BIOZONE

IMPLEMENTATION GUIDE

Version 1.0

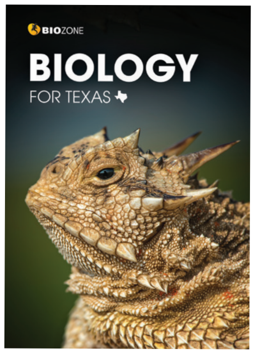
BIOLOGY

FOR TEXAS

2024-2025 Calendar

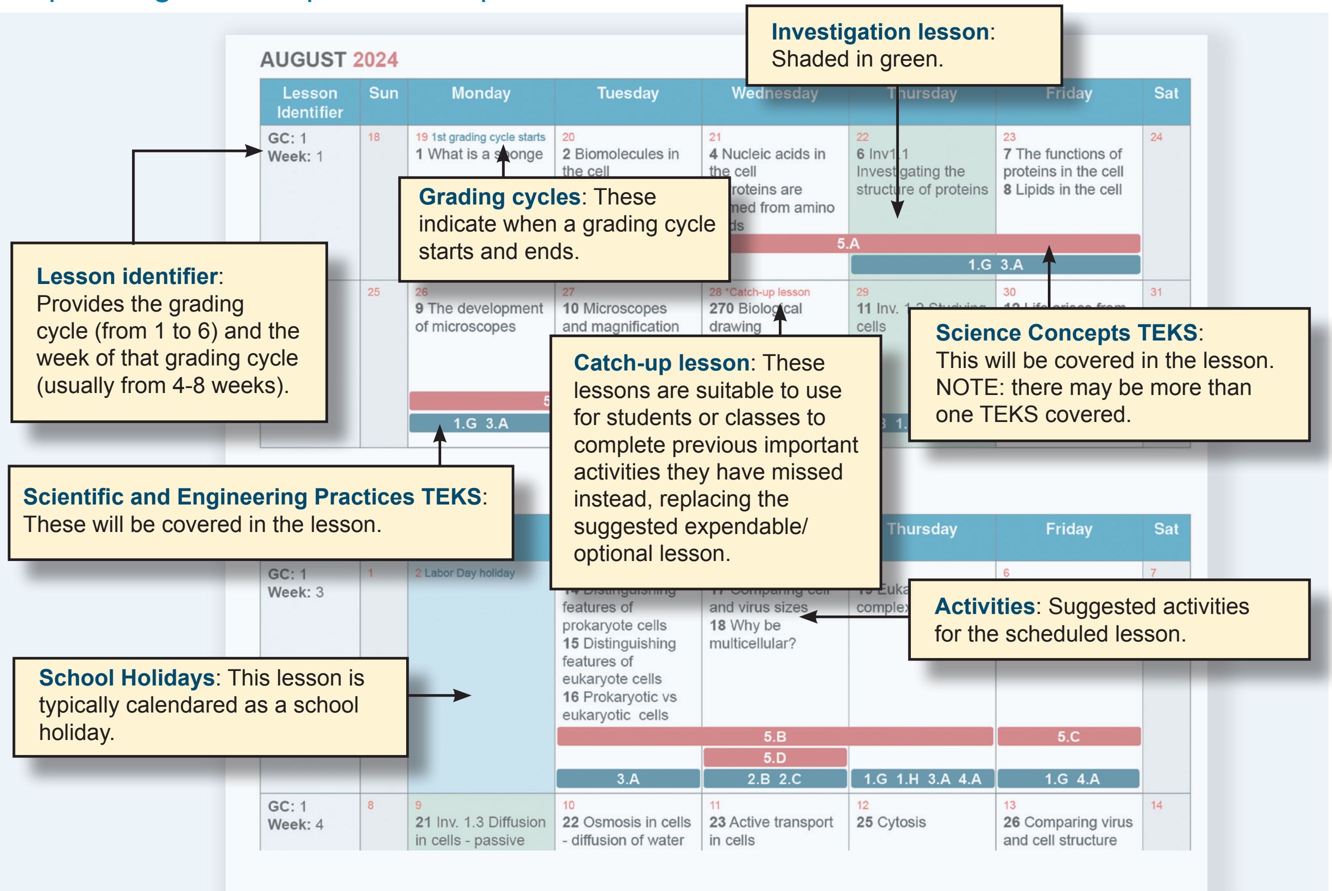
Contents

IMPLEMENTATION GUIDE



This Implementation Guide complements the Classroom Guide in **BIOZONE's** *Biology for Texas*, Teacher Edition, providing additional teacher tools for effective lesson implementation of the worktext.

Unpacking the Scope and Sequence Guide



This scope and sequence guide is based on a teaching program that has a regular Biology lesson once a day, of around 45-50min. However, the guide can be easily adapted to specifically cater for less frequent, yet longer, lessons that occur in some schools. The dates of each month will change, and holidays will shift, depending on the calendared year. The detailed lesson implementation guide can be easily modified to reflect these changes. Grading cycles can be adjusted depending on the individual needs of the school, class, or students.

Activities in chapter 10, containing additional Scientific and Engineering Practices TEKS, can be integrated into appropriate lessons, based on the individual student and class needs, at the teacher's discretion. These can also be added into the scope and sequence or pacing guide if preferred.

The suggested scope and sequence order of the concepts taught follows the structure of the worktext, with consideration given to building from cellular level in chapter 1 to the interconnected ecosystem level in chapter 9. Concepts covered earlier in the course are designed to be built upon, and incorporated, as the biological systems expand.

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BIOZONE Corporation
USA and Canada
FREE phone: 1-855-246-4555
FREE fax: 1-855-935-3555
Email: sales@biozone.com
Web: www.biozone.com

Scope and Sequence Guide - **Biology for Texas**

AUGUST 2024

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 1 **Week:** 1	18	19 1st grading cycle starts **1** What is a sponge? 5.B	20 **2** Biomolecules in the cell **3** Carbohydrates in the cell	21 **4** Nucleic acids in the cell **5** Proteins are formed from amino acids 5.A	22 **6** Inv1.1 Investigating the structure of proteins 1.G 3.A	23 **7** The functions of proteins in the cell **8** Lipids in the cell	24
GC: 1 **Week:** 2	25	26 **9** The development of microscopes 5.A 1.G 3.A	27 **10** Microscopes and magnification 2.C	28 *Catch-up lesson **270** Biological drawing **271** Practicing biological drawing 1.F	29 **11** Inv. 1.2 Studying cells 1.B 1.C 1.D 1.F	30 **12** Life arises from life **13** The cell is the unit of life 5.B 5.D 1.B 4.B	31

SEPTEMBER 2024

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 1 **Week:** 3	1	2 Labor Day holiday	3 **14** Distinguishing features of prokaryote cells **15** Distinguishing features of eukaryote cells **16** Prokaryotic vs eukaryotic cells 3.A	4 **17** Comparing cell and virus sizes **18** Why be multicellular? 5.B 5.D 2.B 2.C	5 **19** Eukaryotes have complex cells 1.G 1.H 3.A 4.A	6 **20** Cell membrane structure 5.C 1.G 4.A	7
GC: 1 **Week:** 4	8	9 **21** Inv. 1.3 Diffusion in cells - passive transport 1.B 1.C 1.D 1.E 2.D 3.A 4.A	10 **22** Osmosis in cells - diffusion of water 5.C	11 **23** Active transport in cells **24** Ion pumps 5.A 3.A	12 **25** Cytosis	13 **26** Comparing virus and cell structure 5.D 3.A 4.B	14
GC: 1 **Week:** 5	15	16 **27** Viral reproduction and disease 3.A	17 **28** How is viral disease transmitted? 1.F	18 **29** Epidemics and pandemics 5.D 1.F 3.A	19 **30** Inv. 1.4 Modeling viral disease outbreak and spread 1.B 1.E 1.F 1.G 2.B 2.D	20 *Catch-up lesson **31** Viral disease case study: COVID-19 3.A	21
GC: 1 **Week:** 6	22	23 **32** What is a sponge? revisited **33** Summing up 5.A 5.B 5.D	24 **34** The power to rebuild 1.A	25 **35** Growth and repair of cells **36** The Eukaryotic cell cycle 6.C 3.A	26 **37** Mitosis and cytokinesis **38** Inv. 2.1 modeling mitosis 6.A	27 **39** DNA replication **40** Stages of DNA replication	28
GC: 1 **Week:** 7	29	30 **41** Evidence for a semi-conservative model 2.C 3.A 4.A 4.B					

OCTOBER 2024

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 1 **Week:** 7			1 **42** Differentiation of cells **43** Blood cell differentiation **44** Specialization of plant cells **45** Specialization of animal cells 6.B 3.A	2 **46** Cells and the environment **47** The role of the environment in cell development 2.B 2.C	3 **48** Cell cycle disruptions and cancer 6.C 1.G 1.H 3.A 4.A	4 1st grading cycle ends **49** The power to rebuild revisited **50** Summing up 6.A 6.B 1.G 4.A	5
GC: 2 **Week:** 1	6	7 2nd grading cycle starts **51** Mouse trap	8 **52** A closer look at chloroplasts and mitochondria **53** Energy in cells 11.A 11.B 1.F 3.A	9 **54** Introduction to photosynthesis **55** Stages in photosynthesis	10 **56** Inv. 3.1 Investigating photosynthetic rate 1.B 1.D 1.F 2.B 2.C	11 **57** Energy transfer between systems **58** Energy from glucose 11.A 2.C	12
GC: 2 **Week:** 2	13	14 **59** Aerobic cellular respiration 11.A 2.C	15 **60** Inv 3.2 Measuring respiration 1.B 1.C 1.D 1.E 1.F 2.B 2.C	16 **61** Modeling photosynthesis and respiration 11.A 1.G	17 **62** Reactions in cells **63** What are enzymes? **64** How enzymes work and spread 11.B 1.F 2.B 3.A	18 **65** Inv. 3.3 Enzymes have optimal conditions to work 1.C 1.D 1.E 1.F 2.B 3.A 3.B	19
GC: 2 **Week:** 3	20	21 **66** Design an experiment to test catalase activity 11.B 1.A 1.B 1.C 1.F 2.B 2.D	22 **67** Mouse trap revisited **68** Summing up	23 **69** Complex interactions **70** The hierarchy of life **71** Overview of body systems **72** The body's systems work together 4.A	24 **73** Homeostasis **74** Negative feedback regulates the body 12.A 3.A	25 **75** Nervous regulatory systems **76** Hormonal regulation **77** Nervous and endocrine interactions	26
GC: 2 **Week:** 4	27	28 **78** Interactions regulating the blood **79** Interactions regulating respiratory gases 12.A 2.B 4.A	29 **80** Inv 4.1 / 4.2 Effect of exercise on heart rate and breathing 1.B 1.F 2.C 2.B 3.A	30 **81** Interactions for nutrient absorption **82** Regulating blood glucose levels 4.B	31 **83** Interacting systems: The menstrual cycle **84** Interacting systems: Pregnancy and birth		

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NOVEMBER 2024

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 2 **Week:** 4						1 **85** The immune system **86** The body's defenses: A layered system 12.A	2
GC: 2 **Week:** 5	3	4 **87** Blood clotting and defense **88** Interacting systems: responding to infection 12.A	5 **89** Plant organ systems **90** Inv. 4.3 Interacting systems in plants 12.B 1.C 1.D 1.E 1.F 3.A 4.A	6 **91** Xylem and phloem **92** Stem and root structure **93** Transpiration 12.B 3.A	7 **94** Inv. 4.4 investigating transpiration 12.B 1.A 1.B 1.E 1.F 2.B 3.A 4.A	8 **95** Uptake at the root **96** Translocation 12.B	9
GC: 2 **Week:** 6	10	11 **97** Asexual reproduction **98** Inv. 4.5 Investigating plant propagation 12.B 1.B 2.B	12 *Catch-up lesson **99** Insect pollinated plants **100** Wind pollinated plants **101** Pollination and fertilization 12.B	13 **102** Inv. 4.6 Seed structure and germination **103** Seed dispersal 12.B 1.B 2.B	14 **104** Responses in plants **105** Tropisms and growth responses 12.B	15 **106** Auxins, gibberellins, and ABA **107** Plant hormones as signal molecules **109** Gibberellins and stem elongation 12.B 1.F 2.C 2.D	16
GC: 2 **Week:** 7 **GC:** 3 **Week:** 1	17	18 **108** Investigating phototropism **110** Investigating gravitropism **111** Investigating gravitropism in seeds **112** Nastic responses 12.B 1.G 3.A	19 2nd grading cycle ends **113** Complex interactions revisited **114** Summing up	20 3rd grading cycle starts **115** Real-life superpowers **116** DNA and chromosomes **117** DNA and RNA 7.A 1.G	21 **118** Inv. 5.1 Modeling DNA structure **119** Discovering DNA 7.A 1.G 2.A 4.B	22 **120** The origin of DNA 7.A 3.A	23
	24	25 Thanksgiving break	26 Thanksgiving break	27 Thanksgiving break	28 Thanksgiving break	29 Thanksgiving break	30

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DECEMBER 2024

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 3 **Week:** 2	1	2 **121** Introduction to gene expression **122** Transcription **123** mRNA editing 7.B	3 **124** The genetic code **125** Translation	4 **126** Inv 5.2 Modeling gene expression 1.G	5 **127** DNA sequence and traits 7.A	6 **128** Mutations 7.C	7
GC: 3 **Week:** 3	8	9 **129** Changes to DNA 7.C	10 **130** Effects of mutation 3.A	11 **131** Molecular technologies and DNA 7.D	12 **132** Polymerase chain reaction **137** Testing for COVID-19	13 **133** Gel electrophoresis **134** Making recombinant DNA 3.A	14
GC: 3 **Week:** 4	15	16 **135** Gene editing with CRISPR 7.D 4.B	17 *Catch-up lesson **136** Genetic engineering for insulin	18 **138** Molecular technologies and research 3.B 4.C	19 **139** Real-life superpowers revisited	20 **140** Summing up	21
	22	23 Winter holidays	24 Winter holidays	25 Winter holidays	26 Winter holidays	27 Winter holidays	28
	29	30 Winter holidays	31 Winter holidays				

JANUARY 2025

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
				1 Winter holidays	2 Winter holidays	3 Winter holidays	4
GC: 3 **Week:** 5	5	6 **141** Anyone for chocolate? **142** What is a trait? **143** Different alleles for different traits 1.B 2.B 3.A 4.A	7 **144** Sources of variation **145** Inv. 6.1 Examples of genetic variation 1.F	8 **146** Sexual reproduction produces genetic variation 8.A	9 **147** Meiosis **148** Meiosis and variation 3.A	10 **149** Inv. 6.2 Modeling meiosis 1.D 1.F 1.G 3.A	11
GC: 3 **Week:** 6	12	13 **150** Linked genes and variability **151** Mendelian genetics 8.A	14 **152** Monohybrid crosses **153** Probability 2.B 2.C 3.B	15 *Catch-up lesson **154** Practicing monohybrid crosses	16 **155** Dihybrid crosses 8.B	17 **156** Non-Mendelian genetics **157** Incomplete dominance 2.B 3.B	18
GC: 3 **Week:** 7	9	20 MLK Day	21 **158** Codominance 8.B 2.B	22 **159** Sex linkage	23 **160** Testing the outcomes of genetic crosses 2.B 2.C	24 **161** Anyone for chocolate? Revisited **162** Summing up	25
GC: 4 **Week:** 1	26	27 3rd grading cycle ends **162** Summing up research project 3.B 4.B	28 4th grading cycle starts **163** Dinosaur or bird? **164** Evolution and common ancestry 9.A 3.B 4.A 4.B	29 **165** Fossil formation **166** The fossil record **167** Interpreting the fossil record 9.B 1.F 2.B 3.A 4.A	30 **168** Transitional fossils	31 **169** Anatomical homology	

FEBRUARY 2025

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 4 **Week:** 2	2	3 **170** Biogeography and common ancestry 9.A 1.A	4 **171** DNA evidence for common ancestry **172** Protein evidence for common ancestry 9.A 2.B 4.A	5 **173** Developmental homology 9.A	6 **174** Changes in the fossil record 9.A 9.B 1.G 1.F 3.A	7 **175** Punctuated equilibrium and gradualism 9.B 2.B 3.A 4.A	8
GC: 4 **Week:** 3	9	10 **176** Developing the theory of evolution 1.H 4.A 4.B	11 **177** Dinosaur or bird? Revisited 9.A 3.A	12 **178** Summing up 9.A 9.B 3.A	13 **179** How does an elephant lose its tusks? 10.A 10.B 3.B	14 **180** How does natural selection work? **182** The role of variation in populations 10.B 3.A	15
GC: 4 **Week:** 4	16	17 **182** Inv. 8.1 Modeling natural selection with M&Ms 10.B 1.B 1.C 1.E 1.G 2.A	18 **183** Natural selection in Galapagos finches 10.B 1.F 1.G 2.B 4.A	19 **184** Selection pressure in populations 10.A 1.G 3.A	20 **185** Directional selection in moth populations 10.A 10.B 2.B	21 **186** Measuring gene pool change **187** Natural selection in rock pocket mice 10.B 1.F 2.B 2.C 3.A	22
GC: 4 **Week:** 5	23	24 **188** Inv. 8.2 Modeling natural selection in rock pocket mice 10.B 1.B 1.C 1.E 1.G 2.A	25 **189** What is a species? **190** How species form 10.C 1.G 3.A	26 **191** Patterns of evolution **192** Evolutionary mechanisms in gene pools 10.C 10.D	27 **193** Gene flow 10.D 1.G 2.D 3.A 4.B	28 *Catch-up lesson **193** Gene flow (2nd lesson) 10.D 1.G 2.D 3.A 4.B	

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MARCH 2025

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 4 **Week:** 9	2	3 **194** Genetic drift **195** The founder effect 10.D 2.C 4.A	4 **196** Genetic bottle necks 1.G 4.A	5 **197** Mutations and the gene pool **198** Genetic recombination and the gene pool 1.G 2.B 3.B	6 **199** How does an elephant lose its tusks? Revisited 10.A 10.B 1.G 1.F 3.A	7 4th grading cycle ends **200** Summing up 10.C 10.D 3.A	8
	9	10 Spring Break	11 Spring Break	12 Spring Break	13 Spring Break	14 Spring Break	15
GC: 5 **Week:** 1	16	17 5th grading cycle starts **201** A mammoth task 13.C 13.D 4.A 4.B	18 *Catch-up lesson **202** Components of an ecosystem 2.B	19 **203** Habitat and tolerance range **204** The ecological niche	20 **205** Ecosystem dynamics 13.D	21 **206** The resilient ecosystem **207** A case study in ecosystem resilience 13.A 2.B 3.A	22
GC: 5 **Week:** 2	23	24 **208** Species interactions 1.G	25 **209** Predator-prey relationships 13.A 2.B	26 **210** Predation and destabilized ecosystems **211 Inv. 9.1** Investigating predator-prey stability 2.D 1.C 1.E 1.F 2.C	27 **212** Competition for resources **213** Intraspecific competition **214** Interspecific competition 4.A	28 **215** The impact of competing alien species 1.B	29
GC: 5 **Week:** 3	30	31 **216** Parasitism: one-sided benefits 13.A 1.B 3.B					

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APRIL 2025

Lesson Identifier	Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
GC: 5 **Week:** 3			1 **216** Parasitism: one-sided benefits (research) 13.A 1.B 3.B	2 **217** Commensalism: free for the taking	3 *Catch-up lesson **217** Commensalism: free for the taking (research)	4 **175** Mutualism: A beneficial dependence 1.C 1.E 3.B	5
GC: 5 **Week:** 4	6	7 Inv. 9.2 Mutualism: A beneficial dependence 13.A 1.C 1.E 3.B	8 *Catch-up lesson **219** Eat or be eaten 13.B 1.F	9 *Catch-up lesson **220** Photoautotrophs and heterotrophs **221** Trophic levels 3.A 3.B	10 **222** Matter cycles through an ecosystem	11 **223** Disruption of matter cycles 1.G	12
GC: 5 **Week:** 5	13	14 **224** Energy flows through an ecosystem 1.F 1.G 2.B 2.C 3.A	15 **225** Ecological pyramids 2.A 4.A	16 **226** Inv. 9.3 Investigating ecological pyramids 13.B 1.F 1.B 3.B	17 **227** Disruption to biomass and energy flow 3.A	18 Good Friday	19
GC: 5 **Week:** 6	20	21 Easter Monday	22 *Catch-up lesson **228** Nutrient cycles 13.C 1.G	23 **229** The carbon cycle 3.A	24 **230** Inv. 9.4 Modeling the carbon cycle (part one) 1.C 1.D 1.F	25 *Catch-up lesson **230** Inv. 9.4 Modeling the carbon cycle (part two)	26
GC: 5 **Week:** 7	27	28 **231** Disruptions to the carbon cycle 13.C 1.G 3.A	29 **232** Inv. 9.5 ocean acidification 1.B 1.C 1.D 2.B 2.D 4.A	30 **233** The nitrogen cycle 1.G 3.A			

NOTES

MAY 2025

<table>
<tr><th>Lesson Identifier</th><th>Sun</th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th><th>Sat</th></tr>
<tr><td>GC: 5
Week: 7</td><td></td><td></td><td></td><td></td><td>1
234 Disruptions to the nitrogen cycle
13.C
1.F 2.B 2.C</td><td>2 5th grading cycle ends
274 Analyzing experimental data (summative)
1.B 1.C 1.E 1.F
2.B 2.D 4.A</td><td>3</td></tr>
<tr><td>GC: 6
Week: 1</td><td>4</td><td>5 6th grading cycle starts
235 Ecosystem changes can be permanent</td><td>6
236 Biodiversity in an ecosystem</td><td>7
237 Keystone species and ecosystem stability
13.A</td><td>8 *Catch-up lesson
263 Correlation or causation
269 Detecting bias in samples</td><td>9
238 Human activity and biodiversity</td><td>10</td></tr>
<tr><td></td><td></td><td colspan="3">13.D</td><td></td><td>13.D</td><td></td></tr>
<tr><td></td><td></td><td>1.G 3.A</td><td>1.F 2.B 2.C</td><td>3.A</td><td>1.F 2.B 2.C</td><td>1.B 1.F 2.A 2.B
2.C 2.D 3.A 4.B</td><td></td></tr>
<tr><td>GC: 6
Week: 2</td><td>11</td><td>12 *Catch-up lesson
238 Human activity and biodiversity</td><td>13
238 Inv. 9.6 Human activity and biodiversity (part one)</td><td>14
238 Inv. 9.6 Human activity and biodiversity (part two)</td><td>15
239 Human impacts on marine biodiversity</td><td>16
239 Inv. 9.7 Human impacts on marine biodiversity</td><td>17</td></tr>
<tr><td></td><td></td><td colspan="5">13.D</td><td></td></tr>
<tr><td></td><td></td><td colspan="5">1.B 1.F 2.A 2.D 3.A</td><td></td></tr>
<tr><td></td><td></td><td colspan="3">2.B 2.C 4.B</td><td colspan="2">3.C</td><td></td></tr>
<tr><td>GC: 6
Week: 3</td><td>18</td><td>19
240 Deforestation and species survival</td><td>20
240 Deforestation and species survival (debate)</td><td>21
241 Can't see the wood for the trees</td><td>22
241 Can't see the wood for the trees (research lesson 1)</td><td>23 *Catch-up lesson
241 Can't see the wood for the trees (research lesson 2)</td><td>24</td></tr>
<tr><td></td><td></td><td colspan="5">13.D</td><td></td></tr>
<tr><td></td><td></td><td colspan="2">2.B 3.B 3.C 4.A</td><td colspan="3">3.A 3.B 4.B</td><td></td></tr>
<tr><td>GC: 6
Week: 4</td><td>25</td><td>26 Memorial day</td><td>27 *Catch-up lesson
242 The effects of damming on biodiversity
13.D
3.A</td><td>28 *Catch-up lesson
243 Humans depend on biodiversity</td><td>29
244 A mammoth task revisited</td><td>30 6th grading cycle ends
245 Summing up
13.A</td><td>31</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2">13.D</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2">1.F</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>3.C 4.A</td><td>3.A 3.B</td><td></td></tr>
</table>

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Pacing Guide - **Biology for Texas**

Grading Cycle	Week of GC	Number lessons	Date start	Chapter	Activities covered (☐ Investigation ☐ Summative assessment)
1	1	5		1	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8
1	2	5		1	☐ 9 ☐ 10 ☐ 270 ☐ 271 ☐ 11 ☐ 12 ☐ 13
1	3	4		1	☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20
1	4	5		1	☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26
1	5	5		1	☐ 27 ☐ 28 ☐ 29 ☐ 30 ☐ 31
1	6	1		1	☐ 32 ☐ 33
1	6	4		2	☐ 34 ☐ 35 ☐ 36 ☐ 37 ☐ 38 ☐ 39 ☐ 40
1	7	4		2	☐ 41 ☐ 42 ☐ 43 ☐ 44 ☐ 45 ☐ 46 ☐ 47 ☐ 48 ☐ 49 ☐ 50
2	1	5		3	☐ 51 ☐ 52 ☐ 53 ☐ 54 ☐ 55 ☐ 56 ☐ 57 ☐ 58
2	2	5		3	☐ 59 ☐ 60 ☐ 61 ☐ 62 ☐ 63 ☐ 64 ☐ 65
2	3	2		3	☐ 66 ☐ 67 ☐ 68
2	3	3		4	☐ 69 ☐ 70 ☐ 71 ☐ 72 ☐ 73 ☐ 74 ☐ 75 ☐ 76 ☐ 77
2	4	5		4	☐ 78 ☐ 79 ☐ 80 ☐ 81 ☐ 82 ☐ 83 ☐ 84 ☐ 85 ☐ 86
2	5	5		4	☐ 87 ☐ 88 ☐ 89 ☐ 90 ☐ 91 ☐ 92 ☐ 93 ☐ 94 ☐ 95 ☐ 96
2	6	5		4	☐ 97 ☐ 98 ☐ 99 ☐ 100 ☐ 101 ☐ 102 ☐ 103 ☐ 104 ☐ 105 ☐ 106 ☐ 107 ☐ 109
2	7	2		4	☐ 108 ☐ 110 ☐ 111 ☐ 112 ☐ 113 ☐ 114
3	1	3		5	☐ 115 ☐ 116 ☐ 117 ☐ 118 ☐ 119 ☐ 120
3	2	5		5	☐ 121 ☐ 122 ☐ 123 ☐ 124 ☐ 125 ☐ 126 ☐ 127 ☐ 128
3	3	5		5	☐ 129 ☐ 130 ☐ 131 ☐ 132 ☐ 137 ☐ 133 ☐ 134
3	4	5		5	☐ 135 ☐ 136 ☐ 138 ☐ 139 ☐ 140
4	1	5		6	☐ 141 ☐ 142 ☐ 143 ☐ 144 ☐ 145 ☐ 146 ☐ 147 ☐ 148 ☐ 149
4	2	5		6	☐ 150 ☐ 151 ☐ 152 ☐ 153 ☐ 154 ☐ 155 ☐ 156 ☐ 157
4	3	4		6	☐ 158 ☐ 159 ☐ 160 ☐ 161 ☐ 162
4	4	1		6	☐ 162
4	4	4		7	☐ 163 ☐ 164 ☐ 165 ☐ 166 ☐ 167 ☐ 168 ☐ 169
4	5	5		7	☐ 170 ☐ 171 ☐ 172 ☐ 173 ☐ 174 ☐ 175
4	6	3		7	☐ 176 ☐ 177 ☐ 178
4	6	2		8	☐ 179 ☐ 180 ☐ 182
4	7	5		8	☐ 181 ☐ 183 ☐ 184 ☐ 185 ☐ 186 ☐ 187
4	8	5		8	☐ 188 ☐ 189 ☐ 190 ☐ 191 ☐ 192 ☐ 193
4	9	5		8	☐ 194 ☐ 195 ☐ 196 ☐ 197 ☐ 198 ☐ 199 ☐ 200
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5	4	5		9	☐ 218 ☐ 219 ☐ 220 ☐ 221 ☐ 222 ☐ 223
5	5	4		9	☐ 224 ☐ 225 ☐ 226 ☐ 227
5	6	4		9	☐ 228 ☐ 229 ☐ 230
5	7	5		9	☐ 231 ☐ 232 ☐ 233 ☐ 234 ☐ 274
6	1	5		9	☐ 235 ☐ 236 ☐ 237 ☐ 263 ☐ 269 ☐ 238
6	2	5		9	☐ 238 ☐ 239
6	3	5		9	☐ 240 ☐ 241
6	4	4		9	☐ 242 ☐ 243 ☐ 244 ☐ 245

Vertical Alignment Guide - **Biology for Texas**

Main Concept	Grade / Subject - Student Expectation TEKS			
	Science Grade 6	Science Grade 7	Science Grade 8	Biology (Grade 9-12)
Biomolecules Activity 2-8				**5.A** relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell
Cells Activity 9-19	**13.A** describe the historical development of cell theory and explain how organisms are composed of one or more cells, which come from pre-existing cells and are the basic unit of structure and function		**13.A** identify the function of the cell membrane, cell wall, nucleus, ribosomes, cytoplasm, mitochondria, chloroplasts, and vacuoles in plant or animal cells	**5.B** compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity
	13.B identify and compare the basic characteristics of organisms, including prokaryotic and eukaryotic, unicellular and multicellular, and autotrophic and heterotrophic			
Homeostasis Activity 20-25				**5.C** investigate homeostasis through the cellular transport of molecules
Viruses Activity 26-31				**5.D** compare the structures of viruses to cells and explain how viruses spread and cause disease
Cell Cycle / Mitosis Activity 35-41				**6.A** explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models
Cell Specialization Activity 42-47				**6.B** explain the process of cell specialization through cell differentiation, including the role of environmental factors
Cell Cycle Disruption / Cancer Activity 48				**6.C** relate disruptions of the cell cycle to how they lead to the development of diseases such as cancer
DNA Structure Activity 116-120			**13.B** describe the function of genes within chromosomes in determining inherited traits of offspring	**7.A** identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA
Gene Expression Activity 121-127				**7.B** describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)
DNA Changes / Mutation Activity 128-130				**7.C** identify and illustrate changes in DNA and evaluate the significance of these change
Molecular Technology Activity 131-138				**7.D** discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices

Vertical Alignment Guide - **Biology for Texas**

Main Concept	Grade / Subject - Student Expectation TEKS			
	Science Grade 6	**Science Grade 7**	**Science Grade 8**	**Biology (Grade 9-12)**
Meiosis / Genetic Variation Activity 143-150		**13.C** compare the results of asexual and sexual reproduction of plants and animals in relation to the diversity of offspring and the changes in the population over time		**8.A** analyze the significance of chromosome reduction, independent assortment, and crossing-over during meiosis in increasing diversity in populations of organisms that reproduce sexually
Genetic Inheritance Activity 151-160				**8.B** predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles
Common Ancestry Activity 164-173		**10.A** describe the evidence that supports that Earth has changed over time, including fossil evidence, plate tectonics, and superposition		**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental
Fossil Record Abrupt Appearance and Stasis Activity 174-175				**9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record
Natural Selection in Populations Activity 182-185	**13.C** describe how variations within a population can be an advantage or disadvantage to the survival of a population as environments change	**13.D** describe and give examples of how natural and artificial selection change the occurrence of traits in a population over generations	**13.C** describe how variations of traits within a population lead to structural, behavioral, and physiological adaptations that influence the likelihood of survival and reproductive success of a species over generations.	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals
Natural Selection Elements Activity 176 Activity 180-181 Activity 187-188				**10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success
Speciation Activity 189-191				**10.C** analyze and evaluate how natural selection may lead to speciation
Evolution and Gene Pools Activity 186 Activity 192-198				**10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population
Photosynthesis and Cellular Respiration Activity 52-61				**11.A** explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes
Enzymes Activity 62-66				**11.B** investigate and explain the role of enzymes in facilitating cellular processes.

Vertical Alignment Guide - **Biology for Texas**

Main Concept	Grade / Subject - Student Expectation TEKS			
	Science Grade 6	**Science Grade 7**	**Science Grade 8**	**Biology (Grade 9-12)**
Animal Body Systems Activity 70-88		**13.A** identify and model the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, urinary, reproductive, integumentary, nervous, immune, and endocrine systems		**12.A** analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals
		13.B describe the hierarchical organization of cells, tissues, organs, and organ systems within plants and animals;		
Plant Systems Activity 89-112				**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures.
Ecosystems Activity 202-207	**12.A** investigate how organisms and populations in an ecosystem depend on and may compete for biotic factors such as food and abiotic factors such as availability of light and water, range of temperatures, or soil composition	**14.B** describe the characteristics of the recognized kingdoms and their importance in ecosystems such as bacteria aiding digestion or fungi decomposing organic matter		
	12.C describe the hierarchical organization of organism, population, and community within an ecosystem			
Ecological Relationships Activity 208-218	**12.B** describe and give examples of predatory, competitive, and symbiotic relationships between organisms, including mutualism, parasitism, and commensalism			**13.A** investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability
Matter Cycling and Energy Flow in Ecosystems Activity 219-227	**13.B** identify and compare the basic characteristics of organisms, including prokaryotic and eukaryotic, unicellular and multicellular, and autotrophic and heterotrophic	**12.A** diagram the flow of energy within trophic levels and describe how the available energy decreases in successive trophic levels in energy pyramids	**12.A** explain how disruptions such as population changes, natural disasters, and human intervention impact the transfer of energy in food webs in ecosystems	**13.B** analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models
Nutrient Cycles Activity 228-234		**12.B** describe how ecosystems are sustained by the continuous flow of energy and the recycling of matter and nutrients within the biosphere		**13.C** explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles
Biodiversity Activity 235-243		**11.A** analyze the beneficial and harmful influences of human activity on groundwater and surface water in a watershed;	**12.B** describe how primary and secondary ecological succession affect populations and species diversity after ecosystems are disrupted by natural events or human activity	**13.D** explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability
		11.B describe human dependence and influence on ocean systems and explain how human activities impact these systems	**12.C** describe how biodiversity contributes to the stability and sustainability of an ecosystem and the health of the organisms within the ecosystem.	
Classification		**14.A** describe the taxonomic system that categorizes organisms based on similarities and differences shared among groups;		

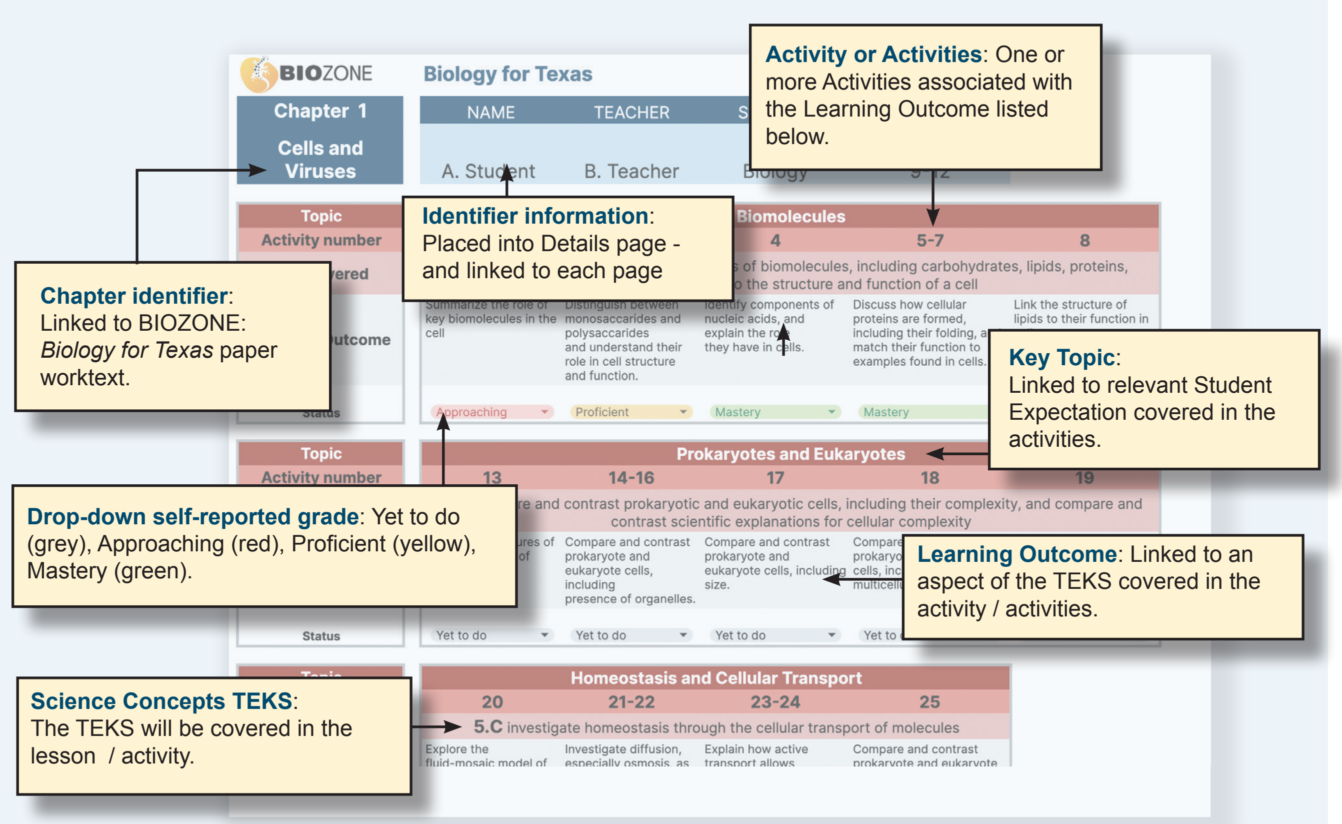
Data Analysis Guide - **Biology for Texas**

According to educational research, one of the most successful pedagogical tools leading to student academic achievement is self-reported grades (Hattie, J. (2009) *Visible Learning*). For each activity in *Biology for Texas*, full and correct student answers are provided in the Teachers's Edition. With teacher guidance, answers can be provided to the whole class at the completion of the activity, or in smaller groups during the lesson, and students are then able to assess their responses and report on their overall grade for each activity, linked to the corresponding Learning Outcome.

