



# BIOLOGY

FOR NGSS







# BIOLOGY

FOR NGSS



# Contents

## CLASSROOM GUIDE

The Concept Maps.....	CG3
The Contents: A Planning Tool.....	CG4
Pacing Guides.....	CG4
Identifying Learning Intentions and Goals.....	CG5
Scaffolded Learning with the =5Es.....	CG6
Practical Investigations.....	CG9
Engineering Design Solutions.....	CG10
Evaluating Student Performance.....	CG11
How are English Language Learners Supported?.....	CG15
Differentiated Learning.....	CG16
The Teacher Toolkit.....	CG17
Teacher's Notes.....	CG20
The Teacher's Digital Edition.....	CG21
Identifying CCCs and SEPs by Number.....	CG22
Summary of BIOZONE's 3D Approach By Chapter.....	CG23
Identifying Common Core State Standard Connections ....	CG28

## STUDENT EDITION

Student Edition with Answers in Place .....	i - 404
---	---------

## APPENDIX

Answers to Long Answer Questions.....	A1
---------------------------------------	----

**Purchases of this book may be made direct from the publisher:**



### BIOZONE Corporation

USA and Canada

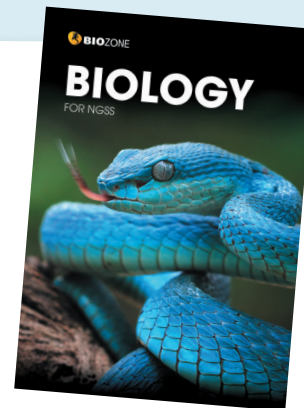
FREE phone: 1-855-246-4555

FREE fax: 1-855-935-3555

Email: [sales@thebiozone.com](mailto:sales@thebiozone.com)

Web: [www.thebiozone.com](http://www.thebiozone.com)

## FAQs ABOUT BIOLOGY FOR NGSS



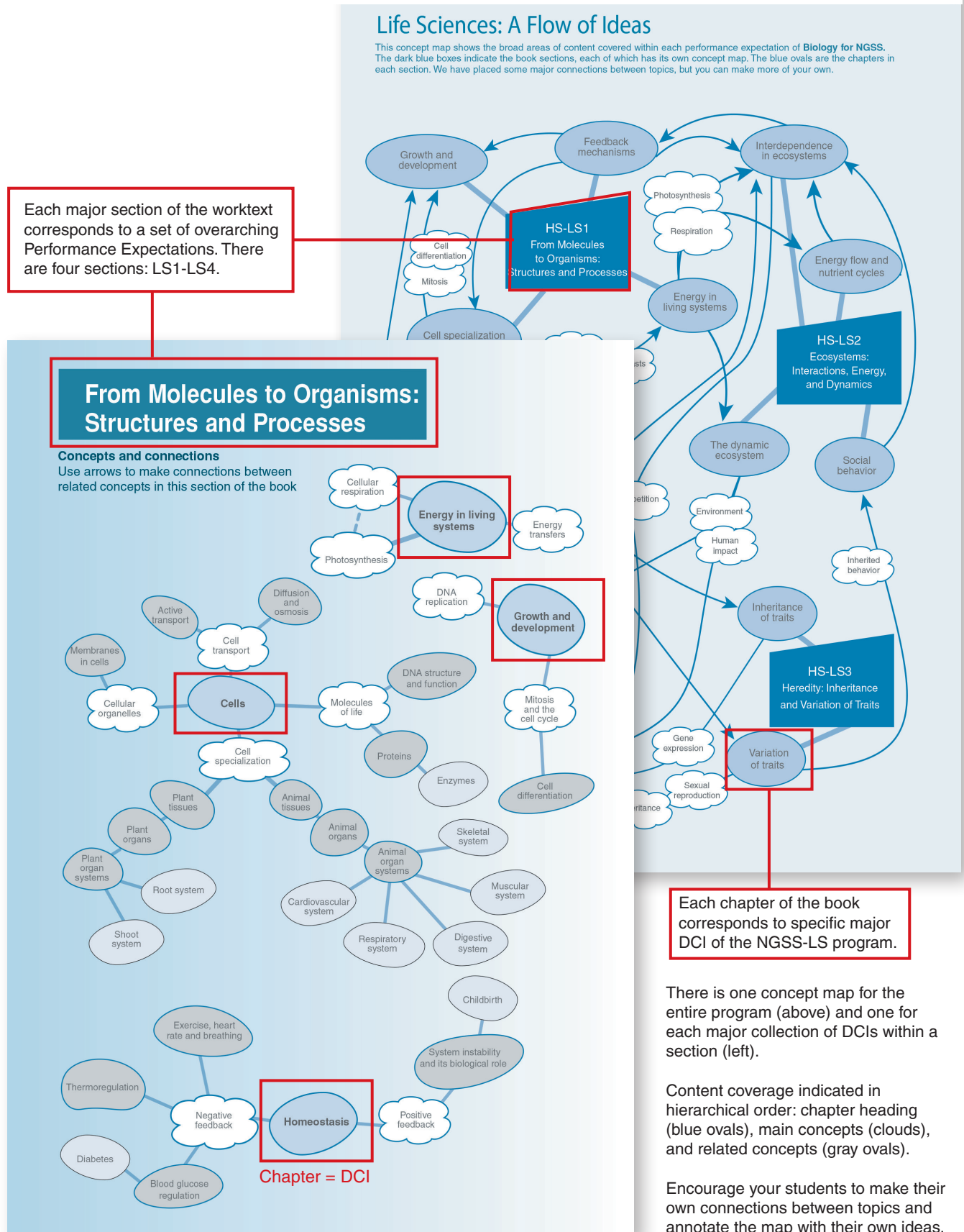
Where can I find the course overview?	CG3
What is its pedagogical approach?	CG4- CG8
Pacing Guides: How do I allocate time through the program?	CG4
Does it cater for all three dimensions of the NGSS?	CG22- CG25
How are the 5Es incorporated?	CG6-CG8
Are the Common Core State Standards addressed?	CG26- CG28
Are there practical investigations?	CG9
How is engineering design addressed?	CG10
How can I evaluate student performance?	CG11- CG12
Are there test banks?	CG12, CG19
How do I use the worktext in the classroom?	CG13- CG16
Are there tools for differentiated instruction?	CG15- CG16
How can I support English language learners?	CG15
Are there supporting resources for teachers?	CG17- CG19
Are there teacher's notes?	CG20

Next Generation Science Standards (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product and do not endorse it.



