

**Cross-Reference Guide: Biology 20 Alberta Science with Project WILD and Below Zero \***

<b>Unit B: Ecosystems and Population Change</b>	<b>Project Wild*</b>	<b>Below Zero*</b>
<p><b>General Outcome 1</b>  <i>Students will explain that the biosphere is composed of ecosystems, each with distinctive biotic and abiotic characteristics.</i></p>		
<b>Specific Outcomes for Knowledge</b>		
<p><b>20–B1.1k</b>            define species, population, community and ecosystem and explain the interrelationships among them</p>	72 Puddle Wonders! 105 Riparian Retreat 177 The Edge of Home	
<p><b>20–B1.2k</b>            explain how terrestrial and aquatic ecosystems support a diversity of organisms through a variety of habitats and niches; e.g.,</p> <ul style="list-style-type: none"> <li>• terrestrial: canopy, sub-canopy, forest floor, soil</li> <li>• aquatic: littoral, limnetic, profundal and benthic zones</li> </ul>	105 Riparian Retreat 109 Water Canaries 118 Kelp Help 165 Micro Odyssey 168 Wetland Metaphors 172 Marsh Munchers(m) <b>180</b> Blue Ribbon Niche 283 The Glass Menagerie	41 Snow Place Like Home 45 Snow Experiments 55 Fishy Deep Freeze
<p><b>20–B1.3k</b>            identify biotic and abiotic characteristics and explain their influence in an aquatic and a terrestrial ecosystem in the local region; e.g., <i>stream, lake, prairie, boreal forest, vacant lot, sports field</i></p>	165 Micro Odyssey 177 The Edge of Home 180 Blue Ribbon Niche 237 Migration Headache 283 The Glass Menagerie	49 Snowsense 53 Snug Under the Snow 55 Fishy Deep Freeze 151 An Ice Place to Be!
<p><b>20–B1.4k</b>            explain how limiting factors influence organism distribution and range; e.g.,</p> <ul style="list-style-type: none"> <li>• <i>abiotic factors: soil, relative humidity, moisture, ambient temperature, sunlight, nutrients, oxygen</i></li> <li>• <i>biotic factors: competitors, predators and parasites</i></li> </ul>	147 Quick Frozen Critters(m) 153 Muskox Manoeuvres 156 How Many Bears Can Live In This Forest? 180 Blue Ribbon Niche 188 Rainfall and the Forest <b>206</b> Oh Deer! <b>237</b> Migration Headache 283 The Glass Menagerie 289 Shrinking Habitat	55 Fishy Deep Freeze 65 It's A Gasp 69 The Great Escape 97 Snow Lovers or Haters? 131 Snakes and Ladders

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<b>Specific Outcomes for Knowledge</b>		
<b>20–B1.5k</b> explain the fundamental principles of taxonomy and binomial nomenclature, using modes of nutrition at the kingdom level and morphological characteristics at the genus species level.	139 Adaptation Artistry 165 Micro Odyssey 197 Fashion a Fish	

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<b>Specific Outcomes for Science, Technology and Society (STS)</b> (Social and Environmental Contexts Emphasis)		
<b>20-B1.1sts</b> <ul style="list-style-type: none"> <li>• explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3–4.1]</li> <li><i>evaluate the impact that human activity has had, or could have, on the biodiversity in an ecosystem:</i> <ul style="list-style-type: none"> <li>- wetlands management</li> <li>- land use</li> <li>- interbasin water transfer</li> <li>- habitat fragmentation</li> </ul> </li> </ul>	109 Water Canaries 180 Blue Ribbon Niche 184 Hooks and Ladders 237 Migration Headache 245 Where Have All the Salmon Gone? 276 Water We Eating?(e#1). 289 Shrinking Habitat 293 Migration Barriers	65 It's A Gasp 131 Snakes and Ladders 137 Snowmobile Savvy 141 Shocking Snow! 145 The Acid Test

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<p style="text-align: center;"><b>Specific Outcomes for Science, Technology and Society (STS)</b>            (Social and Environmental Contexts Emphasis)</p>		
<p><b>20-B1.1sts</b></p> <ul style="list-style-type: none"> <li>• explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3–4.1] <i>evaluate the impact that human activity has had, or could have, on the biodiversity in an ecosystem:</i> <ul style="list-style-type: none"> <li>- <i>wetlands management</i></li> <li>- <i>land use</i></li> <li>- <i>interbasin water transfer</i></li> <li>- <i>habitat fragmentation</i></li> <li>- <i>urbanization</i></li> <li>- <i>slash-and-burn and clearcutting practices</i></li> </ul> </li> <li>• assess the environmental consequences of the introduction of new species into established ecosystems (such as tropical fish in Banff Hot Springs, starlings, quack grass, scented chamomile, purple loosestrife) and discuss the responsibility of society to protect the environment through science and technology</li> </ul>	<p>295 To Compromise or Not To Compromise            312 To Dam or Not to Dam            322 Deadly Waters            337 Flip the Switch For Wildlife            354 Dragonfly Pond            363 Turtle Hurdles            376 Watershed</p> <p>222 Planting Animals            242 Aquatic Roots</p>	
<p><b>20-B1.2sts</b>            explain how conventions of mathematics, nomenclature and notation provide a basis for organizing and communicating scientific theory, relationships and concepts (NS6b)</p> <ul style="list-style-type: none"> <li>• <i>research the historical development of the modern classification system</i></li> <li>• <i>research plant and animal systems of classification developed by Aboriginal peoples in their cultural practices.</i></li> </ul>		

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<b>Specific Outcomes for Skills</b> (Nature of Science Emphasis)			
<b>Initiating and Planning</b> <b>20–B1.1s</b> formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues; and define and delimit problems to facilitate investigation	<ul style="list-style-type: none"> <li>hypothesize the role of biotic and abiotic factors in ecosystems; <i>e.g.</i>, <i>competition and chinooks</i> (IP–NS3) [ICT C6–4.1]</li> </ul>	28 Habitat Lap Sit 62 Water Plant Art (e#2,3) 92 Eco-Enrichers 105 Riparian Retreat 135 Pond Succession 156 How Many Bears Can Live in This Forest? 165 Micro Odyssey 168 Wetland Metaphors 180 Blue Ribbon Niche 206 Oh Deer! 227 Checks and Balances 230 No Water Off a Duck's Back 283 The Glass Menagerie 299 Deadly Links 319 Deadly Skies 337 Flip the Switch For Wildlife!	41 Snow Place Like Home (var#1)
	<ul style="list-style-type: none"> <li><i>plan a field study to gather and evaluate biotic and abiotic characteristics associated with an ecosystem, such as the effects that dominant plants have on abiotic conditions such as soil and microclimate</i> (IP–NS1, IP–NS2, IP–NS3, IP–NS4).</li> </ul>	105 Riparian Retreat (e#2) 168 Wetland Metaphors e#1 177 The Edge of Home 180 Blue Ribbon Niche 322 Deadly Waters	41 Snow Place Like Home 49 Snowsense 53 Snug Under the Snow 99 Snow Floats 103 Winter Wonders

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<b>Specific Outcomes for Skills</b> (Nature of Science Emphasis)			
<b>Performing and Recording</b> <b>20–B1.2s</b> conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	<ul style="list-style-type: none"> <li>perform a field study to measure, quantitatively, appropriate abiotic characteristics of an ecosystem and to gather, both quantitatively and qualitatively, evidence for analysis of the diversity of life in the ecosystem studied (PR–NS3, PR–NS4, PR–NS5) [ICT F2–4.1]</li> </ul>	72 Puddle Wonders! 109 Water Canaries 188 Rainfall and the Forest 245 Where Have All the Salmon Gone? 283 The Glass Menagerie 319 Deadly Skies 322 Deadly Waters	41 Snow Place Like Home 49 Snowsense 53 Snug Under the Snow 99 Snow Floats 103 Winter Wonders 141 Shocking Snow!
	<ul style="list-style-type: none"> <li>research and develop a land reclamation strategy for a disturbed area, as a solution to environmental damage; e.g., <i>open-pit mine, garbage dump, school yard reclamation</i> (PR–SEC1, PR–NS1, PR–NS4) [ICT C1–4.1].</li> </ul>	345 Can Do! 348 Improving Wildlife Habitat in the Community	137 Snowmobile Savvy(m)
<b>Analyzing and Interpreting</b> <b>20–B1.3s</b> analyze data and apply mathematical and conceptual models to develop and assess possible solutions	<ul style="list-style-type: none"> <li>apply classification and binomial nomenclature systems in a field study (AI–NS1)</li> </ul>	109 Water Canaries 165 Micro Odyssey 180 Blue Ribbon Niche 245 Where Have All the Salmon Gone? 283 The Glass Menagerie	
	<ul style="list-style-type: none"> <li>analyze the interrelationship of biotic and abiotic characteristics that make up the ecosystem studied (AI–NS2, AI–NS3, AI–NS6)</li> </ul>	72 Puddle Wonders! 109 Water Canaries 188 Rainfall and the Forest	41 Snow Place Like Home 45 Snow Experiments 49 Snowsense 53 Snug Under the Snow
<b>Analyzing and Interpreting</b>			

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<b>20–B1.3s</b> analyze data and apply mathematical and conceptual models to develop and assess possible solutions	<ul style="list-style-type: none"> <li>analyze the interrelationship of biotic and abiotic characteristics that make up the ecosystem studied (AI–NS2, AI–NS3, AI–NS6)</li> </ul>	245 Where Have All the Salmon Gone? 283 The Glass Menagerie 319 Deadly Skies 322 Deadly Waters	65 It's A Gasp 99 Snow Floats 103 Winter Wonders 141 Shocking Snow! 145 The Acid Test
	<ul style="list-style-type: none"> <li>evaluate the accuracy and reliability of instruments used for measurement and identify the degree of error in the field-study data (AI–NS4)</li> </ul>		
	<ul style="list-style-type: none"> <li><i>compile and organize evidence from a variety of sources, for or against human activity being responsible for ecosystem change, and analyze the relationship between human activity and changing ecosystems (AI–NS2, AI–NS6, AI–SEC2) [ICT C2–4.1, C7–4.2].</i></li> </ul>	168 Wetland Metaphors 180 Blue Ribbon Niche 184 Hooks and Ladders 211 The Hunter 216 Here Today, Gone tomorrow 227 Checks and Balances 230 No Water Off a Ducks Back 237 Migration Headache 245 Where Have All the Salmon Gone? 293 Migration Barriers 299 Deadly Links 312 To Dam or Not to Dam(e#2,3) 316 Facts and Falsehoods 319 Deadly Skies 322 Deadly Waters	65 It's A Gasp 141 Shocking Snow! 145 The Acid Test 131 Snakes and Ladders 137 Snowmobile Savvy

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<b>Communication and Teamwork 20–B1.4s</b> work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	<ul style="list-style-type: none"> <li>• <i>work cooperatively to gather and share data on a field trip (CT–NS1, CT–NS2)</i></li> </ul>	72 Puddle Wonders! 105 Riparian Retreat (e#2) 109 Water Canaries 168 Wetland Metaphors (e#1) 177 the Edge of Home 180 Blue Ribbon Niche 188 Rainfall and the Forest 245 Where Have All the Salmon Gone? 283 The Glass Menagerie 319 Deadly Skies 322 Deadly Waters	41 Snow Place Like Home 49 Snowsense 53 Snug Under the Snow 99 Snow Floats 103 Winter Wonders 141 Shocking Snow!
	<ul style="list-style-type: none"> <li>• <i>work cooperatively to make clear and logical arguments to defend a decision on a given issue, such as human impact on ecosystems, land reclamation or wildlife habitat preservation (CT–SEC1, CT–SEC2, CT–SEC3) [ICT C1–4.4]</i></li> </ul>	227 Checks and Balances 289 Shrinking Habitat <b>303</b> Keeping Score <b>306</b> Planning For People and Wildlife 337 Flip the Switch for Wildlife <b>345</b> Can Do!	147 Kindness that Kills! 137 Snowmobile Savvy

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	<ul style="list-style-type: none"> <li><i>develop, present and defend a strategy to improve wildlife habitats (CT–SEC3) [ICT C1–4.4].</i></li> </ul>	227 Checks and Balances 289 Shrinking Habitat <b>303</b> Keeping Score <b>306</b> Planning for People and Wildlife 337 Flip the Switch for Wildlife <b>345</b> Can Do! <b>348</b> Improving Wildlife Habitat in the Community	137 Snowmobile Savvy 147 Kindness that Kills! (e, eval)

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<b>Specific Outcomes for Knowledge</b>		
<p><b>20–B2.1k</b>            explain that variability in a species results from heritable mutations and that some mutations may have a selective advantage</p>	137 The Thicket Game(m) 139 Adaptation Artistry 142 Seeing is Believing or The Eyes Have It! (m) 197 Fashion a Fish	99 Snow Floats 103 Winter Wonders
<p><b>20–B2.2k</b>            discuss the significance of sexual reproduction to individual variation in populations and to the process of evolution</p>		
<p><b>20–B2.3k</b>            compare Lamarckian and Darwinian explanations of evolutionary change</p>		
<p><b>20–B2.4k</b>            summarize and describe lines of evidence to support the evolution of modern species from ancestral forms; i.e., the fossil record, Earth's history, biogeography, homologous and analogous structures, embryology, biochemistry</p>		
<p><b>20–B2.5k</b>            explain speciation and the conditions required for this process</p>		
<p><b>20–B2.6k</b>            describe modern evolutionary theories; i.e., punctuated equilibrium, gradualism.</p>		

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<p><b>Specific Outcomes for Science, Technology and Society (STS)</b>            (Nature of Science Emphasis)</p>		
<p><b>20-B2.1sts</b>            explain that scientific knowledge and theories develop through hypotheses, the collection of evidence, investigation and the ability to provide explanations (NS2)</p> <ul style="list-style-type: none"> <li>• <i>discuss the nature of science as a way of knowing (contributions of Buffon, Lyell, Malthus and Wallace to evolution and contributions of Aristotle, Galileo and Popper to the philosophy of science)</i></li> <li>• <i>describe how paleontology and the role of evidence in the accumulation of knowledge have provided invaluable data for theories explaining observable variations in organisms over time (Burgess Shale)</i></li> <li>• <i>discuss geologic evidence and probable causes for past mass extinctions and contrast these to the forces driving the current decline in species.</i></li> </ul>		

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<b>Specific Outcomes for Skills</b> (Nature of Science Emphasis)			
<b>Initiating and Planning</b> <b>20–B2.1s</b> formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	<ul style="list-style-type: none"> <li>design an investigation to measure or describe an inherited variation in a plant or an animal population (IP–NS1, IP–NS2, IP–NS3, IP–NS4)</li> </ul>		
	<ul style="list-style-type: none"> <li>hypothesize the adaptive significance of the variations in a range of homologous structures in extant and extinct organisms (IP–NS3).</li> </ul>	139 Adaptation Artistry 142 Seeing is Believing or The Eyes Have It! 197 Fashion a Fish	
<b>Performing and Recording</b> <b>20–B2.2s</b> conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	<ul style="list-style-type: none"> <li><i>gather data, actual or simulated, on organisms to demonstrate how inherited characteristics change over time, as illustrated by Darwin’s finches, peppered moths, bacteria and domesticated plants and animals (PR–NS1, PR–NS4).</i></li> </ul>		
<b>Analyzing and Interpreting</b> <b>20–B2.3s</b> analyze data and apply mathematical and conceptual models to develop and assess possible solutions	<ul style="list-style-type: none"> <li>analyze data, actual or simulated, on plants and animals to demonstrate how morphology changes over time; <i>e.g., Darwin’s finches, peppered moths, bacteria, domesticated plants or animals (AI–NS2) [ICT C6–4.2, C7–4.2]</i></li> </ul>		

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<b>Analyzing and Interpreting</b> <b>20–B2.3s</b> analyze data and apply mathematical and conceptual models to develop and assess possible solutions	<ul style="list-style-type: none"> <li>analyze DNA sequences from online or other sources to infer the relationship between different organisms at various classification levels (AI–NS2) [ICT C1–4.1]</li> </ul>		
	<ul style="list-style-type: none"> <li>state a conclusion or generalization based on research data, suggesting how it supports or refutes an explanation for biological change, and identify new questions or problems that arise from what was learned (AI–NS5, AI–NS6) [ICT C7–4.2].</li> </ul>		
<b>Communication and Teamwork</b> <b>20–B2.4s</b> work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	<ul style="list-style-type: none"> <li>use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results (CT–NS2).</li> </ul>		

**\* End Notes** (for all tables)

**bold** - very strong correlation of activity with outcome/expectation

m - minor modification required for SLE

# - relevant step in activity procedure

e - include extension activity

aq - aquatic extension

eval - evaluation section of activity

var - variation section of activity

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