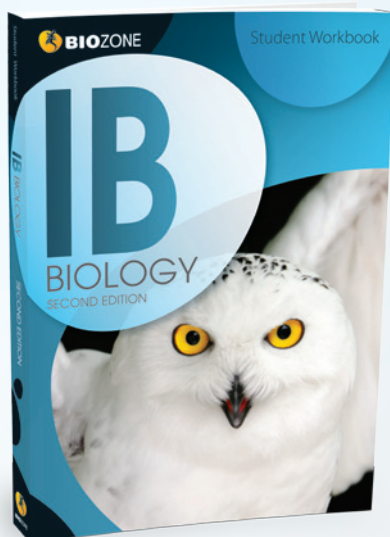


CLASSROOM GUIDE





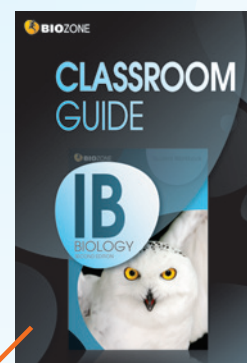
Engage students with write-on activities directly in the Workbook

IB BIOLOGY SERIES

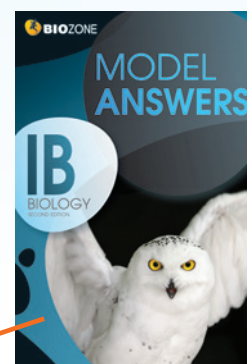
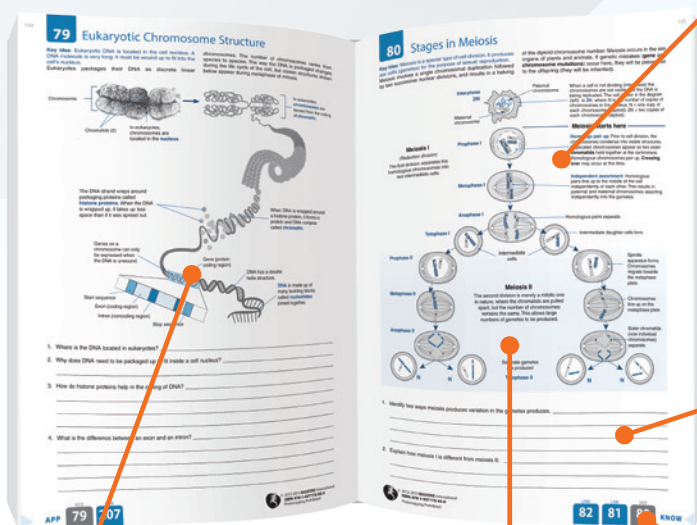
www.thebiozone.com/ib



Options
Workbooks for each of the four IB Options (available 2015)



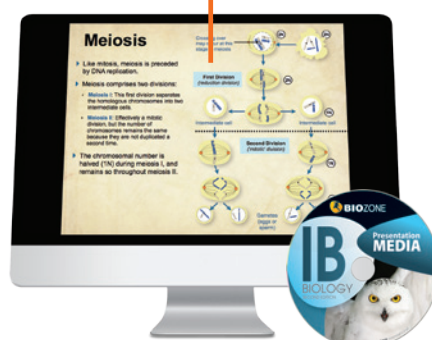
Explain
Classroom Guide provides teaching strategies



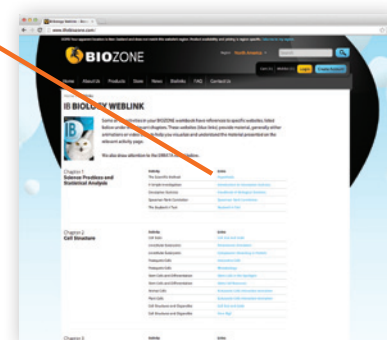
Evaluate student performance with Model Answers



Elaborate on and review ideas using the Teacher's Digital Edition with "reveal answers" feature



Enhance workbook activities with Presentation Media - editable PowerPoint slides (coming soon)



Explore extra content with comprehensive weblinks

BIOZONE - Resources for Lifelong Learners

This Classroom Guide complements **BIOZONE's** IB BIOLOGY Student Workbook. Our resources have always emphasized critical thinking and conceptual understanding. The new student workbook series for IB BIOLOGY continues this successful formula, providing engaging and relevant material fully revised to meet the teaching and learning requirements of the **new IB Biology Programme**. We welcome feedback on this workbook and its accompanying products.

www.theBIOZONE.com/IB

Making the most of *IB Biology*

Creating Lifelong Learners	2
The Contents: A Plan of Action	3
Introducing the IB Biology Content	4
Finding Your Way Around	5
Understandings, Applications and Skills ...	6
Links - Making Connections	8
The Group Four Project	10
Making Use of Weblinks	12
Teaching Strategies for Classroom Use ..	13
Choosing Activities for Home Study	15
Focus on Scientific Literacy	16
IB Biology Presentation Media	17
The Teacher's Digital Edition	18
Integrated Course Guide for IB Biology ...	19
Resources on BIOZONE's Website	20

FAQs ABOUT OUR IB BIOLOGY STUDENT WORKBOOK



What is its pedagogical approach?	2
What are the five Es?	2
How do I use the tab system?	5
How does it address the understandings, applications, and skills?	6
How does it address the nature of science, theory of knowledge, and international-mindedness?	6
How do students demonstrate understanding of ideas?	6
How can I evaluate student performance?	6
How does it accommodate the Group 4 project	10
What are weblinks?	12
How do I use the workbook in the classroom?	13
How can I use it to build scientific literacy?	16
How do I use the workbook if I'm taking an integrated approach to teaching IB Biology?	19



Creating Lifelong Learners

We want today's biology students to be self-motivated, lifelong learners, to develop a sound grasp of biological knowledge, to plan and evaluate their work, and to think critically and independently. In developing IB Biology, we have utilized the 5Es instructional model as a basis for developing materials to specifically address the IB Biology syllabus. By successfully completing the activities, which make up the bulk of the student workbook, students can demonstrate competence in skills and ideas. This is central to meeting the understandings, applications and skills of the IB Biology Diploma Programme. BIOZONE's suite of resources for the SL and HL component of IB Biology can help your students achieve key competencies in all areas of biology.



BIOZONE encourages the development of the IB learner profile using the 5 Es model



The Five Es

- Engage:** make connections between past and present learning experiences.
- Explore:** become actively involved in the activity.
- Explain:** communicate the learning experience.
- Elaborate:** expand on the concepts learned.
- Evaluate:** assess understanding of the concepts.

ENGAGE: Highly visual activities	Use activities in class to engage a student when introducing a topic, or to consolidate student understanding and summarize the material covered by other methods. Using activities in class provides valuable opportunities for peer-to-peer learning.
ENGAGE: A connected plan of study	The check-box format of the contents pages and the chapter introductions provides a focus for planning achievement.
EXPLORE: Independent, self directed study	Activities are self-contained so students are encouraged to be independent learners and seek the answers to questions posed by the activity. Capable students can work quickly and independently through the core material and can use the time for extension. Less able students can review or finish activities at home. Most activities are supported by web-based resources in the form of animations and video clips.
EXPLAIN: Communicating is the key to consolidation	All activities first engage the student with a key idea and a visually inviting delivery of content. Student engagement with this material leads them to the questions in which they must communicate their understanding of the content. Students are encouraged to use appropriate biological terms as referenced in the chapter introduction (key terms).
ELABORATE: Building up	Most introductory activities are supported by activities in which students apply their understanding of ideas to a new situation. These 'follow-on' activities often involve data analysis, and support scientific practices.
EVALUATE: Easy assessment	Encourage self assessment with chapter reviews (these can be graded if desired) or use specific activities to evaluate a student's skills and understanding or scientific ideas.
WHAT ABOUT HOMEWORK?	Assign activities as homework to review a completed topic, explore a related concept, or introduce a topic prior to in-class practical work or extension.



The Contents: A Plan of Action

The contents pages are not merely a list of the activities in the workbook. Encourage your students to use them as a planning tool for their program of work. Students can identify the activities they are to complete and then tick them off when completed. The teacher can also see at a glance how quickly the student is progressing through the assigned material. In future editions, the contents will also be annotated to provide information at a glance about new and revised activities so that teachers can easily review and note any revisions since the last edition.

Contents	
Note to the Student & Acknowledgments	iii
Using This Workbook	1
Using BIOZONE's Website	2
CORE TOPICS	
Topic 1: Cell Biology	
<i>Understandings, Applications, and Skills</i>	3
1 Cell Theory	5
2 Unicellular Eukaryotes	6
3 Surface Area and Volume	7
4 Cell Sizes	9
5 Calculating Linear Magnification	10
6 Multicellularity	11
7 Stem Cells and Differentiation	12
8 Types of Stem Cells	13
9 Using Stem Cells to Treat Disease	15
10 Comparing Prokaryotic and Eukaryotic Cells	16
11 History of Microscopy	17
12 Prokaryotic Cell Structure	18
13 Binary Fission in Prokaryotes	19
14 Plant Cells	20
15 Animal Cells	22
16 Identifying Structures in an Animal Cell	24
17 Identifying Structures in a Plant Cell	25
18 The Structure of Membranes	26
19 How Do We Know? Membrane Structure	28
20 Diffusion	29
21 Osmosis	30
22 Estimating Osmolarity	31
23 Active Transport	32
24 Ion Pumps	33
25 Exocytosis and Endocytosis	34
26 Active and Passive Transport Summary	35
27 Investigating the Origin of Life	36
28 The First Cells	37
29 Origin of the Eukaryotes	38
30 The Common Ancestry of Life	39
31 Why Cells Need to Divide	40
32 Mitosis and the Cell Cycle	41
33 Recognizing Stages in Mitosis	43
34 Regulation of the Cell Cycle	44
35 Cancer: Cells Out of Control	45
36 Chapter Review	46
37 KEY TERMS: Did You Get It?	48
Topic 2: Molecular Biology	
<i>Understandings, Applications, and Skills</i>	49
38 Organic Molecules	51
39 Water	52
40 The Properties of Water	53
41 Sugars	54
42 Condensation and Hydrolysis of Sugars	55
43 Polysaccharides	56
44 Starch and Cellulose	57
45 Lipids	58
46 Lipids and Health	60
47 Amino Acids	61
48 Proteins	62
49 The Role of Proteins	63
50 Enzymes	64
51 Enzyme Reaction Rates	65
52 Investigating Catalase Activity	66
53 Applications of Enzymes	68
54 Nucleotides and Nucleic Acids	69
55 Creating a DNA Model	71
56 DNA Replication	75
57 Meselson and Stahl's Experiment	77
58 Genes to Proteins	78
59 The Genetic Code	79
60 Transcription and Translation	80
61 The Role of ATP in Cells	81
62 Cell Respiration	83
63 Measuring Respiration	84
64 Anaerobic Metabolism	85
65 Investigating Alcoholic Fermentation in Yeast	86
66 Photosynthesis	88
67 Pigments and Light Absorption	89
68 Separation of Pigments by Chromatography	90
69 Factors Affecting Photosynthetic Rate	91
70 Chapter Review	92
71 KEY TERMS: Did You Get It?	94
Topic 3: Genetics	
<i>Understandings, Applications, and Skills</i>	95
72 Alleles	97
73 Changes to the DNA Sequence	98
74 Mutagens and Variation	99
75 Gene Mutations and Genetic Diseases	100
76 The Sickle Cell Mutation	101
77 Genomes	102
78 Prokaryotic Chromosome Structure	103
79 Eukaryotic Chromosome Structure	104
80 Stages in Meiosis	105
81 Modelling Meiosis	106
82 Non-disjunction in Meiosis	108
83 Karyotypes	109
84 Human Karyotype Exercise	111
85 The Human Genome Project	114

The teacher can see at a glance how this student is progressing through this unit of work. Any concerns with progress can be addressed early.

Students can mark the check boxes to indicate the activities they should complete. This helps them to quantify the work to be done and plan their work.

Ticking off the activities as they are completed gives students a sense of progression and helps them to be more personally organized in their work.



This identifies the IB Biology topic to which this chapter applies.

Theory of Knowledge:

TOKs are identified in association with their relevant activity.

For students:

The understandings, applications, and skills are purposefully brief, with enough information to provide a framework, but not so much that students are overwhelmed.