# 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.



# 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.

**Contents**

Using This Book.....vii  
Using BIOZONE'S Resource Hub .....x  
Life Sciences: A Flow of Ideas.....xii

**1. Science Practices**  
Key Skills and Knowledge ..... 1

1 Ticking off the activities as they are completed gives students a sense of progression and helps them to be more personally organized in their work.  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12 A Case Study: Catalase Activity ..... 14  
13 Recording Results ..... 15  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26 Biological Drawings ..... 29  
27 Practicing Biological Drawings ..... 31  
28 Analyzing Experimental Data ..... 32

**CONCEPT MAP**  
**MOLECULES AND ORGANISMS** ..... 35

**2. Cell Specialization and Organization**  
DCI: LS1.A  
Key Skills and Knowledge ..... 36

29 Frogslide ..... 37  
30 The Hierarchy of Life ..... 38  
31 Introduction to Cells ..... 39  
32 Microscopes and Magnification ..... 41  
33 Studying Cells ..... 43  
34 Plant Cells ..... 45  
35 Animal Cells ..... 47  
36 Identifying Organelles ..... 49  
37 The Structure of Membranes ..... 50  
38 Diffusion in Cells ..... 53

39 Osmosis in Cells ..... 54  
40 Diffusion and Cell Size ..... 55  
41 Observing Diffusion in ..... 56  
42 Factors Affecting Membranes ..... 57  
43 Active Transport ..... 58  
44 What is an Ion Pump? ..... 59  
45 Specialization in Plant ..... 60  
46 Specialization in Animal ..... 61  
47 What is DNA? ..... 62  
48 Nucleotides ..... 63  
49 DNA and RNA ..... 64  
50 Modeling the Structure ..... 65  
51 Genes Code for Proteins ..... 66  
52 Cracking the Genetic Code ..... 67  
53 Amino Acids Make Up ..... 68  
54 The Functional Structure ..... 69  
55 Proteins Have Many Functions ..... 70  
56 Reactions in Cells ..... 71  
57 Enzymes Catalyze Reactions ..... 72  
58 Enzymes Have Optimum ..... 73  
59 Investigating Catalase ..... 74  
60 Organ Systems Work Together ..... 75  
61 Regulation and Gas Exchange ..... 76  
62 Regulation and Gas Exchange ..... 77  
63 Plant Organ Systems ..... 78  
64 Interacting Systems in ..... 79  
65 Review Your Understanding ..... 80  
66 Summing Up ..... 81

**3. Feedback Mechanisms**  
DCI: LS1.A

Key Skills and Knowledge ..... 100

67 Hot Dog ..... 101  
68 Homeostasis ..... 102  
69 Keeping in Balance ..... 103  
70 Negative Feedback Mechanisms ..... 105  
71 Positive Feedback Mechanisms ..... 106  
72 Sources of Body Heat ..... 107  
73 Thermoregulation ..... 108  
74 Thermoregulation in Humans ..... 111  
75 Body Shape and Heat Loss ..... 113  
76 Controlling Blood Glucose Levels ..... 116  
77 Type 2 Diabetes ..... 118

**CODING:** Activity is marked: ☐ to be done ☒ when completed ☒ Practical investigation

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

The teacher has an alternative investigation of their own they wish to use, so they indicate to the students to skip this activity.

## 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](#) and the Digital Teacher's Edition. 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 and Digital 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.

150

## CHAPTER 5

# Energy in Living Systems

Activity number

99 111

### Anchoring Phenomenon

**Putting Things in Jars:** Under what conditions can an animal survive in a sealed system?

**What is ATP and why is it important?**

- 1 Living organisms use cellular respiration as the process by which organic molecules are broken down to release energy and form molecules of ATP. ATP is an energy molecule and its hydrolysis provides the energy to do cellular work [CCC-6] [SEP-2] to show how ATP provides energy to carry out life's functions [LS1.C].

**How does photosynthesis convert light energy into stored energy?**

- 2 Photosynthesis is the process that captures light energy and converts it into stored chemical energy [SEP-2] [CCC-6] [LS1.C]. In plants, photosynthesis occurs in organelles called chloroplasts, and consists of two stages; the independent phase and light dependent phase [SEP-1] [CCC-4] [CCC-6]. Use a model [SEP-2] to construct an explanation [SEP-6] for how photosynthesis transforms light energy into stored chemical energy [HS-LS1-5]. During photosynthesis, carbon dioxide and water are converted into glucose and oxygen [SEP-2] [CCC-6] [LS1.C].
- 3 Conduct an investigation [SEP-3] to demonstrate that light drives photosynthesis [CCC-6] [LS1.C].

**How is glucose used to make other macromolecules?**

- 4 Glucose consists of carbon, oxygen, and hydrogen atoms. Construct an explanation based on evidence for how organisms build a wide range of molecules (e.g. amino acids, nucleic acids, fats) from the atoms in glucose [CCC-6] [SEP-6] [HS-LS1-6].

**How are photosynthesis and cellular respiration connected?**

- 5 Use a diagrammatic model [SEP-2] to show how the glucose produced during photosynthesis is used in cellular respiration [LS1.C] [CCC-6] [HS-LS1-5].

**How is energy produced during cellular respiration?**

- 6 Use a model [SEP-2] to compare the ATP production from aerobic and anaerobic pathways in different organisms [CCC-6]. Construct an explanation [SEP-6] for the different ATP yields in different pathways [CCC-6] [LS1.C] [HS-LS1-7].
- 7 Cellular respiration takes place in the cell cytoplasm and in the mitochondria. In cellular respiration, glucose and oxygen are used to produce ATP [CCC-6]. In the cytoplasm, glucose is broken down into pyruvate, which then enters the mitochondria. In the mitochondria, pyruvate is broken down into carbon dioxide and water, and the energy is used to produce ATP [CCC-6] [LS1.C] [HS-LS1-7]. Use a model [SEP-2] based on evidence to construct an explanation [SEP-6] of cellular respiration.
- 8 Use a respirometer to investigate [SEP-3] [SEP-6] cellular respiration in different organisms, e.g. seeds [CCC-6] [LS1.C].
- 9 Use a model to illustrate the chemical process of cellular respiration. What are the inputs and outputs? Use the model to show that bonds in oxygen and food molecules are broken and bonds in new compounds are formed, resulting in a net transfer of energy [SEP-2] [CCC-6] [LS1.C] [HS-LS1-7].

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

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

The relevant Science and Engineering Practices are indicated in blue.

The relevant Crosscutting Concepts are indicated in green.

The relevant Disciplinary Core Idea are indicated in orange.

The relevant Performance Expectation is indicated in red.

Disciplinary Core Idea  
LS1.C

# Scaffolded Learning with the 5 Es

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.

## 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 encourages the development of the NGSS learner profile using the 5Es model**

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.

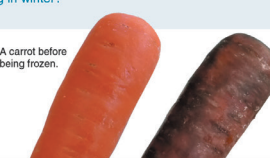
The subsequent activities in a chapter take the students, step by step, through phenomena that explore the ideas inherent in the anchoring phenomenon. By the time students revisit the anchoring phenomenon at the end of the chapter, they should be able to fully explain it.

29
**Frogsicle**
3

**Key Question:** How does the wood frog survive freezing in winter?

**Freezing cells and tissues**

▶ Try this: take a vegetable like a lettuce or carrot and put it in the freezer overnight. Thaw it out the next day. What happens? If you have a fridge with the cooling panel exposed at the back, or an open ice box for making ice cubes, you may have come across this problem. Sometimes, fruit or vegetables get pushed to the back of the fridge and part of them freezes. When they thaw out, they become limp, and sometimes a bit slimy.



A carrot before being frozen.


65
**Review Your Understanding**
97

**Key Question:** How does the wood frog survive freezing in winter?

▶ At the beginning of the chapter you were introduced to the wood frog, a multicellular vertebrate that is able to survive freezing temperatures down to -6°C. The mechanisms the frog used to survive freezing included:

- Increasing the amount of glucose in the blood around the organs by up to 100 times the normal amount.
- Increasing urea in the extracellular spaces (spaces outside the cells).
- Having proteins that operate at lower temperatures than similar proteins in other frogs.
- Proteins in the cells plasma membranes allow glucose and urea to enter the cell as freezing proceeds.
- Both breathing and the heartbeat stop.
- Antifreeze

▶ You should not stop the frog



1. Annotate the

2. F

1. V

2. F

(

(

(

(

Cell

Antifreeze protein

Water

Ice crystals

Water channel protein (aquaporin)

Cell

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited



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.

