Biology, Grade 12

University Preparation SBI4U

This course provides students with the opportunity for in-depth study of the concepts and processes that occur in biological systems. Students will study theory and conduct investigations in the areas of biochemistry, metabolic processes, molecular genetics, homeostasis, and population dynamics. Emphasis will be placed on the achievement of detailed knowledge and the refinement of skills needed for further study in various branches of the life sciences and related fields.

Prerequisite: Biology, Grade 11, University Preparation

Big Ideas

Biochemistry

- Technological applications that affect biological processes and cellular functions are used in the food, pharmaceutical, and medical industries.
- Biological molecules and their chemical properties affect cellular processes and biochemical reactions.
- Biochemical compounds play important structural and functional roles in cells of all living organisms.

Metabolic Processes

- All metabolic processes involve chemical changes and energy conversions.
- An understanding of metabolic processes enables people to make informed choices with respect to a range of personal, societal, and environmental issues.

Molecular Genetics

- DNA contains all the genetic information for any living organism.
- Proteins control a wide variety of cellular processes.
- Genetic research and biotechnology have social, legal, and ethical implications.

Homeostasis

- Organisms have strict limits on the internal conditions that they can tolerate.
- Systems that maintain homeostasis rely on feedback mechanisms.
- Environmental factors can affect homeostasis.

Population Dynamics

- Population growth follows predictable patterns.
- The increased consumption of resources and production of waste associated with population growth result in specific stresses that affect Earth's sustainability.
- Technological developments can contribute to or help offset the ecological footprint associated with population growth and the consumption of natural resources.

Fundamental Concepts Covered in This Course (see also page 5)

Fundamental Concepts	Biochemistry	Metabolic Processes	Molecular Genetics	Homeostasis	Population Dynamics
Matter					
Energy					
Systems and Interactions					
Structure and Function					
Sustainability and Stewardship					
Change and Continuity					

A. SCIENTIFIC INVESTIGATION SKILLS AND CAREER EXPLORATION

OVERALL EXPECTATIONS

Throughout this course, students will:

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe careers related to the fields of science under study, and describe contributions of scientists, including Canadians, to those fields.

SPECIFIC EXPECTATIONS

A1. Scientific Investigation Skills

Throughout this course, students will:

Initiating and Planning [IP]*

A1.1 formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research

A1.2 select appropriate instruments (e.g., dialysis tubing, glassware, sphygmomanometer) and materials (e.g., DNA models, plants, plant cuttings, molecular models), and identify appropriate methods, techniques, and procedures, for each inquiry

A1.3 identify and locate a variety of print and electronic sources that enable them to address research topics fully and appropriately

A1.4 apply knowledge and understanding of safe laboratory practices and procedures when planning investigations by correctly interpreting Workplace Hazardous Materials Information System (WHMIS) symbols; by using appropriate techniques for handling and storing laboratory equipment and materials and disposing of laboratory and biological materials (e.g., plants and invertebrates); and by using appropriate personal protection

Performing and Recording [PR]*

A1.5 conduct inquiries, controlling relevant variables, adapting or extending procedures as required, and using appropriate materials and equipment safely, accurately, and effectively, to collect observations and data

A1.6 compile accurate data from laboratory and other sources, and organize and record the data, using appropriate formats, including tables, flow charts, graphs, and/or diagrams

A1.7 select, organize, and record relevant information on research topics from a variety of appropriate sources, including electronic, print, and/or human sources, using suitable formats and an accepted form of academic documentation

Analysing and Interpreting [AI]*

A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and/or error; and suggest improvements to the inquiry to reduce the likelihood of error

A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias

* The abbreviation(s) for the broad area(s) of investigation skills – IP, PR, AI, and/or C – are provided in square brackets at the end of the expectations in strands B–F to which the particular area(s) relate (see pp. 20–22 for information on scientific investigation skills).

