INTERNATIONAL ADVANCED LEVEL

Biology

Getting Started

Pearson Edexcel International Advanced Subsidiary in Biology (XBI01)
Pearson Edexcel International Advanced Level in Biology (YBI01)

For first teaching in September 2013
First examination January 2014
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Getting started for teachers

Introduction

This Getting Started book will give you an overview of the new Edexcel International Advanced Level (IAL) in Biology and what it means for you and your students. The guidance in this book is intended to help you plan the course in outline and to give you further insight into the principles behind the content to help you and your students succeed in the course.

Key principles

The specification has been developed with the following key principles:

Inspiring content

The specification has been designed after extensive consultation with practising teachers and professional bodies. It provides an innovative and contemporary Biology course with inspiring topics that include current scientific developments, and motivating practical work.

A focus on choice

You can choose whether to teach the course using a context-led approach or a concept-led approach, or even a mixture of the two, whichever is the most appropriate style for you and your students. The context-led approach is based on the Salters-Nuffield Advanced Biology Project. Throughout this material the acronym SNAB is used to denote Salters-Nuffield Advanced Biology.

Manageable and well supported

The specification has a realistic and manageable level of content and assessment. Extensive support is available from Edexcel — Ask the Expert team plus the Project Director based at the University of York Science Curriculum Centre.
Assessment overview

AS units

<table>
<thead>
<tr>
<th>Unit 1: Lifestyle, Transport, Genes and Health</th>
<th>Unit 2: Development, Plants and the Environment</th>
<th>Unit 3: Practical Biology and Research Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>One exam:</td>
<td>One exam:</td>
<td>One exam:</td>
</tr>
<tr>
<td>1 hour 30 minutes</td>
<td>1 hour 30 minutes</td>
<td>1 hour 30 minutes</td>
</tr>
<tr>
<td>40% of AS</td>
<td>40% of AS</td>
<td>20% of AS</td>
</tr>
<tr>
<td>January and June entry</td>
<td>January and June entry</td>
<td>January and June entry</td>
</tr>
</tbody>
</table>

A2 units

<table>
<thead>
<tr>
<th>Unit 4: The Natural Environment and Species Survival</th>
<th>Unit 5: Energy, Exercise and Coordination</th>
<th>Unit 6: Practical Biology and Experimental Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>One exam:</td>
<td>One exam:</td>
<td>One exam:</td>
</tr>
<tr>
<td>1 hour 30 minutes</td>
<td>1 hour 45 minutes</td>
<td>1 hour 30 minutes</td>
</tr>
<tr>
<td>40% of A2</td>
<td>40% of A2</td>
<td>20% of A2</td>
</tr>
<tr>
<td>January and June entry</td>
<td>January and June entry</td>
<td>January and June entry</td>
</tr>
</tbody>
</table>
Overviews

This section provides at a glance overviews of the course to help you see what you will need to teach.

- The Course overviews are a diagrammatic representation of the course in outline, whether you want to teach a concept-led or context-led curriculum.
- The Unit overviews give a summary of the content of each unit so that you can organise your teaching effectively.

Course overviews

Concept-led approach
Context-led approach

Biology contexts

Unit 1 AS
- Heart disease, blood cholesterol levels
- Genetics, Cystic fibrosis
- DNA profiling, forensics, time of death
- Hospital acquired infection
- Tuberculosis, Human Immunodeficiency Virus

Unit 2 AS
- Health, lifestyle factors
- Environment and phenotype interaction
- Stem cell research, medical therapies
- Conservation of endangered species
- Nature versus nurture
- Sprinter compared to long distance runner?
- Brain imaging, coordination, Parkinson's Disease
- Human Genome Project, genetically modified organisms, animals in medical research

Unit 4 A2
- Plants as a source of medicinal products
- Global warming
- Conservation of endangered species

Unit 5 A2
- Environment and phenotype interaction
- Nature versus nurture
- Sprinter compared to long distance runner?
- Brain imaging, coordination, Parkinson's Disease
- Human Genome Project, genetically modified organisms, animals in medical research

Plants as a source of medicinal products

Conservation of endangered species

Nature versus nurture

Sprinter compared to long distance runner?

Brain imaging, coordination, Parkinson's Disease

Human Genome Project, genetically modified organisms, animals in medical research
Unit overviews

There are three possible approaches to each unit so that you can choose the approach that most suits your students. Whichever approach you take, the assessment will be exactly the same.

Concept approach

This approach begins with a study of the laws, theories and models of biology, and finishes with an exploration of their practical applications.

