

Focus on success: GCSE science

Disciplinary language

Build on your students' assessment performance using our self-guided, modular training pack

calibrated

*mitosis
meiosis*

solenoid

Pre-reading
booklet



Contents	Page
Using this resource	4
Summary of activities	5
Disciplinary language route map	9
Essential background information	10
Pre-session health check	16
Post-session health check	17

Using this resource

This pack is designed to help you deliver a CPD session on the use of disciplinary language in science for your teaching colleagues.

Using the completed pre-session health checks and route map provided, you'll be able to design a bespoke session to focus learning on the areas your colleagues are less confident teaching.

This resource pack is intended to help you deliver a CPD session for teaching colleagues on GCSE science. It focuses on using disciplinary language in science, giving your colleagues the opportunity to explore how it's assessed and consider implications for the classroom.

Before the session

- Ask your colleagues to each complete the pre-session health check (page 16 in this booklet).
- Use the responses to the health check to tailor the training session to your colleagues' needs. The route map on page 9 will help you plan which activities to use in the session.
- Each colleague should have a copy of the *Activities booklet* and the *Appendix booklet*.
- The post-session health check should be provided for each colleague.

Running the session

- Establish why the explicit teaching of disciplinary language is beneficial to students in answering exam questions.
- Remind teachers that the command words used in assessment need to be explicitly taught so that students can fully access the papers.
- The presentation will provide guidance and discussion questions to move you through your bespoke session.

After the session

- Ask your colleagues to each complete the post-session health check (page 17 in this booklet) to ensure the training has been successful.
- As a group, discuss how you can support each other to embed the learning in your teaching.
- A certificate of attendance can be created and printed for each delegate.

Summary of activities

Setting the scene and research

Slide 2 of the PowerPoint lists some of the barriers students may have to understanding the assessment and disciplinary language of science. More detailed background notes are available for the presenter on page 12 of this booklet.

Activity 1a: Setting the scene

Use the information on slide 3 as prompts to discuss the key challenges your students have with engaging and using disciplinary language. Discuss which barriers they face in understanding the assessment language.

There has been a lot of research carried out into literacy in science and literacy across the curriculum. In this training, we've selected one piece of research carried out by the Education Endowment Foundation (EEF) about literacy in general in secondary schools. We recommend you read the whole report, but the essence is captured on page 12 of this booklet and on slide 6 of the PowerPoint.

Activity 1b: Applying the research

- Share the key messages from the EEF guidance report shown on slide 6 of the PowerPoint.
- Discuss your own department's practice to consider if you explicitly teach the disciplinary language and in which Key Stage this starts to happen.
- Referring to slide 7, which introduces the idea of tiers of words, ensure your teachers have an understanding of the differences between the tiers.
- Identify some words your department would classify as Tier 2 words which need to be explicitly taught.

Disciplinary language

The following activities are aimed at identifying the possible causes for misunderstanding, misspelling and misusing disciplinary language. It's very difficult in reality to separate the reasons out, as in a student's mind they often overlap.

A student may hold a misconception about a process or phenomenon or misspell words as they're not good at spelling. They also may confuse aspects of an explanation of a process or concept because they don't understand the complex, abstract nature of what's being taught.

We appreciate that teaching and learning is a very complex process. In the next activities, we highlight a number of key elements teachers could focus on to help students tackling their assessments. Essential background information for the presenter is on page 10 of this booklet.

This activity focuses on words, often in the same topic, that students confuse the meaning of when answering questions.

Activity 2a: Words in the same topic that have different meanings

As a group:

- using Table 1 on page 5 of the *Activities booklet*, discuss why students may confuse these words
- share any other words you know from experience students confuse in this way and add these to the table
- share any resources or strategies you use, or could develop, to address this problem. We've used a simple dominoes activity to demonstrate one way of explicitly teaching the meaning between these words.

There are a number of words in science that must be spelt correctly (or at least phonetically) because there's another very similar word which has a different meaning. If the wrong spelling of the word is used (phonetic spelling is accepted), the examiner cannot award the mark because they don't know if the student really understands and knows the answer. There are only a few of these words and most have been mentioned in the examiner reports over time or are underlined in the mark scheme.