26

## 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**

Chemical matter can be stored in different parts of the cycle for varying lengths of time, e.g. a carbon atom will stay in the ocean, on average, more than 500 years.

1. What is a nutrient cycle? \_\_\_\_\_

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

©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited

### 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.

228

## 150 The Carbon Cycle

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

**Photosynthesis and carbon**

- 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 ( $\text{CO}_2$ ). 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  $\text{CO}_2$  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?

©2022 BIOZONE International  
ISBN 978-1-98-856032-4  
Photocopying Prohibited

229

## 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.**

- In this investigation, you will make a simple ecosystem 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.
- 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/gas you will have, how much organic material you will add, and where you will put your ecosystem (light/dark).
- Draw a picture of your bottle ecosystem or take a photograph and attach (right). Label the picture to include important design features.
- Leave your bottle ecosystem for a week. Observe it carefully of various times during the week. After a week, note down any changes since you set it up.
- Return any living organisms back to the aquarium and dispose of any waste materials.

1. (a) What produces the  $\text{O}_2$  in your system?  
(b) What produces the  $\text{CO}_2$  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:

©2022 BIOZONE International  
ISBN 978-1-98-856032-4  
Photocopying Prohibited

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.

231

## 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  $\text{CO}_2$  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 to 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 glaciolenses (G) 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	606	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	708

©2022 BIOZONE International  
ISBN 978-1-98-856032-4  
Photocopying Prohibited

232

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?

©2022 BIOZONE International  
ISBN 978-1-98-856032-4  
Photocopying Prohibited



# 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**

**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 enhance visible detail. Sections must be made very thin.

**Investigation 2.1 Preparing an onion slide**

See appendix for equipment list.

**Caution:** 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 slide 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 epidermis (upper cell layer) until the inner surface of the epidermis is exposed.

3. Carefully peel the epidermis off the onion. The epidermis is a single layer of cells.

4. Place the slide and coverslip on a clean surface.

5. Carefully place the epidermis on the slide, making sure it is flat and not folded.

6. Use a small drop of iodine solution.

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 solution.

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.

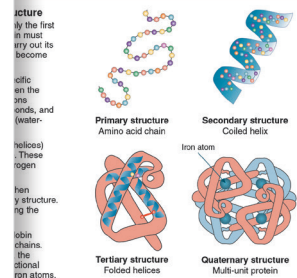
11. Replace the slide on the microscope and view the stained onion peel.

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

38

## Structure of Proteins

help us understand the structure of a protein?



## protein structure

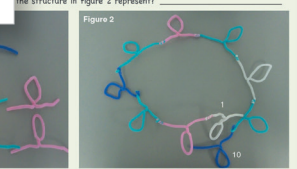
Proteins are made up of amino acids. The sequence of amino acids in a protein determines its structure. The structure of a protein determines its function.

We have used 2 white, 2 pink, 2 purple, and 4 blue but you can color represents a different amino acid.

cleaner (Figure 1). The twist represents the amino acid's functional

by twisting their arms together in the following sequence:  
1) pink 2) blue 3) white 4) blue 5) purple.

The structure in Figure 2 represents?



©2022 BIOZONE International  
ISBN: 978-0-945669-1-4  
Photocopying Prohibited

## Appendix: Equipment list

### 2: Cell Structure

#### Investigation 2.1

##### Preparing an onion slide

Per student/pair

Light microscope

Onion/bulb leaf

Glass microscope slides

Coverslips

Scalpel or razor

Iodine stain

Filter paper/tissue paper

#### Investigation 2.2

##### Simple diffusion across a membrane

Per student/pair

200 mL beaker

1 mL pipette

Glucose diphosphate

Lugol's iodine

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

Timer

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°, 30°, 40°, 50°, 60°

90°C

Paper towels

Colorimeter set to 510 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)

Slippery tape

2 x binder clips or paper clips

#### Investigation 2.8

##### Effect of temperature on enzyme activity

Per group/temperature

1 x soaping dish/section plate 1 x test tube

1 x plastic pipette

Water bath

Timer

0.1 M lactase solution (DMSO)

2 M, 1% amylose 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/heat material

2 x 100 mL beakers

2 x thermometers

2 x larger containers (to fit beakers)

Insulating material (beef fat, feathers, wool, cotton balls)

Weights or tape (optional)

Timer

2 x 100 mL warm tap water (~45°C)

Ice water

#### Investigation 3.2

##### Investigating 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

Potatoes/jelly

1 cm<sup>3</sup> pipette

Clamp stand

Leafy plant shoot

Water

Cooling oil (for optional set up)

Timer or watch

Lamp or plastic bag and water spray

Boiling, 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 Digital 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.

262

## 170 Modeling a Solution

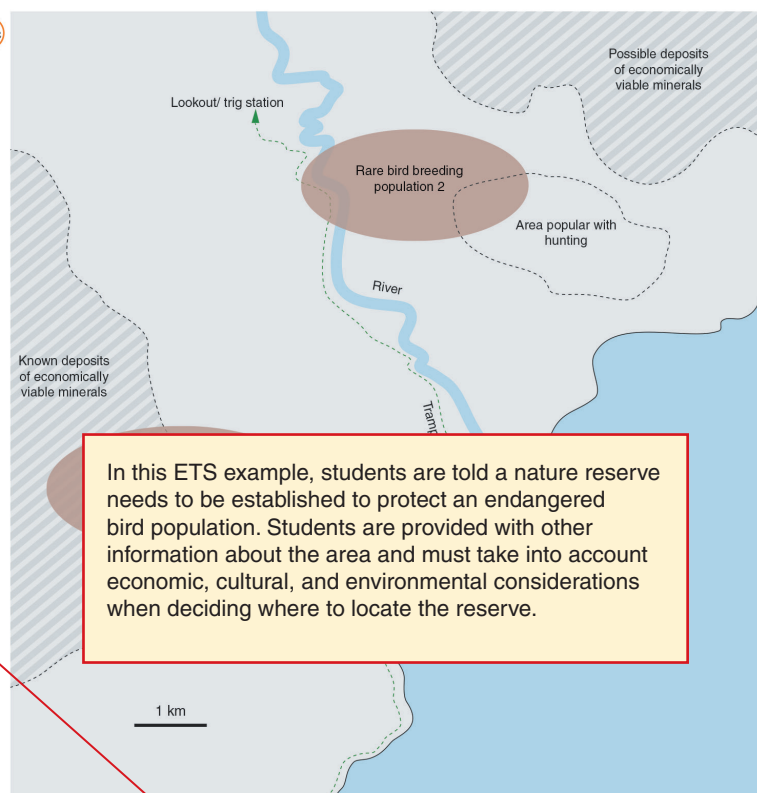
**Key Question:** What factors should be considered when modeling a conservation solution?



► **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<sup>2</sup>) 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<sup>2</sup>) 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.



In this ETS example, students are told a nature reserve needs to be established to protect an endangered bird population. Students are provided with other information about the area and must take into account economic, cultural, and environmental considerations when deciding where to locate the reserve.



©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited

## 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.

142

93

Modeling Mitosis

**Key Question:** How can I model the stages of mitosis to help to visualize and understand the process?

### Investigation 4.1 Modeling mitosis

See appendix for equipment list.

