



SCIENCE RESOURCES

About BIOZONE

Inspiring better outcomes for our planet through science education.

BIOZONE has more than 30 years' experience in the development of engaging and effective resources for science teaching and learning.

Our resources are unlike any you've seen before, and a departure from the traditional basal textbook paradigm. We take a 'worktext' approach, combining the very best features of a traditional textbook with an interactive workbook. The resulting hybrid provides well designed, compact lessons that engage students and provide a rigorous, yet accessible, programme of work

Our extraordinary suite of resources meets the challenges of teaching today's students, whether they be in a traditional classroom environment, an informal teaching setting or learning remotely.

BIOZONE is renowned for its engaging presentation of content with a strong visual appeal.

Our expert writers bring science to life through the use of real-world examples in both content and assessment. We continually revise and improve on our resources to ensure they remain current and relevant to your needs. Part of this process is engaging with you, as teachers, and valuing your feedback.

By their innovative design, our resources encourage student interaction, using simple investigations and data analysis to engage students in the science around them. Innovative strategies to encourage critical thinking and problem-solving help your students develop the 21st-century skills they need to succeed.

**Pictured: The Milky Way
from Lake Tekapo in New Zealand**
*Image by Graham Holtshausen
on Unsplash*

Cover Image: Beta fish
Betta Splendens
*Photo by Blend Hell
from unsplash*

Our Writing Team



Jill Mellanby MLIS; BSC(hons); PGCE(Sec); Dip. Pub.

Jill began her science career with a degree in biochemistry and, after a short spell in research labs, became a science teacher both in the UK and then New Zealand. She spent many years managing the Royal Society of New Zealand's academic publishing programme of eight science journals which allowed her to hone her project management and editorial skills. She was also a part of the Expert Advice writing team at the Royal Society of New Zealand, producing science pieces for a public audience. She joined the **BIOZONE** team in late 2021 as editor.



Lissa Bainbridge-Smith M.Sc (hons)

Lissa graduated with a Masters in Science (hons) from the University of Waikato. After graduation she worked in industry in a research and development capacity for eight years. Lissa joined **BIOZONE** in 2006 and is hands-on developing new curricula. Lissa has also taught science theory and practical skills to international and ESL students.



Sarah Gaze M.Ed., GradDipT (Sec), B.Sc.

Sarah has 16 years experience as a Science and Chemistry teacher, recently completing MEd. (1st class hons) with a focus on curriculum, science and climate change education. She has a background in educational resource development, academic writing, and art. Sarah has recently joined the **BIOZONE** team at the start of 2022.



Kent Pryor B.Sc, GradDipT (Sec)

Kent has a BSc from Massey University majoring in zoology and ecology and taught secondary school biology and chemistry for 9 years before joining **BIOZONE** as an author in 2009.

What's NEW at BIOZONE

The team at BIOZONE is excited to announce the latest additions to our catalogue. We have developed some creative solutions to assist teachers in the classroom and beyond.

Introducing eBook LITE and PLUS

You can now purchase our eBooks in different formats. eBook LITE provides an excellent addition to the print book for those looking for digital options, whereas eBook PLUS is the full featured version that provides all the functions of the eBook LITE version, PLUS interactive components and student answering online. Student answers may form a 'Record of Work'. See page 3 for details.

eBook LITE now with answers at the back!

You can now seamlessly access the Model Answers through your eBook LITE. Model Answers have been added to the end of our eBook LITE titles to make it even easier for students to complete self-revision and for teachers to refer to in their lesson planning. See page 3 for details.

Online Model Answers

Online Model Answers are accessible via a login that is unique to your school. The teacher's admin access gives you the ability to control how much and when students can view individual answers; ideal for supporting homework, revision and work on deeper understanding. See page 6 for details.

Love our products and purchase them every year?

We can offer your school discounted prices for multi-year purchases when purchased directly through **BIOZONE**. Contact us for more details sales@biozone.co.uk



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Pictured: Bullfinch
P. pyrrhula
Photo by Colin Davis
from Unsplash

What people are saying about our products...

“The Workbooks are closely linked to the IB Diploma syllabus, and every activity is relevant. The style of questioning closely matches Paper 2 (short answer) IB questions, and students quickly get used to writing a succinct, accurate response, with no ‘padding’.”

– Lesley, Head of Science - IB Biology

“BIOZONE is a brilliant resource, a one stop shop for the student”

“Recent discovery of the 3D models has been another gamechanger in how I can present to students.”

– Jonathan - AQA Biology

“This is really unlike any other workbook on the market right now. It provides great summaries of topics with questions at the end of each topic; which is very beneficial because you don’t have to keep flicking through another textbook while working on this one. At end of each section e.g. homeostasis you must write a review of all you have learned and then will be given a test. I feel like other workbooks such as CGP give you exam style questions, but they don’t really make sure you understand the topic. It doesn’t just feature questions, it teaches you how to make biological drawings and also has a really helpful maths section at the beginning covering pie charts, histograms, scatter charts, ratios, experiments etc...”

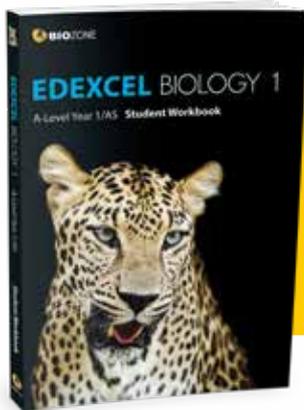
– Lawrence - AQA Biology

The Many Benefits of BIOZONE’s Resources

- A departure from the traditional basal textbook paradigm, instead taking a ‘worktext’ approach. Students write their answers directly into the book - thereby forming a ‘record of work’.
- Compact lessons engage students in learning and provide a rigorous, yet accessible program of work.
- Engaging presentation of content with visually appealing, high quality photographs and explanatory illustrations.
- Activities encourage student interaction and inquiry through simple ‘hands-on’ opportunities, real-world case studies, and data analysis.
- Resource suites are self-contained; there is no requirement for additional purchases or expensive kits.
- Titles are available in both print and digital formats.
- **BIOZONE’s** resources offer a cost effective solution for all budgets.
- We continually revise and improve our resources to ensure they remain current and relevant to your needs.
- Our expert writers bring science to life through the use of everyday and investigative phenomena from engagement to assessment.

Hybrid Learning

BIOZONE understands how hard it has been for you and your students to teach and learn remotely. Poor access to broadband, extra support, and learners being left behind are some of the current concerns of remote teaching. We want to show you how **BIOZONE** can help.



Print

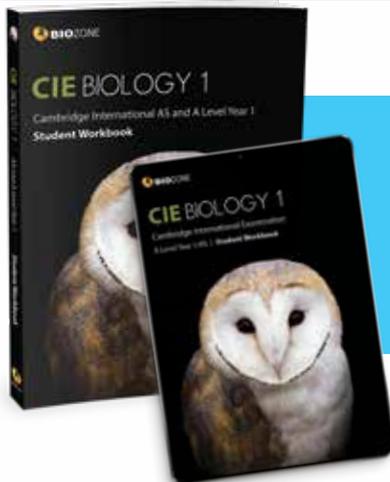
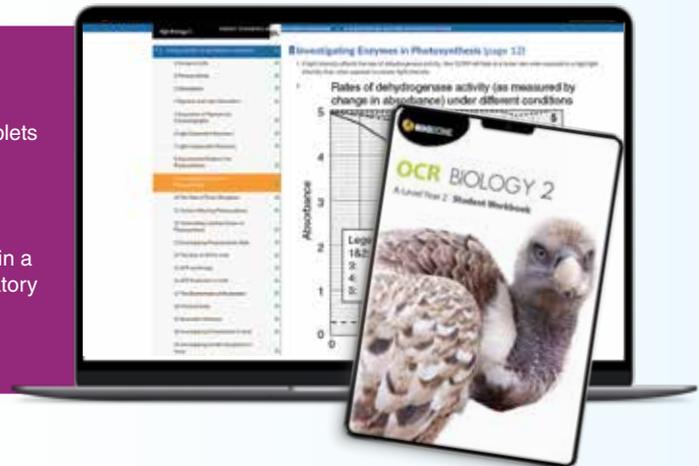
Students write their answers directly into the spaces provided in their BIOZONE print book – forming an important 'Record of Work'. If the teacher wants to grade or review student work remotely, students may be asked to write their answers into the school's own LMS. A great solution for no or limited broadband access.

Digital

eBooks provide the same content as the print books and function on both tablets and computers. The text-to-speech* functionality assists teachers who have students with a learning disability, or students who are learning English as a second language.

Online Model Answers contain fully worked answers to each of the activities in a teacher-controlled format. Designed to embed knowledge, with extra explanatory detail to support student understanding.

* Text-to-speech available on eBooks.



Hybrid Solutions

In a virtual classroom, it's difficult to monitor students who need extra support. Use a combination of both print and digital versions of the same BIOZONE book to provide your students with a rich and varied learning experience.

eBook LITE

Affordable Option *NOW with answers in the back!*

eBook LITE provides an excellent addition to the print book for those looking for low-cost digital options. See the full function list in the comparison table on page 5.



24 Dilution Plating

Key Idea: Dilution plating is a means to estimate culture density based on plate counts after a serial dilution. The number of colonies in a culture can be measured directly (e.g. by counting in a hemocytometer) or indirectly. Indirect methods require measuring culture dry weight or turbidity (light absorbance) to control for cell density.

