DISCUSSION GUIDE

Into the Outdoors

CAREERS IN AGRICULTURE

Farm Science

GRADE LEVELS
6-12

CONTENT AREA
Agriculture

UNIT THEME
Careers In Agriculture

TOPIC
The careers in agriculture that contribute to soybean production.

The following short video follows the elements of the discussion guide and highlights key points for Agriculture.

Careers In Agriculture - https://vimeo.com/294245336

ENDURING KNOWLEDGE

Students should know what each of the four careers discussed in the videos involve, and how each career supports farmers.

Learning Targets:

1. Students should know what a precision agronomist, a commodities broker, a large animal veterinarian and a farm implement dealer do.
2. Students should know how a precision agronomist, a commodities broker, a large animal veterinarian and a farm implement dealer can benefit farmers.
3. Students should understand the importance of farming to sustain the world's population.
4. Students should understand how tools like hedging, precision agriculture, animal health and specialized farming implements all increase the farmer's bottom line.
5. Students should understand the steps agronomists and veterinarians utilize to identify problems in the crop field or to diagnose sick livestock.
6. Students should understand how individual interests, technological innovations and specialized education enable people to have important and fulfilling careers that assist farmers in producing enough food to feed the world's population.

TEACHER BACKGROUND

Video Series Summary:

In the original Into the Outdoors episode, two students were given an assignment to study agriculture, but they did not know any farmers. Their teacher said that she did not know any farmers either, but she had four friends that worked with farmers in the agricultural industry. She provided the students with a device that transported them to visit and learn about each of these careers for their report.

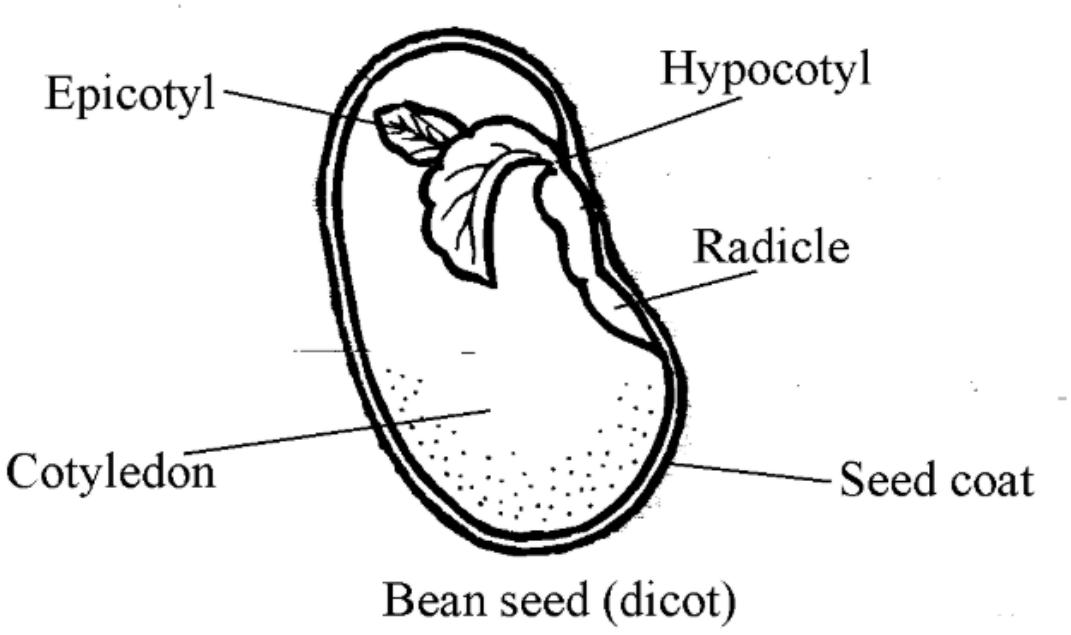
The students visited four professionals that support soy farmers: a precision agronomist, a commodities broker, a large animal veterinarian and a farm implement sales representative.