Topic 5

Evolution and Biodiversity

Key terms

adaptation
analogous character
Archaea (archaens)
artificial selection
Eubacteria (bacteria)
binomial nomenclature
clade
cladistics
cladogenesis
cladogram
class
dichotomous key
domain
Eukarya (eukaryotes)
evolution
family
fossil record
genus
homologous structure
kingdom
meiosis
mutation
natural selection
natural classification
order
pentadactyl limb
phyletic gradualism
phylogeny
phylum
selective breeding
sexual reproduction
shared derived characteristic
species

5.1 Evidence for evolution

Understandings, applications, skills

<input checked="" type="checkbox"/> 1 Explain how populations evolve into separate species by phyletic gradualism (anagenesis). Recognize that gradual divergence is only one model for the pace of evolutionary change in species.	137
<input checked="" type="checkbox"/> 2 Use examples to explain how populations evolve into separate species by phyletic gradualism (anagenesis). Recognize that gradual divergence is only one model for the pace of evolutionary change in species.	138
<input checked="" type="checkbox"/> 3 Explain how populations evolve into separate species by phyletic gradualism (anagenesis). Recognize that gradual divergence is only one model for the pace of evolutionary change in species.	139
<input checked="" type="checkbox"/> 4 Describe different or many ways in which populations evolve into separate species by phyletic gradualism (anagenesis). Recognize that gradual divergence is only one model for the pace of evolutionary change in species.	140
<input checked="" type="checkbox"/> 5 Explain how populations evolve into separate species by phyletic gradualism (anagenesis). Recognize that gradual divergence is only one model for the pace of evolutionary change in species.	141
<input type="checkbox"/> 6 Describe phenotypic change in populations, using the example of melanistic insects in polluted areas.	144

TOK Experiments cannot be performed to verify past events or their causes, but there are scientific methods to establish beyond reasonable doubt the past history of species. How do these methods compare to those historians used?

5.2 Natural selection

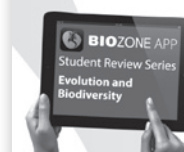
Understandings, applications, skills

<input type="checkbox"/> 1 Explain the role of mutation, meiosis, and sexual reproduction in generating variation between individuals in a species. Explain natural selection in terms of variation, over-production of individuals, adaptation, and differential survival of offspring. Describe the patterns of natural selection and relate this to genetic change in a population over time (i.e. evolution).	142
<input type="checkbox"/> 2 Explain what is meant by an adaptation and give examples. Relate adaptation to environment to survival and successful reproduction.	143
<input type="checkbox"/> 3 Describe examples, including (but not restricted to) changes in beak size in Galapagos finches and evolution of antibiotic resistance in bacteria, to show how natural selection in the prevailing environment can lead to genetic change in populations.	145-148

TOK Natural selection is a theory for the mechanism by which evolution occurs. The evidence for it is overwhelming. How much evidence is needed to support a theory and what counter evidence is required to refute it?

—The activities pertaining to the corresponding understandings, applications, and skills.

Page two of chapter
introduction



Student Review Series provide colour review slides for purchase. Download via the free BIOZONE App, available on the App Store.

Introduce the understanding with a grounding activity

Follow with an activity supporting an application of that understanding

142 Mechanism of Natural Selection

Key Idea Mechanism of natural selection describes how organisms that are better adapted to their environment survive to produce a greater number of offspring. Evolution is the change in inherited characteristics in a population over generations. Evolution is the consequence

of interaction between four factors: (1) The potential for populations to increase in numbers. (2) Genetic variation as a result of mutation and sexual reproduction. (3) Competition for resources, and (4) survival of individuals with better survival and reproduction.

Natural selection is the term for the mechanism by which better adapted organisms survive to produce a greater number of viable offspring. This has the effect of increasing their proportion in the population so that they become more common. This is the basis of Darwin's theory of evolution by natural selection.

Evolution demonstrates the basic concept of evolution using the analogy of a population of

In a bag of M&M's, there are many different colors, which is called variation in a population. As you eat the M&M's, you are selecting the ones that you like best. This is the same thing that happens in nature when you both select, and reject them to stay.

The blue candy becomes more common...

Eventually, you are left with a bag of M&M's that contain the selection in a population. As you keep changing the make-up of the M&M's population. This is the basic principle of selection that drives evolution in natural populations.

Darwin's Theory of Evolution by Natural Selection

Darwin's theory of evolution by natural selection is outlined below. It is widely accepted by the scientific community today and is one of founding principles of modern science.

Overproduction	Variation
Populations produce too many young. Many young die.	Individuals show variations. Some variations are heritable.
Populations generally produce more offspring than are needed to replace the parents, resulting in a constant number. A constant number of individuals with different traits will survive and reproduce.	Individuals in a population have different phenotypes and genotypes. Genotypes determine phenotypes, and phenotypes, and interactions with their environment, influence survival and reproduction success.

Natural Selection

Natural selection favors the individuals best suited to the environment of the time.

Individuals that are better suited to their environment, those with favorable variations will be more likely to survive. Reproductive rates of these often favorable individuals will rise.

Inherited

Variations are inherited. The best suited variants leave more offspring.

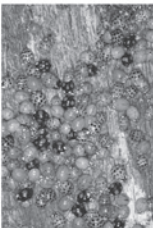
The variations (both favorable and unfavorable) are passed on to the next generation. This results in many more descendants of individuals with favorable characteristics.

1. Identify the four factors that interact to bring about evolution in populations: _____

KNOW 142 144 270 271

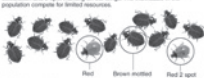
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Variation, Selection, and Population Change




Natural populations. In the leafhopper population shown, some genetic variation. This is a result of **mutation** (which creates new alleles) and sexual reproduction (which produces new combinations of alleles). Some variants are more suited to the environment of the tree than others. These variants will leave more offspring, as described by the hypothetical population (right).


1. Variation through mutation and sexual reproduction:
In a population of brown beetles, mutations independently produce red and white spots, leading to the three phenotypes. The individuals in the population compete for limited resources.



2. Selective predation:
Brown mottled beetles are eaten by birds but red and white are avoided.



3. Change in the genetics of the population:
Red beetles have fewer sources and become more numerous with each generation. Brown beetles have poor genes and become rare.



- What produces the genetic variation in populations?
- Define evolution:
- Explain how the genetic make-up of a population can change over time:

5. Complete the table below by calculating the percentage of beetles in the example above right.

Beetle population	% Brown beetles	% Red beetles	% Red beetles with spots
1			
2			
3			

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145 Selection for Beak Size in Darwin's Finches

Key Idea: The effect of natural selection on a population can be verified by making quantitative measurements of phenotypic traits.

Natural selection acts on the phenotypes of a population. Individuals with phenotypes that increase their fitness produce

more offspring, increasing the proportion of the genes corresponding to that phenotype in the next generation. Numerous population studies have shown natural selection can cause phenotypic changes in a population relatively quickly.

The finches on the Daphne Island near Darwin's finches are finches in that they are consuming a common source of food. However, they are not the same species. In this activity you will analyze data from the measurement of beak depth of the finches' ground blue (Geospiza fortis) on the island of Daphne Major near the coast of the Galapagos Islands. The measurements were taken in 1976 before the drought (because the island was hit by the drought in 1975) and in 1978 after the drought (because the island was hit by the drought in 1977).

Beak depth (mm)	No. 1976 birds	No. 1978 survivors	Beak depth of offspring (mm)	Number of birds
2.50-2.75	1	0	2.76-2.79	2
2.76-2.99	10	1	2.99-3.24	1
3.00-3.24	59	3	3.25-3.50	0
3.25-3.50	47	3	3.50-3.75	21
3.50-3.75	45	6	3.75-4.00	34
3.75-4.00	40	9	4.00-4.25	27
4.00-4.25	25	10	4.25-4.50	24
4.25-4.50	3	1	4.50-4.75	15
4.75-5.00	0	0	4.75-5.00	2

1. Use the data above to draw two separate sets of histograms:

- On the left-hand grid draw **selective-size histograms** for the number of 1976 birds per beak depth and the number of 1978 survivors per beak depth.
- On the right-hand grid draw a histogram of the beak depths of the offspring of the 1978 survivors.

- What does the approximate mean beak depth on the graphs of the 1976 beak depths and the 1978 offspring.
- How much has the average moved from 1976 to 1978?
- Is beak depth heritable? What does this mean for the process of natural selection in the finches?

3. The 1978 drought resulted in plants dying and not producing seed. Based on the graphs, what can you say about competition between the birds for the remaining seeds, i.e. in what way would the seeds probably seed up?

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APP 271 274

Finding Your Way Around

The content of the IB Biology Student Workbook is organized into 12 chapters, each one beginning with an introduction and concluding with a student's self-test of understanding and vocabulary. Inviting, concept-based activities make up the bulk of each chapter, with each activity focussing on an understanding, application, and/or skill. An important feature of each activity is the key idea, which encapsulates the main focus of the content provided. Clear annotated diagrams and photographs are a major part of almost all activities and the student's understanding of the information is tested through a series of questions and/or data handling and interpretation tasks. The tabs for each activity identify the nature of the activity, and identify related material and external weblinks, which provide support for the activity.

76 The Sickle Cell Mutation

Key Idea: Sickle cell anemia is caused by a mutation that affects the beta chain of the hemoglobin (Hb) molecule. Sickle cell anemia is an inherited disorder caused by a gene mutation that codes for a faulty beta (β) chain Hb protein.

This in turn causes the red blood cells to deform, resulting in a range of medical problems. The allele is codominant and the mutation is found in heterozygotes, but individuals with only one mutated allele show resistance to malaria.

Normal Red Blood Cells
Each red blood cell (RBC) contains about 270 million hemoglobin molecules. In their normal state, the red blood cells have a flattened disc shape which allows them to squeeze through capillaries to offload their oxygen to tissues.

Normal hemoglobin produces normal red blood cells
Each hemoglobin molecule is made up of two α -chains and two β -chains linked together.

Sickle Cells
The mutated form of hemoglobin has reduced solubility and precipitates when deprived of oxygen. This deforms the red blood cells giving them a rigid sickle shape, which prevents their movement through capillaries.

Sickle Cell Anemia
The sickle RBCs are removed from the circulation leading to anemia. Their rigid shape blocks small vessels and leads to widespread tissue and organ damage.

TOK: Sickle cell and malaria
The sickle cell mutation (HbS) is lethal in the homozygous state, but heterozygotes are much less susceptible to malaria than unaffected people. This is because the malarial parasite cannot infect the deformed blood cells. A high frequency of the mutation is present in many regions where malaria is endemic (present in the population all the time).

1. Identify how many of the following are extracted or coded for in the DNA sequence above:
(a) Bases: _____ (b) Triplets: _____ (c) Amino acids coded for: _____

2. Write the mRNA sequence for the DNA template strand in the diagram above:

3. Determine the amino acid sequence coded by the mRNA (in question 2 above) for the fragment of the normal protein we are studying here. Use the mRNA-amino acid table earlier in this workbook (consult the index):
Amino acids: _____

4. Rewrite the DNA sequence above with the 17th nucleotide (base) changed from a T to A. This is the sickle cell mutation:
Mutant DNA: _____ Type of mutation: _____

5. Write the mRNA sequence for the mutant DNA strand above:

6. Determine the amino acid sequence coded by the mRNA (in question 5 above) for the fragment of the mutant protein we are studying here. Use the mRNA-amino acid table earlier in this workbook (consult the index):

7. Explain how the sickle cell mutation results in the symptoms of the disease:

8. Briefly explain why there is a high frequency of the sickle cell mutation in populations where malaria is endemic:

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LINK 142 LINK 75 LINK 59 WEB 76 APP

76 The Sickle Cell Mutation

Key Idea: Sickle cell anemia is caused by a mutation that affects the beta chain of the hemoglobin (Hb) molecule. Sickle cell anemia is an inherited disorder caused by a gene mutation that codes for a faulty beta (β) chain Hb protein.

The **key idea** provides a focus for each activity. It summarizes the focus of the activity and provides a clear take-home message for the student.

Annotated diagrams, sometimes including photo panels, explain the content of the page, providing the information necessary to complete the activity. In this activity, a **Theory of Knowledge** box explains heterozygote advantage.

Understanding of content is tested through questions, data handling, analysis, prediction, or summary. Students are often required to apply their understanding to a new scenario or make connections to related content. Students must interact with the information on the page in order to complete the activity. It is this interaction that provides the valuable learning experience and reinforcement and explanation of the key idea.

Related content is identified through the tab system. This activity also has a weblink assigned to it (see below).

LINK 142 LINK 75 LINK 59 WEB 76 APP

Links

This tab indicates activities that provide content which is related to or builds on the content on the page.

Weblinks

Bookmark the weblinks page: www.thebiozone.com/weblink/IB-3930/
Access the external URL for the activity by clicking the link.
See page 12 for more details.

