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CAREER EXPLORATION ACTIVITY TOOLKIT

AN EDUCATIONAL RESOURCE FOR GRADES 9 TO 12

AGRICULTURE IN THE CLASSROOM CANADA

The **thinkAG Career Exploration Activity Toolkit** contains a selection of activities that engage Grade 9-12 students in exploring the wide variety of career opportunities available in the agriculture and agri-food sector.

Learning Outcomes

These activities have been developed with the following learning goals in mind:

- to inspire students to explore agri-food career options
- to demonstrate to students that technical skills (e.g. calculating, data analysis, machine operation, etc) are important in agri-food careers
- to demonstrate to students that employability skills (e.g. communication, team work, critical thinking) are important in agri-food careers

Please note: *Activities in the Toolkit do not list specific curricular outcomes.*

Overview

Activities in the Toolkit relate to the following ag-sector career pathways:

- Agricultural Business
- Agricultural Mechanics
- Animal Science
- Environmental Services
- Food Science
- Natural Resources
- Plant Science

The kit contains 12 activities, each of which take between 15 to 30 minutes to deliver. Activities can be delivered in several different ways:

1. Each activity can be delivered individually, as a standalone exploration of a specific career pathway in agriculture and food.
2. Several activities can be delivered as 'stations' in a career exploration event, with students rotating through stations in small groups (5-8 students)
3. Several activities can be delivered as 'stations' in a career competition, with students rotating through stations in small groups (5-8 students). Students are judged on how they exhibit the employability skills associated with the various activities.

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Overview of Agri-Food Career Activities

Agricultural Business Pathway

AGRICULTURE ACCOUNTING: Students learn about the importance of math skills in the agriculture industry while competing in teams to complete equations in an AgriStability Flows Activity. They also learn about the ag careers that involve applying math skills (Ag Financial Service Representative, Farm Business Manager, Financial Analyst, Accounting Manager, Accountant, Chartered Professional Accountant).

AGRICULTURE COMMUNICATIONS: Students learn about the impact that marketing and agriculture communication have on consumers and producers (farmers) while playing the AdFarming Game. They also learn about available ag communication careers (Marketing Specialist, Public Relations Specialist, Agriculture Journalist, Ag Literacy and Advocacy Specialist, Social Media Strategist).

MARKETING: Students learn about the importance of marketing in the agriculture industry by creating ads promoting ag-sector careers to their peers. They also learn about careers associated with agriculture marketing (Social Media Strategist, Communications Specialist, Marketing Specialist, Sales Representative, Public Relations Specialist).

Agricultural Mechanics Pathway

PRECISION AGRICULTURE: Students design a variable rate irrigation system that demonstrates how precision agriculture helps farmers make decisions about their farming operations. They also learn about careers associated with precision agriculture (Geospatial Analytics Scientist, Precision Agriculture Specialist, Design Engineer, Mechanical Engineer).

ROBOTICS: Students learn about the important role that technology plays in modern agriculture by operating a hydraulic arm. They also learn about ag-careers related to technology (Hydraulics Technician, Automation Technician, Design Engineer, Mechanical Engineer).

Animal Science Pathway

ANIMAL NUTRITION: Students learn about the basic principles of preparing animal feed (particle size, particle shape, and moisture content) to prevent feed sorting and feed handling problems. They also learn about ag-sector careers associated with animal nutrition [Feed Mill Operator, Feed Mill Manager, Sales Representative (Feed and Animal Health), Herd Nutritionist, Ruminant Nutritionist].

Environmental Services Pathway

WATER MANAGEMENT: Students learn about the impact that agricultural soil and water conservation practices have on soil erosion by engaging in a soil assessment activity. They also learn about careers associated with those practices (Restoration Specialist, Soil Scientist, Nutrient / Waste Management Specialist, Environmental Compliance Officer, Environmental Engineer, Environmental Protection Technician, Waste Management Technician).

Food Science Pathway

FOOD PROCESSING AND PRESERVATION: Students learn about steps required in processing certain food products by competing in teams to determine the processing sequences for making bread, cheese and hamburger patties. They also learn about careers associated with those processes (Production Worker, Machinist and Maintenance Worker, Packaging Technician, Sales and Marketing Personnel, Research and Product Development Personnel).

MAKING & MARKETING SALAD DRESSING: Students learn about emulsions by creating their own salad dressings and create marketing plans for their salad-dressing products. They also learn about various careers associated with food science (Food Production Supervisor, Food Safety/ Quality Assurance Manager, Nutritionist/Dietician, Product Development Food Scientist, Research & Development Technician, Flavour Technologist, Packaging Engineer and Process Engineer).

Plant Science Pathway

BIO-PRODUCTS: Students create bio-plastic and learn about technological advances in the creation of bio-plastics and their benefits. They also learn about ag-sector careers associated with bio-products (Analytical Chemist, Bioinformatics Scientist, Biostatistician, Laboratory Technician, Research and Development Manager).

DNA EXTRACTION: Students extract DNA from strawberries to investigate DNA: where it is found, and how it looks and feels. Participating in DNA extraction familiarizes students with one aspect of the work that biotechnologists do: deciding how to use information contained in DNA to improve crops. They also learn about ag-sector careers associated with biotechnology (Plant Biologist, Plant Geneticist, Research Station Manager).

SOIL ANALYSIS: Students learn about the important role that soil testing plays in resolving problems in crop production. They also learn about the careers associated with plant and soil science (Soil Scientist, Environmental Scientist, Biological Technician, Environmental Technician, Agronomist).

NOTE: Career Pathways are based on categories from AgCareers.com

Table of Contents

Table of Contents

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Agriculture Business Pathway -

AGRICULTURE ACCOUNTING GAME

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students learn about the importance of math skills in the agriculture industry, and about the ag careers that involve applying math skills.

Suggested Time

15 minutes

Materials Required

- **Appendix A**: *AgriStability Flow Activities 1-6*
- **Appendix B**: *Answer Key (AgriStability Flow Activities 1-6)*
- Pencils and paper
- Calculators
- **Optional:** Prize for the winner of the *Ag-Accounting Game.*

1. **Ask students: *How many of you would like to be an entrepreneur or your own boss?***

2. **Then, ask students: *What are some of the skills that an entrepreneur in an agriculture business needs in order to be successful?***

   Examples of entrepreneurs: a farmer, someone with a consulting firm, a custom equipment operator, a food processor.

   Suggested responses:

   - *Practical farming skills (for a farmer)* . . . to grow and harvest crops, and to care for livestock
   - *Organizational skills* . . . to maintain accurate records for items such as invoices, warranties, taxes and payrolls
   - *People skills (such as interpersonal and communication skills)* . . . to establish and maintain good relationships with other business people, labourers, buyers and consumers
   - *Analytical, problem solving and critical thinking skills* . . . to be able to analyze issues and think them through in order to make well-informed decisions
   - *Mechanical skills* . . . to complete routine maintenance on basic farm machinery or other equipment used in an ag-business operation
   - *Management skills* . . . to manage employees, business associates (e.g. agents and buyers), as well as one's own use of time
   - *Business savvy* . . . to deal with banks and financial institutions, to work with buyers and sellers, and to deal with marketing and promotions. An ag-business entrepreneur must be able to balance budgets, pay bills, hire employees, keep records, write business plans, build websites and design marketing materials.[1]

3. **Ask students: *How are math skills useful for operating an agricultural business?***

   Math skills are useful for tracking crop and livestock inventories, income and expenses. To help them operate their businesses effectively, many farmers work with professionals who apply their math skills in the ag-business world.

4. **Ask students: *Who are some professionals with strong math skills who help ag business entrepreneurs run their businesses?***

   - *AG FINANCIAL SERVICE REPRESENTATIVES* work for agricultural lending banks and agricultural insurance companies to develop and grow portfolios for all types of farming operations, such as traditional, part-time and hobby operations, and agricultural businesses.
   - *FARM BUSINESS MANAGERS* analyze, report on, and give advice about the financial well-being of farms. They conduct strenuous record keeping and oversee such things as farmers' management accounts and budgeting.
   - *FINANCIAL ANALYSTS* look at various parts of a company's finances in order to help them make better financial decisions.
   - *ACCOUNTING MANAGERS* are responsible for the administration of management accounts, organizational budgeting and administration of accounting.
   - *ACCOUNTANTS* assist in the preparation and examination of farmers' financial records. They also play a major role in ensuring taxes are paid and accurate financial records are kept.

(continued)

1 *Based on information found at https://biznakenya.com/skills-new-farmers-need-in-order-to-be-successful/*

- *CHARTERED PROFESSIONAL ACCOUNTANTS* do what accountants do (see above) and more. They work with farmers to assess annual finances and discuss future plans (e.g. transitioning the farm to a son/daughter, reorganizing taxes by changing from a partnership to a corporation). Some CPAs prepare AgriStability applications for farms with commodities that are vulnerable to conditions such as price changes and the weather.

5. **Get students to play the *Ag Accounting Game*. Tell students that this game involves using their math skills to prepare data for applications for financial assistance from the AgriStability program.[2]**

   a. Divide students into small groups. Each group will receive a different Activity Sheet.

   b. Hand out pencils, paper and calculators.

   c. Tell students that they will be working together in their groups to become the first team to plug numbers into an equation to make it flow to its "final answer" (hence the name, *AgriStability Flows Activity*). They will use additional information to calculate missing numbers in the equation. The winner is the first group to come up with the correct, missing numbers. (The winner receives a prize, if you have decided to offer one.

   d. Give each group an *AgriStability Flows Activity Sheet* (1-6). Tell them that "bu" is the abbreviation for "bushels," which is a weight measurement unit that varies from commodity to commodity. For example, one bushel of barley weighs 48 lbs., one bushel of canola weighs 50 lbs., and one bushel of wheat weighs 60 lbs.

   e. Let the game begin!

6. **After playing the game, remind students that this activity has demonstrated the applicability of math skills in the agriculture sector and the variety of careers which use those skills.**

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2 Note: The AgriStability *program is a government-funded risk management program designed to help farm operations that face large margin declines caused by production loss, increased costs or market conditions.*

Thanks to Kyla Smith and Karly Nagel of MNP for sharing the game concept and materials used for this activity.

Ag Financial Service Representative profile:
https://m.agcareers.com/career-profiles/ag-financial-service-representative.cfm

Farm Business Manager profile:
https://m.agcareers.com/career-profiles/farm-business-manager-accountant.cfm

Financial Analyst profile:
https://m.agcareers.com/career-profiles/financial-analyst.cfm

Accounting Manager profile:
https://m.agcareers.com/career-profiles/accounting-manager.cfm

Accountant profile:
https://m.agcareers.com/career-profiles/accountant.cfm

Activity #1: Client with Barley Inventory

Instructions: Plug in the missing numbers to make the equation flow! Use **ABC** to calculate the missing quantities (Production, Sales, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Barley = 48 lbs. / bu

BARLEY INVENTORY

Opening inventory	200 bu		
Production	? bu	(Use **A** below to calculate.)	
Purchases	40 bu		
Sales	? bu	(Use **B** below to calculate.)	
Amount fed	60 bu		
Used for seed	? bu	(Use **C** below to calculate.)	
Ending inventory	250 bu		

A) The barley yield for the current year was 80 bu/acre, and the client farmed 100 acres of barley.

B) Client sold $31,560 of barley in the year at $4.00/bu.

C) Barley used for seed was total amount of seed purchased.

ANSWERS

(Round to the nearest whole number)

1) Production: _____ bu

2) Sales: _____ bu

3) Used for seed: _____ bu

Activity #2: Client with Canola Inventory

Instructions: Plug in the missing numbers to make the equation flow!
Use **ABC** to calculate the missing quantities (Purchases, Sales, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Canola = 50 lbs. / bu

CANOLA INVENTORY

Opening inventory	150	bu	
Production	300	bu	
Purchases	?	bu	(Use **A** below to calculate.)
Sales	?	bu	(Use **B** below to calculate.)
Amount fed	NA		
Used for seed	?	bu	(Use **C** below to calculate.)
Ending inventory	206	bu	

A) All canola purchased was seeded.
B) There was $2,500 of canola sold for $10.25 per bushel.
C) The seed rate for canola was 4.5 pounds per acre. There were 140 acres seeded.

ANSWERS

(Round to the nearest whole number)

1) Purchases: _____ bu

2) Sales: _____ bu

3) Used for seed: _____ bu

Activity #3: Client with Wheat Inventory

Instructions: Plug in the missing numbers to make the equation flow! Use **ABC** to calculate the missing quantities (Production, Amount Fed, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Wheat = 60 lbs. / bu

WHEAT INVENTORY

Opening inventory	250	bu	
Production	?	bu	(Use **A** below to calculate.)
Purchases	300	bu	
Sales	3,052	bu	(Use **B** below to calculate.)
Amount fed	?	bu	
Used for seed	?	bu	(Use **C** below to calculate.)
Ending inventory	250	bu	

A) The wheat yield for the current year was 50 bu/acre, and the client farmed 70 acres of wheat.

B) There were 10 cows; each ate 10 pounds of wheat per day for 365 days. How many bushels of wheat were fed?

C) The seed rate was 2 bu/acre. How many bushels of wheat were seeded on 70 acres?

ANSWERS

(Round to the nearest whole number)

1) Production: _____ bu

2) Amount fed: _____ bu

3) Used for seed: _____ bu

Activity #4: Client with Barley Inventory

Instructions: Plug in the missing numbers to make the equation flow! Use **ABC** to calculate the missing quantities (Production, Amount Fed, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Barley = 48 lbs. / bu

BARLEY INVENTORY

Opening inventory	105	bu	
Production	?	bu	(Use **A** below to calculate.)
Purchases	300	bu	
Sales	6,592	bu	(Use **B** below to calculate.)
Amount fed	?	bu	
Used for seed	?	bu	(Use **C** below to calculate.)
Ending inventory	53	bu	

A) The barley yield for the current year was 72 bu/acre, and the client farmed 100 acres of barley.

B) There were 10 cows; each ate 10 pounds of barley per day for 365 days. How many bushels of barley were fed?

C) The seed rate is 2 bu/acre. How many bushels of barley were seeded on 100 acres?

ANSWERS

(Round to the nearest whole number)

1) Production: _____ bu

2) Amount fed: _____ bu

3) Used for seed: _____ bu

Activity #5: Client with Barley Inventory

Instructions: Plug in the missing numbers to make the equation flow! Use **ABC** to calculate the missing quantities (Production, Amount Fed, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Barley = 48 lbs. / bu

BARLEY INVENTORY

Opening inventory	400	bu	
Production	?	bu	(Use **A** below to calculate.)
Purchases	30	bu	
Sales	1,000	bu	(Use **B** below to calculate.)
Amount fed	?	bu	
Used for seed	?	bu	(Use **C** below to calculate.)
Ending inventory	385	bu	

A) The barley yield for the current year was 80 bu/acre, and the client farmed 62.5 acres of barley.

B) The client had 10 cows that ate 1.10bu of barley for 365 days.

C) The client purchased all of his/her seed, and the purchases contained only seed purchases.

ANSWERS

(Round to the nearest whole number)

1) Production: _____ bu

2) Amount fed: _____ bu

3) Used for seed: _____ bu

Activity #6: Client with Barley Inventory

Instructions: Plug in the missing numbers to make the equation flow! Use **ABC** to calculate the missing quantities (Production, Amount Fed, Used for Seed).

The winner is the first group to arrive at the correct answers.

EQUATION

Opening inventory + *Production* + *Purchases* – *Sales* – *Amount fed* – *Used for seed* = *Ending inventory*

NOTE

Barley = 48 lbs. / bu

BARLEY INVENTORY

Opening inventory	300	bu	
Production	?	bu	(Use **A** below to calculate.)
Purchases	500	bu	
Sales	6,597	bu	(Use **B** below to calculate.)
Amount fed	?	bu	
Used for seed	?	bu	(Use **C** below to calculate.)
Ending inventory	67	bu	

A) The barley yield for the current year was 75 bu/acre, and the client farmed 100 acres of barley.

B) Client had 10 cows; each ate 20 pounds of barley per day for 365 days. How many bushels of barley was fed?

C) The seeding rate was 2.5 bu/acre. How many bushels of barley was seeded on 100 acres?

ANSWERS

(Round to the nearest whole number)

1) Production: _____ bu

2) Amount fed: _____ bu

3) Used for seed: _____ bu

Answer Key

Activity 1

1. 8,000 bu
2. 7,890 bu
3. 40 bu

Activity 2

1. 12.6 bu
2. 244 bu
3. 12.6 bu

Activity 3

1. 3,500 bu
2. 608 bu
3. 140 bu

Activity 4

1. 7,200 bu
2. 760 bu
3. 200 bu

Activity 5

1. 5,000 bu
2. 4,015 bu
3. 30 bu

Activity 6

1. 7,500 bu
2. 1,520 bu
3. 250 bu

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Agricultural Business Pathway -

AGRICULTURE COMMUNICATIONS

GRADE LEVELS: 9 TO 12

Grade Levels

9-12

Overview

Students learn about the impact that marketing and agriculture communication have on consumers and producers (farmers), and about available careers in agriculture communication.