Digital Student Progress Trackers, downloadable from the Resource Hub in Google Sheet format, are available in both individual student version and Teacher version. These allow a student to self-report their grades for each Learning Outcome leading to a specific Student Expectation, as part of the Texas Essential Knowledge and Skills (TEKS) for Biology. The students can track their progress as they move through each TEKS, identify patterns in their understanding, and be able to respond by working with more scaffolding, extension, or targeted revision. Teachers can collate the self reported grades on their Teacher Version of the Student Progress Tracker, and easily identify both individual student and whole class trends with the embedded data analysis tools.

Printable Student Progress Tracker templates are available at the back of this guide (IG106-117), and can be used for students to record their progress, as a supplement or alternative to the digital program.

Unpacking the Student Progress Tracker (Student Version)



Self-reported grade

- ☐ **Approaching** relates to a student assessing their responses to the Learning Outcome linked to the activity/activities to be **up to 1/3 correct**.
- ☐ **Proficient** relates to a student assessing their responses to the Learning Outcome linked to the activity/activities to be **over 1/3 correct and up to 2/3 correct**.
- ☐ **Mastery** relates to a student assessing their responses to the Learning Outcome linked to the activity/activities to be **over 2/3 correct**.

Teachers can decide if the self-reported grades relates to a student's first attempt or the final grade after further corrective attempts are made. The grades can also be adjusted after further scaffolding, review, or revision takes place.

Each 'sheet' in the Student Progress Tracker relates to one chapter in the *Biology for Texas* worktext.

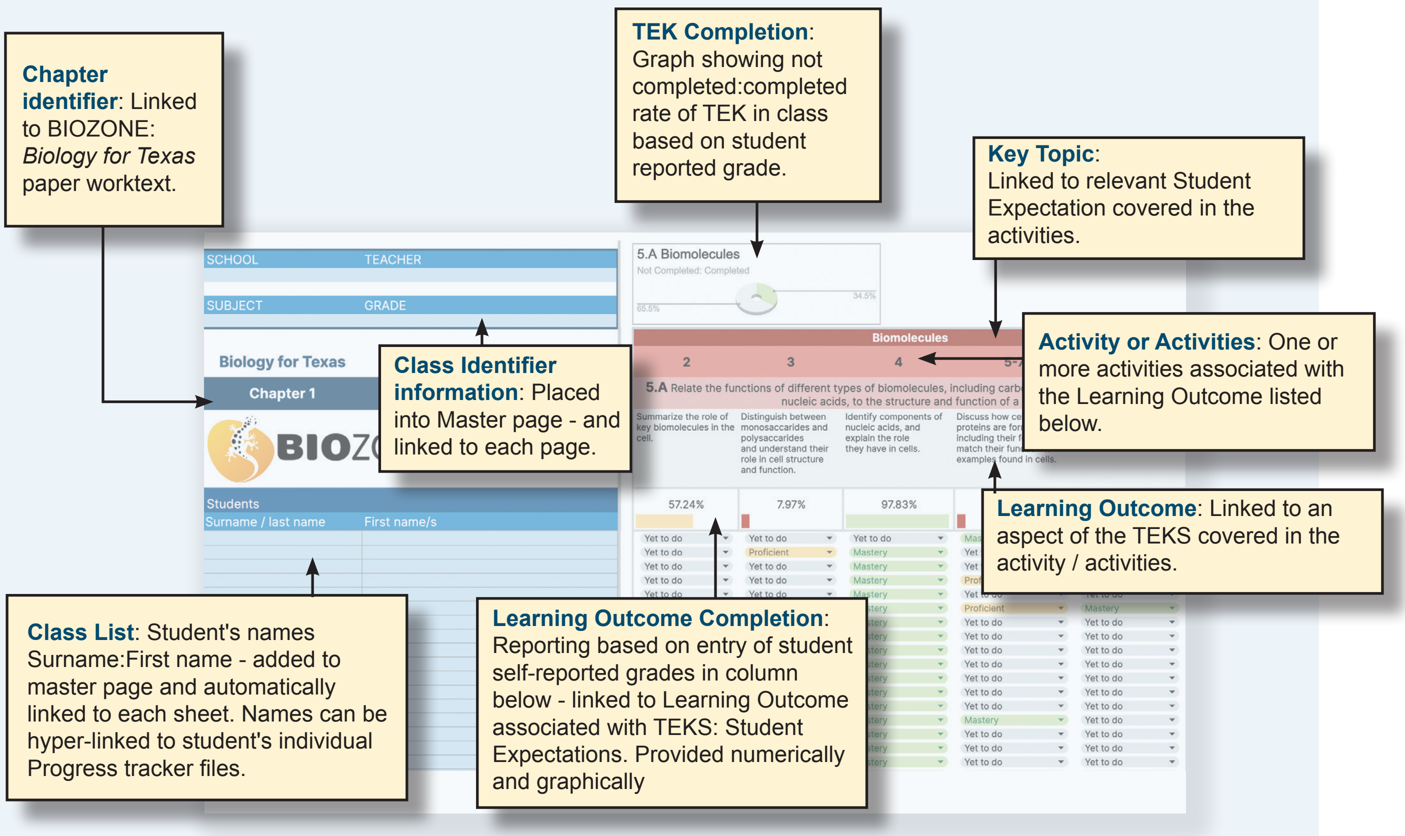
Students download their **STUDENT: Student Progress Tracker Google Sheet** file from the Implementation page in the Resource Hub. The file is then renamed, replacing the term "STUDENT" with their name.
Alternatively, the classroom teacher can download a copy of the **STUDENT: Student Progress Tracker Google Sheet** for each of their students in class, place in a folder in their Google drive, rename each file and send the link of the file to the respective students. The individual student links for each of their Google sheets, can be hyper-linked into the TEACHER'S version of the program, in the name section of the TEACHER MASTER sheet.

Hattie, J. (2009) *Visible Learning*. Rutledge. New York.

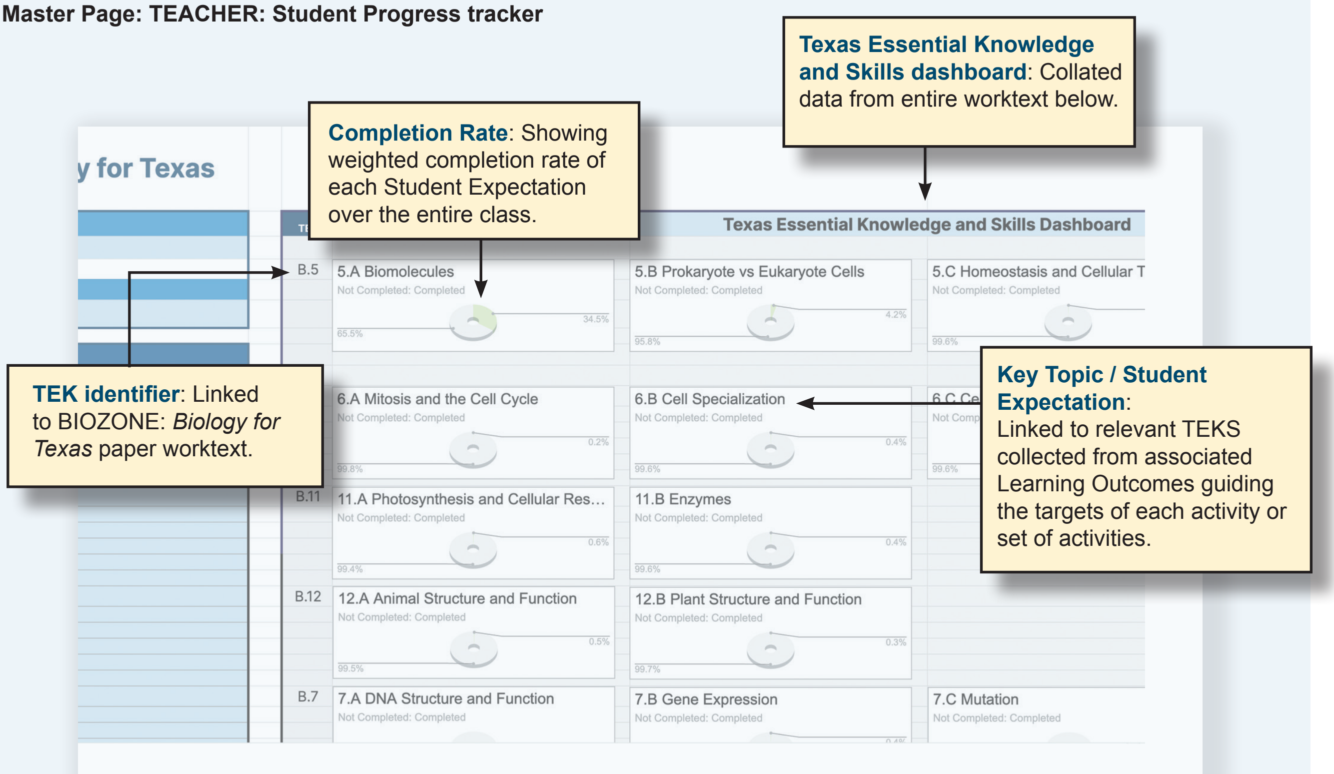
Data Analysis Guide - **Biology for Texas**

Unpacking the Student Progress Tracker (Teacher Version)

Chapter Page: TEACHER: Student Progress tracker



Master Page: TEACHER: Student Progress tracker



Data Analysis Guide - **Biology for Texas**

Gathering information on students self-reported grade
There are a number of different methods to transfer self-reported grades from Students to teachers SPT:

- ☐ Capturing information from a students individual Student Progress Tracker (SPT) file in a folder by clicking on hyper-linked the class list.
- ☐ Opening individual students Student Progress Tracker files in a digital folder and recording their self-reported grade in their TEACHER SPT.
- ☐ Collecting students' self-reported grade during a lesson, either by viewing their open Student Progress Tracker, or collecting the grade verbally or written beside the Learning Outcome (on the front page of each chapter in the worktext).

Vertical data analysis
Percentage rate coverage - given both numerically and graphically at the top column of each Learning Outcome - indicates the average weighted 'completion' in the class. This value is weighted on the 'success rate', where Mastery > Proficient > Approaching is more significant in weighting. The value is also weighted against total number of students in class - where students can be added to the class and the values will automatically adjust. Low values of percentage rate coverage may indicate to the teacher that the class may have to target this Learning Outcome for revision and/or further work.

Horizontal data analysis
Progress of individual students can be clearly identified using the color-coded drop-down indicators viewed across a page, horizontally. A student showing an "Approaching" trend may need to be referred to the scaffolding advice listed in the Lesson implementation section of this Implementation guide. Likewise, a student showing a "Mastery" trend may need to be further extended, with advice and suggestions also listed under each lesson/activity in the Lesson implementation guide.

Teacher reflection

Teacher reflection is an essential component in any program and lesson. The reflections can guide future lessons and be used in subsequent years to adapt and modify a program or lessons to best suit the classes and students. They can be conducted individually by teachers, as well as shared between teachers in faculty meetings.

Reflections can be divided into: 1. How you felt the lesson matched your expectations and any thoughts on future changes that could improve the lesson delivery, and 2. How the lesson was effective in allowing students to achieve the student outcomes and meet the TEKS aligned to that lesson. The following list of questions, although not exhaustive, can be used to scaffold your reflections.

1. Expectations and future modifications

- ☐ Was the lesson implemented as planned?
- ☐ What were the enablers and constraints to effective lesson implementation?
- ☐ How could the enablers and constraints be addressed to adjust the lesson in future?
- ☐ Were there any unexpected outcomes in this lesson? Could they be used to leverage future lessons?
- ☐ How can any unexpected student responses or misconceptions arising be addressed in future lessons?
- ☐ How can this lesson be further adapted to connect to students' lived experiences?
- ☐ What were you most pleased with about how this lesson was implemented? Can you use that example or method in the future?

2. Meeting the needs of students

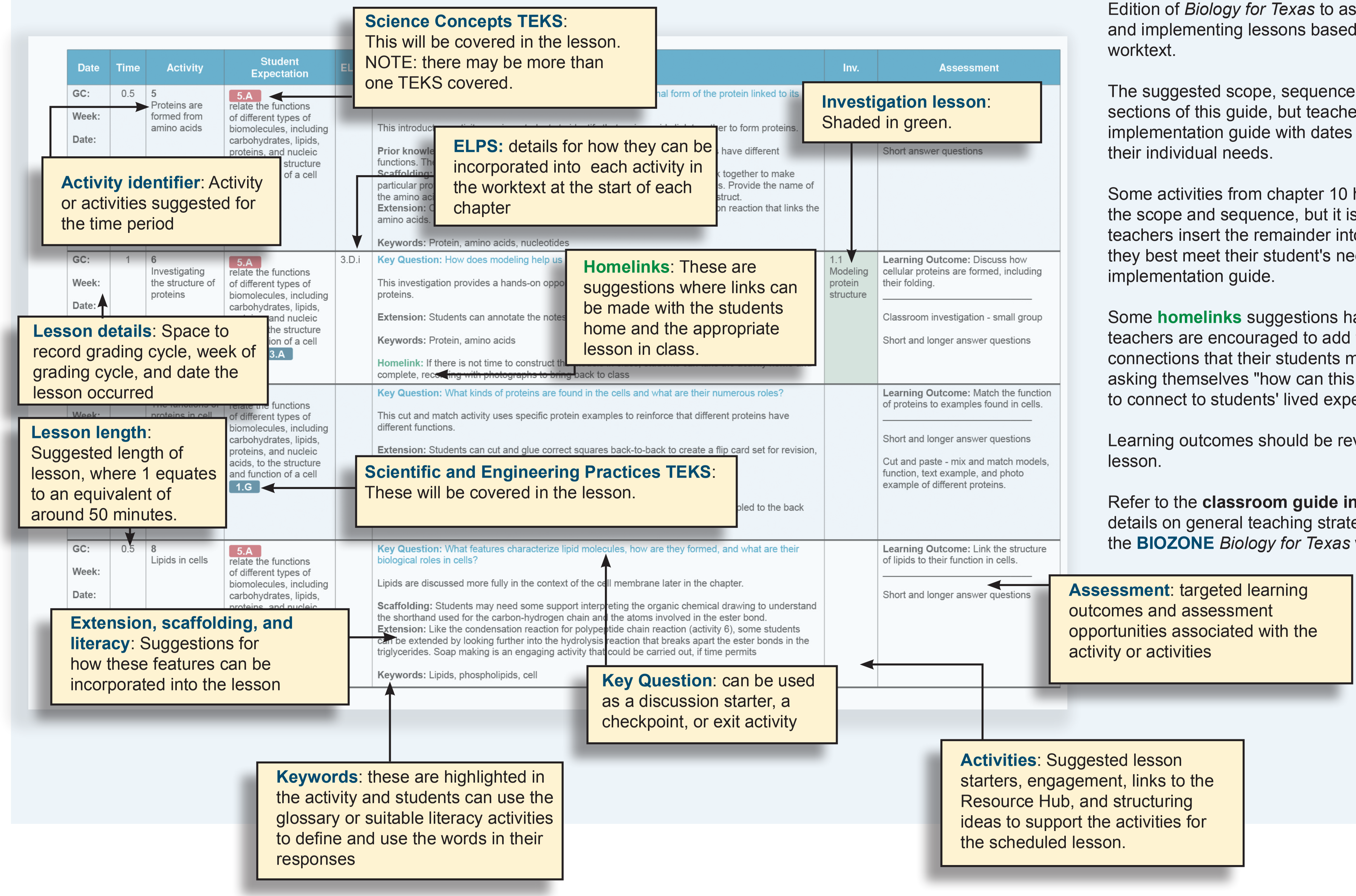
- ☐ What data has been/should be collected on student achievement i.e. from the Student Progress Tracker, but also completion of activities, proportion of activities completed correctly, length of time to complete activities and/or obtain Learning Outcome/s, student voice feedback on ease or difficulty of tasks, engagement levels?
- ☐ If data has been collected, what are obvious trends, or data points? and what do they indicate class wide, grouping band wise, and/or individual student wise?
- ☐ Did all students achieve the lesson Learning Outcome/s?
- ☐ How can the students who did not meet the Learning Outcome/s, be provided with further opportunity to achieve them?
- ☐ Was the pedagogy used in the lesson effective in allowing students to succeed? What pedagogy will you use, use more frequently, or not use again?
- ☐ Were the students engaged with the lesson and the lesson delivery? What parts of the lesson were most/least engaging?
- ☐ Was the differentiation of teaching addressed with all students? How did you know?
- ☐ Where could further lesson adaptations be made to address the need of all students?
- ☐ Were the teaching methods successful in delivering the ELPS (if applicable)?If not, how could these lesson prompts be modified in future lessons?
- ☐ Was the science vocabulary correctly applied by students in the lesson?
- ☐ What further pedagogy or resources, such as those provided in the Resource Hub, could be used in future lessons to improve the student's understanding?

You may wish to add a further section under each appropriate chapter sheet to consolidate your findings and actions to be taken:

Teacher:		**Class:**	
Date / Activity number	**Reflection / Evidence from Student Progress Tracker**	**Possible future interventions:**	**Actions to be taken:**

Lesson Implementation Guide - **Biology for Texas**

Unpacking the Lesson Implementation Guide



This lesson implementation guide has collated information from across the **BIOZONE** Teachers Edition and Student Edition of *Biology for Texas* to assist teachers in planning and implementing lessons based on activities in the worktext.

The suggested scope, sequence, and pacing are in previous sections of this guide, but teachers can amend the lesson implementation guide with dates and lesson length to suit their individual needs.

Some activities from chapter 10 have been included within the scope and sequence, but it is recommended that teachers insert the remainder into lessons where they feel they best meet their student's needs, and amend the lesson implementation guide.

Some **homelinks** suggestions have been provided, but teachers are encouraged to add to them, based on specific connections that their students may have with the material, asking themselves "how can this lesson be further adapted to connect to students' lived experiences?"

Learning outcomes should be reviewed at the end of each lesson.

Refer to the **classroom guide in the Teachers Edition** for details on general teaching strategies, and effective use of the **BIOZONE** *Biology for Texas* worktext.

CHAPTER 1 Cells and Viruses

In this chapter, the key focus is for students to understand the key structural and functional differences of cells and viruses. Students' prior knowledge of basic cell structure from earlier grades can now be applied to understand cellular biomolecules, and explain eukaryote complexity, cellular transport, and comparisons with viruses.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**1** What is a sponge?		**TC** 4.D.i	**Key Question:** How can we tell what type of organism a sponge is by using a microscope? **Content Anchor:** The content anchor, "Are sponges animals?", asks students to consider what evidence might be found at a cellular level to classify organisms? In revisiting this activity, students apply their learning about the structure of viruses, and prokaryote and eukaryote cells, to answer the question. **Prior knowledge:** Extensive unpacking of this area of knowledge can be assisted by using the Best Evidence Science Teaching Resource package located in the activity section of the Resource Hub. Diagnostic questions, expected responses, researched evidence and follow on activities are all included. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words. **Homelink:** If students have any sponges at home, either genuine or artificial, observe the structure of the sponges, and ask to bring any samples into school for other students to see.		▸ Small group discussion ▸ Short and longer answer questions ▸ Draw features of sponge cell based on preconceptions
GC: **Week:** **Date:**	0.5	**2** Biomolecules in the cell	**5.A** relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell		**Key Question:** What biomolecules are present in the cells of organisms, and what role do they play in the function and structure of the cell? This activity can be used as a reference page for summarizing biomolecules. Students should take away an understanding of the importance of key biomolecules in cellular structure and function. **Prior knowledge:** Atomic and molecular structure would be an advantage. **Scaffolding:** Provide background information and definitions if required. **Extension:** Use a periodic table to locate the key elements in biomolecules. **Keywords:** Cells, carbohydrates, lipids, proteins, nucleotides, cell wall, glucose, phospholipids, organelles		**Learning Outcome:** Summarize the role of biomolecules in the cell ▸ Short answer questions
GC: **Week:** **Date:**	0.5	**3** Carbohydrates in cells	**5.A** relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell	2.C.iii	**Key Question:** How are both simple and complex carbohydrates involved in the structure and function of cells? Emphasis should be on how the biomolecule contributes to the structure and function of the cell, rather than just the structure and function of the biomolecule. For digital collaboration, students can use a shared Google Doc or TEAMS WORD Doc to start or continue their research together. The groups then can paste their key points onto one class shared digital document. **Scaffolding:** This activity could be considered information heavy by some students. Ensure the glossary is used for keywords. **Extension:** Students take a deeper look at how different organisms work together symbiotically to break down the cellulose in plant cell walls. **Keywords:** Cells, carbohydrates, glucose, cell wall, organelles		**Learning Outcome:** Distinguish between monosaccarides and polysaccarides and understand their role in cell structure and function. ▸ Short and longer answer questions ▸ Students work in small 'expert groups' to research one of the polysaccharides in more detail, then return to a larger group to share their findings.
GC: **Week:** **Date:**	0.5	**4** Nucleic acids in cells	**5.A** relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell		**Key Question:** What are nucleic acids, and how do they contribute to the structure and function of cells? This activity provides a brief introduction to nucleic acids, and is unpacked further in chapter 5. Encourage students to refer back to this introductory activity when needed. **Extension:** students can compare and contrast DNA and RNA, and explore the different cells and organisms that contain each type of nucleic acid. **Keywords:** Nucleotides, genes, proteins, eukaryote, nucleus, prokaryote Although the ATP molecule (another type of nucleic acid) is covered in activity 53, it could be introduced here at the teacher's discretion.		**Learning Outcome:** Identify components of nucleic acids, and explain the role they have in cells. ▸ Short answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**5** Proteins are formed from amino acids	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell		**Key Question:** How is protein formed in the cell, and how is the final form of the protein linked to its function? This introductory activity requires students to identify that amino acids link together to form proteins. **Prior knowledge:** Students should understand that globular and fibrous proteins have different functions. The role of proteins is explored further in the following activities. **Scaffolding:** Teachers could make amino acid cards, which the students can link together to make particular proteins or, more correctly, polypeptide chains, the precursor to proteins. Provide the name of the amino acid, and a 'recipe' for particular chains, that the students need to construct. **Extension:** Chemistry minded students can take a closer look at the condensation reaction that links the amino acids. **Keywords:** Protein, amino acids, nucleotides		**Learning Outcome:** Discuss how cellular proteins are formed. ▸ Short answer questions
GC: **Week:** **Date:**	1	**6** Investigating the structure of proteins	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 1.G 3.A	3.D.i	**Key Question:** How does modeling help us understand the structure of a protein? This investigation provides a hands-on opportunity to model how polypeptide chains fold into functional proteins. **Extension:** Students can annotate the notes with examples of the different protein structure types. **Keywords:** Protein, amino acids **Homelink:** If there is not time to construct the models in class, students can take the activity home and complete, recording with photographs to bring back to class	1.1 Modeling protein structure	**Learning Outcome:** Discuss how cellular proteins are formed, including their folding. ▸ Classroom investigation - small group ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**7** The functions of proteins in cell	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 1.G		**Key Question:** What kinds of proteins are found in the cells and what are their numerous roles? This cut and match activity uses specific protein examples to reinforce that different proteins have different functions. **Extension:** Students can cut and glue correct squares back-to-back to create a flip card set for revision, or to test each other in pairs. **Keywords:** Cells, nucleus, proteins, genes, nuclear membrane, glucose For any card type resources made by students, a zip-lock type plastic bag can be stapled to the back cover of the worktext, and cards placed inside for storage.		**Learning Outcome:** Match the function of proteins to examples found in cells. ▸ Short and longer answer questions ▸ Cut and paste - mix and match models, function, text example, and photo example of different proteins.
GC: **Week:** **Date:**	0.5	**8** Lipids in cells	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 3.A		**Key Question:** What features characterize lipid molecules, how are they formed, and what are their biological roles in cells? Lipids are discussed more fully in the context of the cell membrane later in the chapter. **Scaffolding:** Students may need some support interpreting the organic chemical drawing to understand the shorthand used for the carbon-hydrogen chain and the atoms involved in the ester bond. **Extension:** Like the condensation reaction for polypeptide chain reaction (activity 6), some students can be extended by looking further into the hydrolysis reaction that breaks apart the ester bonds in the triglycerides. Soap making is an engaging activity that could be carried out, if time permits **Keywords:** Lipids, phospholipids, cell		**Learning Outcome:** Link the structure of lipids to their function in cells. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**9** The development of microscopes	1.B 4.B		**Key Question:** When did humans discover cells, and what role did the microscope play? The next section on cell structure is introduced with historical developments of the microscope. A number of supporting materials, including short videos and an interactive on van Leeuwenhoek, can be found in the Resource Hub. **Prior Knowledge:** students can build on their prior knowledge of cell theory, in particular researching the contributions of Schleiden, Schwann, and Virchow. **Extension:** Protists are also introduced in this activity. An extension activity could involve researching one or more examples and comparing/contrasting the cellular features of each. Individually or in pairs, students can research the work of the scientists involved in furthering our understanding of cell theory and microscopes, and could include reference to who influenced their work. Alternatively, they can collate the information from the class and create a timeline using an online programme. **Keywords:** Cell		**Learning Outcome:** Explore the development of microscopes. ——— ▸ Longer answer questions
GC: **Week:** **Date:**	1	**10** Microscopes and magnification	2.C		**Key Question:** What are the important features of a light microscope, and how do you calculate the magnification of the image they produce? Most students will have previous experience in using microscopes but they will all still benefit from a demonstration of correct use. This activity can include a practical component where students look at hair strands, pre-prepared slides, or even small living protists (if teachers have access to samples of pond or drain water). **Scaffolding:** Some students may need support with magnification calculations: the teacher could project the first example onto the board, and work through it step-by-step. There is a link to a virtual microscope lab in the Resource Hub for those students unable to access a lab.		**Learning Outcome:** Demonstrate use of a laboratory microscope and carry out magnification calculations. ——— ▸ Label microscope ▸ Calculate magnification ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**270** Biological drawing **271** Practicing biological drawing	1.F		**Key Question:** What is the purpose of a good biological drawing when studying a specimen? What kind of detail is needed when making accurate and useful biological drawings? **Scaffolding:** Students may have concerns that they are not artistic, so remind them that a good biological drawing can be very simple. Equally, remind students to draw what they see, and follow the rules provided in activity 270 to produce scientifically accurate drawings. Alternatively, teachers can project an image onto the board. Practice is provided in activity 271.		**Learning Outcome:** Construct a biological drawing from a provided photograph. ——— ▸ Draw a biological drawing of a cell from a photo
GC: **Week:** **Date:**	1	**11** Studying cells	1.B 1.C 1.D 1.F		**Key Question:** What techniques are used to prepare and view cells under a light microscope? **Scaffolding:** For best results, the teacher could demonstrate the onion slide investigation step-by-step before students begin. Alternatively, a video in the Resource Hub shows the procedure. Pre-prepared slides of animal cells can be provided so that students can compare the two types of cells. **Extension:** students can make a scientific drawing on a piece of paper, labeling any key structures and including a scale and magnification value for their onion cell sample. **Homelink:** look for interesting small objects at home that could be brought in to look at through a microscope, including any small protists that may be in pond water	1.2 Preparing an onion slide	**Learning Outcome:** Prepare an onion slide and view using a microscope. ——— ▸ Laboratory investigation - small group ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.75	**12** Life arises from life	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell		**Key Question:** How have the experiments of Louis Pasteur and Robert Koch contributed to our understanding of microbiology, the study of microscopic life? Students return to the history of science and explore the work of Louis Pasteur and Robert Koch in the role of advancing microbiology and germ theory. **Scaffolding:** Students have been asked to research both further, but this could be scaffolded by the teacher preparing an exemplar for one of the scientists, or creating template sheets for students to complete. **Literacy:** The method above can apply to all areas of this worktext that require 'essay-type' answers. The range of literacy abilities and level of English language proficiency will vary: advanced learners can plan and write their own essays independently, whereas fill-in-the-blank cloze essays are more suitable for beginners. For those in between, you can supply a list of keywords, an exemplar, or provide an outline template. **Keywords:** Cells		**Learning Outcome:** Research the work of past scientists involved in microbiology. ____________________ ▸ Short and longer answer questions ▸ Research scientists contributions to microbiology
GC: **Week:** **Date:**	0.25	**13** The cell is the unit of life	5.B compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity 5.D compare the structures of viruses to cells and explain how viruses spread and cause disease	3.D.i	**Key Question:** How do we classify cell types, and what do they all need for survival? The reference schematic encourages students to start thinking about how different cell types are related to each other, and how they are classified. **Scaffolding:** For cellular requirements, teachers can provide the three headings to students and they can work in groups to share ideas, which can then be collated as a class, before checking against the list in the activity. **Extension:** Supply small groups with a set of cards, each with a different type of cell or virus on. Students can arrange them on a large, blank piece of paper, adding connections between them for classification. Ask the groups to provide a justification for their choices. **Keywords:** Cells, prokaryotic, eukaryotic, nucleus, viruses, glucose, organelles, cell walls **Homelink:** look around home at examples of living things - add examples of what you find to your activity page.		**Learning Outcome:** Identify key features of different groups of cells. ____________________ ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**14** Distinguishing features of prokaryotic cells **15** Distinguishing features of eukaryotic cells **16** Prokaryotic vs eukaryotic cells	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 1.G	4.C.iv	**Key Questions:** What are the distinguishing features of prokaryotic cells? What are the distinguishing features of eukaryotic cells? How can we compare and contrast prokaryotic and eukaryotic cells? The order of these activities is flexible. You may wish to complete the general comparison (activity 16) first, followed by the more detailed activities (14 and 15). An alternative approach is to split the class so that half researches prokaryotes, while the other half researches eukaryotes. The students can then be placed into pairs, one from each group, and can share their expertise, completing the comparison activity together. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Eukaryotic and prokaryotic cells - covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Keywords:** Cells, prokaryotic, eukaryotic, nucleus, viruses, glucose, organelles, cell walls		**Learning Outcome:** Compare and contrast prokaryote and eukaryote cells, including presence of organelles. ____________________ ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**17** Comparing cell and virus sizes	**5.B** compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity **5.D** compare the structures of viruses to cells and explain how viruses spread and cause disease **2.B** **2.C**		**Key Question:** How do different types of cells vary in size, and how do they compare to the size of a typical virus? **Scaffolding:** Students may need some support with the conversions. We suggest completing a worked example on the board first. The scale lines can be drawn on the edge of a piece of paper and held up against the specimen to make measuring easier. The log scale may need some explanation to students, asking what the advantages might be in its use. You can refer to activity 254, p432, in ch10 as background. You could project a log scale on the board, and encourage students to come up and write on where their measurements and specimens fit onto it. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Cell shape and size - covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Keywords:** Cells, prokaryotic, eukaryotic, viruses **Homelink:** Do you have any reading material at home on viruses and cells? Is it clear about the differences in relative size of the micro-organisms? How could publishers make the size more apparent?		**Learning Outcome:** Compare and contrast prokaryote and eukaryote cells, including size. ▸ Calculate sizes of microorganisms ▸ Label a log scale with worked example
GC: **Week:** **Date:**	0.5	**18** Why be multicellular?	**5.B** compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity	3.D.i	**Key Question:** What are some advantages of multicellular form for both prokaryotes and eukaryotes? The lesson could start with an engagement video from the Resource Hub. **Extension:** Deeper investigation of cyanobacteria or slime mold life cycles is also possible. As this is the final activity on comparing cells, students could make a summary poster or chart for revision. **Keywords:** Cells, prokaryotic, eukaryotic, gene expression		**Learning Outcome:** Compare and contrast prokaryote and eukaryote cells, including multicellular forms. ▸ Longer answer questions ▸ Questions can be completed individually, or in small groups and shared or reviewed with the class.
GC: **Week:** **Date:**	1	**19** Eukaryotes have complex cells	**5.B** compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity **1.G** **1.H** **3.A** **4.A**		**Key Question:** What was the origin of complexity in eukaryote cells and what is the evidence to support the claims? **Scaffolding:** The activity is information rich, and can be broken up with Resource Hub videos, or group discussions. The sequencing on the first page can be broken down into a series by making cards that small groups of students can place in sequential order of occurrence, with justification. **Literacy:** When answering question 3, focus the students on the skills of paraphrasing and outlining/summarizing, helping them understand that first they must read the information provided, then rewrite in words they would typically use, not just copy the text provided. Ideally, teachers could have posters of common scientific terminology, such as theory, hypothesis, and scientific law, on the classroom walls, that students can refer back to when needed. **Keywords:** Cells, prokaryotic, eukaryotic, organelles, plasma membrane Chloroplast and mitochondria structure are covered in activity 52.		**Learning Outcome:** Evaluate evidence for eukaryote complexity, including endosymbiosis, and bacteria engulfment by protists. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**20** Cell membrane structure	5.C investigate homeostasis through the cellular transport of molecules 1.G 4.A		**Key Question:** What are the key components of plasma membranes and how do they enable cellular homeostasis? Students can use multiple means of demonstrating membrane structure, including the cut-out model provided and the 3D images and videos in the Resource Hub. **Extension:** You may wish to assign the freeze-fracture comprehension activity to more capable students. **Scaffolding:** For delivery to the whole class, each step of the comprehension activity could be assigned to a small group, to simplify into their own words, then share with the class. **Literacy:** Students may need to use the glossary, or an online search to decipher the language. Students could use a thesaurus to select alternative terms. These guidelines can be used in any activity with dense and complex literacy challenges. **Keywords:** Plasma membrane, cell, lipid, phospholipid, proteins, active transport, glucose		**Learning Outcome:** Explore the fluid-mosaic model of the cell membrane, including building a model and examining evidence for its structure. ▸ Short and longer answer questions ▸ Construct 3D paper model
GC: **Week:** **Date:**	2	**21** Diffusion in cells - passive transport **22** Osmosis in cells - diffusion of water	5.C investigate homeostasis through the cellular transport of molecules 1.B 1.C 1.D 1.E 1.F 2.D 3.A 4.A	3.D.i	**Key Questions:** What is diffusion, and what factors affect the rate of diffusion of a particle from one point to another across a cell membrane? How does osmosis transport water across a semi-permeable membrane to ensure water balance homeostasis in the cell? These two activities are interchangeable in order. The demonstration in activity 22 can be performed alongside the diffusion lab. Videos demonstrating osmosis and diffusion are in the Resource Hub. After completing the practicals, students should explain the process. Emphasis should be on the movement from high to low concentration, and the passive nature of the process. Some students may include selective permeability. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Diffusion and the cell membrane - covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Keywords:** Cell, proteins, plasma membrane, glucose **Homelink:** Place small peeled potato pieces in water and some more in salty water and leave. What do you notice about them the next day? Discuss your observations in class.	1.3 Simple diffusion across a membrane	**Learning Outcome:** Investigate diffusion, especially osmosis, as a process in passive transport in the cell membrane, that is linked to cellular homeostasis. ▸ Short and longer answer questions ▸ Laboratory investigation - small groups
GC: **Week:** **Date:**	2	**23** Active transport in cells **24** Ion pumps **25** Cytosis	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 5.C investigate homeostasis through the cellular transport of molecules 3.A		**Key Questions:** What is active transport, and how does the process transport molecules and ions across a cellular membrane? How do ion pumps transport ions and molecules across cellular membranes? How does the folding of the plasma membrane enable the cell to bring in or export material? Activity 23 provides a generalized description of active transport. Activity 24 details ion pumps. **Extension:** Students could be extended by looking into the importance of the sodium-ion pump for cellular function. Cellular transport is concluded with an investigation into the process of cytosis. Reference this when students investigate how some viruses enter the cell by endocyctosis. Students may want to return to the model of eukaryotic organelles in activity 15 to remind themselves about terminology. A QR code links to a 3D model of the cell. **Keywords:** Cell, proteins, plasma membrane, active transport, lipid, glucose, exocytosis, endocytosis, viruses		**Learning Outcome:** Explain how active transport allows substances to travel against the concentration gradient in the cellular membrane. **Learning Outcome:** Link the role of cytosis to maintaining cellular homeostasis, distinguishing between exocytosis and endocytosis. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**26** Comparing virus and cell structure	5.D compare the structures of viruses to cells and explain how viruses spread and cause disease 3.A 4.B		**Key Question:** How does the structure of viruses compare to the structure of cells? Students compare virus types. Viral classification is provided for interest, but students do not need to recall it. **Extension:** Students could construct a chart to compare cells and viruses. **Keywords:** Virus, cells, prokaryotes, eukaryotes, protein		**Learning Outcome:** Compare and contrast viral and cellular structures, linking to the classification of living organisms. ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**27** Viral reproduction and disease	5.D compare the structures of viruses to cells and explain how viruses spread and cause disease 3.A		**Key Question:** How do viruses enter cells, reproduce and cause disease? Modes of viral replication are covered in this activity. Teachers can add a sequencing card activity for both the lytic/lysogenic cycles and endocytosis entry. **Keywords:** Virus, cell, nucleus, protein **Homelink:** Ask your parents or grandparents, or older caregivers, what viruses used to be more common when they were children, and how were they prevented? If any families come from other countries, what types of viruses are more common there?		**Learning Outcome:** Link the method of reproduction to the classification of viruses, including the use of 'spikes' to gain entry to cells. **Learning Outcome:** Distinguish between viral lysogenic and lytic cycles, linking to appearance of disease. ▸ Short and longer answer questions
GC: **Week:** **Date:**	4	**28** How is viral disease transmitted? **29** Epidemics and pandemics **30** Modeling viral disease outbreak and spread **31** Viral disease case study: COVID-19	5.D compare the structures of viruses to cells and explain how viruses spread and cause disease 1.B 1.E 1.F 1.G 2.B 2.D 3.A	4.C.ii	**Key Questions:** How do viruses transmit disease from host to host? How does transmission of viral disease become an epidemic or pandemic? How can computer modeling be used to demonstrate viral disease outbreak and spread? How is SARS-CoV-2 coronavirus transmitted, and how does it cause disease in humans? Viral disease, transmission, and spread are covered in activities 28-31. Teachers could use the context of COVID-19, provided as a detailed case study in activity 31 for this section. Alternatively, students could apply their own experience with other viral diseases, such as flu, as they work through this material. The spreadsheet modeling disease spread in activity 30 has flexible delivery options. Students can build their own model, or use the pre-made spreadsheet provided in the Resource Hub if teachers are short on time. For digital collaboration in the literature search for activity 28 and the viral disease case study in activity 31, students can use a shared Google Doc or TEAMS WORD Doc to start or continue their research together. The groups then can paste their key points onto one class shared digital document to keep a record of their pooled knowledge. Prior to this, a small activity where groups are placed together to discuss particular roles in the group are decided could be useful. In subsequent group activities, where students are working digitally, the role of leadership can be passed onto other students. **Keywords:** Virus, cells **Homelink:** What rules could you make for yourself around home to reduce transmission of viruses?	1.4 Modeling disease outbreak and spread	**Learning Outcome:** Conduct a literature search on the method of transmission, entry, and disease symptoms of a selected human virus. **Learning Outcome:** Define the terms epidemic and pandemic, and discuss factors involved in their origin. **Learning Outcome:** Summarize key features shared by zoonotic diseases. **Learning Outcome:** Model viral disease spread using a digital simulation. **Learning Outcome:** Describe the methods of SARS-CoV-2 coronavirus transmission, and aspects of the COVID-19 disease. ▸ Short and longer answer questions ▸ Literature search of select virus ▸ Drawing model ▸ Model disease spread using a spreadsheet