Most cells are often very large, so most counting methods rely on counting a very small number of cells. A commonly used indirect method is serial dilution followed by plate counts. Dilution plating is used to count the total number of viable cells in a culture. The number of viable cells is determined by counting the number of colonies that grow on a plate.

Plate counts are widely used in microbiology. It is a quick method to count microorganisms. However, it requires some time to perform and is not suitable for high-throughput applications. It is also a labor-intensive method.

1. In the example of serial dilution above, use the equation provided to calculate the cell concentration of the original culture.

2. (a) Explain the term **viable count**.

(b) Explain why dilution plating is a useful technique for obtaining a viable count.

(c) Investigate an alternative technique, such as turbidimetry and identify how the technique differs from dilution plating.

Frequency (Hz)	L1 (m)	L2
256	0.33	5.0
364	0.23	7.0
440	0.20	8.0
512	0.16	9.0
625	0.14	10.0

eBook Teacher's Edition

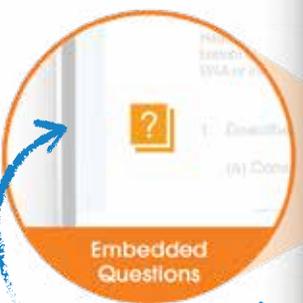
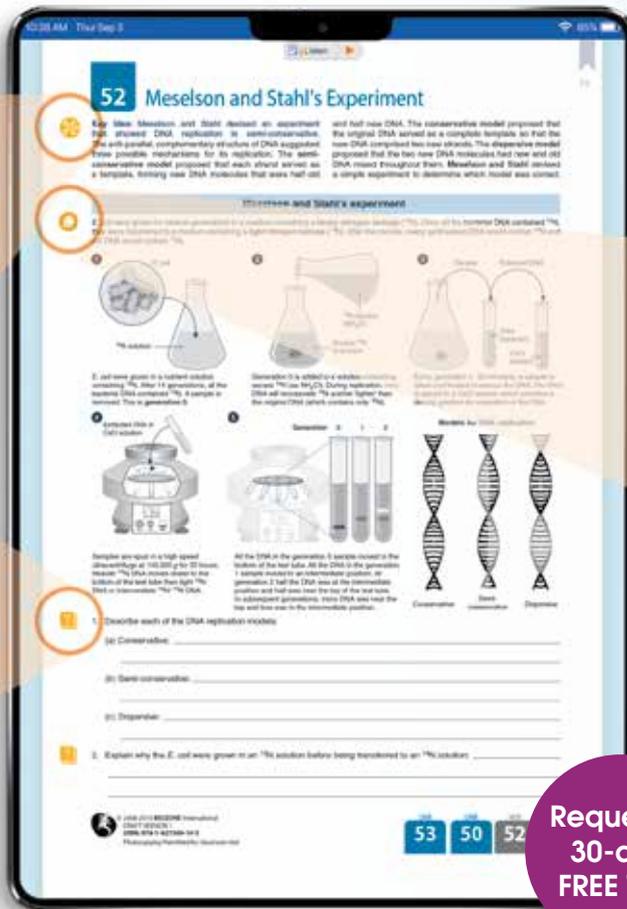
The Teacher's Edition contains all the features of the eBook PLUS, apart from the online student answering feature. In its place are the suggested answers provided by the publisher.

Designed to replicate our printed Teacher's Editions in a digital format. Teachers' eBooks are compatible with both eBook LITE and PLUS Student Editions.

eBook PLUS

Full-Feature Option

This full-featured version of our eBooks provides all the functions of the eBook LITE version, PLUS the interactive components and **student answering online**. Student answers may form a 'Record of Work' and you may choose to grade a selection of activities. See the full function list in the Comparison Table on page 5.



Students answer questions online to be viewed or graded by their teacher

Request a 30-day FREE Trial

BIOZONE.co.uk/ebooks

Get the BIOZONE eBooks Reader App

Our eBook Reader App allows each eBook to be downloaded to the device for offline access, minimise bandwidth required at home. However, interactive elements, such as questions and homework, still require internet connection to function.

Our eBooks Reader App is available for use on tablets.



Questions? sales@biozone.co.uk

Compare BIOZONE's eBooks

School Managed Licenses

	eBook LITE	eBook PLUS	eBook Teacher's Edition
Embedded Publisher Questions: Students can answer questions online	-	✓	-
Additional Teacher & Student Offline Resources: Activities that require graphing, drawing, model making, Offline PDFs and spreadsheets	-	✓	-
Embedded Resource Hub: Links to YouTube videos, web links, spreadsheets, 3D models, online simulations	-	✓	✓
Answers in Place: See all of the suggested answers for each activity	-	-	✓
Answers in the back - NEW!	✓	-	-
User Notes, Drawing and Mark-up Tools	✓	✓	✓
Disability Support: Read Aloud (Text-to-Speech)* English only	✓	✓	✓
Selected Text: Colour highlight, Dictionary definition, Access Google search, Access Wikipedia lookup	✓	✓	✓

Need Technical Support?

BIOZONE offers several methods of support to help guide you through the eBooks platform

Knowledge Base

Check out our Knowledge Base with Articles, Short Video Tutorials and FAQs that you can use to quickly answer any questions and troubleshoot your issues.

👍 ebookshelp.thebiozone.com

Training Platform

We created a set of videos designed for our first-time users that will walk you through the eBooks platform and its features.

📺 biozone.co.uk/ebooks/training/

Technical Support

Our helpful IT support team is always happy to help with your queries. We supply dedicated support and reply within 24 hours.

👤 support@biozone.co.uk

FREE 30 day trial for our eBooks

With our 30 day FREE trials you get to try out all available eBooks for your selected title. That means you can compare our eBook PLUS, LITE and Teacher's Edition eBooks if they are available for purchase.

Online Model Answers - How it works

FREE*
with class
sets!

School gets a single teacher administrator login (that can be shared with all teachers) to activate which answers are visible to students

Activity page thumbnail from the student book.

ACTIVITY NUMBER AND TITLE

INDEX SYSTEM

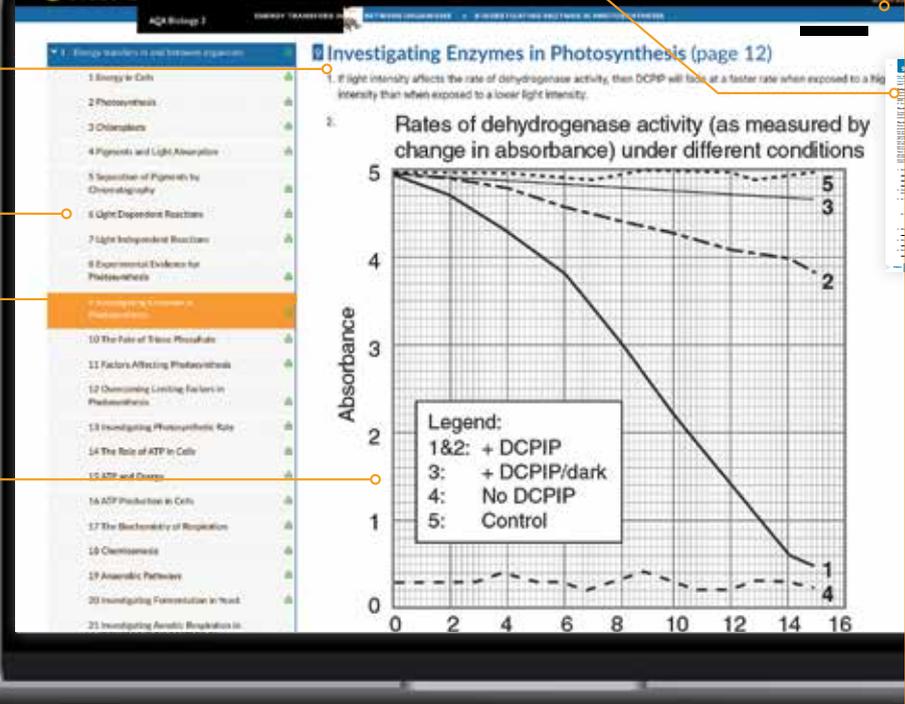
The index system is used to jump to the required answers.

PADLOCK

Teachers can activate the answers to one activity or a whole chapter with just one click. Once an answer has been activated by the teacher, it is available to all students, in all classes, for that school.

SUGGESTED ANSWERS

Students access the available answers with extra explanatory detail to support understanding. You will be provided with a student login that is unique to your school.



BIOZONE's Online Model Answers help to support your use of our workbooks with:

- Fully worked answers to each of the activities – to embed knowledge
- Extra explanatory detail – to support understanding
- Providing a great tool for teachers to support students with remote learning

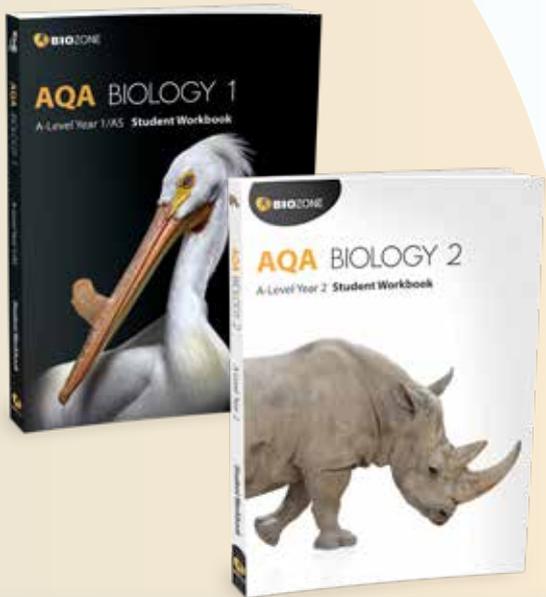
Online Model Answers are accessible via a login that is unique to your school. The teacher's admin access gives you the ability to control how much, and when, students can view individual answers – ideal for supporting homework, revision and work on deeper understanding.

