CLASSROOM GUIDE

BIOZONE

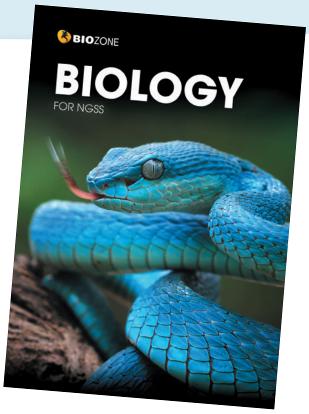
BIOLOGY

FOR NGSS

Contents

CLASSROOM GUIDE

FAQs ABOUT BIOLOGY FOR NGSS



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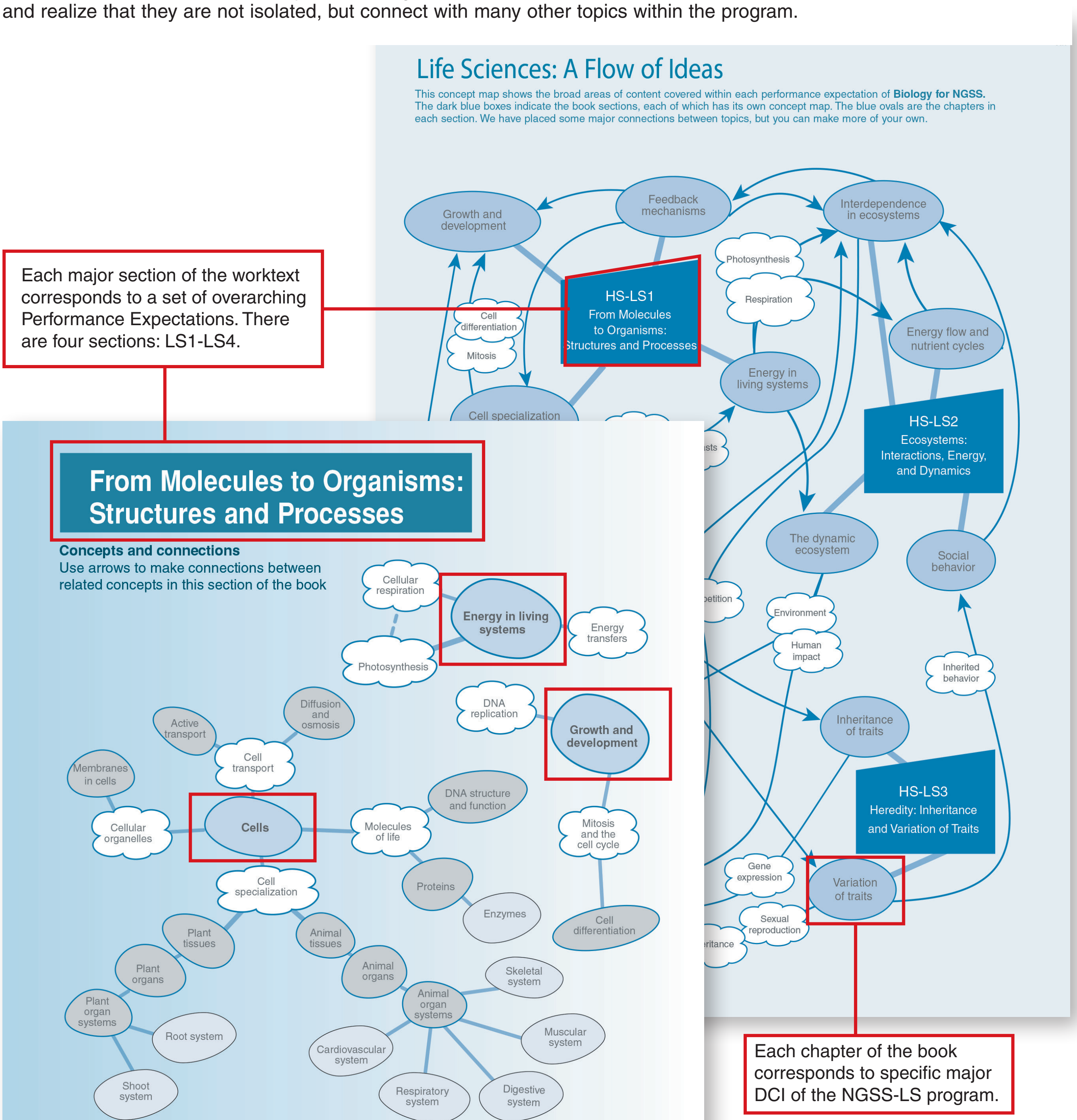
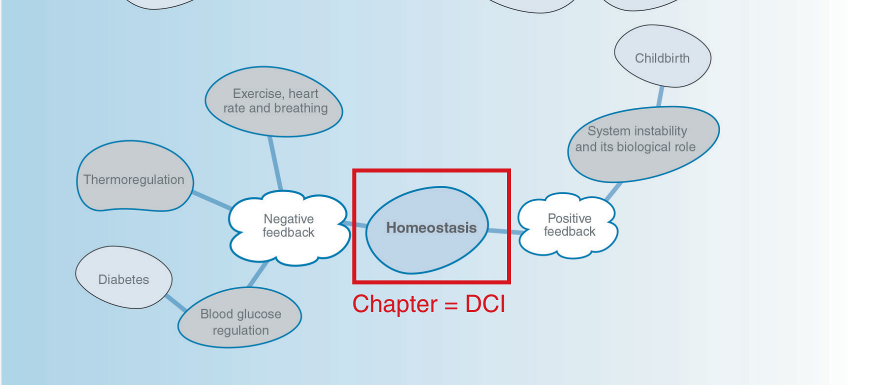
The Concept Maps

The concept maps in *Biology for NGSS* have two broad purposes: to provide a map of ideas covered in the program and to provide a vehicle for students to make their own connections between those ideas. They are particularly useful as graphic organizers for striving students and visual learners. The introductory map provides an overview of the structure of the *NGSS Life Sciences* program. Section concept maps divide the book into four parts, each providing a visual summary of one of four broad areas within the program, corresponding to LS1-LS4. Encourage students to draw their own connections between ideas on the concept maps as they work through the topics. This will help students to see the interrelatedness the topics, and realize that they are not isolated, but connect with many other topics within the program.





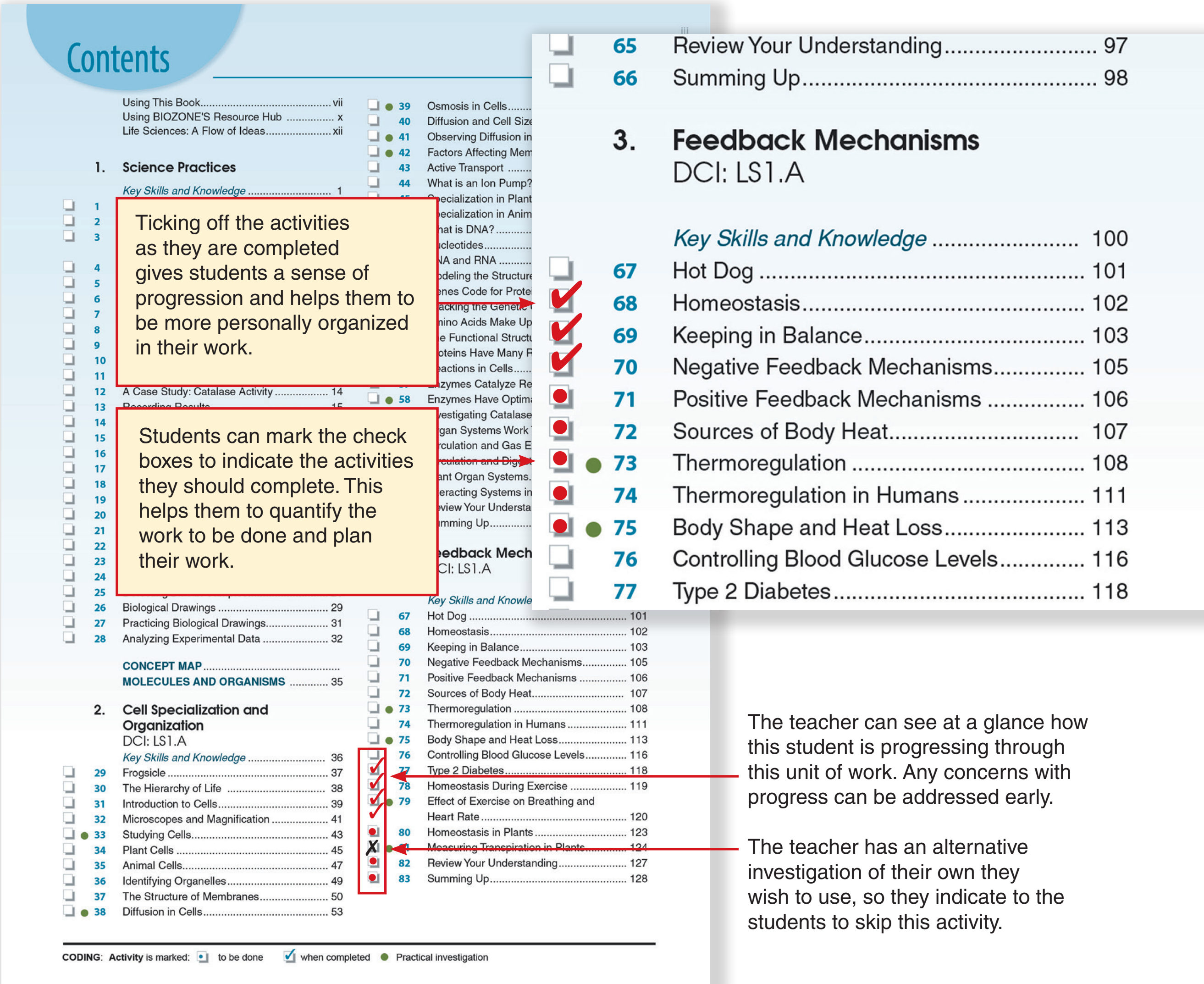
There is one concept map for the entire program (above) and one for each major collection of DCIs within a section (left).

Content coverage indicated in hierarchical order: chapter heading (blue ovals), main concepts (clouds), and related concepts (gray ovals).

Encourage your students to make their own connections between topics and annotate the map with their own ideas.

The Contents: A Planning Tool

The contents pages are not merely a list of the activities in the student edition. Encourage your students to use them as a planning tool for their program of work. Students can identify the activities they are to complete and then tick them off when completed. The teacher can also see at a glance how quickly the student is progressing through the assigned material.



Pacing Guide

A pacing guide is available for teachers to download from the Resource Hub for this title.

The 9-12 NGSS framework is fluid in terms of the grade in which each program is offered, so in many respects defies a rigid pacing guide. Within grade, other variables contribute to changes in pacing:

- There are opportunities for students to spend longer on some activities, e.g. in improving or refining their design solutions or in exploring simulations beyond the minimum. These elaborations will demand more time.
- The time allocated for investigations will depend on (1) how you choose to organize the class (which may be determined by available resources) and (2) how far students take the investigation. Adjust your lesson plan to incorporate more or less material as needed. You may have investigations you already like to use, so you could choose to leave out equivalent investigations in the book. To help you, activities including a practical investigation are identified with a green dot (●) in the contents of the student work text.
- For spreadsheet modeling activities, completed models are available on **BIOZONE's Resource Hub**. If you need to save time, students can use these spreadsheets instead of taking time to construct it themselves.
- The pace may quicken as students complete more of the book and become more familiar with the style and information flow. Students gain increasing levels of competence and learn valuable skills that enable them to arrive at solutions more quickly.
- Depending on the ability of your students, you may need to use the Science Practices chapter more often to help develop math and science practice skills. Have students carry out the activities as homework if you are short on time.

Identifying Learning Intentions and Goals

In developing *Biology for NGSS*, we have embraced the three dimensions of the NGSS framework, emphasizing the application of ideas and skills to new scenarios. The activities in *Biology for NGSS* have been specifically designed to address the **Disciplinary Core Ideas (DCIs), Science and Engineering Practices, and Crosscutting Concepts** in a way that helps students to meet specific **Performance Expectations**.

In the Teacher's Edition, all three dimensions are embedded in the chapter introduction and color coded for easy identification (below). The performance expectations are also identified. It is important to note that *this coding is a tool for the teacher and is not present in the Student Edition*.

This identifies the chapter number.

CHAPTER 7

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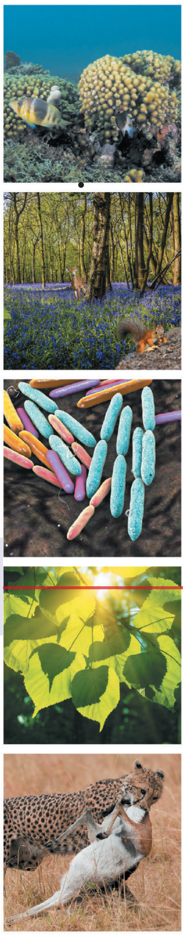
Energy Flow and Nutrient Cycles

Activity number



Anchoring Phenomenon

Eat or be Eaten: How did energy and matter move through prehistoric ecosystems? 136 155

Guiding questions
The guiding questions help students identify important questions in the chapter.

How do energy and matter move in ecosystems?

- ☐ 1 Understand how energy enters an ecosystem [CCC-5]. Use information from a mo… energy flow and cycling matter [SEP-2] to construct an argument [SEP-2] about the… of photosynthesis and respiration [LS2.B].
- ☐ 2 Use models of aerobic and anaerobic respiration [SEP-2] to compare and contrast… cycling of matter [LS2.B] [CCC-5] [HS-LS2-3]. Apply new information about nutrient… cycling in the context of a compost heap to explain the change in matter over time [SEP-6].
- ☐ 3 Define the role of a producer in an ecosystem. Use a model of photosynthesis [SEP-2] to develop ideas on energy flow [CCC-5] and importance of producers [LS2.B]. Define the role of a consumer in an ecosystem. Understand how groups of different consumers are classified. Use a schematic model [SEP-2] to compare the flow of energy and cycling of matter [CCC-5] in an ecosystem [LS2.B]. 139 140
- ☐ 4 Identify the trophic levels of a simple food chain [LS2.B]. Consider the limits of food chain links in light of energy transfer [SEP-1] [CCC-5]. Evaluate the model [SEP-2] of a simple food web and its application to real life. Construct a food web by combining food chains from given organisms [LS2.B]. 141 142 143

The activity in the book related to this question or statement.

- ☐ 5 Use information in models [SEP-2] on ecological energy inputs and outputs to exp… the difference between gross (GPP) and net primary production (NPP) [SEP-1] [L… [CCC-5]. Develop a simple word equation to describe the mathematical relationshi… [SEP-5] between NPP and GPP. Use a model of energy flow [SEP-2] [CCC-4] to calculate [SEP-5] energy transfer between levels [LS2.B] [CCC-5]. Quantify energy… transfer and trophic efficiency in an ecosystem [HS-LS2-4]. Calculate efficiency of energy movement [SEP-5] through different agricultural systems [CCC-4] [HS-LS2-4]. Use data to calculate and graph [SEP-4] NPP change in brassica plant growth [LS2.B].
- ☐ 6 Consider the benefits and advantages of using number, biomass, and energy pyramid models [SEP-2] to inform of the movement of matter and energy through an ecosystem [LS2.B] [CCC-5]. Convert a mathematical table of trophic level organism numbers into a pyramid of numbers model [SEP-5] [CCC-4] [HS-LS2-4]. Engage with a digital interactive to explore biomass pyramids in an aquatic ecosystem [SEP-2] [SEP-5] and construct explanations for observations seen [SEP-6] [LS2.B] [CCC-5]. 146 147

The relevant Science and Engineering Practices are indicated in **blue**.

How do water, oxygen, carbon, and nitrogen cycle through ecosystems?

- ☐ 7 Interpret a model [SEP-2] to construct an argument [SEP-7] on the importance of matter cycling through an ecosystem [LS2.B] [CCC-5]. Identify features of change [CCC-7] in a hydrological cycle model [SEP-2] that enable water to cycle through an ecosystem to provide matter used in photosynthesis and respiration [LS2.B]. 148 149
- ☐ 8 Using a model of the carbon cycle [SEP-2], understand the importance of photosynthesis as a process [LS2.B] [PS3.D] in converting carbon found in the atmosphere as carbon dioxide to carbon incorporated into organic molecules entering the food chain [CCC-4] [HS-LS2-5]. Investigate [SEP-3] the carbon cycle [CCC-5] using a "bottle ecosystem" model [SEP-2] considering how various factors may influence… observations [LS2.B] [CCC-2] [CCC-4] [HS-LS2-5]. 150 151

A red number indicates the summative assessment for this chapter, where an NGSS performance expectation is addressed.

- ☐ 9 Use a model of the oxygen cycle [SEP-2] to understand the relationship to the processes of photosynthesis and respiration [LS2.B]. Develop an explanation for th… interdependence of the oxygen and carbon cycles [SEP-6] [CCC-4] [CCC-5].
- ☐ 10 Analyse models [SEP-2] and data [SEP-4] of the relationship between photosynthe… and respiration in the carbon cycle to discuss how changes impact the system [LS… [PS3.D] [CCC-4].
- ☐ 11 Identify nitrogen compounds in a nitrogen cycle model [SEP-2] and then interpret to suggest how nitrogen is moved through the tropic levels [SEP-6] [LS2.B] [CCC-4]. 154
- ☐ 12 Process data [SEP-5] and compare energy efficiency in a corn field and pasture [SEP-4]. Calculate energy [SEP-5] and biomass transfers in real and experimental systems [LS2.B] [CCC-5] [HS-LS2-4]. 156

This identifies the DCI(s) to which this chapter applies.

