



Technology MATH

Technology helps farmers and ranchers produce more food at less cost and better quality. Here are some examples how:

1. If a farmer planted 5 acres per hour with a horse-drawn planter in 1900, how many acres did he plant in an 8-hour day?

2. Today's farmer can plant 50 acres per hour with a tractor and seeder. How many acres can he plant in an 8-hour day?

3. How many more acres can the farmer plant in a day now compared with 1900?

4. Before milking machines were invented in 1894, a farmer could milk 6 cows per hour by hand. How long would the milking take if the farmer had 15 cows?

5. Farmers now can milk a cow in about 8 minutes with a milking machine. If a farmer has 12 milking machines going at once, how many cows can be milked in one hour?

6. If a prize-winning cow produces one calf per year, how many calves will she have in 5 years?

7. If 10 embryos from the cow are transferred to 10 other cows each year, how many calves will there be in 5 years?

TECHNOLOGY IN AGRICULTURE

Technology is the practical application of science. In agriculture, you'll find technology on the farm, in research laboratories, in factories where equipment is designed and manufactured, in processing plants where food and fiber products are made, and in stores where products are sold to you.

VIDEO: N.D. Agriculture Aerial

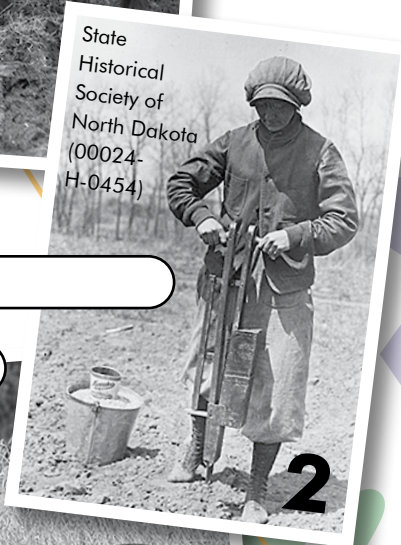
From Hand Tools to Big Machines

When people started farming, they did everything by hand. But today, farmers rely on the help of machines.

Name each hand tool and machine. Choose from: truck, horse-drawn plow, hand planter, plow, wagon, planter, combine, scythe. Then **place the number** of the hand method in the box of the similar machine method.



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USDA

Technology Then to Now

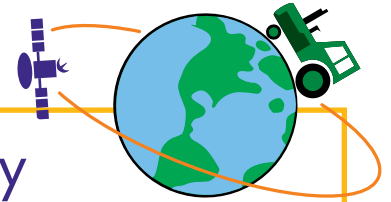
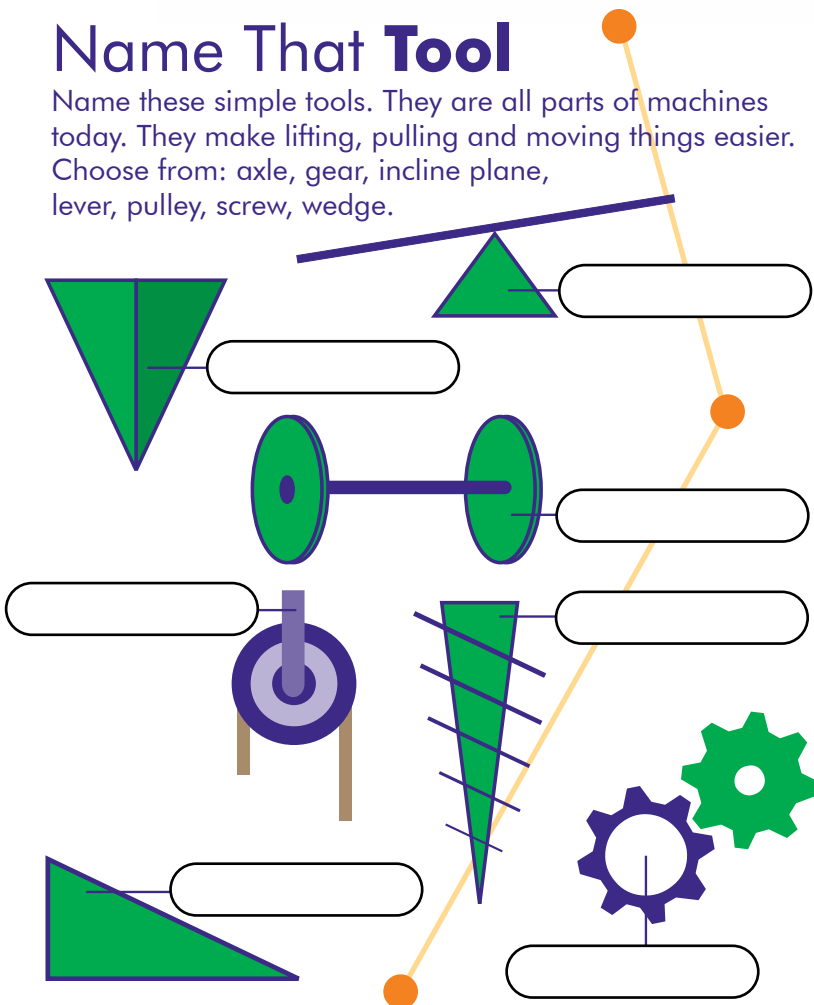
Number these tools in order from earliest (1) to present (6).

