Scientists and world leaders estimate the world’s population will reach nine billion by the year 2050. That is two billion more than today! Imagine how much more food will be needed for two billion more people. Imagine how many clothes they will need. Imagine how much fuel and medicine they will need. The agriculture industry is responsible for growing plants and raising livestock that will become our food, clothing, shelter and fuel. Farmers need to do this in a sustainable way.

So, what is sustainability? To be sustainable, we must meet the needs of the present without compromising the needs of the future. This includes protecting the environment. It includes making sure farmers can earn a profit. It includes meeting the social needs of the community. In agriculture, farmers use best management practices and technology to grow the most food on their land. These practices help ensure economic, social, and environmental success.

Scientists, engineers, and others in food and fiber industries are using technology. This allows them to produce more with less.

- Animal geneticists study heredity and genetics and then work with farmers. Farmers select the most desirable traits in their animals. With improved genetics, they can produce more meat, milk and eggs.
- Soybean plants and other legumes have nodules on their roots. These nodules host bacteria that convert nitrogen from the air into a plant-usable form in the soil. This process is called nitrogen fixation. Farmers take advantage of this by alternately planting corn and soybeans each year. Nitrogen left in the soil from the soybean crop can be used by corn plants the following year.
- Ethanol is a renewable fuel made from corn and other crops. These crops have a high starch or sugar content. Through the process of fermentation, starch is converted to sugar and then to ethanol.
- Distillers grains are a by-product of ethanol production. They can be used by cattle farmers as an inexpensive and nutrient-rich feed. Cattle have ruminant digestive systems and can digest grass, distillers grains and other plant materials.

These are just a few examples of how science and technology are helping us produce more with less land and resources. Scientists and farmers work together to make agriculture even better!
Material in the soil and keeping it healthy.

These organisms also give off waste of their own from burrowing and creating tunnels. These organisms help aerate the soil by eating organic materials, like worms, bugs, and microscopic organisms.

It includes all kinds of living things, like plant matter, manure, or other decaying organic material and a source of nutrients. They have a water source, and potentially some supplemental grains and minerals. They are in a large, incredibly complex ecosystem of its own.

The soil is also home to lots of nutrients. It's a large, finite amount of matter in the world. The matter just gets redistributed in different ways over time.

First, let's look at the soil. Soil is an ecosystem in itself.

The manure from the cattle and any extra grass can be applied in a cattle pasture to help create the proteins that build the cattle's own muscles. That's how our beef comes! The cattle need to eat grass to make muscle, and good meat quality.

Soil nutrients are very important for the plants growing on the pasture. How is the matter cycled here?

As the plants grow, cattle eat them. Then the cycle can start again! How many places might you cycle the matter?

The matter just gets redistributed in different ways over time. Things like nitrogen, phosphorus, potassium, and more are all very important in plant and soil health. The soil is also home to lots of nutrients.
Weston realizes that we have a limited amount of land and we must work together to preserve it.

Tyler Marion, Product Engineer
Tyler Marion is an engineer at Hog Slat, Inc. He designs ventilation and cooling systems for pig barns. Maintaining comfortable temperatures is very important in pig production. Tyler designs new products or improves existing products. This helps pig farmers take better care of their animals. He works with others to evaluate products, create designs, and find partners to help create end products.

Tyler attended North Carolina State University, where he learned about many types of engineering. He studied mechanical engineering and electrical engineering through the lens of agriculture. He says this program allowed him to gain an understanding of many concepts. This prepared him well to be an agricultural engineer.

The best part about his job, Tyler says, is seeing a project go from inception to completion. In many engineering roles, individuals only work on part of a project and have to pass it on to someone else.

“Our industry offers a unique opportunity to see it start to finish,” he said.

For students thinking about being an engineer, Tyler has some advice. First, an interest in learning more about math will help a lot. Math is important in engineering.

“Pay attention to detail,” he added, saying that problems come up when details are missed. “If you make it a habit now to pay attention to detail, it will help later.”

John Patience, Animal Science Professor
Every day John Patience gets to think about animals and often works with them. As a professor of animal science at Iowa State University, his career has allowed him to help the swine industry. He works with students and designs experiments that will improve pig health. He then works with industry professionals to help them apply the results of the experiments within their herds.

“People who are good with livestock are observational,” he said. “They read their pigs. That’s how they keep animals happy and healthy.”

He is constantly looking for problems the industry is facing that he can help solve. Many swine farmers are trying to reduce the need to use antibiotics. This is a trend that consumers are asking for. Some of John’s research projects are focused on creating diet ingredients that will help pigs ward off disease and stay healthy.

