IS INDUSTRIAL FARMING DOING MORE HARM THAN GOOD?

DOES FARMING HELP OR HARM THE EARTH?

By Tricia J. Hoover

LEXILE 860

Imagine the earth before humans. There was no farming. No industry. No fishing or drilling for oil. There was no litter or pollution. Trees grew tall and were never cut down for lumber. Then humans came along and everything changed.

Human activities have had a major effect on the earth and the atmosphere. Unchecked, these activities threaten our world. The good news is that humans are aware of the damage being done. Science ideas are being developed to help combat the problems and to protect Earth's resources and the environment. Let's take a look and see how.

Earth's Natural Resources

The activities of humans affect Earth's **natural resources** and the environment. Natural resources are usable materials that occur in nature. These are things such as wood, water, land, gas, and air. Every natural resource we use either has to be grown and harvested or mined from the Earth. This requires a lot of work, so it's important to protect resources and not to waste them. Resources can be either renewable or nonrenewable.

Natural resources need to be harvested or mined from the earth.

Renewable resources are natural resources that will replenish during a finite amount of time. Renewable resources can be replenished at the same rate or faster than they are being used up. Some examples of renewable natural resources are water, wood, and food that occurs naturally in the wild.

Nonrenewable resources are natural resources that will not replenish in a finite amount of time. They are being used up faster than they can be replenished. Some examples of nonrenewable natural resources are oil, metal, and minerals.

Human activity has both a positive and a negative impact on many natural resources and the environment. Let's take a closer look at one of these activities to see its effects and to see what science ideas are being used to protect the resources.

What is Farming?

Farming, also referred to as agriculture, is raising crops and livestock for food. It has been around for over 10,000 years. Before then, humans didn't raise crops or animals. They hunted and gathered what food they needed. **Industrial farming** is farming that is designed to raise the maximum amount of crops and livestock at a minimum cost.

Farming Helps

Industrial farming has made food much more plentiful. Producing food on a large scale helps keep people from being hungry around the world. It also helps people pursue other interests because they don't have to farm and produce their own food. There is enough food for everyone to buy at the store. Without industrial farms, the average American would have to work much harder for food.

Farming gives us a variety of delicious foods to eat.

Because industrial farming grows arge amounts of food, produce can be shipped around the world. This gives us a large variety of foods, especially fruits and vegetables, all year long and not just when they are in season. But having food readily available comes with a cost.

Farming Harms

Farming also hurts Earth's natural resources. Pesticides are used to help control the insects that would otherwise attack the crops. Fertilizers are added to the soil to help crops grow bigger and faster. Both pesticides and fertilizers are chemicals. They can run off into water which can make both humans and animals sick. **Soil degradation** is another big problem. This happens when poor farming practices lower the quality of the soil. As the nutrients in the soil are used up, it is more difficult to grow crops. Eventually, the soil becomes unusable. It can take years to recover. As soil degradation occurs, new areas for farming must be found. Forest lands are often cleared of trees to make way for more farmland. This **deforestation** is not good for the environment.

Farming Solutions

There are science ideas being put into use today to help minimize the negative effects of farming. **No-till farming** is a technique of farming when crops are grown, but the soil is not disturbed by tilling. **Tilling** is when soil is turned over and disturbed. Farmers till their fields to remove weeds and get the soil loosened up for planting.

Farming has both positive and negative effects on the Earth's resources.

But tilling also removes plant material holding soil in place and keeping soil moist. No-till farming allows this plant material to remain in place. That helps to reduce **erosion**. This means less of the nutrient-rich topsoil will be worn away by wind or water.

Terracing helps control the flow of water when farming.

Terracing is when the farmland is made into a series of flat level areas that resemble steps. On each level, different crops can be grown. When it rains, instead of nutrients washing away, they are washed down to the next level. Water is conserved more with terracing than if crops were planted on a hillside.

A newer idea is the use of cover crops. Cover crops are crops that are planted in a field after harvesting. They have several purposes.

- Cover crops increase soil fertility by acting as a natural fertilizer. They restore nitrogen in the soil, which is a vital nutrient for plant growth.
- Cover crops provide a root anchor for the soil to reduce erosion.
- Cover crops provide a cover over the soil to keep the soil moist after a rain.

Can We Make a Difference?

