TECHNOLOGY IN AGRICULTURE

This issue of the North Dakota Ag Mag focuses on agricultural technology. The information and activities are geared primarily toward the state's third, fourth and fifth graders.

The Ag Mag is distributed three times per year. Subscriptions are free, but if you're not on the mailing list or if you know someone else who wants to be added, contact the North Dakota Department of Agriculture at 1-800-242-7535 or ndda@nd.gov.

The magazine also is on the N.D. Agriculture in the Classroom website at **www.ndaginclassroom.org**.

This magazine is one of the N.D. Agriculture in the Classroom Council activities that helps K-12 teachers integrate information and activities about North Dakota agriculture across the curriculum in science, math, language arts, social studies and other classes. It's a supplemental resource rather than a separate program.

Answers to Technology MATH

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? **5 acres per hour X 8 hours = 40 acres**

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? **50 acres per hour X 8 hours = 400 acres**

3. How many more acres can the farmer plant in a day now compared with 1900? **400 acres – 40 acres = 360 acres**

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? **15 cows ÷ 6 cows per hour = 2 ½ hours**

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? **60 minutes per hour ÷ 8 minutes per cow = 7.5 cows per hour X 12 milking machines (one for each cow) = 90 cows per hour**

6. If a prize-winning cow produces one calf per year, how many calves will she have in 5 years? **1 calf per year X 5 years = 5 calves**

7. If 10 embryos from the cow are transferred to 10 other cows each year, how many calves will there be in 5 years? **10 transferred embryos that result in calves X 5 years = 50 calves from the surrogate mothers**

From **Hand Tools** to **Big Machines**

Idea: Have students research the size of an acre. It's 43,560 square feet, but students seem to best understand when compared to the size of a football field.
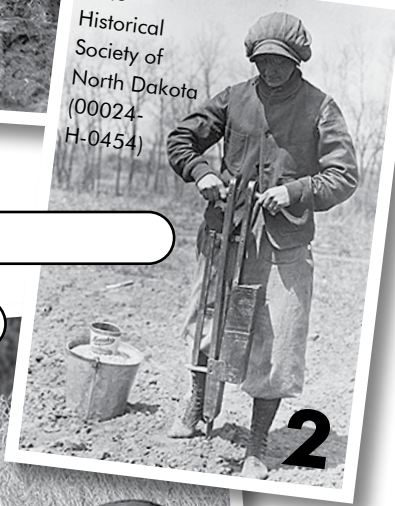
1 horse-drawn plow

www.istockphoto.com

combine www.istockphoto.com

3

State Historical Society of North Dakota (00024-H-0454)

hand planter

scythe

2

truck www.istockphoto.com

4

3

www.istockphoto.com

plow

1

www.istockphoto.com

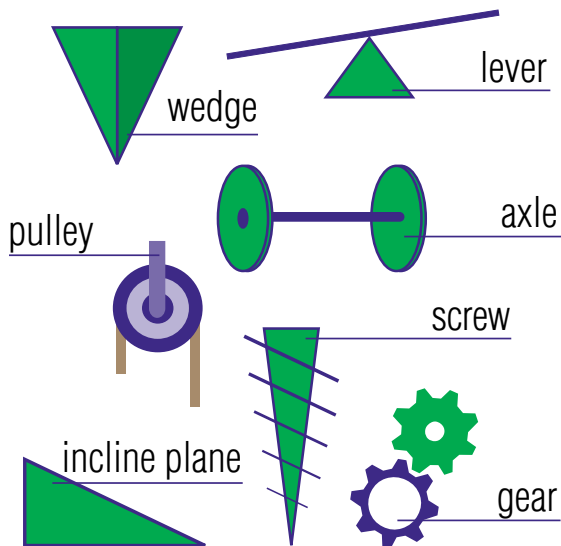wagon

www.istockphoto.com

4

planter

2

USDA

Answers to Technology **Then** to **Now**

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

4 small tractor

3 horse-drawn plow

6 unmanned aerial vehicle

2 walking cultivator

5 four-wheel drive tractor

1 hoe

Answers to Name That **Tool**

wedge
lever
pulley
axle
screw
incline plane
gear

Idea: Develop an agricultural technology timeline. Archeological investigations in North Dakota document the presence of both hunting and gathering, and farming people dating back to 2000 B.C. Have students research what major ag technologies should be included on the timeline. Include tools, machines, plants and animals. Also, discuss and include the forms of farm power in order: people, animal, steam engine and gasoline engine.
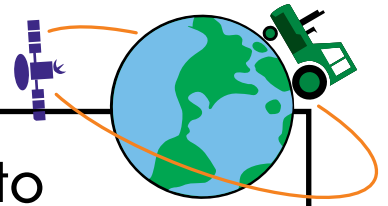
Answers to Technology in **Agriculture**

Circle the correct word to accurately 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 (veterinarian or **veterinarian**) can treat the sick animal.

