



 **CANADIAN  
AGRICULTURAL  
PARTNERSHIP**  
Innovate. Grow. Prosper.

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# Connecting Agriculture to Alberta Senior High School Curriculum

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Alberta 

Canada 

*This guide provides an overview of connections to agriculture that can be developed around Alberta competencies, literacy and numeracy supports and programs of study for Science, Social Studies, Health/Wellness and Career and Technology Studies courses.*

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*A new survey from Linking Environment and Farming (LEAF) has found that although teenagers' knowledge of food and farming is "limited" there is a "real desire" to know more about how food is produced.... Interestingly, in a sector that frequently talks about a skills gap and worker shortages, almost a third of teens – 32% – said they would consider a career in food and farming. But only 22% reported being provided with information on the options open to them.*

Askew, K (2018). *Teen trends: A 'real desire' to know more about how food is produced*. William Reed online: Foodnavigator.com. [www.foodnavigator.com/Article/2018/11/07/Teen-trends-A-real-desire-to-know-more-about-how-food-is-produced?utm\\_source=copyright&utm\\_medium=OnSite&utm\\_campaign=copyright](http://www.foodnavigator.com/Article/2018/11/07/Teen-trends-A-real-desire-to-know-more-about-how-food-is-produced?utm_source=copyright&utm_medium=OnSite&utm_campaign=copyright)

## Addressing Competencies

**Competencies** are combinations of knowledge, skills and attitudes that students develop and apply for successful learning, living and working. They emphasize aspects of learning that apply within and across all subject areas. Competencies should be explicitly addressed in programs and resources, with activities and strategies that support their development.

Competencies are integrated across all learning outcomes in curriculum. They are developed through and supported by learning activities and experiences in the classroom. Teachers observe for evidence of competencies in students' work, but do not evaluate the competencies.



## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Communication

- > Integrate messages from agricultural stakeholders with different opinions, views or experiences to enrich understandings.
- > Model respect and responsibility when reinforcing communication skills.
- > Plan activities that encourage students to select style, content and format of messages to inform, instruct, motivate, persuade, or share ideas.
- > Share information through verbal and non-verbal formats.



## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Collaboration

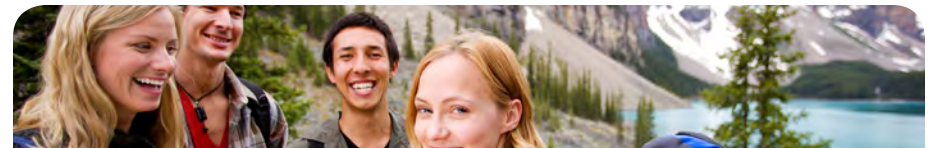
- > Build relationships and encourage the sharing of ideas between the real-world context of agricultural communities, individuals and students.
- > Provide opportunities for students to interview and/or work with individuals in agricultural industries.
- > Plan activities that encourage students to work together and contribute their own ideas.



## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Critical Thinking

- > Provide opportunities for students to question and analyze evidence on the benefits and risks involved in agricultural practices, food security and food insecurity.
- > Plan activities that involve causes and consequences of economically and environmentally sustainable food production and agricultural practices.
- > Use activities that encourage students to compare and analyze different approaches and practices in agriculture.
- > Ask students to make predictions on future effects, results and trends in agriculture.



## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Creativity and Innovation

- > Plan activities that ask students to create or manipulate tools, technologies and materials that are connected with food production and agricultural practices.
- > Share examples of innovative approaches that have been implemented by agricultural producers and researchers.
- > Provide background information on the technologies that contribute to agricultural innovation and change.



#### CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Managing Information

- > Use inquiry-based research methods to investigate the science involved in food production and agricultural practices.
- > Provide multiple sources of information that present and share different perspectives on issues involved with agriculture.
- > Ensure that students have opportunities to assess the reliability and validity of information that is presented to them.
- > Integrate background information on food production, agricultural practices and current trends and issues in farming.



#### CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Problem Solving

- > Share information about the needs and priorities of agricultural producers balanced with needs and priorities of the environment and society.
- > Ask students to take action to implement solutions and recommendations in response to agricultural issues and dilemmas.
- > Provide opportunities for students to work together and independently to examine evidence and generate solutions to problems and challenges in agriculture.



#### CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Cultural and Global Citizenship

- > Share perspectives on the values that are part of sustainable agricultural production, now and in the future.
- > Provide opportunities for students to demonstrate a commitment to environmental sustainability and stewardship.
- > Provide information that addresses the impact of agriculture on healthy and sustainable communities.
- > Explore the global context of agriculture, including the global marketplace, trade and government policies.
- > Examine and compare agricultural practices and products in other areas of the world.



#### CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Personal Growth and Well-being

- > Provide background information that informs students about influences on and impact of food choices.
- > Ask students to assess the personal connections they have to agriculture and food quality.
- > Integrate information that shares the interests, values, skills and education involved in careers connected to agriculture.



*Literacy and Numeracy are:*

- *Life-long and active processes that begin at birth and develop throughout one's lifetime*
- *Foundational to successful living, learning and participating in today's society*
- *Used to make decisions that impact one's life*
- *The means through which students develop knowledge and understanding in each subject/discipline area*
- *A shared responsibility of all K to 12 educators in all subjects or disciplines*

*We use literacy and numeracy every day when we interpret a utility bill, choose a cellphone plan, answer an email, post a message on social media, figure out how much paint to buy, compare prices at the grocery store or interpret a political cartoon.*

Alberta Education. *Literacy and Numeracy*: Author. Online <https://education.alberta.ca/literacy-and-numeracy/about-literacy-and-numeracy/>

## Addressing Literacy and Numeracy

Alberta Education's **literacy** and **numeracy** progressions are a series of outcomes that are used to support students in meeting the learning outcomes in the current provincial curriculum. They are integrated across all subject areas and are meant to be used to plan effective learning experiences that foster the development of literacy and numeracy.





## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Literacy

**Literacy** is the ability, confidence and willingness to engage with language to acquire, construct and communicate meaning in all aspects of daily living. How can literacy be addressed with senior high students?

- > Provide a broad range of sources (print, digital, videos, oral stories, experts, elders, accounts), including primary and secondary sources, to support responses to problems, questions or topics.
- > Build in strategies that ask students to identify misconceptions, perspectives, points of view and biases to determine the reliability, validity and authenticity of sources.
- > Provide opportunities for students to construct meaning by reflecting on and comparing their background knowledge of a concept or topic and applying multiple strategies when viewing, listening to and interacting with sources.
- > Use activities that ask students to organize the information they are presented with or research around a specific purpose or intent.
- > Provide opportunities for students to select and use different modes and media to represent and communicate their experiences, understandings and knowledge of concepts.
- > Integrate activities that encourage students to analyze and explain the ways media can be used to shape opinions and evoke emotions.



## CONNECTING AGRICULTURE TO ALBERTA CURRICULUM

### Numeracy

**Numeracy** is the ability, confidence and willingness to engage with quantitative or spatial information to make informed decisions in all aspects of daily living. How can numeracy be addressed with senior high students?

- > Provide opportunities for students to use statistics, rates, percentages, scales and ratios in real-life situations connected to agriculture.
- > Build in strategies that ask students to make predictions based on agricultural and food production trends and priorities, sustainability trends and consumer trends in real-life situations.
- > Use activities that ask students to organize agriculturally related data and statistics, using charts and graphs, to make informed judgements and decisions.
- > Provide activities that ask students to use their knowledge of probability to evaluate claims and predictions to make informed decisions in real-life situations, focusing on sustainability, food quality and safety, health benefits and risks, climate change and other agricultural issues and challenges.
- > Integrate opportunities for students to use maps and other navigational tools to analyze land use and change.
- > Use activities that include diagrams and models to represent complex phenomena.



## Finding Topics and Themes in Alberta Senior High Curriculum

Students and society often have limited understanding of the sources, processes, and issues related to food production. However, there are numerous opportunities to connect to agriculture in Alberta curriculum and develop programs and resources that help teachers integrate important concepts related to food, the agriculture industry and environmental sustainability into their classrooms. Teachers need to see these curriculum connections in the subject areas they teach and find value in the approaches provided in programs and resources.

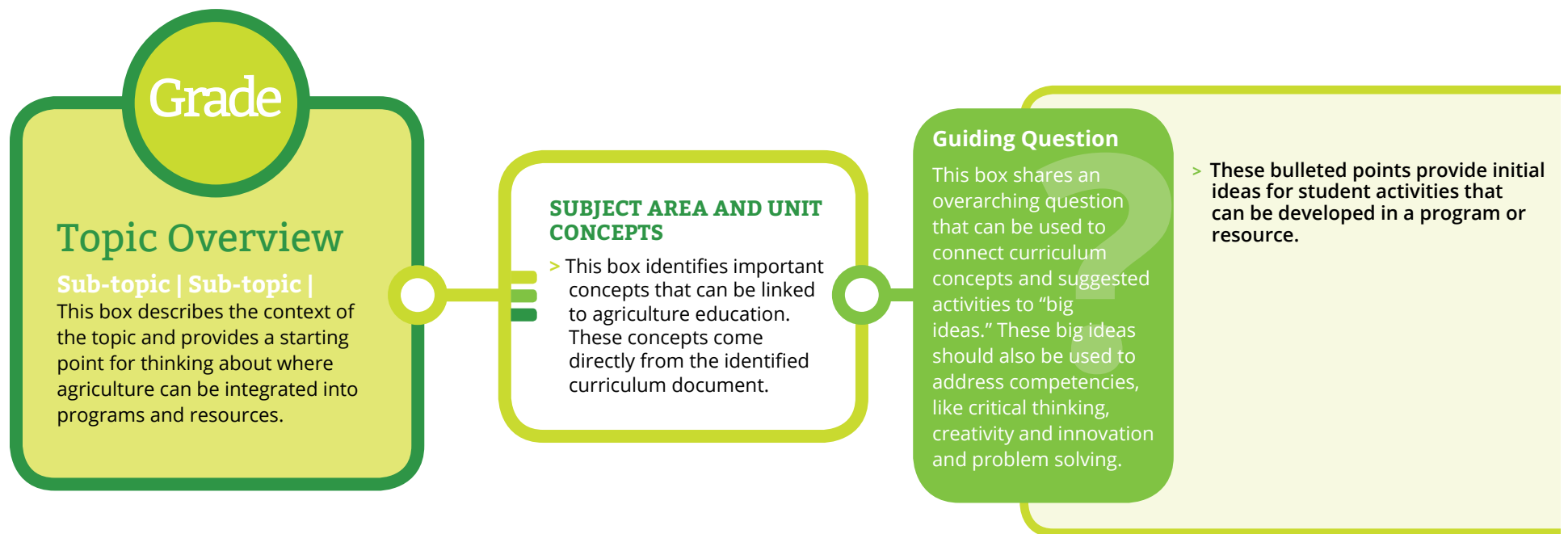
Most curriculum is developed around conceptual understandings and procedural knowledge and skills - or knowledge, skills and attitudes.

Agricultural topics and themes can be drawn from concepts identified in general and specific learning outcomes in curriculum documents. Activities can then be developed to integrate and support increased understandings of concepts related to food production and consumption, food safety, agricultural issues, and sustainability.

The following topics and themes are illustrated with an overview of examples of concepts and activity starters that are drawn directly from Alberta curriculum documents. Each topic and theme overview is followed by specific learning outcomes that teachers address in Social Studies, Science, Health/Wellness, Career and Technology Studies (CTS) courses.

- > **Environment and Sustainability** (Land, Energy, Water, Soil)
- > **Plants and Plant Health; Animals and Animal Welfare** (Crops, Livestock)
- > **Food and Agricultural Commodities** (Chemistry, Reactions, Nutrients, Food Production)
- > **Food Security and Economies of Food Production** (Globalization, Nationalism, Trade, Policies)
- > **Technologies** (Automation/Robotic Technology, Biotechnology, Genetics)

# How to Read the Topic and Theme Maps







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# Connecting Agriculture to Alberta Senior High School Curriculum Grade 10

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# 10

## Environment and Sustainability

Land | Energy | Water | Soil

The use of land, energy, water and soil are central to agricultural practices and the food supply. Not only are resources such as soil and water vital to agricultural productivity, but agriculture both affects and is affected by the local, regional, and global environment. Concepts related to environmental issues and decisions in Science and Social Studies curriculum can be explored through an agricultural lens.



### SCIENCE 10 Unit D

- > Environmental monitoring and impacts
- > Climate and greenhouse effects
- > Biological and habitat diversity

Why is it important to monitor the effects of human activity on environmental elements and conditions?

- > Predict the effect of climate change on a specific agricultural operation.
- > Explain the risks and benefits of agricultural activity on biodiversity of plants and animals.
- > Collect information from different sources on how climate change is monitored by agricultural producers.
- > Provide different perspectives on ways that human actions today may affect the sustainability of agricultural biomes for future generations; identify potential conflicts between human wants and needs and protecting agricultural environments.

### SCIENCE 14 Unit D

- > Food chains, food webs and energy pyramids and flows
- > Ecosystems, biotic and abiotic factors and human impact
- > Modern agricultural technologies
- > Ecosystem balance and wastes

How do human activities affect, challenge and protect ecosystems, energy flows and food chains?

- > Use a crop or livestock farm as a study of an ecosystem.
- > Research ways that agricultural wastes are produced and recycled.
- > Investigate the social, economic and environmental factors that influence the use of pesticides and herbicides in crop farming.
- > Find out how modern agricultural technologies affect food chains and food webs.
- > Compare alternative agricultural practices that promote sustainability.

### SOCIAL STUDIES 10-1 / 10-2

- > Impact of globalization on land, cultures, economies and quality of life
- > Local, national and international contexts of globalization

How has globalization shaped policies and actions related to the use of land and resources?

- > Research the impact of globalization on agricultural trade in Canada.
- > Assess how multiple perspectives, including economics, spirituality, stewardship, sustainability and resource development, should be considered when developing agricultural land and resources.
- > Evaluate government actions and policies associated with globalization that impact agriculture (land and resource use, resource development agreements, environmental legislation).

# 10

## Environment and Sustainability

Land | Energy | Water | Soil

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 10 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SCIENCE

### Science 10 Unit D - Energy Flow in Global Systems

#### Specific Learning Outcomes:

1. Describe how the relationships among input solar energy, output terrestrial energy and energy flow within the biosphere affect the lives of humans and other species

✓ Describe and explain the greenhouse effect, and the role of various gases—including methane, carbon dioxide and water vapour—in determining the scope of the greenhouse effect

4. Investigate and interpret the role of environmental factors on global energy transfer and climate change

✓ Investigate and identify human actions affecting biomes that have a potential to change climate (e.g., emission of greenhouse gases, draining of wetlands, forest fires, deforestation) and critically examine the evidence that these factors play a role in climate change (e.g., global warming, rising sea level(s))

✓ Describe the limitations of scientific knowledge and technology in making predictions related to climate and weather (e.g., predicting the direct and indirect impacts on Canada’s agriculture, forestry and oceans of climate change, or from changes in energy transfer systems, such as ocean currents and global wind patterns)

✓ Assess, from a variety of perspectives, the risks and benefits of human activity, and its impact on the biosphere and the climate (e.g., compare the Gaia hypothesis with traditional Aboriginal perspectives on the natural world; identify and analyze various perspectives on reducing the impact of human activity on the global climate)

**Skill:** Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues

✓ Identify questions to investigate that arise from practical problems and issues (e.g., develop questions related to climate change, such as “How will global warming affect Canada’s northern biomes?”; “How will a species be affected by an increase or decrease in average temperature?”)

**Skill:** 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

- ✔ Use library and electronic research tools to collect information on a given topic (e.g., research sources of greenhouse gases; research protocols to control human sources of greenhouse gases)

**Skill:** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✔ Identify and apply criteria for evaluating evidence and sources of information, including identifying bias (e.g., investigate the issue of global climate change)
- ✔ State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis (e.g., summarize an analysis of the relationship between human activity and changing biomes)
- ✔ Explain how data support or refute a hypothesis or a prediction (e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)

**Skill:** Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✔ Identify multiple perspectives that influence a science-related decision or issue (e.g., consult a wide variety of electronic sources that reflect varied viewpoints and economic, social, scientific and other perspectives on global warming and climate change)

**Attitude:** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)

## SCIENCE

### Science 14 Unit D - Investigating Matter and Energy in the Environment

#### Specific Learning Outcomes:

1. Describe how the flow of matter in the biosphere is cyclical along characteristic pathways and can be disrupted by human activity

- ✔ Assess the costs and benefits of technological developments that produce materials the ecosystem cannot recycle (e.g., disposable plastics, heavy metals)
- ✔ Explain how biodegradable materials reduce the impact of human-made products on the environment
- ✔ Describe, in general terms, how water, carbon, oxygen and nitrogen are cycled through the biosphere
- ✔ Assess the impact of modern agricultural technology on the natural pathways of recycling matter
- ✔ Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., fishing technologies that result in harvesting more than the rate of reproduction, use of pesticides such as DDT, impact of driving a car on atmospheric compositions)

2. Analyze a local ecosystem in terms of its biotic and abiotic components, and describe factors of the equilibrium

- ✔ Describe the relationship between land use practices and altering ecosystems (e.g., swamp drainage, slash and burn forestry, agriculture)
- ✔ Trace the development of a technological application that has altered an ecosystem (e.g., power generation, fishing, logging, oil and gas exploration, agricultural practices)

**Skill:** Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- ✔ Identify questions to investigate arising from practical problems and issues (e.g., develop questions related to recycling, ozone depletion or introduction of exotic species)
- ✔ Define questions and problems to facilitate investigation (e.g., develop questions to guide investigations on composting, recycling, impact of farming practices on local ecosystems)



- ✔ Design an experiment; and identify the manipulated, responding and controlled variables (e.g., investigate the amount of waste materials produced by a school or family on a daily or weekly basis)
- ✔ Select appropriate methods and tools for collecting data and information to solve problems (e.g., plan and conduct a search for environmental projects, using a wide variety of electronic sources)

**Skill:** Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

- ✔ Carry out procedures, controlling the major variables (e.g., perform quantitative experiments to demonstrate that cellular respiration releases some thermal energy)
- ✔ Estimate measurements (e.g., collect quantitative data that demonstrate how closed populations of organisms—hay infusions, pond water samples, fruit flies, brine shrimp—change over time; present the data in tables, graphs or charts)
- ✔ Organize data, using a format that is appropriate to the task or experiment (e.g., analyze the biotic and abiotic data collected in an ecosystem study, and present this information in a written or graphic format or in an oral presentation to peers)

**Skill:** Analyze qualitative and quantitative data, and develop and assess possible explanations

- ✔ Identify and evaluate potential applications of findings (e.g., experimentally determine the biodegradability of various forms of organic matter, and relate findings to composting and recycling)
- ✔ Identify new questions and problems that arise from what was learned (e.g., “Should there be more controls on bringing live animals and plants to Canada from the United States and other countries?”, “How can we reduce the amount of household wastes?”)