Background:

Agronomy is the science and technology of producing and using plants for food, fuel, fiber, and land reclamation. Agronomy has come to encompass work in the areas of plant genetics, plant physiology, meteorology, and soil science. Agronomists help soybean farmers ensure the crop they plant is healthy and increase their yield to get the best investment.

TEACHER BACKGROUND

What Is A Soybean?



A soybean is essentially the seed of the soybean plant. Inside of every soybean seed are the parts needed for the seed to grow into a healthy plant. There is a protective leaf-like structure (cotyledon) that covers the two baby leaves (cotyls) and one baby root (radicle). The bean has a hard seed coat around the outside to protect the seed over a period of dry conditions or during the winter. The seed coat is what allows farmers to dry soybeans for long term storage, and use them for seed to plant new soybean fields the following spring. The cotyledon stores food for the new plant to use. As the root and little leaves grow, the cotyledon shrinks and loses its color. This shrinking happens because the young plant is pulling nutrients from the cotyledon until it develops the capacity to take nutrients from the soil. These nutrients inside the cotyledon are also what makes the soybean nutritious for people and animals.

How Can Technology Help Farmers Keep Soybean Plants Healthy?

Many livestock and crop farmers have added new words to their business vocabulary in the past few years. Alongside "silage", "pickup", and "section", they are now using the word "app", "tablet", "implement", and "internet." Technology has exponentially increased farm production from the mid 1800's, where seed was cast by hand or hand-held machines, to today, where specialized technology and assistants help multiply their yield and marketing efficiency.

A farmer may hire an agronomist, or "plant doctor", to help monitor plants and make sure they are in the best health to produce the best product yield. Some agronomists are able to use technology that seems pretty fun!

Agronomists may use drones to observe and photograph planted fields and use hand-held tablets to diagnose problems that crops are showing, like disease, pests or lack of fertilizer. Other uses for drones in agriculture include checking remote equipment like sprinklers, mid-field weed identification, and cattle herd monitoring. Drones are limited to the height they can fly, so they do not cause accidents with airplanes and helicopters. Often farmers hire a specialized drone pilot to safely check crops mid-season and an agronomist to create an action plan to keep their plants healthy and increase their end of season product yield and quality.

Agronomists may use a systematic approach to their work, such as the "3D" analysis system. Using this approach, tasks are split into three parts: discovery, diagnosis and documentation. "Discovery" means using technology like drones to fly over a field and collect photographs to pinpoint any areas within the field that appear to be unhealthy. "Diagnosis" means going directly to the sighted, unhealthy areas to get an up close and personal view of what may be causing the plant sickness. "Documentation" means taking all of the data collected, putting it in print and presenting it to the farmer while also giving them solutions that can help improve the crop yield. Examples of these solutions would be recommending a special type of fertilizer in a specific area or a pesticide to stop an infestation.

Experienced drone pilots can observe and document the condition of 4,000 acres of crops per day, whereas a human can only scout 2-3 acres per day on foot. The drone takes thousands of photos that are then stitched together to make a photographic map of the entire crop field. After the precision agronomist finds problem areas by drone, he or she will physically go out to look for the problems and photograph them up close with an internet-linked device. Diagnosis of a particular disease, malnutrition, or parasite infestation can be simplified with an agronomy application or "app." The app can compare the photograph the agronomist took to thousands of photos that are already in the database to find the precise problems the plant is experiencing. The app recommends treatment to the agronomist, who uses this data to put together a report with treatment recommendations the farmer could use.

One app precision agronomists use is called "Pocket Agronomist." This app, available for iPhones and iPads, was developed using photos taken by agronomists over the past 20-30 years. Experts have categorized the photos by the problems they represent and uploaded possible solutions for those problems. This way, when an agronomist takes a photo of an ailing plant, the app's artificial intelligence has already learned what each problem looks like and is able to diagnose the source of the problem and its treatment. Technology like drones and specialized apps allows the farmer to spot-treat his crops instead of spraying the entire field. This greater precision saves the farmer a lot of time and saves the crops so the farmer's bottom line is better and the world's food production and food quality is increased.

What Is A Bottom Line?