- small tractor
- horse-drawn plow
- unmanned aerial vehicle
- walking cultivator
- four-wheel drive tractor
- hoe



Name That Tool

Name these simple tools. They are all parts of machines today. They make lifting, pulling and moving things easier. Choose from: axle, gear, incline plane, lever, pulley, screw, wedge.



Technology in Agriculture

Check the correctly spelled word to complete each sentence.

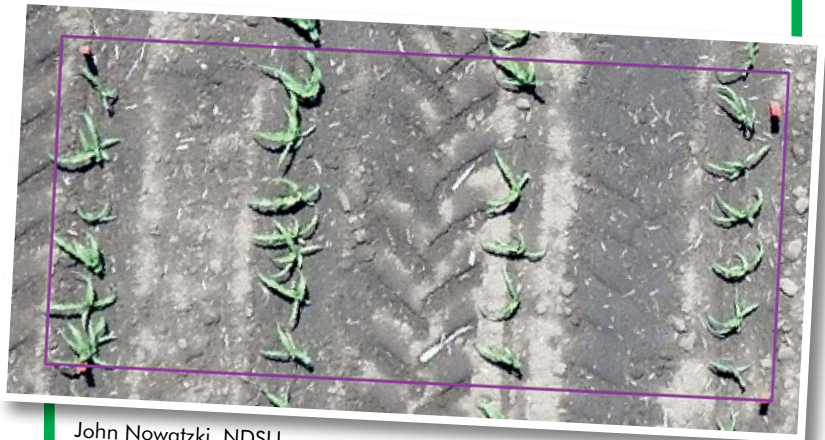
1. Today (satellites or satelights) and computers help farmers and ranchers grow crops and livestock more efficiently and take better care of the land.
2. Photos are taken of their (feilds or fields) and pastures from space.
3. Global Positioning Systems (GPS) identify the exact (coordinates or coordinants) – latitude and longitude – of the photo.
4. The photos can show where some of the plants are more yellow so may need more (nitrogen or nitrojen) fertilizer.
5. The farmer can apply fertilizer only to that area to save money and protect the (environment or enviroment).
6. Computers use GPS so the tractor can plant (strait or straight) rows, avoid placing fertilizer or pesticides where not needed, and even steer and turn itself.
7. Unmanned (arial or aerial) vehicles now can do many of the same things satellites have done but more accurately and cheaper.
8. For example, a UAV can fly over a beef cattle feedlot and identify a steer that has a high (temperture or temperature).
9. The sick animal can be (seperated or separated) from the others.
10. A (veternarian or veterinarian) can treat the sick animal.

UAVs in Agriculture

Unmanned aerial vehicles (UAV) are a new technology in agriculture. UAVs, sometimes called drones, are flown by remote control because they don't have a human pilot.

Special cameras and sensors on UAVs can help farmers and ranchers in many ways. They can:

- Show what part of a crop field might need more fertilizer or might have a disease
- Tell which beef steer in the feedlot has a raised temperature and might be sick
- Find cattle that may be separated from the rest of the herd in a pasture
- Use global positioning systems (GPS) to gather data about crops and livestock



John Nowatzki, NDSU

In this photo from a UAV, how many young corn plants are in the 1 meter X 2 meter rectangle?

See where it looks like a plant didn't grow in a row. Check the possible reasons why there is no plant:

- The planter didn't drop a seed.
- The seed didn't germinate.
- The planter planted the seed too deeply.
- Insects ate the small plant.

What two things are needed for most seeds to germinate?

Can a Drone Do That?

In addition to agricultural uses, check the box if a drone can do this activity.



Xin (Rex) Sun, NDSU

Can a drone:

- Kill field mice?
- Help firefighters fight a wildfire?
- Catch fish?
- Feed your cat?
- Help during an emergency?
- Make your lunch?
- Deliver a package?
- Inspect land, or above-ground or underground lines?

