AQA qualification support

AS/A-level Biology: Preparing to Teach

General information

BOOKLET 1

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Contents

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Contacts/Administration

Contact points for A-level /Biology

Please contact the subject department for further help and advice about the above specification and any information about standardisation.

Customer support team

A-level Science Department
AQA, Guildford, GU2 7XJ

Telephone: 01483 477 756 (Option 2)

email: alevelscience@aqa.org.uk

For help with Support Meeting Information, please contact:

Teacher Support Manager

Eilish Gorse

AQA, Guildford, GU2 7XJ

Telephone: 0161 957 3646

email: teachercpd@aqa.org.uk

Websites

AQA: aqa.org.uk

JCQ: jcq.org.uk

Administration

Entries:

Direct Line: 0161 455 5482

Fax: 0161 455 5408

email: entries@aqa.org.uk

Web: http://web.aqa.org.uk/exams-office/entries.php

Pre Exam Services – Access Arrangements/Special Consideration/ Modified Question Papers

Direct Line: 01483 477884
Fax: 01483 556417

email: specialneeds@aqa.org.uk

Post Results Services

Direct Line: 0844 209 6619 – EOS (Exam Office Support)
Fax: 01483 556 344

email: resultsenquiries-s@aqa.org.uk (Guildford office)
resultsenquiries-n@aqa.org.uk (Manchester office)

Web: http://web.aqa.org.uk/exams-office/about-results/re-marks.php

For general queries about additional AQA support; follow these web links:

e-aqa: http://web.aqa.org.uk/help/eaqa.php

Secure Key Materials (SKM) can be accessed through the above e-AQA link. You will find copies of some of the materials that we have used in this meeting on this site, as well as selected items that have been used at previous Teacher Support Meetings.

Online Booking Service: https://coursesandevents.aqa.org.uk

In-school CPD: http://web.aqa.org.uk/qual/cpd/cpd_inschool_guidelines.php

For subject coursework and controlled assessment standardisation meetings; please contact either the Internal Assessment Standardisation team or relevant subject departments.

For further guidance on standardisation please refer to:
http://web.aqa.org.uk/support/teacher-online-standardisation
http://store.aqa.org.uk/support/pdf/AQA-TOLS-GUIDE.PDF

Programme for the day

09:45 - 10:00	Tea/Coffee on arrival
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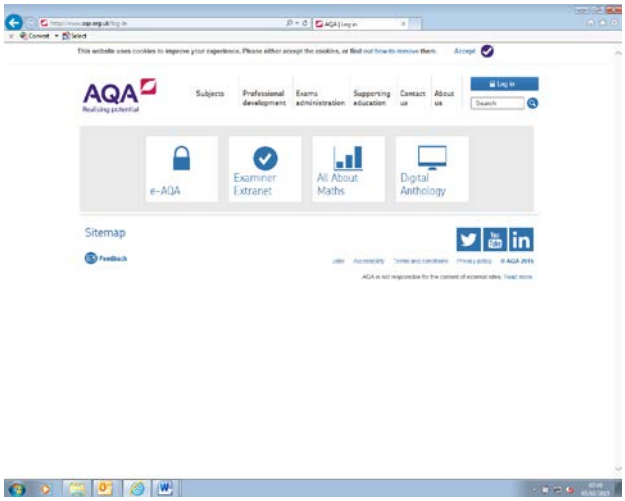
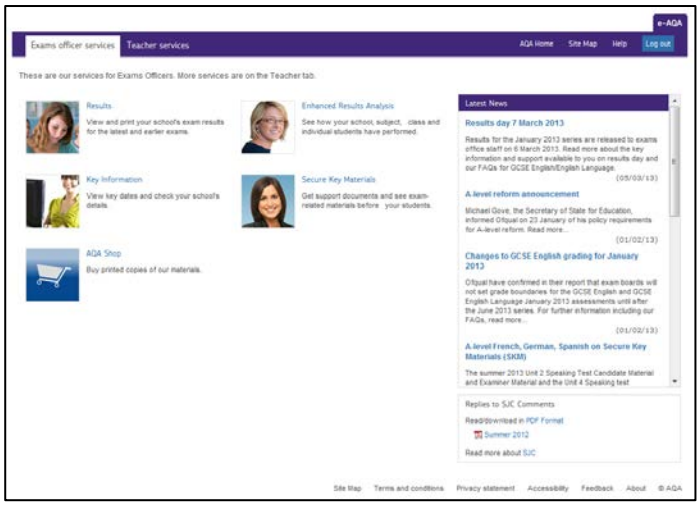
15.45	Close

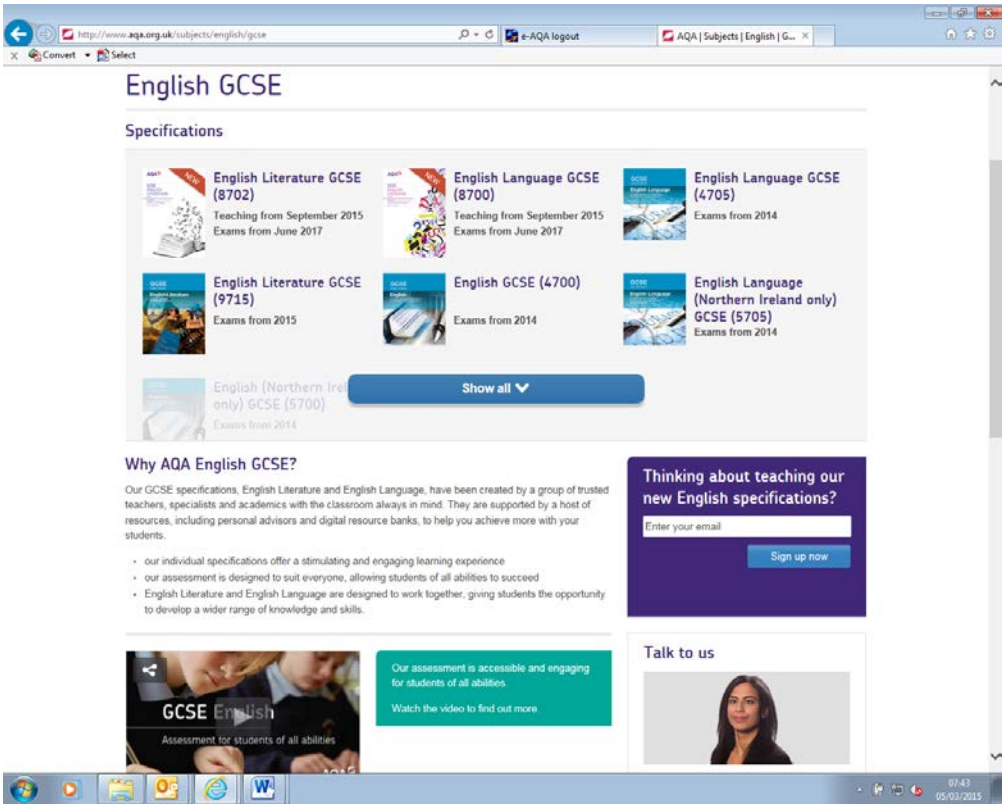
Guide to using e-AQA and ERA

To access e-AQA you will need a password from your Examinations Officer. Listed below are the materials available on e-AQA:





The regular AQA website (www.aqa.org.uk) contains materials and guidance by subject:



Unleash the potential...

Getting started

Enhanced Results Analysis (ERA) is a free online tool, offering instant exam results analysis by school, subject, classes/groups and individual students. ERA is used by thousands of teachers to identify their students' strengths and weaknesses, and improve performance. **More than 43,000 teachers are already using ERA so what are you waiting for?** Unleash its potential today!

> "ERA is really easy to use. Any service that **informs departments** and can be used in an empowering way to **enhance teaching and learning** – and is free – has to be a fantastic educational tool. It would be foolish to overlook its value."
>
> **Melanie, Head of English**

Top tip

"Play around with ERA and take the time to become familiar with it, as it saves a lot of time doing independent analysis."
Katie, Head of English

ERA will help you:

1. see how students performed in specific topics and identify those who need extra support
2. tailor your lesson plans and focus your teaching where it's needed most to maximise every student's progress
3. inspire your students: teachers who use ERA say their students are keen to see their marks for themselves so they know exactly where they need to improve to get the grade they aspire to
4. spot year-on-year trends and measure achievement against other schools and colleges for a broader perspective
5. create management reports for senior leadership teams.

Register for ERA in five easy steps

1. Complete the online form at: **aqa.org.uk/era-register**
2. Your form is sent to your school or college's centre administrator for verification. This may take a few days, but it's important to make sure that access to results is only given to teachers at AQA centres.
3. As soon as your request is approved, we will send you a confirmation email.
4. Click the link in this email to log onto e-aqa at **aqa.org.uk/era-login**
5. You're ready to unleash ERA's potential!

Who's using ERA?

22.6% Heads of department
16.7% Subject heads
50.1% Teachers
8.2% Exam officers
2.4% Other

and when?

36% Summer results period
14% March results period
50% Outside main results periods

Don't forget to download our other ERA guides

Subject performance | School performance | Student performance | Group performance

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Unleash the potential...

Review your school's performance

ERA allows you to take a snapshot of your school or college's performance. You can also view results according to qualification (for example A-level or GCSE), an individual examination, different classes and so much more.

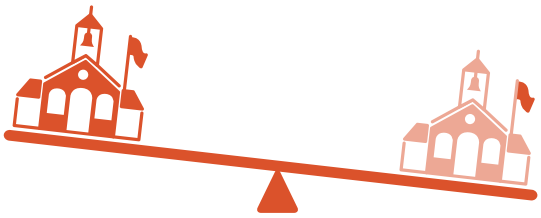
> "This feature is really useful, because the first thing I want to see on results day is the overall performance for my subject, in terms of the number of students receiving A*-C, A*-B, etc and the performance of specific groups."
>
> **Katie, Head of English**

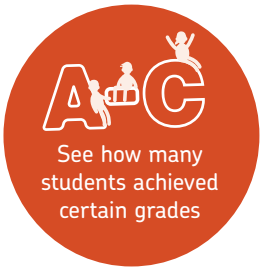
Dig a little deeper

Find out the percentage of students who have achieved an A*-C overall, compared to previous years, similar centres or the AQA national average.

Or...

See how many students in your school/college got an A*-C in your subject.





Grades overview – two easy steps!

1. Access 'Grades overview' from the left-hand panel on the ERA start page.
2. For more detailed analysis, select:
   - 'Entry code' for the specific assessment taken
   - 'Groups' to show any specific groups you have created (see our 'Group performance' guide for more on creating groups).

Did you know...?

ERA's not just for results time:

50% of ERA usage occurs outside of the main results periods to help teachers plan, set targets, provide feedback to students and create reports.

"ERA is a powerful tool that allows us to compare. As a department head, I use ERA to see how well our students have achieved in relation to other centres and the AQA national average. It's also invaluable for the analysis report that we produce for the senior leadership team and governers."

Melanie, Head of English

Don't forget to download our other ERA guides

Getting started | Subject performance | Student performance | Group performance

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Unleash the potential...