Human activities like farming have both a positive and a negative impact on the environment and on Earth's natural resources. We can make a difference. Communities can work together to come up with new science ideas to solve problems. These ideas will help protect and preserve natural resources.

Did You Know?

Environmental science is a rapidly growing career field. **There are all sorts of specialties in the field, such as Climatologist, Microbiologist, Ecologist, and Agricultural Engineer.** Maybe a career in environment science is for you!

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Imagine the earth before humans. There was no farming of plants or animals, no industry, and no fishing or drilling for oil. There was no litter or pollution on the land or in the water. Trees grew tall and were never cut down for lumber. Then humans came along and everything changed.

Human activities have had a major effect on the earth and the atmosphere, and unchecked, these activities threaten our world. But the good news is that humans are aware of the damage being done, and science ideas are being developed to help combat the problems and to protect Earth's resources and the environment. Let's take a look and see how.

LEXILE 1030

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Farming gives us a variety of delicious foods to eat.

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Farming Harms

Farming also hurts Earth's natural resources and the surrounding environment. Pesticides are used to help control the insects that would otherwise attack the crops, and fertilizers are added to the soil to help grow crops bigger and faster. But both pesticides and fertilizers are chemicals and can run off into water which can make both humans and animals sick. **Soil degradation** is another big problem that happens when poor farming practices lower the quality of the soil. As the nutrients in the soil are used up, it is more difficult to grow crops. Eventually, the soil becomes unusable and can take years to recover. As soil degradation occurs, new areas for farming must be found. Forest lands are often cleared of trees to make way for more farmland. This **deforestation** is not good for the environment.

Farming Solutions

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Farming has both positive and negative effects on the Earth's resources.

Tilling is when soil is turned over and disturbed. Farmers till their fields to remove weeds and get the soil loosened up for planting. But tilling also removes plant material holding soil in place and keeping soil moist. No-till farming allows this plant material to remain in place which helps to reduce **erosion**. This means less of the nutrient-rich topsoil will be worn away by wind or water.

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DOES FARMING HELP OR HARM THE EARTH?

NAME_____

WHAT CAN YOU INFER FROM THE STATEMENT IN THE TEXT THAT AS NUTRIENTS ARE USED UP IN THE SOIL, IT IS MORE DIFFICULT FOR CROPS TO GROW?

A. WITHOUT FERTILIZERS, CROPS WILL NOT GROW AS BIG.

B. CROPS NEED NUTRIENTS IN THE SOIL TO GROW BIGGER AND MORE EASILY.

C. NUTRIENTS ALLOW US TO PRODUCE MANY MORE FOODS THAT WE ENJOY.

D. INSECTS FEED ON NUTRIENTS IN THE SOIL, BUT PESTICIDES KEEP THEM AWAY.

WHAT REASON DOES THE AUTHOR GIVE FOR PEOPLE NO LONGER NEEDING TO GROW THEIR OWN FOOD?

A. HUMANS NO LONGER NEED TO HUNT AND GATHER.

B. INDUSTRIAL FARMING HAS MADE FOOD MORE PLENTIFUL.

C. THERE ARE MORE VARIETIES OF FRUITS AND VEGETABLES.

D. FOOD CAN GROW ANYWHERE IN THE WORLD ALL YEAR LONG.

HOW DOES TERRACING FARMLAND HELP CROPS?

A. IT WASHES AWAY HARMFUL PESTICIDES.

B. WATER AND NUTRIENTS ARE CONSERVED.

C. IT PROVIDES COVER WHICH KEEPS THE SOIL IN PLACE.

D. SOIL IS ERODED, MAKING IT BETTER FOR NEW CROPS TO BE PLANTED.

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HOW DOES TERRACING FARMLAND HELP CROPS?

FARMING: ANSWER KEY

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FARMING: ANSWER KEY

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WHAT CAN YOU INFER FROM THE STATEMENT IN THE TEXT THAT AS NUTRIENTS ARE USED UP IN THE SOIL, IT IS MORE DIFFICULT FOR CROPS TO GROW?

You can infer that plants need nutrients in order to grow well.

WHAT REASON DOES THE AUTHOR GIVE FOR PEOPLE NO LONGER NEEDING TO GROW THEIR OWN FOOD?

Industrial farming has made food more plentiful.

HOW DOES TERRACING FARMLAND HELP CROPS?

Each terracing level lets water and nutrients flow to the next level down instead of being washed away.

