BC Science 10 Workbook Answers

Unit 1: Sustaining Earth's Ecosystems

Chapter 1 Biomes and ecosystems are divisions of the biosphere.

Section 1.1 Biomes

Cloze Activity

Biomes and ecosystems

Page 4

1. biotic
2. abiotic
3. biome
4. terrestrial
5. temperature; precipitation
6. latitude
7. elevation
8. ocean currents
9. climatograph
10. adaptations
11. structural; physiological; behavioural

Applying Knowledge

Various biomes

Page 5

BIOME	LOCATION(S)	PHYSICAL FEATURES
tundra	upper northern hemisphere	• layer of permanently frozen soil (permafrost) • flat terrain cold and dark most of year
boreal forest	northern hemisphere	• short summer growing season • many marshes, shallow lakes, and wetlands soil is very wet
temperate deciduous forest	eastern Canada, eastern United States, eastern Asia, and western Europe	• large seasonal changes • four distinct seasons • long warm growing season • enriched soil
temperate rainforest	coast of Chile, northwest coast of North America, New Zealand, southern Australia	• narrow strips along coastlines backed by mountains • ocean winds • large amounts of moisture on windward side of mountains
Grassland (temperate and tropical)	temperate: centre of North America (prairies) and in Russia (steppes) tropical: north and south of equator in Africa, South America, northern Australia	• flat land • strong winds • temperate: rich, fertile soil • tropical: heavy rain • precipitation followed by dry period
tropical rainforest	around the equator: northern South America, Central America, central Africa, and southeast Asia	• poor soil • heavy rain • limited plant growth on forest floor due to canopy

desert (hot and cold)	every continent	• hot desert:
		  • very little rainfall or a lot in very short time period
		  • salty soil
		• cold desert:
		  • snow and spring rain
		  • salty soil, little erosion

permanent ice (polar ice)	polar land masses and ice caps of Arctic, Greenland, and Antarctica	• strong winds • little soil • limited fresh water • very cold year round

Interpreting Illustrations

Climatographs

Page 6

A. permanent ice
B. boreal forest
C. temperate rainforest
D. grassland
E. desert (hot)
F. tropical rainforest

Assessment

Biomes

Page 7

1. C **2.** B **3.** E **4.** D **5.** F **6.** A **7.** D **8.** B **9.** C **10.** A **11.** B **12.** C

Section 1.2 Ecosystems

Comprehension

Parts of an ecosystem
Page 10

1. An ecosystem has abiotic components that interact with biotic components, while a habitat is the place in which an organism lives.
2. Three main abiotic components of ecosystems are (any three of) oxygen, water, nutrients, light, and soil.
3. A population refers to all the members of a particular species within an ecosystem, while a community is all the populations of different species within an ecosystem.
4. Symbiosis is the interaction between members of two different species that live together in a close association.
5. Commensalism is a symbiotic relationship in which one species benefits and the other species is not helped or harmed.
6. Mutualism is a symbiotic relationship in which both organisms benefit, while parasitism is a symbiotic relationship in which one species benefits and the other is harmed.
7. Predation is where one organism eats all or part of another organism.

Interpreting illustrations

Biotic interactions in ecosystems
Page 11

1. I. organism
   II. ecosystem
   III. population
   IV. community
   V. biosphere
2. Largest Biosphere
   Ecosystem
   Community
   Population
   Smallest Organism
3. Lists will vary but should include a variety of plants and animals.

Applying Knowledge

Symbiotic relationships
Page 12

1. Term: Mutualism
   Explanation: Both organisms benefit. The ant gets its food and shelter while the plant is protected from insects.
2. Term: Competition
   Explanation: Harmful interaction between two or more organisms as they compete for the same resource. The knapweed prevents other species from populating the soil by releasing a chemical.
3. Term: Predation
   Explanation: One organism (predator) eats all or part of another organism (the prey). The lynx is the predator and the snowshoe hare is the prey.
4. Term: Commensalism
   Explanation: One species benefits and the other species is not helped or harmed.
   The Spanish moss captures nutrients and moisture from the air with no harmful effects on the trees.
5. Term: Parasitism
   Explanation: One species benefits and another is harmed. The pine beetle has its food source and the pine tree is destroyed.