Suggested Time

15 minutes

Materials Required

- **Appendix A:** *AdFarming Game Board*
- **Appendix B:** Sets of *Game Cards*, one per group (1 *Hens*, 1 *Bushels of Canola*, 1 *Cow*)
- Game pieces (e.g. coloured circles of paper/plastic, monopoly pieces, small objects) (1 per group)
- Dice (one die per game board)
- "Monopoly money" (two $1 bills per group + extra $1 bills to provide during the game)

1. **Ask students: *Who are the stakeholders in the agriculture industry?***

   A stakeholder is any person, organization or group that has a big interest in a business and its activities. Stakeholders can affect how a business operates, and can be affected by how a business operates.[1]

   Examples of stakeholders in agriculture:

   - consumers
   - producers
   - truck drivers
   - employees

2. **Tell students: *As you can imagine, stakeholders have access to different information based on their place in the food system. They also may have different perceptions and priorities based on what kind of stakeholder they are. As a result, they rely on the work done by agriculture communicators.***

3. **Ask students: *What are the responsibilities of an agriculture communicator?***

   An agriculture communicator is responsible for communicating agriculture-related information to ag-industry stakeholders. Responsibilities include:

   - communicating ideals and standards of the agriculture industry
   - communicating new trends in the agriculture industry
   - providing insights into various ag-related issues
   - providing recommendations about various ag-related issues[2]

4. **Tell students: *You will be playing the AdFarming Game that focuses on situations that affect stakeholders. This game challenges you to consider what agriculture communicators might do to help stakeholders work their way through these situations.***

5. **Ask students: *What are examples of specific jobs in agriculture communication?***

   - *MARKETING SPECIALISTS* are responsible for ensuring that appropriate messages and mediums are used to meet sales targets. They oversee the promotion of companies' or clients' products or services. Additionally, they work with suppliers regarding training/education, pricing, inventory management, quality of communication, reporting, trade-show co-ordination and more.

   - *PUBLIC RELATIONS SPECIALISTS* are responsible for creating and maintaining a positive company brand for employees and clientele. They work to ensure that company product launches receive maximum exposure and follow protocols.

   - *AGRICULTURE JOURNALISTS* are responsible for reporting and writing features that are relevant to those involved in agriculture. Their stories, however, may also be seen by non-agriculture readers. Agriculture journalists produce web and print articles that report current trends in agriculture, and research and verify data and sources used in the story. They may also use social media to push stories, build traffic on social channels and distribute content.

   - *AG LITERACY AND ADVOCACY SPECIALISTS* are responsible for designing, implementing and co-ordinating plans that promote agricultural literacy and advocacy. These specialists work with organizations to ensure that the most effective literacy and advocacy methodologies and technologies are being utilized. They also work with marketing and communications specialists to develop messages appropriate for consumers, and to develop social media plans that promote literacy and advocacy.

[continued]

1 *http://study.com/academy/lesson/what-is-a-stakeholder-in-business-definition-examples-quiz.html*
2 *http://study.com/academy/lesson/what-is-a-stakeholder-in-business-definition-examples-quiz.html*

- *SOCIAL MEDIA STRATEGISTS* are responsible for developing, managing and tracking Internet content on their employers' social media pages. They manage day-to-day social editorial calendars for social media channels, and drive engagement. *Because of the popularity of social media, social media strategists play a crucial role in defining agriculture's brand to the masses.*

6. **Get students to play the *AdFarming Game:***

   a. Students establish teams (2-3 students)

   b. Each team receives:

      - one set of **Game Cards** (1 Hen, 1 Bushel of Canola, 1 Cow)
      - **$2**
      - one **Game Piece**
      - Each team starts with a **Game Piece** on the **red Start/End Season** rectangle.

   c. A team rolls a die, then moves around the board. Each square landed on contains a different scenario that will determine if money / resources are gained or lost.

   d. Groups can earn $1 bonus for each square they land on if they identify the role an agriculture communicator played, or could potentially play, in the situation. When a team gets back to the **Start/End Season rectangle**, they are done.

   e. After all students have finished playing the game, they count up their money to see who had the best farming year. *The team with the most money wins!*

7. **Ask students: *After playing the AdFarming Game, what skills do you think a person working in ag communications needs?***

   - great communication skills
   - ability to pay attention to details
   - active listening skills
   - good problem-solving skills
   - decision-making skills
   - writing ability
   - creativity

This activity was adapted from the *AdFarming Game* by AdFarm Canada. Thanks to AdFarm for providing the design of the game board and game cards.

Marketing Specialist profile:
https://www.agcareers.com/career-profiles/marketing-specialist.cfm

Public Relations Specialist profile:
https://www.agcareers.com/career-profiles/public-relations-specialist.cfm

Agriculture Journalist profile:
https://www.agcareers.com/career-profiles/agriculture-journalist.cfm

Ag Literacy and Advocacy Specialist profile:
https://www.agcareers.com/career-profiles/agricultural-literacy-and-advocacy-specialist.cfm

Social Media Strategist profile:
https://www.agcareers.com/career-profiles/social-media-strategist.cfm

AdFarming Game Board

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START/END SEASON

1 A large fast food chain launches a new Canadian Beef campaign. Beef demand goes up! **Collect $1 per cow.**

2 A number of beauty companies find that canola oil makes a great addition to many beauty products. It becomes a sought after ingredient and demand for canola increases! **Collect $1 per bushel of canola.**

3 The World Health Organization says that red meat might cause cancer. Beef demand decreases. **Give up 1 cow.**

4 A new #eatlocal campaign gains popularity across Canada. Everyone wants your local products! **Collect $1 per cow, $1 per bushel of canola** and **$1 per hen.**

5 A major celebrity becomes an endorser for Canadian eggs. Egg demand goes up! **Collect $1 per hen.**

6 A large trucking company decides to use canola-based biodiesel in their trucks in order to be more environmentally friendly. Demand for canola increases. **Collect $1 per bushel of canola.**

7 A well-known health and wellness blogger writes about canola oil having the least saturated fat of any culinary oil. Demand for canola oil increases. **Receive $1 per bushel of canola.**

8 A local restaurant chain decides they will only serve Certified Humane Beef. Since you give your cows antibiotics when they get sick you can no longer be a beef supplier for the restaurant. **Give up $1 per cow.**

9 Many of the grocery stores that sell your beef and eggs are replaced with Whole Foods Markets. Whole Foods only sells organic, and since your operation is non-organic you can't be a supplier. **Give up $1 per cow** and **$1 per hen.**

10 New infant feeding guidelines in Canada say that infants can eat whole eggs at 6 months of age. Mommy bloggers spread the word and demand for eggs increases! **Collect $1 per hen.**

11 A documentary about the safety of modern agriculture is released. People's concerns about genetically modified and non-organic food are put at ease. **Collect $1 per cow, $1 per hen** and **$1 per bushel of canola.**

12 After much backlash a local restaurant chain decides their beef does not have to be Certified Humane. You are able to supply them with beef again. **Collect $1 per cow.**

13 Canola oil receives a health claim from the U.S. Food and Drug Administration based on its unsaturated fat content. Demand for canola oil increases! **Collect $2 per bushel of canola.**

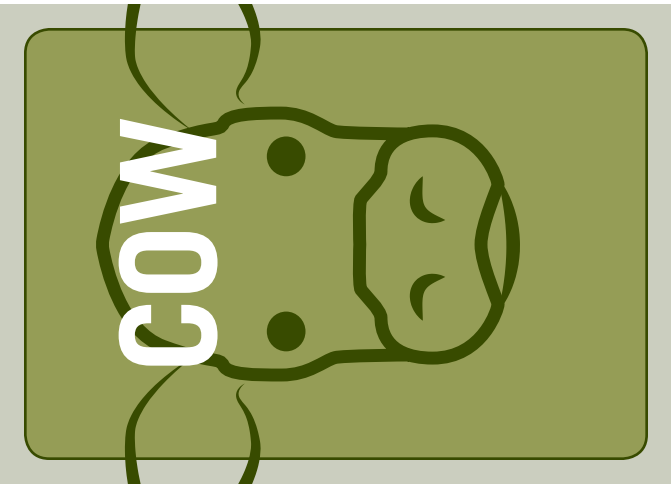
14 There is an outbreak of BSE at a cattle farm in a neighboring province. Your cows are fine, but people are nervous to buy beef based on what they hear in the media. **Give $2 per cow.**

15 You start feeding your hens a diet containing flaxseed, a known source of omega-3 fatty acid. You can now sell your eggs as Omega-3 eggs, which consumers pay more for. **Collect $1 per hen.**

16 You talk about why you farm the way you do at a number of community events. Consumers gain trust in your farming methods and you earn your social license to farm. **Receive $3 per cow, $3 per hen** and **$3 per bushel of canola.**

ADFARMING GAME

AdFarming Game Cards



Instructions:

✂ Copy as many Game Cards as you need and cut them out for students to use in the AdFarming Game.

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Agricultural Business Pathway -

MARKETING

GRADE LEVELS: 9 TO 12

Grade Levels

9-12

Overview

Students learn about the importance of marketing in the agriculture industry by creating ads promoting ag-sector careers to their peers. They also learn about careers associated with agriculture marketing.

Suggested Time

15 minutes

Materials Required

- **Appendix A**: Printout of photo showing *Student Examples of Marketing Challenge Ads*
- **Appendix B**: Laminated printouts of *Media Templates* for Twitter, Instagram, Snapchat, Facebook
- **Appendix C**: Printouts of *Ad Images & Messages* that students can insert into their ads using an adhesive
- **Appendix D**: Laminated printouts of *The 5 Ps of Marketing*
- Dry-erase markers
- Adhesives such as Sticky Tack / Velcro / tape

1. **Ask students: *What are some of your favourite commercials or ads? What was it about them that appealed to you and caught your attention?***

2. **Ask students: *Did any of these commercials/ads inspire you to buy something or do something, such as go to a movie? If so, then you were influenced by marketing.***

3. **Ask students: *What is "marketing"?***

   Get students to brainstorm their definitions, then share with them a few of the following definitions:

   - Marketing is about meeting the needs and wants of a consumer.
   - Marketing is about matching the right message to the right person.
   - Marketing is about knowing the market, creating the right product, creating desire for that product, and letting the right people know you have it.
   - Marketing is the art and science of persuasive communication.
   - Marketing is helping customers understand how much they need something they never knew they needed. [1]

4. **Tell students: *The world of marketing is HUGE in the agriculture and food industries. Companies have products and/or services that they want to sell to consumers. In order to do that, they need to connect with consumers by marketing to them.***

5. **Tell students: *At this station, you are going to get involved in a Marketing Challenge! You won't be selling a product; rather, you will be selling an idea.***

6. **Tell students: *Your Marketing Challenge is to figure out how to make a career in agriculture or the agri-food sector sound exciting to your high-school peers . . . people just like you!***

7. **Tell students: *To inspire your peers to consider pursuing ag careers, you will be creating ads that could be posted on social media.***

   a. Show students the photo of *Student Examples of Marketing Challenge Ads* (**Appendix A**).

   b. Hand out the *Media Templates* (**Appendix B**) and *Ad Images & Messages* (**Appendix C**) that they will choose from to create their own ads.

8. **Tell students: *As marketers, you first need to develop a marketing strategy based on what are known as The 5 Ps.***

   a. Get students into groups of 2-3 per group.

   b. Hand out *The 5 Ps of Marketing* sheets (**Appendix D**) and dry-erase markers.

   c. Get groups to fill out their sheets using dry-erase markers.

9. **Tell students: *Using your marketing strategy, create an ad using one of the media templates and one of the images.***

   a. Hand out adhesive for attaching ad images to templates.

   b. Get groups to create their ads.

   c. Get groups to share their ads and explaining their marketing strategies.

[continued]

1 *(http://heidicohen.com/marketing-definition/)*

10. **Ask students: *What skills did you used to complete the Marketing Challenge?***

    - *COMMUNICATION:* Writing skills are used when creating ad copy and scripts for media, and speaking skills are used when communicating effectively with colleagues and clients. Marketers should be able to handle questions on-the-spot, and manage presentation software such as PowerPoint or Prezi.

    - *ANALYTICAL THINKING:* Marketing requires a lot of research-based analysis to determine the target audience wants and needs. Marketers often have to change course based on new information, and should be able to adapt plans based on this information.

    - *CREATIVITY:* Marketers need to be able to think of new and exciting ideas that appeal to their clients and their target audiences.

    - *NEGOTIATION:* This is an undervalued skill in marketing. Negotiation involves the ability to drive a hard bargain. Negotiation involves working with clients about budgets, timelines and expectations, as well as working with designers and vendors.

    - *STRESS MANAGEMENT:* Marketing is one of the most stressful career options that you can choose; deadlines are demanding, and many things can go wrong at the last minute. To be a good marketer, you need to be able to handle stress without panicking.

    - *TECHNOLOGY:* These skills are essential for a marketer. Comfort with technology requires continual learning as new technologies emerge.

11. **Ask students: What kinds of jobs would require using these skills?**

    - *SOCIAL MEDIA STRATEGISTS* develop, manage and track Internet content on their employers' social media pages. Because of the popularity of social media, social media strategists play a crucial role in defining agriculture's brand.

    - *COMMUNICATIONS SPECIALISTS* have primary responsibilities in the fields of writing, editing, branding, and public and media relations.

    - *MARKETING SPECIALISTS* are responsible for communicating appropriate messages to the public. By doing so, they ensure that the company they work for meets its sales goals.

    - *SALES REPRESENTATIVES* for food, seed, feed and fuel products market their particular products to different companies within the agricultural sector, including producers, suppliers and dealers. To be able to do so, they are given a certain territory to work within.

    - *PUBLIC RELATIONS SPECIALISTS* develop influential company-brand messages for clients.

12. **Finally, remind students that marketing is a vital aspect of the agriculture industry, and offers many career opportunities that are useful as we strive to feed a growing world.**

Sources / Credits

This station is adapted from the original FCC AgriBiz Challenge in Regina, Saskatchewan (now AITC Canada GenAg competition) and from materials provided by Becky Parker, Ag Careers Program Manager, AITC-Canada.