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**32** What is a sponge? revisited	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 5.B compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity		**Key Question:** How can we tell what type of organism a sponge is by using a microscope? The content anchor, "Are sponges animals?", asks students to consider what evidence might be found at a cellular level to classify organisms? In revisiting this activity, students apply their learning about the structure of viruses, and prokaryote and eukaryote cells, to answer the question. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words.		▶ Short and longer answer questions ▶ Redrawing animal cell
GC: **Week:** **Date:**	2	**33** Summing up (Chapter 1)	5.A relate the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids, to the structure and function of a cell 5.B compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity 5.D compare the structures of viruses to cells and explain how viruses spread and cause disease 3.A		**Summing Up:** Summative Assessment **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▶ Multichoice ▶ Short and longer answer questions ▶ Research question

CHAPTER 2 Cell Cycle

In this chapter, the key focus is for students to understand the importance of cell replication and the role of the cell cycle in this process. When the checks of this highly regulated process fail, cancerous cells can form. Students should be able to explain cellular differentiation and its ability to lead to many cell types.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**34** The power to rebuild	**1.A**	**TC** 1.B.i 4.C.i 2.D.ii	**Key Question:** What are the axolotl's superpowers of regeneration that allow it to regrow amputated limbs and even parts of its brain? The content anchor, "The power to rebuild", asks students how cells are able to replicate, differentiate and, in the extreme case of the axolotl, even rebuild limbs and parts of the nervous system. **Homelink:** Do any families you know have a pet axolotl? Are you able to take photos, or inform the class on how they are looked after?		▸ Short and longer answer questions ▸ Discussion in pairs
GC: **Week:** **Date:**	0.5	**35** Growth and repair of cells	**6.A** explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models		**Key Question:** How do cells reproduce and repair themselves, and how do organisms grow? This activity introduces the purpose of mitosis; asexual reproduction, repair, and growth. Growth will be the key focus moving on through the chapter. **Prior knowledge:** Extensive unpacking of this area of knowledge can be assisted by using the Best Evidence Science Teaching Resource package located in the activity section of the Resource Hub. Diagnostic questions, expected responses, researched evidence and follow on activities are all included. **Extension:** Extend students by taking a closer look at the other two processes. Viral reproduction was investigated in the previous chapter, so students could compare viral reproduction with bacterial or yeast asexual reproduction, and create a compare/contrast table to show their findings. **Keywords:** cell division, mitosis, cell cycle **Homelink:** If you have any yeast at home, ask your parents how they use it to make bread or in baking. If possible, 'grow' some yeast yourself and take photos to bring into class.		**Learning Outcome:** Explain the three functions of mitotic cell division. ___ ▸ Longer answer questions
GC: **Week:** **Date:**	0.5	**36** The eukaryotic cell cycle	**6.A** explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models **6.C** relate disruptions of the cell cycle to how they lead to the development of diseases such as cancer **3.A**	2.C.iii	**Key Question:** What are the phases of the eukaryotic cell cycle, and what specific cellular events occur in each phase? **Literacy:** Students need to recall the order and names of the stages of the cell cycle. They can refer to the glossary or the Online Biology Dictionary link in the Resource Hub as they build their vocabulary with these terms. This can be facilitated with a colored cell cycle template, which students annotate with the stages. Refer back to the cell cycle checkpoints when you cover activity 48, cell cycle disruptions and cancer. Teachers need to be aware of the impact on children when the subject of cancer arises. It could trigger emotional responses if students have had close family, or even themselves, affected by cancer. Students may be curious about the subject, and questions can be directed back to the cell cycle at this point. Tip: for recall activities using templates or even organization charts, such as the fishbone chart in activity 240, the images can be printed and laminated. Have students use non-permanent markers with ink that can be wiped off so they can be reused. The Resource Hub provides strategy guides on learning tools that can be used throughout the worktext. **Keywords:** cell cycle, cell division, DNA replication, chromosomes, interphase, mitosis, cytokinesis		**Learning Outcome:** Identify the main phases, and their sub-divisions, in the eukaryote cell cycle. ___ **Learning Outcome:** Describe the events that occur in each phase of the cell cycle. ___ **Learning Outcome:** Explain how the cell cycle is regulated by the checkpoints. ___ ▸ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**37** Mitosis and cytokinesis	6.A explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models		**Key Question:** What happens in the different stages of mitosis leading up to the formation of two daughter cells, and is it different for plant and animal cells? Students will need to sequence and name the stages of mitosis. Wipe-clean templates could be used to aid recall. Alternatively, the mitosis stages can be cut into individual cards, and the students can reassemble them in the right order, and name the stage. In activity 38, students use a model which will help with sequencing. Students can ask about the importance of mitosis, and cytokinesis when cells divide, and the order of these processes. For example, what would happen if mitosis did not take place and cells continued to divide? Students also need to be clear about the distinction between mitosis and meiosis; the latter is covered in chapter 5. They can return to activity 37 to compare the two processes after covering meiosis. **Keywords:** mitosis, cell cycle, cytokinesis, interphase, chromosomes, chromatids		**Learning Outcome:** Name, order, and summarize the key steps of mitosis. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.75	**38** Modeling mitosis	6.A explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models 1.C 1.F 1.G 3.B	3.B.iii	**Key Question:** How can I model the stages of mitosis to help to visualize and understand the process? This model uses pipecleaners and string to reinforce the stages of mitosis. The activity is most effective if photos are taken and attached for recall. If short on time, teachers could photograph images of a demonstration model they prepared earlier, and hand out the individual images for students to place in their books and label. If assigned as homework, provide the material to take home, or there are interactives on the Resource Hub. **Homelink:** If there is not time to construct the models in class, students can take the activity home and complete, recording with photographs to bring back to class	2.1 Modeling mitosis	**Learning Outcome:** Model the process of mitosis. ▶ Classroom investigation - in pairs ▶ Short answer questions
GC: **Week:** **Date:**	1	**39** DNA replication **40** Stages of DNA replication	6.A explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models 3.A		**Key Questions:** How does a cell make a copy of its DNA before mitosis occurs? How does DNA unwind for replication and how are enzymes involved? Activity 39 provides an overview of DNA replication and more detail is provided in activity 40. **Extension:** Provide students with an unlabelled copy of stages shown in activity 40. Ask them to sequence and label it, then check it against the models in the worktext. **Scaffolding:** Supporting videos and interactives in the Resource Hub can be used to introduce or scaffold the activities. **Keywords:** mitosis, DNA replication, chromosome, cell division, chromatids, semi-conservative For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation.		**Learning Outcome:** Identify and describe the key steps of DNA replication, including the role of enzymes. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**41** Evidence for semi-conservative DNA replication	2.C 3.A 4.A 4.B		**Key Question:** How do we know that DNA replication is semi-conservative? Students simulate Meselson and Stahl's experiment which proved DNA replication is semi-conservative. Use videos in the Resource Hub to engage students and set the context of the experiment. **Scaffolding:** Some students may need scaffolding. Project the activity on a board with the first generation completed as a class activity before students attempt the second generation themselves. **Extension:** Extend question 3 by asking students to provide bullet points for their question outline, then attach their full answer to the page. A class discussion can involve the importance of the semi-conservative DNA replication process and what the possible consequences might be if it did not follow this model. Refer students to activity 4 (nucleotide structure), or the DNA structure material in chapter 5 if necessary. **Keywords:** DNA replication, semi-conservative		**Learning Outcome:** Model Meselson and Stahl's semi-conservative DNA replication experiments. **Learning Outcome:** Use evidence to support the semi-conservative model. ▶ Modeling activity ▶ Simple calculations ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**42** Differentiation of cells	6.B explain the process of cell specialization through cell differentiation, including the role of environmental factors		**Key Question:** How do many different cell types arise during development of the embryo? Activity 42 covers cell differentiation and environmental influences. Stem cells can be introduced with a short video from the Resource Hub, or students can discuss in groups what they already know about stem cells. Students need to understand that all cells (with few exceptions) have a full set of chromosomes, but in most cases their differentiation is predetermined by the type of cell they divide from. Contrast this with stem cells, which have the potential to differentiate into almost any type of cell. Ask students why differentiation is important. **Extension:** Students can investigate the application of stem cells to medical treatments. **Keywords:** mitosis, stem cells, chromosomes		**Learning Outcome:** Describe the properties of stem cells, and their role in differentiation of cells. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**43** Blood cell differentiation	6.B explain the process of cell specialization through cell differentiation, including the role of environmental factors		**Key Question:** How do stem cells, which are undifferentiated, develop into many different blood cell types? This activity looks at a specific type of cell differentiation: blood cells. Students can understand the terms totipotent, pluripotent, and multipotent, but do not have to recall the names for various types of blood cells. **Extension:** Blood cell types and their roles in immunity could be investigated further. **Keywords:** stem cells		**Learning Outcome:** Analyze the differentiation of blood cells.
GC: **Week:** **Date:**	0.5	**44** Specialization in plant cells **45** Specialization in animal cells			**Key Questions:** How does cell specialization allow plant cells to carry out specialist functions? How does cell modification allow animal cells to carry out specialist functions? These two activities explore the specialization of animal and plant cells. Refer back to these when investigating plant and animal structure and function in chapter 4. The class can be split into two, each summarizing specialization in plants and animal cells. A research component could be included. **Extension:** Summaries can be swapped with a partner in class, who adds further detail and returns it to the original author. **Keywords:** cell specialization, mitosis **Homelink:** Do you have any plants at home that you can observe? Can you bring in any samples to class to look at under the microscope.		**Learning Outcome:** Link the function of different plant and animal cells to their specialization. **Learning Outcome:** Explain the advantage of cell specialization to an organism. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**46** Cells and the environment	6.B explain the process of cell specialization through cell differentiation, including the role of environmental factors		**Key Question:** How can the environment affect an organism's phenotype? This activity explores the role of the environment in phenotype. A range of introductory videos are available in the Resource Hub, and teachers may choose to focus deeper on one of the case studies in the activity, or cover all for a broad comparison. Note: differentiation here is seen as changes in phenotype NOT genotype. Epigenetics is introduced at a basic level, with its effect on gene expression described in activity 121. **Extension:** The specific mechanism of epigenetics is not required, but extension students may be interested to investigate further. **Keywords:** epigenetics		**Learning Outcome:** Investigate the effect of environmental factors, such as temperature, on cell differentiation, and subsequent phenotype changes in selected case studies. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**47** The role of the environment in cell development	6.B explain the process of cell specialization through cell differentiation, including the role of environmental factors 1.F 2.B 3.A	3.D.i	**Key Question:** How can the environment or experiences of an individual affect the development of following generations? Activity 47 uses a case study to observe how environmental influences can affect the genetic material, and how these changes can be passed on to subsequent generations. The data requires 3 plots of line graphs. Refer students to activity 261 in the Science Practices chapter for a refresher on the features of a line graph. **Keywords:** epigenetics		**Learning Outcome:** Plot and analyze data to make an evidence-based statement on the link between environmental influences and changes in gene expression. ▸ Short and longer answer questions ▸ Plot data into line graphs
GC: **Week:** **Date:**	1	**48** Cell cycle disruptions and cancer	6.C relate disruptions of the cell cycle to how they lead to the development of diseases such as cancer	4.F.viii	**Key Question:** What happens when cell cycle checkpoints fail? This activity revisits the checkpoints of the cell cycle, in context of disruptions. The technical terms used in this activity will need to be unpacked. Two key terms all students should be familiar with are tumor suppressor genes (genes that stop cell division), and proto-oncogenes (genes that switch cell division on). Students need to know that mutations to these genes can result in uncontrolled cell division because the cell cycle runs unchecked. Mutation is covered in more detail in activities 128 -130. Apoptosis (programmed cell death) is examined as another process that, if disrupted, leads to uncontrolled cell growth. Be mindful of students who have been impacted by this disease. **Extension:** Students can examine the role of carcinogenic virus examples provided in cancer formation. **Keywords:** cell cycle, cell division		**Learning Outcome:** Identify genes responsible for cell cycle checkpoint regulation. **Learning Outcome:** Describe how disruptions in regulatory genes can lead to development of cancer. **Learning Outcome:** Explain the link between decreased apoptosis rate and the development of cancer. **Learning Outcome:** Describe how cancer causing viruses affect the cell cycle. ▸ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**49** The power to rebuild revisited	**6.A** explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models **6.B** explain the process of cell specialization through cell differentiation, including the role of environmental factors		**Key Question:** What are the axolotl's superpowers of regeneration that allow it to regrow amputated limbs and even parts of its brain? The content anchor, "The power to rebuild", asks students how cells are able to replicate, differentiate and, in the extreme case of the axolotl, even rebuild limbs and parts of the nervous system. **Keywords:** cell division		▸ Short and longer answer questions ▸ Labeling mitosis stages
GC: **Week:** **Date:**	0.5	**50** Summing up (Chapter 2)	**6.A** explain the importance of the cell cycle to the growth of organisms, including an overview of the stages of the cell cycle and deoxyribonucleic acid (DNA) replication models **6.B** explain the process of cell specialization through cell differentiation, including the role of environmental factors **1.F** **1.G**	4.F.x	**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▸ Multichoice ▸ Short and longer answer questions ▸ Constructing a theoretical model of mitosis and cell differentiation

CHAPTER 3

Photosynthesis and Cellular Respiration

In this chapter, the key focus is for students to explain how matter is conserved and energy is transferred during the cellular processes of photosynthesis and cellular respiration. This should be demonstrated through chemical equations and models. The role of enzymes in cellular processes are investigated and explained.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**51** Mouse trap		2.I.iv	**Key Question:** Under what conditions can an animal survive in a sealed system? The content anchor, "Mouse Trap", uses the context of a historical experiment, placing a mouse and plant in a bell jar, to unpack the students' prior knowledge of the processes of photosynthesis and cellular respiration.		▶ Short and longer answer questions ▶ Draw model of processes
GC: **Week:** **Date:**	0.5	**52** A closer look at chloroplasts and mitochondria	11.B Investigate and explain the role of enzymes in facilitating cellular processes		**Key Question:** Why are chloroplasts and mitochondria important and what do they look like? Mitochondria and chloroplasts are integral to cellular respiration and photosynthesis. The information expands on that provided in chapter 1. This activity could be used with activity 19 when covering the endosymbiosis theory if you wish. Models are shown in the book and Resource Hub, but it is also useful for the teacher to project images of the structures onto the board, and annotate the features. **Extension:** Some students could be extended by investigating cellular respiration and photosynthesis in prokaryotic cells, again linking to the endosymbiosis theory. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** chloroplasts, mitochondria, organelles, photosynthesis, ATP, cellular respiration		**Learning Outcome:** Explain the role of mitochondria and chloroplasts in cells. ___ ▶ Short and longer answer questions ▶ Label chloroplast image
GC: **Week:** **Date:**	0.5	**53** Energy in cells	11.A explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes 3.A		**Key Question:** How does ATP provide the energy needed to perform essential life functions? Remind students that ATP is a type of nucleic acid. If you have taught this alongside activity 4, then review ATP now. Classes may have access to molymods (plastic molecular models) that can be useful to build an ATP model and show the reaction to form ADP. Colored blocks, with each color representing a different type of atom can also be used. The convention for atom model colors are: Hydrogen = White, Oxygen = Red, Chlorine = Green, Nitrogen = Blue, Carbon = Black, Sulphur = Yellow, Phosphorus = Orange. The models are a useful way of emphasizing the conservation of matter - where the same number and type of atoms need to be present as both the reactants and products. **Extension:** The Resource Hub has material for students wanting to understand the law of conservation at a deeper level **Keywords:** adenosine triphosphate (ATP), cellular respiration		**Learning Outcome:** Describe the structure and function of ATP in cells. ___ **Learning Outcome:** Draw a model showing the chemical transformation between ATP and ADP molecules. ___ ▶ Short and longer answer questions ▶ Draw model of ATP/ADP relationship

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**54** Introduction to photosynthesis	**11.A** explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes		**Key Question:** How does photosynthesis convert sunlight, carbon dioxide, and water into glucose and oxygen? The central graphic provides a visual overview of photosynthesis. If time permits, the activity can be contextualized with the history of photosynthetic scientific discoveries, such as Van Helmont and the conservation of mass experiments. A video is provided on the Resource Hub. **Scaffolding:** Using colored beads or plastic bricks to mimic the equation can help students in their understanding. Pulling apart represents bonds breaking, and joining together represents bonds forming. A wikihow link on the Resource Hub can scaffold understanding for students with limited chemistry. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Plant nutrition and photosynthesis- covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Extension:** Question 4(a) is marked as extension. **Keywords:** photosynthesis, chlorophylls, glucose, light dependent, light independent		**Learning Outcome:** Write a simple word equation for photosynthesis. ——— **Learning Outcome:** Identify the energy forms and the transformations occurring during photosynthesis. ——— ▸ Short and longer answer questions ▸ Interpret data from a graph
GC: **Week:** **Date:**	0.5	**55** Stages in photosynthesis	**11.A** explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes **11.B** Investigate and explain the role of enzymes in facilitating cellular processes		**Key Question:** What are the two main reactions in photosynthesis? The photosynthetic process is divided into the light dependent and light independent phases. **Scaffolding:** Each stage involved in the photosynthesis reactions could be written onto a card, with the molecules involved clearly drawn or named, and then small groups of students can sequence the steps, before completing the activity. The role of the enzyme RuBisCo in the photosynthesis process should be highlighted here **Keywords:** photosynthesis, ATP, glucose, light dependent, light independent		**Learning Outcome:** Describe the location, the component functions, and the steps that occur in the light dependent and light independent phases of photosynthesis. ——— ▸ Short and longer answer questions ▸ Label photosynthesis process model
GC: **Week:** **Date:**	1	**56** Investigating photosynthetic rate	**1.B** **1.D** **1.F** **2.B** **2.C**	4.C.iii	**Key Question:** How does light intensity affect photosynthesis rate? Photosynthetic rate is measured by students counting gas bubbles produced from a Cabomba cutting exposed to different light intensities. Other methods of measuring photosynthetic rate are included on the Resource Hub. **Extension:** Teachers could alter the investigation, and ask students to plan their own method for measuring photosynthesis, or provide the equipment and ask them to select a variable to change, such as temperature and light color. (Using LED bulbs controls the temperature). Cabomba is also used in chapter 9, for modeling the carbon cycle. Teachers could keep a small tank or jar of the plant so they have a ready supply at hand.	3.1 Investigating photosynthetic rate	**Learning Outcome:** Investigate the photosynthetic rate in Cabomba plants when altering light levels. ——— ▸ Laboratory investigation - in small groups ▸ Short and longer answer questions ▸ Graph collected data

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**57** Energy transfer between systems			**Key Question:** How is the stored energy in glucose used to power the chemical reactions which occur in living organisms? Use the diagram to illustrate the connectedness between photosynthesis and cellular respiration. To reinforce the concept of matter conservation, students could annotate the diagram with molecular models (small colored circles or molymods) for the reactants and product of photosynthesis. The schematic drawing in question 2 can be sketched onto a larger piece of paper, and students can work in small groups to complete it, before they transfer the information to their own page. The activity is well supported by content on the Resource Hub. **Keywords:** photosynthesis, glucose, cellular respiration, ATP		**Learning Outcome:** Construct a schematic diagram representing energy flow and conservation of matter during photosynthesis and respiration. ________________ ▸ Longer answer questions ▸ Label model of energy transfer
GC: **Week:** **Date:**	0.5	**58** Energy from glucose	11.A explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes 2.C	4.F.v	**Key Question:** How is energy released from glucose during the process of cellular respiration? Start by comparing the two equations for photosynthesis and cellular respiration. Ask the students to explain how these processes together show the conservation of matter and the transfer of energy. Ask where and in what form does the energy originate? Where and in what form does the energy end up after the reaction? The four pathways shown for ATP production can be used as an expert group activity. Divide the class into four groups (or eight if a large class) where each group discusses and writes down summary points about their pathway. The groups split to form new groups of four, and each person explains their 'expert' pathway knowledge to the others. **Extension:** Question 9 is tagged as an extension question. **Keywords:** cellular respiration, aerobic respiration, diffusion, ATP, mitochondria, glucose, anaerobic metabolism, fermentation, glycolysis **Homelink:** look at the labels of some of the food containers and packages at home. Record down some of the energy information - what types of food have the highest amount of energy per weight?		**Learning Outcome:** Write a simple word equation for respiration. ________________ **Learning Outcome:** Describe the general location of respiration and the transportation of the reactants and products. ________________ **Learning Outcome:** Compare and contrast aerobic and anaerobic respiration, including fermentation. ________________ ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**59** Aerobic cellular respiration	11.A explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes 2.C		**Key Question:** What are the stages of aerobic cellular respiration? Students should use the diagram to note the main steps and their location. Emphasize the equation for cellular respiration; use strategies previously discussed if required. **Scaffolded:** If students require support with the percentage calculations in this question, complete a worked example with the class or refer to activity 252 in the Science Practices chapter. **Extension:** Explain that a mole is a specific unit of measurement. More able students may want to know that a molecule and a mole (6.02 × 1023 particles) are different, and a standard measure for reactants or products. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM. org: Best Evidence Science Teaching: Cellular respiration- covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] This activity is well supported with explanatory videos on the Resource Hub. **Keywords:** cellular respiration, glucose, ATP, glycolysis, link reaction, Krebs cycle, mitochondrion		**Learning Outcome:** Detail the steps of respiration, including reactants/products, and the specific location where they each occur. ________________ **Learning Outcome:** Discuss the transfer of energy and pathways from storage as glucose to the cells of body tissue. ________________ **Learning Outcome:** Calculate the energy efficiency of respiration. ________________ ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**60** Measuring respiration	1.B 1.C 1.D 1.E 1.F 2.B 2.C	3.F.ii	**Key Question:** How can a respirometer be used to measure the rate of cellular respiration in germinating seeds? Components of the investigation will need to be prepared ahead of time. To prepare four day old germinated seeds, place mung bean seeds onto damp tissue in a petri dish. Place in a warm area and do not let the tissue dry out. Mung beans are large enough for the students to handle easily. Make sure all connections are secure when setting up the equipment to ensure the experiment runs well. This investigation could be completed in conjunction with activity 102, which investigates the germination of seeds. The investigation could then be referred back to when covering cellular respiration. **Keywords:** cellular respiration	3.2 Measuring respiration	**Learning Outcome:** Investigate respiration rates in germinated and non-germinated seeds. ——— ▸ Laboratory investigation - in small groups of 4 ▸ Plot collected data in tables and in a graph ▸ Calculate rates of respiration ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**61** Modeling photosynthesis and respiration	11.A explain how matter is conserved and energy is transferred during photosynthesis and cellular respiration using models, including the chemical equations for these processes 1.G		**Key Question:** How can models be used to demonstrate photosynthesis and cellular respiration? The components could be cut up and laminated for multiple uses (e.g. modeling the photosynthesis and cellular respiration equations). Students keep them for revision. Molymods could also be used. Pair students up for this investigation, one manipulates the models and the other writes down the answers. Students can switch roles for question 2. Students can be referred back to activities 55 and 58 if they need a reminder about the processes. **Homelink:** If there is not time to construct the models in class, students can take the activity home and complete, recording with photographs to bring back to class	3.3 Modeling photosynthesis and respiration	**Learning Outcome:** Model photosynthesis and respiration reactions. ——— ▸ Classroom investigation - individual ▸ Short and longer answer questions ▸ Write chemical equations ▸ Draw a model to represent the process of photosynthesis ▸ Label a model showing respiration
GC: **Week:** **Date:**	0.25	**62** Reactions in cells	11.B Investigate and explain the role of enzymes in facilitating cellular processes 1.F 2.B 3.A	4.C.iii	**Key Question:** How do anabolic and catabolic reactions build or break down molecules in the body? The focus now moves to the role of enzymes in cellular processes. The lesson could start with an introductory video from the Resource Hub. **Extension:** Students can be extended with a compare and contrast table of anabolic and catabolic reactions, linked to photosynthesis and cellular respiration, before they interact with the content in the activity. **Literacy:** For terms such as endergonic and exergonic, the prefixes can be elaborated on. Ask students to think of any similar words in science, so they can associate the terms with 'in' and 'out' (entrance and exit). Provide examples if necessary, e.g. endotherm and exotherm. **Keywords:** metabolism, enzymes, anabolic reactions, catabolic reactions, photosynthesis, organelles, chloroplasts, glucose, cellular respiration, ATP, mitochondria		**Learning Outcome:** Compare anabolic and catabolic reactions. ——— ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**63** What are enzymes?	**11.B** Investigate and explain the role of enzymes in facilitating cellular processes **1.F** **2.B** **3.A**	4.F.ix	**Key Question:** How do anabolic and catabolic reactions build or break down molecules in the body? The focus now moves to the role of enzymes in cellular processes. The lesson could start with an introductory video from the Resource Hub. **Extension:** Students can be extended with a compare and contrast table of anabolic and catabolic reactions, linked to photosynthesis and cellular respiration, before they interact with the content in the activity. **Literacy:** For terms such as endergonic and exergonic, the prefixes can be elaborated on. Ask students to think of any similar words in science, so they can associate the terms with 'in' and 'out' (entrance and exit). Provide examples if necessary, e.g. endotherm and exotherm. **Keywords:** metabolism, enzymes, anabolic reactions, catabolic reactions, photosynthesis, organelles, chloroplasts, glucose, cellular respiration, ATP, mitochondria		**Learning Outcome:** Compare anabolic and catabolic reactions. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**64** How enzymes work	**11.B** Investigate and explain the role of enzymes in facilitating cellular processes		**Key Question:** What are enzymes and what role do they play in biological reactions? Encourage students to recall the types of biomolecules they encountered in chapter 1. They should recall from activity 7 that enzymes are proteins. They should understand the key features of enzymes. **Extension:** Compare the redundant 'lock and key' model with the induced fit model of enzyme activity. Discuss why models (and hypotheses) can be superseded when new findings come along. Apply the information about enzymes and metabolic rate to activity 65. Without enzymes, metabolic reactions would proceed slowly because of our relatively low body temperature. Question 1(b) is tagged as extension. **Keywords:** enzymes, catabolism, anabolism, catalysts, active site, denaturation		**Learning Outcome:** Explain the importance of enzymes to human metabolism. **Learning Outcome:** Describe the induced fit model of enzyme activity. ▸ Longer answer questions
GC: **Week:** **Date:**	1	**65** Enzymes have optimal conditions to work	**11.B** Investigate and explain the role of enzymes in facilitating cellular processes **1.C** **1.D** **1.E** **1.F** **2.B** **3.A** **3.B**	4.G.iii	**Key Question:** What conditions are optimal for enzymes, and what happens to their structure and function outside of these conditions? Students investigate the role of amylase enzyme on starch. Students will need to be very organized and have assigned roles to record the results. You could perform an iodine test to demonstrate a positive and negative result. Ensure students use appropriate vocabulary in question 4 (enzyme, product, substrate). **Extension:** You can ask students to plan another experiment to test enzyme activity if you wish, e.g. effect of enzyme concentration. They can consider the variables involved, repeatability, and data collection and this can be used to prepare for activity 66. Refer them to the Science Practices chapter for help in planning. **Keywords:** enzymes, optimum, denatured, glucose **Homelink:** Do you have any enzymes in products at home? In washing powder? What do you think the enzymes are in the product for? Ask your parents what they think.	3.4 Effect of temperature on enzyme activity	**Learning Outcome:** Explain how concentration and temperature affect enzyme reaction rates. **Learning Outcome:** Investigate the effect of temperature on amylase enzyme reaction rates. ▸ Laboratory investigation - small group ▸ Interpreting data in graphs ▸ Graphing collected data ▸ Longer answer question

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**66** Design an experiment to test catalase activity	11.B Investigate and explain the role of enzymes in facilitating cellular processes 1.A 1.B 1.C 1.F 2.B 2.D		**Key Question:** What factors must be taken into consideration when planning an investigation? Students apply their understanding of enzyme activity to design an investigation into catalase activity. **Scaffolding:** If needed, use the 'fair test' template on the Resource Hub for planning, this allows students to consider all of the variables before writing a full plan. Direct students to the equation provided, highlighting that oxygen is one of the products, the amount produced is the dependent variable. If students are considering using the amount or concentration of H_2O_2 as the independent variable, remind them that a fair test has only one variable changed, and there are already different gemination ages for the mung beans. **Keywords:** enzyme		**Learning Outcome:** Plan an investigation to test how the number of days of mung bean germination affect the catalase enzyme reaction rate. **Learning Outcome:** Evaluate a planned investigation on enzyme reaction rate. ▶ Short and longer answer questions ▶ Planning an investigation, including data table design and evaluation
GC: **Week:** **Date:**	0.5	**67** Mouse trap revisited			**Key Question: U**nder what conditions can an animal survive in a sealed system? The content anchor, "Mouse Trap", uses the context of a historical experiment, placing a mouse and plant in a bell jar, to unpack the students' prior knowledge of the processes of photosynthesis and cellular respiration.		▶ Short and longer answer questions ▶ Interpreting data in a graph ▶ Constructing detailed model of respiration and photosynthesis relationship
GC: **Week:** **Date:**	0.5	**68** Summing up (Chapter 3)			**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▶ Multichoice ▶ Short and longer answer questions

