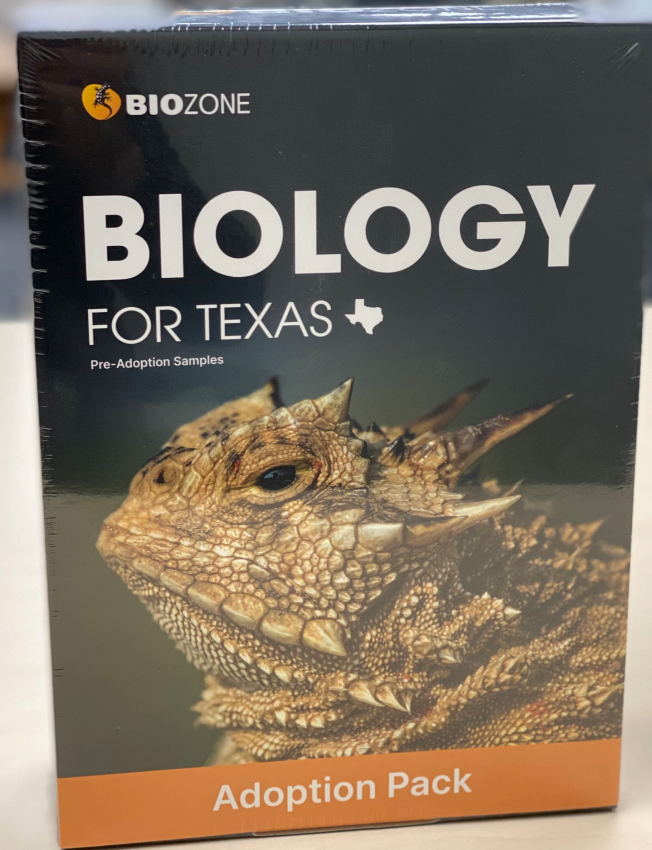


Scan to
learn more about **Biology for Texas**
or to **request an adoption pack**



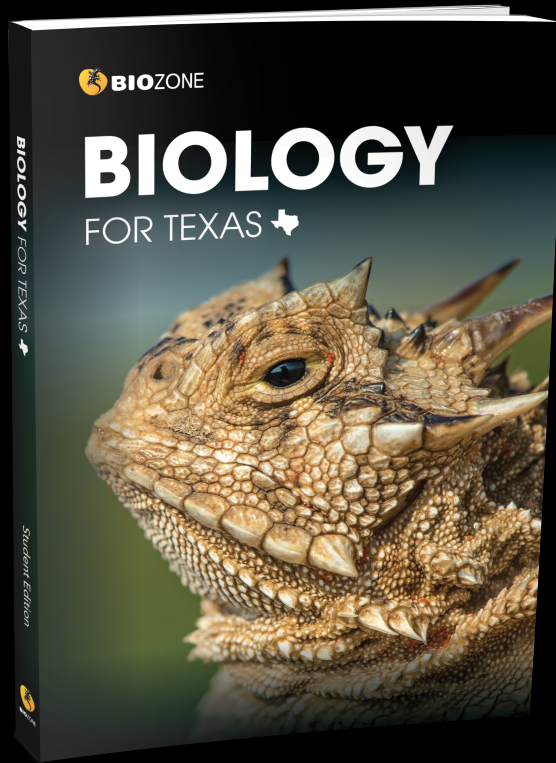
Introducing:

Lissa Bainbridge-Smith

Author

Professional development team leader





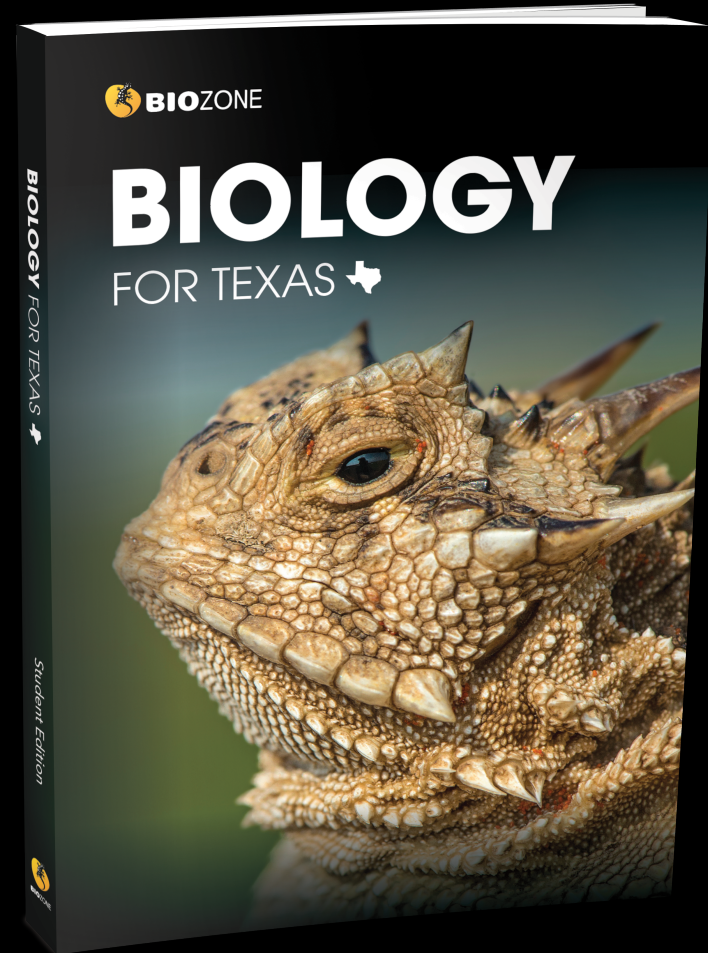
Biology for Texas

Why this title *needs* to be
on your resource list



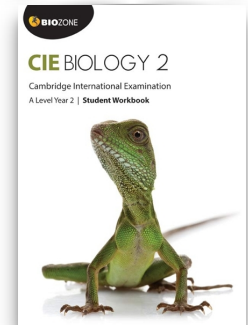
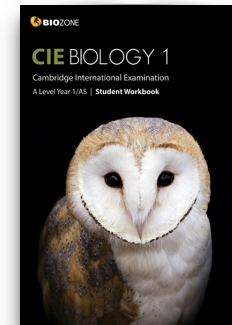
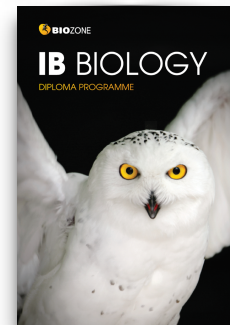
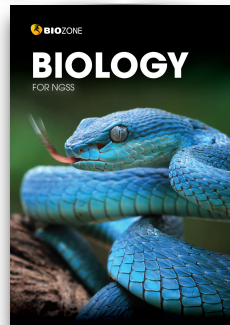
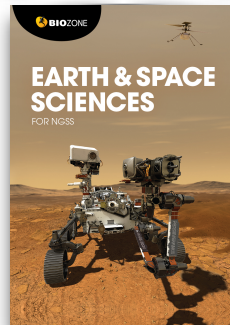
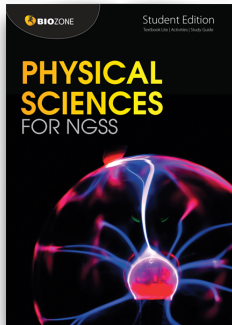
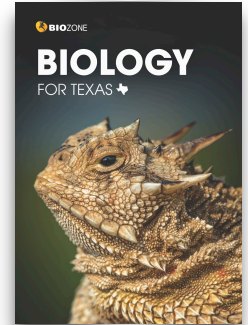
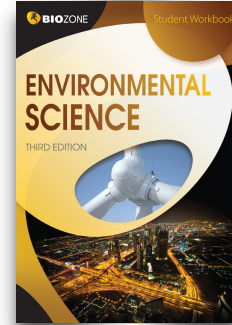
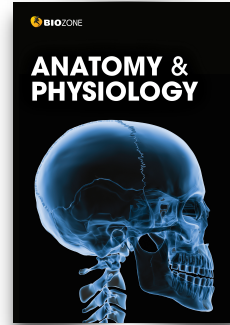
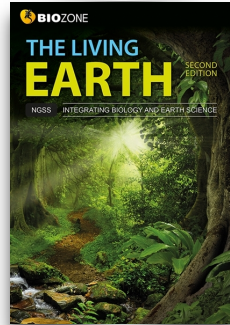
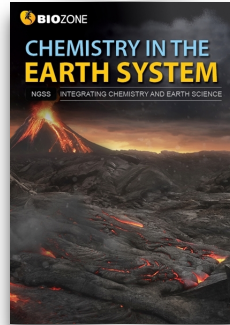
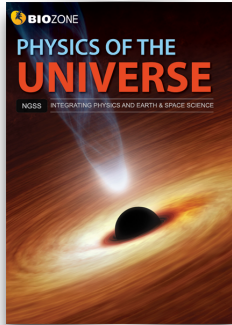
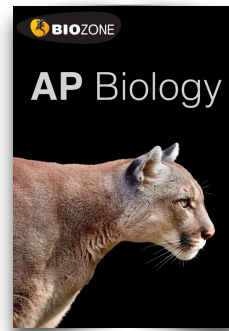
Overview

- Product overview
- BIOZONE's points of difference
- About Biology for Texas
 - Features
 - Teacher toolkit
- Digital platform: BIOZONE WORLD



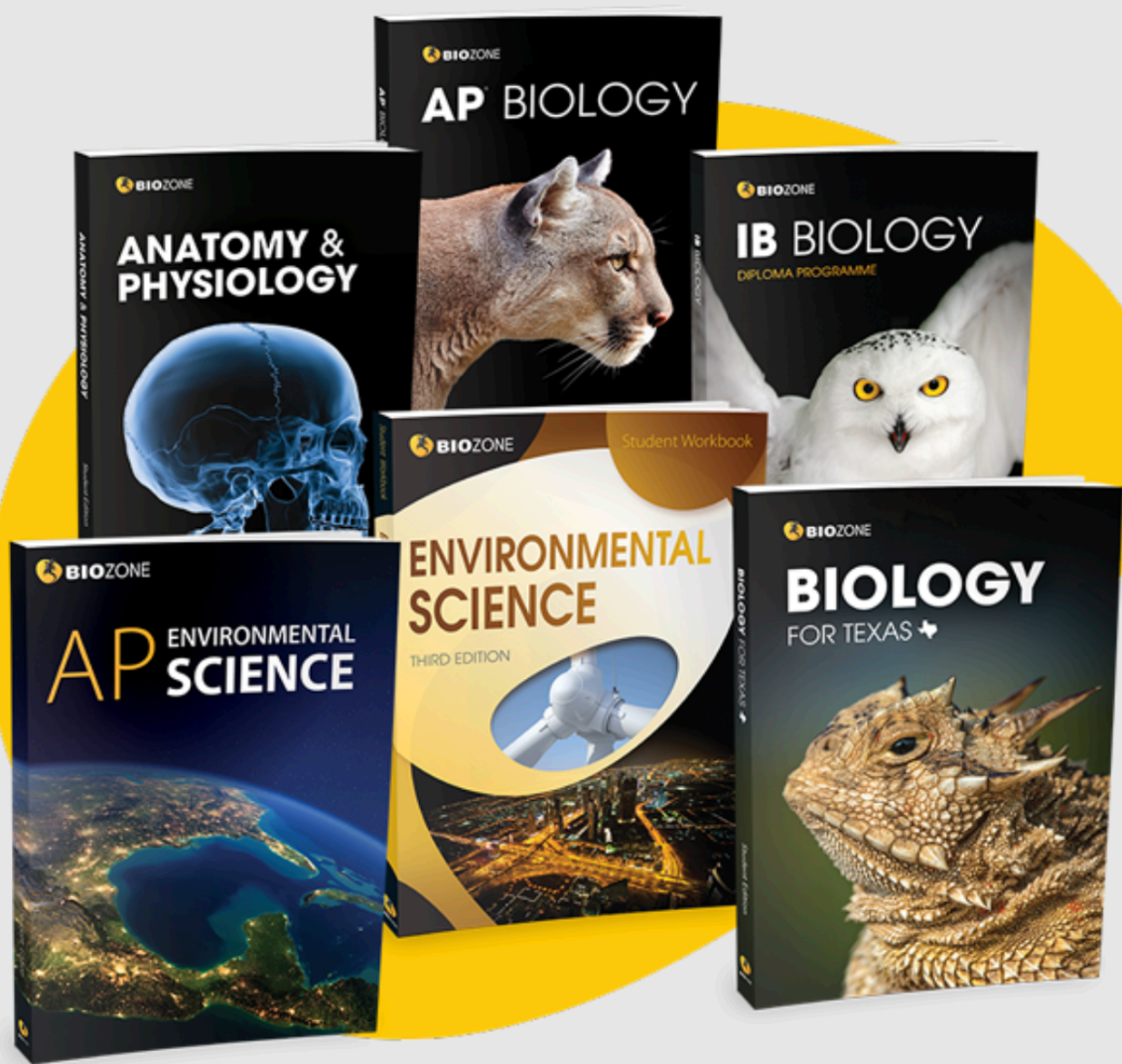
BIOZONE

SCIENCE US PROGRAMS



BIOZONE

TEXAS PROGRAMS



What sets BIOZONE apart?

Teachers write our resources



Questions?

Author Hotline: authors@biozone.com

Curricula-specific Titles

Designed *not* aligned

- Titles are written to meet the requirements of a **specific program**.
- Specific program components are integrated and identified:
 - ▶ **Program specific content**, examples, case studies
 - ▶ **Practical requirements** and **skills**
 - ▶ Curricula specific **assessment tools**



BIOZONE Worktexts

Combine the very
best features of a
textbook

.... with the utility of
workbook



A 3-in-1 hybrid resource

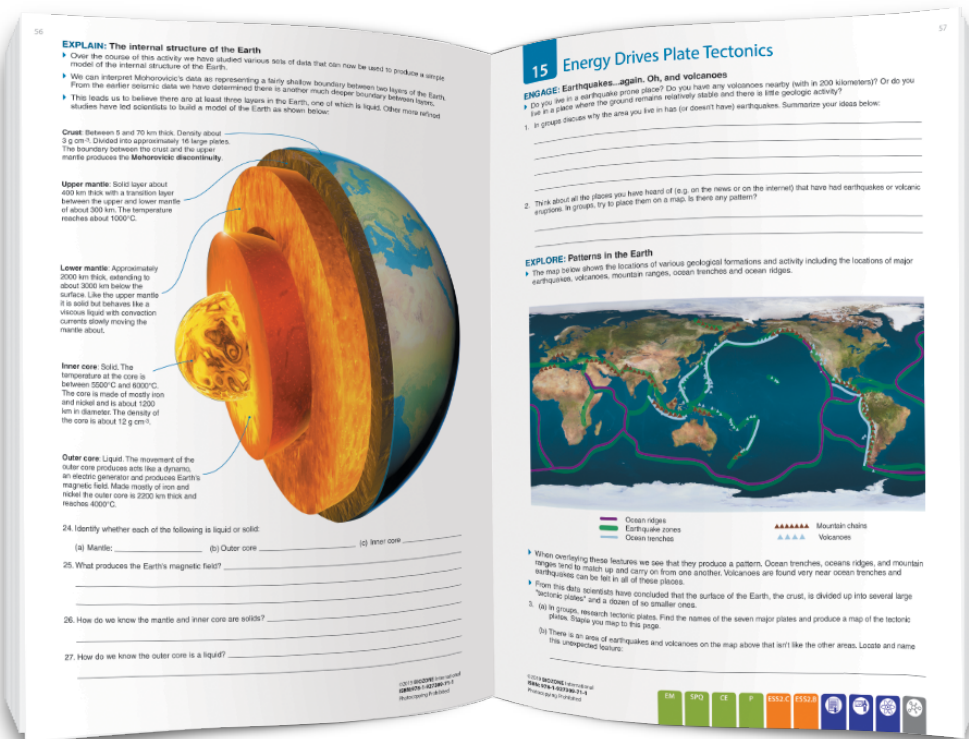
Part textbook

Part study guide

Part activity workbook

Supported by the: **Teacher Toolkit**

Designed to be a **consumable resource** ...



What is the **BIOZONE** solution?