Activities are coded

KNOW = understanding: content you need to know.
APP = applying your understanding of content to new scenarios.
SKILL = demonstrate your knowledge through doing or constructing.
REFER = reference - use this for information
REVISE = review the material in the section
TEST = test your understanding



Understandings, Applications, and Skills

In developing *IB Biology*, we have focussed on the understandings, applications, and skills identified in the IB Biology guide, while also integrating the theory of knowledge, international mindedness, and nature of science where appropriate throughout the workbook. The activities in *IB Biology* have been specifically written to address the content of the IB Biology programme. Our focus is student engagement through the use of a concept-based, highly visual design and opportunity to demonstrate understanding.

Topic 6 Human Physiology

Key terms
absorption
absorption (of water)
antibody
artery
asthma (as, etc)
blood clot
breathing
capillary
cardiac cycle
coronary occlusion
decomposition
digestive tract
gas exchange
heart
homeostasis
humane
intestinal villi
lung
lymphocyte
muscular cycle
negative feedback
neuron
neurotransmitter
paramecium
pathogen
peristalsis
phagocyte
plasma
respiratory gas
respiratory pressure
respiratory rate
small intestine
spermatozoa
stomach
temperature
thermoregulation
ventilation
ventricle

6.1 Digestion and absorption
Understandings, applications, skills

- 1 Explain how food is moved through the gut by peristalsis. Identify the layers of the gut wall and the role of the muscularis in peristalsis. 161
- 2 Describe digestion in the small intestine with reference to the role of enzymes. Describe the structure of the small intestine and the role of the villi in absorption. 162-167
- 3 Use diagrams to show the absorption of digested food in the small intestine. 168

6.2 The blood system
Understandings, applications, skills

- 1 Describe the human circulatory system, with separate pulmonary and systemic circuits. Describe William Harvey's discovery of how the blood is circulated. 169
- 2 Name the major categories of blood vessels in humans, state their function, and recognize them by their structure. Describe the structure of each type of blood vessel and relate its structure to its function in the circulatory system. 171-174
- 3 Describe the basic structure of the heart. Recognize the chambers and valves of the heart in diagrams and dissections. 175
- 4 Describe the intrinsic control of heart beat by the sinoatrial node. Explain how the heart is initiated and how the signal is propagated through the heart. Explain how the heart's basic rhythm is influenced through nervous and hormonal input. 176-179
- 5 Describe the events in the cardiac cycle. Describe the pressure changes in the left atrium, left ventricle, and aorta during the cardiac cycle. 179-180

6.3 Defence against infectious disease
Understandings, applications, skills

- 1 Describe the role of the skin and mucous membranes as a first line of defence against pathogens. 177
- 2 Describe the mechanism and role of blood clotting, including the role of platelets, clotting factors, thrombin, and fibrinogen. Describe the causes and consequences of blood clot formation in coronary arteries. 176-178
- 3 Describe non-specific defences against pathogens by phagocytic white blood cells. Describe the role of inflammation in enhancing the activity of phagocytes. 179-180
- 4 Describe the basis of specific immunity against pathogens. Recognize that some lymphocytes act as memory cells and state their role. 177

The introduction to each chapter provides a summary of the **understandings, applications, and skills**, presented as a series of short student learning aims. The students achieve understanding of each statement by completing its corresponding activity.

Activities are written and presented so that students progressively extend and deepen their understanding, using what they have learned in earlier activities to complete later related activities and to solve new problems.

171 The Heart

Key idea: Humans have a four-chambered heart divided into left and right halves. It acts as a double pump. The heart is the centre of the human cardiovascular system. It is a muscular organ made up of four chambers (two left and two right ventricles) that alternately fill and empty of blood, acting as a double pump. The left side pumps blood to the body tissues and the right side pumps blood to the lungs. The heart has a double pump system. The right side pumps blood to the lungs, and the left side pumps blood to the body tissues. The heart has a double pump system. The right side pumps blood to the lungs, and the left side pumps blood to the body tissues.

Human Heart Structure
(sectioned, anterior view)

Top view of a heart in section, showing valves

Posterior view of heart

Key to abbreviations

Activity number

168 169 170 171 174 175 176 177 178 179 180

Activities integrate the **Nature of Science, Theory of Knowledge, and International-Mindedness** where appropriate. Specific TOKs are noted underneath the corresponding activity statement.

6.2 The blood system
Understandings, applications, skills

- 1 Describe the human circulatory system, with separate pulmonary and systemic circuits. Describe William Harvey's discovery of how the blood is circulated. 168
- 2 Name the major categories of blood vessels in humans, state their function, and recognize them by their structure. Describe the structure of each type of blood vessel and relate its structure to its function in the circulatory system. 169-170
- 3 Describe the basic structure of the heart. Recognize the chambers and valves of the heart in diagrams and dissections. 171-174
- 4 Describe the intrinsic control of heart beat by the sinoatrial node. Explain how the heart is initiated and how the signal is propagated through the heart. Explain how the heart's basic rhythm is influenced through nervous and hormonal input. 175-176
- 5 Describe the events in the cardiac cycle. Describe the pressure changes in the left atrium, left ventricle, and aorta during the cardiac cycle. 177-179
- 6 Describe the causes and consequences of coronary occlusions. 176

TOK We know now that emotions are brain-based, not the result of heart activity. Is science-based knowledge more valid than belief based on intuition?

6.3 Defence against infectious disease
Understandings, applications, skills

- 1 Describe the role of the skin and mucous membranes as a first line of defence against pathogens. 177
- 2 Describe the mechanism and role of blood clotting, including the role of platelets, clotting factors, thrombin, and fibrinogen. Describe the causes and consequences of blood clot formation in coronary arteries. 176-178
- 3 Describe non-specific defences against pathogens by phagocytic white blood cells. Describe the role of inflammation in enhancing the activity of phagocytes. 179-180
- 4 Describe the basis of specific immunity against pathogens. Recognize that some lymphocytes act as memory cells and state their role. 177

168 The Circulatory System

Key idea: The human circulatory system is an efficient, closed-loop system that transports blood to and from the body's tissues. The blood is pumped by the heart, which is a muscular organ. The blood is transported to the body's tissues, and then returns to the heart. The blood is transported to the body's tissues, and then returns to the heart.

Schematic Overview of the Human Circulatory System

Engage, explore and explain

169 Blood Vessels

Key idea: Arteries transport blood away from the heart and veins transport blood back to the heart. Capillaries allow the exchange of material between the blood and the tissues.

169 Blood Vessels

Key idea: Arteries transport blood away from the heart and veins transport blood back to the heart. Capillaries allow the exchange of material between the blood and the tissues.

Elaborate

The KEY IDEA provides a focus for each activity. The key ideas through a chapter provide a concise summary of the chapter content.

Students become actively involved in the learning activity by interacting with the material, answering the question and completing the set tasks. Many activities are suitable as assessment tasks.

Engage, explore, explain, elaborate, evaluate: Activities are nested. An introductory activity introduces and builds understanding of a specific core idea, and a subsequent activity involves applying that understanding to a new situation, e.g. analyzing data, finding a solution, or interpreting new information.



236 Transpiration

Key Idea Water moves through the xylem primarily as a result of evaporation from the leaves and the cohesive and adhesive properties of water molecules. Plants take water up the stem. Approximately 90% of the water a plant absorbs from the soil is lost by evaporation from the leaves and stems. The loss of water through the leaves is called **transpiration** and the flow of water through the plant is called the **transpiration stream**. Plants rely on a gradient in solute concentration that increases from the roots to the air to move water through their cells. Water moves passively from the soil to the leaves along the gradient of increasing solute concentration. The gradient is the driving force for the movement of water up a plant. Transpiration has benefits to the plant because evaporative water loss cools the plant and the transpiration stream helps the plant to take up minerals. Factors contributing to water movement are described below.

The Role of Stomata
Water loss occurs mainly through stomata (pores) in the leaf. The rate of water loss varies according to the size of the stomata, which open or close the gaps.
• Stomata closed: gas exchange and transpiration rates decrease.
• Stomata closed: gas exchange and transpiration rates decrease.

Explain

1. (a) What is transpiration?
(b) Describe one benefit of the transpiration stream.

2. How does the plant regulate the amount of water lost from the leaves?

237 Xylem

Key Idea The xylem is involved in water and mineral transport in vascular plants. It is the principal water-conducting tissue in vascular plants. It is also involved in conducting dissolved minerals, in food storage, and in supporting the plant body. As in animals, tissues in plants are groups of different cell types that work together for a common function. In angiosperms, factors contributing to water movement are described below.

The Structure of Xylem Tissue
The xylem tissue consists of a group of cells that transport water and dissolved minerals. The cells are arranged in a columnar fashion. The cells are dead when they are fully mature. The cells are surrounded by living cells called parenchyma cells. The xylem tissue is located in the stem of the plant.

Elaborate

1. (a) What is the function of xylem?
(b) How can xylem be dead when mature and still carry out its function?

2. Identify four main cell types in xylem and explain their role in the tissue:
(a) Vessel element
(b) Tracheid
(c) Xylem parenchyma
(d) Xylem fiber

3. Draw the structure of primary xylem from the larger image of a stem section above. Staple it to this page.

256 KEY TERMS: Did You Get It?

1. Match each term to its definition, as identified by its preceding letter code.

Term	Definition
anther	A. Transfer of pollen from the male anther to the female stigma.
cohesion-tension	B. Plant that flowers in response to a period of dark exceeding a certain length.
long-day plant	C. Partial explanation for the movement of water up the transpiration stream.
transpiration	D. Device used for investigating the rate of transpiration.
phloem	E. Plant hormone that plays a part in plant growth and the photoperiodic response.
phytochrome	F. Vascular tissue that conducts water and mineral salts from the roots to the rest of the plant. Dead in its functional state.
potometer	G. Tissue that conducts dissolved sugars in vascular plants. Composed mostly of sieve tubes and companion cells.
short-day plant	H. A pigment in plants responsible for the photoperiodic effect. Regulates the timing of flowering with different effects in long-day and short-day plants.
stomata	I. The growing region of the plant where mitosis and cell division occur.
strobilus	J. Temporary reproductive structure in angiosperms.
xylem	K. Pores in the leaf surface through which gases can pass.
	L. Plant that flowers when exposed to dark periods of less than a critical length.

Evaluate

2. (a) What does the image (left) show?
(b) In what tissue would you find it?
(c) Is this tissue alive or dead?
(d) What transport process is it associated with?
(e) What is being moved in this process?

3. (a) What is the function of the structure shown in the photo (right)?
(b) What is the hormone involved in the response?

4. (a) What is the name given to the plant group with two cotyledons in the seed?
(b) What is the name given to the plant group with one cotyledon in the seed?

This activity begins by engaging the student with something familiar (enzymes) and goes on to introduce the concept that the specific structure of enzymes enables them to catalyse biochemical reactions in cells.

In the activity that follows, students can demonstrate their deeper understanding of the content by interpreting graphs of enzyme reaction rates.

A connection is made to cellular respiration. Other activities build on the understanding of this metabolic pathway.

Groups of activities incorporate the understandings, applications, and skills.

KNOW

The need for and structure of the gas exchange system

APP

How breathing is brought about by antagonistic muscles

SKILL

Use data to explore lung function and ventilation

184 Introduction

Key Idea All cells exchange in the process of metabolism. The exchange of gases between the organism and the environment. Living cells require energy for the activities of metabolism. This energy is released in cells by the breakdown of substances in cellular respiration. As a result, the gas oxygen is consumed and the gas carbon dioxide is produced.

The Need for Gas Exchange
Gas exchange is the process of exchanging gases between the organism and the environment. It is a vital process for all living organisms. The rate of gas exchange is affected by factors such as temperature, humidity, and the concentration of gases in the environment.

Learn

1. What is gas exchange?
(a) What gases are involved in gas exchange?
(b) By what transport process are the gases moved?
(c) What is the main function of a gas exchange surface?

2. Name three features of gas exchange surfaces.

185 The Gas Exchange System

Key Idea Lung is the site of gas exchange between the organism and the environment. The lungs are composed of millions of small air sacs called alveoli. The alveoli are surrounded by a network of blood capillaries. The exchange of gases between the alveoli and the blood is called gas exchange. The rate of gas exchange is affected by factors such as temperature, humidity, and the concentration of gases in the environment.

The Structure of the Lung
The lungs are composed of millions of small air sacs called alveoli. The alveoli are surrounded by a network of blood capillaries. The exchange of gases between the alveoli and the blood is called gas exchange. The rate of gas exchange is affected by factors such as temperature, humidity, and the concentration of gases in the environment.

Understand

4. During inspiration, which muscles are:
(a) Contracting
(b) Relaxed

5. During expiration, which muscles are:
(a) Contracting
(b) Relaxed

6. Explain the role of antagonistic muscles in breathing.

186 Breathing

Key Idea Breathing provides a continual supply of air to the lungs. The air is then transported to the alveoli where it is exchanged with the blood. Breathing involves the contraction and relaxation of the diaphragm and the intercostal muscles.