Disciplinary Core Idea
LS2.B
PS3.D

The relevant Disciplinary Core Idea are indicated in **orange**.

The relevant Crosscutting Concepts are indicated in **green**.

The relevant Performance Expectation is indicated in **red**

Scaffolded Learning with the 5Es

In developing *Biology for NGSS* we have utilized the **5Es Instructional Model** as a basis for developing materials to address all three dimensions of the NGSS framework: Disciplinary Core Ideas (DCIs), Science and Engineering Practices, and Crosscutting Concepts. By successfully completing the activities, students can demonstrate competence in all three dimensions. This is central to meeting the performance expectations for *Biology for NGSS* with confidence.

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

The Five Es

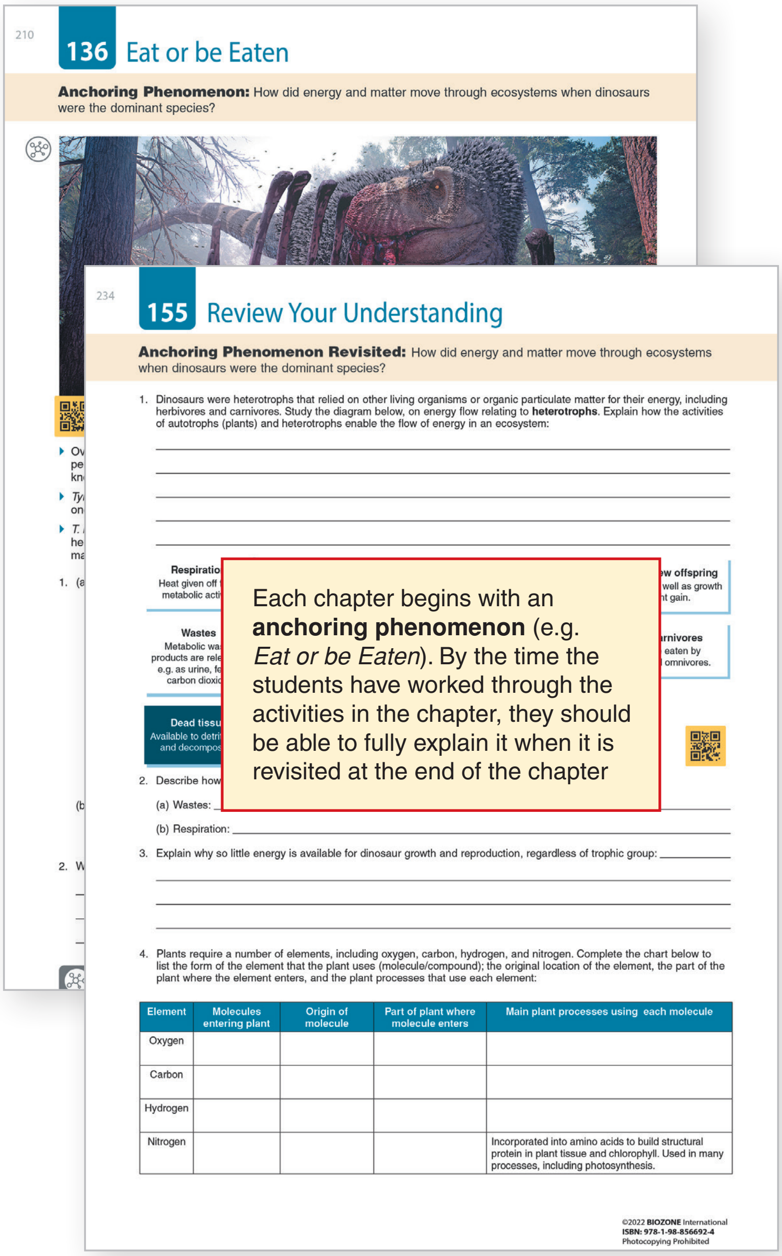
Engage:	make connections between past and present learning experiences.
Explore:	become actively involved in the activity.
Explain:	communicate the learning experience.
Elaborate:	expand on the concepts learned.
Evaluate:	assess understanding of the concepts.

BIOZONE's NGSS series is **phenomenon-based**. Students engage with phenomena through their own investigations and observations, through modeling and data analysis, and through collaborative work and discussion.

Using phenomena to drive inquiry promotes discussion and the sharing of ideas. The scaffold approach presents opportunities to look at phenomena from several different perspectives. This allows students of all abilities to expand their thinking and understanding, increasing understanding as they progress through the program.

Each chapter begins with an **anchoring phenomenon** (right). In each instance, we have chosen a phenomenon that the student may be familiar with, but which they cannot explain (or cannot explain fully). Teachers can use this activity to find out what the students already know (or think they know) before delving into the content more fully.

The subsequent activities in a chapter take the students, step by step, through phenomena that explore the ideas inherent in the anchoring phenomenon. By the time students revisit the anchoring phenomenon at the end of the chapter, they should be able to fully explain it.



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136 Eat or be Eaten

Anchoring Phenomenon: How did energy and matter move through ecosystems when dinosaurs were the dominant species?

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155 Review Your Understanding

Anchoring Phenomenon Revisited: How did energy and matter move through ecosystems when dinosaurs were the dominant species?

1. Dinosaurs were heterotrophs that relied on other living organisms or organic particulate matter for their energy, including herbivores and carnivores. Study the diagram below, on energy flow relating to **heterotrophs**. Explain how the activities of autotrophs (plants) and heterotrophs enable the flow of energy in an ecosystem:

Each chapter begins with an **anchoring phenomenon** (e.g. *Eat or be Eaten*). By the time the students have worked through the activities in the chapter, they should be able to fully explain it when it is revisited at the end of the chapter

2. Describe how
(a) Wastes:
(b) Respiration:

3. Explain why so little energy is available for dinosaur growth and reproduction, regardless of trophic group:

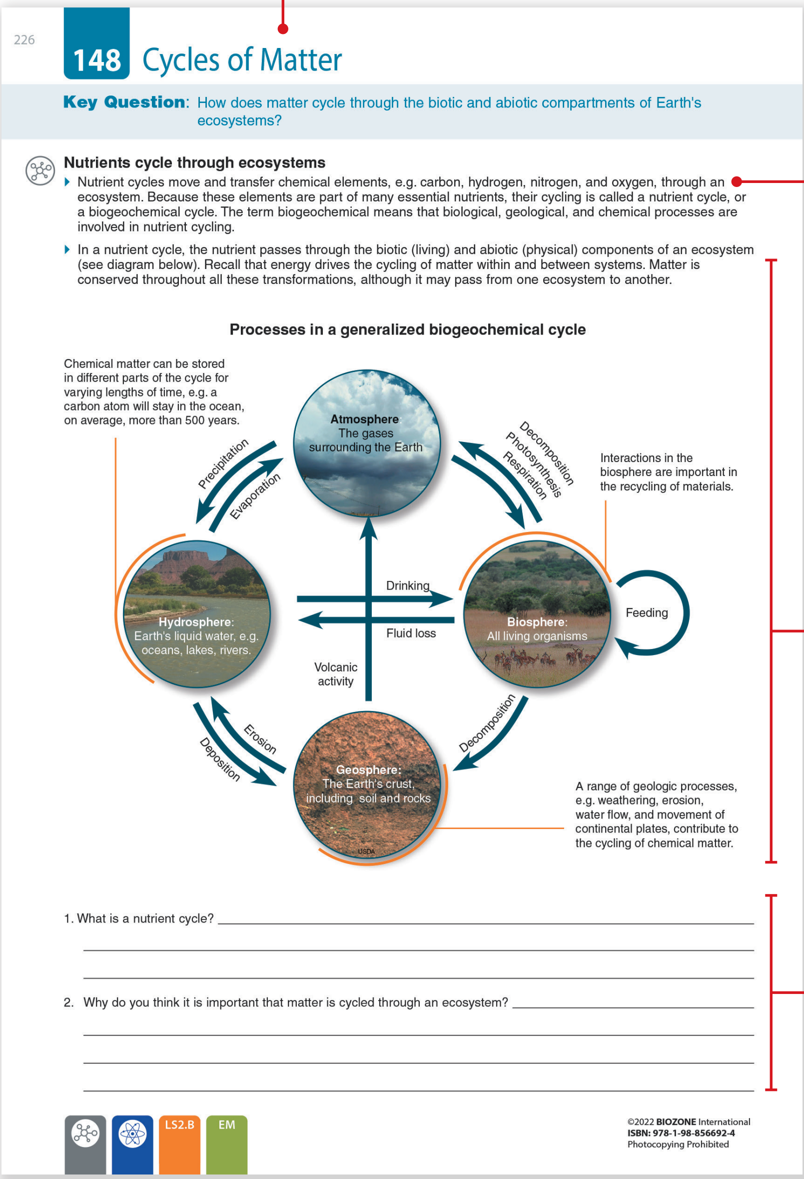
4. Plants require a number of elements, including oxygen, carbon, hydrogen, and nitrogen. Complete the chart below to list the form of the element that the plant uses (molecule/compound); the original location of the element, the part of the plant where the element enters, and the plant processes that use each element:

Element	Molecules entering plant	Origin of molecule	Part of plant where molecule enters	Main plant processes using each molecule
Oxygen				
Carbon				
Hydrogen				
Nitrogen				Incorporated into amino acids to build structural protein in plant tissue and chlorophyll. Used in many processes, including photosynthesis.

The content of the *Biology for NGSS* is organized into 14 chapters based on the DCIs of the High School Life Sciences framework. Chapter 1 addresses basic skills for students in life sciences. Chapters 2 - 14 each begin with an introduction outlining learning goals, which is immediately followed by the anchoring phenomenon. Activities make up the bulk of each chapter, with each one focusing on the student investigating and developing understanding of a phenomenon, applying that understanding to new scenarios, and developing (or practicing) a skill or essential science practice, such as graphing, data analysis, modeling, or evidence-based explanation.

Annotated diagrams and photographs are a major part of most activities, and the student's understanding of the information is evaluated through questions and/or tasks involving data handling and interpretation. Tabs at the bottom of the page identify Crosscutting Concepts, Science and Engineering Practices, and Disciplinary Core Ideas, as appropriate. Resource Hub tabs indicate if the activity is supported via **BIOZONE's Resource Hub**, which provides online teacher and student support for specific aspects of the activity.

Concepts are presented as a logical sequence, which may be divided among several consecutive activities. Understanding is developed progressively through exploration and explanation.



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148 Cycles of Matter

Key Question: How does matter cycle through the biotic and abiotic compartments of Earth's ecosystems?

Nutrients cycle through ecosystems

- Nutrient cycles move and transfer chemical elements, e.g. carbon, hydrogen, nitrogen, and oxygen, through an ecosystem. Because these elements are part of many essential nutrients, their cycling is called a nutrient cycle, or a biogeochemical cycle. The term biogeochemical means that biological, geological, and chemical processes are involved in nutrient cycling.
- In a nutrient cycle, the nutrient passes through the biotic (living) and abiotic (physical) components of an ecosystem (see diagram below). Recall that energy drives the cycling of matter within and between systems. Matter is conserved throughout all these transformations, although it may pass from one ecosystem to another.

Processes in a generalized biogeochemical cycle

1. What is a nutrient cycle? ______

2. Why do you think it is important that matter is cycled through an ecosystem? ______

LS2.B EM

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ENGAGE
The first activity in a related sequence is often an introductory type activity. It may begin with a brief task, observation, or example to engage student thinking.

Students are given enough information to complete the activity's questions or tasks.

Information to answer the questions is often on the page, but students may need to analyze data or information and draw conclusions to answer the questions. Sometimes students are asked to carry out their own research or investigation.

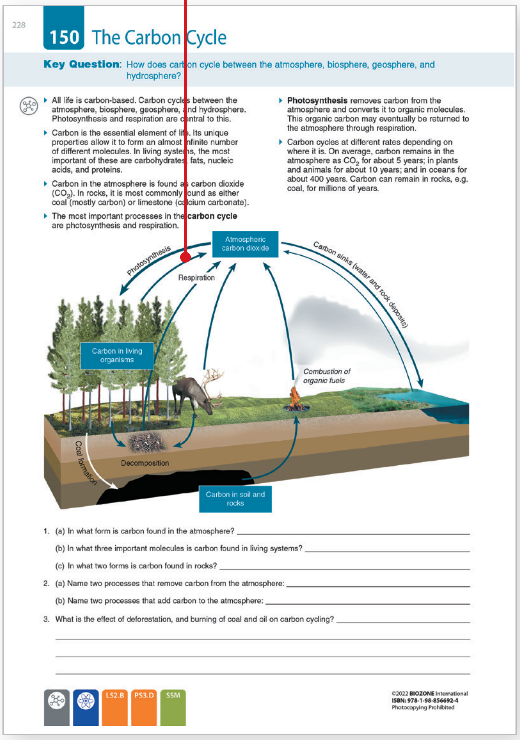
Questions allow students to demonstrate their understanding. By inputting their answers students form a record of work, allowing for easy revision in context with the stimulus information.

Relevant SEPs, DCIs, and CCCs are identified through the tab system.

This activity also has supporting resources on **BIOZONE's Resource Hub** assigned to it.

A related sequence of activities allow students to build a deeper understanding of their knowledge as they progress through the activity sequence. Students have already been introduced to biogeochemical cycles, and now begin to **EXPLORE** the carbon cycle.

Students may have many opportunities to explore through a variety of activities including practical investigations, creating models, analyzing or using second hand data, or interpreting diagrams. In this example, students have the opportunity to **EXPLORE** the carbon cycle through a simple practical investigation.



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150 The Carbon Cycle

Key Question: How does carbon cycle between the atmosphere, biosphere, geosphere, and hydrosphere?

- All life is carbon-based. Carbon cycles between the atmosphere, biosphere, geosphere, and hydrosphere. Photosynthesis and respiration are central to this.
- Carbon is the essential element of life. Its unique properties allow it to form an almost infinite number of different molecules. In living systems, the most important of these are carbohydrates, fats, nucleic acids, and proteins.
- Carbon in the atmosphere is found as carbon dioxide (CO_2). In rocks, it is most commonly found as either coal (mostly carbon) or limestone (calcium carbonate).
- The most important processes in the **carbon cycle** are photosynthesis and respiration.
- **Photosynthesis** removes carbon from the atmosphere and converts it to organic molecules. This organic carbon may eventually be returned to the atmosphere through respiration.
- Carbon cycles at different rates depending on where it is. On average, carbon remains in the atmosphere as CO_2 for about 5 years; in plants and animals for about 10 years; and in oceans for about 400 years. Carbon can remain in rocks, e.g. coal, for millions of years.

1. (a) In what form is carbon found in the atmosphere? ___
   (b) In what three important molecules is carbon found in living systems? ___
   (c) In what two forms is carbon found in rocks? ___
2. (a) Name two processes that remove carbon from the atmosphere: ___
   (b) Name two processes that add carbon to the atmosphere: ___
3. What is the effect of deforestation, and burning of coal and oil on carbon cycling? ___

LS2.B PS3.D SSM

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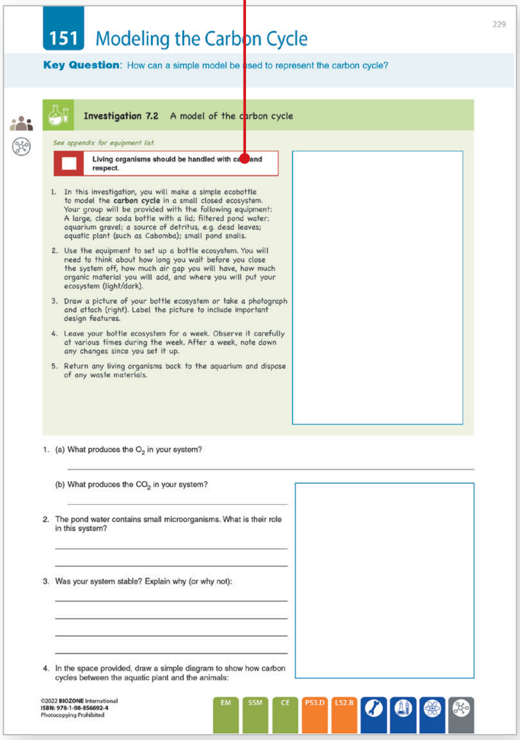

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151 Modeling the Carbon Cycle

Key Question: How can a simple model be used to represent the carbon cycle?

Investigation 7.2 A model of the carbon cycle

See appendix for equipment list.

Living organisms should be handled with care and respect.

1. In this investigation, you will make a simple ecobottle to model the **carbon cycle** in a small closed ecosystem. Your group will be provided with the following equipment: A large, clear soda bottle with a lid; filtered pond water; aquarium gravel; a source of detritus, e.g. dead leaves; aquatic plant (such as Cabomba); small pond snails.
2. Use the equipment to set up a bottle ecosystem. You will need to think about how long you wait before you close the system off, how much air gap you will have, how much organic material you will add, and where you will put your ecosystem (light/dark).
3. Draw a picture of your bottle ecosystem or take a photograph and attach (right). Label the picture to include important design features.
4. Leave your bottle ecosystem for a week. Observe it carefully at various times during the week. After a week, note down any changes since you set it up.
5. Return any living organisms back to the aquarium and dispose of any waste materials.

