Chapter 3

Developing writing in Science
Learning through writing

“… it (writing) gives us time and opportunity for reflection. The words are not gone as soon as spoken, but are before us on the page for consideration, and this enables us to deal with more complex ideas and the relationships between them.”  
Andrew Wilkinson, Ed., The writing of writing, OUP, 1986

Whenever writing takes place, there is always a purpose and an intended reader. Sometimes we write for ourselves and, in this case:
- writing helps in the capture and development of thoughts and ideas, because it leaves a record that can be returned to, considered and modified.

At other times, we write with the intention of communicating to others, which contributes to learning because:
- communicating in writing clarifies, confirms, even transforms understanding through a complex process of:
  - linking ideas and pieces of information and organising them logically;
  - ‘wrestling’ with words to form clear, meaningful sentences.

Recording is an important purpose for writing, but high-quality writing tasks will be designed to have a learning outcome as well. A consistent approach to teaching writing across the school will boost the quality of both pupils' learning and pupils' writing.
Research shows that on average pupils spend at least a third of their time writing in science. Pupils’ writing can be improved if they have the opportunity to talk through their thinking with others.

**ACTIVITY:**
The time spent on writing in science is a considerable investment; not only does it reinforce literacy skills for life but it secures learning in science and prepares pupils for future assessments of their understanding of science concepts.

As a department you might find it useful to:
- identify the purposes for writing in science in your department. You could note these and compare them to the handout ‘Purposes of writing in science’ - see additional document: 3_Purposes_of_writing.docx.
- you may find it useful to map the purposes of writing in your school over the year groups by tallying teacher responses for the different key stages. Are there consistencies across the department?

Is there an area which you need to strengthen?

**ACTIVITY:**
Writing will support learning in science when:
- the purpose is clear;
- the writing helps pupils to organise their thinking;
- pupils are challenged to think and make decisions about their writing;
- pupils are asked to write for a variety of purposes and audiences; and
- the writing is well chosen and supports the point of the lesson.

Working with a partner, use this department discussion paper to decide how well your writing tasks ‘support pupil learning in science’ - see additional document: ‘3_Supporting_pupils_in_writing_in_science.docx’
Writing is often the key instrument through which attainment is measured at Key Stage 4 so it should be a focus to support pupils to higher grades at GCSE. Command words indicate the writing required to answer the question.

- Carry out an exam paper analysis with colleagues in your department or local network. Some ideas to help in this analysis can be found in the Linear assessment ibook or on the National STEM Centre website.
- Don’t forget to check out any guidance from your GCSE awarding body on writing in science eg:
  - AQA guidance on quality of written communication
  - OCR teacher’s handbook
  - Edexcel subject guidance

Decide as a science team how you will use this analysis to help you to plan lessons to support writing skills in science.

In your GCSE scheme of learning you may have included ‘literacy’ activities which require pupils to undertake writing for specific purposes. For example students may be asked:

- to summarise information from different sources on the same topic;
- write in a particular style such as in a scientific article; and
- evaluate or grade a piece of scientific writing.

To support your department in developing writing skills and in particular to challenge the more able pupils, review some of the Learning Skills for Science guidance and materials here which were produce as part of the Science Enhancement Project.
Structures and types of writing in science

Pupils have been writing up their investigative work for six years in primary schools so already have many skills in this area. The type of writing we offer pupils should reflect the outcomes of the lesson with the best practice building a specific literacy outcome to the science lesson if relevant. You can support your pupils to produce high quality writing if they are clear about success criteria and outcomes for any writing task.

**ACTIVITY:**
Research suggests that writing in science is one of the most complex tasks for a pupil since it involves:
- thinking processes – linking ideas and information and organising them logically;
- formal language for specific audiences and purposes – examinations, controlled assessment, presentations, etc;
- reflecting on their own and each others’ writing through peer and self-assessment to clarify thoughts and eliminate misunderstanding.

You may wish to explore the research by Professor Lynn Cameron on weaknesses in writing, particularly those of advanced bilingual learners which you could apply to all learners.

With colleagues in your department, think about the support for scientific writing in your science curriculum at all key stages and reflect on the statement from Ofsted’s 2013 science report

‘Maintaining Curiosity’
- review evidence in primary and secondary schools for good and weaker practice in scientific writing;
- how does this compare with your department?
- check out the comments for primary school writing. How could you apply these in science in your school or use them as part of your transition work with feeder schools?

**ACTIVITY:**
Pupils are expected to engage with a wide range of non-fiction text types in science at Key Stages 4. You may find the following activity helpful as part of a department meeting:
- share handout 3.8 from p76 of *Literacy in Science* on ‘Types of writing’ for discussion in small groups. Find out if all science staff are clear and confident about types of texts in non-fiction writing. It may be helpful if a member of the English department could join the meeting to clarify any misunderstandings.
Structures and types of writing in science

ACTIVITY:
As a science teacher, you will have used writing frames or prompt sheets to scaffold pupils’ writing attempts, for example to plan investigations. In order to improve pupils’ writing in science there are three key principles.

Teacher modelling
Scaffolding pupils’ efforts
Developing independence

Chapter 4 of the Linear Assessment iBook - Visit the Linear Assessment iBook - Chapter 4 - contains video clips demonstrating the use of these principles to help you develop writing in science.