1. You can work in pairs for this activity if you wish.
2. Use the information on the previous pages to model **mitosis** in an animal cell using pipe cleaners and string. Work in pairs and use four chromosomes for simplicity ( $2N = 4$ ). Photograph or Film each stage.
3. Photo 1 (below) can be used as a starting point for your model. It represents a cell in interphase before mitosis begins. The circular structures are the replicated
4. Before you start, identify the structures A-C in photo  
A: \_\_\_\_\_ B: \_\_\_\_\_ C: \_\_\_\_\_
5. Remember to label your photos as you place them on the

Photo 1

65

Review Your Understanding

**Key Question:** How does the wood frog survive freezing in winter?

- ▶ At the beginning of the chapter you were introduced to the wood frog, a multicellular vertebrate that is able to survive freezing temperatures down to  $-6^{\circ}\text{C}$ . The mechanisms the frog used to survive freezing included:
  - Increasing the amount of glucose in the blood around the organs by up to 100 times the normal amount.
  - Increasing urea in the extracellular spaces (spaces outside the cells).
  - Having proteins that operate at lower temperatures than similar proteins in other frogs.
  - Proteins in the cells plasma membranes allow glucose and urea to enter the cell as freezing proceeds.
  - Both breathing and the heartbeat stop.
  - Antifreeze proteins bind to ice crystals.
- ▶ You should now be able to explain how these mechanisms stop the frog from freezing to death.

1. Annotate the diagram below to help explain how the points above help the frog survive freezing:

©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited



## 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.

170 **112 Summing up**

**Investigation 5.3 Modeling photosynthesis and**

Self-appendix for equipment list

- Work by yourself for this task. If you have beads or molecular models, use them on the next page.
- Cut out the atoms and shapes on the following page. They are color-coded to match the atoms in the model.

Carbon

Hydrogen

3. Use the atoms and shapes to make the end products of photosynthesis.

1. Write the equation for cellular respiration here:

(a) State the starting reactants in cellular respiration:

(b) State the total number of atoms of each type needed to make the starting reactants:

(c) Use the atoms you have cut out to make the starting reactants in cellular respiration:

(d) State the end products of cellular respiration:

(e) State the total number of atoms of each type needed to make the end products:

(f) Use the atoms you have cut out to make the end products of cellular respiration:

(g) Name the end products of cellular respiration that are utilized in photosynthesis:

(h) Name the energy source for this process and add it to the model you made.

2. Write the equation for **cellular respiration** here:

(a) State the starting reactants in cellular respiration:

(b) State the total number of atoms of each type needed to make the starting reactants:

(c) Use the atoms you have cut out to make the starting reactants in cellular respiration:

(d) State the end products of cellular respiration:

(e) State the total number of atoms of each type needed to make the end products:

(f) Use the atoms you have cut out to make the end products of cellular respiration:

(g) Name the end products of cellular respiration that are utilized in photosynthesis:

Sunlight energy → +

173

**LST-5** 3. **Photosynthesis** is the process in which carbon dioxide is fixed to form glucose. In the space below, draw a diagram to show the process of photosynthesis, including reactants and products and the location of the reactions involved.

**LST-7** 4. Cellular respiration is a continuous, integrated process. A simple diagram of the process in a eukaryote is shown below. (a) In the diagram, fill in the rectangles with the process and the ovals with the substance used or produced. Use the following word list (some words can be used more than once): pyruvate, glycolysis, glucose, oxygen ( $O_2$ ), link reaction, electron transport chain (ETC), Krebs cycle, ATP, carbon dioxide ( $CO_2$ ), water ( $H_2O$ ). (b) Add in a pathway to show fermentation. Write the two possible products of this pathway in eukaryotes.

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.

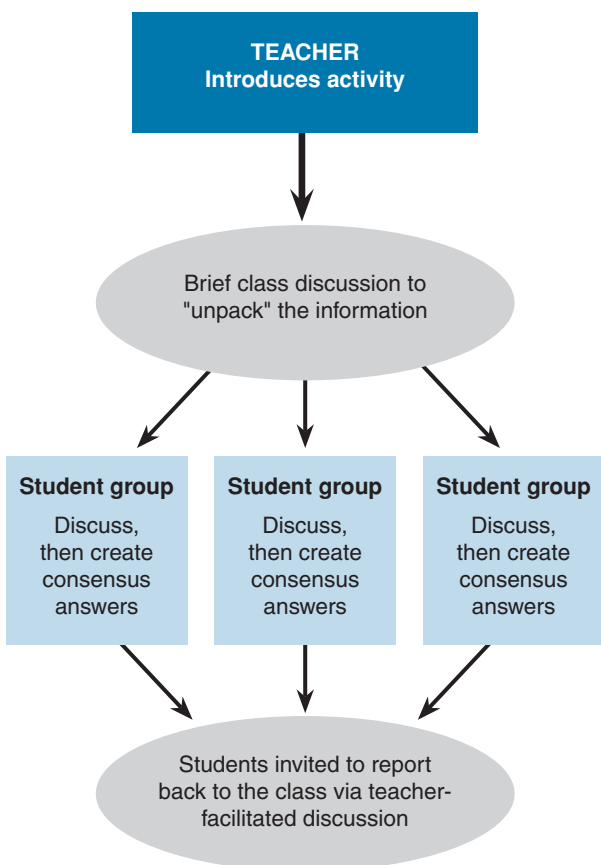
©2022 BIOZONE International

# 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.

76

### 54 The Functional Structure of Proteins

**Key Question:** How does modeling help us understand the structure of a protein?

**Proteins fold up into a functional structure**

- ▶ The amino acid sequence of a protein is only the first step in making a functional protein. A protein must fold into a functional structure in order to carry out its biological role. This is where the 'R' groups become important.
- ▶ The amino acid chain will fold up into a specific shape depending on the interactions between the different 'R' groups (below). These interactions include hydrogen bonds, disulfide (S-S) bonds, and hydrophobic (water-hating) and hydrophilic (water-loving) interactions.
- ▶ First, the amino acid chain folds into coils (helices) and sheets to create a secondary structure. These shapes are created and maintained by hydrogen bonds between CO and NH groups.
- ▶ More distant parts of the folded chain can then interact to create a highly organized, tertiary structure. Disulfide bridges are important in maintaining the folded structure.

**Primary structure**  
Amino acid chain

**Secondary structure**  
Coiled helix

Iron atom

**Students work in pairs or small groups to model the three dimensional (functional) structure of proteins. Sharing ideas and observations promotes scientific dialogue.**

2. Twist a loop in the center of each pipe cleaner (Figure 1). The twist represents the amino acid's functional group.

3. Join the amino acids together (Figure 2) by twisting their arms together in the following sequence: 1) white 2) pink 3) blue 4) purple 5) blue 6) pink 7) blue 8) white 9) blue 10) purple.

What level of protein organization does the structure in Figure 2 represent?

Figure 1

Figure 2

©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited

204

### 132 Modeling Population Growth

**Key Question:** How does changing the starting position of populations affect the way a population grows?

**Computer simulations can be used to model population growth**

- ▶ **Population growth** can be simulated using spreadsheets or computer programs. In this investigation, you will use **Populus**, a JavaScript program, which will run on Mac or Windows platforms. It models population growth, as well as the effects of **competition**.
- ▶ In this activity, you will model continuous density-independent (exponential) and density-dependent (logistic) growth.

Populus is shareware. Download it free: <https://cbs.unm.edu/populus/overview> (you can also download via BIOZONE's Resource Hub)

The opening screen looks like this:

Model allows you to choose which type of simulation you want to run.