CHAPTER 4 Animal and Plant Structure and Function

In this chapter, the key focus for students is that interactions occur between systems, allowing plants and animals to perform a multitude of functions. Students' prior knowledge of different body systems and some plant systems from previous grades is developed to build a deeper understanding of the co-ordination occurring between systems.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**69** Complex interactions		**TC:** 4.E.i	**Key Question:** How do organisms maintain their internal environment and what interactions between organ systems occur to assist this? The content anchor, "Complex interactions" asks students to consider how living organisms can regulate their internal systems and co-ordinate numerous organ systems. **Prior Knowledge:** Students use their prior knowledge to suggest how multiple organ systems work together to enable a life function to occur in both plants and animals.		▶ Short and longer answer questions
GC: **Week:** **Date:**	0.75	**70** The hierarchy of life **71** Overview of body systems **72** The body's systems work together	4.A	1.A.ii	**Key Questions:** How are the cells of organisms organized so that they work together in a coordinated way? What are the organ systems of the body, and what are their main components? Activity 70 provides an overview to the hierarchy of life, and demonstrates how complexity builds at each level. Activity 71 recaps the 11 different body systems. These activities can be used for reference as students work through the chapter. The Resource Hub provides material to extend interested students and support those with gaps in their knowledge. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Working together: cells, tissues and organ systems- covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Keywords:** organ systems, organs, cells, homeostasis		**Learning Outcome:** Identify 11 human body organ systems and their functions. ▶ Short and longer answer questions ▶ Identify body systems and match with function
GC: **Week:** **Date:**	0.5	**73** Homeostasis	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals 3.A		**Key Questions:** How do the body's organ systems work together to maintain the body? How do organisms maintain a constant internal environment despite changes in their external environment? The concepts of homeostasis and system interactions are introduced. Teachers may choose to swap the order of teaching activities 72 and 73, so that students are armed with more knowledge about the homeostasis process first. The lesson could start with groups of students brainstorming what they understand about homeostasis and the structures in the human body that are involved. Finish with a classroom discussion when reviewing answers. Students should then be able to alter their answers to align with the model answer. **Keywords:** homeostasis, organ systems		**Learning Outcome:** Define homeostasis and its key components, and explain the importance of homeostasis in the body. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**74** Negative feedback regulates the body	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals 3.A		**Key Question:** How do negative feedback mechanisms detect changes in the body's internal environment away from normal and return it to a steady state? Negative feedback is the most common homeostatic control method. Several models are used to illustrate negative feedback loops. **Extension:** Any of the examples: blood pH, stomach emptying, or thermoregulation, can be explored at a greater depth by students as an extension opportunity. **Keywords:** negative feedback, homeostasis		**Learning Outcome:** Discuss how feedback mechanisms control homeostasis, including blood glucose levels. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**75** Nervous regulatory systems **76** Hormonal regulation **77** Nervous and endocrine interactions	**12.A** analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals **3.A**		**Key Questions:** How does the nervous system regulate functions of the body? How do the hormones regulate functions of the body? In what ways are the nervous and endocrine systems both similar and different, and how do they work together to maintain homeostasis? The basics of the nervous regulatory system and hormonal (endocrine) system are explored individually, before their interaction is explored in activity 77. The focus is on how these systems interact to maintain homeostasis. **Literacy:** Students can work in small groups or pairs to read the material and answer questions. **Scaffolding:** Use mixed ability groups, including student mentors who have a more comprehensive understanding of the concepts covered in each group. This provides capable students with learning opportunities as they mentor and explain concepts; other students receive scaffolding. **Keywords:** homeostasis, tissues, hormones, cells		**Learning Outcome:** Compare and contrast how the nervous and hormonal regulatory systems function when interacting together to regulate the body. ▸ Longer answer questions
GC: **Week:** **Date:**	1	**78** Interactions regulating the blood **79** Interactions regulating respiratory gases	**12.A** analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals **2.B** **4.A**	4.C.iii	**Key Questions:** How do the circulatory and urinary systems interact to remove wastes from the body's tissues and help maintain blood volume and pressure? How do the circulatory and respiratory systems interact to provide the body's tissues with oxygen and remove carbon dioxide? These activities explore the regulation of the blood and regulation of respiratory gases through system interactions. **Scaffolding:** Ask students to carefully study the models (diagrams) and help them understand the information by projecting the image onto the whiteboard. Annotate the diagram with notes or direction arrows during class discussion. **Extension:** Students can add their own notes and annotations in the worktext. **Keywords:** cells, tissues, hormones, diffuse		**Learning Outcome:** Explain the roles of the circulatory and urinary system when interacting together to remove wastes. **Learning Outcome:** Describe how the circulatory and respiratory system interact to regulate respiratory gases. ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**80** Effect of exercise on heart rate and breathing	**12.A** analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals **1.B** **1.F** **2.B** **2.C** **3.A**	2.I.i	**Key Question:** What interactions occur between the circulatory, respiratory, and muscular systems during exercise? A simple experiment investigating the effect of exercise on heart rate provides context and background for students to plan their own investigation into the effect of exercise on breathing rate. The amount and type of physical exercise can be adjusted, depending on the health status of the students in the class. Members of a sports team could volunteer to perform the exercise, so that other students can collect data. **Homelink:** Part of this investigation could be done at home, if the student has willing family members to participate in data collection.	4.1 Investigating the effect of exercise on heart rate 4.2 Investigating the effect of exercise on breathing rate	**Learning Outcome:** Plan an investigation to test the effect of exercise on the circulatory and respiratory systems. ▸ Classroom investigation - small groups ▸ Plan and conduct a classroom investigation ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**81** Interactions for nutrient absorption	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals 3.A	4.F.ix	**Key Question:** How do the circulatory and digestive systems interact to provide the body's tissues with the nutrients that they require? This activity highlights interactions between the circulatory and digestive system to enable nutrient absorption. **Extension:** Students could record their understanding of the key interactions by developing their own summary tables. It can also be used for other interactions in the chapter (regulation, reproduction, and defense from injury and illness).This could also be in the form of a body outline, where each page has one of the headings above, and students indicate the systems involved by annotating the sheet. **Keywords:** cells, tissues, hormones		**Learning Outcome:** Describe how the circulatory and digestive system interact together to provide the body's cells with nutrients. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**82** Regulating blood glucose levels	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals 2.B 4.B		**Key Question:** How is a constant blood glucose level maintained in the body? **Homelink:** Diabetes is a fairly common disease in western countries. A person with this condition, or family member, may wish to share their story of diabetes with the class as a way to introduce this topic. Alternatively, videos on the Resource Hub can be used as engagement. **Extension:** Students can distinguish between type I and type II diabetes, comparing the malfunctioning mechanism for both. Refer students to the Resource Hub if they need background on the body systems and organs involved. **Keywords:** negative feedback, hormones, cells		**Learning Outcome:** Discuss how feedback mechanisms control homeostasis, including blood glucose levels. ▸ Short and longer answer questions
GC: **Week:** **Date:**	04	**83** Interacting systems: the menstrual cycle	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals		**Key Question:** What is the interaction between the endocrine system and the female reproductive system? **Scaffolding:** This is a complex topic. To deepen understanding of the interactions, you may want students to combine the information, including ovarian cycle, menstrual cycle, and timing of hormones, on a circular chart representing the 28 day month. Approach the topic of menstruation in an open way, but be aware that, for some female students, it may be a subject that is discussed very little at home, and especially not around males. **Keywords:** hormones, negative feedback		**Learning Outcome:** Summarize the roles of hormones in controlling the menstrual and ovarian cycles, and the interactions involved. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**84** Interacting systems: pregnancy and birth	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals		**Key Question:** What interactions occur between systems during fetal development and birth? **Scaffolding:** The complex hormonal regulation model could be scaffolded by drawing and annotating a diagram showing a series of the stages of birth. This would help students to comprehend the sequence of hormones released, and the function they serve. Students need to understand that, although the circulatory system of the baby and the mother are separate, there is a constant flow of substances shared between. **Keywords:** cells, tissues, organ, diffusion, hormone		**Learning Outcome:** Analyze how the circulatory and reproductive systems interact together to maintain pregnancy and induce birth. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**85** The immune system **86** The body's defenses: a layered structure	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals		**Key Questions:** What is the structure of the immune system? How does a layered defense system provide resistance against disease? Ensure students have a good understanding of the complexity of the immune system and the multiple layers of defense. An infectious disease can be used to give more context for the students. **Extension:** Students could be extended by researching a selected disease and detailing the specific immune system response triggered by it. **Keywords:** cells, antibodies, antigen		**Learning Outcome:** Outline how the immune, endocrine, and circulatory systems interact to defend the body from bleeding and infection. ——— ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**87** Blood clotting and defense **88** Interacting systems: responding to infection	12.A analyze the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals	4.F.ix	**Key Questions:** How does blood clotting occur and how does it help repair injury and prevent further infection? What organ systems interact to prevent and respond to infection? Students can be asked to share their experiences of what happens after they get a small cut, to relate their own experience to the blood clotting process. Likewise, students can discuss what they notice after they get a skin infection, and be asked why they think those responses may occur. Use the activities to explore the mechanisms and systems involved in responding to injury or illness. Some students may be interested to know that fever is an example of positive feedback. These types of control are rare in humans because they can be dangerous if unresolved. **Keywords:** cells, tissues		**Learning Outcome:** Outline how the immune, endocrine, and circulatory systems interact to defend the body from bleeding and infection. ——— ▸ Longer answer questions
GC: **Week:** **Date:**	0.25	**89** Plant organ systems	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures	5.B.i	**Key Question:** What are the different parts of the plant organ system? This activity serves as a refresher for students, covering the key structures and functions in a plant. Teachers can provide a few plant examples, or provide images of different plants so that students can identify the same structures on each. Refer students to chapter 3 to link the structures to the process of photosynthesis. **Extension:** Students can research how different plant structures are modified to allow plants to survive in extreme environments **Keywords:** organ systems, hormones		▸ Longer answer questions ▸ Match functions into correct category
GC: **Week:** **Date:**	0.75	**90** Interacting systems in plants	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.C 1.D 1.E 1.F 3.A 4.A		**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? Students use the microscopic techniques introduced in chapter 1 to view the internal structures of plants involved in water balance and transport. If plant specimens are difficult to obtain, the images can be printed onto clear acetate at a high resolution and enlarged for students to see features clearly, then cut and glued onto glass slides. **Scaffolding:** Images provided in the Resource Hub can be projected onto the board and annotated to scaffold student understanding. **Keywords:** transpiration, diffusion	4.3 Investigating vascular tissue	**Learning Outcome:** Draw a slide specimen of root and stem cells, involved in maintaining water balance in a plant. ——— ▸ Laboratory investigation - small group ▸ Construct a scientific drawing from slides ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**91** Xylem and phloem **92** Stem and root structure **93** Transpiration	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 3.A	4.F.ix	**Key Questions:** What is the structure of the vascular tissue in plants? What is the structure of the vascular tissue in the stems and roots of plants? How does the process of transpiration help maintain water homeostasis in plants? The structures of the xylem and phloem are examined individually, then in the context of the roots and stems. Finally, the role of these structures in transport, along with the role of stomata, are combined to demonstrate how water is transported through the plant. Visualization of the transpiration process can be supported by videos and animations on the Resource Hub. **Keywords:** tissue, cells, homeostasis, transpiration **Homelink:** who waters the house plants at home? Collect information on how much water different plants require, and how often they need to be watered.		**Learning Outcome:** Describe structural features of xylem and phloem vascular tissue, found in roots and stems. **Learning Outcome:** Investigate how vascular tissue and stomata interact together in the process of transpiration to maintain water balance. ▸ Short and longer answer questions ▸ Identify structures in plant micrographs
GC: **Week:** **Date:**	1	**94** Investigating transpiration	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.A 1.B 1.E 1.F 2.B 3.A 4.A		**Key Question:** What effects do physical factors in the environment, such as humidity, temperature, light level, and air movement, have on transpiration rate in plants? For students unable to access the laboratory, two levels of transpiration investigation simulations are provided in the Resource Hub, with most questions in the activity still able to be answered. **Scaffolding:** Teachers could prepare a demonstration of the equipment setup to assist students with a successful set up of their own. Use the activities in the Science Practices chapter to help students with graphing, and identifying variables. **Extension:** Extend the investigation by asking students to plan and write the method out in full, adding all the other variables that are controlled, and how they are controlled. **Keywords:** transpiration	4.4 Investigating plant transpiration	**Learning Outcome:** Investigate how vascular tissue and stomata interact together in the process of transpiration to maintain water balance. ▸ Laboratory investigation - small groups ▸ Graph collected data ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**95** Uptake at the roots	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** How are water and minerals transported through the roots to the xylem of a plant? Students could view cross sections of the roots using a microscope, or they could be projected onto a board. Although models in the book help to explain the process, it is important that students can also relate these models to actual structures in the plant. The process of osmosis is covered in more detail in chapter 1, if teachers wish to recover this material briefly as an introduction. **Scaffolding:** Teachers could scaffold question 5 by listing the structures on the board, for students to use in their answer. **Keywords:** transpiration, cells, tissue, diffusion, osmosis		**Learning Outcome:** Discuss how osmosis and translocation allow the movement of water, minerals, and sugars through the plant. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**96** Translocation	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** What model best explains the movement of the products of photosynthesis through the phloem of a plant? **Scaffolding:** Refer to activity 22, Osmosis in Cells, to help students understand the osmotic process involved in translocation. An animated video showing translocation is on the Resource Hub, and can help to clarify this dynamic process for the students. **Keywords:** hormones, organ		**Learning Outcome:** Discuss how osmosis and translocation allow the movement of water, minerals, and sugars through the plant. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**97** Asexual reproduction in plants	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** What structures do plants use to carry out asexual reproduction? Students move onto plant reproduction processes in this activity, and many will bring a base of knowledge that has been covered in previous grades. Teachers could provide the class with a range of asexual plant examples, as shown in the photos. Some classes may have access to school or local gardens to view the plants. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM. org: Best Evidence Science Teaching: Sexual and asexual reproduction in flowering plants- covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Extension:** Students could be asked to discuss advantages of asexual vs sexual reproduction in plants. **Keywords:** tissues		**Learning Outcome:** Explore different methods of asexual reproduction in plants. ▸ Longer answer questions
GC: **Week:** **Date:**	0.75	**98** Investigating plant propagation	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.B 2.B		**Key Question:** Does the type of growing medium affect the ability of plants to grow from cuttings? This investigation could take place in the class or an outdoor glasshouse, or even at students' homes (for a home task). Activity 267 in the Science Practices chapter provides support for calculating medians. **Homelink:** Students could continue with their plant propagation investigation at home, especially if there is a suitable place for the plant to continue growing. Do any parents have horticultural experience they could share with the class?	4.5 Plant propagation	**Learning Outcome:** Investigate the propagation of plants in different mediums. ▸ Short and longer answer questions ▸ Laboratory investigation - small groups
GC: **Week:** **Date:**	0.5	**99** Insect pollinated flowers **100** Wind pollinated flowers	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures	4.F.iii	**Key Questions:** How do the structures of insect pollinated flowers carry out the function of reproduction? How do the structures of wind pollinated flowers carry out the function of reproduction? Students can complete a simple insect pollinated flower dissection in groups, using a scalpel and magnifying glass to observe the structures. They could dissect a wind pollinated flower for comparison (although these are likely to be smaller and require more precision). **Extension:** Students can making a scientific drawing of the dissected flowers. Further extension can be offered for students to research the shape and color of the flowers, linked to the type of pollinator they attract. **Homelink:** What flowers do you have present at home. Students can observe and bring in samples or photos of them to share with the class.		**Learning Outcome:** Analyze and describe the different mechanisms of plant pollination and fertilization, and the structures involved. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**101** Pollination and fertilization	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures **3.A**	4.F.ix	**Key Question:** How do the structures of flowers ensure pollination and fertilization occur efficiently? Agapanthus flowers, if available, are suitable to dissect and observe the ovary structure of a flower. This could be completed in conjunction with activities 99 and 100. **Scaffolding:** Making a flow chart of the steps involved in fertilization will help scaffold question 1.		**Learning Outcome:** Analyze and describe the different mechanisms of plant pollination and fertilization, and the structures involved. ▸ Longer answer question
GC: **Week:** **Date:**	0.75	**102** Seed structure and germination	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures **1.B** **2.B**		**Key Question:** What is the structure of plant seeds and how does the structure help germination of the seed? **Extension:** The germination investigation can be extended by students planning a second experiment, where another variable was changed, such as light, warmth, or oxygen. They will need to develop a hypothesis, identify all variables and the control, as well as write a complete method showing how they have controlled all other variables. On completion of the investigation, students could dissect both germinated and non-germinated seeds to observe, and possibly draw, the internal structures. For digital collaboration, students can use a shared Google Doc or TEAMS WORD Doc to plan their together. This is especially useful if one or more group members are working from home, and keeps a digital record of the groups planning. Activities in the Science Practices chapter support this activity. **Keywords:** tissue, cells, hormones, enzymes **Homelink:** Students can continue germinating seeds at home. Some students may wish to germinate pea or vegetable seeds and record their growth.	4.6 Germination investigation	**Learning Outcome:** Investigate factors affecting germination in seeds. ▸ Short and longer answer questions ▸ Label structures in a seed ▸ Laboratory investigation - small group ▸ Plot collected data in a graph
GC: **Week:** **Date:**	0.25	**103** Seed dispersal	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** What features of plants help them disperse their seeds? The final activity involved with plant reproduction involves methods of seed dispersal. Clarify the distinction between pollination and seed dispersal, as these separate processes can be confused by students. **Extension:** Students can be extended by researching unusual methods of seed dispersal. **Homelink:** Students could collect samples of seeds, especially unusual ones, and bring them in to class to be examined.		**Learning Outcome:** Describe different examples of seed dispersal methods. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**104** **Responses in plants**	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question: H**ow do plants respond to their surroundings? The third function of plants: responses, is introduced in this activity. Students can begin the activity in a small group, brainstorming and sharing ideas for how plants may respond to their environments. Further engagement can be provided by a selection of introductory videos on the Resource Hub. **Keywords:** tropism		**Learning Outcome:** Explain how plants respond to environmental change, and the hormones involved. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**105** Tropisms and growth responses	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** How do plants respond to their surroundings? **Scaffolding:** To scaffold students, the seedling image can be projected onto the board and the different tropisms written up, and crossed off when used. **Extension:** Students can be extended by finding other words that begin with the tropism prefixes, which will also help them remember the original tropism term. **Literacy:** Like all new words introduced in this chapter and book, flash cards can be made of meaning and word, obtained from the glossary, to be used as an additional revision tool. **Keywords:** tropism		**Learning Outcome:** Explain how plants respond to environmental change, and the hormones involved. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**106** Auxins, gibberellins, and ABA	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** What is the function of plant hormones? Many students associate hormones with animals only. They can be reminded that plant hormones provoke a response in certain plant cells, just as they do in animals. Videos are available on the Resource Hub that cover tropisms and plant hormones, to provide another type of media for learning. **Keywords:** auxin		**Learning Outcome:** Explain how plants respond to environmental change, and the hormones involved.. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**107** Plant hormones as signal molecules	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures		**Key Question:** What is the role of auxin in promoting apical growth in plants? Talk students through the results and encourage them to relate them to the effects of auxin. The auxin investigation could be completed in class as a practical component if time and resources are available. As with many plant investigations, an extended preparation period is required prior to running the experiments. Radish seeds and seedlings especially produced for fast growth can be used for the responses segment if quicker results are needed. **Keywords:** auxin, hormones, tissues, cells		**Learning Outcome:** Investigate the effect of auxin and gibberellins hormones on plant growth. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**108** Investigating phototropism	**12.B** explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures **1.G**		**Key Question:** What is the effect of light on the growth of a plant? Refer students to activity 106 for information about plant hormones involved in phototropism. **Scaffolding:** To scaffold the drawing of cells, teachers can project the link, or direct the students, from the Biology Dictionary found on the Resource Hub. **Homelink:** Students could perform a simple phototropism or gravitropism or investigation at home, bring in the plants, or photos of plants, to class		**Learning Outcome:** Investigate the effect of environmental stimuli, such as light and gravity, on phototropism and gravitropism responses. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**109** Gibberellins and stem elongation	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.F 2.C 2.D		**Key Question:** What is the effect of gibberellins of plant growth responses? **Scaffolding:** The teacher may have to break down the calculations of the mean and standard deviation into steps for students. Support for calculating means and standard deviation can be found in chapter 10, activities 267 and 268. Some students may need to be presented with the standard deviation answers, and just complete the mean calculations.		**Learning Outcome:** Investigate the effect of auxin and gibberellins hormones on plant growth. ▸ Short and longer answer questions ▸ Plot a line graph from provided data
GC: **Week:** **Date:**	0.5	**110** Investigating gravitropism **111** Investigating gravitropism in seeds	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.G 3.A		**Key Questions:** What are the mechanisms that allow plants to respond to gravity? What is the role of auxin in a plant's response to gravity? The models in activity 110 can be projected onto the board and annotated by the teacher in the initial class discussion. The experiment in activity 111 is very simple and students could carry it out themselves if you wish. **Extension:** Students can evaluate the method used in the investigation, and rewrite it to include more detail that would allow greater reliability and accuracy in the results. Chapter 10 can be referred to for specifics on investigations. **Keywords:** auxin, tissues, cells		**Learning Outcome:** Investigate the effect of environmental stimuli, such as light and gravity, on phototropism and gravitropism responses. ▸ Short and longer answer questions ▸ Draw a model of expected plant growth
GC: **Week:** **Date:**	0.25	**112** Nastic responses	12.B explain how the interactions that occur among systems that perform functions of transport, reproduction, and response in plants are facilitated by their structures 1.G		**Key Question:** How do plants respond to non-specific stimuli? Access to a Mimosa plant, Venus flytrap or sundew plants is helpful for demonstrating the response. Prevent multiple touches, as the response is best when a single touch occurs. **Extension:** Extension can be offered to students interested in the mechanism of the response of one of the above plants, either as a research project or presentation. **Keywords:** hormones, cells **Homelink:** some students may have some of these plants at home. The can record their responses and bring their videos or photos into class		**Learning Outcome:** Explore how some plants use reversible nastic responses to respond to non-specific stimuli, such as touch. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**113** Complex interactions revisited			**Key Question:** How do organisms maintain their internal environment and what interactions between organ systems occur to assist this? The content anchor, "Complex interactions" asks students to consider how living organisms can regulate their internal systems and co-ordinate numerous organ systems. Students use their prior knowledge to suggest how multiple organ systems work together to enable a life function to occur in both plants and animals. **Keywords:** organ systems		▸ Longer answer questions
GC: **Week:** **Date:**	0.5	**114** Summing up (Chapter 4)			**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct.		▸ Multichoice ▸ Short and longer answer questions

CHAPTER 5 DNA and Gene Expression

In this chapter, the key focus is for students to understand how work of multiple scientists led to our current knowledge about the origin, structure, and function of DNA, as well as gene expression and the effect of mutation. Aspects of genetic technology, including PCR testing, gel electrophoresis, recombinant DNA, and CRISPR gene editing, are also required.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**115** Real-Life superpowers			**Key Question: W**hat is the result of changes in DNA and can they produce beneficial results? The content anchor, "Real-Life Superpowers", uses the context of super abilities in humans, caused by genetic mutations, to introduce the chapter. Prior knowledge: Students utilize prior knowledge to discuss possible advantages and disadvantages of mutations, and what impact they might have on gene expression and phenotype in organisms. **Keywords:** mutations		▸ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**116** DNA and chromosomes	7.A identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA		**Key Question: H**ow are DNA, genes, and chromosomes related? The 'unpacking' of a chromosome is used as a revision and introductory exercise. **Literacy:** Genetics adds new terms to the vocabulary that students are likely to recall from previous grades. Genetics is an area of biology that heavily uses vocabulary terms, so encourage students to use the glossary provided. Teachers could generate word scrambles, crosswords, word finds, matching word to definition, and fill in the blanks to build vocabulary. **Keywords:** DNA, chromatin, chromosomes, genes, transcribing, histone proteins		**Learning Outcome:** Relate the structure of DNA to gene expression. __________ ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**117** DNA and RNA	7.A identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA 1.G	4.D.i	**Key Question: What are the differences between DNA and RNA?** Nucleic acids were introduced in activity 4; now students become familiar with how they are connected together to form DNA and RNA. **Scaffolding:** Students are unlikely to have encountered some terms, such as 3', 5', hydroxyl, and terminal, and these should be clarified at the start of the lesson. **Literacy:** Students can also create additional pages of glossary terms for each chapter that can be attached into the book. This compare and contrast activity can be completed in small groups, before a class discussion. **Keywords:** nucleotides, DNA, condensation reaction		**Learning Outcome:** Contrast DNA and RNA structure. __________ ▸ Compare and contrast table ▸ Short answer question
GC: **Week:** **Date:**	0.5	**118** Modeling DNA structure	7.A identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA 1.G 2.A		**Key Question:** What is the structure of DNA and how can it be modeled? This activity focuses on using scientific models to convey information. It shows how models can be adapted and become more complex as more information is discovered. Begin by asking students to draw a model of how they think DNA could be represented, then compare their model with the ones provided in the worktext. Historically scientific discoveries by Watson and Crick, Franklin, and Chargaff, are included. Building the paper model reinforces the base-pairing rule. The Resource Hub provides instructions for creating a DNA model with candy. **Keywords:** DNA, nucleotide	5.1 Modeling DNA structure	**Learning Outcome:** Evaluate models of DNA and construct a paper DNA model. __________ ▸ Short and longer answer questions ▸ Classroom investigation - pairs

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**119** Discovering DNA	**7.A** identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA **4.B**	TC 2.C.i	**Key Question:** How did scientists figure out the structure of DNA and that it was responsible for encoding information for controlling processes in a cell? **Scaffolding:** This activity is information heavy, and can be divided into sections. Short documentaries on the Resource Hub are provided for support, if required. **Literacy:** Use the question dice template on the Resource Hub to help students generate two-level questions. They can ask their peers to answer them. The question dice can be used in any activity where a large amount of information needs to be unpacked, understood, and discussed. For digital collaboration with the timeline, students can use a shared Google Doc or TEAMS WORD Doc to start or continue their research together. The groups then can paste their key points onto one class shared digital document to keep a record of their pooled knowledge. Students could extract DNA from kiwifruit: they will actually be able to see the DNA. Refer to the link 'Bang goes the Theory", pg72, in the Resource Hub, for a suggested method. **Keywords:** DNA, traits		**Learning Outcome:** Analyze evidence from past scientists' research into DNA structure. **Learning Outcome:** Create a timeline of DNA structure research. ▶ Short and longer answer questions ▶ Create a timeline of DNA scientific developments - small groups then whole class
GC: **Week:** **Date:**	1	**120** The origin of DNA	**7.A** identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA **3.A**	5.B.ii	**Key Question:** What are the current theories for the origin of DNA? This activity offers a number of hypotheses for the origin of DNA/RNA. Key to this activity is assisting students to understand the nature of science. Reinforce that it is considered 'good science' for scientists to modify old hypotheses, or construct new ones when new evidence is uncovered. Students can be asked why scientists 'change their minds', and why there might be different hypotheses offered for the same phenomenon. **Extension:** Ask students to investigate the process of formulating a hypothesis, including multiple repeats of experiments, and peer review. The Science Practices chapter supports this approach.		**Learning Outcome:** Evaluate evidence for the origins of DNA and RNA. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**121** Introduction to gene expression	**7.B** describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)		**Key Question:** How is the information in DNA turned into proteins? Activity 121 provides an engaging overview of gene expression. Students should extract the main stages and their locations. Unfamiliar terms can be defined using the glossary. **Keywords:** DNA, nucleotides, gene expression, genes, transcription, translation		**Learning Outcome:** Explain the role of DNA in gene expression. ▶ Deciphering a code ▶ Longer answer questions
GC: **Week:** **Date:**	0.5	**122** Transcription	**7.B** describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)		**Key Question:** What is the purpose of transcription, where does it occur, and what are the key steps in the process? Transcription is explored in more detail. Students need to connect the process to the location in the cell, namely the nucleus, for transcription. An analogy of a photocopier can be used, where the mRNA is the different inks/toner used in different combinations to produce a (color) copy - the transcript. The 'master' (DNA) remains behind, from where repeated copies can be made from it. The copy is used to give instructions for the next phase, translation, outside the nucleus. **Keywords:** transcription, DNA, gene		**Learning Outcome:** Describe the process of transcription. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**123** mRNA editing	7.B describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)		**Key Question:** How does mRNA editing affect the primary mRNA or protein produced? The focus is on how mRNA can be edited by removing introns and joining the remaining exons together, thus creating a vast number of different proteins. The Resource Hub offers an interactive to visualize the process. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** gene, transcription, nucleotide		**Learning Outcome:** Explain how mRNA editing allows for many protein types to be produced from few genes. ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**124** The genetic code	7.B describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)		**Key Question:** How is the information in the sequence of nucleotides that make up DNA converted into amino acids? Ensure students extract and understand the term codon. **Scaffolding:** Use the 'code crackers' activity, on the Resource Hub. It uses a colored code wheel to decode the codons. This can be printed and laminated for repeated use. **Extension:** Material that involves locating a variety of codons from a code sheet is also provided in the Resource Hub. You may want capable students to consider why several different codons code for the same amino acid. **Keywords:** DNA, codons		**Learning Outcome:** Relate codons to amino acids. **Learning Outcome:** Define the term degenerate in the context of gene expression. ▶ Decode codon sequences ▶ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**125** Translation	7.B describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA)		**Key Question:** What is the purpose of translation, where does it occur, and what are the key steps in the process? This activity describes the second stage of gene expression: translation. You can combine this activity with gene expression modeling, activity 126, or use one of the interactives, or videos in the Resource Hub to solidify understanding. **Keywords:** translation, codons		**Learning Outcome:** Describe the role of genetic components in the context of gene expression. ▶ Short answer questions
GC: **Week:** **Date:**	1	**126** Modeling gene expression	7.B describe the significance of gene expression and explain the process of protein synthesis using models of DNA and ribonucleic acid (RNA) 1.G		**Key Question:** How can a model be used to explain gene expression? Any generic plastic building brick can be used in this modeling activity. **Scaffolding:** For students with dexterity challenges, larger style blocks could be used. If photographing and printing the final result is difficult, students could draw, or sketch around the outline, and color their models in the space provided. Having a class set of plastic bricks will also be useful for modeling any chemical reactions, such as photosynthesis. **Keywords:** gene expression, DNA	5.2 Modeling gene expression	**Learning Outcome:** Investigate the effect of environmental stimuli, such as light and gravity, on phototropism and gravitropism responses. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**127** DNA sequence and traits	**7.A** identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA	3.B.ii	**Key Question:** How does the DNA specify the traits of an organism? Students can refer to activity 124 to link DNA, codons, and traits/phenotype. Variation and inheritance will be covered in the next chapter. **Extension:** Students can be extended by deeper investigation into one of the case studies in the activity, or their own researched case study. **Keywords:** transcription, translation, nucleotides, DNA, traits, gene		**Learning Outcome:** Using scientific vocabulary to explain how the nucleotide sequence can specify traits in an individual. ▸ Longer answer question
GC: **Week:** **Date:**	1	**128** Mutations	**7.A** identify components of DNA, explain how the nucleotide sequence specifies some traits of an organism, and examine scientific explanations for the origin of DNA **7.C** identify and illustrate changes in DNA and evaluate the significance of these change		**Key Question:** What are mutations? The concept of mutations arises in several areas of the worktext. This activity, demonstrating the process of mutation at a genetic level, can be referred back to at any time. Students could have a 'brainstorm' of possible causes of mutations as an introduction to the activity. Ensure students can differentiate and understand the significance of somatic and gametic mutations. **Extension:** Use the genetic mutation simulation on the Resource Hub for extension. **Keywords:** mutation, DNA, nucleotide, gene		**Learning Outcome:** Link mutations to variation in a population, including reasons for why some are retained, some eliminated, and some remain as silent mutations. ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**129** Changes to DNA	**7.C** identify and illustrate changes in DNA and evaluate the significance of these change		**Key Question:** How do mutations change the DNA sequence? Students can model these changes with strips of paper that have the sequences written on them; they can then be cut and removed, or reattached. **Extension:** Bases can be written on the strips of paper instead, and the codons can be interpreted using the table in activity 124. After the mutation, the codons can be reinterpreted using the codon chart and students can compare the differences. The mutation simulation on the Resource Hub would also work well for this activity. **Keywords:** mutations, DNA, nucleotide		**Learning Outcome:** Distinguish between different types of mutation. ▸ Identifying mutations in codon sequences ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**130** Effects of mutations	**7.C** identify and illustrate changes in DNA and evaluate the significance of these change **3.A**	1.E.iii	**Key Question:** What types of effects are caused by mutations, and are they always harmful? This activity offers a wide range of case studies on beneficial and harmful mutation in humans. Cover them all broadly or select a few to cover in more detail. An alternative delivery is to assign expert groups to one case study. After a set time, one student from each expert group forms another group sitting in a circle, and students take it in turn to briefly outline the effects of 'their' mutation. This type of activity is useful when multiple areas or case studies of information are to be covered. Firstly, the students in the expert group pay close attention and contribute, as there is an expectation they will share their knowledge. Secondly, students each have a turn at talking and sharing equally, so normally reticent students have an opportunity to contribute. **Keywords:** mutations, DNA, gene		**Learning Outcome:** Discuss the effects of mutations, using examples. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**131** Molecular technologies and DNA	7.D discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices		**Key Question:** How does DNA manipulation alter an organism's DNA either by adding new DNA or editing the existing DNA? This activity is an introduction to molecular technology and its applications. Most students would have heard the term GMO. Prior knowledge: Use an initial class discussion to elicit prior knowledge and misconceptions would be useful. Students may have varied opinions on whether GMO is good or bad,the views can be addressed through this series of activities. **Keywords:** DNA, gene		**Learning Outcome:** Describe the value of molecular technology to humans, including genetic modification ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**132** Polymerase chain reaction	7.D discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices		**Key Question:** What are the principles behind the polymerase chain reaction and why is it useful in biotechnology? PCR, and PCR could be a familiar term to students, but they probably won't have without knowledge of the process. Create sequencing cards, students annotate them a summary of the process step. The Resource Hub has animated videos which will also be useful to show the process. **Keywords:** polymerase chain reaction, DNA		**Learning Outcome:** Describe the value of molecular technology to humans, including PCR. ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**133** Gel electrophoresis **134** Making recombinant DNA	7.D discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices 3.A		**Key Questions:** What is gel electrophoresis, how does it work, and what kind of information does it provide? How can DNA from one species be inserted in the DNA of another species? Ensure students have a good understanding of gel electrophoresis before moving to activity 134. The steps in the gel electrophoresis could be written on small cards, and groups of students can try to recall the sequencing of the steps from the activity. The online gel electrophoresis simulation lab in the Resource Hub, provides an alternative delivery mode. There are many steps in producing recombinant DNA. A paper strip activity could be generated to help students understand the steps. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** gel electrophoresis, DNA, nucleotides, gene		**Learning Outcome:** Analyze and discuss the purpose of gel electrophoresis. **Learning Outcome:** Explain the purpose of using recombinant DNA, and describe its usefulness to human industry. ▸ Short and longer answer questions ▸ Converting a given DNA strand into gel electrophoresis model ▸ Interpreting gel electrophoresis data
GC: **Week:** **Date:**	1	**135** Gene editing with CRISPR	7.D discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices 4.B		**Key Question:** What is CRISPR/Cas9 and how does it edit DNA? This relatively new technology is often reported in mainstream media. Find examples of its use to share with your class if you wish. Use the videos and animations on the Resource Hub to introduce the activity effectively. Students could work in small groups to define and research new terms (e.g.PAM sequence or Cas9). Ensure students can differentiate between gene knock in and gene knock out. **Keywords:** DNA, genes, mutations, nucleotide		**Learning Outcome:** Discuss how CRISPR can benefit humans, and human health. ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**136** Genetic engineering for insulin	**7.D** discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices		**Key Questions:** How does the DNA specify the traits of an organism? Students can refer to activity 124 to link DNA, codons, and traits/phenotype. Variation and inheritance will be covered in the next chapter. **Extension:** Students can be extended by deeper investigation into one of the case studies in the activity, or their own researched case study. **Keywords:** transcription, translation, nucleotides, DNA, traits, gene **Homelink:** Some students may have family members who use insulin. The students can ask them if they know how their insulin was manufactured. Are there any other medications that might be genetically engineered, and used by families?		**Learning Outcome:** Using scientific vocabulary to explain how the nucleotide sequence can specify traits in an individual. ▸ Longer answer question
GC: **Week:** **Date:**	0.5	**137** Testing for COVID-19	**7.D** discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices	4.F.iii	**Key Question:** What are mutations? The concept of mutations arises in several areas of the worktext. This activity, demonstrating the process of mutation at a genetic level, can be referred back to at any time. Students could have a 'brainstorm' of possible causes of mutations as an introduction to the activity. Ensure students can differentiate and understand the significance of somatic and gametic mutations. **Extension:** Use the genetic mutation simulation on the Resource Hub for extension. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** mutation, DNA, nucleotide, gene		**Learning Outcome:** Link mutations to variation in a population, including reasons for why some are retained, some eliminated, and some remain as silent mutations. ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**138** Molecular technologies and research	**7.D** discuss the importance of molecular technologies such as polymerase chain reaction (PCR), gel electrophoresis, and genetic engineering that are applicable in current research and engineering practices **3.B** **4.C**	4.F.vii	**Key Question:** How do mutations change the DNA sequence? Students can model these changes with strips of paper that have the sequences written on them; they can then be cut and removed, or reattached. **Extension:** Bases can be written on the strips of paper instead, and the codons can be interpreted using the table in activity 124. After the mutation, the codons can be reinterpreted using the codon chart and students can compare the differences. The mutation simulation on the Resource Hub would also work well for this activity. **Keywords:** mutations, DNA, nucleotide		**Learning Outcome:** Distinguish between different types of mutation. ▸ Identifying mutations in codon sequences ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**139** Real-life superpowers revisited			**Key Questions:** What types of effects are caused by mutations, and are they always harmful? This activity offers a wide range of case studies on beneficial and harmful mutation in humans. Cover them all broadly or select a few to cover in more detail. An alternative delivery is to assign expert groups to one case study. After a set time, one student from each expert group forms another group sitting in a circle, and students take it in turn to briefly outline the effects of 'their' mutation. This type of activity is useful when multiple areas or case studies of information are to be covered. Firstly, the students in the expert group pay close attention and contribute, as there is an expectation they will share their knowledge. Secondly, students each have a turn at talking and sharing equally, so normally reticent students have an opportunity to contribute. **Keywords:** mutations, DNA, gene		**Learning Outcome:** Discuss the effects of mutations, using examples. ▶ Short and longer answer questions
GC: **Week:** **Date:**	1	**140** Summing up (chapter 5)			**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▶ Multichoice ▶ Short and longer answer questions ▶ Label a diagram showing gene expression ▶ Complete a cloze activity on gene expression ▶ Interpret gel electrophoresis data

