BIOZONE

BIOLOGY

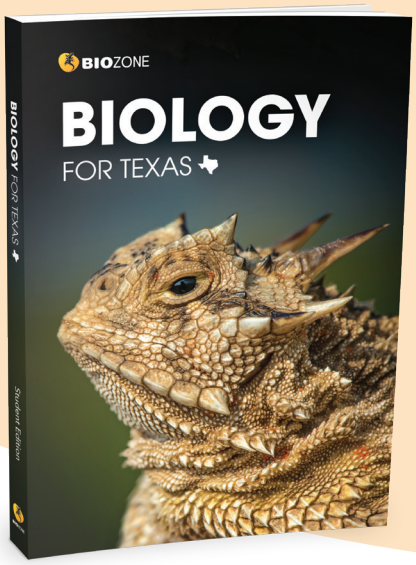
FOR TEXAS

FREE SAMPLE

for classroom trial

This sample packet may be photocopied and trialled in the classroom.

BIOLOGY FOR TEXAS



Biology for Texas has been specifically written for the **Texas Essential Knowledge and Skills** (TEKS) for Science (High School Biology). Biology for Texas is a well-rounded resource, combining the program's required elements with **BIOZONE**'s trademark rigorous and highly visual approach. The **English Language Proficiency Standards** (ELPS), nature of science, scientific inquiry, and science and ethical components of the programs are integral within the activities.

BIOZONE's unique, interactive worktext approach encourages direct interaction with the content. Students record their answers within the context of the stimulus material, thereby forming a **record of work** for quick and easy revision.

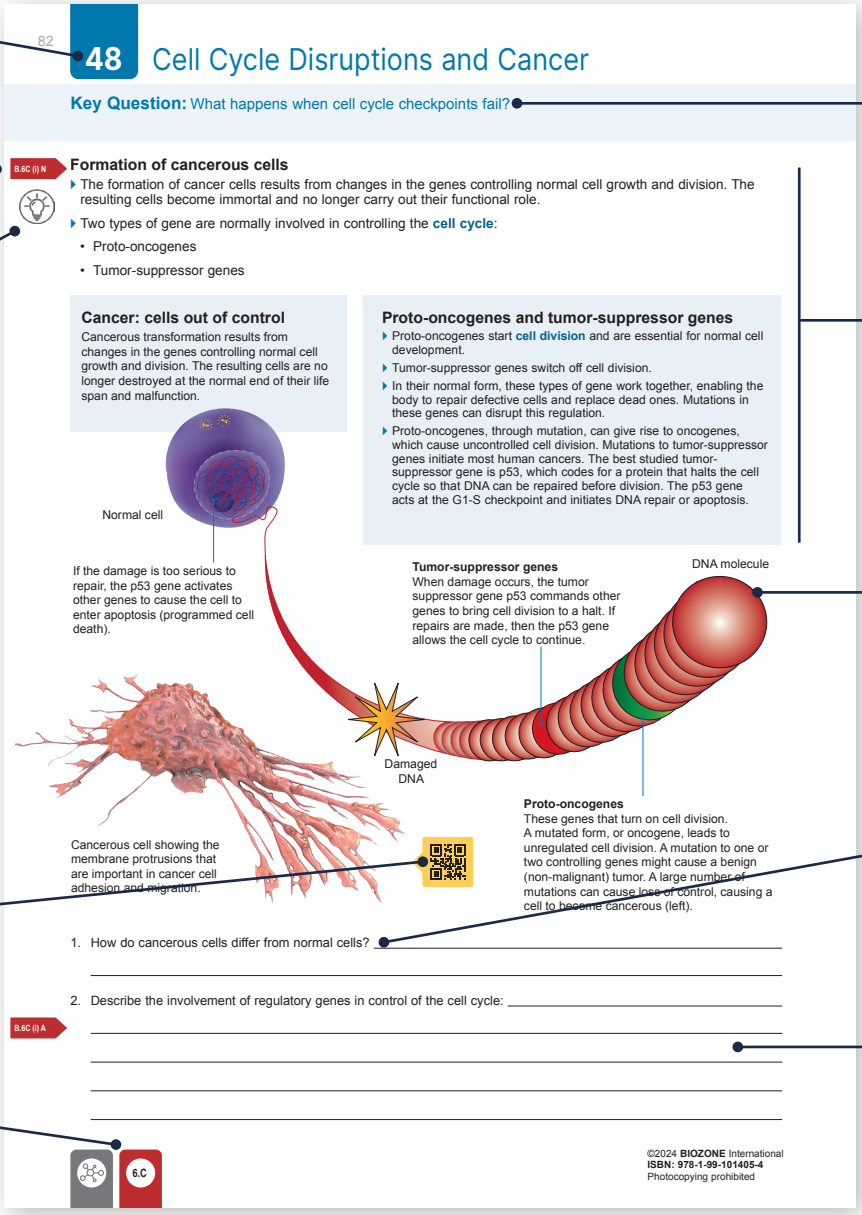
Activity number
Activities are numbered to make navigation through the book easier.

TEKS Breakouts
Specific breakouts are identified.
(Teacher's Edition only)

ELPS
Icons identify where ELPS are incorporated.

QR Codes
Scan the QR code to directly interact with 3D models (above).

Activity coding system
Tab codes indicate online support via BIOZONE's **Resource Hub** and identify the TEKS covered in the activity.



82

48 Cell Cycle Disruptions and Cancer

Key Question: What happens when cell cycle checkpoints fail?

B.6C (i) N

Formation of cancerous cells

- The formation of cancer cells results from changes in the genes controlling normal cell growth and division. The resulting cells become immortal and no longer carry out their functional role.
- Two types of gene are normally involved in controlling the **cell cycle**:
  - Proto-oncogenes
  - Tumor-suppressor genes

Cancer: cells out of control
Cancerous transformation results from changes in the genes controlling normal cell growth and division. The resulting cells are no longer destroyed at the normal end of their life span and malfunction.

Proto-oncogenes and tumor-suppressor genes

- Proto-oncogenes start **cell division** and are essential for normal cell development.
- Tumor-suppressor genes switch off cell division.
- In their normal form, these types of gene work together, enabling the body to repair defective cells and replace dead ones. Mutations in these genes can disrupt this regulation.
- Proto-oncogenes, through mutation, can give rise to oncogenes, which cause uncontrolled cell division. Mutations to tumor-suppressor genes initiate most human cancers. The best studied tumor-suppressor gene is p53, which codes for a protein that halts the cell cycle so that DNA can be repaired before division. The p53 gene acts at the G1-S checkpoint and initiates DNA repair or apoptosis.

Normal cell

If the damage is too serious to repair, the p53 gene activates other genes to cause the cell to enter apoptosis (programmed cell death).

Tumor-suppressor genes
When damage occurs, the tumor suppressor gene p53 commands other genes to bring cell division to a halt. If repairs are made, then the p53 gene allows the cell cycle to continue.

DNA molecule

Damaged DNA

Proto-oncogenes
These genes that turn on cell division. A mutated form, or oncogene, leads to unregulated cell division. A mutation to one or two controlling genes might cause a benign (non-malignant) tumor. A large number of mutations can cause loss of control, causing a cell to become cancerous (left).

Cancerous cell showing the membrane protrusions that are important in cancer cell adhesion and migration.

1. How do cancerous cells differ from normal cells? _____

2. Describe the involvement of regulatory genes in control of the cell cycle: _____

B.6C (i) A

6.C

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Key Question
A key question provides a primary focus for the activity. It helps students to understand where the activity's emphasis lies.

Content organization
Logically organized content makes it easier for students to access and engage with the information.

Comprehensive, engaging diagrams
Engaging, high quality diagrams provide a visual focus whilst delivering important information in an accessible format.

Direct questioning
A direct questioning style helps students easily identify what is being asked.