*Terms and Conditions

1. Unless renewed your license to online model answers will expire **14 months** from date of purchase.
2. Available only with class sets of accompanying titles.
3. Not for individual sale.
4. Only available through BIOZONE directly.
5. All products published by BIOZONE Learning Media (UK) Ltd are subject to copyright law and MAY NOT BE PHOTOCOPIED, duplicated, or put into any electronic medium, in part or whole, without the written permission of BIOZONE Learning Media (UK) Ltd.

Please note: If you have purchased a class set via a reseller, contact us with proof of purchase.

Find out more: sales@biozone.co.uk



AQA Biology 1&2 Student Workbooks

RRP (per book) £16.99

Volume Discount Price £10.99 **

AQA Biology 1 ISBN: 978-1-927309-19-3

AQA Biology 2 ISBN: 978-1-927309-20-9

BIOZONE's AQA Biology student workbooks have been written for the AQA AS and A Level Biology.

Clear diagrams and explanations, straightforward language, and targeted learning outcomes, drawn from the specification content, accompany a variety of questions and tasks to create an innovative resource that encourages achievement in students of all abilities. AQA Biology Student Workbooks are well suited for classroom or homework use, independent study, review, exam preparation, and extension.

Features

- **Varied, engaging activities.** Provide ample opportunity for students to explore and test their understanding of the specification content
- **Clear specification Map.** The workbook structure follows the specification, with a variety of engaging contexts providing relevance to today's learners.
- **Scaffolded learning.** The concept-based approach provides a scaffold for student learning. A wealth of illustrative examples support required content and build knowledge and skills.
- **Support for practical and mathematical skills.** Activities supporting mathematical and practical skills, including the 12 required practicals, are provided in a dedicated chapter and integrated throughout.
- **Clear learning outcomes.** Learning outcomes outline the knowledge and skills that students must acquire, with additional guidance, as appropriate.
- **Scientific literacy.** Confidence is developed through targeted activities.
- **Unique tab system.** BIOZONE's unique tab system identifies relevant online resources and connections to related concepts across the entire specification.

 Student Edition (Print)

Digital Formats

 eBook LITE

 eBook PLUS

Teacher Support Material

 Classroom Guide (Download)

 Model Answers (Print)

 Digital Teacher's Edition

Student Support Material

 Weblinks

 Online Model Answers

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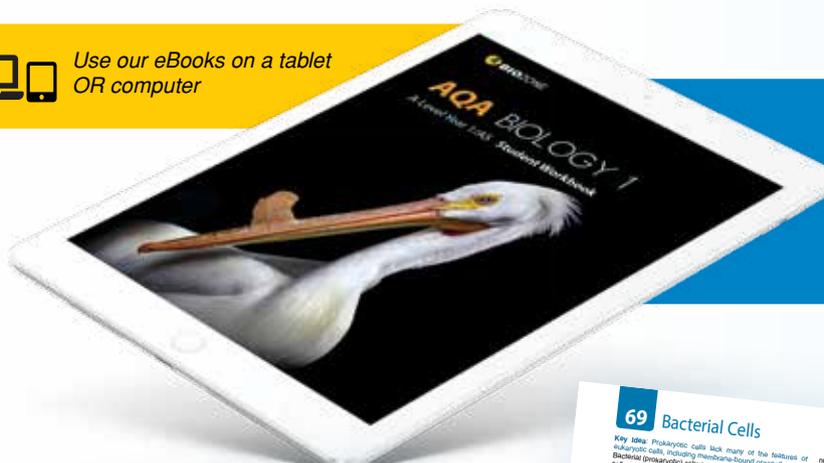
* ALL prices exclude any applicable VAT and shipping.

** Discount pricing is for purchases of over 10 copies of a single title directly from BIOZONE.

Teacher support materials are for teacher purchase only and will not be sold to students. Teachers' Editions can only be purchased when ordering a class set of 10+ student editions of the same title.



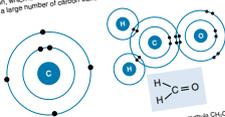
Use our eBooks on a tablet
OR computer



Two eBook options available:
eBook LITE
eBook PLUS
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30 Organic Molecules

Key Idea: Organic molecules are those with carbon-hydrogen bonds. They make up most of the chemicals found in living organisms and can be portrayed as formulae of molecules. Molecular biology is a branch of science that studies the molecular basis of biological activity. All life is based around carbon, which is able to combine with many other elements to form a large number of carbon-based (or organic) molecules.



A carbon atom (above) has four electrons that are available to form up to four covalent bonds with other atoms. A covalent bond forms when two atoms share a pair of electrons. The number of covalent bonds formed between atoms in a molecule determines the shape and chemical properties of the molecule.

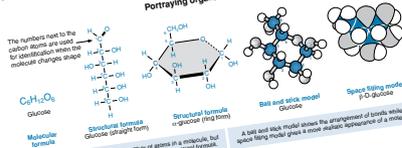
Specific groups of atoms, called functional groups, attach to a C-H core and determine the specific chemical properties of the molecule. The organic macromolecules (large complex molecules) that make up living things can be grouped into four classes: carbohydrates, lipids, proteins, and nucleic acids. This diagram (bottom) illustrates some of the common ways in which organic molecules are portrayed.

Organic macromolecule	Structural unit	Elements
Carbohydrates	Sugar molecules	C, H, O
Proteins	Amino acid	C, H, O, N, S
Lipids	Fat	C, H, O
Nucleic acids	Nucleotide	C, H, O, N, P

Molecular (empirical) formula CH₂O is a simple organic molecule. A carbon (C) atom bonds with two hydrogen (H) atoms and an oxygen (O) atom. In the structural formula (left box), the bonds between atoms are represented by lines. Covalent bonds are very strong, so the molecules formed are very stable.

The most common elements found in organic molecules are carbon, hydrogen, and oxygen. But organic molecules may also contain more elements, such as nitrogen, phosphorus, and sulfur. Most organic macromolecules are built up out of repeating units or building blocks. In fact, lipids are only chains of glucose.

Portraying organic molecules



The molecular formula expresses the number of atoms in a molecule, but does not convey its structure. This is indicated by the structural formula.

- Study the table above and state the three main elements that make up the structure of organic molecules.
- Study the table above and state the three main elements that make up the structure of organic molecules.
- Name two other elements that are also frequently part of organic molecules.
- (a) On the diagram of the carbon atom top left, mark with arrows the electrons that are available to form covalent bonds with other atoms.
- (b) State how many covalent bonds a carbon atom can form with neighbouring atoms.
- Distinguish between molecular and structural formulae for a given molecule.

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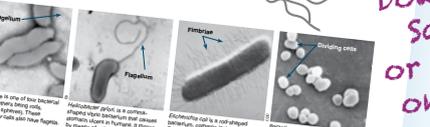
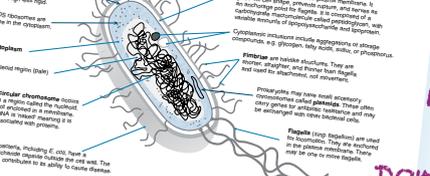
31 30 KNOW

DIGITAL TEACHER'S EDITION

The Digital Teacher's Edition includes suggested answers on each page in an interactive HIDE/SHOW format, making it suitable for use with an interactive whiteboard.

69 Bacterial Cells

Key Idea: Prokaryotic cells lack many of the features of eukaryotic cells, including membrane-bound organelles. Bacteria (prokaryotic) cells are much smaller than eukaryotic cells and lack many eukaryotic features, such as a distinct nucleus and membrane-bound cellular organelles. The cell structure and has a role in the organism's ability to cause disease. A generalized prokaryote, *E. coli*, is shown below.

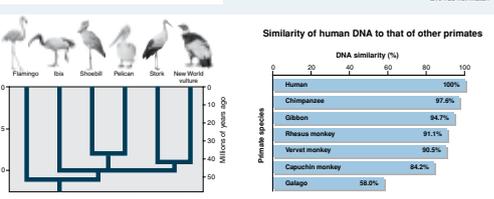


- Describe three features distinguishing prokaryotic cells from eukaryotic cells:
 -
 -
 -
- Describe the function of flagella in bacteria.
 - Explain how flagella differ structurally and functionally from cilia.

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or check out the
online preview
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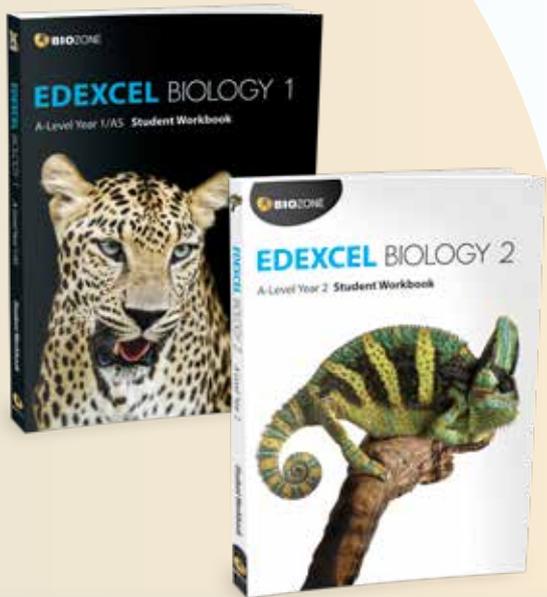
more widely used to compare genomes, although DNA-DNA hybridisation is still used to help identify bacteria.