Preferences lets you to load saved files and save new ones.

Help loads a comprehensive PDF file covering all aspects of the program.

If it fills the entire screen, grab the lower corner and resize it with the mouse.

**Populus**  
Simulations of Population Biology

Department of Ecology, Institute of Science  
University of Minnesota

Prepared by:  
Lari Rose, Anne Anderson, Shantel Southworth  
and Chris Smith

Version 6.0.0

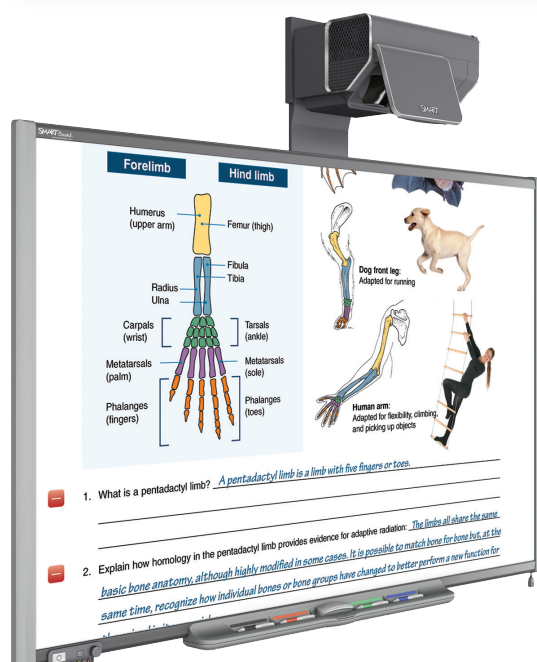
**Investigation 6.3 Density independent growth**

See app

1. Click on 'Density independent growth'.
2. Set the initial population size to 10.
3. Set the growth rate to 0.2.
4. Set the carrying capacity to 0.
5. Up the simulation speed to 'Fast'.
6. Set the plot type to 'dN/dt vs N'.
7. No.
8. Reset  $r$  to 0.2 and increase population size to 20. What happens to the shape of the graph now?
9. Leave the population size at 20 but decrease  $r$  to -0.2. What happens to the shape of the graph now?
10. Set the parameters back to  $N = 10$  and  $r = 0.2$ . Set the plot type to  $dN/dt$  vs  $N$  and view the plot. Describe the shape of the graph and explain what it means.
11. Change the  $r$  value until the population doubles over one time period. What is the  $r$  value?

**SAVE AND PRINT ALL YOUR SIMULATIONS AND ATTACH THEM TO THIS PAGE**

©2022 BIOZONE International  
ISBN: 978-1-98-856692-4  
Photocopying Prohibited



## Interactive revision of tasks in class

- The **Digital Teacher's Edition** provides a digital rights managed (DRM) version of the student book as PDF files. It features useful HIDE/SHOW answers, which can be used to review activities in class using a data projector or interactive whiteboard (left).
- 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 eBooks, **text to speech** (read aloud) and **translation** functions support ELLs in their learning journey. More information on these features is provided below.

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.

BIOZONE eBooks (CG17) provide support not only for ELLs but students who have difficulty reading. Simply highlight a passage of text and the text will be **read aloud** when the listen button is activated (**A**). Select the **translate function** and the selected text will be translated into one of 21 languages (including Spanish). Students can have the translated text read out loud in their selected language too (**B**). To learn more about using these functions visit: <https://ebookshelp.thebiozone.com/help/text-translation>

# 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:

**Requirements for photosynthesis**  
Photosynthesis is not a single process but two complex processes (the light-dependent and light-independent reactions) each with multiple steps.

**Light energy from the sun**  
Chloroplasts absorb light energy  
CO<sub>2</sub> gas is taken up by stomata  
Water is taken up by the roots from the soil

**Production of photosynthetic products**  
Oxygen is produced as a by-product of the light-dependent reactions  
Glucose is produced as a by-product of the light-independent reactions

**Energy capture occurs in the light-dependent reactions**  
The light-dependent reactions occur in the thylakoid membranes of the chloroplasts. Light energy is captured by chlorophyll and other pigments, which then transfer the energy to a series of electron carriers. This process produces oxygen and a high-energy electron carrier (NADPH).

**Glucose is produced in the light-independent reactions**  
The light-independent reactions occur in the stroma of the chloroplast. They use the high-energy electron carrier (NADPH) and CO<sub>2</sub> to produce glucose. This process is also known as the Calvin cycle.

**What is the role of the light-dependent reactions?**  
The light-dependent reactions capture light energy and convert it into chemical energy in the form of NADPH and ATP. They also release oxygen as a by-product.

**What is the role of the light-independent reactions?**  
The light-independent reactions use the chemical energy from NADPH and ATP to fix CO<sub>2</sub> and produce glucose. They do not require light.

**How does photosynthesis contribute to the carbon cycle?**  
Photosynthesis removes CO<sub>2</sub> from the atmosphere and converts it into glucose. This process is essential for the carbon cycle, as it provides the primary source of organic carbon for most ecosystems.

**Graph showing primary production (gC/m<sup>2</sup>/day) vs. depth (m) for different depths.**

**Extension Questions:** Red flag codes beside a section or question (on the Teacher's Edition or Digital 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.

**Aerobic and anaerobic pathways for ATP production**

**Aerobic respiration**  
Aerobic respiration is the process of breaking down glucose to produce ATP in the presence of oxygen. It occurs in the mitochondria and involves three main stages: glycolysis, the Krebs cycle, and the electron transport chain. Glycolysis occurs in the cytoplasm and produces pyruvate. The Krebs cycle occurs in the mitochondrial matrix and produces CO<sub>2</sub> and high-energy electrons. The electron transport chain occurs in the inner mitochondrial membrane and produces ATP.

**Anaerobic respiration**  
Anaerobic respiration is the process of breaking down glucose to produce ATP in the absence of oxygen. It occurs in the cytoplasm and involves two main stages: glycolysis and fermentation. Glycolysis is the same as in aerobic respiration, but fermentation follows glycolysis and produces lactic acid or ethanol and CO<sub>2</sub>.

**Diagram showing the pathways for ATP production.**

**NEED HELP? See activity 6**

**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.

**33 Studying Cells**

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

**Investigation 2.1 Preparing an onion slide**

**Caution:** Be careful when using scalpels or knives. Always wear safety glasses and gloves, and use proper technique.

**Steps for preparing an onion slide:**

1. Clean the glass slide and cover slip with a wet cloth.
2. Peel a small piece of onion skin from the inner layers of the onion.
3. Carefully peel off the epidermis from the onion skin, leaving the cells intact.
4. Place the peel in the center of a clean glass slide and cover it with a drop of water.
5. Use a small piece of fine or filter paper to flatten the onion skin.
6. Carefully lower a coverslip over the peel, trapping the water. To avoid air bubbles, lower the coverslip at an angle.
7. After viewing the slide under various magnifications, remove the slide and place it on the bench.
8. At the edge of the coverslip, place a small drop of water.
9. On the opposite side of the coverslip, place a piece of paper or cloth to draw the water away from the coverslip.
10. Repeat the slide on the microscope and view the stained onion peel.

**Why must sections viewed under a microscope be very thin?**

**Why do you think the specimen is covered with a coverslip?**

**Why would no chloroplasts be visible in an onion epidermis cell slide?**

**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 experience the benefits of collaboration in the scientific process of discovery. By speaking and listening to each other, communication skills and scientific vocabulary are extended.