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions with reference to scientific knowledge

Communicating [C]*

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

A1.12 use appropriate numeric, symbolic, and graphic modes of representation (e.g., biological diagrams, three-dimensional molecular models), and appropriate units of measurement (e.g., SI and imperial units)

A1.13 express the results of any calculations involving data accurately and precisely, to the appropriate number of decimal places or significant figures

A2. Career Exploration

Throughout this course, students will:

A2.1 identify and describe a variety of careers related to the fields of science under study (e.g., scientific journalist, fisheries and wildlife officer, physician, infectious disease researcher, geneticist) and the education and training necessary for these careers

A2.2 describe the contributions of scientists, including Canadians (e.g., Evelyn Roden Nelson, Maude Menten, Albert Juan Aguayo, Kimberley J. Fernie, Michael Archer), to the fields under study

B. BIOCHEMISTRY

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology;

B2. investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions;

B3. demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function.

SPECIFIC EXPECTATIONS

B1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

B1.1 analyse technological applications related to enzyme activity in the food and pharmaceutical industries (e.g., the production of dairy products; breadmaking; the use of enzymes to control reaction rates in pharmaceuticals) [AI, C]

Sample issue: Natural enzymes are used in many food production processes to speed up chemical reactions, which reduces water usage and energy consumption. Scientists are now designing and producing synthetic enzymes that will be more efficient catalysts and allow new technological applications in medicine and industry.

Sample questions: Why are there so many different varieties of cheese when the production process is basically the same for all cheeses? What types of food production processes use enzymes to improve production yields? How do they do so? How and why are enzymes used as pharmaceutical supplements to treat digestive system disorders such as celiac disease and lactose intolerance?

B1.2 evaluate, on the basis of research, some advances in cellular biology and related technological applications (e.g., new treatments for cancer, HIV/AIDS, and hepatitis C; radioisotopic labelling to study the function of internal organs; fluorescence to study genetic material within cells; forensic biological techniques to aid in crime resolution) [IP, PR, AI, C]

Sample issue: In nuclear medicine, radioactive compounds are injected into the body so that images of cells can be scanned to diagnose and treat medical conditions such as cancer and heart disease. Radioisotopes may now be used so routinely and effectively that we have come to rely on them despite concerns about production safety.

Sample questions: How are drugs used to target tumour cells during chemotherapy? How are scientists using bacteria to create antibiotics that fight drug-resistant bacteria strains? What role might nanotechnologies play in replacing current diagnostic and treatment technologies?

B2. Developing Skills of Investigation and Communication

By the end of this course, students will:

B2.1 use appropriate terminology related to biochemistry, including, but not limited to: *active and passive transport, covalent and ionic bond, allosteric site, substrate, substrate-enzyme complex,* and *inhibition* [C]

B2.2 plan and conduct an investigation to demonstrate the movement of substances across a membrane (e.g., the effects of salt water and distilled water on a potato) [IP, PR]

B2.3 construct and draw three-dimensional molecular models of important biochemical compounds, including carbohydrates, proteins, lipids, and nucleic acids [PR, C]

B2.4 conduct biological tests to identify biochemical compounds found in various food samples (e.g., use Benedict's solution to test for carbohydrates in food samples), and compare the biochemical compounds found in each food to those found in the others [PR, AI, C]

B2.5 plan and conduct an investigation related to a cellular process (e.g., factors that affect enzyme activity; factors that affect transport of substances across cell membranes), using appropriate laboratory equipment and techniques, and report the results in an appropriate format [IP, PR, C]

B3. Understanding Basic Concepts

By the end of this course, students will:

B3.1 explain the roles of various organelles, such as lysosomes, vacuoles, mitochondria, internal cell membranes, ribosomes, smooth and rough endoplasmic reticulum, and Golgi bodies, in cellular processes

B3.2 describe the structure of important biochemical compounds, including carbohydrates, proteins, lipids, and nucleic acids, and explain their function within cells

B3.3 identify common functional groups within biological molecules (e.g., hydroxyl, carbonyl, carboxyl, amino, phosphate), and explain how they contribute to the function of each molecule