The Mechanism of Breathing
Breathing involves the contraction and relaxation of the diaphragm and the intercostal muscles. The diaphragm contracts and moves downwards, increasing the volume of the thoracic cavity. This causes the air pressure to decrease, and air is drawn into the lungs. The intercostal muscles contract and pull the rib cage outwards, further increasing the volume of the thoracic cavity.

Do

1. Describe how each of the following might be expected to influence values for lung volumes and capacities obtained:
(a) Height
(b) Gender
(c) Age

2. A percentage active in PE, and PFC in 100% of normal are indicators of improved lung function. a) in active; b) Explain why a lower volume is a more reliable indicator of lung function than total volume.

(c) Asthma is treated with drugs to relax the airways. Suggest how asthmatics could be used during asthma treatment.

LINKS - Making Connections

The Link tabs help students to connect ideas between different topics in the IB Biology programme. Connections may be made to activities that build on or develop an idea, utilize the same core principles in another biological context, or examine the evidence for a biological process such as DNA replication or ATP synthesis. The connections help students to appreciate that the same core principles underlie many biological phenomena and there is evidence to support them. Understanding these core principles brings understanding to a wide range of contexts and situations, even if they are unfamiliar.

54 Nucleotides and Nucleic Acids

Key idea: Nucleotides are the building blocks of DNA and RNA. They are made up of a phosphate group, a sugar, and a nitrogenous base. The sequence of bases in DNA determines the genetic code.

Key idea: DNA replication is the process by which a cell makes a copy of its DNA. It involves the unwinding of the DNA double helix and the synthesis of new DNA strands using the original strands as templates.

56 DNA Replication

Key idea: DNA replication is the process by which a cell makes a copy of its DNA. It involves the unwinding of the DNA double helix and the synthesis of new DNA strands using the original strands as templates.

Key idea: The semi-conservative model of DNA replication states that each new DNA molecule consists of one original (parental) strand and one newly synthesized strand.

57 Meselson and Stahl's Experiment

Key idea: Meselson and Stahl's experiment provided evidence for the semi-conservative model of DNA replication. They used heavy and light nitrogen isotopes to track the fate of the original DNA strands during replication.

Key idea: The results of the experiment showed that each new DNA molecule consists of one original (parental) strand and one newly synthesized strand, supporting the semi-conservative model.

14 Plant Cells

Key idea: Plant cells are eukaryotic cells. They have a nucleus, mitochondria, and other organelles. They are surrounded by a cell wall, which provides structural support and protection.

Key idea: The cell wall is made of cellulose, a complex carbohydrate. It is thicker in some parts of the cell, such as the corners, and thinner in others.

17 Identifying Structures in a Plant Cell

Key idea: The electron micrograph shows the internal structure of a plant cell. Labels include: cell wall, nucleus, nucleolus, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus, mitochondrion, and chloroplast.

Key idea: The cell wall is the outermost layer of the cell. It is made of cellulose and provides structural support and protection.

44 Starch and Cellulose

Key idea: Starch and cellulose are both polysaccharides made of glucose units. However, they differ in the type of glycosidic bonds that link the glucose units. Starch has alpha-1,4 glycosidic bonds, while cellulose has beta-1,4 glycosidic bonds.

Key idea: This difference in bonding makes starch soluble in water and digestible by many animals, while cellulose is insoluble and not digestible by most animals.

75 Gene Mutations and Genetic Diseases

Key idea: Gene mutations are changes in the DNA sequence. They can be inherited or acquired. Some mutations can lead to genetic diseases, such as sickle cell anemia.

Key idea: Sickle cell anemia is caused by a single gene mutation that affects the structure of hemoglobin, the protein that carries oxygen in the blood.

91 Codominance of Alleles

Key idea: Codominance is a type of inheritance where both alleles are expressed in the heterozygous state. In cattle, this results in a roan coat color, which is a mixture of red and white.

Key idea: The inheritance of codominant alleles can be tracked using a Punnett square, which shows the possible genotypes and phenotypes of the offspring.

96 Pedigree Analysis

Key idea: Pedigree analysis is a method used to study the inheritance of a trait. It involves drawing a family tree that shows the relationships between individuals and the presence or absence of the trait.

Key idea: Pedigree charts can be used to determine the mode of inheritance of a trait, such as whether it is dominant or recessive, and to predict the probability of an individual having the trait.

EXAMPLE 1

DNA replication

Connect the details of DNA structure to the replication of DNA. Understand how the semi-conservative model was confirmed.

EXAMPLE 2

The plant cell and the cell wall

Apply the understanding of the structure of the plant cell to label an electron micrograph. Relate the function of the cell wall to the structure of cellulose.

EXAMPLE 3

Disease, codominance, and pedigrees

Learn about genetic diseases caused by codominant alleles, understand the relationship between codominance and phenotype, and examine the inheritance patterns of codominant alleles through pedigree analysis.



142 Mechanism of Natural Selection

Key Idea Darwin's theory of natural selection describes how variation and inheritance in a population can lead to the change in phenotypic characteristics in the population over generations. Variation is a prerequisite for natural selection to occur.

Natural selection is the term for the process by which organisms with favourable traits survive and reproduce, passing on their genes to the next generation. This leads to the change in the frequency of alleles in the population over time.

Darwin's Theory of Evolution by Natural Selection

1. Variation: Individuals in a population have different traits.

2. Inheritance: Traits are passed on from parents to offspring.

3. Selection: Individuals with favourable traits survive and reproduce more successfully.

4. Speciation: Over time, populations can diverge into new species.

5. Extinction: Some populations may become extinct.

6. Adaptation: Populations become better suited to their environment.

7. Natural selection leads to the formation of new species.

8. The fossil record provides evidence for evolution.

9. The modern synthesis of evolution integrates genetics with natural selection.

10. The study of evolution helps us understand the diversity of life on Earth.

11. The study of evolution helps us understand the origins of life.

12. The study of evolution helps us understand the future of life.

13. The study of evolution helps us understand the role of humans in the world.

14. The study of evolution helps us understand the importance of conservation.

15. The study of evolution helps us understand the value of science.

271 Natural Selection

Key Idea Natural selection is the process by which organisms with favourable traits survive and reproduce, passing on their genes to the next generation. This leads to the change in the frequency of alleles in the population over time.

Stabilizing Selection

Directional Selection

Disruptive Selection

1. Explain why fluctuating selection is important to understanding natural selection.

2. Describe the evidence from the ground finches on Santa Cruz Island that provides support for the statement.

3. The ground finches on Santa Cruz Island are now undergoing rapid change with a bimodal distribution for the number of beak size. Explain why this is a disruptive selection.

4. Predict the consequences of the end of the drought and an increased abundance of medium-size seeds on food.

274 Disruptive Selection in Darwin's Finches

Key Idea Disruptive selection is the form of natural selection in which the extreme phenotypes are favoured over the intermediate phenotypes. This leads to the change in the frequency of alleles in the population over time.

Beak size in Darwin's Finches

Beak size in Darwin's Finches

1. (a) How did the drought affect seed size on Santa Cruz Island?

(b) How did the change in seed size during the drought create a selection pressure for changes in beak size?

2. How does the finch differ from the three different reproductive success in D. finch?

3. (a) How did selection in D. finch affect the population?

(b) Give reasons for your answer.

EXAMPLE 4

Natural selection

Make connections between the mechanism of natural selection and the effect of types of natural selection on phenotypic spread in populations. Real world examples of natural selection support the explanation of core principles.

178 Blood Clotting and Defence

Key Idea Blood clotting involves a cascade of events that lead to the formation of a blood clot. This process is essential for preventing blood loss and for defending the body against infection.

Blood Clotting

Clotting Factors

1. What role does blood clotting have in internal defence?

2. Explain the role of each of the following in the sequence of events leading to blood clotting.

(a) Vessel spasm

(b) Release of chemicals from platelets

(c) Clumping of platelets in the wound site

(d) Formation of a fibrin mesh

3. (a) What is the role of clotting factors in the formation of a blood clot?

(b) Why are these clotting factors referred to as 'clotting factors'?

225 Control of Metabolic Pathways

Key Idea The control of metabolic pathways is essential for maintaining the balance of the body's metabolism. This involves the regulation of enzyme activity and the production of feedback loops.

Enzyme Regulation

Inductive Synthesis from Threonine

1. With reference to the threonine metabolic pathway, explain how and product inhibition occurs.

2. Explain the role of an allosteric regulator in product inhibition.

282 Targets for Defence

Key Idea The immune system is designed to defend the body against infection and disease. This involves the recognition and destruction of pathogens and the production of antibodies.

Defence Targets

Defence Targets

1. (a) Explain the role and purpose of the major histocompatibility complex (MHC).

(b) Explain the importance of each of the following systems.

EXAMPLE 5

Defence and metabolism

Understand that blood clotting involves a cascade of enzyme-catalysed metabolic reactions. Link blood clotting with the immune system and the need to prevent invasion by pathogens.

203 The Female Reproductive System

Key Idea The female reproductive system is responsible for the production and development of eggs and for the transport of eggs to the uterus. It also plays a role in the regulation of the menstrual cycle.

Ovarian and Uterine Cycles

1. The female reproductive system consists of the ovaries, fallopian tubes, uterus, and vagina. Explain the function of each of these structures.

2. In a few words or a short sentence, state the function of each of the structures listed in (a) to (d) in the diagram.

3. (a) Name the organ identified (A) in the diagram.

(b) Name the event associated with the organ that occurs every month.

(c) Name the process by which mature eggs are produced.

4. Where does fertilisation occur?

257 Meiosis and Variation

Key Idea Meiosis is a type of cell division that results in the production of four haploid daughter cells from a single diploid parent cell. This process is essential for the production of gametes and for the maintenance of the chromosome number.

Meiosis and Variation

Meiosis and Variation

1. How does independent assortment increase the variation in gametes?

2. (a) What is crossing over?

(b) How does crossing over increase the variation in the gametes (and hence the offspring)?

311 Oogenesis

Key Idea Oogenesis is the process by which a single egg cell is produced from a single diploid parent cell. This process is essential for the production of gametes and for the maintenance of the chromosome number.

Oogenesis

Oogenesis

1. Name the process by which mature eggs are produced.

2. Name the process by which mature eggs are produced.

3. Explain why males can have the potential to father many offspring, while females have a limited potential to produce offspring.

EXAMPLE 6

Reproduction and variation

Link the reproductive system with the production of gametes and the recombination of alleles during meiosis.

305 Diagnostic Urinalysis

Key Idea Urinalysis is a common diagnostic test that involves the examination of urine. It can be used to detect a wide range of conditions, including infections, kidney disease, and diabetes.

Diagnostic Urinalysis

Diagnostic Urinalysis

1. Why is urinalysis a frequently used diagnostic technique for common diseases?

2. What might the following abnormal results in a urinalysis suggest to a doctor?

(a) Excess glucose

(b) A red blood cell

3. Why might an athlete who is asked to provide a sample of urine for a drug test be asked to provide a sample of urine for a drug test?

291 Monoclonal Antibodies

Key Idea Monoclonal antibodies are antibodies that are produced by a single clone of B cells. They are used in a wide range of applications, including diagnosis, therapy, and research.

Monoclonal Antibodies

Monoclonal Antibodies

1. (a) Which mouse cells are used to produce monoclonal antibodies?

(b) What problem is associated with the use of mice to produce monoclonal antibodies?

2. Which characteristics of tumour cells allow an organism to produce antibody-producing lymphocytes to be made?

3. Describe how applications of monoclonal antibodies.

285 Antibodies

Key Idea Antibodies are proteins that are produced by B cells in response to an antigen. They are used to neutralise and destroy pathogens and to mark them for destruction by other immune cells.

Antibodies

Antibodies

1. Describe the structure of an antibody, identifying the specific features that contribute to its function.

2. Describe the various ways in which antibodies neutralise antigens.

EXAMPLE 7

Antibodies and applications

Link the basic understanding of antibody structure and mode of action with production of monoclonal antibodies and their diagnostic uses.



Group 4 Project

Laboratory work and other practical components are an important part of the IB Biology course. Practical sessions challenge students to be self-organized, to work cooperatively, to plan ahead, and to think critically about the design, implementation, and evaluation of their experimental work. The IB course has a strong practical component, aimed at providing a framework for laboratory experience. BIOZONE has integrated the Group 4 aims into the IB Biology workbook. Students will encounter activities that will help them build both practical and analytical skills.

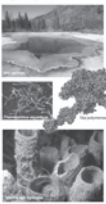
Aims of the Group 4 Project

The aims of the Group 4 project are integrated throughout the workbook. A wide range of activities aim to help students develop a critical awareness of science in the modern world, how it can be used to build knowledge, and its implications and applications.