3

Agriculture in **Space**

Background: Global Positioning Systems (GPS) use satellites in space that send signals to receivers on farm equipment. GPS tracks the exact position of a tractor by identifying its precise coordinates (longitude and latitude) and then plotting the position on an electronic map. Farmers use GPS to help them apply different amounts of seed, fertilizer or pesticides to different parts of a field. They program the implement's application controllers so that when the implement is entering a certain area of the field, the controllers change the amount of seed, fertilizer or pesticide the implement is applying.

Farmers also can use GPS to guide their tractors so they don't overlap when applying fertilizer or other products. GPS can steer the tractor for hands-free driving, or it can activate flashing lights on the dashboard to tell the driver if the equipment is drifting off the row.

Telematics is an electronic technology that captures data from farm equipment and transfers the information to the Internet in real time. Electronic sensors in the equipment monitor engine operation, fuel consumption, combine efficiency, planter accuracy and other actions. Cellular technology transfers the data to office computers or directly to the farmer's cell phone. Equipment dealers, agronomists and other professionals also may use the farmer's information to correct technical problems without traveling to the field. In addition, the data may be stored for easy record keeping.

Idea: The following trunks with supplies and teaching guides are available through your county office of NDSU Extension. See www.ag.ndsu.edu/extension/directory.

Garmin eTrex Legend GPS Trunk includes 10 hand-held GPS units, leader's resource binder, GPS Basics PowerPoint, instruction books, PC interface cables to connect GPS unit to computer and 10 laminated instruction sheets on how to facilitate an elementary scavenger hunt.

Geocaching Trunk includes six GPS units, geocaching instructions and books on geocaching. Geocaching is a fun sport that spans across the world. Groups that use this trunk need to supply their own prizes and protective plastic or metal boxes for the cache. Learn more at www.geocaching.com.

The Lego Mindstorms Robotics Trunk includes an intelligent computer-controlled Lego brick and the brain of this MINDSTORMS robot. This trunk includes four NXT Robotics sets, extra pieces, instructions and resources to build and program several different robots. This trunk is designed for ages 12 and older.

Answers to Can a **Drone** Do That?

Can a drone:

☐ Kill field mice? **No, at least not yet.**

☑ Help firefighters fight a wildfire? **Yes, by sending photos from high above, drones help firefighters plan how to get the fire out.**

☑ Catch fish? **Surprisingly, yes. Fishing using drones is becoming more common every day.**

☐ Feed your cat? **No, not likely.**

☑ Help during an emergency? **Yes. Drones can help deliver food, water, life jackets and medical supplies to those stranded by floods or other natural disasters.**

☐ Make your lunch? **Probably not as good as your mom – but someday they may do that, too – or at least deliver lunch.**

☑ Deliver a package? **Yes. Companies are starting to deliver product orders, medical supplies, meals, groceries and more via drone.**

☑ Inspect land, or above-ground or underground lines? **Yes. Drones can quickly and safely see if there's a fire, a leak, a break and more.**

The LEGO Education WeDo Robotics Trunk is an easy-to-use robotics construction set that introduces youth ages 7 and older to building models featuring motors and sensors, programming their models and exploring a series of activities. This trunk includes six WeDo construction sets, four activity packs and software. You will need laptops or desktop computers to program the robot creations.

Idea: Have students search YouTube for videos of robots that break up grain stuck in a bin, pick fruits and vegetables, herd sheep, kill weeds and much more.

Idea: Research the coordinates (latitude and longitude) of your school and other North Dakota, U.S. and world locations.

Answers to **UAVs** in **Agriculture**

Idea: Ask students if they know what unmanned aerial vehicles are. Do they know other names for them? (drones, unmanned aerial systems) They might have heard about drones used in military strikes, but ask them to brainstorm ways UAVs might have positive uses, especially related to agriculture.

Idea: Ask students to brainstorm other possible reasons for why seeds may not grow in a field or garden.

Idea: Discuss germination. Why do seeds not sprout in North Dakota in the winter?
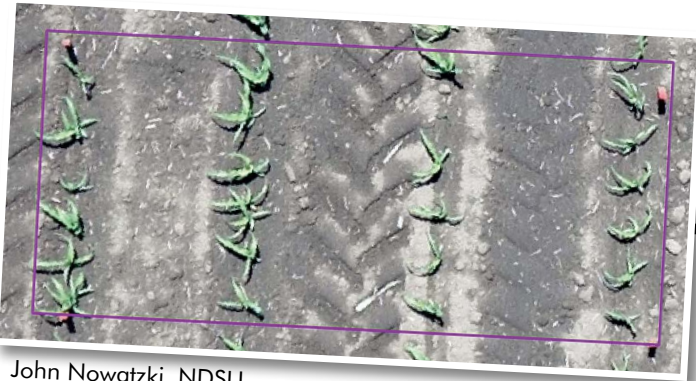
John Nowatzki, NDSU

In this photo from an UAV, how many young corn plants are in the 1 meter X 2 meter rectangle? __**24**__

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?