The relationships among the New World vultures and storks have been determined using DNA hybridisation. It has been possible to estimate how long ago various members of the group shared a common ancestor.

- Explain how DNA hybridisation can give a measure of genetic relatedness between species:

- Study the graph showing the results of a DNA hybridisation between human DNA and that of other primates.
 - Which is the most closely related primate to humans?



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 Classroom Guide (Download)

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 Online Model Answers

EDEXCEL Biology 1&2 Student Workbooks

RRP (per book) £16.99

Volume Discount Price £10.99 **

EDEXCEL Biology 1 ISBN: 978-1-927309-25-4

EDEXCEL Biology 2 ISBN: 978-1-927309-26-1

BIOZONE's EDEXCEL Biology student workbooks have been written for the EDEXCEL Level 3 AS and A Level specifications for Biology B.

Clear diagrams, concise explanations, and targeted learning objectives accompany a variety of questions and tasks to create an innovative resource that encourages achievement in students of all abilities. EDEXCEL Biology Student Workbooks are well suited for classroom or homework use, independent study, review, exam preparation, and extension.

Features

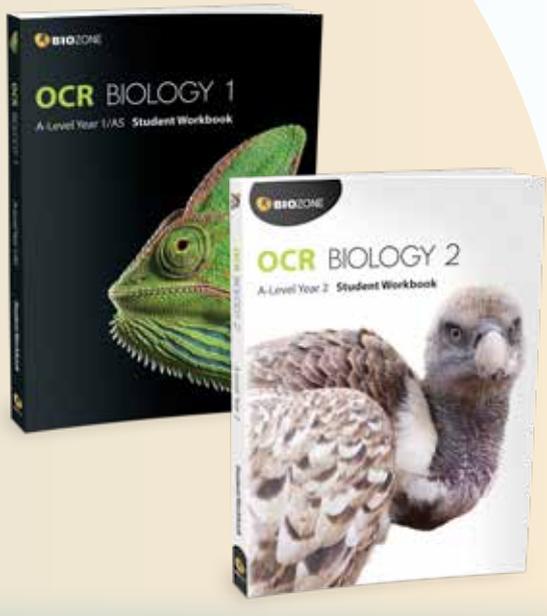
- **Varied, engaging activities.** 400+ activities provide ample opportunity for students to explore and test their understanding of the specification content
- **Easy to follow.** The workbook structure follows the topic order of the specification, providing a variety of real-world contexts within which to develop knowledge, skills, and understanding.
- **Scaffolded learning.** The concept-based approach provides a scaffold for student learning. A wealth of illustrative examples support required content and build knowledge and skills.
- **Support for practical and mathematical skills.** Activities supporting mathematical and practical skills, including the 16 required practicals, are provided in a dedicated chapter and integrated throughout.
- **Clear learning outcomes.** Learning outcomes outline the knowledge and skills that students must acquire, with additional guidance as appropriate.
- **Scientific literacy.** Confidence is developed through targeted activities.
- **Unique tab system.** BIOZONE's unique tab system identifies relevant online resources and connections to related concepts across the entire specification.

See price list for pricing information at:
www.biozone.co.uk/pricelist

* ALL prices exclude any applicable VAT and shipping.

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OCR Biology 1&2 Student Workbooks

RRP (per book) £16.99

Volume Discount Price £10.99 **

OCR Biology 1 ISBN: 978-1-927309-13-1

OCR Biology 2 ISBN: 978-1-927309-14-8

BIOZONE's OCR Biology student workbooks have been written for the OCR Level 3 AS and A Level specifications for Biology A.

Clear diagrams and explanations, straightforward language, and targeted learning outcomes drawn from the specification content accompany a variety of questions and tasks to create an innovative resource that encourages achievement in students of all abilities. OCR Biology Student Workbooks are well suited for classroom or homework use, independent study, review, exam preparation, and extension.

Features

- **Varied, engaging activities.** Provide ample opportunity for students to explore and test their understanding of the specification content
- **Clear specification map.** The workbook structure follows the specification, with a variety of engaging contexts providing relevance to today's learners.
- **Scaffolded learning.** The concept-based approach provides a scaffold for student learning. A wealth of illustrative examples support required content and build knowledge and skills.
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223 Interpreting the Fossil Record

Key Idea: Fossils provide a record of the appearance and extinction of organisms. The fossil record can be used to establish the relative order of past events.

Fossils provide a record of the appearance and disappearance of organisms over time. Rock layers (strata) are arranged in the order of deposition (unless they have been disturbed by geological events). Strata from adjacent locations can be correlated because a particular stratum at one location is the same age as the same stratum at a different location. Placing the strata in a sequential (relative) order of past events in a rock profile allows scientists to provide relative dates of past events, but it can not provide an absolute date for an event.

The formation of rock strata

The Earth's landscape has been shaped over a very long time through natural geological processes that continue today. Over time, layers of sedimentary rock, silt, or lava were deposited. Heavier layers were deposited on top of older layers so that the heaviest layers became buried. Layers are usually deposited horizontally and remain as they have been deposited by the order of deposition (unless they have been disturbed by geological processes such as erosion, folding or erosion).

Gaps in the fossil record

One of the difficulties with interpreting the fossil record is that it contains gaps. Without a complete record, it can be difficult to establish the evolutionary history of a taxon. There are several reasons for gaps in the fossil record, including:

- Organisms are only preserved as fossils under certain conditions in the preservation environment.
- Fossils are often destroyed or obscured through changes in the preservation environment.
- Some organisms do not fossilise well. The record is biased towards organisms with hard parts.

Profile with sedimentary rocks containing fossils

Recent fossils are found in more recent strata. The layer of rock that most recent fossils are found in is called the fossiliferous layer. Fossiliferous layers often contain fossils in other layers.

Extend outside the number of extinct species is far greater than the number of species living today.

Many primitive fossils are found in older sedimentary rocks. Fossils in older layers tend to have more generalised forms in contrast, organisms are today have specialised forms.

Each rock layer (stratum) is unique in terms of the type of rock, sedimentary or volcanic and the type of fossils it contains.

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231 Adaptation

Key Idea: Adaptations are inherited traits that have evolved and help maintain natural selection. They have a functional role in an organism's life and enhance an individual's fitness. An adaptation (or adaptive trait) is any heritable trait that exhibits an organism's functional position in the environment of behaviour and reflect ancestry as well as adaptation.

Ear length in rabbits and hares

The earliest sites of many mammals are used as important organs to assist in thermoregulation (controlling heat and cold of their body). The ears of rabbits and hares serve to cool, dry climates such as the high altitude of the Rocky Mountain USA. The Arctic hare lives in a cool climate of Alaska, northern Canada and Greenland, but has ears that are relatively large. This reaction to the use of the ear's surface area, heat and heat loss is typical of cold climate species.

Body size in relation to climate

Regulation of body temperature requires a large amount of energy and mammals exhibit a range of structural and physiological adaptations to increase or decrease heat loss. One of the most important of these is the production of an insulating layer of fat, called blubber, which reduces heat loss by preventing conduction. Mammals living in cold climates have a thicker layer of fat, which is more effective at preventing heat loss to the environment. Animals in colder regions therefore conserve heat by reducing the surface area exposed to the environment. Cold adapted species also tend to have more compact bodies and shorter limbs than their counterparts in hot climates.

Number of horns in rhinoceroses

Not all differences between species can be explained by natural selection. Some differences are due to genetic drift and random events, and these differences are not necessarily adaptive. The number of horns in rhinoceroses is an example of this. The relationship between the number of horns and the size of the rhinoceros is not necessarily adaptive. The number of horns is determined by the number of horns that are inherited from the parents.

Adaptation to environment

1. Distinguish between adaptive (genetic) and acclimatisation.

2. Explain the nature of the relationship between the length of extremities (such as limbs and ears) and climate.



220 **223** **KNOW**

1. Discuss the importance of fossils as a record of evolutionary change over time:

2. Why can gaps in the fossil record make it difficult to determine an evolutionary sequence?

231 **KNOW**

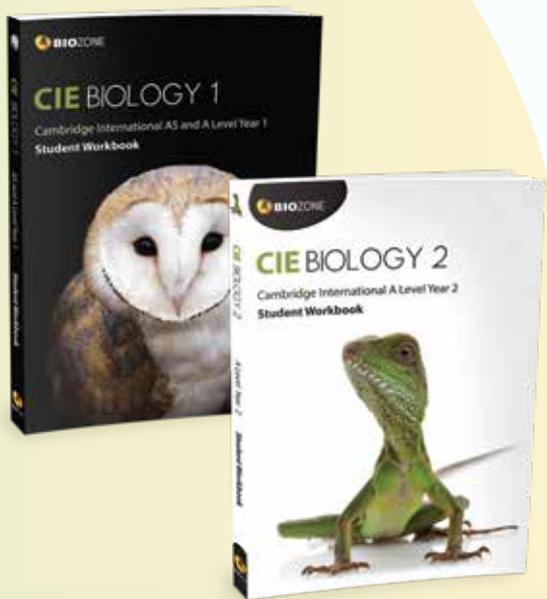
Malaria in humans is caused by various species of Plasmodium, a protozoan parasite transmitted by Anopheles mosquitoes. The inexpensive antimalarial drug chloroquine was used successfully to treat malaria for many years, but its effectiveness has declined since resistance to the drug was first recorded in the 1950s. Chloroquine resistance has spread steadily (above) and now two of the four Plasmodium species, P. falciparum and P. vivax are chloroquine-resistant. P. falciparum alone accounts for 80% of all human malarial infections and 90% of the deaths, so this rise in resistance is of global concern. New anti-malarial drugs have been developed, but are expensive and often have undesirable side effects. Resistance to even these newer drugs is already evident, especially in P. falciparum, although this species is currently still susceptible to artemisinin, a derivative of the medicinal herb Artemisia annua.