Throughout the workbook, students have the opportunity to demonstrate understanding and apply their knowledge. They can practise their skills in formulating hypotheses, designing experiments, evaluating methodologies, and analysing and evaluating data.

97 Amazing Organisms, Amazing Enzymes

Read the text and answer the questions. The text describes the structure and function of enzymes, and how they are affected by temperature and pH. It also discusses the role of enzymes in various biological processes.



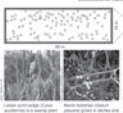
1. Why was H₂O₂ used as a substrate and the rate measured?
2. Explain why this experiment was an important part of the development of PCR.
3. Explain how investigating the properties of other organisms can lead to advances in unrelated areas of science.

98 56 KNOW

1. Appreciate scientific study and creativity

121 Chi-Squared Exercise in Ecology

Read the text and answer the questions. The text describes a chi-squared test used to determine if there is a significant difference between the observed and expected frequencies of a categorical variable.



1. State the null hypothesis (H_0) for this investigation.
2. In words, summarise the observed results in table 1.
3. Calculate the expected results for each category of H_0 and H_A . Enter the figures in table 2.
4. Calculate the value of χ^2 for the observed results.
5. Using the χ^2 value, find the P -value corresponding to your calculated χ^2 value from the χ^2 table provided.
6. State whether or not you reject your null hypothesis. Explain your answer.
7. What could you conclude about the plant community?

120 KNOW

3. Apply knowledge, methods, and techniques

321 Planning a Quantitative Investigation

Read the text and answer the questions. The text describes the steps involved in planning a quantitative investigation, including identifying variables, designing an experiment, and collecting data.




1. Identify the independent and dependent variables.
2. Design an experiment to test the hypothesis.
3. Collect data and calculate the mean and standard deviation.
4. Analyse the data using a statistical test.
5. Draw a conclusion based on the results.

318 319

4. Analyse, evaluate, and synthesize

209 DNA Molecules

Read the text and answer the questions. The text describes the structure and function of DNA molecules, and how they are used in various biological processes.




1. What is the structure of DNA?
2. How is DNA used in various biological processes?
3. How is DNA used in forensic science?

209 54 56

5. Critical awareness of communication and collaboration

318 The Scientific Method

Read the text and answer the questions. The text describes the steps involved in the scientific method, including formulating a hypothesis, designing an experiment, and collecting data.



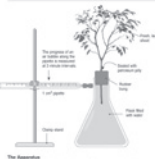
1. Why might an experiment be repeated at a later date?
2. Explain why a method must be repeatable.
3. In which situations is it difficult, if not impossible, to control all the variables?

318

2. Knowledge, methods and, techniques

238 Investigating Plant Transpiration

Read the text and answer the questions. The text describes the steps involved in investigating plant transpiration, including setting up an experiment, collecting data, and analysing the results.



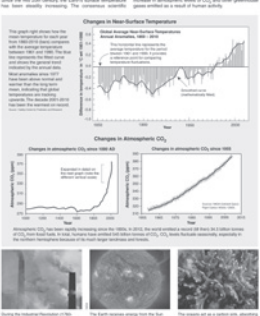
1. State the hypothesis.
2. Design an experiment to test the hypothesis.
3. Collect data and calculate the mean and standard deviation.
4. Analyse the data using a statistical test.
5. Draw a conclusion based on the results.

21 236 322

6. Develop experimental and investigative skills

130 Global Warming

Read the text and answer the questions. The text describes the causes and effects of global warming, and the role of greenhouse gases in the process.



1. What is the evidence for global warming?
2. How is global warming affecting the environment?
3. What are the causes of global warming?

133 132 131 130

7. Develop communication skills

134 Applying the Precautionary Principle

Read the text and answer the questions. The text describes the precautionary principle and its application in various fields, including science, policy, and law.



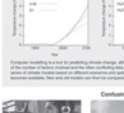
1. How would the precautionary principle be applied to the development of a new technology?
2. Give an example, other than the one described, where the precautionary principle might be applied.

134

8. Ethical implications of science and technology

Climate Modelling

Read the text and answer the questions. The text describes the use of climate models to predict future climate conditions, and the challenges involved in the process.



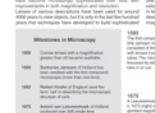
1. What is the purpose of climate modelling?
2. How is climate modelling used in various fields?
3. What are the challenges involved in climate modelling?

111

9. Appreciate scientific possibilities and limitations

11 History of Microscopy

Read the text and answer the questions. The text describes the history of microscopy, from the invention of the first microscope to modern techniques.



1. What is the history of microscopy?
2. How is microscopy used in various fields?
3. What are the challenges involved in microscopy?

11

10. Relationships between scientific disciplines



Making Use of Weblinks

13 Binary Fission in Prokaryotes

Key Idea: Binary fission involves division of the parent body into two, fairly equal, parts to produce two identical cells. Binary fission is a form of asexual reproduction carried out by most prokaryotes, some eukaryotic organisms, such as choanoflagellates, and some unicellular eukaryotes (although the process is somewhat different in eukaryotic cells). The time required for a bacterial cell to divide, or for a population of bacterial cells to double, is called the generation time. Generation times may be quite short (20 minutes) in some species and as long as several days in others.

Most bacteria reproduce asexually by binary fission (left). The cell's DNA is replicated and each copy attaches to a different part of the plasma membrane. When the cell begins to pull apart, the replicated and original chromosomes are separated. Binary fission in bacteria does not involve mitosis or cytokinesis.

This gram-positive coccus (right) is in the process of binary fission. A cross wall (arrow) has formed.

This *Salmonella typhimurium* bacterium (left) has completed cell division. The separation between the two cells can be clearly seen (arrow).

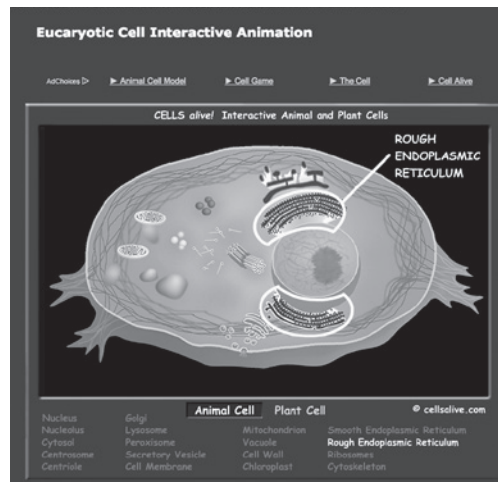
Generation time (minutes)	Population size
0	1
20	2
40	4
60	8
80	
100	
120	
140	
160	
180	
200	
220	
240	
260	
280	
300	
320	
340	
360	

- What is binary fission?
- Explain why the formation of the cross wall is important in binary fission:
- Explain the term generation time:
- A species of bacteria reproduces every 20 minutes. Complete the table (left) by calculating the number of bacteria present at 20 minute intervals.
- State how many bacteria were present after:
 - 1 hour:
 - 3 hours:
 - 6 hours:

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76 13 APP

The tab system at the base of each activity identifies if there is a weblink available to support the activity's content. The weblinks are distinct from the general Biolinks site on BIOZONE's website. They are coded with the activity number and are only accessible through a specific url (below), so bookmark the address at the beginning of your teaching year and always have them on hand. The weblinks comprise short video clips or animations aimed specifically at the activity content. These are external sites from a wide range of reputable sources and are invaluable as support to explain content or view an animation of a complex process such as DNA packing or translation. It's easy and we've done the hard work for you. Just click and view.



Weblinks exist for most of the activities in the workbook, from cells to evolution.

www.thebiozone.com/weblink/IB-3930/

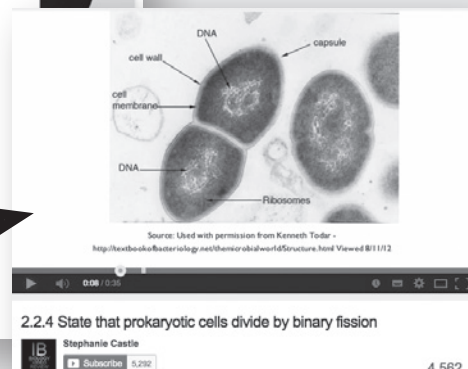
This WEBLINKS page provides links to **external web sites** with supporting information for the activities. Almost exclusively, they are narrowly focussed animations and video clips relevant to the activity on which they are cited. They offer great support to aid student understanding of basic concepts, especially for visual learners.

IB BIOLOGY 2ND EDITION WEBLINKS

Some of the activities in your BIOZONE workbook have references to specific websites, listed below under the relevant chapters. These websites (blue links) provide material, generally either animations or video clips, to help you visualize and understand the material presented on the relevant activity page.

Activity #	Title	Weblinks Title
1	The Cell Theory	All Cells Arise From Pre-Existing Cells
2	Unicellular Eukaryotes	Paramecium Animation
3	Unicellular Eukaryotes	Cytoplasmic Streaming in Paramecium
4	Cell Size	Cell Size and Scale
6	Multicellularity	The Nature of Stem Cells
7	Stem Cells and Differentiation	Stem Cells Quick Reference
8	Types of Stem Cells	Unlocking Stem Cell Potential
9	Using Stem Cells to Treat Disease	Stem Cells in Use
10	Comparing Prokaryotic and Eukaryotic Cells	Plant, Animal and Bacterial Cell Models
11	History of Microscopy	Introduction to Microscopy Through the Ages
12	Prokaryotic Cell Structure	Interactive Cells
13	Binary Fission in Prokaryotes	Prokaryotic Cells Divide by Binary Fission
14	Plant Cells	Eukaryotic Cells Interactive Animations

Weblink Animation



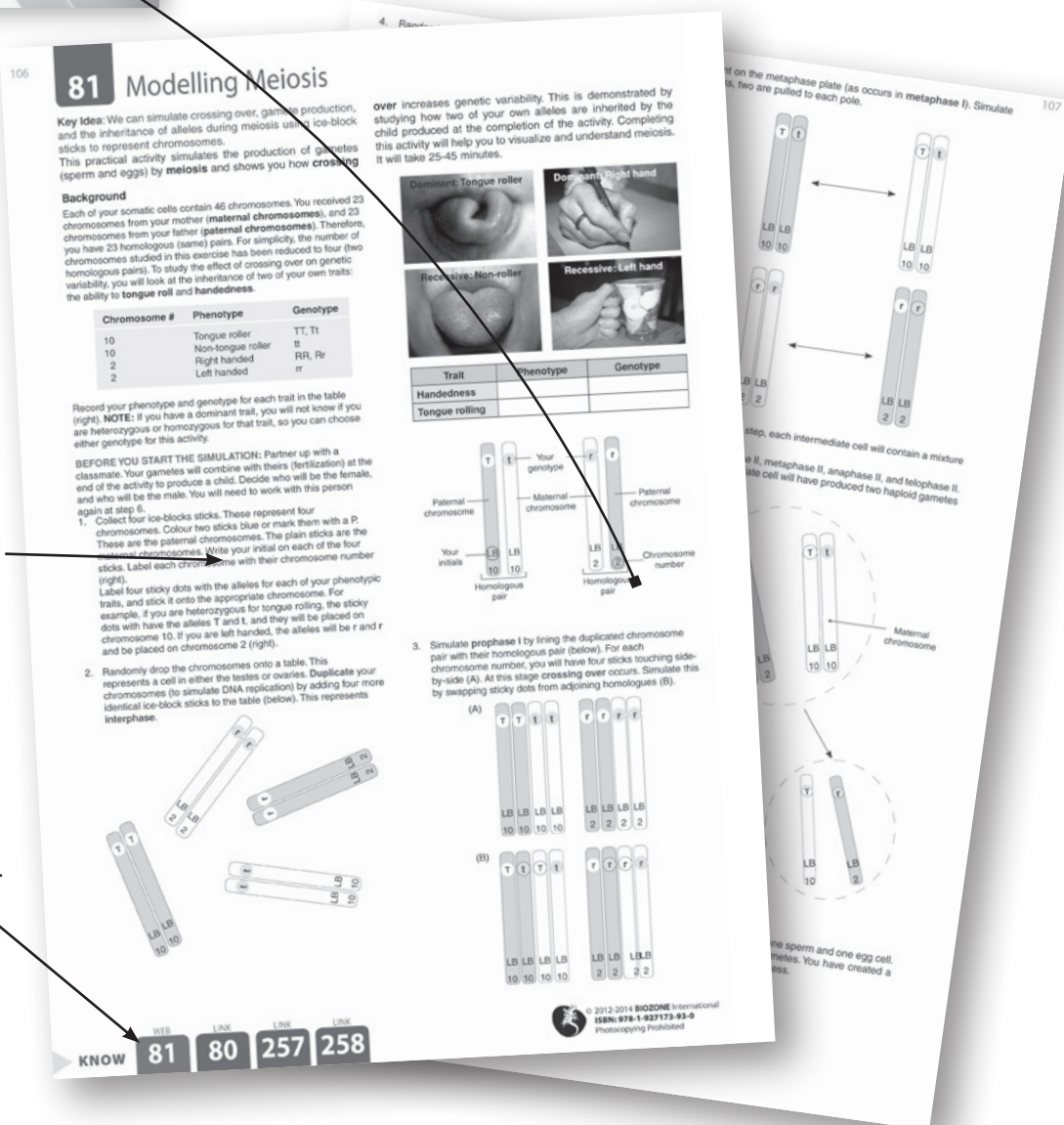
Bookmark weblinks by typing in the address: it is not accessible directly from BIOZONE's website
Corrections and clarifications to current editions are always posted on the weblinks page