**Skill:** Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results

- ✔ Receive, understand and act on the ideas of others (e.g., revise text documents based on feedback from others)

- ✔ Communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., represent the movement of matter and energy in an ecosystem, using food chains, webs or pyramids, and communicate this information in the form of a graphic illustration; describe the biogeochemical cycles of carbon, nitrogen or oxygen, and communicate this information in clearly labelled charts, models or diagrams)
- ✔ Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise (e.g., perform a field study on an aquatic or terrestrial ecosystem)
- ✔ Evaluate individual and group processes used in planning, problem solving, decision making and completing a task (e.g., evaluate group brainstorming ideas for environmental projects)

**Attitude:** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., examine their personal role in the preservation of the environment; make personal decisions based on feelings of responsibility toward less privileged parts of the global community and toward future generations; participate in the social and political systems that influence environmental policy in their community)

**Attitude:** Show concern for safety in planning, carrying out and reviewing activities (e.g., consider safety and show concern for the environment when disposing of used materials)

## SOCIAL STUDIES

### Social Studies 10-1 Perspectives on Globalization

#### Specific Learning Outcomes:

3.1 Recognize and appreciate multiple perspectives that exist with respect to the relationships among politics, economics, the environment and globalization (GC, ER, PADM)

3.2 Recognize and appreciate impacts of globalization on the interdependent relationships among people, the economy and the environment (GC, ER, PADM)

3.7 Explore multiple perspectives regarding the relationship among people, the land and globalization (spirituality, stewardship, sustainability, resource development) (LPP, CC, ER, GC)

3.8 Evaluate actions and policies associated with globalization that impact the environment (land and resource use, resource development agreements, environmental legislation) (LPP, ER, GC)

3.9 Analyze multiple perspectives on sustainability and prosperity in a globalizing world (ER, LPP, GC)

4.3 Accept political, social and environmental responsibilities associated with global citizenship (C, GC, ER)

4.8 Analyze how globalization affects individuals and communities (migration, technology, agricultural issues, pandemics, resource issues, contemporary issues) (GC, LPP)

4.10 Evaluate means by which individuals, governments, organizations and businesses could address opportunities and challenges of globalization (pro-globalization activism, anti-globalization activism, legislation, agreements, consumer activism, corporate responsibility) (GC, C, PADM, ER)

#### S.3 Develop skills of geographic thinking:

Assess the impact of human activities on the land and the environment

## SOCIAL STUDIES

### Social Studies 10-2 -Living in a Globalizing World

#### Specific Learning Outcomes:

3.1 Recognize and appreciate multiple perspectives that exist with respect to the relationships among politics, economics, the environment and globalization (GC, ER, PADM)

3.2 Recognize and appreciate impacts of globalization on the interdependent relationships among people, the economy and the environment (GC, ER, PADM)

3.7 Explore multiple perspectives regarding the relationship among people, the land and globalization (spirituality, stewardship, sustainability, resource development) (LPP, CC, ER, GC)

3.8 Evaluate actions and policies associated with globalization that impact the environment (land and resource use, resource development agreements, environmental legislation) (LPP, ER, GC)

3.9 Analyze multiple perspectives on sustainability and prosperity in a globalizing world (ER, LPP, GC)

4.3 Accept political, social and environmental responsibilities associated with global citizenship (C, GC, ER)

4.8 Analyze how globalization affects individuals and communities (migration, technology, agricultural issues, pandemics, resource issues, contemporary issues) (GC, LPP)

4.10 Evaluate means by which individuals, governments, organizations and businesses could address opportunities and challenges of globalization (pro-globalization activism, anti-globalization activism, legislation, agreements, consumer activism, corporate responsibility) (GC, C, PADM, ER)

#### S.3 Develop skills of geographic thinking:

Assess the impact of human activities on the land and the environment

# 10

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

An understanding of life processes at the cellular level can be applied to the knowledge and skills required to ensure the health of animals and plants and the quality of the food supply. Concepts related to animal and plant health are found in Science and Career and Technology Studies (CTS) curriculum.



Note that there are numerous CTS courses specific to a broad range of agricultural activities and practices. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

### SCIENCE 10 Unit C

- > Microscopy and the emergence of cell theory
- > Cellular structures and functions, and technological applications
- > Cell specialization in multicellular organisms; i.e., plants
- > Mechanisms of transport, gas exchange, and environmental response in multicellular organisms; i.e., plants

How does an understanding of the role of cell theory further and improve practices that ensure plant and animal health?

- > Investigate the function and structure of cells in the life processes of crop plant species and livestock animals.
- > Examine processes of diffusion and osmosis to practical food production applications, such as cheese making, and uses of honey and berries as antibacterial and preservative agents.
- > Analyze the specialized structures of crop plant species, focusing on the implications for water and soil.
- > Research the importance of nutrients for plant and animal species and how they impact health on a cellular level.
- > Investigate careers related to agriculture, including horticulture, genetics and health-related.

### SCIENCE 14 Unit D

- > Microscopy, structure and function of plant and animal cell parts, and the cell theory
- > Functions of cells in organs and organ systems
- > Photosynthesis and respiration
- > Capture, storage and use of energy by living organisms
- > Role of technology to monitor life functions

How does an understanding of the role of cell theory further and improve practices that ensure plant and animal health?

- > Investigate the structure and function of crop plant and livestock animal cell parts and explain why this knowledge is important to plant and animal health and welfare.
- > Explore the life functions important to crop plant and livestock animal species, including photosynthesis and respiration and connect this knowledge to agricultural practices.
- > Investigate ways that technology is used to monitor life functions.

### CTS AGRICULTURE COURSES

- > Agricultural practices and activities
- > Animal and plant basics

What is the significance and importance of agriculture for quality of life, sustainable environments and human activities?

- > Explore the implications of the diversity of agricultural practices in Alberta and/or Canada, using first-hand accounts and experiences from agricultural producers.
- > Develop best practices for plant propagation or animal care/welfare in a specific agricultural field.
- > Focus on skills related to sustainable agricultural practices, including soil management and applications of technology.
- > Investigate the balance and relationship between economic and environmental decisions and their impact on quality of life.
- > Research agricultural careers and occupations.

# 10

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

The outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 10 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and correlate them to the activities that are created. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SCIENCE

### Science 10 Unit C - Cycling of Matter in Living Systems

#### Specific Learning Outcomes:

1. Explain the relationship between developments in imaging technology and the current understanding of the cell
  - ✓ Identify areas of cell research at the molecular level (e.g., DNA and gene mapping, transport across cell membranes)
2. Describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications:
  - ✓ Compare passive transport of matter by diffusion and osmosis with active transport in terms of the particle model of matter, concentration gradients, equilibrium and protein carrier molecules (e.g., particle model of matter and fluid-mosaic model)
  - ✓ Use models to explain and visualize complex processes like diffusion and osmosis, endo- and exocytosis, and the role of cell membrane in these processes
  - ✓ Identify the structure and describe, in general terms, the function of the cell membrane, nucleus, lysosome, vacuole, mitochondrion, endoplasmic reticulum, Golgi apparatus, ribosomes, chloroplast and cell wall, where present, of plant and animal cells
  - ✓ Compare the structure, chemical composition and function of plant and animal cells, and describe the complementary nature of the structure and function of plant and animal cells
  - ✓ Describe the role of the cell membrane in maintaining equilibrium while exchanging matter
  - ✓ Describe how knowledge about semi-permeable membranes, diffusion and osmosis is applied in various contexts (e.g., attachment of HIV drugs to cells and liposomes, diffusion of protein hormones into cells, staining of cells, desalination of sea water, peritoneal or mechanical dialysis, separation of bacteria from viruses, purification of water, cheese making, use of honey as an antibacterial agent and berries as a preservative agent by traditional First Nations communities)
  - ✓ Describe cell size and shape as they relate to surface area to volume ratio, and explain how that ratio limits cell size (e.g., compare nerve cells and blood cells in animals, or plant root hair cells and chloroplast-containing cells on the surface of leaves)

**Skill:** Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues

- ✔ Define and delimit problems to facilitate investigation (e.g., how do plants adjust to accommodate different environmental conditions such as varying levels of light and fertilizer)
- ✔ Design an experiment, identifying and controlling major variables (e.g., design an investigation to determine the effect of CO<sub>2</sub>(g) concentration on the number of chloroplasts found in an aquatic plant cell)
- ✔ State a prediction and a hypothesis based on available evidence and background information (e.g., hypothesize how biochemical interconversions of starch and glucose might regulate the turgor pressure of cells; hypothesize the direction of root and plant growth of a bean plant growing on a rotating turntable, and predict the effects of varying RPMs on the angle of growth)

**Skill:** 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

- ✔ Carry out procedures, controlling the major variables and adapting or extending procedures (e.g., perform an experiment to determine the effect of tonicity on plasmolysis and deplasmolysis in plant cells, such as staminal hairs or aquatic leaf cells, identify variables that do affect plasmolysis, such as the amount of light and heat, and control these variables)
- ✔ Use instruments effectively and accurately for collecting data (e.g., use a microscope to observe movement of water in plants; prepare wet mounts of tissue from flowering plants, and observe cellular structures specific to plant and animal cells; stain cells to make them visible)
- ✔ Estimate quantities (e.g., compare sizes of various types of cells under the microscope; calculate magnification, field of view and scale)
- ✔ Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data (e.g., organize data obtained from measuring daily temperature and bloom dates of plant species, such as aspen, poplar, common purple lilac and crocus to determine a relationship between the two variables)
- ✔ Use library and electronic research tools to collect information on a given topic (e.g., upload and download text, image, audio and video files on emerging technologies for studying cells)
- ✔ Select and integrate information from various print and electronic sources or from several parts of the same source (e.g., create electronic documents containing multiple links, or summarize articles based on the scientific principles and/or technological developments)

## SCIENCE

### Science 14 Unit C - Investigating Matter and Energy in Living Systems

#### Specific Learning Outcomes:

3. Describe, in general terms, the structure and function of plant and animal cell parts; and trace the development of the cell theory
  - ✔ Describe the structure of the major parts of plant and animal cells, including the cell membrane, nucleus, vacuole, mitochondrion, chloroplast and cell wall
  - ✔ Describe, using analogies where appropriate, the functions of the major parts of plant and animal cells, including the cell membrane, nucleus, vacuole, mitochondrion, chloroplast and cell wall (e.g., compare cell functions to the functioning of a city)
4. Identify and compare, in general terms, the life functions common to living systems, from cells to organ systems
  - ✔ Describe the relationship between photosynthesis and cellular respiration in terms of biological energy storage; i.e., capture of energy from the Sun in glucose during photosynthesis, and the release of energy from glucose during respiration
  - ✔ Identify life functions common to living systems; i.e., energy conversion, response to the environment, growth, reproduction, and conservation or dissipation of thermal energy (e.g., torpor, dormancy, hibernation, estivation, vascular skin, sweat gland behaviour)
  - ✔ Describe how cell structure has been adapted for specific life functions (e.g., stomata in the leaves for water balance; skin cells are flat to cover large surface area; plant cell walls provide structural support; nerve cells are long for transmission of impulses; storage of chemical energy in roots [e.g., sugar beets], stems [e.g., sugar cane] and fruits [e.g., apples])

**Skill:** Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

- ✔ Use instruments effectively and accurately for collecting data (e.g., prepare wet mounts of tissue, and observe cellular structures specific to plant cells and animal cells; observe structures using photomicrographs or electron micrographs)
- ✔ Organize data, using a format that is appropriate to the task or experiment (e.g., determine the nutrient components in popular diets)

- ✔ Use tools and apparatus safely (e.g., stain a variety of animal and plant cells, use the compound microscope to identify cellular structures from prepared slides of plant and animal tissue or from microslides, and accurately represent these structures in clearly labelled diagrams)

**Skill:** Analyze qualitative and quantitative data, and develop and assess possible explanations

- ✔ Identify new questions and problems that arise from what was learned (e.g., “How do water and dissolved materials move in living plant and animal cells?”)
- ✔ Identify and evaluate potential applications of findings (e.g., experimentally determine the biodegradability of various forms of organic matter, and relate findings to composting and recycling)
- ✔ Identify new questions and problems that arise from what was learned (e.g., “Should there be more controls on bringing live animals and plants to Canada from the United States and other countries?”, “How can we reduce the amount of household wastes?”)

## CAREER AND TECHNOLOGY STUDIES

### AGR1010 - Introduction to Agriculture

Find the full range of **Agriculture Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *NAT cluster (Natural Resources)*. *Agriculture* courses are part of this cluster. These courses all have applicability to resources or programs focused on agriculture and agricultural careers.

#### Specific Learning Outcomes:

1. Demonstrate an understanding of the diversity of agricultural activity in Alberta, Canada and the global community
  - ✔ 1.1 Describe the history and development of agriculture; e.g., marketing boards, farm-owned co-operatives, crop breeding, high efficiency farming methods, conservation methods, women in agriculture
  - ✔ 1.2 Explain the function of subsistence agriculture and commercial agriculture
  - ✔ 1.3 Compare agricultural activities in rural and urban areas; e.g., scale of industry, labour requirements, type of commodity produced, market opportunities, degree of mechanization
  - ✔ 1.4 Describe production and consumption patterns of agricultural products at local, national and international levels
  - ✔ 1.5 Identify evolving and emerging forms of agriculture that have potential to provide aesthetic, emotional, economic and health benefits; e.g., food and textiles, industrial applications, greenhouse production, interior plantscape and landscape, animal husbandry and health care
  - ✔ 1.6 Identify business/labour that provides inputs and services to agriculture
  - ✔ 1.7 Describe the function of community services and government agencies serving agriculture
2. Demonstrate an understanding of the economic, environmental and social significance of agriculture
  - ✔ 2.1 Relate consumer needs and wants to a rationale for the exchange of agricultural goods and services at local, national and global levels
  - ✔ 2.2 Describe the exchange of agricultural goods and services between Canada and other nations and describe the impact on the Canadian economy

- ✓ 2.3 Assess the environmental impact of agriculture; e.g., water management, waste management, crop production
- ✓ 2.4 Assess the impact of agriculture on quality of life factors; e.g., rural and urban development, sustainable food supply, use of natural resources, lifestyle
- ✓ 2.5 Define sustainable agricultural production
- ✓ 2.6 Explain the importance of sustainable production systems in meeting societal needs for food, conserving natural resources and enhancing the quality of the environment
- ✓ 2.7 Assess the impact of choices and decisions made by citizens on the agriculture industry; e.g., selection of foods and textiles, use of land and/or chemicals, concern for animal welfare, support given to development and research
- ✓ 2.8 Assess the impact of inputs on agricultural practices; e.g., production/use of chemicals, cost of primary resources/chemicals/machinery

### 3. Demonstrate basic competencies

- ✓ 3.1 Demonstrate fundamental skills to:
  - 3.1.1 Communicate
  - 3.1.2 Manage information
  - 3.1.3 Use numbers
  - 3.1.4 Think and solve problems
- ✓ 3.2 Demonstrate personal management skills to:
  - 3.2.1 Demonstrate positive attitudes and behaviours
  - 3.2.2 Be responsible
  - 3.2.3 Be adaptable
  - 3.2.4 Learn continuously
  - 3.2.5 Work safely
- ✓ 3.3 Demonstrate teamwork skills to:
  - 3.3.1 Work with others
  - 3.3.2 Participate in projects and tasks

### 4. Make personal connections to the cluster content and processes to inform possible pathway choices

- ✓ 4.1 Complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- ✓ 4.2 Create a connection between a personal inventory and occupational choices

# 10

## Food and Agricultural Commodities

Chemistry | Reactions  
Nutrients | Food  
Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science and Career and Technology Studies (CTS) curriculum.

### SCIENCE 10 Unit A

- > How chemical substances meet human needs
- > Workplace Hazardous Materials Information System (WHMIS) and safe practices
- > International Union of Pure and Applied Chemistry (IUPAC) nomenclature, ionic and molecular compounds, acids and bases
- > Evidence of chemical change
- > Role and need for classification of chemical change

### What is the chemistry of food and other agricultural products?

- > Investigate how the chemical processes and changes involved in food production meet human needs.
- > Research careers associated with food production.
- > Explore how chemical reactions occur when preparing food (e.g., baking); food products (e.g., homogenizing; cheese making); fuel (e.g., biofuels).
- > Assess the implications of chemical reactions and chemical change in agricultural waste handling.
- > Differentiate between acids, bases and neutral solutions in agricultural products and commodities.
- > Identify safe practices for handling specific examples of foods and other agricultural commodities.

### SCIENCE 14 Unit A

- > Safe handling, storage and disposal of household chemicals
- > Workplace Hazardous Materials Information System (WHMIS) and consumer product symbols
- > Solutions and solubility of household substances
- > Dilution and concentration
- > Preparing solutions
- > Separating mixtures
- > Acids and bases

### What is the chemistry of food and other agricultural products?

- > Identify and describe the implications of mixtures and solutions in production of food, biofuels, herbicides, fertilizers and animal feed.
- > Describe how the concepts of solutions and solubility, solutes and solvents are applied to the production of prepared foods and other agricultural commodities.
- > Assess the implications of chemical reactions and chemical change in agricultural waste handling.
- > Differentiate between acids, bases and neutral solutions in agricultural products and commodities.
- > Identify safe practices for handling specific examples of foods and other agricultural commodities.



# 10

## Food and Agricultural Commodities

Chemistry | Reactions  
Nutrients | Food  
Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science and Career and Technology Studies (CTS) curriculum.



### SCIENCE 14 Unit C

- > Diets and human nutritional needs
- > Social influences on human dietary-induced disorders and circulatory diseases

How can lifestyle choices be strengthened by knowledge of food composition and nutrients?

- > Analyze food composition and nutrient value by examining a range of food products produced in Alberta and Canada; discuss the use of these food products in popular diets.
- > Assess the social impact food trends, like 'buy organic' and 'buy local', from the perspective of consumers and agricultural producers.
- > Identify social influences that affect food choices and develop strategies for making food choices that offer balanced nutritional benefits.

### CTS FOODS COURSES

- > Food production
- > Agricultural products and commodities
- > Food nutrition

What choices and benefits are provided by the diversity of agricultural production?

- > Visually map the basic steps involved in planting, growing and harvesting a plant commodity or in raising, growing and finishing an animal commodity in Alberta.
- > Identify the agricultural products that are used in a variety of recipes.
- > Assess the nutrients that are provided by a range of different agricultural products.
- > Identify Alberta producers and/or groups and the food products they create.
- > Analyze food labels for evidence of Alberta or Canadian origins.
- > Demonstrate the interrelationships among food choices and nutrients
- > Apply knowledge of nutrients to cooking methods.