The "bottom line" is a term that economists use to reveal how much actual profit is made from the production and sale of a product after costs are subtracted. It takes time, energy and materials to produce any product. Paying for all of those expenses takes away from the profit the farmer can make. The bottom line is also influenced by market values. Anything that is produced and sold has a value or price that can be put on the product. This value rises and falls depending on what is happening to the economy, world events, and—in the case of agriculture—even the weather.

A commodities broker is a specific economist that helps farmers maximize their bottom line. They look at what is going on in the world, or will likely happen in the growing season, and advise the farmers on how to "hedge" their sales. Hedging means that the farmer stores the crop until prices are likely to be highest. If the farmer sold the crop right after harvesting, the supply of that crop would be high, because all of the other farmers have crop to sell, too. When supply is high, people offer less money for the crop because they know there is a lot available and they can buy it cheaply. However, if an event happens to make the supply lower than the demand for the crop, prices will rise Commodities brokers anticipate when demand will go up to advise the farmer when to wait and when to sell their crop.

A commodity broker's job duties are meeting with clients, monitoring international markets, providing investment advice and market recommendations to clients, trading on behalf of clients, visiting international suppliers, investigating new business openings, negotiating price, specification and delivery details and devising 'hedging strategies". Basically a commodity broker will find special deals for their clients and then call them and let them know about the opportunities available. They will help manage the costs overall, ensuring that the client receives the best return on their investment They also help farmers capture the best prices of the year, protecting against the uncertainty of a bountiful harvest or a poor harvest. Hedging is often considered an advanced investing strategy, but the principles of hedging are fairly simple.

Commodities brokering is a fast-paced career field because prices change daily. The broker has to be very aware of how world events might affect the market so they can anticipate what will happen to crop prices days or even months before the price rises or falls. Through the broker, farmers are also able to lock in sales before their crop is even planted.

If prices are high, they could contract their crop to be sold to a certain buyer in hopes that they get a good yield after the crop grows, and the price they are pre-selling it for is higher than the price will be when the crop is ready to harvest. Farming is a risky business, so having a partner to help manage risk is very important to help the farmer keep the farm business viable. If the soybeans are sold at a price that is lower than what it cost the farmer to produce them, the farm will go out of business. None of us want farmers to quit farming, or we will end up with a major food shortage! Hiring commodity brokers is essential to the future of the soybean farm and supporting other soy-dependent means of food production, like dairying.

How Is Soy Essential To Dairy Production?

In order for a cow to produce milk, it must be healthy. In order to be healthy, the cow needs good nutrition so it can have the building blocks to sustain milk production and fight disease. Cows who are kept in dairy barns instead of roaming pastures must be fed because they cannot forage for themselves. The food has to be something that can be stored and transported, but still provide the cow with the nutrition it needs to be at optimal health. In addition, each cow has individual health needs, and each cow must have babies every year to continue milk production and grow the herd. With so many individual animals that have so many needs, a specialist must be called in to monitor their health and address their needs. This specialist is a large animal veterinarian.

Large animal veterinarians (vets) are specialized practitioners that manage the health of livestock species such as cattle, horses, sheep, goats and pigs. They are licensed animal health professionals who are trained to diagnose and treat illnesses that affect various livestock species. These medical professionals conduct health exams, give vaccinations, draw blood, prescribe medications, clean and suture wounds, take ultrasounds and x-rays, and perform surgeries. Vets usually make in-person farm calls to visit their patients, often utilizing a customized truck outfitted with necessary medical equipment. Large animal veterinarians frequently work long hours and spend a great deal of time on the road as they travel from farm to farm. They also must be on call for potential emergencies on weekends and holidays. The work itself can be particularly demanding for large animal vets, as they must be capable of restraining and treating animals of substantial size.

A large animal veterinarian must go through eight years of specialized training as part of their college education, and serve under a more experienced vet before he or she can work alone. The vet must be familiar with any signs of stress the cows exhibit, be an expert at what cows need to be healthy and what leads them to become sick, and be able to recognize and diagnose illnesses, nutrient deficiencies, infections and parasites. It is essential that the cows have optimal health so our food is safe and nutritious for us, too. In order to keep track of each individual cow's health, the cows wear an "activity tracker" that reports her stomach movement, food digestion and any medications she needs to take.