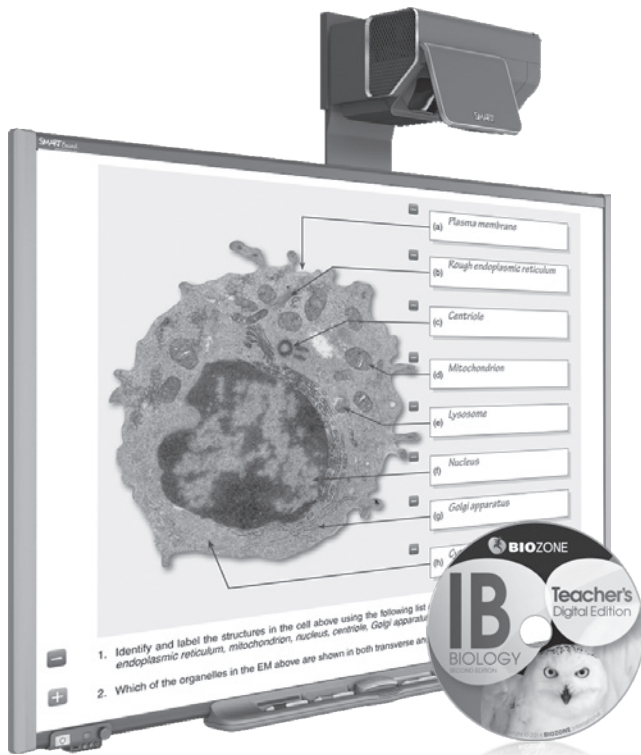


Regardless of which activity you might be attempting in class, a 5-10 minute introduction to the task by the teacher is useful orientation for all students. For collaborative work, the teacher can then divide the class into appropriate groups, each with a balance of able and less able students. Depending on the activity, the class may regroup at the end of the lesson for collaborative discussion.

- Use **peer-to-peer learning** for more challenging activities where the content may be more complex and the questions require students to draw on several areas of their knowledge to synthesize an answer. Examples of such activities include those with a graphing component followed by an evaluation task.
- Stronger peers can assist weaker students and both groups benefit from verbalizing their thoughts and presenting them to a group. ESL students can ask their peers to explain unfamiliar terms (both scientific and English) and this benefits both parties. **Paper practicals** (e.g. *Modelling Meiosis, Creating A DNA Molecule*) are another ideal vehicle for this kind of peer-to-peer learning.

Encourage able students to extend their knowledge by visiting the **recommended weblinks** for the activity.





2 Interactive revision of tasks in class

- Use the workbook PDFs with HIDE/SHOW answers on the **Teacher's Digital Edition** to review activities in class using a data projector or interactive whiteboard.
- Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their work and receive helpful feedback on their responses.
- This approach is particularly suited to activities with questions requiring a discussion, as students will be able to clarify some aspects of their responses. Stronger students can benefit by contributing to the explanatory feedback and class discussion.

Students A and B will work through simpler questions themselves but may require assistance with the more challenging questions in an activity.

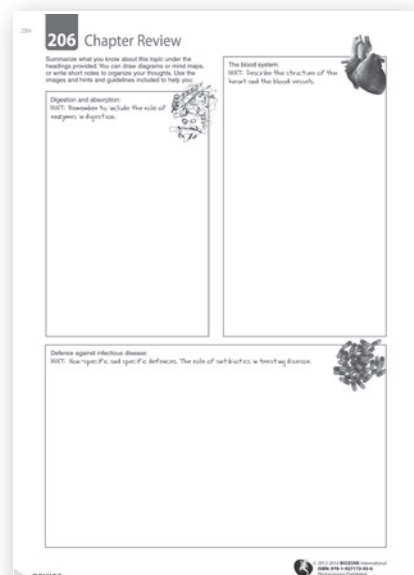
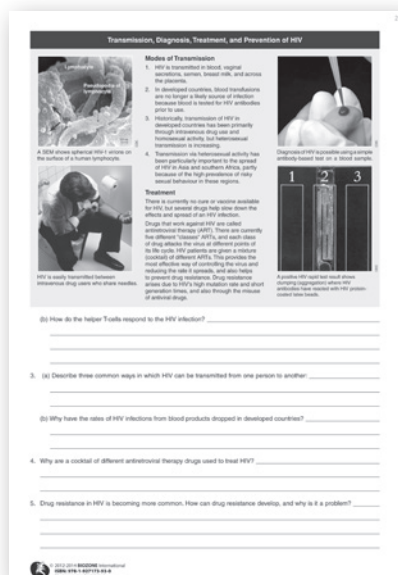
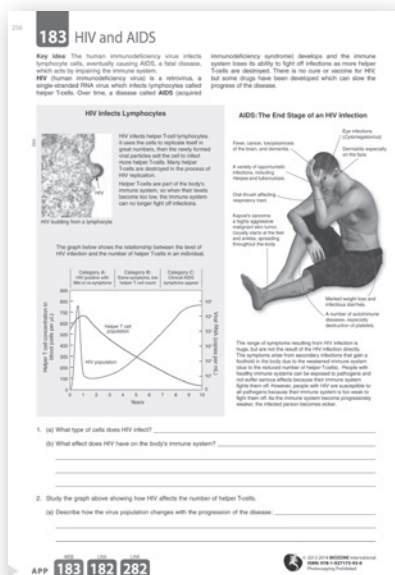
Student C is capable. She completes all of an activity including the more challenging questions.



Student D (above) is capable and completes the set work quickly. She can assist her peers and demonstrate her understanding in the relevant section of the review sheets.

3 Gaining confidence

- The questions in BIOZONE's workbook activities have generally been written in a direct questioning style, e.g. "What are the differences between A and B", or "Why are A and B different?". This makes it easier for the students to understand what is required to answer the question.
- Questions are also arranged so that simpler questions (describe, what, identify, name) are generally asked first, followed by questions demanding an explanation (explain, how, why, account for). This allows students to gain confidence from answering the simpler questions first before attempting the questions that require more comprehensive answers.
- This arrangement also allows teachers to direct students appropriately so that some may attempt only the simpler questions themselves and work with peers to attempt the more challenging questions.



Choosing Activities for Home Study

Many of the workbook activities are ideal for homework or as vehicles for a quick synoptic assessment. Chapter reviews, literacy activities, and follow-on activities are ideal as homework. They provide a way in which to review and consolidate material that has recently been completed, helping learners by presenting the material in a slightly different way. The information for review activities can be found in the content of the chapter, although stronger students may not need to refer back to source material to complete the set work.

14 Plant Cells

Key Idea: Plant cells are eukaryotic cells. They have many features in common with animal cells, but they also have several unique features. Eukaryotic cells have a similar basic structure, although they may vary tremendously in size, shape, and function. Certain features are common to almost all eukaryotic cells, including their three main regions: a **nucleus** (usually located near the centre of the cell), surrounded by a watery **cytoplasm**, which is itself enclosed by the **plasma membrane**. Plant cells are also surrounded by a thick **cell wall**, which gives them a regular shape.

Starch granule: Carbohydrate stored in amyloplasts (plastids specialized for storage). Plastids are unique to plants. Non-photosynthetic plastids visually store materials.

Chloroplast: Specialized plastids, 2 µm x 5 µm, containing the green pigment chlorophyll. They contain dense stacks of membranes (grana) within a colourless fluid which is much like cytosol. They are the sites for photosynthesis and occur mainly in leaves.

Cell wall: A semi-rigid structure outside the plasma membrane, 0.1 µm to several µm thick. It is composed mainly of cellulose. It supports the cell and limits its volume.

Middle lamella: The first division, it contains pectin (P), special ch...

1. (a) Describe the function of the cell wall and the plasma membrane.

(b) The cell wall and the plasma membrane...

17 Identifying Structures in a Plant Cell

1. Study the diagrams on the other pages in this chapter to familiarize yourself with the structures found in plant cells. Identify and label the ten structures in the cell below using the following list of terms: nuclear membrane, cytoplasm, endoplasmic reticulum, mitochondrion, starch granules, chromosome, vacuole, plasma membrane, cell wall, chloroplast.

206 Chapter Review

Summarize what you know about this topic under the headings provided. You can draw diagrams or mind maps, or write short notes to organize your thoughts. Use the images and hints and guidelines included to help you.

Digestion and absorption:
HINT: Remember to include the role of enzymes in digestion.

The blood system:
HINT: Describe the structure of the heart and the blood vessels.

Defence against infectious disease:
HINT: Non-specific and specific defences. The role of antibiotics in treating disease.

265 Using the Chi-squared Test

Key Idea: The chi-squared test (χ^2) tests the outcome of dihybrid crosses against the expected Mendelian ratio. When using the chi-squared test, the null hypothesis is that the ratio of offspring of different phenotypes is as predicted.

Step 1: Calculate the expected value (E)
In this case, this is the sum of the observed divided by the number of categories (see notes).

Step 2: Calculate $O - E$
The difference between the observed and expected values. As a measure of the deviation from a predicted value, they are all squared. This step is usually performed as part of a tabulation.

Step 3: Calculate the value of χ^2
$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

The calculated χ^2 value is given at the bottom of the tabulation.

Step 4: Calculating degrees of freedom (df)
The probability that any particular χ^2 value is exceeded depends on the number of degrees of freedom. This is the total number of categories minus the number of predicted values.

Footnote: Many Mendelian crosses are based on a 3:1 ratio. The total number of categories is 2.

Table 1: Critical values of χ^2 for df at 5% significance. If the test statistic is greater than the critical value, the result is significant.

Degrees of freedom	0.05
1	3.84
2	5.99
3	7.88
4	9.49
5	11.07

WEB 14 KNOW

WEB 17 LINK

REVISE

WEB 266 REFER

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Most students will have internet access. Encourage them to visit the assigned **weblinks** if they are having trouble understanding a subject or visualizing a process. They should also check activities indicated as **links**.

Review activities are ideal as homework. Students can produce their own review and then have it checked by the teacher or compare and discuss it with peers if they want to check their thinking.

Set simpler activities or preparatory reading (REFER activities) for homework. This encourages less able students to achieve and to be properly prepared for in-class lessons.



Focus on Scientific Literacy

Within all areas of science, scientific literacy is an important area of focus. With it, communication in the topic is more effective, more concise, and less cumbersome. BIOZONE's aim is to provide a method by which students would encounter and become familiar with scientific terms in various contexts. Beginning with the list of KEY TERMS at the beginning of each chapter, students can create their own glossary of commonly used terms. They can learn to use these key terms appropriately by encountering them in context within the activities, and reinforce their understanding of the term by completing the literacy activities throughout the workbook. These take several forms:

Literacy activities use a range of question types to test vocabulary and understanding of basic principles. Questions include analysis or completion of flow charts, drawings or photographs, mix and match definitions, cloze questions and other vocab builders, and multiple choice.

Mix and match activities ask students to match each key term to its best definition. Finding the correct definition increases retention of the terms and their meanings.

Comprehension activities require the students to read a short section of text, e.g. a mock article, and then answer some questions based on understanding and correctly interpreting the information provided. The aim is to provide high-interest material in a way that encourages engagement and focus.