Context approach — based on SNAB

This approach begins with an application that draws on many different areas of biology, and then moves on to the biological concepts underlying this application.

Integrated approach

In this approach, concept and context approaches are mixed according to the needs of the students.

All approaches include understanding How Science Works, looking at the way scientific knowledge develops.

The following tables summarise the content of each unit, which is the same whichever approach you take.

AS units

UNIT 1: Lifestyle, Transport, Genes and Health

Topic 1: Lifestyle, health and risk

- Circulatory system
- Lifestyle factors (role of diet, exercise, smoking) in relation to cardiovascular disease
- Correlation, causation and concept of risks to health
- Structure and function of molecules, eg carbohydrates

Core practicals

- Effect of caffeine on Daphnia heart rate
- Vitamin C content of food and drink
Topic 2: Genes and health

- Properties and transport of materials across cell membranes; osmosis, passive and active transport
- Structure and function of carbohydrates, lipids and proteins; enzyme action
- Structure and role of DNA and RNA
- DNA replication; protein synthesis
- Meselson and Stahl’s classic experiment
- Monohybrid inheritance
- Cystic fibrosis
- Gene mutations
- Principles of gene therapy; social and ethical issues

Core practicals

- Alcohol concentration or temperature on membrane permeability
- How enzyme concentration affects the rate of reactions

UNIT 2: Development, Plants and the Environment

Topic 3: The voice of the genome

- Development of multicellular organisms from single cells
- Cell structure and ultrastructure of eukaryote and prokaryote cells
- Cell differentiation
- Cell division
- Fertilisation
- Tissue organisation
- Genotype and environmental influence on phenotype
- Stem cell research and its implications

Core practicals

- Staining root tip to observe mitosis
- Plant tissue culture to demonstrate totipotency
**Topic 4: Biodiversity and natural resources**

- Biodiversity, endemism, adaptations and natural selection
- Principles of taxonomy
- Plant cell structure and relationship to function
- Structure and role of cellulose, starch, inorganic ions
- Transport of water
- Traditional and novel uses of plant products, natural resources
- Role of zoos and seed banks in conservation of endangered species

**Core practicals**

- Determining tensile strength of plant fibres
- Investigating plant mineral deficiencies
- Investigating antimicrobial properties of plants

**UNIT 3: Practical Biology and Research Skills**

Students should do a variety of practical work during the AS course to develop their practical skills. This should help them to gain an understanding and knowledge of the practical techniques that are used in experimental work.

Centres should provide opportunities for students to plan experiments, implement their plans, collect data, analyse their data and draw conclusions to prepare them for the assessment of this unit.

Experiments should cover a range of different topic areas and require the use of a variety of practical techniques.
A2 Units

UNIT 4: The Natural Environment and Species Survival

Topic 5: On the wild side

- Photosynthesis
- How ecosystems work, energy transfer within ecosystems
- Habitats, abiotic, biotic factors
- Evidence for global warming; effects on plants and animals
- Reproductive isolation leading to speciation
- Will climate change lead to extinction of species or evolution by natural selection?
- Light-dependent and independent reactions
- Nutrient recycling

Core practicals

- Study on the ecology of a habitat
- Effects of temperature on the development of organisms

Topic 6: Infection, immunity and forensics

- Analytical techniques in forensics — DNA profiling and polymerase chain reaction (PCR)
- Determining time of death of an animal
- Structure of bacteria and viruses
- Infectious diseases (eg HIV and TB) and immunology
- Combating infection, developing immunity, host immunity, antigens, antibodies, antibiotics, the immune response
- Evolutionary battles between invading pathogens and hosts
- Hospital practice relating to infection prevention and control

Core practicals

- DNA amplification using PCR
- Gel electrophoresis
- Effect of different antibiotics on bacteria
UNIT 5: Energy, Exercise and Coordination

Topic 7: Run for your life
- Physiological adaptations of animals to undertake strenuous exercise
- Biochemical requirements — ATP, glycolysis, anaerobic/aerobic respiration
- Homeostasis (gene regulation, temperature regulation)
- Muscle physiology
- Performance-enhancing substances

Core practicals
- Investigating respiration
- Effects of exercise on tidal volume and breathing rate

Topic 8: Grey matter
- The nervous system
- Development of vision and learning, response to stimuli, Hubel and Wiesel’s experiments
- Brain structure and function
- Brain imaging
- Imbalances in brain chemicals, eg Parkinson’s disease
- Ethical issues raised by the Human Genome Project and genetically modified organisms

Core practicals
- Investigating habituation to a stimulus

UNIT 6: Practical Biology and Investigative Skills

Students should undertake a variety of practical work and investigations during the AS and A2 course to develop their practical skills and extend their knowledge of useful procedures and techniques.