Marketing Specialist profile
https://m.agcareers.com/career-profiles/marketing-specialist.cfm

Public Relations Specialist profile
https://m.agcareers.com/career-profiles/public-relations-specialist.cfm

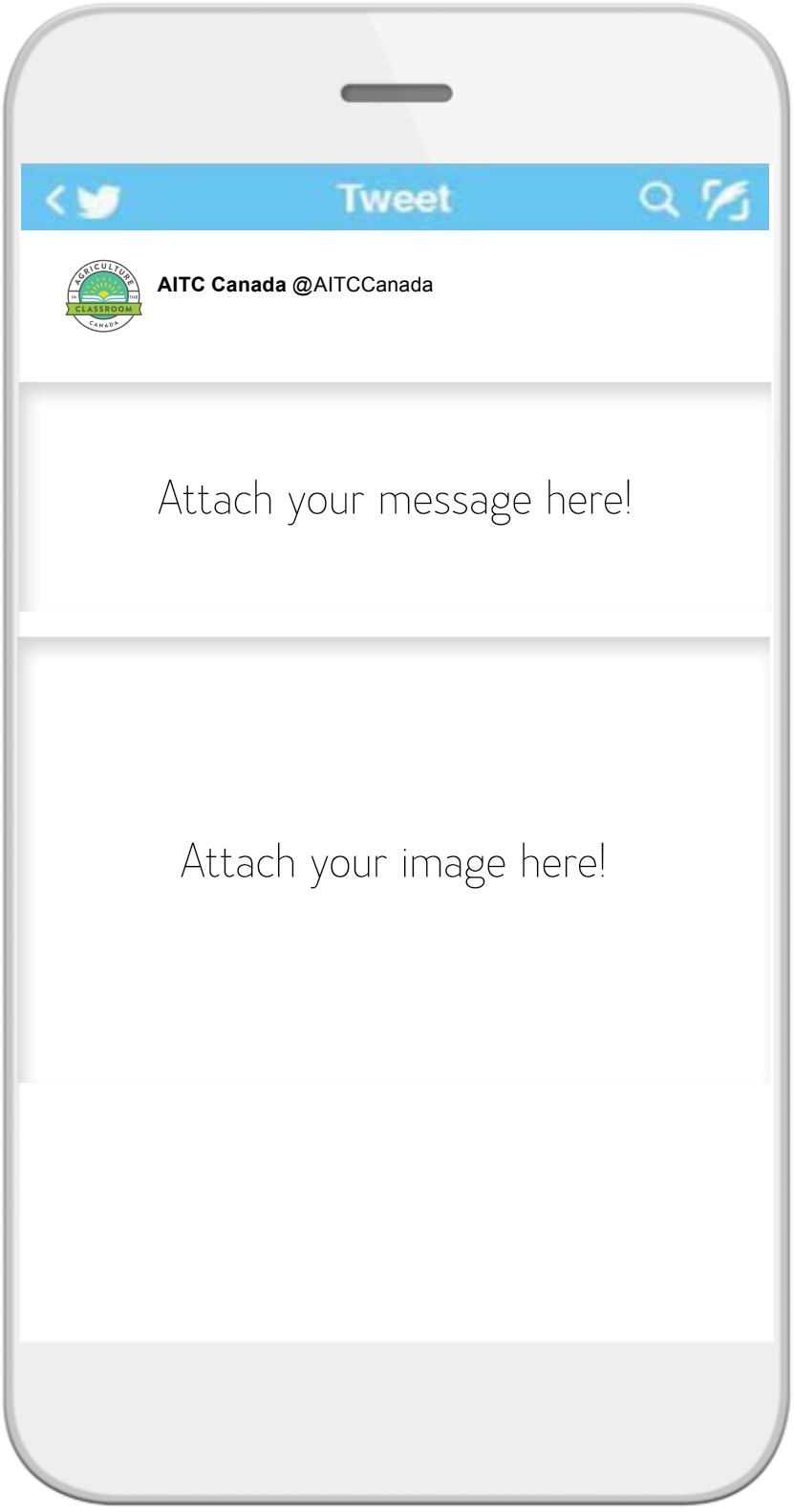
Sales Representative profile
https://m.agcareers.com/career-profiles/sales-representatives-food-seed-feed-fuel.cfm

Communications Specialist profile
https://m.agcareers.com/career-profiles/communications-specialist.cfm

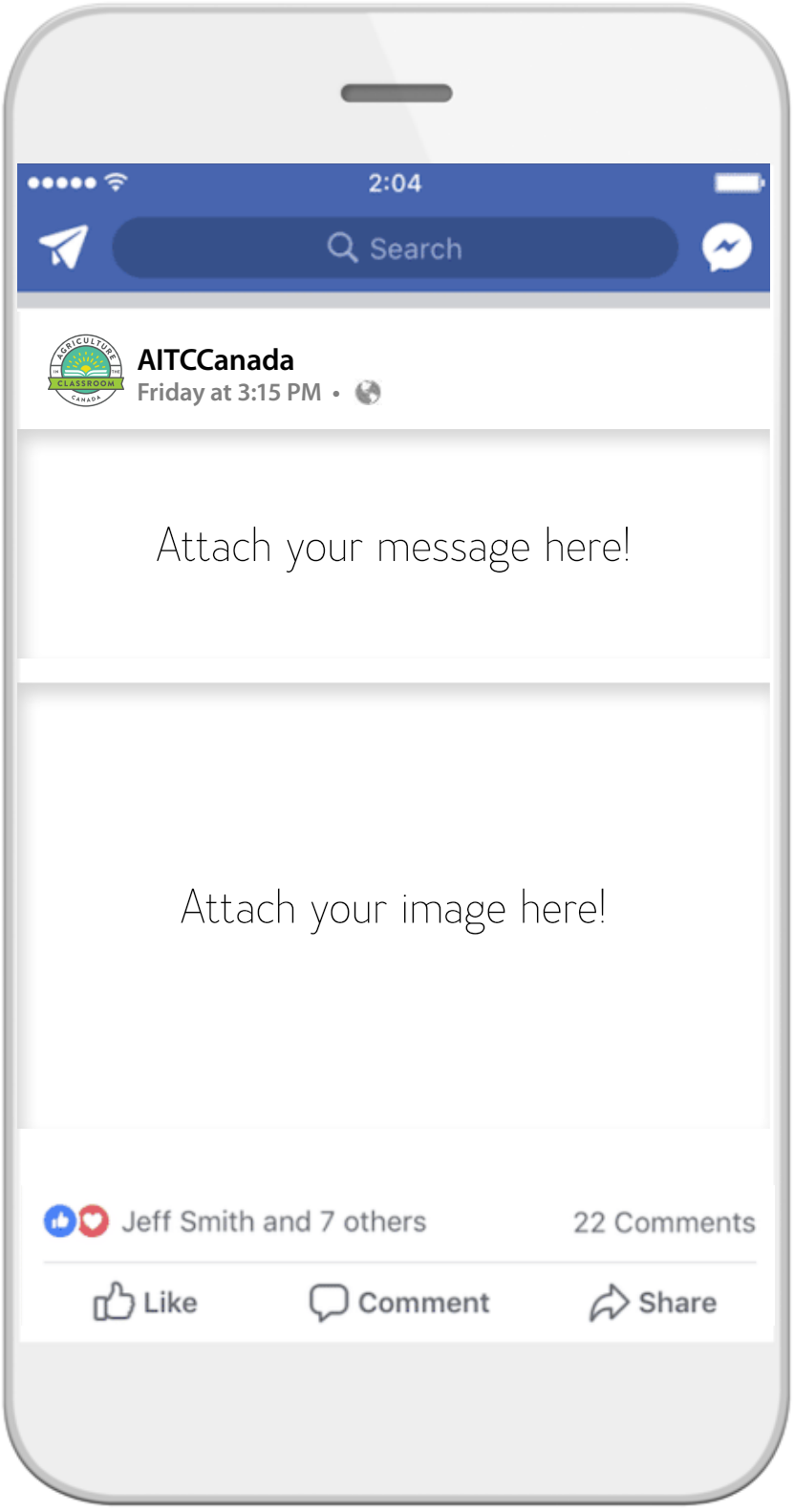
Social Media Strategist profile
https://m.agcareers.com/career-profiles/social-media-strategist.cfm

Student Examples of Marketing Challenge Ads

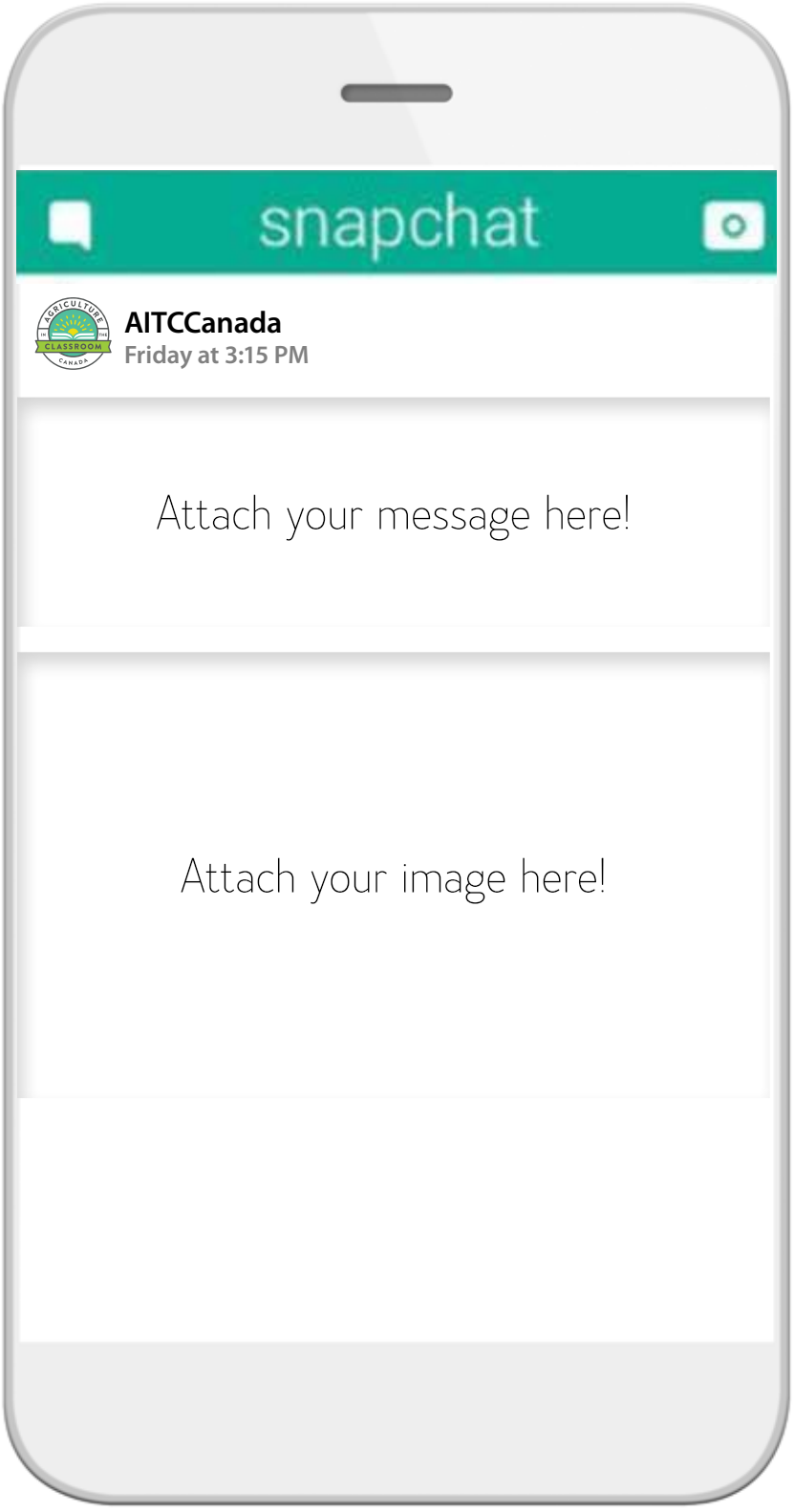
Media Templates



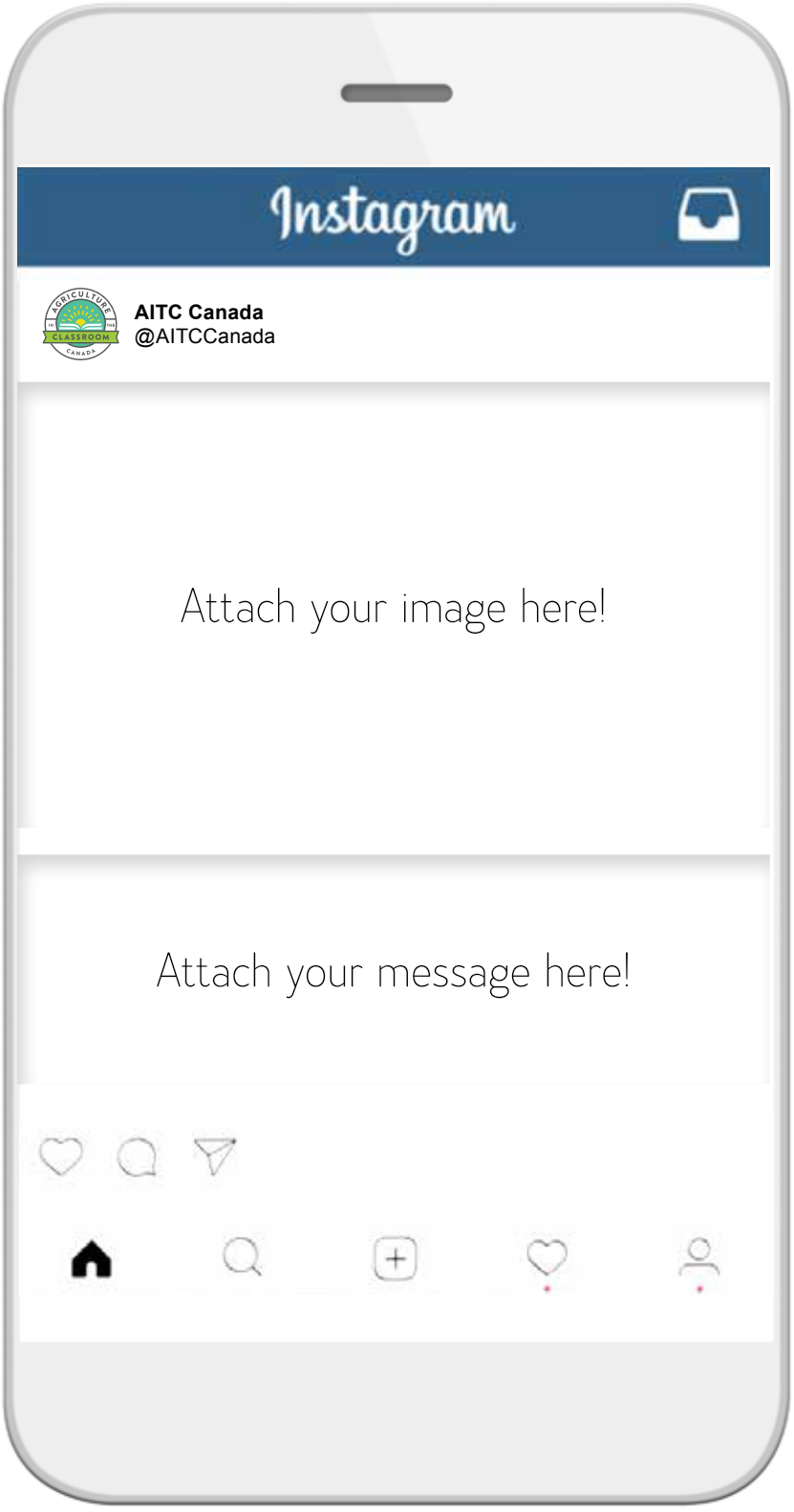
Media Templates



Media Templates



Media Templates



Advertising Images

Instructions:

✂ Cut out the advertising images for your students to attach to the media templates provided in Appendix A.

Advertising Images

Instructions:

✂ Cut out the advertising images for your students to attach to the media templates provided in Appendix A.

Advertising Images

Instructions:

✂ Cut out the advertising images for your students to attach to the media templates provided in Appendix A.

Advertising Messages

Four agriculture jobs are waiting for every grad of an ag program.

One in 8 Canadian jobs is related to the agriculture and agri-food industries.

Over 230 unique career paths are available in the agri-food industry.

Global demand for food is expected to rise 60% by 2050.

More than 74,000 job opportunities in the Canadian ag sector will exist by 2022.

Instructions:

✂ Cut out the advertising messages for your students to attach to the media templates provided in Appendix A.

The 5 Ps of Marketing

1. PRODUCT ***What are you selling?*** You're selling a message that promotes choosing to pursue a career in agriculture. Choose one message: - *Four agriculture jobs are waiting for every grad of an ag program.* - *One in 8 Canadian jobs is related to the agriculture and agri-food industries.* - *Over 230 unique career paths are available in the agri-food industry.* - *Global demand for food is expected to rise 60% by 2050.* - *More than 74,000 job opportunities in the Canadian ag sector will exist by 2022.* - Create your own message!	
2. PRICE ***What do you hope to receive in exchange for your peers "buying into" your marketing message?*** Consider the benefits to society, which you can include in your marketing message.	
3. PEOPLE ***Whom are you trying to inspire to "buy into" your message?*** Your target audience is your peers . . . people just like you! Consider their major considerations when choosing career paths. Consider their interests, their wants and needs, and their issues and concerns.	
4. PROMOTION ***How will you entice your peers to consider your message about pursuing a career in agriculture?*** You can make your message more interesting by using the ad images provided, or you can create your own ad image.	
5. PLACE ***Where will your peers find your message?*** (e.g. Twitter, Instagram, Snapchat, Facebook)	

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Agricultural Mechanics Pathway -

PRECISION AGRICULTURE

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students design a variable rate irrigation system that demonstrates how precision agriculture helps farmers make decisions about their farming operations. Students also learn about careers associated with precision agriculture.

Suggested Time

20 to 25 minutes

Materials Required

- For each group:
  - 16 oz. bottle of water
  - 1 funnel (to pour water from cups back into the water bottle when testing the design of a VRI system)
  - 1 large Styrofoam cup that can hold more than 16 oz.
  - 3 plastic cups (each marked with 2 oz., 6 oz. and 8-oz. levels)
- Variety of straws (jumbo, regular, coffee) and pipe cleaners
- Scissors, tape, rubber bands, paper clips, rulers
- Printouts of each of the following:
  - **Appendix A**: *Variable Rate Irrigation*
  - **Appendix B**: *Variable Rate Technology*
  - **Appendix C**: *Example of a Student-designed VRI System*
  - **Appendix D**: *Engineering Design Process*

1. **Ask students:** ***Approximately how many people live on Earth today?***

   Approximately 7.5 billion

2. **Ask students:** ***By 2050, when you're in your mid-40s & early-50s, approximately how many people will be living on Earth?***

   Approximately 9.6 billion

3. **Ask students:** ***In order to accommodate about 2 billion more people, what necessities will be required?***

   Food, water, shelter, etc.