B3.4 describe the chemical structures and mechanisms of various enzymes

B3.5 identify and describe the four main types of biochemical reactions (oxidation-reduction [redox], hydrolysis, condensation, and neutralization)

B3.6 describe the structure of cell membranes according to the fluid mosaic model, and explain the dynamics of passive transport, facilitated diffusion, and the movement of large particles across the cell membrane by the processes of endocytosis and exocytosis

C. METABOLIC PROCESSES

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. analyse the role of metabolic processes in the functioning of biotic and abiotic systems, and evaluate the importance of an understanding of these processes and related technologies to personal choices made in everyday life;

C2. investigate the products of metabolic processes such as cellular respiration and photosynthesis;

C3. demonstrate an understanding of the chemical changes and energy conversions that occur in metabolic processes.

SPECIFIC EXPECTATIONS

C1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

C1.1 analyse the role of metabolic processes in the functioning of and interactions between biotic and abiotic systems (e.g., specialized microbes and enzymes in biotechnological applications to treat wastewater in the pulp and paper industry; microbes and enzymes in bioremediation, such as in the cleanup of oil spills; energy transfer from producers to consumers) [AI, C]

Sample issue: Most restaurants dispose of cooking oil and grease in an environmentally sound way to avoid contaminating municipal sewer systems. One method they can use is bioaugmentation, which uses microorganisms to metabolize oils into bacterial biomass, carbon dioxide, and water. However, this process can create unpleasant odours, which are undesirable in a food service setting.

Sample questions: How do symbiotic bacteria use metabolic processes to produce biohydrogen from food waste? How are microbes used in the bioremediation of contaminated groundwater sites? What is the relationship between the position of a particular species in the food chain and the energy required to maintain that species?

C1.2 assess the relevance, to their personal lives and to the community, of an understanding of cell biology and related technologies (e.g., knowledge of metabolic processes is relevant to personal choices about exercise, diet, and the use of pharmacological substances; knowledge of cellular processes aids in our understanding and treatment of mitochondrial diseases [a group of neuromuscular diseases]) [AI, C]

Sample issue: Some fad weight-loss diets include pills that are believed to speed up the body's metabolism to help a person lose weight quickly. Other diets rely on very low calorie intake for rapid weight loss. However, such methods can lead to destructive metabolic processes in the body, causing organ failure.

Sample questions: How does stem-cell research related to degenerative diseases use technologies to change the metabolic processes of the cells? Why is it important when changing your diet to know how the cells in your body will react to the introduction of new substances or the removal of other substances?

C2. Developing Skills of Investigation and Communication

By the end of this course, students will:

C2.1 use appropriate terminology related to metabolism, including, but not limited to: *energy carriers, glycolysis, Krebs cycle, electron transport chain, ATP synthase, oxidative phosphorylation, chemiosmosis, proton pump, photolysis, Calvin cycle, light and dark reactions,* and *cyclic and noncyclic phosphorylation* [C]

C2.2 conduct a laboratory investigation into the process of cellular respiration to identify the products of the process, interpret the qualitative observations, and display them in an appropriate format [PR, AI, C]

C2.3 conduct a laboratory investigation of the process of photosynthesis to identify the products of the process, interpret the qualitative observations, and display them in an appropriate format [PR, AI, C]

C3. Understanding Basic Concepts

By the end of this course, students will:

C3.1 explain the chemical changes and energy conversions associated with the processes of aerobic and anaerobic cellular respiration (e.g., in aerobic cellular respiration, glucose and oxygen react to produce carbon dioxide, water, and energy in the form of heat and ATP; in anaerobic cellular respiration, yeast reacts with glucose in the absence of oxygen to produce carbon dioxide and ethanol)

C3.2 explain the chemical changes and energy conversions associated with the process of photosynthesis (e.g., carbon dioxide and water react with sunlight to produce oxygen and glucose)

C3.3 use the laws of thermodynamics to explain energy transfer in the cell during the processes of cellular respiration and photosynthesis

C3.4 describe, compare, and illustrate (e.g., using flow charts) the matter and energy transformations that occur during the processes of cellular respiration (aerobic and anaerobic) and photosynthesis, including the roles of oxygen and organelles such as mitochondria and chloroplasts

D. MOLECULAR GENETICS

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;

D2. investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell;

D3. demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.