207 KEY TERMS: Did You Get It?

1. (a) What process moves food through the gut? _____
(b) In what region of the digestive system does most absorption occur? _____
(c) What is the function of the villi in the small intestine? _____
(d) What organ secretes amylase into the small intestine? _____
2. (a) What type of blood vessel transports blood away from the heart? _____
(b) What type of blood vessel transports blood to the heart? _____

71 KEY TERMS: Did You Get It?

1. Test your vocabulary by matching each term to its definition, as identified by its preceding letter code.

amino acid _____

ATP _____

catabolism _____

catalyst _____

condensation _____

denaturation _____

disaccharide _____

DNA _____

enzyme _____

fermentation _____

hydrolysis _____

lipid _____

- A Chemical reaction that combines two molecules. Water is produced as a by-product.
- B Chemical reaction in which a molecule is split by water (as H^+ and OH^-).
- C A double sugar molecule used as an energy source and a building block of larger molecules. Examples are sucrose and lactose.
- D The process by which mRNA is decoded to produce a specific polypeptide.
- E A nucleotide comprising a purine base, a pentose sugar, and three phosphate groups, which acts as the cell's energy carrier.
- F A model for DNA replication which proposes each DNA strand serves as a template, forming a new DNA molecule with half old and half new DNA.
- G A globular protein which acts as a catalyst to speed up a specific biological reaction.
- H A complex carbohydrate with a structural and energy storage role in cells. Examples include cellulose, starch, and glycogen.
- I A substance or molecule that lowers the activation energy of a reaction but is itself not used up during the reaction. In biological systems, this function is carried out by enzymes.
- J Also called fat or oil. A biological compound made up of glycerol and fatty acid components.
- K The loss of a protein's three-dimensional functional structure.
- L Macromolecules that form from the joining of multiple amino acids together.
- M A building block of proteins.
- N A carbohydrate monomer. Examples include fructose and glucose.
- O A polynucleotide molecule that occurs in two forms, DNA and RNA.
- P Metabolic process in which complex molecules are broken down into simpler ones.
- Q Process which provides an alternative way to produce energy if oxygen is temporarily unavailable. Does not involve a terminal electron acceptor.
- R Universally found macromolecules composed of chains of nucleotides. These molecules carry genetic information within cells.

210 DNA Carries the Code

Key idea: A series of experiments in the 1940s and 1950s confirmed that it was DNA that carried the genetic information.

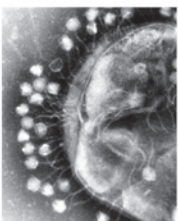


Streptococcus pneumoniae colonies showing the characteristic smooth, rounded appearance.

Scientists had known about DNA since the end of the 19th century, but its role in storing information remained unknown until the 1940s, and its structure remained a mystery for another decade after that. In 1928, experiments by British scientist Frederick Griffith gave the first indications that DNA was responsible for passing on information. Griffith had been working with two strains of the bacteria *Streptococcus pneumoniae*. Only one strain (the pathogenic strain) caused pneumonia and it was easily identified because it formed colonies with smooth edges. The other, benign strain formed colonies with rough edges. When mice were injected with the pathogenic strain they developed pneumonia and died. The mice injected with the benign strain did not. Mice injected with the heat-killed pathogenic strain did not develop pneumonia either. This showed that the disease was not caused by a chemical associated with the bacteria, or a response by the body to the bacteria, it was the bacterial cells themselves. In a second experiment, Griffith mixed the benign strain with the heat-killed pathogenic strain and injected it into healthy mice. To his surprise, the mice developed pneumonia. When bacteria from the mice were recovered and cultured they produced colonies identical to the pathogenic strain. Somehow the harmless bacteria had acquired information from the dead pathogenic strain. Griffith called this process **transformation**.

In 1944, American scientists, led by Oswald Avery, continued with Griffith's experiments. They made an extract from the heat-killed pathogenic strain and treated it with chemicals to destroy any lipids, carbohydrates, or proteins. This was mixed with the benign strain and transformation still occurred. This established that no proteins, lipids, or carbohydrates were responsible for the transformation. When another identical extract was treated with chemicals that break down DNA, the transformation did not take place - the benign strain failed to acquire the information required to cause pneumonia. From this it was deduced that DNA was the unit that was carrying the information from one bacteria to another.

Another experiment in 1952 by Alfred Hershey and Martha Chase, confirmed what the other two experiments had shown. Hershey and Chase worked with viruses, which were known to have DNA and to transfer information to their host. However, there was debate over whether the information was transferred by the DNA or by the protein coat of the virus. Hershey and Chase used radioactive sulfur and radioactive phosphorus to mark different parts of the virus. The sulfur was incorporated into the protein coat while the phosphorus was incorporated into the viral DNA. The viruses were then mixed with bacteria and the infected bacteria analysed. The bacteria were found to contain radioactive phosphorus but not radioactive sulfur, showing that the virus had indeed passed information to its host by injecting its own DNA.



1. How did Griffith confirm that it was the bacteria causing the pneumonia and not something else?

2. Why were sulfur and phosphorus used in Hershey's experiment?

3. Why is it important to conduct two different experiments (e.g. Avery's and Hershey's) when investigating a hypothesis?

The Vocabulary and Comprehension activities frequently require students to apply the knowledge they have gained in the chapter to solving a new problem. This tests their deeper understanding of basic principles.



IB Biology Presentation Media

Support your teaching of the IB biology program with **IB Biology Presentation Media**. This title provides 12 sets of full colour slides corresponding to the 12 (11 topics + Data Handling and Analysis) chapters of the IB Biology Student workbook. The extent of each set broadly reflects the coverage in the workbook, and may include additional detail and illustrations. The slide sets are in **full colour**, **fully editable**, and **site licenced**.



BIOZONE APP
Student Review Series
Science Practices

Equivalent titles, as non-editable screens, are available as **Student Review Series** through the BIOZONE app.

274 Disruptive Selection in Darwin's Finches

Key Idea: Disruptive selection in the finch *Geospiza fortis* produces a bimodal distribution for beak size. The Galapagos Islands, 975 km west of Ecuador, are home to the finch species *Geospiza fortis*. A study during a prolonged drought on Santa Cruz Island showed how disruptive selection can change the distribution of genotypes in a population. During the drought, large and small seeds were more abundant than the preferred intermediate sized seeds.

Beak size vs fitness in *Geospiza fortis*

Beak size of 15 birds was measured over a three year period (2004-2006), at the end of each year. At the end of the year individuals were captured, banded, and their beaks were measured.

The proportion of observed phenotypes was recorded at the end of the year after the birds were measured. (Remember: individuals had their beaks measured). The proportion of beak sizes in the population at the end of the year gave a measure of fitness. Beak size was measured in millimeters (mm).

These values were used to create a bimodal distribution (left) typical of disruptive selection.

Measurements of the beak length, width, and depth were combined into one single measure.

These values were used to create a bimodal distribution (left) typical of disruptive selection.

Beak Size Pairing in *Geospiza fortis*

Pairing under extremely wet conditions

Pairing under dry conditions

A 2007 study found that breeding pairs of birds had similar beak sizes. Males and females with similar beak sizes tended to breed together, and males and females with large beaks tended to breed together. This selection maintained the bimodal distribution in the population during extremely wet conditions. If food size wasn't a factor in mate selection, the beak size would have not.

1. (a) How did the drought affect seed size on Santa Cruz Island?

(b) How did the change in seed size during the drought create a selection pressure for changes in beak size?

2. How does beak size relate to fitness (differential reproductive success) in *G. fortis*?

3. (a) Is mate selection in *G. fortis* random / non-random? (circle one)

(b) Give reasons for your answer:

91 Codominance of Alleles

Key Idea: In codominance, neither allele is recessive and both alleles are equally and independently expressed in the heterozygote. Codominance is an inheritance pattern in which both alleles in a heterozygote contribute to the phenotype and both alleles are independently and equally expressed. Examples include the human blood group AB and certain coat colours in horses and cattle. Roan (red and white) is equally dominant with white. Animals that have both alleles have coats that are roan (both red and white hairs are present).

In the diagram cattle breed, coat colour is inherited. White (homozygous) parents always produce calves with white coats. Red parents always produce red calves. However, when a red parent mates with a white one, the calves have a coat colour that is different from either parent: a mixture of red and white hairs, called roan. Use the example (left) to help you to solve the problems below.

1. Explain how codominance of alleles can result in offspring with a phenotype that is different from either parent:

2. A white bull is mated with a roan cow (right).

(a) Fill in the spaces to show the genotypes and phenotypes for parents and calves.

(b) What is the phenotype ratio for this cross?

(c) How could a cattle farmer control the breeding so that the herd ultimately consisted of only red cattle?

3. A farmer has only roan cattle on his farm. He suspects that one of the neighbouring farms may have jumped the fence to mate with his roan cattle in the year because half the calves born were red and half were roan. One neighbour has a red bull, the other has a roan.

(a) Fill in the spaces (right) to show the genotype and phenotype for parents and calves.

(b) Which bull serviced the cows? red or roan (circle one)

4. Describe the classical phenotypic ratio for a codominant gene resulting from the cross of two heterozygotes (e.g. a cross between two roan cattle).

128 The Carbon Cycle

Key Idea: The continued availability of carbon in ecosystems depends on carbon cycling through the abiotic and biotic components of an ecosystem. Carbon dioxide is converted by autotrophs into carbohydrates via photosynthesis and returned to the atmosphere as CO_2 through respiration (breathes). These flows can be measured. Some of the sinks and processes involved in the carbon cycle, together with the carbon fluxes, are shown below.

Carbon cycles between the biotic and abiotic environment. Carbon dioxide is converted by autotrophs into carbohydrates via photosynthesis and returned to the atmosphere as CO_2 through respiration (breathes). These flows can be measured. Some of the sinks and processes involved in the carbon cycle, together with the carbon fluxes, are shown below.

1. Add arrows and labels to the diagram above to show:

(a) Densification of biomass by acid rain

(b) Release of carbon from the marine food chain

(c) Burning of fossil fuels

2. (a) Name the processes that release carbon into the atmosphere:

(b) In what form is the carbon released?

3. Name the four geological reservoirs (banks), in the diagram above, that can act as a source of carbon:

(i) _____ (ii) _____

(iii) _____ (iv) _____

4. (a) Identify the process carried out by algae or plants (A)

(b) Identify the process carried out by decomposers (B)

5. What would be the effect on carbon cycling if there were no decomposers present in an ecosystem?

Disruptive Selection in Finches

Measurements of beak sizes in the finch *Geospiza fortis* were recorded during a prolonged drought on the Galapagos Island of Santa Cruz.

It was found that the finches had either large or small beaks but not intermediate sized beaks.

Individual fitness was measured by recording the presence or absence of individual beaks after one year.

Measurements of the beak length, width, and depth were combined into one single measure (left). Plotted against:

Codominance

In cases of codominance, both alleles are independently and equally expressed in the heterozygote. Examples include:

- Roan (stippled red and white) coat color in cattle. A cross between a red bull and a white cow produces all roan offspring.
- ABO human blood groups.

Red bull C^RC^R **White cow** C^WC^W

Parents

Gametes C^R C^R C^W C^W

Possible fertilizations

F₁ offspring Roan Roan Roan Roan



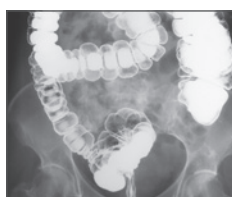
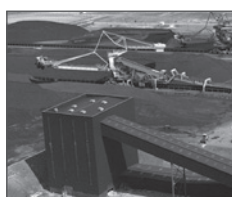
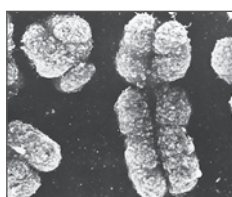
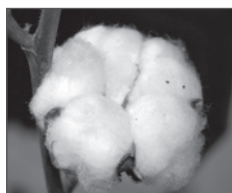
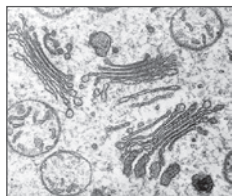
Access the *Weblinks* directly from this link for a range of animations and video clips to support the activities.



Many activities with data handling are supported by working spreadsheets, which include all data and comments on graphical analysis.

Integrated Course Guide for IB Biology

Although the IB Biology syllabus is divided into Standard Level (SL) and Higher Level (HL) sections, it can easily be taught as an integrated course, with the HL components taught in the same block as the SL components. For teachers choosing to take an integrated approach, the guide below will help you to quickly locate the activities in the IB Biology workbook that pertain to the general subject areas listed.