Assessment

Ecosystems
Page 13

1. D **2.** E **3.** B **4.** F **5.** A **6.** C **7.** G **8.** B **9.** D **10.** C

Chapter 2 Energy flow and nutrient cycles support life in ecosystems.

Section 2.1 Energy Flow in Ecosystems

Cloze activity

Energy flow
Page 16

1. biomass
2. energy flow
3. photosynthesis
4. consumer
5. decomposition
6. biodegradation
7. decomposers
8. food chains; trophic
9. primary producers
10. primary consumers; secondary consumers
11. tertiary consumers
12. food webs; food pyramids

Interpreting Illustrations

Food chains, food webs, and food pyramids
Page 17

1. bunchgrass, algae

2. third trophic level
3. secondary consumers
4. primary consumer
5. secondary or tertiary consumer
6. earthworms, beetles, small insects, bacteria, fungi
7. a model that shows the loss of energy from one trophic level to another
8. producers, such as plants
9. carnivores, such as great horned owls

Illustrating Concepts

Modelling a local ecosystem
Page 19

1. Student should include 12 organisms and cover all four trophic levels.
2. Food chain: student should include four trophic levels: primary producers, primary consumers, secondary consumers, and tertiary consumers.
3. Food web: student should include interconnecting arrows between various organisms to demonstrate the feeding relationships.
4. Food pyramid: student should show a series of boxes decreasing in size from bottom to top. The pyramid should include producers, herbivores, carnivores, and top carnivores.

Assessment

Energy flow in ecosystems
Page 20

1. C **2.** F **3.** H **4.** A **5.** E **6.** G **7.** B **8.** D **9.** D **10.** A **11.** B **12.** C **13.** D **14.** D

Section 2.2 Nutrient Cycles in Ecosystems

Comprehension

Nutrient cycles
Page 24

1. Nutrients are stored in Earth's atmosphere, oceans, and land masses.
2. Biotic processes, such as decomposition, and abiotic processes, such as river run-off, can cause nutrients to flow in and out of stores.
3. Photosynthesis converts solar energy into chemical energy. Carbon, in the form of carbon dioxide, enters through the leaves of plants and, in the presence of sunlight, reacts with water to produce carbohydrates and oxygen.
4. Cellular respiration involves carbohydrates reacting with oxygen to form carbon dioxide, water, and energy.
5. Decomposers, such as bacteria and fungi, convert organic molecules, such as cellulose, back into carbon dioxide, which is then released into the atmosphere.
6. Nitrogen fixation is the process in which nitrogen gas is converted into compounds that contain nitrate or ammonium.
7. Denitrification is a process by which denitrifying bacteria, using a series of chemical reactions, convert nitrate back into nitrogen gas.
8. Eutrophication is the process by which excess nutrients result in increased plant production and decay in aquatic ecosystems.

Interpreting Illustrations

The cycling of nutrients in the biosphere
Page 25

1. Human activities that can affect a nutrient cycle could include land clearing, agriculture, urban expansion, mining, industry, and motorized transportation.
2. These human activities increase the amounts of nutrients in a cycle faster than natural biotic and abiotic processes can move them back into stores.
3. Terms and arrows could be similar to Fig 2.17 on page 70. Students may also add other facts or effects that they have thought of.
4. Changes in the carbon, nitrogen, and phosphorus cycles can affect the health and variety of organisms that live in an ecosystem.
5. Answers will vary but they should include a human activity, a description of the activity, and its impact on a specific part of the local ecosystem.