1. (a) What produces the O_2 in your system?
   (b) What produces the CO_2 in your system?
2. The pond water contains small microorganisms. What is their role in this system?
3. Was your system stable? Explain why (or why not):
4. In the space provided, draw a simple diagram to show how carbon cycles between the aquatic plant and the animals:

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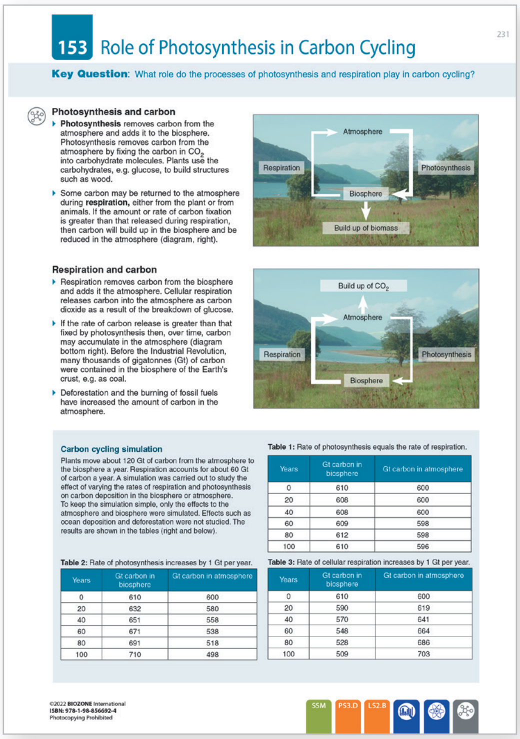
EM SSM CE PS3.D LS2.B

Students **EXPLAIN** phenomena by building on what they discovered through exploration. They are encouraged to use scientific principles and logical reasoning to construct explanations and devise solutions to the problems presented to them. After sound explanations of phenomena are developed, students have opportunity to **ELABORATE**, applying their understanding to new phenomena or using their experience to develop or refine engineering solutions to relevant problems. Where incorporated, **EVALUATE** sections can be used for formative assessment if you wish. In this example, students apply their knowledge of photosynthesis and cellular respiration (earlier chapter) to explain how they influence the carbon cycle.



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153 Role of Photosynthesis in Carbon Cycling

Key Question: What role do the processes of photosynthesis and respiration play in carbon cycling?

Photosynthesis and carbon

- **Photosynthesis** removes carbon from the atmosphere and adds it to the biosphere. Photosynthesis removes carbon from the atmosphere by fixing the carbon in CO_2 into carbohydrate molecules. Plants use the carbohydrates, e.g. glucose, to build structures such as wood.
- Some carbon may be returned to the atmosphere during **respiration,** either from the plant or from animals. If the amount or rate of carbon fixation is greater than that released during respiration, then carbon will build up in the biosphere and be reduced in the atmosphere (diagram, right).

Respiration and carbon

- Respiration removes carbon from the biosphere and adds it the atmosphere. Cellular respiration releases carbon into the atmosphere as carbon dioxide as a result of the breakdown of glucose.
- If the rate of carbon release is greater than that fixed by photosynthesis then, over time, carbon may accumulate in the atmosphere (diagram bottom right). Before the Industrial Revolution, many thousands of gigatonnes (Gt) of carbon were contained in the biosphere of the Earth's crust, e.g. as coal.
- Deforestation and the burning of fossil fuels have increased the amount of carbon in the atmosphere.

Carbon cycling simulation

Plants move about 120 Gt of carbon from the atmosphere to the biosphere a year. Respiration accounts for about 60 Gt of carbon a year. A simulation was carried out to study the effect of varying the rates of respiration and photosynthesis on carbon deposition in the biosphere or atmosphere. To keep the simulation simple, only the effects to the atmosphere and biosphere were simulated. Effects such as ocean deposition and deforestation were not studied. The results are shown in the tables (right and below).

Table 1: Rate of photosynthesis equals the rate of respiration.

Years	Gt carbon in biosphere	Gt carbon in atmosphere
0	610	600
20	608	600
40	608	600
60	609	598
80	612	598
100	610	596

Table 2: Rate of photosynthesis increases by 1 Gt per year.

Years	Gt carbon in biosphere	Gt carbon in atmosphere
0	610	600
20	632	580
40	651	558
60	671	538
80	691	518
100	710	498

Table 3: Rate of cellular respiration increases by 1 Gt per year.

Years	Gt carbon in biosphere	Gt carbon in atmosphere
0	610	600
20	590	619
40	570	641
60	548	664
80	528	686
100	509	703

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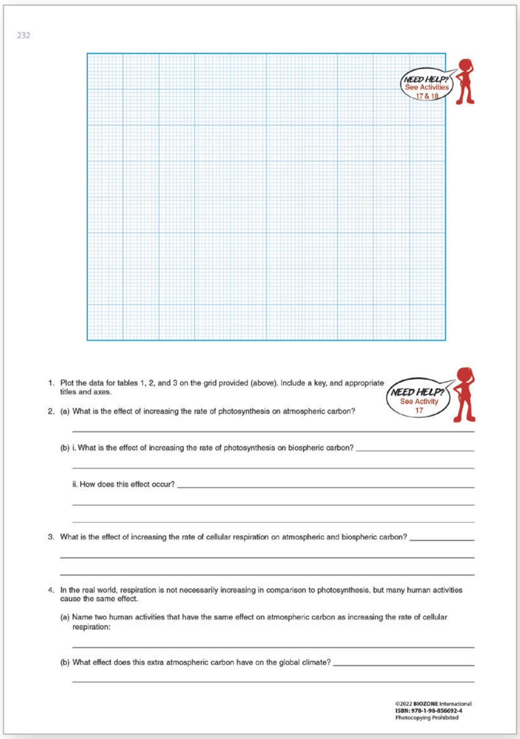
SSM PS3.D LS2.B



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1. Plot the data for tables 1, 2, and 3 on the grid provided (above). Include a key, and appropriate titles and axes.

2. (a) What is the effect of increasing the rate of photosynthesis on atmospheric carbon?
   (b) i. What is the effect of increasing the rate of photosynthesis on biospheric carbon? ___
   ii. How does this effect occur? ___
3. What is the effect of increasing the rate of cellular respiration on atmospheric and biospheric carbon? ___
4. In the real world, respiration is not necessarily increasing in comparison to photosynthesis, but many human activities cause the same effect.
   (a) Name two human activities that have the same effect on atmospheric carbon as increasing the rate of cellular respiration:
   (b) What effect does this extra atmospheric carbon have on the global climate? ___

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Practical Investigations

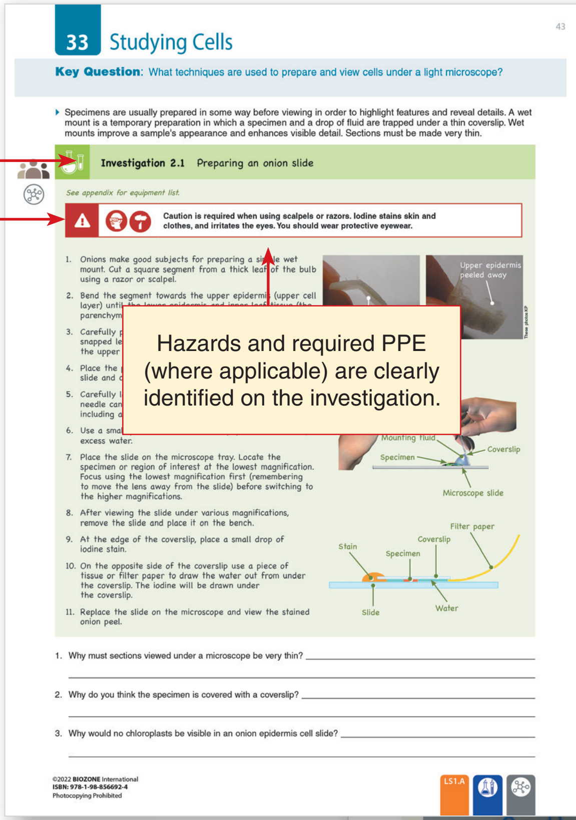
Throughout *Biology for NGSS*, students are given opportunities to explore phenomena through experimentation. These **investigative phenomena** are opportunities for students to develop competency in laboratory procedures, to practice and refine skills in observation and analysis, and to manipulate data. Some investigations act as stimulus material, while others require students to take what they have already learned and apply their knowledge to a more complex scenario.

The investigations provide an excellent opportunity for collaborative work and will stimulate discussion and the sharing of ideas. You may wish to pair students of different abilities together. Confident students can guide and encourage less able students and, in this relaxed environment, striving students will be encouraged to share their own observations and thoughts. Collaboration through paired practical work provides an excellent opportunity for English language learners to interact in meaningful ways to extend their English language and scientific vocabulary.

Each investigation is clearly numbered sequentially through the chapter.

The investigations provide students with health and safety information at the start of the investigation.

- Ensure your students read through the procedure fully *before beginning* the investigation.
- Highlight any hazardous or important steps, and make sure the students follow your directions.



33 Studying Cells

43

Key Question: What techniques are used to prepare and view cells under a light microscope?

- Specimens are usually prepared in some way before viewing in order to highlight features and reveal details. A wet mount is a temporary preparation in which a specimen and a drop of fluid are trapped under a thin coverslip. Wet mounts improve a sample's appearance and enhances visible detail. Sections must be made very thin.

Investigation 2.1 Preparing an onion slide

See appendix for equipment list.

Caution is required when using scalpels or razors. Iodine stains skin and clothes, and irritates the eyes. You should wear protective eyewear.

1. Onions make good subjects for preparing a si[…]le wet mount. Cut a square segment from a thick leaf of the bulb using a razor or scalpel.
2. Bend the segment towards the upper epidermi[…] (upper cell layer) unti[…] parenchym[…]
3. Carefully […] snapped le[…] the upper […]
4. Place the […] slide and […]
5. Carefully […] needle can[…] including […]
6. Use a smal[…] excess water.
7. Place the slide on the microscope tray. Locate the specimen or region of interest at the lowest magnification. Focus using the lowest magnification first (remembering to move the lens away from the slide) before switching to the higher magnifications.
8. After viewing the slide under various magnifications, remove the slide and place it on the bench.
9. At the edge of the coverslip, place a small drop of iodine stain.
10. On the opposite side of the coverslip use a piece of tissue or filter paper to draw the water out from under the coverslip. The iodine will be drawn under the coverslip.
11. Replace the slide on the microscope and view the stained onion peel.

1. Why must sections viewed under a microscope be very thin? ______
2. Why do you think the specimen is covered with a coverslip? ______
3. Why would no chloroplasts be visible in an onion epidermis cell slide? ______

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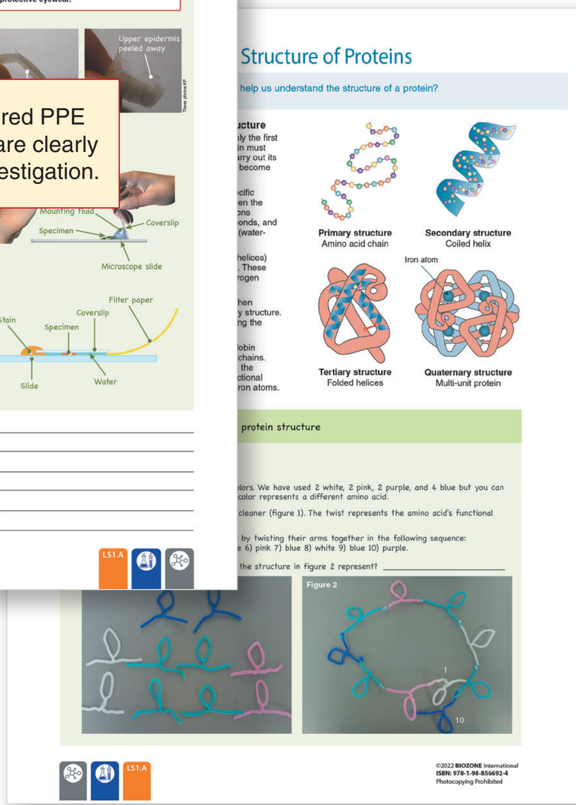
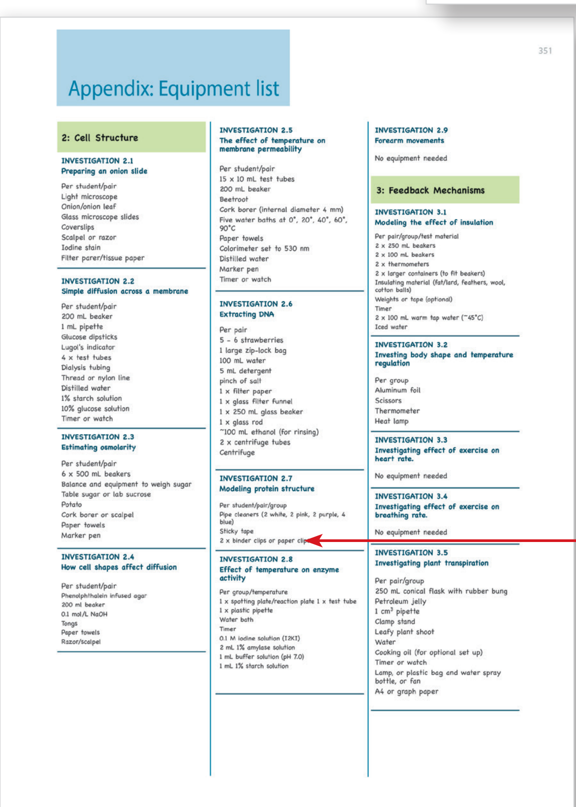
LS1.A

Hazards and required PPE (where applicable) are clearly identified on the investigation.



Structure of Proteins



Appendix: Equipment list

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2: Cell Structure

INVESTIGATION 2.1
Preparing an onion slide

Per student/pair
Light microscope
Onion/onion leaf
Glass microscope slides
Coverslips
Scalpel or razor
Iodine stain
Filter parer/tissue paper

INVESTIGATION 2.2
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 2.3
Estimating osmolarity

Per student/pair
6 x 500 mL beakers
Balance and equipment to weigh sugar
Table sugar or lab sucrose
Potato
Cork borer or scalpel
Paper towels
Marker pen

INVESTIGATION 2.4
How cell shapes affect diffusion

Per student/pair
Phenolphthalein infused agar
200 ml beaker
0.1 mol/L NaOH
Tongs
Paper towels
Razor/scalpel

INVESTIGATION 2.5
The effect of temperature on membrane permeability

Per student/pair
15 x 10 mL test tubes
200 mL beaker
Beetroot
Cork borer (internal diameter 4 mm)
Five water baths at 0°, 20°, 40°, 60°, 90°C
Paper towels
Colorimeter set to 530 nm
Distilled water
Marker pen
Timer or watch

INVESTIGATION 2.6
Extracting DNA

Per pair
5 - 6 strawberries
1 large zip-lock bag
100 mL water
5 mL detergent
pinch of salt
1 x filter paper
1 x glass filter funnel
1 x 250 mL glass beaker
1 x glass rod
~100 mL ethanol (for rinsing)
2 x centrifuge tubes
Centrifuge

INVESTIGATION 2.7
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

INVESTIGATION 2.8
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 (I2KI)
2 mL 1% amylase solution
1 mL buffer solution (pH 7.0)
1 mL 1% starch solution

INVESTIGATION 2.9
Forearm movements

No equipment needed

3: Feedback Mechanisms

INVESTIGATION 3.1
Modeling the effect of insulation

Per pair/group/test material
2 x 250 mL beakers
2 x 100 mL beakers
2 x thermometers
2 x larger containers (to fit beakers)
Insulating material (fat/lard, feathers, wool, cotton balls)
Weights or tape (optional)
Timer
2 x 100 mL warm tap water (~45°C)
Iced water

INVESTIGATION 3.2
Investing body shape and temperature regulation

Per group
Aluminum foil
Scissors
Thermometer
Heat lamp

INVESTIGATION 3.3
Investigating effect of exercise on heart rate.

No equipment needed

INVESTIGATION 3.4
Investigating effect of exercise on breathing rate.

No equipment needed

INVESTIGATION 3.5
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

No kits are required for the investigations.

The investigations have been designed using everyday materials and equipment easily found in most high school laboratories.

A list of the equipment and chemicals required for each investigation is provided in the appendix of the Student Edition.