Moisture and **Warm Temperature**

Answers to Career Corner

Write the definition's letter with the correct word.

1. Research — **D.** Systematic investigation to establish facts

2. Agronomist — **B.** Crop scientist

3. Artificial intelligence — **E.** Computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making and translation between languages

4. Precision agriculture — **C.** Farming that uses data and equipment to reduce inputs (water, fertilizer, herbicides, insecticides, etc.)

5. Genome — **A.** An organism's complete set of DNA

Answers to **Grand Farm's Grand Plan**

More than seven 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. **10,000,000,000**

How many zeroes does the numeral have? **10 zeroes**

Idea: Have students go to https://grandfarm.com/ to learn more about Grand Farm.

Answers to 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:

1. Inspires collaboration among businesses, organizations and researchers to develop the future farm, which will solve issues critical to farmers worldwide. – **E.** working with other people or groups to achieve, create or do something

2. Is creating the prototype for the first fully autonomous farm. – **A.** a preliminary model to test a concept from which other forms are developed; and **H.** operates on its own by learning from its surroundings and completing tasks without continuous human input

3. Supports innovation by supporting for new ventures, engaging partners and creating economic vibrancy. – **D.** the creation, development and implementation of a new product, process or service with the aim of improving efficiency, effectiveness or competitive advantage

4. Provides makerspace for research and innovation. – **B.** onsite spaces for creators, innovators, builders, entrepreneurs and students

5. Offers an ecosystem. – **G.** a community of people with similar interests from across the globe who interact

6. Hosts field plots where partners carry out research projects, test experimental technologies and gather together to create connections. – **F.** untested; procedures carried out under controlled conditions to discover unknown effects or to test hypotheses

7. Research projects now focus on soil health monitoring, unmanned aerial and ground systems, autonomous vehicles, plant sensing and precision spraying. – **C.** finding and identifying

Answers to **Agricultural Technologies**

This drone has 1. **6** rotors and a camera on the bottom. It is taking photos of the 2. **wheat** crop.

This drone has 3. **8** rotors. The orange pad is for targeting its 4. **landing**.

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. **77**%. The prediction accuracy for identifying the weed is 6. **51**%.

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

Artificial intelligence can 8. **recognize** 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

U.S. Farm Productivity		
Year	Ag Technology	Number of People Each Farmer Feeds
1850	Horse-drawn plow	4
1910	Steam tractor	7
1986	Combine	77
2019	Satellites and computers	166

Idea: Talk to students about the technology in agriculture they see around them and how people use technology to produce, process and market food. Ask students if they recognize some of the machines and tools in agriculture – tractors, planters, computers – and if they know what they are used for.

Idea: When people first started farming, they did all the work by hand. Talk to students about what this might have been like. Have you planted a garden? Imagine doing this all day every day. What tools would you invent to make planting and tending a garden easier?

Idea: Visit a farm, implement dealership or food processing plant to look at technology. Attend a farm show or ask a farmer, implement dealer, elevator manager or food processor to visit the class.

Idea: Discuss world population trends and the need to be able to produce more food. The world now has nearly 7½ billion people. By 2050, the population is expected to grow to almost 9.6 billion. Ask students to imagine what their classroom would be like if the number of students in the class increased at the same rate the population is growing. Rather than 25 students in the room, there would be almost 40. Where would they all sit?

In the past, the demand for more food has been met through technology. Will we be able to do so in the future? Ask students what kind of inventions we might need in the future to produce all the food the world needs.

Ask students if they can think of some negative side effects of technology. There are several. Technology, for instance, is partly responsible for the reduction in the number of farmers needed to produce food. Technology also introduces man-made substances into nature. It raises ethical questions about whether people should create new plants from non-related species or clone animals. How would your students solve these problems?

Technology Ag Mag Standards and Benchmarks

English Language Arts and Literacy Content Standards for Reading Informational/Nonfiction Text

Gr. 3, RI.1 Ask and answer questions to demonstrate understanding of a text (textual evidence), referring explicitly to the text as the basis for the answers.

Gr.3, RI.2 Determine the main idea of a text and recount the key details to explain how they support the main idea.

Gr.3, RI.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Gr.4, RI.1 Refer to details and examples in a text (textual evidence) when explaining what the text says explicitly and when drawing inferences from the text. Summarize the text.

Gr.4, RI.2 Determine the main idea of a text and explain how it is supported by key details.