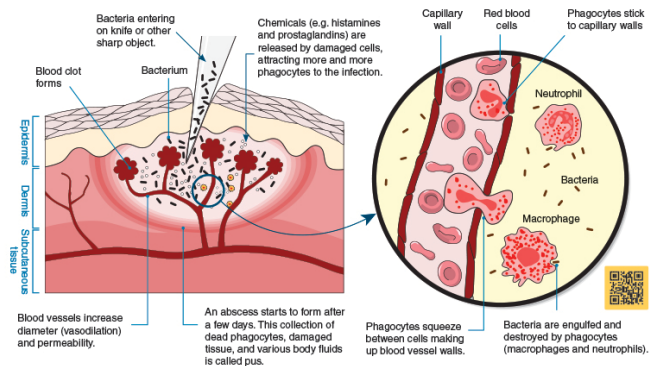


Each year of an adoption, students get a fresh new copy of the worktext to begin their learning journey.

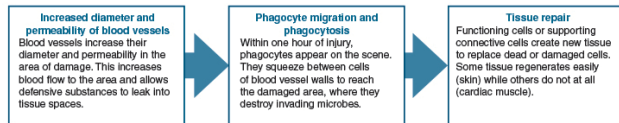
128 Inflammation

Key idea: Inflammation is a defensive response to damage. The inflammation process involves pain, redness, heat, and swelling. Damage to the body's tissues can be caused by physical agents, e.g. sharp objects, heat, radiant energy, or electricity;

microbial infection; or chemical agents, e.g. gases, acids and bases. The damage triggers a defensive response called **inflammation**. The inflammatory response is beneficial and the process of inflammation can be divided into three distinct stages. These are described below.



Stages in the inflammatory response



1. Outline the three stages of inflammation and identify the beneficial role of each stage:

- (a) _____
- (b) _____
- (c) _____

2. State the role of histamines and prostaglandins in inflammation: _____

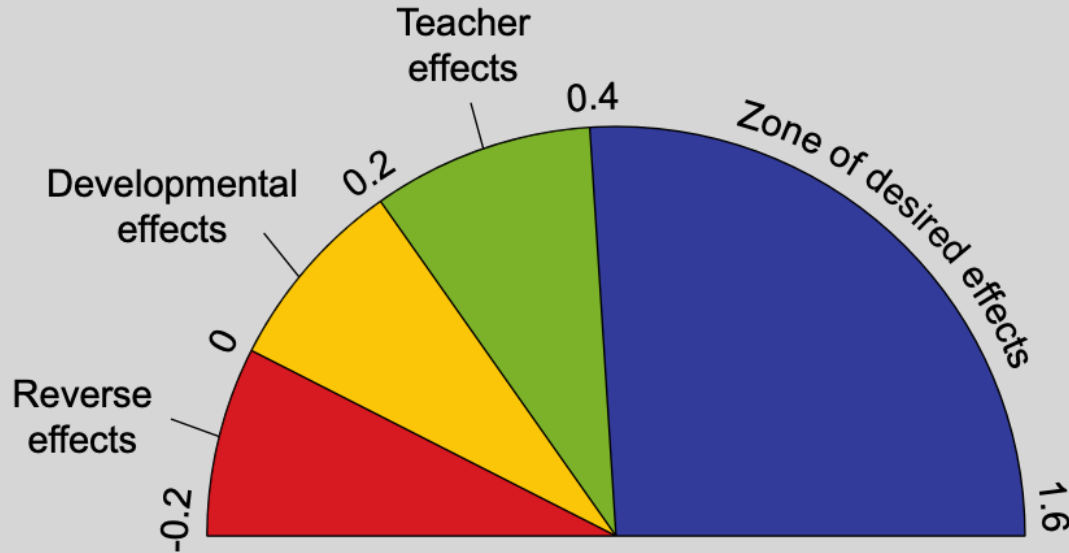
Why are BIOZONE Worktexts Unique?

- A reputation for **scientific rigor** ...
... but our information is **accessible**
- **Graphical delivery** of science concepts
- **Chunked text**
- Students interact directly with material - **record of work**
- **Easy revision**
- **Self-grading and answer refinement**



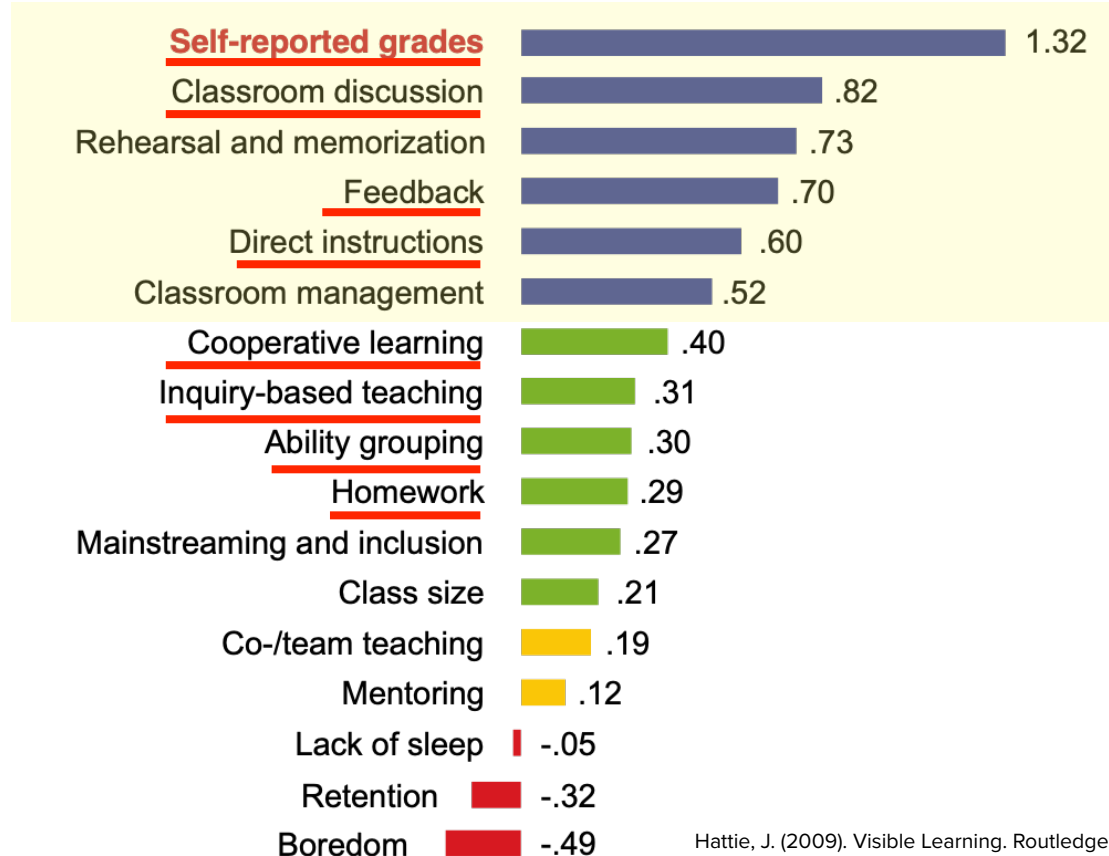
Many factors influence student achievement

- Some detrimentally (red)
- Others positively (yellow, green, blue)
- **Results greater than 0.4 accelerate student learning (blue)**



Influences on student achievement

- BIOZONE products incorporate many of the factors shown to positively influence student achievement.
- **Self-reported grades;** one of the most successful pedagogical tools to academic achievement.
- Where does the data come from?
A synthesis of >2,000 meta studies involving over 100,000 individual studies and 300 million students.



How can students self-grade with BIOZONE?

CLASSROOM

Biology For Texas (SAMPLE) > Chapter 8: Evolution And Natural Selection > 184 Selection Pressure In Populations >

105% - +

No Presets

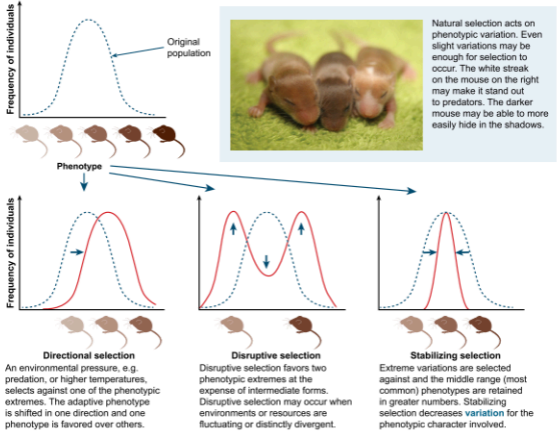
184 Selection Pressure in Populations

319

Key Question: How do environmental factors create selection pressure on populations?

Environmental factors act as a **selection pressure**, favoring survivability of some **traits** over others. Individuals with **phenotypes** better suited to the environment have better reproductive success and there are more of them. More of these successful **alleles** will exist in the **population**.

Over time, **natural selection** may lead to a permanent change in the genetic makeup of a population. Natural selection is always linked to the suitability of the phenotype in the current environment, so it is a dynamic process. It may favor existing phenotypes or shift the phenotypic median, as demonstrated in the models shown below.



Natural selection acts on phenotypic variation. Even slight variations may be enough for selection to occur. The white streak on the mouse on the right may make it stand out to predators. The darker mouse may be able to more easily hide in the shadows.

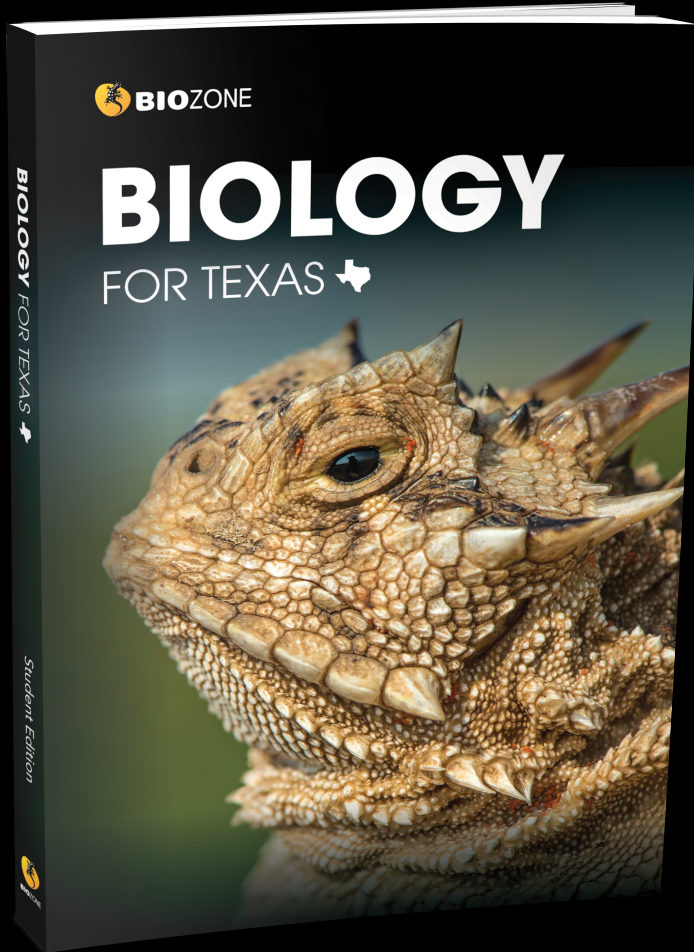
Directional selection
An environmental pressure, e.g. predation, or higher temperatures, selects against one of the phenotypic extremes. The adaptive phenotype is shifted in one direction and one phenotype is favored over others.

Disruptive selection
Disruptive selection favors two phenotypic extremes at the expense of intermediate forms. Disruptive selection may occur when environments or resources are fluctuating or distinctly divergent.

Stabilizing selection
Extreme variations are selected against and the middle range (most common) phenotypes are retained in greater numbers. Stabilizing selection decreases **variation** for the phenotypic character involved.

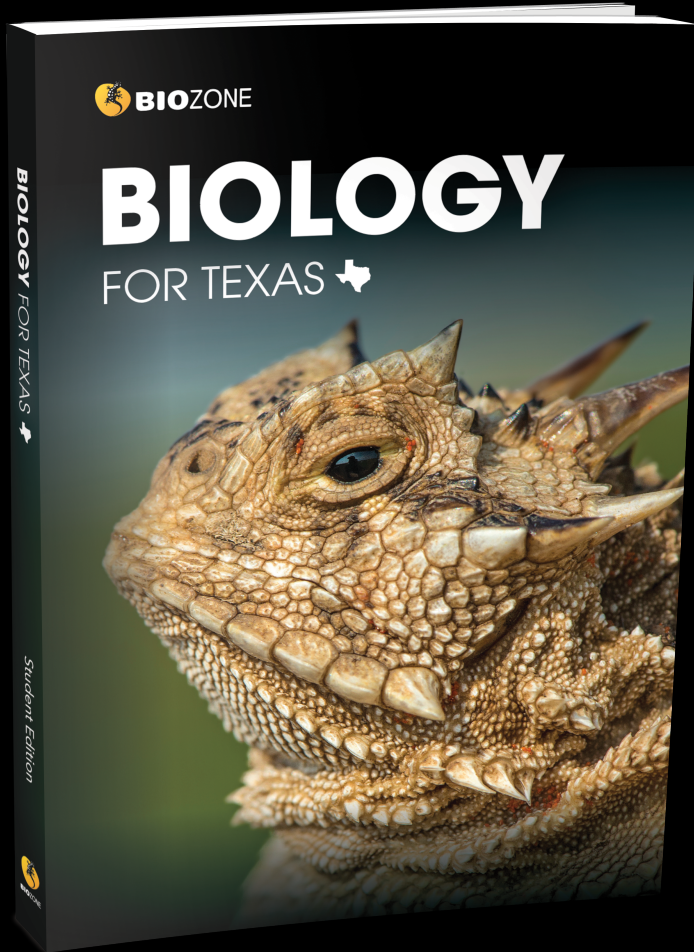
1. Analyze how fluctuating (as opposed to stable) environments favor disruptive (diversifying) selection:
Fluctuating environments are more likely to provide resource instability (e.g. food shortages), which may favor diversification of phenotypes to exploit extremes of the resource range. For example, droughts may

- Students record their answers
- Suggested answers are provided.
- **Teacher's Edition** and **BIOZONE World**.
- With *teacher guidance*, answers can be provided to the class.
- Students can refine their answers and strengthen their understanding.
- This provides a powerful additional learning moment.



BIOLOGY FOR TEXAS





SPECIFICALLY DESIGNED

Written for the **Texas Essential
Knowledge and Skills (TEKS)**
for Science (High School Biology)
specified in **Proclamation 2024.**

HOW WELL DID WE SCORE?