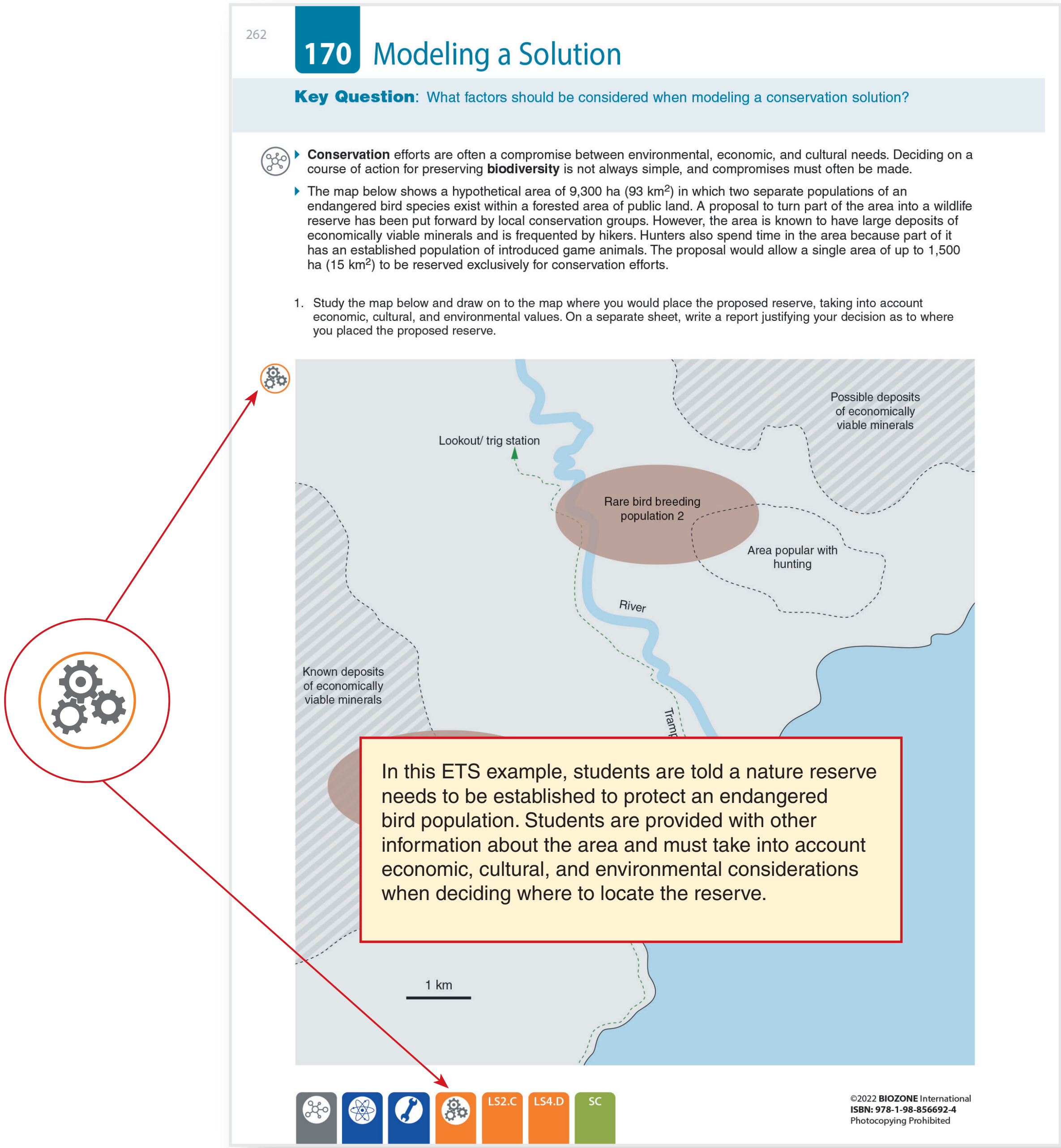
Engineering Design Solutions

At high school, students are expected to analyze major global issues and apply strategic thinking and problem solving to design possible solutions to a specific problem. Often, their solutions include taking into consideration scientific knowledge, the use of technology, and the impact of the solution on society.

Engineering Design (ETS) standards are indicated throughout the NGSS framework. They are incorporated into this title through the integration of engineering and design challenges, where appropriate. Typical Engineering Design tasks include analyzing problems, developing solutions using engineering, evaluating a design solution based on costs and benefits, or modeling a design solution. These activities provide students with a opportunity to apply their knowledge within a design challenge and think outside the box to come up with potential solutions.

The ETS components are indicated in the chapter introduction of the Teacher's Edition, and also in the summary tables in the Classroom Guide. They are also identified through the tab system on the activity itself (bottom of page and margin). Such tasks are usually examples of ELABORATE or EVALUATE as they involve the students applying what they have learned to solve a problem. As such, they also make good tasks for formative or summative assessment.

The ETS icon at the bottom of the page and in the margin identify when an ETS is covered.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170 Modeling a Solution

Key Question: What factors should be considered when modeling a conservation solution?

- **Conservation** efforts are often a compromise between environmental, economic, and cultural needs. Deciding on a course of action for preserving **biodiversity** is not always simple, and compromises must often be made.
- The map below shows a hypothetical area of 9,300 ha (93 km^2) in which two separate populations of an endangered bird species exist within a forested area of public land. A proposal to turn part of the area into a wildlife reserve has been put forward by local conservation groups. However, the area is known to have large deposits of economically viable minerals and is frequented by hikers. Hunters also spend time in the area because part of it has an established population of introduced game animals. The proposal would allow a single area of up to 1,500 ha (15 km^2) to be reserved exclusively for conservation efforts.

1. Study the map below and draw on to the map where you would place the proposed reserve, taking into account economic, cultural, and environmental values. On a separate sheet, write a report justifying your decision as to where you placed the proposed reserve.

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Evaluating Student Performance

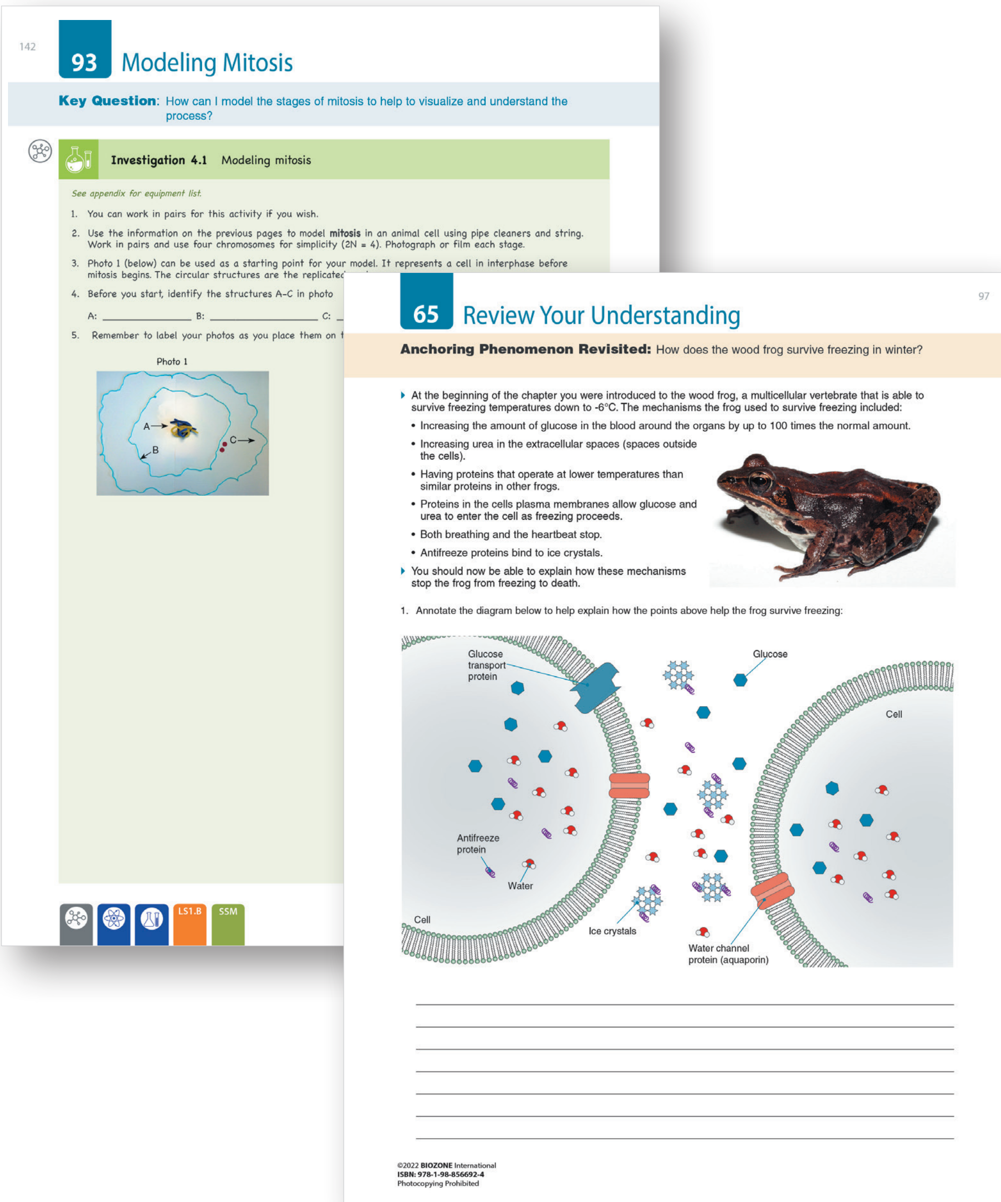
Biology for NGSS provides ample opportunity for students to demonstrate their understanding and proficiency in all three dimensions of the standards. Opportunities for both formative and summative assessment are provided.

Activities and assessments have been designed to be three-dimensional in their approach, with the goal of enabling achievement of specific performance expectations. Performance expectations (PE) are not always met through completion of one activity or assessment, but through completion of a connected suite of tasks (as intended by the framework).

Assessments involve a variety of tasks appropriate to a 3D approach, e.g., constructing models, analyzing and interpreting data, explaining, and communicating understanding through short and long answers, drawings, calculations, group work, design, and problem solving. The structure of the tasks is such that students use specific science and engineering practices and apply relevant crosscutting concepts to demonstrate their understanding of disciplinary core ideas.

FORMATIVE ASSESSMENT

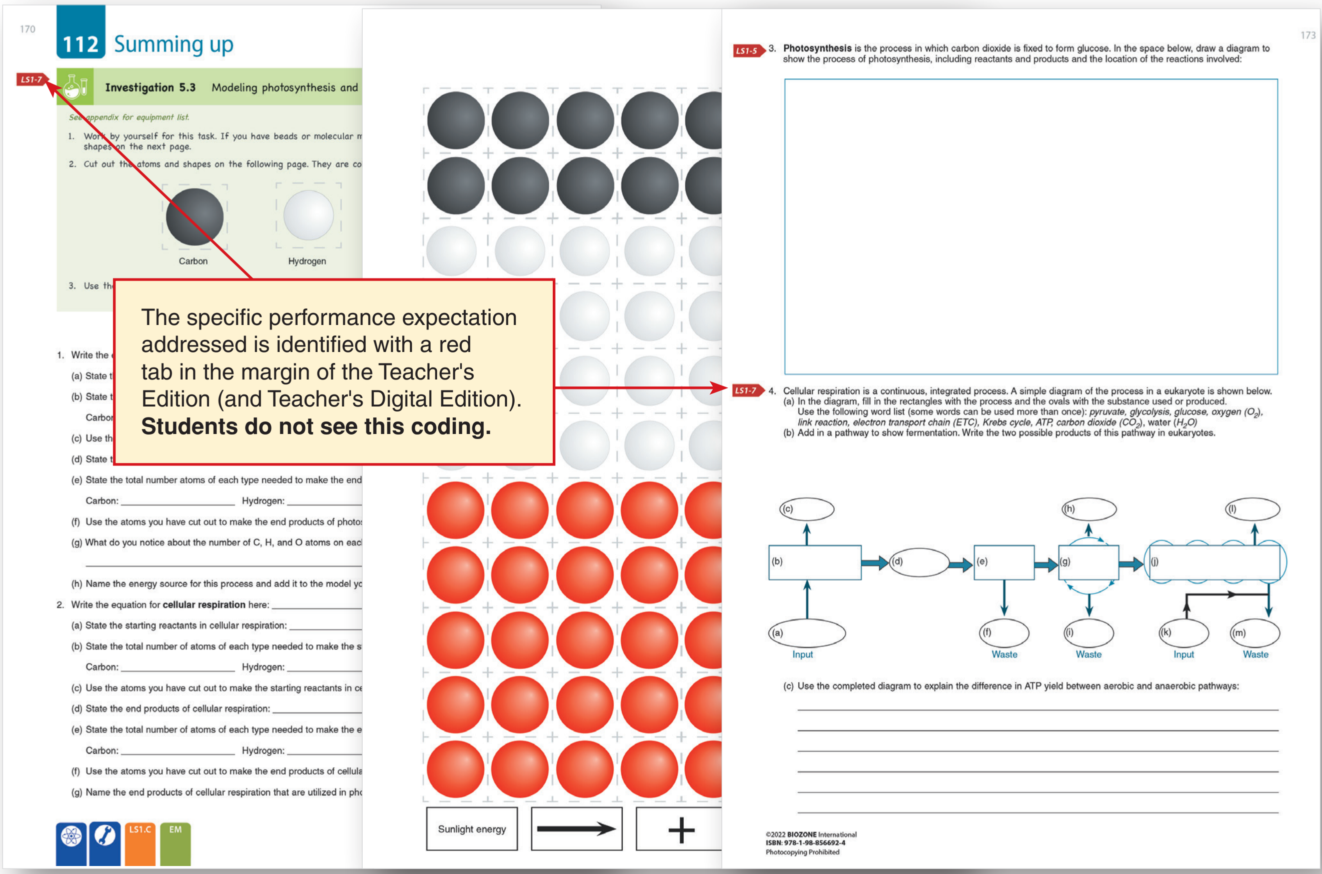
Formative assessments can be chosen by the teacher to determine how a student's knowledge is progressing within a selected topic. We suggest that 'ELABORATE' and 'EVALUATE' activities be used for formative assessment. These may incorporate some aspect of a performance expectation, with the goal being to build confidence. Teachers can revise their instruction, revisit material, or set further tasks if a student is having difficulty with the material. Revisiting the Anchoring Phenomenon (Review Your Understanding) near the end of each chapter also provides a way to evaluate student understanding.



SUMMATIVE ASSESSMENT

Summing up tasks at the close of each chapter can be used as a formal summative testing moment to evaluate student skills, understanding, and application of knowledge. These tasks are designed to meet part or all of one or more performance expectations. Material to address specific performance expectations is identified with a red tab in the margin throughout the Teacher's Edition. Performance expectations are also identified in the chapter introduction, and in the tables summarizing BIOZONE's 3D approach by chapter earlier in this guide.

Note: All coding associated with assessment is hidden from the student and is available only in teachers' materials.

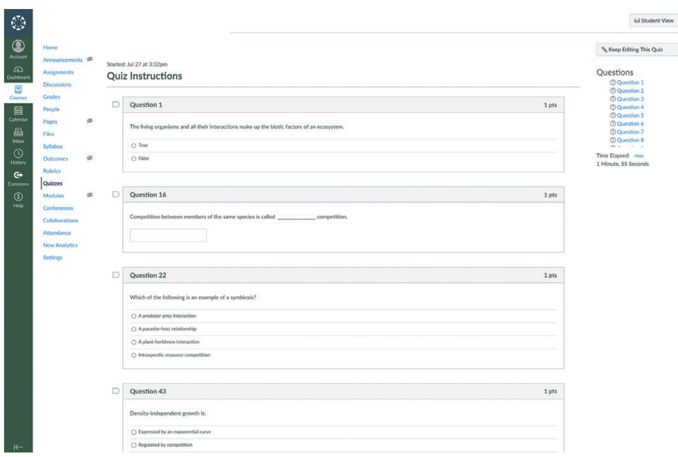


Summative assessments are three dimensional assessments of student understanding, including but not restricted to:

• Short answer questions • Long answer questions • Graphing • Data analysis and interpretation • Modeling

TEST BANKS

- BIOZONE provide test banks to test student understanding of the DCI content within each chapter.
- These test content knowledge, and take the form of:
  - Multiple choice
  - Modified True/False
  - Matching
  - Yes/No
  - True/False
  - Multiple response
  - Short answer
  - Numeric response
- Test bank questions are formatted for ingestion into test generator software such as ExamView.
- Questions can be edited and can be used in other formats such as Google forms, Quizlet, or Kahoot for variation.

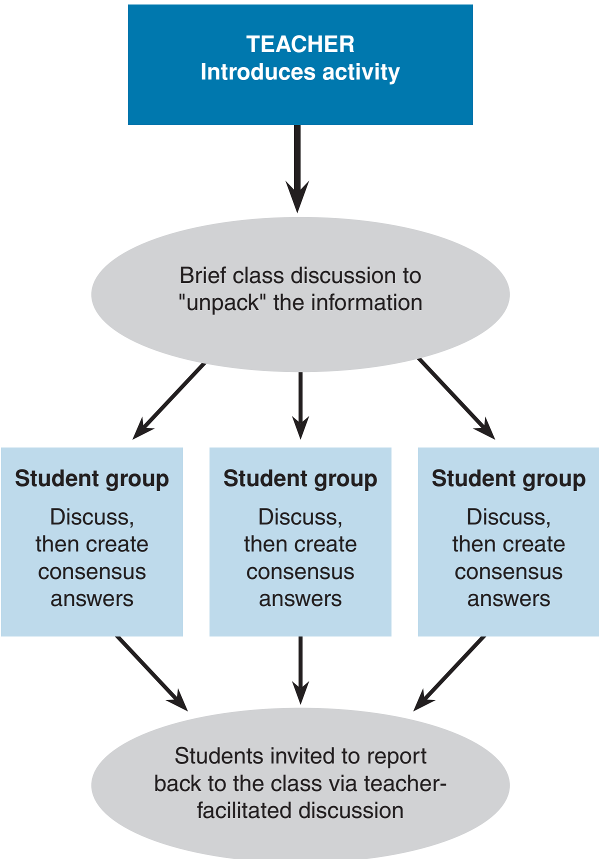


Teaching Strategies for Classroom Use

Achieving effective differential instruction in classes is a teaching challenge. Students naturally have mixed abilities, varying backgrounds in the subject, and different language skills. Used effectively, BIOZONE's student books and supporting resources can make teaching a mixed ability class easier. Here, we suggest some approaches for differential instruction.

