



# AGRICULTURE

## Worksheet 11

*A worksheet produced by the Native Access to Engineering Programme*



## What is agriculture?

According to the *Merriam Webster's Collegiate Dictionary*, agriculture is:

*The science, art, or practice of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation and marketing of the resulting products.*

In other words, agriculture is about the production of food – both animal and plant - from the land. It is closely related to other food production activities like aquaculture, and other plant production activities like forestry and horticulture.

### *What do we farm in Canada?*

Agricultural engineers combine knowledge from different fields of engineering (like mechanical, civil, or electrical engineering) with agricultural sciences such as botany and animal husbandry. This combined knowledge is used in the development of solutions to problems in the agriculture industry.



## Beginnings

*What is the difference between agriculture and other ways of obtaining nourishment, such as hunting, fishing and/or gathering?*

The Earth is a remarkable planet. It provides all life with the sustenance its needs in order to live: air, water and nutrients. We have survived and evolved through the generosity and bounty of the Earth. All over the planet early peoples accessed this bounty through hunting, fishing and the gathering of wild plants, berries and grains. Even in harsh environments like the Arctic or Australian deserts, people have found enough food to survive and thrive for thousands of years.



Hunting, fishing and gathering all involved going out and searching for food. Sometimes food was easier to find than others and, even when it was abundant, often entire communities would have to move throughout seasons of good weather in order to feed themselves. The food accumulated through hunting and gathering was wild. In agriculture it is not.

*What would be the advantages of farming over hunting and gathering?  
Can you think of any disadvantages?*

Archaeological evidence tells that that some time more than 12,000 years ago, in several, geographically diverse areas including the Americas, people began practicing early forms of agriculture: they began tilling soil, raising animals, planting seeds and harvesting plants in areas close to where they were living. These people began the process of domestication.



## Domestication

*What is domestication?*

Domestication is the managing of a species' evolution through breeding. It involves propagating desirable traits, and weaning out undesirable traits. While domestication began with species found in the wild, it eventually leads to the development of new species which exist only in domesticated form.

*Can you think of any domesticated species?  
Can you identify plants or animals your nation has domesticated?*

Corn was domesticated by people native to the Americas.



Dogs were domesticated from wolves and other wild canines.

Certain First Nations peoples still get a high percentage of their diet from wild sources including goose, moose, caribou, seal, fish and plants because of they have maintained or reclaimed traditional practices, but on a global scale this is unusual. At the beginning of the twenty-first century there is very little we eat which comes from truly wild species, and, indeed, there would be little hope of supporting 6 billion people without large scale domestication and agriculture.



## The case of corn

Corn is the only major grain cereal indigenous to the western hemisphere. It is a valuable food source.

*Can you think why corn is such a good food source?*

Each ear or cob contains hundreds of kernels, attached to a rigid fibrous mass and enclosed within a protective husk. They are easy to harvest, dry and store. There is archaeological evidence that domesticated corn existed in what is now central Mexico at least 7000 years ago. Pictures on pottery show baskets of full of ears substantially smaller than the ones we know today. Still, no one knows the exact origin of corn.

One theory says that corn arose from a now extinct ancestor which had a small cob. Another theory, and one for which there is growing evidence, suggests that corn is the result of cross breeding between two wild grasses, *Tripsacum dactyloides* also known as Eastern Gama Grass and *Zea diploperennis*. The *Zea diploperennis* looks very much like a corn plant and has a grain spike in which individual kernels line up in a single row. Eastern gama grass looks less like corn but sometimes produces paired kernels which researchers think may have led to the multi-kernelled corn cob.



Gama Grass may be one of corn's ancestors.

Domestication begins simply because people are observant. Whatever theory about corn is correct, it was the Native peoples in the Americas who noticed the new plants and their amazing food source. At some point they made the decision to select and grow the seeds from these plants, eventually leading to the more than 150 types of corn known today.

*Why would a multi-kernelled corn cob be important to ancient peoples?*



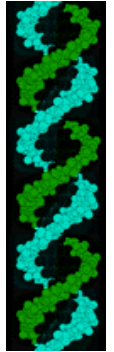
*What other traits do you think humans domesticated in plants and animals?*

# Big controversy

*When you deliberately select to plant certain seeds or breed two specific dogs, what are you doing?*

Selective breeding or domestication is actually a crude form of gene manipulation, one that humans have been practicing for thousands of years.

These days, farmers, scientists and agricultural engineers continue the long history of plant and animal manipulation under more controlled circumstances. In plants, their research leads to new strains which can survive in harsh weather, produce better food value, grow quicker or are more resistant to disease. These strains are often developed in the "old-fashioned" way through careful selective breeding of plants which show particular traits. Other times, researchers actually modify a plant's genes to produce the desired trait.