CHAPTER 6 Patterns of Inheritance

In this chapter, the key focus is for students to understand different mechanisms for passing genetic information from one generation to another. They need to understand the details of meiosis, and be able to predict the possible phenotypes and genotypes of offspring. Students need to analyze both Mendelian and non-Mendelian traits and demonstrate their ability to predict genotype and phenotype ratios using a range of case studies.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**141** Anyone for chocolate?		**1.A.i**	**Key Question:** Can we get a chocolate labrador puppy from black parents? The content anchor, "Anyone for chocolate", asks students to consider how traits in Labrador dogs may be passed on, and how breeders are able to introduce specific traits into litters of pedigree dogs. This helps identify a student's prior knowledge around the topic. **Keywords:** genes **Homelink:** What type of pets do the students have at home? Are they able to describe the color of them, and any features that might be the same or different to their pets parents or siblings. Are these traits likely to be inherited?		▶ Short and longer answer questions
GC: **Week:** **Date:**	0.75	**142** What is a trait? **143** Different alleles for different traits **144** Sources of variation			**Key Questions:** What are traits, and how are they inherited and passed from one generation to the next? What are alleles, and what determines whether a trait will be passed onto offspring? What are some of the ways in which variation arises? These activities provide background to the topic. **Literacy:** Review some key vocabulary terms in inheritance. To establish the relationship between the terms in inheritance genetics, teachers can print commonly used terms onto strips of paper and hand them out to small groups. The groups can then arrange them on a large, blank piece of paper and draw connections between them, annotating relationships. i.e. DNA > genes; genes are made from long segments of DNA that code for a protein. An example is also shown in activity 144 between genotype and phenotype. The mind map created can be shared, and additional connections can be made. Students can photograph the mind map and use it for review. Creating genetic definition flip cards, with term/image on one side, and definition on the other side can also be useful during a revision lesson. Note: the key words are bolded in blue. Sources of variation will be important in this chapter, so ensure students have a good understanding of how this arises by interacting with the graphic in activity 144. **Keywords:** traits, gene, continuous variation, discontinuous variation, phenotype, genotypes, allele, heterozygous, homozygous dominant, homozygous recessive		**Learning Outcome:** Define the genetic terms: trait, true breeding, homologous pairs, allele, homozygous, heterozygous, recessive, dominant, phenotype, genotype, sexual reproduction, and mutation. ______ **Learning Outcome:** Explain what is meant by the term trait and how these are passed onto offspring via alleles. ______ ▶ Short and longer answer questions
GC: **Week:** **Date:**	1	**145** Examples of genetic variation	1.F		**Key Question:** What is continuous and discontinuous variation, and what is the difference between quantitative and qualitative traits? Traits to measure in class could include width of hand, from outstretched little finger to thumb, as a continuous phenotype. Value laden phenotypes, such as skin color, are best to be avoided. Before the investigation, as a class, construct a list of both continuous and discontinuous traits in humans, then narrow down the list to those that can be easily measured in class. Activity 265 in the Science Practices chapter provides guidelines for using tally charts and constructing histograms. Digital collaboration could involve a shared class Google Doc or TEAMs WORD Doc, where students add their own data to a class set - this would also be useful for students who are away and need access to the data, as well as students working from home so they can participate. **Extension:** Students can be extended by completing graphs for a discontinuous and continuous phenotype. The extra graph can be attached to the page. **Keywords:** traits, continuous variation, discontinuous variation, genes, phenotypes, allele, recessive, dominant	6.1 Phenotypic variation in your class	**Learning Outcome:** Distinguish between continuous and discontinuous traits, linked to quantitative or qualitative data. ______ **Learning Outcome:** Investigate the incidence of selected continuous or discontinuous traits in your class. ______ ▶ Short and longer answer questions ▶ Classroom investigation - small groups then whole class ▶ Plot a histogram from collected data

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**146** Sexual reproduction produces genetic variation	8.A analyze the significance of chromosome reduction, independent assortment, and crossing-over during meiosis in increasing diversity in populations of organisms that reproduce sexually		**Key Question:** Why is variation in a population or species important, and what strategies do sexually reproducing species have to increase variation? Use the stimulus photos to ask students to list the pros and cons of asexual and sexual reproduction. The main diagram shows how beneficial mutations move through generations by sexual reproduction, producing variation. The process of mutations interacting is called epistasis. Use the material on the Resource Hub to support delivery of this content. **Keywords:** variation		**Learning Outcome:** Discuss the role of sexual reproduction in producing genetic variation in a population. — ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**147** Meiosis **148** Meiosis and variation	8.A analyze the significance of chromosome reduction, independent assortment, and crossing-over during meiosis in increasing diversity in populations of organisms that reproduce sexually 3.A	4.G.iv	**Key Questions:** What is meiosis, and how does it produce haploid cells for the purposes of sexual reproduction? What are the important ways of introducing variation into the gametes formed during meiosis? This activity is designed to help students learn the steps and sequencing of meiosis. Use the videos and interactives on the Resource Hub to support students to acquire and retain this knowledge. Students can refer to question 3 when they need to revise the steps. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** meiosis, genes, variation, independent assortment, recombination, alleles		**Learning Outcome:** Sequence and recall the names of the stages in the process of meiosis that occurs in sex cells. — **Learning Outcome:** Explain how recombination during meiosis increases variation in the chromosomes of gametes. — **Learning Outcome:** Link the number of chromosomes present in gametes or cells at different stages of meiosis. — ▸ Short and longer answer questions ▸ Sequence stages in meiosis -in pairs ▸ Draw a model of select gamete combinations ▸ Calculate numbers of gamete combinations ▸ Draw gene sequences representing crossing-over
GC: **Week:** **Date:**	1	**149** Modeling meiosis	8.A analyze the significance of chromosome reduction, independent assortment, and crossing-over during meiosis in increasing diversity in populations of organisms that reproduce sexually 1.D 1.F 1.G 3.A	3.D.ii	**Key Question:** How is variation introduced into the gametes formed during meiosis? These activities can be combined and run together if you wish to reinforce what is happening within the physical model. Genetic recombination is covered again in activity 198, in the context of evolutionary mechanisms, so students need a clear understanding of this process. They can refer back to these activities if they need to. In the physical model, the dots representing alleles can be different colors for different alleles, to make an easy visual reference during crossing over. **Keywords:** meiosis, variation **Homelink:** If there is not time to construct the models in class, students can take the activity home and complete, recording with photographs to bring back to class	6.2 Modeling meiosis using ice block sticks	**Learning Outcome:** Model the process of meiosis in a classroom activity. — ▸ Short and longer answer questions ▸ Classroom investigation - small groups

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**150** Linked genes and variability	8.A analyze the significance of chromosome reduction, independent assortment, and crossing-over during meiosis in increasing diversity in populations of organisms that reproduce sexually 2.B 3.A		**Key Question:** How is variation affected when genes and linked? This activity uses fruit flies, a commonly used organism in genetics experimentation, to explore the effect of linked genes on variability. The activity could be introduced with a short video from the Resource Hub on the experiments of Thomas Morgan. **Extension:** In small groups, students could write the advantages of using fruit flies for this research, and discuss it as a class activity. Students can also be extended by researching examples of linked genes in humans and other organisms, and discuss the evolutionary advantage of this phenomenon. **Scaffolding:** For visual learners, consider making sets of 'chromosomes', either wooden or plastic, with genes stripe colored on them. This will make visualization of linked genes easier for the students to understand. **Keywords:** genes, alleles, variation		**Learning Outcome:** Discuss the relationship between gene linkage and variation. ▸ Complete a model of a sex linked cross ▸ Longer answer questions
GC: **Week:** **Date:**	0.5	**151** Mendelian genetics	1.B 2.B 4.A	3.F.i	**Key Question:** How can we predict the outcome of genetic crosses? Most students will have heard of Mendel and be aware of his experiments. Refresh understanding by showing the TED-Ed video on the Resource Hub. **Scaffolding:** Teachers may need to scaffold some students when they calculate percentages and convert numerical data into ratios. Refer to activities 252 and 253 in the Science Practices chapter. **Extension:** Extension could be offered with a timeline research and presentation activity on the history of genetics discoveries, either on paper, or using a digital program. **Keywords:** gene, phenotype, dominant, allele, recessive, traits, homozygous		**Learning Outcome:** Predict the outcome of genetic crosses in Mendelian genetics. ▸ Short and longer answer questions ▸ Calculate phenotype ratios
GC: **Week:** **Date:**	0.5	**152** Monohybrid crosses	3.B	2.E.iii	**Key Question:** How can we predict the outcome of genetic crosses? Ensure students have secure knowledge of the terms used, e.g. dominant, recessive, and use Punnett squares before progressing through the chapter. **Scaffolding:** Completing a few Punnett squares on the board is a good way to help students. A common example, Mendel's pea flowers, is used to demonstrate Mendelian inheritance for a single gene. Information from activity 155, explaining features of a Punnett square, can be modified to suit a monohybrid Punnett square, drawn on the board, and students can annotate their page. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** gene, monohybrid crosses, allele, trait, genotype, dominant, phenotype, homozygous, recessive		**Learning Outcome:** Use Punnett squares to calculate offspring genotype and phenotype ratios in a monohybrid cross. **Learning Outcome:** Describe the steps required for a test cross, and the expected outcomes for a heterozygous and homozygous parent. ▸ Short and longer answer questions ▸ Calculate a test cross

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**153** Probability	2.B 2.C	1.E.ii	**Key Question:** How can we determine how likely an event is to happen? This activity provides guidance for using two commonly used rules in inheritance, the product rule and sum rule. **Extension:** To extend question 3, two coins or tokens, with an allele drawn on each side (B, b, L, and l), can be handed out to small groups. Students can toss the two coins 16 times and record the ratio of genotypes (each will have 4 alleles - 2 x B and/or b, and 2x L and/or l). Students then compare their ratios to those in the Punnett square, and discuss why there might be differences. Ratios can be shared from all groups in the class and averaged. A class plenary can then discuss the averaged ratio of genotypes, and whether it more closely represents the Punnett square ratios. The final discussion can be on how this might be represented in real-life examples. **Keywords:** genotype, phenotype		**Learning Outcome:** Calculate probability of genotypes and phenotypes of offspring. ▶ Calculate probabilities ▶ Use a Punnett square
GC: **Week:** **Date:**	1	**154** Practicing monohybrid crosses			**Key Question:** How can we use a monohybrid cross to study the inheritance pattern of one gene, and what are the predictable ratios in the offspring from this cross? Students gain practice in using monohybrid crosses in this activity. It can be used to reinforce understanding or could be used as a formative assessment opportunity. **Keywords:** monohybrid crosses, genotype, phenotype		**Learning Outcome:** Use Punnett squares to calculate offspring genotype and phenotype ratios in a monohybrid cross. ▶ Calculate probabilities ▶ Use a Punnett square
GC: **Week:** **Date:**	1	**155** Dihybrid crosses	8.B predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles		**Key Question:** How can we use dihybrid crosses to study the inheritance pattern of two unlinked genes, and what are their predictable ratios? Once students have mastered Punnett squares for monohybrid crosses, they can move onto dihybrid crosses; practice examples are provided. Material in the Resource Hub can be used for extension in class or set as homework. Teachers can make a class set of laminated 4 × 4 grids (or 2 × 2 grids for monohybrid crosses) which students can write on with a wipeable marker, to save paper in class. **Keywords:** dihybrid crosse, genes, dominant		**Learning Outcome:** Use Punnett squares to calculate offspring genotype and phenotype frequencies in a dihybrid cross. ▶ Calculate genotype and phenotype ratios using a Punnett square
GC: **Week:** **Date:**	0.5	**156** Non-Mendelian genetics	8.B predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles		**Key Question:** How can the patterns that do not fit Mendelian genetics be explained? This activity provides an introduction to non-Mendelian inheritance. Incomplete dominance, codominance, and sex linkage, are covered in other activities. This activity is designed to be used with small groups or pairs working together, to elicit their prior knowledge and preconceptions on inheritance examples that do not follow the rules of Mendelian genetics. One option could be to complete the first half on calico cats as an introductory exercise, then move directly onto sex linkage in activity 159. Likewise, the lower section on colored roses can be a lesson starter, then move onto activity 157 to investigate incomplete dominance. The order of teaching of the next three activities is flexible. **Keywords:** traits, genes, phenotype, alleles, genotypes, heterozygous, dihybrid cross		**Learning Outcome:** Contrast between Mendelian and non-Mendelian inheritance. ▶ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	3	**157** Incomplete dominance **158** Codominance **159** Sex linkage	**8.B** predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles **2.B** **3.B**		**Key Questions:** What inheritance patterns occur when neither allele is dominant over the other? What inheritance patterns occur when two alleles are both dominant? How does having genes on the sex chromosomes affect the possible phenotypes of genetic crosses? These activities use case studies to explore non-Mendelian inheritance. Students utilize Punnett squares and evaluate phenotype/genotype probabilities and ratios. **Extension:** Students can be extended by researching the ABO blood type as an example of multiple alleles, and how it is possible for O negative blood to be considered a universal donor. The hemophilia allele passing through the English royal family could be an interesting side project for some students. **Keywords:** heterozygous, phenotype, homozygous, alleles, gene, trait, genotype, dominant, recessive For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Homelink:** Do the students have any examples of pets or farm animals showing some of these patterns that they can discuss in class, and share with other students?		**Learning Outcome:** Distinguish between complete and incomplete dominance. __________ **Learning Outcome:** Calculate genotype and phenotype probabilities in offspring from incomplete dominance crosses. __________ **Learning Outcome:** Define and give examples of codominance. __________ **Learning Outcome:** Calculate probability of phenotypes and genotypes in offspring resulting from codominance crosses. __________ **Learning Outcome:** Use Punnett squares to calculate offspring phenotype and genotype frequencies from multiple allele crosses. __________ **Learning Outcome:** Explain the connection between sex-linked genes and their effect on the phenotype of offspring. __________ **Learning Outcome:** Calculate the probability of genotype and phenotypes in offspring from crosses of various sex-linked genes. __________ ▶ Short and longer answer questions ▶ Calculate phenotype and genotype ratios using a Punnett square

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**160** Testing the outcomes of genetic crosses	8.B predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles 2.B 3.C		**Key Question:** How can we use the chi-squared test to test the outcome of a dihybrid cross against expected outcome? The chi-squared test is actually quite straightforward but can look daunting to some students. Most are unlikely to have encountered the chi-square test previously. Teachers may decide to offer the activity to their extension students only, who have strengths in mathematics. A spreadsheet on the Resource Hub, can be used to support the calculations to get the chi-square result. Supporting videos on the Resource Hub also go through the process of chi-square calculations step-by-step. **Keywords:** dihybrid crosses, genotypes, phenotypes, alleles, genes, heterozygous		**Learning Outcome:** Compare the outcome of genetic crosses against predicted outcomes, using the chi-square test. ▸ Perform a chi-squared test for goodness of fit
GC: **Week:** **Date:**	0.5	**161** Anyone for chocolate? revisited	8.B predict possible outcomes of various genetic combinations using monohybrid and dihybrid crosses, including non-Mendelian traits of incomplete dominance, codominance, sex-linked traits, and multiple alleles		**Key Question:** Can we get a chocolate Labrador puppy from black parents? The content anchor, "Anyone for chocolate", asks students to consider how traits in Labrador dogs may be passed on, and how breeders are able to introduce specific traits into litters of pedigree dogs. This helps identify a student's prior knowledge around the topic. **Keywords:** gene, dominant, recessive		▸ Short and longer answer questions ▸ Use a Punnett square to calculate genotype and phenotype ratios
GC: **Week:** **Date:**	1.5	**162** Summing up (Chapter 6)	3.B 4.B		**Summing Up: Summative Assessment** For the research project, digital collaboration could involve a shared class Google Doc or TEAMs WORD Doc to start or continue their research together. This would allow inclusion for students who work at home to still be able to collaborate with others. **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▸ Multichoice ▸ Short and longer answer questions ▸ Construct a diagram showing the process of meiosis ▸ Use a Punnett square to calculate genotype and phenotype ratios ▸ Conduct a research project on past and current genetic research and knowledge - groups of four

CHAPTER 7 Common Ancestry

In this chapter, the key concept for students to understand in this chapter is that scientists use multiple types of evidence when developing hypotheses or theories. The chapter presents evidence for common ancestry from the fossil record, exploring different homologies, and using scientific explanations to understand why there are gaps in the record. The chapter concludes with a journey through the history of evolutionary theory, culminating in Darwin's Theory of Evolution by Natural Selection. This leads into the next chapter.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**163** Dinosaur or bird?	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **4.A** **4.B**		**Key Question:** How does scientific evidence allow us to continually build ideas about the common ancestry between different groups of organisms? The content anchor "Dinosaur or Bird?" introduces students to the idea that various types of evidence, and different ways of looking at evidence, can be used to make claims about evolutionary processes. Feathered velociraptors are used as the context. **Keywords:** fossil **Homelink:** Are there any 'dinosaur experts' amongst the students or their families? Have any students been to a museum with dinosaur fossils on display? This is an opportunity for some students to share.		**Learning Outcome:** Explain the link between new scientific evidence and changes in scientific understanding about common ancestry. ▶ Longer answer questions
GC: **Week:** **Date:**	0.5	**164** Evolution and common ancestry	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **3.B**		**Key Question:** Where can evidence for evolution, and therefore common ancestry, be found? This activity provides a visual summary of all the information used to determine common ancestry. Students could provide additional examples from prior knowledge. **Extension:** The examples from each group could be added to a larger class poster which could be added periodically as students move through the chapter. The final poster could be used as a revision tool. **Keywords:** Evolution, common ancestor, homology, geologic time scale		**Learning Outcome:** Identify and elaborate on examples of scientific evidence for common ancestry of organisms on earth. ▶ Linking images to examples - small groups
GC: **Week:** **Date:**	0.25	**165** Fossil formation	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record **4.A**		**Key Question:** How do fossils form and preserve a record of once-living organisms? Students can recall the process of fossil formation and deposition covered in previous grades. For engagement, teachers may be able to access some examples of fossils, and there are explanatory videos in the Resource Hub. **Extension:** Students can research locations, dates, and species of fossil finds in Texas. **Keywords:** fossils, fossil record **Homelink:** Do some students have access to any fossil samples at home? Have any students been to areas with fossils and can share their experience.		**Learning Outcome:** Link the process of fossil formation to the likely presence or absence of fossilized species. ▶ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**166** The fossil record	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record **3.A**		**Key Question:** How can the fossil record be used as evidence for common ancestry? This short activity provides an opportunity for small group discussion on why fossils are found in the order they are and how the information can be used to track evolutionary change. This activity provides a springboard for later ones, including transitional fossils, and how this information can be used as evidence for common ancestry. Students should have a good understanding of this before moving on. The fossil record 'gaps' are introduced here, and more fully in activities 174-175. **Literacy:** This activity is information rich, and can be unpacked by allowing students to interact in small groups or pairs and ask each other specific questions about the material to elicit further understanding. Teachers can place key 'question starter terms', such as what, who, when, where, how, and why on the board and verbally instruct the students on a method to select a question starter, whether random or methodically, how to construct questions, how to alternate questioning and answering, and then provide a few verbal examples of possible questions. Additionally, the teacher can add 'second level question starter terms' such as, is/was, would, can/could, will, might, and should, and instruct some or all students to also incorporate one of these terms into their question. **Keywords:** fossils, fossil record		**Learning Outcome:** Discuss the link between the fossil record and layered rock strata. ——— ▸ Longer answer question
GC: **Week:** **Date:**	0.5	**167** Interpreting the fossil record	**9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record **1.F** **2.B** **3.A**		**Key Questions:** How can we use fossils in rock strata to order past events, from oldest to most recent? Students apply what they already know about fossil deposition and disruption from geological events to correctly age the strata. You could begin the activity with image cards of different fossils. Students will need to research the images to identify the age of fossil species, and place them in order of rock strata; see the Resource Hub for ideas. An online interactive game offers an opportunity to reinforce learning.		**Learning Outcome:** Interpret rock profiles containing fossils and rocks of different ages. ——— ▸ Short and longer answer questions ▸ Sequence rock layers from a model
GC: **Week:** **Date:**	1	**168** Transitional fossils	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental	3.H.iii TC: 3.G.i	**Key Question:** How do transitional fossils provide important links in the fossil record? Explain the importance of transitional fossils. Show an image of Archaeopteryx and ask students why they think it is an example of such a fossil, based on its features. Remind students about the ideas discussed in the content anchor: how does this fossil provide evidence for evolutionary processes? The horse fossil record (provided) is an excellent documentation of the evolution of the modern horse. **Extension:** Other extension examples could include whale evolution or hominid evolution. Students could present their findings in a poster or slideshow. **Keywords:** transitional fossils, fossil record, common ancestor, evolution		**Learning Outcome:** Define transitional fossils, and discuss how they are able to provide evidence for common ancestry. ——— ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**169** Anatomical homology	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental		**Key Question:** What is anatomical homology, and how can it provide evidence for common ancestry? Students should define the term homology, specifically anatomical homology, and understand that internal structures of different animals can be reasonably similar, even when the external structures appear not to be. The specialization of the generalized pentadactyl limb is an excellent example. **Extension:** Students can investigate why similar looking features, like penguin flippers and shark fins, have no close anatomical homology at all. Vestigial structures could also be applied as extension. Examples may include tail bones and an appendix in humans, pelvis bones in whales, or wing bones in flightless birds. **Keywords:** common ancestor, evolution		**Learning Outcome:** Identify differences in homologous structures due to adaptation for different functions. __________ **Learning Outcome:** Discuss how the pentadactyl limb in different mammals can provide evidence for common ancestry. __________ ▸ Matching homologous structures to function ▸ Longer answer questions
GC: **Week:** **Date:**	1	**170** Biogeography and common ancestry	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **1.A**	4.F.ii	**Key Question:** How does biogeography provide evidence for common ancestry, especially species of isolated island biota? The activity uses the origin and dispersal of the camel family as evidence for common ancestry in the context of biogeography. Remind students that continents have moved and were not always in their current location. Likewise, sea level has altered over time, exposing or hiding land features as it changed. Ask students how members of the camel family can occupy multiple continents, then unpack the information provided. **Keywords:** common ancestor		**Learning Outcome:** Evaluate the process of biogeography in providing evidence for common ancestry, using information from provided examples. __________ ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.5	**171** DNA evidence for common ancestry	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **2.B**		**Key Question:** How can comparison of DNA sequences be used as evidence for common ancestry? Students should understand that DNA and protein homology can both provide evidence for molecular homology, and are a way to determine common ancestry. **Scaffolding:** All students should be able to make comparisons using the short DNA sequences, but some may need support decoding the phylogenetic tree. See the Resource Hub. Emphasize that order of branching, not the length of branches, determines common ancestry. Students could refer back to DNA base coding if they want to revisit nucleotide base sequences. **Extension:** The molecular clock hypothesis is a good extension opportunity. The video on John Maynard Smith in the Resource Hub can be used as a starter, and gives students the opportunity to evaluate different evidence, including endosymbiosis. This can be linked back to concepts covered in chapter 1 (TEK 5.B(iii)). **Literacy:** This could also be an opportunity for teachers to discuss terminology, and the difference between hypothesis, theory, and law. Direct students to the glossary, and use the molecular clock hypothesis and theory of evolution as examples. **Keywords:** homology, common ancestry, phylogenetic tree		**Learning Outcome:** Analyze data from phylogenetic trees to discuss how DNA differences can provide evidence for common ancestry. __________ ▸ Interpreting data from a phylogenetic tree

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**172** Protein evidence for common ancestry	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **4.A**		**Key Question: How can comparisons of protein homology determine common ancestry between living species?** Protein homology uses changes in the Pax-6 protein and hemoglobin protein as case studies. The hemoglobin comparison visually shows how closely related species have fewer differences than more distantly related species. **Extension:** Discussion on Pax-6 can be extended by asking students why it is important for some proteins to be conserved (relatively unchanged). Can they think of any examples of conserved proteins? **Keywords:** homologies, common ancestor, evolution		**Learning Outcome:** Analyze amino acid sequences from different species to identify the extent of common ancestry. ▸ Interpreting data from a model ▸ Longer answer question
GC: **Week:** **Date:**	1	**173** Developmental homology	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental		**Key Question: How can similar stages of embryonic development in different species provide evidence for common ancestry?** Direct attention to the graph. Do students see that each species passes through the same developmental stages at the same Carnegie sequence? This is evidence for common ancestry. In the second part of the activity, they explore how apoptosis shapes the limb bud into its final shape. Review activity 48 if required. This will help remind students about the connections between biology topics and that they are not stand alone concepts. As a summary, students could construct a mind map of the different types of evidence for common ancestry, showing links to other areas of biology. **Keywords:** homology, common ancestor		**Learning Outcome:** Analyze data of embryo development from different species to discuss how it can be used as evidence for common ancestry. ▸ Longer answer question
GC: **Week:** **Date:**	1	**174** Changes in the fossil record	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record **1.G** **1.F** **3.A**	3.G.ii	**Key Question: Why is there often an abrupt appearance in the fossil record of many new groups?** The Cambrian explosion represents a time when a large diversity of life forms appear in the fossil record over a relatively short time. You could begin with a short video from the Resource Hub. Students do not need to remember the names of geologic time periods, but they are provided on the diagram so that the students have a context for the time period. They can see from the diagram that life becomes more complex. Students can place Tiktaalik (activity 178) on the timeline. The information on the second page addresses common questions regarding abrupt appearances in the fossil record. The questions can be answered as a group, and key points gathered as a whole class. For digital collaboration, students can use a shared Google Doc or TEAMS WORD Doc to create a shared class timeline of the geologic timescale. Individuals or groups can be assigned different time periods to become 'experts' in and then paste their key findings onto one class shared digital document. **Keywords:** geologic time scale, fossils		**Learning Outcome:** Suggest explanations for the abrupt appearance of new fossils in the Cambrian explosion. ▸ Longer answer question

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**175** Punctuated equilibrium and gradualism	**9.B** examine scientific explanations for varying rates of change such as gradualism, abrupt appearance, and stasis in the fossil record **2.B** **3.A** **4.A**		**Key Question:** How can models of the rate of change in evolution be used to explain the abrupt appearance or stasis of species in the fossil record? It is important for students to realize that evolutionary change does not occur at a constant rate, and that the fossil record can be used to monitor the changes. Students can compare the differences between punctuated equilibrium and phyletic gradualism, and apply this to the fossil record. **Extension:** Students can investigate other examples of 'living fossils', such as the New Zealand tuatara. The trilobite models provide an opportunity for students to examine alternative hypotheses. A compare and contrast template could be drawn on the board to compare the two models; students can contribute their ideas to it. Once students have completed the analysis questions in "testing a model", they may want to go back and evaluate their answers in question 4 and rewrite it on fresh paper. It is important to note that, although numerous examples, such as horse transitional fossils or camel biogeography, have been provided, students need to be focused on general evidence so that they can demonstrate their understanding to novel contexts when assessed. **Keywords:** transitional fossils		**Learning Outcome:** Suggest explanations for the abrupt appearance of new fossils in the Cambrian explosion. ___ **Learning Outcome:** Evaluate punctuated equilibrium and gradualism as models that can provide scientific explanations for stasis and abrupt appearance of fossils in the fossil record. ___ ▶ Short and longer answer questions ▶ Interpreting data from graphs
GC: **Week:** **Date:**	1	**176** Developing the theory of evolution	**1.H** **4.A** **4.B**		**Key Question:** How did a succession of scientists' observations, ideas, and hypotheses advance the development of the theory of evolution? The introduction to the development of the theory of evolution provides a bridge between this chapter and the next, which examines mechanisms of natural selection. Students need to understand that most scientific knowledge has been built upon the discoveries and scientific research of others that have gone before them. A timeline activity can be constructed if desired. **Keywords:** mutation, DNA, nucleotide, gene		**Learning Outcome:** Explore the time-line of scientific discoveries leading to Darwin's theory of evolution through natural selection. ___ ▶ Longer answer questions
GC: **Week:** **Date:**	1	**177** Dinosaur or bird? revisited	**9.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **3.A**	3.G.ii	**Key Question:** Why is there often an abrupt appearance in the fossil record of many new groups? The Cambrian explosion represents a time when a large diversity of life forms appear in the fossil record over a relatively short time. You could begin with a short video from the Resource Hub. Students do not need to remember the names of geologic time periods, but they are provided on the diagram so that the students have a context for the time period. They can see from the diagram that life becomes more complex. Students can place Tiktaalik (activity 178) on the timeline. The information on the second page addresses common questions regarding abrupt appearances in the fossil record. The questions can be answered as a group, and key points gathered as a whole class. **Keywords:** geologic time scale, fossils		▶ Longer answer questions ▶ Interpreting data from a phylogenetic tree
GC: **Week:** **Date:**	1	**178** Summing up (Chapter 7)	**9.A** **9.B** **1.H** **4.A** **4.B**		**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct.		▶ Multichoice ▶ Short and longer answer questions ▶ Matching terms to definitions ▶ Interpreting data from a phylogenetic tree

CHAPTER 8 Evolution and Natural Selection

The key concept for students to understand in this chapter is that variation exists among members of a species and some of this variation is heritable. At a basic level, we know this because offspring often resemble their parents. Variation results in some individuals having better traits for surviving in a particular environment than others. In general, organisms produce more offspring than are needed to replace the parents, which leads to competition for resources. Individuals with traits that give them an advantage in a particular environment are more likely to survive and pass those traits to their offspring. Individuals with less advantageous traits are unlikely to survive. This is how natural selection works and led to Darwin's theory of evolution by means of natural selection.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**179** How does an elephant lose its tusks?	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals **10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **3.B**	**1.E.i** **TC:** **2.C.ii**	**Key Question: H**ow does poaching cause African elephants to be born without tusks? The content anchor, "How does an elephant lose its tusks?" opens and concludes this chapter and demonstrates an example of evidence of evolution by natural selection. It shows how evolution is an ongoing process rather than something that only occurred in the past, and has been the mechanism that has resulted in the biodiversity we see on Earth today. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** population, phenotype		▸ Longer answer questions
GC: **Week:** **Date:**	0.5	**180** How does natural selection work?	**10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **3.A**		**Key Question:** How does natural selection act as a mechanism for evolution? Recall that the development of evolutionary theory was introduced in the previous chapter (activity 176). Teachers could start with a short, engaging video from the Resource Hub on the life and times of Darwin. Students could work in small groups, brainstorming what might be required in a population for natural selection to occur. Follow by a short class plenary/ discussion before moving on to the activity. The M&M's® photo panels are a simple, visual model of selection in action. The succinct overview on the first page can be used to visually reinforce the theory of evolution by natural selection. **Literacy:** Ensure students understand the terms natural selection, evolution, and phenotype by referring them to the glossary. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Explaining evolution - covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Keywords:** Evolution, population, variation, phenotype, natural selection, traits		**Learning Outcome:** Identify the factors involved in the process of natural selection. __________ **Learning Outcome:** Evaluate how factors that result in differential reproductive success can cause a change of inherited characteristics in a population over time. __________ ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**181** Modeling natural selection with M&Ms	**10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **1.B** **1.C** **1.E** **1.G** **2.A**	1.D.i 3.H.ii	**Key Question:** How can modeling be used to investigate the process of natural selection? This activity uses M&M's® to explore the selection pressures acting on phenotype variation in a population. As students have not yet covered the concept of selection pressures, the teacher may wish to read out (or have students read out) the top paragraphs in activity 184. Return to this activity later. Model simulations are an important pedagogical tool to assist conceptual development of phenomena in students. The candy can be substituted for non-food tokens if there is risk of allergies. If food is being used, advise the students not to consume until after the investigation due to hygiene risk. Teachers can ask students to make predictions before the investigation, and facilitate further, in-depth, discussion after. **Extension:** Data could be pooled at the end. This could be in the form of a shared digital Google Doc or TEAMS spreadsheet. Students can calculate the mean from pooled class data. Discuss why some groups' data may differ from the class mean. **Keywords:** natural selection, selection pressure, population	8.1 Investigating natural selection with M&Ms	**Learning Outcome:** Investigate the process of natural selection using a model. ▶ Short and longer answer questions ▶ Classroom investigation - small groups
GC: **Week:** **Date:**	0.5	**182** The role of variation in populations	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals **10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **3.A**		**Key Question:** Why is variation an important factor to enable natural selection to act on populations? This is a short but crucial activity, showing the importance of variation in evolution. Discuss new terms, e.g. fitness, with students. Observing variation in local populations, or in images provided by the teacher, allows students to see differences in phenotypes. What effect might variation have on fitness? Are all individuals selected against equally? How might this affect fitness? For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** variation, phenotypes, population, fitness, traits, alleles		**Learning Outcome:** Discuss the importance of variation in populations as a required factor needed for natural selection to occur. ▶ Short and longer answer question
GC: **Week:** **Date:**	1	**183** Natural Selection in Galápagos Finches	**10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **1.F** **1.G** **2.B** **4.A**		**Key Questions:** How did studying Galápagos finch beaks provide evidence for evolution by natural selection? This activity provides a context in which to explore fitness, a term introduced in the previous activity. Darwin's famous work on the beaks of the Galápagos finches is used as a case study for natural selection. Introducing the species of finches, their diets, and beak phenotypes, shows students how wide the variation amongst the finches is. The graphing activity shows how selection pressure (drought) drove selection, based on beak size. Support material is provided in the Resource Hub. **Extension:** For extension, some students may want to delve deeper into Darwin's natural selection theory and present a report or presentation. Other research ideas could be an account of the other species he studied, or the work of Wallace in helping develop the theory. **Keywords:** natural selection, phenotypes, population, fitness, traits, evolution		**Learning Outcome:** Evaluate how natural selection acts upon the beak phenotype in Galápagos finches to provide evidence for evolution by natural selection. ▶ Short and longer answer questions ▶ Draw histograms from provided data ▶ Analyze provided data

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**184** Selection pressure in populations	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals **1.G** **3.A**	2.I.iii	**Key Question:** How do environmental factors create selection pressure on populations? Selection pressures are introduced in a general sense, followed by specific examples of each. Students need to name and describe the three types of selection. Teachers could provide students with a local example, or ask students to research an example themselves. **Keywords:** selection pressure, traits, phenotypes, alleles, population, natural selection		**Learning Outcome:** Analyze and evaluate the effect of selection pressures on populations that can result in directional selection, disruptive selection, and stabilizing selection, giving examples of each. ▸ Short and longer answer questions ▸ Analyze provided graphed data
GC: **Week:** **Date:**	1	**185** Directional selection in moth populations	**10.A** analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental **10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **2.B**	3.G.ii	**Key Question:** How did environmental selection pressure create change in the peppered moth populations in the past? The peppered moth is used to explore directional selection in more detail. Students interpret a graph to study historical shifts in moth phenotypes in response to environmental conditions. **Extension:** Support material is provided in the Resource Hub, including an interactive game that could be used as extension. Reinforce the fact that selection pressures have caused change to the population, not the individuals themselves. **Keywords:** selection pressure, phenotype, populations		**Learning Outcome:** Analyze data related to directional selection of peppered moth populations of different colors in industrial areas of the UK. ▸ Short and longer answer questions ▸ Analyze provided data
GC: **Week:** **Date:**	0.5	**186** Measuring gene pool change	**2.C** **3.A**		**Key Question:** What is a gene pool, and how is it significant for evolutionary change? Gene pool changes are illustrated using a simple diagrammatic model. A basic tabulation activity gives students an opportunity to practice basic data transformations. It provides a good opportunity for students to compare data sets (phase 1 and phase 2). **Scaffolding:** Teachers can reinforce this skill by using tokens to create sets of beetles for each genotype. Call out different scenarios, e.g. half the yellow tokens eaten by new predators. The students recalculate the genotype frequency after each event. **Keywords:** gene pool, population, natural selection, phenotypes, allele		**Learning Outcome:** Measure the change of allele frequency in a theoretical gene pool, linking to evidence for natural selection. ▸ Calculate gene pool change frequencies ▸ Analyze gene pool change data

