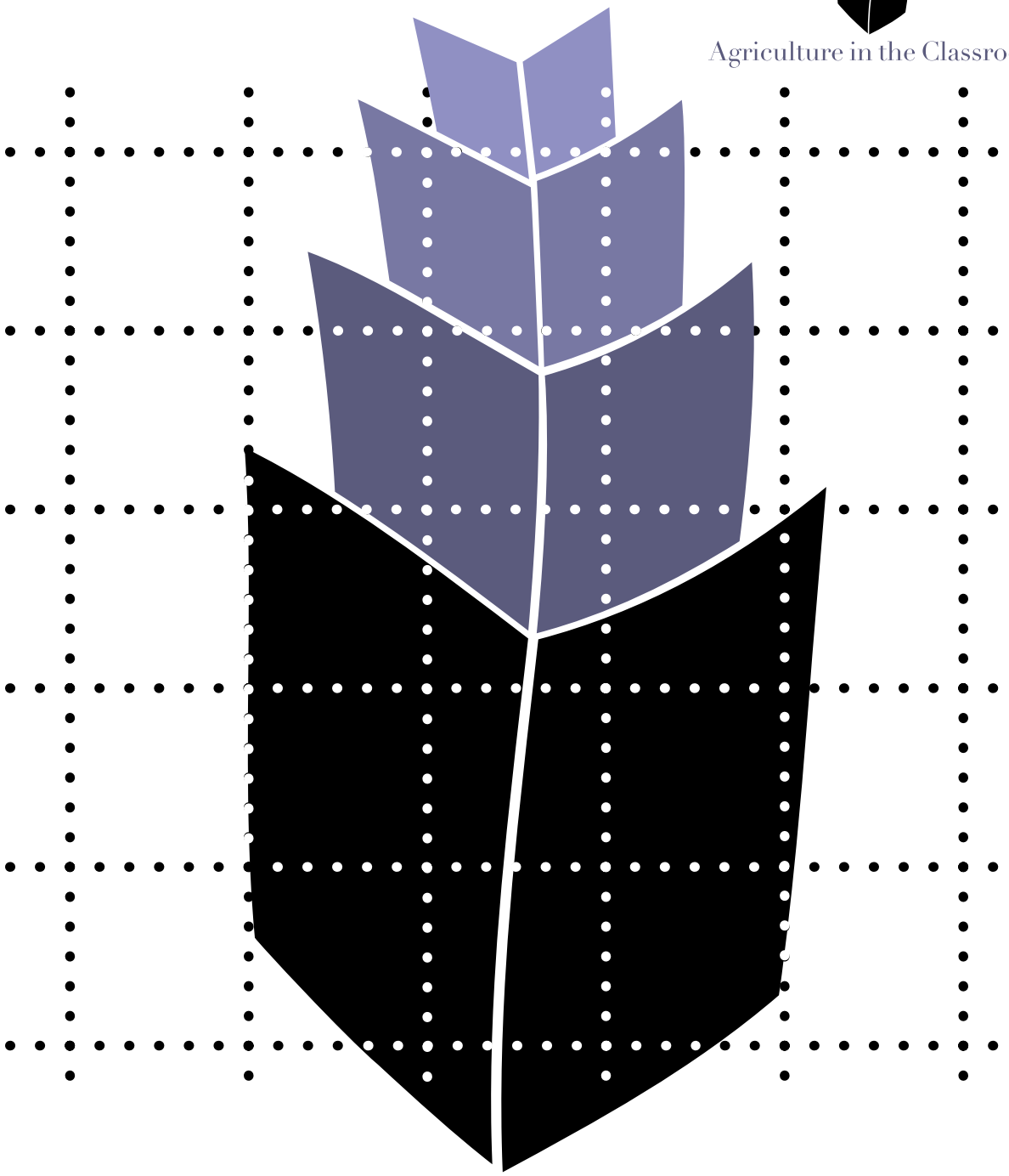
Technology in Agriculture

Agriculture in the Classroom



Agriculture in the Classroom **2002 Study Series**

Agriculture In The Classroom (Sask) Inc. is a non-profit organization funded by the agri-food industry with assistance from Saskatchewan Agriculture, Food and Rural Revitalization. AITC is mandated to assist Saskatchewan learners and educators in increasing their awareness and understanding of the complexities and importance of agriculture through partnerships with educators, agri-business, and agriculture organizations. AITC's efforts enable more people to make informed choices and decisions related to food, the environment, lifestyles, and agriculture practices.

The agriculture and agri-food industry in Saskatchewan makes a significant contribution to the provincial economy, to the well-being of both rural and urban communities, and to the environment. This industry is constantly evolving within the traditional family farm and the large international agri-businesses. It is important to provide the general public with a greater awareness and understanding of industry changes and the impact they have on Saskatchewan people.

This series of two publications on Agriculture in Saskatchewan, *Healthy Food,Healthy Body* and *Technology in Agriculture* has been produced with major assistance from Canadian Adaptation and Rural Development in Saskatchewan as well as industry Program Partners. The material for these publications was developed by Saskatchewan teachers, members of the industry, professional agrologists and various organizations as part of the Agriculture in the Classroom 2002 Summer Writing Workshop.

While the material in this publication is deemed reliable and accurate to the best of AITC's knowledge, author contributors of the materials to this collaborative effort are solely responsible for the content and information which they have contributed to produce this booklet. The views of the authors and contributors do not necessarily represent the views of AITC.

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Summer Writing Workshop 2002 Program Partners

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Agriculture and Agri-Food Canada
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Agriculture - Our History, Our Future

From a presentation by Al Scholz, Saskatchewan Agrivision Corporation

Sir John A. MacDonald's national vision of Canada directly affected railroad development, immigration and agriculture in Saskatchewan. The infrastructure built to support this policy created an export-based grain economy in Saskatchewan. This included a land survey system and the formation of hundreds of small towns along a vast network of railroads each with a post office and grain elevators.

Saskatchewan became the fastest growing province between 1900 and 1930, with the most vigorous export economy in Canada. The Pioneer vision resulted in many creative initiatives, such as farmer-owned co-operative grain companies, the Canadian Wheat Board, telephone co-operatives and credit unions.

Around 1935, Canada's economy shifted from agricultural to industrial. After 1945, world trade in food products expanded with increased competition from other countries. Saskatchewan farmers adapted quickly; replacing horses with tractors, inventing dryland tillage equipment, expanding farm size, increasing yields through fertilizers and crop protection products, and accepting new crops and varieties.

The elimination of the Crow Transportation Subsidy in 1995 provided an incentive for increased local use of grains through value-added processing of crops and increased livestock production. Increases in manufacturing in rural communities created more jobs and the export of higher priced food products. Saskatchewan's dependence on the export of raw commodities was reduced, offsetting high transportation costs and the low margins associated with commodities.

In the 21st century, Saskatchewan's "New Pioneers" continue to adopt innovative approaches to respond to new market opportunities. Saskatchewan has approximately 47% of Canada's agricultural land; approximately 60% of which is best suited to a wide range of cereals, oilseeds, pulses, fruits, vegetables, herbs and spices and 40% of which is best suited to livestock production and processing. The potential for a renewed agricultural industry based on a diversity and value-added processing is great.