Write-on answers
Students input their answers directly onto the page. This becomes their **record of work** and helps them revise for tests and exams.

www.**BIOZONE**.com/TEXAS

CHAPTER 8

Evolution and Natural Selection

TEKS
Scientific and Engineering Practices

B.1: Investigation and Inquiry
1.B 1.C 1.E 1.F 1.G

B.2: Data and Patterns
2.A 2.B 2.C 2.D

B.3: Communicating in Science
3.A 3.B

B.4: Science as a Human Endeavor
4.A 4.B

TEKS
Science Concepts

B10.A analyze and evaluate how natural selection produces change in populations and not in individuals

B10.B analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success

B10.C analyze and evaluate how natural selection may lead to speciation

B10.D analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population

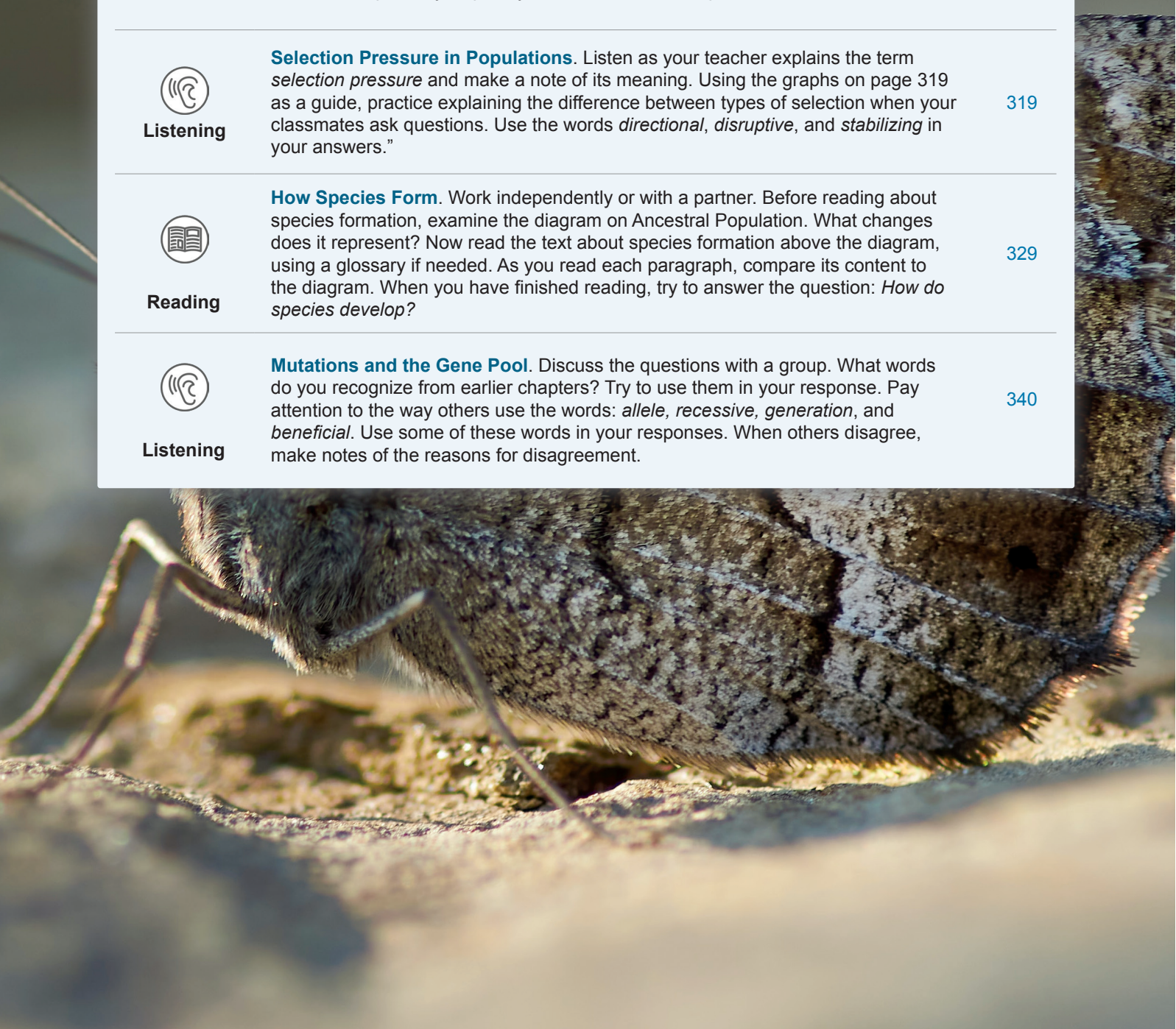
RESOURCE HUB
bit.ly/3yaOp7Z

Learning Outcomes
I know I have achieved this when I can:

		Activity number
☐	Identify the factors involved in the process of natural selection.	180
☐	Evaluate how factors that result in differential reproductive success can cause a change of inherited characteristics in a population over time.	180
☐	Investigate the process of natural selection using a model.	181
☐	Discuss the importance of variation in populations as a required factor needed for natural selection to occur.	182
☐	Evaluate how natural selection acts upon the beak phenotype in Galápagos finches to provide evidence for evolution by natural selection.	183
☐	Analyze and evaluate the effect of selection pressures on populations that can result in directional selection, disruptive selection, and stabilizing selection, giving examples of each.	184
☐	Analyze data related to directional selection of peppered moth populations of different colors in industrial areas of the UK.	185
☐	Measure the change of allele frequency in a theoretical gene pool, linking to evidence for natural selection.	186
☐	Analyze data on the relationship between the rock pocket mice coat color phenotype and the selection pressure of rock color in the environment.	187
☐	Carry out a spreadsheet simulation activity to investigate the effect of gene pool changes on rock pocket mice.	188
☐	Define the term species, using both BSC and PSC concepts.	189
☐	Link isolating mechanisms to speciation, giving examples.	190
☐	Compare and contrast patterns of evolution: divergent and convergent evolution, and adaptive radiation.	191
☐	Explain and differentiate between the terms gene flow and genetic drift, as evolutionary mechanisms.	192
☐	Analyze how lack of gene flow creates reduced diversity in gene pools, using examples.	193
☐	Research the cost-benefit of wildlife corridors as a means to increase gene flow between populations.	193
☐	Analyze changes in gene pools due to genetic drift, from data provided.	194
☐	Calculate allele frequency change in populations due to the founder effect.	195
☐	Analyze the impact of the bottleneck effect on Texan red wolf populations.	196
☐	Research the impact of a beneficial mutation on the gene pool of a population, using a selected example.	197
☐	Analyze the relationship between genetic recombination and the addition of variation to a population's gene pool.	198
☐	Discuss the changes over time due to selection pressures in the tusk phenotype of an African elephant population.	199

ELPS English Language Proficiency Standards

		Page number
Learning	**How Does an Elephant Lose its Tusks?** Use the question words in question numbers 1 and 2 to decide how to start your answers. For example, question 1 (a) begins "What do you think…?" Begin your answer with "I think…" Use the words: *might*, *advantage*, and *disadvantage* in your answer to question 1(b). What are two different ways you can begin your answer to question 2?	312
Learning	**Modeling Natural Selection with M&M's®**. As you carry out the investigation, practice describing the results in each round. Use the sentence frame: *In round _____, the proportion of _____ [color] was _____*. To answer the questions, use and reverse the wording of the questions: *Over time, the blue M&M's _____. This model is useful because _____*. If you have trouble describing, ask your partner how they might say it.	315
Speaking	**Modeling Natural Selection with M&M's®**. Carry out the M&M's® modeling activity with a partner. At each stage, discuss your results. What is happening to the color distribution of the M&M's®? At the end of the activity, discuss your results. Together, answer the questions: Why did this happen? How does this represent the process of evolution? Optionally, explain your results to another pair.	315
Listening	**Selection Pressure in Populations**. Listen as your teacher explains the term *selection pressure* and make a note of its meaning. Using the graphs on page 319 as a guide, practice explaining the difference between types of selection when your classmates ask questions. Use the words *directional*, *disruptive*, and *stabilizing* in your answers."	319
Reading	**How Species Form**. Work independently or with a partner. Before reading about species formation, examine the diagram on Ancestral Population. What changes does it represent? Now read the text about species formation above the diagram, using a glossary if needed. As you read each paragraph, compare its content to the diagram. When you have finished reading, try to answer the question: *How do species develop?*	329
Listening	**Mutations and the Gene Pool**. Discuss the questions with a group. What words do you recognize from earlier chapters? Try to use them in your response. Pay attention to the way others use the words: *allele, recessive, generation*, and *beneficial*. Use some of these words in your responses. When others disagree, make notes of the reasons for disagreement.	340