**109 Aerobic Cellular Respiration**

**Key Question:** How does aerobic cellular respiration convert the chemical energy in glucose into usable energy (ATP), carbon dioxide, and water?

**Aerobic respiration**  
Aerobic respiration is the process of breaking down glucose to produce ATP in the presence of oxygen. It occurs in the mitochondria and involves three main stages: glycolysis, the Krebs cycle, and the electron transport chain. Glycolysis occurs in the cytoplasm and produces pyruvate. The Krebs cycle occurs in the mitochondrial matrix and produces CO<sub>2</sub> and high-energy electrons. The electron transport chain occurs in the inner mitochondrial membrane and produces ATP.

**Anaerobic respiration**  
Anaerobic respiration is the process of breaking down glucose to produce ATP in the absence of oxygen. It occurs in the cytoplasm and involves two main stages: glycolysis and fermentation. Glycolysis is the same as in aerobic respiration, but fermentation follows glycolysis and produces lactic acid or ethanol and CO<sub>2</sub>.

**Diagram showing the pathways for ATP production.**

**1. Which of the four steps in cellular respiration (glycolysis, Krebs cycle, electron transport chain, and fermentation) occurs in the cytoplasm?**

**2. (a) What are the main reactants (inputs) for cellular respiration?**  
(b) What are the main products (outputs) for cellular respiration?

**3. Which of the four steps of cellular respiration occurs in the mitochondrion?**

**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.

**Appendix: English/Spanish Glossary**

**alcoholic fermentation:** Fermentation that produces ethanol and CO<sub>2</sub> from glucose. It is a type of anaerobic respiration.

**anaerobic:** A biological process that does not require oxygen.

**ATP (Adenosine Triphosphate):** A molecule that stores and transfers chemical energy within cells.

**cellular respiration:** The process by which cells convert glucose and oxygen into ATP, CO<sub>2</sub>, and H<sub>2</sub>O.

**glycolysis:** The first stage of cellular respiration, which occurs in the cytoplasm and breaks down glucose into pyruvate.

**Krebs cycle:** The second stage of cellular respiration, which occurs in the mitochondrial matrix and produces CO<sub>2</sub> and high-energy electrons.

**electron transport chain:** The third stage of cellular respiration, which occurs in the inner mitochondrial membrane and produces ATP.

**fermentation:** The process by which cells convert glucose into lactic acid or ethanol and CO<sub>2</sub> in the absence of oxygen.

**lactic acid:** A product of anaerobic respiration that can cause muscle fatigue and soreness.

**ethanol:** A product of alcoholic fermentation that is used in various industries.

**CO<sub>2</sub> (Carbon Dioxide):** A gas that is produced as a by-product of cellular respiration and is released into the atmosphere.

**H<sub>2</sub>O (Water):** A product of cellular respiration that is used in various biological processes.

**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).

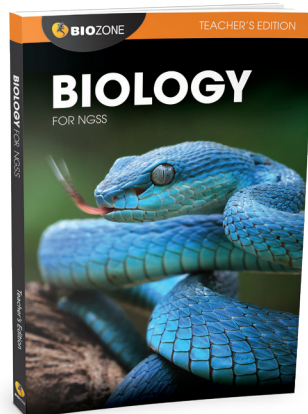
**Challenge Question:** Do you ever need an extra challenge for your more able students? The Teacher's Edition includes challenge questions. These are useful for extending gifted and talented students in particular (or any students keen to have go!). It can be downloaded from BIOZONE's Resource Hub,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

**Challenge question:** What descriptive statistics can you calculate from this ladybug swarm?



# 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.



## 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 *Biology for NGSS* and how to use them in your planning, delivery, and assessment.

The Classroom Guide provides a guide to 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. The Teacher's Edition follows the same flow as the Student Edition, and all suggested model answers are in place. Additional teacher coding identifies G&T 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.

## EBOOK VERSIONS

BIOZONE eBooks provide a digital replica of the printed worktext, allowing students and teachers to seamlessly transition between both formats in a hybrid delivery situation. eBook material can be incorporated into several learning management systems. You can direct students to the required activity and provide notes and guidance about what you want them to do.

BIOZONE provides three different eBook products:

### eBook LITE

Students interact with the BIOZONE content using notes, highlights, bookmarks, and some simple drawing tools. Other features include embedded text to speech reader, and text translation into 21 languages.

### eBook PLUS

Contains all the functionality of eBook Lite plus direct interaction with the BIOZONE **Resource Hub**. Students can also answer and submit responses for review or grading.

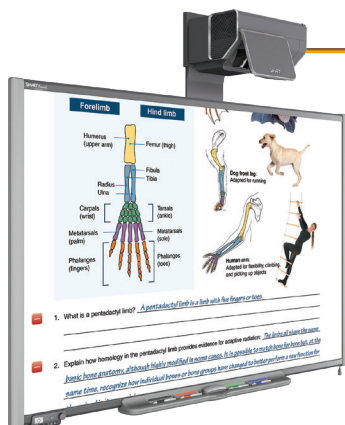
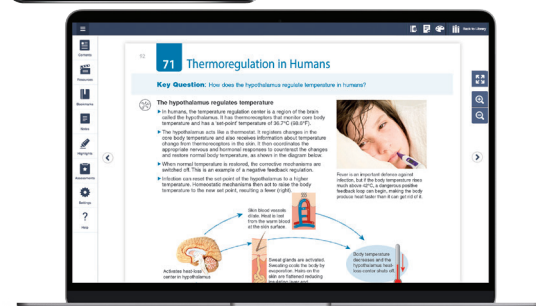
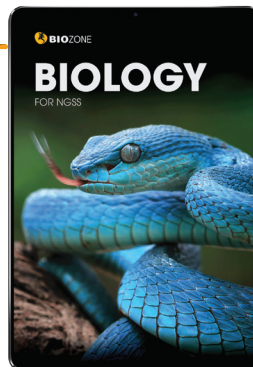
### eBook Teacher's Edition

Provided free with a classroom purchase, this resource has all the content of the printed Teacher's Edition and the functionality described above (including direct access to BIOZONE's **Resource Hub**).

Learn more about how to use the eBooks:

<https://www.thebiozone.com/ebooks/training/>

<https://ebookshelf.thebiozone.com/help/>



## DIGITAL TEACHER'S EDITION

This teacher's resource includes a non-printable PDF version of the Teacher's Edition, with a useful feature to hide and display the suggested answers. You can also find computational spreadsheets and other helpful material within the Digital Teacher's Edition (page CG20). The Digital Teacher's Edition is a DRM product, and sold as a separate product.

Material can be displayed to students through an interactive whiteboard or shared screen. This resource is an excellent way to introduce an activity to the class before having them work on the activity. If working on a practical investigation, you can highlight important steps or identify potential hazards before beginning. Many teachers use the show/hide answer feature to review answers with the class after a group discussion. If you are running short of time you can efficiently review the answers with the entire class to save time. See more about the Digital Teacher's Edition on page CG21).



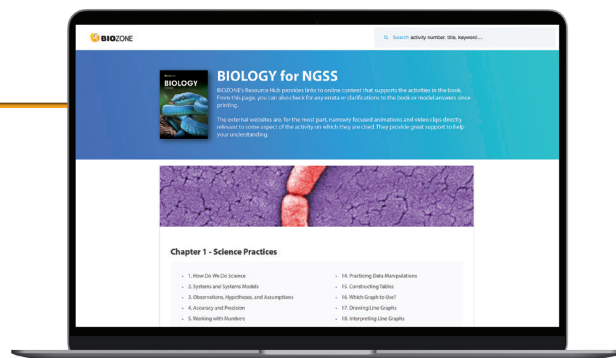
## RESOURCE HUB

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

The **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 material has been tagged as gifted and talented material and can be used to extend 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 gifted 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. Gifted and talented students, or students with a particular interest in the topic can be assigned this material at your discretion.