MAKING A START

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



Using collaboration to maximize learning outcomes

- The structure of *Biology for NGSS* allows for a flexible approach to unpacking the content with your students.
- The content can be delivered in a way to support collaboration, where students work in small groups to share ideas and information to answer and gain a better understanding of a topic, or design a solution to a problem.
- By working together to ask questions and evaluate each other's ideas, students maximize their own and each other's learning opportunities. They are exposed to ideas and perspectives they may not have come up with on their own.
- Collaboration, listening to others, and voicing their own ideas is valuable for supporting English language learners and developing their English and scientific vocabularies.
- Use a short, informal collaborative learning session to encourage students to exchange ideas about the answer to a question. Alternatively, collaboration may take a more formal role that lasts for a longer period of time, e.g. assign groups to work together for a practical activity, to research an extension question, or design a solution to a problem.

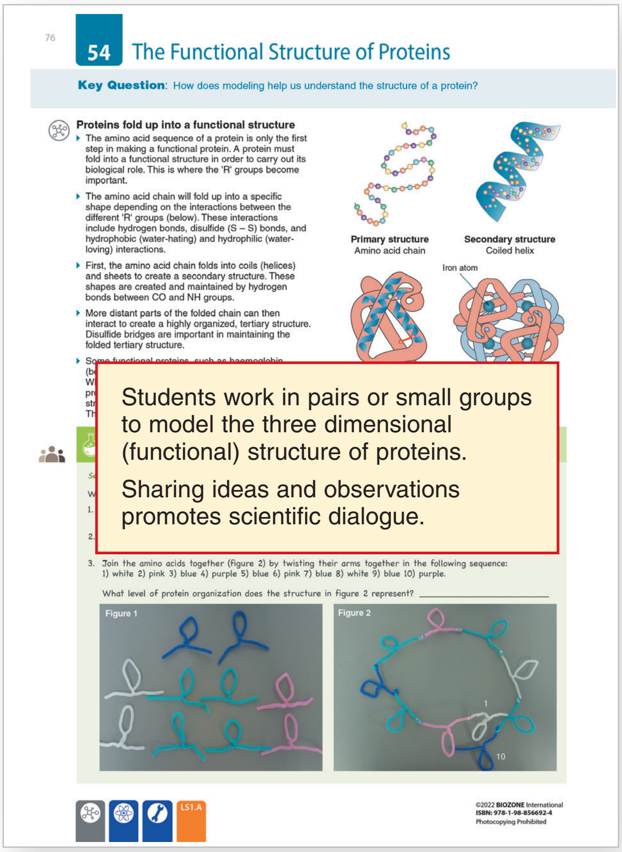
The teacher introduces the topic. They provide structure to the session by providing background information and setting up discussion points and clear objectives. Collaboration is emphasized to encourage participation from the entire group. If necessary, students in a group can be assigned specific tasks.

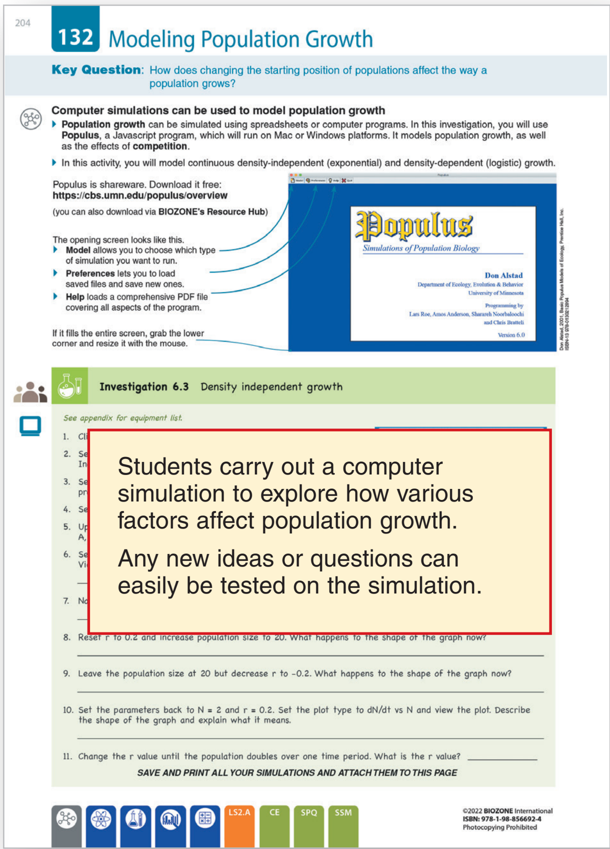
Students work in small groups so that everyone's contribution is heard. They collaborate, share ideas, and engage in discourse. The emphasis is on discussing questions and formulating a consensus answer, not just sharing ideas.

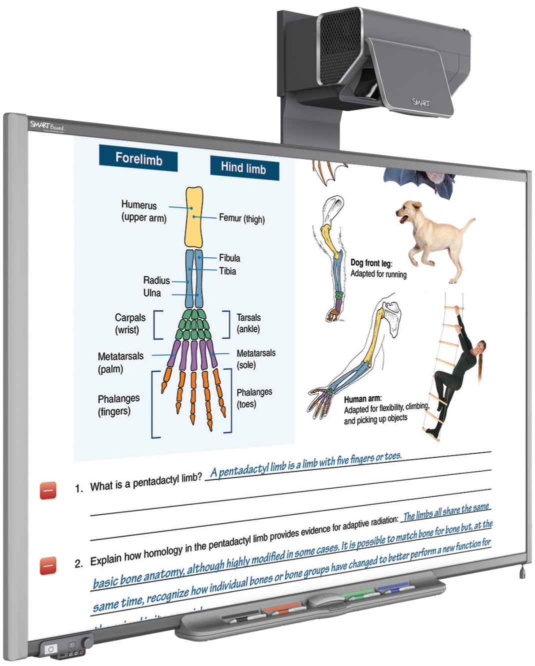
At the end of the session, students report back on their findings. Each student should have enough knowledge to report back on the group's findings. Reporting consists primarily of providing answers to questions, but may involve presenting a report, model, or slide show, or contributing to a debate.

Peer to peer support

- **Peer-to-peer learning** is emphasized throughout the book, and is particularly valuable for more challenging activities in which the content is more complex or the questions require students to draw on several areas of their knowledge to solve a problem.
- Stronger students can assist their peers and both groups benefit from verbalizing their ideas. Students for whom English is a second language can ask their classmates to explain unfamiliar terms and this benefits the understanding of both parties.
- **Practical investigations** are an ideal vehicle for peer-to-peer learning. Students can work together to review their results, ask and answer questions, and describe phenomena. There are also opportunities for students to collaborate using online simulations, e.g. modeling population growth, shown below.







Interactive revision of tasks in class

Review answers in class via BIOZONE WORLD
The teacher view in BIOZONE WORLD has model answers which can be toggled on and off using the show/hide buttons on an activity page.

View activities in BIOZONE WORLD on a shared screen and reveal the answers as required. This is ideal for:

- Providing a concise model answer after a group or class discussion.
- Self marking by students. Students can amend their answer if necessary, providing a powerful secondary learning moment.
- Providing a quick review of answers if time is short.

Students benefit from the feedback in class, where questions can be addressed, and teachers benefit by having students self-mark their work and receive helpful feedback on their responses.

This approach is particularly suited to activities with questions requiring a discussion, as students will be able to clarify some aspects of their responses. Stronger students can benefit by contributing to the explanatory feedback and class discussion.

NGSS for collaboration and discovery

- BIOZONE's *Biology for NGSS* provides multiple chances for collaboration and discovery. By working together and sharing ideas, students are exposed to different perspectives and levels of knowledge about phenomena.
- NGSS requires deeper student engagement, with less emphasis on facts and more on understanding. By exploring principles and concepts within a context, students are more easily able to apply these principles to new phenomena.
- BIOZONE's *Biology for NGSS* uses the NGSS framework to develop student understanding by providing a range of activities. These include encouraging students to think about and share what they already know and then build on this knowledge by exploring and explaining phenomena.

Student A is capable. He helps to lead the discussion and records the discussion in a structured way.

Students B and C are also capable but less willing to lead discussion. They will add ideas to the discussion but need a little direction from A to do so.

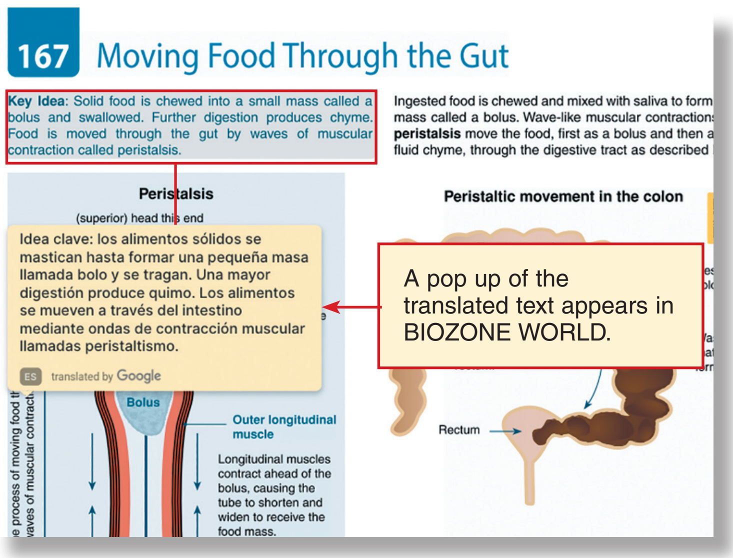
Student D is less able but gains ideas and understanding from the discussion of students A, B, and C. She may add to the discussion as she gains confidence in the material being studied.

How are English Language Learners Supported?

BIOZONE has several support mechanism in place to support English Language Learners (ELLs) in your classroom. In the printed books, a **glossary** of important key terms is provided in English and Spanish. In the digital platform, a **translation function** supports ELLs in their learning journey. More information on these features is provided below.


Appendix: English/Spanish Glossary

Each glossary term is first provided in English (black text) with the Spanish translation directly beneath (blue text).



Encourage all students to use the **glossary** to build scientific literacy and become comfortable with using the terms appropriately. The glossary is available in English and Spanish to support Spanish speakers to more easily learn key terms.

Key terms, which have been **bolded** within an activity, are included in the glossary. Key terms are only bolded the first time they appear within an activity.

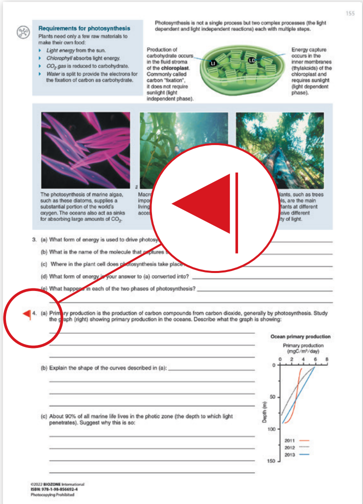
Translation function

BIOZONE WORLD, our digital platform, provides a translation feature to support to students who have English as a second language. The content can be translated into ~150 languages.

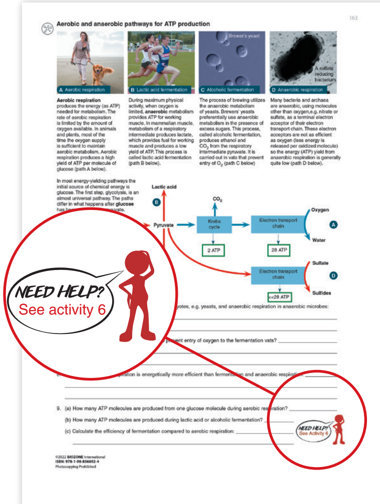
Simply activate the translation feature, select the language for translation, and roll the cursor over the text to be translated. A pop up box of the translated text appears on the page. The English text is still visible. Having both languages visible supports students with their English language development while having the reassurance of their first language accessible.

Differentiated Learning

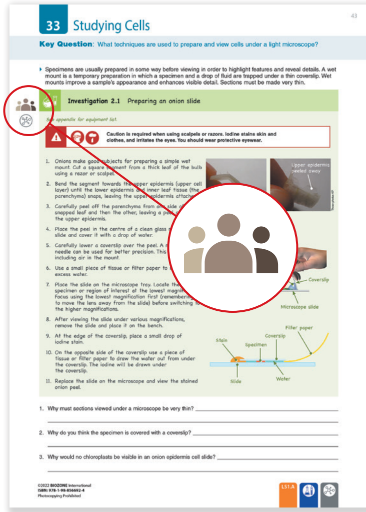
The structure of *Biology for NGSS* promotes differentiated instruction and has been designed to cater for students of all abilities. BIOZONE's collaborative approach to science inquiry encourages students of all abilities to share their ideas and knowledge with their peers, while at the same time broadening their own understanding of phenomena.
There are several ways you can use *Biology for NGSS* to implement differential instruction in your classroom:



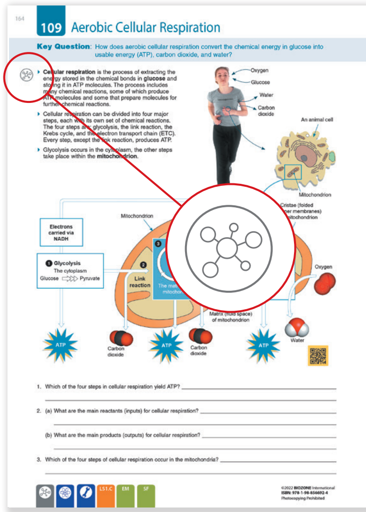
Extension Questions: **Red flag codes** beside a section or question (on the Teacher's Edition) indicate that students may need extra guidance from the teacher. These questions are also suitable as challenges for more able students to tackle on their own.



Need Help? Icon: The red NEED HELP? icon identifies where material is available in the Science Practices chapter to support a particular math or science practice skill. You can set these activities as homework as a refresher before the students attempt the activity needing the skill. Encourage students to refer to the Science Practices chapter often.



Collaboration Icon: A group symbol indicates where students can work together. Group work provides opportunities for student collaboration and peer-to-peer support to explore phenomena. Working in groups, students can experiences the benefits of collaboration in the scientific process of discovery. By speaking and listening to each other, communication skills and scientific vocabulary are extended.



Resource Hub: the **Resource Hub** supports learners of all abilities and also provides teacher support materials (CG18). Use the videos, games, and animations to help striving learners with their understanding of content. Some material is specifically tagged for gifted and talented students and for teachers.

Glossary: Glossaries have been provided to help improve scientific literacy. Encourage students to refer to the glossary whenever they are unsure about the meaning of a key term. Key terms are identified by **bold black text**. The glossary is provided in both English and Spanish (CG15).

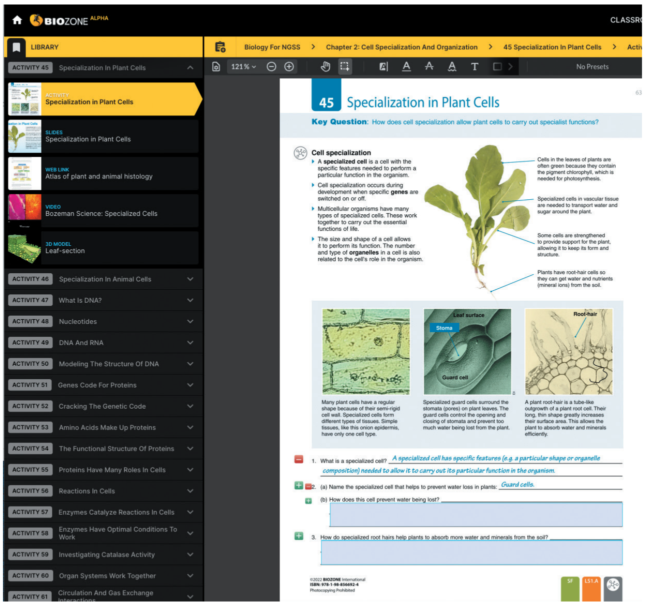
Challenge Question: Do you ever need an extra challenge for your more able students? The Teacher's Edition includes challenge questions. These are useful for extending gifted and talented students in particular (or any students keen to have go!). It can be downloaded from BIOZONE's **Resource Hub**, where it is the first link for each chapter.