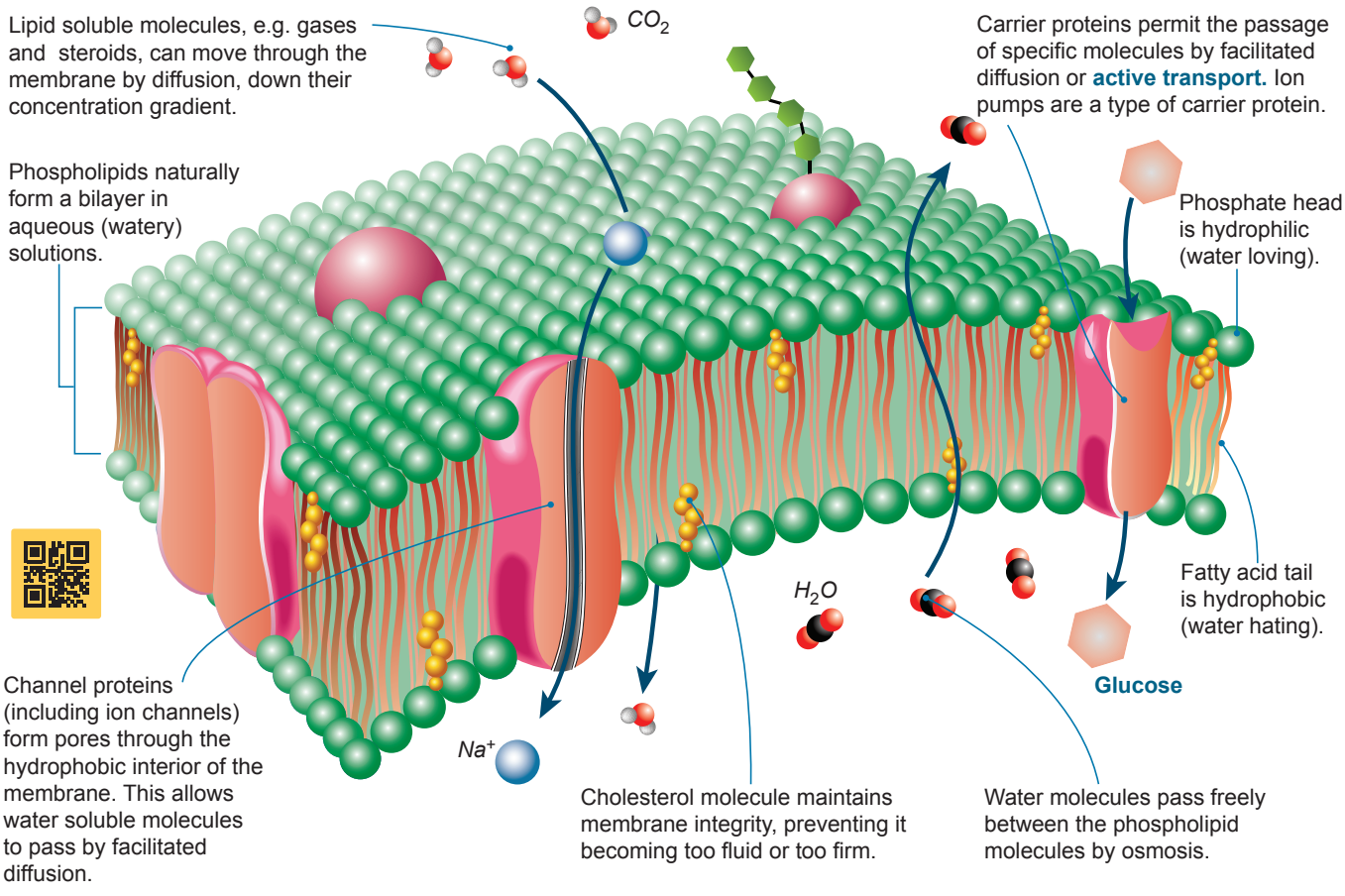


20 Cell Membrane Structure

Key Question: What are the key components of plasma membranes and how do they enable cellular homeostasis?

B.5C (i) N

- The **plasma membrane** encloses the contents of a **cell**. It is a key structure in regulating cellular homeostasis: the process of maintaining a steady state of conditions inside the cell. The membrane does this by enabling and controlling movement of substances in and out of the cell.
- Recall **lipid** structure from activity 8. The fluid-mosaic model of membrane structure (below) describes a **phospholipid** bilayer with **proteins** of different types moving freely within it.
- The double layer of lipids is quite fluid. It is a dynamic structure and is actively involved in cellular activities.



1. List the important components of the plasma membrane: _____

_____

2. Identify which kind of molecule on the diagram:

B.5C (i) A

(a) Can move through the plasma membrane by diffusion: _____

_____

(b) Forms a channel through the membrane: _____

_____

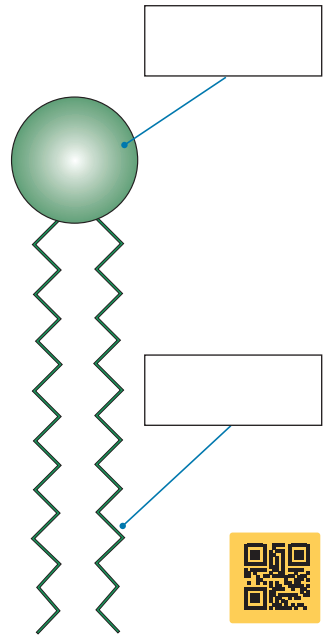
_____

3. List the types of proteins pictured in the diagram: _____

_____

4. (a) On the diagram (right) label the hydrophobic and hydrophilic ends of the phospholipid.

(b) Which end is attracted to water? _____



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B.6C (i) N

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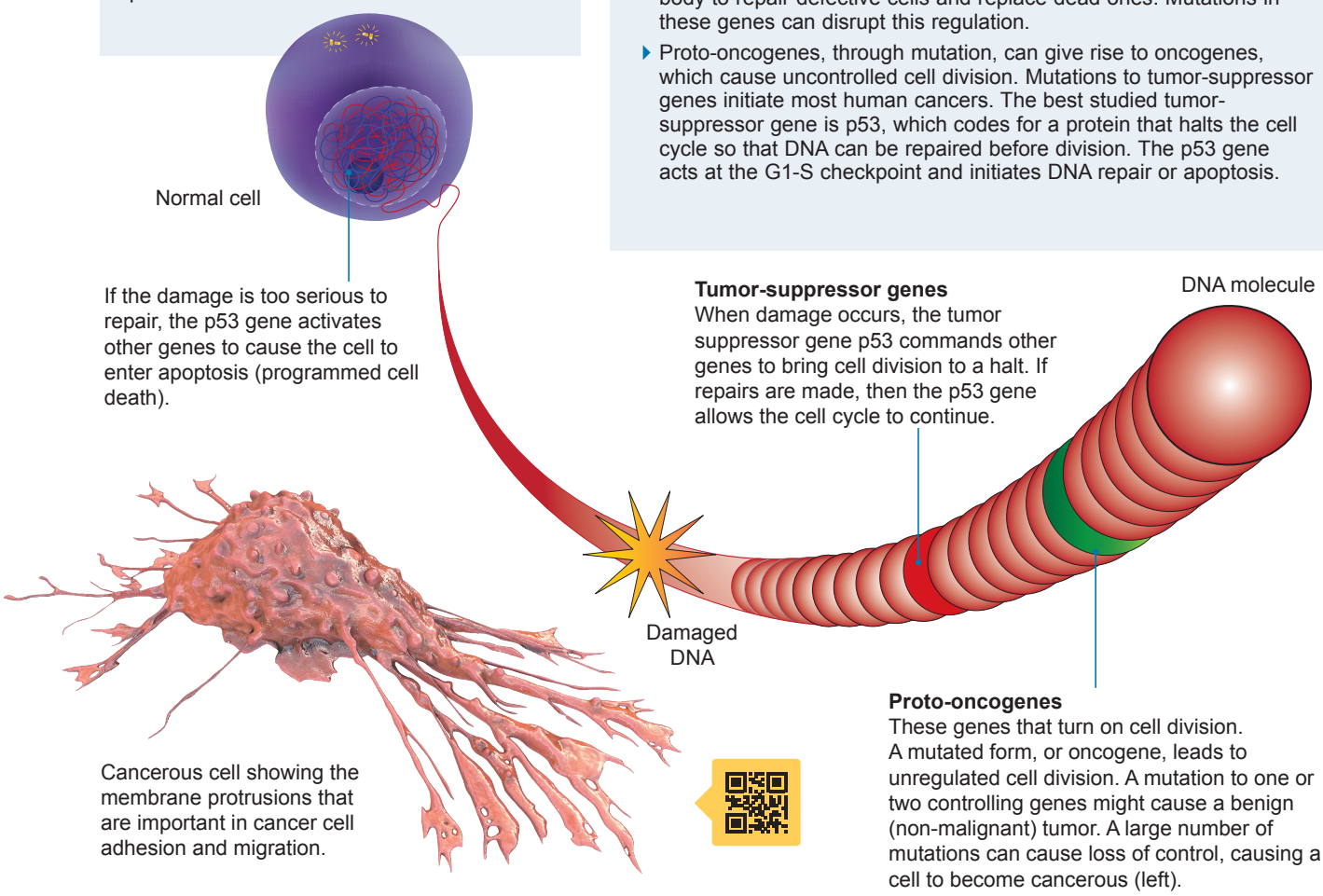

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_____

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B.6C (i) A

_____

_____

_____

_____

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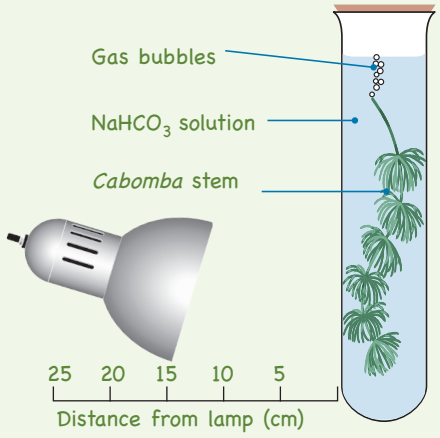
56 Investigating Photosynthetic Rate

Key Question: How does light intensity affect photosynthesis rate?