Subject area	IB topic	Workbook chapter	Activity number
Cell biology	1.1	Cell Biology	1-9
	1.2		10-17
	1.3		18-19
	1.4		20-26
	1.6		31-35
Molecular biology	2.1	Molecular Biology	38, 46
	2.2		39-40
	2.3		42-45
	2.4		47-49
	7.3	Nucleic Acids (HL)	219
Cellular metabolism	2.5	Molecular Biology	50-53
	2.8		61-65
	2.9		66-69
	8.1	Cellular Metabolism (HL)	222-225
	8.2		226-227
	8.3		228-231
Structure and function of DNA	2.6	Molecular Biology	54
	2.7		55-60
	7.1	Nucleic Acids (HL)	208-211
	7.2		212-216
	7.3		217-218
Chromosomes and meiosis	3.1	Genetics	72-73, 76-77
	3.4		74-75
	3.2		78-79, 83-84
	3.3		80-82
	10.1	Genetics and Evolution (HL)	257-259
Heredity	3.4	Genetics	86-96
	10.2	Genetics and Evolution (HL)	261-268
Genetic engineering	3.2	Genetics	85
	3.5		97-113
Ecology	4.1	Ecology	116-121, 127, 129
	4.2		122-126
	4.3		128
	4.4		130-135
Classification	5.3	Evolution and Biodiversity	149-155
	5.4		156-157
Evolution	1.5	Cell Biology	27-30
	5.1	Evolution and Biodiversity	137-141
	5.2		142-148
	10.3	Genetics and Evolution (HL)	269-279
Digestion	6.1	Human Physiology	160-167
Transport	6.2	Human Physiology	168-176
Gas exchange	6.3	Human Physiology	184-190
Defence and immune system	6.4	Human Physiology	177-183
	11.1	Animal Physiology (HL)	282-291
Homeostasis and osmoregulation	6.6	Human Physiology	197-201
	11.3	Animal Physiology (HL)	297-307
The nervous system	6.5	Human Physiology	191-196
Muscles and movement	11.2	Animal Physiology (HL)	292-296
Reproduction	6.6	Human Physiology	202-205
	11.4	Animal Physiology (HL)	308-315
Plant biology	9.1	Plant Biology (HL)	234-239
	9.2		240-242
	9.3		243-245
	9.4		246-254



Resources on BIOZONE's Website

BIOZONE's web site should be the first stop for biologists. As well as providing all our product information (including shipping dates) and updates, www.thebiozone.com provides quick access to the latest RSS newsfeeds and podcasts from around the world. The Resource hub also provides quick links to access the websites of publishers of references cited in the workbooks. Perhaps of greatest value to students and teachers is the BIOLINKS area of Biozone's website. The BIOLINKS pages are distinct from *Weblinks* (which are specific to each workbook edition) and provide a database of well organized hyperlinks pertaining to topics of interest in biology. The database is updated regularly, so that outdated, not operational, or no longer relevant sites are removed and new sites are added as they appear.

The screenshot shows the BIOZONE website interface. The top navigation bar includes the BIOZONE logo, a search bar, and links for Cart, Wishlist, Admin, Log Out, and My Account. The main menu features links for Home, About Us, Products, Store, News, Biolinks, FAQ, and Contact Us. The Biolinks section is highlighted, showing a grid of topics including Anatomy & Physiology, Animal Behaviour, Animal Biology, Biochemistry, Biodiversity, Biotechnology, Cell Biology, Conservation, Ecology, Earth Science, Evolution, Genetics, Health & Disease, Human Evolution, Human Impact, Microbiology, Resource Management & Agriculture, Space Biology, Student Projects, Biology Glossaries, and Examination Boards. A callout box points to the 'Cell Biology' link, stating: 'Click on a topic to see a list of all its links. Each topic has relevant subtopics to make searching easier and each link has a brief description.'

The detailed view of the 'CELL BIOLOGY' page shows a grid of product images, including a textbook titled 'CELL BIOLOGY & BIOCHEMISTRY', a tablet displaying 'Electron Transport Chain', and a CD-ROM titled 'Cell Biology & Biochemistry'. To the right, a list of products is shown: 'Student Review Series for iPad and iPod', 'Student Workbook', and 'Presentation Media'. A 'View Product' button is located below this list. Below the product grid, a disclaimer states: 'BIOZONE is not responsible for the content of external internet sites. Please note that listing any other company's products on this website does not, in any way, denote BIOZONE's endorsement of them.'

The page also features a section titled 'General Sites for Cell Biology' with links to various resources:

- BBC News:** Cell discovery clues to body clock and beating jet lag. New discoveries into how the body clock works could provide clues to help combat jet lag, research suggests.
- Kimball's Biology Pages:** A comprehensive biology site created and maintained by John W. Kimball, a retired graduate of Harvard College where he taught immunology.
- Molecular Biology Web Book:** A free web book, covering such topics as Cells and viruses, protein structure, DNA and Cell division.
- NIH:** Using technology to study cellular and molecular biology. Using Technology to Study Cellular and Molecular Biology—developed with the the National Center for Research Resources (NCRR)—is a creative, inquiry-based instruction program designed to promote active learning and stimulate student interest in medical topics.
- DNA Replication and Mutation:**
 - DNA Replication by John Kyrk
 - Karyotype Activities Genetic Science Learning Center
 - DNA Repair Nature

On the right side of the page, there is a section for 'RSS Newsfeeds From NewScientist.com' with a list of recent news items:

- European Commission sues UK over polluted air
- Electric heart sock could kick out pacemakers
- Space Images reveal California's vanished snowpack
- Today on New Scientist
- UK's carbon plans make up for oil and gas spurge

Below this list, it says 'Powered by: RSS-to-JavaScript.com'. Further down, there is a section for 'From BBC NEWS' with more news items:

- Scientists track Fukushima plume
- Crystal is 'oldest scrap of crust'
- 'Biggest meteorite impact' hits Moon
- Rare 'polio-like' disease reports
- Farmers' union condemns flood plans

At the bottom of this section, it says 'Powered by: RSS-to-JavaScript.com' and 'From nature.com'. The final news item is 'Lateral junction dynamics lead the way out'.

Annotations on the page provide additional context:

- 'RSS Newsfeeds and Podcasts in the right hand column provide the latest news and information from the world of science.'
- 'Click on the link to access the named site. The brief description tells you how the site may be of interest, as well as any country specific bias, if this is relevant.'



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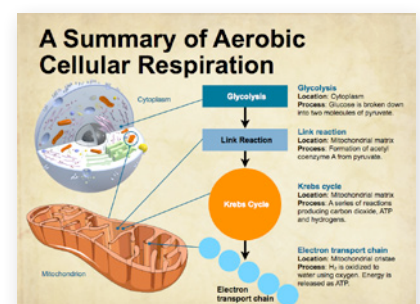
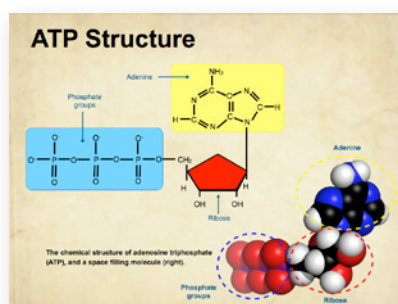
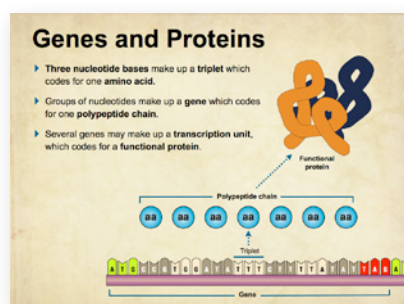
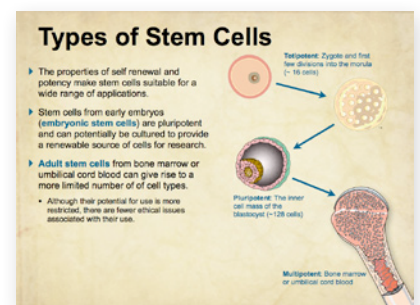
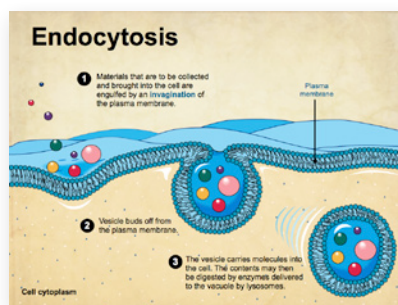
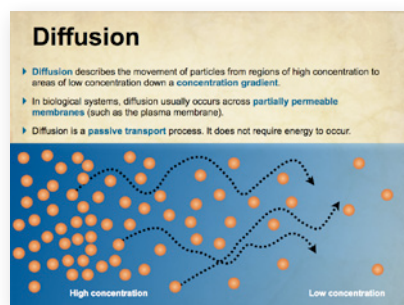
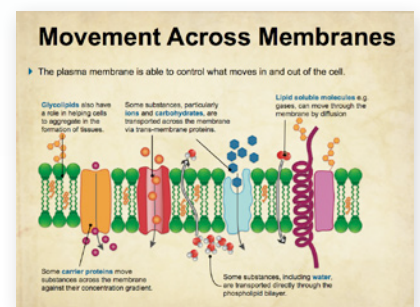
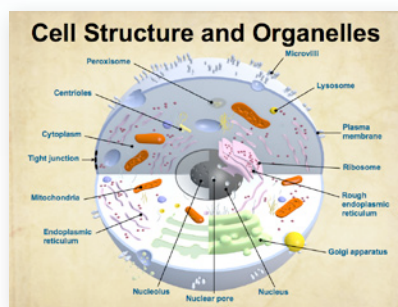
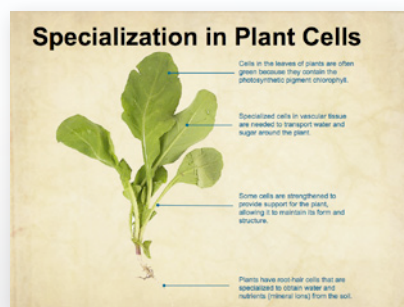
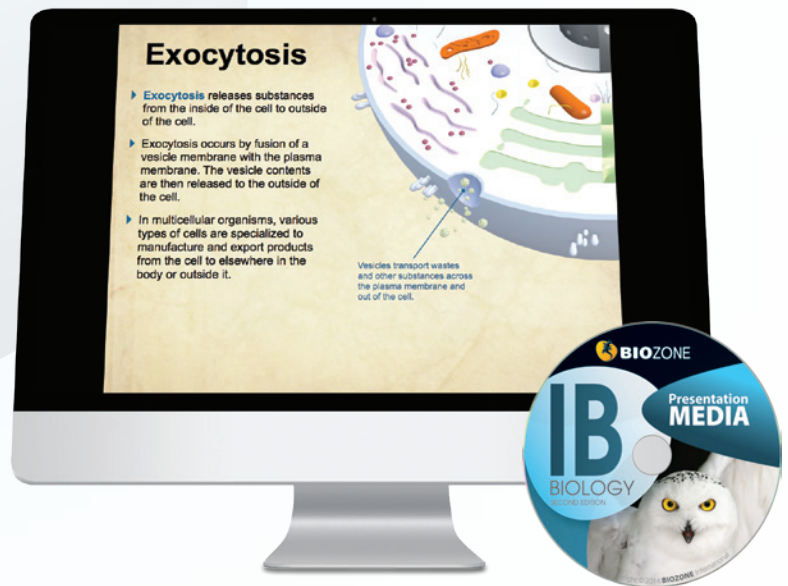
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The **IB** BIOLOGY Series

BIOZONE's IB BIOLOGY Student Workbook has been completely redesigned and revised to address the new IB Diploma Programme for Biology. It incorporates both SL and HL content in a single, easily navigated volume, with clear indicators to specific components of the IB Biology Programme.

Targeted learning objectives summarize the required understandings, applications, and skills, prefacing each of the 11 comprehensive chapters and providing the necessary framework for delivering the programme content.

Understandings, Applications, and Skills

The understandings, applications, and skills required for each topic are summarized in clear learning objectives that provide the IB learner with specific performance expectations.

TOK and International-Mindedness

Specific indicators to these components of the IB programme are made in the introduction to each chapter and throughout the workbook. Students are encouraged through questions and visual material to address them in context as appropriate.

Literacy and Comprehension

A literacy and comprehension activity concludes each chapter, testing knowledge of important terms, synthesis of information, and understanding of basic concepts. A perfect synoptic self-test for students.

Syllabus and Cross-Curricula Links

BIOZONE's unique tab system identifies specific utilizations and makes connections to related concepts across the entire IB Biology syllabus.

Group 4 Experimental Skills and Mathematical Requirements

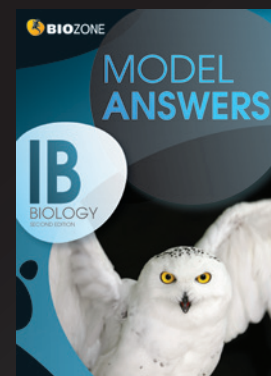
These components of the syllabus are addressed in two complementary ways. Activities including data handling and interpretation are integrated throughout the workbook, providing real-world scenarios in context. A comprehensive concluding chapter supports this, developing skills in basic planning, computation, graphing, and data analysis.

Weblinks

These support activities where relevant and appropriate, to extend learning beyond the workbook and to assist students in visualizing complex processes.

Group 4 Aims

Over 320 varied and engaging activities provide ample opportunity for students to address and meet the Group 4 aims. The wide range of tasks facilitates effective differential instruction: introduce, consolidate, extend, and test using the same workbook.



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