suggested approach

- Ask pupils to work in pairs.
- Ask them to draw a picture to show how we see. Quickly review the drawings to see if there are any standard misconceptions present (there probably will be). If there are, discuss them before moving on.
- Provide each pupil pair with the pair of arguments on handout 3.30.
- Ask them to identify the evidence for the view in each argument.
- Ask them to decide which is better and why.
- Carry out a 'modelled write' that would improve the argument.
- Give each pupil a copy of handout 3.31. Ask them to make the links with the 'modelled write'.

Some points to make

Neither argument presented on handout 3.30 is very good, but the second is better because it provides some evidence to support the idea.

Start writing the argument on the board together with pupils. Help them to understand the structure by agreeing the opening and then starting the next paragraph with *'The evidence for this is…'*.

At this point it may well help to break the class into small groups so that pupils can suggest pieces of evidence to be included in the argument.

Once this has happened, discuss with pupils what evidence there is and then together finish the argument.