To prepare students effectively for this paper it is essential that centres provide opportunities for students to plan investigations, implement their plans, collect data, analyse their data, draw conclusions and evaluate their findings. It will be helpful to students for centres to approach the practical procedures and techniques named in the specification in the context of simple investigations rather than as isolated skills.
The Specification

All biology specifications incorporate the Ofqual Science criteria published in 2007. The criteria are designed to ensure:

- integration of How Science Works
- reduced assessment burden
- increased participation in post-16 study

FAQs

What is the difference between the International Advanced Level (IAL) specification and the current GCE specification?

The IAL specification is made up of 6 units which are examined by externally marked written papers while the current 2008 GCE specification is made up of 6 units, 2 of which are internally assessed coursework/practicals.

Also, the IAL examinations are available in January and June while the GCE examinations are available in June only.

Another difference is that IALs are regulated by Pearson, therefore the award is IAL while GCEs are regulated by Ofqual and the award is GCE.

Which award will a student receive if he/she completes written papers for the AS course and completes a coursework/practical assessment in the A2 course?

The student will be awarded an IAL.

Are there any content or structural changes in the IAL specification?

No. There are no changes to content or structure, so teachers can carry on planning and teaching in the normal way.

If a student has already completed some GCE units, would it be possible to combine them with IAL units to complete an IAL award?

Yes. HOWEVER, only relevant GCE units which have been banked up to and including June 2013 can be used in combination with IAL units for a full IAL award. This service is available until June 2015 only.
How many times can a student re-sit a unit examination?

A student can re-sit a unit examination once i.e. each unit examination can be taken twice and the higher of the two marks will be used to calculate the overall subject grade.

How can I take a contemporary route through the specification?

The specification is designed to enable students to engage with modern and up-to-date issues in biology, irrespective of the approach taken.

How do I attempt practicals and how much do students need to do in order to succeed in the examination?

Recommended core practicals are provided for each unit. Extensive support is offered for students, teachers and technicians relating to the core practicals. Practical-related questions will be asked in the written exams.

What is ‘How Science Works’ and how does it affect the new specification?

How Science Works is a section of the Advanced Level Science criteria, building on the Key Stage 4 Programme of Study for science, so that students continue to develop an understanding of the scientific process, the development of models and theories to explain scientific phenomena, and all the factors surrounding the advance of scientific knowledge. This allows students to understand the wider applications and implications of biology.
Course planner

This course planner has been developed to help you plan the organisation and delivery of the course.

You can use the course planner to plan your course delivery in outline. The timings are based on a two-year course but they can easily be adapted for one-year courses.

<table>
<thead>
<tr>
<th>Week number</th>
<th>Examined content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
</tr>
<tr>
<td>1–7</td>
<td>Unit 1, Topic 1: Lifestyle, health and risk</td>
</tr>
<tr>
<td>8–14</td>
<td>Unit 1, Topic 2: Genes and health</td>
</tr>
<tr>
<td>15</td>
<td>Revision/Examination series</td>
</tr>
<tr>
<td>16–22</td>
<td>Unit 2, Topic 3: The voice of the genome</td>
</tr>
<tr>
<td>23–29</td>
<td>Unit 2, Topic 4: Biodiversity and natural resources</td>
</tr>
<tr>
<td>30–31</td>
<td>Revision and AS exams</td>
</tr>
<tr>
<td>32–34</td>
<td>Unit 4, Topic 5: On the wild side (start)</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
</tr>
<tr>
<td>1–4</td>
<td>Unit 4, Topic 5: On the wild side (continued)</td>
</tr>
<tr>
<td>5–12</td>
<td>Unit 4, Topic 6: Infection, immunity and forensics</td>
</tr>
<tr>
<td>13–14</td>
<td>Revision/Examination series</td>
</tr>
<tr>
<td>15–21</td>
<td>Unit 5, Topic 7: Run for your life</td>
</tr>
<tr>
<td>22–28</td>
<td>Unit 5, Topic 8: Grey matter</td>
</tr>
<tr>
<td>31–35</td>
<td>Revision and A2 exams</td>
</tr>
</tbody>
</table>
Getting started for students

Student guide

What will I learn?