Problem and Solution Chart Graphic Organizer

Complete the problem and solution charts using information from the text.

PROBLEM

WHAT IS THE PROBLEM?	WHY IS IT A PROBLEM?	WHAT IS CAUSING THE PROBLEM?

SOLUTION

WHAT IS A SOLUTION?	WHY DOES IT HELP SOLVE THE PROBLEM?	WHO BENEFITS FROM THE SOLUTION?

SHOULD FARMERS CUT DOWN TREES TO GROW MORE CROPS?

A farmer in Iowa is thinking about removing the trees from several acres of land he just purchased to make room for more crops. Would you advise the farmer to keep the trees or remove the trees? Why? What additional advice would you provide to the farmer? Use information from the text to support your argument.

SYSTEMS AND SYSTEM MODELS

What larger systems could a farm be a part of, and how does it interact with those larger systems?

DID YOU EVER WONDER WHAT NUTRIENTS PLANTS NEED FOR HEALTHY GROWTH?

GROWING CROPS FOR THE FUTURE

By Tricia J. Hoover

What makes soil healthy?
How do farmers produce so many crops?
How can we keep crops healthy while saving water?
Have you ever wondered about the science behind food? If so, then a career as an agronomist could be for you!

What Is an Agronomist?

Agriculture is the science behind farming. This includes growing crops and raising animals. Agribusiness is the study of how agriculture and the economy relate to each other. Its main goal is to make as much money as possible while meeting the needs of customers in a sustainable way. Sustainability is meeting our needs without using up our available resources. For example, when farmers are growing crops, they do not want to use up the nutrients in the soil.

LEXILE 860

Agribusiness involves natural resources such as farms, foods, fisheries, forests, and fibers. Farmers want to deliver a great product. They also want minimal impact to the environment while still making money.

An agronomist may spend time in a lab, running experiments on crops and soil.

An agronomist is an expert in the science, practice, and management of agriculture and agribusiness. Agronomists study, care for, and research crops. They look for how to fight diseases, improve quality, and promote growth for crops. An agronomist may specialize in one area. This could be in crop rotation, which is growing different crops each year on the same piece of land. This could be in soil fertility, which is the amount of nutrients in the soil. This could be in plant breeding, which is using plants we currently have to create new varieties of plants. This could be in weed control or irrigation, which is bringing water to plants. Let's look at what agronomists do on a daily basis!

A Day in the Life

Agronomists spend time outside. They travel around the country meeting with farmers and farm owners. Crops need to be observed. When there are issues, seeing them firsthand is helpful. A

Agronomists also spend time in a laboratory. They run experiments on crops. They test soil and water nutrients. They run experiments checking light and air quality.

Agronomists often work out in the field, looking at crops and checking soil and water.

Running a farm and producing healthy crops is not easy. Many times, agronomists are called in to help. They may give technical advice to farmers. They may make crop calendars and work flow plans. These will help the farm produce the maximum healthy output. They may create a plan for the use of fertilizers, which add nutrients to the soil, and pesticides, which control weeds and insects. That way those products don't get overused. They may also look for ways to conserve and recycle water and other resources.

Labels need to be earned. Foods that claim to be fair trade must be certified fair trade. Foods that claim to be organic must be certified organic.

Farms may also need to pass certain tests. For example, for a farm to call itself "organic," it needs special accreditation. For something to be organic, there are restrictions on pesticides, chemical fertilizers, and artificial sweeteners. Fair trade is another example of something that must be accredited. For a food producer to be able to call a product "fair trade," the producer needs to know where all the ingredients of that food came from. Agronomists can help farmers and food producers trace their ingredients.

All that grass needs to be maintained. Agronomists give advice on watering, cold weather, and handling foot and cart traffic.

Agronomists need to be proficient in digital agriculture. Digital agriculture are the tools that collect, store, and analyze electronic data having to do with the agricultural food chain. This use of digitalization in agriculture has improved food systems. Some of these digital tools include remote sensing, artificial intelligence, and geographic information systems. Geographic information systems can record the specific locations of drought, excess rain, and extreme weather. This information can be used for future planning.

Five Places an Agronomist May Work

Agronomists work with many different types of businesses.

Soil health and proper growing conditions are critical in keeping grapes healthy for wine production.