SPECIFIC EXPECTATIONS

D1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

D1.1 analyse, on the basis of research, some of the social, ethical, and legal implications of biotechnology (e.g., the bioengineering of animal species, especially those intended for human consumption; the cultivation of transgenic crops; the patenting of life forms; cloning) [IP, PR, AI, C]

Sample issue: Corporations that have patented genetically modified (GM) seeds legally require farmers to buy new seeds from them each planting season. Corporations that find GM crops on a farm that did not purchase their seed can take the farmer to court. However, natural processes such as cross-pollination can result in the migration of GM crops to neighbouring farms.

Sample questions: Should private companies be able to patent life forms, including genetic material? Why or why not? Who owns and controls our personal genetic information? Who should have access to our personal genetic information and decide how it will be used? What are the ethical implications of reproductive technologies that allow postmenopausal women to conceive?

D1.2 analyse, on the basis of research, some key aspects of Canadian regulations pertaining to biotechnology (e.g., current or potential legislation for mandatory DNA fingerprinting, human cloning, ownership of a genome, patenting of genetically modified organisms), and compare them to regulations from another jurisdiction [IP, PR, AI, C]

Sample issue: Modern biotechnologies, such as selective breeding, are regulated under Health Canada's Food and Drugs Act and the Canadian Environmental Protection Act. It is an ongoing challenge to ensure that our regulations keep up with advances in scientific knowledge and technologies, as well as with developments in other countries.

Sample questions: What is the role of the Canadian Food Inspection Agency with respect to biotechnology? What role does the Canadian Environmental Protection Act play in regulating biotechnology? Why was bovine growth hormone approved for use in dairy cattle in the United States but not in Canada? Why does Mexico have laws to limit the cultivation of genetically modified corn? What countries have banned human cloning? What is Canada's position on this issue?

D2. Developing Skills of Investigation and Communication

By the end of this course, students will:

D2.1 use appropriate terminology related to molecular genetics, including, but not limited to: *polymerase I, II, and III, DNA ligase, helicase, Okazaki fragment, mRNA, rRNA, tRNA, codon, anticodon, translation, transcription,* and *ribosome subunits* [C]

D2.2 analyse a simulated strand of DNA to determine the genetic code and base pairing of DNA (e.g., determine base sequences of DNA for a protein; analyse base sequences in DNA to recognize an anomaly) [AI]

D2.3 conduct an investigation to extract DNA from a specimen of plant or animal protein [PR]

D2.4 investigate and analyse the cell components involved in the process of protein synthesis, using appropriate laboratory equipment and techniques, or a computer simulation [PR, AI]

D3. Understanding Basic Concepts

By the end of this course, students will:

D3.1 explain the current model of DNA replication, and describe the different repair mechanisms that can correct mistakes in DNA sequencing

D3.2 compare the structures and functions of RNA and DNA, and explain their roles in the process of protein synthesis

D3.3 explain the steps involved in the process of protein synthesis and how genetic expression is controlled in prokaryotes and eukaryotes by regulatory proteins (e.g., the role of operons in prokaryotic cells; the mechanism of gene expression in eukaryotic cells)

D3.4 explain how mutagens, such as radiation and chemicals, can cause mutations by changing the genetic material in cells (e.g., the mechanisms and effects of point mutations and frameshift mutations)

D3.5 describe some examples of genetic modification, and explain how it is applied in industry and agriculture (e.g., the processes involved in cloning, or in the sequencing of DNA bases; the processes involved in the manipulation of genetic material and protein synthesis; the development and mechanisms of the polymerization chain reaction)