In biology you will develop practical skills, by planning experiments, collecting data, analysing experimental results and making conclusions. You will also learn how scientific models are developed, the applications and implications of science, the benefits and risks that science brings and the ways in which society uses science to make decisions.

Unit 1: Lifestyle, transport, genes and health

What makes heart disease so common? You will learn more about the circulatory system and the kinds of lifestyle choices, such as diet and exercise, that put you more, or less, at risk of suffering from heart disease.

You will find out how some parts of the body work, for example, about the lungs and how materials are transported around the body, and the role of enzymes.

You will also learn about genetics and what can happen if errors occur during the replication of DNA, considering the social and ethical issues raised by genetic screening and gene therapy.

Unit 2: Development, plants and the environment

Do you know how you came to have your natural hair colour? You will learn that your physical characteristics have been determined by your genetic makeup and influenced by the environment. In doing so, you will learn some cell biology, about the two main types of cell division and the purpose of each type, and about sexual reproduction.

Have you also ever wondered how there came to be so many different types of organisms in the world, ranging from microscopic organisms such as viruses to huge mammals such as whales? This unit explains the term biodiversity, and also the concept of natural selection and how it can lead to adaptation which drives evolution.

In this unit you will also learn about plants and their structure, and how the properties of some plants may be used to tackle issues such as sustainability.
Unit 3: Practical biology and research skills

Students are expected to develop experimental skills, and a knowledge and understanding of experimental techniques, by carrying out a range of practical experiments and investigations covered in Units 1 and 2.

This unit will assess students’ knowledge and understanding of experimental procedures and techniques that were developed when they did those experiments.

Unit 4: The natural environment and species survival

Global warming and climate change are buzzwords that appear in media headlines and have been the source of much controversy and political divide. So which side are you on and why? You will learn about the different types of evidence for global warming and the possible causes of it, and the effect it will have on animals and plants. You will also learn about ecology, photosynthesis and speciation.

This unit covers the fascinating area of immunology — the war that goes on between our immune system and pathogens. You will learn what defences the body has against invading pathogens and how some micro-organisms, such as *Mycobacterium tuberculosis*, can get the better of us by attacking our defences.

You will have the opportunity to look into the world of the forensic scientist and appreciate the application of scientific knowledge in this context.

Unit 5: Energy, exercise and coordination

All mammals, including humans, have similar physiologies that facilitate movement. Why is it rare to find an athlete who is both a sprinter and a marathon runner? In this unit you will build on your knowledge about joints and movement, and learn more about the precise mechanism of skeletal muscle contraction, respiration and homeostasis in the context of exercise.

The brain is the most complicated, and probably least understood organ in the body. It has the complex task of coordinating our bodily functions and movement, making sense of all the sensory information it receives, as well as storing our thoughts, emotions and memories. As the brain is such a complicated and vital organ, there is a lot of potential for it to go wrong which can have drastic effects on the health of the person. You will also look at the effects of disease and drugs on the brain and how these effects, in turn, affect the body and the mind.
Unit 6: Practical biology and investigative skills

Students are expected to develop a wide knowledge and understanding of experimental procedures and techniques throughout the whole of their Advanced Level course. They are expected to become aware of how these techniques might be used to investigate interesting biological questions.

This unit will assess students’ knowledge and understanding of experimental procedures and techniques and their ability to plan whole investigations, analyse data and to evaluate their results and experimental methodology.
How will I be assessed?

Assessment at AS Level
All Units are externally assessed written examination papers, each lasting 90 minutes. The papers will contain objective questions, short questions and longer questions.

Assessment at A Level
All Units are externally assessed written examination papers. Units 4 and 6 last 90 minutes; Unit 5 lasts 105 minutes. The papers will contain objective questions, short questions and longer questions.

Is this the right subject for me?

AS and A level Biology is suitable if you:
- have an interest in, and enjoy biology and want to find out about how things work in the biological world by the application of imaginative, logical thinking
- want to use biology to progress onto further studies in Higher Education or support other qualifications or enter biology-based employment
- are taking A levels in the other sciences and/or mathematics or other relevant courses such as Physical Education and want to take another course that will support those studies.

What can I do after I’ve completed the course?
Biology leads on to a wide range of courses and careers. This could include:
- an undergraduate degree in a life sciences, medicine, environmental science, forensic science and related courses or a BTEC Higher National (HNC and HND)
- employment, for example in the areas of biological testing, biotechnology, independent research and the food industry.

To find out more talk to your biology teacher and visit your careers office or www.iob.org for further information on careers and courses in biology. For the full specification check www.edexcel.com/ial