Technology in Animal Agriculture

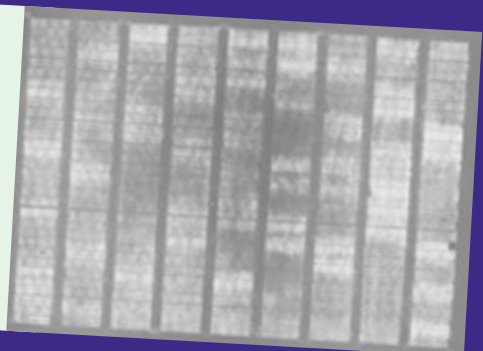
- **VIDEO:** Robotic Dairy
- **VIDEO:** Cattle GPS Collars and Smart Tags

Photography from Drones

In addition to regular photos like the ones above, drones with special cameras can take near infrared photos. Infrared waves cannot be seen by the human eye but detect heat. Near infrared photos can show a farmer:

- If an area of a field needs more or less fertilizer or water
- Which part of the crop is ready to harvest
- Where disease might be affecting a crop
- Other growth details

Examine this photo of a research trial studying nitrogen in a crop. The darker colors are healthier plants.



Mike Ostlie, NDSU

Career Corner

Mike Ostlie, Agronomist
NDSU Carrington Research Extension Center



As a research agronomist, Mike finds answers to agricultural questions using research studies.

"I find out what farmers and ranchers are doing, including problems they have and things they want to know more about, then I design and carry out research projects to accurately answer one or two questions at a time," Mike said.

Mike especially enjoys applying new technologies to agriculture. He uses unmanned aerial vehicles (UAVs or drones), unmanned ground vehicles (UGVs or robots), artificial intelligence software and other technologies to conduct studies that may help farmers.

"Many people think that precision ag is just about flying drones," Mike said. "Indeed, they can help find problem areas in a field and provide information needed to adjust seeding or fertility practices, but they are a small part of the technologies that will play a bigger role in ag each year. An emerging ag industry is robotics, which can be anything from self-driving tractors to miniature planters to fruit harvesters.

"On the biology side, the crops' genomes will play a bigger role in the future of precision agriculture and pest management. One day farmers will be able to analyze their crops' genome to help identify problems that reduce yield."

Mike grew up on a farm that raised many different crops as well as sheep. He wanted to learn more about the biology and technology of agriculture. He completed his bachelor's and master's degrees in crop and weed sciences at North Dakota State University and Ph.D. in weed science at Colorado State University to prepare for research work.

Mike hopes students will consider ag science careers.

"There will be many job opportunities on and off of farms for people who understand agriculture and can write computer codes, analyze images, fix electrical components or extract DNA samples," he said. "The best way to learn is a mixture of hands-on experience through part-time jobs and internships, and formal education in your area of interest.

"It is an exciting time to study agronomy. Every year there are new companies, products or computer programs that have the potential to improve farming efficiency and improve rural lives."



NDSU

Write the definition's letter with the correct word.

- Research
 - Agronomist
 - Artificial intelligence
 - Precision agriculture
 - Genome
- An organism's complete set of DNA
 - Crop scientist
 - Farming that uses data and equipment to reduce inputs (water, fertilizer, herbicides, insecticides, etc.)
 - Systematic investigation to establish facts
 - Computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making and translation between languages

Grand Farm's Grand Plan



More than 7 billion people now live on Earth. That's a lot, but in a few years, there will be nearly 10 billion people. Write 10 billion in numerals.

How many zeroes does the numeral have?

Earth isn't getting larger, so how will we be able to feed all those people without destroying our home?

That's what Grand Farm is helping figure out. Scientists and farmers are working together at Grand Farm south of Fargo to research possibilities. Many worldwide companies located in the area also are helping. Grand Farm will help North Dakota and Minnesota be a world leader in how to use technology to grow more food.

Understand the Grand Farm Education and Research Initiative

Insert the letter of the definition below with the word in this story to better understand Grand Farm.

Grand Farm:

- Inspires **collaboration** among businesses, organizations and researchers to develop the future farm, which will solve issues critical to farmers worldwide.
- Is creating the **prototype** for the first fully **autonomous** farm.
- Supports **innovation** by supporting for new ventures, engaging partners and creating economic vibrancy.
- Provides **makerspace** for research and innovation.
- Offers an **ecosystem**.
- Hosts field plots where partners carry out research projects, test **experimental** technologies and gather together to create connections.
- Research projects now focus on soil health monitoring, unmanned aerial and ground systems, autonomous vehicles, plant **sensing** and precision spraying.