D3.6 describe the functions of some of the cell components used in biotechnology (e.g., the roles of plasmids, restriction enzymes, recombinant DNA, and vectors in genetic engineering)

D3.7 describe, on the basis of research, some of the historical scientific contributions that have advanced our understanding of molecular genetics (e.g., discoveries made by Frederick Griffith, Watson and Crick, Hershey and Chase)

E. HOMEOSTASIS

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity;

E2. investigate the feedback mechanisms that maintain homeostasis in living organisms;

E3. demonstrate an understanding of the anatomy and physiology of human body systems, and explain the mechanisms that enable the body to maintain homeostasis.

SPECIFIC EXPECTATIONS

E1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

E1.1 assess, on the basis of findings from a case study, the effects on the human body of taking chemical substances to enhance performance or improve health (e.g., the risks and benefits of taking large quantities of vitamins or amino acids; the effects on the human body of substances that people use to cope with stress) [PR, AI, C]

Sample issue: Steroids are a class of drugs that can be used for healing and building of tissues under proper medical supervision. However, if used for the wrong purpose, such as athletic performance enhancement, or if they are taken incorrectly, steroids can be dangerous and result in negative long-term effects on many body systems.

Sample questions: How do certain classes of drugs help with neurotransmission in the brain? What effects does aloe vera have on the human body? How do common antidepressants work? Why should people, especially young people, be carefully monitored when on such medications? What are the possible side effects of statin drugs used to lower cholesterol? Why has the federal government proposed legislation to regulate natural health products?

E1.2 evaluate, on the basis of research, some of the human health issues that arise from the impact of human activities on the environment (e.g., the effects of synthetic estrogen compounds released into our water systems; the effects of leaching of compounds from plastic products into soil and water) [IP, PR, AI, C]

Sample issue: Human-produced biosolids are a low-cost source of nutrient-rich organic matter that is often spread on agricultural land rather than being sent for incineration or landfill disposal. Opponents of land application of biosolids are concerned about the potential health impact of heavy metals, bacteria, and drugs that may remain in the biosolids.

Sample questions: In what ways have mining, forestry, and hydroelectric developments affected the health of Aboriginal people in Northern Ontario? What are the links between air pollution and respiratory diseases such as asthma? What types of human activity have led to the thinning of the ozone? What human health conditions are related to this phenomenon? How can the dumping of chemicals down sinks and into storm sewers affect the incidence of skin conditions among swimmers at local beaches?

E2. Developing Skills of Investigation and Communication

By the end of this course, students will:

E2.1 use appropriate terminology related to homeostasis, including, but not limited to: *insulin, testosterone, estrogen, nephron, dialysis, pituitary, synapse,* and *acetylcholine* [C]

E2.2 plan and construct a model to illustrate the essential components of the homeostatic process (e.g., create a flow chart that illustrates representative feedback mechanisms in living things) [IP, AI, C]

E2.3 plan and conduct an investigation to study a feedback system (e.g., stimulus response loop) [IP, PR, AI]

E2.4 plan and conduct an investigation to study the response mechanism of an invertebrate to external stimuli (e.g., the instinctive behaviour of an invertebrate in response to a stimulus such as light), using appropriate laboratory equipment and techniques [IP, PR, AI]

E3. Understanding Basic Concepts

By the end of this course, students will:

E3.1 describe the anatomy and physiology of the endocrine, excretory, and nervous systems, and explain how these systems interact to maintain homeostasis

E3.2 explain how reproductive hormones act in human feedback mechanisms to maintain homeostasis (e.g., the actions of male and female reproductive hormones on their respective body systems)

E3.3 describe the homeostatic processes involved in maintaining water, ionic, thermal, and acid–base equilibrium, and explain how these processes help body systems respond to both a change in environment and the effects of medical treatments (e.g., the role of feedback mechanisms in water balance or thermoregulation; how the buffering system of blood maintains the body's pH balance; the effect of medical treatments on the endocrine system; the effects of chemotherapy on homeostasis)

F. POPULATION DYNAMICS

OVERALL EXPECTATIONS

By the end of this course, students will:

F1. analyse the relationships between population growth, personal consumption, technological development, and our ecological footprint, and assess the effectiveness of some Canadian initiatives intended to assist expanding populations;

F2. investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem;

F3. demonstrate an understanding of concepts related to population growth, and explain the factors that affect the growth of various populations of species.