Activity 2b: Similar sounding and spelt words

Refer to Table 2 on page 6 of the *Activities booklet*.

- Are there any other words that look/sound the same that your students confuse with one another?
- Discuss the particular barriers to learning and challenges to teaching the spelling of Tier 3 words.
- Share strategies you use in the department to explicitly teach these Tier 3 words. We have shown a word-fill as one resource you could use.

Precision in writing

Open-ended writing is an excellent way for students to show what they really know and understand about processes and phenomena. It can be used to identify misconceptions and gaps in understanding, particularly of complex processes or where linking ideas is needed to explain something. More detailed background notes are available for the presenter on page 13.

Misconceptions

Here, you can reflect on how teachers, once they've identified a misconception, can challenge it and help the student come to a plausible alternative. We've used one very common example seen in all three sciences: that of energy being 'made' or 'produced'.

Activity 3a: Misconceptions

- Look at pages 4 and 5 in the *Appendix booklet* which shows where energy misconceptions arise across all sciences. In your group, discuss some other common misconceptions across topics.
- Referring to the strategy shown of writing about an identified misconception using images and key vocabulary, do you think linking ideas in this way helps address the misconception?
- What other teaching strategies can you use to address misconceptions like this?

Writing about complex ideas

Students struggle to write precisely about complex ideas such as bonding. Even though they may learn the correct vocabulary, they may not fully understand the ideas and how these ideas link together in a sequence. Students will be better equipped to access the marks in the higher tariff questions by having opportunities to logically sequence explanations using the correct disciplinary language, either written or verbally,

Activity 3b: Writing about complex ideas

Look at the student responses.

- What are the key concepts they have muddled up or misunderstood?
- How can you identify these types of misunderstanding from the assessment materials you currently use?
- What teaching strategies can you use to break down complex ideas and processes to help students use the correct disciplinary language and sequence their explanations?

The examiners' commentary can be found on page 6 of the *Appendix booklet*.

The language of working scientifically

The working scientifically language can be challenging for students to understand and apply as many of the words aren't used in their everyday vocabulary. Some, like 'resolution', are infrequently used even in their science lessons. Some words, like 'accuracy' and 'precision', have subtly different meanings even to scientists. The [Subject specific vocabulary](#) defines the key terms we use in our GCSE science specifications.

In assessments, students will need to **understand** what a term means and then **apply** that understanding to a practical setting or set of data. These situations may be familiar or unfamiliar.

Activity 4a

- Using Table 3 on page 11 of the *Activities booklet*, which working scientifically words do your students struggle with?
- Which words are introduced and embedded at KS3?
- Referring to your scheme of work, identify an order for your practical lessons where you'll:
 - introduce and explicitly explain the meaning of the word
 - have an activity to check students' understanding of it
 - embed its use to reinforce the understanding
- Compare across the three sciences to check that each term you have identified is covered a number of times.

Activity 4b

Using the separate booklet *Working scientifically vocabulary*, discuss how you might use this with your students in:

- teaching and learning
- revision and exam preparation.

The language of assessment

This activity is based on a session from the spring 2021 Virtual Communities. It looks at the common problems students have with the language examiners use in questions.

Command words are used to indicate the way students need to answer the question. The activity covers a selection of command words that students find difficult to accurately address. This could be because they don't understand what's required by the command word. For example, lots of students when asked to 'explain' something simply write a description.

Activity 5: Command words

For each of the command words selected, the definition given is taken from our [Command words](#) resource. The examiners' requirements are listed and then, using a student response, there are a series of questions to allow your team to discuss whether the student has matched the requirements or not.

These are **not** exercises in allocating marks. The examiner commentaries are given at the end of the booklet so you can compare your department's ideas with theirs. You could use these exercises, plus the extra examples found on page 7 of the *Appendix booklet* (or your own examples), with your students to help them understand what they should be doing.