- Golf Courses – Golf courses have a lot of grass. There are driving ranges, putting greens, fairways, and roughs. All these areas must be grown to the standards of the golf course. Agronomists advise golf course owners on how best to manage their properties.

- Vineyards – Wine is made with grapes. Agronomists work hard to make sure the grapes are up to standards. The soil where the grapevines grow must be checked for nutrients. The leaves of the grapevines must be analyzed to make sure they have the proper amount of nutrients like magnesium and iron. Working with vineyards is a whole specialized area of agronomy.

There are brownfield areas in many places. This land can be used, but it takes a good agronomist to help make sure it's done safely.

- Brownfield Lands – A brownfield land is any land that is no longer in use because it is contaminated. Brownfield lands can be caused by many things including pollution and hazardous waste. Just because an area is a brownfield land does not mean it can never be used for anything again. Agronomists can study and analyze the land. They look for ways in which crops can be produced so they do not cause health problems to either the grower or the consumer.

- Greenhouses – Greenhouses provide us with all types of food year round. We can now enjoy vine-ripe tomatoes any time of the year. Greenhouses also grow fresh flowers. Agronomists make sure the bouquet you receive for that special occasion looks healthy and fresh.

Greenhouses supply a significant quantity of our crops. With proper farming techniques, they can provide healthy produce year round.

- Seed Production Companies – The crops that we eat start from seeds. If the seeds aren't healthy, then the crops won't be healthy either. Agronomists who work in seed production need to understand seed varieties, species, quality standards, and what is required to make sure the seed becomes a healthy plant.

In the Field

Dr. Norman Borlaug might be the world's most famous agronomist. He is known as the "Father of the Green Revolution." He is credited with saving billions of lives from starvation. He specialized in finding solutions to problems with wheat. In 1970 he won the Nobel Peace Prize. The Green Revolution is also known as the Third Agricultural Revolution. It was a time when new technologies were adapted to farming. These included growing more crops for cereal on less land and proper use of chemical fertilizers. Also included were better irrigation and new methods for cultivating crops using mechanical machines.

Farm techniques continue to improve. Maybe you can be involved in the next great agricultural revolution!

Is a Career in Agronomy for You?

We don't just need food. We need healthy food. Agronomists help make sure the food that reaches us is the best it can be. Nobody wants to eat small sour grapes or brown lettuce. If you care about what you eat and you want to help make it even better, you could become an agronomist. Next time you pick up a nice piece of fruit and take a bite, think about it. You could change the world!

Did You Know?

Agriculture is the largest employer in the world. In the United States, there are 914 million acres of farmland. On average, a farmer in the United States can feed 155 people. Back in 1960, that number was only 26 people. Farming techniques are much better now!

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LEXILE 1050

The sustainability of agribusiness involves natural resources such as farms, foods, fisheries, forests, and fibers. What all this means is that farmers want to deliver a great product with minimal impact to the environment while still making money.

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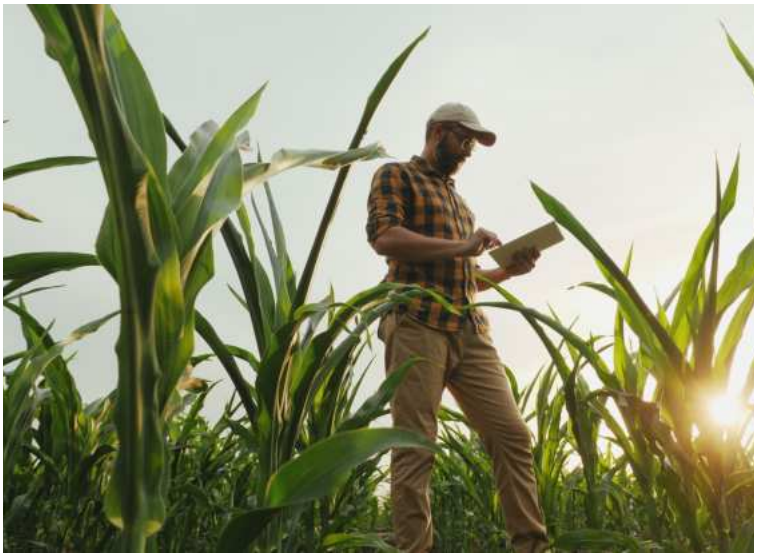
An agronomist is an expert in the science, practice, and management of agriculture and agribusiness. Agronomists study, care for, and research crops. They look for how to fight diseases, improve quality, and promote growth for all sorts of crops. An agronomist may specialize in areas such as crop rotation, which is growing different crops each year on the same piece of land, or soil fertility, which is the amount of nutrients in the soil. They may specialize in weed control, plant breeding, which is using plants we currently have to create new varieties of plants, or irrigation, which is bringing water to plants. Let's look at what agronomists might do on a daily basis!