Note that there are numerous CTS courses specific to a broad range of food and nutrition topics. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

# 10

## Food and Agricultural Commodities

Chemistry | Reactions |

Nutrients | Food Production

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 10 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SCIENCE

### Science 10 Unit A - Energy and Matter in Chemical Change

#### Specific Learning Outcomes:

1. Describe the basic particles that make up the underlying structure of matter, and investigate related technologies
  - ✓ Identify examples of chemistry-based careers in the community (e.g., chemical engineering, cosmetology, food processing)
3. Identify and classify chemical changes, and write word and balanced chemical equations for significant chemical reactions, as applications of Lavoisier's law of conservation of mass
  - ✓ Provide examples of household, commercial and industrial processes that use chemical reactions to produce useful substances and energy (e.g., baking powder in baking, combustion of fuels, electrolysis of water into H<sub>2</sub>(g) and O<sub>2</sub>(g))

**Skill:** Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues

- ✓ Define and delimit problems to facilitate investigation
- ✓ Design an experiment, identifying and controlling major variables (e.g., design an experiment to differentiate between categories of matter, such as acids, bases and neutral solutions, and identify manipulated and responding variables)
- ✓ State a prediction and a hypothesis based on available evidence and background information (e.g., state a hypothesis about what happens to baking soda during baking)
- ✓ Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring and decision making (e.g., list appropriate technology for classifying compounds, such as litmus paper or conductivity tester)

## SCIENCE

### Science 14 Unit A - Investigating Properties of Matter

#### Specific Learning Outcomes:

2. Describe solutions and solubility, solutes and solvents; and then describe how these concepts are applied to the production of prepared foods and other useful materials

- ✓ Provide examples of insoluble and soluble mixtures (e.g., oil and water, vinegar and water); and, in general terms, account for the difference
- ✓ Provide examples of the effect of temperature change on solubility, and explain this effect on the basis of the particle model of matter (e.g., concentration of brines for pickling and syrups for canning)
- ✓ Link concentration changes and the concept of dilution to changes in the ratio of the amount of solute to the amount of solvent (e.g., investigate how concentrated products, such as orange juice, evaporated milk or instant coffee are made)

**Skill:** Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- ✓ Select appropriate methods and tools for collecting data and information to solve problems (e.g., separate a mixture using standard techniques, such as filtration, evaporation, crystallization or chromatography)

**Skill:** Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

- ✓ Carry out procedures, controlling the major variables (e.g., investigate properties, such as physical appearance, density, conductivity, solubility, magnetism and melting point, of sample materials in the laboratory and in a reference source, and tabulate the results)
- ✓ Organize data, using a format that is appropriate to the task or experiment (e.g., prepare a chart that describes the properties of common household solutions and lists procedures for their safe use, storage and disposal)

**Skill:** Analyze qualitative and quantitative data, and develop and assess possible explanations

- ✓ Predict the value of a variable, by interpolating or extrapolating from graphical data (e.g., use data collected by computer in the laboratory or by other means to demonstrate that the solubility of substances varies directly with the temperature)
- ✓ Identify and evaluate potential applications of findings (e.g., relate the use of standard laboratory separation techniques to the processes used in water treatment and purification; investigate how soaps and detergents can dissolve in both water and oil)

**Skill:** Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results

- ✓ Communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., write a paragraph to describe how chemicals are used at home and in industry)

**Attitude:** Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields (e.g., research answers to questions, such as: "What is the pH of the shampoo and other cleaning solvents used in my home?"; recognize that part-time jobs require science- and technology-related knowledge and skills)

**Attitude:** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., assume part of the collective responsibility for the impact of humans on the environment; consider the impact of technologies, weighing scientific, technological and ecological factors; evaluate the long-term impact of waste disposal, such as paints and cleaning solutions, on the environment and the quality of life of living organisms)

## SCIENCE

### Science 14 Unit C - Investigating Matter and Energy in Living Systems

#### Specific Learning Outcomes:

1. Describe, in general terms, the exchange of matter by the digestive and circulatory systems, the functional relationship between the two systems and the need for a healthy diet and lifestyle

- ✓ Assess the nutrient components of prepared foods by reading labels, and evaluate a variety of popular diets in terms of nutrient composition
- ✓ Analyze and discuss mixed diets and vegetarian diets in meeting human nutritional needs

**Skill:** Ask questions about relationships between and among observable variables, and plan investigations to address those questions • rephrase questions in a testable form, and clearly define practical problems (e.g., “Is there a relationship between social attitudes and diet?”)

## CAREER AND TECHNOLOGY STUDIES

### FOD1070 Farm to Table

Find the full range of **Foods Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *HRH cluster (Health, Recreation & Human Services)*. *Foods* courses are part of this cluster. Selected courses have potential applicability to resources or programs focused on food production and agricultural careers.

#### Specific Learning Outcomes:

1. Demonstrate an understanding of the significance of agriculture to Alberta
  - ✓ 1.1 Identify how Alberta agricultural products can be used in the daily diet
  - ✓ 1.2 Examine the scope and significance of Alberta’s agricultural industry, considering:
    - 1.2.1 Economic contributions
    - 1.2.2 Environmental stewardship
    - 1.2.3 Impact on food choices and diets
  - ✓ 1.3 Identify Alberta grown products used by fast-food restaurants
2. Identify and describe the basic steps and procedures involved in producing a plant or an animal commodity
  - ✓ 2.1 Explore a plant’s or an animal’s physical growth requirements
  - ✓ 2.2 Describe plant or animal health
  - ✓ 2.3 Identify equipment and buildings required
  - ✓ 2.4 Describe the role of the producers throughout the stages of production
  - ✓ 2.5 Explore consumer perceptions of agriculture production of products
  - ✓ 2.6 Identify and address one or more myths related to farming; e.g., hormones, food value of organic versus conventional products, brown eggs versus white eggs

### 3. Demonstrate knowledge and skills in the planning, preparing and evaluating of Alberta grown agricultural products

- ✓ 3.1 Prepare a minimum of five recipes based on local food products rich in:
  - 3.1.1 Carbohydrates; e.g., bread from grain, salads/soups from vegetables or fruit
  - 3.1.2 Protein; e.g., cheese, locally produced meat products
- ✓ 3.2 Identify steps in developing a product from a locally grown food and prepare the food; e.g., preparing jam from local fruits or berries

### 4. Identify and demonstrate safe and sanitary practices

- ✓ 4.1 Maintain a clean, sanitary, safe work area
- ✓ 4.2 Apply universal precautions related to:
  - 4.2.1 Personal protective equipment (PPE); e.g., hair coverings, aprons, gloves
  - 4.2.2 Hand-washing techniques
  - 4.2.3 Infectious diseases
  - 4.2.4 Blood-borne pathogens
  - 4.2.5 Bacteria, viruses, molds
  - 4.2.6 Safety and first-aid applications; e.g., back safety, cuts, slip and trip hazards
- ✓ 4.3 Use all materials, products and implements appropriately
- ✓ 4.4 Clean, sanitize and store materials, products and implements correctly
- ✓ 4.5 Dispose of waste materials in an environmentally safe manner

### 5. Demonstrate basic competencies

- ✓ 5.1 Demonstrate fundamental skills to:
  - 5.1.1 Communicate
  - 5.1.2 Manage information
  - 5.1.3 Use numbers
  - 5.1.4 Think and solve problems

- ✓ 5.2 Demonstrate personal management skills to:
  - 5.2.1 Demonstrate positive attitudes and behaviours
  - 5.2.2 Be responsible
  - 5.2.3 Be adaptable
  - 5.2.4 Learn continuously
  - 5.2.5 Work safely
- ✓ 5.3 Demonstrate teamwork skills to:
  - 5.3.1 Work with others
  - 5.3.2 Participate in projects and tasks

### 6. Make personal connections to the cluster content and processes to inform possible pathway choices

- ✓ 6.1 Complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- ✓ 6.2 Create a connection between a personal inventory and occupational choices

## CAREER AND TECHNOLOGY STUDIES

### FOD1080 Food & Nutrition

Find the full range of **Foods Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *HRH cluster (Health, Recreation & Human Services)*. Foods courses are part of this cluster. Selected courses have potential applicability to resources or programs focused on food production and agricultural careers.

#### Specific Learning Outcomes:

1. Identify and explain the interrelationships among food choices, nutrients and wellness

✓ 1.1 Identify sources and explain functions of the leader nutrients, including:

1.1.1 Water

1.1.2 Carbohydrates; e.g., sugar, starch, cellulose

1.1.3 Proteins

1.1.4 Fats

1.1.5 Fat-soluble vitamins

1.1.6 Water-soluble vitamins

1.1.7 Minerals

✓ 1.2 Explain the effects of cooking and processing of leader nutrients

✓ 1.3 Describe the relationship of food choices with:

1.3.1 Wellness

1.3.2 Illness; e.g., heart disease, cancers, diabetes, obesity, eating disorders

2. Describe the importance of health issues and eating habits

✓ 2.1 Apply healthy food choices in relation to Eating Well with Canada's Food Guide

✓ 2.2 Determine individual dietary requirements

✓ 2.3 Create a personal dietary analysis

✓ 2.4 Recognize alternative and culturally diverse menus

✓ 2.5 Identify correct serving sizes

✓ 2.6 Provide examples of healthy snacks and how they relate to the food groups

✓ 2.7 Design and analyze a balanced meal in relation to:

2.7.1 Food groups

2.7.2 Leader nutrients

3. Interpret nutrition information

✓ 3.1 Analyze reliable and unreliable nutrition information

✓ 3.2 Examine and interpret information on food labels or other sources

4. Demonstrate knowledge and skills in the planning, preparing and evaluating of nutritious foods

✓ 4.1 Prepare, compare and/or analyze a minimum of five recipes that emphasize:

4.1.1 The four food groups and related nutrients

4.1.2 A modified recipe; e.g., fibre content, fat content, type of fat, sugar content

4.1.3 Use in a meal

✓ 4.2 Complete a nutritional analysis of one prepared recipe

5. Identify and demonstrate safe and sanitary practices

✓ 5.1 Maintain a clean, sanitary, safe work area

✓ 5.2 Apply universal precautions related to:

5.2.1 Personal protective equipment (PPE); e.g., hair coverings, aprons, gloves

5.2.2 Hand-washing techniques

5.2.3 Infectious diseases

5.2.4 Blood-borne pathogens

5.2.5 Bacteria, viruses, molds

5.2.6 Safety and first-aid applications; e.g., back safety, cuts, slip and trip hazards

✓ 5.3 Use all materials, products and implements appropriately

✓ 5.4 Clean, sanitize and store materials, products and implements correctly

✓ 5.5 Dispose of waste materials in an environmentally safe manner

## 6. Demonstrate basic competencies

### 6.1 Demonstrate fundamental skills to:

- 6.1.1 Communicate
- 6.1.2 Manage information
- 6.1.3 Use numbers
- 6.1.4 Think and solve problems

### 6.2 Demonstrate personal management skills to:

- 6.2.1 Demonstrate positive attitudes and behaviours
- 6.2.2 Be responsible
- 6.2.3 Be adaptable
- 6.2.4 Learn continuously
- 6.2.5 Work safely

### 6.3 Demonstrate teamwork skills to:

- 6.3.1 Work with others
- 6.3.2 Participate in projects and tasks

## 7. Identify possible life roles related to the skills and content of this cluster

### 7.1 Recognize and then analyze the opportunities and barriers in the immediate environment

### 7.2 Identify potential resources to minimize barriers and maximize opportunities

# 10

## Food Security and Economies of Food Production

Globalization | Nationalism | Trade | Policies

Food security, according to the Food and Agriculture Organization, exists “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” Food security is often linked to geographic location, economic inequalities and poverty. Concepts related to food security, economic issues, globalization and social or economic inequalities in Social Studies curriculum can be explored through an agricultural lens.



### SOCIAL STUDIES 10-1 / 10-2

- > Impact of globalization on land, cultures, economies and quality of life
- > Local, national and international contexts of globalization

How does globalization affect social and economic access to resources?

- > Describe the impact of food deserts and food swamps on opportunity and access to a nutritious and safe food supply.
- > Predict the effect of increasing globalization on the global food supply and investigate actions that agricultural producers can implement.
- > Create a food policy that addresses equal access to a nutritious and safe food supply.
- > Investigate issues and examples related to food production (e.g., waste) and food safety in a global context.
- > Research and compare initiatives to support local food production in a global context.



# 10

## Food Security and Economies of Food Production

Globalization | Nationalism | Trade | Policies

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 10 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SOCIAL STUDIES

### Social Studies 10-1 Perspectives on Globalization

#### Specific Learning Outcomes:

- 3.1 Recognize and appreciate multiple perspectives that exist with respect to the relationships among politics, economics, the environment and globalization (GC, ER, PADM)
- 3.2 Recognize and appreciate impacts of globalization on the interdependent relationships among people, the economy and the environment (GC, ER, PADM)
- 3.7 Explore multiple perspectives regarding the relationship among people, the land and globalization (spirituality, stewardship, sustainability, resource development) (LPP, CC, ER, GC)
- 3.8 Evaluate actions and policies associated with globalization that impact the environment (land and resource use, resource development agreements, environmental legislation) (LPP, ER, GC)
- 3.9 Analyze multiple perspectives on sustainability and prosperity in a globalizing world (ER, LPP, GC)
- 4.3 Accept political, social and environmental responsibilities associated with global citizenship (C, GC, ER)
- 4.8 Analyze how globalization affects individuals and communities (migration, technology, agricultural issues, pandemics, resource issues, contemporary issues) (GC, LPP)
- 4.10 Evaluate means by which individuals, governments, organizations and businesses could address opportunities and challenges of globalization (pro-globalization activism, anti-globalization activism, legislation, agreements, consumer activism, corporate responsibility) (GC, C, PADM, ER)

## SOCIAL STUDIES

### Social Studies 10-2 Living in a Globalizing World

#### Specific Learning Outcomes:

3.1 Recognize and appreciate multiple perspectives that exist with respect to the relationships among economics, politics, the environment and globalization (GC, ER, PADM)

3.2 Recognize and appreciate impacts of globalization on the interdependent relationships among the economy, people and the environment (GC, ER, PADM)

3.7 Explore multiple perspectives on relationships among people, the land and globalization (spirituality, stewardship, sustainability, resource development) (LPP, CC, GC, ER)

3.8 Analyze the impact of actions and policies associated with globalization on the environment (land and resource use, resource development agreements, environmental legislation) (LPP, ER, GC)

3.9 Examine multiple perspectives on sustainability and prosperity in a globalizing world (ER, LPP, CC)

4.3 Accept political, social and environmental responsibilities associated with global citizenship (C, GC, ER)

4.8 Examine how globalization affects individuals and communities (migration, technology, agricultural issues, pandemics, resource issues, contemporary issues) (GC, LPP)

4.10 Analyze means by which individuals, governments, organizations and businesses in Canada could address the opportunities and challenges of globalization (pro-globalization activism, anti-globalization activism, legislation, agreements, consumer activism, corporate responsibility) (GC, C, PADM, ER)

# 10

## Technologies

Automation | Robotics |  
Biotechnology | Genetics

Agricultural technology encompasses advancements in automation and robotics, information technology applications as well as biotechnology and genetics. Concepts related to genetics, technologies used to deal with climate change and biotechnology in Science curriculum can be explored through an agricultural lens.

### SCIENCE 10 Unit C

- > Cellular structures and functions, and technological applications
- > Use of explanatory and visual models in science

How does scientific research inform technological advancements in agriculture?

- > Research how advancements in cell and genetic research has affected agricultural livestock and/or crop practices.
- > Identify benefits and challenges related to the use of genetic technologies in agricultural and food production.

### SCIENCE 10 Unit D

- > Social and environmental contexts for investigating climate change
- > Human activity and climate change

What strengths and limitations does technology provide?

- > Investigate the strengths and limitations of technology used to predict weather and aid farmers in planting and harvesting crops.
- > Make informed predictions about the future impact of global warming and climate change.

### SCIENCE 14 Unit D

- > Impact of modern agricultural technologies
- > Biotic and abiotic factors and ecosystems

What are the intended and unintended consequences of technologies?

- > Compare the impact of materials that can and cannot be recycled in agricultural production pathways.
- > Identify and research one example that illustrates how technology has changed agricultural practices.

# 10

## Technologies

Automation | Robotics |

Biotechnology | Genetics

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## SCIENCE

### Science 10 Unit C - Cycling of Matter in Living Systems

#### Specific Learning Outcomes:

1. Explain the relationship between developments in imaging technology and the current understanding of the cell

- ☑ Identify areas of cell research at the molecular level (e.g., DNA and gene mapping, transport across cell membranes)

**Skill:** 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

- ☑ Use library and electronic research tools to collect information on a given topic (e.g., upload and download text, image, audio and video files on emerging technologies for studying cells)
- ☑ Select and integrate information from various print and electronic sources or from several parts of the same source (e.g., create electronic documents containing multiple links, or summarize articles based on the scientific principles and/or technological developments)

## SCIENCE

### Science 10 Unit D - Energy Flow in Global Systems

#### Specific Learning Outcomes:

4. Investigate and interpret the role of environmental factors on global energy transfer and climate change

- ✓ Describe the limitations of scientific knowledge and technology in making predictions related to climate and weather (e.g., predicting the direct and indirect impacts on Canada's agriculture, forestry and oceans of climate change, or from changes in energy transfer systems, such as ocean currents and global wind patterns)
- ✓ Assess, from a variety of perspectives, the risks and benefits of human activity, and its impact on the biosphere and the climate (e.g., compare the Gaia hypothesis with traditional Aboriginal perspectives on the natural world; identify and analyze various perspectives on reducing the impact of human activity on the global climate)

**Skill:** 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

- ✓ Use library and electronic research tools to collect information on a given topic (e.g., research sources of greenhouse gases; research protocols to control human sources of greenhouse gases)

**Skill:** Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Identify multiple perspectives that influence a science-related decision or issue (e.g., consult a wide variety of electronic sources that reflect varied viewpoints and economic, social, scientific and other perspectives on global warming and climate change)

## SCIENCE

### Science 14 Unit D - Investigating Matter and Energy in the Environment

#### Specific Learning Outcomes:

1. Describe how the flow of matter in the biosphere is cyclical along characteristic pathways and can be disrupted by human activity

- ✓ Assess the costs and benefits of technological developments that produce materials the ecosystem cannot recycle (e.g., disposable plastics, heavy metals)
- ✓ Assess the impact of modern agricultural technology on the natural pathways of recycling matter
- ✓ Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., fishing technologies that result in harvesting more than the rate of reproduction, use of pesticides such as DDT, impact of driving a car on atmospheric compositions)

2. Analyze a local ecosystem in terms of its biotic and abiotic components, and describe factors of the equilibrium

- ✓ Trace the development of a technological application that has altered an ecosystem (e.g., power generation, fishing, logging, oil and gas exploration, agricultural practices)





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# Connecting Agriculture to Alberta Senior High School Curriculum Grade 11

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# 11

## Environment and Sustainability

Land | Energy | Water | Soil

The use of land, energy, water and soil are central to agricultural practices and the food supply. Not only are resources such as soil and water vital to agricultural productivity, but agriculture both affects and is affected by the local, regional, and global environment. Concepts related to ecological and environmental issues and decisions in Science, Biology and Social Studies curriculum can be explored through an agricultural lens.