Review subject performance

ERA allows you to see how your students have performed in your subject. You can create general performance summaries and comparisons with previous years, analyse results for each exam component – right down to individual questions – and highlight areas that need extra attention.

> "On results day, the first thing I want to know is **how well my students have done** overall, compared to our expectations. I then want to see how near or far they were from the next grade. The **subject breakdown** allows us to see if one particular area has let a student down."
>
> **Simon, Head of Chemistry**

Quick win

You can click the 'Download results' tab to build customised performance records and create reports throughout the year to track improvements and trends.

Top tips

Get started: click on the 'Marks analysis' tab in the left-hand panel on the ERA start page.

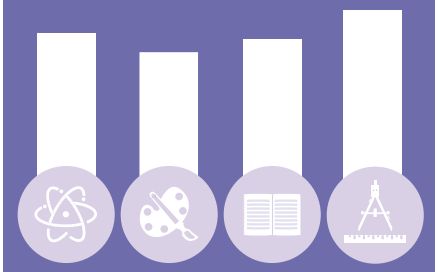
Compare your results: on the 'Marks analysis' page, use the tabs in the top toolbar to make comparisons with other centres, previous years and between groups (eg males and females). See our 'Group performance' reference guide for more on creating groups.

Analyse different subject components (eg for French these will be reading, writing, listening and speaking) by clicking the 'View components' tab.

See a question-by-question breakdown within each component, by clicking on 'View questions'.

View performance by question paper and mark scheme and see examiners' reports via the 'View questions' tab.

View the user guide in the ERA section on our website to view these steps in more detail.



Five reasons to review performance by subject

1. Find out instantly if your performance is better than last year.
2. View your students' marks for each question on a given paper.
3. Pinpoint exactly where individual students have lost marks.
4. Highlight topics/subject areas for improvement, or that need additional focus.
5. Identify the students who need extra help and in what areas.

Did you know...?

34% of the total ERA usage is in the autumn term, following the summer results period. Teachers use ERA to identify areas for improvements and to tailor their teaching plans for the year ahead.

Don't forget to download our other ERA guides

Getting started | School performance | Student performance | Group performance

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Unleash the potential...
Review individual student performance

With ERA, you can see your students' performance in every subject and highlight near misses, so you can focus your teaching where it's needed most. You can also give this detailed feedback to your students to help them prioritise their studies.

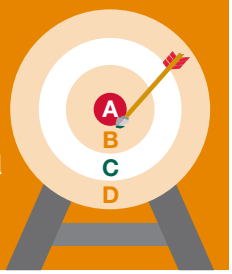
"ERA's really helped us **build a much clearer picture** of what our skills priorities are for our students. It has enabled us to **pinpoint individual students, skills and topics** that we now know we need to focus on."
Bradley, Key Stage 4 Coordinator, English

Identify areas for improvement by:

- highlighting which topics your students answered well and those where improvements could be made
- understanding how students fared against the key skills and assessment objectives for each specification
- downloading students' results for selected subjects to analyse them in applications – such as Microsoft Excel – create your own reports and feed back to your students.

Zoom in on your students' results

1. Click on 'Marks analysis'.
2. Choose your qualification and subject.
3. View components.
4. Select 'View skills and topics analysis'.
5. Choose the assessment area or specific question you are interested in.



"ERA is useful as a diagnostic tool, allowing us to look closely at the questions on which our students have performed less well. This enables the department to focus on that particular area in our planning and teaching. But it is important to exercise caution to ensure that other questions and topics are not then ignored."

Melanie, Head of English

Don't forget to download our other ERA guides

Getting started | School performance | Subject performance | Group performance

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Unleash the potential...
Review group performance

Our 'Maintain groups' feature lets you create and customise different areas for comparison. You can create as many groups as you like – using your own data and a little imagination!

> "I have to report on gender performance at school and I can create groups of male and female students to compare their results."
>
> **Shaun, English teacher**

VS

Before you get started

- Make sure you have all the data you need to create the group – for example, if you are comparing performance of those who are learning a language against those who don't, you will need to have this information for every student.
- Ask your colleagues to add their class lists so you can use them to compare the performances of different classes.
- Decide on the level of security for your group(s). 'Private' means only you can see and edit the group; 'Read' allows others to see and report using the group, but they can't edit it; 'Read/write' allows all teachers in your centre to see and edit the group.
- You can only set up groups once candidates' entries have been submitted.

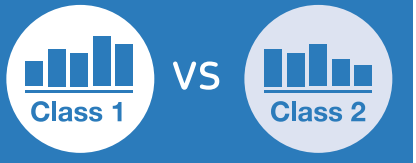
Step by step – creating your own groups

1. Select 'Maintain groups'.
2. Click 'Create new'.
3. Name your group: eg 'French A'.
4. Decide if the group is private.
5. Add students by ticking the box next to their name.
6. Save your group – you're done!

Viewing the results for your groups

7. Select 'Maintain groups'.
8. Choose which groups you want to compare.
9. Click the 'Marks analysis' icon.
10. Pick a subject and tick the 'Include groups' box then click 'Search' to view the results.

Make meaningful comparisons



Don't forget to download our other ERA guides

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A and AS level Biology
Preparing to Teach

Sue Madden/ Olga Markoulides /Clare Lucas

Summer 2015

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Structure of the day

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15.30 – 15.45	Support from AQA and completion of evaluation forms
15.45	**Close**

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Housekeeping - health and safety

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Preparing to teach Biology – planning sheet

AQA Realising potential

Preparing to Teach Biology – My Action Plan

Task	Resources/support required	How long it will take	When	Done?
Become familiar with the new specification				
Update my biology knowledge on any topic areas not taught before				
Plan SOL / become familiar with AQA SOL				
Plan 'route way'				
Read through the SAMs				
Share information about required practical activities with technicians				
Decide which practical activities to do in additional to the 12 required ones				
Order any additional equipment required for the 12 practical activities				
Devise a tracking system for the practical endorsement				
Plan how students will keep a record of their practical work				
Consider buying new text books				
Disseminate information to my department				

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Session 1:
Overview of the AS and A-level specifications

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Activity

- Use the post-it notes to write down any questions you have that you would like answering throughout the training session.
- As we go through the session, if your question is answered then you can remove the post-it from the table.
- Use a separate post-it for each question.

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Notations

- Specification
- Assessment model
- Assessment objectives
- Common to all boards All
- AQA specific AQA

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Changes to Ofqual rules

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Rules for all Science A-level from 2015

All

- AS and A-level decoupled
- AS will be a stand-alone qualification
- Both AS and A-level are linear courses
- AS at the current standard of the current AS (eg end of year 12).
- A-level at the standard of the current A-level (eg the whole of AS and A2, end of year 13).

AQA

What have AQA decided on

- Minimum assessment time
- Minor changes to the subject content

	AS	A-level
Assessment time	3 hours	6 hours
Maximum number of timetable slots	2	3
Coursework/controlled assessment?	No	No
Practical endorsement	No	Yes
Practical based marks	15%	15%
Maths (Higher tier GCSE) marks	10%(B), 20%(C), 40%(P)	

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Features of AQA Biology

- Developed by a huge number of teachers, examiners and HE.
- Designed to prepare young people for further study and employment, focusing on the skills that students need and universities want.
- Designed to engage young people in this subject and provide effective assessments across the ability range.
- AS co-teachable with first year of A-level
- Different models in Biology, Chemistry and Physics.
- Largely context-free

	Biology
Breadth	Essay (No multiple choice)
AS Papers	Split by skills
A-level papers	Split by content
AS practical 15%	Throughout papers
A-level practical 15%	Discrete section

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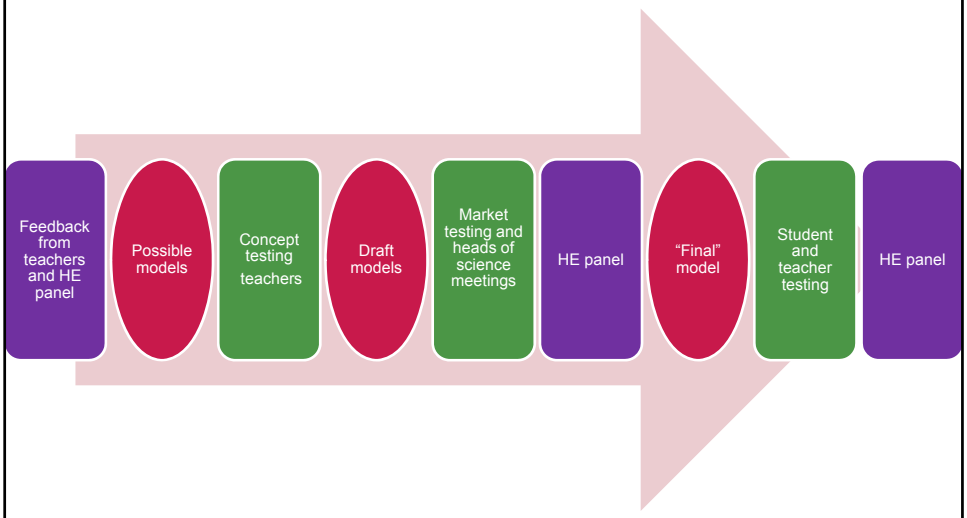
Teacher and university led design



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Changes to the specification

Reorganised some topics to give a more logical running order (for example carbohydrates, cells, DNA and protein synthesis).

Removed the 'biology and health' emphasis – with a shift to a more conceptual approach.

Reduced time that needs to be spent teaching specific examples (present examples such as cholera may still be used as applications in exams).

Reduced overlap with GCSE, ensuring better progression (for example - added ADH and control of blood water potential, more detail of digestion and changes to nutrient cycles).

Updated some areas, with reduction in required examples/processes - example, the control of gene expression and genetic engineering.

Mathematical skills – 10% of marks now require the use of level 2 mathematical skills.

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Timeline

All

	Sept 2014	June 2015	Sept 2015	June 2016	Sept 2016	June 2017	Sept 2017	June 2018
Legacy A-level Biology	Last two years teaching	AS exams		Last A2 exams				
New A-level Biology			First teaching	First AS exams		First A-level exams		
Legacy GCSE Sciences			Last two years teaching			Last linear GCSE		
New GCSE Sciences		Draft specs in schools			First teaching			First linear GCSE

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AQA

New assessment objectives (AOs)

All

These apply to both AS and A-level

		A-level	AS
AO1	Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures	30-35%	35-40%
AO2	Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data	40-45%	40-45%
AO3	Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: • make judgements and reach conclusions • develop and refine practical design and procedures	25-30%	20-25%

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AQA

The AS and A-level assessment models

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AQA

AS and A-level topics

AS and A-level

1. Biological molecules
2. Cells
3. Organisms exchange substances with their environment
4. Genetic information, variation and relationships between organisms

A-level only

5. Energy transfers in and between organisms
6. Organisms respond to changes in their internal and external environments
7. Genetics, populations, evolution and ecosystems
8. The control of gene expression

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AQA

AS specification at a glance

2.2 AS

Assessments

Paper 1	Paper 2
What's assessed	**What's assessed**
• Any content from topics 1–4, including relevant practical skills	• Any content from topics 1–4, including relevant practical skills
Assessed	**Assessed**
• written exam: 1 hour 30 minutes • 75 marks • 50% of AS	• written exam: 1 hour 30 minutes • 75 marks • 50% of AS
Questions	**Questions**
• 65 marks: short answer questions • 10 marks: comprehension question	• 65 marks: short answer questions • 10 marks: extended response questions

AS and A-level are now decoupled which means the marks from AS no longer count towards the final A-level grade.