Source: [www.canolainfo.org/html/whatiscanola.html](http://www.canolainfo.org/html/whatiscanola.html)

Crops that have been genetically modified may be hardier, produce their pesticides, produce higher yields or more nourishing food. The question is, might they also damage the environment and our health?

*What would be different between selective breeding and genetic modification?  
What ethical questions arise from this type of research?*

Genetically modification food (GMF) is a highly controversial issue which is debated on an international level. While the arguments are complex, those who support it say that GMF is the only way we can continue to feed the world's growing population and those who are against GMF say we have no idea about the long-term, possibly harmful effects of genetic manipulation of our food.

*What are your views on the debate about genetically modified foods?*

## Old questions, new answers (or maybe old ones)

Agricultural engineers and scientists ask questions like

- What is the best crop to plant in a specific soil type?
- How can livestock be maintained in harsh climates?
- Are there more efficient ways to harvest crops?
- How can a plant be fertilized without chemicals?

*How old do you think these questions are?  
What questions might you ask about agriculture in your region?*

The questions are very old. People have been asking the same questions since the beginnings of agriculture. In answering them, people through time have developed different and evolving methods and tools to help provide more food for their families or communities; in other words, they have practiced agricultural engineering. And in fact, engineers are discovering that some traditional methods of farming work just as well as – and sometimes better than – newer methods.



# Intercropping: The Three Sisters

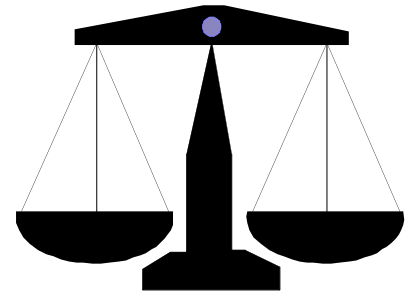
After originating in Mexico, domesticated corn spread both north and south through the Americas where it was a staple in the diet of many Aboriginal peoples. In the areas occupied by the Iroquois people - Iroquois, Mohawk, Oneida, Onondaga, Cayuga and Tuscarora – corn was grown in huge fields together with beans and squash.



*This grouping of corn, beans and squash is referred to by a specific name.  
Do you know what it is?*

The practice of growing more than one crop in a single field is called intercropping. Intercropping was and is used by native populations all over the world; the development of single crop acreage is a relatively recent western practice.

In a forested or wild area the flora - plant life - and fauna – animal life, are very diverse. Over a long period of time, each element in the system comes to live in co-operation and support of the others. In healthy communities their needs are complementary: plant may sink its roots deep into the Earth, while another finds nutrients closer to the surface; one may seek to sway with the wind, while another may prefer lying closer to the warm earth; yet another may attract insects that are the enemy of its neighbour. Balance is maintained.



*You may have heard the term biodiversity in the news.  
Do you know what this term means?*



Source: [www.attra.org/attra-pub/intercrop.html](http://www.attra.org/attra-pub/intercrop.html)

The three sisters were grown together in one mound. This picture illustrates strip intercropping of corn, soybeans and wheat.

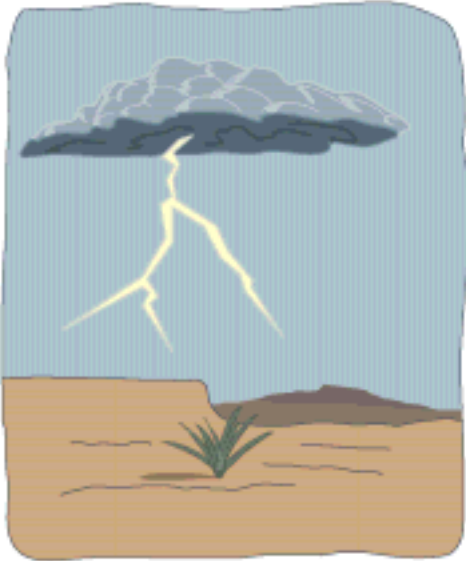
Corn, beans and squash – the Three Sisters – were intercropped by many different nations, and for good reason. When planted together the Three Sisters create a balanced system in which they sustain one another. The tall corn provides support for the delicate bean plant. It in turn provides valuable nitrogen to the soil, fertilizing the plants around it. Squash, planted at the base of the trio, shades the ground, controlling the growth of weeds which might otherwise compete with the other plants for nutrients.

Scientists are starting to realize the value and wisdom of intercropping. By more closely mimicking the natural world, intercropping lessens the chances that an entire season's produce will be lost due to weather, pests or disease.

## Other aspects of agriculture

Raising plants or animals on a farm requires a lot of work; there is much more to agriculture than we have room to write about on these few pages. Take a moment to think about raising food.