Chloroquine is a suppressive drug. It is only effective at killing the malarial parasite once the parasite has entered the blood-borne stage of its life cycle.

The use of chloroquine in many African countries was halted during the 1980s because resistance developed in P. falciparum. Recent studies in Malawi and Kenya have revealed a significant decrease in chloroquine resistance since the drug was withdrawn. There may be a significant fitness cost to the PfcRT mutants in the absence of anti-malarial drugs, leading to their decline in frequency once the selection pressure of the drugs is removed. This raises the possibility of reintroducing chloroquine as an anti-malarial treatment in the future.

1. Describe the benefits of using chloroquine to prevent malaria:

2. With reference to Plasmodium falciparum, explain how chloroquine resistance arises:



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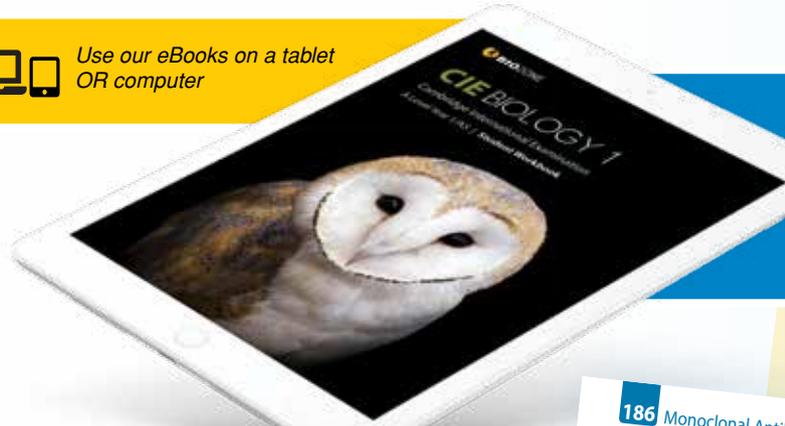
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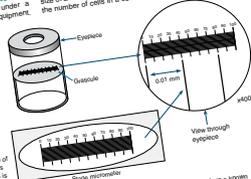
32 Measuring and Counting Using a Microscope

Key Idea: Graticules make it possible to measure cell size. Haemocytometers are used to count the number of cells. Measuring and counting objects to be viewed under a microscope requires precisely marked measuring equipment.

Measuring cell size

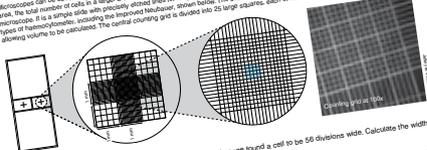
A graticule is a scale placed in the eyepiece of a microscope. It is usually about 1 mm long and divided into 100 equal units. A graticule is used in combination with a stage micrometer to work out the size of an object being viewed. The stage micrometer is a slide with a scale that is exactly 1 mm long and also divided into 100 divisions so that each division is 0.01 mm. This division is placed on the microscope stage so that a precise scale can be obtained as that a precise scale can be obtained at each magnification.

Two common pieces of equipment are the graticule and the haemocytometer. A graticule can be used to measure the size of an object whereas a haemocytometer is used to count the number of cells in a set area or volume.



Counting cells

Microscopes can be used as a tool to count cells or other small objects (e.g. pollen grains). By counting the number of cells in a known area, the total number of cells in a larger area can be calculated. A haemocytometer is commonly used to count cells viewed with a light microscope. It is a simple slide with precisely divided lines forming a grid and was developed for counting blood cells. There is a number of types of haemocytometers, including the improved Neubauer, shown below. The slide holds a coverslip 0.1 mm above the surface of the grid, so the volume to be calculated. The central counting grid is divided into 25 large squares, each of which is further divided into 16 smaller squares.



- A student using the graticule shown at the top of this page found a cell to be 56 divisions wide. Calculate the width of the cell in micrometres.
- A second student grew yeast cells in 5 cm³ of nutrient solution. The student used the haemocytometer shown above to count the number of yeast cells each day for 3 days.

Day	Area	Volume
Day 1		
Day 2		
Day 3		
- Calculate the area and volume of the grid shown in blue. Complete the table below based on the counts obtained.

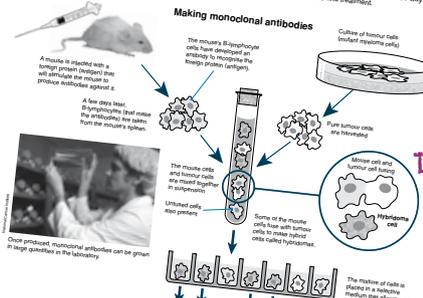
Number of cells counted	Area	Volume

- A biologist wished to know the number of pollen grains produced per anther by a flower with eight anthers. She cut the anthers and placed them in 5 cm³ of distilled water. Shaking this vigorously using a haemocytometer she counted 6 grains in the large central counting grid (1 x 1 mm). Calculate the total number of pollen grains produced per anther.

28 7 DATA

186 Monoclonal Antibodies

Key Idea: Monoclonal antibodies are artificially produced antibodies that neutralise specific antigens. They have wide applications in diagnosing and treating disease, in detecting pregnancy and in food safety tests. A monoclonal antibody is an artificially produced antibody that binds to and neutralises one specific type of antigen. A monoclonal antibody binds an antigen in the same way that a normally produced antibody does. Monoclonal antibodies



- Which mouse cells are used to produce monoclonal antibodies?

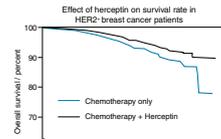
(b) What problem is associated with the use of mice to produce monoclonal antibodies?
- Which characteristic of tumour cells allows an ongoing culture of antibody-producing lymphocytes to be made?

(a) _____
- List four applications of monoclonal antibodies:

(a) _____

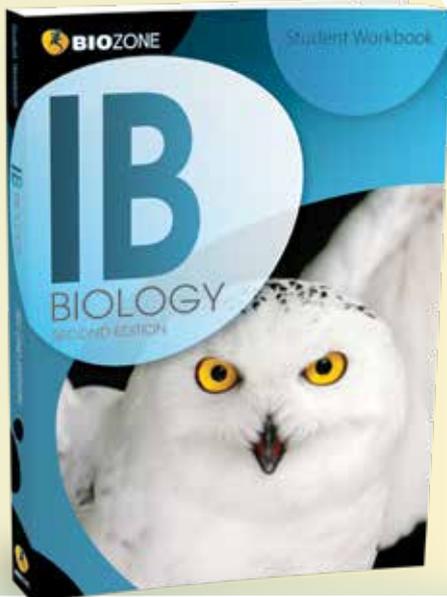
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1. (a) Why does the immune system not detect HER2⁺ cells as abnormal and destroy them? _____
- (b) How does Herceptin detect and destroy HER2⁺ cells? _____
- (c) Study the graph (right). What effect does Herceptin have on survival rates of women treated for HER2⁺? _____



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Features

- **Diagrams, illustrations and photographs.** Clear, uncomplicated diagrams, illustrations, and photographs support and reinforce the text.
- **Key ideas.** The introduction to each activity is prefaced by a key idea, summarizing the primary focus of the activity.
- **End of chapter synoptic activities.** End of chapter synoptic activities provide a means of self-testing or assessment. They focus on the understanding of content and vocabulary.
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- **Understandings, applications, and skills.** The understanding, applications, and skills required for each topic are summarised in a series of learning objectives that provide the IB learner with performance expectations. Key terms arising from these provide the basis of the literacy activities that conclude each topic.
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6 Multicellularity

Key Idea: Specialized cells and tissues arise through cell differentiation, which is regulated through differential gene expression. The complex interactions of cells in multicellular organisms results in the emergence of new properties. The cell is the functional unit structure from which living organisms are made. In multicellular organisms, cell specialization produces specialized cells with specific differentiation products specialized cells with specific functions. Cells with related functions associate to form tissues, and tissues are organized into organs. With each cell tissue, and tissues are organized into organs. With each cell tissue, and tissues are organized into organs. With each cell tissue, and tissues are organized into organs.

How cells in the mass of an organism's cells have the same genetic material, but the cells have a wide variety of shapes and functions? The answer is through cell differentiation.

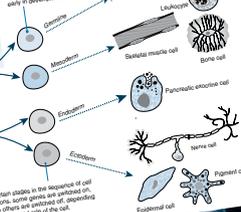
During development, the unspecialized stem cells of the zygote divide into germinal, endoderm, mesoderm, or ectoderm lines to form specialized cells. Although stem cells have the same genetic material (genes), differences in gene expression determine which line of cells forms. Once the developmental pathway of a cell is determined, it cannot then change into another cell type.