Saskatchewan is uniquely poised to take advantage of the new economy. Career opportunities in agriculture are suddenly much broader and more exciting. Saskatchewan's growing agricultural industry will mean an increase in jobs requiring expertise in marketing, sales, engineering, logistics, economics, finance and the biological sciences.

The agriculture industry is one of the fastest growing sectors in the economy. With almost one-half of Canada's agricultural land base, a strong pioneer heritage of innovation and success, our central location, world-class research and training institutions, a strong core business sector, and an enviable work ethic we have the best quality of life in the world. Nothing is holding us back!

Did You Know…

- the agricultural industry world wide is transforming from a focus solely on providing food to also supplying the expanding bio-products market? This includes the bio-medical (nutraceutical and health products), bio-energy (ethanol, bio-diesel and methane) and bio-industrial (bio-plastics, soaps, oils) markets, which are increasingly important with concerns about the use of non-renewable resources and global warming.
- that Iran and Algeria are the two largest export wheat markets for Canada based on Canadian Wheat Board sales from 1996-2001?

Crop Production Technologies

Did You Know?

- satellites orbit the earth at a height of 17 600 km?
- the earth's diameter is about 12 800 km?
- GPS satellites are monitored by the US Department of Defense (DOD)?
- sources of deviation from orbit include atmospheric and weather conditions that interfere with radio signals, timing errors by the satellite or receiver clocks, and bouncing signals?

From a presentation by Trever Crowe, Department of Agricultural and BioResource Engineering, University of Saskatchewan

The Role of Technologists and Engineers in Agriculture

There is an interdependency among many different fields of engineering, technology, and agriculture. For example, in the construction of a combine, mechanical, electrical and civil engineers contribute to the design and functioning of the engine, transmission, and other working parts; computer engineers design digital monitors; and agricultural engineers deal with the interactions between the machine and the crop. Control systems are vital in the development of technology pertinent to precision agriculture. Control systems can be one of two types:

a) **Open-loop systems** - These are systems where no information is fed back to a controller, so the system cannot automatically respond to changes in the environment.

b) **Closed-loop systems** - These are systems where the response of the system is monitored and fed back to a controller so that the system can react to environmental changes.

The goal of precision agriculture is to improve efficiency in a number of areas in agriculture, not necessarily to increase production. Examples of areas where efficiency is examined include:

a) **Seeding** - Designing precision seeding equipment that can control fertilizer levels based on existing soil nutrient levels requires an understanding of relationships among the seed, soil, fertilizer, and moisture.

b) **Pest Control** - Applying pesticides only where pests exist requires knowing where the pests are, whether the pest population warrants pesticide application, and a way to control the equipment.

c) **Harvest** - Collecting yield data at specific locations in the field helps to understand and manage practices in the future. Precision harvest equipment presents prospects for quality monitoring of the crop.

Current Technologies

Air seeders incorporate control systems to optimize seed and fertilizer rates. Distributing the right amount of seed per hectare (kg seed/ha) is controlled by

a) Calibration (kg seed/revolution)
b) Speed of Revolution (revolutions/sec.)
c) Ground Speed of Tractor (km/hour)
d) Width of the Seeding Implement (m)

$$\frac{\text{kg seed}}{\text{Revolution}} \times \frac{\text{rev}}{\text{s}} \times \frac{\text{h}}{\text{km}} \times \frac{\text{km}}{1000\text{m}} \times \frac{1}{\text{m}} \times \frac{1000\text{m}^2}{\text{ha}} = \frac{\text{kg seed}}{\text{ha}}$$

If the amount being seeded is different from the desired pre-set level, the computer changes the speed of the feed roll revolutions.

Harvest combines use different strategies for determining yield (x-ray, impact plates, torque, etc.). Other sensors are used to determine protein, moisture, and oil concentrations in the harvested crops.

These measurements are used in determining quality, and the price that a grower will get for the grain. Yield sensors allow very precise maps to be made of a field - but precise measurements of position must also be known. These are most often obtained using Global Positioning Systems (GPS).

The use of Global Positioning Systems (GPS) in Agriculture

The applications for GPS are limitless - from on-board road maps to the tracking of truck drivers to pizza delivery personnel to constructing yield maps and soil nutrient grids to hobbies such as GeoCaching (the high-tech version of orienteering).

How it Works

If you want to locate a point on a 2-dimensional surface like a sheet of paper, you need to know the distance of the point from 3 other reference points (Figure 1). If you know the distance from your point to one station, you can describe one circle. Knowing two stations allows you to describe 2 circles, and two points of overlap give 2 potential points in space for your "location". When you know the distance to 3 stations, you can precisely identify your own location.

To locate a specific point in 3-dimensional space, you need to have a fourth point of reference. In 3-dimensions, knowing the distance to one satellite allows you to construct a sphere around your point. Knowing the distance to 2 satellites gives you two spheres - and where they overlap describes a circle. Adding a 3rd reference point will identify 2 points on that circle, and the 4th reference point will define your specific location.

You need a minimum of 4 satellites above the horizon in order to define your specific location.

How do we calculate our distance from 4 satellites?

We use the velocity of radio signals sent out from the satellites.

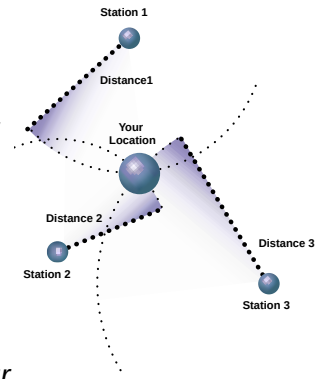
a) Radio waves travel at the speed of light (300 000 km/sec; 186 000 miles/sec)

b) We measure the time it takes (t) for these waves to move from the satellite to the GPS receiver.

Therefore, the distance to the satellite is
t (seconds) x 300 000 km/second = distance (km)

Clocks that measure to the nanosecond are required because timing accuracy is an issue. An error of 1/100 second will give a distance error of 3 000 kilometers!

Figure 1. *Identifying a precise location in 2-dimensions.*



Career Path - Engineering Professor

Name
Trever Crowe
Employer
Department of Agricultural and Bioresource Engineering, University of Saskatchewan
Previous Positions
Graduate Student
Skills that are essential for the job include
Communication (verbal and written), Problem Solving, People Skills (being able to work with students and colleagues as a team), Time Management, Technical Analytical Capability.
Related Careers
Research and extension personnel in Government, Research Scientist, Instructor at Community College
Starting Salary
Assistant Professor - ~$55 000
Salary after 5 years
~$65 000
Education
Ph.D. in Agricultural and Biological Engineering from University of California at Davis

Applying Technology to Crop Production

From a presentation by Aaron Baldwin, Cargill

The types and uses for technology in agriculture are broad, extending from using personal computers to assist in information gathering and organization to sophisticated satellite technologies that are used in the field.

Application of Technology

Digital photography is being used to take aerial photos of farmland to aid in crop management. The larval stages of some insect pests can be detected by this technology. Images can be used for planning fertilizer applications, and soil moisture can be estimated digitally by analyzing colours in the photos.