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A-level specification at a glance

2.3 A-level

Assessments

Paper 1	Paper 2	Paper 3
What's assessed	**What's assessed**	**What's assessed**
• Any content from topics 1–4, including relevant practical skills	• Any content from topics 5–8, including relevant practical skills	• Any content from topics 1–8, including relevant practical skills
Assessed	**Assessed**	**Assessed**
• written exam: 2 hours • 91 marks • 35% of A-level	• written exam: 2 hours • 91 marks • 35% of A-level	• written exam: 2 hours • 78 marks • 30% of A-level
Questions	**Questions**	**Questions**
• 76 marks: a mixture of short and long answer questions • 15 marks: extended response questions	• 76 marks: a mixture of short and long answer questions • 15 marks: comprehension question	• 38 marks: structured questions, including practical techniques • 15 marks: critical analysis of given experimental data • 25 marks: one essay from a choice of two titles

The new course is fully co-teachable, which means that the AS topics are identical to the first half of the A-level.

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Specification layout - 1

3.8 The control of gene expression (A-level only)

Cells are able to control their metabolic activities by regulating the transcription and translation of their genome. Although the cells within an organism carry the same genetic code, they translate only part of it. In multicellular organisms, this control of translation enables cells to have specialised functions, forming tissues and organs.

There are many factors that control the expression of genes and, thus, the phenotype of organisms. Some are external, environmental factors, others are internal factors. The expression of genes is not as simple as once thought, with epigenetic regulation of transcription being increasingly recognised as important.

Humans are learning how to control the expression of genes by altering the epigenome, and how to alter genomes and proteomes of organisms. This has many medical and technological applications.

Consideration of cellular control mechanisms underpins the content of this section. Students who have studied it should develop an understanding of the ways in which organisms and cells control their activities. This should lead to an appreciation of common ailments resulting from a breakdown of these control mechanisms and the use of DNA technology in the diagnosis and treatment of human diseases.

Each section begins with an overview to put the topic into a biological context and will NOT be directly assessed.

3.8.1 Alteration of the sequence of bases in DNA can alter the structure of proteins (A-level only)

Content	Opportunities for skills development
Gene mutations might arise during DNA replication. They include addition, deletion, substitution, inversion, duplication and translocation of bases. Gene mutations occur spontaneously. The mutation rate is increased by mutagenic agents. Mutations can result in a different amino acid sequence in the encoded polypeptide. • Some gene mutations change only one triplet code. Due to the degenerate nature of the genetic code, not all such mutations result in a change to the encoded amino acid. • Some gene mutations change the nature of all base triplets downstream from the mutation, ie result in a frame shift. **Students should be able to** relate the nature of a gene mutation to its effect on the encoded polypeptide.	

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Specification layout - 2

3.1.4.2 Many proteins are enzymes

Content	Opportunities for skills development
Each enzyme lowers the activation energy of the reaction it catalyses. The induced-fit model of enzyme action. The properties of an enzyme relate to the tertiary structure of its active site and its ability to combine with complementary substrate(s) to form an enzyme-substrate complex. • The specificity of enzymes • The effects of the following factors on the rate of enzyme-controlled reactions – enzyme concentration, substrate concentration, concentration of competitive and of non-competitive inhibitors, pH and temperature. **Students should be able to:** • appreciate how models of enzyme action have changed over time • appreciate that enzymes catalyse a wide range of intracellular and extracellular reactions that determine structures and functions from cellular to whole-organism level. **Required practical 1**: investigation into the effect of a named variable on the rate of an enzyme-controlled reaction.	**MS 0.5** Students could be given the hydrogen ion concentration of a solution in order to calculate its pH, using the formula: $pH = -\log_{10}[H^+]$

Content is largely context free

Left hand side: Content.

Everything on this side can be assessed in question papers.

Clear. Includes enough detail to show what is required.

Required practicals are here also.

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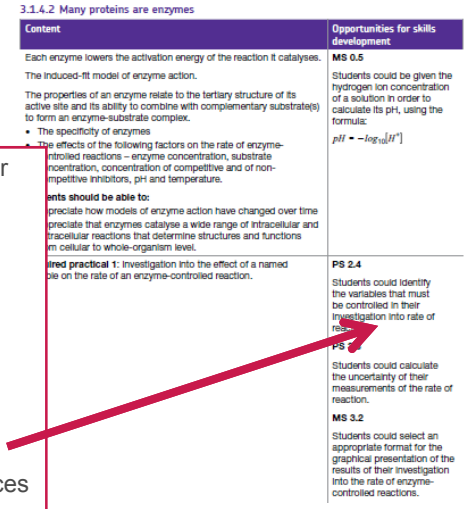
Specification layout - 3

Right hand side: Opportunities for skills development. This is not assumed knowledge for the assessment.

Shows where teachers could introduce:
AT – apparatus and techniques
MS – mathematical skills
PS – practical skills.

The numbers reference appendices at the back of the specification.



3.1.4.2 Many proteins are enzymes

Content	Opportunities for skills development
Each enzyme lowers the activation energy of the reaction it catalyses. The induced-fit model of enzyme action. The properties of an enzyme relate to the tertiary structure of its active site and its ability to combine with complementary substrate(s) to form an enzyme-substrate complex. • The specificity of enzymes • The effects of the following factors on the rate of enzyme-ntrolled reactions – enzyme concentration, substrate ncentration, concentration of competitive and of non-mpetitive inhibitors, pH and temperature. **ents should be able to:** ppreciate how models of enzyme action have changed over time ppreciate that enzymes catalyse a wide range of intracellular and tracellular reactions that determine structures and functions m cellular to whole-organism level.	**MS 0.5** Students could be given the hydrogen ion concentration of a solution in order to calculate its pH, using the formula: $pH = -\log_{10}[H^+]$
ired practical 1: Investigation into the effect of a named ble on the rate of an enzyme-controlled reaction.	**PS 2.4** Students could identify the variables that must be controlled in their investigation into rate of re... **PS ...** Students could calculate the uncertainty of their measurements of the rate of reaction. **MS 3.2** Students could select an appropriate format for the graphical presentation of the results of their investigation into the rate of enzyme-controlled reactions.

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Skills in the specification

- There are three sets of 'skills' that are identified in the specification:
  - mathematical skills (MS)
    - arithmetic and numerical computation
    - handling data
    - algebra
    - graphs
    - geometry and trigonometry
  - apparatus and Techniques (AT)
    - will be discussed in session 2
  - practical skills to be assessed in exams (PS).
- All of these skills have been specified by the DfE Subject Criteria.
- The AQA Subject Content (Chapter 3 of the Specification) details AQA's interpretation of these skills and how they will (and will not) be assessed.
- Many of the skills have been mapped onto the specifications to support you in your planning.

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Activity 1 - The specification

Please take some time now to have a look at the specification.

You may want to:

- familiarise yourself with the layout of the new specification
- look at the new areas on the specification you have not taught before or for several years.

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Helpful documents – summary of changes

3.1.1 Disease may be caused by infectious pathogens or may reflect the effects of lifestyle

What's gone

Following feedback from teachers, this section has been removed from the new specification.

3.1.2 The digestive system, 3.1.2 Carbohydrate digestion and 3.1.3 Absorption

Now found in: 3.3 Digestion and absorption

What's new

These topics have been brought together and expanded to include the digestion of proteins and lipids, including the action of exopeptidases and endopeptidases in protein digestion and the action of lipase and bile in the digestion of lipids. The role of micelles in the absorption of the products of lipid digestion is also included.

Available resources

Wikibooks: Medical Physiology/Gastrointestinal Physiology/Digestion and Absorption - 1.4 Protein Digestion

What's gone

The structure of the digestive system has been removed; this topic is covered at GCSE.

What's changed

Digestion of carbohydrates has been limited to digestion of starch to maltose by amylase.

What's the same

The concept of digestion as the hydrolysis of polymers into their constituent monomers.

3.1.2 Carbohydrate digestion and 3.2.4 Carbohydrates

Now found in: 1.2 Carbohydrates

What's new

There is no new content.

What's gone

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Helpful documents – switching documents

Biological molecules

Current OCR specification	New AQA specification
Specification reference 2.1.1 and 2.1.2.	Specification reference 1.1 to 1.7.
• This specification covers the biochemistry of water, carbohydrates, lipids, proteins, nucleic acids and protein synthesis in a broadly similar way to the new AQA specification.	• The AQA specification offers slightly more guidance to teachers and students, for example it shows the structures of an amino acid, of α-glucose and of β-glucose that students are expected to know. • The AQA specification also shows progression from GCSE, for example, in some aspects of DNA replication.

Biological molecules

Current Edexcel specification	New AQA specification
Specification reference Unit 1 topic 1.	Specification reference 1.1 to 1.7.
Both specifications cover the biochemistry of water, carbohydrates, lipids, proteins, nucleic acids and protein synthesis adly similar way.	
ı Edexcel specification requires factual recall of mples of disease (eg cystic fibrosis) and of torical experimental work (eg Meselson and hl's classic experiment of 1958).	• The AQA specification offers more guidance to teachers and students, for example it shows the structures of α-glucose and β-glucose that students are expected to know and specifies the model they should use to demonstrate understanding of enzyme action (the induced-fit model). • The AQA specification also shows progression from GCSE in, for example, including the concept of DNA replication.

Biological molecules

Current WJEC specification	New AQA specification
Specification reference 1.1 and 5.1.	Specification reference 1.1 to 1.7.
• This specification covers the biochemistry of water, carbohydrates, lipids, proteins and nucleic acids in a broadly similar way to the new AQA specification.	• The AQA specification offers guidance to teachers and students. For example it shows the structures of α-glucose and β-glucose that students are expected to know.
• The treatment of DNA replication requires students to learn experimental evidence (eg the classic Meselson and Stahl experiment published in 1958).	• The treatment of DNA replication has been updated to show progression beyond GCSE.

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Session 2 Practical work – at the heart of the new specification

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What is practical work and why is it so important?

All

- It supports and consolidates scientific **knowledge and understanding.**
- It develops **investigative skills.**
- It builds and mastery of **practical skills.**

Slide 28

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All boards: required apparatus and techniques

All

	apparatus and techniques
AT a	use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH)
AT b	use appropriate instrumentation to record quantitative measurements, such as a colorimeter or potometer
AT c	use laboratory glassware apparatus for a variety of experimental techniques to include serial dilutions
AT d	use of light microscope at high power and low power, including use of a graticule
AT e	produce scientific drawing from observation with annotations
AT f	use qualitative reagents to identify biological molecules
AT g	separate biological compounds using thin layer/paper chromatography or electrophoresis
AT h	safely and ethically use organisms to measure: • plant or animal responses • physiological functions
AT i	use microbiological aseptic techniques, including the use of agar plates and broth
AT j	safely use instruments for dissection of an animal organ, or plant organ
AT k	use sampling techniques in fieldwork
AT l	use ICT such as computer modelling, or data logger to collect data, or use software to process data

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Assessment of practical skills

An understanding of practical work and skills will be assessed in two ways:

1. exam papers
2. the practical endorsement.