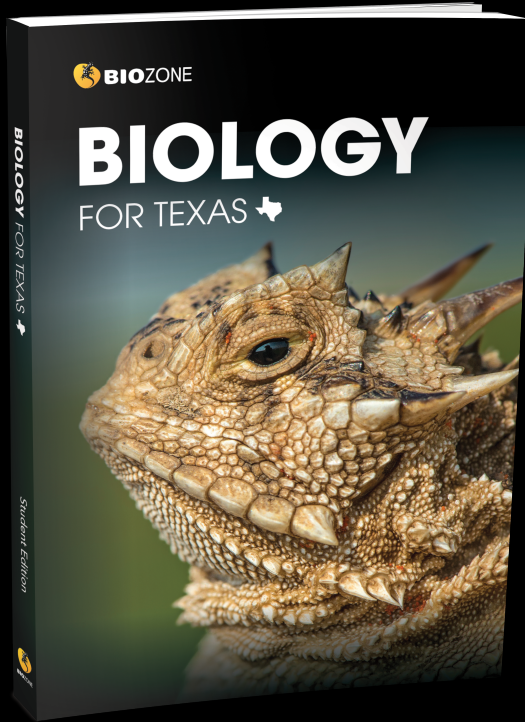
Student TEKS	Teacher TEKS	Student ELPS	Teacher ELPS
100%	100%	100%	100%



50 / 52

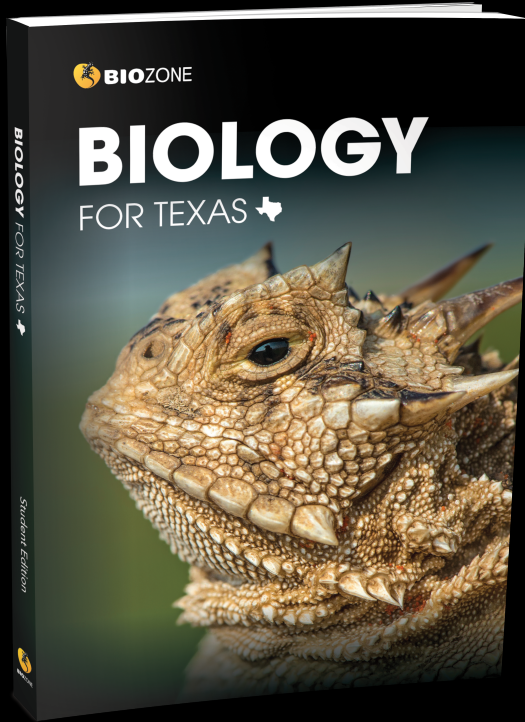
High quality resource

Design Features



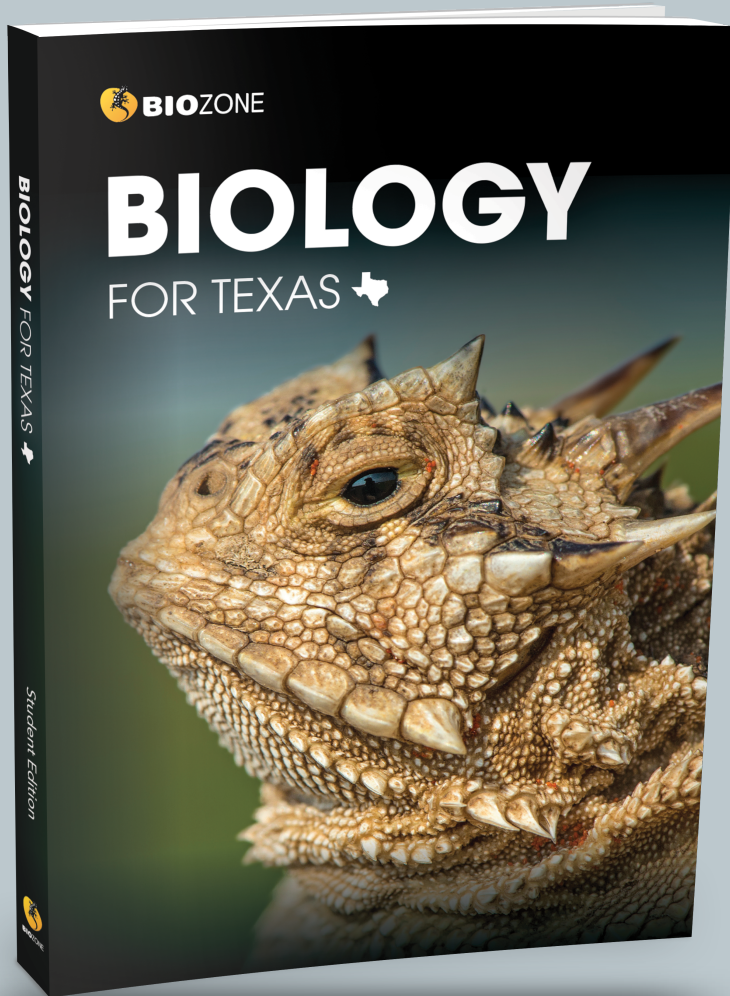
- Written and structured on the **HS Biology TEKS**
- **TEKS** clearly identified
- **ELPS** clearly identified (4 levels)
- **Content anchors** book-end each chapter
- **In-built assessments**
- **In-built practical Investigations** and equipment list
- **QR codes** for direct access to 3D models
- **Digital and print** options

Support Features



- **Translation tool** - digital platform
150 languages including Spanish (experimental)
- **Science skills chapter**
- **Glossary** (English & Spanish)
- **Extensive teacher support materials**
- **Implementation and PD training**

STRUCTURE



BIOLOGY FOR TEXAS

1. Cells and Cellular Processes
2. Cell Cycle
3. Photosynthesis and Cellular Respiration
4. Animal and Plant Structure and Function
5. DNA and Gene Expression
6. Patterns of Inheritance
7. Common Ancestry
8. Evolution and Natural Selection
9. Ecological Interactions
10. Science Practices

Structure of a chapter

CHAPTER INTRODUCTION

Identifies the activities relating to the learning outcomes. Relevant TEKS and ELPS are identified.

CONTENT ANCHOR

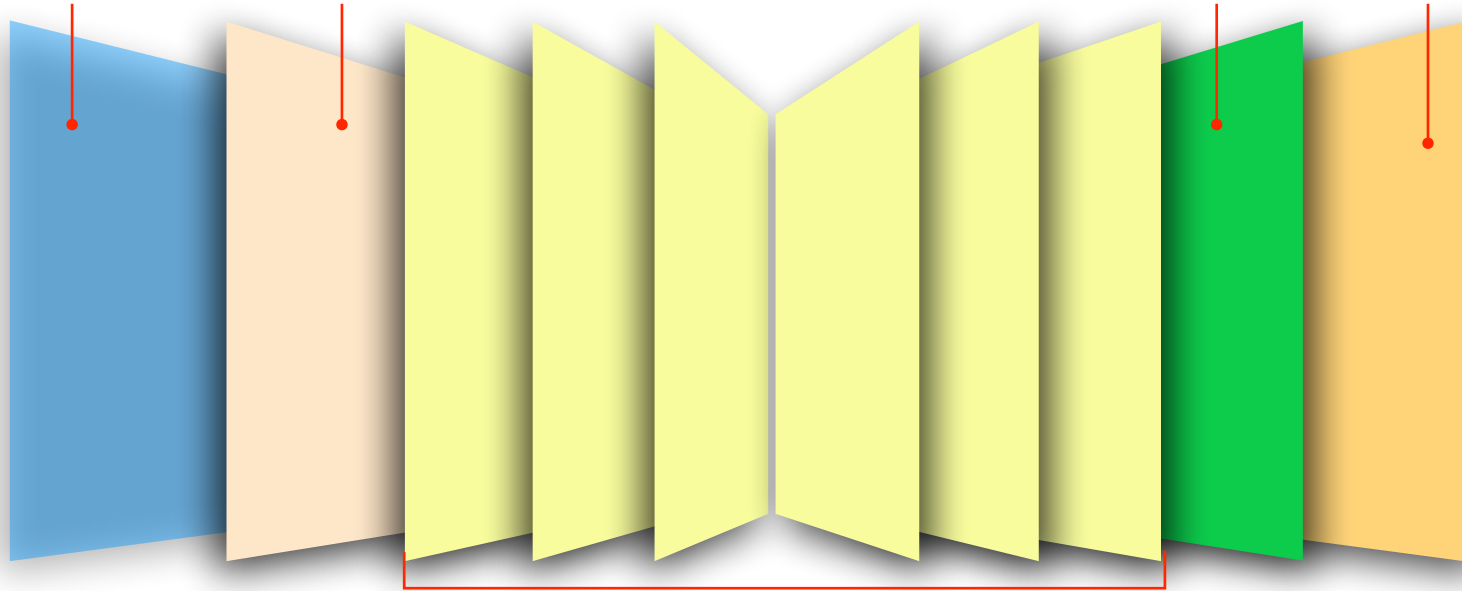
The first activity is an anchor for the chapter. It introduces a phenomenon that students come to understand through the activities in the chapter.

CONTENT ANCHOR REVISITED

Students should be able to explain various aspects of the content anchor fully.

SUMMING UP

Find out what students know about the content and skills they have explored in the chapter.



ACTIVITY PAGES

- Material is scaffolded over a learning sequence to develop deeper understanding.
- Questions allow students to demonstrate their understanding of the material.

Chapter Introduction

• Learning objectives and TEKS

- Concise learning statements summarize key learning points.
- Use the check boxes record progress.
- The TEKS covered in the chapter are clearly identified.
- QR code links to curated digital resources

CHAPTER 3

Photosynthesis and Cellular Respiration

TEKS

Scientific and
Engineering Practices

B.1: Investigation and Inquiry

1.A 1.B 1.C 1.D
1.E 1.F 1.G

B.2: Data and Patterns

2.B 2.C 2.D

B.3: Communicating in Science

3.A 3.B

B.4: Science as a Human Endeavor

TEKS

Science Concepts

B.11.A explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes

B.11.B Investigate and explain the role of enzymes in facilitating cellular processes

Learning Outcomes

I know I have achieved this when I can:

Activity
number

- | | |
|--|----|
| <input type="checkbox"/> Explain the role of mitochondria and chloroplasts in cells. | 52 |
| <input type="checkbox"/> Describe the structure and function of ATP in cells. | 53 |
| <input type="checkbox"/> Draw a model showing the chemical transformation between ATP and ADP molecules. | 53 |
| <input type="checkbox"/> Write a simple word equation for photosynthesis. | 54 |
| <input type="checkbox"/> Identify the energy forms and the transformations occurring during photosynthesis. | 54 |
| <input type="checkbox"/> Describe the location, the component functions, and the steps that occur in the light dependent and light independent phases of photosynthesis. | 55 |
| <input type="checkbox"/> Investigate the photosynthetic rate in <i>Cabomba</i> plants when altering light levels. | 56 |
| <input type="checkbox"/> Construct a schematic diagram representing energy flow and conservation of matter during photosynthesis and respiration. | 57 |
| <input type="checkbox"/> Write a simple word equation for respiration. | 58 |
| <input type="checkbox"/> Describe the general location of respiration and the transportation of the reactants and products. | 58 |
| <input type="checkbox"/> Compare and contrast aerobic and anaerobic respiration, including fermentation. | 58 |
| <input type="checkbox"/> Detail the steps of respiration, including reactants/products, and the specific location where they each occur. | 59 |
| <input type="checkbox"/> Discuss the transfer of energy and pathways from storage as glucose to the cells of body tissue. | 59 |
| <input type="checkbox"/> Calculate the energy efficiency of respiration. | 59 |
| <input type="checkbox"/> Investigate respiration rates in germinated and non-germinated seeds. | 60 |
| <input type="checkbox"/> Model photosynthesis and respiration reactions. | 61 |
| <input type="checkbox"/> Compare anabolic and catabolic reactions. | 62 |
| <input type="checkbox"/> Explain the importance of enzymes to human metabolism. | 63 |
| <input type="checkbox"/> Describe the induced fit model of enzyme activity. | 63 |
| <input type="checkbox"/> Link enzyme activity to lowering activation energy of reactions. | 64 |
| <input type="checkbox"/> Explain how concentration and temperature affect enzyme reaction rates. | 65 |
| <input type="checkbox"/> Investigate the effect of temperature on amylase enzyme reaction rates. | 65 |
| <input type="checkbox"/> Plan an investigation to test how the number of days of mung bean germination affect the catalase enzyme reaction rate. | 66 |
| <input type="checkbox"/> Evaluate a planned investigation on enzyme reaction rate. | 66 |



RESOURCE HUB

bit.ly/3ZmNAge

Chapter Introduction

• Student ELPS

- Student ELPS covered in the chapter are clearly identified and explained.
- Icons provide visual prompts.
Also present in activity margins for easy identification.

• Teacher ELPS

- Teacher's Edition lists and explains student ELPS.
- Teacher's Edition lists and explains teacher ELPS.
- ELPS level is clearly identified.

ELPS Level	ELPS English Language Proficiency Standards		Page number
Beginning	4.C.III	Comprehend English vocabulary used routinely in written classroom materials	<div data-bbox="1468 125 1535 169"></div> <div data-bbox="1468 169 1535 234">Learning Recognize Multiple-Meanings</div> <div data-bbox="1555 125 1787 234">Investigating Photosynthetic rate. Notice the words in this investigation. You know the words <i>place</i> and <i>position</i> in <i>Place the tube in a rack and position a lamp</i>... But have you heard them used as verbs? In this context, <i>place</i> means "put" and <i>position</i> means "put in a certain way." Look at run, record, and mean. What do they mean in this context?</div> <div data-bbox="1796 169 1845 191">100</div>
Beginning	4.F.V	Use visual and contextual support to develop background knowledge needed to comprehend increasingly challenging language	<div data-bbox="1468 245 1535 289"></div> <div data-bbox="1468 289 1535 365">Reading Build on What You Know</div> <div data-bbox="1555 245 1787 365">Energy from Glucose. Before reading the page, look carefully at the images, including the direction of arrows. What do you already know about air that goes in and out of an animal's mouth? Read the key question. How do humans carry out gas exchange? Make a prediction about the content of this page based on what you already know.</div> <div data-bbox="1796 289 1845 311">102</div>
Advanced High	3.F.II	Give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments	<div data-bbox="1468 376 1535 420"></div> <div data-bbox="1468 420 1535 551">Speaking Collaborate</div> <div data-bbox="1555 376 1787 551">Measuring Respiration. Take turns with your classmates as you complete the investigation. Have each team member describe their actions as they complete each task. Listen for key words, expressions, and scientific terminology your classmates use. When it is your turn, try to use words and expressions in the same way that they do.</div> <div data-bbox="1796 442 1845 464">106</div>
Intermediate	4.F.IX	Use support from peers and teachers to develop grasp of language structures needed to comprehend increasingly challenging language	<div data-bbox="1468 562 1535 606"></div> <div data-bbox="1468 606 1535 682">Reading Use Text Features and Human Support</div> <div data-bbox="1555 562 1787 682">What are Enzymes? Ask your classmates or teacher to point to each section of the model as they describe how enzymes work. Then read through the text describing each image. Notice that passive sentence structures are common in scientific text. Ask your teacher to rephrase the sentences using active voice, i.e., "Two substrate molecules move into the active site..."</div> <div data-bbox="1796 606 1845 627">114</div>
Advanced	4.G.III	Demonstrate comprehension of increasingly complex English by responding to questions commensurate with content area and grade level needs	<div data-bbox="1468 693 1535 737"></div> <div data-bbox="1468 737 1535 813">Learning Make it Simple</div> <div data-bbox="1555 693 1787 813">Enzymes have Optimal Conditions to Work. Before attempting to answer the questions, work with your team to clarify just what the questions are asking. Where possible, rewrite the question. For example, you can simplify question 5 to say, "What is the purpose of this investigation?"</div> <div data-bbox="1796 737 1845 758">118</div>
Teacher only			
Intermediate	2.L.IV	Demonstrate listening comprehension of increasingly complex spoken English by collaborating with peers commensurate with content and grade-level needs	<div data-bbox="1468 857 1535 900"></div> <div data-bbox="1468 900 1535 977">Listening Listen Actively</div> <div data-bbox="1555 857 1787 977">Beginning of Chapter. Provide tips for active listening before grouping students to complete investigations. Tell them to ask questions and summarize what they hear others say. Suggest that native speakers describe their actions as they model the activity before requiring English learners to contribute. Persuade English learners to use the visual aids provided with investigations to pick up key content-area language.</div> <div data-bbox="1796 922 1845 944">100</div>

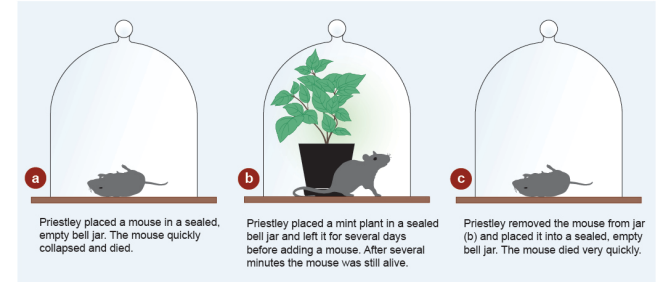
Content Anchors

- Begin every chapter
- Familiar to students, but cannot be fully explained
- Encompass chapter content
- **Two purposes**
 - Engage students
 - Teachers gauge prior knowledge, misconceptions and knowledge gaps

Content Anchor: Under what conditions can an animal survive in a sealed system?

Mouse in a jar

► Around 1772, Joseph Priestley carried out a series of experiments. He wanted to see if there was a relationship between the survival of plants and animals in a closed system. One of his experiments is shown below.



1. (a) Can you explain why the mouse died in jars (a) and (c), but not in jar (b)? _____

(b) What metabolic or chemical processes might explain the results that Joseph Priestley obtained? _____

2. Draw a very simple diagram to show what is happening in jar (b):

3. In another experiment, Joseph Priestley left a plant covered with a bell jar for many days. He then placed a candle with a glowing wick into the jar. The wick ignited and began to burn. What was present to allow the wick to ignite?



Learning Sequence

Scaffolded delivery

- Working through the learning sequence builds and develops a deeper understanding.

54 Introduction to Photosynthesis

Key Question: How does photosynthesis convert sunlight, carbon dioxide, and water into glucose and oxygen?