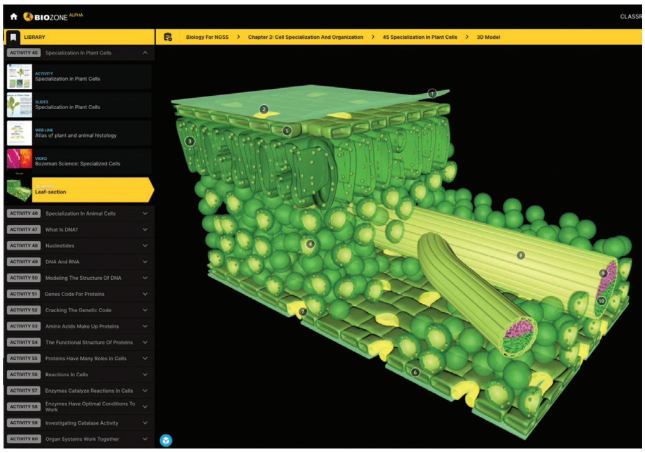
The Teacher Toolkit

BIOZONE's **Teacher Toolkit** is a suite of resources specifically developed to help you plan and deliver an engaging NGSS program. Additional assessment tools are provided, allowing teachers to easily assess student understanding. A brief description of the tools is provided below and in the following pages.

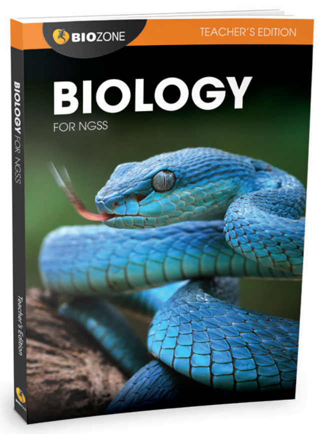
BIOZONE WORLD

- BIOZONE WORLD, our digital science platform, brings our digital worktexts and rich collection of digital resources together in a single location for easy use. Click on an activity to access the additional resources provided. These include: presentation slides, interactive 3D models, and curated videos and weblinks. Educators can easily plan lessons, assign work, and grade student responses using BIOZONE WORLD.
- Students' access to BIOZONE WORLD allows them to use tools to markup, highlight, and bookmark content. They can also answer questions online, and submit their work for review or grading. Students have access to the curated collection of digital resources (presentation slides, 3D models, and curated videos and weblinks).
- Teacher access to BIOZONE WORLD includes the features available to students plus teacher-only additional features, including:
    - Managing class student enrolments.
    - The ability to view, grade, and give feedback on submitted student work.
    - Forced hand-in feature.
    - Ability to display the content on a shared screen (e.g. interactive whiteboard) to introduce or review an activity, or highlight areas of particular importance, e.g. an important step in a practical investigation.
    - Model answers in place. Show/hide buttons toggle answers on and off; ideal for sharing data or answers with students.
      Students do not have access to model answers on BIOZONE WORLD.
- The translation tool within BIOZONE WORLD translates the content into over 150 languages.
- Find out more: biozone.com/us/biozone-world





TEACHER'S EDITION - PRINT



The *Biology for NGSS* Teacher's Edition is the teacher's companion to the student worktext. Use this resource to gain insight into the features of B*iology for NGSS* and how to use them in your planning, delivery, and assessment.

Features of the Teacher's Edition include:

- Suggested **model answers** in place for each activity.
- A **Classroom Guide** at the beginning of the Teacher's Edition provides a guide to the best use of BIOZONE's resources. It includes teacher notes (CG20), covers strategies for teaching in a differentiated classroom, information about the assessment tools, the benefits of collaborative learning, and supporting delivery of the three dimensions and Common Core State Standards. An overview of the Teacher Toolkit is also provided. Additional teacher coding identifies extension material, Common Core State Standards, and Performance Expectations. Long answers requiring more space than is allowed on the page are included at the back of the Teacher's Edition.

RESOURCE HUB

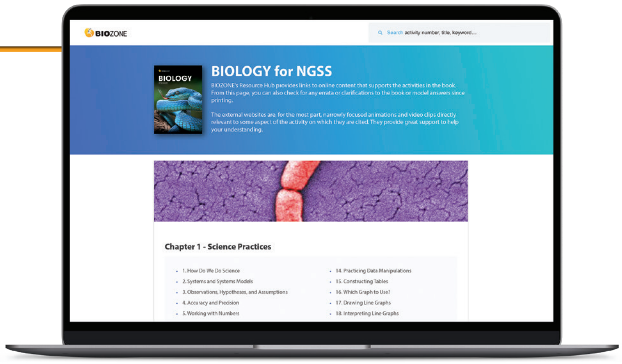
The BIOZONE **Resource Hub** is a **free resource**, available to both students and teachers. It offers a curated collection of Open Educational Resources (OER) specifically chosen to support the content of the worktext. Resources include videos, animations, games, 3D models, spreadsheets, and source material.

Content on the BIOZONE **Resource Hub** can be accessed by both print and digital users. **Print users** can access the material using the QR code in the worktext or bookmark the link provided (below right). For **BIOZONE WORLD users**, these same resources are ingested into the platform and automatically appear with the selected activity.

The BIOZONE **Resource Hub** is an effective tool to engage students of all abilities within a differentiated classroom. Most resources can be used by students of all abilities. 3D models, videos, games, and simulations are great tools for engaging students in a topic, or supporting striving students in their learning journey.

Some components have been tagged as extension material and can be used to extend more capable or gifted students. These types of resources may require more reading or synthesis of information. Our spreadsheet models can be used as is, or you can have students graph the information themselves. You may wish to challenge more capable students to build their own models, or manipulate the ones provided to observe the outcomes.

Some material is tagged as a teacher resource. Teacher resources often provide background or additional material to an activity. Capable students, or students with a particular interest in the topic can be assigned this material at your discretion.



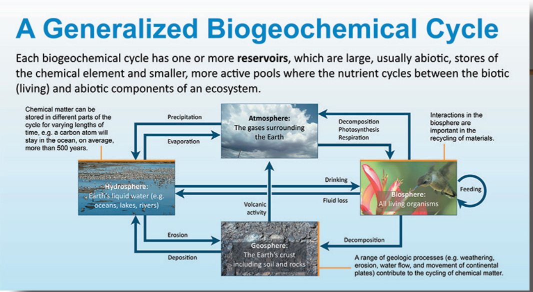
BIOZONE **Resource Hub** content is easily shared with your students through your LMS. You can provide notes and guidance about what you want students to do with the resource.
The BIOZONE **Resource Hub** can be accessed directly via the QR code below:

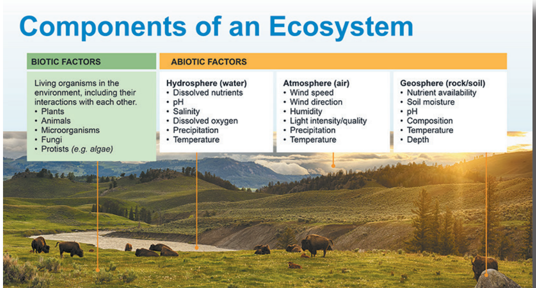
Or bookmark the following link:

www.BIOZONEhub.com

Then enter the code in the text field

NBI3-6924





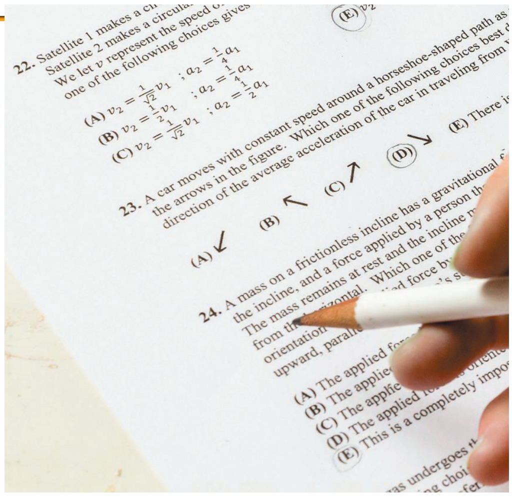
PRESENTATION SLIDES

Presentation Slides are a very popular way for teachers to deliver a lesson in a presentation style format. Presentation Slides are a useful delivery tool in both face to face or remote teaching.

The Presentation Slides are a sizeable collection of slides specifically designed to support and enhance the content of the worktext. A set of slides is available for each chapter of *Biology for NGSS*. In some instances, the slide sets contain extra material or examples not contained within the worktext, and are excellent for providing new scenarios for students to work on.

The Presentation Slides are fully ingested into BIOZONE WORLD and automatically appear with the selected activity.

TEST BANK AND QUESTION LIBRARY



Test bank content and access to the question library are complementary with multi-year purchases.

- BIOZONE's test bank content can be ingested into test generator software such as Illuminate and ExamView.

Assessments within *Biology for NGSS* have been designed, for the most part, to be fully three dimensional, to assess the Performance Expectations specified in the NGSS framework. However, we understand that a variety of assessment tools are useful within a differentiated classroom. A range of opportunities to test student understanding enables teachers to identify gaps and misconceptions and to be able to address these before a formal assessment moment.

BIOZONE's Test Bank Content has been specifically curated to test student understanding of the DCI content of the material. The test bank questions are not three dimensional; however, they complement the three dimensional assessments within the worktext.

A range of question types is available (CG16). The Test Bank Content is provided in QTI and RTF formats, providing teachers with flexibility in how they deliver and use the questions. Questions are fully editable, teachers can pick and mix questions from the entire suite of questions and edit the wording to customize the tests for individual classrooms.

- Encourage student participation by converting the questions into a Kahoot or Quizlet format. Students can work individually, in pairs, or small groups to learn and share ideas in a fun environment. Multiple choice and true/false questions are easily converted to Kahoot quizzes. Review the answers with the class for a quick refresher of key ideas and correct any commonly occurring misconceptions.
- Questions can be easily ingested into LMS in a number of formats, e.g. Google forms, or a Google or word document.
- Test Banks can be used to gauge student understanding at the end of activities, a set of related activities, or at the end of a chapter.

83 Growth and Development of Organisms

Questions

1. Briefly explain how multicellular organisms can develop from a single cell:
2. What two things must occur for a new cell to be produced?
3. Explain the role of mitosis in:
   (a) A developing embryo: ____________
   (b) An adult: ________________

117 Population Density and Distribution

Questions

1. (a) How would you express the population density of a terrestrial species?
   (b) How would you express the population density of an aquatic species?
2. Explain how the distribution and availability of resources might influence population density?
3. Explain how the behavior of a species might influence the population density:
4. What factors might influence the distribution of individuals in their environment?
5. What type of distribution pattern would you expect to see when:
   (a) Resources are not evenly spread out: ________________
   (b) Resources are evenly spread out: ________________
   (c) Animals are social: ________________
   (d) Animals are territorial: ________________
6. Why do you think random distributions are uncommon in nature?

The Question Library provides all of the questions from the Student Edition worktext in a format that can be ingested into a range of LMS or other digital delivery tools.

Questions within the worktext are generally scaffolded; easier questions are asked first, to build student confidence, and the questions may become more complex or difficult as students progress through an activity.

The Question Library content is **fully editable**, providing teachers with flexibility and control in assigning questions within a differentiated classroom. The questions can be customized to match a student's learning ability or reading level.

Teacher's Notes

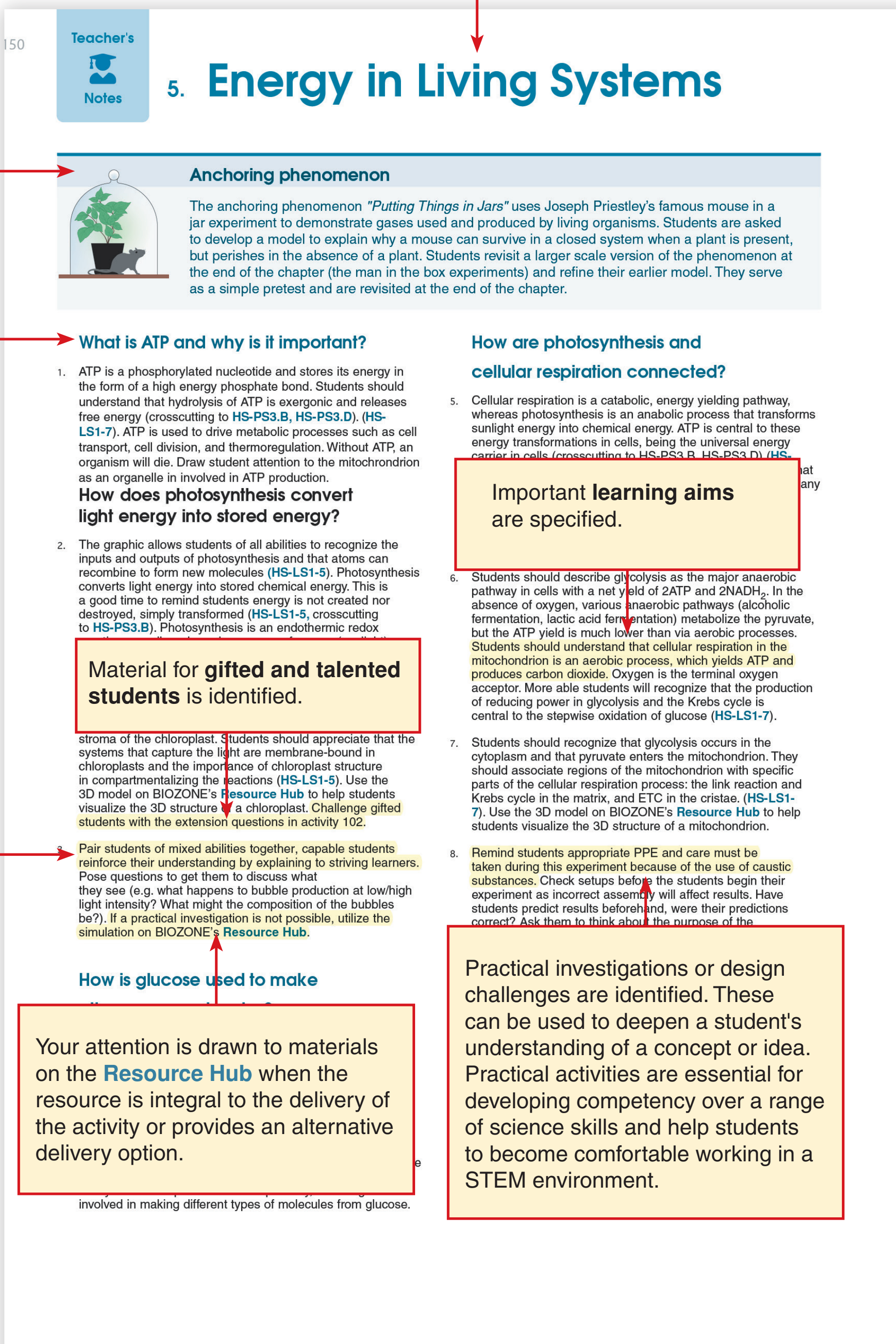
Extended teacher's notes are found at the front of each chapter in the Teacher's Edition of *Biology for NGSS*. These notes provide context for the material and additional detail for the learning points (matched point for point). Where appropriate, opportunities to incorporate group work, practical activities, or design challenges are explained. Suggestions for differentiated instruction are also provided, including ways to support striving learners, e.g. through peer-to-peer support.
Most activities are supported by material on **BIOZONE's Resource Hub**. The Resource Hub provides access to a large collection of free resources to supplement your teaching. They are identified with a hub icon in the margin of both the Student Edition and Teacher's Edition. Where the resource is integral to the delivery of the activity, e.g. online data sets, computer simulations, or spreadsheets, we have indicated this in the teacher's notes.

Chapter number and name

The **anchoring phenomenon** provides a context for the chapter. We have included some questions you may wish to ask your students to engage them in the topic, and ideas for student engagement.

The **guiding questions** and **numbering of learning aims** is the same as in each chapter introduction of the Student Edition and Teacher's Edition (learning aims are matched point for point).

Opportunities for **group work** are identified. They provide opportunities for collaboration and can be used to develop ELA/ELD skills such as speaking and listening, developing language, and research and presentation skills.



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Teacher's Notes

5. Energy in Living Systems

Anchoring phenomenon

The anchoring phenomenon *"Putting Things in Jars"* uses Joseph Priestley's famous mouse in a jar experiment to demonstrate gases used and produced by living organisms. Students are asked to develop a model to explain why a mouse can survive in a closed system when a plant is present, but perishes in the absence of a plant. Students revisit a larger scale version of the phenomenon at the end of the chapter (the man in the box experiments) and refine their earlier model. They serve as a simple pretest and are revisited at the end of the chapter.

What is ATP and why is it important?

1. ATP is a phosphorylated nucleotide and stores its energy in the form of a high energy phosphate bond. Students should understand that hydrolysis of ATP is exergonic and releases free energy (crosscutting to HS-PS3.B, HS-PS3.D). (HS-LS1-7). ATP is used to drive metabolic processes such as cell transport, cell division, and thermoregulation. Without ATP, an organism will die. Draw student attention to the mitochrondrion as an organelle in involved in ATP production.

How does photosynthesis convert light energy into stored energy?

2. The graphic allows students of all abilities to recognize the inputs and outputs of photosynthesis and that atoms can recombine to form new molecules (HS-LS1-5). Photosynthesis converts light energy into stored chemical energy. This is a good time to remind students energy is not created nor destroyed, simply transformed (HS-LS1-5, crosscutting to HS-PS3.B). Photosynthesis is an endothermic redox

Material for **gifted and talented students** is identified.

stroma of the chloroplast. Students should appreciate that the systems that capture the light are membrane-bound in chloroplasts and the importance of chloroplast structure in compartmentalizing the reactions (HS-LS1-5). Use the 3D model on BIOZONE's Resource Hub to help students visualize the 3D structure of a chloroplast. Challenge gifted students with the extension questions in activity 102.