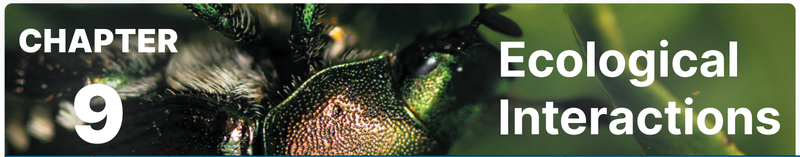
Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**187** Natural selection in rock pocket mice	10.B analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success 1.F 2.B 3.A		**Key Question:** How does natural selection act upon the coat color of rock pocket mice? This activity uses a data set to illustrate how coat color acts as a selection pressure in populations of rock pocket mice. Introduce the activity with a short video about rock pocket mice, from the Resource Hub. This will familiarize students with the environments and the two coat color phenotypes. Data analysis of rock pocket mice provides an opportunity to graph, and examine patterns. **Scaffolding:** Direct students to activity 264 in the Science Practices chapter for guidelines on how to draw a bar graph. Finish the activity with a class discussion. **Keywords:** natural selection, selection pressure		**Learning Outcome:** Analyze data on the relationship between the rock pocket mice coat color phenotype and the selection pressure of rock color in the environment. __________ ▸ Interpret provided data ▸ Draw a column graph from provided data ▸ Short and longer answer questions
GC: **Week:** **Date:**	1	**188** Modeling natural selection in rock pocket mice	10.B analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success 1.B 1.C 1.E 1.G 2.A		**Key Question:** How can we use a computer model to simulate changes in the gene pool due to natural selection? This computational model (spreadsheet model) models gene pool changes in a population of rock pocket mice due to natural selection. Although it may appear daunting at first glance, the steps are easy to follow once you get started. If the spreadsheet is placed into a digital collaborative setting, such as Google Sheets, or TEAMS spreadsheet, then groups can work togrterh, and students at home can also participate. **Scaffolding:** There are options for delivery: students can follow the instructions to build the spreadsheet themselves, then graph the results or the teacher can project the spreadsheet onto the board and work through, step by step, as a demonstration. Alternatively, a premade spreadsheet in the Resource Hub can be utilized. Teachers may want students to do their own graphing. **Keywords:** gene pools, genotypes, population, natural selection, alleles **Homelink:** If there is not time to complete the computer simulation in class, students can take the activity home and complete.	8.2 Investigating gene pool changes	**Learning Outcome:** Carry out a spreadsheet simulation activity to investigate the effect of gene pool changes on rock pocket mice. __________ ▸ Construct a spreadsheet with formula ▸ Use a spreadsheet to calculate gene pool change ▸ Analyze data from spreadsheets
GC: **Week:** **Date:**	0.5	**189** What is a species?	1.G 3.A		**Key Question:** How can we define a species? Explore the two definitions of species provided. 1) biological species concept: a group of organisms that can interbreed to produce fertile offspring. 2) phylogenetic species concept: where species are defined on the basis of their evolutionary history through shared, derived characteristics. Students will probably be more aware of the biological species concept. The domestic dog example provides a talking point for why morphological appearance is not always a good indicator of species. You could refer back to molecular homology and reference how it's use in redefining the classification of organisms. Ask students to provide examples of 'species' that can interbreed, and discuss why they are still considered species. Evaluate the use of both BSC and PSC systems of species definitions. **Keywords:** species **Homelink:** Students may like this opportunity to discuss the differences in their dogs from home, sharing photos.		**Learning Outcome:** Define the term species, using both BSC and PSC concepts. __________ ▸ Longer answer question

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**190** How species form	**10.C** analyze and evaluate how natural selection may lead to speciation	4.F.i	**Key Question:** How do isolating mechanisms lead to the formation of new species? The steps in species formation are summarized within an accessible diagram in this activity. **Literacy:** A number of new terms are introduced throughout. Encourage students to use the glossary to find their definitions and encourage them to use these terms as they discuss the content. **Scaffolding:** Material in the Resource Hub supports the content. **Extension:** Students can be extended by delving into the squirrel or cichlid speciation examples more deeply. **Keywords:** species, selection pressure, evolution, population, gene pools, zygote, gene flow		**Learning Outcome:** Link isolating mechanisms to speciation, giving examples. ______ ▸ Longer answer questions
GC: **Week:** **Date:**	1	**191** Patterns of evolution	**10.C** analyze and evaluate how natural selection may lead to speciation		**Key Question:** What particular patterns of evolution might be seen in populations moving into a new environment? Highlight that species diversification does not occur in a uniform way. Compare and contrast divergent and convergent evolution and explain adaptive radiation. Adaptive radiation in mammals provides a good case study. Use the content in the Resource Hub to support and extend student understanding. **Keywords:** species, evolution, selection pressures		**Learning Outcome:** Compare and contrast patterns of evolution: divergent and convergent evolution, and adaptive radiation.. ______ ▸ Short and longer answer questions ▸ Interpreting data from models
GC: **Week:** **Date:**	1	**192** Evolutionary mechanisms in gene pools	**10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population		**Key Question:** Aside from natural selection, what other evolutionary mechanisms can change a gene pool over time? This activity examines evolutionary mechanisms in gene pools: recombination, genetic drift, mutation, and migration, and reiterates that changes in allele frequency in a population over time cause micro-evolutionary changes. These mechanisms all contribute to changes in a gene pool. Tag this activity as a reference page; students can refer back to it at any time for definitions and clarification of the four mechanisms. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** mutations, gene flow, genetic drift, recombination, gene pool, population, evolution		**Learning Outcome:** Explain and differentiate between the terms gene flow and genetic drift, as evolutionary mechanisms. ______ ▸ Define terms

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**193** Gene flow	10.D analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population 1.G 2.D 3.A 4.B		**Key Question:** What is the effect of gene flow on the allele frequencies of a population, and how does population size affect its influence? Use the key question to ask students how gene flow into and out of a population could affect allele frequencies. What answers do they come up with? Unpack the activity, looking at the two populations: one with gene flow, the other without. Students should notice that when organisms move in or out of a gene pool, their genes/alleles move with them, altering the composition of the gene pool. Highlight that geographical barriers prevent gene flow and this can decrease genetic diversity in the isolated gene pool. Unpack the case studies (Texas ocelot and Texas puma) as illustrative examples. This activity may take several lessons to complete. Support and extension material is provided in the Resource Hub. Some schools may have an opportunity to visit a nearby conservation reserve for a field trip, or invite a conservation expert to the school to discuss work they are doing to conserve species impacted by lack of gene flow. **Keywords:** gene flow, population, alleles, gene pools, variation, natural selection, genetic drift, species		**Learning Outcome:** Analyze how lack of gene flow creates reduced diversity in gene pools, using examples. **Learning Outcome:** Research the cost-benefit of wildlife corridors as a means to increase gene flow between populations. ▸ Short and longer answer questions ▸ Complete cost-benefit analysis of a wildlife corridor
GC: **Week:** **Date:**	1	**194** Genetic drift	10.D analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population 4.A		**Key Question:** How does the evolutionary mechanism of genetic drift, including the founder and bottleneck effect, create change in the gene pool of a population? This activity introduces the concept of genetic drift. It is expanded upon in the following two activities by looking at the founder effect and the bottleneck effect. The model and data provided illustrate the effect of genetic drift. For a hands-on alternative, teachers provide marbles and containers for students to carry out the simulation themselves. Alternatively, this could be a teacher-led demonstration. **Literacy:** Remind students to use the glossary to define terms such as alleles, genetic drift, gene pool, population, and variation, should they need to. **Keywords:** genetic drift, allele, gene pool, population, variation		**Learning Outcome:** Analyze changes in gene pools due to genetic drift, from data provided. ▸ Short and longer answer questions ▸ Analyze data
GC: **Week:** **Date:**	0.5	**195** The founder effect	10.D analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population 2.C		**Key Question:** How does the founder effect result in differences between the proportions of alleles found in a parent and founder population? Introduce the activity with the short videos in the Resource Hub on anole lizards and the founder effect. The diagram illustrates the founder effect visually, and the tables calculating allele frequencies show how allele frequencies vary between the two populations. Note that the allele calculations simply involve counting the occurrence of 'A' and 'a' alleles within the population, followed by calculating the percentage. Specific examples are provided: anole lizard data and examples of the founder effect on human populations,. The human examples help students understand that the human species also experiences evolutionary change. **Extension:** Students can be extended by a deeper investigation of different founder effect case studies, such as cheetah populations. **Keywords:** alleles, founder effect, population, selection pressures		**Learning Outcome:** Calculate allele frequency change in populations due to the founder effect. ▸ Short and longer answer questions ▸ Calculate gene pool allele frequencies ▸ Analyze provided data

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**196** Genetic bottlenecks	**10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population **1.G** **4.A**		**Key Question:** How do genetic bottlenecks affect the genetic diversity of populations? Genetic bottlenecks are the result of large scale reductions in a population. The reduction in numbers may result in loss of genetic diversity, but it should be noted that all phenotypes can be affected equally. The red wolf case study on genetic bottlenecks is an engaging way to put a regional context to this activity. Material in the Resource Hub can be used to support its delivery. The key idea is to discuss the consequences of this mechanism: even if populations grow back to their original size, they may not recover their genetic diversity. This links to biodiversity (including genetic biodiversity) covered in-depth in chapter 9. **Keywords:** gene pool, population		**Learning Outcome:** Analyze the impact of the bottleneck effect on Texan red wolf populations. ▸ Longer answer questions ▸ Analyze provided data
GC: **Week:** **Date:**	1	**197** Mutations and the gene pool	**10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population **2.B** **3.B**	2.C.iv	**Key Question:** How does the evolutionary mechanism of mutation affect the gene pool in a population? Mutation has previously been covered, in activities 128-130. Revisit if students need to refresh their understanding of mutations. The emphasis is on how mutation is a source of new alleles. What is the effect of the new allele on a population's gene pool? Students should understand that most mutations do not provide a selective advantage. However, they can sometimes be beneficial. The Antarctic ice-fish is provided as a case study of beneficial mutation. **Extension:** Other examples could include investigating sickle cell mutations, with reference to malaria in humans, or red color vision in monkeys. The nylonase bacteria has a mutation that allows the organism to 'digest' nylon. This has an application in the breakdown of plastic in wastewater plants and provides an interesting context. Resources to support this activity are provided on the Resource Hub. **Keywords:** mutations, alleles, gene pool, phenotype, population		**Learning Outcome:** Research the impact of a beneficial mutation on the gene pool of a population, using a selected example. ▸ Short and longer answer questions ▸ Analyze provided data ▸ Research a selected species relating to beneficial mutations
GC: **Week:** **Date:**	1	**198** Genetic recombination and the gene pool	**10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population **1.G**		**Key Question:** Aside from natural selection, what other evolutionary mechanisms can change a gene pool over time? Key Questions: How does the evolutionary mechanism of genetic recombination affect the gene pool in a population? Details of genetic recombination have been previously covered in activity 148 (meiosis and variation). Refer back if students need to be reminded of the process. The key focus of this activity is looking at how recombination can increase variation in a gene pool, and therefore act as a microevolutionary mechanism. **Homelink:** Students can investigate genetic variation in their own extended families, or teachers can provide images of families for students to note differences in phenotypes. **Keywords:** allele, crossing over, variation, recombination, gene pool, phenotype, genotype, population		**Learning Outcome:** Analyze the relationship between genetic recombination and the addition of variation to a population's gene pool. ▸ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: Week: Date:	0.5	**199** How does an elephant lose its tusks? revisited	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals **10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **4.A**		**Key Question:** How does scientific evidence allow us to continually build ideas about the common ancestry between different groups of organisms? The content anchor, "How does an elephant lose its tusks?" opens and concludes this chapter and demonstrates an example of evidence of evolution by natural selection. It shows how evolution is an ongoing process rather than something that only occurred in the past, and has been the mechanism that has resulted in the biodiversity we see on Earth today.		**Learning Outcome:** Discuss the changes over time due to selection pressures in the tusk phenotype of an African elephant population. ――――――――― ▸ Longer answer questions ▸ Interpreting data from a graph
GC: Week: Date:	1	**200** Summing up (Chapter 8)	**10.A** analyze and evaluate how natural selection produces change in populations and not in individuals **10.B** analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success **10.C** analyze and evaluate how natural selection may lead to speciation **10.D** analyze evolutionary mechanisms other than natural selection, including genetic drift, gene flow, mutation, and genetic recombination, and their effect on the gene pool of a population **3.A**		**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▸ Multichoice ▸ Short and longer answer questions ▸ Matching terms to definitions ▸ Interpreting data from graphs ▸ Complete a model on speciation ▸ Complete a cloze activity



CHAPTER 9 Ecological Interactions

In this chapter, the key focus for students to understand in this chapter is that disruption in ecosystems, whether the result of natural changes or human activity, can impact ecosystem stability and biodiversity. Students will bring prior knowledge of ecology concepts into the class from previous grades. This will be built on to explore the consequences of change

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**201** A mammoth task	**13.C** explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles **13.D** explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability **4.A** **4.B**	**TC: 1.F.i** **3.E.i**	**Key Question:** How could bringing back the woolly mammoth help restore the stability of a lost ecosystem? The content anchor, "A Mammoth Task" introduces students to the idea that stability of an ecosystem is dependent on a wide range of interactions, and change to any one, either through natural means or human activity, can create changes in the ecosystem. Human intervention can sometimes be used to reverse the changes. **Keywords:** ecosystem		▸ Longer answer questions
GC: **Week:** **Date:**	2	**202** Components of an ecosystem **203** Habitat and tolerance range **204** The ecological niche	**2.B**	4.F.iii	**Key Questions:** What are the abiotic and biotic components that comprise an ecosystem? What is a habitat? How does the tolerance range of an organism determine its optimum position in a habitat? What is an organism's niche? How is it influenced by interactions with other species? These introductory activities review key concepts in ecology with a variety of case studies. The nested relationship between population (one species, usually in a geographically connected region), community (the biotic component of an ecosystem), and ecosystem (the community and its abiotic environment) needs to be understood so that these terms are used appropriately. The specific characteristics of particular ecosystems arise as a result of the interactions between biotic and abiotic components. As an alternative, these activities can be approached using a local example of an ecosystem, allowing students to explore, in a local context, key aspects of a selected animal or plant habitat and niche. **Literacy:** Students should refer to the glossary to become familiar with the terms used. For students, where English is a second language, it is recommended that they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, so they can easily interpret newly encountered words, especially those in this activity that they are unlikely to have used in everyday conversation. **Keywords:** biotic factors, ecosystems, abiotic factors, habitat, niche, competition, predation, parasitism		**Learning Outcome:** Define and use the following terms in context: ecosystem, biotic factor, abiotic factor, habitat, and niche. ______ ▸ Short and longer answer questions ▸ Analyzing data from a graph

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GC: **Week:** **Date:**	1	**205** Ecosystem dynamics	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 2.B		**Key Question:** How do ecosystems remain relatively stable over the long term, while responding to short-term and cyclical changes? The terms stability and biodiversity are introduced in this activity, and it is important that students become familiar with them, and also the relationship between them. Examples are provided, but local case studies could be identified for students to research in a small group. **Extension:** The Resource Hub contains material on termites which can be used for extension. **Keywords:** ecosystems, biotic, abiotic factors, climate change, biodiversity, keystone species		**Learning Outcome:** Link ecosystem stability and resilience to high biodiversity in ecosystems, using case studies and data. ▸ Longer answer questions ▸ Analyzing data from a graph
GC: **Week:** **Date:**	0.5	**206** The resilient ecosystem	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 2.B 3.A		**Key Question:** How is the resilience of an ecosystem affected by its biodiversity, health, and the frequency with which it is disturbed? A new term, resilience, is introduced. Use the graphs to explore this concept. **Extension:** Students could be extended by building a mind map of the terms covered so far in the chapter, as there are multiple interconnections between them. **Scaffolding:** Some students may need help to interpret the graphical evidence provided. **Keywords:** resilience, ecosystem, biodiversity		**Learning Outcome:** Link ecosystem stability and resilience to high biodiversity in ecosystems, using case studies and data. ▸ Longer answer question ▸ Analyzing data from a graph
GC: **Week:** **Date:**	0.5	**207** A case study in ecosystem resilience	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 3.A	4.G.ii	**Key Question:** How are resilient ecosystems able to recover from moderate fluctuations? This activity takes a closer look at ecosystem resilience in the form of a case study. An introductory video from the Resource Hub, can be used at the start of the lesson. **Scaffolding:** Some students may need support with the interpretation of the information in the graph in this activity. Consider breaking students into small groups, and then discuss as a class, where students can share their analysis. **Keywords:** ecosystem resilience		**Learning Outcome:** Link ecosystem stability and resilience to high biodiversity in ecosystems, using case studies and data. ▸ Short and longer answer questions ▸ Analyzing data from a graph
GC: **Week:** **Date:**	1	**208** Species interaction	1.G		**Key Question:** How do interactions and relationships between species influence the size and distribution of their populations? Species interactions were covered in previous grades so this activity serves as a reminder. **Extension:** The activity provides a wide range of examples but students could be extended by drawing up a chart with interaction types as headings; they can research online to find more examples. It could be made into a class competition between groups, to see which group can find the most examples, with local examples worth double points. Each interaction will be explored in more detail in following activities. **Keywords:** ecosystems, mutualism, parasitism, commensalism, predation, competition **Homelink:** Students can observe examples of different interactions around their homes, or in close by parks, and bring back their observations for discussion in class.		**Learning Outcome:** Identify the type of species interactions from given examples, and describe whether each species benefits, is harmed, or is not impacted by the relationship. ▸ Constructing a model showing species interactions ▸ Short and longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**209** Predator-prey relationships	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 2.B		**Key Question:** How are populations of predators and prey related, and how do they change over time? Predator-prey relationships are an engaging topic for students. The hare-lynx relationship can be introduced by watching a video from the Resource Hub. Discussion on the data in class or small groups can precede the students answering the questions, which could be in the form of summarizing the key points discussed. Additional case study ideas from local examples can be used for a research focus. **Keywords:** predation		**Learning Outcome:** Investigate, using provided case studies and data, how predator-prey relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how predator-prey relationships can influence ecosystem stability. ▸ Short and longer answer questions ▸ Analyzing data from a graph
GC: **Week:** **Date:**	0.5	**210** Predation and destabilized ecosystems	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 2.D		**Key Question:** How can predator-prey interactions destabilize an ecosystem? This activity uses a well documented case study to look at the effects of predation on ecosystem stability. Data is presented as an accessible infographic. **Scaffolding:** Evaluation in question 2 may need some scaffolding as it is a more complex skill. **Extension:** To extend, students can identify elements of the unstable predator-prey system on Coronation Island, and then compare and contrast to the more stable systems in the previous activity.		**Learning Outcome:** Investigate, using provided case studies and data, how predator-prey relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how predator-prey relationships can influence ecosystem stability. ▸ Evaluating research on predation
GC: **Week:** **Date:**	0.5	**211** Investigating predator-prey stability	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 1.C 1.E 1.F 2.C		**Key Question:** Does a predator-prey system stabilize over time? The predator-prey simulation investigation is generalized, but teachers could select a context that is relatable to students if they wished. **Scaffolding:** Modifications to the activity may need to be made to accommodate all students, such as a bigger spoon or tokens for students with physical impairment. Large classes may need two sets of equipment and be divided into 2 groups for the investigation. The class discussion at the end can compare group results with the overall pattern suggested at the start. **Extension:** Students can be extended by comparing their investigation results with the Coronation Island data, looking for similarity **Keywords:** ecosystem	9.1 Investigating predator-prey populations	**Learning Outcome:** Investigate, using provided case studies and data, how predator-prey relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how predator-prey relationships can influence ecosystem stability. ▸ Classroom investigation - large groups ▸ Plot a line graph from collected data ▸ Calculating population growth rate

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**212** Competition for resources	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 2.B		**Key Question:** How does competition for limited resources negatively affect species? This introductory activity defines competition and the types of resources organisms compete for. Students most often think of animals in competition, so remind students that plants undergo competition too. **Literacy:** Ensure students can distinguish between intraspecific and interspecific competition. You may wish to define the prefixes intra, and inter, so students are aware of the distinction when applied to competition types. Teachers could provide scenario images; students need to identify the type of competition shown and what resource(s) are being competed for. **Keywords:** abiotic, competition, habitat, ecosystem, intraspecific competition, interspecific competition		**Learning Outcome:** Investigate, using provided case studies and data, how competition relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how competition relationships can influence ecosystem stability. ▸ Longer answer question
GC: **Week:** **Date:**	0.5	**213** Intraspecific competition	13.D investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 4.A		**Key Question:** Why does intraspecific competition occur, and how does intraspecific competition regulate population size? **Extension:** Students can be extended by developing positive/negative impact charts for each of the three types of intra-species competition: scramble, contest, and social order, identifying which members of the population are advantaged, and how each type of behavior benefits the population overall. Students may note be unfamiliar with the rufous-collared sparrow, so provide context with a short video from the Resource Hub. **Keywords:** intraspecific competition, competition, habitat		**Learning Outcome:** Investigate, using provided case studies and data, how competition relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how competition relationships can influence ecosystem stability. ▸ Longer answer question
GC: **Week:** **Date:**	0.25	**214** Interspecific competition	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability	4.G.ii	**Key Question:** Why does interspecific competition occur, and how does it affect the species involved? Refer to activity 204 to remind students that competition forces organisms to occupy a smaller niche than is actually available to them. Ask students why interspecific competition is less intense than intraspecific competition. Plant and animal examples are provided but local examples could be used instead. For example, species of birds of prey in competition. Ask students to research the niches of each, such as hunting region, food type, and nest location (or this could be provided on information cards), and identify how they avoid being in direct competition. **Keywords:** interspecific competition, habitat, niches, competition, ecosystem		**Learning Outcome:** Investigate, using provided case studies and data, how competition relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how competition relationships can influence ecosystem stability. ▸ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**215** The impact of competition from alien species	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 1.B		**Key Question:** What impact do alien species have on stability of the ecosystem into which they are brought, either as introduced or invasive species? Alien species most often have a negative effect as they out-compete established species. Alien in this context is a scientific term meaning a species is outside its natural range. Ensure students know species can be introduced by humans accidentally or on purpose, or find their way into new locations independently. **Extension:** Two case studies affecting Texas are provided. Extension can include finding another example, or investigating species and resources the introduced species competes with. **Keywords:** ecosystems **Homelink:** Do students have any examples of 'pest species' around their home that they can photograph and bring into class to share. Some students may be keen to join in an eradication volunteer programme in their local area to remove pest plants.		**Learning Outcome:** Investigate, using provided case studies and data, how competition relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how competition relationships can influence ecosystem stability. ▸ Longer answer questions ▸ Research a local alien pest species
GC: **Week:** **Date:**	1	**216** Parasitism: one sided benefits	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 1.B 3.B		**Key Question:** How can parasitic outbreaks impact ecosystem stability? The zombie cockroach example is an engaging introduction to parasitism. If required, teachers can expand on the Cyclospora parasite outbreak that many students may be familiar with. Reemphasize the benefit-loss balance for examples provided. Ask students to determine what each species benefits or loses from in each example. Link parasitism to destabilization using white nose syndrome in bats. **Extension:** For extension, students can discuss the consequences of a parasite outbreak, and why it is likely to be unsustainable in an ecosystem in the long term. **Keywords:** parasitism, ecosystem, food web		**Learning Outcome:** Investigate, using provided case studies and data, how parasitism relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how parasitism relationships can influence ecosystem stability. ▸ Short and longer answer questions ▸ Design, and present, a solution to halt white-nose syndrome in Indiana bats
GC: **Week:** **Date:**	2	**217** Commensalism: Free for the taking	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 1.B		**Key Question:** How does commensalism support an ecosystem to maintain sufficient populations of particular species? Define commensalism, if required. Highlight the positive and neutral benefits experienced by the species involved. The case study has a Texas focus. Highlight the impacts if there is a change in the relationship (question 2). The report can be used as a summative assessment if desired. For digital collaboration, students can use a shared Google Doc or TEAMS WORD Doc to start or continue their research together. The groups can then paste their key points onto one class shared digital document. **Keywords:** commensalism, ecosystem		**Learning Outcome:** Investigate, using provided case studies and data, how commensalism relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how commensalism relationships can influence ecosystem stability. ▸ Short and longer answer questions ▸ Investigate the consequences of lost of a species involved in a commensalistic relationship

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	2	**218** Mutualism: A beneficial dependence	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 1.C 1.E 3.B		**Key Question:** How can the disruption of mutualistic relationships result in ecosystem instability? Define mutualism, if required. Highlight the beneficial outcomes to all the species involved. A range of case studies are provided as contextual examples. Students conduct an investigation of their own. If a field visit to observe the pollination of flowering plants is not possible, then students can view a video of the process from the Resource Hub instead. This may be a good option for those students with severe allergic reactions to bee stings. **Keywords:** ecosystems, mutualism, habitat, trophic levels	9.2 Mutualistic relationships in the community	**Learning Outcome:** Investigate, using provided case studies and data, how mutualism relationships can influence ecosystem stability. **Learning Outcome:** Evaluate how mutualism relationships can influence ecosystem stability. - Longer answer questions - Field investigation - small groups and individual - Presentation project on observations of a local mutualistic relationship
GC: **Week:** **Date:**	1	**219** Eat or be eaten	13.B analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models 1.F		**Key Question:** How does energy and matter move through an ecosystem where the Texas blind salamander is the apex predator? Introducing the engaging context of the Texas blind salamander with a video from the Resource Hub will set the scene of this activity. The chapter moves on to energy and matter moving through the ecosystem, and this activity provides students with a recap lesson, covering concepts from previous grades. **Keywords:** ecosystem		**Learning Outcome:** Relate the sequence of energy and matter moving through an ecosystem to the trophic levels of a species. - Longer answer questions - Construct a model on feeding relationships
GC: **Week:** **Date:**	1	**220** Photoautotrophs and heterotrophs **221** Trophic levels	13.B analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models 3.A 3.B	4.G.ii	**Key Questions:** How can organisms be divided into groups based on their role of matter cycling and energy flow through an ecosystem? How do trophic levels determine the sequence in which matter (and energy) move from autotrophs to different types of heterotrophs? Students will be familiar with the terms producer and consumer, but they can now be extended. The next two activities are essentially recap lessons to re-establish concepts covered in previous grades. **Prior Knowledge:** In the Resource Hub can be found downloadable support material: STEM.org: Best Evidence Science Teaching: Trophic levels and biomass transfer - covering prior knowledge diagnostic questions and response activities, including research on expected answers and common student misconceptions. [NOTE: Set up free registration at https://www.stem.org.uk/secondary/resources/collections/science/best-evidence-science-teaching] **Extension:** Online labs and interactives in the Resource Hub provide extension material; also, links to a card resource game for students to construct food chains and webs. **Keywords:** producers, autotrophs, heterotrophs, consumers, ecosystems, food chain, food web, trophic levels		**Learning Outcome:** Relate the sequence of energy and matter moving through an ecosystem to the trophic levels of a species. - Shorter and longer answer questions - Interpret data from a model - Construct a food chain and identify trophic levels

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	2	**222** Matter cycles through an ecosystem **223** Disruption of matter cycles	13.B analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models 1.G 3.A		**Key Questions:** How is matter, that is essential to sustain the life of organisms, retained within an ecosystem? How can the disruption of matter cycles impact an ecosystem? This activity introduces nutrient cycles in terms of how matter moves through the ecosystem. Students can refer back to chapter 3 if they need to clarify the process of photosynthesis and respiration when looking at the carbon and oxygen cycles. Nutrient cycles are explored in more detail in later activities. Disruptions to matter cycles are explored within the context of Texas Longhorn cattle or rangelands. **Keywords:** ecosystems, biodiversity		**Learning Outcome:** Analyze the consequences of disruption to matter cycles that impact ecosystem stability. - Longer answer questions - Construct a model of matter cycling
GC: **Week:** **Date:**	1	**224** Energy flows through an ecosystem	1.F 1.G 2.B 2.C 3.A		**Key Question:** How does energy flow through an ecosystem? The 10% rule is an important concept to illustrate that not all energy passes to the next trophic level. **Scaffolding:** Students may need scaffolding for the efficiency calculations in this activity. This could be achieved by working through some steps on the board. The initial food chain in the activity can be used as a context for the calculations. **Extension:** Question 5 is tagged as extension. **Keywords:** ecosystem, trophic level, food chain, consumer		**Learning Outcome:** Calculate energy efficiency in an ecosystem, applying 10% rule. - Short and longer answer questions - Identify processes occurring in a energy transfer model - Calculate energy transfer - Calculate energy efficiency
GC: **Week:** **Date:**	1	**225** Ecological pyramids	1.F 1.G 2.A 4.A		**Key Question:** How can the number of organisms, amount of energy, or amount of biomass at each trophic level be represented in an ecosystem? Ecological pyramids represent relationships between trophic levels, and it is important for the students to select the most appropriate way to represent data. Students should be able to justify their choice from the different ecological pyramids. **Scaffolding:** Inverted pyramids (question 6) may need explanation. **Keywords:** trophic levels, ecosystem, consumer **Homelink:** What types of ecological pyramids can be seen around the students homes or local areas? Are they able to bring in images of the different species in their areas so other students can construct pyramids from the information?		**Learning Outcome:** Evaluate the use of ecological pyramids to represent the amount of energy, organisms, or biomass in each trophic level. - Shorter and longer answer questions - Interpret information from ecological pyramids - Construct a pyramid of numbers

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**226** Investigating ecological pyramids	13.B analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models 1.B 1.F 3.B		**Key Question:** What patterns do we see in ecological pyramids of real-world examples? This interactive investigation allows students to collect and analyze data from a virtual river simulation to construct biomass and energy pyramids. The simulation is tagged as extension, but all students can complete it with support. For students unable to access a device, or work online, this activity can be projected onto the board, and students can complete the questions as a class. This linked interactive programme allows students to collect and analyze data from a virtual river simulation to construct biomass and energy pyramids To enable digital collaboration in the class, so groups can share and discuss their results, a shared Google Doc or TEAMS WORD Doc can be created. The groups can then paste screenshots of their results onto one class shared digital document. This would also enable students who are working from home, to participate in the whole class activity.	9.3 Exploring biomass pyramids	**Learning Outcome:** Collect and analyze data from a virtual river simulation to construct biomass and energy pyramids. ——— ▸ Classroom investigation - digital ▸ Summarize investigation findings
GC: **Week:** **Date:**	1	**227** Disruption to biomass and energy flow	13.B analyze how ecosystem stability is affected by disruptions to the cycling of matter and flow of energy through trophic levels using models 1.F 3.A		**Key Question:** How do different disruption events affect the way biomass and energy move through an ecosystem, and what impact do they have on ecosystem stability? Simple schematics demonstrate how a variety of disturbances can affect trophic levels. In question 3, students apply their understanding to model the effect of disruption of Hurricane Harvey on bird species **Keywords:** trophic levels, ecosystems, autotrophic, producer, food chains, consumer, predation		**Learning Outcome:** Analyze the changes in ecosystem stability due to disruption to biomass and energy flow. ——— ▸ Longer answer questions ▸ Construct a model to show disruption to biomass and energy flow
GC: **Week:** **Date:**	1	**228** Nutrient cycles	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.G	4.G.ii	**Key Question:** How does matter cycle through the biotic and abiotic compartments of Earth's ecosystems? The activity summarizes biogeochemical cycles and their interactions. If there is access to a compost bin, students can examine the difference in material between the fresh waste on top, and composted material at the bottom. **Keywords:** ecosystem, biotic, abiotic **Homelink:** Do any students have families who have a compost bin at home? If so, ask the students to record down the information provided to them by family members, about how to construct and maintain the compost bin, and bring their observations back to class to share.		**Learning Outcome:** Use and develop models to demonstrate the importance of functioning carbon and nitrogen cycles to ecosystem stability. ——— ▸ Longer answer questions ▸ Construct a model to show modeling of nutrients
GC: **Week:** **Date:**	2	**229** The carbon cycle **230** Modeling the carbon cycle	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.C 1.D 1.F 1.G 3.A		**Key Questions:** How does carbon cycle between the atmosphere, biosphere, geosphere, and hydrosphere? How can a simple model be used to represent the carbon cycle? The carbon cycle was covered in previous grades, so a more complex model is provided. **Scaffolding:** To scaffold for students with gaps in their knowledge, they can be referred to the Resource Hub for less complex carbon cycle interactives. **Extension:** Links to online lab modules are available to extend students. Students can complete the model in activity 230 or the teacher could have a premade model available as an engagement activity **Keywords:** carbon cycle, ecosystems **Homelink:** If there is not time to construct the models in class, students can take the activity home and complete, recording with photographs to bring back to class	9.4 A model of the carbon cycle	**Learning Outcome:** Use and develop models to demonstrate the importance of functioning carbon cycles to ecosystem stability. ——— ▸ Short and longer answer questions ▸ Interpret information from a model ▸ Laboratory investigation - small groups ▸ Construct a model of carbon cycling from investigation findings

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**231** Disruptions to the carbon cycle	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.G 3.A		**Key Question:** How have the concentrations of carbon dioxide in the Earth's atmosphere changed over time, and what are the implications of this for ecosystem stability? Once students have a secure understanding of the carbon cycle, they can explore the effects of disruption on it. Data showing short- and long-term changes are provided. Students should understand that some variation is natural, but human activity has caused disruption to the carbon cycle. The greenhouse effect is explained in this activity, to explain the effect of disrupting the carbon cycle and its effect on temperature. **Extension:** The effect of temperature change is illustrated using the North American Pika, but the lesson can be extended by using one or more of the examples in the Resource Hub. Climate change impacts will be covered in activity 238, in the context of biodiversity impacts. **Keywords:** climate change		**Learning Outcome:** Use and develop models to demonstrate the importance of functioning carbon cycles to ecosystem stability. **Learning Outcome:** Analyze consequences of carbon cycle disruptions, including climate change. ▸ Longer answer questions ▸ Interpret data from graphs
GC: **Week:** **Date:**	1	**232** Ocean acidification	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.B 1.C 1.D 2.B 2.D 4.A	2.I.v	**Key Question:** How does the increasing amount of carbon dioxide in the atmosphere affect the pH, and therefore stability of the marine ecosystem in the oceans? Ocean acidification is often talked about, but it is important to note that the oceans are not actually acidic, although the pH is trending down. **Scaffolding:** Some students may be daunted by the chemistry contained within the graphic, so talk through this as a class if necessary. The oceans act as a carbon sink so it is important that students link increased carbon in the ocean to a disruption in the carbon cycle. This investigation requires access to dry ice. As an alternative, students can use straws to blow into the solutions, however there is a risk, so great care must be taken to ensure no liquid is consumed.	9.5 Investigating how dry ice affects pH	**Learning Outcome:** Use and develop models to demonstrate the importance of functioning carbon to ecosystem stability. **Learning Outcome:** Investigate the link between increased atmospheric carbon, in the form of carbon dioxide, and increased ocean acidification. ▸ Longer answer questions ▸ Laboratory investigation - small groups
GC: **Week:** **Date:**	1	**233** The nitrogen cycle	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.G 3.A		**Key Question:** What is the importance of nitrogen cycling through the ecosystem? The activity provides an overview of the nitrogen cycle followed by a more complex model (marked as extension). Complete one or both, depending on the level required **Extension:** The second model will require some understanding of chemical formulae that is not stipulated in the TEKS for this subject. **Keywords:** nitrogen cycle, abiotic, biotic		**Learning Outcome:** Use and develop models to demonstrate the importance of functioning nitrogen cycles to ecosystem stability. ▸ Short and longer answer questions ▸ Write formula for nitrogen compounds on a nitrogen cycle model