Computer models can be created by combining agronomic data and weather information. These computer models can then be used to make forecasts and help producers in planning their crops and crop treatments.

Geographic Information Systems, or satellite imaging can be used to create a map of an area. In conjunction with soil tests, the land's history, a salinity map, and current crop information, satellite imaging can be used to construct a map that integrates all of this information. The information can then be used to help make decisions about which crops to plant, and how to manage them (i.e fertilizer rates, pesticides, etc.).

Consumer-Driven Research

Ultimately, the needs and desires of the consumers dictate the kinds of research and processing that companies use. For example: after surveying customers, a seed-oil company requests a certain type of canola from the grain company. The canola must meet certain requirements that can impact what kind of seed is used and how the crop is managed and harvested.

The canola may need to have a certain trait, such as high linoleic acid content, or give oil that is good for frying potato chips. If this seed does not exist, plant breeders may have to work on developing such a seed.

The producer may need to manage and harvest the crop in a particular way. He or she must consider what kinds of fertilizers and pesticides can be used and how efficiently, as the consumers may demand organic products with no synthetic fertilizers or pesticides. Precision equipment and GPS technology can help assess and manage the crop's growth, and give information on crop moisture and oil content at the time of harvest. Accurate weather information can help a grower determine when it is best to harvest in order to get the maximum quality from the seed.

Grain Handling

From a presentation by Kevin Ewart, Cargill

There are a number of key stakeholders in the grain handling system in Western Canada. Each represents a different aspect of the agricultural process from field to plate.

Producers

There are currently 97 000 producers in Western Canada.The principal crops in Saskatchewan include wheat, barley, oats, durum, flax, canola, peas, and lentils. Canada exports approximately 70% of its production. This is high in comparison to other countries such as the United States that exports approximately 10% of its grain production.

Technology is having a great impact on grain producers. Innovations such as direct seeding equipment, improved production systems, expanded information systems for marketing and record-keeping, and advancements in agronomic information on conditions and crops help increase producers' efficiency.

The Farm Centre

Agronomists serve producers by delivering agronomic information and market details (risk management, planting plans, cash flow needs, transportation of grain, and disease identification). They use laptop computers to access market details remotely. Large elevators with more efficient grain transportation and cleaning systems are being constructed. Consumer convenience is an important consideration. For instance: producers will have the ability to unload an entire truck of grain without moving the truck, and automated platform scales weigh grain.

Grain Companies

Grain companies operate primary elevators and export terminals. They purchase grain and act as agents for the Canadian Wheat Board. Grain companies also purchase other grain (e.g., canola, oats) to be shipped around the world. These companies also handle, store, and clean grain for export and ship railcars to port areas in Canada.

Additionally, grain companies help producers in making grain marketing decisions, and sell grain and other agricultural inputs to growers.

Technological advancements have led to the closure of many of the grain companies' smaller elevators and the development of larger and more efficient, but fewer, inland terminals.

Transportation

Grain is transported in Western Canada through an existing infrastructure of railways, and highways to port where it is transported abroad by ship.

Consumers

Industry is moving toward value-added products. This has led to an increase in oilseed processing, malt production, specialty crop processing (e.g. pea, lentil, chickpea), ethanol and livestock production.

Career Path - Farm Service Group Manager

Name
Kevin Ewart
Employer
Cargill Limited
Previous Positions
Sector Crop Inputs Manager, Facility Manager Crop Inputs Manager
Skills required for job
Strong interpersonal and communications skills, computer skills, time management skills, financial management skills, ability to lead people in a rapidly changing business environment, flexibility.
Education
B.Comm.

Livestock Production Technologies

From a presentation by John McKinnon, Beef Chair, University of Saskatchewan

Managed Livestock Systems vs. Open Market Systems

Canada's poultry and dairy industries are supply-managed. Farmers are given a quota for poultry products (meat, eggs) or for milk in the dairy industry. Excess production is not rewarded. In contrast, Canada's beef and pork industries operate in an open market system. Supply is dependent on demand within Canada and worldwide. Prices fluctuate in response to the relationship between supply and demand. Table 1 compares annual farm receipts in these industries for Canada and Saskatchewan.

In Saskatchewan, the open-market beef and pork industries generate more straight cash receipts and comprise higher percentages of the Canadian industry than those in the supply-managed industries.

Technological Advances in the Beef Industry

Challenge #1
Stop the loss in market share.

Beef lost market share because…..

- the fat content was high. The reaction by the beef industry was to change the beef grading system to compare muscle, fat, and bone. The grades ranged from A1 to A4. The industry had moved from a 2-step system (with the designations "red" or "blue") to this 4-step system.

- of inconsistent market quality. The reaction by the beef industry was to examine fat distribution throughout the muscle (marbling). The creation of a replacement grading system based on yield and marbling followed. The grades consisted of A (traces of marbling), AA (slight marbling), AAA (small marbling), and Prime (most

Table 1. *Comparison of Production Rates in Different Livestock Operations. Annual Farm Cash Receipts (2000).*

	Canada	Saskatchewan	% of Canada
Poultry	$ 1.3 Billion	$ 86.9 Million	6.7%
Dairy	$ 4.0 Billion	$ 110 Million	2.8%
Beef	$ 6.6 Billion	$ 1 Billion	15%
Pork	$ 2.2 Billion	$ 215 Million	9.8%

marbling). Meat was also given a yield grade of Canada 1 (leanest), Canada 2 (mid-grade lean), and Canada 3 (low-grade lean).

- consumer perception of food safety was poor. Potential concerns were in the areas of E. coli contamination of meat, the environment (e.g. Walkerton), antibiotic and drug use, transmissible disease (e.g. Mad Cow Disease), and animal management concerns.

Challenge #2

Restore beef as the red meat of choice by ensuring consumer confidence in quality and safety of beef products.

This challenge is being met by the Canadian Beef Industry through many technological advancements.

- Canada's "Computer Vision System in Grading Cattle" has been developed. In the past, cattle grading systems have consisted of human inspectors briefly examining carcasses. This is subject to human error and is subjective. The Computer Vision System is one of the most advanced systems in the world, consisting of 2 cameras - a rib eye camera, and a whole carcass camera. The rib eye camera assesses amounts of marbling, quality grade, fat composition, area, colour, and tenderness. The whole carcass camera takes 232 measurements that are used to assess the saleable yield and grade.

- Body composition of live animals can now be assessed through the use of ultra-sound. A computer is attached to a probe that is run over the surface of the cow. On the probe is a series of crystals that generate an ultrasound wave. The computer interprets the wave and an image of the animal muscle, fat, and bone is produced.

- A test for obesity genes has been developed. Scientists are attempting to use selective breeding within the cattle population to decrease the percentage of fat in meat. The research is focusing on the hormone leptin which affects fat deposition and appetite. Research indicates that the obese gene inhibits the production of leptin.

- The National Identification Program involves mandatory ear bar-code tagging of cattle (effective July 1, 2002). The purpose of the program is to ensure food safety, disease control, quality assurance, and to maintain export markets through consumer confidence.

- The Information Management System (IMS) involves the use of electronic identification to act as a data history from birth to slaughter for each cow. The IMS allows the producer to closely monitor his/her inputs to produce the best quality cattle. The processor can use the IMS to inform the consumer of the quality and the history of the meat. Feedback from the consumer can allow the processor to inform the producer of improvements to be made. Still to be resolved is the issue of who owns the information.