### SCIENCE 20 Unit A

- > Solution
- > Concentration
- > Dilution

How are chemical principles applied to substances and solutions used in sustainable agricultural practices?

- > Identify water-based solutions used in agricultural applications, and investigate their chemical composition and how they are used.
- > Using agricultural practices as examples, explore how chemical principles are applied to sustainable livestock and crop farming.

### SCIENCE 20 Unit D

- > Biotic and abiotic factors
- > Population size
- > Species diversity
- > Human interventions in biogeochemical (nitrogen, carbon, water) cycles
- > Autotrophs, heterotrophs, food chains, food webs
- > Trophic levels, biomass, energy and pyramids
- > Human population growth, biodiversity and carrying capacity

How can the interests of a growing human population be balanced with the need for sustainable ecosystems?

- > Describe, illustrate or create a model of an agricultural ecosystem, identifying its characteristics.
- > Analyze ways that matter cycles and energy flows through agriculturally-based ecosystems, and assess the implications of this knowledge in terms of protecting the environment for future generations.
- > Investigate ways that agriculturally-based species diversity is protected by human intervention.
- > Investigate the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation.

### SCIENCE 24 Unit C

- > Role of environmental factors (toxins, pathogens) and genetic factors on human health
- > Human actions to reduce contamination by pathogens

How is human health affected by environmental conditions?

- > Identify guidelines that agricultural producers use to protect the environment and human health, including biosecurity and waste management.
- > Define an environmental pathogen and the practices that agricultural producers use to prevent it.



# 11

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### BIOLOGY 20 Unit A

- > Equilibrium
- > Trophic levels
- > Food chains, food webs and ecological pyramids (energy, biomass and numbers)
- > Carbon, nitrogen, oxygen and phosphorus cycles
- > Water properties

How have human activities and technological advances affected the balance of energy and matter in the biosphere?

- > Illustrate or create a model that represents the constant flow of energy through agricultural ecosystems.
- > Investigate the use of water in agricultural operations, focusing on how water purification and conservation is applied to livestock and crop production.
- > Investigate the extent to which human activities can support or disrupt the balance in an ecosystem, including impact on biodiversity.
- > Use an agricultural context to explain how energy in the biosphere can be perceived as a balance between both photosynthetic and chemosynthetic activities and cellular respiratory activities.

### SOCIAL STUDIES 20-1 / 20-2

- > Nationalism
- > Internationalism
- > Environmental issues
- > Global affairs

How has growing internationalism shaped decisions that affect global environments and land use?

- > Research and assess the extent to which agricultural histories, practices and products - connected to the land and environment - form part of Canadian nationalist identities.
- > Find examples that illustrate how internationalism policies, connected to agriculture, can result in positive and negative impacts on global environments.
- > Make connections between international issues of economics, conflict, poverty, debt, disease, environment and human rights, using agricultural examples.
- > Investigate Canadian support of agriculture in developing countries.

# 11

## Environment and Sustainability

Land | Energy | Water | Soil

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## SCIENCE

### Science 20 Unit A - Chemical Changes

#### Specific Learning Outcomes:

**A1.1k** Explain how dissolving substances in water is often a prerequisite for chemical reactions and chemical changes; e.g., batteries, baking, medications

**A1.1sts** Explain how science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

☑ Identify properties of aqueous solutions that enable chemical reactions important for industry

**A1.2sts** Explain that science and technology have influenced, and been influenced by, historical development and societal needs (SEC2) [ICT F2–4.8]

☑ Compare the ways in which concentrations are expressed in chemistry laboratories, industrial processes, household products and environmental studies

**A1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

☑ Evaluate the risk involved in the handling, storage and disposal of solutions that are in common use in the laboratory, in the home and in industry across Alberta (AI–SEC2, PR–NS5)

**A1.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

☑ Research, in teams, the impact of the release of effluent into waterways (IP–SEC3, PR–SEC1, AI–SEC3, CT–SEC1) [ICT C1–4.1]

**A3.2sts** Discuss the appropriateness, risks and benefits of technologies, assessing each potential application from a variety of perspectives, including sustainability (ST7) [ICT F2–4.2, F3–4.1]

☑ Identify challenges when taking scientific knowledge from the laboratory and applying the knowledge to large-scale manufacturing processes or to the development of products, considering such things as the supply of raw materials, energy, labour and the storage and disposal of waste products

## SCIENCE

### Science 20 Unit D - Changes in Living Systems

#### Specific Learning Outcomes:

**D1.1k** Investigate and analyze an aquatic or a terrestrial local ecosystem, distinguish between biotic and abiotic factors, describe how these factors affect population size and

- ✓ Infer the abiotic effects on life; e.g., light, nutrients, water, temperature
- ✓ Infer biotic interactions; e.g., predator-prey relationships, competition, symbiotic relationships
- ✓ Infer the influence of biota on the local environment; e.g., microclimates, soil, nutrients

**D1.5k** Describe the effects of introducing a new species into, or largely removing an established species from, an environment; e.g., zebra mussel, carp and the Eurasian milfoil in Canada's lakes, purple loosestrife in Alberta, the horse or the buffalo in the plains region of Alberta

**D1.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ Evaluate and select appropriate procedures and technology to measure the impact of introducing species X into a specific environment (IP-NS4) [ICT C6-4.5]
- ✓ Predict disruptions in the nitrogen cycle that are caused by human activities (IP-NS3)

**D1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze field study data to identify the interrelationships of biotic and abiotic components of the ecosystem studied; e.g., dominant plants, micro-climates and habitats, niches and interrelationships of biota (AI-NS1, AI-NS2) [ICT C7-4.2]
- ✓ Analyze the information presented by opposing sides on an environmental issue, such as that of an environmental group and that of an industry representative, to determine bias (AI-NS4, AI-SEC1) [ICT C2-4.1, C2-4.2]
- ✓ Demonstrate and assess the effect of environmental factors on population growth curves (AI-NS2, AI-NS6) [ICT C7-4.2]

- ✓ Apply the growth curve for open populations to identify the long-term impact on Earth's carrying capacity and the demands on natural resources for a growing human population (AI-NS2, AI-NS4, AI-NS6)

**D1.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Elicit feedback from others on an environmental issue (CT-NS1)
- ✓ Participate in a variety of electronic group formats to gather and share information about environmental issues (CT-NS1) [ICT C5-4.2]

**D2.1k** Outline the biogeochemical cycles of nitrogen, carbon, oxygen and water and, in general terms, describe their interconnectedness, building on knowledge of the hydrologic cycle from Science 10, Unit D

**D2.2k** Describe artificial and natural factors that affect the biogeochemical cycles:

- ✓ Nitrogen cycle; e.g., automobile, agricultural and industrial contributions to NO<sub>x</sub> combining with water to produce nitric acid, nitrogen in manure and fertilizers
- ✓ Carbon cycle; e.g., emissions of carbon oxides from extraction, distribution and combustion of fossil fuels, releases associated with deforestation and cement industries
- ✓ Water cycle; e.g., extraction of ground water, dams for hydro-electricity and irrigation

**D2.3k** Analyze and describe how energy flows in an ecosystem, using the concepts of conservation of energy (second law of thermodynamics); energy input and output through trophic levels, food webs, chains and pyramids; and specific examples of autotrophs and heterotrophs

**D2.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F2-4.8, F3-4.1]

- ✓ Assess whether the efforts to reduce human impact on biogeochemical cycles are viable, taking into consideration a variety of perspectives (considerations for deep-well and deep-ocean injection of wastes, for example, include properties of waste, concentration, uncertainty, environmental concerns, risks and benefits to human health and organisms, costs)

- ✓ Discuss the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation, considering such things as manufacturing, the oil industry, agricultural systems, the mining industry and domestic daily water consumption
- ✓ Contrast the diet of people in developing countries and that of people in developed countries in terms of energy efficiency and environmental impact, and describe ways to address potential food shortages in the future

**D2.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Draw, by hand or using technology, annotated diagrams of energy flow in food chains, webs and pyramids (PR-NS4)

**D3.5k** Describe how factors including space, accumulation of wastes (e.g., salinization of soil), competition, technological innovations, irrigation practices (e.g., Hohokam farmers) and the availability of food impact the size of populations

## SCIENCE

### Science 24 Unit C - Disease Defence and Human Health

#### Specific Learning Outcomes:

1. Describe how human health is affected by societal and environmental factors, and describe the need for action by society to improve human health
  - ✓ Describe, in general terms, how human diseases may arise from an interaction of variables, including poor nutrition, stress, pathogens and environmental contamination
  - ✓ Analyze the relationship between social conditions and disease (e.g., hunger and malnutrition; sanitation and bacterial, viral, fungal diseases)
2. Analyze the relationship between human health and environmental pathogens
  - ✓ Investigate and describe the conditions necessary for the growth of a specific pathogen (e.g., viruses, fungi, bacteria)
5. Analyze how longevity in humans has increased over time as a result of a better understanding of pathogens and genetics, and improved sanitary conditions and personal hygiene
  - ✓ Assess the ongoing need for public health department guidelines and personal actions to maintain and improve upon the health of the community (e.g., food handling and preparation in protecting human health, quarantines, use of sewers and landfills)

**Attitude:** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., share the responsibility for maintaining clean air and clean water)

## BIOLOGY

### Biology 20 Unit A - Energy and Matter Exchange in the Biosphere

#### Specific Learning Outcomes:

**A1.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Perform an experiment to demonstrate solar energy storage by plants (PR-NS3, PR-NS4, PR-NS5)
- ✓ Draw, by hand or using technology, annotated diagrams of food chains, food webs and ecological pyramids (PR-NS4)
- ✓ Collect evidence from various print and electronic sources on how human activities can have a disrupting influence on photosynthetic and cellular respiratory activities (PR-SEC1, PR-SEC2) [ICT C1-4.1]
- ✓ Use local histories obtained from Aboriginal Elders to describe the importance of plant productivity to human sustainability (PR-SEC2)
- ✓ Measure rates of evapotranspiration under various environmental conditions and relate these rates to photosynthetic activity (PR-NS2, PR-NS3, PR-NS4)
- ✓ Investigate and integrate, from print and electronic sources, information on the C3 and C4 photosynthetic mechanisms or on the applications of cellular biochemistry in medicine or industry (PR-NS1, PR-NS4) [ICT C1-4.1]

**A2.1k** Explain and summarize the biogeochemical cycling of carbon, oxygen, nitrogen and phosphorus and relate this to general reuse of all matter in the biosphere

**A2.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ Discuss the influence of human activities on the biogeochemical cycling of phosphorus, sulfur, iron and nitrogen: – feedlot operations – composting – fertilizer applications – waste and sewage disposal – vehicle and refinery emissions – acid deposition – persistent organic pollutants
- ✓ Discuss the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation: – manufacturing and processing – petrochemical industry – agricultural systems – mining industry – domestic daily water consumption

- ✓ Analyze the relationship between heavy metals released into the environment and matter exchange in natural food chains/webs and analyze the impact of this relationship on quality of life.
- ✓ Describe how human activities can have a disrupting influence on the balance in the biosphere of photosynthetic and cellular respiratory activities: – fossil fuel combustion – depletion of stratospheric ozone – forest destruction
- ✓ Evaluate the impact that human activity has had, or could have, on the biodiversity in an ecosystem: – wetlands management – land use – interbasin water transfer – habitat fragmentation – urbanization – slash-and-burn and clearcutting practices – monoculturing of forests, lawns, field crops

**A2.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ Design an experiment to compare the carbon dioxide production of plants with that of animals (IP-NS1, IP-NS2, IP-NS3, IP-NS4)
- ✓ Predict disruptions in the nitrogen and phosphorus cycles that are caused by human activities (IP-NS3) [ICT C6-4.1]
- ✓ Predict the effects of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium due to a significant reduction of photosynthetic organisms through human activity (IP-NS3) [ICT C6-4.1]

**A2.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Work cooperatively in a group to investigate the influence of human activities on the biogeochemical cycles and use appropriate multimedia to present the information to a group (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.2, F2-4.7, P3-4.1]
- ✓ Work cooperatively as a group to investigate, synthesize and present information on the effects of changes to stratospheric ozone levels on society, agriculture, plants and animals (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.4, C7-4.2, F2-4.7]

**A3.2k** Explain how the equilibrium between gas exchanges in photosynthesis and cellular respiration influences atmospheric composition

## SOCIAL STUDIES

### Social Studies 20-1 / 20-2 To what extent should we embrace nationalism?

#### Specific Learning Outcomes:

3.3 Demonstrate a global consciousness with respect to the human condition and global affairs (C, GC)

3.8 Analyze impacts of the pursuit of internationalism in addressing contemporary global issues (conflict, poverty, debt, disease, environment, human rights) (GC, PADM, ER)

# 11

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

An understanding of life processes at the cellular level can be applied to the knowledge and skills required to ensure the health of animals and plants and the quality of the food supply. Concepts related to animal and plant health are found in Science, Biology and Career and Technology Studies (CTS) curriculum.



#### SCIENCE 20 Unit D

- > Biotic and abiotic factors
- > Population size
- > Species diversity
- > Human population growth, biodiversity and carrying capacity
- > Adaptation of organisms, natural selection

How do organisms adapt and respond to human intervention?

- > Describe the characteristics of the biotic factors (animals, plants) in an agriculturally-based ecosystem and explore the interactions between biotic and abiotic factors.
- > Investigate the effects of introducing an organism (such as a biological pest control) into an agricultural ecosystem.
- > Design an investigation to compare the carbon dioxide production of crop plants with that of livestock.
- > Gather data, actual or simulated, on domestic crop plants to demonstrate how inherited characteristics change over time.
- > Assess habitat loss and the responsibility of society to protect the environment for future generations.

#### BIOLOGY 20 Unit A

- > Biosphere
- > Trophic levels
- > Food chains, food webs and ecological pyramids (energy, biomass and numbers)
- > Carbon, nitrogen, oxygen and phosphorus cycles
- > Water properties

How does crop and livestock production affect the balance of energy and matter?

- > Diagram the flow of energy in agricultural production and practices, including those used to grow crops and raise livestock.
- > Analyze the use of water in crop or livestock farming.
- > Research the influence of crop production, feedlots and agricultural waste management on the biogeochemical cycling of phosphorus, sulfur, iron and nitrogen.
- > Investigate the effects of changes to stratospheric ozone levels on society, agriculture, plants and animals.

#### BIOLOGY 20 Unit B

- > Ecosystem
- > Adaptation and variation
- > Natural selection
- > Species
- > Biotic/abiotic characteristics
- > Population

How can an understanding of ecosystems be applied to sustainable practices in agriculture?

- > Explain how ecosystems - biotic and abiotic factors - support agricultural production of crops and livestock.
- > Investigate species of plants and animals used in agriculture.
- > Gather data to explain how domesticated plant and animal species used in agriculture have changed biologically over time.

# 11

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

An understanding of life processes at the cellular level can be applied to the knowledge and skills required to ensure the health of animals and plants and the quality of the food supply. Concepts related to animal and plant health are found in Science, Biology and Career and Technology Studies (CTS) curriculum.



#### BIOLOGY 20 Unit C

- > Absorption of light by pigments
- > Krebs cycle
- > Light-dependent and independent reactions
- > Electron transport systems
- > Aerobic and anaerobic respiration
- > Glycolysis

How is diversity maintained in plant and animal populations?

- > Analyze the role of photosynthesis as the biological basis of agriculture.
- > Research and analyze the effects of herbicides on the biochemistry of photosynthesis.
- > Use experimental methods to investigate how changes in carbon dioxide and oxygen concentration affect photosynthesis in crop plants.
- > Interpret data on the oxygen consumption of an animal and relate this to metabolic rate.
- > Use experimental methods to demonstrate, quantitatively, the oxygen consumption of germinating seeds and measure temperature change over time of germinating and non-germinating seeds.

#### CTS AGRICULTURE COURSES

- > Agricultural practices and activities
- > Animal and plant basics

What is the significance and importance of agriculture for quality of life, sustainable environments and human activities?

- > Explore the implications of the diversity of agricultural practices in Alberta and/or Canada, using first-hand accounts and experiences from agricultural producers.
- > Develop best practices for plant propagation or animal care/welfare in a specific agricultural field.
- > Focus on skills related to sustainable agricultural practices, including soil management and applications of technology.
- > Research agricultural careers and occupations.

Note that there are numerous CTS courses specific to a broad range of agricultural activities and practices. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.



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## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

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## SCIENCE

### Science 20 Unit D - Cycling of Matter in Living Systems

#### Specific Learning Outcomes:

**D1.1k** Investigate and analyze an aquatic or a terrestrial local ecosystem, distinguish between biotic and abiotic factors, describe how these factors affect population size

- Infer the abiotic effects on life; e.g., light, nutrients, water, temperature
- Infer biotic interactions; e.g., predator-prey relationships, competition, symbiotic relationships

**D1.5k** Describe the effects of introducing a new species into, or largely removing an established species from, an environment; e.g., zebra mussel, carp and the Eurasian milfoil in Canada’s lakes, purple loosestrife in Alberta, the horse or the buffalo in the plains region of Alberta.