The food that is given to cows in dairy barns is called a "Total Mixed Ration" (TMR). The main component of TMR is haylage, which is cut grass that has been partially dried and ensiled (put in a silo or stored in a roll) to exclude air. If you've seen large plastic-wrapped rolls of dry grass around a farm, it's likely haylage. The TMR also includes corn and soybean meal. The corn provides carbohydrates for energy and the soy provides the cow with protein she needs to make milk. The vet looks closely at the particle length, moisture and composition of the TMR to make sure each cow is getting the rations of haylage, corn and soy that she needs to produce milk.

At some point in the season, each cow will give birth. Although the calves are separated from the mother after drinking her first milk (the colostrum), the calf will still continue to be fed its own mother's milk. The calves are separated to keep them all safe and help the cows continue to do their jobs, but someone must watch them closely every day to make sure they are thriving and growing at the expected rate. Calves drink up to two gallons of their mother's milk each day and will double their birth weight in two months, up to around 160 pounds. The vet checks every day to make sure the calf's eyes are bright, its nose is moist and that it seems to be feeling well, overall. The colostrum helps provide immunities to the calve, but in the barnyard, it will also need other inoculations and immunizations to keep it healthy. The vet must develop a customized vaccination schedule to meet the unique challenges of each farm

With all the work that large animal vets do, from nutrition to vaccination to caring for sick cows or helping them give birth, it is no surprise that vets are essential to dairy farming and milk supply production. But, what other tools and assistants do farmers need to maximize their production? Well, no farmer in our time would make any money or contribute enough food to the supply by planting and harvesting by hand. Therefore, they need the right machinery for the job.

Farming Implements

A farming implement is a machine that is specially designed to do one task or a variety of tasks on the farm. A tractor is a multi-task farm implement because it can pull heavy loads or other implements behind it. The most precise farm implements are designed to do one task, but do it very efficiently in order to save the farmer time and money, and ultimately conserve resources like seed. The farmer goes to a dealership where experts can showcase implements for purchase, provide maintenance and repair services, and spare parts. Mechanics for farm implements must go back to school for a period of time every year to keep up-to-date on rapidly changing technology.

Without specialized implements dealers, farmers would lack the tools needed to nurture crops, foster livestock and sustain a living. As an agricultural implements dealer, duties typically involve all that is related to selling and promoting a line of products offered by companies they represent. Depending on the organization, a sales representative might have to be familiar with a type of equipment and how it operates or have knowledge in such areas as fertilizers and how they affect crops. Prior experience in a specialized agricultural area is expected by the employing dealership. Some sales representatives are tasked with expanding the dealership's customer base and providing product training to retail clients. Sales professionals might also be required to attend regional meetings and conferences to keep up with changes in the field and expand their product knowledge. Good communication and public speaking skills are required to sell products to individuals or groups of potential customers. Other duties might include creating and writing monthly and quarterly reports. Sales representatives might be required to attain computer skills related to programs and software utilized by the company. Farm implements and products are a complex business and require specialized knowledge to get the right product to the field.

If you're lucky, you can view or even sit in specialized farm implements at your county fair. Many dealers showcase their lines at the fair to help farmers see new technology and find ways to help them increase their crop yield. As global food needs grow, technology in farming helps farmers keep up with the food production we all need.

VOCABULARY:

Agronomist: an expert in the science of soil management and crop production.

Crop Scouting: the process of precisely assessing pest pressure (typically insects) and crop performance to evaluate economic risk from pest infestations and disease, as well as to determine the potential effectiveness of pest and disease control interventions.Scouting is usually sold as a commercial service to farmers as part of integrated pest management.

Precision Agriculture (PA): PA, satellite farming or site specific crop management (SSCM), is a farming management concept based on observing, measuring and responding to inter- and intra-field variability in crops.