Investigation 3.1 Measuring bubble production in *Cabomba*

See appendix for equipment list.

1. Fill a boiling tube 2/3 full with a 20°C solution of 1% sodium hydrogen carbonate ($NaHCO_3$).
2. Cut ~ 7 cm long piece of *Cabomba* stem (cut underwater). Place the *Cabomba* into the boiling tube (cut end up). Carefully push the *Cabomba* down.
3. Place the boiling tube in a rack and position a lamp so that it will shine on the tube when switched on.
4. 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.
5. 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.
6. Use a ruler to mark out distances 0, 5, 10, 15, 20, and 25 cm from the boiling tube.
7. Starting at 25 cm, move the lamp to each of the distances in turn 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).
8. Record your results in the table (right). Calculate the mean rate of gas production for each distance (and lamp OFF).
9. After you have finished recording, remove the stopper from the tube and test the gas with a glowing splint. What happens?



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* 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?

B.1B (vi) A
B.1D (i) A
B.1F (v) A
B.2C (i) A
B.1F (ii) A
B.2B (ii) A

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79 Interactions Regulating Respiratory Gases

Key Question: How do the circulatory and respiratory systems interact to provide the body's tissues with oxygen and remove carbon dioxide?

B.12A(i) N

B.4A(i)N

Circulatory system

Function

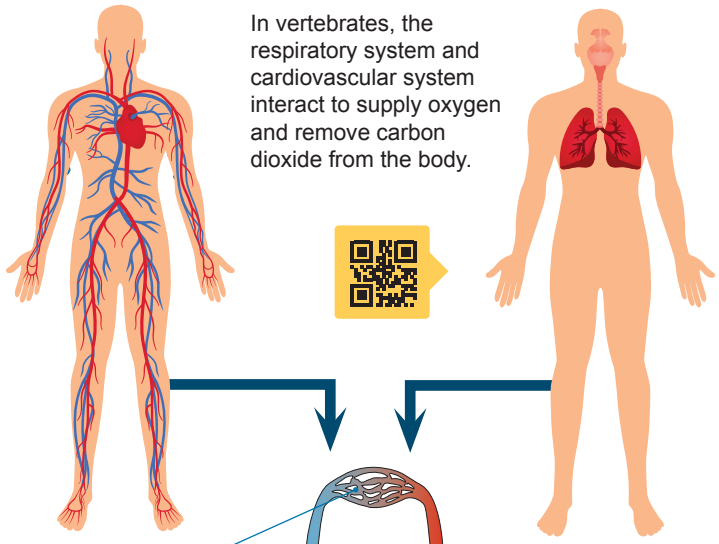
Delivers oxygen (O_2) and nutrients to all **cells** and **tissues**. Removes carbon dioxide (CO_2) and other waste products of metabolism. CO_2 is transported to the lungs.

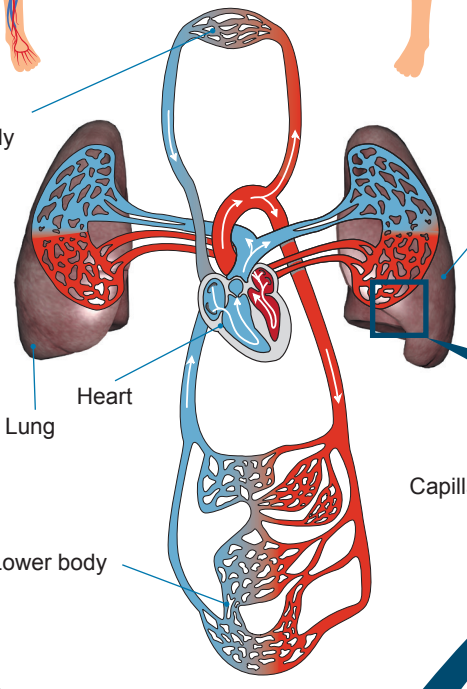
Components

- Heart
- Blood vessels:
  - Arteries
  - Veins
  - Capillaries
- Blood

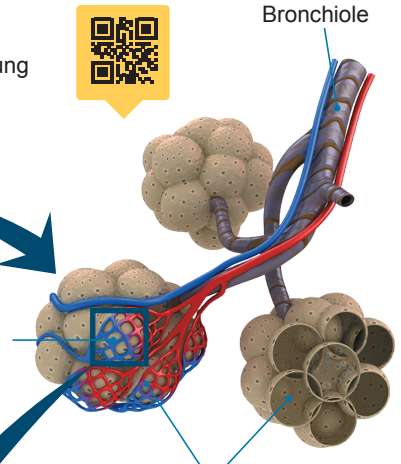
Interaction between systems

In vertebrates, the respiratory system and cardiovascular system interact to supply oxygen and remove carbon dioxide from the body.

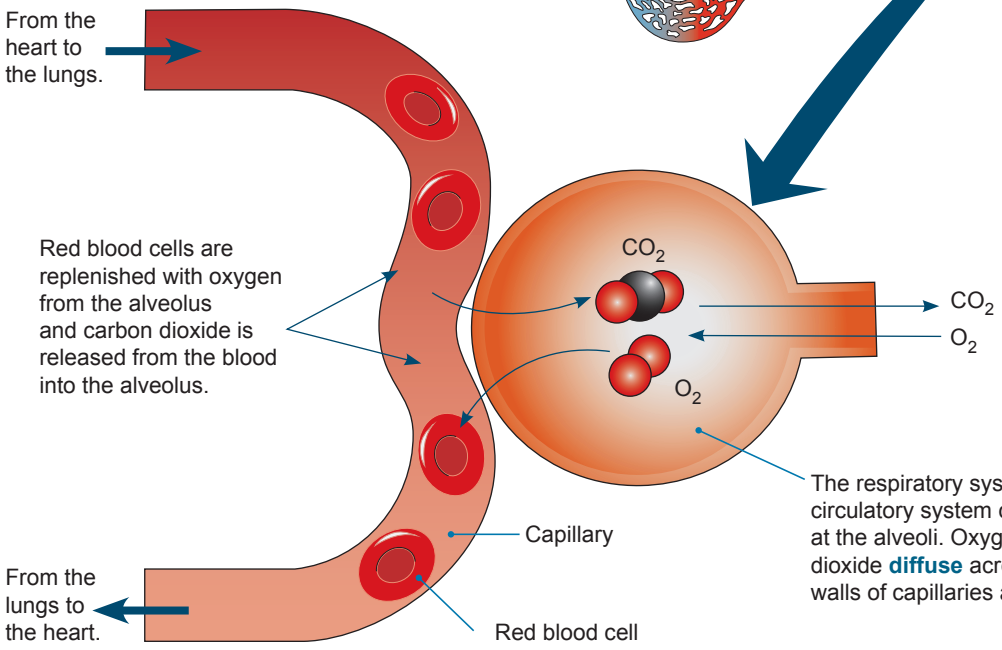




Oxygen (O_2) from inhaled air moves from the lungs into the circulatory system and is transported to the heart by red blood cells. The heart pumps the blood to the body where O_2 is released and carbon dioxide (CO_2) is picked up. The blood returns to the heart and is pumped to the lungs where CO_2 is released into the lungs to be breathed out.



The airways of the lungs end at the alveoli (singular, alveolus). These are microscopic air sacs that enable gas exchange.



Red blood cells are replenished with oxygen from the alveolus and carbon dioxide is released from the blood into the alveolus.

The carbon dioxide released from the blood exits the body during exhalation. Inhalation brings in fresh air, containing oxygen.

The respiratory system and the circulatory system come together at the alveoli. Oxygen and carbon dioxide **diffuse** across the thin walls of capillaries and alveoli.