Plants, algae, and some bacteria are photoautotrophs. They use pigments called **chlorophylls** to capture light energy which is used in a process called **photosynthesis**.

During photosynthesis, carbon dioxide and water are converted into glucose and oxygen. The reaction requires energy obtained from sunlight, which is transformed into chemical energy within the bonds of the glucose molecule. This chemical energy fuels life's essential processes.

The final product is a carbohydrate called **glucose**, which is used to produce other carbohydrates such as **starch**, and **cellulose**. Energy is stored in the chemical bonds of the glucose molecule.

The high energy electrons are added to carbon dioxide to make carbohydrate. This is called **fixing** carbon.

Organelles called **chloroplasts** inside the plant's cells contain **chlorophyll** pigments, which absorb sunlight energy and use it for the process of photosynthesis.

Chlorophyll molecules are bound to the inner membranes of the chloroplast.

The energy absorbed by the chlorophyll is used to split water into hydrogen and oxygen atoms. This process is called **photolysis**.

The hydrogen atoms carry the electrons that provide energy for the next step of photosynthesis.

Oxygen is a by-product of splitting water.

Photosynthesis is commonly displayed as either of the two equations on the right. Both are correct, but the bottom equation cancels the extra water molecules.

$$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow{\text{Light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$$

$$6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{Light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

- Write the word equation for photosynthesis: _____
- Where does the oxygen released during photosynthesis come from? _____

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55 Stages in Photosynthesis

The structure of a chloroplast

The internal structure of chloroplasts is characterized by a system of membrane structures called **thylakoids** arranged into stacks called **grana**.

Liquid stroma contains the enzymes for the light independent phase (see activity 55) as well as the chloroplast DNA.

Stroma lamellae connect the grana. They make up 20% of the thylakoid membranes.

A double membrane envelope (inner and outer membrane) encloses the chloroplast.

Grana are stacks of thylakoids.

Thylakoid membranes are the site of light absorption and provide a large surface area for binding chlorophyll (see below). They are organized so they do not shade each other.

Chloroplasts are the organelles responsible for photosynthesis. A mesophyll leaf cell contains between 50-100 chloroplasts. Chloroplasts contain light capturing pigments, e.g. chlorophyll, that are used for photosynthesis. Chloroplasts are generally aligned so that their broad surface runs parallel to the cell wall to maximize the surface area available for light absorption. The image (left) shows chloroplasts in leaf cells. They appear green because they absorb blue and red light and reflect green light.

4. Use the diagram of the chloroplast above to help you label this transmission electron microscope image of a chloroplast.

5. What does chlorophyll do? _____

6. What features of chloroplasts help maximize the amount of light that can be absorbed? _____

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55 Stages in Photosynthesis

Key Question: What are the two main reactions in photosynthesis?

Photosynthesis has two phases, the **light dependent phase** and the **light independent phase**.

In the reactions of the light dependent phase, light energy is converted to chemical energy in the form of **ATP** and **NADPH**. This phase occurs in the thylakoid membranes of the chloroplasts.

In the reactions of the light independent phase, chemical energy is used to make carbohydrate. This occurs in the stroma of chloroplasts.

An overview of the two stages of photosynthesis is shown in the diagram of a chloroplast below.

Light dependent phase (LDP):
Location: Thylakoid membranes of the grana.
Process: In the first phase of photosynthesis, chlorophyll captures light energy, which is used to split water producing O_2 gas (exhaled as a waste product), electrons and H^+ ions, which are transferred to the molecule **NADPH**. ATP is also produced.

Light independent phase (LIP):
Location: Stroma.
Process: The second phase of photosynthesis uses the **NADPH** and **ATP** produced in the LDP to drive a series of enzyme-controlled reactions (the **Calvin cycle**) that fix carbon dioxide to produce these phosphates. This phase does not need light to proceed.

Chloroplast outer membrane

Thylakoid

CO_2 from the air provides the raw materials for glucose production.

Monosaccharides, e.g. glucose, and other carbohydrates, lipids, and amino acids.

Enzymes are required for photosynthesis to proceed

Enzymes facilitate cellular processes, including photosynthesis. Rubisco (right) is the central enzyme in the LIP or photosynthesis (carbon fixation) catalyzing the first step in the Calvin cycle. However, it is remarkably inefficient, processing just three reactions a second. To compensate, Rubisco mixes up almost half the protein content of chloroplasts.

- Where does the light dependent phase of photosynthesis occur? _____
- Where does the light independent phase of photosynthesis occur? _____
- How are the light dependent and light independent phases linked? _____
- What is the role of the enzyme Rubisco? _____

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56 Investigating Photosynthetic Rate

Key Question: How does light intensity affect photosynthesis rate?

Investigation 3.1 Measuring bubble production in *Cabomba*

See spreads for equipment list.

- Fill a boiling tube 2/3 full with a 20°C solution of 1% sodium hydrogen carbonate (NaHCO_3).
- Cut ~ 7 cm long piece of *Cabomba* stem (cut under water). Place the *Cabomba* into the boiling tube (cut end up). Carefully push the *Cabomba* down.
- Place the boiling tube in a rack and position a lamp so that it will shine on the tube when switched on.
- To test the set-up, switch on the lamp for one minute to check that bubbles emerge freely from the stem. If they don't, you may have to recut the stem to open it.
- When you have checked your set-up, switch off the lamp and, after 5 minutes, use a stopwatch to record the number of bubbles emerging from the stem in one minute. Repeat.
- Use a ruler to mark out distances 0, 5, 10, 15, 20, and 25 cm from the boiling tube.
- Starting at 25 cm, move the lamp to each of the distances in turns and use a stopwatch to record the number of bubbles emerging from the stem in one minute. Run two tests at each distance and allow 5 minutes after moving to a new distance before recording (this allows for acclimation).
- Record your results in the table (right). Calculate the mean rate of gas production for each distance (and lamp OFF).
- After you have finished recording, remove the stopper from the tube and test the gas with a glowing splint. What happens?

Gas bubbles
Cabomba stem

Distance (cm)	Bubbles per minute		
	Test 1	Test 2	Mean
Off			
25			
20			
15			
10			
5			
0			

NEED HELP? See activity 267

1. Use your calculated means to draw a graph of gas production vs light intensity (distance). _____

2. What did your splint test tell you about the gas produced by the *Cabomba* plants? _____

3. From this experiment what can you say about photosynthesis, light, and the gas produced? _____

4. How could you improve the design of this investigation? _____

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Practical Investigations

- Practical Investigations are clearly identified in green boxes.
 - Help meet the programs' practical requirements
 - Investigative phenomena
 - Promote collaboration
 - Enhance communication
 - Develop laboratory skills
- Investigations use equipment commonly found in high school laboratories and classrooms.
 - No special kits are required.
- Equipment list is provided.

Appendix: Equipment list

1: Cells and Viruses INVESTIGATION 1.1 Modeling protein structure Per student/pair/group Pipe cleaners (2 white, 2 pink, 2 purple, 4 blue) Sticky tape 2 x binder clips or paper clips	3: Photosynthesis and cellular respiration INVESTIGATION 3.1 Measuring bubble production in Cabomba Per pair/group Balance 1.0 g Cabomba aquatica Water 1 x large beaker (large enough to hold the glass funnel) 1 x glass funnel 0.2 mol/L sodium hydrogen carbonate solution (enough to cover the plant) 1 x test tube 1 x lamp with a 60W bulb Lux meter Timer 1 x ruler or tape measure	INVESTIGATION 3.4 Effect of temperature on enzyme activity Per group/temperature 1 x spotting plate/reaction plate 1 x test tube 1 x plastic pipette Water bath Timer 0.1 M iodine solution (I ₂ KI) 2 mL 1% amylase solution 1 mL buffer solution (pH 7.0) 1 mL 1% starch solution
INVESTIGATION 1.2 Preparing an onion slide Per student/pair Light microscope Onion/onion leaf Glass microscope slides Coverslips Scalpel or razor Iodine stain Filter paper/tissue paper	INVESTIGATION 3.2 Measuring respiration in germinating seeds Per group 3 x boiling tubes Marker pen 6 x cotton balls 15% KOH solution 2 x eye dropper or plastic pipette 3 x gauze pieces Germinated bean seeds (enough to fill one quarter of the boiling tube) Ungerminated bean seeds (enough to fill one quarter of the boiling tube) Glass beads (enough to fill one quarter of the boiling tube) 3 x 2-hole tube stoppers 3 x bent glass tubes or pipettes 3 x tubes (must be able to be clamped shut) 3 x screw clips A few drops of colored liquid 3 x syringes (must fit tube with screw clamp attached) 3 x clamp stands or rack Water bath (25°C) Ruler Timer	4: Animal and Plant Structure and Function INVESTIGATION 4.1 Investigating effect of exercise on heart rate. 1 x stopwatch per group
INVESTIGATION 1.3 Simple diffusion across a membrane Per student/pair 200 mL beaker 1 mL pipette Glucose dipsticks Lugol's indicator 4 x test tubes Dialysis tubing Thread or nylon line Distilled water 1% starch solution 10% glucose solution Timer or watch	INVESTIGATION 4.2 Investigating effect of exercise on breathing rate. Equipment depends on group method	INVESTIGATION 4.3 Investigating vascular tissue Per student/pair Light microscope Dicot plants (e.g. buttercup sunflowers) Monocot plant (e.g. maize or corn) Glass microscope slides Coverslips Scalpel or razor Access to a computer or device with internet connection
INVESTIGATION 1.4 Modeling disease outbreak and spread Per student/pair Computer Spreadsheet application e.g. Excel	INVESTIGATION 4.4 Investigating plant transpiration Per pair/group 250 mL conical flask with rubber bung Petroleum jelly 1 cm ³ pipette Clamp stand Leafy plant shoot Water Cooking oil (for optional set up) Timer or watch Lamp, or plastic bag and water spray bottle, or fan A4 or graph paper	
2: Cell Cycle INVESTIGATION 2.1 Modeling mitosis Per student/pair 4 x pipe-cleaners (2 colors) cut in half Yarn or string A3 sheet of paper Marker	INVESTIGATION 3.3 Modeling photosynthesis and cellular respiration Per Individual, pair, or group Scissors	

Content Anchor Revisited

- Revisited at end of chapter
- Students should be able to fully explain the Content Anchor
- Formative assessment
- Is there anything which needs to be revisited before moving on?

Content Anchor Revisited: Under what conditions can an animal survive in a sealed system?

Man in a box

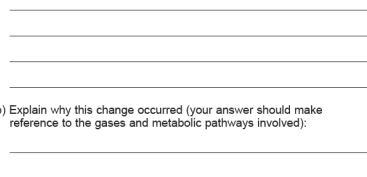
- ▶ In 2012, researchers carried out a larger version of Joseph Priestley's famous mouse in a jar experiment.
- ▶ 274 plants were placed in a sealed container with oxygen-depleted air (12.4% oxygen). A healthy 47-year-old man entered the container for 48 hours. Gas levels were monitored throughout the experiment. The container was kept in constant light.
- ▶ The experiment was run to completion with no harm to the person within the box.
- ▶ Ethics approval was obtained beforehand and medical staff were on hand during the experiment.



1. Use your understanding from the information in this chapter to identify:

- (a) The two gases primarily being monitored in the experiment: _____
- (b) The two metabolic processes involved in this experiment: _____

2. (a) The graph on the right shows the change in oxygen concentration over the course of the experiment. Describe the trend in oxygen levels over time:



- (b) Explain why this change occurred (your answer should make reference to the gases and metabolic pathways involved):

3. Revisit the model you produced in activity 51. Refine it and add more detail to explain the relationship between cellular respiration and photosynthesis:



Summative Assessment

Test understanding

122

68 Summing Up

Read each question carefully. Place a cross in the box beside the best answer to the question from the four answer choices provided.

1. Which statement best describes the function of ATP?
- ☐ (a) ATP is a structural component of plant cell walls
 - ☐ (b) ATP carries the genetic information of organisms
 - ☐ (c) ATP provides the energy for chemical reactions to occur
 - ☐ (d) ATP is a biological catalyst

2. Select the option which correctly identifies the organelle below AND the cellular process which takes place in it:



- ☐ (a) Chloroplast, photosynthesis
- ☐ (b) Chloroplast, cellular respiration
- ☐ (c) Mitochondrion, photosynthesis
- ☐ (d) Mitochondrion, cellular respiration

3. Enzymes speed up reactions by:
- ☐ (a) Reducing the activation energy needed
 - ☐ (b) Increasing the activation energy needed
 - ☐ (c) Adding energy to the reaction
 - ☐ (d) Taking part in the reaction and forming part of the product(s)

4. The type of energy transformation occurring during photosynthesis is:
- ☐ (a) Light to heat
 - ☐ (b) Light to chemical
 - ☐ (c) Chemical to heat
 - ☐ (d) None of the above

5. Which group of macromolecules do enzymes belong to?
- ☐ (a) Lipids
 - ☐ (b) Proteins
 - ☐ (c) Carbohydrates
 - ☐ (d) Nucleotides

6. A solution of amylase was heated to 70°C for 10 minutes. When the treated amylase was added to a solution of starch, the iodine test showed no sugars had been produced. This is because:
- ☐ (a) The enzyme has been denatured
 - ☐ (b) An enzyme inhibitor is preventing the enzyme from working
 - ☐ (c) There is no substrate present
 - ☐ (d) Amylase does not catalyze the reaction which converts starch in to sugars

7. The diagram below is showing:



- ☐ (a) A catabolic reaction, such as cellular respiration
- ☐ (b) A catabolic reaction, such as photosynthesis
- ☐ (c) An anabolic reaction, such as cellular respiration
- ☐ (d) An anabolic reaction, such as photosynthesis

8. The model below is of a glucose molecule. During cellular respiration glucose is converted into:



- ☐ (a) Starch and carbon dioxide
- ☐ (b) Starch and water
- ☐ (c) Water and oxygen
- ☐ (d) Water and carbon dioxide

9. Enzymes can change shape when exposed to extremes of temperature or pH. What is the most likely results if the shape of an enzyme changes?

- ☐ (a) The enzyme will no longer be able to bind its substrate
- ☐ (b) Enzyme activity will speed up
- ☐ (c) The enzyme will bind a new substrate
- ☐ (d) Different products will be produced during the reaction

10. Which molecules are both the products of cellular respiration and the raw materials for photosynthesis?

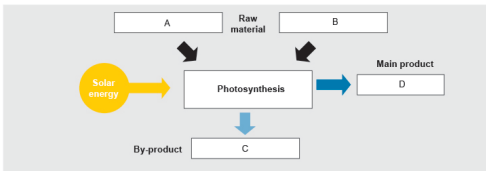
- ☐ (a) Carbon dioxide, ATP, and oxygen
- ☐ (b) Carbon dioxide and water
- ☐ (c) Glucose and oxygen
- ☐ (d) Glucose, ATP, and oxygen

11. Which answer correctly describes the equation below, and the organelle in which it takes place?



- ☐ (a) Photosynthesis, chloroplast
- ☐ (b) Photosynthesis, mitochondrion
- ☐ (c) Cellular respiration, chloroplast
- ☐ (d) Cellular respiration, mitochondrion

Question 12 and 13 relate to the process of photosynthesis, shown below:



12. Raw materials A and B are:
- ☐ (a) Oxygen, carbon dioxide
 - ☐ (b) Carbon dioxide, water
 - ☐ (c) Water, oxygen
 - ☐ (d) Water, glucose

13. Main product D and by-product C are
- ☐ (a) D: Oxygen C: Glucose
 - ☐ (b) D: Carbon dioxide C: Oxygen
 - ☐ (c) D: Glucose C: Oxygen
 - ☐ (d) D: Water C: Glucose

14. Students investigated the effect of different light wavelengths (color) on the rate of photosynthesis. They used a leaf disk assay in which the rate of photosynthesis is measured indirectly by timing how long it takes for prepared leaf disks (right) to float to the surface when placed in an illuminated beaker of sodium hydrogen carbonate. The results are tabulated below:

- (a) Why do you think photosynthesizing leaf disks would float?

- (b) Which light color was the most effective at driving photosynthesis? Explain:

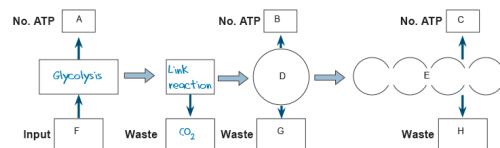
- (c) Which light color was the least effective at driving photosynthesis?