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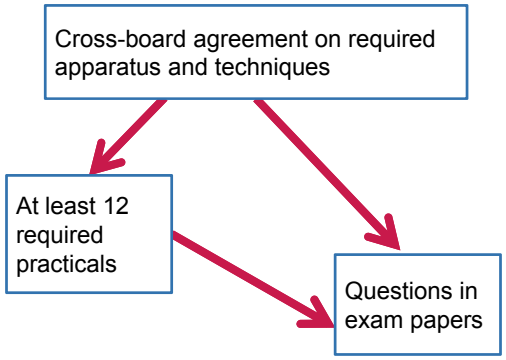
Assessment for A-level

- Questions will be asked in the papers based on practical work.
- It will be assumed that all students have completed all 12 and understand the underlying skills, apparatus and techniques.



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AQA required practicals

- 12 required practical activities designed with CLEAPSS
  - the first six required practicals are in AS and the following six are in A-level
- Many more opportunities for practical activities
- Not constrained – flexible
- There is no need to tell us what you're doing with your students
- A full investigation is not needed, students must demonstrate investigative approaches (more about this later)
- Cover the required apparatus and techniques

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Practical activities embedded in schemes of work (SOW)

There are suggestions throughout the SOW where past ISA/EMPA practicals can be integrated for example:

Learning objective	Time taken	Learning Outcome	Learning activity with opportunity to develop skills	Assessment opportunities	Resources
The movement of water across partially permeable membranes by osmosis. The concepts of water potential and hypotonic, hypertonic and isotonic solutions.	0.4 weeks	• define osmosis in terms of water potential • explain the terms hypotonic, hypertonic and isotonic • explain the movement of water due to osmosis in or out of cells • explain the effect of osmosis on plant and animal cells.	**Learning activities:** - Teacher explanation of osmosis and water potential to arrive at an A-level definition. - Jigsaw learning: Working in teams of three, one student goes to each information station to discover about the effect of placing plant and animal cells in hypotonic, isotonic and hypertonic solutions. - Students feedback to one another. - Teacher assessment and explanation to address areas of weakness. - Exam questions. **Skills developed by learning activities:** **AT d/AT e -** Use an optical microscope to examine and draw onion cells which are plasmolysed/turgid. **AO1 –** Development of knowledge of osmosis and water potential. **AO2 –** Application of knowledge and understanding of osmosis to explain concepts such as plasmolysis, haemolysis and turgor. **8.4.2.2 and 8.4.2.4**	Students could undertake the BIO3T ISA P from 2012. **Past exam paper material:** HBI3T 2014 EMPA Exampro	http://www.nuffieldfoundation.org/practical-biology/observing-osmosis-plasmolysis-and-turgor-plant-cells http://www.cleapss.org.uk http://highered.mheducation.com/sites/0072495855/student_view0/chapter2/animation__how_osmosis_works.html **Rich question:** Present diagrammatic representation of cells with numerical water potentials, and ask students to represent the net movement of water with arrows between cells.

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The 12 required practicals

Required activity	apparatus and technique reference
1. Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction	a, b
2. Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index	d, e
3. Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue	c, h, j
4. Investigation into the effect of a named variable on the permeability of cell-surface membranes	a, b, c, j
5. Dissection of animal or plant respiratory system or mass transport system or of organ within such a system	e, h, j
6. Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth	c, i
7. Use of chromatography to investigate the pigments isolated from leaves of different plants, eg, leaves from shade-tolerant and shade-intolerant plants or leaves of different colours	b, g
8. Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts	a, b
9. Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms	b, i
10. Investigation into the effect of an environmental variable on the movement of an animal using either a choice chamber or a maze	h
11. Production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample	b, c
12. Investigation into the effect of a named environmental factor on the distribution of a given species	a, h, k

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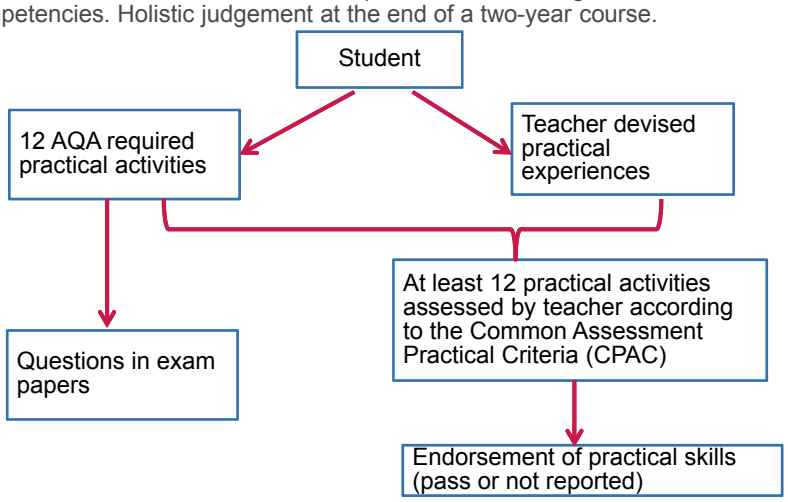
Assessment for endorsement

All

Teacher assesses students abilities in practical work through a set of competencies. Holistic judgement at the end of a two-year course.



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Five competencies – common to all boards

All

Common Practical Assessment Criteria (CPAC) – assessed by the teacher for endorsement

1. Follows written procedures
2. Applies investigative approaches and methods when using instruments and equipment
3. Safely uses a range of practical equipment and materials
4. Makes and records observations
5. Researches, references and reports

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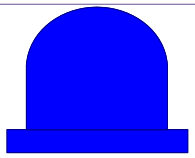
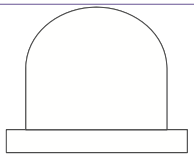
De Bono's thinking hats - 1



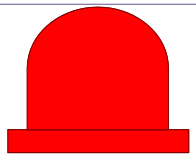
PROCESS

- Managing the thinking.
- Conclusions, decisions
- Planning for action.



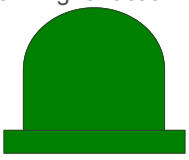
FACTS

- What do I know?
- What do I need to find out?



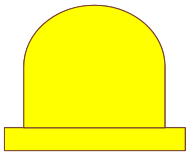
FEELINGS

- Feelings, gut instinct
- No reasons given
- Feelings can change



CREATIVITY

- Ideas, alternatives, possibilities
- Solutions to problems



POSITIVES

- Optimism, benefits

CHALLENGES

- Potential problems

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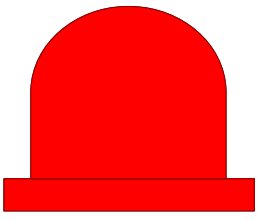
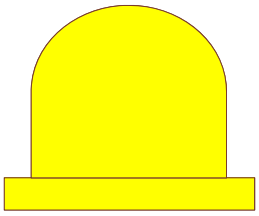
Practical endorsement - 2

- De Bono's thinking hats:



EMOTIONS



POSITIVES

- How do you feel about the practical endorsement?
- What benefits will the practical endorsement bring?

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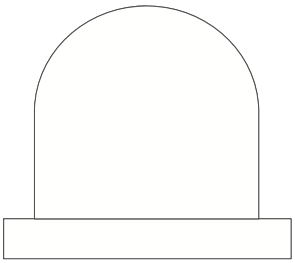
Practical endorsement - 3

All

- De Bono's thinking hats:



FACTS

- What questions do you have?

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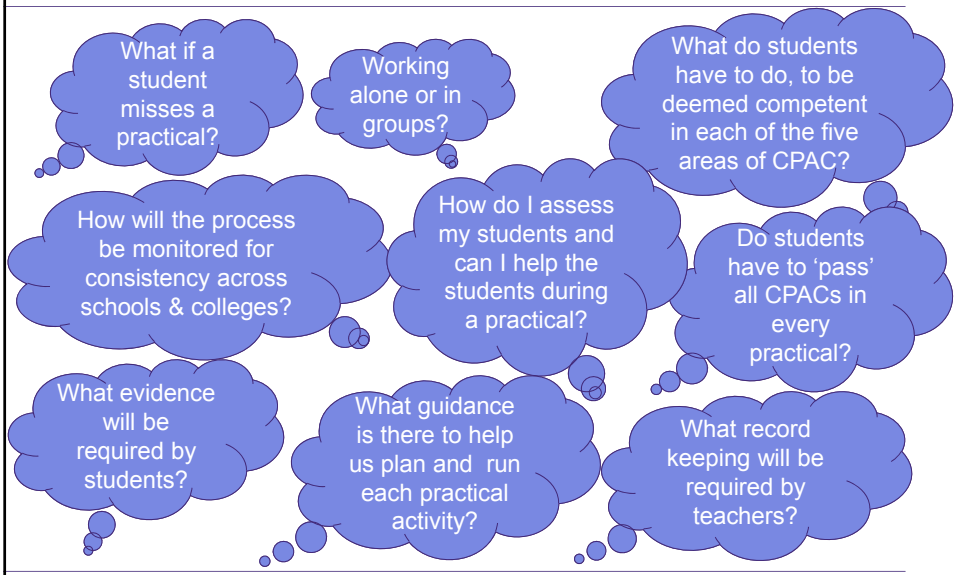
Practical endorsement - questions



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Organising practicals

Working alone or in groups?

- Students can work in groups for required practical activities
- Do not have to be carried out in silence or exam conditions
- Students can peer assess each other

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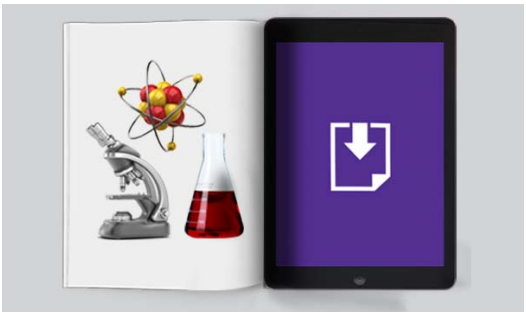
Practical handbooks

What guidance is there to help us plan and run each practical activity?



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Practical handbooks

What guidance is there to help us plan and run each practical activity?

- The Combined practical handbook:
  - how the practical endorsement works
  - guidelines about tabulating data, significant figures, uncertainties, graphing, statistical tests.

- Biology practical handbook:
  - student protocols for each of the 12 required practical activities
  - practical activities designed with CLEAPSS
  - practical ladders.

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Practical 1 - method

A-level Biology required practical No. 1

Student Sheet

Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction

The effect of temperature on the rate of the reaction catalysed by trypsin

Casein is a protein found in milk. Trypsin is an enzyme that digests casein. When trypsin is added to a dilute solution of milk powder, the casein is digested and the solution goes clear.