4. **Tell students:** ***In order to provide more food for a growing population, farmers around the world will need to grow at least twice as much more food by 2050 as they do today. Farmers will be working with limited resources such as arable land, water and nutrients in order to do this. They intend to grow more food on the same amount of land (or less) without degrading the environment.***

5. **Ask students:** ***In recent years, farmers have been able to farm more efficiently due to the availability of technology. What are some examples of technology that farmers are using today?***

   - cell phones
   - soil testing
   - automated irrigation systems
   - computers
   - **precision agriculture**

6. **Tell students:** ***Precision agriculture helps farmers break their fields into smaller areas in order to specifically manage each area. This type of field management gives plant life more immediate and specific care as opposed to treating entire fields in the same manner. Precision agriculture involves using various technological instruments to make agriculture practices more precise and efficient. Presently, one farmer can feed about 155 people. By 2050, new technological advancements in the agricultural revolution of precision farming will help one farmer feed 265 people using the same amount of land.[1] That is like you being able to grow 70% more hair on your head in 2050 than you can grow today!***

7. **Ask students:** ***Precision agriculture is also known as "site-specific crop management," or SSCM. What are some examples of technology used in precision agriculture?***

   See **Additional Information** for details about each of the following examples:

   - self-steering tractors
   - agricultural robots
   - drones
   - global positioning systems, or GPSs
   - Variable Rate Technology

   Variable rate technology allows farmers to control the precise amount of inputs (seed, fertilizer, water, etc) which is needed for different areas of the field.

   Tell students, they are going to learn specifically about Variable Rate Irrigation (VRI)

8. **Tell students:** ***By using VRI systems, farmers can apply different rates of water to a field that match the needs of specific zones of that field.***

   Get students to think about how they can use different filters on different photos in an app like Instagram or Snapchat depending on the qualities and characteristics of the photo.

(continued)

1 *https://en.wikipedia.org/wiki/Precision_agriculture*

9. **Show students the photos *Variable Rate Irrigation* (Appendix A). Ask students: *Where is more water needed in this field?***

   It appears that adequate water is being applied to the left-hand side of the field, whereas more water is needed on the right-hand side. In conclusion, this field would benefit from a VRI system.

10. **Ask students: Why would farmers want to use VRI systems?**

    - To increase crop yields.

      Too much or too little water decreases plant health and, consequently, crop yield.

    - To provide precise amounts of water that complement soil types, which can vary within a field.

      Clay-based soil retains high amounts of water, and thereby allows roots to soak in water for a longer time. Sandy soil retains minimal amounts of water, and thereby allows water to run through it before penetrating roots.

    - To conserve water

11. **Tell students: *VRI systems involve using several types of technology: GPS, field computers, rate controllers and telematics.***

    Telematics is "the technology of sending, receiving and storing information relating to remote objects such as vehicles via telecommunication devices."[2]

    Show students the photo *Variable Rate Technology* (**Appendix B**).

12. **Tell students: *You will be using household items to design a VRI system.***

    Show students the photo of an *Example of a Student-designed VRI System* (**Appendix C**).

13. **Designing a VRI System:**

    a. Get students into groups of three.

    b. Give all groups scissors, tape, rubber bands, paper clips and rulers.

    c. Give each group:

       - one 16-oz. bottle of water
       - 1 funnel
       - 1 large Styrofoam cup that can hold more than 16 oz.
       - 3 plastic cups (each marked with 2 oz., 6 oz. and 8-oz. levels)

    d. Get each group to **select several** of **only two** of the following materials: jumbo straws, regular straws, coffee straws, pipe cleaners.

14. **Tell students: *It's time to think like an engineer! Here's the process that many engineers follow while designing something.***

    Show students the graphic *Engineering Design Process* (**Appendix D**).

15. **Tell students: *The engineering design process is not linear. At any point, you may want to return to a previous step in order to redesign or improve your idea.***

(continued)

2 *https://www.fleetmatics.com/what-is-telematics*

16. Using the graphic, take students through the process by applying it to their groups' design challenge:

a. *IDENTIFY THE PROBLEM:* You need to increase the efficiency of water use, by directing precise amounts of water to different areas based on their needs.

b. *IDENTIFY THE OBJECTIVE:* You need to design a device that will vary water flow in an irrigation system so that it divides 16 oz. of water into three cups: 2 oz. into the first cup, 6 oz. into the second cup, and 8 oz. into the third cup.

c. *IDENTIFY THE CONSTRAINTS:* You have limited resources to use for this design. You have been allowed to choose only two of the four materials available.

d. *GENERATE IDEAS AND POSSIBLE SOLUTIONS:* Brainstorm how to use your chosen resources in the design of potential solutions.

e. *EVALUATE AND COMPARE POSSIBLE SOLUTIONS:* Test your potential solutions.

f. *SELECT A SOLUTION:* Refine the design selected: Test your chosen design until you get it right: 2 oz. of water flows into the first cup, 6 oz. flows into the second cup, and 8 oz. flows into the third cup.

g. *REFLECTION:* Was your design successful? What could you do to improve your design? Why is varying water amounts important?

h. *COMMUNICATE THE FINAL PRODUCT:* Share your VRI System and reflection with other groups.

17. Give students 10 minutes to design and share VRI systems they create using the Engineering Design Process.

18. Afterwards, ask students: *What skills were useful during your design process?*

- critical thinking
- analytical thinking
- problem-solving
- active listening
- communication
- organization

19. Inform students that these skills, plus technology skills, would be required in the following careers related to precision agriculture:

- *GEOSPATIAL ANALYTICS SCIENTISTS* assess, integrate, manipulate and extract data from GPS and other databases in order to improve software platforms used in precision agriculture.

- *PRECISION AGRICULTURE SPECIALISTS* provide support and technical assistance to growers who are using precision technologies on their farms.

- *DESIGN ENGINEERS* design and develop agricultural equipment and system products, and serve as a technical resource by participating in design reviews and providing input for new projects.

- *MECHANICAL ENGINEERS* are involved with the generation, distribution and use of energy. They could be involved in the control and automation of manufacturing systems, the design and development of machines, or the solutions to environmental problems.

This station activity was adapted from Molly Brandt and Erin Ingram, University of Nebraska-Lincoln:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=513&author_state=0&content=SCIENCE&grade=6&theme_id=5

Geospatial Analytics Scientist profile:
https://lm.agcareers.com/career-profiles/geospatial-analytics-scientist.cfm

Precision Agriculture Specialist profile:
https://lm.agcareers.com/career-profiles/precision-agriculture-specialist.cfm

Design Engineer profile:
https://lm.agcareers.com/career-profiles/design-engineer.cfm

Mechanical Engineer profile:
https://lm.agcareers.com/career-profiles/mechanical-engineer.cfm

Additional Information

http://www.farms.com/precision-agriculture/technology/
https://www.earthobservatory.nasa.gov/Features/PrecisionFarming/

Variable Rate Irrigation provides exactly the right amount of water to each foot/meter of the field.

Source:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=513&author_state=0&content=SCIENCE&grade=6&theme_id=5

Variable Rate Technology

Variable Rate Irrigation is possible by integrating different technologies.

GPS Units are used by farmers to create field maps to determine a field's boundaries.

Field computers allow farmers to control the application of fertilizers, herbicides, and pesticides through automated delivery systems.

Rate controllers make it possible for farmers to control how much irrigation, fertilizer, etc. is applied in a field.

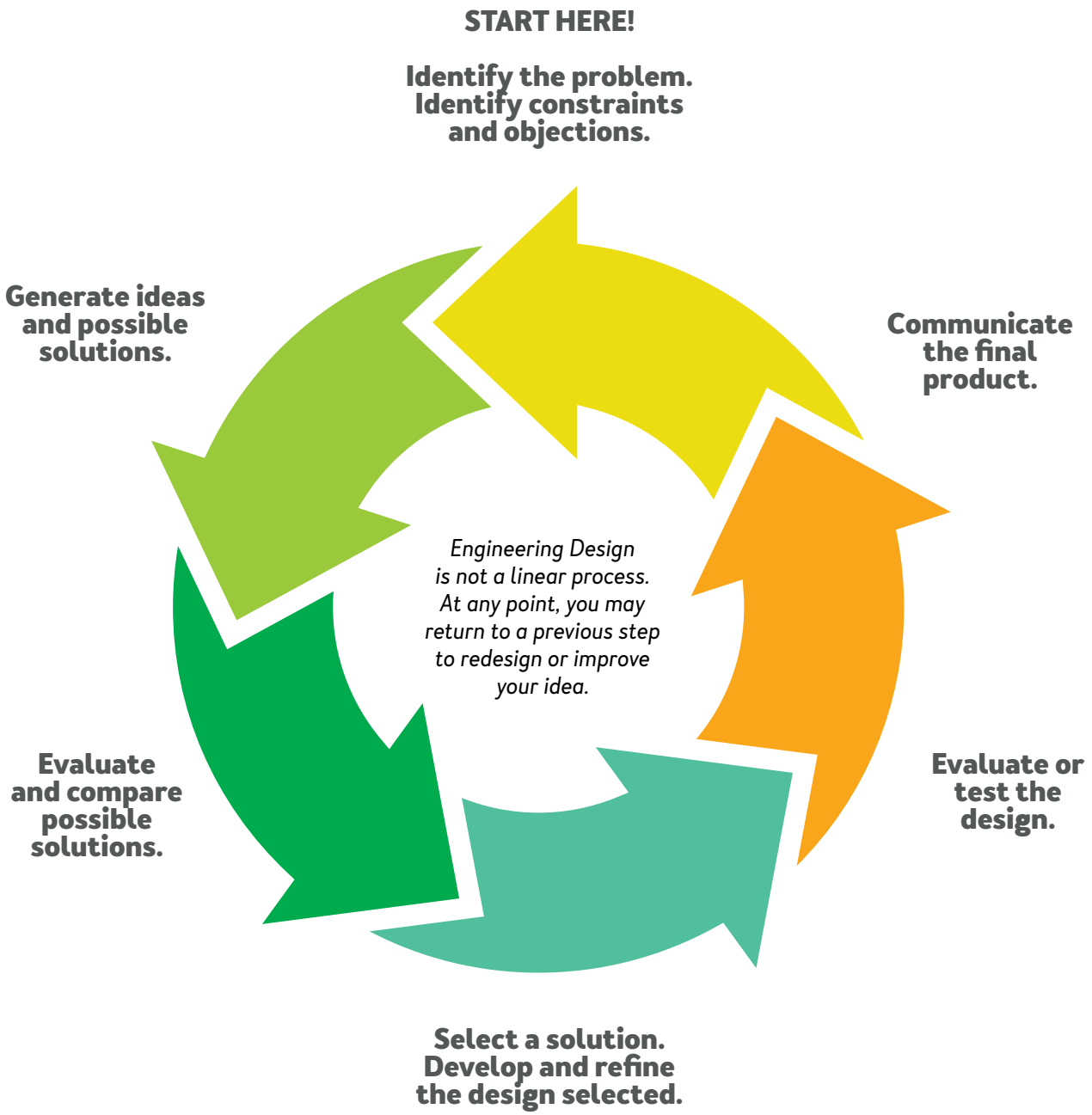
Telematics allows information collected in a field to be transferred to the internet.

Source:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=513&author_state=0&content=SCIENCE&grade=6&theme_id=5

Example of a student-designed VRI system

Source:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=513&author_state=0&content=SCIENCE&grade=6&theme_id=5

Engineering Design Process



Source:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=513&author_state=0&content=SCIENCE&grade=6&theme_id=5

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Agricultural Mechanics Pathway -

ROBOTICS

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students learn about the important role that technology plays in modern agriculture by operating a hydraulic arm, and about ag-careers related to technology.

Suggested Time

15 minutes

Materials Required

- Hydraulic robotic arm. Choose one of the following options:
  - purchased from Amazon: *https://www.amazon.ca/OWI-Robotic-Arm-Edge-OWI535/dp/B0017OFRCY/ref=sr_1_1?ie=UTF8&qid=1504898077&sr=8-1&keywords=robotic+arm*
  - made out of cardboard: *https://youtu.be/P2r9U4wkjcc*
- Photo of CMP Automated Seedling Planting System (**Appendix A**) or video of system: *https://youtu.be/Yb2PFvogVNM*
- Small planting pots
- Transplanting plugs (e.g. tomato and/or pepper seedlings) or bulbs (e.g. onions, garlic)

1. **Ask students: *What words come to mind when you think about careers involving agriculture?***

   Allow students to respond.

2. **Then ask them (if they haven't provided the following responses): How about considering words such as "technology," "innovation" and "robotics"?**

3. **Ask students: *Many jobs in agriculture use new technology such as robotics. What are some examples of robotic technology used in agriculture?***

   - robotic milkers
   - drones
   - driverless tractors
   - soil testing
   - greenhouse operations

4. **Tell students: *Using robotics does not necessarily mean that people are being replaced and losing jobs. Rather, if robotic devices can do repetitive work such as moving materials from one place to another, then people are freed up to do other important jobs such as designing, building, programming, testing and maintaining these sophisticated pieces of technology.***

5. **Tell students: *Here is an example of a robot designed by an Ontario company.***

   Show students the photo CMP Automated Seedling Planting System (**Appendix A**) or a video of this system: *https://youtu.be/Yb2PFvogVNM*

6. **Tell students: *Many agriculture careers involve designing, building, programming, testing and maintaining these sophisticated pieces of technology.***

   - *HYDRAULICS TECHNICIANS* are responsible for overseeing and implementing the installation, maintenance and repair of hydraulic components of equipment.

   - *AUTOMATION TECHNICIANS* are responsible for the installation, operation and maintenance of computer/robotic systems used in a variety of agricultural sectors.

   - *DESIGN ENGINEERS* design and develop agricultural equipment and system products, and serve as technical resources by participating in design reviews and providing input for new projects.

   - *MECHANICAL ENGINEERS* are involved with the generation, distribution and use of energy. Their expertise could be required to help with the automation of manufacturing systems, the design and development of machines, or the solutions to environmental problems.

7. **Tell students: *Some robots are designed to operate independently while others require the skills of automation technicians. You will now use your skills as automation technicians in an activity that requires you to complete a planting task using a hydraulic robotic arm.***

8. **Instruct students to use the robotic arm, one by one, to move one plug or bulb into a pot. Encourage them to work together as a team to encourage each other and to offer suggestions for how to effectively move a plug/bulb into the pot.**

(continued)

9. **Ask students, as they complete this activity: *What skills would help automation technicians work both individually and as a team.***

   Prompt students to consider both Technical Skills and Soft Skills.

   Having Technical Skills means that you have the specific knowledge and abilities required for a particular job.

   Having Soft Skills means that you are capable of:

   . . . *being a team player*, which means that you can be co-operative and, when required, a strong leader.

   . . . *being flexible*, which means that you can adapt to any situation no matter what is thrown at you.

   . . . *communicating effectively*, which means that you can effectively listen, articulate your thoughts, and use appropriate body language.

   . . . *problem solving* and *being resourceful*, which means that you can deal with unexpected issues that inevitably arise.

   . . . *accepting feedback*, which means that you can accept feedback gracefully, and then use it.

   . . . *showing confidence*, which means that you believe that you are capable of doing the job because you have the knowledge and skills required for it, yet are not arrogant about this belief.

   . . . *thinking creatively*, which means that you can come up with unique solutions or alternatives. This skill is invaluable; it drives innovation! [1]

10. **OPTIONAL**

    Tell students: *Innovation in agricultural robotics is such a "hot commodity" that an annual competition is held to find robotic solutions for the agriculture industry.*

    Introduce students to *AgBot Challenge* by telling them the following:

    a. *AgBot Challenge* is an annual competition held in the U.S. that requires competing teams to design unmanned robots to complete challenges.

    b. *AgBot Challenge 2016* required competitors to design a seeder that could plant corn in rows, and turn around at the end of rows to continue planting.

    c. The winner of *AgBot Challenge 2016* was a team from the University of Regina! They won $50,000!

1 *Based on The Soft Skills Most Employers Seek https://www.thebalance.com/top-soft-skills-2063721*

Sources / Credits

This station was adapted from a station developed by Becky Parker, AgScape.

Hydraulics Technician profile:
https://m.agcareers.com/career-profiles/hydraulics-technician.cfm

Automation Technician profile:
https://m.agcareers.com/career-profiles/automation-coordinator-technician.cfm

Design Engineer profile:
https://m.agcareers.com/career-profiles/design-engineer.cfm

Mechanical Engineer profile:
https://m.agcareers.com/career-profiles/mechanical-engineer.cfm

CMP Automated Seedling Planting System

Source:
http://www.cmpautomation.ca/automation-solutions/solution/automated-seedling-transplanting-system

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Animal Science Pathway -

ANIMAL NUTRITION

GRADE LEVELS: 9 TO 12

Grade Levels

9-12

Overview

Students learn about the basic principles of preparing animal feed (particle size, particle shape, and moisture content) in order to prevent feed sorting and feed handling problems, and about ag-sector careers associated with animal nutrition.