Disciplinary language route map

Area for development



Essential background information

Aim of the teaching guide

The aim of this training pack is to look at some of the problems students have with using the disciplinary language of science and the language of assessments in science GCSEs. We want to facilitate a discussion about how you might use this information with your teachers and students to help them write precise responses.

There's an extensive catalogue of work covering the issue of improving literacy in science, as well as misconceptions students have resulting from misunderstanding scientific words. In this training pack, we are **not** trying to repeat this body of work. We've signposted a few resources in the *Appendix booklet* that you might want to look at, but we know there's a huge catalogue of possible resources teachers can refer to.

What do we mean by 'disciplinary language'?

The term 'disciplinary language' refers to the way in which we read, write and talk in a subject. This covers vocabulary specific to a subject, as every subject has its own language.

Within the subject of science, we need to teach students the skills of writing, talking and reading like a scientist. ('Teachers should develop pupils' spoken language, reading, writing and vocabulary as integral aspects of the teaching of every subject' – *National curriculum 2014*).

Giving students the opportunities to develop these skills in science lessons, through all the Key Stages, will:

- support their understanding of science
- help them develop their scientific literacy
- help them to think like scientists
- encourage them to question and explore the wonders of science.

In assessments, students will need to bring these skills together in order to understand what the question is asking them to do and then to write a precise, logical and well-structured answer.

Accessibility of exam papers

At AQA, we've used extensive research to make our papers as accessible as possible. However, there are limitations to how accessible any science paper can appear to be due to the complex, and often abstract, nature of science and its disciplinary language.

The only barrier to achieving marks on an exam paper should be knowledge and understanding of the science, not unnecessarily complicated language or the question structure. This means we're careful to ensure that there are no 'confounding elements' (things that could get in the way of answering the question) in the language we use to write questions. Confounding elements include:

- inappropriate reading age
- use of passive language
- idiom and jargon
- ellipsis (leaving words out)
- use of negatives.

This does **not** mean that the expected, often quite complex, disciplinary language of science will not be required by the student in their responses or be used in the questions.

Reading age

According to accepted research, a question with a reading age of 16 means that an average 16-year old would score only 50% on a test of comprehension of what that question is asking. GCSE papers are targeted at 16-year-olds, so we make sure that most students will have a chance of understanding what we're asking them to do by setting the reading age at about 13 years old.

The main measure of reading age used in the UK is the Flesch–Kinkaid Grade Level. It uses a combination of word count and number of syllables per word to come up with an indication of the grade level someone needs to be at to understand a piece of text. For GCSE science papers we aim for a Flesch–Kinkaid grade of between 7 and 8.

One of the main factors that increases the reading age in GCSE science papers is the use of words of three or more syllables. It's almost impossible to avoid this with any science assessment because many of the words used are scientific terms, which elevate the reading age. However, it's possible to reduce the reading age with careful choice of words and sentence structure. One way we do this is to keep the carrier language (words that join up specific disciplinary vocabulary) as simple as possible.

It's not possible to 'dumb down' the science vocabulary in exam papers because these words are necessary parts of the disciplinary language.

Simplifying the language of assessment

We use a number of different ways to make questions accessible while retaining the level of conceptual difficulty. It's important to remember that simplifying the language is not 'dumbing down'.

For example, we use short sentences to invite the student into the question and not be put off by a barrage of text. We want them to see the steps and progress through the 'story'. This sort of scaffolding and question structure is used at both Foundation and Higher tier. Some teachers have asked why there appears to be more reading for Foundation tier questions than Higher tier

questions. The answer to this is that breaking a question up into short steps makes the question more accessible, even though there is ultimately more reading required.

The example below shows how we might restructure a question to help students understand what is required while retaining the level of conceptual difficulty:

‘A student is provided with three painted metal rods, one of which was made from brass, one from magnetised steel and one from non-magnetised steel. Describe how, without scratching the paint, the student could identify each of the rods.’