A Day in the Life

If you want to be an agronomist, I hope you like being outside. A large part of being an agronomist is traveling around the country, meeting with farmers and farm owners. Crops need to be observed, and when there are issues, seeing them firsthand is critical.



Agronomists often work out in the field, looking at crops and checking soil and water.

That said, not all of the job of being an agronomist is out in the field. Many agronomists spend time in a laboratory, running experiments on crops. They may test soil and water nutrients and run various experiments checking light and air quality.

Running a farm and producing healthy crops is not an easy task. Many times, agronomists are called in to help. They may give technical advice to farmers, such as making crop calendars and work flow plans. These will help the farm produce the maximum healthy output. They may create a plan for the use of fertilizers, which add nutrients to the soil, and pesticides, which control weeds and insects, so these products do not get overused. They may also look for ways to conserve and recycle water and other resources.

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Farms may also specialize, and in order to do so, they may need to pass certain tests. For example, for a farm to call itself “organic,” it needs special accreditation. For something to be organic, there are restrictions on pesticides, synthetic fertilizers, and artificial sweeteners. Fair trade is another example of something that must be accredited. For a food producer to be able to call a product “fair trade,” the producer needs to know where all the ingredients of that food came from. Agronomists can help farmers and food producers trace where their ingredients come from.

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A relatively new requirement for an agronomist is that they need to be proficient in digital agriculture. Digital agriculture are the tools that collect, store, and analyze electronic data having to do with the agricultural food chain. This use of digitalization in agriculture has optimized food systems. Some of these digital tools include remote sensing, artificial intelligence, and geographic information systems. Geographic information systems can record the specific locations of drought, excess rain, and extreme weather and use this information for future planning.

Five Places an Agronomist May Work

Farms are the first thing we think of when talking about agriculture, but agronomists work with many different types of businesses.

Soil health and proper growing conditions are critical in keeping grapes healthy for wine production.

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- Vineyards – When adults drink wine, they may not think about the science behind the grapes used to make the wine, but agronomists have been hard at work making sure the grapes are up to standards. The soil where the grapevines grow must be checked for nutrients. The leaves of the grapevines must be analyzed to make sure they have the proper amount of nutrients like magnesium and iron. Working with vineyards is a whole specialized area of agronomy.

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- Greenhouses – It used to be that certain types of food were only available at certain times of the year. Modern agriculture has changed that. Greenhouses provide us with all types of food year round. We can now enjoy vine-ripe tomatoes any time of the year. Another crop grown in greenhouses is fresh flowers. Agronomists help make sure the bouquet you receive for that special occasion looks healthy and fresh.

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CAREER FOCUS: AGRONOMIST

NAME_____

WHAT GROUP OF SKILLS WOULD BE MOST USEFUL FOR AN AGRONOMIST?

A. COMMUNICATION SKILLS, WILLINGNESS TO TAKE RISKS, AND ABILITY TO SPEAK SEVERAL LANGUAGES

B. ABILITY TO SPEND LONG HOURS OUTSIDE, COMMUNICATION SKILLS, AND ABILITY TO DESIGN EXPERIMENTS

C. ABILITY TO RUN LONG DISTANCES, ABILITY TO SPEAK SEVERAL LANGUAGES, AND WILLINGNESS TO TAKE RISKS.

D. ABILITY TO SPEAK IN FRONT OF LARGE CROWDS, ABILITY TO DESIGN ANIMAL ENCLOSURES, AND ABILITY TO RUN LONG DISTANCES.

WHICH JOB WOULD MOST LIKELY NOT BE DONE BY AN AGRONOMIST?

A. PERFORMING EXPERIMENTS WITH PLANTS

B. VISITING A FIELD TO CHECK CROP QUALITY

C. GATHERING SOIL AND WATER SAMPLES

D. WRITING A RESTAURANT FOOD REVIEW FOR THE NEWSPAPER

WHY COULD DR. NORMAL BORLAUG BE CONSIDERED A FRIEND OF THE ENVIRONMENT?