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**234** Disruptions to the nitrogen cycle	13.C explain the significance of the carbon and nitrogen cycles to ecosystem stability and analyze the consequences of disrupting these cycles 1.F 2.B 2.C		**Key Question:** What are the consequences of disrupting the nitrogen cycle? Human impacts on the nitrogen cycle through fertilizer application are described. The examples are very general, so local examples could be provided by the teacher if desired. **Extension:** Some material on the second page is tagged as extension. Biodiversity is introduced to bridge to the final section of this chapter. **Keywords:** nitrogen cycle, biodiversity, ecosystem		**Learning Outcome:** Use and develop models to demonstrate the importance of functioning nitrogen cycles to ecosystem stability. **Learning Outcome:** Analyze consequences of nitrogen cycle disruptions, including aquatic eutrophication. ▸ Longer answer questions ▸ Interpret data from a graph ▸ Calculate nitrogen quantities from provided data
GC: **Week:** **Date:**	1	**235** Ecosystem changes can be permanent	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.G 3.A		**Key Question:** Can there be such severe disturbances to ecosystems that they never return to their original state? Students have already covered ecosystem resilience, but need to understand that some events are so significant an ecosystem cannot return to its original state. Mt Saint Helens is provided as a case study and its eruption in 1980. **Scaffolding:** If students require help interpreting the schematic, project the image onto the board and draw over, as the class discusses the changes. For a Texas example, students could explore the loss of wetlands around the Gulf of Mexico coast. **Keywords:** ecosystem, climate change, biodiversity		**Learning Outcome:** Analyze the effect of permanent ecosystem change, either natural or human-caused, on biodiversity. ▸ Short and longer answer questions ▸ Interpret information from a schematic diagram
GC: **Week:** **Date:**	1	**236** Biodiversity in an ecosystem	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.F 2.B 2.C		**Key Question:** How is biodiversity measured in an ecosystem? Biodiversity and its importance is introduced. Students explore biodiversity measures and then compare biodiversity in two ecosystems using the Simpson's Index of Diversity. If the tables are used, the mathematical calculations are straightforward, although some students will require support to complete them. **Scaffolding:** A digital calculator tool for Simpson's Index of Diversity is provided in the Resource Hub, which may help students who struggle with mathematics. This index will be used again in activity 238, so students will need to understand clearly what the values from 0-1 indicate. **Keywords:** biodiversity, ecosystem **Homelink:** Students could make observations of species in areas around their homes, if they have access to different environments. What species are there that they can see? How may of each type of species are there? Parents could be asked if biodiversity has changed.		**Learning Outcome:** Calculate biodiversity values in provided examples using the Simpson's Index of Diversity method. ▸ Short and longer answer questions ▸ Interpret data from a model ▸ Calculate biodiversity using the Simpson's Index of Diversity formula

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**237** Keystone species and ecosystem stability	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 3.A		**Key Question:** What are keystone species, and why are they important for ecosystem stability? Keystone species are introduced in the content anchor, and a variety of other case studies are offered in this activity. Students must understand the importance of keystone species and their key functional positions in ecosystems. Removal of a keystone species can have a disproportionate influence on ecosystem stability. These roles may be different in each case but include species with roles in nutrient recycling (termites), as predators (sea otters, mountain lions, sea stars), in shaping the characteristics of the environment (elephants, prairie dogs), and even as pollinators (hummingbirds in the Sonoran desert). You could use one of the videos on the Resource Hub as a starter for this activity. **Keywords:** keystone species, ecosystems		**Learning Outcome:** Link the loss of keystone species to ecosystem destabilization. ▸ Short and longer answer questions ▸ Interpret data from graphs
GC: **Week:** **Date:**	2	**238** Human activity and biodiversity	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.B 1.F 2.A 2.B 2.C 2.D 3.A 4.B	4.F.vi	**Key Question:** How is human activity affecting biodiversity on Earth? Refer to activity 231 to review the impact of changes in the carbon cycle. Three climate change impact case studies are provided; the focus is on how these changes affect biodiversity. Other examples can be found in the Resource Hub. If investigating all examples, more than one lesson will be required. The investigation requires application of the Simpson's Index of Diversity, so refer back and provide support to students as required. This has been tagged as extension as a reminder that some students will require support. Part 4 of the investigation can be completed in groups or with the class. **Keywords:** biodiversity, habitat, climate change, keystone species	9.6 investigating biodiversity and human impacts	**Learning Outcome:** Analyze and investigate, using group simulations, the impact of human activity on biodiversity. ▸ Longer answer questions ▸ Interpret data from graphs ▸ Classroom investigation - small and larger groups
GC: **Week:** **Date:**	2	**239** Human impacts on marine biodiversity	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.B 1.F 2.A 2.D 3.A 3.C		**Key Question:** What is the impact of unsustainable fishing on fish stocks? Some students will have more knowledge of the fishing industry than others, so an introductory video from the Resource Hub could set the scene. Work through the material provided before beginning the investigation. **Scaffolding:** The investigation can be structured so that any physically impaired students can use a larger tool to 'catch' fish more easily. The data from the investigation can be collated as a class and averaged. Explain the importance of reliability in results by using multiple sets of data. Students can share the rules they have made in question 8 and, as an alternative method, the class can all use the same agreed 'rules'. Activity 239 will require more than one lesson to complete. **Keywords:** habitat, climate change **Homelink:** Are any families involved in fishing? Has fishing and the types of fish they catch changed in recent years. Do any students or their families have knowledge of the fishing quota system that they could share with the class?	9.7 A model of human impacts on fish stocks	**Learning Outcome:** Explain and model how marine harvesting, specifically overfishing, has led to a decrease in fish biodiversity, and marine ecosystem stability in our oceans. ▸ Longer answer questions ▸ Classroom investigation - larger groups ▸ Develop solutions for sustainable fishing ▸ Complete a fishbone chart to identify overfishing consequences

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	2	**240** Deforestation and species survival	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 2.B 3.B 3.C 4.A		**Key Question:** How does deforestation impact species survival? Deforestation may not be a context students have observed locally, so utilize the Resource Hub to support the content. This activity provides an opportunity for a class debate. Teachers may wish to explain the ground rules of the debate and act as mediator, if students are unfamiliar with the approach. If time is short, two groups can organize themselves on either side, with the remainder of the class observing and making notes for their presentation report. For digital collaboration, students can use a shared Google Doc or TEAMS WORD Doc to develop their debating points. This would allow students at home to participate. **Keywords:** biodiversity, habitat		**Learning Outcome:** Debate the pros and cons of prioritizing protection of endangered forest species to maintain biodiversity. - Short and longer answer questions - Identify trends in data - Participate in a class debate on forestry and species protection - Report on debate key points
GC: **Week:** **Date:**	3	**241** Can't see the wood for the trees	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 3.A 3.B 4.B		**Key Question:** How has human activity affected a high biodiversity area, and what are some possible solutions for restoring it, or preventing more loss? The case study of Madrean Pine-Oak Woodlands provides a context for how humans affect biodiversity. Once completed, students consider different conservation options for a local species. Some schools may have the opportunity to visit a conservation area, or invite a conservation expert in to discuss conservation efforts, or their role as a conservation officer and what the job entails. **Keywords:** ecosystem, biodiversity, climate change		**Learning Outcome:** Research the impacts of human activity on a local species. - Longer answer questions - Small group discussion - Interpret data from a model - Research local endangered species
GC: **Week:** **Date:**	1	**242** The effects of damming on biodiversity	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 3.A		**Key Question:** What is the effect of damming on ecosystems? How does the human activity of damming affect biodiversity? Begin the lesson with a short video from the Resource Hub to engage students with the damming process. After a general introduction to damming, specific examples on the Colorado River are provided for context. This activity could be completed at home or in class. **Keywords:** ecosystems, biotic, abiotic, biodiversity		**Learning Outcome:** Explain the impacts of damming on ecosystem biodiversity. - Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: Week: Date:	1	**243** Humans depend on biodiversity			**Key Question:** What are the ecosystem services that humans depend upon? This activity highlights that biodiversity is not only important for ecosystem stability, but that humans depend on biodiversity too. Before beginning the activity, ask students to consider how humans might depend on biodiversity. Introduce the term 'ecosystems services'. Teachers could assign groups of students to research and present on the different types: cultural, supporting, provisioning, and regulatory. **Keywords:** ecosystem, biodiversity		▶ Longer answer questions
GC: Week: Date:	1	**244** A mammoth task revisited	13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.F 3.C 4.A		**Key Question:** How could bringing back the woolly mammoth restore a lost ecosystem? The content anchor, "A Mammoth Task" introduces students to the idea that stability of an ecosystem is dependent on a wide range of interactions, and change to any one, either through natural means or human activity, can create changes in the ecosystem. Human intervention can sometimes be used to reverse the changes. **Keywords:** ecosystem, keystone species		▶ Longer answer questions ▶ Complete consequent chart in small groups ▶ Participate in class debate on reintroducing woolly mammoths to an ecosystem ▶ Construct a summary statement on debate findings
GC: Week: Date:	1	**245** Summing up (Chapter 9)	13.A investigate and evaluate how ecological relationships, including predation, parasitism, commensalism, mutualism, and competition, influence ecosystem stability 13.D explain how environmental change, including change due to human activity, affects biodiversity and analyze how changes in biodiversity impact ecosystem stability 1.F 3.A 3.B		**Summing Up: Summative Assessment** **Scaffolding:** Teachers may wish to make a differentiated selection of questions, for example just the multi-choice questions, to assign to some groups of students - especially if they have already reached the standard of the TEKS informed Learning Outcomes elsewhere in the chapter. Conversely, students who have yet to reach a sufficient standard of achievement in some TEKS, may use the summative assessment to obtain this standard - and record this in the Student Progress tracker. Teachers may wish to assign a marking schedule to this assessment, where a particular grade (approaching, proficient, mastery) can be awarded based on the proportion of questions that are correct. It is also recommended for assessments, where English is a second language for students, it is an equitable advantage they have digital access to a translation app, such as https://translate.google.com/ on their devices or a small hand-held digital translator, to allow them the fairest opportunity for success.		▶ Multichoice ▶ Short and longer answer questions ▶ Plot a line graph from provided data

CHAPTER 10 Science Practices

This chapter provides support for the science practices. Activities can be used at any time, and the chapter is not designed to be delivered in sequence. Use it whenever support is required for a Scientific and Engineering Practices skill. Activities can be set prior to, or as part of, a lesson. Where relevant, activities in the content chapters have a 'Need help?' icon that refers to the Science Practices chapter.

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**246** How do we do science?	1.A 4.C		**Key Question:** What are the key aspects of the scientific method and how can we use the scientific method to better understand our world? This activity outlines the dynamic process of the scientific method. It could be a suitable start to the Biology for Texas program, to reinforce that the scientific process is not linear and is subject to refinement. Adapt as a postbox activity if desired, as follows: Statements from the activity, along with any additional statements considered relevant by the teacher, are placed on boxes or plastic containers around the room. Small groups move around each station, read the statement, and write their comment, reflection, or answer, on a piece of paper and post' it into a slot in top of the box. The teacher rings a bell, and students move onto the next box. When all stations have been covered, each group takes responsibility for the stations they are at and read the statements. The group summarizes the statements and reports on the findings. **Keywords:** observations, data		**Learning Outcome:** Discuss the features of Science, in small groups. ▸ Discuss statements in groups ▸ Research a science discipline
GC: **Week:** **Date:**	0.5	**247** Systems and systems models	1.G 2.A		**Key Question:** What are models and why do we use them in science? Models can be many things and are a helpful tool to understand systems. Refer students to this when they explore different models.. **Keywords:** models, data, graph		**Learning Outcome:** Define and link the terms system and model, in a science context. ▸ Small and longer answer questions
GC: **Week:** **Date:**	0.25	**248** Hypotheses, laws, and theories	1.H		**Key Question:** In science, what is the difference between a hypothesis, a theory, and a law? **Literacy:** The terms hypothesis, law, and theory, are terms students will frequently come across. This reference page provides clear differentiation between each. Encourage students to use these terms in the correct context.		**Learning Outcome:** Define and compare the scientific terms hypothesis, law, and theory. ▸ Longer answer questions
GC: **Week:** **Date:**	0.5	**249** Observations and assumptions	1.A 1.B		**Key Question:** What is the importance of making observations, producing hypotheses, and recognizing assumptions? This activity could be used prior to any investigation that requires observations. Explain why assumptions sometimes need to be made in science. **Literacy:** Several terms are introduced. Ensure students use the glossary to obtain clear definitions of each. **Keywords:** observations, predictions, assumptions		**Learning Outcome:** Generate a hypothesis from a provided case, and describe the assumptions used. ▸ Longer answer question

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**250** Accuracy and precision	1.B		**Key Question:** What do accuracy and precision mean, how are they different, and why are they important when taking measurements? Investigations requires students to obtain results that are both accurate and precise. The simple analogy in this activity explains the two clearly, for students who are having trouble differentiating the terms. When reporting results, students often report to levels they have not accurately been able to measure. The section on significant figures explains how to report to levels that are meaningful for the investigation. **Keywords:** accuracy, precision		▸ Longer answer question ▸ Calculate number of significant figures
GC: **Week:** **Date:**	0.25	**251** Working with numbers	2.C		**Key Question:** How is mathematical notation used, and how does converting and manipulating numbers make them easier to understand? This activity can be used as a reference throughout the program when any of these mathematical skills are required. A few practice questions are given but teachers can expand on these with additional questions. **Scaffolding:** For students who need scaffolding for mathematics, teachers can construct a worked exemplar of each problem on the board. Ensure that students have written down the simple steps required to solve the problem.		**Learning Outcome:** Convert between decimal and standard form in given numerical values. ▸ Convert between decimal and standard form ▸ Convert between different measurement units ▸ Estimate mathematical calculations
GC: **Week:** **Date:**	0.25	**252** Tallies, percentages, and rates	2.C		**Key Question:** How is unprocessed (raw) data manipulated or transformed to make it easier to understand and to identify important features? Students will encounter tally charts, percentage calculations, and rates several times within Biology for Texas. This activity explains each, and provides practice examples. **Keywords:** data, raw data, variable		**Learning Outcome:** Discuss the value of processing raw data. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**253** Fractions and ratios	2.C		**Key Question:** How are fractions and ratios used to provide a meaningful comparison of sample data where the sample sizes are different? Fractions and ratios often cause problems for students. This activity provides support for carrying out these transformations. Ratios feature often in the inheritance material, so teachers may want students to complete this activity before carrying out ratios in that chapter.		**Learning Outcome:** Calculate fractions and ratios from provided numerical values. ▸ Calculate ratios ▸ Calculate and simplify fractions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**254** Dealing with large numbers	2.C		**Key Question:** How does using logarithms or log-linear (semi-log) graphs make large scale changes in numerical data more manageable? Exponential and log transformations are compared as ways to graph data dealing with large numbers. **Scaffolding:** Log transformations can initially confuse students, but graphing data onto log paper can make very large numbers easier to work with and interpret. A worked example has been provided to demonstrate how log transformations can be calculated.		**Learning Outcome:** Evaluate the usefulness of logarithm and semi-log graphs for processing exponential data. ▸ Short and longer answer questions
GC: **Week:** **Date:**	0.25	**255** Apparatus and measurement	1.D		**Key Question:** Why must the apparatus used in experimental work be appropriate for the experiment or analysis and be used correctly? Selecting the correct apparatus and glassware is an important skill when designing an investigation. Highlight to students that the wrong equipment can affect their results and make the outcome of their investigation invalid. Teachers could place different measuring apparatus out and present a range of laboratory scenarios, with students asked to identify the correct piece of equipment to use for the task. The investigations in Biology for Texas provide a list of equipment required (see equipment list in appendix). However, on some occasions, students plan their own investigation and need to select the correct equipment, so this activity will prove useful for this. **Keywords:** accuracy		**Learning Outcome:** Calculate the percentage error for provided measurements. ▸ Short answer question ▸ Calculate percentage errors
GC: **Week:** **Date:**	0.25	**256** Types of data	1.E		**Key Question:** What types of data may be collected during an investigation? Understanding different types of data is integral to understanding the best ways to collect and report it. Here, students are introduced to quantitative, qualitative, and ranked data. Emphasize that quantitative data or numerical data is easier to analyze without bias. **Keywords:** data, quantitative, qualitative		**Learning Outcome:** Classify data as quantitative, ranked, or qualitative. **Learning Outcome:** Evaluate the suitability of collecting qualitative or quantitative data in different types of investigations. ▸ Short and longer answer question
GC: **Week:** **Date:**	0.25	**257** Variables and controls	1.B		**Key Question:** What are variables in an investigation, and what is the purpose of a controlled variable? This activity introduces the types of variables students will encounter within the investigations they carry out. They often confuse dependent and independent variables, so ensure these are understood, and students can graph them. Explain to students that experimental controls are an important component of investigations. They are included to check that the experiment is working properly and that the results can be trusted (e.g. the control line on a Rapid Antigen Test for Covid-19). **Keywords:** dependent variable, independent variable, variable, control, observations		**Learning Outcome:** Define independent, dependent, and control variables, describing the purpose of each in an investigation. ▸ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.25	**258** Recording results	1.D 1.E		**Key Questions:** How does accurately recording results (using tables or data loggers) make it easier to understand and analyze your data later? Recording results and observations is a key skill in science. Explain the significance of log books and ensure students make accurate records in a timely manner. Data loggers are becoming common tools for recording data, and are very helpful for long term or remote data collection. However, not all schools will have access to data loggers, and some apps on phones may be substituted. **Keywords:** data, table		**Learning Outcome:** Discuss the value of accurate data recording, including tables, and the use of dataloggers. ▶ Longer answer questions
GC: **Week:** **Date:**	0.25	**259** Constructing tables	1.F		**Key Question:** What is the purpose of recording data in an organized table during an experiment? Explain how recording data in tables not only helps to organize results a logical way, but often allows for trends in the data to be observed more easily. Refer students to this activity when they need to construct tables themselves. **Keywords:** data, table, descriptive statistics, mean		**Learning Outcome:** Discuss the value of accurate data recording, including tables. ▶ Longer answer questions
GC: **Week:** **Date:**	1-2	**260** Which graph to use? **261** Drawing line graphs **262** Drawing scatter graphs **263** Correlation and causation **264** Drawing bar graphs **265** Drawing histograms **266** Drawing pie graphs	1.F		**Key Questions:** How does the type of data you collected affect the type of graph you should choose to display your data? What kind of data is plotted on line graphs, and how do they show the relationship between the independent variable and the dependent variable? How does a scatter graph show continuous data where there is a relationship between two interdependent variables? What does correlation mean, and why can you not assume a correlation is the result of causation? What kind of data is shown on bar graphs? What kind of data is shown on a histogram? What kind of data is shown on pie graphs? Students often need reminding that the type of graph they use to display their data depends on the type of data they have collected. These activities provide guidance on selecting the correct type of graph to use and the features of each graph type. It is helpful to use these activities as a refresher just before a graphing component is required. Encourage students to refer to these activities often so that they become familiar with the rules of graphing. Drawing a line of best fit is an additional skill to be covered, in conjunction with scatter plots. The concepts of correlation and causation can be returned to, whenever relevant. **Keywords:** variable, independent variable, graphs, data, dependent variable, mean		**Learning Outcome:** Plot a line graph, from provided data. **Learning Outcome:** Draw a scatter plot, including a line of best fit. **Learning Outcome:** Distinguish between correlation and causation in data. **Learning Outcome:** Process raw data and draw a bar graph and histogram, from provided data. **Learning Outcome:** Calculate percentages from provided data and use the values to construct pie graphs. ▶ Shorter and longer answer questions ▶ Plot a line graph from provided data ▶ Construct a scatter plot and draw a line of best fit ▶ Convert raw data into a table ▶ Plot a bar graph ▶ Plot a frequency histogram ▶ Calculate percentages ▶ Plot a pie graph

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	1	**267** Mean, median, and mode	2.B 2.B		**Key Question:** What are descriptive statistics and how are they used to summarize a data set and describe its basic features? Measures of central tendency are commonly used in Biology for Texas. Information and flow charts are provided to help students select the correct measure (mean, median, or mode). An example is provided to help consolidate understanding of the skills required. **Scaffolding:** Teachers could pair up students of differing mathematical abilities to work through the problems. **Keywords:** data, descriptive statistics, mean, median, mode, variables		**Learning Outcome:** Calculate mean, median, and mode, from provided data. ▶ Convert raw data into a table ▶ Draw a frequency histogram ▶ Calculate mean, median, and mode from plotted data
GC: **Week:** **Date:**	1	**268** What is standard deviation? **269** Detecting bias in samples	2.B 2.B		**Key Questions:** What does standard deviation measure, what is its purpose, and how is it calculated? What is sampling bias, and how can it be detected and eliminated? **Scaffolding:** Activity 268 covers standard deviation, a concept that can be challenging for some students. Provide support as required. For some, this may mean providing the final calculation, and having students analyze the data only. Evaluating data for bias (activity 269) is an advanced skill, and teachers may need to scaffold delivery for students needing support. **Keywords:** mean, data, descriptive statistics, mean, median, mode		**Learning Outcome:** Calculate standard deviations, explaining what this statistical tool indicates about the data and sampling bias of the data. ▶ Short and longer answer questions ▶ Calculate the standard deviation from provided data
GC: **Week:** **Date:**	1	**270** Biological drawings **271** Practicing biological drawings	1.F		**Key Questions:** What is the purpose of a good biological drawing when studying a specimen? What kind of detail is needed when making accurate and useful biological drawings? A number of opportunities for the students to use biological drawings exist in the worktext, especially in chapter 1, when observing cells and using microscopes. Students may have concerns that they are not artistic, so remind them that a good biological drawing can be very simple. Equally, remind students to draw what they see, and follow the rules provided in activity 270 to produce scientifically accurate drawings. Alternatively, teachers can project an image onto the board. Practice is provided in activity 271. **Keywords:** biological drawings		**Learning Outcome:** Construct a biological drawing from a provided photograph. ▶ Construct a biological drawing from a supplied photomicrograph
GC: **Week:** **Date:**	0.5	**272** Safety and ethics in investigations	1.C		**Key Questions:** What safety and ethical issues need to be addressed during investigations? Safety is an important aspect in the classroom any time an investigation is carried out. This activity can be used on day one as an engagement activity to highlight appropriate behavior and practices. It is also suitable as a homework activity before the first laboratory session. Reminders can be provided throughout the program, as appropriate. Draw student attention to specific safety rules for each investigation or demonstration, and use TEA Texas Safety Standards to promote safe activity. The second part of the activity addresses ethics, and the importance of honest and ethical practices and reporting. **Keywords:** data		**Learning Outcome:** Define independent, dependent, and control variables, describing the purpose of each in an investigation. ▶ Longer answer questions

Date	Time	Activity	Student Expectation	ELPS	Notes	Inv.	Assessment
GC: **Week:** **Date:**	0.5	**273** **A** qualitative practical task	1.E 1.F		**Key Questions:** How can qualitative data be recorded and analyzed? This activity provides an excellent example of collecting and analyzing qualitative data. It could be delivered prior to an investigation collecting qualitative data or it could be used as an assessment task. **Keywords:** quantitative data		**Learning Outcome:** Discuss procedures for collecting qualitative data, in a provided case study. Longer answer questions
GC: **Week:** **Date:**	1	**274** Analyzing experimental data	1.B 1.C 1.E 1.F 2.B 2.D 4.A		**Key Questions:** What is the effect of fertilizer on the growth of radishes? An experimental method, background and quantitative data are provided. Students work through a series of questions designed to test their understanding of the investigation set-up, before tabulating data and carrying out central tendency calculations. Finally, they graph and analyze the data. The activity could be used as a summative assessment.		**Learning Outcome:** Define independent, dependent, and control variables, describing the purpose of each in an investigation. **Learning Outcome:** Process raw data into a data table. **Learning Outcome:** Plot a line graph, from provided data. **Learning Outcome:** Evaluate an investigation method, from a provided case study. ▸ Short and longer answer questions ▸ Convert raw data into a table ▸ Calculate mean, median, and mode ▸ Plot a line graph from processed data

Research and Resources - **Biology for Texas**

The design and content of the worktext, **BIOZONE Biology for Texas**, has been developed with the underlying principles of current and well-supported research in Pedagogy and Science. Below is a list of some of our key readings and resources, which teachers may wish to use to further develop their own pedagogical understandings and/or use in their classrooms.

General Pedagogy

Oxford University Press: Models of learning and best practice pedagogy: https://bit.ly/3WwNSs3

Education Endowment Foundation: Working with parents to support children's learning: https://bit.ly/3MwfQjl

University of Michigan: Three activities to activate prior knowledge: https://bit.ly/3IGDZT1

SplashLearn: Pedagogy in Education: 7 benefits of pedagogy in teaching: https://bit.ly/3MoouQM

Visible learning: Hattie and evidence-based strategies: https://bit.ly/3INJ5gq

John Hatties Instructional Strategies: https://bit.ly/3BXPJNn

Science Education

Education Endowment Foundation: Improving Secondary Science: https://bit.ly/3BWGWuM

The Science Teacher: Prior knowledge in science lessons: https://bit.ly/3IEzg4h

Berkeley University of California: Understanding Science: For educators: https://bit.ly/3MS4DLf

National Center for Science Education: Resources and advice: https://bit.ly/3OEJ02f

University of York: Best Evidence Science Teaching: https://bit.ly/3MxQHo7

Edutopia: Science education https://bit.ly/3OBM0fW

5E Pedagogy

Inquisitive: A teachers guide to the 5E pedagogical model: https://bit.ly/3IzNlzO

BSCS Science Learning: Bybee et al. (2006), The BSCS 5E instructional model: Origins and effectiveness https://bit.ly/3OzoLmu

Literacy and Cognitive Support

Education Endowment Foundation: Improving Literacy in Secondary Schools: https://bit.ly/3q99xKX

Tools for student learning https://bit.ly/3MzgzQL

Global Digital Citizen Foundation: Critical thinking workbook https://bit.ly/3MTyh2G

Ditch That Textbook: Graphic Organizers: https://bit.ly/3q2lNNf

Making Connections - **Biology for Texas**

As students progress through **Biology for Texas**, it is important that they can identify and evaluate connections between both the core Science Concepts and the Scientific and Engineering Practices, in the context of their current learning. The 'Making Connections' templates in the following pages are provided so teachers can facilitate the students with this process. This can occur in the initial stages of a chapter or activity, revealing prior knowledge and any misconceptions held by students that can be addressed, during the learning phase, as a complementary activity, or as a review tool, when students are developing revision materials.

Using the Making Connections templates

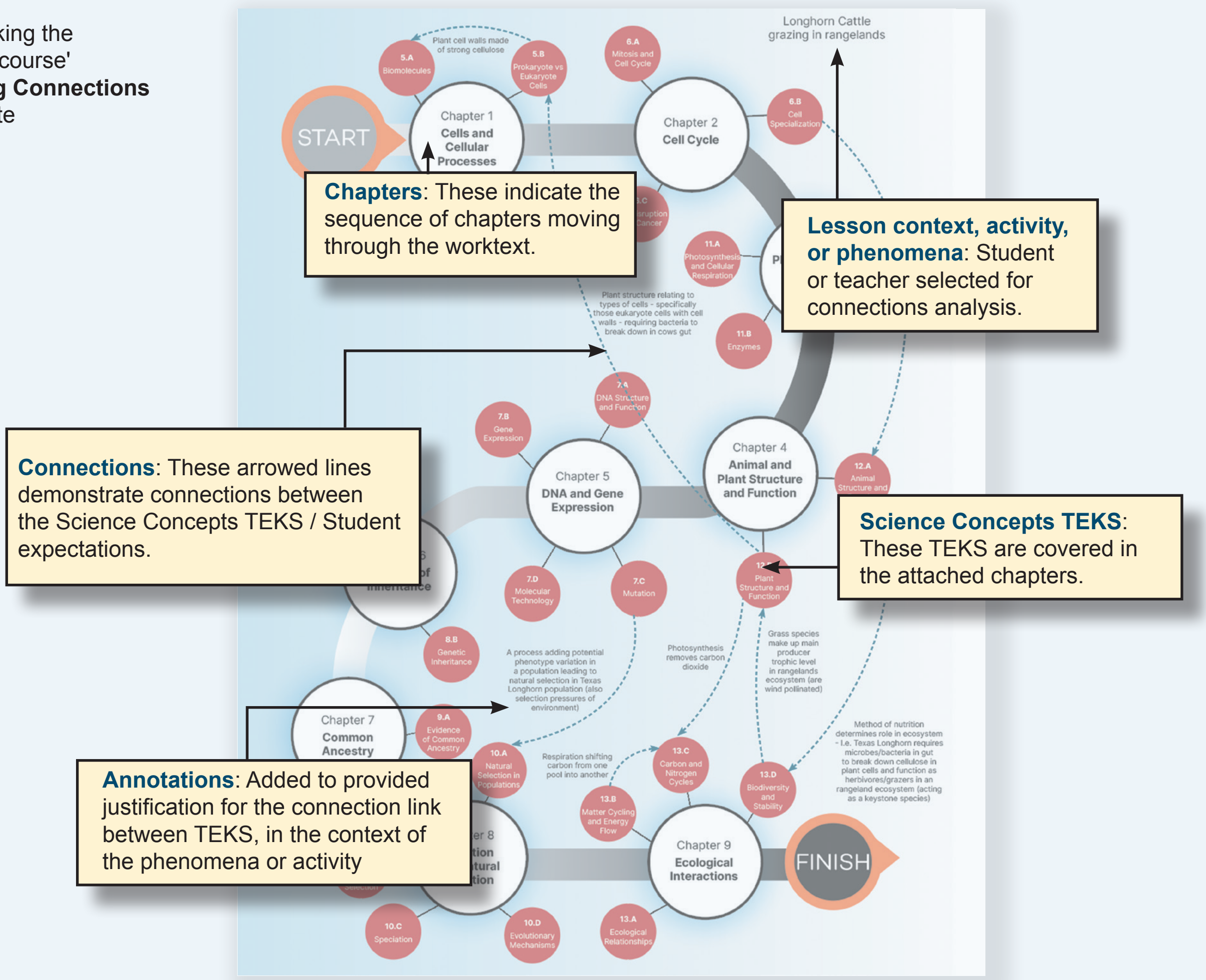
The first 'whole course' making connections template can be printed (either as letter size or a larger A3) and distributed to individual students or small groups.

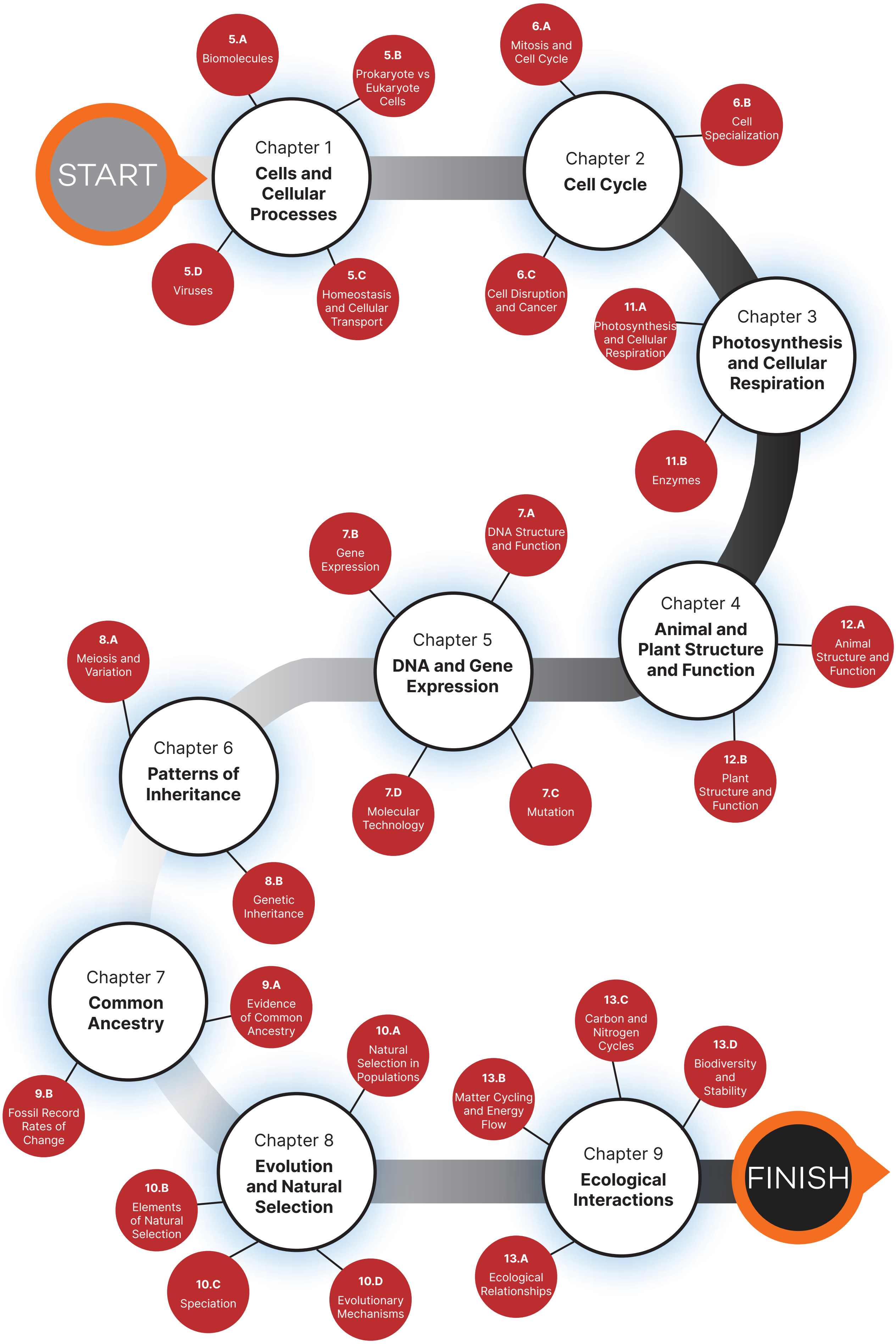
- ☐ The activity, context, or phenomena is written at the top, and students draw in connecting lines to show the relationship between science concepts, annotating with rationale for the connections.
- ☐ The template can be added to as the students progress through the course.
- ☐ Relevant Scientific and Engineering Practices can be indicated, i.e. models, investigations, that have contributed to their understanding of the core concepts.