3. Pair students of mixed abilities together, capable students reinforce their understanding by explaining to striving learners. Pose questions to get them to discuss what they see (e.g. what happens to bubble production at low/high light intensity? What might the composition of the bubbles be?). If a practical investigation is not possible, utilize the simulation on BIOZONE's Resource Hub.

How is glucose used to make

Your attention is drawn to materials on the **Resource Hub** when the resource is integral to the delivery of the activity or provides an alternative delivery option.

involved in making different types of molecules from glucose.

How are photosynthesis and cellular respiration connected?

5. Cellular respiration is a catabolic, energy yielding pathway, whereas photosynthesis is an anabolic process that transforms sunlight energy into chemical energy. ATP is central to these energy transformations in cells, being the universal energy carrier in cells (crosscutting to HS-PS3.B, HS-PS3.D) (HS-

Important **learning aims** are specified.

6. Students should describe glycolysis as the major anaerobic pathway in cells with a net yield of 2ATP and $2NADH_2$. In the absence of oxygen, various anaerobic pathways (alcoholic fermentation, lactic acid fermentation) metabolize the pyruvate, but the ATP yield is much lower than via aerobic processes. Students should understand that cellular respiration in the mitochondrion is an aerobic process, which yields ATP and produces carbon dioxide. Oxygen is the terminal oxygen acceptor. More able students will recognize that the production of reducing power in glycolysis and the Krebs cycle is central to the stepwise oxidation of glucose (HS-LS1-7).

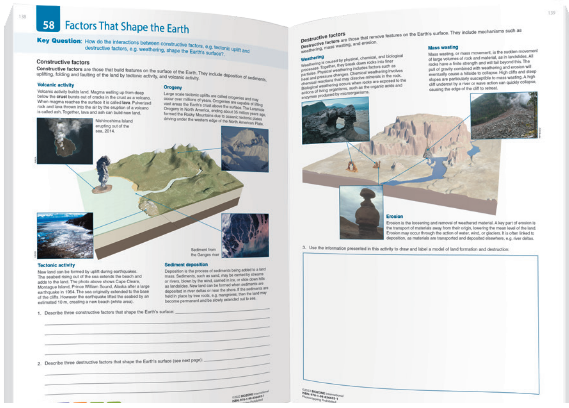
7. Students should recognize that glycolysis occurs in the cytoplasm and that pyruvate enters the mitochondrion. They should associate regions of the mitochondrion with specific parts of the cellular respiration process: the link reaction and Krebs cycle in the matrix, and ETC in the cristae. (HS-LS1-7). Use the 3D model on BIOZONE's Resource Hub to help students visualize the 3D structure of a mitochondrion.

8. Remind students appropriate PPE and care must be taken during this experiment because of the use of caustic substances. Check setups before the students begin their experiment as incorrect assembly will affect results. Have students predict results beforehand, were their predictions correct? Ask them to think about the purpose of the

Practical investigations or design challenges are identified. These can be used to deepen a student's understanding of a concept or idea. Practical activities are essential for developing competency over a range of science skills and help students to become comfortable working in a STEM environment.

BIOZONE's Pedagogy

A worktext approach



BIOZONE's delivery method is a departure from a traditional textbook. We combine the very best features of a textbook with the utility of a workbook, producing a worktext resource. Importantly, the worktext is owned by the student: it is their own resource to utilize. Whether they are using the print or digital version, students customize their worktext with notes and annotations, checking off their progress in the contents and chapter introductions, and input their answers on the pages as they work through the activities.

Using a highly graphical approach and short blocks of text, we deliver textbook quality information in an accessible and engaging way, ensuring students are not overwhelmed by large amounts of information. As students interact with the stimulus material and work through activities, they are encouraged to input their answers directly onto the page. This simple act reinforces the learning moment and forms a record of work as they progress through the material. Students find revision a breeze because the stimulus material, questions, and their answers are in one place.

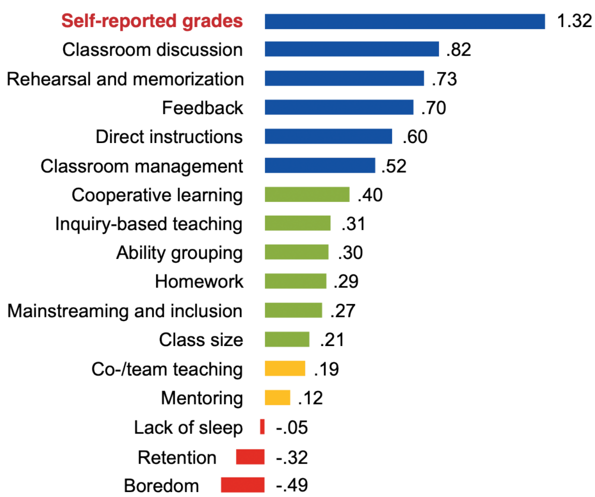
We have included a wide range of activity types in this title. These include practical activities (experimental investigations, modelling, and simulations), research activities, and assessment tasks. The variety of activity types provides flexibility in the way teachers can assign them. For example, work can be assigned to be carried out as homework, completed in class, or set for revision. Teachers can assign students to work on activities individually or set work as a group. The activity based approach simplifies assigning work, and teachers can utilize this approach to set work for substitute teachers in their absence

Not all answers need to be graded!

Within the activities, there are plenty of opportunities for students to record answers to the questions. This approach reinforces the learning moment, provides space for students to record their work, and acts as a revision tool when students are preparing for assessments. This approach does not mean that teachers are expected to review or grade all student responses. We suggest that only key activities or questions are graded. This might be assessment tasks a the end of each chapter or at the conclusion of a unit. You may also choose to grade activities with content that students have traditionally found challenging, or where there is often a misunderstanding of the topic. Teachers can also choose to share answers with students. Sharing the model answers allows students to self report grades: an exercise known to be a powerful pedagogical learning tool (Hattie(2009)). Having access to model answers also allows students to refine their initial response if needed. This provides a powerful second learning moment to consolidate and extend understanding.
Teachers can utilize the show/hide model answer feature in the digital platform to share answers.

Features to accelerate student learning

Student learning can be influenced by many factors. A synthesis of more than 1,400 meta studies by Hattie (2009) involving over 80,000 individual studies and 300 million students has revealed some of the major influences to student learning. Some factors negatively influence student learning (red, right) while others have positive effects (yellow, green, and blue, right). BIOZONE's approach incorporates many of the factors shown to positively influence student learning, these are underlined in red on the diagram (right). By utilizing *Biology for NGSS*, these factors are organically incorporated into content delivery and enhance the teacher and learner experience.



Hattie, J. (2009). Visible Learning. Routledge

Identifying CCCs and SEPs by Number

CROSSCUTTING CONCEPTS (CCCs)

CCCs are unifying ideas that apply across all disciplines of science. A CCC connects topics where the same unifying concept underpins the content. A statement for each numbered CCC is provided below. CCCs are identified by number in the tables following and in the embedded coding in the chapter introductions (Teacher's Edition). Statements are paraphrased.

1: Patterns
In grades 9-12, students observe patterns in systems at different scales and cite patterns as evidence for causality in supporting explanations of phenomena. They recognize that classifications or explanations at one scale may need revision using a different scale, thus requiring improved investigations and experiments. They identify and analyze patterns, and use analysis to re engineer and improve designed systems.

2: Cause and effect
In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlations and to make claims about cause and effect. They suggest cause and effect relationships to explain and predict behaviors in natural and designed systems. They also propose causal relationships by examining what is known about smaller-scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

3: Scale, proportion, and quantity
In grades 9-12, students understand that the significance of a phenomenon depends on the scale, proportion, and quantity at which it occurs. They recognize that patterns observable at one scale many not be observable or exist at other scales and that some systems can only be studied indirectly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another.

4: Systems and system models
In grades 9-12, students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize why these predictions have limited precision and reliability. They also design systems to do specific tasks.

5: Energy and matter
In grades 9-12, students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed, only transferred and transformed. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

6: Structure and function
In grades 9-12, students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal a system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their structure, the way their components are shaped and used, and the molecular substructures of their various materials.

7: Stability and change
In grades 9-12, students understand that much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over short or very periods of time. They see that some changes are irreversible and that negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize that systems can be designed for more or less stability.

SCIENCE & ENGINEERING PRACTICES (SEPs)

SEPs for NGSS are overlapping and interconnected practices that students should know and understand. A statement for each numbered SEP is provided below. SEPs are identified by number in the tables following and in the embedded coding in the chapter introductions (Teacher's Edition).

1: Asking questions and defining problems
"Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations."

2: Developing and using models
"Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s)."

3: Planning and carrying out investigations
"Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual mathematical, physical, and empirical models".

4: Analzying and interpreting data
"Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data."

5: Using mathematics and computational thinking
"Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and non-linear functions, including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simulations are created and used based on mathematical models of basic assumptions."

6: Constructing explanations and designing solutions
"Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories".

7: Engaging in argument from evidence
"Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science."

8: Obtaining, evaluating, and communicating information
"Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs."

Summary of BIOZONE's 3D Approach By Chapter

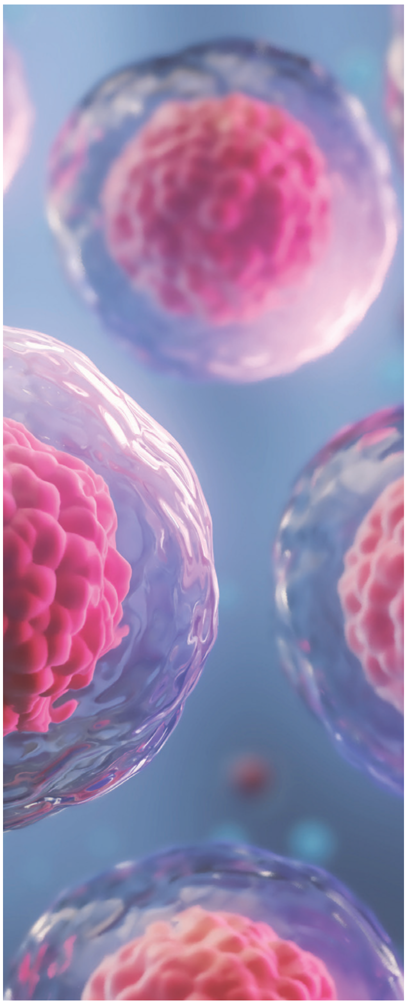
Science and Engineering Practices (SEPs), Crosscutting Concepts (CCCs), Disciplinary Core Ideas (DCIs), and Performance Expectations (PEs) for each chapter of *Biology for NGSS* are listed in the tables following. An introductory "Science Practices" chapter is also included. Performance Expectations are met within the chapter and/or the *Summing Up* activity.

1: SCIENCE PRACTICES

Activity	SEP	DCI	CCC	PE
1	1, 8	NA	4	NA
2	2	NA	4	NA
3	1	NA		NA
4-8	5	NA		NA
9	3,5	NA		NA
10-13	3	NA		NA
14	5	NA		NA
15-17	4	NA		NA
18	5	NA	1	NA
19	4	NA		NA
20	4,6	NA	2	NA
21-22	4	NA		NA
23-25	4,5	NA		NA
26-27	2	NA	4	NA
28	4,5,6,7	NA		NA

2: CELL SPECIALIZATION AND ORGANIZATION

Activity	SEP	DCI	CCC	PE
30	2	LS1.A		
32	3	LS1.A		
33	3	LS1.A	1	
34-35	2	LS1.A	6	
36		LS1.A	6	
37	2	LS1.A	4,6	
38	3,4,6	LS1.A	6	
39	3,4,5,6	LS1.A	6	
40	5	LS1.A	6	
41	3,4,6	LS1.A		
42	3,5,6	LS1.A		
44-46		LS1.A	6	
47	3,6	LS1.A		
48-49		LS1.A	6	
50	2	LS1.A	4,6	
51	2	LS1.A	6	
52	2,6	LS1.A	6	
53		LS1.A	6	
54	2,6	LS1.A		
55	2	LS1.A	6	
57		LS1.A	6	
58	3,4,6	LS1.A		
59	3,5,7	LS1.A	4	
60-64	2	LS1.A		
66		LS1.A		HS-LS1-1, HS-LS1-2



3: FEEDBACK MECHANISMS

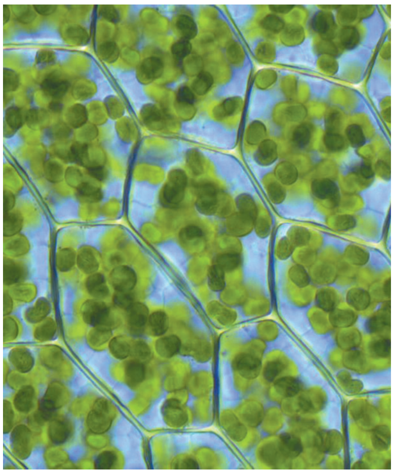
Activity	SEP	DCI	CCC	PE
68-69	2	LS1.A	7	
70	2,4	LS1.A	7	
71		LS1.A	7	
72		LS1.A	5	
73	2,3,4	LS1.A	5	
74	2	LS1.A	7	
75	1,2,3,4,5	LS1.A	5,7	
76-77		LS1.A	7	
78	4,5	LS1.A	7	
79	3,4,5,8	LS1.A	7	HS-LS1-3
80	2	LS1.A	7	
81	2,3,4,5	LS1.A	7	

4: GROWTH AND DEVELOPMENT

Activity	SEP	DCI	CCC	PE
85		LS1.B		
86-87	2	LS1.B	4	
88	2,8	LS1.B	4	
89		LS1.B		
90	2	LS1.B	4	
91-92	2	LS1.B	4	HS-LS1-4
93	2,3	LS1.B	4	HS-LS1-4
94	2	LS1.B	4	
95	2	LS1.B	6	
96		LS1.B	6	
98		LS1.B		HS-LS1-4

5: ENERGY IN LIVING SYSTEMS

Activity	SEP	DCI	CCC	PE
100	5	LS1.C	5,6	
101-102	2	LS1.C	5	
103	1	LS1.C	5,6	
104	2	LS1.C	5,6	HS-LS1-5
105	3,4	LS1.C	5	
106	6	LS1.C	5	HS-LS1-6
107	2	LS1.C	5	HS-LS1-5
108	2,6	LS1.C	5	HS-LS1-7
109	2,6	LS1.C	5,6	HS-LS1-7
110	3,4,6	LS1.C	5	
112	2,6	LS1.C		HS-LS1-5, HS-LS1-7


Kristian Peters

6: INTERDEPENDENCE IN ECOSYSTEMS

Activity	SEP	DCI	CCC	PE
113		LS2.A	2	
114		LS2.A		
115		LS2.A	3	
116		LS2.A		
117	4,6	LS2.A		
118		LS2.A	3	
119-120		LS2.A		
121		LS2.A	2,3	
122	2	LS2.A		

6 CONTINUED: INTERDEPENDENCE IN ECOSYSTEMS

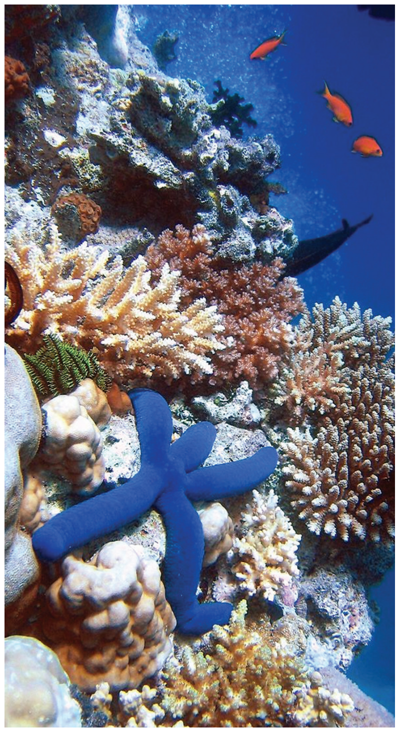
Activity	SEP	DCI	CCC	PE
123	6	LS2.A	2	
124	4,6	LS2.A	2	
125	5	LS2.A	3	
126		LS2.A	3	
127	3,4,5	LS2.A	2,4	HS-LS2-1, HS-LS2-2
128		LS2.A		
129	2,3,4,5	LS2.A	3,4	
130	2,5	LS2.A		
131	5	LS2.A		HS-LS2-1, HS-LS2-2
132	2,3,4,5	LS2.A	2,3,4	HS-LS2-1, HS-LS2-2
133	4,5	LS2.A	2,3	

7: ENERGY FLOW AND NUTRIENT CYCLES

Activity	SEP	DCI	CCC	PE
137	2, 7	LS2.B	5	
138	2, 6	LS2.B	5	HS-LS2-3
139		LS2.B	4, 5	
140	2	LS2.B	5	
141		LS2.B	5	
142-143	2	LS2.B	5	
144	1,2	LS2.B	5	
145	2,5	LS2.B	4, 5	HS-LS2-4
146	2	LS2.B	4, 5	HS-LS2-4
147	2,5,6,8	LS2.B	5	HS-LS2-4
148	2	LS2.B	5	
149	2	LS2.B	7	
150	2	LS2.B, PS3.D	4	HS-LS2-5
151	2,3,6	LS2.B, PS3.D	2,4,5	HS-LS2-5
152	2	LS2.B	4, 5	
153	2,4	LS2.B, PS3.D	4	HS-LS2-5
154	2	LS2.B	4, 5	
156	4,5	LS2.B	5	HS-LS2-4