15. Outline the differences between photosynthesis and cellular respiration, including reference to the raw materials used and the waste products produced.

123

124

Refer to the diagram of cellular respiration below for questions 16-17



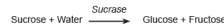
16. The total number of ATP molecules produced in steps A, B, and C is:

- ☐ (a) Approximately 20
- ☐ (b) Approximately 28
- ☐ (c) Approximately 32
- ☐ (d) Approximately 38

17. The waste products G and H are

- ☐ (a) G: Oxygen H: Carbon dioxide
- ☐ (b) G: Carbon dioxide H: Oxygen
- ☐ (c) G: Water H: Carbon dioxide
- ☐ (d) G: Carbon dioxide H: Water

18. Study the enzymatic word equation below and answer the following questions:



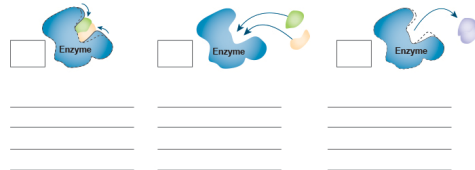
- (a) Identify the substrate: _____
- (b) Identify the products: _____
- (c) Identify the enzyme: _____

19. Identify the following statements as true of false (circle the correct answer)

- (a) Enzymes are biological catalysts. They lower the activation energy of a reaction. True / False
- (b) Enzyme inhibitors allow enzymes to work faster. True / False
- (c) The induced fit model states that the enzyme changes shape when a substrate fits into the active site. True / False

20. The diagram below outlines the three main steps when an enzyme catalyzes a reaction. The steps are NOT in order.

- (a) In the boxes below, write the numbers 1 - 3 to indicate the correct order of sequence:
- (b) Write a brief description under each image to describe what is happening:



TEKS & ELPS

Locating the Breakouts

Differentiated for easy identification

- Breakout codes in the margin of Teacher's Edition identifies the breakouts.
 - **Red** = Science Concept breakouts
 - **Blue** = Scientific and Engineering Practice breakouts
- A **N** denotes a narrative component.
- An **A** denotes an activity component.

200

117

DNA and RNA

B.7A (i) A

1. Complete the following table, s

Sugar present	
Bases present	
Number of strands	

2. If you wanted to use a radioac
would you label?

Locating the ELPS

- Chapter fronts
- Margin icons
- Summary tables in Teacher's Edition
 - The four proficiency levels are identified
- Strategies provided for delivering ELPS

Strategies for Using the ELPS

A typical classroom has a mix of students who come from a wide range of educational backgrounds, and have varied academic ability and English language skills. The English Language Proficiency Standards (ELPS) outline instruction and support that must be provided to English language learners (ELLs) in order for them to have a full opportunity to learn English and to succeed academically.

The ELPS have been integrated throughout *Biology for Texas* in a way that requires students to think critically, understand and learn new concepts, process complex academic material, and interact and communicate in English within the science classroom. The information below provides general strategies for using the features of *Biology for Texas* to deliver the ELPS as you work through the chapters. A complete summary of the specific ELPS covered in this worktext can be found on CG52-CG56.

Beginning:

Have students preview the chapter, identifying text features such as the chapter title, Key Questions, headings, boldface words, illustrations, graphics, and captions that can aid understanding.

Begin each lesson by reading aloud the Key Question, pausing to discuss any unfamiliar words. Lead a class discussion of the question and students' responses. Tell students to keep the question in mind as they read the rest of the section. Invite and answer questions as needed.

Throughout the chapter, chunk the reading to allow for frequent checks for understanding. Remind students to look for cognates as they read. Have students highlight important information and note any questions they have. Students can address their questions to you or a classmate. Then, have students work in pairs or small groups to complete the questions, activities, and investigations.

Check in with students throughout each lesson to make sure they are following the point-of-use ELPS activity instructions as well as the general instructions. Remain available to answer questions.

Examples of ELPS addressed: 1.B.i, 2.C.iii, 2.C.iv, 2.D.i, 2.D.ii, 2.I.v, 3.D.i, 3.E.i, 3.F.i, 4.D.i, 4.F.i, 4.F.ii, 4.F.vii

Intermediate:

Intermediate: Use the strategies provided above for Beginning ELLs as needed. In addition, provide intermediate students with a guided notetaking sheet to capture key ideas. Then have them use their notes to complete the questions, activities, and investigations individually or with a partner.

Examples of ELPS addressed: 1.B.i, 1.E.iv, 2.C.iii, 2.C.iv, 2.D.i, 2.D.ii, 2.I.v, 3.D.i, 3.E.i, 3.F.i, 4.D.i, 4.F.i, 4.F.ii, 4.F.vii, 4.G.iv

Advanced:

Use the strategies provided above for Beginning and Intermediate ELLs as needed. Have students take notes of key ideas as they read the text. Students can use their notes to complete the questions, activities, and investigations independently. These students may also benefit from working with a less advanced student to answer questions, assist with vocabulary acquisition, and summarize key concepts.

Examples of ELPS addressed: 1.B.i, 1.E.i, 1.E.iii, 1.E.iv, 2.C.iii, 2.C.iv, 2.D.i, 2.D.ii, 2.I.v, 3.D.i, 3.E.i, 3.F.i, 3.F.ii, 3.H.iii, 4.D.i, 4.F.i, 4.F.ii, 4.F.vii, 4.G.v

Advanced High:

Have students take notes on key ideas as they read the text. Students can use their notes to complete the questions, activities, and investigations independently. Pair students with less advanced students to answer questions, assist with vocabulary acquisition, summarize key concepts, and perform investigations. Since these students show an aptitude for learning languages, they might enjoy exploring the Greek and Latin roots of scientific terms. Challenge them to identify words with Greek and Latin roots in each chapter. What is the meaning of the roots and how can they help us to understand the terms? For instance, chloroplast comes from the Greek words *khloros*, meaning "green" and *plastos*, meaning "formed."

Examples of ELPS addressed: 1.B.i, 1.E.i, 1.E.iii, 1.E.iv, 2.C.iii, 2.C.iv, 2.D.i, 2.D.ii, 2.I.v, 3.D.i, 3.E.i, 3.F.i, 3.F.ii, 3.H.iii, 4.D.i, 4.F.i, 4.F.ii, 4.F.vii, 4.F.x, 4.G.v

Inbuilt support

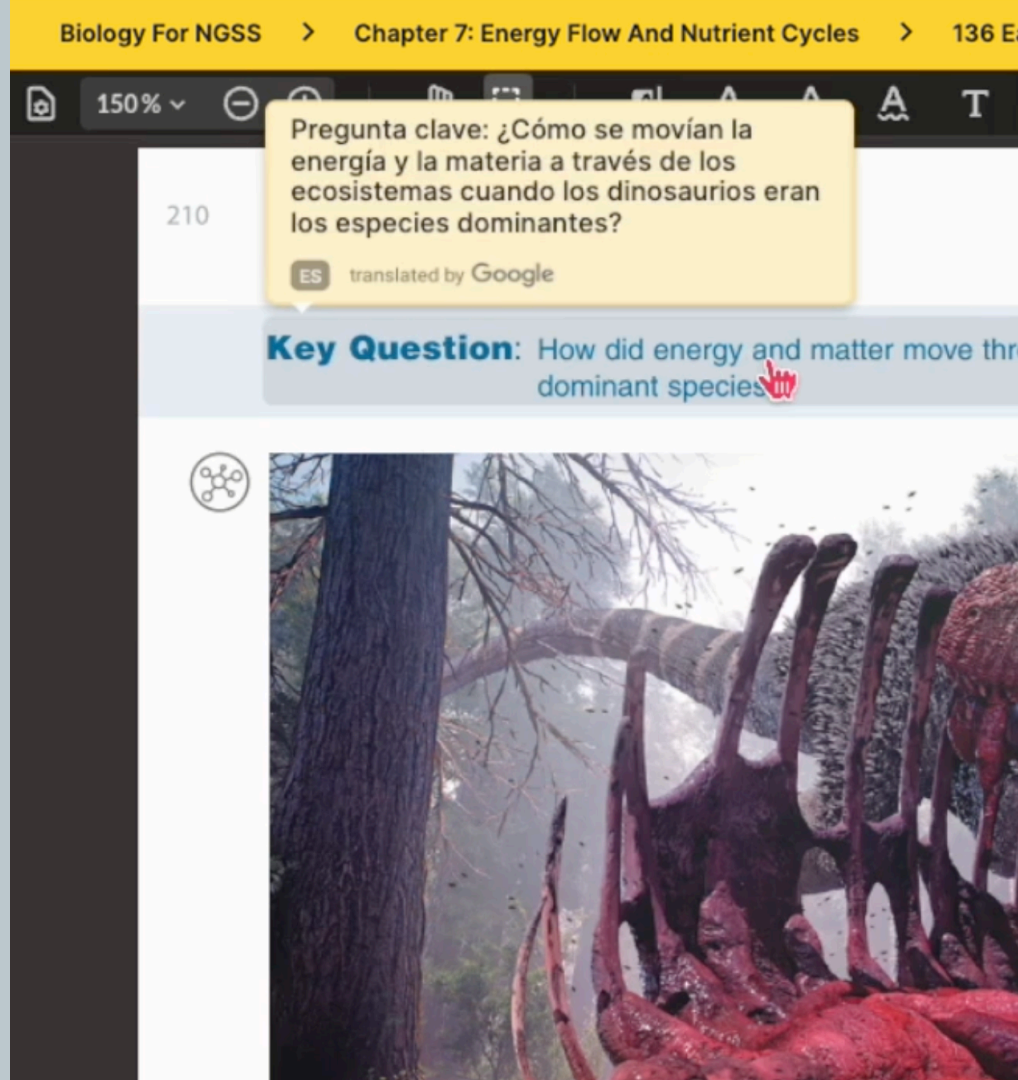
Translation

Digital platform

Experimental feature:

Translation for 150 languages

in realtime - highlight with text-to-text translation.



Glossary

Building scientific literacy

248

143 Different Alleles

Key Question: What are alleles, and what do they do in offspring?

Homologous chromosomes

In sexually reproducing organisms, chromosomes are generally found in pairs in their cell's nucleus. One of each pair of chromosomes came from the original gametes, formed through meiosis in the parents, and brought together at fertilization. The pairs are called homologues or homologous pairs. Each homologue carries an identical assortment of **genes**, but the version of the gene, known as the **allele**, from each parent may differ. This diagram shows the position of three different

Glossary: English/Spanish



abiotic factor: Non-living, physical features in an ecosystem, including temperature, humidity, and rainfall.
factor abiótico: Características físicas no vivas en un ecosistema, incluida la temperatura, la humedad y la lluvia.

accuracy: The correctness of a measurement; how close a measured value is to the true value.
exactitud: La exactitud de una medición; qué tan cerca está un valor medido del valor verdadero.

active site: Region of an enzyme where the substrate binds and undergoes a chemical reaction.
sitio activo: Región de una enzima donde el sustrato se une y sufre una reacción química.

anabolic reaction / anabolism: A chemical reaction that constructs large, complex molecules from simpler molecules.
reacción anabólica: Una reacción química que construye moléculas grandes y complejas a partir de moléculas más simples.

anaerobic respiration: Type of respiration that does not require oxygen.
respiración anaeróbica: Tipo de respiración que no requiere oxígeno.

antibody: A protein produced by the body in response to a specific antigen and aimed at targeting and destroying it.
anticuerpo: Una proteína producida por el cuerpo en respuesta a un antígeno.

bioinformatics: The use of computer science, mathematics, and information theory to organize and analyze complex biological data.
bioinformática: El uso de las ciencias computacionales, las matemáticas y la teoría de la información para organizar y analizar datos biológicos complejos.

biological drawing: An illustration that visually communicates the structure of a subject being studied, showing specific details.
dibujo biológico: Una ilustración que comunica visualmente la estructura de un tema que se está estudiando, mostrando detalles específicos.

biotic factor: Relation to the living

allele: Any of the alternative versions of a gene that may produce distinguishable phenotypes.

alelo: Cualquiera de las versiones alternativas de un gen que puede producir fenotipos distinguibles.

aerobic: A biological process that requires oxygen.
aeróbico: Un proceso biológico que requiere oxígeno.

aerobic respiration: type of respiration that requires oxygen.
Respiración aeróbica: tipo de respiración que requiere oxígeno.

allele: Any of the alternative versions of a gene that may produce distinguishable phenotypes.
alelo: Cualquiera de las versiones alternativas de un gen que puede producir fenotipos distinguibles.

amino acid: Any organic compound containing both an amino group and a carboxylic acid group.
aminoácido: Cualquier compuesto orgánico que contenga tanto un grupo amino como un grupo ácido carboxílico. Los bloques de construcción de las proteínas.

assumed to be true but is not (or cannot be) tested.
presunción: Una afirmación que se supone que es verdadera pero que no se prueba (o no se puede probar).

ATP/adenosine triphosphate: An organic compound that serves as an energy source for metabolic processes.
ATP/trifosfato de adenosina: Un compuesto orgánico que sirve como fuente de energía para los procesos metabólicos.

auxin: Any of several plant hormones that regulate the growth and development of plants.
auxina: Cualquiera de varias hormonas vegetales que regulan el crecimiento y desarrollo de las plantas.

biodiversity: The amount of biological variation present in a region (includes genetic, species, and habitat diversity).
biodiversidad: La cantidad de variación biológica presente en una región (incluye genética, especies y diversidad de hábitat).

carbon cycle: The process by which carbon is exchanged between living organisms, the earth and its atmosphere.
ciclo del carbono: El proceso por el cual el carbono se intercambia entre los organismos vivos, la tierra y su atmósfera.

catabolic reaction / catabolism: The breakdown of large, complex molecules into smaller, simpler molecules.
reacción catabólica: La descomposición de moléculas grandes y complejas en moléculas más pequeñas y simples.

catalyst: A substance that modifies and increases the rate of a chemical reaction without being consumed in the process.
catalizador: Sustancia que modifica y aumenta la velocidad de una reacción química sin ser consumida en el proceso.

Science Practices

Supporting Scientific and Engineering Practices

- **Dedicated chapter** supports students to master the Scientific and Engineering Practices TEKS
- **Need help icon** directs students to support



CHAPTER 10

Science Practices

TEKS

Scientific and
Engineering Practices

B.1: Investigation and Inquiry

1.A 1.B 1.C 1.D
1.E 1.F 1.G 1.H

The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models.

B.2: Data and Patterns

2.A 2.B 2.C 2.D

The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs.

B.3: Communicating in Science

The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions.

B.4: Science as a Human Endeavor

4.A 4.C

The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society.

Learning Outcomes

I know I have achieved this when I can:

Activity
number

- | | |
|---|----------|
| <input type="checkbox"/> Discuss the features of Science, in small groups. | 246 |
| <input type="checkbox"/> Define and link the terms system and model, in a science context. | 247 |
| <input type="checkbox"/> Define and compare the scientific terms hypothesis, law, and theory. | 248 |
| <input type="checkbox"/> Generate a hypothesis from a provided case, and describe the assumptions used. | 249 |
| <input type="checkbox"/> Convert between decimal and standard form in given numerical values. | 250-251 |
| <input type="checkbox"/> Discuss the value of processing raw data. | 252 |
| <input type="checkbox"/> Calculate fractions and ratios from provided numerical values. | 253 |
| <input type="checkbox"/> Evaluate the usefulness of logarithm and semi-log graphs for processing exponential data. | 254 |
| <input type="checkbox"/> Calculate the percentage error for provided measurements. | 255 |
| <input type="checkbox"/> Classify data as quantitative, ranked, or qualitative. | 256 |
| <input type="checkbox"/> Evaluate the suitability of collecting qualitative or quantitative data in different types of investigations. | 256 |
| <input type="checkbox"/> Define independent, dependent, and control variables, describing the purpose of each in an investigation. | 257, 274 |
| <input type="checkbox"/> Discuss the value of accurate data recording, including tables, and the use of dataloggers. | 258-259 |
| <input type="checkbox"/> Plot a line graph, from provided data. | 261, 274 |
| <input type="checkbox"/> Draw a scatter plot, including a line of best fit. | 262 |
| <input type="checkbox"/> Distinguish between correlation and causation in data. | 263 |
| <input type="checkbox"/> Process raw data and draw a bar graph and histogram, from provided data. | 264-265 |
| <input type="checkbox"/> Calculate percentages from provided data and use the values to construct pie graphs. | 266 |
| <input type="checkbox"/> Calculate mean, median, and mode, from provided data. | 267 |
| <input type="checkbox"/> Calculate standard deviations, explaining what this statistical tool indicates about the data and sampling bias of the data. | 268-269 |
| <input type="checkbox"/> Construct a biological drawing from a provided photograph. | 271 |
| <input type="checkbox"/> Identify safety issues and risks in the classroom laboratory, and also in fieldwork settings. | 272 |
| <input type="checkbox"/> Discuss procedures for collecting qualitative data, in a provided case study. | 273 |
| <input type="checkbox"/> Process raw data into a data table. | 274 |
| <input type="checkbox"/> Evaluate an investigation method, from a provided case study. | 274 |



RESOURCE HUB

bit.ly/3ycPUSZ

56 Investigating Photosynthetic Rate



Investigation 3.1 Measuring bubble production in *Cabomba*

See appendix for equipment list.