Respiratory system

Function

Provides surface for gas exchange. Moves fresh air into and stale air out of the body.

Components

- Airways:
  - Pharynx
  - Larynx
  - Trachea
- Lungs:
  - Bronchi
  - Bronchioles
  - Alveoli
- Diaphragm

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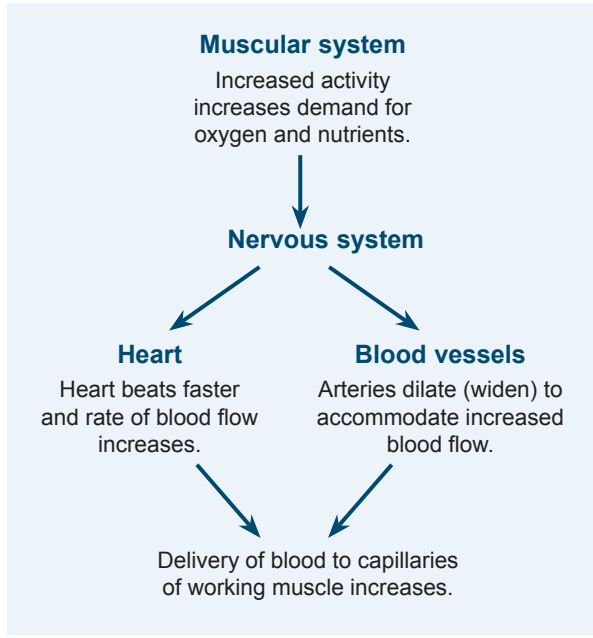
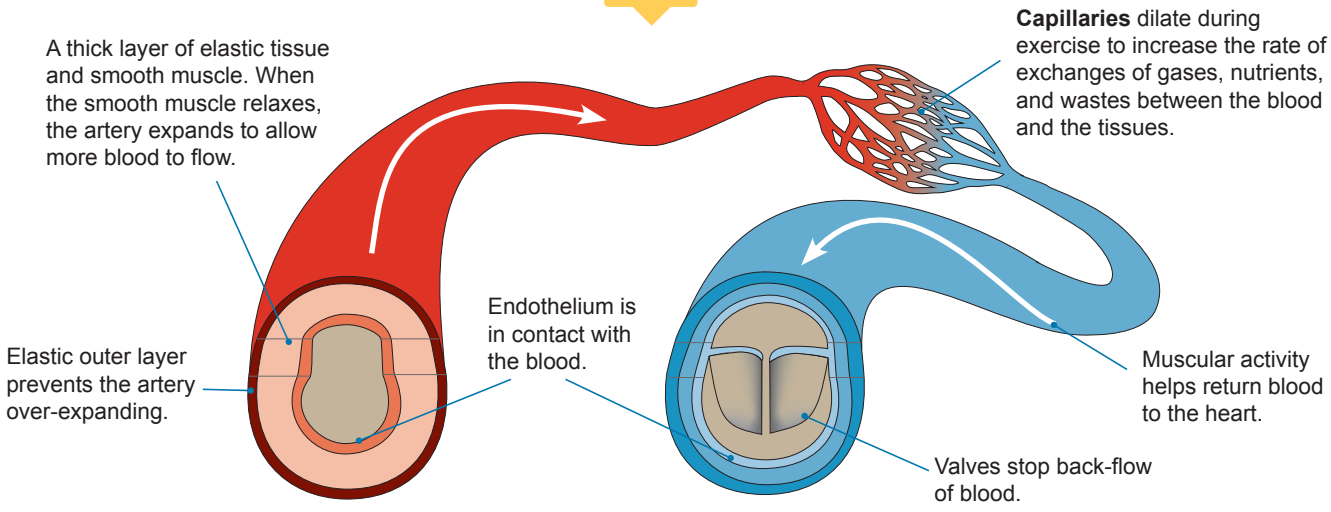
B.12A(i) N

Responding to exercise

- During exercise, your body needs more oxygen to meet the extra demands placed on the muscles, heart, and lungs. At the same time, more carbon dioxide must be expelled. To meet these increased demands, blood flow must increase. This is achieved by increasing the rate of heart beat. As the heart beats faster, blood is circulated around the body more quickly, and exchanges between the blood and tissues increase.
- The arteries and veins must be able to cope with the extra pressure of higher blood flow and must expand (dilate) to accommodate the higher blood volume. If they didn't, they could rupture (break). During exercise, the muscular, circulatory and nervous systems interact to maintain the body's systems in spite of increased demands (right).





Artery

The strong, stretchy structure of arteries enables them to respond to increases in blood flow and pressure as more blood is pumped from the heart.

Vein

Veins return blood to the heart. They are less muscular than arteries, but valves and the activity of skeletal muscles, especially during exercise, help venous return.

1. In your own words, describe how the circulatory system and respiratory system work together to provide the body with oxygen and remove carbon dioxide:

B.12A(i) A

2. (a) What happens to blood flow during exercise? _____

   (b) How do body systems interact to accommodate the extra blood flow needed when a person exercises?

B.12A(i) A

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126 Modeling Gene Expression

Key Question: How can a model be used to explain gene expression?

Models can be used to explain the process of gene expression

The following exercise will help you understand and explain the three important steps in the process of **gene expression**. Using plastic building blocks, you will model how proteins are produced using the information stored in **DNA**.

B.7B (i) N
B.7B (ii) N
B.7B (iii) N

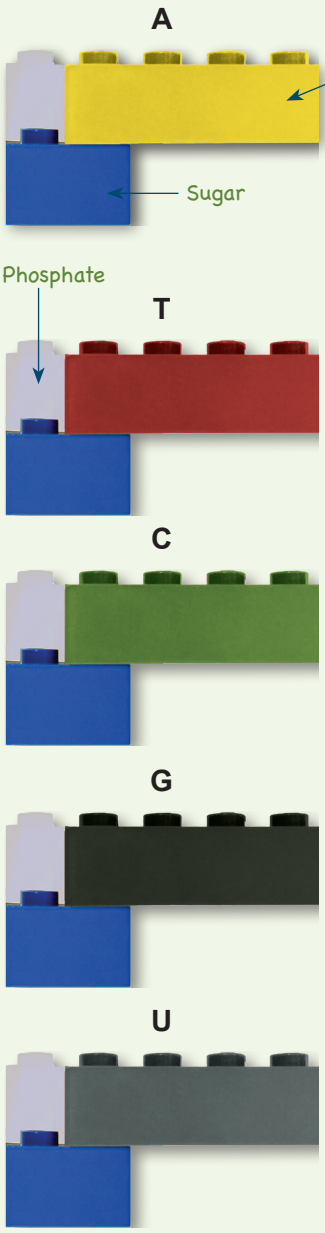
Investigation 5.2 Modeling gene expression

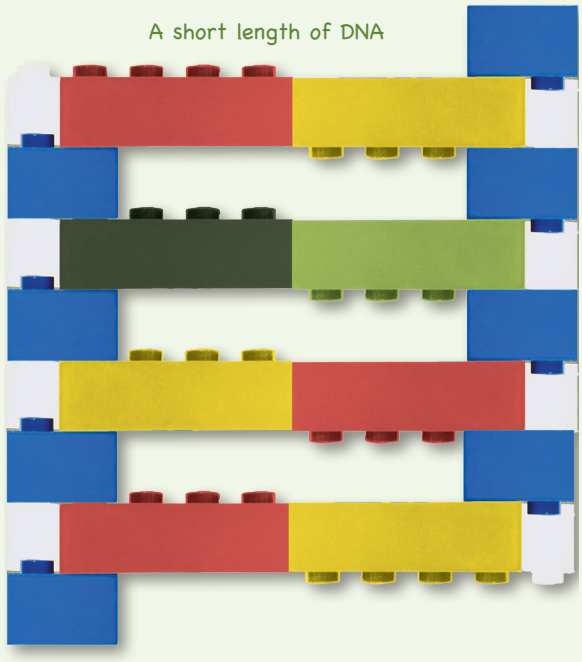
See appendix for equipment list.