A. HE PREVENTED PEOPLE FROM STARVING.

B. HE HELPED PEOPLE TO REDUCE THEIR USE OF FERTILIZERS.

C. HE THOUGHT PEOPLE SHOULD CUT DOWN TREES TO CREATE MORE FARMLAND.

D. HE THOUGHT ALL FARMERS SHOULD RAISE CROPS AND LIVESTOCK.

CAREER FOCUS: AGRONOMIST

NAME_____

LIST AT LEAST THREE SKILLS THAT WOULD BE MOST USEFUL FOR AN AGRONOMIST.

WHY WOULD AN AGRONOMIST MOST LIKELY NOT WRITE A RESTAURANT FOOD REVIEW IN THE NEWSPAPER?

WHY COULD DR. NORMAL BORLAUG BE CONSIDERED A FRIEND OF THE ENVIRONMENT?

AGRONOMIST: ANSWER KEY

WHAT GROUP OF SKILLS WOULD BE MOST USEFUL FOR AN AGRONOMIST?

A. COMMUNICATION SKILLS, WILLINGNESS TO TAKE RISKS, AND ABILITY TO SPEAK SEVERAL LANGUAGES

B. ABILITY TO SPEND LONG HOURS OUTSIDE, COMMUNICATION SKILLS, AND ABILITY TO DESIGN EXPERIMENTS

C. ABILITY TO RUN LONG DISTANCES, ABILITY TO SPEAK SEVERAL LANGUAGES, AND WILLINGNESS TO TAKE RISKS.

D. ABILITY TO SPEAK IN FRONT OF LARGE CROWDS, ABILITY TO DESIGN ANIMAL ENCLOSURES, AND ABILITY TO RUN LONG DISTANCES.

WHICH JOB WOULD MOST LIKELY NOT BE DONE BY AN AGRONOMIST?

A. PERFORMING EXPERIMENTS WITH PLANTS

B. VISITING A FIELD TO CHECK CROP QUALITY

C. GATHERING SOIL AND WATER SAMPLES

D. WRITING A RESTAURANT FOOD REVIEW FOR THE NEWSPAPER

WHY COULD DR. NORMAL BORLAUG BE CONSIDERED A FRIEND OF THE ENVIRONMENT?

A. HE PREVENTED PEOPLE FROM STARVING.

B. HE HELPED PEOPLE TO REDUCE THEIR USE OF FERTILIZERS.

C. HE THOUGHT PEOPLE SHOULD CUT DOWN TREES TO CREATE MORE FARMLAND.

D. HE THROUGH ALL FARMERS SHOULD RAISE CROPS AND LIVESTOCK.

AGRONOMIST: ANSWER KEY

LIST AT LEAST THREE SKILLS THAT WOULD BE MOST USEFUL FOR AN AGRONOMIST?

Answers will vary. Potential answers could include: ability to be outside for long periods of time, ability to design experiments and analyze data, ability to communicate with others, etc.

WHY WOULD AN AGRONOMIST MOST LIKELY NOT WRITE A RESTAURANT FOOD REVIEW IN THE NEWSPAPER?

A journalist or food critic would most likely write a food review in a newspaper. Agronomists are more concerned with how food is grown and not as interested in what it tastes like at a restaurant.

WHY COULD DR. NORMAL BORLAUG BE CONSIDERED A FRIEND OF THE ENVIRONMENT?

Possible answer: He helped farmers to grow more food on less land and reduce their use of fertilizers..

WOULD YOU WANT TO BE AN AGRONOMIST?

Take a moment to consider becoming an agronomist.

- What would you list as your pros (parts of the job you would enjoy) and cons (parts of the job you would not enjoy)?
- What area would you be most likely to specialize in? Why?
- What steps would you need to take now and later to prepare yourself to pursue agronomy?
- Is this a career path that interests you right now? Why or why not?

ENERGY AND MATTER

Choose one of the five places an agronomist may work that is included in the text. Describe the energy and matter that an agronomist would be monitoring as it moves into and out of that system. What energy and/or matter might the agronomist need to add to the system or remove from the system? Why?

Concept Wheel Graphic Organizer

In the center of the wheel describe what an agronomist does. Around the outside, take notes using information from the text. Answer the given questions and add information you think is important and/or want to remember.