**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. Alternatively, the **Resource Hub** can be accessed directly through the icons (left) in the eBook Plus and eBook Teacher's Edition, the QR code below, or bookmark the following link: **www.BIOZONEhub.com** and then enter the code **NBI3-6924** if they are using the printed version.



## PRESENTATION MEDIA (SLIDES)

Presentation Media (slides) are a very popular way for teachers to deliver a lesson in a presentation style format, or have students review in their own time. Presentation Slides are a useful delivery tool in both face to face or remote teaching.

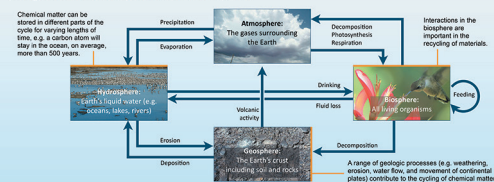
The Presentation Slides are a sizeable collection of **fully editable slides** specifically designed to support and enhance the content of the worktext. A set of slides is available for each chapter of *Biology for NGSS*. In some instances, the slide sets contain extra material or examples not contained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

The sets are fully editable, allowing teachers to customize slides for lessons or to suit student ability. Select a range of slides to support the content you are delivering and use them as they are or edit the slides. Add your own text or images, delete, add, or move slides around. The slides can be printed out for students to make their own notes on; then they can review their notes in context with the material. Presentation Slides are easily ingested into your LMS.

Slides are provided in both PowerPoint and Keynote formats.

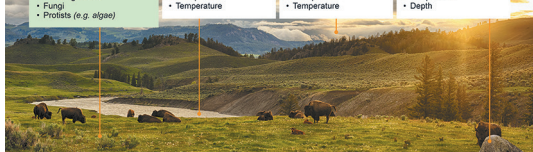
### A Generalized Biogeochemical Cycle

Each biogeochemical cycle has one or more **reservoirs**, which are large, usually abiotic, stores of the chemical element and smaller, more active pools where the nutrient cycles between the biotic (living) and abiotic components of an ecosystem.



### Components of an Ecosystem

BIOTIC FACTORS	ABIOTIC FACTORS
<p>Living organisms in the environment, including their interactions with each other:</p> <ul style="list-style-type: none"> <li>Plants</li> <li>Animals</li> <li>Microorganisms</li> <li>Fungi</li> <li>Protists (e.g. algae)</li> </ul>	<p><b>Hydrosphere (water)</b></p> <ul style="list-style-type: none"> <li>Dissolved nutrients</li> <li>pH</li> <li>Salinity</li> <li>Dissolved oxygen</li> <li>Precipitation</li> <li>Temperature</li> </ul> <p><b>Atmosphere (air)</b></p> <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> <li>Humidity</li> <li>Light intensity/quality</li> <li>Precipitation</li> <li>Temperature</li> </ul> <p><b>Geosphere (rock/soil)</b></p> <ul style="list-style-type: none"> <li>Nutrient availability</li> <li>Soil moisture</li> <li>pH</li> <li>Composition</li> <li>Temperature</li> <li>Depth</li> </ul>



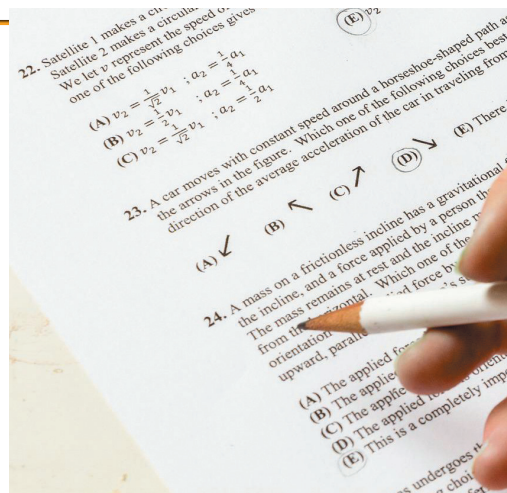
## TEST BANKS

Assessments within *Biology for NGSS* have been designed on 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 Banks have 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 with the worktext.

A range of question types is available (CG16). The Test Banks are 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.

- ▶ Test banks can be ingested into test generator software such as Illuminate and ExamView.
- ▶ 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?

## QUESTION LIBRARY

The Question Library provides all of the questions from the Student Edition worktext in a format which 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 and Digital 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.

150

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?**

- 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 mitochondrion as an organelle involved in ATP production.
- 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.

**How does photosynthesis convert light energy into stored energy?**

stoma 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.

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**

involved in making different types of molecules from glucose.

**How are photosynthesis and cellular respiration connected?**

- 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-LS1-7).
- Students should describe glycolysis as the major anaerobic pathway in cells with a net yield of 2ATP and 2NADH<sub>2</sub>. 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).
- 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.
- 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

involved in making different types of molecules from glucose.



# The Digital Teacher's Edition

The *Digital Teacher's Edition* is a DRM product, sold separately, and aimed primarily at extending the pedagogical tools at a teacher's disposal. Many of the features of this resource have been developed in response to requests from teachers themselves.

The **Classroom Guide** is provided as a printable PDF.

A digital (PDF) version of the Teacher's Edition (non-printable) is provided. Use the interactive buttons to **HIDE** or **SHOW** the answers.



Access BIOZONE's **Resource Hub** directly from this link for a range of resources to support the activities.

Link to **Excel®** spreadsheets for selected activities with a data analysis or computer modeling component.

A **BONUS** sample copy from the planned presentation media for *Biology for NGSS*. It is fully editable.

**56 Reactions in Cells**  
Key Question: How do anabolic and catabolic reactions build or break down molecules in the body?

**64 Interacting Systems in Plants**  
Key Question: How do the shoot and root systems of plants interact to balance water uptake and loss, so that the plant can maintain the essential functions of life?

**BIOZONE**  
© 2012 BIOZONE International Ltd  
This worksheet has been provided by Biozone International Ltd for use in practising the calculation of some basic descriptive statistics, followed by a column graph of the data. Examples are taken from the workbooks.

• Select View > Formula bar from the menu to view/hide the formulae for each cell.  
• Select View > Comments from the menu to view/hide the comments for each cell.

**Weight (in kg) of newborn babies**

Weight class	Tally	Frequency
0.0-0.49	0	0
0.5-0.99	0	0
1.0-1.49	1	1
1.5-1.99	1	1
2.0-2.49	0	0
2.5-2.99	5	5
3.0-3.49	22	22
3.5-3.99	5	5
4.0-4.49	3	3
4.5-4.99	3	3

**Plot a histogram**

**Histogram of birth weight (kg)**

**Calculation of statistics**

MEAN	MEDIAN	MODE	RANGE	VARIANCE	STANDARD DEVIATION	STANDARD ERROR	95% CI (Excel)	95% CI (SE X 19.05)
2.5	2.5	3.0-3.49	4.99	1.5	1.5	0.387	2.725	2.725

Use the interactive buttons to reveal the answers as you work through the activity on-screen.

Activities that manipulate data using formulae are supported by spreadsheets. These include all data and comments on graphical analysis.