Zygote

The zygote (fertilized egg) has all the information stored in the chromosomes to make a complete human organism.

230 Different Cell Types

The cells that produce the gametes are sex cells in gametogenesis.



At fertilization in the zygote of cell divisions, some give rise to daughter cells that divide and differentiate on the divided side of the cell.



The contractile basement membrane in cells produce the emergent properties of mesoderm.

Muscle tissue displays the emergent properties of forceful contraction and extensibility (flexible) in original shape.

Muscle and other fibrous structural proteins form organs. The heart pumps, excretes, the emergent properties of contraction and relaxation and control of blood flow.

Digestive work together as organ systems. The circulatory system allows the emergent properties of circulation and exchange.

- Using examples, explain the concept of emergent properties: _____
- Explain how cellular differentiation allows a multicellular organism to carry out complex functions: _____

7 6 KNOW

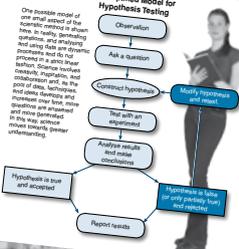
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318 The Scientific Method

Key Idea: The scientific method is a rigorous process of observation, measurement, and analysis that helps us to explain phenomena and predict changes in a system. Scientific knowledge grows through a process called the scientific method. This process involves observation and measurement, hypothesizing and predicting, and planning and executing investigations designed to test formulated hypotheses.

A Simplified Model for Hypothesis Testing



Forming a Hypothesis

- Features of a good hypothesis:**
- It is based on observations and prior knowledge of the system.
 - It offers an explanation for an observation.
 - It allows for a testable prediction.
 - It is written as a definite statement and not as a question.
 - It is testable by experimentation.
 - It leads to predictions about the system.

Testing a Hypothesis

- Features of a good method:**
- It is based on observations and prior knowledge of the system.
 - It is replicable.
 - It includes a control which does not receive treatment.
 - It includes a replication where possible.
 - The method includes a dependent and independent variable.
 - One independent variable is changed (manipulated) between treatment groups.

Hypothesis Involving Manipulation

Used when the ability to manipulate variables is a feature of the system.

Example: The concentration of sodium bicarbonate affects the rate of growth of algae A.

Hypothesis of Cause

Used when manipulating specific parameters, such as a nutrient level, type of microorganism, or the rate of flow.

Example: Microorganisms require 20% of water in preference to the type when feeding.

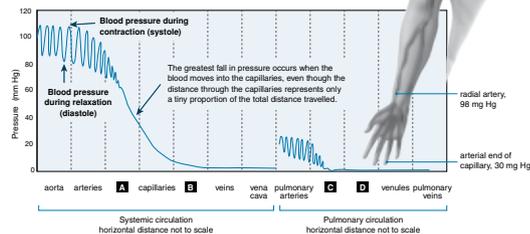
Hypothesis Involving Observation

Used when hypotheses are only tested in one natural environment where conditions cannot be changed.

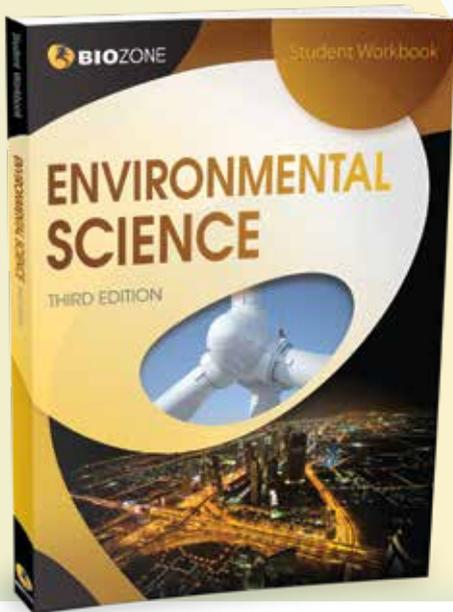
Example: Fern abundance is related to the amount of canopy.

- Why might an accepted hypothesis be rejected at a later date?
- Explain why a method must be replicable.

The pulmonary circuit must operate at a much lower pressure than the systemic circuit to prevent fluid from accumulating in the alveoli of the lungs. The left side of the heart must develop enough 'upward' pressure to enable increased blood flow to the muscles of the body and maintain kidney filtration rates without decreasing the blood supply to the brain.



- What is the purpose of the valves in the heart? _____
- The heart is full of blood, yet it requires its own blood supply. Suggest two reasons why this is the case: _____



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Anatomy and Physiology Student Workbook

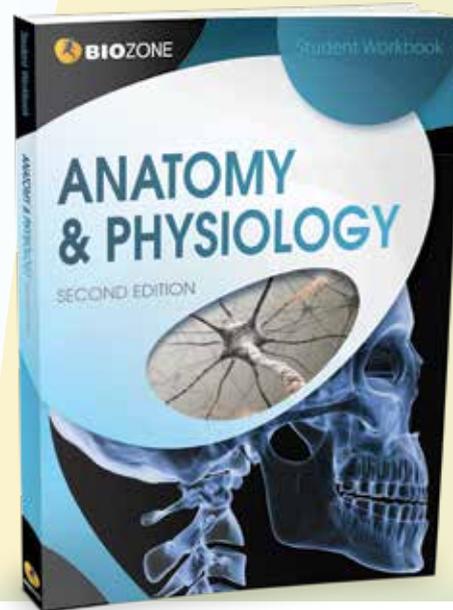
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BIOZONE's Anatomy and Physiology Student Workbook explores the essentials of human structure and function through engaging, generously illustrated write-on activities.

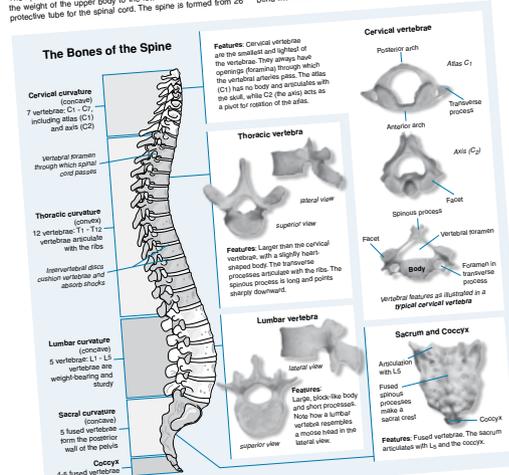
Homeostasis provides the unifying theme throughout the workbook and key interactions between body systems are indicated using annotated introductory figures.

Using key examples, students are encouraged to explore each body system within the contexts of disease, medicine and technology, ageing, and exercise. The result is a rounded exploration of the functioning human.



The Bones of the Spine

The spine supports the skull and shoulder girdle and transmits the weight of the upper body to the lower limbs. It also forms a protective tube for the spinal cord. The spine is formed from 26 vertebrae, separated and connected by discs of cartilage called the **intervertebral discs**. Together, the vertebrae form an S-shaped bend which brings the center of mass to the mid-line of the body.



- Identify the vertebrae associated with each of the following features:
 - Functional role in bearing much of the spinal load: _____
 - Articulate with the ribs. Vertebral body is heart shaped (highlight this on the diagram): _____
 - Articulates with the skull and lacks a vertebral body: _____
 - Typically has a small body and foramina (openings) in the transverse processes: _____
 - Forms the posterior wall of the bony pelvis: _____
- Suggest a function of the S-shape of the spine: _____
- At birth, the spine consists of 33 bones, 9 more than an adult. What happens to these extra bones? _____

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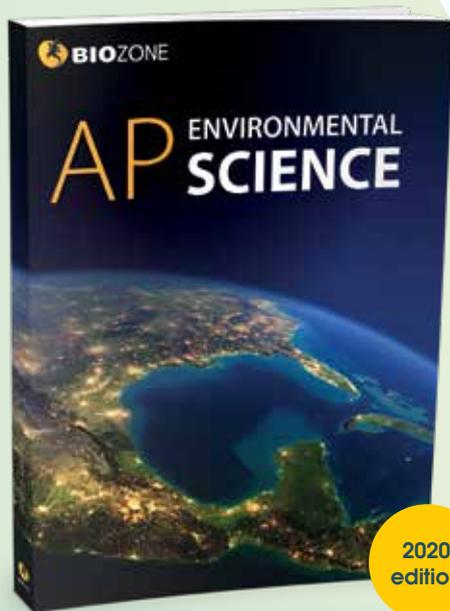
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ISBN: 978-1-98-856632-0

BIOZONE's AP Environmental Science is a dedicated title to address Advanced Placement Curriculum of the college board in the USA. This title takes a global perspective, examining the very latest issues concerning the environment, while still providing the foundation for students to understand and engage with the science involved. Current concerns in the global community, including wildfires, COVID-19, glacial retreat, and loss of biodiversity are examined, with the emphasis being on the interconnectedness of Earth's systems and the importance of ecosystem services. Using current case studies, student investigations, and data analysis.

BIOZONE's AP Environmental Science emphasises the application of knowledge to understanding the Earth's systems and identifying and analysing environmental problems and their solutions. This easily navigated resource addresses the two essential components of the course framework: science practices and course content. Its interdisciplinary approach and highly visual format encourage students to engage fully with the principles, ideas, and methodologies required to understand the natural world.