**D1.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- Evaluate and select appropriate procedures and technology to measure the impact of introducing species X into a specific environment (IP-NS4) [ICT C6-4.5]
- Design an investigation to compare the carbon dioxide production of plants with that of animals (IP-NS1, IP-NS2, IP-NS3, IP-NS4)
- 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)

**D1.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- Perform a field study; measure, qualitatively and quantitatively, appropriate biotic and abiotic factors in the aquatic or terrestrial ecosystem chosen; and present data in a form that describes, in general terms, the structure of the ecosystem; e.g., pH, temperature, precipitation, water hardness, turbidity, dissolved oxygen content, humidity, wind, light intensity, soil composition, plants, animals, micro-organisms (PR-NS4) [ICT C6-4.2]

**D1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze field study data to identify the interrelationships of biotic and abiotic components of the ecosystem studied; e.g., dominant plants, micro-climates and habitats, niches and interrelationships of biota (AI-NS1, AI-NS2) [ICT C7-4.2]
- ✓ Analyze the information presented by opposing sides on an environmental issue, such as that of an environmental group and that of an industry representative, to determine bias (AI-NS4, AI-SEC1) [ICT C2-4.1, C2-4.2]

**D3.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Analyze data, actual or simulated, on organisms to demonstrate how inherited characteristics change over time; e.g., Darwin's finches, bacteria, domestic plants and animals (AI-NS2) [ICT C7-4.2]

## BIOLOGY

### Biology 20 Unit A - Energy and Matter Exchange in the Biosphere

#### Specific Learning Outcomes:

**A1.1k** Explain, in general terms, the one-way flow of energy through the biosphere and how stored energy in the biosphere, as a system, is eventually "lost" as heat; e.g.,

- ✓ Photosynthesis/chemosynthesis
- ✓ Cellular respiration (muscle-heat generation, decomposition)
- ✓ Energy transfer by conduction, radiation and convection

**A1.1sts** Explain that the process of scientific investigation includes analyzing evidence and providing explanations based upon scientific theories and concepts (NS5f) [ICT C6-4.2]

- ✓ Explain how metabolic heat release from harvested grain can be reduced by drying processes prior to grain storage and explain the scientific principles involved in this technology

**A1.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ Predict a relationship between solar energy storage by plants and varying light conditions (IP-NS3) [ICT C6-4.1]
- ✓ Predict disruptions in the nitrogen and phosphorus cycles that are caused by human activities (IP-NS3) [ICT C6-4.1]
- ✓ Predict the effects of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium due to a significant reduction of photosynthetic organisms through human activity (IP-NS3) [ICT C6-4.1]
- ✓ Predict the effects of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium due to a significant reduction of photosynthetic organisms through human activity (IP-NS3) [ICT C6-4.1]

**A1.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Perform an experiment to demonstrate solar energy storage by plants (PR-NS3, PR-NS4, PR-NS5)

- ✓ Draw, by hand or using technology, annotated diagrams of food chains, food webs and ecological pyramids (PR-NS4)
- ✓ Collect evidence from various print and electronic sources on how human activities can have a disrupting influence on photosynthetic and cellular respiratory activities (PR-SEC1, PR-SEC2) [ICT C1-4.1]

**A2.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze data collected on water consumption and loss in plants and animals (AI-NS2, AI-NS3, AI-NS4) [ICT C7-4.2]

**A3.2k** Explain how the equilibrium between gas exchanges in photosynthesis and cellular respiration influences atmospheric composition

**A3.2sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ Describe how human activities can have a disrupting influence on the balance in the biosphere of photosynthetic and cellular respiratory activities: – fossil fuel combustion – depletion of stratospheric ozone – forest destruction
- ✓ Work cooperatively as a group to investigate, synthesize and present information on the effects of changes to stratospheric ozone levels on society, agriculture, plants and animals (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.4, C7-4.2, F2-4.7]
- ✓ Predict a relationship between solar energy storage by plants and varying light conditions (IP-NS3) [ICT C6-4.1]
- ✓ Design an experiment to compare the carbon dioxide production of plants with that of animals (IP-NS1, IP-NS2, IP-NS3, IP-NS4)
- ✓ Predict disruptions in the nitrogen and phosphorus cycles that are caused by human activities (IP-NS3) [ICT C6-4.1]
- ✓ Predict the effects of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium due to a significant reduction of photosynthetic organisms through human activity (IP-NS3) [ICT C6-4.1]
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- ✓ Perform an experiment to demonstrate solar energy storage by plants (PR-NS3, PR-NS4, PR-NS5)
- ✓ Draw, by hand or using technology, annotated diagrams of food chains, food webs and ecological pyramids (PR-NS4)
- ✓ Collect evidence from various print and electronic sources on how human activities can have a disrupting influence on photosynthetic and cellular respiratory activities (PR-SEC1, PR-SEC2) [ICT C1-4.1]

## BIOLOGY

### Biology 20 Unit B - Ecosystems and Population Change

#### Specific Learning Outcomes:

**B1.1sts** Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ Evaluate the impact that human activity has had, or could have, on the biodiversity in an ecosystem: – wetlands management – land use – interbasin water transfer – habitat fragmentation – urbanization – slash-and-burn and clearcutting practices – monoculturing of forests, lawns, field crops
- ✓ 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

**B2.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

**B2.2s** 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

- ✓ 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)

**B2.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze data, actual or simulated, on plants and animals to demonstrate how morphology changes over time

## BIOLOGY

### Biology 20 Unit C - Photosynthesis and Cellular Respiration

#### Specific Learning Outcomes:

**C1.1sts** Explain how scientific knowledge may lead to the development of new technologies, and new technologies may lead to or facilitate scientific discovery (ST4) [ICT F2-4.4, F2-4.8]

- ✓ Analyze the role of photosynthesis as the biological basis of agriculture and forestry

**C1.2sts** Explain that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability (ST7) [ICT F3-4.1]

- ✓ Research and analyze the effects of herbicides on the biochemistry of photosynthesis

**C1.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ Identify a testable factor that would affect the rate of photosynthesis (IP-NS1)
- ✓ Predict and hypothesize the effect of changes in carbon dioxide and oxygen concentration on photosynthesis (IP-NS3) [ICT C6-4.1]

**C1.2s** 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

- ✓ Use local histories obtained from Aboriginal Elders to describe the importance of plant productivity to human sustainability (PR-SEC2)
- ✓ Measure rates of evapotranspiration under various environmental conditions and relate these rates to photosynthetic activity (PR-NS2, PR-NS3, PR-NS4)
- ✓ Investigate and integrate, from print and electronic sources, information on the C3 and C4 photosynthetic mechanisms or on the applications of cellular biochemistry in medicine or industry (PR-NS1, PR-NS4) [ICT C1-4.1]
- ✓ Use experimental methods to demonstrate, quantitatively, the oxygen consumption of germinating seeds (PR-NS2, PR-NS3, PR-NS4, PR-NS5)
- ✓ Measure temperature change over time of germinating and non-germinating seeds (PR-NS2, PR-NS3, PR-NS4, PR-NS5)

## CAREER AND TECHNOLOGY STUDIES

### AGR2010 - Diversity in Agriculture

Find the full range of **Agriculture Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *NAT cluster (Natural Resources)*. *Agriculture* courses are part of this cluster. These courses all have applicability to resources or programs focused on agriculture and agricultural careers.

#### Specific Learning Outcomes:

1. Analyze a range of economic, environmental and social issues in agriculture
  - ✓ 1.1 List and categorize concerns being expressed regarding a social, economic and environmental issue in agriculture; e.g., environmental impacts, nutritional or food safety concerns, social, political or economic factors, legal/ethical factors
  - ✓ 1.2 Analyze a current issue in agriculture critically by:
    - 1.2.1 Identifying conflicts among different stakeholder groups
    - 1.2.2 Gathering information relevant to different sides of the issue
    - 1.2.3 Considering the implications of adopting different alternatives
2. Compare and contrast issues that involve agriculture in Alberta and Canada with similar issues at a global level
  - ✓ 2.1 Relate a local social, economic and environmental issue in agriculture to a similar issue at the global level; e.g., world food distribution, carbon sequestration, nutraceuticals, zoonotic diseases
  - ✓ 2.2 Compare statements made by scientists, different interest groups and the media regarding the issue
  - ✓ 2.3 Describe costs and benefits associated with different approaches for dealing with the issue at local and global levels
3. Present a plan of action to address a complex issue in agriculture
  - ✓ 3.1 Identify and describe a complex issue in agriculture, assuming the role of one of the stakeholders
  - ✓ 3.2 Clarify the issue and identify related perspectives
  - ✓ 3.3 Develop a position and provide a rationale
  - ✓ 3.4 Outline a personal plan of action

4. Demonstrate basic competencies
  - ✓ 4.1 Demonstrate fundamental skills to:
    - 4.1.1 Communicate
    - 4.1.2 Manage information
    - 4.1.3 Use numbers
    - 4.1.4 Think and solve problems
  - ✓ 4.2 Demonstrate personal management skills to:
    - 4.2.1 Demonstrate positive attitudes and behaviours
    - 4.2.2 Be responsible
    - 4.2.3 Be adaptable
    - 4.2.4 Learn continuously
    - 4.2.5 Work safely
  - ✓ 4.3 Demonstrate teamwork skills to:
    - 4.3.1 Work with others
    - 4.3.2 Participate in projects and tasks
5. Identify possible life roles related to the skills and content of this cluster
  - ✓ 5.1 Recognize and then analyze the opportunities and barriers in the immediate environment
  - ✓ 5.2 Identify potential resources to minimize barriers and maximize opportunities

# 11

## Food, Nutrition, and Agricultural Commodities

Chemistry | Reactions

Nutrients | Food

Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science, Chemistry and Career and Technology Studies (CTS) curriculum.



### SCIENCE 20 Unit A

- > Concentration
- > Dilution
- > Hydrocarbon reactions important to industry in Alberta

How is an understanding of chemical principles important to food production?

- > Identify how concentration and dilution is relevant to food production processes, such as baking and cooking, as well as processes such as application of fertilizers, herbicides, etc.
- > Investigate chemical reactions involved in the production of agricultural commodities and in agricultural production.
- > Compare current fuel production with the traditional use of animal oils and fats in the production of fuel.

### SCIENCE 24 Unit A

- > Commonly used materials, and chemical change in everyday life
- > Describing and classifying combustion and rusting reactions, acid-base reactions, and simple composition and decomposition reactions
- > Chemical reactions at home and in the workplace
- > Environmental effects of chemical change technologies

How is an understanding of chemical principles important to food production?

- > Identify examples of chemical changes involved in cooking and agricultural production practices, including application of fertilizers, herbicides, etc.
- > Investigate simple chemical processes occurring in food production and preparation.
- > Explain how acid-base neutralization reactions occur in food production.
- > Prepare an inventory of useful chemical substances used in food production and preparation.

### CHEMISTRY 20 Unit A

- > Ionic bond
- > Covalent bond
- > Intramolecular and intermolecular forces
- > Hydrogen bond

Why do substances created from agricultural products have different chemical properties?

- > Identify everyday processes and products in which ionic compounds are significant, such as in the composition of foods.
- > Investigate the chemical processes involved in the production of biofuels.
- > Relate the molecular properties of biofuels, including melting point and boiling point, to chemical bonding.

# 11

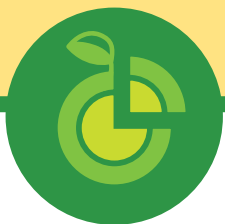
## Food, Nutrition, and Agricultural Commodities

Chemistry | Reactions

Nutrients | Food

Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science, Chemistry and Career and Technology Studies (CTS) curriculum.



### CHEMISTRY 20 Unit C

- > Homogeneous mixtures
- > Solubility
- > Concentration
- > Dilution
- > Strong acids and base
- > Weak acids and bases
- > Indicators
- > Hydronium ion/pH
- > Hydroxide ion/pOH

Why is an understanding of acid-base and solution chemistry important in daily lives?

- > Provide examples of how solutions and solution concentrations are applied in agricultural products and processes.
- > Explain the role of concentration in risk-benefit analyses for determining the safe limits of particular substances, such as pesticide residues.
- > Provide examples of processes and products that use knowledge of acid and base chemistry in food preparation and preservation.

### CTS FOODS COURSES

- > Food nutrition
- > Agricultural products and commodities

How does a diverse range of agricultural food products support health and quality of life?

- > Assess the relationship between food choices and body image.
- > Identify the agricultural products that are used in a variety of recipes.
- > Assess the nutrients that are provided by a range of different agricultural products.
- > Develop strategies for achieving and maintaining a healthy balance of food choices.

Note that there are numerous CTS courses specific to a broad range of food and nutrition topics. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

# 11

## Food and Agricultural Commodities

Chemistry | Reactions |

Nutrients | Food Production

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 11 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

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## SCIENCE

### Science 20 Unit A - Chemical Changes

#### Specific Learning Outcomes:

**A1.1k** Explain how dissolving substances in water is often a prerequisite for chemical reactions and chemical changes; e.g., batteries, baking, medications

**A1.1sts** Explain how science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

☑ Identify properties of aqueous solutions that enable chemical reactions important for industry

**A1.2sts** Explain that science and technology have influenced, and been influenced by, historical development and societal needs (SEC2) [ICT F2–4.8]

☑ Compare the ways in which concentrations are expressed in chemistry laboratories, industrial processes, household products and environmental studies

**A2.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

☑ Describe procedures for safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information (IP–ST3, PR–NS5)

**A3.1sts** Develop an understanding that science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

☑ Explain the traditional uses of oil sands (pitch) as caulking for canoes and the use of animal oils and fats as fuels



## SCIENCE

### Science 24 Unit A - Applications of Matter and Chemical Change

#### Specific Learning Outcomes:

**A 1.** Describe how everyday life depends upon technological products and processes that produce useful materials and energy

- ✓ Identify common materials and their uses, and describe how everyday life has changed over the past 100 years with the development of new materials (e.g., acids, bases, alloys, plastics, ceramics, fibres, composites)
- ✓ Identify examples of chemical changes involved in cooking, cleaning, personal care and gardening (e.g., acids in vinegar, citrus fruits and rhubarb react with aluminum kitchen utensils; bases in drain cleaners react with grease; emulsifiers and softeners are ingredients in skin creams; pesticides interfere with metabolic processes in living systems)

**A 2.** Investigate and classify chemical reactions

- ✓ Investigate evidence of chemical change; i.e., change of phase, appearance, colour, odour, energy (e.g., heat, light)

**A 4.** Analyze common technological products and processes encountered in everyday life and careers, and analyze their potential effects on the environment

- ✓ Analyze and explain common acid–base neutralization reactions (e.g., neutralization of stomach acid by antacids, use of baking soda or baking powder, use of lemon juice on fish dishes)

**Skill:** Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

- ✓ Select and integrate information from various print and electronic sources or from several parts of the same source (e.g., prepare an inventory of useful chemical substances used in a typical day, and classify them in categories: acids, bases, salts, alloys and polymers)
- ✓ Demonstrate a knowledge of Workplace Hazardous Materials Information System (WHMIS) standards, by selecting and applying proper techniques for handling and disposing of laboratory materials (e.g., recognize substances, circumstances and actions that may be hazardous to people and the environment)

**Skill:** Analyze qualitative and quantitative data, and develop and assess possible explanations

- ✓ Compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots (e.g., report findings of investigations of chemical change)
- ✓ Identify new questions or problems that arise from what was learned (e.g., “What is the possibility of drastic climate change due to global warming?”)

## CHEMISTRY

### Chemistry 20 Unit A - The Diversity of Matter and Chemical Bonding

#### Specific Learning Outcomes:

**A1.1sts** Explain that the goal of science is knowledge about the natural world (NS1)

- ✓ Identify everyday processes and products in which ionic compounds are significant, such as in the composition of household products and foods and in life processes

**A2.2sts** Explain that scientific knowledge and theories develop through hypotheses, the collection of evidence, investigation and the ability to provide explanations (NS2)

- ✓ Relate chemical properties to predicted intermolecular bonding by investigating melting and boiling points

**A2.3sts** Explain that scientific knowledge is subject to change as new evidence becomes apparent and as laws and theories are tested and subsequently revised, reinforced or rejected (NS4)

- ✓ Explain how scientific research and technology interact in the production and distribution of beneficial materials, such as polymers, household products and solvent

## CHEMISTRY

### Chemistry 20 Unit C - Matter as Solutions, Acids and Bases

#### Specific Learning Outcomes:

**C1.1sts** Explain how science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

- ✓ Provide examples of how solutions and solution concentrations are applied in products and processes, scientific studies and daily life

**C1.2sts** explain that science and technology have influenced, and been influenced by, historical development and societal needs (SEC2) [ICT F2–4.8]

- ✓ Compare the ways in which concentrations of solutions are expressed in chemistry laboratories, household products and environmental studies

**C2.2sts** Explain that technological problems often require multiple solutions that involve different designs, materials and processes and that have both intended and unintended consequences (ST3) [ICT F3–4.1]

- ✓ Provide examples of processes and products that use knowledge of acid and base chemistry (the pulp and paper industry, the petrochemical industry, food preparation and preservation, cleaning aids, sulfuric acid in car batteries, treating accidental acid or base spills using neutralization and dilution)

## CAREER AND TECHNOLOGY STUDIES

### FOD2030 - Food Decisions & Health

Find the full range of **Foods Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *HRH cluster (Health, Recreation & Human Services)*. *Foods* courses are part of this cluster. Selected courses have potential applicability to resources or programs focused on food production and agricultural careers.

#### Specific Learning Outcomes:

1. Describe the relationships between body image, wellness, healthy eating and active living

- ✓ 1.1 Describe basic body shapes
- ✓ 1.2 Identify psychological and social factors that influence body image
- ✓ 1.3 Describe body composition, considering the following factors:
  - 1.3.1 Health costs of unhealthy lifestyle choices; e.g., tobacco use for weight management, fad diets, physical inactivity
  - 1.3.2 Body weight versus body composition
  - 1.3.3 Methods of measuring body composition
  - 1.3.4 Variables in ideal body composition
- ✓ 1.4 Discuss why most diets are ineffective and interfere with natural metabolism and hunger regulation, and:
  - 1.4.1 Formulate and apply criteria for evaluation of diets
  - 1.4.2 Compare concepts of maintaining a healthy body weight versus dieting to manage weight

2. Describe strategies for achieving and maintaining adequate food intake, according to Eating Well with Canada's Food Guide, and healthy active living, according to Canada's Physical Activity Guide to Healthy Active Living

- ✓ 2.1 Predict the impact of food intake and active living on the energy balance equation and changes in energy input and energy output by:
  - 2.1.1 Evaluating factors influencing energy input
  - 2.1.2 Analyzing the significance of food patterns in altering energy input
  - 2.1.3 Differentiating among factors that affect energy output

2.1.4 Comparing energy output required for different types and levels of physical activity

2.1.5 Discussing goals for achieving and maintaining healthy body composition

✓ 2.2 Analyze personal energy balance equation

3. Demonstrate knowledge and skill in the planning, preparing and evaluating of suitable foods for achieving growth and development during teen years

✓ 3.1 Select, prepare and evaluate a minimum of five recipes suitable for healthy living

✓ 3.2 Prepare a homemade snack and compare the nutritional values to a comparable commercial snack; e.g., granola, granola bar, cookies, muffins

✓ 3.3 Select, prepare and evaluate the effectiveness of foods in meeting the goals of optimal nutrition, considering:

3.3.1 Different cooking methods; e.g., deep-fried potatoes versus oven-baked potatoes

3.3.2 Varying ingredients; e.g., fat substitution with fruit purée

✓ 3.4 Plan, prepare and evaluate a healthy balanced meal to assist with the achievement of:

3.4.1 Growth and development during teen years

3.4.2 Healthy body weight

4. Identify and demonstrate safe and sanitary practices

✓ 4.1 Maintain a clean, sanitary, safe work area

✓ 4.2 Apply universal precautions related to:

4.2.1 Personal protective equipment (PPE); e.g., hair coverings, aprons, gloves

4.2.2 Hand-washing techniques

4.2.3 Infectious diseases

4.2.4 Blood-borne pathogens

4.2.5 Bacteria, viruses, molds

4.2.6 Safety and first-aid applications; e.g., back safety, cuts, slip and trip hazards

✓ 4.3 Use all materials, products and implements appropriately

✓ 4.4 Clean, sanitize and store materials, products and implements correctly

✓ 4.5 Dispose of waste materials in an environmentally safe manner

5. Demonstrate basic competencies

✓ 5.1 Demonstrate fundamental skills to:

5.1.1 Communicate

5.1.2 Manage information

5.1.3 Use numbers

5.1.4 Think and solve problems

✓ 5.2 Demonstrate personal management skills to:

5.2.1 Demonstrate positive attitudes and behaviours

5.2.2 Be responsible

5.2.3 Be adaptable

5.2.4 Learn continuously

5.2.5 Work safely

✓ 5.3 Demonstrate teamwork skills to:

5.3.1 Work with others

5.3.2 Participate in projects and tasks

6. Identify possible life roles related to the skills and content of this cluster

✓ 6.1 Recognize and then analyze the opportunities and barriers in the immediate environment

✓ 6.2 Identify potential resources to minimize barriers and maximize opportunities

# 11

## Food Security and Economies of Food Production

Globalization | Nationalism | Trade | Policies

Food security, according to the Food and Agriculture Organization, exists “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” Food security is often linked to geographic location, economic inequalities and poverty. Concepts related to food security, economic issues, globalization and social or economic inequalities in Science and Social Studies curriculum can be explored through an agricultural lens.