1. Fill a boiling tube 2/3 full with a 20°C solution of 1% sodium

Gas bubbles



1. Use your calculated means to draw a graph of gas production vs light intensity (distance).

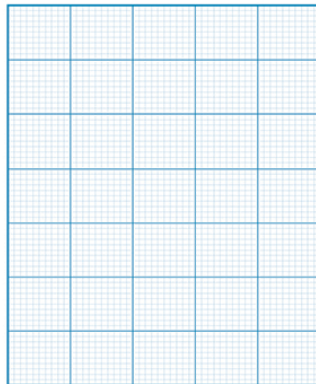
2. What did your splint test tell you about the gas produced by the *Cabomba* plant?

NEED HELP?
See Activity
261



3. From this experiment what can you say about photosynthesis, light, and the gas produced?

4. How could you improve the design of this investigation?



stopper from the tube and test the gas with a glowing splint. What happens?

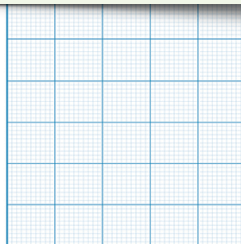
NEED HELP?
See Activity
267



5			
0			

3. From this experiment what can you say about photosynthesis, light, and the gas produced?

4. How could you improve the design of this investigation?

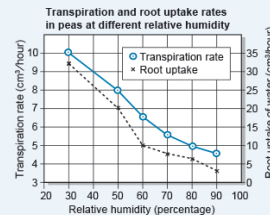
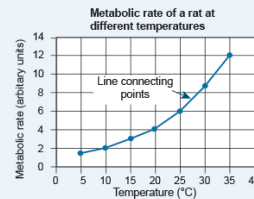


261 Drawing Line Graphs

Key Question: What kind of data is plotted on line graphs, and how do they show the relationship between the independent variable and the dependent variable?

Graphs provide a way to visually see **data** trends. Line graphs are used when one variable (the **independent variable**) affects another, the **dependent variable**. Important features of line graphs are:

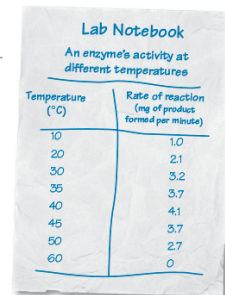
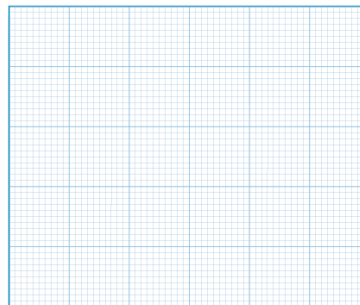
- ▶ The data must be continuous for both variables.
- ▶ The dependent variable is usually a biological response.
- ▶ The independent variable is often time or the experimental treatment.
- ▶ The relationship between two variables can be represented as a continuum and the data points are plotted accurately and connected directly (point to point).
- ▶ Line graphs may be drawn with a measure of error. The data are presented as points (the calculated **means**), with bars above and below, indicating a measure of variability or spread in the data, e.g. standard deviation.
- ▶ More than one curve can be plotted per set of axes. If the two data sets use the same measurement units and a similar range of values for the dependent variable, one scale on the y axis is used. If the two data sets use different units and/or have a very different range of values for the dependent variable, two scales for the y axis are used (see right). Distinguish between the two curves with a key.



1. The results (shown right) were collected in a study investigating the effect of temperature on the activity of an enzyme.

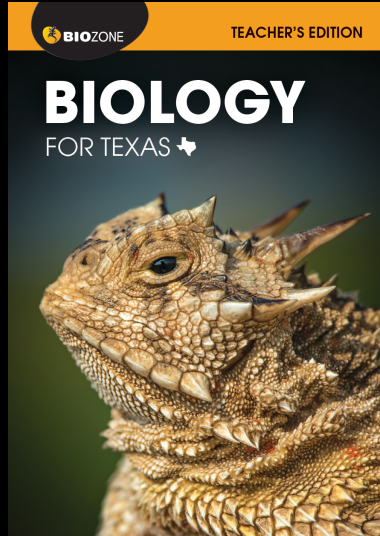
(a) Using the results provided, plot a line graph on the grid below:

(b) Estimate the rate of reaction at 15°C: _____

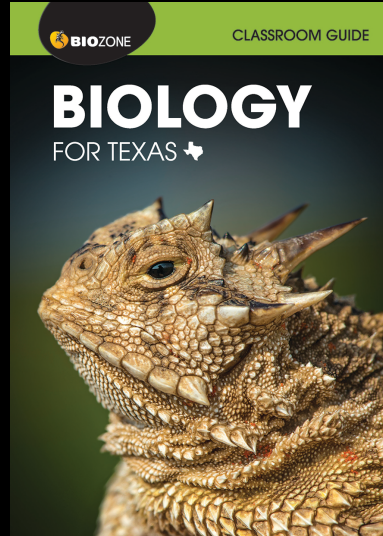


Teacher Support

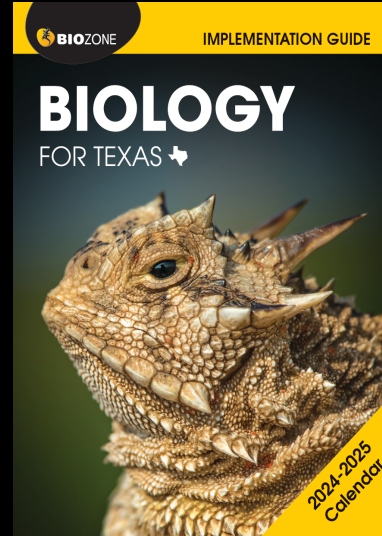
Teacher Resources



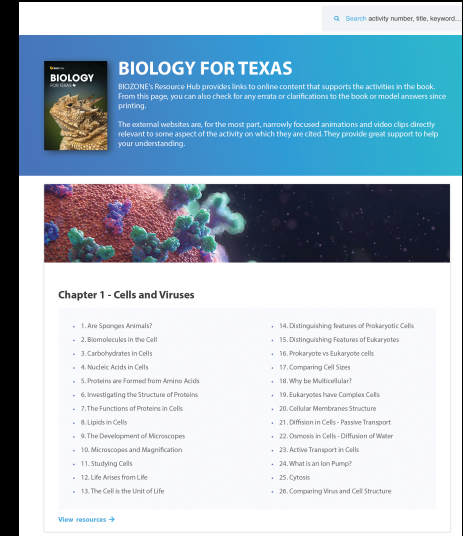
Teacher's Edition



Classroom Guide



Implementation Guide



Resource Hub

Test Bank + Question Library

Teacher's Edition

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- Additional content:

- Classroom Guide
 - Student and Teacher ELPS
 - TEKS and breakouts
 - Model answers in place

LIBRARY

ACTIVITY 3 Carbohydrates In Cells

ACTIVITY

Carbohydrates in Cells

SLIDES

Carbohydrates in Cells

VIDEO

2 Minute Classroom: Carbohydrates (2...

WEB LINK

Conducts Science: Structure, classif...

VIDEO

Khan Academy: Introduction to biomol...

ACTIVITY 4 Nucleic Acids In Cells

ACTIVITY 5 Proteins Are Formed From Amino Acids

ACTIVITY 6 Investigating The Structure Of Proteins

ACTIVITY 7 The Functions Of Proteins In Cells

ACTIVITY 8 Lipids In Cells

ACTIVITY 9 The Development Of Microscopes

ACTIVITY 10 Microscopes And Magnification

ACTIVITY 11 Studying Cells

ACTIVITY 12 Life Arises From Life

Biology For Texas

Chapter 1: Cells And Cellular Processes

3 Carbohydrates In Cells

88%

No Presets

3

Carbohydrates in Cells

Key Question: How are both simple and complex carbohydrates involved in the structure and function of cells?

Carbohydrates and the function of cells

- Monosaccharides, commonly termed simple sugars, play a central role in cell function, providing a source of energy that is quickly released during cellular respiration.
- Polysaccharides, or complex sugars, function as energy storage: starch in plant cells, and glycogen in animal cells.
- Plants, and some single-celled organisms, are called producers. They manufacture simple carbohydrates in the form of glucose during photosynthesis. All other organisms, called heterotrophs, acquire carbohydrates by eating.
- Simple carbohydrates are the building blocks that join together to form complex carbohydrate macromolecules.

Carbohydrates and the structure of cells

- Some complex carbohydrates have multiple strong bonds between molecules. This allows them to form rigid cellular structural components, such as plant cell walls, made from cellulose, or fungal cell walls made from chitin.
- Carbohydrates also form an important component of the cell membrane, controlling and facilitating movement of substances in and out, and allowing cells to recognize each other.

Glucose is a versatile molecule. It provides energy to power cellular reactions. It can form energy storage molecules such as glycogen, or it can be used to build structural molecules in polymer form.

Simple carbohydrates, in the form of glucose, enter the food chain when photosynthesis combines carbon, oxygen, and hydrogen, obtained from carbon dioxide and water.

Fructose, often called fruit sugar, is a simple monosaccharide. It is often made from sugar cane (above). Both fructose and glucose can be directly absorbed into the bloodstream to travel to cells.

Monosaccharides

- Monosaccharides (mono = one) are single-sugar biomolecules and include glucose and fructose.
- They are used as a primary energy source for fueling cell metabolism.
- Monosaccharides can be classified by the number of carbon atoms they contain, and join together to form carbohydrate macromolecules, such as starch and glycogen.

Glucose isomers

Molecules such as glucose can have many different isomers.

Isomers are compounds with the same chemical formula (same types and numbers of atoms) but different arrangements of atoms. The different arrangement of the atoms means that each isomer has different properties.

- Describe the two major functions of monosaccharides in the cell:
 - Primary energy source for cellular metabolism.
 - Structural units for disaccharides and polysaccharides (energy sources and structural carbohydrates).
- A large amount of energy is released during the breakdown of the glucose molecule into smaller water and carbon dioxide molecules. How is this relevant to the role that glucose plays in the cell?

The energy stored in glucose and released during its breakdown in cellular respiration is used by the cell to drive various cellular reactions.
- Glucose is highly soluble (easily dissolved) so it can easily be carried in the blood. Discuss how this makes it suitable as a biomolecule that is used to supply cells with an energy source:

The solubility of glucose allows it to dissolve easily in the blood plasma and be carried through even the smallest of blood vessels, the capillaries, from where it can be transported to wherever it is needed.

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Classroom Guide

- In Teacher's Edition or **download for free**
- Product orientation and features
- Teacher resources explained
- Planning, delivery, and assessment strategies
- Teacher notes (mini lesson plans)
- TEKS and ELPS summary tables

TEKS

SCIENTIFIC AND ENGINEERING PRACTICES

B.1: Scientific and engineering practices.

► The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models.

TEKS Student Expectation	Activity Number	Page number	Activity Number	Page number	Activity Number	Page number
B1.A Ask questions and define problems based on observations or information from text, phenomena, models, or investigations	34	63	94	166, 167	246	424
	66	119, 120	170	295	249	427
B1.B Apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems	9	17	94	166, 167, 168	226	384
	11	20	98	173	232	393
	12	22	102	179	238	406
	21	38	151	260	239	410
	30	53	181	315	249	427
	56	100	188	326	250	428
	60	106	215	367	257	435
	66	119	216	369	274	457
	80	143, 144	217	370		
B1.C Use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards	11	20	66	119, 120	232	393
	21	38	181	315	272	452, 453, 454
	38	69	211	361	274	457
	60	106	218	372		
	65	117	230	389		
B1.D Use appropriate tools	11	20	90	161	255	433
	21	38	149	256	258	436
	60	106	230	389		
	65	117	232	393		
B1.E Collect quantitative data using the International System of Units (SI) and qualitative data as evidence	21	38	94	167	258	436
	30	53	181	315	273	455
	60	106	211	361	274	456, 457
	65	117	218	372		
	90	161	256	434		
B1.F Organize quantitative and qualitative data using scatter plots, line graphs, bar graphs, charts, data tables, digital tools, diagrams, scientific drawings, and student-prepared models	11	20	145	251	238	406
	21	38	149	256	239	408, 411
	28	49	167	289	244	419
	29	51	174	299	245	421
	30	53, 54	183	318	259	437
	38	69	187	323	260	438
	47	81	188	325, 326, 327	261	439
	50	87	211	362	262	440
	56	100	219	373	263	441
	60	106, 107, 108	224	380, 381	264	442
	65	117, 118	225	382, 383	266	444
	66	120	226	384	270	449, 450
	80	142	227	385	271	451
	90	161	230	389	273	455
	94	167, 168	234	397	274	456, 457, 458
	109	187	236	400, 401		

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- Lesson implementation guide
- Concept maps
- Progress tracker:
 - Teacher and student
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IG106



Biology for TEXAS – Progress Tracker

Chapter 1: Cells and Viruses

Student Name _____ Class _____

5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell					
Activity	Biomolecules	Learning Outcomes	Approaching	Proficient	Mastery
2		Summarize the role of key biomolecules in the cell.			
3		Distinguish between monosaccharides and polysaccharides and understand their role in cell structure and function.			
4		Identify components of nucleic acids, and explain the role they have in cells.			
5-7		Discuss how cellular proteins are formed, including their folding, and match their function to examples found in cells.			
8		Link the structure of lipids to their function in cells.			
5.B compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity					
Activity	Prokaryotes and Eukaryotes	Learning Outcomes	Approaching	Proficient	Mastery
13		Identify key features of different groups of cells.			
14-16		Compare and contrast prokaryotic and eukaryotic cells, including presence of organelles.			
17		Compare and contrast prokaryotic and eukaryotic cells, including size.			
18		Compare and contrast prokaryotic and eukaryotic cells, including multicellular forms.			
19		Evaluate evidence for eukaryotic complexity, including endosymbiosis, and bacteria engulfment by protists.			
5.C Investigate homeostasis through the cellular transport of molecules					
Activity	Homeostasis and Cellular Transport	Learning Outcomes	Approaching	Proficient	Mastery
20		Explore the fluid-mosaic model of the cell membrane, including building a model and examining evidence for its structure.			
21-22		Investigate diffusion, especially osmosis, as a process in passive transport in the cell membrane, that is linked to cellular homeostasis.			
23-24		Explain how active transport allows substances to travel against the concentration gradient in the cellular membrane.			
25		Compare and contrast prokaryotic and eukaryotic cells, including multicellular forms.			
5.D compare the structure of viruses to cells and explain how viruses spread and cause disease					
Activity	Viruses	Learning Outcomes	Approaching	Proficient	Mastery
26		Compare and contrast viral and cellular structures, linking to the classification of living organisms.			
27		Link the method of reproduction to the classification of viruses, including the use of 'spikes' to gain entry to cells.			
27		Distinguish between viral lyso-genic and lytic cycles, linking to appearance of disease.			
28		Conduct a literature search on the method of transmission, entry, and disease symptoms of a selected human virus.			
29		Define the terms epidemic and pandemic, and discuss factors involved in their origin.			
29		Summarize key features shared by zoonotic diseases.			
30		Model viral disease spread using a digital simulation.			
31		Describe the methods of SARS-COV-2 coronavirus transmission, and aspects of the COVID-19 disease.			

* after completing the activity, shade the square aligning to self-assessment of your progress. This may be revised after subsequent revision.

Resource Hub

Curated Digital Resources

- **FREE for teachers and students**
- Access to curated materials and resources which support the content of the worktext.