Suggested Time

15 minutes

Materials Required

Activity 1:

- Cereal (three varieties such as Cheerios, Shreddies and Corn Flakes; about 4 cups of each)
- One-cup capacity containers (three per group)
- Four-cup capacity containers with lids (one per group)
- Ziploc sandwich bags (three per group)

Activity 2 (optional):

- Fine sand, marbles and rocks (of similar size to each other and the marbles)(one cup of each per group)
- Small plastic drinking cups (three per group)
- Water (about ½ cup per group)

Introduction

Note: ***Set up the MATERIALS REQUIRED before beginning your presentation.***

1. **Ask students:** ***Do you eat like a pig?***

   Many students will say, "No!" because of the negative connotation of the question. "Yes," however, is the correct answer. If students eat like a pig, then they eat a healthy, balanced diet that their bodies need in appropriate amounts to promote energy, growth and health. Pigs eat balanced diets that are rich in whole grains, vitamins and minerals. These diets are prepared by swine nutritionists in such a way that pigs will eat everything their bodies need every time they consume a meal. Often the feed is a mixture of ground grains.

2. **Ask students:** ***Why would farmers feed their animals ground grains instead of whole grain?***

   Pigs and chickens are able to eat whole grains (such as corn). There are several reasons that whole corn should be processed (ground) before being fed to them:

   - The nutrition contained in corn kernels is more easily digested by these animals if the kernels are ground.

   - When these animals are fed whole ingredients such a corn kernels, they will pick out the ingredients they like most and eat those first, just like people picking M & Ms out of a trail mix. Chickens have colour preferences and will sort out yellow corn kernels to eat first. Pigs also sort out their favourite ingredients. Mixing ground corn into the feed prevents this feed sorting, and ensures that pigs and chickens eat the correct amount of all ingredients in their feed.

(Continued)

Activity 1

The Effect of Particle Size on Feed Sorting

A. LARGE PARTICLES

1. **Get students to break into groups of 3 or 4. Give each group a container with a lid and three one-cup capacity containers.**

2. **Taking turns, group members fill each of the one-cup containers with a cereal type. Explain that when an animal feed is created, they use different ingredients which help to provide different nutrients, vitamins and minerals (think of the food groups in the food guide).**

3. **Group members then add their cereal types to the four-cup container. One group member acts as the mixer by putting the lid on the container of cereal, then shaking.**

4. **After mixing the cereals, get each group to deconstruct their cereal mix by pulling out the original cereal particles and putting them back into their one-cup containers.**

5. **Make the point that this is what chickens and pigs do if they are allowed to pick and choose what they eat. What impact would this behaviour have on the nutrition that they are receiving?**

(Continued)

B. SMALL PARTICLES

1. **Give each group three Ziplock bags, and get group members to put each type of cereal into the bags, squeeze out the air, seal tightly, then grind using their fists.**

2. **Taking turns, group members add the ground cereals to the four-cup container, and mix.**

3. **After mixing the ground cereals, get each group to attempt to deconstruct their cereal mix by pulling out the original cereal particles and putting them back into their one-cup containers. This process is difficult to do because the cereal particles are similar in size.**

4. **Make the point that cereals in a grounded state are difficult to sort out for picky eaters such as chickens and pigs; hence, they end up consuming ALL of the nutritious food that they are fed.**

(Continued)

Photos: https://www.fda.gov/AnimalVeterinary/ResourcesforYou/AnimalHealthLiteracy/ucm280837.htm

5. **Tell students: As you have discovered, livestock food that is ground up provides animals with more balanced nutrition than does food in its whole form. Many careers are associated with creating recipes for nutritious animal feed, and with the production and selling of those feed products.**

   - *FEED MILL MANAGER/OPERATOR:* ***Feed mill managers*** are responsible for overseeing the production, quality, costs and safety of mills that produce animal feed. These managers maintain feed inventories and order ingredients as needed, and handle customers' questions and complaints. Additionally, they ensure that all employees are trained about safety and stay up-to-date with their safety education. ***Feed mill operators*** are responsible for assisting with the management of feed mills and their crews, and with the processes of storing, mixing and delivering feed for cattle, hogs and poultry. They oversee daily, weekly and monthly routine preventative maintenance tasks, including greasing bearings, checking gear boxes and inspecting belts. They make sure that mills and their surroundings are kept clean.

   - *SALES REPRESENTATIVE (FEED AND ANIMAL HEALTH):* A sales representative of feed and animal healthcare products sells and services products produced for the animal industry by their companies. They provide technical information to veterinarians and related animal health personnel, and develop and implement a sales-call process to productively manage accounts in a specific territory.

   - *HERD NUTRITIONIST:* Herd nutritionists research and provide advice about raw material product selection, maintenance feeding programs and modification of diets to meet certain desired outcomes. They educate farmers and employees about appropriate diets, product mixes, dietary planning and preparation of fodder or food to treat an illness or disease in livestock. They also work to enhance and maintain optimum health performance of the animals.

   - *RUMINANT NUTRITIONIST:* Ruminant nutritionists determine feed rations, conduct research and consult farmers and ranchers regarding feeding practices for their animals. Ruminant animals include cattle, sheep, llamas and goats. They assess the condition of animals (level of fatness) as well as the level of activity and physiological demands (productivity performance, reproductive needs, growth and/or lactation requirements, or the need for weight gain or loss) depending on season, temperature, and hair coat thickness.

(Continued)

Activity 2 (optional)

The Effects of Particle Size and Shape on Feed Handling

1. **Tell students: Animal nutritionists often deal with problems when they are creating ground livestock diets. One of these challenges involves preventing feed handling problems. The following activity shows you the importance of preventing such problems.**

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2. **Provide each group with three plastic cups. Get them to fill one with fine sand, one with marbles and one with rocks.**

---

3. **Get each group to build three cup-shaped piles, one of sand, one of marbles, and one of rocks. Ask students: Which pile holds its shape better? Why?**

   The sand pile is able to maintain its shape because smaller sized particles are more likely to pack together.

---

4. **Ask students: Why does the rock pile hold its shape better than the marble pile?**

   The rocks' uniform but irregular shapes allow them to stack better. The marbles roll off each other and don't pack together because of their uniformly round shape.

(Continued)

Photos: https://www.fda.gov/AnimalVeterinary/ResourcesforYou/AnimalHealthLiteracy/ucm280837.htm

5. **Get each group to put the sand, marbles and rocks back into the cups. Get them to add a small amount of water to the sand, marbles and rocks, and then make piles again. Ask students, What effect does the added moisture have on each castle?**

   The water makes the sand pile hold together even better than before, while the marble pile and rock pile remain unchanged.

6. **Make the point that feed that is finely ground and contains moisture (such as added fat) can create what is known as feed handling problems.**

   TYPICAL CAUSES OF FEED HANDLING PROBLEMS:

   - Feed ingredients are ground too fine.
   - Fat or another liquid product is added to the feed.

   WHAT HAPPENS:

   - When the ingredients are very small and contain moisture, the feed tends to pack together and has a hard time moving through the feeding system.

   RESULTS:

   - Possible "out of feed" occurrence.
   - Analogy: Think of an hourglass minute timer filled with sand that comes with some board games. When the timer is turned upside down, the sand runs from the top to the bottom of the hourglass in 1 minute. Sometimes, the sand packs together and gets stuck. The timer has to be shaken to restart the flow.
   - When feed packs together, it stops flowing through the feeding system. The feed lines or feeders may need to be agitated to restart the flow.
   - Feed handling problems disrupt a steady flow of feed for livestock, and disrupt farm operations.

7. **Make the point that animal nutritionists use their expert knowledge to prevent problems associated with livestock feed (e.g. feed sorting, feed handling), and to maximize animal health and performance.**

This station is an adaptation of:
https://www.fda.gov/AnimalVeterinary/ResourcesforYou/AnimalHealthLiteracy/ucm280837.htm

Feed Mill Operator profile:
https://www.agexplorer.com/career/feed-mill-operator

Feed Mill Manager profile:
https://www.agexplorer.com/career/feed-mill-manager

Sales Representative (Feed and Animal Health) profile:
https://m.agcareers.com/career-profiles/sales-representative--feed-and-animal-health.cfm

Herd Nutritionist profile:
https://m.agcareers.com/career-profiles/herd-nutritionist.cfm

Ruminant Nutritionist profile:
https://m.agcareers.com/career-profiles/ruminant-nutritionist.cfm

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Environmental Services Pathway -

WATER MANAGEMENT

GRADE LEVELS: 9 TO 12

Grade Levels

9-12

Overview

Students learn about the impact that agricultural soil and water conservation practices have on soil erosion, and about careers associated with those practices.

Suggested Time

15 minutes

Materials Required

- Three plastic 1L or 2L soda bottles
- Soil
- Leaf and forage material for creating the condition of natural soil coverage
- A chunk of sod, sized to fit within the plastic bottle cutaway area
- Clear plastic cups or glass beakers to capture and assess water runoff
- Water, at least 100 mL
- *Top Agricultural Careers in Environmental Services* Infographic: *https://www.agcareers.com/infographics/top-agricultural-careers-in-environmental-services-infographic-46.cfm*

Before doing this presentation, prepare the plastic soda bottles:

Cut an oval shape around the top of each bottle to create a "boat." Make sure that the sides of each "boat" are higher than the mouth of each bottle. (See photo.)

1. **Ask students: *What are some ways that agriculture interacts with the environment?***

   - natural resources (soil, water, air quality)
   - animal habitats
   - biodiversity
   - conservation of land
   - energy/fossil fuel use
   - waste production

2. **Tell students: *Healthy soil is the lifeblood of sustainable agriculture. Farmers are land stewards who seek ways to improve soil health without harming the environment.***

3. **Ask students: *What are some agriculture careers that would help farmers with their stewardship of environmental sustainability and conservation?***

   - *SOIL SCIENTISTS* research soil samples taken from fields and evaluate soil nutrient levels to determine which crops would grow best in these fields. They also make recommendations to minimize the impact of soil erosion in an area.

   - *NUTRIENT / WASTE MANAGEMENT SPECIALISTS* develop appropriate methods for removing and managing animal and food waste in the environment. They monitor processes that remove or destroy harmful materials, chemicals and micro-organisms from water and/or land. Additionally, these specialists analyze the fertilizer value of applied manure.

   - *RESTORATION SPECIALISTS* research situations caused by man-made practices and their impact on natural habitats, then make recommendations about how to improve and replenish ecosystems.

   For examples of other careers possibilities, show students the infographic *Top Agricultural Careers in Environmental Services*.

4. **Tell students: *You will be doing a soil assessment that people working in environmental services would conduct. You will be showing how soil conditions affect soil erosion: bare soil, soil with some cover, and soil with plants in it.***

5. **<u>Soil Assessment Activity:</u>**

a. Lay the three plastic bottles flat on a raised platform. (See photo.)

b. Fill two bottles with soil. Cover soil in one bottle with leaf-and-plant matter.

c. Place sod in the third bottle.

d. Elevate the far ends of the bottles so that water will drain from them. Place a clear cup or beaker beneath the mouth of each bottle.

e. Ask students to predict which soil sample will have the most soil erosion; in other words, the most sediment in the runoff.

f. Pour an equal amount of water (~100 mL) onto each "boat" and evaluate the results by looking at the colour of the runoff.

(continued)

Photo source: *http://learnaboutag.org/matrix/lessonplan.cfm?lpid=82*

6. **Ask students: *Why is the sod sample most effective for stopping soil erosion?***

   The sod's fibrous roots, rhizomes (horizontal stems growing below the ground) and stolons (horizontal stems growing above the ground) help hold soil in place while water travels over and through it, thereby reducing soil erosion. Land that is tilled and left bare during winter is vulnerable to wind-and-water erosion. Nutrients applied to soil can run off and enter waterways and groundwater.

   Furthermore, topsoil that is washed or blown away can take decades to replace naturally.

   See **Additional Information (p. 71)**.

7. **Ask students: *Based on the results of this soil assessment activity, what are some recommendations that a soil scientist, nutrient management specialist or restoration specialist might give a farmer?***

   Farmers are land stewards who can reduce and reverse negative impacts on the environment by using conservation practices:

   - *CROP ROTATION:* This practice involves growing different crops on the same plot of land in sequential growing seasons. Different crops use different amounts of nutrients. If the same crop is planted season after season, then the soil becomes depleted of certain nutrients, which results in increased fertilizer use. For example, some crops use a lot of nitrogen while others are able to return nitrogen to the soil. An example of a rotation pattern is planting corn one year and soybeans the next year. Soybeans are legumes, which "fix" nitrogen into soil, resulting in a soybean crop not requiring nitrogen fertilizer input.

   - *COVER CROPPING:* Instead of leaving soil bare and exposed after a main crop is harvested, farmers can plant another crop and leave it in the field over winter. For example, a farmer might harvest corn and then plant rye to cover the field.

   - *CONSERVATION TILLAGE:* Crop residue from a harvest can be left on a field during winter; then, during the following Spring, a new crop can be seeded amid the residue. For example, corn stalks can be left on a field after harvest; then, soybeans can be seeded amid stalk residue the following Spring.

   - *HABITAT PRESERVATION:* This conservation practice involves reserving or returning an area of a farm to its pre-cultivation state, such as a grassland or wetland. These areas provide food and shelter for wildlife, prevent erosion and runoff, and provide an alternative to farming marginal land.

   - *CONTOUR FARMING:* In hilly areas, rows of crops are planted perpendicular to the slope rather than parallel to it, thereby following the contour of water flow over such landscape. This practice slows runoff from the land, thereby allowing water to penetrate soil and reduce erosion.

   - *BUFFER STRIPPING:* This conservation practice involves planting vegetation such as grass (not maintained by mowing or fertilizers) at the edge of a field that buffers (is next to) a body of water such as a lake or river. These natural filter strips help protect water quality by trapping and filtering sediment, nutrients and other pollutants in runoff.

8. **Ask students: *What skills would a person working in environmental services need?***

   - communicating concisely
   - attending to details
   - analyzing
   - problem solving
   - conducting research and collecting data

(continued)

9. **Tell students:** ***This activity has demonstrated the importance of water resource management services in the agriculture sector. Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources.***[1]

Additional Information

Water resource management is vital for feeding a growing world!

A layer of topsoil is only 2 to 8 inches thick. Topsoil is where much of the growing activity of plants occurs because it contains the highest concentration of organic matter, earthworms and micro-organisms. Without topsoil, plant life is impossible. One inch of topsoil can take over 500 years to form naturally.

1 *https://en.wikipedia.org/wiki/Water_resource_management*

Sources / Credits

This activity is adapted from Ann Butkowski, Minnesota Agriculture in the Classroom:
http://learnaboutag.org/matrix/lessonplan.cfm?lpid=82
and
https://www.education.com/science-fair/article/grasses/

Restoration Specialist profile:
https://www.agcareers.com/career-profiles/restoration-specialist.cfm

Soil Scientist profile:
https://www.agcareers.com/career-profiles/soil-scientist.cfm

Nutrient / Waste Management Specialist profile:
https://www.agcareers.com/career-profiles/nutrient-management-waste-management-specialist.cfm

Image of Soil Erosion Demo

Source:
http://learnaboutag.org/matrix/lessonplan.cfm?lpid=82

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Food Science Pathway -

FOOD PROCESSING & PRESERVATION

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students learn about steps required in processing certain food products and about careers associated with those steps.

Suggested Time

15 minutes

Materials Required

- Printouts of food processing steps for *Bread-Making Process, Cheese-Making Process, Hamburger Patty-Making Process* [**Appendix A, B, C**]
- *Top Agricultural Careers in Food Technology* Infographic: *https://www.agcareers.com/infographics/top-agricultural-careers-in-food-technology-infographic-53.cfm*

1. **Ask students: *What is "food processing"?***

   Food processing involves altering food from its raw form for human consumption. Any time a food is altered from its original state, whether it's due to refining, heating, storing or other means, it has been processed.

2. **Ask students: *What are some methods used for processing and preserving raw forms of food that people purchase or grow and harvest themselves?***

   - Refrigeration and freezing
   - Canning
   - Dehydration
   - Pickling
   - Fermentation
   - Vacuum packing

   These methods work by slowing down the growth of disease-causing bacteria, or by killing bacteria altogether. These methods also slow down or stop the action of enzymes that can degrade the quality of food by affecting its appearance, odor, flavour and texture.