*What concerns would you have if you were a farmer?*



**Irrigation:** All life needs water to survive. Farming in soil is a notoriously water-intensive activity. In dry areas or areas in which rainfall is unpredictable, farmers must find ways to deliver water to their crops on a regular and consistent basis and so they irrigate. Irrigation can be as simple as carrying water to plants by bucket, but it can also be more complex.

In the Americas, Aboriginal people developed a number of methods for watering plants raised in arid areas. Some like the Anasazi, collected rain water in gated ditches. Although rain was infrequent, this method allowed them to store water and use it during very dry periods, simply by raising the gate and allowing the water to run out towards the plants. Others, like the Hopi, worked with the land, planting their crops at the mouth of an arroyo (a natural gully) so that any rain or melt water would naturally flow towards and water the crops. Still others, like the Hohokum, built long networks of irrigation ditches which diverted water from streams to their crop lands. These irrigation methods were very efficient and are still used in many places today.

**Fertilization:** Healthy soil contains many nutrients and minerals required by plants to grow. In cultivated fields the soil is worked very hard, many nutrients are removed and, because harvesting leaves little biomass, they may not be sufficiently replaced.

Aboriginal farmers in the Americas knew the value of allowing the land to return to its natural state. The rhythm of Iroquois village life actually moved in part with the needs of the soil. The Iroquois lived in longhouses made from narrow tree trunks and long branches found in the forests near their homes. These multi-family structures were very durable and lasted about 20 years. This was also about the same amount of time that nearby soil could be farmed before losing its nutrients, so Iroquois villages moved every 20 years or so.

These days farmers follow the wisdom of allowing fields to lie fallow after a few seasons of planting. They also use both natural and chemical fertilizers to reintroduce nutrients to the soil.



Chemical fertilizer is delivered to fields in a number of forms, including anhydrous ammonia.

Source: www.corbis.com

*What are some problems associated with chemical fertilizer's?*

Farmers also have to use special tools, have places to store the food they grow and provide shelter for the animals they raise. As you can see it is a very challenging job. Agricultural engineers and scientists work with farmers to try and make the growing and harvesting of agricultural produce easier and more efficient.

# Agriculture in Canada



The agriculture and the agri-food industry, which includes everyone involved in food production from the farmer who raises it to the waiters and waitresses who serve it in restaurants, is the third largest industry in Canada. Surprisingly, only 7% of Canada's 900 million acres of land are farmed.

*How many hectares of Canada are farmland?  
What do you think so little of the land is farmed?*

Canada is one of the world's largest food producers. While we do import food from the United States and other countries, on average a Canadian farm produces enough food to feed 120 people, and a lot of produce is exported.

*Why would we import food from other countries?*



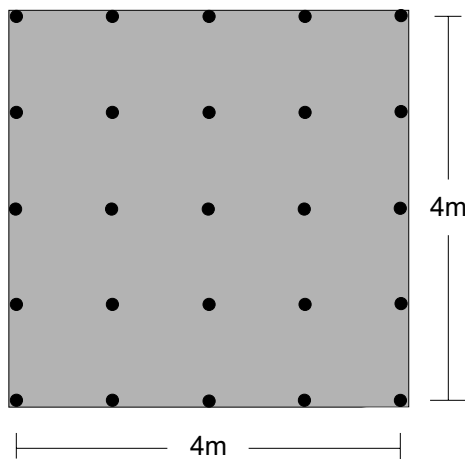
We are very blessed that this land continues to provide so much of what we need to survive on a daily basis.

## Sources

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# Math problems

1. Your class is learning about traditional agriculture methods. You decide to conduct a project to grow the Three Sisters - corn, beans and squash - in a 4m x 4m plot next to the school. There are 12 students in your class; the teacher divides you into 4 groups of 3. She tells you that the plot must be divided equally between the groups, and that you must mark each group's section by placing rope around the posts she has placed in the plot. The posts are 1m apart both horizontally and vertically. Can each person in the class come up with a different way to divide the plot into 4 sections of equal area?



Source: [www.gardengatemagazine.com/tips/27tip3.html](http://www.gardengatemagazine.com/tips/27tip3.html)

2. On your family's land there are 300 sugar maples. Each spring you tap the trees to make syrup which is sold through the community co-op.
- If it takes 40 litres of sap to make 1 litre of maple syrup and each tree produces about 25 litres of sap, how much syrup do you produce?
  - You can the syrup in 500ml tins. How many cans of syrup do you have?
  - Each tin costs you 68¢. You sell syrup at the co-op for \$2.50 per tin. What is your profit?



Source: [www.corbis.com](http://www.corbis.com)