Applying Knowledge

The carbon, nitrogen, and phosphorus cycles
Page 26

The carbon cycle

Why is the carbon cycle important?	cellular respiration provides energy for living things
How is carbon stored?	short term: vegetation, land and marine animals, decaying organic material, carbon dioxide in its dissolved form long term: dissolved carbon dioxide in deeper ocean waters; coal, oil, and gas deposits; marine sediments and sedimentary rock
How is carbon cycled?	photosynthesis, respiration, decomposition, ocean processes, volcanic eruptions, forest fires

Name several human activities that affect the carbon cycle.	industry, motorized transport, land clearing, agriculture, urban expansion

The nitrogen cycle

Why is the nitrogen cycle important?	component of DNA, proteins, muscle function in animals; growth of plants
How is nitrogen stored?	nitrogen gas in atmosphere, oceans, organic matter in soil
How is nitrogen cycled?	nitrogen fixation, nitrification, uptake, denitrification
Name several human activities that affect the nitrogen cycle.	fossil fuel combustion, power plants, sewage treatment, motorized forms of transport, clearing forests, grassland burning, chemical fertilizers leading to eutrophication

The phosphorus cycle

Why is the phosphorus cycle important?	carries energy to plant cells and animal cells; root development in plants; bone development
How is phosphorus stored?	phosphate rock; ocean floor sediments as PO_4^{-3}, HPO_4^{-2}, $H_2PO_4^{-}$
How is phosphorus cycled?	chemical weathering, physical weathering
Name several human activities that affect the phosphorus cycle.	commercial fertilization and detergents negatively affect species, causing fish death

Assessment

Nutrient cycles in ecosystems

Page 29

1. F **2.** A **3.** E **4.** B **5.** D **6.** G **7.** C **8.** B **9.** A **10.** D **11.** C **12.** B

Section 2.3 Effects of Bioaccumulation on Ecosystems

Cloze activity

Bioaccumulation

Page 33

1. bioaccumulation
2. keystone species
3. biomagnification
4. producers
5. PCBs
6. half-life
7. persistent organic pollutants
8. parts per million
9. heavy metals
10. lead; cadmium; mercury
11. bioremediation

Applying Knowledge

Impact of bioaccumulation on consumers

Page 34

CHEMICAL	EFFECTS ON PRODUCERS, PRIMARY CONSUMERS, AND SECONDARY CONSUMERS	EFFECTS ON HUMANS
toxic organic chemicals from red tide	Produces toxic chemicals that affect clams, mussels, and oysters. Toxins bioaccumulate in fish and mammals.	Can cause paralytic shellfish poisoning, leading to serious illness or death.
DDT	Bioaccumulates in plants and then in fatty tissue of fish, birds, and animals that eat the plants. Affects aquatic food chains.	Changed into a chemical form that is stored in fat tissue. Can cause nervous system, immune system, and reproductive disorders.
lead	In fish and birds it can cause nervous system damage, affect fertility rates, kidney failure, and impair mental development.	Harmful effects range from anemia, nervous system damage, sterility in men, low fertility rates in women, impaired mental development, and kidney failure.
cadmium	Plants take up cadmium from the soil and pass it on to the animals that eat them. Highly toxic to earthworms and other soil organisms. In fish, cadmium contributes to higher death rates, and lower reproduction and growth rates.	Accumulates in lung tissues, causing lung diseases, such as cancer. Leads to infertility and damage to central nervous system, immune system, and DNA.
mercury	Bacteria change mercury into methylmercury, a toxin that accumulates in the brain, heart, and kidneys of vertebrates. Levels of methylmercury in fish depend on how high they are on the food chain.	Methylmercury is absorbed in digestion and enters the blood and then the brain. It affects nerve cells, heart, kidney, lungs, and it suppresses the immune system.