Gr.4, RI.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Gr.5, RI.1 Quote accurately using textual evidence when explaining what the text says explicitly and when drawing inferences from the text. Summarize the text.

Gr.5, RI.2 Determine two or more main ideas of a text and explain how they are supported by key details.

Gr.5, RI.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

Craft and Structure

Gr.3, RI.4; Gr.4, RI.; Gr.5, RI.4
Determine the meaning of general academic and domain specific words and phrases in a text relevant to a grades 3,4 and 5 topics or subject areas.

Mathematics Standards and Benchmarks

Domain: Operations and Algebraic Thinking

Cluster: Use the four operations with whole numbers to solve problems.

4.OA.1 Interpret a multiplication equation as a comparison. Represent verbal statements of multiplicative comparisons as multiplication equations.

Domain: Number and Operations in Base Ten

Cluster: Use place value understanding and properties of operations to perform multi-digit arithmetic.

3.NBT.3 Using strategies based on place value and properties of operations, multiply one digit whole numbers by multiples of 10 in the range 10-90.

Domain: Number and Operations – Fractions

Note: Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.

Cluster: Develop understanding of fractions as numbers.

3.NF.1 Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts.

Understand a fraction a/b as the quantity formed by "a" parts of size 1/b.

North Dakota Science Standards

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 4-PS4-3
Construct a code to convey information by researching past and present methods of transmitting information.

PS4.C: Information Technologies and Instrumentation -Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information — convert it from digitized form to voice — and vice versa.

Earth and Human Activity

Performance Standard 5-ESS3-1
Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

ESS3.C: Human Impacts on Earth Systems -Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. However, individuals and communities are doing things to help protect Earth's resources and environments.

North Dakota Social Studies Standards

Geographic Representation

G.3_5.2 Use geographic tools and technologies to acquire, process, and report information from a spatial perspective.

G.3_5.3 Use maps, satellite images, photographs, and other representations to explain relationships between the locations of places, regions, and their environmental characteristics.

History Standards: Cause, Effect, and Current Events

H.3_5.5 Describe multiple causes and effects of contemporary global events and developments in relation to North Dakota.

North Dakota Agriculture in the Classroom Activities

This **Ag Mag** is just one of the North Dakota Agriculture in the Classroom Council projects. Each issue of the Ag Mag focuses on an agricultural commodity or topic and includes fun activities, bold graphics, interesting information and challenging problems. Send feedback and suggestions for future Ag Mag issues to:

> Becky Koch
> NDSU Agriculture Communication
> 701-866-6162
> becky.koch@ndsu.edu

Another council teacher resource is **Project Food, Land & People** (FLP). Using the national FLP curriculum, N.D. Ag in the Classroom provides 600-level credit workshops for teachers to instruct them in integrating hands-on lessons that promote the development of critical thinking skills so students can better understand the interrelationships among the environment, agriculture and people of the world. Teachers are encouraged to adapt their lessons to include North Dakota products and resources.

Project Food, Land & People's 55 lessons include:

- Amazing Grazing
- Cows or Condos?
- By the Way
- Seed Surprises
- Schoolground Caretakers
- Could It Be Something They Ate?
- What Piece of the Pie?
- and many more.

For information, contact:

> Jill Vigesaa
> N.D. Farm Bureau Foundation
> 701-799-5488
> jill.vigesaa@gmail.com

The N.D. Geographic Alliance conducts a two-day **Agricultural Tour for Teachers**. The tour includes farm and field visits, tours of agricultural processing plants to see what happens to products following the farm production cycle, and discussions with people involved in the global marketing of North Dakota farm products.

For information, contact:

> Marilyn Weiser
> North Dakota Geographic Alliance
> 701-858-3063
> marilyn.weiser@gmail.com

Educators may apply for **mini-grants for up to $500** for use in programs that promote agricultural literacy. The Agriculture in the Classroom Council, working with the N.D. FFA Foundation, offers these funds for agriculture-related projects, units and lessons used for school-age children. The mini-grants fund hands-on activities that develop and enrich understanding of agriculture as the source of food and/or fiber in our society. Individuals or groups such as teachers, 4-H leaders, commodity groups and others interested in teaching young people about the importance of North Dakota agriculture are welcome to apply.

Examples of programs that may be funded: farm safety programs, agricultural festivals, an elementary classroom visiting a nearby farm and ag career awareness day. Grant funds can be used for printing, curriculum, guest speakers, materials, food, supplies, etc. More ideas and an application are at **www.ndaginclassroom.org**.

For information, contact:

> Beth Allen
> N.D. FFA Foundation
> 701-224-8390
> ballen@ndffa.org

North Dakota Agriculture in the Classroom Council

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Jackie Buckley – Youth Ag Education Representative
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Dolores Rohrich – Northern Pulse Growers Association
Suzanne Wolf – North Dakota Soybean Council

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