### SCIENCE 20 Unit D

- > Human interventions in biogeochemical (nitrogen, carbon, water) cycles
- > Trophic levels, biomass, energy and pyramids
- > Human population growth, biodiversity and carrying capacity

What are the implications of growing food demands on energy cycles and the environment?

- > Research and identify examples of food products and agricultural activities in developing and developed countries.
- > Compare the energy efficiency of the diet of people in developing countries with people in developed countries.
- > Assess projections of human population growth and compare to projections of food production.
- > Identify issues related to the demands on natural resources for a growing human population.

### SCIENCE 24 Unit C

- > Role of environmental factors (toxins, pathogens) and genetic factors on human health
- > Human actions to reduce contamination by pathogens

How have agricultural producers contributed to the development of safe food production practices?

- > Analyze the relationship between human health and environmental pathogens.
- > Investigate the causes of some examples of social and economic conditions (poverty, hunger and malnutrition) that lead to food insecurity.
- > Identify agricultural practices that promote food safety and security.
- > Propose ideas for the role of agricultural producers in health-related issues.

### SOCIAL STUDIES 20-1 / 20-2

- > Nationalism
- > Internationalism
- > Global affairs

How does nationalism and internationalism affect global food security?

- > Compare the impact of nationalism and internationalism in issues related to food security and insecurity.
- > Assess the relationship between decisions about the use of resources with the provision of a safe food supply.

# 11

## Food Security and Economies of Food Production

### Globalization | Nationalism | Trade | Policies

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 11 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SCIENCE

### Science 20 Unit D - Changes in Living Systems

#### Specific Learning Outcomes:

D2.2sts Explain that science and technology are developed to meet societal needs and expand human capabilities (SEC1) [ICT F2–4.8]

- ✓ Contrast the diet of people in developing countries and that of people in developed countries in terms of energy efficiency and environmental impact and describe ways to address potential food shortages in the future

D3.3s Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Demonstrate and assess the effect of environmental factors on population growth curves (AI–NS2, AI–NS6) [ICT C7–4.2]
- ✓ Apply the growth curve for open populations to identify the long-term impact on Earth’s carrying capacity and the demands on natural resources for a growing human population (AI–NS2, AI–NS4, AI–NS6)

## SCIENCE

### Science 24 Unit C - Disease Defence and Human Health

#### Specific Learning Outcomes:

C 1. Describe how human health is affected by societal and environmental factors, and describe the need for action by society to improve human health

- ✓ Describe, in general terms, how human diseases may arise from an interaction of variables, including poor nutrition, stress, pathogens and environmental contamination
- ✓ Analyze the relationship between social conditions and disease (e.g., hunger and malnutrition; sanitation and bacterial, viral, fungal diseases)
- ✓ Analyze the impact of public health initiatives and maintaining high standards of personal hygiene in fostering healthier societies and individuals (e.g., provision of potable water, clean air standards, treatment of human and animal wastes, safe handling of food)

## SOCIAL STUDIES

### Social Studies 20-1 / 20-2 To what extent should we embrace nationalism?

#### Specific Learning Outcomes:

3.3 Demonstrate a global consciousness with respect to the human condition and global affairs (C, GC)

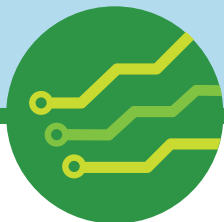
3.8 Analyze impacts of the pursuit of internationalism in addressing contemporary global issues (conflict, poverty, debt, disease, environment, human rights) (GC, PADM, ER)

# 11

## Technologies

Automation | Robotics |  
Biotechnology | Genetics

Agricultural technology encompasses advancements in automation and robotics, information technology applications as well as biotechnology and genetics. Concepts related to genetics, biotechnology and technologies used to address environmental issues in Science and Biology curriculum can be explored through an agricultural lens.



### SCIENCE 20 Unit D

- > Human interventions in biogeochemical (nitrogen, carbon, water) cycles
- > Human population growth, biodiversity and carrying capacity
- > Adaptation of organisms, natural selection
- > Evidence for the theory of evolution

How do ecosystems and organisms change over time and respond to natural and human interventions?

- > Explore the use of technology in dealing with environmental issues that address soil health, water conservation and their importance to agriculture.
- > Compare changes in animal and plant species used in agriculture through natural selection and human intervention, including the application of biotechnologies.
- > Trace the changes in a domesticated plant and animal used in agriculture over time, describing how technologies have influenced those changes.

### SCIENCE 24 Unit C

- > Role of environmental factors (toxins, pathogens) and genetic factors on human health
- > Impact of recent genetic research on societal decision making

How have increased understandings of genetics in agriculture affected human health?

- > Identify ethical and social issues and benefits involved in the use of genetic technologies in agriculture.
- > Assess, qualitatively, the risks and benefits of cloning plants and animals for agriculture.

### BIOLOGY 20 Unit B

- > Adaptation and variation
- > Natural selection
- > Population
- > Species
- > Evidence for evolution

What mechanisms are involved in the change of populations over time?

- > Compare changes in animal and plant species used in agriculture through natural selection and human intervention, including the application of biotechnologies.
- > Investigate the impact of technology on variations in an agricultural plant or animal species.
- > Trace the changes in a domesticated plant and animal used in agriculture over time, describing how technologies have influenced those changes.

# 11

## Technologies

Automation | Robotics |

Biotechnology | Genetics

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 11 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

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## SCIENCE

### Science 20 Unit D - Changes in Living Systems

#### Specific Learning Outcomes:

**D2.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F2–4.8, F3–4.1]

- ✓ Evaluate the influence of society, and the impact of a variety of technologies, on the nitrogen cycle
- ✓ Discuss the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation, considering such things as manufacturing, the oil industry, agricultural systems, the mining industry and domestic daily water consumption

**D3.2k** Describe the adaptation of species over time due to variation in a population, population size and environmental change; e.g., bacterial resistance to antibiotics, giraffe neck length, gazelle speed

**D3.3k** Describe evidence for evolution by natural selection; e.g., fossils, biogeography, embryology, homologous and vestigial structures, biochemical research

**D3.5k** Describe how factors including space, accumulation of wastes (e.g., salinization of soil), competition, technological innovations, irrigation practices (e.g., Hohokam farmers) and the availability of food impact the size of populations

**D3.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Gather data, actual or simulated, on organisms to demonstrate how inherited characteristics change over time; e.g., Darwin’s finches, bacteria, domestic plants and animals (PR–NS1, PR–NS4)



**D3.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze data, actual or simulated, on organisms to demonstrate how inherited characteristics change over time; e.g., Darwin's finches, bacteria, domestic plants and animals (AI-NS2) [ICT C7-4.2]

## SCIENCE

### Science 24 Unit C - Disease Defence and Human Health

#### Specific Learning Outcomes:

5. Analyze how longevity in humans has increased over time as a result of a better understanding of pathogens and genetics, and improved sanitary conditions and personal hygiene

- ✓ Relate the advances in genetic research to ethical and social issues (e.g., the human genome project, genetic engineering, cloning, screening for genetic disorders)

**Skill:** Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results

- ✓ Develop, present and defend a position or course of action, based on findings (e.g., assess, qualitatively, the risks and benefits of cloning plants and animals for agriculture; produce a brochure that explains how to reduce the chances of getting a communicable disease, such as the common cold)

**Attitude:** Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds (e.g., carefully research and openly discuss ethical dilemmas associated with applications of advancements in genetics)

## BIOLOGY

### Biology 20 Unit B - Ecosystems and Population Change

#### Specific Learning Outcomes:

**B1.1sts** Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ 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

**B2.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ 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)

**B2.2s** 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

- ✓ 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)

**B2.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze data, actual or simulated, on plants and animals to demonstrate how morphology changes over time; e.g., Darwin's finches, peppered moths, bacteria, domesticated plants or animals (AI-NS2) [ICT C6-4.2, C7-4.2]





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# Connecting Agriculture to Alberta Senior High School Curriculum Grade 12

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# 12

## Environment and Sustainability

Land | Energy | Water | Soil

The use of land, energy, water and soil are central to agricultural practices and the food supply. Not only are resources such as soil and water vital to agricultural productivity, but agriculture both affects and is affected by the local, regional, and global environment. Concepts related to environmental issues and decisions in Science, Chemistry and Social Studies curriculum can be explored through an agricultural lens.



### SCIENCE 30 Unit B

- > Sources and environmental impact of SO<sub>x</sub>, NO<sub>x</sub>, acid deposition and photochemical smogs
- > Sources, uses and environmental effects of organic compounds
- > Biomagnification and persistence of pollutants

What scientific, technological and agricultural practices best meet human needs while sustaining the environment?

- > Identify and research agricultural sources of acids and bases and assess their impact on agricultural plants and animals and the environment.
- > Investigate and analyze the usage of herbicides and pesticides in agricultural activities and production and compare with the impact of not using them.
- > Create a group visual display explaining initiatives taken by an agricultural producer to reduce emissions that can cause acid deposition.
- > Compare technologies and biological alternatives used in agricultural and food production.

### SCIENCE 30 Unit D

- > Balancing energy use with sustainable development
- > Conversion of solar energy, fossil fuels and wind and water power into thermal and electrical energy
- > Nuclear, wind, hydro, biomass, tidal, solar, fuel cell and geothermal alternative energy technologies

What is the energy future in agriculture?

- > Investigate and assess the environmental impact of the use of various energy sources in agricultural production.
- > Research and predict potential future uses of alternative energy sources in agriculture.
- > Create a visual display of initiatives taken by agricultural industries to protect the environment.

### CHEMISTRY 30 Unit A

- > Enthalpy of formation
- > Enthalpy of reaction
- > Fuels and energy efficiency

What are the impacts of energy use on society and the environment?

- > Compare the benefits and challenges involved in the use of biofuels.
- > Investigate, through experiments, the chemical composition of biofuels.
- > Evaluate the economic and environmental impacts of carbon based and biomass fuels.

# 12

## Environment and Sustainability

Land | Energy | Water | Soil

The use of land, energy, water and soil are central to agricultural practices and the food supply. Not only are resources such as soil and water vital to agricultural productivity, but agriculture both affects and is affected by the local, regional, and global environment. Concepts related to environmental issues and decisions in Science, Chemistry and Social Studies curriculum can be explored through an agricultural lens.



### CHEMISTRY 30 Unit C

- > Organic compounds
- > Saturated/unsaturated hydrocarbons
- > Functional groups identifying alcohols, carboxylic acids, esters and halogenated hydrocarbons
- > Esterification
- > Combustion reactions

How does society rely on and make sustainable decisions about the use of organic compounds?

- > Predict the effect of climate change on a specific agricultural operation.
- > Explain the risks and benefits of agricultural activity on biodiversity of plants and animals.
- > Collect information from different sources on how climate change is monitored by agricultural producers.
- > Provide different perspectives on ways that human actions today may affect the sustainability of agricultural biomes for future generations; identify potential conflicts between human wants and needs and protecting agricultural environments.

### SOCIAL STUDIES 30-1 / 30-2

- > Individualism and collectivism
- > Ideologies
- > Liberalism

How have ideologies shaped policies and actions related to the use of land and resources?

- > Explore how ideology influences decisions about the land, environment and agricultural practices.
- > Evaluate the impact of diverse perspectives and beliefs on priorities and decision-making regarding the use and development of resources.
- > Research how ideology shapes responses to current issues in agriculture.

# 12

## Environment and Sustainability

Land | Energy | Water | Soil

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 12 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.



## SCIENCE

### Science 30 Unit B - Chemistry and the Environment

#### Specific Learning Outcomes:

**B1.9k** Describe impacts on the biotic and abiotic components of the environment caused by acid deposition; e.g., lowered pH in water systems, accelerated corrosion, metal leaching from bedrock, the impact of leached metals on plants and the food chain

**B1.2sts** Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3–4.1]

- ✓ Identify and explain how human activities and natural events contribute to acid deposition in the environment
- ✓ Explain how the introduction of environmental contaminants, i.e., herbicides, pesticides, dichlorodiphenyltrichloroethane (DDT), CFCs, SO<sub>2</sub>(g), CO<sub>2</sub>(g), particularly persistent organic pollutants (POPs), affects living systems globally
- ✓ Explain the role of concentration in a risk-benefit analysis for determining the safe limits of particular substances; e.g., pesticide residues, chlorinated or fluorinated compounds

**B1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Research and plot on a map the distribution patterns of acid deposition as influenced by prevailing winds (A1–ST4) [ICT C6–4.3]
- ✓ Interpret data from water quality tests, such as pH, BOD, dissolved oxygen and organic compounds
- ✓ Analyze alternatives to the use of chemical technologies; e.g., bioremediation for contaminated soil, biological controls for pests, biodegradable products (AI–SEC2)

**B1.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Prepare a group visual display explaining initiatives taken by industry to reduce emissions that can cause acid deposition (CT–SEC2) [ICT C1–4.4, P4–4.2]

- ✔ Work cooperatively with team members to investigate the impact of the use of reproductive hormones in agriculture on the environment (such as the feminization of fish) and, using appropriate multimedia, present the information to the class (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.4, P3-4.1]

**B2.3k** Identify organic compounds commonly considered to be environmental pollutants; i.e., hydrocarbons, organic waste, CFCs, polychlorinated biphenyls (PCBs), dioxins and furans

**B2.5k** Identify and explain how human activities and natural events contribute to the production of photochemical smog, the depletion of the ozone layer and increased concentrations of organic compounds in the environment; e.g., driving a car, use of CFCs, agricultural practices

**B2.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✔ Design an investigation of alternatives to the use of pesticides or herbicides (IP-ST2) [ICT C2-4.1]
- ✔ Plan an evaluation, including a risk-benefit analysis, of a chemical process or an issue related to its use (IP-SEC2) [ICT F3-4.1]

**B2.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✔ Investigate the action of a pesticide or herbicide, considering toxicity, volatility, target specificity and resistance development (PR-SEC1)
- ✔ Debate the issue of whether protecting the environment should have priority over economic interests (PR-SEC1) [ICT C1-4.4, C2-4.2]
- ✔ Design and perform an experiment to demonstrate that an environmental factor can cause a change in the expression of genetic information in an organism (IP-NS2, IP-NS3, IP-NS4, PR-NS3, PR-NS4, PR-NS5) [ICT F1-4.2]

**B3.1k** Describe the risks and benefits of using chemical processes that may produce products and/or by-products that have the potential to harm the environment

**B3.3k** Describe alternatives to the use of chemical technologies; e.g., bioremediation for contaminated soil, biological controls for pests, biodegradable products

**B3.2sts** Explain that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability (ST7) [ICT F2-4.2, F3-4.1]

- ✔ Explain the meaning of technological fix and explain the need for broader considerations in reducing the environmental impact of the by-products of chemical processes

## SCIENCE

### Science 30 Unit D - Energy and the Environment

#### Specific Learning Outcomes:

**D1.5k** Describe the environmental impact of developing and using various energy sources; i.e., conventional oil, oil sands, solar power, wind power, biomass, hydroelectricity, coal burning power, nuclear power, geothermal

**D1.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

- ✓ Identify questions to investigate that arise from science- and technology-related issues; e.g., “Which energy sources and technologies best balance the need for global energy demand with acceptable environmental impacts?” (IP-SEC1) [ICT F2-4.8]

**D1.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Present a visual display of initiatives taken by industry to protect the environment (CT-SEC2) [ICT C1-4.4, P6-4.1]
- ✓ 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]

**D2.2sts** Explain that science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2-4.4, F2-4.8]

- ✓ Determine how the allocation of funds for research into the development of new energy conversion devices and sources balances the needs of society with preservation of the environment

## CHEMISTRY

### Chemistry 30 Unit A - Thermochemical Changes

#### Specific Learning Outcomes:

**A1.2sts** Explain that technological problems often require multiple solutions that involve different designs, materials and processes and that have both intended and unintended consequences (ST3) [ICT F3-4.1]

- ✓ Evaluate the impact of the combustion of various energy sources, including fossil fuels and biomass, on personal health and the environment and describe the technologies used by early peoples to mitigate the harmful effects of combustion.

**A1.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Select and integrate information from various print and electronic sources to create multiple-linked documents about the use of alternative fuels (PR-ST1) [ICT C1-4.1, P5-4.1]

**A2.3sts** Explain that the products of technology are devices, systems and processes that meet given needs; however, these products cannot solve all problems (ST6) [ICT F3-4.1]

- ✓ Evaluate the economic and environmental impacts of different fuels by relating carbon dioxide emissions and the heat content of a fuel



## CHEMISTRY

### Chemistry 30 Unit C - Chemical Changes of Organic Compounds

#### Specific Learning Outcomes:

**C1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze the contributions and limitations of scientific and technological knowledge in societal decision making, in relation to the costs and benefits of societal use of petrochemicals, pharmaceuticals and pesticides (AI-SEC2) [ICT F3-4.1]
- ✓ Explore aspects of present-day reliance on extracted or synthesized nutrients, with consideration of the synergy of compounds (reliance on vitamin supplements, meal replacements and nutraceuticals versus traditional methods of consuming natural foods) (AI-SEC2)

**C2.3sts** Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ Assess the positive and negative effects of various reactions involving organic compounds, relating these processes to quality of life and potential health and environmental issues; e.g., – burning fossil fuels and climate change – production of pharmaceuticals and foods – by-products (CO<sub>2</sub>, dioxins) of common reactions – recycling of plastics – impact of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) on the ozone layer – trans fats in the diet

**C2.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Investigate the issue of greenhouse gases; identify some greenhouse gases, including methane, carbon dioxide, water and dinitrogen oxide (nitrous oxide); and analyze their contribution to climate change (AI-SEC1, AI-SEC2) [ICT F3-4.1]

## SOCIAL STUDIES

### Social Studies 30-1 Perspectives on Ideology

#### Specific Learning Outcomes:

**1.6** Explore themes of ideologies (nation, class, relationship to land, environment, religion, progressivism) (TCC, PADM, LPP)

**3.9** Evaluate the extent to which the principles of liberalism are viable in the context of contemporary issues (environment concerns, resource use and development, debt and poverty, racism, pandemics, terrorism, censorship, illiberalism) (PADM, ER, LPP)

**4.8** Evaluate the extent to which ideology should shape responses to contemporary issues (I, C, GC)

**4.9** Develop strategies to address local, national and global issues that demonstrate individual and collective leadership (C, GC)

## SOCIAL STUDIES

### Social Studies 10-2 - Understandings of Ideologies

#### Specific Learning Outcomes:

**1.6** Identify themes of ideologies (nation, class, relationship to land, environment, religion) (TCC, PADM, LPP)

**3.8** Evaluate the extent to which the values of liberalism are viable in the context of contemporary issues (environment concerns, resource use and development, debt and poverty, racism, pandemics, terrorism, censorship) (PADM, ER, LPP)

**4.7** Analyze the extent to which ideology should shape responses to contemporary issues (I, C, GC)

**4.8** Develop strategies to address local, national and global issues that demonstrate individual and collective leadership (C, GC)

# 12

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

An understanding of life processes at the cellular level can be applied to the knowledge and skills required to ensure the health of animals and plants and the quality of the food supply. Concepts related to animal and plant health are found in Science, Biology and Career and Technology Studies (CTS) curriculum.