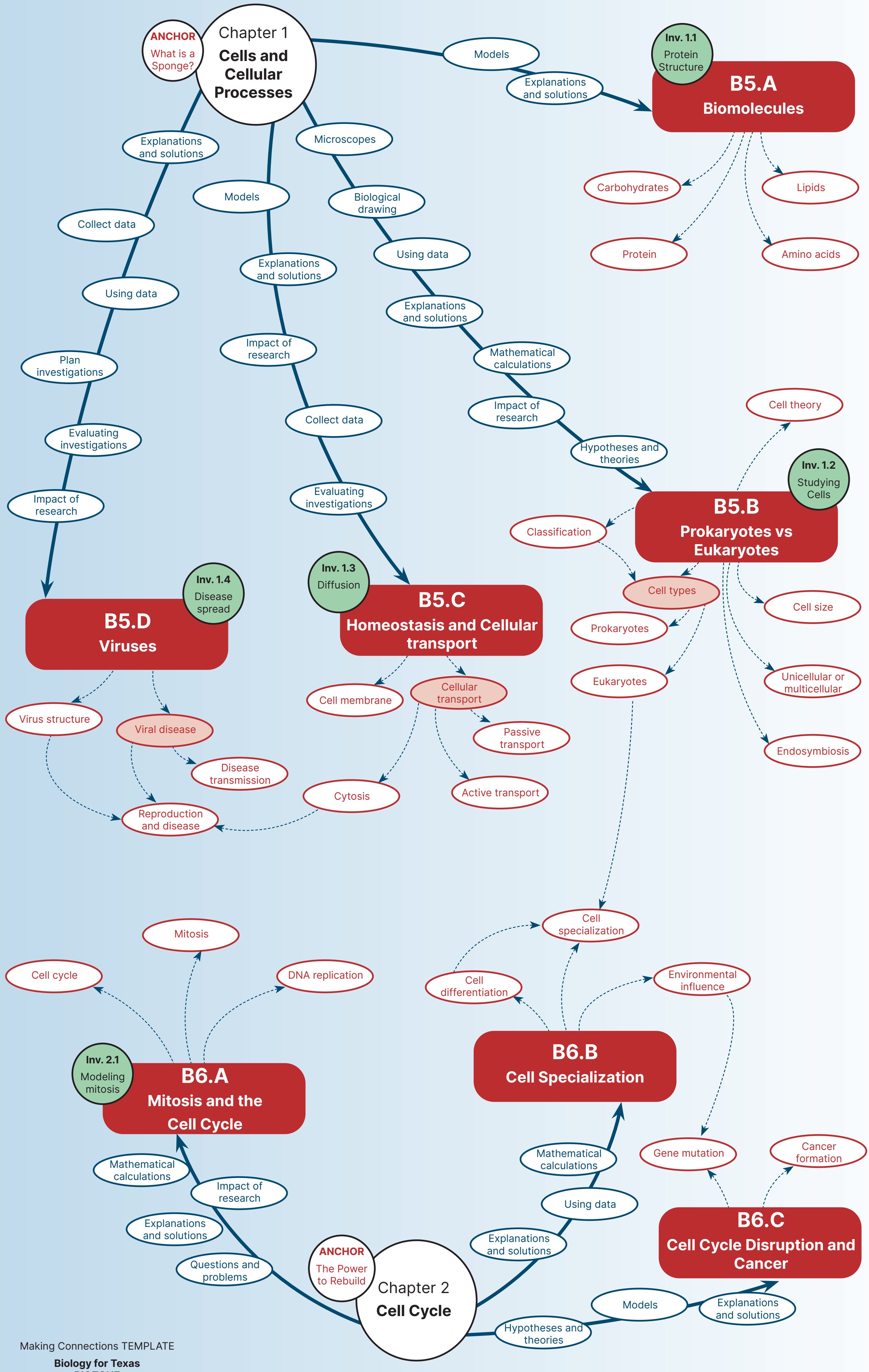
The paired/single chapter making connections templates show both the key science concepts and associated Scientific and Engineering Practices utilized in the worktext.

- ☐ Some initial connections have been added to allow the students an understanding of the concept connectedness of the Biology course.
- ☐ Students can select one or more of the identified Scientific and Engineering Practices and link it to a suitable core concept, annotating on the template, or on a separate sheet, how the connection has contributed, or facilitated, to reach a greater understanding. i.e. in chapter 7, the students can connect *analyzing data* with *DNA evidence*, and describing how that has allowed *explanations and solutions* to be developed, relating to evidence for common ancestry.
- ☐ The template can be use as a whole class starter, in small group brainstorm sessions, or as individual activities, with the templates added to periodically to create a revision resource.
- ☐ The chapter templates can be joined together, and placed on a larger poster, or on the wall, to allow students to add to the connections between core Science Concepts and the Scientific and Engineering Practices as they progress through the course.
- ☐ Students can also identify any Scientific and Engineering Practices activities they have utilized from Chapter 10, especially those referenced with the 'Need Help" icons throughout the activities, adding notes to their templates.

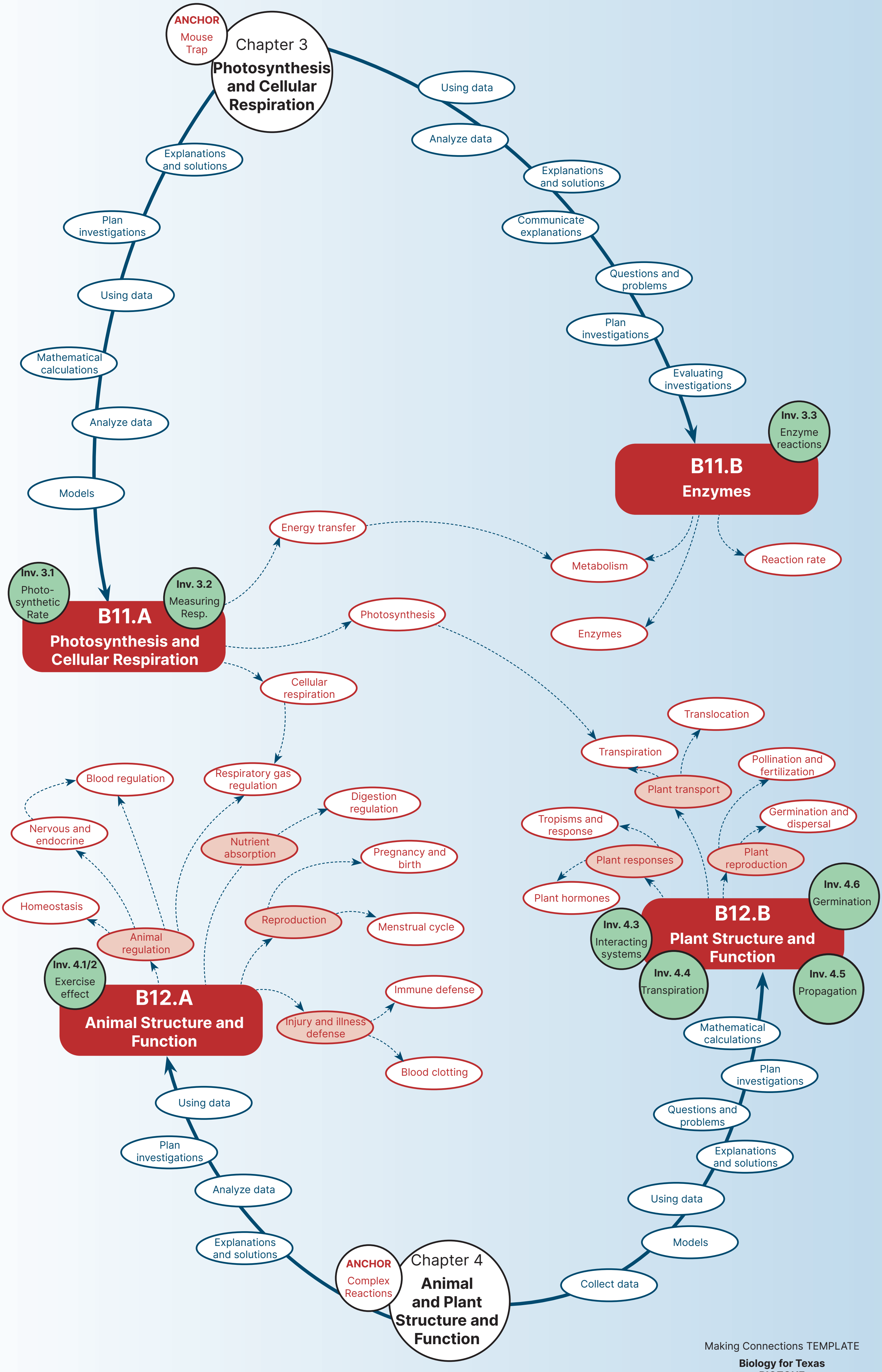
Unpacking the 'whole course' **Making Connections** template

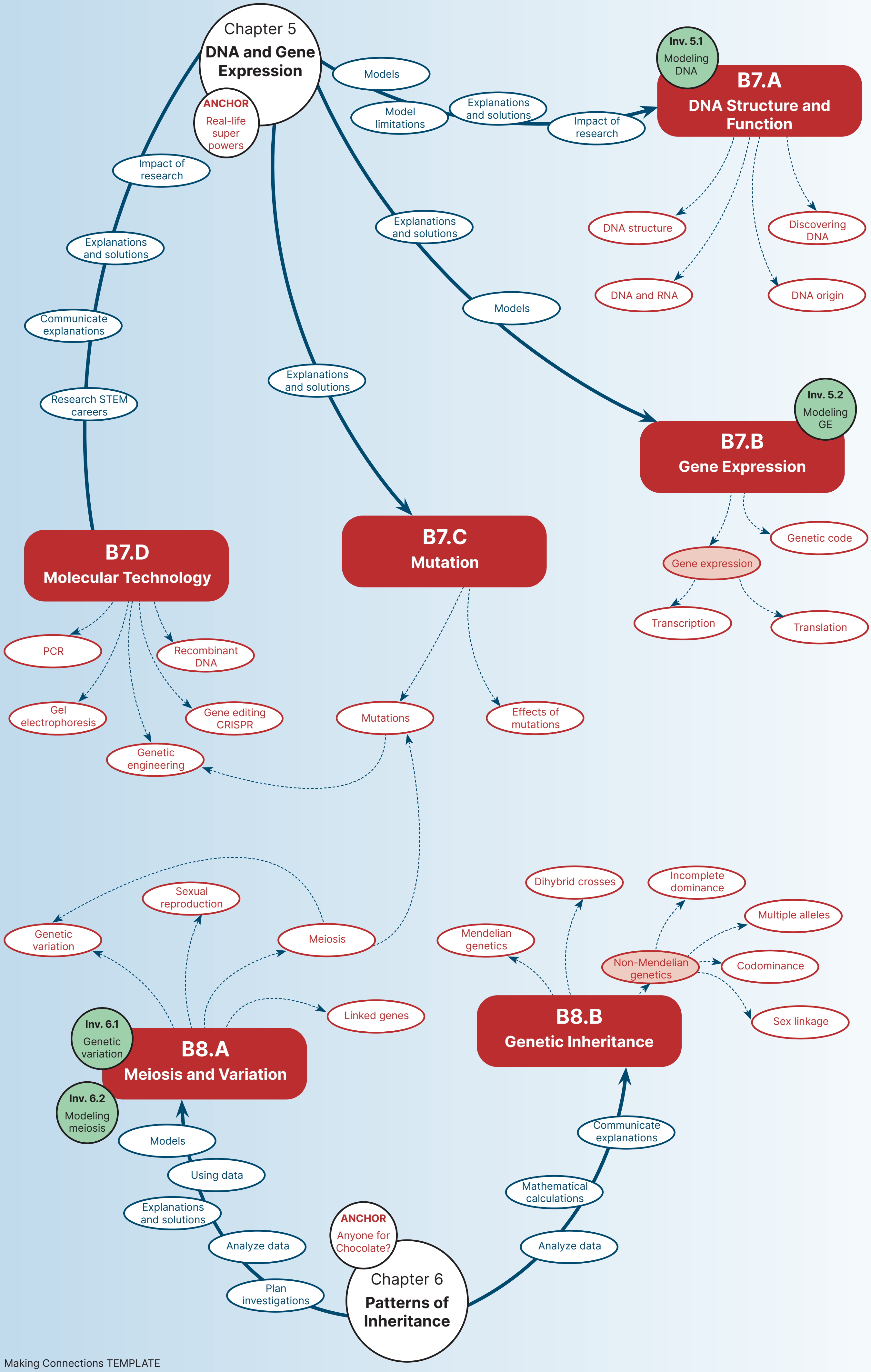



START
Chapter 1
Cells and Cellular Processes
5.A
Biomolecules
5.B
Prokaryote vs Eukaryote Cells
5.C
Homeostasis and Cellular Transport
5.D
Viruses
Chapter 2
Cell Cycle
6.A
Mitosis and Cell Cycle
6.B
Cell Specialization
6.C
Cell Disruption and Cancer
Chapter 3
Photosynthesis and Cellular Respiration
11.A
Photosynthesis and Cellular Respiration
11.B
Enzymes
Chapter 4
Animal and Plant Structure and Function
12.A
Animal Structure and Function
12.B
Plant Structure and Function
Chapter 5
DNA and Gene Expression
7.A
DNA Structure and Function
7.B
Gene Expression
7.C
Mutation
7.D
Molecular Technology
Chapter 6
Patterns of Inheritance
8.A
Meiosis and Variation
8.B
Genetic Inheritance
Chapter 7
Common Ancestry
9.A
Evidence of Common Ancestry
9.B
Fossil Record Rates of Change
Chapter 8
Evolution and Natural Selection
10.A
Natural Selection in Populations
10.B
Elements of Natural Selection
10.C
Speciation
10.D
Evolutionary Mechanisms
Chapter 9
Ecological Interactions
13.A
Ecological Relationships
13.B
Matter Cycling and Energy Flow
13.C
Carbon and Nitrogen Cycles
13.D
Biodiversity and Stability
FINISH

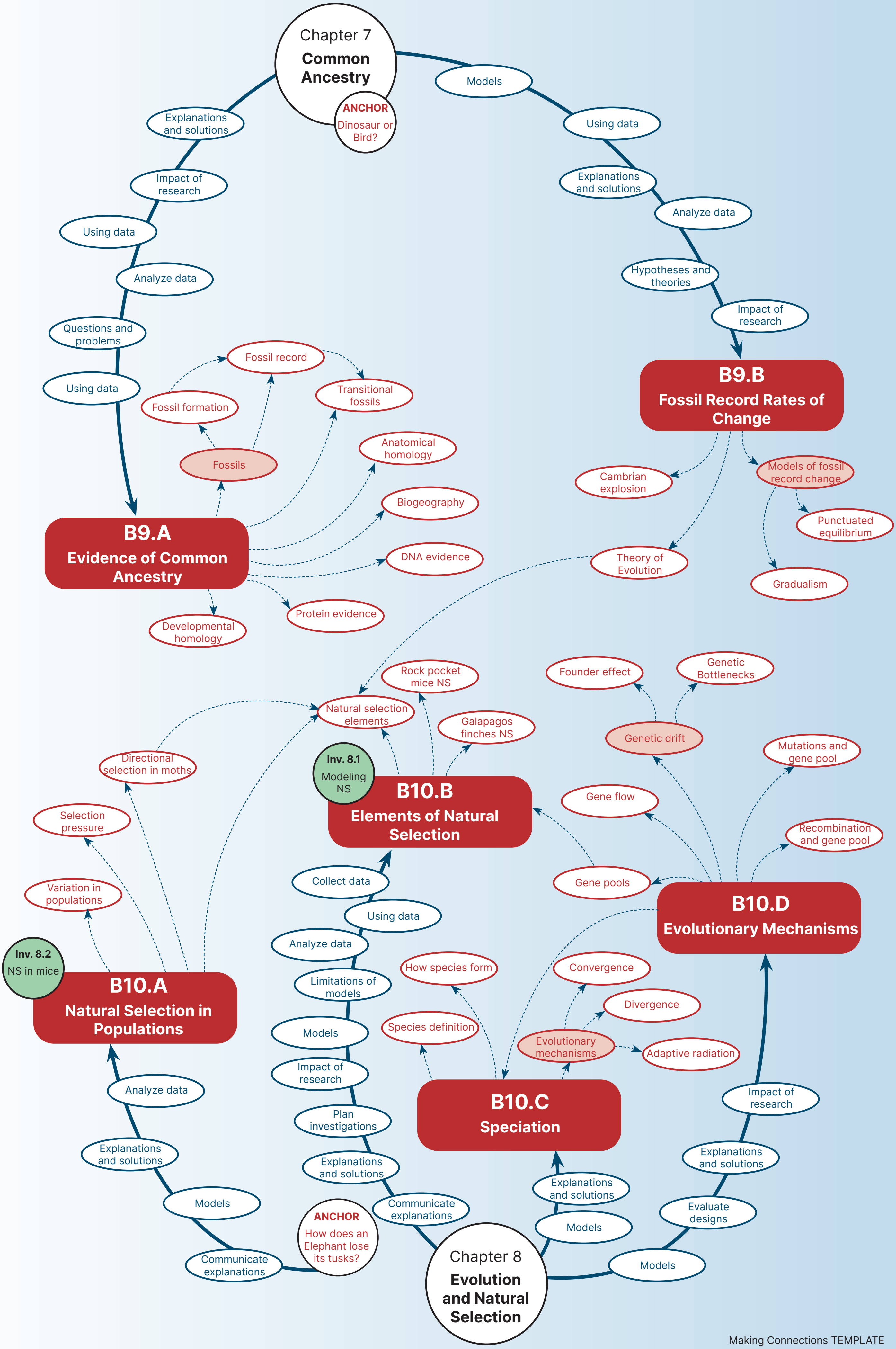


ANCHOR
What is a Sponge?
Chapter 1
Cells and Cellular Processes
Models
Explanations and solutions
Inv. 1.1
Protein Structure
B5.A
Biomolecules
Carbohydrates
Lipids
Protein
Amino acids
Explanations and solutions
Collect data
Using data
Plan investigations
Evaluating investigations
Impact of research
Models
Explanations and solutions
Impact of research
Collect data
Evaluating investigations
Microscopes
Biological drawing
Using data
Explanations and solutions
Mathematical calculations
Impact of research
Hypotheses and theories
Cell theory
Inv. 1.2
Studying Cells
B5.B
Prokaryotes vs Eukaryotes
Classification
Cell types
Cell size
Prokaryotes
Eukaryotes
Unicellular or multicellular
Endosymbiosis
Inv. 1.4
Disease spread
B5.D
Viruses
Virus structure
Viral disease
Disease transmission
Reproduction and disease
Inv. 1.3
Diffusion
B5.C
Homeostasis and Cellular transport
Cell membrane
Cellular transport
Passive transport
Cytosis
Active transport
Cell specialization
Cell differentiation
Environmental influence
Mitosis
Cell cycle
DNA replication
Inv. 2.1
Modeling mitosis
B6.A
Mitosis and the Cell Cycle
B6.B
Cell Specialization
Gene mutation
Cancer formation
B6.C
Cell Cycle Disruption and Cancer
Mathematical calculations
Impact of research
Explanations and solutions
Questions and problems
ANCHOR
The Power to Rebuild
Chapter 2
Cell Cycle
Mathematical calculations
Using data
Explanations and solutions
Hypotheses and theories
Models
Explanations and solutions

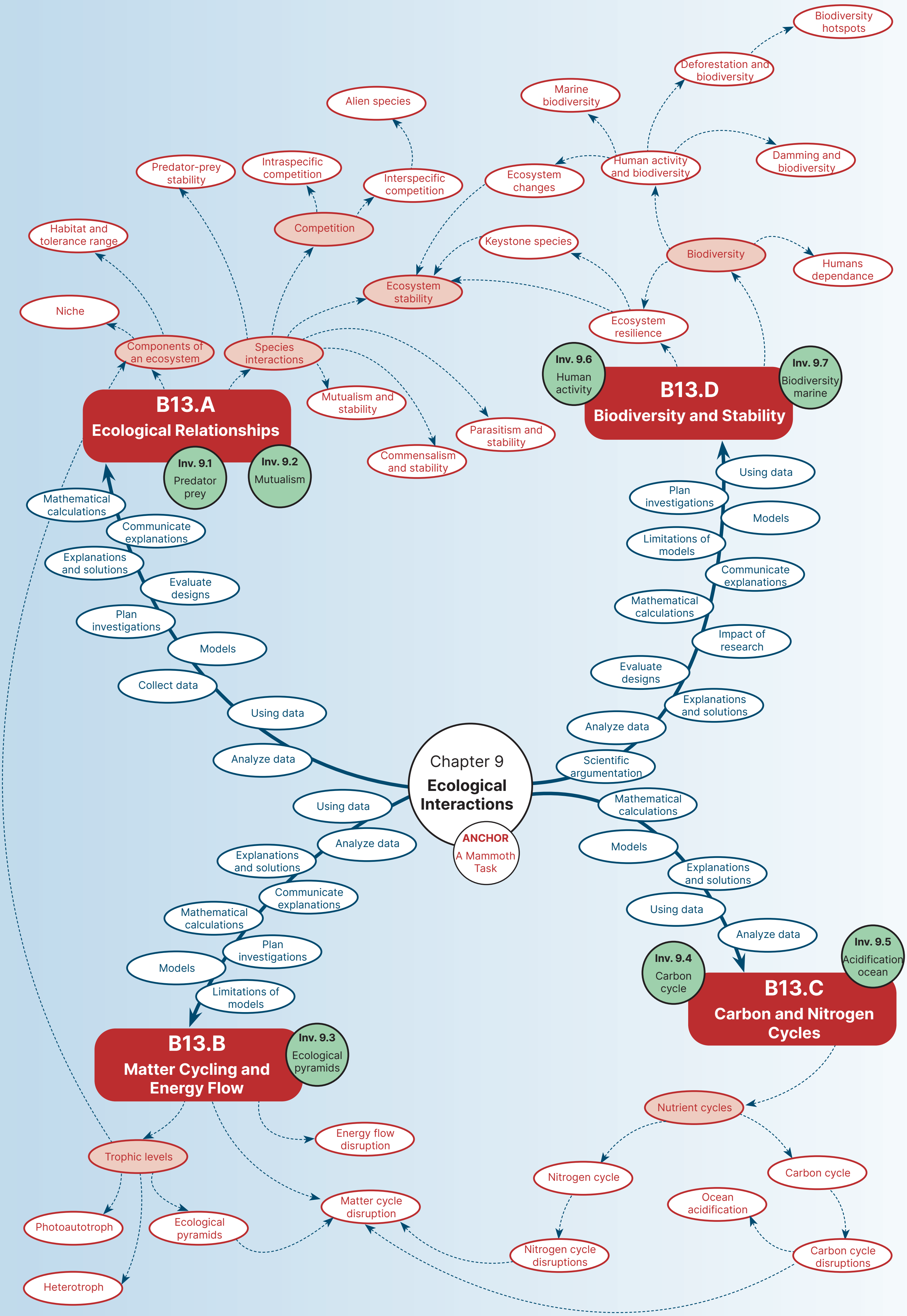

ANCHOR
Mouse Trap
Chapter 3
Photosynthesis and Cellular Respiration
Using data
Analyze data
Explanations and solutions
Communicate explanations
Questions and problems
Plan investigations
Evaluating investigations
Inv. 3.3
Enzyme reactions
B11.B
Enzymes
Explanations and solutions
Plan investigations
Using data
Mathematical calculations
Analyze data
Models
Energy transfer
Metabolism
Reaction rate
Enzymes
Inv. 3.1
Photo-synthetic Rate
Inv. 3.2
Measuring Resp.
B11.A
Photosynthesis and Cellular Respiration
Photosynthesis
Cellular respiration
Translocation
Transpiration
Pollination and fertilization
Plant transport
Germination and dispersal
Tropisms and response
Plant responses
Plant reproduction
Plant hormones
Inv. 4.6
Germination
B12.B
Plant Structure and Function
Inv. 4.3
Interacting systems
Inv. 4.4
Transpiration
Inv. 4.5
Propagation
Blood regulation
Respiratory gas regulation
Digestion regulation
Nervous and endocrine
Nutrient absorption
Pregnancy and birth
Homeostasis
Reproduction
Menstrual cycle
Animal regulation
Inv. 4.1/2
Exercise effect
B12.A
Animal Structure and Function
Immune defense
Injury and illness defense
Blood clotting
Mathematical calculations
Plan investigations
Questions and problems
Explanations and solutions
Using data
Models
Collect data
Using data
Plan investigations
Analyze data
Explanations and solutions
ANCHOR
Complex Reactions
Chapter 4
Animal and Plant Structure and Function



Chapter 5
DNA and Gene Expression
ANCHOR
Real-life super powers
Models
Model limitations
Explanations and solutions
Impact of research
Inv. 5.1
Modeling DNA
B7.A
DNA Structure and Function
DNA structure
Discovering DNA
DNA and RNA
DNA origin
Impact of research
Explanations and solutions
Communicate explanations
Research STEM careers
Explanations and solutions
Explanations and solutions
Models
Inv. 5.2
Modeling GE
B7.B
Gene Expression
Genetic code
Gene expression
Transcription
Translation
B7.D
Molecular Technology
PCR
Recombinant DNA
Gel electrophoresis
Gene editing CRISPR
Genetic engineering
B7.C
Mutation
Mutations
Effects of mutations
Sexual reproduction
Genetic variation
Meiosis
Linked genes
Inv. 6.1
Genetic variation
B8.A
Meiosis and Variation
Inv. 6.2
Modeling meiosis
Models
Using data
Explanations and solutions
Analyze data
Plan investigations
Dihybrid crosses
Incomplete dominance
Multiple alleles
Mendelian genetics
Non-Mendelian genetics
Codominance
Sex linkage
B8.B
Genetic Inheritance
Communicate explanations
Mathematical calculations
Analyze data
ANCHOR
Anyone for Chocolate?
Chapter 6
Patterns of Inheritance

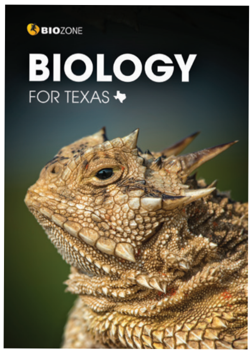


Chapter 7
Common Ancestry
ANCHOR
Dinosaur or Bird?
Models
Using data
Explanations and solutions
Analyze data
Hypotheses and theories
Impact of research
B9.B
Fossil Record Rates of Change
Cambrian explosion
Models of fossil record change
Punctuated equilibrium
Theory of Evolution
Gradualism
Explanations and solutions
Impact of research
Using data
Analyze data
Questions and problems
Using data
Fossil record
Transitional fossils
Fossil formation
Fossils
Anatomical homology
Biogeography
B9.A
Evidence of Common Ancestry
DNA evidence
Protein evidence
Developmental homology
Rock pocket mice NS
Founder effect
Genetic Bottlenecks
Natural selection elements
Galapagos finches NS
Genetic drift
Mutations and gene pool
Directional selection in moths
Inv. 8.1
Modeling NS
B10.B
Elements of Natural Selection
Gene flow
Selection pressure
Recombination and gene pool
Gene pools
Collect data
Variation in populations
Using data
B10.D
Evolutionary Mechanisms
Analyze data
Inv. 8.2
NS in mice
How species form
Convergence
B10.A
Natural Selection in Populations
Limitations of models
Divergence
Species definition
Models
Evolutionary mechanisms
Adaptive radiation
Impact of research
Analyze data
B10.C
Speciation
Impact of research
Plan investigations
Explanations and solutions
Explanations and solutions
Explanations and solutions
Explanations and solutions
Models
ANCHOR
How does an Elephant lose its tusks?
Communicate explanations
Evaluate designs
Models
Communicate explanations
Models
Chapter 8
Evolution and Natural Selection



Making Connections TEMPLATE

Information for Caregivers - **Biology for Texas**



Dear Parents and Caregivers,

Our Biology class will be using BIOZONE's *Biology for Texas* this year. The purpose of this letter is to provide information about where to access guidance resources to reinforce student learning and development at home.

A strong partnership between home and school is a vital component to supporting learning, and adds value to your learners' progress throughout the course. Caregivers are encouraged to support their learners by being informed of the course material, including components available in the **Resource Hub** (see below).

Resources for Caregivers

- A full digital online flipbook copy of the book can be found in the "**Homelink**" section of the BIOZONE **Resource Hub**

www.BIOZONEhub.com

Then enter the code: **TXB1-4054** or scan the QR code.

Also provided in **Homelink** is:

- A downloadable "**User Guide for Caregivers**". This guide will walk you through the key features of the book and associated components of the learning program.
- A link to the Texas Essential Knowledge and Skills (TEKS), the official TEA academic standards for this Biology course.
- A link to the TEA STEM (science, technology, engineering, mathematics) Family Companion Guide (in both English and Spanish) that provides valuable guidance on talking to your teenager about the subject, encouraging engagement, and suggestions for learning outside the classroom.
- Additional useful links include a parent's guide to success in science, keeping teens engaged in science, and encouraging teen girls to pursue science.

Information about the teaching programme

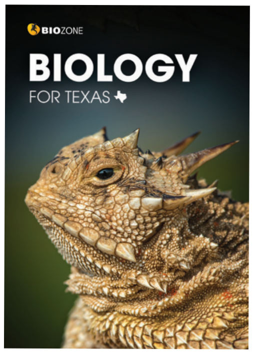
- Further details about the learning program can be found in the "**Teacher Support**" section of the **Resource Hub**. This can be accessed from the tab on the left-hand side of the screen.

Included in the downloadble *Biology for Texas* **Implementation Guide** is the:

- **Scope and Sequence Guide** and **Pacing Guide**, noting that the class will most likely have a modified version to best suit the specific needs of the learners.
- **Lesson Implementation Guide**, that provides extended teaching suggestions corresponding to each activity in the book, including **Homelinks**, "suggestions where links can be made with the student's home and the appropriate lesson in class.

Please feel free to contact the School or Biology classroom teacher if you would like further information about BIOZONE's *Biology for Texas* in addition to that provided above.

Information for Students - **Biology for Texas**



Biology students,

Our Biology class will be using BIOZONE's *Biology for Texas* this year. The purpose of this letter is to provide information about where to access resources to reinforce your learning.

You are encouraged to explore all of the course material, including components available in the **Resource Hub** that you can use to supplement the worktext, such as videos, interactives, and links (see below for how to access). Additionally, your paper copy of the worktext has information on how to best use the program, located at the front in the introductory section.

Digital Copy of the Worktext

If you require access to *Biology for Texas*, but do not have your paper copy, a full digital online flipbook can be found in the "**Homelink**" section of the BIOZONE **Resource Hub**.

www.BIOZONEhub.com

Then enter the code: **TXB1-4054** or scan the QR code.

Additional Resources

Further details about the learning program can be found in the "**Teacher Support**" section of the **Resource Hub**. This can be accessed from the tab on the left-hand side of the screen.

Included in the downloadble *Biology for Texas* **Implementation Guide** is the:

- **Scope and Sequence Guide** and **Pacing Guide**, noting that your class will likely have a modified version, adapted to best suit the specific needs of your school and Biology class.
- **Lesson Implementation guide**, that provides detailed suggestions and information corresponding to each activity in the worktext, including **Homelinks**, "suggestions where links can be made with the student's home and the appropriate lesson in class". This information can be used to assist independent learning or at-home learning, and prompt you to give suggestions to the teacher for further **Homelinks** ideas.
- **Data Analysis guide**, that explains how to download and use the digital **STUDENT: Student Progress Tracker** to record and monitor your progress against the TEKS informed Learning Outcomes as you work through activities. Printable Student Progress Tracker templates available at the back of the Implementation Guide (IG106-117) can be used as a supplement or alternative to the digital program. These tools allow you to understand which areas will need further revision, or may prompt you to explore extension ideas listed in the **Lesson Implementation guide.**
- **Making Connections Templates** can be printed out, and used independently in class, for homework, or revision, to identify connections between the concepts and the TEKS covered in the activities.

Please feel free to contact your Biology classroom teacher if you would like further information about BIOZONE's *Biology for Texas*, in addition to that provided above.

Assessment Rubric - **Biology for Texas**

An exemplar rubric for Activity 216 is provided below. Teachers can use the assessment rubric template for reports, presentations, and investigations. Student responses and grade boundaries expectations are dependent on the specific lived-experience, location, and background of the students in the school and class, so the rubric will be most effective if completed, in collaboration with other Biology teachers, to best reflect their student’s needs. When designing a rubric, it should be possible for a student to receive multiple 'ticks' for Approaching and Proficient, but will count as meeting the highest criteria if having at least 1 'tick'. The details in the activity question in the worktext should guide requirements to reach Mastery level, but extra conditions could be added also.

Student Name:	**Class:**
School:	
Task: White-nose syndrome in Indiana bats presentation (Activity 216)	

Approaching	Proficient	Mastery
A presentation of one or more partial solutions to restore Indiana bat populations	A well crafted presentation of one or more scientific OR engineering solutions to restore Indiana bat populations, using data and references to support your ideas.	A well crafted presentation of one or more scientific AND engineering solutions to restore Indiana bat populations, using data and references to support your ideas, and including considerations of biological factors and human activities

Key Requirements:	Approaching	Proficient	Mastery
Presentation is neat and logically organized			
Presentation uses appropriate graphics and contains mostly error-free grammar			
Presentation provides clear and consise, and error-free, explanations, that is correctly targeted to the audience.			
Background research: Evidence of at least one source			
Background research: Evidence of multiple sources, including sources of data			
Background research: Evidence of multiple sources, including sources of data, that are correctly listed in an appendix			
Conservation plan of solutions: One or more partial solutions, not backed with references of data			
Conservation plan of solutions: One scientific or one engineering solution, with evidence of supporting data and references			
Conservation plan of solutions: One scientific and one engineering solution, with evidence of supporting data and references			
Presentation shows evidence of considering biological factors and human activites in at least one of the solutions			
Ecological stability: Presentation partially links their solution to ecological stability			
Ecological stability: Presentation clearly links their solution to ecological stability			
Ecological stability: Presentation cleary links their solution to ecological stability and informs audience about methods to protect it.			
Grade Comments:	☐ Presentation meets criteria for 3/4 categories above	☐ Presentation meets criteria for 4/5 categories above	☐ Presentation meets criteria for 5/5 categories above
Next Steps:			

Student Name:	**Class:**
School:	
Task:	

Approaching	Proficient	Mastery

Key Requirements:	Approaching	Proficient	Mastery

Grade Comments:	☐ Presentation meets criteria for / categories above	☐ Presentation meets criteria for / categories above	☐ Presentation meets criteria for / categories above

Next Steps:

Lesson Plan Checklist - **Biology for Texas**

Before the start of teaching

- [ ] Read through the Classroom Guide in the Teacher's Edition, understanding the structure of the worktext.
- [ ] Open the Resource Hub and familiarize yourself with the contents. The Resource Hub is accessible on all device operating systems, including chromebooks, tablets, desktops, phones, and laptop devices.
- [ ] Utilize readings in the Teacher Support section of the Resource Hub.
- [ ] Use or modify the Scope and Sequence Guide in the Implementation Guide to plan the years course.
- [ ] Read the Data Analysis Guide, located in the Implementation Guide and/or Resource Hub.
- [ ] Download the TEACHERS: Student Progress Tracker file and populate with student details.
- [ ] Download the STUDENTS: Student Progress Tracker file and place one copy per student into separate folders, that the teacher and individual student have access to.

Prior to the first lesson

- [ ] Print and send / email the Caregivers and Students information letter, located in the Implementation Guide
- [ ] Print the first Student Progress Tracker, in the Implementation Guide, to distribute (if using paper)
- [ ] Print the first Making Connections sheet, in the Implementation Guide, to distribute (if using paper)
- [ ] Ensure students have a QR code scanner app downloaded onto their phones / tablets. QR code readers are compatible on all operating systems including Android and iOS, and can be dowloaded for free from the app stores. Test one or more of the codes in the book to make sure it is correctly working - some schools may restrict phone / tablet use to home.
- [ ] Distribute paper and/or digital Student Edition worktexts, which students then name and read introduction.

For each lesson

- [ ] Complete lesson plan, either from the paper or digital template provided, or a school developed version. Information can be gathered from the Lesson Implementation Plan and activity/s selected.
- [ ] Peruse the relevant activity section in the Resource Hub to select preferred resources to use in the lesson or direct students to. Some resources may need to be downloaded and printed beforehand.
- [ ] Prepare and modify any presentation media to best suit the lesson plan for thge activity/s.
- [ ] Check if the activity is an investigation, then read through the equipment list at the back of the book.
- [ ] Check if the activity includes any group work requiring large sheets of paper and/or pens, to prepare.
- [ ] After lesson completion, ensure students have self-graded their work and checked off in their Student Progress Tracker (digital or paper). This information can be collated from the individual student digital folder or from their paper copies, either after each lesson, or weekly,
- [ ] Use the Reflection section of the Data Analysis Guide to help with data analysis after the lesson.

Lesson Planner - **Biology for Texas**

Grading Cycle:	Date:	Chapter	Activity Number/s	Activity Title/s:

Science Concepts TEKS:	Scientific and Engineering Practices TEKS:

ELPS:

Learning Outcome/s:

Materials / Equipment / Preparation Required for Lesson:

Instructional Practice:

Homelinks:

Prior Knowledge	Scaffolding	Extension

Reflection: