Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 1** *Students will* describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time.	**Project Wild***	**Below Zero***
Specific Outcomes for Knowledge		
30–D1.1k describe the Hardy-Weinberg principle and explain its significance in population gene-pool stability and nonequilibrium values		
30–D1.2k describe the factors that cause the diversity in the gene pool to change; i.e., natural selection, genetic drift, gene flow, nonrandom mating, bottleneck effect, founder effect, migration, mutation		
30–D1.3k apply, quantitatively, the Hardy-Weinberg principle to observed and published data to determine allele and genotype frequencies, using the equations p + q = 1 and p2 + 2pq + q2 = 1		
30–D1.4k describe the molecular basis of gene-pool change and the significance of these changes over time; i.e., mutations and natural selection *(e.g., drug-resistant bacteria, herbicide- resistant plants).*		

* See end notes for abbreviations

Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 1** *Students will* describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time. **Specific Outcomes for Science, Technology and Society (STS)** (Social and Environmental Contexts Emphasis)		**Project Wild***	**Below Zero***
30-D1.1sts explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3–4.1]	• *discuss the introduction of exotic species into new ecosystems*	220 Who Lives Here? 222 Planting Animals 242 Aquatic Roots	
	• *discuss the development of ecological reserves to preserve gene-pool diversity*		
	• *assess the bottleneck effect characteristic of small populations, such as in whooping crane and swift fox populations, and suggest strategies to counteract it*		
	• *investigate the role of gene banks in the preservation of endangered species and genotypes, particularly of plants and animals used in agriculture*		

* See end notes for abbreviations

	• *assess habitat loss and the responsibility of society to protect the environment for future generations*	98 Environmental Barometer 145 Polar Bears In Winnipeg? 150 Classroom Carrying Capacity 216 Here Today, Gone Tomorrow 222 Planting Animals 227 Checks and Balances 289 Shrinking Habitat 295 To Compromise or Not To Compromise 337 Flip the Switch for Wildlife!	131 Snakes and Ladders 137 Snowmobile Savvy 141 Shocking Snow! 151 An Ice Place to Be! 155 Mighty Migrators (m)
30-D1.2sts explain how concepts, models and theories are often used in interpreting and explaining observations and in predicting future observations (NS6a)	• *assess the role and importance of models in ecology, such as the Hardy-Weinberg principle, in explaining scientific phenomena such as changes in gene frequencies.*		

Unit D: Population and Community Dynamics **General Outcome 1** *Students will* describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
Initiating and Planning **30–D1.1s** formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• *identify a question about the resistance of bacteria to specific antibiotics or about the resistance of plants to specific herbicides* (IP–NS1).		

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 1** *Students will* describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
Performing and Recording 30–D1.2s 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	• design and perform an investigation and/or a computer simulation to demonstrate population growth and gene-pool change (IP–NS2, IP–NS3, IP–NS4, PR–NS3, PR–NS4, PR–NS5) [ICT C6–4.4, F1–4.2]		
	• *research, integrate and synthesize information on a related topic, such as:* − *the development and persistence of deleterious genes in gene pools* − *the development of bacterial resistance to antibiotics* (PR–NS1) [ICT C7–4.2].		
Analyzing and Interpreting 30–D1.3s analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• calculate and interpret results based on the Hardy-Weinberg principle in problem-solving exercises (AI–NS6) [ICT C6–4.1].		
Communication and Teamwork 30–D1.4s work collaboratively in addressing problems and apply the skills and	• use appropriate notation and significant digits to show gene frequency and changes in gene frequency over time (CT–NS2).		

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 1** *Students will* describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
conventions of science in communicating information and ideas and in assessing results			

* See end notes for abbreviations

Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 2** *Students will* explain the interaction of individuals in a population with one another and with members of other populations. **Specific Outcomes for Knowledge**	**Project Wild***	**Below Zero***
30–D2.1k describe the basis of species interactions and symbiotic relationships and describe the influence of these interactions on population changes; i.e., • predator-prey and producer-consumer relationships • symbiotic relationships: commensalism, mutualism and parasitism • interspecific and intraspecific competition	131 Good Buddies 147 Quick Frozen Critters 153 Muskox Manoeuvres 165 Micro Odyssey 172 Marsh Munchers 180 Blue Ribbon Niche 211 The Hunter 289 Shrinking Habitat	55 Fishy Deep Freeze 69 The Great Escape 73 Whine and Dine 77 Moose Morsels 107 Winter Buddies 131 Snakes and Ladders 147 Kindness that Kills!
30–D2.2k explain the role of defence mechanisms in predation and competition; *e.g., mimicry, protective coloration, toxins, behaviour*	137 The Thicket Game 147 Quick Frozen Critters 153 Muskox Manoeuvres	81 Snow Way to Hide
30–D2.3k explain how mixtures of populations that define communities may change over time or remain as a climax community; i.e., primary succession, secondary succession.	133 Forest in a Jar 135 Pond Succession 180 Blue Ribbon Niche 206 Oh Deer! 227 Checks and Balances 262 Watered Down History (m) 283 The Glass Menagerie 289 Shrinking Habitat (m)	

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 2** *Students will* explain the interaction of individuals in a population with one another and with members of other populations. **Specific Outcomes for Science, Technology and Society (STS)** (Social and Environmental Contexts Emphasis)		**Project Wild***	**Below Zero***
30-D2.1sts explain why Canadian society supports scientific research and technological development to facilitate a sustainable society, economy and environment (SEC4a) [ICT F2–4.2, F2–4.8]	• *discuss public support for scientific work done on predator-prey relationships as part of wildlife management in national and provincial parks, such as the introduction of wolves*	222 Planting Animals 227 Checks and Balances	69 The Great Escape (m)
	• *identify examples of wildlife management techniques used by Aboriginal peoples*		
	• *assess the long-term implications of fire control and prevention on population and ecosystem stability, diversity and productivity*	224 Smokey the Bear Said What? (m)	
	• *assess the impact of parasites on populations and how this impact could be reduced, considering examples such as liver flukes in elk and lungworms in bighorn sheep.*		

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 2** *Students will* explain the interaction of individuals in a population with one another and with members of other populations. **Specific Outcomes for Skills** (Social and Environmental Contexts Emphasis)		**Project Wild***	**Below Zero***
Initiating and Planning **30–D2.1s** formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• *plan an investigation of species interaction in a national park or wilderness area* (IP–NS2, IP–NS3).		69 The Great Escape
Performing and Recording **30–D2.2s** 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	• design and perform an experiment or a simulation to demonstrate interspecific and intraspecific competition (IP–NS2, IP–NS3, IP–NS4, PR–NS3, PR–NS4, PR–NS5)	156 How Many Bears Can Live in This Forest? 206 Oh Deer! 289 Shrinking Habitat	55 Fishy Deep Freeze 69 The Great Escape 107 Winter Buddies
	• design and perform an experiment to demonstrate succession in a micro-environment and record the pattern of succession over time; *e.g., hay infusion* (IP–NS2, IP–NS3, IP–NS4, PR–NS3, PR–NS4, PR–NS5)	133 Forest in a Jar (m) 135 Pond Succession(m)	
	• perform simulations to investigate relationships between predators and their prey; *e.g., computer simulation, role-playing* (PR–NS2, PR–NS3, PR–NS4).	137 The Thicket Game 147 Quick Frozen Critters 153 Muskox Manoeuvres 172 Marsh Munchers 299 Deadly Links	69 The Great Escape 73 Whine and Dine

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 2** *Students will* explain the interaction of individuals in a population with one another and with members of other populations. **Specific Outcomes for Skills** (Social and Environmental Contexts Emphasis)		**Project Wild***	**Below Zero***
Analyzing and Interpreting 30–D2.3s analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• summarize and evaluate a symbiotic relationship (PR–NS1, AI–NS6)		129 What Gall!
	• *research and analyze the effects of clearcutting versus selective logging practices on ecosystems* (PR–SEC1, AI–SEC2).		
Communication and Teamwork 30–D2.4s work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• *research and present practical solutions for reducing the impact of highway fencing on animals in Banff and Jasper National Parks* (CT–SEC1, CT–SEC2) [ICT C1–4.4]	293 Migration Barriers 348 Improving Wildlife Habitat in the Community	
	• *develop, present and defend a position on whether organisms should be deliberately introduced into new environments* (CT–SEC1, CT–SEC2) [ICT C1–4.4, C7–4.2]	222 Planting Animals 242 Aquatic Roots	
	• *research and present characteristics of interrelationships between organisms for analysis by classmates* (CT–SEC1, CT–SEC2) [ICT C1–4.4, C7–4.2].		

* See end notes for abbreviations

Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time. **Specific Outcomes for Knowledge**	**Project Wild***	**Below Zero***
30–D3.1k describe and explain, quantitatively, factors that influence population growth; i.e., • mortality, natality, immigration, emigration • change in population size, Δ*N* = [natality + immigration] – [mortality + emigration]		
30–D3.2k *describe the growth of populations in terms of the mathematical relationship among carrying capacity, biotic potential, environmental resistance and the number of individuals in the population; i.e.,* • growth rate, *gr*=Δ*Nt*, where Δ*n* is the change in number of individuals in a population and Δ*t* is change in time • per capita growth rate, *cgr* = $\frac{\Delta N}{}$, where Δ*N* is the change in number of individuals in *N* a population relative to *N*, the original number of individuals • population density, *D*p = $\frac{N}{A}$, or *D*p = $\frac{V}{N}$, where *N* is the number of individuals in a given space, *A* is the area, and *V* is the volume		
30–D3.3k explain the different population growth patterns; i.e., • logistic growth pattern (S-shaped curve) and exponential growth pattern (J-shaped curve) • open and closed populations	206 Oh Deer!	
30–D3.4k describe the characteristics and reproductive strategies of *r*-selected and *K*-selected organisms		