8: THE DYNAMIC ECOSYSTEM

Activity	SEP	DCI	CCC	PE
158	2,4	LS2.C	3,7	
159	4	LS2.C	7	
160	2,4	LS2.C	7	
161	7	LS2.C	7	
162	2,4	LS2.C	7	
163	4,7	LS2.C	7	
164	2,3,4,6	LS2.C, LS4.D ETS1.B	7	HS-LS2-7
165	2	LS2.C, LS4.D	7	
166	1,6,8	LS2.C, LS4.D	7	
167	2,3,4,5,6	LS2.C, LS4.D ETS1.B	7	HS-LS2-7
168	6,7	LS2.C, LS4.D ETS1.B	7	HS-LS2-7
169	2,4,6,7,8	LS2.C, LS4.D	7	HS-LS2-7
170	2,6,7,9	LS2.C, LS4.D ETS1.B		HS-LS2-7
171		LS2.C, LS4.D		HS-LS2-6, HS-ETS1-3
172	2,6			HS-LS2-6



Richard Ling cc 2.5, 3.0

9: SOCIAL BEHAVIOR

Activity	SEP	DCI	CCC	PE
174		LS2.D	2	
175	2	LS2.D	2	
176	4,7	LS2.D	2	HS-LS2-8
177		LS2.D		
178	4	LS2.D	2	HS-LS2-8
179		LS2.D	2	
180	4	LS2.D	2	
181	7	LS2.D	2	
182		LS2.D	2	
184	4,5,7	LS2.D	2	HS-LS2-8

10: INHERITANCE OF TRAITS

Activity	SEP	DCI	CCC	PE
186	2	LS3.A		
187	1,2	LS3.A	2	HS-LS3-1
188	1,2	LS3.A	2	
189	2	LS3.A	2	
190	2	LS3.A		
191	1	LS3.A	2	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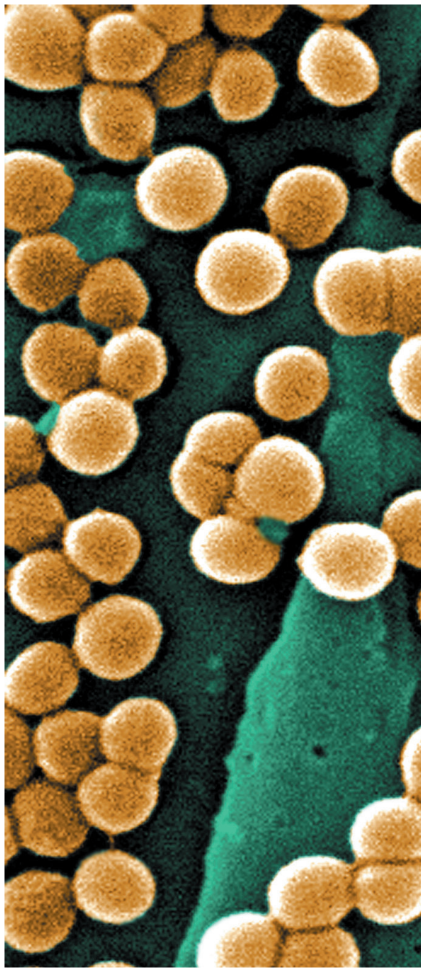
11: VARIATION OF TRAITS

Activity	SEP	DCI	CCC	PE
195	2	LS3.B	2	
196	2	LS3.B		
197	2	LS3.B	2	
198		LS3.B		
199	3,4	LS3.B		
200	2	LS3.B		
201	2	LS3.B		HS-LS3-2
202	2,3,4	LS3.B	2	
203	2	LS3.B	2	HS-LS3-2
204		LS3.B	2	
205	2,3,4	LS3.B	2	
206		LS3.B	2	
207	2	LS3.B	2	
208		LS3.B		
209		LS3.B	2	HS-LS3-2
210	4	LS3.B	2	
211	2,4	LS3.B	3	HS-LS3-3
212	2, 4	LS3.B		HS-LS3-3
213	2,4	LS3.B		
214	2,4	LS3.B	3	
215	4	LS3.B		
216	4,5	LS3.B	3	HS-LS3-3
217	2	LS3.B	2,3	HS-LS3-1
219	2,4,7	LS3.B		HS-LS3-2, HS-LS3-3


CDC

12: EVIDENCE FOR EVOLUTION

Activity	SEP	DCI	CCC	PE
221		LS4.A	1	
222-224	2,4	LS4.A	1	
225-227		LS4.A	1	
228	2,4	LS4.A	1	
229	2	LS4.A	1	
230	4	LS4.A	1	
232	2,7	LS4.A	1	HS-LS4-1

13: NATURAL SELECTION AND ADAPTATION

Activity	SEP	DCI	CCC	PE
234	2	LS4.B, LS4.C	2	
235	2,3,4,6	LS4.B, LS4.C	2	HS-LS4-2
236	6	LS4.B, LS4.C	2	
237	6	LS4.B, LS4.C	1,2	
238		LS4.B, LS4.C		HS-LS4-2, HS-LS4-3
239	4,5,6	LS4.B, LS4.C	1,2	HS-LS4-4
240	2,4	LS4.B, LS4.C	1,2	HS-LS4-3 HS-LS4-3
241	2	LS4.B, LS4.C	1,2	
242	2,4,5,6	LS4.B, LS4.C	1,2	HS-LS4-3
243	2	LS4.B, LS4.C	1	
244-246	2,6	LS4.B, LS4.C	1	
247	2,4,7	LS4.C	2	HS-LS4-5
248	2,4,7	LS4.C	2	HS-LS4-5
249	4,7			
250	6,7	LS4.B, LS4.C	2	

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14: BIODIVERSITY

Activity	SEP	DCI	CCC	PE
252	2,4,5,6	LS4.C, LS4.D ETS1-B	2	HS-LS4-6
253	7	LS4.D	2	
254	2,8	LS4.D	2	
255	4,7	LS4.D	2	
256	6	LS4.D	2	
257	1,2,4,8	LS4.C, LS4.D	2	
258	1,4,8	LS4.C, LS4.D	2	
259	4	LS4.D	2	
261	6,8	LS4.D, ETS1-B	2	

Identifying Common Core State Standards Connections

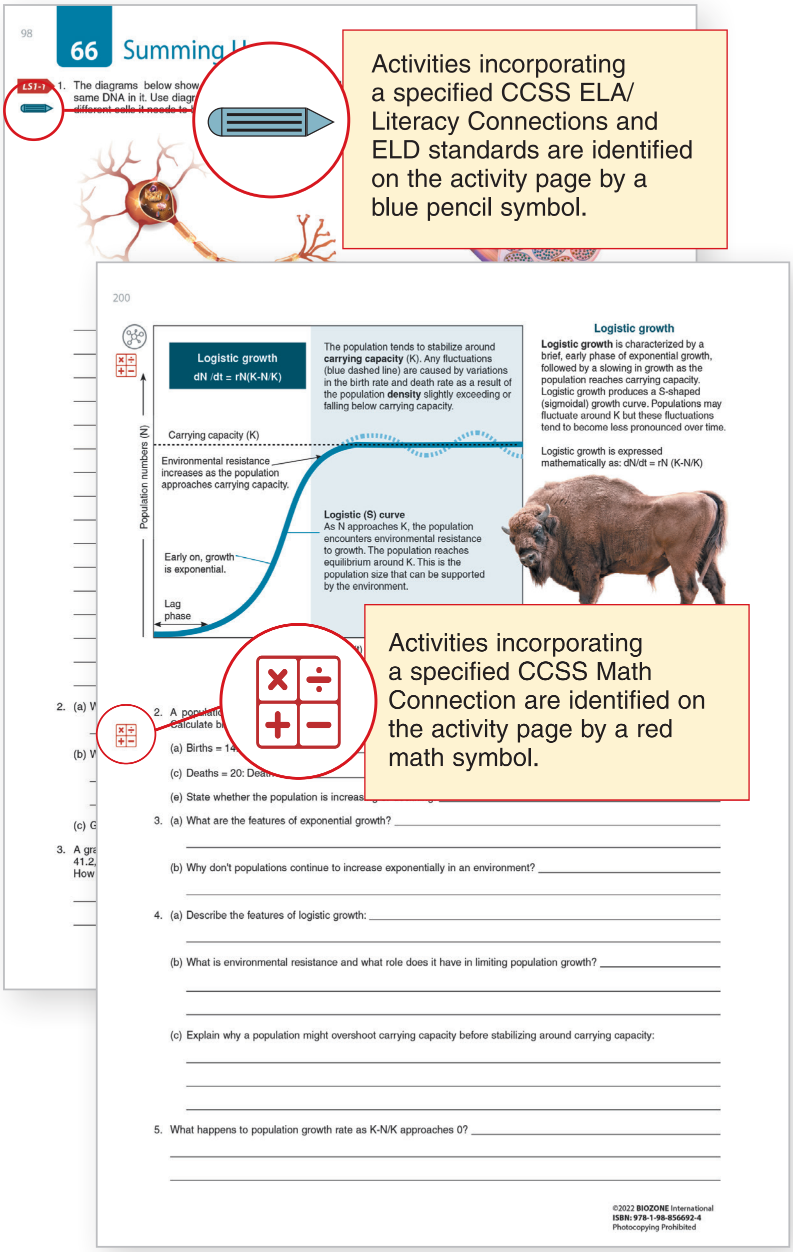
The activities in *Biology for NGSS* provide many opportunities to address the **Common Core State Standards** (CCSS) for numeracy, and literacy, and English language development (ELD). The incorporation of these standards allows students to practice and develop these key skills while exploring science.

Activities incorporating representative citations of the CCSS Math Connections, ELA/ literacy, and ELD Connections specified in the NGSS Science Framework are identified by codes (right) in the **Teacher's Edition** and **Teacher's Digital Edition**. Note that this coding is a tool for the teacher and is not present in the Student Edition.

- A red calculator indicates a math connection.
- A blue pencil indicates an ELA/literacy or ELD connection.

A list of the specific Math Connections, ELA/ Literacy Connections and ELD Standards addressed in the NGSS framework can be found in the tables at the bottom of this page and on the following pages.

BIOZONE recognizes that ELD Standards are not to be used in isolation, and are intended to be implemented in conjunction with ELA/Literacy and other academic content standards. This is why you will see them appearing along with the relevant ELA/literacy connection in the following tables.



1: SCIENCE PRACTICES

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
1	The Nature of Science		WHST.9-12.2,
5,8	Working With Numbers / Large Numbers	MP.4	
17, 19, 21, 22	Drawing Graphs	MP.4, HSS.ID.A.1, HSS-ID.B.6	
23, 24, 25, 28	Mean, Median, Mode; Statistics; Standard Deviation; Sample Bias, Data	MP.4, HSS.ID.A.1, HSS.ID.A.2, HSS.IC.A.1	

2: CELL SPECIALIZATION AND ORGANIZATION

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
32	Microscopes and Magnification	MP.4	
38	Diffusion in Cells		RST.9-10.3, RST.11-12.3, SL9-10.1.C, SL,11-12.1.B
39-40	Osmosis in Cells; Diffusion and Cell Size	MP.4, HSF-IF.C7	, RST.11-12.3, SL,11-12.1.B
41,42	Diffusion in Cells; Membrane Permeability		, RST.11-12.3, SL,11-12.1.B
54	The Functional Structure of Proteins		RST.11-12.3, SL,11-12.1.B
58, 59	Enzymes' Optimal Conditions; Catalase	MP.4, HSF-IF.C7	RST.11-12.3, SL,11-12.1.B

3: FEEDBACK MECHANISMS

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
73	Thermoregulation	MP.2, MP.4	WHST.11-12.8, WHST.9-12.7, RST.11-12.3, SL,11-12.1.B
75	Body Shape and Heat Loss	HSS-ID.A.1	RST.11-12.3, SL,11-12.1.B
78	Homeostasis During Exercise	MP.4	
79, 81	Effect of Exercise; Measuring Transpiration in Plants	MP.4, HSS-ID.A.1	RST.11-12.3, SL,11-12.1.B

4: GROWTH AND DEVELOPMENT

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
88	Modeling DNA Replication	MP.4	
90, 91	The Eukaryotic Cell Cycle, Mitosis		RST.11-12.2
93	Modeling Mitosis		RST.11-12.3, SL,11-12.1.B
98	Summing Up	MP.4, HSN-Q.A.1,	

5: ENERGY IN LIVING SYSTEMS

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
102	Introduction to Photosynthesis		RST.9-10.7
105	Investigating Photosynthetic Rate	MP.4, MP.5, N-Q.A.1	RST.11-12.3, SL,11-12.1.B
108	Energy from Glucose	MP.5	
109	Aerobic Cellular Respiration, Measuring Respiration	MP.4, MP5, N-Q.A.1	

6: INTERDEPENDENCE IN ECOSYSTEMS

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
124	Predator Prey Relationships	HSS-ID.A.1	
127	Carrying Capacity Simulation	HSS-ID.A.1	RST.11-12.3, SL,11-12.1.B
129	Population Growth	MP.4, HSN-Q.A.2,HSN-Q.A.3 HSS-ID.A.1	RST.11-12.3, SL,11-12.1.B
130	Plotting Bacterial Growth	MP.4, HSN-Q.A.1, HSS-ID.A.1	
131	Investigating Bacterial Growth	HSS-ID.A.1	RST.11-12.3, SL,11-12.1.B

7: ENERGY FLOW AND NUTRIENT CYCLES

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
141	Food Chains		RST.11-12.2
145	Energy Flow in Ecosystems	HSN-QA3	
146	Ecological Pyramids	HSN.Q.A.1, HSN.Q.A.2	
147	Investigating Ecological Pyramids	MP.2	WHST.11-12.2.E, RST.11-12.3, SL,11-12.1.B
153	Role of Photosynthesis in Carbon Cycling	HSS-ID.A.1	
156	Summing Up	HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3	

8: THE DYNAMIC ECOSYSTEM

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
160, 161	A Case Study in Ecosystem Resilience; Keystone Species	HSF-IF.C.7	
164, 167	Human Impacts: Ecosystems; Fish Stocks	MP.4	RST.11-12.3, SL,11-12.1.B
168	Evaluating a Solution to Overfishing		WHST.9-12.7
169, 170	Deforestation; Modelling a Solutionl		SL,11-12.1.B, WHST.9-12.7
171	Review Your Understanding		SL,11-12.1.B, WHST.9-12.7

9: SOCIAL BEHAVIOR

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
178	How Social Behavior Improves Survival	MP.2	
180	Cooperative Defense	MP.2	
181	Cooperative Attack	MP.4	
184	Summing Up	MP.2, MP.4, HSS.ID.A.1	

10: INHERITANCE OF TRAITS

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
187	DNA Carries the Code		RST.11-12.8, WHST.11-12.9
188	DNA Packaging and Control of Transcription		RST.11-12.1, WHST.11-12.9
189	Changes after Transcription and Translation	MP.4	

11: VARIATION OF TRAITS

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
199	Examples of Genetic Variation	MP.4, HSS.ID.A.1, HSN.Q.A.1	RST.11-12.3 WHST.9-12.2, SL,11-12.1.B
202	Modeling Meiosis	MP.4	RST.11-12.3, SL,11-12.1.B
205	Evolution of Antibiotic Resistance		RST.11-12.3
210	Genes and Environment Interact	MP.4, HSS.ID.A.1, HSN.Q.A.1	
211-215	Predicting and Practising mono- and dihybrid, and test crosses	MP.4	RST.11-12.4
216	Testing the Outcome of Genetic Crosses	HSS-IC.A.2	RST.11-12.4
217-219	Pedigree Analysis ; Review Your Understanding; Summing Up	MP.4	RST.11-12.4

12: EVIDENCE FOR EVOLUTION

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
228	DNA Evidence for Evolution		RST.11-12.4
231	Review Your Understanding		RST.11-12.4
232	Summing Up		RST.11-12.4, WHST.11-12-2

13: NATURAL SELECTION AND ADAPTATION

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
235	Modeling Natural Selection		RST.11-12.3, SL,11-12.1.B
238	Natural Selection in Finches	MP.2, HSN.Q.A.1, HSS.ID.A.1	
239	Natural Selection in Rock Pocket Mice	MP.2, HSN.Q.A.1, HSS.ID.A.1	
240	Natural Selection in Deer Mice		RST.11-12.3, SL,11-12.1.B
242	Gene Pool Simulation	MP.4	RST.11-12.3, SL,11-12.1.B
247	Extinction is a Natural Process	MP.4	

14: BIODIVERSITY

Activity number	Activity	CCSS Math connection	CCSS ELA/Literacy & ELD connection
252	Biodiversity	MP.2, HSA.SSE.A.1.A, HSA.CED.A.4	RST.11-12.3, SL,11-12.1.B
254	Biodiversity Hotspots		RST.11-12.5, WHST.11-12.7
257	*In-Situ* Conservation		WHST.9-12.7
258	Conservation and Genetic Diversity		WHST.9-12.7
260	Review Your Understanding		WHST.9-12.7
261	Summing Up		SL.11-12.5