- a preliminary model to test a concept from which other forms are developed
- onsite spaces for creators, innovators, builders, entrepreneurs and students
- finding and identifying
- the creation, development and implementation of a new product, process or service with the aim of improving efficiency, effectiveness or competitive advantage
- working with other people or groups to achieve, create or do something
- untested; procedures carried out under controlled conditions to discover unknown effects or to test hypotheses
- a community of people with similar interests from across the globe who interact
- operates on its own by learning from its surroundings and completing tasks without continuous human input

Agricultural Technologies

Use these words and numbers to fill in the blanks below: landing, 8, wheat, 77, robot, 6, recognize, 51



Artificial intelligence can help farmers recognize plants and weeds. In this drone picture, the percentage value means AI prediction accuracy. In other words, 100% means the software is totally confident in its identification. The highest prediction accuracy for corn is 5. %. The prediction accuracy for identifying the weed is 6. %.



This drone has 1. rotors and a camera on the bottom. It is taking photos of the 2. crop.

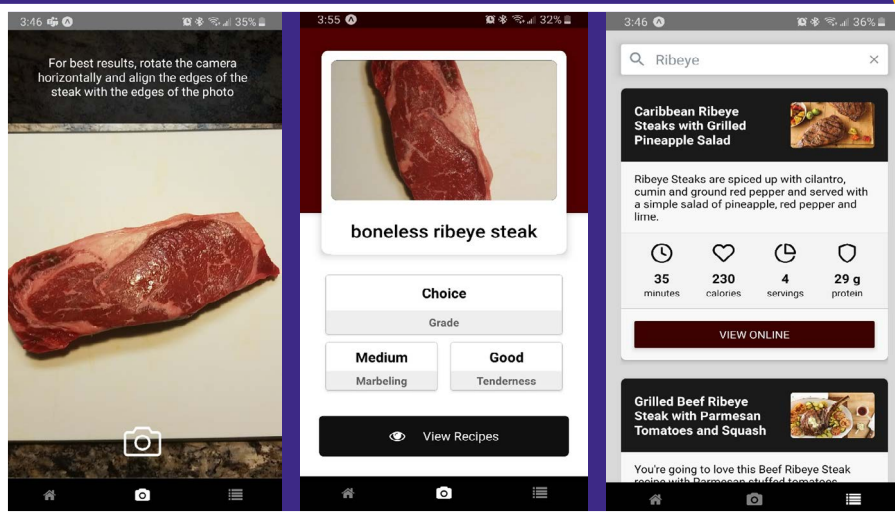


This drone has 3. rotors. The orange pad is for targeting its 4. .



After confidently identifying a weed, a 7. can spray a pesticide precisely on the weed to destroy it.

Photos by Xin (Rex) Sun and Yu (Heather) Zhang, NDSU



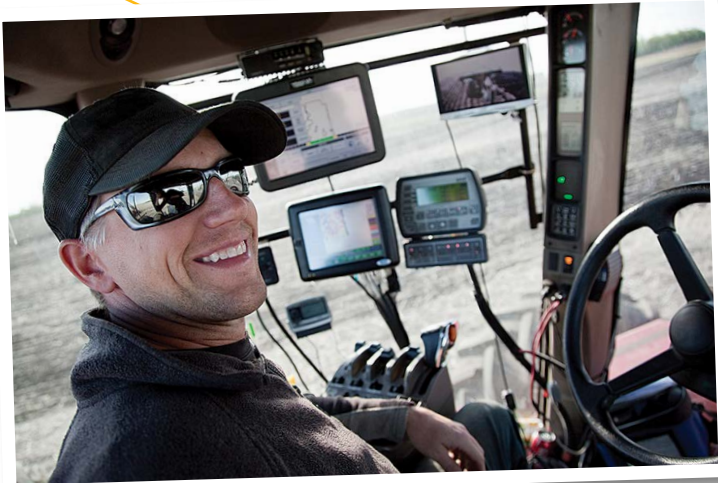
Artificial intelligence can 8. objects. This app, which is still under development, will help consumers identify a meat cut they take a photo of and see recipes for preparing it.

Why Technology in Agriculture is Important

Today about 7.5 billion people live on Earth. The United Nation predicts world population to reach nearly 11 billion by 2100. They all will need to eat every day. Technology will help make that possible.

Use these numbers to fill in the missing numbers in the U.S. Farm Productivity chart below: **77, 1850, 166, 1910**

U.S. Farm Productivity		
Year	Ag Technology	Number of People Each Farmer Feeds
<input type="text"/>	Horse-drawn plow	4
<input type="text"/>	Steam tractor	7
1986	Combine	<input type="text"/>
2019	Satellites and computers	<input type="text"/>



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Living Ag Classroom Now Online

Living Ag Classrooms couldn't be held in person across North Dakota in Spring 2021. However, you can watch videos, download worksheets and learn about North Dakota agriculture in other ways at the [Virtual Living Ag Classroom](#).



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