You will have read or heard that there is a move by the Department for Education towards assessment without levels.

As part of your department’s assessment policy you could include tracking pupil progress through COMPETENCIES in types of scientific writing.

Working with the literacy link person or coordinator in the department:
• review the teacher guidance for supporting
• Scientific Writing - Writing explanations, arguments and discussions
• look at the steps tables to illustrate pupil competencies in each writing type; these are not fixed to a key stage and often are the key to progression to higher grades at GCSE
• review the exemplar materials provided, then plan a department CPD session to share these materials. Ask teachers to bring along an example of a pupil’s writing so that you can agree which step pupils are working at
• in the teacher guidance you will find suggested ways to help pupils to progress through the writing steps. You may find these useful when differentiating writing tasks.

As an alternative, you could review the Literacy in Science training materials from the National Strategy on the national STEM Centre website and:
• use the handout 3.14 ‘Non-fiction writing in science’ to discuss the balance of these types of writing across each of your year groups.
• divide the teacher support materials in ‘Additional Handouts’ between your team and ask them to feedback at the next meeting how they trialled them with a class

Hopefully arising from discussion, you will note that different activities may include more than one text type and that it is important to introduce these text types at Key Stage 3 to allow for stretch and challenge later.

try placing the card sort about text types in science on the Aide Memoire sheet (see pages 23 and 25 in the linked document)
ACTIVITY:
Over the past few years and indeed into the future the demand on pupils to generate pieces of extended writing in science increases. How does your department prepare pupils to deliver high quality extended writing?

This video clip shows how one school in Scotland began to develop and challenge extended writing in science.

In a department meeting you could spend some time exploring the challenges we present to pupils to produce extended writing. Pose the challenge 'Explain how the cup of tea cools down', give staff 5 minutes to draft an answer.

Now ask:
1. what decisions did you make as you wrote the answer?
2. what was difficult about doing this?
3. what would students find difficult?

4. how would you change the title of the task to support and challenge all pupils?

Have a team discussion and try to draw out the links between thinking and writing. Make the point that pupils write so much better if they have the opportunity to talk through their thinking.
Our examination system demands that pupils demonstrate what they know, understand and can do under timed conditions. We expect them to retrieve information independently and to write for a purpose so it is important that we support them to meet these expectations.

ACTIVITY:
If we are to help pupils to progress towards independence, it is important that we can recognise the features of good writing. Try this activity to check why this is a good piece of writing - see additional document:
3_Modelling_an_example_of_good_writing.docx
• you could use this piece of writing with your department to agree criteria for good writing. For example
  - shows a sound knowledge and understanding of the subject area
  - uses a wide range of key words accurately
  - answers in continuous prose
  - organises information clearly, putting points in a logical order and linking them together
  - uses all the information provided to give a clear and detailed answer to the question
  - faultless spelling, punctuation and grammar
• now try these criteria with samples of writing across the department to check for consistency

ACTIVITY:
So that pupils can develop independence in writing and begin to draw together their thoughts into text, it is helpful if you use the same conventions as English teachers to establish a purpose for writing.

Pupils need to know what they are writing and who they are writing for. It helps if you can define this with them especially if the task you are setting involves retrieval of information from text books or the internet. Purposes for writing are about the text types involved and will help pupils to consider the overall structure and kinds of sentences required. This is common practice in English lessons so do confer with English teaching colleagues.

Common text types are:
• instruction
• recount
• explanation/description
• information

Linking research skills and writing
Linking research skills and writing

ACTIVITY:
Using models to exemplify progression towards independence will help your science team to assess and identify the next learning steps for pupils.

At a department meeting or literacy CPD session:
• look at the ‘Teacher guidance sheet: Progress in writing in science’, on p99 of Literacy in Science - see additional document: 3_Lit_in_science_participants.docx
• allocate an aspect of non-fiction writing to pairs of colleagues and ask them to use the guidance to construct exemplars of dependent and independent writing
• share the exemplars across the department and with pupils also

ACTIVITY:
Writing independently can rely upon pupils’ abilities to retrieve information and present them in the most appropriate form for the intended audience and purpose.

• Resources on the National Stemcentre elibrary which develop pupils’ Research Skills and Information Retrieval can also help you to assess how well your pupils are doing in developing independence.

• Use the PMI (PLUS MINUS INTERESTING) - see additional document: 3_PMI.doc sheet to help you to evaluate how you could use these resources in your department to support pupils as they develop their independent writing skills.

Often the text types may become combined into a piece of writing at GCSE so it is helpful for pupils to identify the types making up a composition.

• Select a text type that is an essential part of one of your lessons next week. With a colleague, explore what the conventions (Insert hyperlink to ‘3_conventions.docx) might be at text, sentence and word level.

• How can you support GCSE pupils to independently construct a piece of science writing which follows these conventions?

• Here are some ideas for independent writing - see additional document: 3_Opportunities_for_writing.doc in GCSE science which you might like to try with your classes.

• persuasion
• discussion
• conclusion
• analysis
• evaluation
What are your priorities or next steps in exploring the development of writing in your department?

You might consider...

• how will you plan opportunities for writing for audience and purpose in science? How will this fit into the new science curriculum?
• how will you ensure that all science staff use the same conventions as English teachers when supporting pupils to develop writing in science?
• what can the science teachers in your department do to support each other to improve pupil writing?