Comprehension

PCBs and the orca

Page 36

1. PCBs are synthetic chemicals. Their full chemical name is polychlorinated biphenyl.
2. PCBs were used for industrial products, such as heat exchange fluids, paints, plastics, and lubricants for electrical transformers.
3. PCBs stay in the environment for a long time. Aquatic ecosystems and species that feed on aquatic organisms are especially sensitive to the effects of PCBs. PCBs bioaccumulate and biomagnify and also have a long half-life.
4. PCBs become concentrated in the orca's blubber.
5. When salmon stocks are low, the orca's blubber is burned for energy. The PCBs are released into the orca's bloodstream and interfere with its immune system making it more susceptible to disease.
6. Diagram should be similar to Fig. 2.55 on page 95 of the student textbook. The pyramid should include the food chain for orcas and demonstrate the total PCB load that the orca is exposed to.

Assessment

Effects of bioaccumulation on ecosystems

Page 37

1. F **2.** D **3.** E **4.** B **5.** C **6.** A **7.** C **8.** D **9.** B **10.** C **11.** A **12.** D

Chapter 3 Ecosystems continually change over time.

Section 3.1 How Changes Occur Naturally in Ecosystems

Cloze Activity

Change in ecosystems

Page 40

1. natural selection
2. adaptive radiation
3. ecological succession
4. primary succession
5. pioneer species
6. climax community
7. secondary succession
8. flooding
9. tsunami
10. drought
11. insect infestations

Analyzing Information

Primary and secondary succession

Page 41

1. Answer should include the following sequence:
   - Lichens begin to grow. This begins the process of soil formation.
   - Plants, such as mosses, begin to grow.
   - Insects, micro-organisms, and other organisms move in.
   - Grasses, wildflowers, and shrubs begin to grow. More insects and micro-organisms move in.
   - Tree seeds are transported by animals. Deciduous trees grow.
   - Coniferous trees germinate.
   - Mature community develops.
2. Answer should include the following sequence:
   - Exposed soil will contain micro-organisms, worms, and insects as well as the seeds of wildflowers, weeds, grasses, and trees.
   - Other seeds may blow in or be carried in by animals.
   - Deciduous trees grow.
   - Coniferous trees return.
   - Mature community may only take decades to establish.

Applying Knowledge

How natural events affect ecosystems

Page 42

NATURAL EVENT	EFFECTS ON MATURE COMMUNITY
Fire	• causes secondary succession • results in regrowth
Flooding	• causes soil erosion • results in soil and water pollution, leading to widespread disease
Tsunami	• water carries away or destroys plants and animals • disrupts habitats and foods webs • salt from salt water changes composition of soil
Drought	• destroys habitats • results in the death of plants and animals • leads to crop failures and livestock deaths
Insect Infestation	• results in losses to forest canopy • disrupts habitats and food webs

Assessment

How changes occur naturally in ecosystems

Page 43

1. B **2.** A **3.** D **4.** E **5.** C **6.** C **7.** D **8.** C **9.** B

Section 3.2 How Humans Influence Ecosystems

Comprehension

Sustainability

Page 46

1. Sustainability is the ability of an ecosystem to sustain ecological processes and maintain biodiversity over time. It also means that humans use natural resources in a way that maintains ecosystem health now and for future generations.
2. Habitat loss refers to the destruction of habitats while habitat fragmentation is the division of habitats into smaller, isolated fragments.
3. Deforestation is the practice in which forests are logged or cleared for human use and never reforested. This practice results in a reduction of the number of plants and animals living in an ecosystem. Erosion occurs since few plants are left to hold the soil in place. As a result of the erosion, nutrients are lost so plants are not able to grow.
4. Aeration, or breaking up compacted soil, reduces run-off by improving the movement of air and water through soil.
5. Examples of contamination due to mining could include introduction of chemicals, toxins, wastes, or micro-organisms into the environment.
6. Overexploitation can result in extinction of a species and a loss of genetic diversity. In turn, the populations are less resistant to disease and less able to adapt to changes in their environment.
7. Traditional ecological knowledge takes the form of stories, songs, cultural beliefs, rituals, community laws, and practices related to agriculture, forests, and ocean resources. It reflects the knowledge about local climate and resources, biotic and abiotic characteristics, and animal and plant cycles.