3. **Ask students: *What are some examples of processed foods that are available in stores?***

   - bread
   - bacon
   - peanut butter
   - canned tuna
   - frozen French fries
   - salt & pepper
   - milk

4. **Ask students: *Why do we process food?***

   Processing foods is beneficial for the following reasons:

   - makes it possible for seasonal produce to be packaged for later consumption
   - enables people without access to other food sources to eat a healthier diet all year round
   - prevents spoilage, and therefore makes food accessible to more people because it can travel farther
   - kills micro-organisms that could grow and lead to disease
   - increases the shelf life of foods while minimizing changes to their quality and nutritional content

5. **Tell students: *As an industry, food processing involves a number of different steps to get food from the farm to the table for human consumption. In Canada, the food processing sector is one of the largest manufacturing employers, and provides employment to almost 250,000 Canadians. The industry contains various activities ranging from the creation of new foods to designing processes for food creation, packaging materials, and shelf life, just to name a few.***

6. **Tell students: *You will be involved in an activity that focuses on the processing steps required to produce various food products: bread, cheese and hamburger patties. To do this, you will compete in teams to put the processing steps into their correct sequences.***

   a. Divide students into teams.

   b. Give each team a set of cards comprised of the processing steps of a food product. Steps for three food products have been provided. Depending on time, teams can be asked to sequence the steps for one or more products:

      - Bread-making Process
      - Cheese-making Process
      - Hamburger-patty-making Process

   c. Each team must put the processing steps for each product into the correct sequence.

   d. The first team who sequences their processing steps in the correct order, wins. Check accuracy using the following Answers:

(continued)

Bread-Making Process

Step 1. The ingredients for the bread are mixed together.
Step 2. The dough is kneaded in a large machine.
Step 3. The dough is portioned and shaped into loaves.
Step 4. The dough is "proofed" (the yeast causes the dough to rise and increase in size).
Step 5. The bread is baked in an oven.

Cheese-Making Process

Step 1. A starter culture and coagulant are added to milk.
Step 2. As the milk cooks, the curds are cut with a special tool.
Step 3. The curds are drained and transformed into solid shapes.
Step 4. The curds are pressed and shaped according to the cheese type.
Step 5. The cheese undergoes a curing and aging process.

Hamburger Patty-Making Process

Step 1. Beef carcasses are inspected for safety and quality.
Step 2. Beef is cut into large pieces.
Step 3. Beef is ground in the mincing machine.
Step 4. The ground beef is placed into the hamburger patty machine.
Step 5. The hamburger patties are packaged.

7. **Ask students: *What types of jobs are involved in the processing steps of each of these food products?***

Prompt students to think about what needs to be done to the food product during each step of its processing sequence. Ask them to consider requirements such as equipment, transportation, packaging, labeling, etc.

The food processing industry involves a variety of jobs. Here are a few examples:

- *PRODUCTION WORKERS:* Skilled workers are needed to complete tasks in production facilities.
- *MACHINISTS AND MAINTENANCE WORKERS:* The increased use of technology requires skilled people to operate machines in processing plants. Workers such as electricians are in high demand to keep machines in good working order.
- *PACKAGING TECHNICIANS:* After food is processed, it needs to be properly packaged to avoid spoilage. These technicians ensure that food is labeled and packaged correctly.
- *SALES AND MARKETING PERSONNEL:* Employees in this area work to sell products and build brand awareness.
- *RESEARCH AND PRODUCT DEVELOPMENT PERSONNEL:* Qualified food scientists develop and test new products.

Supplement this discussion with the infographic *Top Agricultural Careers in Food Technology.*

Sources / Credits

This activity is adapted from a concept developed by AgCareers.com and CareersinFood.com

Production Worker profile:
https://careertrend.com/about-5484495-production-worker-job-description.html

Machinist and Maintenance Worker profiles:
http://jobdescriptions.net/manufacturing/machinist/
http://www.myplan.com/careers/maintenance-and-repair-workers-general/description-49-9071.00.html
https://www.greatsampleresume.com/job-descriptions/maintenance-worker-job-description/

Packaging Technician profile:
http://gpp-co.com/career-opportunities/packaging-technician/

Sales and Marketing Personnel profiles:
https://m.agcareers.com/career-profiles/sales-representatives-food-seed-feed-fuel.cfm
https://m.agcareers.com/career-profiles/marketing-specialist.cfm

Research and Product Development Personnel profile:
https://m.agcareers.com/career-profiles/r-d-technician.cfm

THE BREAD-MAKING PROCESS

The ingredients for the bread are mixed together.

THE BREAD-MAKING PROCESS

The dough is kneaded in a large machine.

THE BREAD-MAKING PROCESS

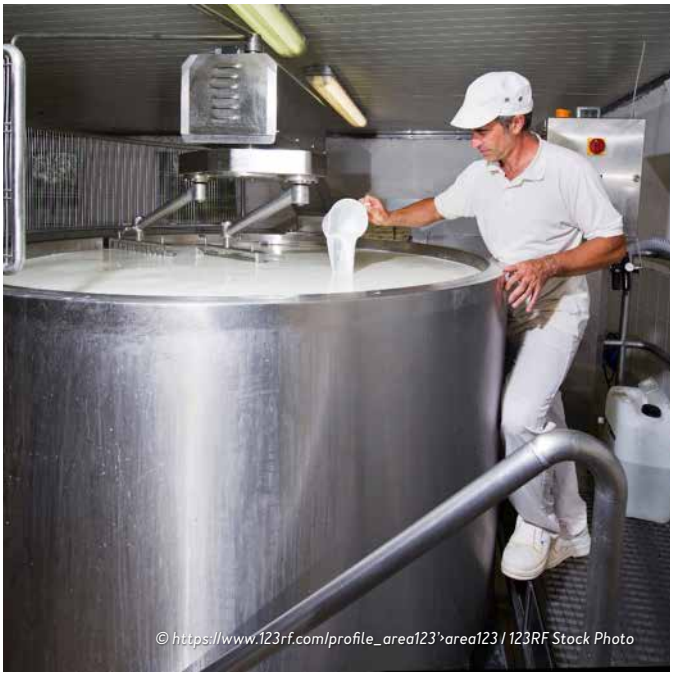
The dough is portioned and shaped into loaves.

THE BREAD-MAKING PROCESS

The dough is 'proofed' (the yeast causes the dough to rise and increase in size).

THE BREAD-MAKING PROCESS

The bread is baked in an oven.



THE CHEESE-MAKING PROCESS

A starter culture and coagulant are added to milk.

THE CHEESE-MAKING PROCESS

As the milk cooks, the curds are cut with a special tool.

THE CHEESE-MAKING PROCESS

The curds are drained and transformed into solid shapes.

THE CHEESE-MAKING PROCESS

The curds are pressed and shaped according to the cheese type.

THE CHEESE-MAKING PROCESS

The cheese undergoes a curing and aging process.

THE HAMBURGER PATTY-MAKING PROCESS

Beef carcasses are inspected for safety and quality.

THE HAMBURGER PATTY-MAKING PROCESS

Beef is cut into large pieces.

THE HAMBURGER PATTY-MAKING PROCESS

Beef is ground in the mincing machine.

THE HAMBURGER PATTY-MAKING PROCESS

The ground beef is placed into the hamburger patty machine.

THE HAMBURGER PATTY-MAKING PROCESS

The hamburger patties are packaged.

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CAREER EXPLORATION ACTIVITY TOOLKIT

Food Science Pathway

MAKING & MARKETING SALAD DRESSING

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students will learn about emulsions by creating their own salad dressings, and create marketing plans for their salad-dressing products. They will also learn about various careers associated with food sciences.

Suggested Time

20-25 minutes

Materials Required

- Glass container (with a lid) half-full of an oil such as canola oil
- Glass container with a spout (e.g. measuring cup) half-full of a vinegar such as balsamic vinegar (for visibility)

Making Salad Dressing

- Oil such as canola or extra-virgin olive oil (3 Tbsp per group)
- White wine vinegar (1 Tbsp per group)
- Dijon mustard (1 tsp per group)
- Liquid honey (1 tsp per group)
- Measuring spoons (Tbsp, tsp)
- Flavourings: salt, pepper, garlic powder, dill, basil, parsley, cilantro, mint, thyme, chili powder, onion powder
- Small containers to put flavourings into
- Disposable tablecloths
- Paper towels
- Hand sanitizer
- Small containers with lids to make salad dressing in (1 per group)
- Vegetables (cut up) for taste testing

Marketing Salad Dressing

- A purchased bottle of salad dressing
- **Appendix A:** *Marketing Salad Dressing* work sheet (1 per group)
- **Appendix B** (Optional): *Salad Dressing Recipes* printouts for students
- *Top Careers in Food Science* infographic: *https://www.agcareers.com/infographics/top-agricultural-careers-in-food-science-infographic-42.cfm*

1. **Tell students:** ***At this station, you will be making your own style of salad dressing (and learning about emulsions) and figuring out a way to get consumers to purchase your salad dressing. You will also learn about the variety of careers that are available in the area of food science!***

2. **Ask students:** ***What is "food science"?***

   Food science involves the study of the makeup of food in order to better understand food processes and to develop safe, nutritious food products for the general public.[1]

3. **Ask students:** ***Food scientists sometimes work with emulsions when creating certain food products. What is an emulsion?***

   An emulsion is a mixture of two liquids that do not ordinarily combine.

   Ordinarily, these liquids are immiscible, which means that they cannot combine due to their incompatible properties such as density or electrostatic charge that cause their particles to repel each other.

4. **Ask students:** ***What is an example of two immiscible liquids?***

   Think of oil and water, or oil and vinegar. (Show students the containers of oil and vinegar.)

5. **Ask students:** ***How could we get these two liquids to mix together? Remember, one is an oil, and one is an acid.***

   If these liquids can be broken down into tiny droplets, then they would mix. (Show this to students by pouring some of the vinegar into the container of oil, placing the lid on the mixture, and gently shaking it.)

6. **Tell students:** ***This shaking action is called physical emulsification, which makes the particle size of the different liquids so small that their relative densities become equal, thereby reducing particle repulsion. Let's see what happens to this emulsion if we let it sit for a moment.***

   Students will see that the oil and vinegar begin to separate from each other, which means that the emulsion is breaking down.

7. **Ask students:** ***A more long-lasting method that we could use to keep the oil and vinegar together is called chemical emulsification. What do you think is involved in chemical emulsification?***

   Chemical emulsification is achieved by introducing an emulsifier. This ingredient is capable of associating with both liquids at the same time, thereby stabilizing the repulsion activity going on between the oil and vinegar. Emulsifiers are important ingredients in salad dressings.

8. **<u>Making Salad Dressing:</u>**

   a. Tell students: *Let's get you making salad dressing so that you can see what an emulsifier can do. All it takes is about two minutes and simple ingredients such as an oil, an acid and an emulsifier, such as mustard or honey.*

   b. Get students into groups of 2-3. Give each group a small container (with a lid) for making the dressing in, measuring spoons and access to the following ingredients: oil, vinegar, Dijon mustard, honey, salt and pepper. Get students to make a basic emulsion using the following recipe:

(continued)

1 *http://www.ift.org/knowledge-center/learn-about-food-science/what-is-food-science.aspx*

Ingredients:

- 3 tablespoons oil
- 1 tablespoon vinegar
- 1 teaspoon Dijon mustard
- 1 teaspoon honey
- Pinch of salt
- Pinch of black pepper

Instructions:

Combine all ingredients in your small container. Securely attach the lid, and shake well. Do a taste test using vegetables. Adjust taste as desired by adding a bit more salt, pepper, mustard, or honey.

To create a unique salad dressing, add small amounts of flavourings such as garlic powder, dill, basil, parsley, cilantro, mint, thyme, chili powder or onion powder. Do another taste test, and adjust taste as desired.

9. **Tell students: *People working in the area of food science not only develop food products but also figure out ways to market them. Let's get you thinking about how to market your unique salad dressing.***

10. **Ask students: *Consider this bottle of salad dressing. What had to happen in order for this bottle to get to this table, waiting to be used in a salad?***

    - Plants such as corn, canola, soy, peanuts, olives, and sunflowers were harvested and made into oil.
    - Someone developed the formulation for the salad dressing.
    - Someone ensured that the salad dressing ingredients met food safety standards.
    - Someone did sensory evaluations to ensure that consumers would like the color, taste, texture and smell of the product.
    - Someone designed the salad dressing container.
    - Someone developed a marketing strategy that would inspire a target consumer to purchase this particular salad dressing.

11. **Tell students: *As you can see, several people with specific jobs in the field of food science were involved in getting this salad dressing to consumers. This means that there are a lot of different career opportunities available within food science.***

    Show students the *Top Careers in Food Science* infographic that highlights the following careers:

    - *FOOD PRODUCTION SUPERVISORS* oversee either entire assembly lines or one entity of them. They are held accountable for the production of outputs and operating activities for food products. They also strive to obtain maximum efficiency at a low cost within specified standards.
    - *FOOD SAFETY/QUALITY ASSURANCE MANAGERS* are responsible for products meeting food safety standards. They oversee procedures to ensure that those specific standards are followed when foods are prepared, processed and packaged.
    - *NUTRITIONISTS/DIETICIANS* are the point of contact for individuals who want advice about eating programs, healthy food selection, and the alteration of diets to achieve their nutrition and diet needs.
    - *PRODUCT DEVELOPMENT FOOD SCIENTISTS* research and revamp the process of canning, freezing, storing, and packaging food.
    - *RESEARCH & DEVELOPMENT TECHNICIANS* are responsible for assisting researchers with product development projects.

(continued)

The following careers also are available in food science:

- *FLAVOUR TECHNOLOGISTS* develop and manufacture flavoring used in food and drink products.
- *PACKAGING ENGINEERS* design packaging materials for food, animal health care products, and other agricultural products such as chemicals, pesticides, and seed.
- *PROCESS ENGINEERS* study the production and manufacturing of products, and focus on factors such as efficiency, quality and safety. These engineers may also help measure sustainability and profitability.

12. **Ask students: *Imagine you're walking down the aisle at a grocery store with the salad dressing. How many different salad dressings are on the shelves? Lots, right?! Now, imagine that you've been hired to develop a marketing strategy for a new type of salad dressing. How are you going to get a consumer who is walking down the aisle to choose your product to purchase instead of the one beside it on the shelf?***

    Possible responses:

    - create colourful packaging
    - put a coupon on the bottle
    - make the product inexpensive

13. **Tell students: *Everything you do when marketing a product depends on who your target consumer is. Let's say that your target consumers are university students. Would they purchase your salad dressing because it comes with a money-saving coupon? Probably. Besides university students, who are examples of other target consumers?***

    Possible responses:

    - senior citizens
    - health-conscious individuals
    - vegans

14. **Ask students: *Besides determining your target consumer, what else should you consider when marketing your product?***

    Possible responses:

    - where to sell the product (e.g. large grocery stores, farmers markets, health-food stores)
    - appearance of packaging
    - marketing strategy

15. **<u>Marketing Salad Dressing</u>**

    a. Tell students: Now that you have a unique salad dressing, you want people to buy it. First, though, you need to determine how you want to market this product.

    b. Hand out *Marketing Salad Dressing* worksheets to groups. Get groups to fill out their worksheets, then share them with their peers. Students could also do taste tests of each others' salad dressings.

    c. Ask students: You've just been involved in making and marketing salad dressing. Now, tell me, what types of jobs are involved in the food-science area of the ag-food sector? Which ones seem interesting? What new food product would you like to create?

    d. Optional: At the end of this station, encourage students to take away the handout *Salad Dressing Recipes*, and to compare their ingredients with the recipes that they created at this station.

Sources / Credits

This activity was adapted from AITC-Saskatchewan's Salad Dressing Activity and AITC-Saskatchewan's Product Development Activity.

Learn To Cook: Making an Emulsion (for Salad Dressing, Mayonnaise, or Sauces)
https://www.youtube.com/watch?v=R7sYROUNO7g

Food Production Supervisor profile:
https://lm.agcareers.com/career-profiles/food-production-supervisor.cfm

Food Safety/Quality Assurance Manager profile:
https://lm.agcareers.com/career-profiles/food-safety-specialist.cfm

Nutritionist/Dietician profile:
https://lm.agcareers.com/career-profiles/nutritionist-dietitian.cfm

Product Development Food Scientist profile:
https://lm.agcareers.com/career-profiles/product-development-food-scientist.cfm

Research & Development Technician profile:
https://lm.agcareers.com/career-profiles/r-d-technician.cfm

Flavour Technologist profile:
https://lm.agcareers.com/career-profiles/flavor-technologist.cfm

Packaging Engineer profile:
https://lm.agcareers.com/career-profiles/packaging-engineer.cfm

Process Engineer profile:
https://lm.agcareers.com/career-profiles/process-engineer.cfm

Marketing Salad Worksheet

Product name: _____

Our target consumers are . . .
(Check off all that apply.)

- ☐ Children
- ☐ Young adults
- ☐ Men
- ☐ Women
- ☐ Families
- ☐ Health-conscious
- ☐ Gluten-free
- ☐ Vegan
- ☐ Middle-income
- ☐ High-income
- ☐ Low-income
- ☐ Other: _____

Words that describe our salad dressing . . .
(Check off all that apply.)

- ☐ Fresh
- ☐ Good-tasting
- ☐ Healthy
- ☐ High-quality
- ☐ Rich
- ☐ Savoury
- ☐ Simple
- ☐ Smooth
- ☐ Spicy
- ☐ Sweet
- ☐ Tasty
- ☐ Tongue-pleasing
- ☐ Veggie-friendly
- ☐ Wholesome
- ☐ Other: _____

Our salad dressing will be sold at . . .
(Check off all that apply.)

- ☐ Large grocery stores (e.g. Safeway)
- ☐ Health-food stores
- ☐ Farmers' markets
- ☐ Online
- ☐ Other: _____

Draw or describe what your packaging will look like.

Salad Dressing Recipes

HERB DRESSING

3 Tbsp	canola oil
1 Tbsp	lemon jice
1 Tbsp	honey
1 tsp	herbs of choice (oregano, thyme, basil, etc.)
½ tsp	Dijon mustard

Combine all ingredients in a jar with a lid. Securely attach the lid, then shake well. Adjust taste if desired.

MEXICAN VINAIGRETTE DRESSING

2 Tbsp	canola oil
½ Tbsp	apple cider vinegar
¾ Tbsp	honey
½ Tbsp	lime juice
¼ tsp	chili powder
Pinch	salt

Combine all ingredients in a jar with a lid. Securely attach the lid, then shake well. Adjust taste if desired.

GREEK DRESSING

(Note: This recipe does not require an emulsifier!)

3 Tbsp	canola oil
1 Tbsp	lemon juice
¾ Tbsp	red-wine vinegar
½ tsp	garlic powder
½ tsp	oregano
½ tsp	basil
½ tsp	parsley
Pinch	salt and pepper

Combine all ingredients in a jar with a lid. Securely attach the lid, then shake well. Adjust taste if desired.

SWEET ONION DRESSING

3 Tbsp	canola oil
1 Tbsp	apple cider vinegar
½ Tbsp	whole-grain mustard
½ tsp	honey
½ tsp	onion powder
Pinch	salt and pepper

Combine all ingredients in a jar with a lid. Securely attach the lid, then shake well. Adjust taste if desired.

Source:
AITC-SK's Salad Dressing Activity

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Plant Science Pathway -

BIOPRODUCTS

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students create bio-plastic, and learn about technological advances in the creation of bio-plastics and their benefits. They also learn about ag-sector careers associated with bio-products.

Suggested Time

15 minutes

Materials Required

- Cornstarch
- Corn oil
- Water
- Food colouring
- Measuring spoons
- Medicine droppers
- Sandwich-size Ziploc bags
- Microwave
- Either provide equipment to show videos or print out photos (See **Additional Resources**)

1. **Ask students: *What are some examples of things made of plastic?***

   Water bottles, toys, bags, automotive parts, etc.

2. **Ask students: *What are some advantages of making things out of plastic?***

   Products are:

   - *Shatter-proof:* If you drop a plastic cup, then it will probably not break.
   - *Inexpensive:* Plastic is less expensive than glass, which means that larger quantities of plastic products can be manufactured for the same amount of money required to make glass products.
   - *Versatile:* Plastics can be made into both flexible and rigid products.

3. **Ask students: *Plastic is also lightweight and durable. How can these traits serve as advantages?***

   Most products found in stores have to be shipped by truck, train or plane. Transporting lighter weight cargo uses less fuel. Durable plastic packaging protects products.

4. **Ask students: *What negative effect do plastics have on the environment?***

   Plastic is traditionally made from petroleum, which is a non-renewable resource whose processing contributes to greenhouse gas emissions. Most petroleum-based plastic is not biodegradable, which means that when this type of plastic is placed in landfills, it does not break down. Non-biodegradable plastic products also end up in our oceans and become established as "garbage patches."

   For more information, see ***Additional Resources****: How Big Is the "Great Pacific Garbage Patch"? Science vs. Myth*

5. **Tell students: *Plastic's positive and negative impact on the environment has inspired people to explore new ways of creating it. Bio-plastics are the result of this exploration. Bio-plastics, or organic plastics, are derived from renewable and sustainable sources (e.g. corn, wheat straw), unlike petroleum-based plastics. Many bio-plastics are designed to biodegrade.***

6. **Tell students: *Today, you will be making your own bio-plastic using corn starch and corn oil.***

   Guide students through the following procedures:

   a. Place 1 Tbsp. of cornstarch into a Ziploc bag.

   b. Add two drops of corn oil to the bag.

   c. Add 1 ½ Tbsp. water to the bag.

   d. Mix the bag contents by rubbing the outside of the bag with fingers.

   e. Add two drops of food colouring. Mix again.

   f. DO NOT completely seal the bag before placing it into a microwave oven set at High for 20-25 seconds. CAREFULLY remove the HOT bag.

   g. Get students to form their plastic into a ball while it is still warm, and to describe what it does, and to compare their biodegradable plastics for similarities and differences.

7. **Ask students: *What could you make with this biodegradable plastic if you let it harden?***

   Get students' responses.

8. **Tell students: *Although creating bio-plastics is not a brand new technology, engineers and scientists are finding new ways to create bio-plastics that possess the same, if not better, qualities of petroleum-based plastic.***

(continued)

Show students videos / photos about the Bio-products Discovery & Development Centre (BDDC) at the University of Guelph, which opened in 2008. (See **Appendix A**)

9. **Inform students that the following ag-careers involve developing bio-products, including bio-plastics:**

   - *ANALYTICAL CHEMISTS* study chemical compounds to determine what they are composed of and how they interact with other substances. For this reason, analytical chemists play an important role in looking at chemistry and how it might affect the environment, food, or how medicines may interact with other medicines or the body of an organism.

   - *BIOINFORMATICS SCIENTISTS* use technology and computer science to study and find solutions in the area of biology. They use databases of genetic information to find ways to identify and treat human, animal and plant diseases and other issues.

   - *BIOSTATISTICIANS* use mathematics and statistics to find ways to solve scientific problems. They assist in developing statistical techniques and use their expertise to design studies and analyze data. Biostatisticians may work with the environment, human or animal health.

   - *LABORATORY TECHNICIANS* collect and prepare samples, carry out experiments, make measurements with scientific equipment, record results and present results for critical analysis.

   - *RESEARCH AND DEVELOPMENT MANAGERS* oversee research activities and develop knowledge-based products for a company.

10. **Tell students: *Developing bio-products such as bio-plastics is a good example of how science is used for creating renewable products that can be used in a variety of engineering applications.***

    Remind students that their corn plastic is environmentally friendly because it will biodegrade eventually, unlike the Ziploc bag that it's contained within.

11. **Ask students: *Why is creating and using bio-products important to our future?***

    Coax students to think about how our future will be affected by limited resources , increasing population, concerns about climate change, etc.

This station is adapted from:
http://handsongreenplastics.blogspot.ca/2012/07/lesson-on-bioplastics.html
https://wisagclassroom.org/wp-content/uploads/2012/04/Corn-Plastic.pdf

Analytical Chemist profile:
https://m.agcareers.com/career-profiles/analytical-chemist.cfm

Bioinformatics Scientist profile:
https://m.agcareers.com/career-profiles/bioinformatics-scientist.cfm

Biostatistician profile:
https://m.agcareers.com/career-profiles/biostatistician.cfm

Laboratory Technician profile:
https://m.agcareers.com/career-profiles/laboratory-technician.cfm

Research and Development Manager profile:
https://www.agcareers.com/career-profiles/research-and-development-manager.cfm

Additional Resources

Bio-products Discovery & Development Centre (BDDC) at the University of Guelph:
https://www.youtube.com/watch?v=SxY6UaIQ9bk (video, 3:17)
https://youtu.be/dKVbvX9VQog (video, 2:57)
https://www.bioproductscentre.com/Media/Gallery (photos)

How Big Is the "Great Pacific Garbage Patch"? Science vs. Myth
https://response.restoration.noaa.gov/about/media/how-big-great-pacific-garbage-patch-science-vs- myth.html

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Plant Science Pathway -

DNA EXTRACTION

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students extract DNA from strawberries in order to investigate DNA: where it is found, and how it looks and feels. Participating in DNA extraction familiarizes students with one aspect of work that biotechnologists do: deciding how to use information contained in DNA to improve crops. Students will also learn about ag-sector careers associated with biotechnology.

Suggested Time

20-25 minutes

Materials Required

Note: *Group* = 2 students

- For DNA Extraction Solution:
  - 50 mLs clear hair shampoo with EDTA (e.g. *Suave*). Do not use one containing conditioner.
  - 5 mLs salt
  - 450 mLs water
- **Appendix A**: *Strawberry Varieties*
- Medium-sized Ziploc bags (1 per group)
- Large strawberries (1 per group) or frozen strawberries (~3 per group, thawed)
- Funnels (1 per group) that do not touch the bottom of a 150 mL cup
- 4" X 4" squares of cheesecloth (2 per group)
- Plastic cups, 150 mL (1 per group)
- Isopropyl alcohol (15 mL per group)
- Ice in a bowl (for keeping isopropyl alcohol cold during Learning Activities)
- Pipettes (1 per group)
- Wooden skewers (1 per group)
- Optional: small, lidded containers for DNA samples

Preparation for Learning Activities

One day before doing the Learning Activities, do the following:

1. **Make the DNA Extraction Solution**
   (Yield: enough for 50 groups of 2 students)

   In a one-L container with a lid, combine:

   - 50 mLs clear hair shampoo
   - 5 mLs salt
   - 450 mLs water

   Stir slowly to avoid foaming. Cover.

2. **Put isopropyl alcohol in freezer.**

3. **If using fresh strawberries, then remove green leaves from them and place strawberries in a bowl. Do not refrigerate. If using frozen strawberries, then move them from the freezer to the fridge to thaw.**

4. **Just before doing the Learning Activities, place the following items on the presentation table:**

   - container of DNA Extraction Solution
   - strawberries in a bowl
   - isopropyl alcohol "on ice"
   - materials for student groups (Ziploc bags, funnels, cheesecloth, plastic cups, pipettes, skewers)

1. **Ask students: *What does a strawberry look like?***

   Get students' responses, which will likely include comments about strawberries being red. Then show students the photo of various types of strawberries (See **Appendix A**: *Strawberry Varieties*). Point out the variety of colours, shapes and sizes.

2. **Ask students: *While these strawberries are all still strawberries, they have different characteristics. How do you think they got to be different?***

   Strawberry farmers and plant breeders worked together to create strawberries that vary in colour, size and sweetness to meet consumers' needs and wants. Plant breeders worked with traits determined by the DNA contained in various strawberry plants in order to create new strawberry varieties that had desired characteristics.

3. **Ask students: *What is DNA?***

   "DNA" is an abbreviation of "deoxyribonucleic acid." In general, DNA contains a set of instructions that tell an organism how to develop and function. Such a set of unique instructions exists in all living organisms. DNA contains genetic information that is inherited. The set of instructions for a particular organism is known as its genome. We humans have a particular genome. Each food that we eat that comes from plants and animals contains its own, particular genome.[1]

4. **Ask students: *Why are scientists interested in studying DNA?***

   DNA can be used to make new medicines. DNA can be used to solve crimes. Scientists can use ancient DNA from mummies and seeds that are thousands of years old in order to identify the genetics of those organisms. And DNA can be used to develop crops with particular traits, such as insect- and weed- resistance, and enhanced vitamins and mineral content. All in all, scientists study DNA for many reasons.[2]

5. **Tell students: *Today, you will model a process that scientists use to get DNA from plants. And you'll be able to see what DNA looks like. DNA can be easily seen with the naked eye when collected from thousands of cells.***

6. **Ask students: *Where do you find DNA in a plant?***

   DNA (most of it) is found in the nucleus of a plant's cell.[3]

7. **Tell students: *The method used for isolating DNA from plant cells is called DNA Extraction.***

   Scientists usually use DNA extraction kits that are available from biotechnology companies. These kits contain ingredients that facilitate the extraction of DNA from organisms' cells.

   The process of DNA extraction begins when a soap-based solution is applied to an organism. This solution causes the nuclei of the organism's cells to open up and release DNA into the solution. Then, isopropyl or ethanol alcohol is added to the solution in order to get the DNA to separate itself from the solution. This step is called "precipitation."

8. **Tell students: *Today, you will be extracting DNA from strawberries by using household items such as shampoo, salt, water and rubbing alcohol (also known as "isopropyl alcohol").***

   Why strawberries? Most organisms have only one genome copy in each of its cells. Every cell in a strawberry, however, contains eight copies of the

(continued)

1 *https://www.scientificamerican.com/article/squishy-science-extract-dna-from-smashed-strawberries/*
http://lucbiotech.org/resources/display/files/dna_extraction_from_strawberrie.pdf

2 *https://www.scientificamerican.com/article/squishy-science-extract-dna-from-smashed-strawberries/*
http://lucbiotech.org/resources/display/files/dna_extraction_from_strawberrie.pdf
https://naitc-api.usu.edu/media/uploads/2015/12/11/LabSheet.pdf

3 *http://lucbiotech.org/resources/display/files/dna_extraction_from_strawberrie.pdf*

strawberry genome, which means that strawberries contain a lot of DNA![4]

9. **Get students to pair up with a partner.**

10. **Guide each student group through the <u>DNA Extraction Procedure</u>:**

    a. Place 1 large strawberry (or ~3 thawed strawberries) into a Ziploc bag. Push out all the air, and seal the bag.

    b. Use fingers to gently mash the strawberry/ strawberries for two minutes, being careful to not break the bag.

    c. Ask students: *What is the purpose of mashing the strawberry/strawberries?*

       Crushing the strawberry content breaks apart its cell walls, thereby releasing nuclei where DNA is located. The more you mash, the more DNA you'll get! This process is called "mechanical separation."[5]

    d. Use a pipette to add 10 mLs of the DNA Extraction Solution to the bag, then push out all air, and reseal the bag. Use fingers to gently mash the mixture for one minute.

    e. Tell students: *This solution is comprised of shampoo, salt and water.*

       Ask students: *What does the shampoo in the extraction solution do? (Hint: What does shampoo do when you wash your hair?)*

       Shampoo breaks down the lipids and proteins that hold together the fatty membranes of cells, thereby releasing DNA. Salt makes DNA molecules stick together and separate from proteins that are also released from the cells.[6]

    f. Place the funnel into the plastic cup, then place cheesecloth squares into the funnel to serve as a filter. Slowly pour the mixture from the bag into the funnel. Let the mixture drip through the cheesecloth until only wet pulp remains in the cheesecloth. Afterwards, remove the cheesecloth from the funnel and place it into the Ziploc bag for disposal. Remove the funnel from the cup.

    g. Ask students: *Why do you need to filter the strawberry mixture?*

       Filtering removes chunks that would make it difficult to see DNA.

    h. Slightly tilt the cup containing the filtered solution, then, using a pipette, add approximately 15 mLs of ice-cold isopropyl alcohol by dripping it slowly down the side of the cup. Allow the alcohol to rest on top of the strawberry mixture. Do not agitate the solution. Let the solution sit for two minutes without disturbing it.

    i. Ask students: *What does the isopropyl alcohol do to the mixture?*

       The ice-cold isopropyl alcohol causes the DNA to precipitate (separate) out of the solution. The colder the alcohol, the greater the amount of DNA extracted. [7]

       DNA "likes" to dissolve in water. It does not, however, "like" cold isopropyl alcohol. Instead, DNA prefers contact with other DNA rather than with alcohol, so it seeks out other DNA to "join" by clumping together with it.[8]

(continued)

4 *https://www.scientificamerican.com/article/squishy-science-extract-dna-from-smashed-strawberries/*

5 *http://ucbiotech.org/resources/display/files/dna_extraction_from_strawberrie.pdf*
https://www.murdoch.edu.au/Biotech-out-of-the-box/_document/Kit-Handout-Sheets/DNA-extraction-from-strawberries.pdf

6 *https://www.murdoch.edu.au/Biotech-out-of-the-box/_document/Kit-Handout-Sheets/DNA-extraction-from-strawberries.pdf*

7 *http://www.apsnet.org/edcenter/K-12/TeachersGuide/PlantBiotechnology/Pages/Activity1.aspx*

8 *https://borntoscience.com/2015/05/05/strawberry-dna-extreme-home-edition/*

j. Ask students: *What do you see happening in your cup?*

Students will see a white mucous-like, thread-like layer on top with a cloudy pink layer beneath.

k. Dip the bamboo skewer into the cup, and spool the white, stringy substance onto it.

l. Ask students: *What do you have on your skewer?*

You have thousands of DNA strands clumped together. Remember, strawberries contain a lot of DNA!

DNA is so small that it is not visible as a single strand to the human eye. It is, however, visible when thousands of threads of DNA clump together.[9]

m. Ask students: *What could this DNA be used for after it is extracted?*

DNA from a strawberry that carries a gene that codes for a specific trait could be used for transformation. The section of DNA that contains this particular gene could be inserted into a different strawberry so that the altered strawberry now has a specific trait that it did not previously possess.[10]

Suggestion: Get students to place their DNA samples into small, lidded containers as a "takeaway" from this event. ("Heh, guys! Look at this DNA!")

11. **Tell students: *We've talked about how traits such as colour, size and sweetness can be altered in strawberries. Ask students: What other traits would scientists be interested in developing in crops?***

Drought resistance, insect resistance, disease resistance, herbicide tolerance, early maturity, height adjustment, etc.

12. **Tell students: *DNA extraction is important because it allows plant and animal breeders to more accurately select for desirable traits. DNA extraction allows scientists to develop traits in an organism that would otherwise happen slowly over many seasons.***[11]

13. **Tell students: *DNA extraction is a process used in biotechnology. Although the principles of biotechnology have been in use for over 6,000 years, the scientific field of biotechnology is relatively new.***[12]

14. **Ask students: *What is biotechnology?***

Biotechnology involves the study of using living organisms and biological processes in order to create food, medicines, devices, materials and new systems that are intended to improve the quality of human life and the environment. The earliest biotechnologists were farmers who developed improved species of plants and animals by cross-pollination and cross-breeding. In recent years, biotechnology has expanded.[13]

(continued)

9 *https://www.murdoch.edu.au/Biotech-out-of-the-box/_document/Kit-Handout-Sheets/DNA-extraction-from-strawberries.pdf*

10 *http://www.apsnet.org/edcenter/K-12/TeachersGuide/PlantBiotechnology/Pages/Activity1.aspx*

11 *https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=381*
https://naitc-api.usu.edu/media/uploads/2015/12/11/LabSheet.pdf

12 *https://naitc-api.usu.edu/media/uploads/2015/12/11/LabSheet.pdf*

13 *http://whatis.techtarget.com/definition/biotechnology*
https://naitc-api.usu.edu/media/uploads/2015/12/11/LabSheet.pdf
Geee! In Genome PowerPoint, AITC-SK

15. **Tell students: *Biotechnology is a part of several ag-sector careers:***

    - *PLANT BIOLOGISTS* specialize in topics such as plant breeding or genetics; they conduct and support research of plant production.

    - *PLANT GENETICISTS* conduct research to understand, improve or create new varieties of plants or crops. By looking at a plant's DNA, they can examine ways to improve shape, size, production level, pesticide and disease tolerance.

    - *RESEARCH STATION MANAGERS* are responsible for the management of research station operations such as animal agriculture, plant breeding, research, crop/seed production, and product development.

Sources / Credits

The activities in this station are adapted from:
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=381
http://www.apsnet.org/edcenter/K-12/TeachersGuide/PlantBiotechnology/Pages/Activity1.aspx
http://ucbiotech.org/resources/display/files/dna_extraction_from_strawberrie.pdf
https://borntoscience.com/2015/05/05/strawberry-dna-extreme-home-edition/
https://www.scientificamerican.com/article/squishy-science-extract-dna-from-smashed-strawberries/
https://naitc-api.usu.edu/media/uploads/2015/12/11/LabSheet.pdf

Plant Biologist profile:
https://m.agcareers.com/career-profiles/plant-biologist.cfm

Plant Geneticist profile:
https://m.agcareers.com/career-profiles/plant-geneticist.cfm

Research Station Manager profile:
https://m.agcareers.com/career-profiles/research-station-manager.cfm

Strawberry Varieties

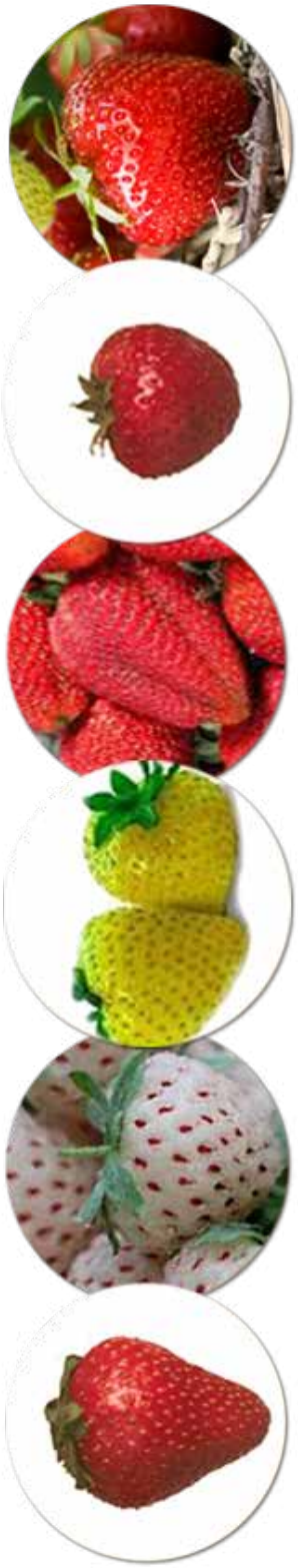

Image Source: https://naitc-api.usu.edu/mediauploads/2015/11/19/Strawberry_Varieties.png

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CAREER EXPLORATION ACTIVITY TOOLKIT

- Plant Science Pathway -

SOIL ANALYSIS

GRADE LEVELS: 9 TO 12

Introduction

Grade Levels

9-12

Overview

Students learn about the important role that soil testing plays in resolving crop problems, and about the careers associated with plant and soil science.

Suggested Time

15 to 20 minutes

Materials Required

- **Appendix A**: Printout of *Essential Nutrients* chart
- **Appendix B**: Three printouts of *Nutrient Deficiencies of Corn (Nitrogen Deficiency, Phosphorus Deficiency, Potassium Deficiency, Zinc Deficiency)*
- **Appendix C**: One printout of each of the following studies: *Corn Case Study #1, #2, #3*
- OPTIONAL: Three NPK soil-nutrient test results (in chambers), one using soil that is deficient in N, one using soil deficient in P, one using soil deficient in K. Prepare soil tests 30 minutes prior to presentation. Soil test kits are available at garden centres and online at: *https://www.amazon.com/Luster-Leaf-1601-Rapitest-Soil/dp/B0000DI845/ref=sr_1_3?ie=UTF8&qid=1508279535&sr=8-3&keywords=soil+testing+kits*

1. **Tell students: *Crop production is big business in (your province).***

2. **Then ask students: *What are some common field crops grown in _____ (your province).***

   Answers depend on which province you're presenting in.

3. **Ask students: *What do all of these crops need in order to survive?***

   They require soil, air, moisture, sunlight and nutrients.

4. **Ask students: *Where do crops get these nutrients from?***

   After students respond, show them the *Essential Nutrients* chart, which strongly indicates that soil is the source for ALL essential nutrients that crops need in order to grow.

5. **Tell students: *This chart shows the importance of having healthy soil. When soil is missing some of the essential nutrients that a specific crop needs, it creates unhealthy growing conditions and problems.***

6. **Tell students: *Corn farmers, for example, have to pay close attention to the nutrient levels of the soil in which their corn crops grow, in particular, to levels of Nitrogen, Phosphorus, Potassium and Zinc.***

7. **Tell students: *You are now going to be soil scientists who face the challenge of helping corn farmers solve problems with their crops. You will be identifying soil-health problems based on different sources of information. In other words, you'll be CSI soil scientists!***

8. **CSI SOIL SCIENTIST ACTIVITY**

   a. Get students to form three groups.

   b. Give each group the following printouts:

      - One copy of *Nutrient Deficiencies of Corn* (**Appendix B**)
      - One copy of a *Corn Case Study*, a different one per group (**Appendix C**)

   c. Tell students: You have one minute to diagnose which nutrient deficiency is creating the problem in your case study. Use the information contained in your printouts.

   d. Get students to present their diagnoses, supported by information from *Nutrient Deficiencies of Corn* and their *Case Study* notes.

   e. Compare student findings to official answers:

   - Case Study 1: Nitrogen deficiency
   - Case Study 2: Potassium deficiency
   - Case Study 3: Phosphorus deficiency[1]

9. **OPTIONAL**

   Ask students: *What other information could you gather in order to confirm your diagnoses?*

   Other information could be provided by soil-nutrient tests. If you have prepared soil-nutrient tests, then show students results for NPK tests. Get students to align these results with their case studies.

10. **Ask students: *What skills did you use to diagnose the problems presented in each Case Study?***

    - observation
    - analysis
    - reading comprehension
    - collaboration

(continued)

1 *For more detail, visit: https://naitc-api.usu.edu/media/uploads/2015/05/26/Case_Study_Answers-_For_Print_Version.pdf*

11. **Tell students: *Farmers can consult with ag-experts who possess these skills (and others) in order to figure out how to maximize soil health and crop productivity. Some of these experts have careers in the following areas:***

    - *SOIL SCIENTISTS* analyze characteristics of soil, different soil types, and research the ability of plants to survive in different conditions.

    - *ENVIRONMENTAL SCIENTISTS* conduct nutrient analyses and establish testing systems for fertilizer products, including on-site field tests and quality control.

    - *BIOLOGICAL TECHNICIANS* support environmental scientists in laboratory research about life cycles of living organisms. They are responsible for conducting field sampling of soil, air, water, crops, fruits and vegetables. They evaluate samples to determine methods for improving yield, quality, and adaptations to mechanization, climate and pests.

    - *ENVIRONMENTAL TECHNICIANS* conduct environmental monitoring. One of their responsibilities is conducting field sampling of soil, air and water.

    - *AGRONOMISTS* make recommendations to growers to help them achieve efficient crop production.

This station was adapted from a station developed by Becky Parker, AgScape, using materials adapted from *https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf*

Soil Scientist profile:
https://m.agcareers.com/career-profiles/soil-scientist.cfm

Environmental Scientist profile:
https://m.agcareers.com/career-profiles/environmental-scientist---specialist.cfm

Biological Technician profile:
https://m.agcareers.com/career-profiles/biological-technician.cfm

Environmental Technician profile:
https://m.agcareers.com/career-profiles/environmental-science-and-protection-technician.cfm

Agronomist profile:
https://m.agcareers.com/career-profiles/agronomist.cfm

Essential Nutrients

ESSENTIAL NUTRIENT	AIR	SOURCE WATER	SOIL
Boron (B)			S
Calcium (Ca)			S
Carbon (C)	A		S
Chlorine (Cl)			S
Copper (Cu)			S
Hydrogen (H)	A	W	S
Iron (Fe)			S
Magnesium (Mg)			S
Manganese (Mn)			S
Molybdenum (Mo)			S
Nicken (Ni)			S
Nitrogen (N)			S
Oxygen (O)	A	W	S
Phosphorus (P)			S
Potassium (K)			S
Sulfer (S)			S
Zinc (Zn)			S

Adapted from https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf)

Nutrient Deficiencies

NUTRIENT DEFICIENCES OF CORN

Zinc Deficiency

Plants lacking zinc show pale- to whitish-colored bands located between the veins of the leaves. The plants may be stunted. Zinc deficiency is associated with soils that are alkaline and contain little organic material.

Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

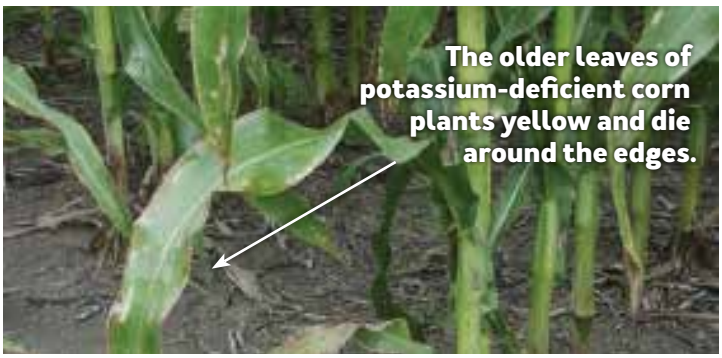
Nutrient Deficiencies

NUTRIENT DEFICIENCES OF CORN

Potassium Deficiency

Plants that lack potassium show stunted growth and mature later than normal plants. Potassium deficiency results in yellowing and drying of the leaf edges, especially on older leaves. The death of cells in the leaves may be visible as a dark discoloration. The stems of potassium-deficient plants are weak and often break below the ears.

Potassium deficiencies happen most often in soils that are sandy, wet, or compacted (dense) or when potassium has been removed through repeated cropping and natural levels are low. Restoring potassium to the soil will help the plants better absorb water and prevent wilting and dry leaves.



Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

Nutrient Deficiencies

NUTRIENT DEFICIENCES OF CORN

Phosphorus Deficiency

Plants that lack phosphorus show stunted growth and mature later than healthy plants. Late-maturing crop plants are more susceptible to frost, harvest damage, disease infection, and summer drought. The leaves and stems often show purpling or reddening.

Phosphorus deficiency can result when soil phosphorus levels have declined due to nutrient removal. It can also occur in cool conditions that reduce diffusion to the root. As a result, many farmers apply some phosphorus with the seed to support early growth when the soil is cool. Restoring phosphorus to the soil allows crop plants to mature properly and be better protected from disease, drought, and frost.

Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

Nutrient Deficiencies

NUTRIENT DEFICIENCES OF CORN

Nitrogen Deficiency

The major symptom of this problem is a general yellowing of the plant. The yellowing begins at the leaf tip and gradually works its way down to the base of the leaf. Older leaves show a V-shaped yellowing of the inner leaves, with the leaf edges remaining green in a V pattern. The plants may appear stunted and spindly. Symptoms of nitrogen deficiency are most noticeable in plants growing in lower, poorly drained parts of the field. Nitrogen deficiency also can result after heavy rains remove nitrogen from sandy soils. Nitrogen is an important building block used by plants for many aspects of growth. Restoring nitrogen to the soil will improve crop yields.

A normal leaf is on the right. Leaves from increasingly nitrogen-deficient plants are on the left.

Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

Corn Case Study #1

PRIMARY INFORMATION

The farmer reports that his corn grows in sandy soil. The plants are stunted and have yellow leaves. They are free of pests, and the fields are free of weeds. The farmer provided the following photograph.

SECONDARY INFORMATION

The farmer sent this additional photograph of an affected leaf. He reports that his fields have been exposed to heavy rains and higher than normal temperatures.

Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

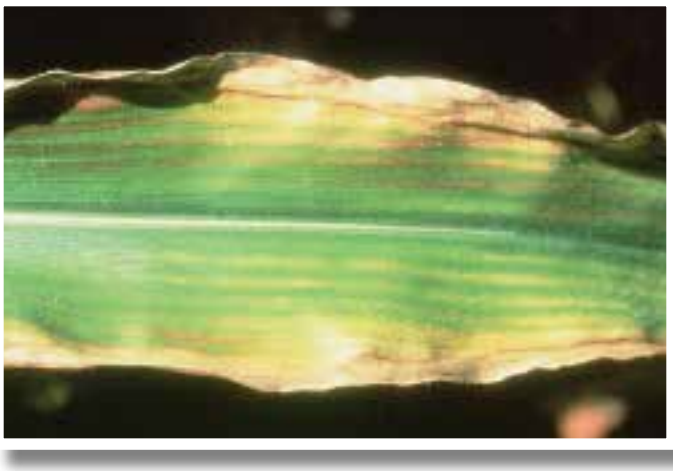
Corn Case Study #2

PRIMARY INFORMATION

The farmer reports that the plants are stunted. Her corn grows in sandy soil. Some weeds are present in the fields. She provided the following photograph, which shows some yellowing of leaves.

SECONDARY INFORMATION

The farmer sent this additional photograph of a leaf from an affected plant. She also reports that some of her plants have stems that are not strong enough to support the ears of corn.



Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

Corn Case Study #3

PRIMARY INFORMATION

The farmer reports that her plants are stunted. Her fields are composed of compacted (dense) soil and are free of weeds. She provided the following photograph of two affected plants.

SECONDARY INFORMATION

The farmer sent this additional photograph of a leaf from an affected plant. The discoloration seen near the tip of the leaf is purplish. She reports that her corn is maturing later than it should and that she is beginning to see some weeds growing in her fields.

Source: https://naitc-api.usu.edu/media/uploads/2015/05/26/Plant_Nutrient_Deficiencies_Handouts_1.pdf

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