Research is a means to an end,” he said. “Before we plan an experiment we ask, ‘what problem is this solving for the industry?’ and ‘how is it going to help the environment, the pig, or the consumer?’”

For students interested in pursuing careers working with animals, he encourages them to visit a farm and see the animals. He says there are so many job opportunities working with animals — beyond veterinarians. He says pigs have very similar digestive systems to humans. Sometimes his research even helps improve human health!

Mark Allen, Geneticist
The study of this DNA and the heredity of traits from one generation to the next is called genetics. There are many careers within agriculture that work with genetics.

There are plant breeders, crop geneticists, livestock breeders, statisticians, genetic engineers and more.

Mark Allen is one person who works with livestock genetics through his work as Director of Genetic Technology at TransOva Genetics. Mark primarily works with the cattle industry. Cattle farmers are very aware of the genetics in their herd. They want to breed healthy, hardy, happy animals. Mark helps these farmers reach their goals through his work.

There are many different technologies Mark uses to help his customers. He works to develop new products for genetic companies and farmers. Shaping current with modern technologies can take him across the country to meet with many different people.

This is Mark’s favorite part of his job.

“I’m on my way to a meeting in Lubbock, Texas at Texas Tech right now,” Mark said. There are a few skills Mark has that have helped him. He is detail-oriented and enjoys working with data. He says his ability to communicate technical ideas has also helped.

If you are interested in genetics, Mark says you should pay attention in science and math classes. Chemistry and biology are very important in genetics. Math plays a large part in science, too. Mark points out that new technologies are important in agriculture.

Whatever the current technology is, it’s being done on a large scale in animal agriculture,” he said.

Maybe your future job will be as a geneticist in animal agriculture!

Candice Engler, Agricultural Engineer
Candice Engler is an agricultural engineer for John Deere. She started her career as a manufacturing engineer, where she worked to streamline the production process of grain drills. She soon gained interest in software and systems engineering.

“Farmers don’t buy a single piece of equipment. They want an entire system in which all of the machines work well together,” Engler said.

In her current role, she leads a team that improves the diagnostic capabilities of John Deere’s products. This helps farmers figure out what is wrong, so they can fix it quickly.

Candice was good at math and science in school. She also developed an interest in figuring out how things work as she worked alongside her dad on the family’s farm. When she was 12, she helped him build a sprayer to help control weeds and insects in their corn and soybean fields. That was her first experience developing something that helped a farmer.

“As an engineer, I apply math and science concepts to help farmers be more effective,” she said. “And by helping farmers, I am helping to feed the world’s growing population.”

John Marion, Product Engineer
John Marion is a product engineer at the Design of Automation Inc. He works with John Deere’s software, such as the JDLink, to help improve the diagnostic capabilities of John Deere’s products.

“The best part about my job is seeing a project go from inception to completion,” Marion said. “I get to work on many projects and I have to move on to the next one.”

For students thinking about being an engineer, John has some advice. First, an interest in learning more about math will help a lot. Math is important in engineering.

“Pay attention to detail,” he added, saying that problems come up when details are missed. “If you make it a habit now to pay attention to detail, it will help later.”

Weston Dittmer, Soil Conservationist
Helping local farmers care for their land was one reason Weston Dittmer went to work for the Natural Resources Conservation Service (NRCS) with the United States Department of Agriculture.

“With my background in agriculture production and an education in agronomy and environmental science, the NRCS was a natural fit for me,” he said.

Approximately one third of his job is meeting with landowners discussing their fields. He scouts out areas where improvements could be made. The goal is to help keep valuable soil from running off the farm. He believes that soil conservation is important in maintaining the soil on a farm.

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The rest of his time is spent in the office working closely with his team. They examine soil maps and report back to farmers. But his job is more than soil conservation. He provides guidance for other natural resources, too. He monitors water quality and flood control. He monitors air quality and helps create end products.

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1 in Every 5 Jobs in Iowa Is in Agriculture. Maybe You Could Help Feed and Fuel America With a Career in Agriculture!
The great thing about corn is that it has a lot of different uses. Field corn, the type of corn primarily grown in Iowa, is harvested after it has dried in the field. The kernels can be used to feed livestock. They can be ground and turned into food for humans, like tortilla chips. The kernels can also be turned into an alcohol called ethanol that can be used to power our vehicles – just like gasoline.