#### SCIENCE 30 Unit A

- > Environmental principles of Mendelian genetics
- > Deoxyribonucleic acid DNA and protein synthesis
- > Mutations and gene therapy
- > Genetic technology

What are the risks, benefits and ethical issues involved in current plant and animal genetic technology?

- > Use Punnett squares to explain the inheritance of single traits and the general process of DNA replication in agricultural plants and animals.
- > Investigate the implications of genetic engineering and its application to gene therapy and the development of genetically modified organisms in agricultural crops and livestock production.
- > Create a timeline to trace the development of plant and animal breeding techniques.
- > Investigate a characteristic of a genetically modified crop and why this characteristic was selected and important.

#### BIOLOGY 30 UNIT C

- > Cell cycle
- > Mitosis and meiosis
- > Mendel's laws of heredity
- > Probability
- > Gene linkage
- > Model of DNA

How has cell theory informed plant and animal health and welfare?

- > Investigate the evolution and applications of cell theory and nanotechnology in agriculture, including animal reproduction and health
- > Create charts, tables and diagrams to show reproductive strategies and cell division in selected crop plants and/or livestock.
- > Perform experiments to determine the probability of inheritance of traits in crop varieties or livestock.

# 12

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

An understanding of life processes at the cellular level can be applied to the knowledge and skills required to ensure the health of animals and plants and the quality of the food supply. Concepts related to animal and plant health are found in Science, Biology and Career and Technology Studies (CTS) curriculum.



#### BIOLOGY 30 Unit D

- > Gene pool
- > Natural selection
- > Population growth patterns

How is diversity maintained in plant and animal populations?

- > Investigate the effects of changes to the gene pool of an agricultural crop.
- > Use a case study of population growth patterns for a closed population in an agricultural environment.

#### CTS AGRICULTURE COURSES

- > Agricultural practices and activities
- > Safety procedures
- > Hazard control
- > Confined spaces

How should hazards and risks involved in working with plants and animals in agriculture be managed?

- > Research and demonstrate safe handling and application practices for substances used in the production of specific types of crops.
- > Investigate safe practices for animal care/welfare in a specific agricultural field.
- > Describe practices used to work with plants or animals in confined spaces in a specific agricultural field.
- > Identify safety practices used to operate machinery.
- > Research safety procedures and regulations that apply to agricultural careers and occupations.

Note that there are numerous CTS courses specific to a broad range of agricultural activities and practices. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

# 12

## Plants and Plant Health; Animals and Animal Welfare

### Crops | Livestock

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## SCIENCE

### Science 30 Unit A - Living Systems Respond to Their Environment

#### Specific Learning Outcomes:

**A3.2k** Explain, with the aid of Punnett squares, the inheritance of single traits by applying current understanding of the gene, segregation and dominance

**A3.3k** Distinguish autosomal from sex-linked patterns of inheritance

**A3.5k** Explain the general process of DNA replication

**A3.9k** Describe, in general terms, genetic engineering and its application to gene therapy and the development of genetically modified organisms

**A3.1sts** Explain that science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

☑ Trace the development of plant and animal breeding techniques, starting with traditional practices (e.g., Hopi/Huron/Iroquois maize breeding), to Mendel’s work on inheritance, to the contributions of many scientists on the discovery of the molecular structure of DNA and the development of recombinant DNA technology

**A3.2sts** Explain that decisions regarding the application of scientific and technological development involve a variety of perspectives, including social, cultural, environmental, ethical and economic considerations (SEC4b)

☑ Assess the risks and benefits of genetic technology and the need for ethical considerations; e.g., stem-cell research, access to genetic screening, genetically modified organisms

**A3.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

☑ Devise an experimental procedure to investigate a characteristic of an organism acquired through genetic engineering, such as genetically modified canola, corn or soybean (IP–NS4)

**A3.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Investigate, with the aid of a pedigree chart, the familial inheritance of a specific trait that is controlled by a single pair of genes (PR-NS2)
- ✓ Predict, quantitatively, the probability of acquiring a particular trait in autosomal and sex-linked patterns of inheritance (AI-NS2) [ICT C6-4.1]
- ✓ Identify and evaluate potential applications of genetic engineering to health and agriculture (AI-SEC4) [ICT C2-4.1, F2-4.4]

**A3.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Research, present and defend a position on genetically modified organisms (CT-SEC3) [ICT C1-4.4]

## BIOLOGY

### Biology 30 Unit C - Cell Division, Genetics and Molecular Biology

#### Specific Learning Outcomes:

**C1.1sts** Explain that science and technology are developed to meet societal needs and expand human capability (SEC1)

- ✓ Evaluate how knowledge of cell division or development of nanotechnology might be applied to the regulation of cancerous growth in plants or animals
- ✓ Discuss and assess the impact of research in plant and animal reproduction on our understanding of mitosis and meiosis in humans (cloning, chromosome shortening)

**C1.2s** 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

- ✓ Research and compare a range of reproductive strategies in organisms and present them in the form of charts, tables or diagrams; e.g., binary fission, budding, the sexual and asexual phases of alternation of generations (PR-NS1, PR-NS4) [ICT C6-4.3]

**C1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze the similarities and differences of cell division in plants and animals (AI-NS2) [ICT C7-4.2]

**C1.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Present two contrasting reproductive strategies, emphasizing the differences (CT-ST2) [ICT C1-4.4]
- ✓ Interpret patterns and trends of inheritance of traits and predict, quantitatively, the probability of inheritance of traits illustrated in monohybrid, dihybrid and sex-linked inheritance, using pedigrees and Punnett squares [ICT C7-4.2]
- ✓ Perform experiments to record and explain predicted phenotypic ratios versus actual counts in genetic crosses to show a relationship between chance and genetic results (PR-NS2, PR-NS3, PR-NS4, AI-NS3)

**C2.1k** Describe the evidence for dominance, segregation and the independent assortment of genes on different chromosomes, as investigated by Mendel

**C2.2k** Compare ratios and probabilities of genotypes and phenotypes for dominant and recessive, multiple, incompletely dominant, and codominant alleles

**C2.3k** Explain the influence of gene linkage and crossing over on variability

## BIOLOGY

### Biology 30 Unit D - Population and Community Dynamics

#### Specific Learning Outcomes:

**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

**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)

**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)

**D1.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

Investigate the role of gene banks in the preservation of endangered species and genotypes, particularly of plants and animals used in agriculture

## CAREER AND TECHNOLOGY STUDIES

### AGR3000 - Agriculture Safety

Find the full range of **Agriculture Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *NAT cluster (Natural Resources)*. *Agriculture* courses are part of this cluster. These courses all have applicability to resources or programs focused on agriculture and agricultural careers.

#### Specific Learning Outcomes:

1. Identify and describe potential hazards found in the agricultural area

- ✓ 1.1 Predict hazards within an agricultural environment; e.g., farm, ranch
- ✓ 1.2 Research the different types of hazards (e.g., chemical, physical, ergonomic, biological, psychosocial) and provide examples of each in an agricultural home or environment
- ✓ 1.3 Describe the major hazards related to farm machinery; e.g., pinch points, wrap points, shear points, pull-in points, crush points
- ✓ 1.4 Describe potential hazards related to animal management by:
  - 1.4.1 Listing the most common injuries that occur around animals
  - 1.4.2 Identifying and describing the warning signs of a threatened animal
  - 1.4.3 Identifying and describing the appropriate way to approach an animal
  - 1.4.4 Describing and demonstrating the appropriate way to handle an animal
- ✓ 1.5 Identify farm environmental hazards; e.g., sun exposure, water hazards, fuel, human factors

2. Examine and demonstrate standards/practices associated with agricultural health and safety

- ✓ 2.1 Examine and demonstrate standards/practices associated with fire safety by:
  - 2.1.1 Examining and justifying the need for fire safety standards
  - 2.1.2 Identifying the fire classifications and comparing the appropriate extinguishers
  - 2.1.3 Analyzing and discussing the elements of fire

2.1.4 Developing a plan to safely address potential fire hazards and identifying fire prevention methods

2.1.5 Demonstrating the use of portable fire extinguishers

- ✓ 2.2 Examine and demonstrate standards/practices associated with electrical safety by:

2.2.1 Investigating potential electrical hazards at home, at school and in an agricultural area

2.2.2 Developing a plan to safely address potential electrical hazards found in the home, at school and on a farm

2.2.3 Creating a strategy for establishing safe work conditions when working with electricity

2.2.4 Explaining and applying lockout/tagout procedures on electrical equipment

- ✓ 2.3 Examine and demonstrate standards/practices associated with ladder safety by:

2.3.1 Identifying equipment, machinery and structures where ladders are used in an agricultural area

2.3.2 Identifying different types of ladders and differentiating when the different types should be used

2.3.3 Illustrating the safe set-up and use of ladders

2.3.4 Identifying and demonstrating the proper inspection, care and storage of ladders

2.3.5 Diagramming ladder safety rules

- ✓ 2.4 Examine and demonstrate standards/practices associated with confined space safety by:

2.4.1 Examining and justifying the need for confined space standards

2.4.2 Identifying and analyzing what constitutes a confined space and describing the associated dangers

2.4.3 Determining what tests should be completed before entering a confined space, given the potential hazards of the space

2.4.4 Creating a plan to be used before entering a given confined space

2.4.5 Discussing the need for a rescue plan—what should be included, and what training should rescuers have (and why)

- ✓ 2.5 Examine and demonstrate standards/practices associated with workplace chemical health and safety by:
  - 2.5.1 Examining and justifying the need for WHMIS legislation
  - 2.5.2 Identifying the classes of WHMIS controlled products
  - 2.5.3 Describing the role of labels on containers of controlled products and describing the type of information that would be found on them
  - 2.5.4 Describing the role of material safety data sheets and describing the type of information that would be found on them
  - 2.5.5 Explaining the responsibilities of suppliers, employers and workers when it comes to the safe handling of chemicals in the workplace
  - 2.5.6 Identifying risk management techniques associated with agricultural chemicals in regard to transportation, storage, spills, handling, exposure and disposal

### 3. Identify and demonstrate methods for dealing with potential hazards in the agricultural area

- ✓ 3.1 Describe and demonstrate the use of personal protective equipment (PPE); e.g., helmets, goggles, safety glasses, earmuffs, earplugs, dust masks, respirators, gloves, safety boots
- ✓ 3.2 Identify and demonstrate the correct health and safety practices in ergonomic safety procedures; e.g., lifting, loading, shovelling, bending, working alone
- ✓ 3.3 Identify and describe common health and safety practices and equipment that should be used around animals
- ✓ 3.4 Create an emergency response action plan for rural areas; e.g., location of first aid kits, emergency numbers, emergency addresses, cell phone availability, legal land descriptions and emergency response directions (create a rural emergency plan kit)
- ✓ 3.5 Prepare a health and safety action plan for:
  - 3.5.1 Farm machinery and equipment safety
  - 3.5.2 Chemical safety
  - 3.5.3 Fire and electrical hazards
  - 3.5.4 Farm environmental hazards

### 4. Research and identify legislation and/or exemptions for agricultural health and safety

### 5. Demonstrate basic competencies

- ✓ 5.1 Demonstrate fundamental skills to:
  - 5.1.1 Communicate
  - 5.1.2 Manage information
  - 5.1.3 Use numbers
  - 5.1.4 Think and solve problems
- ✓ 5.2 Demonstrate personal management skills to:
  - 5.2.1 Demonstrate positive attitudes and behaviours
  - 5.2.2 Be responsible
  - 5.2.3 Be adaptable
  - 5.2.4 Learn continuously
  - 5.2.5 Work safely
- ✓ 5.3 Demonstrate teamwork skills to:
  - 5.3.1 Work with others
  - 5.3.2 Participate in projects and tasks

### 6. Create a transitional strategy to accommodate personal changes and build personal values

- ✓ 6.1 Identify short-term and long-term goals
- ✓ 6.2 Identify steps to achieve goals



# 12

## Food and Agricultural Commodities

Chemistry | Reactions  
Nutrients | Food  
Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science, Biology, Chemistry, Career and Life Management (CALM) and Career and Technology Studies (CTS) curriculum.

### SCIENCE 30 Unit B

- > Acids and bases
- > pH and hydronium ion concentration
- > Organic compounds

What are some important effects of acids, bases and synthetic organic compounds on living systems?

- > Identify acids and bases in products associated with food production and agricultural practices.
- > Investigate the implications of pH and salinization in soil for growing food plants and apply results to an agricultural challenge or problem.
- > Explain why it is important to understand the chemicals used in food production (e.g., preserving foods).

### BIOLOGY 30 Unit C

- > Genetic engineering
- > Genetic modification (GMOs)
- > Technologies

How have biotechnologies affected food production?

- > Identify food products that have been genetically modified.
- > Investigate the use of GMOs in food production, considering conflicting points of view and scientific evidence.
- > Research the history of GMOs, starting with domestication. Analyze how genetic modification has changed over time.

### CHEMISTRY 30 Unit C

- > Organic compounds
- > Saturated/unsaturated hydrocarbons
- > Functional groups identifying alcohols, carboxylic acids, esters and halogenated hydrocarbons
- > Esterification

How does society rely on organic compounds?

- > Identify organic compounds used in food production processes and products, including hydrogenation and esters.
- > Investigate and compare, through experiments, the properties of organic and inorganic compounds used in agriculture.
- > Compare the use of vitamin supplements, meal replacements and nutraceuticals versus traditional methods of consuming natural foods.
- > Assess the risks and benefits of various reactions involving organic compounds in food products.

# 12

## Food and Agricultural Commodities

Chemistry | Reactions  
Nutrients | Food  
Production

Agricultural commodities most obviously encompass food, but also include fuel, fibre and raw materials for a diverse range of products. Concepts related to food, nutrition, fuel, and raw materials used for feed, plastics and other products are found in Science, Biology, Chemistry, Career and Life Management (CALM) and Career and Technology Studies (CTS) curriculum.

### CAREER AND LIFE MANAGEMENT (CALM)

- > Environmental emotional/psychological, intellectual, social, spiritual and physical dimensions of health
- > Personal well-being
- > Personal resources

How is knowledge of food choices and nutrients part of personal life management?

- > Assess the range of food choices and food trends as a determinant of health.
- > Investigate the influences on consumer decision making around food products and agricultural practices and trends.
- > Identify social influences that affect food choices and develop strategies for making food choices that offer balanced nutritional benefits.
- > Explore how agricultural work and ways of life can be integrated into personal well being and connections with nature.

### CTS FOODS COURSES

- > Food production
- > Nutritional considerations
- > Agricultural products and commodities

What choices and benefits are provided by the diversity of agricultural production?

- > Visually map the basic steps involved in planting, growing and harvesting a plant commodity or in raising, growing and finishing an animal commodity in Alberta.
- > Identify the agricultural products that are used in a variety of recipes.
- > Assess the nutrients that are provided by a range of different agricultural products.
- > Identify Alberta producers and/or groups and the food products they create.
- > Analyze food labels for nutritional composition and evidence of Alberta or Canadian origins.

Note that there are numerous CTS courses specific to a broad range of food and nutrition topics. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

# 12

## Food and Agricultural Commodities

### Chemistry | Reactions Nutrients | Food Production

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 12 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

The outcomes identified for this topic are selected from Alberta programs of study and do not represent the whole curriculum. The style, numbers and numbering system used to identify these selected outcomes correlate directly to each specific program of study. The use of “i.e.” and “e.g.” in curriculum outcomes is deliberate, with “i.e.” indicating mandated and “e.g.” indicating optional learning expectations.