Method

You are provided with the following:

- 0.5% trypsin solution
- 3% solution of milk powder
- pH7 buffer solution
- a large beaker to use as a water bath
- test tubes
- test tube rack
- stop watch
- marker pen
- pipettes or syringes
- thermometer.

You are required to find the rate of reaction at **five** different temperatures. Your teacher will tell you whether you are going to investigate all the temperatures yourself or whether you will get some results from other students in your class.

You should read these instructions carefully before you start work.

1. Using a marker pen write an 'X' on the glass halfway down one side of each of three test tubes.
2. Add 10 cm^3 of the solution of milk powder to each of these three test tubes.
3. Add 2 cm^3 of trypsin solution to 2 cm^3 of pH 7 buffer in another set of three test tubes.

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Practical 2 - ladder

PRACTICAL 1

Required practical	Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction.			
Apparatus and techniques covered (Not full statements)	a. Use appropriate apparatus to record a range of quantitative measurements b. Use appropriate instrumentation to record quantitative measurements c. Use laboratory glassware apparatus for a variety of experimental techniques f. Use qualitative reagents to identify biological molecules i. Use ICT such as data logger to collect data or use software to process data			
Indicative apparatus	Laboratory glassware, enzyme (e.g. amylase, lipase, protease, catalase), appropriate substrate(s), heating apparatus, thermometers or data logging equipment, pH meters, volumetric flasks, top pan balances.			
	Amount of choice Increasing independence →			
	Least choice	Some choice	Many choices	Full investigation
	Teacher chooses the enzyme and the factor to be varied. Students vary the factor and measure the outcomes. Experiments fully specified in terms of equipment and method.	Teacher allows a limited choice of enzyme and/or factor. Students vary the factor and measure the outcomes. Experiment probably fully specified by teacher.	Teacher allows a choice of enzyme and/or factor. Students have a number of experimental procedures to choose from, and then follow that procedure.	Student decides on a question. Student researches methods for carrying out the experiment then chooses equipment and materials, justifying all choices.
Opportunities for observation and assessment of competencies				
Follow written procedures	✓✓✓ Students follow written method.	✓✓✓ Students follow written method.	✓✓✓ Students follow a method they have researched.	✓✓✓ Students follow a method they have researched.
Applies investigative approaches and methods when using instruments and equipment	✓ Students must correctly use the appropriate equipment.	✓Students must correctly use the appropriate equipment.	✓✓ Students must correctly use the appropriate equipment.	✓✓✓ Students must choose an appropriate approach, equipment and techniques and identify correct variables for measurement and control.

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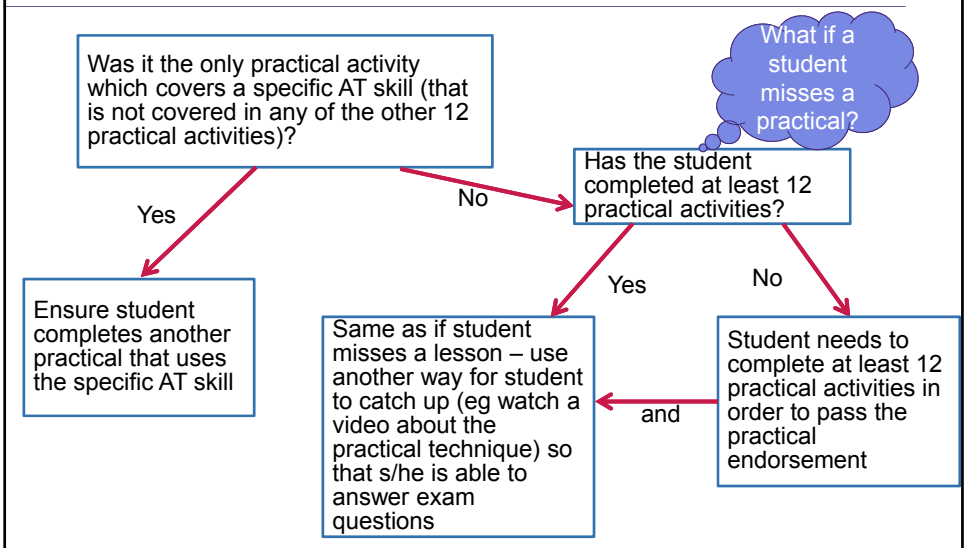
If a student misses a required practical?



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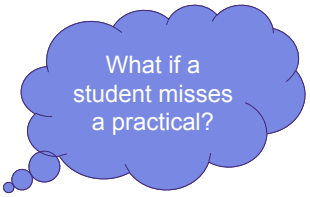
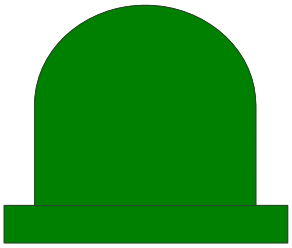
Addressing all the AT skills

- The mapping document lists the 12 required practical activities
- For which AT skills is there only 1 or 2 practical activities?





Creative thinking

- Can you think of some additional practical activities which would allow students to complete these AT skills?
- When could these additional practical activities be included? Which topic do they link to?

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Mapping practicals

AQA Realising potential

Mapping Practical Activities

	Required practical	Apparatus and techniques covered											Examples of possible practical activities	Old ISAs/EMPAs that may be used?	Competencies					Could you make it more investigative? AND/OR is this an opportunity for researching, referencing and reporting? If so, how?
		a	b	c	d	e	f	g	h	i	j	k	l			1	2	3	4	5	
1	Investigation into the effect of a named variable on the rate of an enzyme - controlled reaction	1	1	1			1						1								
2	Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index				1	1	1														
3	Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue			1					1		1		1								

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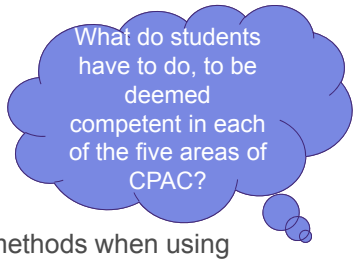
The common practical assessment criteria (CPAC) competencies



1. Follows written procedures ✔
2. Applies investigative approaches and methods when using instruments and equipment
3. Safely uses a range of practical equipment and materials ✔
4. Makes and records observations ✔
5. Researches, references and reports

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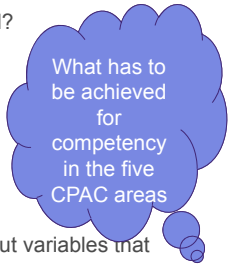
Investigative approaches and research - 1



- What is meant by investigative approach and what might be involved?
  - background reading in order to develop a hypothesis
  - write a hypothesis
  - identify variables (IV, DV, CVs, confounding variables)
  - design a method
    - choose appropriate equipment and techniques for suitably accurate measurements
    - plan how to control necessary variables and what to do about variables that cannot be easily controlled
    - decide how many repeats, sample size etc
  - adjust methods when necessary
  - collate data
  - process and analyse data and draw conclusions (with appropriate research and reading)
  - evaluate methodology in terms of reliability and validity
- Students do not have to complete every aspect for all practical activities. They should have experience of each aspect for carrying out investigations over the course of their A-levels

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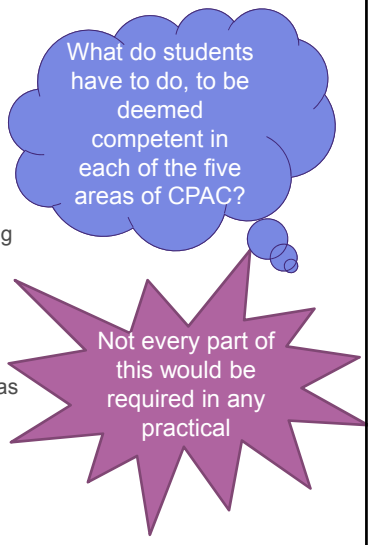
Investigative approaches and researching - 2

Investigating distribution of a species:

- **research** conditions that the species requires/likes/doesn't like
- **decide** how to carry out the experiment, including deciding on the IV and the DV and how to change / measure them
- **design** a method that takes into account confounding variables
- **research** different methods for sampling
- **choose** equipment
- **justify** the method being chosen
- **evaluate** the reliability and validity of the data that has been collected.



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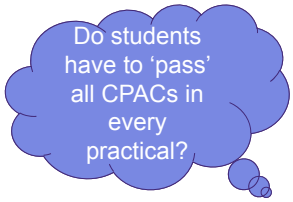
Developing skills for CPAC competencies - 1

Students do not have to be fully competent from the start of year 12



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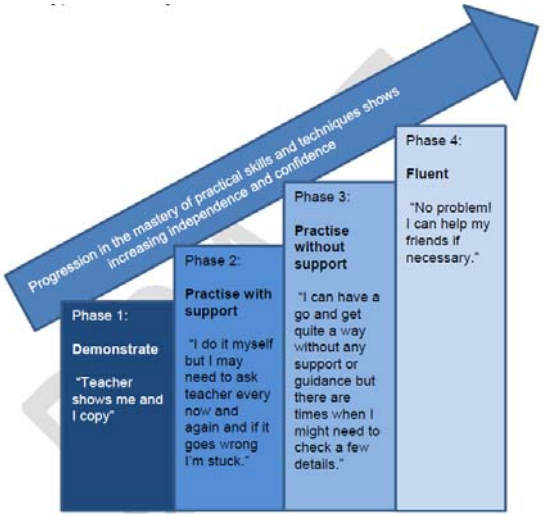
Developing skills for CPAC competencies - 2



Do students have to 'pass' all CPACs in every practical?

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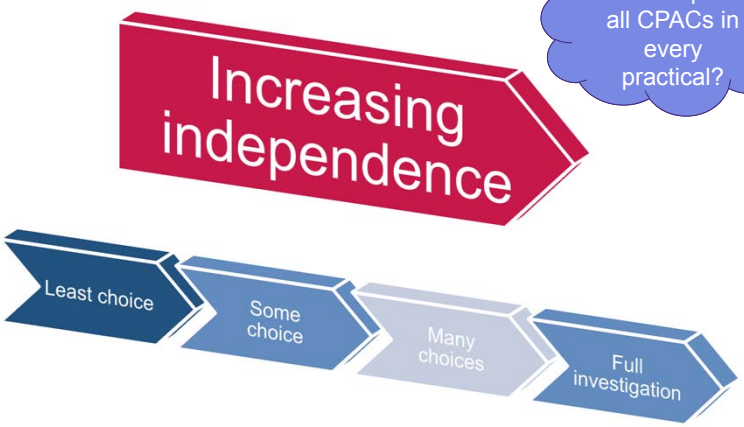
Developing skills for CPAC competencies - 3



Do students have to 'pass' all CPACs in every practical?