# 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 may 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: Analyzing 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.

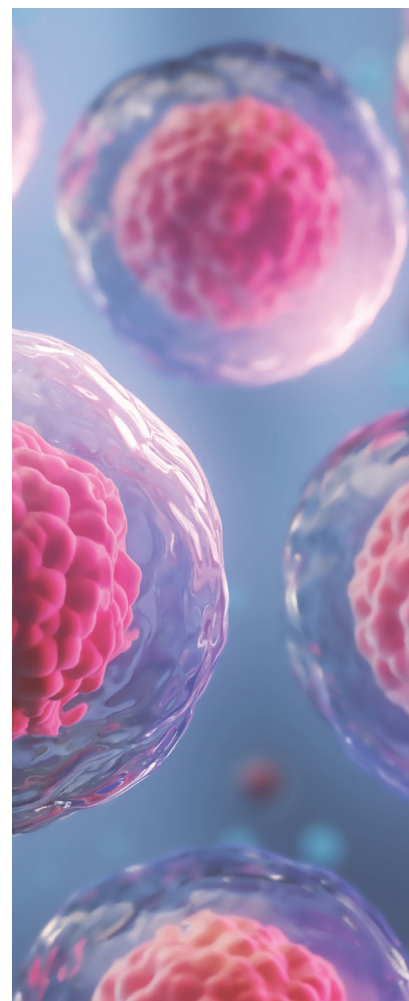
## 1: SCIENCE PRACTICES

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	



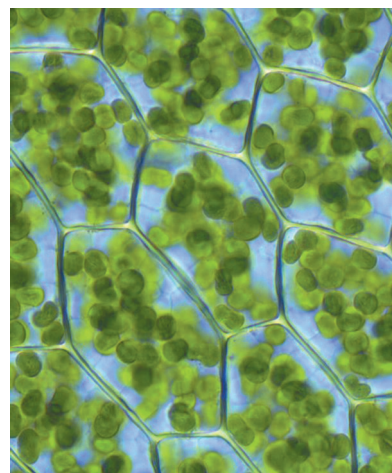
## 4: GROWTH AND DEVELOPMENT

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

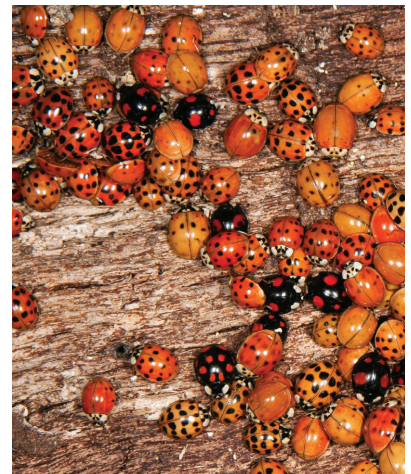
## 6: INTERDEPENDENCE IN ECOSYSTEMS

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-LS1-1, 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	



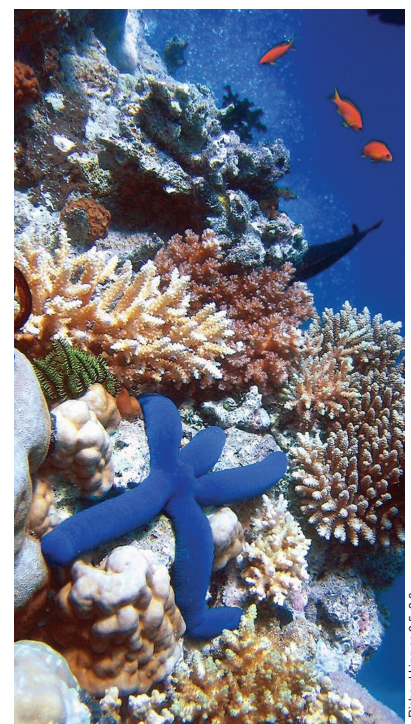
## 7: ENERGY FLOW AND NUTRIENT CYCLES

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





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



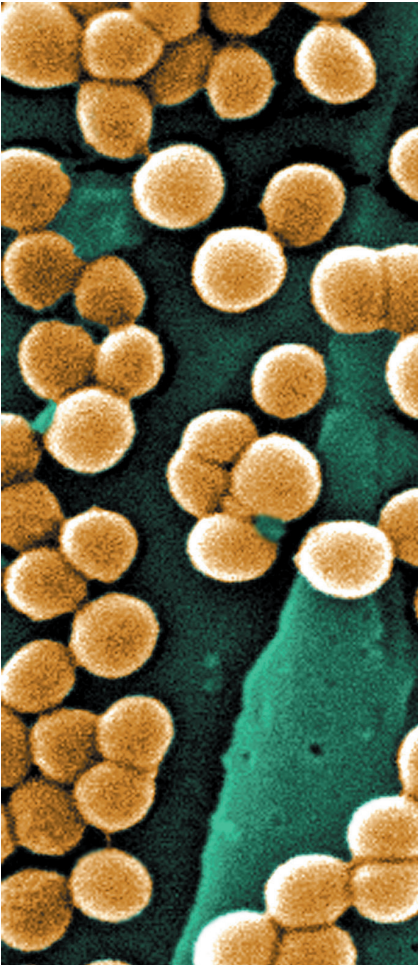
10: INHERITANCE OF TRAITS

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	



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





**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	



Famartin CC 3.0

**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.

**66 Summing Up**

1. The diagrams below show same DNA in it. Use diagrams to explain how different cells need to use the same DNA.

Activities incorporating a specified CCSS ELA/ Literacy Connections and ELD standards are identified on the activity page by a blue pencil symbol.

**200**

**Logistic growth**  
 $dN/dt = rN(K-N/K)$

The population tends to stabilize around carrying capacity (K). Any fluctuations (blue dashed line) are caused by variations in the birth rate and death rate as a result of the population density slightly exceeding or falling below carrying capacity.

Carrying capacity (K)

Environmental resistance increases as the population approaches carrying capacity.

Early on, growth is exponential.

Lag phase

**Logistic (S) curve**  
 As N approaches K, the population encounters environmental resistance to growth. The population reaches equilibrium around K. This is the population size that can be supported by the environment.

**Logistic growth**  
 Logistic growth is characterized by a brief, early phase of exponential growth, followed by a slowing in growth as the population reaches carrying capacity. Logistic growth produces a S-shaped (sigmoidal) growth curve. Populations may fluctuate around K but these fluctuations tend to become less pronounced over time.

Logistic growth is expressed mathematically as:  $dN/dt = rN(K-N/K)$

Activities incorporating a specified CCSS Math Connection are identified on the activity page by a red math symbol.

2. (a) V...  
 (b) V...  
 (c) Deaths = 20: Deaths...  
 (e) State whether the population is increasing or decreasing.

3. (a) What are the features of exponential growth? \_\_\_\_\_  
 (b) Why don't populations continue to increase exponentially in an environment? \_\_\_\_\_

4. (a) Describe the features of logistic growth: \_\_\_\_\_  
 (b) What is environmental resistance and what role does it have in limiting population growth? \_\_\_\_\_

(c) Explain why a population might overshoot carrying capacity before stabilizing around carrying capacity: \_\_\_\_\_

5. What happens to population growth rate as  $K-N/K$  approaches 0? \_\_\_\_\_

©2022 BIOZONE International  
 ISBN: 978-1-98-856692-4  
 Photocopying Prohibited

## 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 Solution		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	<i>In-Situ</i> 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