This is more accessible if rewritten as:

‘A student has three painted metal rods:

- **one is made of brass**
- **one is made of magnetised steel**
- **one is made of non-magnetised steel.**

The student is not allowed to scratch the paint on the rods.

Describe how the student could find out what each rod is made of.’

Research

We recommend you read the recent [improving literacy in secondary schools guidance report](#) published by the Education Endowment Foundation. The guidance emphasises that ‘literacy in secondary school must not simply be seen as a basket of general skills. Instead, it must be grounded in the specifics of each subject’. The report makes the case that ‘by attending to the literacy demands of their subjects, teachers increase their students’ chance of success in their subjects’. We’ve also used their idea of ‘tiers of vocabulary’ when we’re talking about the challenges of teaching the disciplinary language of science.

Please also see the recent [Ofqual research review of science](#). This is an insightful document identifying factors that can contribute to a high-quality school science curriculum.

Barriers to understanding disciplinary language

The disciplinary language of science causes many issues for students, some of which are difficult to solve due to the inherent high level of the language used; for example, there are no alternative words for ‘chromatography’ or ‘delocalised’. All that can be done from a teaching and learning point is to describe and explain, as simply as possible, what the words mean.

Like many words in English, science words can have multiple meanings (like ‘tissue’) or can be used incorrectly in our everyday language (such as ‘mass’ and ‘weight’). Students are bringing language from their everyday life into their science lessons and science assessments, sometimes incorrectly.

There are many well-documented strategies for teachers to use to help support students. What we’re aiming to do in this training is to identify specific elements of how students use disciplinary language that impacts on their ability to answer exam questions.

It's very difficult to separate the reasons why students struggle with disciplinary language as, in reality, the reasons are interlinked. For example, a student uses the word 'glycogen' rather than 'glucagon': this could be because they don't understand the meaning of each word or because they can't spell it correctly (even though in their own mind they understand the meaning).

In this training, we've attempted to separate the elements out and assign words to particular activities, but the teaching and learning of disciplinary language should be approached holistically.

These barriers include:

- using unfamiliar high-level vocabulary
- confusing words in the same topic that have different meanings but seem similar to a student if not properly understood (eg magnification and resolution)
- names of things which need spelling correctly because misspelling of them could result in naming a different substance or term (eg amylase and amylose)
- misconceptions
- describing complex processes where students incorrectly interchange words (eg explaining bonding and structures)
- specific working scientifically terms which are not frequently used by students (eg repeatability and reproducibility)
- command words that mean different things in different subjects (eg evaluate).

Many scientific words are unfamiliar to students, and they'll tend to use these words infrequently. They're specific to an unfamiliar topic and rarely part of their everyday language. Some of these words are seen as pairs and students will confuse them and use them interchangeably (for example glycogen and glucagon; antibiotics and antibodies). When you read a student's answer to a question, it may be clear the student has some understanding of the process they're describing or explaining, but has muddled up the specific word, so cannot be awarded the mark.

Some words must be spelt correctly (or have the correct phonetic spelling) because if they're misspelt the student is actually naming a different scientific term. There are very few of these words at GCSE, so it's worth emphasising them with your students so they don't miss out on marks when they do know the answer but are just spelling it incorrectly.

An example of this is the word 'amylase'. Phonetic spellings would be accepted **but** the first part of the word should sound 'ami-' or 'ama-' and the last part of the word should sound '-lase'. Acceptable examples would be 'amilayse', 'amylaese', 'amalaze'. Spellings such as 'amylyse' or 'amilise' aren't acceptable as phonetic spellings because of the 'ise' sound at the end.

Opportunities to read, write and talk about science are an essential part of improving the precision of writing needed in answering exam questions.

- Reading not only increases interest in this amazing subject, but it widens a student's vocabulary and shows how authors write for different audiences.
- A student can only demonstrate the level of understanding and competency they have about a subject by having the opportunity to write a paragraph or more. Writing provides an opportunity to identify gaps in knowledge and misconceptions.
- Structured dialogue, particularly with a small group of peers, is a quick and often non-threatening way to allow students to show what they've learnt without the laborious task of having to write it all down.

