GCSE science: Virtual communities

Autumn 2022

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Welcome

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Activity 1: How well do you know your AOs?

- Example 1 shows a selection of questions from the **2022 Combined Science: Synergy 1F paper.**
- For each individual item, note which assessment objective you think it is addressing:
  - AO1
  - AO2
  - AO3

Activity 1 feedback

Item	AO	Reason for allocation
5.1	AO1	Recall from the specification about sexually transmitted diseases
5.2	AO2	Students apply maths skills to plot a bar chart
5.3	AO3	Students interpret information from the bar chart to draw a conclusion
5.4	AO2	Students apply maths skill to calculate
7.1	AO1	Recall from the specification on atomic structure
7.3	AO1	Recall of knowledge about radioactive decay
7.5	AO2	Students apply maths skill of understanding ratios
7.6	AO3	Students interpret the diagram to make a judgement

Differentiating between AO1, AO2 and AO3

- If a student can answer a question by adapting information already in their memory, then it's an AO1 question.
- If the student must obtain some new information from the question, for example a description of a novel context, some numbers or data from a graph, then it's an AO2 question.
- If the student must analyse information, for instance to interpret, evaluate, make a judgement or draw a conclusion, then it's an AO3 question.

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Revisiting AO2

- What is AO2? Revisiting the Ofqual guidance
- Identifying AO2 questions in assessments
- Different levels of demand
- Tackling unfamiliar contexts

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Ofqual requirements for AO2

- Students must **apply** knowledge and understanding to provide meaning or explain something.
- Application must relate primarily to:
  - novel situations not clearly indicated in the specification (that means unfamiliar contexts)
  - developing an idea from the specification beyond the basic knowledge
  - making links between different areas of knowledge.
- Two strands:
  - **scientific ideas** assess subject content and includes some maths skills, working scientifically and models
  - **scientific enquiry, techniques and procedures** means practical skills and some more maths skills in practical contexts. 'Encompasses but is broader than' means contexts other than just those of the Required practicals.

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Activity 2: Identifying the strands of AO2

- Look at Example 2, which shows a selection of AO2 questions from the **2022 Combined Science: Synergy 2F paper**.
- For each question, can you identify which strand it assesses?
  - Strand 1: scientific ideas (2/1) or
  - Strand 2: scientific enquiry, techniques and procedures (2/2)?

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Activity 2 feedback

Item	AO2 strand	Reason for allocation
1.6	AO2/1	Students apply knowledge that blood glucose levels rise a short time after food is ingested and is being digested
2.5	AO2/1	The equation is given in the specification so, although this is a low demand question and students are given the equation, it counts as AO2/1
4.6	AO2/2	When drawing a line of best fit (LOBF) where there are no anomalous points, this counts as AO2/2.
7.1	AO2/1	Students apply knowledge that for a recessive allele to be expressed there must be two copies of it

Assessing AO2 in relation to maths skills

- Most maths skills assess AO2, often in a practical or unfamiliar context.
- Examples include:
  - use information to give probabilities
  - manipulate numerical and other data (eg rearranging equations)
  - perform calculations involving rearranging and/or substituting into an equation, whether given, selected or recalled
  - use data from graphs and tables in calculations
  - plot graphs and draw lines of best fit
  - select appropriate axes and scales for plotting
  - construct and translate graphical ways of presenting data (eg bar charts, pie charts, line graphs)
  - suggest why data should be plotted in a particular way (eg why a line graph should be plotted instead of a bar chart)
  - translate tables and statistical diagrams.

Assessing AO2 in relation to practical skills

- AO2 covers many practical skills.
- Primarily in the context of non-required practicals – something completely new or a variant on what students may have done in a required practical.
- Students need to use the skills and understanding they have gained doing practical work to, for example:
  - identify control variables in an unfamiliar practical where the variables are given
  - identify dependent and independent variables in an unfamiliar practical
  - make a prediction or a hypothesis based on information in the specification
  - take readings from scales on apparatus
  - use diagrams to communicate experimental methods.

Assessing AO2 in relation to working scientifically

- AO2 covers much of working scientifically, particularly WS1.2, 2.1, 2.2, 2.3 and much of WS3 when applied to unfamiliar data.
- Examples include:
  - describe patterns, trends and simple relationships
  - use graphs to explain behaviour
  - translate information from one form to another (eg tabular to graphical)
  - use specialist diagrams, such as wave diagrams to explain refraction, Punnett squares to explain inheritance, dot-and-cross diagrams to show atomic structure and bonding
  - apply knowledge and understanding in both familiar and unfamiliar contexts
  - make connections and linkages between ideas in a novel context
  - understand how decisions about science and technology are made in different situations.