Key Features

- **Chapter summaries.** Chapter introductions provide a summary of required content, encapsulating the essential knowledge statements matched point for point.
- **Focussed questions.** Key questions provide the focus for each activity.
- **Inquiry based learning.** Student inquiry is supported through simple hands-on investigations (lab and field based).
- **Key ideas span topics.** The big ideas and science practices spiral across topics and units.
- **Up-to-date case studies.** Through current case studies, students identify and analyse natural and human-made environmental problems and evaluate solutions.
- **Codes create connections.** Concept and science practice codes help students make important connections across the whole program.
- **Personal Progress Checks** provide opportunity for formative assessment and prepare students for their AP exam.

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167 Wildfires

Key Question: What is the effect of global wildfires? The decade 2010 to 2020 saw an unprecedented increase in the number, area, and intensity of forest and bush fires around the world. Forest fires had always been part of nature, with fire seasons occurring every year. However, the past decade has seen fires being more frequent, especially after droughts, which themselves are becoming more frequent. Recent years have seen fires in the Alaskan and Siberian tundra which threaten to affect permafrost and fundamentally change the Arctic landscape.

Australian bush fires

The Australian bush fire season 2019-2020 (also known as the Black Summer) was a period of unusually intense bush fires throughout Australia.

The fire season normally begins around August, but began earlier in 2019. Major fires peaked between January 2020. An estimated 186,000 square kilometers of bush and cropland was destroyed.

Australia is particularly prone to intense bush fires but the fires of 2019-2020 came after a prolonged drought and higher than normal temperatures. Bush and forest fires would normally withstand or be a barrier to large fires were particularly dry and so burned.

Australian bush fires often occur near populated regions and present a particular hazard to those living nearby. Five fires in more extremely populated areas caused by lightning, fire trucks, helicopters, and planes employed to control the fires.

Most of the fires in Australia are caused by lightning, and so are not linked to deforestation by human or logging.

The fires have had a particularly devastating effect on Australian wildlife. Experts estimate more than a billion mammals, birds, and reptiles were killed in the 2019-2020 season. Quilts from destruction and bird added to the large number of animal deaths from the fires. Kangaroo Island, an important habitat for a number of native and endangered species was severely affected, with not only releasing the carbon dioxide, but also the forest's ability to absorb it.

In December 2019, NASA estimated the fires had emitted over 200 million tonnes of carbon dioxide. The damage from the fires and only releases the carbon dioxide, but also the forest's ability to absorb it.

Some cases, the fires are set to clear debris after land has been logged, and so are not the direct cause of deforestation. Some areas naturally from lightning strikes. However, since the world is warming, the results of these lightning strikes are becoming more frequent, especially after droughts, which themselves are becoming more frequent. Recent years have seen fires in the Alaskan and Siberian tundra which threaten to affect permafrost and fundamentally change the Arctic landscape.



Smoke from Australian bush fires as seen from the ISS



Kangaroo Island fire (1)



Kangaroo Island fire (2)

Scopelog Mountain fire NSW



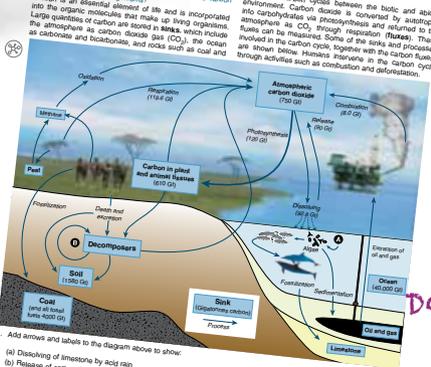
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Additional enrichment for both striving and gifted/ talented students. The hub provides links to third-party online resources such as weblinks, spreadsheets and video clips. You also gain access to our collection of 3D models.

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14 The Carbon Cycle

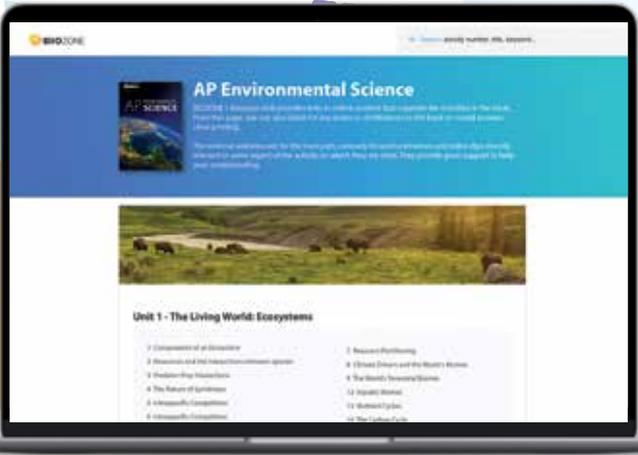
Key Question: How does the cycling of carbon through the abiotic and biotic components of ecosystems make carbon continuously available to organisms? Carbon is an essential element of life and is incorporated into the organic molecules that make up living organisms. Large quantities of carbon are stored in **sinks**, which include the atmosphere as carbon dioxide gas (CO₂), the ocean as carbonate and bicarbonate, and rocks such as coal and limestone. Carbon cycles between the biotic and abiotic environments. Carbon dioxide is converted by autotrophs into carbohydrates via photosynthesis and returned to the atmosphere as CO₂ through respiration. These are shown below. Humans participate in the carbon cycle through activities such as combustion and deforestation.



- Add arrows and labels to the diagram above to show:
 - Dissolving of limestone by acid rain
 - Release of carbon from the marine food chain
 - Mining and burning of coal
 - Burning of peat in a power station
- (a) Name the processes that release carbon into the atmosphere. _____
 (b) In what form is the carbon released? _____
- Name the four geological reservoirs (sinks) in the diagram above, that can act as a source of carbon:
 - _____ (a)
 - _____ (b)
 - _____ (c)
 - _____ (d)
- (a) Identify the process carried out by algae at point A. _____
 (b) Identify the process carried out by decomposers at B. _____
- What would be the effect on carbon cycling if there were no decomposers present in an ecosystem? _____

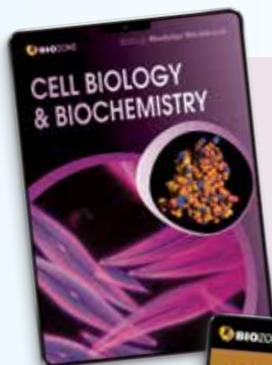
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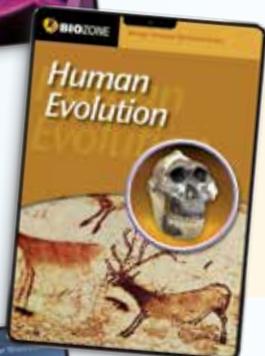


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Challenging concepts are presented clearly and in a way that is accessible even to those with a limited background in chemistry. Cell Biology & Biochemistry covers the structure, function, and study of cells and their components, and is an ideal support volume for a wide range of courses in life sciences.



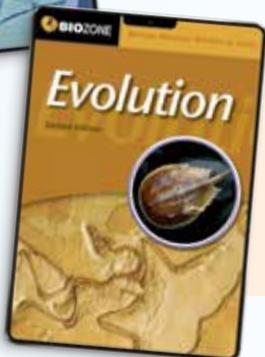
Human Evolution

A comprehensive treatment of human origins; one of biology's most controversial and rapidly changing topics. With an engaging treatment of primate biology, and full, up-to-date coverage of both human physical and cultural evolution, Human Evolution is the perfect supplement for both biology and anthropology students.



Microbiology & Biotechnology

This compact but thorough supplement provides objectives and activities through which students can explore aspects of microbial diversity and modern biotechnology, including genetic engineering, cloning, and genome research.

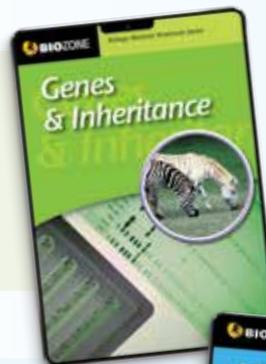


Evolution

A fresh approach to teaching evolutionary principles at this level. Students are invited to explore and critically evaluate the wealth of evidence for our current understanding of evolution through a variety of engaging and thought-provoking activities.

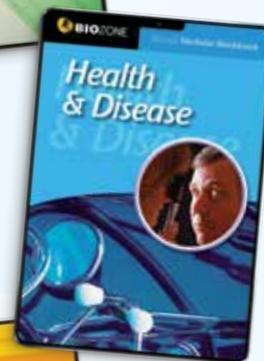
Genes & Inheritance

A seamless integration of fundamental concepts and new information, Genes & Inheritance offers students ample opportunity to both consolidate and extend their knowledge in the rapidly developing areas of molecular genetics and heredity.



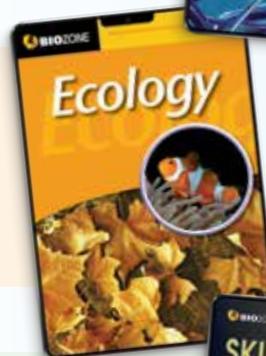
Health & Disease

The ideal companion for students of the life sciences. Health & Disease provides comprehensive coverage of human health, human disease, and the role of modern medicine in treating and preventing health disorders.



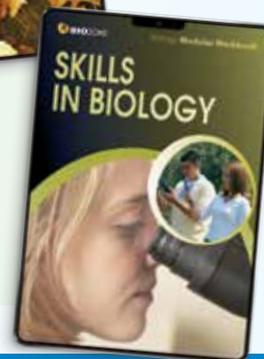
Ecology

Explore fundamental concepts in ecology, from the nature of ecosystems and the basics of ecosystem structure and function, to the complex relationships within and between species and between humans and their environment.