- Branded Beef Programs are niche markets for beef that meet certain program specifications. These brands include Certified Angus Beef, Sterling Silver Premium Beef, Ontario Certified Beef, and Chairman's Reserve Certified Beef. Consumers believe branded beef is superior to unbranded, or generic, beef.

Livestock Processing

Did You Know…

- that Kodak buys some of the bone pieces that come from the fabrication floor to use in the production of camera film?
- that at the Cargill plant, 113 500 kg (250 000 lbs) of hamburger is produced per day?
- that tallow is animal fat and is used in products such as lipstick?

From a presentation by Will Lowe, Cargill

Cargill's only Canadian meat packing plant is found in High River, Alberta. There are two other large packing plants in Western Canada in Brooks, AB (run by IBP) and Calgary (run by XL foods). Cargill's plant handles approximately 1 million head of cattle per year. Meat at the plant is graded by independent graders that check and rate the cattle. The graders are paid by the cattle feedlot owners.

There are 9 major departments in a modern packing plant.

1. Procurement - Most Canadian cattle are born between January and May and are sold in the fall as calves to feedlots (when they are between 225-315 kg (500-700 pounds). Calves that are born in the fall are placed in a feedlot when they are between 270-360 kg (600-800 pounds). Yearling cattle are grassed over the summer. Spring calves will spend approximately 220 days at the feedlot, fall/winter calves will spend 180-220 days on feed, and yearling cattle will spend 100-160 days on feed.

2. Yards & Cattle Receiving - Cattle arrive on trucks and are inspected, weighed and penned. As cattle get closer to the age of slaughter (12-14 months), the producer will notify the area cattle buyers and the cattle are put up for sale to the highest bidder at auction. The formula for the live price sales are determined by the price/pound of the live animal: gross live weight x negotiated pencil shrink = net live weight; net live weight x agreed upon price/pound = price for the animal.

   Cattle prices for these formulae are based on price averages of cattle bought by the plant over a certain time period. Contract cattle prices are based on future markets months in advance of their actual slaughter dates.

3. Kill Floor - A long spiral alley ends at a knocking box where the cattle are humanely stunned with a bolt-action air gun. The Kill Floor consists of 2 main processes:

   a) Skinning - once an animal has been stunned and bled, the carcass moves along an overhead chain and rail. Positioned along the line are approximately 100 workers, many machines and automated devices. At Cargill, approximately 260 head are stunned per hour.

   b) Evisceration (gutting and organ collection) - The Canadian Food Inspection Agency (CFIA) is involved at this point and concentrate on examining internal organs: heart, lung, liver, kidneys, and lymph nodes. Organs are collected, washed, placed in dry ice, and packaged for export. The carcass is then sawed into 2 equal halves. Each side is weighed, tagged, and given a carcass ID and production stamp. Producers are then paid according to the weight of the animal at this point.

4. Cooler (also known as the "Hot Box") - Carcasses are steam pasteurized in a cabinet and washed. The cabinet closes and kills any surface biological pathogens. The carcass is then washed with cool water. After 30-40 hours, the carcass is removed from the cooler, and the rib section is sawed exposing the rib eye muscle. Canadian Grading Agency (CGA) employees determine the quality and yield grade of each carcass. The carcass is then graded as Prime, AAA, AA and A. A Computer Vision System (CVS) is used to complement third party grading systems through the use of a high-tech computer program and cameras. This is used by the packing plant to select product for particular customers. The CVS may one day replace the more subjective human grading system. After the carcasses are graded, stamped, and rolled, they are sorted onto rails in the sales cooler where they wait to be moved to the next step.

5. Fabrication Floor - Initial cuts are made to break the carcass into workable pieces and cuts. There are seven separate tables on the floor, each responsible for different cuts. Bones are chopped up and shipped to different buyers. Pieces move to the end of conveyors into cryovac machines that vacuum pack the product into air-tight plastic bags. The packages are sent to be boxed and warehoused. The fabrication step is like a disassembly line involving approximately 600 workers on the floor at any one time!

6. Pack-Off and Shipping - After fabrication, product is boxed and shipped. Most production done during the day is only in the plant for short periods of time. Boxes leave the plant and are stored in central distribution storage facilities for further shipment. Product requiring more aging, such as the Sterling Silver or Angus Beef, needs to be aged 21-28 days before being cooled to ensure tenderness and taste. Bar-coding labels allow Cargill to maintain a 99% order consistency.

7. Trim & Grind - All of the trimmings are sorted, and put into combo bins. These trimmings are sent to be made into hamburger. This area of the plant is very highly monitored to prevent E. coli contamination or other pathogens from infecting the meat. Once the ground meat passes through metal detectors, it is packaged into 10 and 20 lb. "chubs". It is then fast-frozen in a spiral refrigerator.

8. Rendering - Both edible and inedible portions of the animal are sent to be rendered. The rendering section is the most automated part of the plant. Between ¼ to ⅓ of the animal is processed in this area. Products produced include: protein meals, blood meal, tallow and gel bone.

9. Sales & Marketing - At the Cargill plant, meat is labeled as Sterling Silver, Certified Angus Beef, and Northridge Farms. Cargill is involved in both retail and food service sales. Fifty percent of the processed beef is sold to the US, 25% is sold domestically, 15% is shipped off-shore to Japan and Korea, and 10% is sold to Mexico. One of the issues being addressed primarily in the US is "Country of Origin" labeling, because of the hesitantcy to buy foreign beef due to food safety and terrorist threats.

Emerging Technologies in Agriculture

From a presentation by Ron Kehrig, Saskatchewan Agriculture, Food, and Rural Revitalization

Agriculture is now, more than ever, an intensive knowledge-based industry. Agriculture and technology are converging in the following ways:

1. Information technology (computers, sensors, electronics)
2. Health, medicine, pharmaceuticals
3. Energy (fuels, lubricants)
4. Environmental technologies
5. Material sciences (biomaterials)
6. Genetics, biology, biotechnology

We are currently shifting to the "biological age" by using our knowledge of plants, animals, and natural biological systems to influence agriculture.

Traditionally, we looked at crops as only being useful in narrow ways (for instance, using wheat to make flour). Now we are using technology to expand the ways we use traditional Saskatchewan crops such as wheat, canola, peas, and flax.

- wheat is used to produce ethanol at Pound Maker (see Field Trips section),
- wheat gluten can become a base in cosmetic powders and creams,
- wheat germ protein is used in shampoos and emollients,
- amino acids from wheat are currently being sold under the tradename Hydrotriticum,
- lignin, a component of flax seed, is being researched to benefit diabetics,
- research shows an extract of bearberry leaves can prevent oxidation in meat products as well as (or better than) existing alternatives,
- yellow peas can be used to produce a number of products, including pea flour, proteins, starches, and fibre.
- a bovine colostrum product that aids in the health of young calves is being produced by a Saskatchewan company,
- high-protein canola meal for use in livestock diets has been developed,
- high Omega-3 fatty acid eggs are produced by feeding chickens a diet high in flax,
- oilseeds, pulse crops (like peas and lentils), and cereals (such as wild rice) are processed so that cooking time is reduced,
- canola can be used to make a biodiesel or diesel fuel additive that when added at 0.1% of fuel improves lubrication, reducing engine wear and improving fuel economy,
- straw is used to manufacture particle board,
- starch-based biodegradable plastics and other materials that can replace hydrocarbon-based plastics,
- flax can be used to make food oil, fibre, Nutraceuticals, and feed.