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time. **Specific Outcomes for Science, Technology and Society (STS)** (Nature of Science Emphasis)		**Project Wild***	**Below Zero***
30-D3.1sts explain how concepts, models and theories are often used in interpreting and explaining observations and in predicting future observations (NS6a)	• *develop appropriate investigative strategies, such as a risk-benefit analysis or cost-benefit analysis, for analyzing biological issues*		
	• *compare the growth of the human population with that of populations of other species.*		

Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time. **Specific Outcomes for Skills** (Nature of Science Emphasis)		**Project Wild***	**Below Zero***
Initiating and Planning **30–D3.1s** formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• *identify questions about factors that affect population growth rates* (IP–NS1).	28 Habitat Lap Sit 46 What's for Dinner? 57 Water Wings 133 Forest in a Jar 135 Pond Succession 147 Quick Frozen Critters (var1) 150 Classroom Carrying Capacity	55 Fishy Deep Freeze (m) 65 It's a Gasp 69 The Great Escape (var2) 73 Whine and Dine 141 Shocking Snow! 145 The Acid Test 159 Dinner Time

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
Initiating and Planning **30–D3.1s** formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• *identify questions about factors that affect population growth rates* (IP–NS1).	153 Muskox Manoeuvres 156 How Many Bears Can Live In This Forest? 184 Hooks and Ladders 188 Rainfall and the Forest 206 Oh Deer! 227 Checks and Balances 230 No Water Off a Duck's Back 232 Net Gain, Net Effect (m e#3,8) 237 Migration Headache 245 Where Have All the Salmon Gone? 289 Shrinking Habitat 299 Deadly Links 312 To Dam or Not To Dam 363 Turtle Hurdles	

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Cross-Reference Guide: Biology 30 Alberta Science with Project WILD and Below Zero *

Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
Performing and Recording 30–D3.2s 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	• design and perform an experiment or a computer simulation to demonstrate the effect of environmental factors on population growth rate (IP–NS2, IP–NS3, IP–NS4, PR–NS3, PR–NS4) [ICT C6–4.4, F1–4.2]	28 Habitat Lap Sit 133 Forest in a Jar 135 Pond Succession 156 How Many Bears Can Live in This Forest? 188 Rainfall and the Forest 206 Oh Deer! 227 Checks and Balances 232 Net Gain, Net Effect (m) 237 Migration Headache 299 Deadly Links (aq#2) 312 To Dam or Not To Dam (m) **319** Deadly Skies	65 It's a Gasp 145 The Acid Teat 151 An Ice Place to Be! (e#2)
	• *monitor a paramecium population over time, using a microscope and a grid slide* (PR–NS2, PR–NS3, PR–NS4, PR–NS5)		
	• *research zebra mussel population growth in the Great Lakes* (PR–NS1, PR–NS4)		
	•*research the impact of introduced trout species on populations of native bull trout (Salvelinus confluentus) in Alberta's lakes and streams* (PR–NS1).		

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Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
Analyzing and Interpreting 30–D3.3s analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• graph and interpret population growth of *r*-selected and *K*-selected organisms (AI–NS2) [ICT C7–4.2]		
	• calculate and interpret change in population size, growth rate, per capita growth rate and population density (AI–NS2, AI–NS3, AI–NS4)	206 Oh Deer!	
	• *compare and evaluate human population growth rates in various countries* (AI–NS2) [ICT C7–4.2]		
	• *demonstrate and assess the effect of environmental factors (biotic potential and environmental resistance) on population growth curves* (AI–NS2, AI–NS6)	156 How Many Bears Can Live in This Forest? 188 Rainfall and the Forest 206 Oh Deer! 237 Migration Headache 245 Where Have All the Salmon Gone? 319 Deadly Skies	65 It's a Gasp
	• *calculate population growth rate under ideal conditions, given specific parameters* (AI–NS3, AI–NS4)		
	• *state a generalization based on data for the growth of a closed population* (AI–NS2, AI–NS6)		

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Unit D: Population and Community Dynamics **General Outcome 3** *Students will* explain, in quantitative terms, the change in populations over time.		**Project Wild***	**Below Zero***
Specific Outcomes for Skills (Nature of Science Emphasis)			
	• *explain limitations in identifying changes in populations and explain how traditional knowledge can contribute to knowledge about changes* (AI–NS4).	**206 Oh Deer!**	
Communication and Teamwork 30–D3.4s work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• *develop, present and defend a position on Earth's carrying capacity of Homo sapiens* (CT–SEC1, CT–SEC2, CT–SEC3) [ICT C1–4.4, C7–4.2].		

*** 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

* See end notes for abbreviations