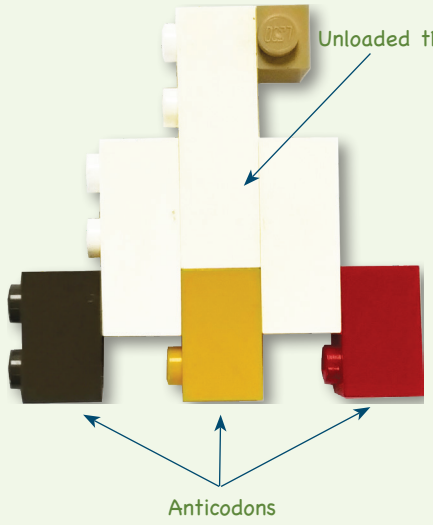
B.7B (i) A
B.7B (ii) A
B.7B (iii) A

1. Plastic blocks can be used to model a vast number objects and processes. The photographs below, and on the following page, show how they could be used to model the bases that make up DNA, a DNA strand, and tRNA. Using blocks like this, model the process of protein synthesis, including mRNA, ribosomes, transcription and translation.
2. Take photos of your models, print them out, and paste the photos in the spaces on the following pages to show protein synthesis. You could also make a video of the process and share with your class and teacher.

B.1G(i)A
B.1G(ii)A







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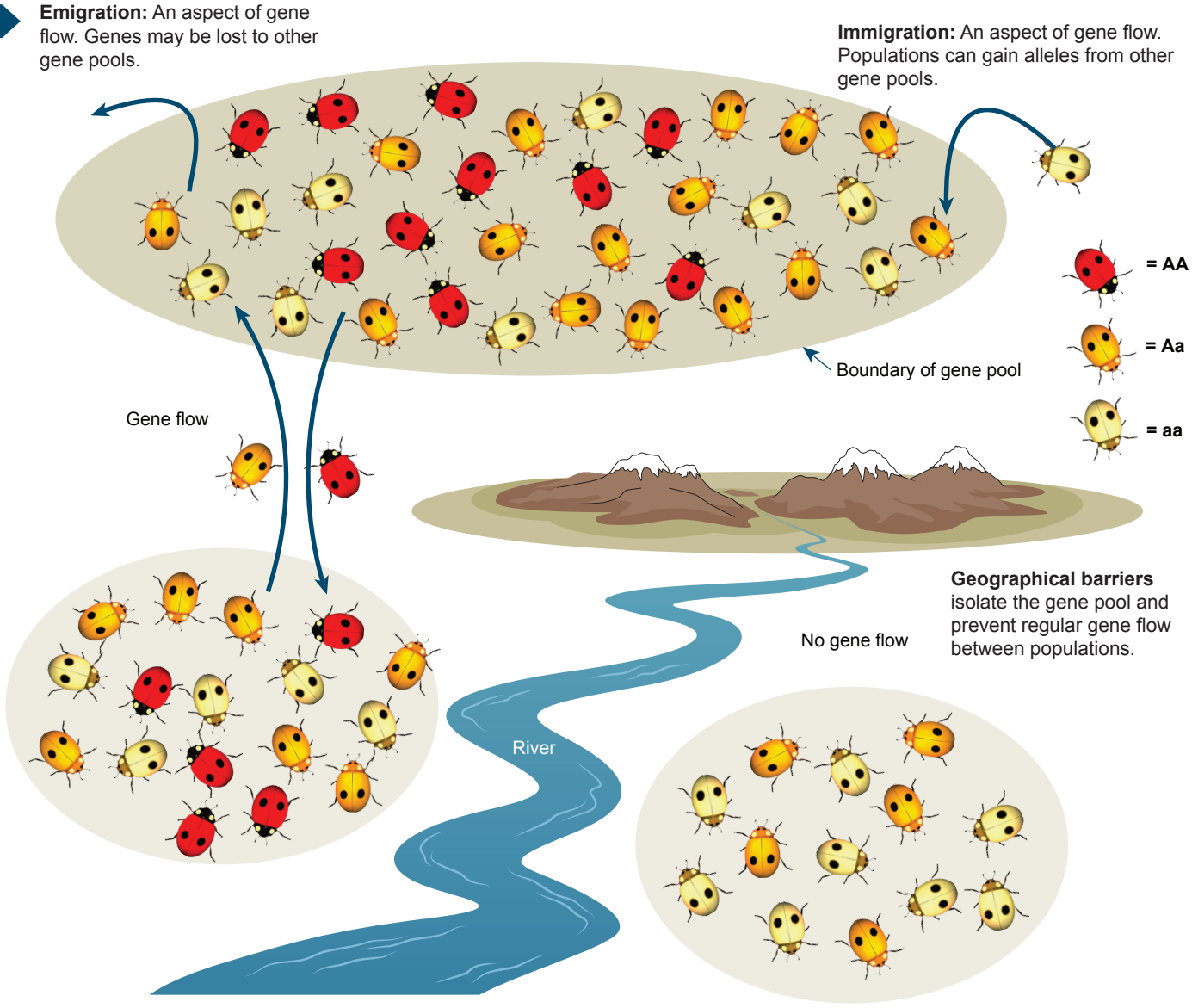
193 Gene Flow

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

B.10D(vi) N

- **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.

B.1G (ii) N



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.

B.10D(vi) N

- 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.

B.10D (ii) N

- 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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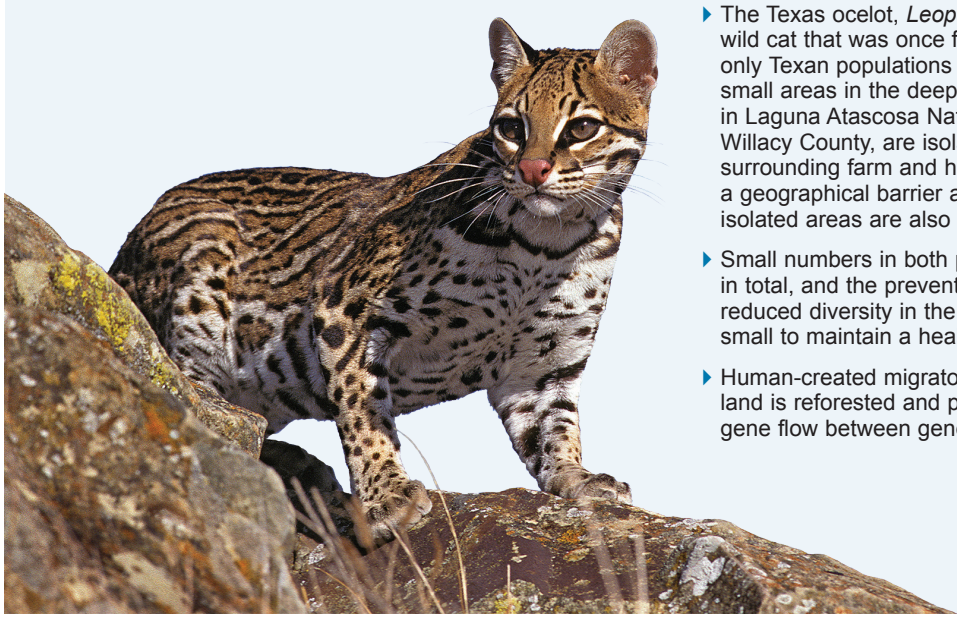
B.10D (ii) N



Lack of gene flow and the Texas ocelot

- The Texas ocelot, *Leopardus pardalis*, is an endangered wild cat that was once found across Texas. Presently, the only Texan populations of ocelots that remain are in two small areas in the deep south. Both small populations, in Laguna Atascosa National Wildlife Refuge and in Willacy County, are isolated from each other due to surrounding farm and human occupied land that acts as a geographical barrier and prevents gene flow. These isolated areas are also called 'genetic islands'.
- Small numbers in both populations, under 100 ocelots in total, and the prevention of gene flow, mean that the reduced diversity in the Texan ocelot gene pool is too small to maintain a healthy and viable wild population.
- Human-created migratory corridors, where connecting land is reforested and protected, can be used to increase gene flow between gene pools of isolated populations.

1. How can gene flow be defined? _____

B.10D (ii) A

_____

_____

2. In general, how is gene flow likely to positively impact the gene pool of a population? _____

B.10D(vi) A

_____

B.3A (vi) A

_____

3. Why are smaller populations more affected by a lack of gene flow? _____

B.10D(ii) A

_____

_____

4. How has lack of gene flow impacted the viability and 'fitness' of the Texas ocelot? _____

_____

_____

5. (a) Wildlife corridors are being built in Texas, such as the Tobin Land Bridge in San Antonio, and the under-highway tunnels in the Laguna Atascosa National Wildlife Refuge, home of a small Texas ocelot population. How do these corridors contribute to gene flow between populations?