We are also using technology to improve the processes of plant and animal agriculture.

- using sensors in the livestock industry allows better control of heating and ventilation in barns, and individual control of animal feeding schedules

- GPS technology is used to map fields, monitor yields, and as a result, allows customization of production processes.
- by using a bioactive membrane on a soil sampling probe, a University of Saskatchewan researcher has mimicked the way a plant root adsorbs nutrients. This allows a better understanding of soil nutrient characteristics.
- improved information technology and quality assurance procedures allows specific product tracking from farm to retail outlet. This has resulted in better food safety, and improved inventory control
- animal vaccines and delivery systems have been improved through technology. A wider variety of vaccines can be delivered through "needle-free" systems.
- bioremediation is the use of organisms to "clean up" the environment. When plants are grown in contaminated areas, the process is called "Phytoremediation". Microbes are also used to remediate contaminated soil.
- adding microorganisms to seeds or soil can improve plant health. Fungi such as mycorhizzae and *Penicillium bilaii* can help plants uptake phosphates. *Rhizobium* species (bacteria) form nodules on the roots of legume plants (peas, lentils, etc.) and fix nitrogen from the air.
- biological controls of pests can include using bacteria or bacterial toxins to kill insects (Bt, or *Bacillus thuringiensis*), fungi to kill weeds (*Colletotrichum gloeosporiodes*), and insects to kill weeds (black dot spurge beetle, *Aphthona nigriscutis*; black weevil, *Omphalapion hookeri*)
- Integrated Pest Management (IPM) integrates the use of cultural, biological, and chemical methods to suppress insects, weeds, and plant diseases. IPM strives to be environmentally and economically responsible.
- Traditional breeding, or genetic modification of crops can make them resistant to herbicides or pests. For instance, there are varieties of wheat that are resistant to insects such as sawfly and midges. Canola varieties exist that are resistant to glyphosate or Roundup™.

Check out these Companies

- Bioriginal Foods (www.bioriginal.com)
- Fytokem Products (www.fytokem.com)
- Philom Bios Inc. (www.philombios.ca)
- MicroBio Group (www.microbiogroup.com)
- Phenix Biocomposites (www.phenixbiocomposites.com)
- Biolin (www.innovationplace.com/html/tenantpages/biolin)
- PoundMaker AgVentures (www.agrivision.sk.ca/roadmap/industries/cattle/casestudy/casestudy_printer.html)
- Milligan BioTech Inc. (www.statpub.com/stat/open/2001/9595.html)
- Parkland Strawboard Inc. (www.panelsource.net/panel/parkland.html)
- Western Ag Inc. (www.westernag.ca)
- Phenomenome Discoveries Inc. (www.phenomenome.com)
- Veterinary Infectious Disease Organization (VIDO)(www.vido.org)

Did You Know…

- that the cosmetics and toiletries industry is a $60 billion market world-wide?
- that humans can not manufacture Omega-3 fatty acids, and must get their daily requirement from food?
- that an idea from a grade 7 science project led to the formation of a company Phenix Biocomposites?
- that flax has been used traditionally to make paint, linoleum, and linen?

A Saskatchewan Case Study: Ethanol Production

Information from: Fueling a new economy: Exploring the opportunities of Ethanol Production.

As agricultural, environmental, and information technologies converge there are more examples of agricultural ventures using a variety of technologies to become efficient in more than one sector. In Saskatchewan, this is driven by a need to add value to commodity crops.

At Pound-Maker Ag ventures in Lanigan, an ethanol production plant was added to an existing feedlot that had originally been built as a way to add value to grain grown by area farmers.

The decision to build this type of integrated enterprise requires an assessment of available technologies, environmental impacts and financial feasibility. There are risks and benefits in both building such a facility, and deciding not to build such a facility.

What is Ethanol?

Ethanol is a 2-carbon alcohol that is a by-product of microbial fermentation. Ethanol can be produced from any food source that contains sugars, or starches and celluloses that can be converted to sugars.

Milling - the grain is ground to a fine powder called "meal."

Mashing - Meal is mixed with water and enzymes in a cooker. The heat breaks down starches to sugar.

Fermentation - Yeast is added to the mash in the fermenter. The yeast uses sugar and produces ethanol as a by product. Carbon dioxide, another product of fermentation, is collected and can be used in the flash-freezing of foods and in carbonated drinks.

Distillation - The "beer" is about 10% ethanol. Other components include non-fermentable solids, and spent yeast cells. The distilled ethanol is about 96% pure. The residue, called "stillage", is removed from the fermentor and can be used as cattle feed.

Dehydration - Any remaining water is removed from the ethanol, making it 100% pure (also called "anhydrous alcohol").

Cellulose is more difficult to break down than starch, but can be used in the commercial production of ethanol. Cellulose is found in straw, wood chips, and other solid waste. A process called "acid hydrolysis" is used to break down cellulose into more usable starch and sugar forms.

Economic Impacts

The non-fermentable components of the fermentation process can be used to feed livestock. In addition to being an efficient use of a renewable resource, coupling the ethanol and livestock operations can have economic benefits to Saskatchewan through job creation.

Environmental Impacts

Ethanol is efficient as a fuel because it contains oxygen. When burned, ethanol is less polluting than other fuels. Because ethanol is made from plants, it is considered a renewable fuel. However, there are also concerns about the environmental impacts of livestock and ethanol plants, including the draw on water resources and the effects of intensive industry on groundwater. There is also disagreement about how efficient ethanol production plants are with respect to carbon dioxide balances.

Case Study Questions & Considerations

1. What are the technological processes involved in running a self-sufficient feedlot?

2. What are the technological processes involved in running an ethanol plant?

   For questions 1&2: What are the required inputs, and what are the by-products of commercial production? What impact is there on the environment?

3. How do the technological processes involved in feedlots and ethanol production merge together? What inputs and by-products are shared? Which inputs are required or produced by only one of the processes? How does linking the feedlot and ethanol plant affect the environment?

4. Research the economics of running a feedlot, an ethanol plant, and both together. How do you balance financial and environmental concerns?

5. How many people are employed by a feedlot? How many by an ethanol plant? How many when both are run together? List the types of jobs that are necessary to directly and indirectly support the integrated operations.

Is an integrated livestock and ethanol production facility feasible? Which of the technological, environmental, and financial aspects were more important.

If you support an integrated livestock and ethanol production facility, why? Were there any aspects or concerns you would have with this facility or would like to change?

If you do not support this type of facility, why not? Are there changes that could be made that would make you reconsider your decision?

What other types of integrated agricultural ventures would you suggest?

Field Trips

Pound-Maker AgVentures Ltd.