Factors that influence level of demand

- Level of demand is determined by factors such as:
  - concept
  - context
  - command words.
- The more complex the situation and the more factors involved, the greater the demand of the question.
- Demand in maths questions has been detailed in the Spring 2020 meeting.

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Changing level of demand

- Examples 3 and 4 show two AO2 questions from the **2022 Combined Science**: Synergy 1F and 1H papers.
- Both assess the ability to interpret evolutionary trees.
- Both use the command prompt 'How many …'
- Both are worth 1 mark.
- Compare the source material for each question:
  - Low demand – simple evolutionary tree diagram, two points of species evolution, simple nomenclature (no binomials), large scale, species splits are on main numbered scale lines.
  - High demand – more complex diagram, five different points of species evolution, nomenclature includes binomials, more complex scale, species evolution points not on main scale lines, students have to interpret a key.

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Activity 3: Changing levels of demand

- Look at Example 5.
- It's a high-demand question assessing the skill of using data from charts to perform a calculation (AO2 in a maths context).
- What adaptations might you make, without changing the skill being assessed, to make this accessible to lower attaining students?
- You might like to consider the source material, question and/or the mark scheme.

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Activity 3 feedback

- Features of Example 5 (high demand):
  - complex diagram to interpret
  - diagram that students may not be very familiar with
  - students expected to know how to do the calculation
  - mark scheme awards only two steps and no allowance for error in reading numbers from resource.
- To lower the demand you might (amongst other things):
  - use a simpler diagram, or present the data in a more familiar format
  - give students the formula to use in the calculation
  - give students one of the numbers to use (eg number of genes in both cauliflower and kale)
  - allow a mark for choosing the correct number to use in the calculation.
- Example 6 shows how the examiners set this question at low demand.

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What do we mean by ‘unfamiliar context’?

Unfamiliar contexts’ can be anything that isn’t clearly mentioned in the specification and can be very wide ranging, for example:

- beta decay in strontium-89
- calculating percentage by mass of chlorine in a molecule of $C_6H_{10}Cl_2$
- testing thermoconductivity of a swimmer’s wetsuit
- comparing number of subatomic particles in atoms of boron and carbon
- explaining inheritance in maple syrup urine disease
- explaining natural selection in tawny owls
- determining specific heat capacity of vegetable oil
- identifying size and direction of force of water on a boat propeller
- explaining the effect of human papillomavirus on human DNA
- investigating concentrations of salts in samples of sea water.

Problems with unfamiliar contexts

Challenges students face when they encounter AO2 questions in unfamiliar contexts:

- Recognising the science they need to apply to answer the question.
- Recognising the practical when it’s slightly different from the one they are familiar with from the classroom.
- Recognising the maths or working scientifically knowledge they need to apply to the science context.
- Having the confidence to tackle a question when it appears unfamiliar to them.

Building unfamiliar contexts into your teaching

- Explicitly tell students to expect questions in an unfamiliar context, for the content, skills and practicals.
- Build opportunities in schemes of work for students to experience the content being put in a context they aren't familiar with.
- Ask students questions about practicals that are slightly different from the ones they've done in class. For example, change the variables being investigated, the chemicals being used, or the context of the practical.
- Help students to gain the confidence and techniques they need to identify the science behind the question by modelling this process with them.

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Activity 4: Recognising the science behind the question

- Look at Examples 7, 8 and 9.
- Each is a question set in a context that students are very unlikely to have encountered: one Biology, one Chemistry, one Physics.
- For one of the examples (depending on your chosen specialism), think how you would help a student look beyond the context and identify the science that is actually being assessed.
- How might you model identifying the science behind the question?

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AQA resources to support AO2

- Virtual Communities meeting autumn 2021 – suggestions for using practical methods in both familiar and unfamiliar contexts to support learning of the science behind the context.
- Hub meeting spring 2020 – assessing maths skills at different levels of demand.
- Hub meeting autumn 2019 – assessing application of physics equations at different levels of demand.
- Focus on Success: assessment objective 2 (AO2) – building unfamiliar contexts into schemes of work; contextualising content in lessons, using legacy specification ISA case studies to integrate AO2 into practicals.
- Focus on Success: Maths in science – auditing students' maths skills, working with your Maths department to ensure consistency of teaching of maths skills in both subjects, using diagnostic questions, approaches you could use to help students build their maths skills in science contexts.

Any questions?

- Your chance to ask questions about aspects of today's meeting.
- Any questions that we don't manage to answer today will be sent to you via email approximately one week after this event.

Event materials

The electronic materials from this event will be available to download shortly. If you aren't able to download them at this time, they will be made available to you in the customer portal of our online booking system.

Once we receive notification that you have attended the course, you will be sent a certificate of attendance email. When you receive the email, please log in to your account and the materials will be available on the 'my resources' tab on the welcome screen.

Get in touch

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

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Thank you