B.10D(ii) A

_____

_____

(b) The wildlife corridors can be expensive to build, but can contribute to a species survival. Use the **Biozone Resource Hub** and your own research to complete the cost-benefit analysis of the wildlife corridor as a means of species conservation of the Texas ocelot below:

B.4B(viii) A

Costs of wildlife corridor	Benefits of wildlife corridor

ISBN: 978-1-99-101405-4

197 Mutations and the Gene Pool

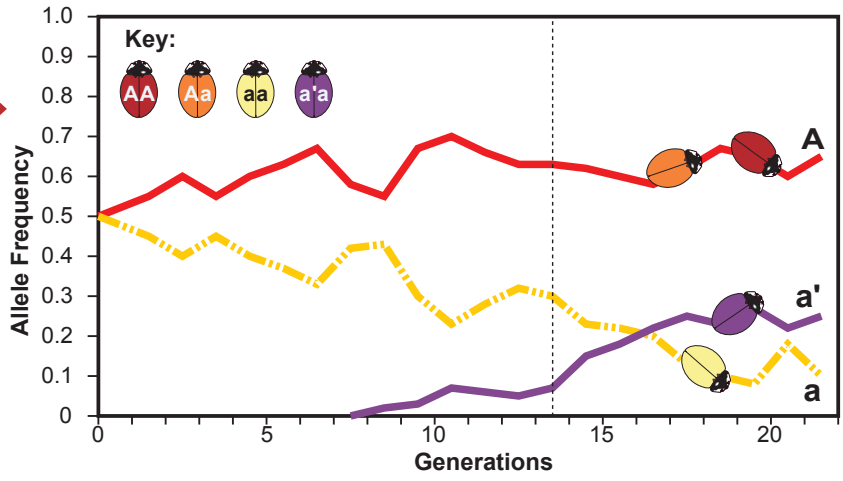
Key Question: How does the evolutionary mechanism of mutation affect the gene pool in a population?

B.10D(vii)N

- **Mutations** are the source of all new **alleles**. Therefore, mutations can change the frequency of existing alleles by competing with them.
- A mutation that is beneficial to the organism is very rare. However, beneficial mutations can give the organism a greatly increased survival advantage, such as hiding from predators or finding food, so that the new allele can increase in frequency in the **gene pool** very quickly.

B.10D(iii) N

B.10D(vii) N



- In the graph above, a random mutation creates a new recessive allele: **a'** and causes a purple **phenotype.**
- The frequency of this new allele increases when environmental conditions change, giving it a competitive advantage over the other recessive allele: **a**
- The frequency of **A** remains relatively stable.
- Eventually, the **a** allele may be lost from the **population** altogether.

- Some mutations are so beneficial, like that producing the 'anti-freeze' protein found in species of Antarctic ice-fish (above), that they allow species to occupy completely new habitats.
- Typically, any mutation is likely to be small in impact. Multiple mutations result in cumulative changes to the gene pool over many generations.
- Mutations that are non-beneficial to survival are rapidly removed from the gene pool, and known as deleterious.
- Mutations that do not cause a consequential change in phenotype, are known as silent mutations. **Selection pressures** do not act on them to remove mutant alleles any faster than other alleles in the gene pool. They are useful for understanding common ancestry between **species**, and for DNA identification.

1. What is a beneficial mutation? _____

_____

2. From the graph above, describe how the gene pool appear (name alleles) after another 10 generations has passed:

B.10D(vii) A

B.2B (ii) A

_____

_____

_____

3. Paraphrase an explanation for why beneficial mutations are likely to rapidly increase in a gene pool: _____

B.10D(vii) A

_____

_____

4. Either individually, or in pairs, research an animal or plant, preferably a local example, that has had one or more beneficial mutations added to the gene pool in the past. Describe the species, the type of beneficial mutation, and how intervention has increased the organism's 'fitness' or reproductive success. Create a report, either written, or digital. Attach the report here, or provide a link, if digital. Include text, images, and a list of information sources.

B.10D(iii) A

B.3B (ii) A

_____

_____

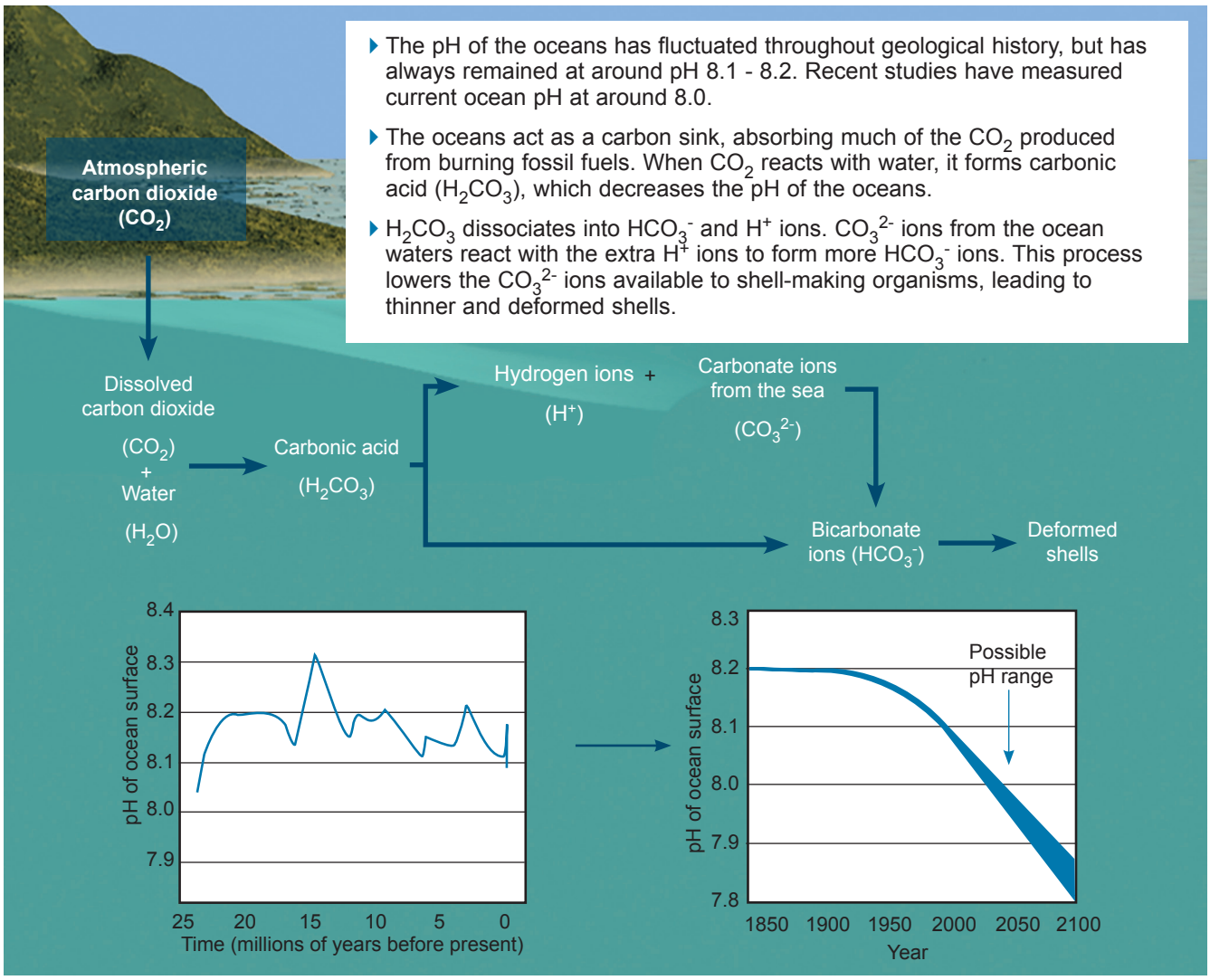
ISBN: 978-1-99-101405-4

232 Ocean Acidification

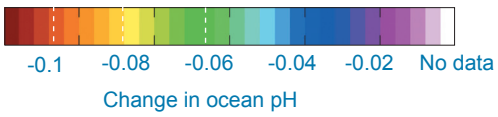
Key Question: How does the increasing amount of carbon dioxide in the atmosphere affect the pH, and therefore stability of the marine ecosystem in the oceans?