Pound-Maker is a 4 500 head feedlot, constructed in 1970 by a group of local farmers who needed another market for their grain. In 1991, a 10 million litre ethanol plant was added to the venture. Pound-Maker employs approximately 50 people.

The tour begins with a slide-show outlining the history of Pound-Maker, followed by a tour of the ethanol facility and feedlot. The tour is suitable for groups of up to 30 people, and would be most suitable for grades 8-12.

Curriculum connections can be made in the areas of Chemistry, Biology, Agriculture, and Career Planning.

Contact Pound-Maker in Lanigan at 306.365.4281.

Cargill Inland Terminal & Canola Crushing Plant

The Cargill Inland Terminal opened in August 2001. It serves a large sector of central Saskatchewan as both a distribution center for crop input products (fertilizers) and a grain handling facility.

A variety of fertilizer types (N, P, K, and S) are available in both granular and liquid form. These arrive by rail or semi-trailer and are stored at the terminal site; granular fertilizers within a hollow-core concrete and wood structure; liquid fertilizers in large tanks. The site also boasts the largest overhead granular fertilizer tower in Western Canada. It hold 500 metric tonnes (MT) of fertilizer that can be custom blended to specific proportions using a computerized automated system.

The site houses a complete range of cereal grain seeds in six hopper bins for a total capacity of 540 MT. The grain terminal can store 20 833 MT within eight large concrete silos. It is serviced by four rail tracks and has the capacity to load ten cars/hour. The grain handling facility uses state-of-the-art equipment to test moisture and protein levels in grain. Through consultation with producers and truckers, the facility was designed to be efficient and user-friendly.

Contact Kevin Ewart in Clavet at 306.668.5252.

Dairy Barns, University of Saskatchewan

The Stone Barn is a unique campus landmark built in 1917. Although no longer used for research, it houses replacement animals for the dairy research unit. For excitement you will be able to see Betty and Wilma, two cows each with a hole (fistula) in their sides that help researchers with their analysis of the digestive process in cattle.

You will be able to observe the milking process in the dairy barn, and learn about research programs that include: artificial insemination for dairy cattle, development of milk replacers for the dairy industry, development of crops for use as alternative protein sources, identification and prevention of trace mineral deficiencies in dairy cattle, and by-product feeding systems using Saskatchewan feeds.

Contact Lynne DeMare in Saskatoon at 306.966.4155

Agriculture Building, University of Saskatchewan

www.ag.usask.ca/exhibits/walkway/index.html

The displays chronicle the evolution and components of agriculture along the Pedestrian Walkway in C, D and E wings in the Agriculture Building. There are 4 displays - "What is…hunger, food, hunting and gathering, agriculture, plant domestication, and animal domestication", "The Story of…wheat, canola, milk, food processing, and meat", "The Great Plains (prairie portrait, history of agriculture, prairie climate, plant adaptations, evolution, and adapting to Saskatchewan)", and "Prairie Farms (agriculture and the environment, farm types, crop production, and animal production)." Educational activity kits are also available.

Contact
Colleen Romuld in Saskatoon at 306.966.4065

Activities

Agriculture - Our History, Our Future

Research your own family tree to find out when and why you or your ancestors came to Saskatchewan. As a class, discuss the different stories. How does agriculture play a role in the reasons for immigration and the culture of your family?

Subject	Level
Social Studies	All Levels

Research diversification on Saskatchewan farms undertaken by farmers in the last 15 years. Research new commodities not grown in Saskatchewan 15 years ago.

Subject	Level
Social Studies	Secondary
Science	Secondary

Design an immigration poster that would attract people to the rural areas. Promote the community's strengths.

Subject	Level
History	Middle & Secondary
Arts Education	All Levels
Media Studies	Secondary
English Language Arts	Middle & Secondary

Convince someone to move to Saskatchewan using persuasive writing.

Subject	Level
English Language Arts	Middle & Secondary

Predict the future of Saskatchewan industry.

Subject	Level
English Language Arts	Middle & Secondary

In the May/June 2002 Edition of "The Visionary", Red Williams defines the "New Pioneer" -

> The new wave of pioneers are turning to value-adding to their commodity products in order to meet the demands of the market and to increase their returns per acre. This takes courage, ingenuity and involves risk, just as was the case for the pioneers of other eras. Compare the "New Pioneer" with the traditional Saskatchewan pioneer image.

Subject	Level
English Language Arts	Middle & Secondary
Social Studies	Middle & Secondary

Compare and contrast Saskatchewan's commodity export market vs. its value-added market.

Subject	Level
Social Studies	Secondary
Agriculture	Secondary
Entrepreneurship	Secondary

Investigate prairie authors that focus on the agriculture industry (i.e. Sinclair Ross, Arthur Slade, W.O. Mitchell, and other more recent non-fiction writers such as Al Scholz). As a group, discuss similarities and differences in the authors' visions of agriculture and community.

Subject	Level
English Language Arts	Secondary
History	Secondary

Design prairie elevators using milk cartons. The scenes painted on the cartons must represent trends or emotions of the agriculture industry.

Subject	Level
Art	Elementary & Middle
Social Studies	Elementary & Middle

Explore current value-added initiatives that are based in Aboriginal culture or communities. (Use "Don't Turn Out the Lights as a resource.)

Subject	Level
Social Studies	Secondary
Native Studies	Secondary
Agriculture	Secondary

Create a game called "Gate to Plate" using a specific commodity (i.e. wild rice).

Subject	Level
Agriculture	Secondary
Art	Middle & Secondary
Social Studies	Middle & Secondary
Math	Middle & Secondary
Entrepreneurship	Secondary

Crop Production Technologies

Students research careers in engineering (civil and mechanical) or technology that relate to agriculture.

Subject	Level
Agriculture	Secondary
Science	Middle & Secondary
Entrepreneurship	Secondary

Students generate examples of "open" and "closed" control systems and identify the different components of each.

Subject	Level
Science	Middle & Secondary
Agriculture	Secondary

Using resource materials (PFRA, etc.), students complete/create a chart of information about technologies in crop production to be shared with other classmates. This could be a jigsaw activity using past, current, and future technologies.

Subject	Level
Agriculture	Secondary
Social Studies	Middle & Secondary
History	Middle & Secondary

Create a science investigation or lab that would increase efficiency in seeding, pest control, harvest, etc. This could be done on a small scale (i.e. trays under grow lamps using different variables such as heat, light, moisture, fertilizer, etc.).

Subject	Level
Science	Middle & Secondary

Try orienteering using GPS technology. Look into GeoCaching – where a disposable camera, log book, and small souvenirs are hidden and must be found. Share the photos and log book with others in the school.

Subject	Level
Physics	Secondary
Physical Education/ Wellness	Middle & Secondary

Brainstorm opportunities for GPS applications

Subject	Level
Agriculture	Secondary
Entrepreneurship	Secondary
Geography	Middle & Secondary
Wildlife Management	Secondary

Grain Handling

Trace the evolution of grain and crop handling in the prairies over the past 100-150 years (i.e. from hand-threshed, milled, and used for our own consumption to mass produced, transported, stored, and shipped to a multitude of markets).

Subject	Level
Social Studies	Middle & Secondary

Report on one of the 8 principal crops, looking at growing stages, diseases, cost, and inputs required. Explore the opportunities for using this crop in a value-added product. Grow a sample of this crop, and taste a variety of products made from these grains.

