# GCSE science: Virtual communities

Autumn 2021

## Welcome

## Today's agenda

- Supporting students in their application of practical skills in unfamiliar contexts.
- Updates and notices from the Relationship Manager.
- Materials you should have access to:
  - slides and *Resources* booklet
  - facilitation pack (this will be available after the session).





## Focus of today's meeting

- What we mean by progressing from 'hands-on' to 'minds-on' using the Working scientifically criteria.
- Helping widen student experience with the limited time you have:
  - experimental methods from GCSE exam papers
  - developing a framework to help students interrogate unfamiliar methods and investigations in exam questions to progress to 'minds-on'.

## What do we mean by ‘hands-on’ and ‘minds-on’?

- What do you understand by the phrases ‘hands-on’ and ‘minds-on’ as aspects of practical investigations?
- Use the Working scientifically criteria to help (*Resources* booklet pages 4–6).





## Differences between ‘hands-on’ and ‘minds-on’

- A student who has had the opportunity for ‘hands-on’ can:
  - follow a method correctly
  - manipulate apparatus correctly and safely
  - make and record observations and results
  - present data in an appropriate format.
- A student who has had the opportunity for ‘minds-on’ can **also**:
  - understand the reasons for using a particular method
  - understand what variables need to be manipulated, if any
  - understand why variables are being (or not being) manipulated
  - understand about sampling
  - understand about sources of error and how to minimise them
  - use their understanding to choose appropriate methods for different situations.
- That is, they can think like a scientist as well as carry out procedures.

## Advantages of using a ‘minds-on’ approach

- Develops the ability to apply practical skills to different situations.
- Students understand more about the principles behind the investigation, rather than simply memorising a recipe, so:
  - are more able to cope with the unfamiliar situations in practical-based exam questions
  - develop transferrable skills for later study/work.
- Embeds these principles in student thinking so they are more confident:
  - independently working at A-level to achieve CPAC criteria
  - doing independent practical research when progressing to higher education.
- Encourages a more open approach to practical investigation.
- Makes practical work more interesting/engaging/applicable.





## Using questions to aid progression to ‘minds-on’

- Our GCSE exam questions cover some aspects of these ‘soft’ practical skills, but not all of them in any one paper. Therefore, the use of whole exam questions is limited in this context.
- Take any method and use targeted questions to explore the science beneath the method.
  - Use a framework of generic questions to draw from for any method
  - Questions can be adapted for specific methods or to change the demand
  - You could include tables of results for further analysis.
- Start with a familiar context (eg a RPA) then progress to unfamiliar ones to give students confidence in tackling unfamiliar contexts.

## Activity 1: Using familiar contexts

- Look at Example 1 on page 10 of the *Resources* booklet. This is a Required practical and students should be familiar with the set-up.
- What questions could you ask students about this method to progress their minds-on thinking?





## Types of questions

- There is a range of categories of questioning a method, in which you will have a bank of specific questions you could use for any example.
- These categories could include:
  - developing or testing hypotheses
  - variables
  - sampling/controls
  - making predictions
  - types of measurements
  - errors
  - evaluating the method.

## Activity 2: Using unfamiliar contexts

- Look at examples 2, 3 and 4 on pages 11–13 of the *Resources* booklet.
- Each one is unlikely to be a method or investigation your students have had direct experience of.
- For each one consider:
  - the Required practical to which it relates
  - how confident you think your students would be in answering questions about this investigation
  - what experience a student would need to be able to deal with questions relating to this example.
- What extra questions might you add to your framework to help students with unfamiliar contexts?





## Further questions for unfamiliar contexts

Questions you might want to add could include:

- the area of subject content it covers
- whether students can see that it's a variant on a required practical
- how it's different from the practical they've done
- what clues they can see in the wording of the investigation to what knowledge they need to apply.

## Introducing Project Calibrate

- Joint project between Oxford University and AQA, funded by the Wellcome Trust, Gatsby Foundation and the Royal Society.
- Aims of the project:
  - to broaden the scope of practical science at Key Stage 4
  - to give students a better understanding of the wide variety of methods scientists use while conducting investigations.
- Approach:
  - 'hands-on' and 'minds-on' practical science
  - challenges the simplistic, step-by-step process of 'the scientific method' as hypothesis testing through experiments
  - uses a tool called Brandon's Matrix to give an account of diversity in scientific methods.
- Free teaching and CPD resources for teachers on different approaches to practical work, including sample summative assessments.

**On screen: Project Calibrate**




## What is Brandon's Matrix?

| | Changing variables | Not changing variables |
|---|---|---|
| Testing a hypothesis | **Manipulative hypothesis testing**<br><br>Testing a hypothesis by changing independent and dependent variables.<br><br>**Example:** Testing the hypothesis that foods high in carbohydrates increase blood sugar levels by measuring blood sugar levels (dependent variable) with different types of food (independent variable). | **Non-manipulative hypothesis testing**<br><br>Testing a hypothesis via a situation that can't be manipulated.<br><br>**Example:** Testing the hypothesis that green ink is a mixture of yellow and blue inks by observing the pattern of inks produced in a chromatogram of a sample of green ink |
| Making measurements and observations | **Manipulative description or parameter measurement**<br><br>Investigation to measure the effects of changing conditions or variables on outcome(s).<br><br>**Example:** Observing the effect of different concentrations of sugar solution on the mass of potato by measuring the change in mass of pieces of potato of the same size left in different concentrations of solution for the same amount of time | **Non-manipulative description or parameter measurement**<br><br>Explaining, observing, classifying, categorising, tracking, measuring.<br><br>**Example:** Observing what happens to a ray of sunlight when it passes through a glass prism. |

Based on information from Project Calibrate

## Project Calibrate: Key findings

Key findings

- The resources helped students understand scientific methods better
- Students indicated that the Project Calibrate approach helped them understand scientific methods better
- Most pupils associated the resources with practical science
- Teachers found the summative assessments useful and indicated that they would use them.




## Project Calibrate

Quotations from participants:

- ‘I liked the questions because they helped me really think about the experiments I have done previously.’ – Science student
- “Before I watched the videos I thought all scientific investigations require a hypothesis of some sort, which these videos disproved in an easy to understand way. Thank you for opening my eyes.” – Science student

Project Calibrate. (2020). Key Research Findings. University of Oxford.

- ‘I think it is a really good way of organising the practicals that we already have in our curriculum. It makes it really, really clear to see what we clearly do assess and what we focus on a lot. And where our areas of weakness are […] I thought it was a really good model and quite easy to understand.’ – Science teacher

Project Calibrate website

## Any questions?

- This is your chance to ask any questions you have.
- Any answers to questions that we don't manage to answer today will be sent to you via email approximately one week after this event.




## Notices and updates for 2022

- Sources of practical questions:
  - Exampro
  - Old specification ISAs
  - Practical handbooks
- Focus on success packs
- Teaching guide: exploring common misunderstandings
- Summer 2022
  - GCSEs and A-levels
  - Practical work (GCSE and A-level) and A-level endorsement: Vocational, Technical and other qualifications; contingency plans

## Event materials

These event materials will be available to download shortly. If you can't download them, you can access them at the customer portal of our online booking system.

Once we receive notification that you have attended this course, we'll email you a certificate of attendance. When you receive this email, log in to your account and you'll see these materials on the 'my resources' tab on the welcome screen.



AQA

## Get in touch

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

Tel: 01483 477 756
Email: gcsescience@aqa.org.uk
Twitter: @AQA

aqa.org.uk



AQA

AQA
Realising potential

# Thank you