Using writing or structured dialogue are particularly useful techniques when dealing with misconceptions. As we know, in order to address misconceptions, they first need to be identified. Only then can strategies be developed to dispel them. A focus on writing in a logical, structured way, using the correct disciplinary language, enables a student to create the necessary, plausible alternative to the often deep-rooted misconception.

Many schools use the extended response questions as the main way of helping students to practice and develop their writing skills. However, if this is the only approach used, it may have limited effect. Students need to learn how to write sentences, construct paragraphs and select key scientific terms before they practice the exam techniques of answering extended response questions. If you limit writing opportunities to exam questions alone, it will narrow the development of writing skills and could reduce a student's confidence in tackling writing.

Using the strategies described in the EEF review, you and your team can develop resources that give students opportunities to develop their scientific writing. With practice over the course of the GCSE, students will be better equipped to access higher marks in longer answer questions.

Working scientifically terms need to be explicitly taught so a student actually understands what they mean. They then need to use the terms in their practical work, data analysis and evaluations. They'll become confident with both the meaning and how to apply the terms, in familiar and unfamiliar contexts. In assessments, these terms will be used in a practical context and with data about things they've not necessarily learnt about. Terms need to be introduced as early as possible throughout the key stages and frequently used in class by the teacher, so they become part of a student's everyday scientific language

Language of assessment: Command words

Command words are used in exam questions to indicate what type of response is required.

See our list of the [command words](#) we use in the GCSE science papers, and what we expect students to do in response to them. Also, any specific requirements for individual questions are made clear in the mark scheme. For example, any word that's underlined is essential for the marking point to be awarded.

Most of the command words are straightforward and students are clear on what's required to answer them, but there are a few that cause students problems, meaning that they may be missing out on marks because they're not doing what the command word requires.

Developing a real understanding of what we're looking for in response to these words will help students to focus their responses more effectively.

Describe	} There's a continuum of requirements through these commands, which is explained in Activity 5. Students often miss out on marks because, for example, they've given a description rather than an explanation.
Explain	
Compare	
Evaluate	
Determine	'Determine' is a specific calculation question where students need to refer to, or use, data and information taken from a table or graph. Students often miss out on marks because they don't understand that they need to refer to the source data in their answer.
Suggest	'Suggest' sometimes trips students up, because these questions are set in an unfamiliar context to which students need to apply their knowledge and understanding. Many students don't sufficiently address the requirements of the question and so fail to gain marks.

Pre-session health check

Grade the area of development statements according to your confidence where 0 is not confident at all and 5 is very confident.

Area of development	Grading 0-5	Reasons/notes/previous training
Do you know the key challenges and barriers facing your students with using the disciplinary language of science and the assessment language examiners use?		
Can you identify the causes for the misunderstanding, misspelling and the misuse of disciplinary language by your students in exam questions?		
Do you have strategies that provide students with a variety of open-ended writing opportunities to help develop precision of vocabulary use in their responses?		
Do you have a planned route through how you teach and embed the understanding of working scientifically words to help students apply these words in exam questions?		
Do you know the examiners' requirements for each command word and how to identify if your students are meeting these requirements in their responses?		

Post-session health check

Grade the area of development statements according to your confidence where 0 is not confident at all and 5 is very confident.

Area of development	Grading 0-5	Reasons/notes
I understand the key challenges and barriers facing my students with using the disciplinary language of science and the assessment language examiners use.		
I have strategies in place to identify the causes for the misunderstanding, misspelling and the misuse of disciplinary language by my students in their written responses. I also have strategies in place to help correct these issues.		
I've developed a number of strategies that give students a variety of open ended writing opportunities to help develop precision of vocabulary use in their responses.		
I have activities and a planned route through the key stages of how to teach and embed understanding and application of working scientifically words.		
I'm confident that I understand the examiners' requirements for each command word and can identify if my students are meeting these requirements in their responses.		

Notes

Contact us

T: 01483 477756

E: gcsescience@aqa.org.uk

aqa.org.uk