Subject	Level
Science/Biology	Middle & Secondary
Food Studies	Middle & Secondary
Home Economics	Secondary

Research and prepare a graph using data such as the number of hours it takes to farm X acres compared over the years and how it has changed due to developments in technology and inputs, etc.

Subject	Level
Agriculture	Secondary

Investigate reasons for the change of top export customers over the past 10 years. Why have these changed? Who were/are they? Who are the lost customers buying from now and why?

Subject	Level
Social Studies	Secondary
Agriculture	Secondary

Brainstorm the impact of changing grain handling transportation on rural highways.

Subject	Level
Social Studies	Middle & Secondary
Science	Middle & Secondary

Job shadow an Agronomist and report back to the class.

Subject	Level
Career and Work Exploration	Secondary
Life Transitions	Secondary

Survey producers on the type of chemicals (fertilizers, pesticides) used and what factors influence the decision to use or not use these inputs.

Subject	Level
Agriculture	Secondary

Investigate the difference between agrologist, agronomist, crop advisor, crop consultant, etc.

Subject	Level
Career and Work Exploration	Secondary
Life Transitions	Secondary
Agriculture	Secondary
Science/Biology	Middle & Secondary

Technologies in Livestock Production

Compare and contrast the quota supply managed (poultry, dairy) and open market systems (pork, beef).

Subject	Level
Entrepreneurship	Secondary
Agriculture	Secondary
Social Studies	Secondary

Research the history of the livestock industries from production for our own use to large-scale production of one type of livestock.

Subject	Level
Agriculture	Secondary
Social Studies	Middle & Secondary
Food Studies	Middle & Secondary

Compare the input costs of various livestock commodities, i.e. poultry vs. hogs vs. beef. Compare the rate of growth vs. feed, etc.

Subject	Level
Agriculture	Secondary
Entrepreneurship	Secondary

Compare the standards used to grade livestock as they have changed over time.

Subject	Level
Agriculture	Secondary

Research differences in specifications of livestock (beef) exported to various countries (cultures) i.e. Japanese vs. Mexican vs. North American markets. Alternately, research regional differences in Canada. How do they relate to cultural differences?

Subject	Level
Food Studies	Secondary
Social Studies	Secondary
Agriculture	Secondary

Debate the different aspects of large-scale livestock production in terms of environmental and economic impacts on a region.

Subject	Level
Language Arts	Middle & Secondary
Social Studies	Middle & Secondary
Science	Middle & Secondary

Cook samples of beef from various beef grades and evaluate in terms of taste, tenderness, etc.

Subject	Level
Food Studies	Secondary

Analyze the genetic traits of various beef cattle in terms of lean:fat ratio, rate of growth, etc.

Subject	Level
Agriculture	Secondary

Research diseases that are inherent to various livestock species (for example in cattle: Mad Cow, Hoof & Mouth, etc.) and the widespread devastation these could cause to the industry if they were unchecked.

Subject	Level
Agriculture	Secondary
Biology	Secondary

Students can research the following for their applications and implications in Agriculture.

1. Ultrasound technology
2. Genetic testing for "obese gene"
3. Implants for growth hormones
4. Antibiotic use in livestock/humans

Subject	Level
Biology/Science	Middle & Secondary
Agriculture	Secondary

Brainstorm what makes an ideal product for the consumer (niche markets). Could you charge premiums for products that meet demands of the industry.

Subject	Level
Agriculture	Secondary
Food Studies	Secondary
Entrepreneurship	Secondary

Livestock Processing

Create a web of all of the uses for cattle and their by-products (e.g. cattle, beef, dairy, manure, fertilizer, by-products, bone, horn, buttons, gelatin, film, pet food, hooves, rendering, tallow, cosmetics).

Subject	Level
Science/Biology	Secondary
Agriculture	Secondary

Analyze a variety of cattle feed in terms of nutritional value (e.g. forage, cereals, pulses, oilseeds).

Subject	Level
Science/Biology	Secondary
Agriculture	Secondary

Discuss the likes and dislikes of beef consumers from a variety of cultures or geographical regions.

Subject	Level
Social Studies	Secondary
Food Studies	Secondary

Trace the path of leather from raw product (hide) to finished product and the processes and procedures involved.

Subject	Level
Clothing, Textiles & Fashion	Secondary
Agriculture	Secondary

Discuss factors that affect the cattle and beef market and create volatility.

Subject	Level
Social Studies	Secondary
Agriculture	Secondary
Math	Secondary

Research drug residues in cattle that are checked by vets (e.g. the 48 hour withdrawal period for monoglutimate, other antibiotics).

Subject	Level
Science/Biology	Secondary

Analyze biological pathogens which could be on a carcass and how the "Hot Box" treatment works to kill them.

Subject	Level
Science/Biology	Secondary

Trace the processing of a beef animal from the cow/calf operation to consumer (i.e. feedlot -> stock yard -> slaughter -> fabrication…etc.)

Subject	Level
Food Studies	Secondary
Agriculture	Secondary

Emerging Technologies in Agriculture

Interview, or have a panel discussion with, a variety of agricultural producers regarding changes they have integrated or used over their agricultural careers.

Subject	Level
Agriculture	Secondary
Social Studies	Middle & Secondary
English Language Arts	Middle & Secondary

Conduct a mapping activity using the convergence concept of agriculture and current technology.

Subject	Level
Biology	Secondary
Agriculture	Secondary
Social Studies	Secondary

Research the variety of end-uses for a common commodity such as wheat (e.g. cosmetics, soaps, food)

Subject	Level
Food Studies	Secondary
Science/Biology	Middle & Secondary
Agriculture	Secondary

Tour a facility such as Bioriginal Food and Science Corp.

Subject	Level
Food Studies	Secondary
Science/Biology	Middle & Secondary
Agriculture	Secondary

Investigate and report on current research on the pharmaceutical and biomedical uses of common crops such as flax, soybean, and borage.

Subject	Level
Health	Middle & Secondary
Science/Biology	Middle & Secondary
Horticulture	Secondary

Discuss functional foods (e.g. Omega-3 eggs) and the processes applied to food to make them more "consumer-ready" (e.g. pre-cooked lentil).

Subject	Level
Food Studies	Middle & Secondary
Agriculture	Secondary
Health	Middle & Secondary

Research biodiesel, including its production, applications, and benefits of use.

Subject	Level
Science/Biology/Chemistry	Secondary
Mechanics	Secondary

Investigate (or design an experiment about) the use of agricultural residues in production of pulp and paper, plastics, building materials, etc.

Subject	Level
Science	Middle & Secondary
Construction & Carpentry	Secondary
Housing	Secondary

Report on the variety of product tracing and testing methods employed to ensure a safe food supply.

Subject	Level
Food Studies	Secondary
Wellness	Secondary
Health	Secondary

Discuss vaccines and their delivery systems, including needle-free systems.

Subject	Level
Health	Middle & Secondary
Wellness	Middle & Secondary
Science/Biology	Middle & Secondary
Agriculture	Secondary

Research and discuss components in common foods that are being linked to health benefits such as disease prevention (e.g. sulfoaphane in broccoli in preventing cancer).