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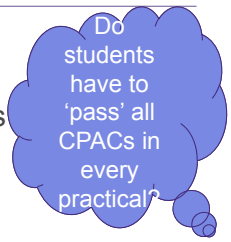
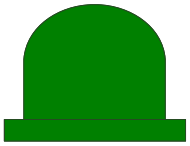
Developing skills for CPAC competencies - 4

- Add to your practical mapping document
- Which practical activities are best suited to assess each CPAC?
- Which practical will you use to introduce each CPAC?
- In which practical(s) will you embed each CPAC?
- Which practical activities can be used to address the different aspects of being investigative?
- You can add additional practical activities to the sheet (do not feel restricted by the 12 required practicals)





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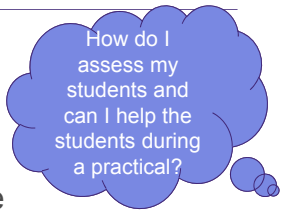
Assessing CPAC competencies

- Make it clear to students which AT skill is being covered and which CPAC is being assessed
- Give students prompt feedback (this can be during the practical work – it is not an exam)
- You could RAG students to track their progress (but not marks):
  - red = haven't show the skill at all
  - amber = beginning to show competency
  - green = confident student could do this independently at university.



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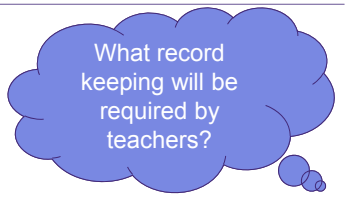
Keeping records - 1



Evidence required for endorsement

1. Documented plans to carry out sufficient practical activities which meet the requirements of the CPAC, incorporating skills and techniques detailed in appendix 5, over the course of the A-level
2. A record of each practical activity undertaken and the date when this was completed
3. A record of the criteria being assessed in that practical activity
4. A record of student attendance
5. A record of which student met the criteria and which did not
6. Student work showing evidence required for the particular task with date
7. Any associated materials provided for the practical activity eg written instructions

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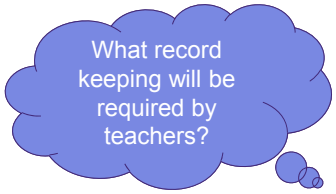
Keeping records - 2



How or where could teachers record this evidence?

See Combined practical handbook for suggested ways of recording evidence

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Keeping records - 3

Some resources that you can use:

- endorsement tracker
- student tracking exemplar.

What record keeping will be required by teachers?

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Keeping records - 4

Example endorsement tracker

What record keeping will be required by teachers?

Student name

	Practical 1	Practical 2	Practical 3	Practical 4	Practical 5	Practical 6	Practical 7	P
Apparatus and techniques covered								
Follow written procedures								
Applies investigative approaches and methods when using instruments and equipment								
Safely uses a range of practical equipment and materials								
Makes and records observations								
Researches, references and reports								
Date								

Ways this sheet could be used:

- Teacher marks each student against each competency for each practical.
- Teacher ticks when a student has demonstrated a competency only.
- Teacher makes notes where a student has (or has not) demonstrated particular competencies.
- Students peer- or self-assess and either make notes or "grade" each competency.

Although the endorsement (and therefore each of the CPAC criteria) is pass/fail, many teachers will wish to judge competencies in individual practical lessons on a finer scale. For example they could use 1-5 or a red/amber/green rating.

This sheet could be glued into the front of lab books or files, or kept centrally by the teacher.

Students must cover all apparatus and techniques and should have experienced each of the 12 required practical activities. However, their competence can be assessed in any practical activity.

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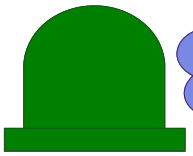
Keeping records - 5

CHALLENGES

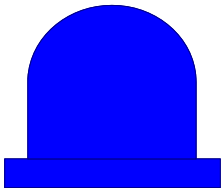
- What are the challenges with keeping these records?



CREATIVITY

- What are the solutions to the challenges?

What record keeping will be required by teachers?



DECISIONS

- Summarise
- How will you keep records of your students' practical work?
- What action will you take?

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Keeping records - 6

AQA advise that the "student "evidence" could be as little as a few results that were then collected as a group, or as much as a full write up of an experiment. It depends on what the teacher is looking for in the context of the particular experiment."

What evidence will be required by students?

Students can record evidence in the following:

- lab book
- practical folder
- handbook which contains details of all the practical activities
- specific 'practical sheets' within their folders or exercise books (could be colour coded)
- can be kept in school or college or at home
- warn students against plagiarism and copying.

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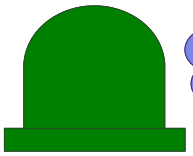
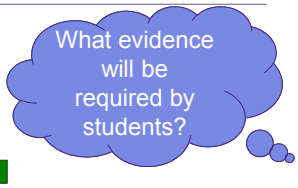
Keeping records - 7

CHALLENGES

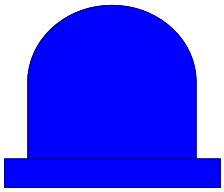
- What are the challenges with students keeping these records?





CREATIVITY

- What are the solutions to the challenges?



DECISIONS

- Summarise
- How and where will your students keep records of their practical work?
- What action will you take?

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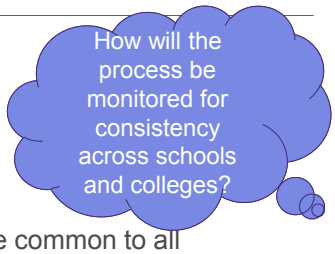
Monitoring practical endorsement



- Consistency - details of administration will be common to all boards.
- AQA is very aware that record keeping and moderation needs to be a workable process, that is not onerous on schools.
- Awarding bodies have made recommendations to Ofqual and it *could* involve:
  - monitoring teaching plans/student logs
  - monitoring teacher assessment
  - student interviews.

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Useful resources

Home > Subjects > Science > AS and A-level > Biology AS and A-level (7401, 7402)

Specifications launch webcast: Part 1 - Science main changes and rules

Specifications launch webcast: Part 2 - Biology content

Practical handbook

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Questions

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Time for lunch

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Session 3 – question papers

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What do teachers want to know?

How similar do the new papers look compared to the old?

Can I use past papers to prepare students for the new papers?

What support is available?

What is difference between the new and old papers?

How will the new topics be assessed?

Has the styles of questions changed?

How will the practical skills be assessed?

How will the maths skills be tested?

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How similar do the new papers look compared to the old?

Section A
Answer **all** questions in this section.

1 Ecologists investigated the size of an insect population on a small island. They used a mark-release-recapture method. To mark the insects they used a fluorescent powder. This powder glows bright red when exposed to ultraviolet (UV) light.

0 1 . 1 The ecologists captured insects from a number of sites on the island. Suggest how they decided where to take their samples.
[2 marks]

0 1 . 2 Give two assumptions made when using the mark-release-recapture method.
[2 marks]

1 _____

2 _____

0 1 . 3 Suggest the advantage of using the fluorescent powder in this experiment.
[2 marks]

How similar do the new papers look compared to the old?

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Command words

Analyse, consider, discuss…

Define…

Describe…

Deduce

Draw

Explain…

Justify

Outline…

State / Give…

Suggest…

- AQA have consolidated the command words for consistency (ie they mean the same thing across GCSE and A-level and also between subjects).
- Command words, where possible, are at the start of the sentences in the question papers.

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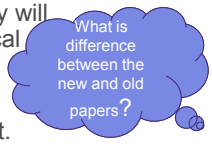
Differences between the old and new specifications

- At least 15% of the overall assessment of AS and A-level Biology will assess knowledge, skills and understanding in relation to practical work.
- Some change of content. See “Summary of changes” document.
- 10% of the overall assessment of AS and A2 Biology will contain mathematical skills equivalent to Level 2 (Higher Tier GCSE level) or above.
- The assessment objectives have changed from the previous specification.
- Reduction of overlap between GCSE and A-level eg no carbon cycle or global warming.
- Development from what was learned at GCSE eg Lock and key → induced fit.



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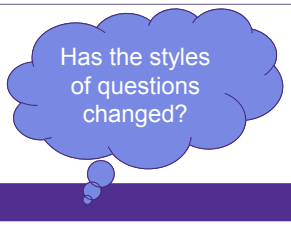
Has the style of questions changed? - 1



2.2 AS

Assessments

Paper 1	Paper 2
What's assessed	**What's assessed**
• Any content from topics 1–4, including relevant practical skills	• Any content from topics 1–4, including relevant practical skills
Assessed	**Assessed**
• written exam: 1 hour 30 minutes • 75 marks • 50% of AS	• written exam: 1 hour 30 minutes • 75 marks • 50% of AS
Questions	**Questions**
• 65 marks: short answer questions • 10 marks: comprehension question	• 65 marks: short answer questions • 10 marks: extended response questions

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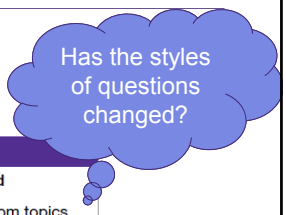
Has the style of questions changed? - 2



2.3 A-level

Assessments

Paper 1	Paper 2	Paper 3
What's assessed	**What's assessed**	**What's assessed**
• Any content from topics 1–4, including relevant practical skills	• Any content from topics 5–8, including relevant practical skills	• Any content from topics 1–8, including relevant practical skills
Assessed	**Assessed**	**Assessed**
• written exam: 2 hours • 91 marks • 35% of A-level	• written exam: 2 hours • 91 marks • 35% of A-level	• written exam: 2 hours • 78 marks • 30% of A-level
Questions	**Questions**	**Questions**
• 76 marks: a mixture of short and long answer questions • 15 marks: extended response questions	• 76 marks: a mixture of short and long answer questions • 15 marks: comprehension question	• 38 marks: structured questions, including practical techniques • 15 marks: critical analysis of given experimental data • 25 marks: one essay from a choice of two titles

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Has the styles of questions changed? - 3

Types of question	New spec		Examples from previous spec
	A-level	AS	
Short answer	P1 P2 P3	P1 P2	All written papers
Long answer	P1 P2 P3		All written papers
Comprehension	P2	P1	Penultimate question on BIOL1
Extended response (structured free response)	P1	P2	Last question on BIOL1 (5+5) and last question on BIOL1 4 (5+5+5)
Critical analysis of data	P3	some Qs will test this	Last 2 questions on BIOL2 and penultimate question on BIOL4 and BIOL5
Essay	P3		BIOL5 last question
Practical skills	P1 P2 P3 (mainly P3)	P1 P2	HSW questions in all papers. ISA (Investigative Skills Assignment) or EMPA (Externally Marked Practical Assignment)

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Activity – 2 preparing students for questions

How would you prepare your students for these types of questions?

- **Extended response (structured free response):**
  - A-level, Paper 1, question 11
  - AS, Paper 2, question 10.
- **Comprehension questions:**
  - A-level, Paper 2, question 10
  - AS, Paper 1, question 9.

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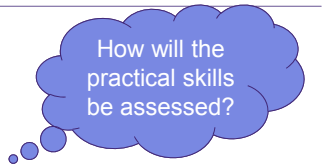
Types of practical question



- Questions set in a practical context, where the question centres on the science, not the practical work.
- Questions that require specific aspects of a practical procedure to be understood in order to answer a question about the underlying science.
- Questions directly on the required practical procedures.
- Questions applying the skills from the required practical procedures and the apparatus and techniques list.