Commodity: a raw material or primary agricultural product that can be bought and sold, such as copper or coffee.

Hedging: protecting oneself against loss (on a bet or investment) by making balancing or compensating transactions.

Bottom Line: the final total of an account, balance sheet, or other financial document.

TMR: total mixed ration is "the practice of weighing and blending all feedstuffs into a complete ration which provides adequate nourishment to meet the needs of dairy cows." Each bite consumed contains the required level of nutrients (energy, protein, minerals and vitamins) needed by the cow.

Colostrum: the first secretion from the mammary glands after giving birth that is rich in antibodies.

Immunity: the ability of an organism to resist a particular infection or toxin by the action of specific antibodies or sensitized white blood cells.

Vaccination: treatment with a vaccine to produce immunity against a disease inoculation. A vaccine is a substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, and treated to act as an antigen without inducing the disease.

Implement: a tool, utensil, or other piece of equipment, especially as used for a particular purpose.

Mechanic: a person who repairs and maintains machinery.

Before Viewing the Video:

Ask the students to discuss what they currently know about how crops like soybeans are produced and sold, and what soybeans are used for. It may be helpful to complete a KWL chart, the K and W before the video and the L after the video. (What I Know. What I Want to Know. What I Learned). Also ask them to discuss what they know about the importance of the critical question and how it affects their lives.

You can either create one or use the *example below*

K-W-L Chart

Topic: _____

What I Know	What I Want To Know	What I Learned

VIEWING AND DISCUSSION GUIDE:

Before viewing the video, it may be helpful to create a "guide sheet" for students to take notes on while watching the video. From the Teacher Background, select key headings and questions that will help guide students in picking out significant information. Include questions about how the topic could impact their lives and how the topic relates to other areas of science.

Here are some examples:

Precision Agriculture:

- What would be the advantage to being precise with crop disease treatment instead of treating all plants, even if they are not sick?
- Why is it difficult for farmers to monitor the health of all their plants and field equipment by walking and inspecting them?
- What technology could be used to help the farmer to identify and find solutions to problems quickly?

Commodities Broker:

- How does a commodities broker help farmers?
- What would happen if a farmer just sold their crop right after harvesting?
- What affects the price of crops when farmers want to sell?
- Why does it matter to everyone if one farmer profits or loses money from sales?

Animal Nutrition:

- What macronutrients do cows need to eat?
- What happens if a dairy cow does not get proper nutrition?
- Besides nutritional monitoring, what other tasks do large animal vets handle for farmers?

Farm Implement Dealer:

- How do farm implements help farmers to be more efficient in planting and caring for their crops?
- What kind of support does an implement dealership provide to farmers?

AFTER VIEWING THE VIDEO

After viewing the video, guide a student discussion about the key points and questions in the Discussion Guide. Also explore what the students learned and the significance of the topic to their lives.

If the topic is potentially controversial or has different stakeholders involved, divide the students into "user groups". Have the different groups prepare a presentation of their viewpoints or goals for a classroom debate on the topic. Focus the discussion to address the critical questions in the video or key points in the Teacher Background. For expanded learning, give the student groups additional time to prepare posters or media presentations as part of their presentations.

Evaluation:

1. An informal assessment can be made from students' notes and their participation in the before and after viewing discussions.
2. Activities can be assessed using rubrics based on good research, presentation, and material construction.

Extended Learning:

- Complete the L part of the KWL chart after the discussion.
- Have students research the answers to the questions they had in their KWL chart or Discussion Guide that were not covered in the discussion.
- Students can group together and research a sub-topic related to the main topic. These sub-topics could include the following: history, innovation or technology, careers, and impacts on the environment or society. Students have the option on the method to present their findings to the class.

Topics for students to investigate further:

1. What kinds of products are soy used in besides human food and TMR for cows?
2. What is the difference between colostrum, foremilk and hindmilk, and what purpose does each serve?
3. What kind of specialized farming implements have been developed other than soybean planters, and what does each do?
4. What other industries use drones to help with monitoring production, finding malfunctions, or keeping people safe?