Subject	Level
Health	Middle & Secondary
Wellness	Middle & Secondary
Science/Biology	Middle & Secondary

Research biological controls and integrated pest management. (Use Innovators in the Schools to have Saskatchewan researchers visit your class.)

Subject	Level
Science/Biology	Secondary
Agriculture	Secondary

Discuss the risks and benefits of herbicide and pesticide resistant crops to producers and consumers.

Subject	Level
Science/Biology	Secondary
Agriculture	Secondary

Experiment with soil testing probes (contact Western Ag Labs) vs. traditional soil sampling techniques.

Subject	Level
Science/Biology	Secondary
Agriculture	Secondary

Field Trips

Research the effects of various fertilizers and minerals on different Saskatchewan crop species. Which nutrients develops roots, stems, etc.?

Subject	Level
Science/Biology/Chemistry	Secondary
Agriculture	Secondary

Investigate the evolution of grain handling, transportation, and storage on the prairies (i.e. sacks -> granaries -> elevators…).

Subject	Level
Social Studies	Secondary
Agriculture	Secondary

Discuss safety issues (environmental, food safety, etc.) pertaining to the use of fertilizers.

Subject	Level
Health	Secondary
Wellness	Secondary
Agriculture	Secondary

Debate or discuss the effect that replacing grain terminals with elevators may have on prairie economy, roadways, etc.

Subject	Level
English Language Arts	Middle & Secondary
Social Studies	Middle & Secondary
Agriculture	Secondary

Research the instruments used to test grain moisture and protein, and then report on how they work. Compare these instruments to tools previously used.

Subject	Level
Agriculture	Secondary
History	Secondary
Industrial Arts	Secondary

Survey producers to investigate their choice of fertilizer and what factors are used in their decisions.

Subject	Level
English Language Arts	Secondary
Science	Secondary
Agriculture	Secondary

Study the construction of a concrete terminal (slip construction).

Subject	Level
Construction & Carpentry	Secondary
Housing	Secondary

Glossary of Terms

Agrologist - In Saskatchewan, an agrologist is a professional in agriculture who belongs to the Saskatchewan Institute of Agrology. As professionals, Agrologists must adhere to a code of ethics or have their professional status revoked.

Agronomic Data - Information about crops.

Agronomist - An agronomist can be any person who is involved in the practice of agriculture. See also, Agrologist.

Animal By-Products - Non-meat parts of a slaughtered animal that are considered allowable for consumption. By-products include blood, blood plasma, liver, and tripe.

Animal Husbandry - Producers are morally and legally obligated to provide for the basic needs of animals under their care. The management of animals and their welfare is animal husbandry.

Commodity - An agricultural product that is sold in large quantities in an unprocessed form. Wheat shipped and sold by the railcar is a commodity.

Global Positioning System (GPS) - This is a system of 24 satellites that orbit the Earth, allowing a person on the ground with a receiver to know their exact geographical location.

Niche Market - A small, specialized market that requires a product or service different from the mainstream. Because niche markets are small, competitors may overlook them. Developments in technology make catering to niche markets easier than in the past. Examples include organic food, and specialty herbs and spices.

Precision Agriculture - the use of technology in agriculture to automate processes so as to improve efficiency - not necessarily increasing production.

Quota - The volume of a product that a producer is entitled to produce during a specified amount of time.

Supply Management - A marketing system where production of a particular commodity is controlled. This ensures domestic demand is met and ensures stable prices for consumers.

Value-added - Products that are "value-added" are produced from a raw commodity usually by processing. The final product is worth more money than the raw material plus the cost of processing.

References

Government of Canada. 2002. Fueling a new economy: Exploring the opportunities of Ethanol Production. Regina: Keewatin Publications.

Williams, C.M. (Red). (May/June 2002). The New Wave of Pioneers. In: The Visionary Newsletter (on-line). Retrieved July 3, 2002 from the World Wide Web www.agrivision.sk.ca/Newletters/nlmayjun-02-1.html

Resources

Printed Material

Karpan, Robin and Arlene Karpan. 2002. Western Canadian Farm Trivia Challenge. Saskatoon: Parkland Publishing.

Scholz, Al. 2001. Don't Turn Out the Lights - Success Stories of Saskatchewan Farmers. Saskatoon: University Extension Press, University of Saskatchewan.

Web Sites

Agriculture and Agri-Food Canada
www.agr.gc.ca
News and information on the many areas of agriculture in Canada.

Agrometeorological Centre for Excellence
www.aceweather.ca
This site has information about weather as it pertains to agriculture. There are a number of links to other related sites.

***Bacillus thuringiensis* - the Natural Insecticide**
www.ag.usask.ca/cofa/departments/hort/hortinfo/pests/bt.html
An article from the Horticulture Department at the U of S about the use of the bacterium Bacillus thuringiensis as an insecticide.

The Biological Control of Weeds
www.agric.gov.ab.ca/agdex/600/641-1.pdf
This publication from Alberta Agriculture, Food, and Rural Revitalization summarizes research into the biological control of weeds using insects and fungi.

Canadian Beef Grading Agency
www.telusplanet.net/public/cbga
The Canadian Beef Grading Agency is a non-profit corporation accredited by the Canadian Food Inspection Agency to deliver grading services for beef in Canada. This site provides information about the grading process.

Canadian Egg Marketing Agency
www.canadaegg.ca
Straight from the Egg's Mouth: This is where you will find an eggs-traordinary supply of information on eggs. They have egg recipes, nutritional and educational resources, egg facts, egg crafts and a playground for children (little and grown-up), egg data and other egg-related site links.

Canadian Renewable Fuels Association
www.greenfuels.org/ethindex.html
This page has links about Ethanol fuel. The main site also includes information about biodeisel.

Canola-based Diesel Additive on Market
www.statpub.com/stat/open/2001/9595.html
This page has information about Milligan BioTech Inc.'s BioDiesel gasoline additive.

Growth Stage Advanced Cropping Solutions
www.growthstage.com
This is a website for a commercial company that uses advanced technologies to predict crop development and weed emergence rates. This information is used to counsel farmers to make efficient management decisions.

Natural Resources Canada
www.NRCan-RNCan.gc.ca:80/inter/index_e.html
The NRCan site has links to resource information as well as an on-line quiz and activity section.

Saskatchewan Agriculture, Food, and Rural Revitalization
www.agr.gov.sk.ca
News and information on the many areas of agriculture in Saskatchewan.

Saskatchewan Agrivision Corporation
www.agrivision.sk.ca
The aim of the Saskatchewan Agrivision Corporation Inc. (SAC Inc.) is to encourage and foster the rapid development of Saskatchewan's agribusiness sector. Highlights of the site include the "Roadmap to the Development of Value-Added Enterprises," "The Visionary" newsletter, and an "Agriculture Opportunity Map." Fact sheets on bio-products, food, herbs and spices, and organic agriculture are also available.

University of Saskatchewan Agriculture
University of Saskatchewan News
www.usask.ca/research/news/995512834.shtml
"Flaxseed May Help Reduce Diabetes, U of S Study Finds". One of the uses of Saskatchewan crops in medical research.

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