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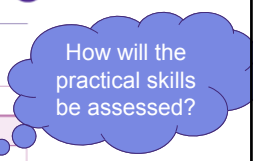
Assessment of practical skills

Practicals skills to be assessed in written papers

All



PS 1.1	Solve problems set in a practical context
PS 1.2	Apply scientific knowledge to practical contexts
PS 2.1	Comment on experimental design and evaluate scientific methods
PS 2.2	Present data in appropriate ways
PS 2.3	Evaluate results and draw conclusions with reference to measurement uncertainties and errors
PS 2.4	Identify variables including those that must be controlled
P2 3.1	Plot and interpret graphs
PS 3.2	Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science
PS 3.3	Consider margins of error, accuracy and precision of data
PS 4.1	Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification

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Activity 3 – assessment of practical skills at A-level

- As in present papers – questions with novel contexts drawn from real life and real research – most notably the 15 mark question in the current BIOL5 papers.
- Can students apply their A-level knowledge and understanding of practical skills/scientific working to a novel context?

A-level, Paper 3, question 5 (15 marks) based on published work of scientists and new content

Activity 3

- Take some time to read through the question. What will the students need to know to be able to answer this well?
- Looking at the list of practical skills (PS) that can be assessed in the written papers, can you identify which PS each aspect of the question is testing?

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A-level, Paper 3, question 5

5 Scientists investigated the effect of a mycorrhizal fungus on the growth of pea plants with a nitrate fertiliser or an ammonium fertiliser. The fertilisers were identical, except for nitrate or ammonium.

The scientists took pea seeds and sterilised their surfaces. They planted the seeds in soil that had been heated to 85 °C for 2 days before use. The soil was sand that contained no mineral ions useful to the plants.

0 5 . 1 Explain why the scientists sterilised the surfaces of the seeds and grew them in soil that had been heated to 85 °C for 2 days.

AT a = use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH)

3.5.3 Energy and ecosystems (A-level only)

Content	Opportunities for skills development
In any ecosystem, plants synthesise organic compounds from atmospheric, or aquatic, carbon dioxide.	**MS 0.1**
0 5 . 2 Explain why plants. Most of the sugars synthesised by plants are used by the plant as respiratory substrates. The rest are used to make other groups of biological molecules. These biological molecules form the biomass of the plants.	Students could be given data from which to calculate gross primary productivity and to derive the appropriate units.
Biomass can be measured in terms of mass of carbon or dry mass of tissue per given area per given time.	**AT a**
The chemical energy store in dry biomass can be estimated using calorimetry.	Students could carry out investigations to find the dry mass of plant samples or the energy released by samples of plant biomass.
Gross primary production (GPP) is the chemical energy store in plant	

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A-level, Paper 3, question 5 continued

5 Scientists investigated the effect of a mycorrhizal fungus on the growth of pea plants with a nitrate fertiliser or an ammonium fertiliser. The fertilisers were identical, except for nitrate or ammonium.

The scientists took pea seeds and sterilised their surfaces. They planted the seeds in soil that had been heated to 85 °C for 2 days before use. The soil was sand that contained no mineral ions useful to the plants.

0 5 . 1 Explain why the scientists sterilised the surfaces of the seeds and grew them in soil that had been heated to 85 °C for 2 days.

[2 marks]

0 5 . 2 Explain why it was important that the soil contained no mineral ions useful to the plants.

[1 mark]

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A-level, Paper 3, question 5 continued

The pea plants were divided into four groups, A, B, C and D.

- **Group A** – heat-treated mycorrhizal fungus added, nitrate fertiliser
- **Group B** – mycorrhizal fungus added, nitrate fertiliser
- **Group C** – heat-treated mycorrhizal fungus added, ammonium fertiliser
- **Group D** – mycorrhizal fungus added, ammonium fertiliser

The heat-treated fungus had been heated to 120 °C for 1 hour.

0 5 . 3 Explain how groups A and C act as controls.

[2 marks]

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A-level, Paper 3, question 5 continued

After 6 weeks, the scientists removed the plants from the soil and cut the roots from the shoots. They dried the plant material in an oven at 90 °C for 3 days. They then determined the mean dry masses of the roots and shoots of each group of pea plants.

0 5 . 4 Suggest what the scientists should have done during the drying process to be sure that all of the water had been removed from the plant samples.

[2 marks]

The scientists' results are shown in **Table 3**.

Table 3

Treatment	Mean dry mass / g per plant (± standard deviation)	
	Root	Shoot
A – heat-treated fungus and nitrate fertiliser	0.40 (±0.05)	1.01 (±0.12)
B – fungus and nitrate fertiliser	1.61 (±0.28)	9.81 (±0.33)
C – heat-treated fungus and ammonium fertiliser	0.34 (±0.03)	0.96 (±0.26)
D – fungus and ammonium fertiliser	0.96 (±0.18)	4.01 (±0.47)

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A-level, Paper 3, question 5 continued

0 5 . 5 What conclusions can be drawn from the data in **Table 3** about the following?

[4 marks]

The effects of the fungus on growth of the pea plants.

The effects of nitrate fertiliser and ammonium fertiliser on growth of the pea plants.

The scientists determined the dry mass of the roots and shoots separately. The reason for this was they were interested in the ratio of shoot to root growth of pea plants. It is the shoot of the pea plant that is harvested for commercial purposes.

0 5 . 6 Explain why determination of dry mass was an appropriate method to use in this investigation.

[2 marks]

0 5 . 7 Which treatment gave the best result in commercial terms? Justify your answer.

[2 marks]

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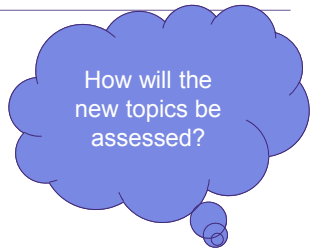
How will the new topics be assessed?



Topics that are new to the specification include:

- the role of mycorrhizae in facilitating the uptake of water and inorganic ions by plants. (3.5.4 Nutrient cycles. A-level only) A-level, Paper 3, question 5
- dihybrid crosses (3.7.1 Inheritance. A-level only). A-level, Paper 2, question 3
- osmoregulation and the structure and role of the nephron (3.6.4.3 Control of blood water potential. A-level only). A-level, Paper 2, question 7.

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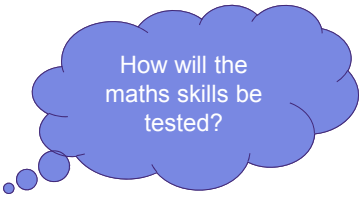
How will the maths skills be tested?



- Maths skills can be tested on any paper.
- A minimum of 10% of the total marks available at each of AS and A-level will assess level 2 maths skills.
- Level 2 means skills equivalent to those needed for Higher Tier GCSE Mathematics, based on the 2012 GCSE Mathematics specifications.

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Standard deviation and statistics - 1

- Students will **not** be required to calculate standard deviations in written papers.
- Students should understand how to select a statistical test that is appropriate for given data and to be able interpret the results of such a statistical test.
- Students could also be asked to explain their choices and interpretation.
- In exams students will **not** be asked to perform a calculation using a statistical test.

How will the maths skills be tested?

MS 1.9	Select and use a statistical test	Students may be tested on their ability to select and use: • the chi-squared test to test the significance of the difference between observed and expected results • the Student's t-test • the correlation coefficient
MS 1.10	Understand measures of dispersion, including standard deviation and range	Students may be tested on their ability to: • calculate the standard deviation • understand why standard deviation might be a more useful measure of dispersion for a given set of data, eg where there is an outlying result

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Standard deviation and statistics - 2

How will the maths skills be tested?

You might wish your students to have a go at carrying out statistical calculations.

Spearman rank correlation test

Calculate the value of the Spearman rank correlation, r_s, from the equation

$$r_s = 1 - \left[\frac{6 \times \Sigma D^2}{n^3 - n}\right]$$

where n is the number of pairs of items in the sample and D is the difference between each pair of ranked measurements.

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Standard deviation and statistics - 3

How will the maths skills be tested?

The *t* test

Use this test when
- you wish to find out if there is a significant difference between two means
- the data are normally distributed
- the sample size is less than 25.

t can be calculated from the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(s_1^2/n_1) + (s_2^2/n_2)}}$$

Where $\bar{x}_1$ = mean of first sample
$\bar{x}_2$ = mean of second sample
s_1 = standard deviation of first sample
s_2 = standard deviation of second sample
n_1 = number of measurements in first sample
n_2 = number of measurements in second sample

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Standard deviation and statistics - 4

How will the maths skills be tested?

The χ^2 test

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O represents the results you observe in the investigation
and E represents the results you expect.

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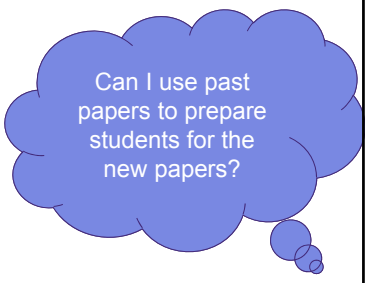
Using past papers

Yes, if you are already with AQA then you can continue to use your current teaching materials and assessment materials.

- You may also want to use Exampro. It also allows you to search using the maths skills specifically so you could put together a “Maths in biology” question pack.
- AQA are also asking Exampro to add on older or legacy questions on topics not currently in the specification.
- If you are new to AQA there is plenty of help available.



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Exampro: A-level Biology demo

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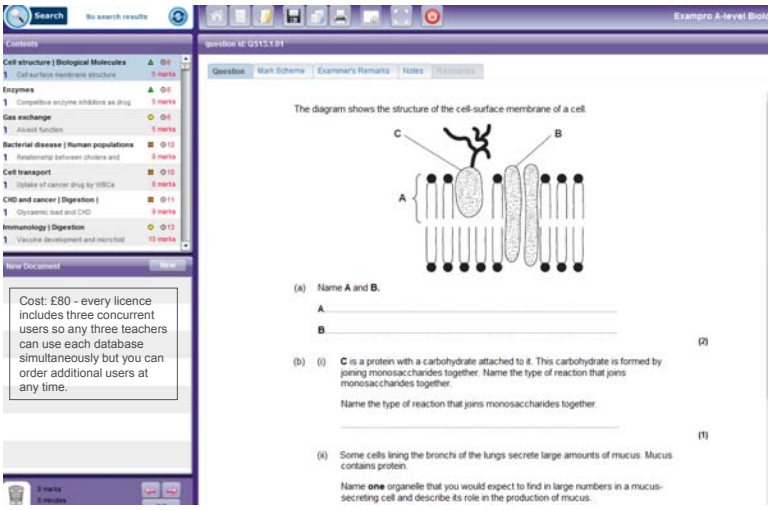
Exampro: the option to buy additional resources



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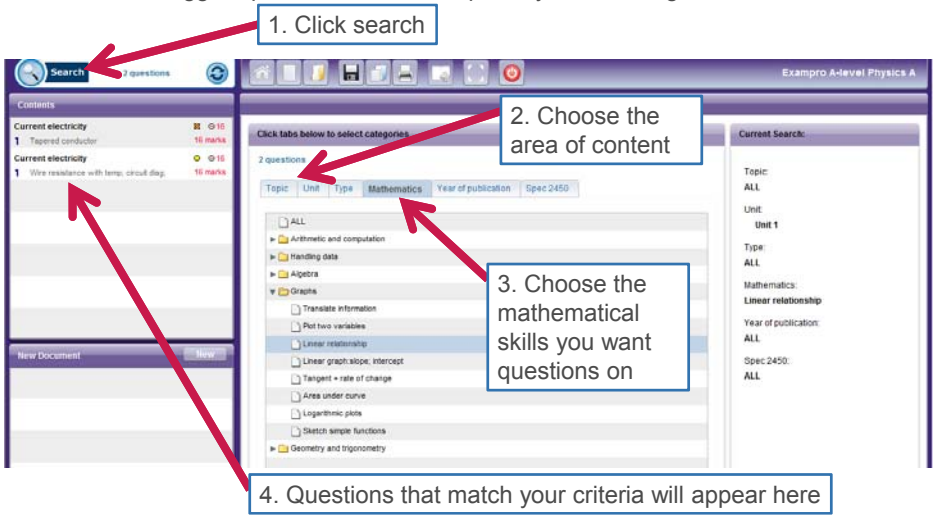
How can you prepare for the new maths requirements?