SPECIFIC EXPECTATIONS

F1. Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

F1.1 analyse the effects of human population growth, personal consumption, and technological development on our ecological footprint (e.g., the deforestation resulting from expanding development and demand for wood products causes the destruction of habitats that support biological diversity; the acidification of lakes associated with some industrial processes causes a decrease in fish populations) [AI, C]

Sample issue: Every day, millions of Canadians drive their vehicles to work, school, or entertainment venues, which creates greenhouse gases and consumes non-renewable resources. These behaviours, and many other consumption habits, all contribute to our ecological footprint. Many experts believe that we are consuming more resources each year than Earth can produce.

Sample questions: How does the Living Planet Index (LPI) help a nation to assess its ecological footprint and sustain its population? How does the planned obsolescence of electronic devices and appliances contribute to our ecological footprint? What impact has rapid population growth into the suburbs had on the local environment? What is the environmental impact of using packaged infant formula instead of breastfeeding a baby for the first six months of life?

F1.2 assess, on the basis of research, the effectiveness of some Canadian technologies and projects intended to nourish expanding populations (e.g., the risks and benefits of growing genetically modified canola; some of the sustainable development projects funded by the Canadian International Development Agency [CIDA]) [IP, PR, AI, C]

Sample issue: Every year, millions of children in developing nations die from diseases and malnutrition related to micronutrient deficiencies. The Canada-based Micronutrient Initiative develops, implements, and monitors programs aimed at eliminating vitamin and mineral deficiencies in expanding populations. The main challenge of such an initiative is to create sustainable solutions that will reach all those who need help.

Sample questions: How are Canadian programs helping to reverse the effects of land degradation and promote sustainable farming in semi-arid and dry sub-humid areas? What is Canada's role in the Flour Fortification Initiative, and how effectively does this initiative meet its goal of nourishing expanding populations?

F2. Developing Skills of Investigation and Communication

By the end of this course, students will:

F2.1 use appropriate terminology related to population dynamics, including, but not limited to: *carrying capacity*, *population growth*, *population cycle*, *fecundity*, and *mortality* [C]

F2.2 use conceptual and mathematical population growth models to calculate the growth of populations of various species in an ecosystem (e.g., use the concepts of exponential, sigmoid, and sinusoidal growth to estimate the sizes of various populations) [PR, AI, C]

F2.3 determine, through laboratory inquiry or using computer simulations, the characteristics of population growth of two different populations (e.g., the different population cycles of a predator and its prey; the population cycles of two populations that compete for food; the increase of Aboriginal compared to non-Aboriginal populations and the significant difference in average age between the two groups) [PR, AI, C]

F3. Understanding Basic Concepts

By the end of this course, students will:

F3.1 explain the concepts of interaction (e.g., competition, predation, defence mechanism, symbiotic relationship, parasitic relationship) between different species

F3.2 describe the characteristics of a given population, such as its growth, density (e.g., fecundity, mortality), distribution, and minimum viable size

F3.3 explain factors such as carrying capacity, fecundity, density, and predation that cause fluctuation in populations, and analyse the fluctuation in the population of a species of plant, wild animal, or microorganism

F3.4 explain the concept of energy transfer in a human population in terms of the flow of food energy in the production, distribution, and use of food resources

F3.5 explain how a change in one population in an aquatic or terrestrial ecosystem can affect the entire hierarchy of living things in that system (e.g., how the disappearance of crayfish from a lake causes a decrease in the bass population of the lake; how the disappearance of beaver from an ecosystem causes a decrease in the wolf population in that ecosystem)