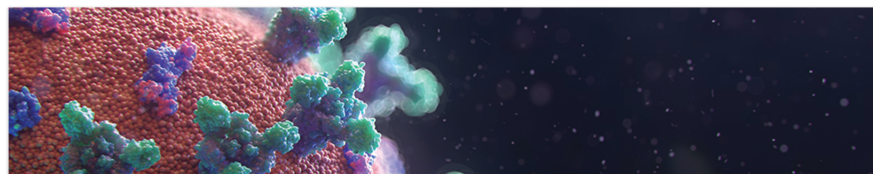
- Articles
- Games
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- 3D Models
- Animations
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BIOLOGY FOR TEXAS

BIOZONE's Resource Hub provides links to online content that supports the activities in the book. From this page, you can also check for any errata or clarifications to the book or model answers since printing.

The external websites are, for the most part, narrowly focused animations and video clips directly relevant to some aspect of the activity on which they are cited. They provide great support to help your understanding.



Chapter 1 - Cells and Viruses

- 1. Are Sponges Animals?
- 2. Biomolecules in the Cell
- 3. Carbohydrates in Cells
- 4. Nucleic Acids in Cells
- 5. Proteins are Formed from Amino Acids
- 6. Investigating the Structure of Proteins
- 7. The Functions of Proteins in Cells
- 8. Lipids in Cells
- 9. The Development of Microscopes
- 10. Microscopes and Magnification
- 11. Studying Cells
- 12. Life Arises from Life
- 13. The Cell is the Unit of Life
- 14. Distinguishing features of Prokaryotic Cells
- 15. Distinguishing Features of Eukaryotes
- 16. Prokaryote vs Eukaryote cells
- 17. Comparing Cell Sizes
- 18. Why be Multicellular?
- 19. Eukaryotes have Complex Cells
- 20. Cellular Membranes Structure
- 21. Diffusion in Cells - Passive Transport
- 22. Osmosis in Cells - Diffusion of Water
- 23. Active Transport in Cells
- 24. What is an Ion Pump?
- 25. Cytosis
- 26. Comparing Virus and Cell Structure

Accessing the Resource Hub

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Access details in introduction chapter.

- Bookmark for quick access
- QR code for quick access

BIOZONE WORLD:

Resources are embedded and show up automatically with an activity.

BIOZONE ALPHA
CLASSROOM
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BIOLOGY LIBRARY

- ACTIVITY 183 Natural Selection In Galápagos Finches
- ACTIVITY 184 Selection Pressure In Populations
- ACTIVITY 185 Directional Selection In Moth Populations
- ACTIVITY 186 Measuring Gene Pool Change
- ACTIVITY 187 Natural Selection In Rock Pocket Mice
- ACTIVITY 188 Modeling Natural Selection In Rock Pocket Mice
- ACTIVITY 189 What Is A Species
- ACTIVITY 190 How Species Form
- ACTIVITY 191 Patterns Of Evolution
- ACTIVITY 192 Evolutionary Mechanisms In Gene Pools
- ACTIVITY 193 Gene Flow

ACTIVITY
Gene Flow

SLIDES
Gene Flow

➔

VIDEO
Animal logic: ... mini jagua...

➔

3D MODEL
Cougar

➔

WEB LINK
Fish and Wildlife ... nature of the...

➔

WEB LINK
Nature.org: Texas Ocelot

➔

WEB LINK
OSU: How the Texas puma saved the Fl...

➔

Biology For Texas (SAMPLE)
>
Chapter 8: Evolution And Natural Selection
>
193 Gene Flow
>
Activity

110%
No Presets

193

Gene Flow

333

Key Question: What is the effect of gene flow on the allele frequencies of a population, and how does population size affect its influence?

► **Gene flow** is the movement of genes into or out of a **population** (immigration and emigration). A population may gain or lose **alleles** through gene flow. Gene flow tends to reduce the differences between populations because the **gene pools** become more similar. The model below graphically represents the elements of gene flow.

Emigration: An aspect of gene flow. Genes may be lost to other gene pools.

Immigration: An aspect of gene flow. Populations can gain alleles from other gene pools.

Gene flow: Genes are exchanged with other gene pools as individuals move between them. Gene flow is a source of new genetic variation and tends to reduce differences between populations that have accumulated because of natural selection or **genetic drift**. Recall that lack of gene flow can lead to speciation (new species forming) in isolated populations, over time.

- The allele frequencies of large populations are more stable because there is a greater reservoir of variability and they are less affected by changes involving only a few individuals.
- Small populations have fewer alleles to begin with and so the severity and speed of changes in allele frequencies are greater when gene flow occurs.
- Endangered species with very low population numbers or restricted distributions, such as the Texas ocelot and Florida panther, may experience severe and rapid allele changes.
- Human intervention to save endangered populations with low diversity often involve artificially creating gene flow by introducing individuals from different populations, even similar sub-species. This has happened in the example of the Texas puma. Migratory corridors can also be created, such as those helping the Texas ocelot.

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Resource Hub

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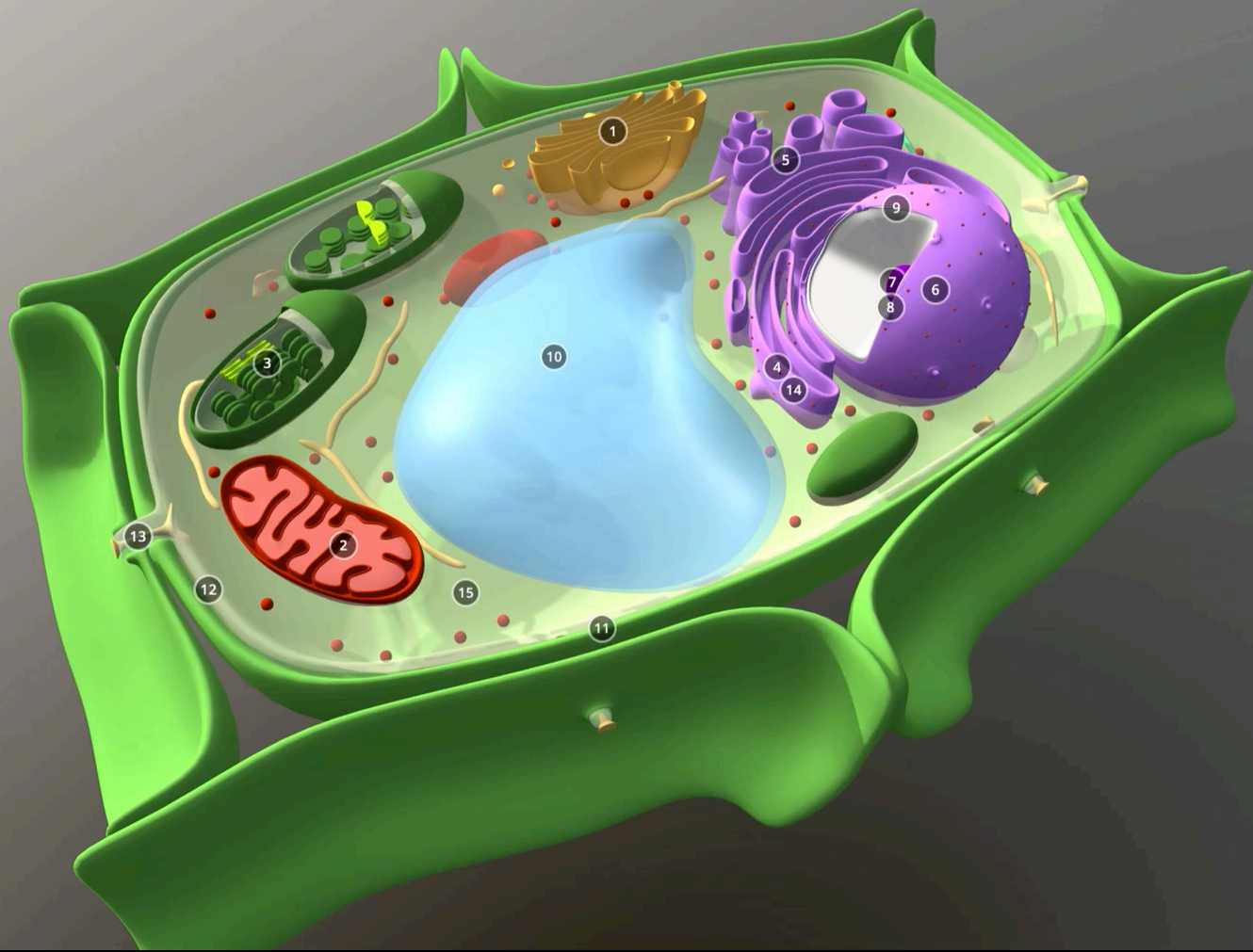
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Biology for Texas

LIST OF RESOURCE HUB MATERIALS

Resource type	Number of resources*
PDFs	36
3D models	182
Videos	455
Weblinks	312
Interactives	245
Spreadsheets	7

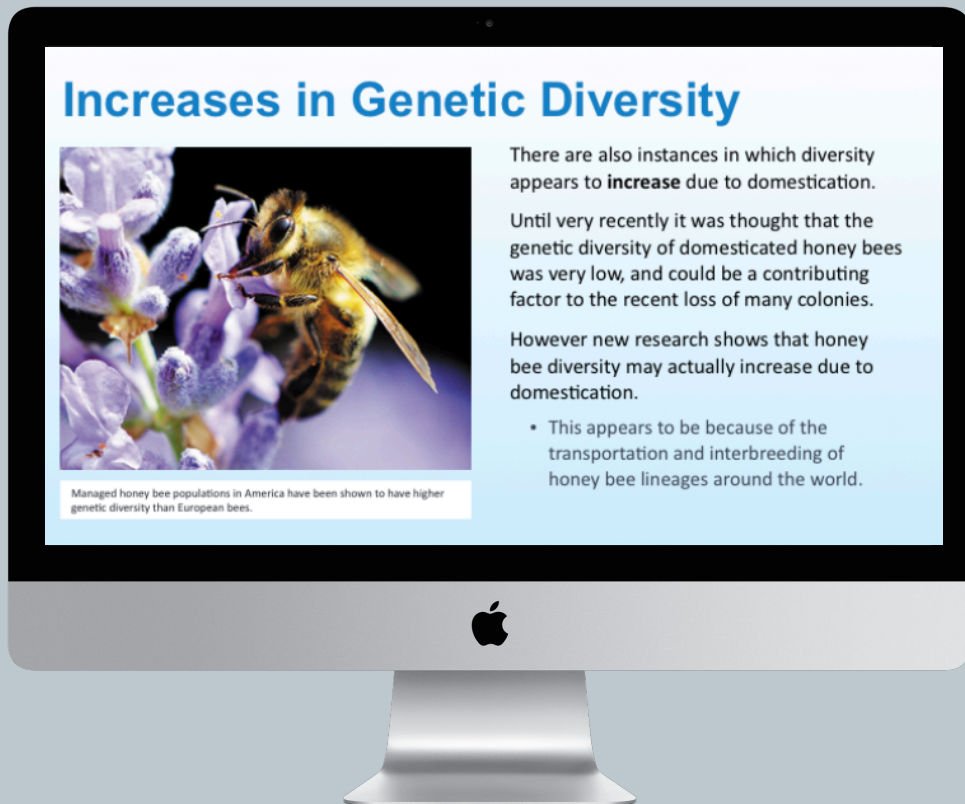
* approximate number of resources



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 - Multiple response
 - True/False
 - Modified true/false
 - Numeric
 - Matching

IS1 Test bank questions TLE2-General ed

Started: Jul 27 at 9:32am

Quiz Instructions

Question 1 1 pts

The living organisms and all their interactions make up the biotic factors of an ecosystem.

☐ True

☐ False

Question 16 1 pts

Competition between members of the same species is called _____ competition.

Question 22 1 pts

Which of the following is an example of a symbiosis?

☐ A predator-prey interaction

☐ A parasite-host relationship

☐ A plant-herbivore interaction

☐ Intraspecific resource competition

Question 43 1 pts

Density-independent growth is:

☐ Expressed by an exponential curve

☐ Regulated by competition

Questions

- Question 1
- Question 2
- Question 3
- Question 4
- Question 5
- Question 6
- Question 7
- Question 8

Time Elapsed: 1 Minute, 55 Seconds

Keep Editing This Quiz

Student View

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- Question library allows you to:
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 - **Customize questions** to suit **reading ability** and possible **ELL** support.

139 Genetic Engineering for Insulin 235

Key Question: How is genetic engineering used to produce insulin?

► Type 1 diabetes mellitus is a metabolic disease caused by a lack of insulin. Around 25 people in every 100,000 suffer from type 1 diabetes. It is treatable only with injections of insulin.

► In the past, insulin was taken from the pancreatic tissue of cows and pigs and purified for human use. The method was expensive and some patients had severe allergic reactions to the foreign insulin or its contaminants.

Using bacteria to produce insulin

► Recall that DNA can be cut with restriction enzymes and joined with DNA ligase. Any fragments of DNA cut with the same restriction enzymes can be joined together to produce recombinant DNA. Bacteria can pick up plasmids and express the genes that are in them.

► These two ideas are important in the production of insulin using the bacteria *E. coli* (below).

The diagram shows a human silhouette with a chromosome labeled '11'. An arrow points to a DNA double helix representing the insulin gene. Text boxes explain that the gene is too large for a bacterial plasmid, so the DNA for chains A and B is isolated. These are then inserted into separate plasmids. The recombinant plasmids are introduced into *E. coli* cells. The bacteria express either the A or B chain, depending on which DNA sequence they were transformed with. The diagram shows two *E. coli* cells, one producing 'b-galactosidase + chain A' and the other 'b-galactosidase + chain B'. The amino acid chains are purified and joined together to produce the final insulin protein, shown as a 3D model of the insulin molecule with 'Insulin A chain' and 'Insulin B chain' labels. A red arrow points from the diagram to the 'RTF' and 'QTI' icons on the right.

1. Explain why, when using *E. coli*, the insulin gene is synthesized as two separate A and B chain nucleotide sequences.

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7.0 255



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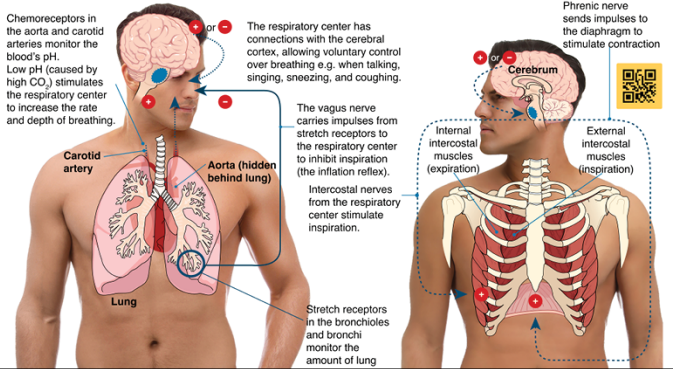
BIOZONE ALPHA CLASSROOM

Anatomy & Physiology (Sample) > Chapter 9: The Respiratory System > 150 Control Of Breathing > Activity

150 Control of Breathing

Key Idea: The basic rhythm of breathing is controlled by the respiratory center, a cluster of neurons located in the medulla oblongata, situated in the brain stem. This rhythm is adjusted in response to the physical and chemical changes that occur when we carry out different activities. Although the control of breathing is involuntary, we can exert some degree of conscious control over it. The diagram below illustrates these controls.

The respiratory center and the control of breathing



The diagram illustrates the control of breathing, showing the respiratory center in the brain and its connections to the lungs and muscles. It is divided into two parts: a frontal view of the head and torso on the left, and a lateral view of the head and torso on the right.

Frontal View (Left):

- Cerebrum:** The respiratory center has connections with the cerebral cortex, allowing voluntary control over breathing e.g. when talking, singing, sneezing, and coughing.
- Chemoreceptors:** In the aorta and carotid arteries monitor the blood's pH. Low pH (caused by high CO_2) stimulates the respiratory center to increase the rate and depth of breathing.
- Carotid artery:** Labeled on the neck.
- Aorta (hidden behind lung):** Labeled in the chest.
- Lung:** Labeled in the chest.


Lateral View (Right):

- Phrenic nerve:** Sends impulses to the diaphragm to stimulate contraction.
- Cerebrum:** Labeled in the brain.
- Internal intercostal muscles (expiration):** Labeled in the chest.
- External intercostal muscles (inspiration):** Labeled in the chest.
- Intercostal nerves:** From the respiratory center stimulate inspiration.
- Stretch receptors:** In the bronchioles and bronchi monitor the amount of lung.