Applying Knowledge

Effects of human activities on ecosystems

Page 47

HUMAN ACTIVITY	EFFECTS ON ECOSYSTEM
deforestation	• reduction in number of plants and animals living in an ecosystem • erosion due to lack of plant roots holding soil in place • removal of nutrients from topsoil
agricultural practices, such as leaving fields bare during non-planting seasons	• wind erosion • soil compaction • hindering growth of plants • addition of excess nitrogen and pollutants due to increased run-off
exploitation of mining resources	• contamination of ground water and surface water through introduction of chemicals, toxins, wastes, or micro-organisms • contaminants affect local plant and animals
overexploitation of natural resources, such as fish	• reduction in population of particular fish • loss of genetic diversity in food web • species less resistant to disease and changes in environment

Analyzing Information

Sustainability

Page 48

EXAMPLE OF LAND USE	EFFECTS ON HABITAT	SUSTAINABLE APPROACH SUGGESTIONS
the conversion of grasslands into cattle ranches in the Interior of British Columbia	• livestock overgrazing • soil compaction • vehicles cause erosion and plant destruction • introduced plants compete with native plants	• grassland management programs • protection of natural grasslands • aeration • weed control
clear-cutting of forests on Vancouver Island	• erosion • stream habitat destruction	• forestry management practices that allow more trees to remain uncut • streambed restoration • less harmful road-building
urbanization of the Fraser Valley	• biodiversity loss • greater reliance on motorized vehicles • increased energy consumption	• redevelopment of industrial areas or buildings • mix of residence, business, and industry • waste treatment • storm water collection • native plantings • additional green areas

Assessment

How humans influence ecosystems

Page 49

1. B **2.** D **3.** G **4.** E **5.** F **6.** A **7.** C **8.** C **9.** D **10.** A **11.** B

Section 3.3 How Introduced Species Affect Ecosystems

Comprehension

Introduced species
Page 52

1. Native species are plants and animals that naturally inhabit an area.
2. An invasive species are organisms that can take over the habitat of native species or invade their bodies.
3. Invasive species often have high reproduction rates, are aggressive competitors, and lack natural predators in their new habitat. Exploiting the new niche, an invasive species can dramatically change an ecosystem.
4. An introduced species can affect a native species through competition, predation, disease, parasitism, and habitat alteration.
5. Examples could include Eurasian milfoil, purple loosestrife, Norway rat, American bullfrog, European starling, Scotch broom, English ivy, and invasive grasses.
6. Scotch broom, English ivy, and invasive grasses are competing with Garry oak trees.
7. Scotch broom produces up to 18 000 seeds per plant. Its yellow flower attracts bees for pollination and it is well adapted for drought.

Applying Knowledge

The impact of introduced invasive species
Page 53

Answers could vary depending on the ecosystem. Answers given are referenced from textbook pages 140–141.

METHOD	INVASIVE SPECIES	EFFECT ON ECOSYSTEM
competition	carpet burweed	• burweed competes with four native plants • spiny tips pierce skin of animals and humans
predation	yellow crazy ants	• ants build supercolonies • devour all plants and prey on young of reptiles, birds, and mammals • ants killed 20 million land crabs on Christmas Island
disease and/or parasites	parasitic lampreys blister rust	• lampreys use sucker-like mouths to attach to fish, then suck the body fluids from prey • blister rust fungus weakens whitebark pine tree defenses making it more vulnerable to insect infestations
habitat alteration	wild boars	• damage environment by rooting and wallowing • spread weeds that interfere with natural succession • eat native birds, reptiles, frogs, soil organisms, fruit, seeds, and bulbs • boars are considered world's most invasive species

Extension Activity

Invasive species in British Columbia
Page 54

Answers may include:

SPECIES	METHOD OF INTRODUCTION	EFFECT ON ENVIRONMENT
purple loosestrife	seeds from Europe in 1800s	• destroys wetlands and chokes out other plants • too dense to effectively shelter wildife
Eurasian milfoil	brought to North America in 1800s	• cuts off sunlight to organisms below • interferes with recreational activities
Norway rat	escaped from early European explorer and fur-trading ships	• feeds on any food source • eats eggs and young of ground-nesting sea birds, causing their decline
American bullfrog	brought to British Columbia in 1930s for frogs' legs in restaurants	• takes over habitats • eats native frogs • attacks ducks and small mammals
European starling	late 1800s, fifty pairs brought to North America	• outcompetes native birds for nesting sites • devastates fruit and grain crops
Scotch broom	Mid-1800s, introduced as decorative garden plant	• replaces native scrubs • ruins habitat for native birds and butterflies • creates an overload of nitrogen that interferes with growth of some native species

Assessment

How introduced species affect ecosystems

Page 55

1. E **2.** A **3.** G **4.** D **5.** B **6.** F **7.** C **8.** A **9.** A **10.** D **11.** B **12.** C

UNIT 2 Chemical Reactions and Radioactivity

Chapter 4 Atomic theory explains the formation of compounds.

Section 4.1 Atomic Theory and Bonding

Comprehension

The atom and the subatomic particles

Page 60

1. (a) atomic number
(b) symbol
(c) name
(d) average atomic mass
(e) common ion charge
(f) other ion charge

2. (a) 35
(b) 79.9
(c) 1–
(d) 35
(e) bromine
(f) 45

3.

Element Name	Atomic Number	Ion Charge	Number of Protons	Number of Electrons	Number of Neutrons
potassium	19	1+	19	18	20
phosphorus	15	0	15	15	16
lithium	3	0	**3**	**3**	**4**
calcium	**20**	2+	20	**18**	**20**
nitrogen	**7**	3–	**7**	**10**	**7**
boron	5	0	**5**	**5**	**6**
argon	**18**	**0**	**18**	18	**22**
aluminum	13	**3+**	**13**	10	**14**
chlorine	**17**	0	**17**	**17**	**19**
sodium	**11**	**1+**	11	10	**12**

Applying Knowledge

Bohr diagrams

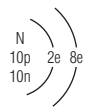
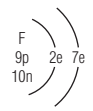
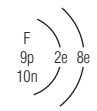
Page 61

1. (a) a diagram that shows how many electrons are in each shell surrounding the nucleus
(b) an arrangement of eight electrons in the outermost shell
(c) outermost shell that contains electrons
(d) electrons in the outermost shell

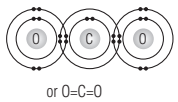
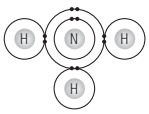
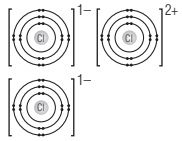
2.

Atom/Ion	Atomic Number	Number of Protons	Number of Electrons	Number of Neutrons	Number of Electron Shells
neon atom	**10**	**20**	**10**	**10**	**2**
fluorine atom	**9**	**9**	**9**	**10**	**2**
fluorine ion	**9**	**9**	**10**	**10**	**2**
sodium atom	**11**	**11**	**11**	**12**	**3**
sodium ion	**11**	**11**	**10**	**12**	**2**

3.

neon atom	fluorine atom	fluorine ion	sodium atom	sodium ion
				

4.

carbon dioxide (CO_2)	ammonia (NH_3)	calcium chloride ($CaCl_2$)
		

Illustrating Concepts

Lewis diagrams

Page 62

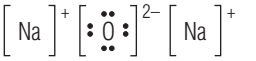
1. (a) a diagram that illustrates chemical bonding by showing only an atom's valence electrons and the chemical symbol
(b) pair of electrons in the valence shell that is not used in bonding
(c) pair of electrons involved in a covalent bond

2. (a) 

(b) 

(c) 

(d) 

3. (a) 

(b)