Each little kernel of corn represents stored energy. That energy can be used for animals and humans to eat or it can be used to power cars and trucks. Because corn is dry when it is harvested, it can be stored in grain bins until it is needed for use.

Ethanol is a type of biofuel that comes from living matter like plants. Ethanol can be made from a lot of different plant matter. Because Iowa grows a lot of corn, it is cheap to use corn to produce ethanol. When corn is harvested, it is dried in the field. The kernels can be used for animal feed called distillers grain. The ethanol will be mixed with gasoline to help power cars and trucks.

THINK & DISCUSS. In a car engine, fuel is burned creating miniature explosions that push pistons. The pistons in turn propel a drive shaft that transfers power and energy to the wheels. This makes the car move forward. Can you diagram this transfer of energy?

DID YOU KNOW? A bushel of corn (roughly 56 pounds) can produce 2.8 gallons of ethanol.

THINK & DISCUSS. Did you know?

Plants are amazing! They provide us with oxygen, food, fiber and medicine. They grow in all regions of the world. Each species has leaves, stems, flowers and root structures adapted to its habitat. These specialized plant parts ensure they can acquire their basic needs. It helps them protect themselves against predators and reproduce.

Flowering plants reproduce by seed. To produce seeds, pollination must occur. Flowers have evolved over millions of years to ensure that tiny grains of pollen are carried from the male flower part to the female flower part. Without this transfer, fertilization does not happen, and seeds are not produced. Most plants rely on receiving pollen from another plant of the same species. But, some plants can pollinate themselves. Soybean plants are self-pollinated. This means that pollen produced within a flower fertilizes the ovary of the same flower on the same plant. Because soybean plants do not need to attract pollinators, their flowers are not showy. Soybean flowers are hidden under the leaves near the plant’s main stem. Each flower is only about the size of your pinky fingernail, but there can be 50 to 75 flowers on one plant.

Cross-pollinated plants rely on insects, animals or wind to transfer pollen between flowers on separate plants of the same species. Corn plants are pollinated by wind. Corn plants have two types of flowers. The corn silk on the ear is the fertile flower. The tassel at the top of the corn plant is the male flower. Wind carries pollen from the tassel to the silks at the end of each immature ear. Pollen grains attach to the sticky end of each silk, and travel down the silks to fertilize each ovary. After pollination, the ovary develops into a kernel of corn at the outer end of each strand of silk.

Our world is filled with flowers of many shapes, sizes and colors. Thanks to the many ways that flowers are pollinated, flowering plants reproduce by seed.
Both domestic turkeys and wild turkeys can be found in all shades of color. They can be colors like brown, black, white and more. But most domestic turkeys today have white feathers. Most wild turkeys have dark brown or black feathers. This difference in feathers evolved through farming. Farmers selected and bred the lighter, whiter colored birds.

Wild turkeys need to maintain their dark colors as camouflage so that they blend in with their natural surroundings – usually forests and woodlands. Genes might mutate and cause a variety of feather colors. However, those brighter, more colorful birds are more susceptible to predators. Therefore, the mutations aren’t usually passed on to the offspring. This natural selection process maintains the dark-colored wild birds.

Turkeys were first domesticated by Native Americans as early as 25 A.D. Since then, farmers have been using artificial selection processes. This process results in the best characteristics for developing meat for human consumption and for the birds to live healthily in large, indoor flocks. Farmers selected for the white feathers for several reasons. One reason is the white feathers are less visible when the carcass is dressed. White feathered birds typically have lighter skin color, too, which is more appealing to consumers. Melanin pigments that cause coloration are similar in the skin and in the feathers.

Farmers also selected for traits like larger size and thick, meaty breasts. This means that domestic turkeys rarely fly because their bodies aren’t built for it. Wild turkeys, on the other hand, can fly at speeds up to 55 miles per hour.

Domestic turkeys also have more white meat than wild turkeys. Dark meat is caused by higher amounts of myoglobin that carries oxygen in the blood. Birds that are more active, like wild turkeys, need more oxygen in their blood and muscles so they can fly at top speeds. Muscles that aren’t used as much will have less myoglobin. Therefore, domestic poultry will often have more white than dark meat.

Domestic turkeys have little fear of humans. They are constantly noisy, constantly clucking. While wild turkeys are known for their gobble, they spend most of their lives quiet so as not to attract predators. Wild turkeys need to be more wary and stealthy if they are to survive.

All these variations are achieved without genetic modifications or hormones. Farmers use selective breeding processes to produce the best turkeys that result in the best meats.