BIOZONE ALPHA LIBRARY

Anatomy & Physiology > Chapter 3: The Skeletal System > 31 The Human Skeleton

- SLIDES: The Human Skeleton
- VIDEO: Anatomy of the skeleton (advanced)
- WEB LINK: Human axial skeleton
- WEB LINK: Skeletal system
- WEB LINK: Skeletal system
- 3D MODEL: Skeleton: Modern Human labelled
- 3D MODEL: Skull: Female Human
- VIDEO: The Skeletal system
- WEB LINK: What are the five main functions of ...
- ACTIVITY 32: The Bones Of The Spine
- ACTIVITY 33: The Limb Girdles
- ACTIVITY 34: Bone
- ACTIVITY 35: The Ultrastructure Of Bone



The 3D model of the human skeleton is shown from a front-three-quarter view. It is labeled with numbers 1 through 28, corresponding to the following bones:

- Skull (frontal bone)
- Skull (parietal bone)
- Skull (occipital bone)
- Skull (temporal bone)
- Skull (sphenoid bone)
- Skull (ethmoid bone)
- Skull (nasal bone)
- Skull (maxilla)
- Skull (mandible)
- Hyoid bone
- Clavicle
- Scapula
- Humerus
- Radius
- Ulna
- Carpals
- Metacarpals
- Phalanx
- Pelvis (ilium)
- Pelvis (ischium)
- Pelvis (pubis)
- Femur
- Tibia
- Fibula
- Tarsals
- Metatarsals
- Phalanx

184 Selection Pressure in Populations

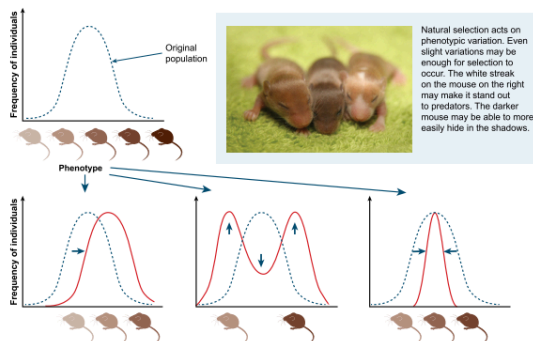
319

Key Question: How do environmental factors create selection pressure on populations?



Environmental factors act as a **selection pressure**, favoring survivability of some **traits** over others. Individuals with phenotypes better suited to the environment have better reproductive success and there are more of them. More of these successful **alleles** will exist in the **population**.

Over time, **natural selection** may lead to a permanent change in the genetic makeup of a population. Natural selection is always linked to the suitability of the phenotype in the current environment, so it is a dynamic process. It may favor existing phenotypes or shift the phenotypic median, as demonstrated in the models shown below.



- Analyze how fluctuating (as opposed to stable) environments favor disruptive (diversifying) selection: _____
- Evaluate the likely effect of rapid environmental change on a population with very low phenotypic variation: _____

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LIBRARY

ACTIVITY 183 Natural Selection In Galápagos Finches

ACTIVITY 184 Selection Pressure In Populations

ACTIVITY Selection Pressure in Populations

SLIDES Selection Pressure in Populations

3D MODEL American Black Bear

WEB LINK American Museum of Natural History: ...

WEB LINK Concord Consortium: Conflicting sele...

WEB LINK Concord Consortium: Deer mice

WEB LINK ThoughtCo: The 5 types of selection

ACTIVITY 185 Directional Selection In Moth Populations

ACTIVITY 186 Measuring Gene Pool Change

ACTIVITY 187 Natural Selection In Rock Pocket Mice

ACTIVITY 188 Modeling Natural Selection In Rock Pocket Mice

ACTIVITY 189 What Is A Species

ACTIVITY 190 How Species Form

ACTIVITY 191 Patterns Of Evolution

ACTIVITY 192 Evolutionary Mechanisms In Gene Pools

Biology For Texas (SAMPLE) Chapter 8: Evolution And Natural Selection 184 Selection Pressure In Populations

105% No Presets

184 Selection Pressure in Populations

Key Question: How do environmental factors create selection pressure on populations?

Environmental factors act as a **selection pressure**, favoring survivability of some **traits** over others. Individuals with **phenotypes** better suited to the environment have better reproductive success and there are more of them. More of these successful **alleles** will exist in the **population**.

Over time, **natural selection** may lead to a permanent change in the genetic makeup of a population. Natural selection is always linked to the suitability of the phenotype in the current environment, so it is a dynamic process. It may favor existing phenotypes or shift the phenotypic median, as demonstrated in the models shown below.

Natural selection acts on phenotypic variation. Even slight variations may be enough for selection to occur. The white streak on the mouse on the right may make it stand out to predators. The darker mouse may be able to more easily hide in the shadows.

Directional selection
An environmental pressure, e.g. predation, or higher temperatures, selects against one of the phenotypic extremes. The adaptive phenotype is shifted in one direction and one phenotype is favored over others.

Disruptive selection
Disruptive selection favors two phenotypic extremes at the expense of intermediate forms. Disruptive selection may occur when environments or resources are fluctuating or distinctly divergent.

Stabilizing selection
Extreme variations are selected against and the middle range (most common) phenotypes are retained in greater numbers. Stabilizing selection decreases variation for the phenotypic character involved.

- Analyze how fluctuating (as opposed to stable) environments favor disruptive (diversifying) selection:
Fluctuating environments are more likely to provide resource instability (e.g. food shortages), which may favor diversification of phenotypes to exploit extremes of the resource range. For example, droughts may lead to seed shortages, so birds may be forced to exploit seeds outside the range of sizes they would normally eat.
- Evaluate the likely effect of rapid environmental change on a population with very low phenotypic variation:
It is likely the population would reduce rapidly as most members would not be able to survive the environmental changes. The few that had adaptations that allowed them to survive the environmental changes would be able to pass on their genes. Little genetic variation in the population would be left (a genetic bottleneck).

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Biology For NGSS (Sample) > Chapter 2: Cell Specialization And Organization > 34 Plant Cells > Activity



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34 Plant Cells

Key Question: What are the general and specific features of a plant cell?

What is an organelle?

- ▶ The word **organelle** means "small organ". Therefore, organelles are the cell's "organs" and carry out the cell's work.
- ▶ Organelles represent one level of organization in a multicellular organism. One component (the cell) is made up of many smaller parts (organelles).
- ▶ Eukaryotic cells contain many different types of organelles. Each type of organelle has a specific role in the cell to help it function.
- ▶ Plant cells have several types of membrane-bound organelles called plastids. These make and store food and pigments. Some of the organelles found in a plant cell are shown below.

Features of a plant cell

- ▶ Plant cells are **eukaryotic cells**. Features that identify plant cells as eukaryotic cells include:
 - ▶ A membrane-bound nucleus.
 - ▶ Membrane-bound organelles, e.g. nucleus, mitochondria, endoplasmic reticulum.
 - ▶ Features that can be used to identify a plant cell include the presence of:
 - Cellulose cell wall.
 - Chloroplasts and other plastids.
 - Large vacuole (often centrally located).



A generalized plant cell

Chloroplast

A specialized plastid containing the green pigment, chlorophyll. Chloroplasts are the site for photosynthesis. Photosynthesis uses light energy to convert carbon dioxide to glucose.

Cellulose cell wall

A semi-rigid structure that lies outside the plasma membrane. It has several

Mitochondrion

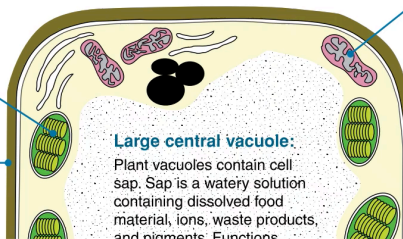
Mitochondria are the cell's energy producers. They use the chemical energy in glucose to make ATP (the cell's usable energy).

Endoplasmic reticulum (ER)

A network of tubes and flattened sacs continuous with the nuclear membrane. There are two types of ER. Rough ER has ribosomes

Large central vacuole:

Plant vacuoles contain cell sap. Sap is a watery solution containing dissolved food material, ions, waste products, and pigments. Functions



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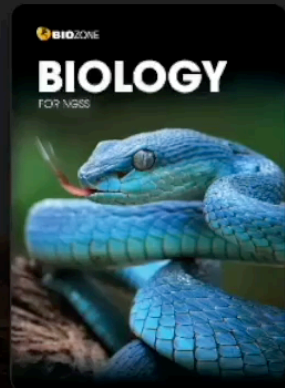

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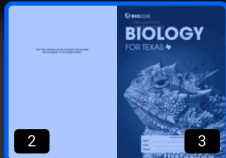
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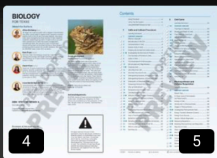


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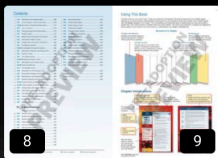
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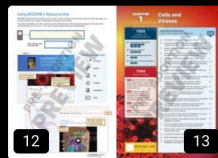
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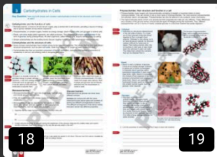


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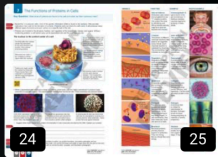
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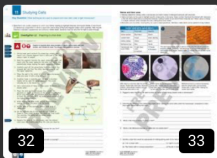


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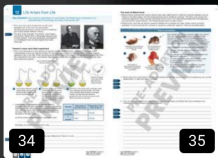
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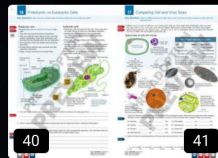
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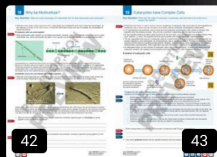
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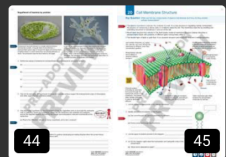
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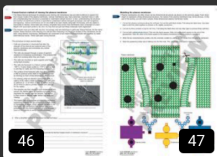


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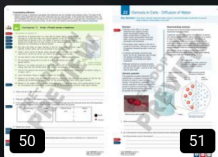
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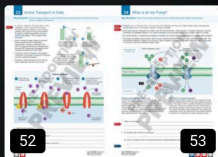
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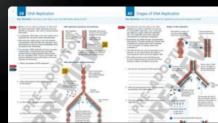
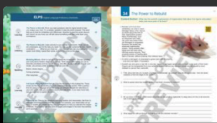
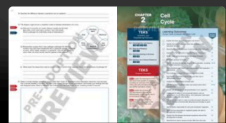
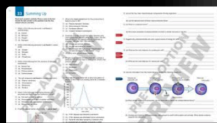
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2 Biomolecules in the Cell

Key Question: What biomolecules are present in the cells of organisms, and what role do they play in the function and structure of the cell?

- Water is the main component of cells and organisms, providing an aqueous environment in which metabolic reactions, the metabolism, can occur.
- Most other substances in cells are compounds of carbon, hydrogen, oxygen, and nitrogen. Carbon can combine with many other elements to form a large number of carbon-based (or organic) molecules.
- The organic molecules that make up living things, called biomolecules, can be grouped into four broad classes: carbohydrates, lipids, proteins, and nucleic acids. In addition, a small number of inorganic ions, such as Mg^{2+} , are also components of larger molecules.

The biomolecules in cells

Centrioles

Proteins have an enormous number of structural and functional roles in cells, e.g. as enzymes, as structural materials such as collagen, in transport, and movement, e.g. cytoskeleton and centrioles.
Components: C, H, O, N, S, P

Chloroplasts in plant cells

Inorganic ions: Dissolved ions participate in metabolic reactions and are components of larger, organic molecules, e.g. Mg^{2+} is a component of the green chlorophyll pigment in the chloroplasts of green plants.

Plant epidermis

Water is a major component of cells. Many substances dissolve in it and metabolic reactions occur in it. In plant cells, fluid pressure against the cell wall provides turgor, which supports the cell. Components: H, O

Animal cell

Chromosome

Nucleotides and nucleic acids: Nucleic acids encode information for the construction and functioning of an organism (DNA and RNA). ATP, a nucleotide derivative, is the energy carrier of the cell.
Components: C, H, O, N, P

Plant cell

Plant cell wall

Chloroplast membranes

Carbohydrates form the structural components of cells, e.g. cellulose cell walls (arrowed). They are important in providing usable energy as glucose, in energy storage and they are involved in cellular recognition.
Components: C, H, O

Simple lipids provide a concentrated source of energy. **Phospholipids** (a complex lipid) are a major component of cellular membranes, including the membranes of organelles, such as chloroplasts and mitochondria.
Components: C, H, O, P, N (phospholipids)

The elements of life

CARBON
6E, 6P, 6N

HYDROGEN
1E, 1P

OXYGEN
8E, 8P, 8N

NITROGEN
7E, 7P, 7N

Carbon is abundant. It has four valence (outer shell) electrons that are available to form up to four covalent (shared electron) bonds with other atoms. Complex biological molecules consist of carbon atoms bonded with other elements, especially oxygen and hydrogen, but also nitrogen, phosphorus, and sulfur.

CARBON
Source: Food
Use: Proteins, lipids, nucleic acids, carbohydrates

PHOSPHORUS
Source: Food
Use: Lipids, nucleic acids

OXYGEN
Source: Atmosphere
Use: Cellular respiration, incorporated in to micromolecules

CARBON
Source: Atmosphere (as carbon dioxide gas)
Use: Proteins, lipids, nucleic acids, carbohydrates

Adipose (fat) tissue

Glycogen in muscle

In animals, energy and carbon are stored as fat and glycogen.

NITROGEN
Source: Food
Use: Proteins, nucleic acids

NITROGEN
Source: Soil
Use: Proteins, nucleic acids

Phosphorus
Source: Soil
Use: Lipids, nucleic acids

Amyloplasts

In plants, energy and carbon are stored as starch in organelles called amyloplasts.

1. Summarize the role of each of the following cell components:

- Carbohydrates:
- Lipids:
- Proteins:
- Nucleic acids:
- Inorganic ions:
- Water:

2. Explain why carbon is so important for building the molecular components of an organism:

3. State the main source of carbon, phosphorus, and nitrogen for animals:

4. (a) State the main source of carbon for plants:

(b) State the main source of phosphorus and nitrogen for plants:



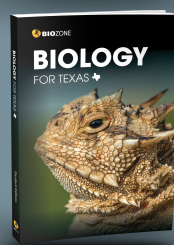
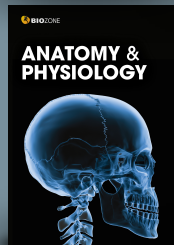
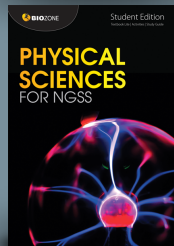
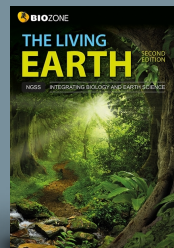
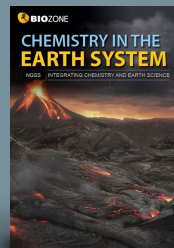
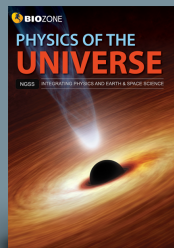
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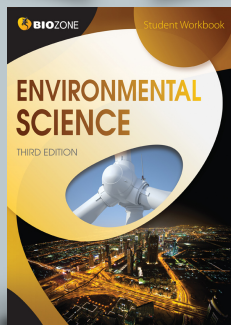
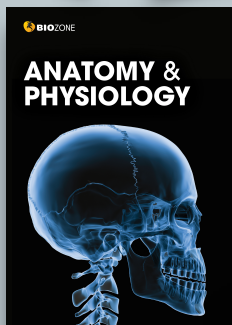
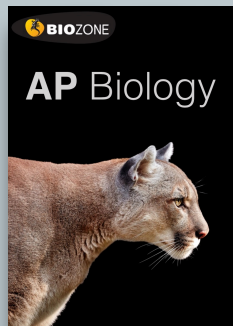
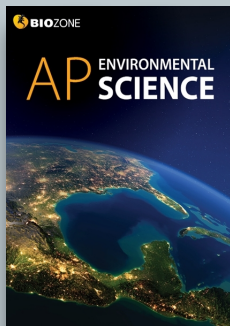
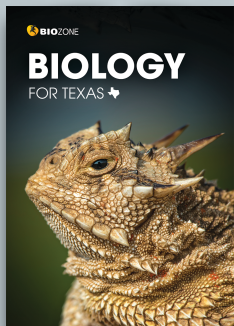
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