Skills in Biology

An essential supplement for all biology students, Skills in Biology provides clear guidelines for planning and executing biological investigations in both the laboratory and the field. Comprehensive coverage of data handling and analysis is also provided.

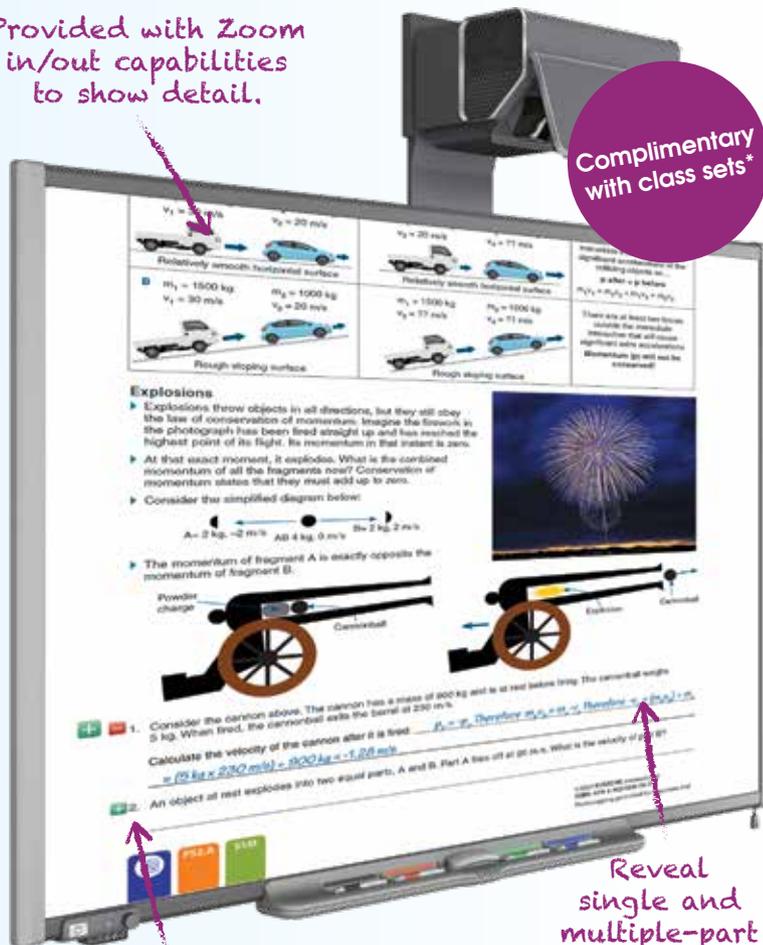


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eBOOKs are currently not for individual sale. Only sold as class sets (a minimum purchase of 10+ copies of the same title required).

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KEY FEATURES

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- Biology for NGSS
- Chemistry in the Earth System
- CIE Biology 1 & 2
- Earth and Space Sciences for NGSS
- IB Biology
- Physical Sciences for NGSS
- Physics of the Universe
- The Living Earth
- Senior Biology 1 & 2

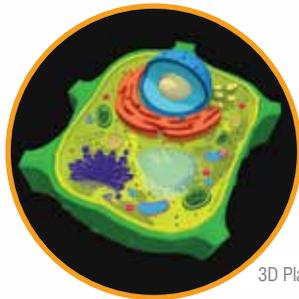
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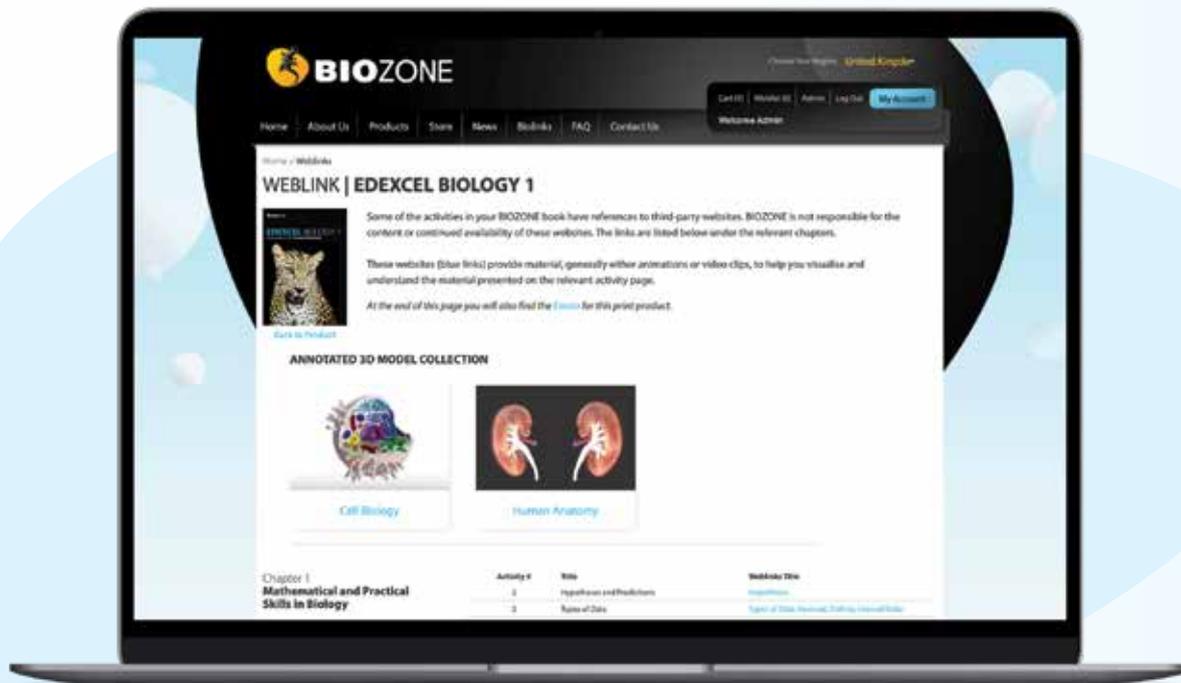
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3D Plant Cell Cartoon

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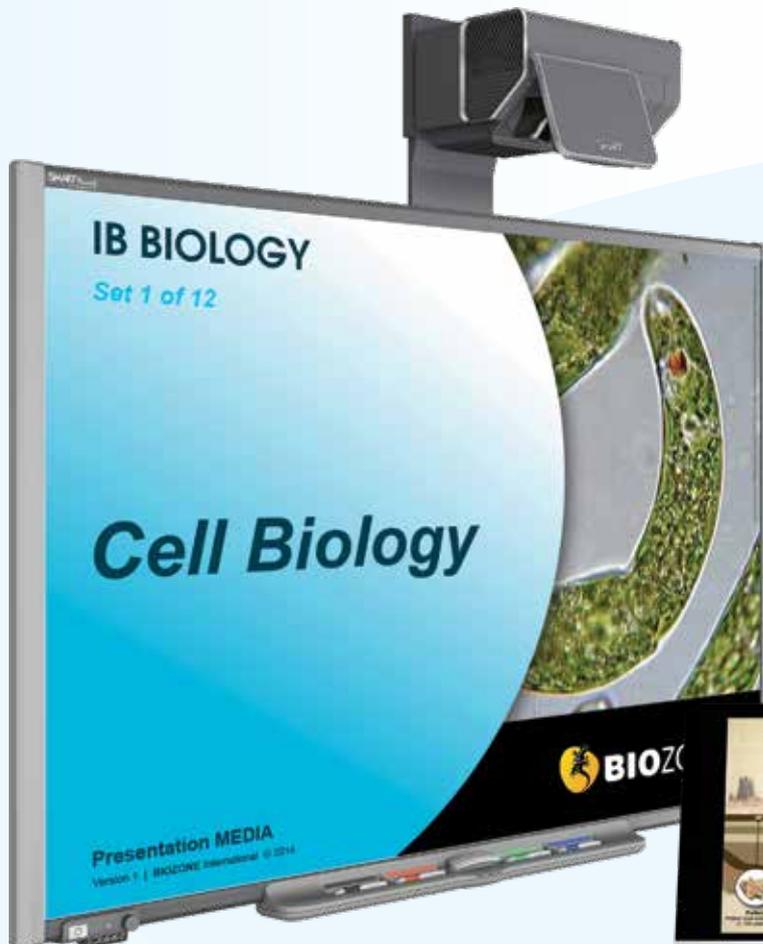
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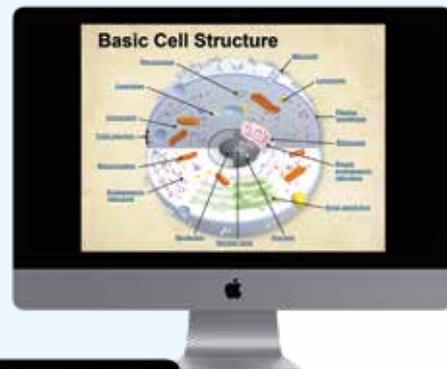
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10. Chemistry in the Earth System
11. Physics of the Universe
12. The Living Earth
13. Physical Sciences for NGSS
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Above: IB Biology



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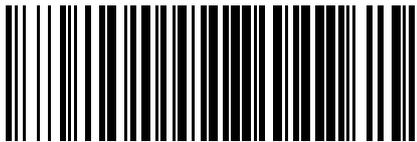


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