## SCIENCE

### Science 30 Unit B - Chemistry and the Environment

#### Specific Learning Outcomes:

**B1.6k** Trace the historical use of acid-base indicators; e.g., early Aboriginal methods of using extracts from natural substances

**B1.1sts** Demonstrate an understanding that science and technology developed to meet societal needs and expand human capacity (SEC1) [ICT F2-4.4, F2-4.8]

✓ Describe, in general terms, the uses of acids and bases in industry; e.g., hydrochloric acid used to extract metals from ores; sulfuric acid used to make fertilizers, paints, plastics, dyes and detergents; and sodium hydroxide used to make soaps and drain and oven cleaners

**B1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

✓ Use titration data to determine the concentration of a strong acid or a strong base (PR-NS2, PR-NS3) [ICT C6-4.2]

## BIOLOGY

### Biology 30 Unit C - Cell Division, Genetics and Molecular Biology

#### Specific Learning Outcomes:

**C3.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

✓ Discuss the implications for society of corporations being able to patent genes, such as the gene for herbicide resistance in canola

✓ Assess the concerns and benefits of genetically modified organisms, such as transgenic food organisms or tree cloning for reforestation

## CHEMISTRY

### Chemistry 30 Unit C - Chemical Changes of Organic Compounds

#### Specific Learning Outcomes:

**C1.2k** Identify and describe significant organic compounds in daily life, demonstrating generalized knowledge of their origins and applications; e.g., methane, methanol, ethane, ethanol, ethanoic acid, propane, benzene, octane, glucose, polyethylene

**C1.1sts** Explain how science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.4, F2–4.8]

- ✓ Describe where organic compounds are used in processes and common products, such as in hydrogenation to produce margarine and esters used as flavouring agents

**C1.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

- ✓ Build molecular models depicting the structures of selected organic and inorganic compounds (PR–NS4) [ICT C6–4.4]
- ✓ Perform an experiment to compare the properties of organic compounds with inorganic compounds, considering properties such as solubility, viscosity, density, conductivity, reactivity (PR–NS2, PR–NS3, PR–NS5)

**C1.3s** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- ✓ Analyze the contributions and limitations of scientific and technological knowledge in societal decision making, in relation to the costs and benefits of societal use of petrochemicals, pharmaceuticals and pesticides (AI–SEC2) [ICT F3–4.1]
- ✓ Explore aspects of present-day reliance on extracted or synthesized nutrients, with consideration of the synergy of compounds (reliance on vitamin supplements, meal replacements and nutraceuticals versus traditional methods of consuming natural foods) (AI–SEC2)

**C2.3sts** Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3–4.1]

- ✓ Assess the positive and negative effects of various reactions involving organic compounds, relating these processes to quality of life and potential health and environmental issues; e.g., – burning fossil fuels and climate change – production of pharmaceuticals and foods – by-products (CO<sub>2</sub>, dioxins) of common reactions – recycling of plastics – impact of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) on the ozone layer – trans fats in the diet

## CAREER AND LIFE MANAGEMENT

### 1: Personal Choices; 2: Resource Choices

#### Specific Learning Outcomes:

**P6.** Determine practices and behaviours that contribute to optimal physical well-being

- ✓ Describe how individuals have control over physical and other dimensions of well-being
- ✓ Analyze safety/risk-taking behaviours, nutritious choices, fitness and exercise as contributors to physical well-being
- ✓ Develop and implement health action plans

**R6.** Develop strategies to be informed consumers

- ✓ Explain the power and importance of sustainable development
- ✓ Describe the influences on personal consumer choices
- ✓ Develop marketplace skills
- ✓ Explain the rights and responsibilities of a consumer
- ✓ Practise the skills for communicating consumer concerns
- ✓ Classify forms of consumer protection
- ✓ Demonstrate informed consumer actions regarding health issues, products and services
- ✓ Analyze the impact of personal values, wants and needs on being an informed and responsible consumer

## CAREER AND TECHNOLOGY STUDIES

### FOD3020 Nutrition & Digestion

Find the full range of **Foods Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *HRH cluster (Health, Recreation & Human Services)*. *Foods* courses are part of this cluster. Selected courses have potential applicability to resources or programs focused on food production and agricultural careers.

#### Specific Learning Outcomes:

1. Describe the processes of digestion, absorption and metabolism in relation to nutrient composition

- ✓ 1.1 Relate the organs of the digestive system with the physical and chemical breakdown of nutrients
- ✓ 1.2 Explain the role of enzymes in the digestive process
- ✓ 1.3 Describe food sources of carbohydrates, fats and proteins and the body's need for these nutrients
- ✓ 1.4 Relate changes in the structures of carbohydrates, fats and proteins with their digestion, absorption and metabolism
- ✓ 1.5 Compare fuel factors for carbohydrates, fats and proteins
- ✓ 1.6 Differentiate among monosaccharides, disaccharides and polysaccharides
- ✓ 1.7 Describe the roles of glucose and glycogen in the body
- ✓ 1.8 Describe the storage of excess energy as fat in the body
- ✓ 1.9 Differentiate between the impact of high-density and low-density lipoproteins in the health of the heart and blood vessels
- ✓ 1.10 Differentiate between dietary and serum cholesterol in predicting the risk of heart disease
- ✓ 1.11 Compare essential and nonessential amino acids
- ✓ 1.12 Contrast the digestion, absorption and utilization of vitamins and minerals with the energy providing nutrients

2. Explain the role of water, minor vitamins and minerals in achieving and maintaining wellness

- ✓ 2.1 Describe the role of water in the body

- ✓ 2.2 Explain the function and identify sources of minor vitamins, including:
  - 2.2.1 Vitamin E
  - 2.2.2 Vitamin K
  - 2.2.3 Vitamin B6
  - 2.2.4 Vitamin B12
  - 2.2.5 Folacin

- ✓ 2.3 Relate inadequate intake of these vitamins with deficiency symptoms and/or diseases

- ✓ 2.4 Explain the function and identify sources of the following minerals:
  - 2.4.1 Sodium
  - 2.4.2 Potassium
  - 2.4.3 Phosphorous
  - 2.4.4 Iodine
  - 2.4.5 Zinc

- ✓ 2.5 Relate inadequate intake of these minerals with deficiency symptoms and/or diseases

- ✓ 2.6 Identify factors that contribute to inadequate intake of vitamins and minerals

- ✓ 2.7 Design and analyze a balanced meal in relation to:
  - 2.7.1 Food groups
  - 2.7.2 Leader nutrients

### 3. Describe nutrient intake, food patterns and diet therapies, considering the prevention and management of disease

- ✓ 3.1 Describe the role of dietary management in various diet-related diseases, including:
  - 3.1.1 Diabetes
  - 3.1.2 Food allergies
  - 3.1.3 Celiac disease
  - 3.1.4 Lactose intolerance
  - 3.1.5 Hypertension
- ✓ 3.2 Assess the psychological and social impact on individuals of adherence to diet therapy; e.g., interview a diabetic student

- ✓ 3.3 Identify strategies for increasing the acceptability of diet therapy to individuals

### 4. Interpret current nutrition controversies

- ✓ 4.1 Identify criteria for evaluating nutrition information and misinformation
- ✓ 4.2 List and describe current nutrition controversies associated with:
  - 4.2.1 Vitamin and mineral supplements
  - 4.2.2 Nutrition claims for specific food products; e.g., bee pollen
- ✓ 4.3 Evaluate given food practices for nutrition implications; e.g., use of amino acid supplements by athletes

### 5. Plan and prepare meal plans to meet specific dietary and nutritional needs of individuals

- ✓ 5.1 Interpret nutrition labelling
- ✓ 5.2 Evaluate nutrient content of foods and meal plans according to Recommended Nutrient Intake (RNI) tables
- ✓ 5.3 Plan, prepare and evaluate food products and meals within the:
  - 5.3.1 Guidelines for carbohydrate, fat and protein intake
  - 5.3.2 Context of dietary management of diet-related diseases
- ✓ 5.4 Prepare and evaluate a variety of food products, including the following, in order to improve intake of specific nutrients:
  - 5.4.1 Low sodium foods
  - 5.4.2 High protein foods
  - 5.4.3 High fibre foods
  - 5.4.4 Lower fat foods

### 6. Identify and demonstrate safe and sanitary practices

- ✓ 6.1 Maintain a clean, sanitary, safe work area
- ✓ 6.2 Apply universal precautions related to:
  - 6.2.1 Personal protective equipment (PPE); e.g., hair coverings, aprons, gloves
  - 6.2.2 Hand-washing techniques
  - 6.2.3 Infectious diseases
  - 6.2.4 Blood-borne pathogens

6.2.5 Bacteria, viruses, molds

6.2.6 Safety and first-aid applications; e.g., back safety, cuts, slip and trip hazards

- ✓ 6.3 Use all materials, products and implements appropriately
- ✓ 6.4 Clean, sanitize and store materials, products and implements correctly
- ✓ 6.5 Dispose of waste materials in an environmentally safe manner

## 7. Demonstrate basic competencies

- ✓ 7.1 Demonstrate fundamental skills to:
  - 7.1.1 Communicate
  - 7.1.2 Manage information
  - 7.1.3 Use numbers
- ✓ 7.2 Think and solve problems
  - 7.2.1 Demonstrate personal management skills to:
  - 7.2.2 Demonstrate positive attitudes and behaviours
  - 7.2.3 Be responsible
  - 7.2.4 Be adaptable
  - 7.2.5 Learn continuously
  - 7.2.6 Work safely
- ✓ 7.3 Demonstrate teamwork skills to:
  - 7.3.1 Work with others
  - 7.3.2 Participate in projects and tasks

## 8. Create a transitional strategy to accommodate personal changes and build personal values

- ✓ 8.1 Identify short-term and long-term goals; identify steps to achieve goals

12

## Food Security and Economies of Food Production

Globalization |  
Nationalism | Trade |  
Policies

Food security, according to the Food and Agriculture Organization, exists “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” Food security is often linked to geographic location, economic inequalities and poverty. Concepts related to food security, identifies, ideologies and social issues in Social Studies curriculum can be explored through an agricultural lens.



### SOCIAL STUDIES 30-1 / 30-2

- > Individual and collective
- > Beliefs and values
- > Ideology
- > Contemporary issues
- > Citizen advocacy

How do values and beliefs shape individual and collective responses to issues of food security?

- > Explore values and beliefs that shape ways that land and resources are used to produce and distribute food.
- > Identify examples of food inequality.
- > Investigate global responses to food insecurity, poverty, the global food supply, and resource inequalities.
- > Investigate issues and examples related to food safety in a global context.



# 12

## Food Security and Economies of Food Production

Globalization | Nationalism | Trade | Policies

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 12 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

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## SOCIAL STUDIES

### Social Studies 30-1 Perspectives on Ideology

#### Specific Learning Outcomes:

- 1.3 Explore factors that may influence individual and collective beliefs and values (culture, language, media, relationship to land, environment, gender, religion, spirituality, ideology) (I, C, LPP)
  
- 1.6 Explore themes of ideologies (nation, class, relationship to land, environment, religion, progressivism) (TCC, PADM, LPP)
  
- 3.4 Explore the extent to which governments should encourage economic equality (PADM, ER, C)
  
- 3.9 Evaluate the extent to which the principles of liberalism are viable in the context of contemporary issues (environment concerns, resource use and development, debt and poverty, racism, pandemics, terrorism, censorship, illiberalism) (PADM, ER, LPP)
  
- 4.2 Exhibit a global consciousness with respect to the human condition and world issues (C, GC)
  
- 4.6 Analyze perspectives on the rights, roles and responsibilities of the individual in a democratic society (respect for law and order, dissent, civility, political participation, citizen advocacy) (C, PADM, ER)

## SOCIAL STUDIES

### Social Studies 30-2 Perspectives on Ideology

#### Specific Learning Outcomes:

1.3 Explore factors that may influence individual and collective beliefs and values (culture, language, media, relationship to land, environment, gender, religion, spirituality, ideology) (I, C, LPP)

1.6 Identify themes of ideologies (nation, class, relationship to land, environment, religion) (TCC, PADM, LPP)

3.4 Explore the extent to which governments should encourage economic equality (PADM, ER, C)

3.8 Evaluate the extent to which the values of liberalism are viable in the context of contemporary issues (environment concerns, resource use and development, debt and poverty, racism, pandemics, terrorism, censorship) (PADM, ER, LPP)

4.2 Exhibit a global consciousness with respect to the human condition and world issues (C, GC)

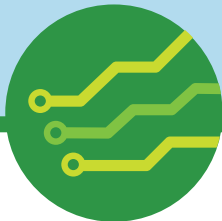
4.6 Examine perspectives on the rights, roles and responsibilities of the individual during times of conflict (humanitarian crises, antiwar movements, pro-democracy movements, contemporary examples) (C, PADM, GC)

# 12

## Technologies

Automation | Robotics |  
Biotechnology | Genetics

Agricultural technology encompasses advancements in automation and robotics, information technology applications as well as biotechnology and genetics. Concepts related to biotechnology, genetic technologies and genetic engineering in Science, Biology and Career and Technology (CTS) curriculum can be explored through an agricultural lens.



### SCIENCE 30 Unit A

- > Environmental principles of Mendelian genetics
- > Deoxyribonucleic acid DNA and protein synthesis
- > Mutations and gene therapy
- > Genetic technology

What are the risks and benefits of genetic technologies?

- > Investigate the implications of genetic engineering and its application to gene therapy and the development of genetically modified organisms in food production.
- > Research conflicting positions regarding genetically modified organisms as they relate to food consumption.

### BIOLOGY 30 UNIT C

- > Gene linkage
- > Model of DNA
- > Genetic engineering

How has knowledge of the molecular nature of genes and DNA led to new biotechnologies?

- > Research and explain the range of biotechnologies.
- > Investigate current applications of gene theory and nanotechnology in agricultural production.
- > Predict the impact of biotechnologies in the future of food production.

### CTS AGRICULTURE COURSES

- > Biotechnology

How are technologies applied to meet human needs and priorities?

- > Trace the history and development of biotechnology as it applies to an agricultural area.
- > Research implications of biotechnology on food production, food/consumer trends and the environment.
- > Compare perspectives on issues associated with biotechnology.

Note that there are numerous CTS courses specific to a broad range of agricultural activities and practices. Programs and resources developed for these 1-credit courses can be designed to cover learning outcomes as a complete course.

# 12

## Technologies

Automation | Robotics |

Biotechnology | Genetics

The specific learning outcomes in the charts that follow are drawn directly from Alberta programs of study for Grade 12 students. These learning outcomes address knowledge, skills and attitudes in the identified subject areas that support this topic. When developing programs or resources, select from these outcomes and develop activities that will help students meet the expectations that the outcomes represent. Note that there may be additional learning outcomes in these subject area programs of study – particularly skills that cross over multiple units – that can be supported through your activities.

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## SCIENCE

### Science 30 Unit A - Living Systems Respond to Their Environment

#### Specific Learning Outcomes:

**A3.9k** Describe, in general terms, genetic engineering and its application to gene therapy and the development of genetically modified organisms

**A3.1sts** Explain that science and technology are developed to meet societal needs and expand human capability (SEC1) [ICT F2–4.8]

✓ Trace the development of plant and animal breeding techniques, starting with traditional practices (e.g., Hopi/Huron/Iroquois maize breeding), to Mendel’s work on inheritance, to the contributions of many scientists on the discovery of the molecular structure of DNA and the development of recombinant DNA technology

**A3.2sts** Explain that decisions regarding the application of scientific and technological development involve a variety of perspectives, including social, cultural, environmental, ethical and economic considerations (SEC4b)

✓ Assess the risks and benefits of genetic technology and the need for ethical considerations; e.g., stem-cell research, access to genetic screening, genetically modified organisms

**A3.1s** Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues

✓ Devise an experimental procedure to investigate a characteristic of an organism acquired through genetic engineering, such as genetically modified canola, corn or soybean (IP–NS4)

**A3.2s** Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information

✓ Identify and evaluate potential applications of genetic engineering to health and agriculture (AI–SEC4) [ICT C2–4.1, F2–4.4]

**A3.4s** Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results

- ✓ Research, present and defend a position on genetically modified organisms (CT-SEC3) [ICT C1-4.4]

## BIOLOGY

### Biology 30 Unit C - Cell Division, Genetics and Molecular Biology

#### Specific Learning Outcomes:

**C1.1sts** Explain that science and technology are developed to meet societal needs and expand human capability (SEC1)

- ✓ Discuss the role of mitosis and biotechnology in regenerating whole, damaged or missing parts of organisms (stem cells, skin tissue)
- ✓ Evaluate how knowledge of cell division or development of nanotechnology might be applied to the regulation of cancerous growth in plants or animals
- ✓ Discuss and assess the impact of research in plant and animal reproduction on our understanding of mitosis and meiosis in humans (cloning, chromosome shortening)
- ✓ Discuss the types and sources of teratogenic compounds found in the environment and the technological means by which they can be removed or controlled to ensure quality of life for future generations

**C2.1sts** Explain that decisions regarding the application of scientific and technological development involve a variety of perspectives, including social, cultural, environmental, ethical and economic considerations (SEC4b) [ICT F2-4.2, F3-4.1]

- ✓ Discuss the contributions of Aboriginal peoples in the development of early plant hybrids
- ✓ Discuss the application of genetic crosses in the development of specific breeds or hybrids (wheat and corn)

**C3.1sts** Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1]

- ✓ Discuss the implications for society of corporations being able to patent genes, such as the gene for herbicide resistance in canola
- ✓ Assess the concerns and benefits of genetically modified organisms, such as transgenic food organisms or tree cloning for reforestation
- ✓ Investigate the role of gene banks in the preservation of endangered species and genotypes, particularly of plants and animals used in agriculture

## CAREER AND TECHNOLOGY STUDIES

### AGR3100 - Biotechnology

Find the full range of **Agriculture Career and Technology Studies** courses on the Alberta Education website. Search for *Alberta CTS Programs of Studies* and look for the *NAT cluster (Natural Resources)*. *Agriculture* courses are part of this cluster. These courses all have applicability to resources or programs focused on agriculture and agricultural careers.

#### Specific Learning Outcomes:

1. Describe the history and development of biotechnology
  - ✓ 1.1 Explain how biotechnology involves the altering of cells and organisms to produce goods and services
  - ✓ 1.2 Provide a historical perspective on methods by which the characteristics of plants and animals have been altered, including:
    - 1.2.1 Natural selection
    - 1.2.2 Selective breeding
    - 1.2.3 Genetic engineering
  - ✓ 1.3 Describe basic vocabulary and techniques used in genetic engineering, including:
    - 1.3.1 Chromosome
    - 1.3.2 Gene
    - 1.3.3 Gene mapping
    - 1.3.4 Gene splicing
    - 1.3.5 Cloning
  - ✓ 1.4 Outline emerging applications of biotechnology
2. Identify the benefits and costs associated with applications of biotechnology in agriculture and food production
  - ✓ 2.1 Describe specific applications of biotechnology in agriculture and food production; e.g., product and market development, industry diversification, production efficiency, disease and pest control
  - ✓ 2.2 Describe environmental, economic and ethical issues related to developments in biotechnology; e.g., use of natural resources, control and patenting of life forms, impact of genetically altered organisms, food quality and safety, world food supply

- ✓ 2.3 Predict possible effects of new biotechnologies on producers, processors, consumers and governments
- ✓ 2.4 Explain the role of legislation in regulating developments in biotechnology
- ✓ 2.5 Identify a specific problem in agriculture and food production recently addressed through biotechnology (e.g., production costs, product quality, market supply, environmental impact) and:
  - 2.5.1 Identify key stakeholder groups affected by the problem
  - 2.5.2 Describe funding and partnerships that were established to address the problem
  - 2.5.3 Explain applications of biotechnology in dealing with the problem; e.g., principles of genetic engineering, scientific design, experimental outcomes
  - 2.5.4 Describe the social, economic and environmental consequences of experimental outcomes
  - 2.5.5 Make recommendations regarding the use of biotechnology and practical solutions to the problem; e.g., management actions, further research
3. Explain the process used to develop a recent biotechnology within Alberta's agriculture industry
4. Demonstrate basic competencies
  - ✓ 4.1 Demonstrate fundamental skills to:
    - 4.1.1 Communicate
    - 4.1.2 Manage information
    - 4.1.3 Use numbers
    - 4.1.4 Think and solve problems
  - ✓ 4.2 Demonstrate personal management skills to:
    - 4.2.1 Demonstrate positive attitudes and behaviours
    - 4.2.2 Be responsible
    - 4.2.3 Be adaptable
    - 4.2.4 Learn continuously
    - 4.2.5 Work safely

4.3 Demonstrate teamwork skills to:

4.3.1 Work with others

4.3.2 Participate in projects and tasks

5. Create a transitional strategy to accommodate personal changes and build personal values

5.1 Identify short-term and long-term goals

5.2 Identify steps to achieve goals