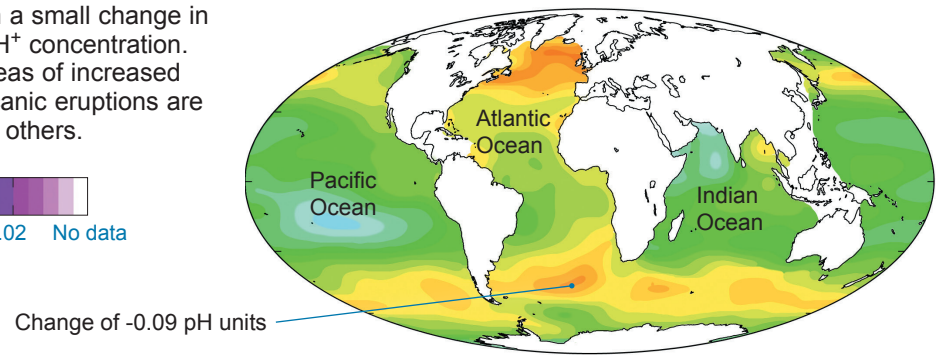
B.13C (iii) N

- The pH of the oceans has fluctuated throughout geological history, but has always remained at around pH 8.1 - 8.2. Recent studies have measured current ocean pH at around 8.0.
- The oceans act as a carbon sink, absorbing much of the CO_2 produced from burning fossil fuels. When CO_2 reacts with water, it forms carbonic acid (H_2CO_3), which decreases the pH of the oceans.
- H_2CO_3 dissociates into HCO_3^- and H^+ ions. CO_3^{2-} ions from the ocean waters react with the extra H^+ ions to form more HCO_3^- ions. This process lowers the CO_3^{2-} ions available to shell-making organisms, leading to thinner and deformed shells.



- pH is a logarithmic scale, so even a small change in pH represents a large change in H^+ concentration. Some areas of the ocean, e.g. areas of increased human activity or underwater volcanic eruptions are more affected by pH change than others.





1. (a) What does the term "ocean acidification" mean? _____

_____

(b) Describe the trend in ocean pH since the 1850s: _____

B.2B (ii) A

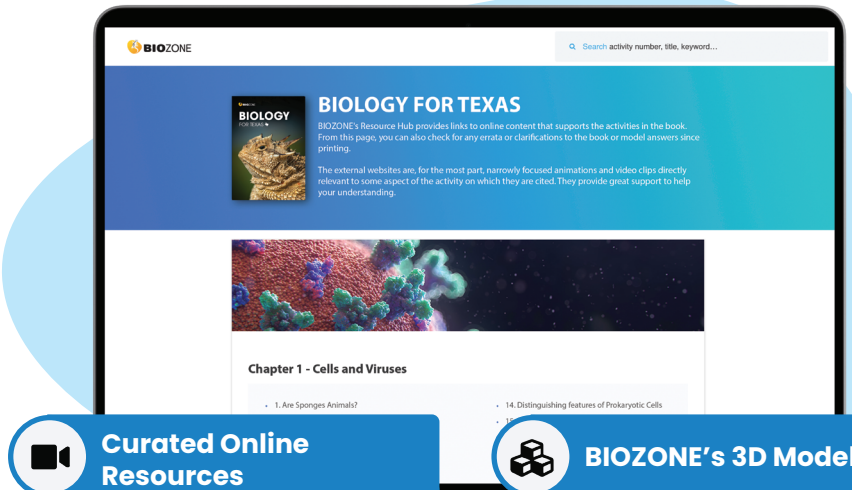
_____

2. Summarize how a disrupted carbon cycle is leading to ocean acidification: _____

B.13C (iii) A

_____

ISBN: 978-1-99-101405-4



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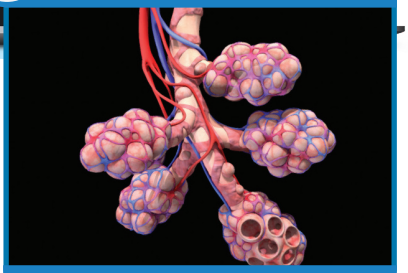

Interactive 3D models provide a fun way to engage students.

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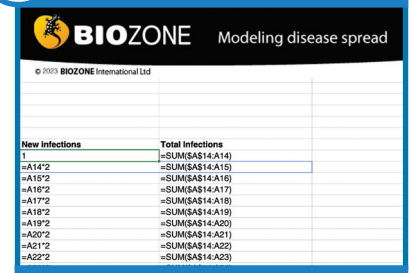

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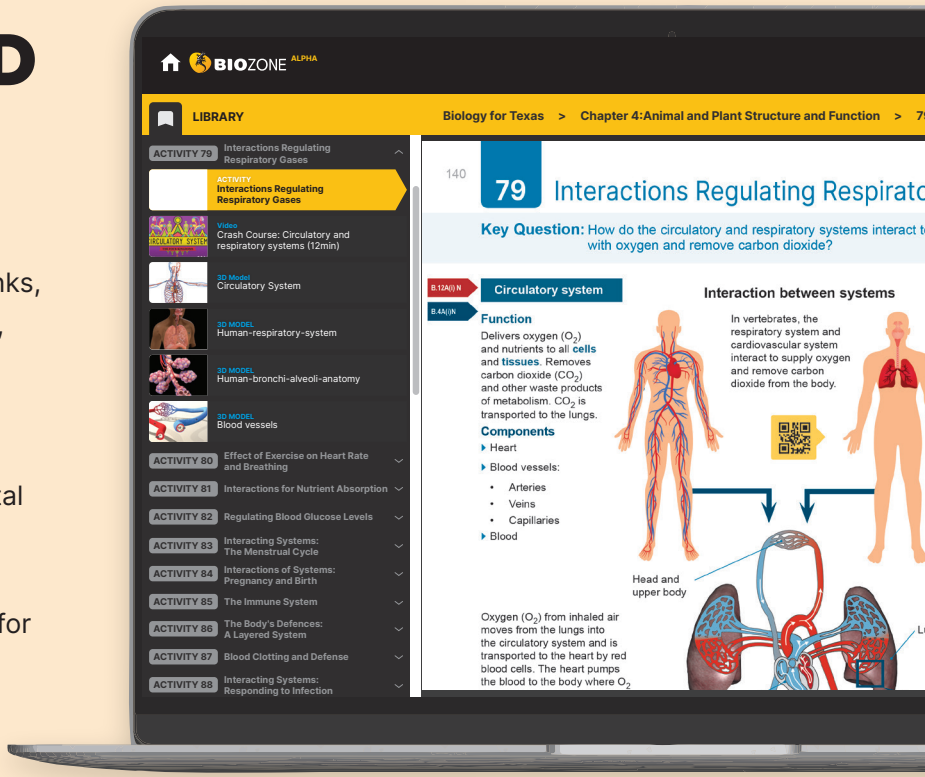

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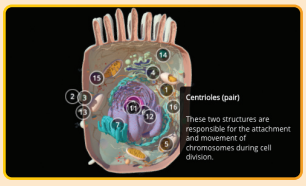

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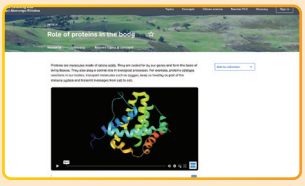

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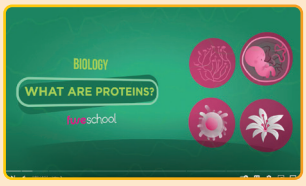

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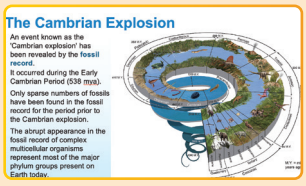

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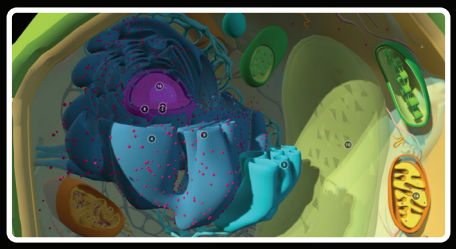

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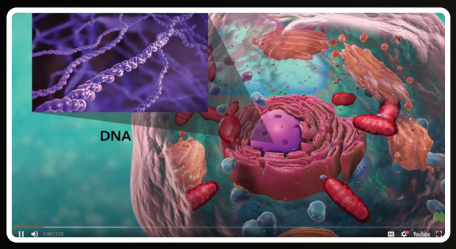

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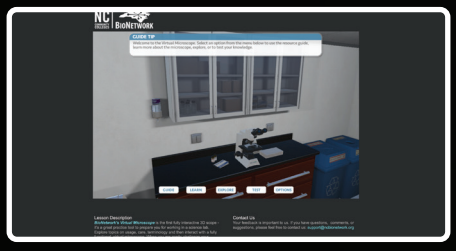

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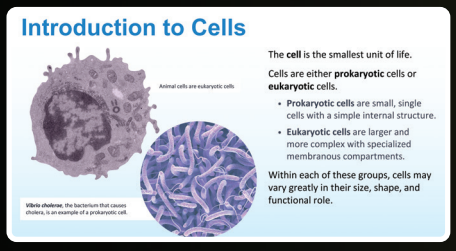

Presentation Slides

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