- Include tagged questions from Exampro in your teaching



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Support - 1

- Specimen assessment materials (SAMS) are already available online.
- e-AQA will have further papers that cannot be accessed by students.
- Available soon will be exemplar marked student responses with examiner commentary, including for the essay.

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Support - 2

Relevant past paper questions are mapped onto the AQA scheme of work eg for the new topic on osmoregulation

Learning objective	Time taken	Learning Outcome	Learning activity with opportunity to develop skills	Assessment opportuniti	
The structure of the nephron and its role in: • the formation of glomerular filtrate • reabsorption of glucose and water by the proximal convoluted tubule • maintaining a gradient of sodium ions in the medulla by the loop of Henle • reabsorption of water by the distal convoluted tubule and collecting ducts.	0.4 weeks	• describe the structure of a nephron • explain the process of ultrafiltration and where it occurs • explain the process of selective reabsorption, where it occurs along a nephron and the transport processes involved • explain the adaptations of cells of the proximal convoluted tubule • explain the importance of maintaining a sodium ion gradient in the medulla, and how this is achieved • explain the reabsorption of water from the distal convoluted tubule and collecting ducts.	**Learning activities:** - Questioning to assess recall from GCSE. - Think – Pair – Share: Provide data showing the concentrations of molecules/ions in the blood plasma and the glomerular filtrate. Ask pupils to suggest an explanation. - Introduce the concept of a nephron, as well as the medulla and cortex of the kidney. - Provide a series of information stations for students to circulate round (videos, animations, suitable webpages, textbooks, comprehensions). - In groups, provide an unlabelled diagram of a nephron and ask students to work in pairs to use their knowledge to label and explain what is happening at different places. - Teacher explanation/reinforcement of the process of ultrafiltration and selective reabsorption. - Exam question **Skills developed by learning activities:** **AO1** – Development of knowledge/understanding relating to the structure of a nephron, and the events which occur at different points along the nephron. **AO2/AO3** – Interpretation of data and application of knowledge to explain it.	**Specimen assessment material:** A-level Paper 2 Q7.4; **Past exam paper material:** BYB4 – Jan 2008 Q2; BYB4 – June 2004 Q6; BYB4 – June 2006 Q5.	**http://bcs.whfreeman.com/thelifewire/content/chp51/5101s.swf** **Rich questions:** - Explain what causes some molecules to be filtered out of the glomerulus? - Which molecules are selective reabsorbed? By which processes does this occur? - Explain the countercurrent multiplier mechanism and why it is important for water reabsorption.
Extension			- Interpret data relating the thickness of the medulla to the maximum urine concentration produced by a range		

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Synoptic essay

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AQA

Essay question

A-level, Paper 3 question 6

Section B
Answer **one** question.

6 Write an essay on **one** of the topics below.

EITHER

0 6 . 1 The importance of movement in living organisms. **[25 marks]**

OR

0 6 . 2 The importance of receptors in living organisms. **[25 marks]**

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AQA

The essay is a synoptic exercise

- As in the present specification, BIOL5, a free response essay addressing a theme in a title, with a choice from two titles (A-level, Paper 3).
- The essay is designed to assess whether students can bring together material from a range of topics to illustrate and explain an important concept or idea.
- The essay is not just a memory test of what a student knows – it is also a test of whether they have some understanding of what they have learnt and can apply what they know.
- The essay will be marked in a similar way to current system but without separate breadth, relevance, or QWC marks – it is felt these often gave too much credit to essays with quite poor content.
- 'Levels' descriptors – used with guidance to achieve a suitable mark and consistency.

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AQA

What we expect from students in the essay

- To identify an underlying theme or idea in an essay title – it will be a 'big idea', not a minor topic.
- To select five (or six) different examples that they can use to illustrate the theme or idea.
- To write a reasonable paragraph about each example (using appropriate A-level terminology) **pointing out how it illustrates the theme or idea.**
- **It is not** – 'think of every possible thing that relates to the title and write as much as you can about it, with no thought of the main theme/idea'.
- This would make it just a memory test (AO1).
- **It is not** – 'write at a very high level (above A-level) about one or two topics'.
- This is not a synoptic approach. We do not wish to encourage learning of rote answers involving one or two important topics which might apply to many titles eg respiration.

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Key points about the essay

1. The essay should have at least five A-level standard paragraphs that are relevant to the title.
2. Essays do not require introduction or conclusion.
3. For above 16 marks, paragraphs or topics need to be interrelated.
4. For above 23 marks should include some evidence of wider reading.
5. There are no longer separate marks for breadth, QWC and relevance - it is all incorporated into one overall mark.

More information and support will be available by the end of the year about exactly how the marking guidelines will be applied.

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Mark scheme 0 – 5 marks

1–5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

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Mark scheme 6 – 15 marks

11–15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.
6–10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.

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Mark scheme 16 – 25 marks

21–25	Extended abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16–20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.

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Preparing students for the essay - 1

- **Practice** could start at AS, with titles that address 'big ideas' in sections
- When teaching, pointing out connections between parts of the specification
- Especially through the 'big ideas' outlined at the start of each section
- Encourage outside reading – eg Biological Science Review – which will help them to put what they learn into broader contexts. To get a top mark (24 or 25) in the essay, we will look for some evidence (at least in one topic) of reading beyond the specification
- Example – Membranes are important in many processes in cells
- What could be the theme of the essay?
- What might be suitable topic areas?

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Preparing students for the essay - 2

- **Theme/idea** – the **role** of membranes in processes – **not just** processes that involve membranes.
- Suitable topics – too many to list all now – eg transport across membranes, protein synthesis, immune response, exchange surfaces, photosynthesis, respiration, receptors (in various topics such as insulin action), neurones, synapses, muscle contraction.
- Take one example – photosynthesis.
- Weaker answers will focus on all of photosynthesis – as a process involving membranes – perhaps mention membranes in chloroplasts (this approach a maximum of about 18 out of 25.
- Good answers will focus on thylakoid membranes in the chloroplast and the roles of components of these membranes in holding pigments, components of the electron transfer chain, ATP synthase and the membrane as a barrier allowing maintenance of a proton gradient – and, perhaps, role of membranes in maintaining the special chemical environment inside chloroplasts.

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Preparing students for the essay - 3

Examples of what teachers can do to prepare their students:

- at the end of each topic, make links to other topics to encourage answers to the essay question become more synoptic
- regularly give students an essay title. Ask them to list the topics that could be written about for that title
- draw mind maps with students showing the topics that could be linked to an essay title and the links between them
- at the end of each teaching each topic, give a series of essay titles and ask students to write a paragraph on the topic and how it links to that title
- students write essays and peer-assess each others' work
- remember students should include five to six topics in the essay, and the essay should take about 40 minutes to write.

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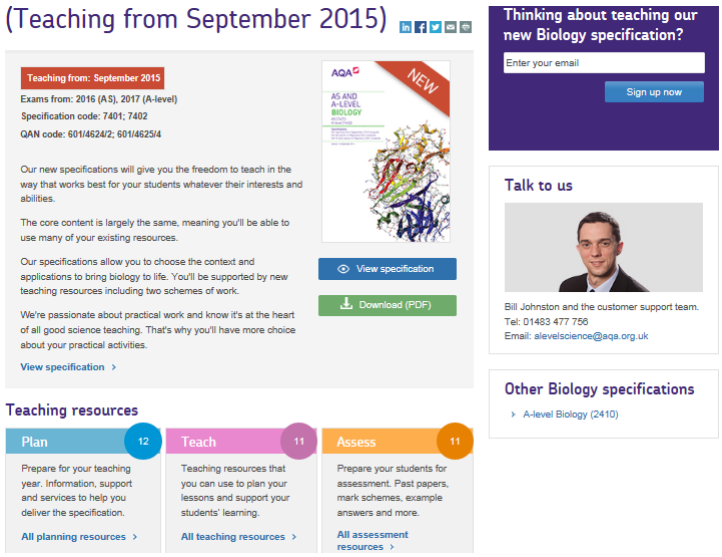
Resources on website - 1



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Resources on website - 2

Planning resources

Practical and detailed resources to build lesson plans and schemes of work and prepare topics and objectives.

- Companion: Guide (297.0 KB)
  - Comparison of content: Human Biology to Biology
  - Guidance on co-teaching
- Launch meeting: Slides (1.6 MB)
- Options evening: Flyer (157.1 KB)
  - Part 1 - Science main changes and rules: Launch webcast
  - Part 2 - Biology content: Launch webcast
  - Summary of changes
  - Switching to AQA from Edexcel
  - Switching to AQA from OCR
  - Switching to AQA from WJEC
- Why choose AQA?: Guide (189.3 KB)

Teaching resources

Tailored and informative resource materials to help you deliver engaging and inspiring lessons.

- A-level Biology: Scheme of work (550.9 KB)
- AS Biology: Scheme of work (669.8 KB)
  - Subject specific vocabulary
  - Teaching plan
  - Textbooks
  - Using your existing textbook
- Using your existing textbook: Teaching resources (1.3 MB)

Assessment resources

Assessment materials to guide efficient evaluation and marking of students' work. Specimen papers and example answers are also available.

- Command words
- Exampro A-level science

AS

- Paper 1 (AS): Specimen question paper (638.3 KB)
- Paper 1 (AS): Specimen mark scheme (259.1 KB)
- Paper 2 (AS): Specimen mark scheme (275.8 KB)
- Paper 2 (AS): Specimen question paper (607.6 KB)

A-level

- Paper 1 (A-level): Specimen question paper (778.0 KB)
- Paper 1 (A-level): Specimen mark scheme (260.2 KB)
- Paper 2 (A-level): Specimen mark scheme (228.9 KB)
- Paper 2 (A-level): Specimen question paper (499.6 KB)
- Paper 3 (A-level): Specimen question paper (528.2 KB)
- Paper 3 (A-level): Specimen mark scheme (290.0 KB)

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Resource on website - 3

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Your questions

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