North Dakota
agMag
December 2006 Teacher's Guide
A Magazine about Agriculture for North Dakota Students

TECHNOLOGY

The North Dakota Ag Mag provides information and activities 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 is also on the Web at www.ag.ndsu.nodak.edu/aginfo/agmag/agmag.htm or through the North Dakota Agriculture in the Classroom Web site 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.

The Council's mission is to cultivate an understanding of the interrelationship of agriculture, the environment and people by integrating agriculture into K-12 education.

The N.D. Agriculture in the Classroom Council is coordinated through the N.D. Department of Agriculture.

For more information, contact:

Jeff Weispfenning or Joanne Beckman
1-800-242-7535, ndda@nd.gov

Another Council teacher resource is **Project Food, Land & People** (FLP). Using the national FLP curriculum, N.D. Ag in the Classroom provides graduate-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 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:

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Since teachers must relate work to **education standards**, the Council is working with North Dakota State University to identify which Project Food, Land & People lessons meet North Dakota's academic standards for grades K-8. Also, the North Dakota Agriculture in the Classroom **Web site at www.ndaginclassroom.org** includes links to educational materials, statistics, resources and activities for students and teachers.

For more information, contact:

Joanne Beckman
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The Ag in the Classroom Council, working with the N.D. FFA Foundation, offers **mini grants** of up to $500 for use in programs that promote agricultural literacy. These mini grants will fund hands-on activities that develop and enrich understanding of agriculture and ag-related industries and the important role they play in North Dakota and society. Educators can let their imaginations be their guides as they design projects to enhance ag education in or outside the classroom.

For information, contact:

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North Dakota Agriculture in the Classroom

www.ndaginclassroom.org

Technology in Agriculture

Technology is the practical application of science. It involves the use of tools, machines, materials, techniques and power sources to make people's lives easier and more productive. People in all phases of agriculture – farmers, food processors, grocery retailers and many others – use technology to produce food, fiber, fuel and other products efficiently.

In North Dakota, you can see agricultural technology every day – combines, tractors, computers and checkout scanners are examples.

But some of the technology is not visible, such as the plant and animal breeding techniques, and the processes used to make your food and many of the products you use.

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 must 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.

Answers to **Tools** and **Machines** –

Air wrench – tightens or loosens bolts with power

Tractor – pulls implements to grow crops and carry out other farm or ranch tasks

Milking machine – milks cows

Truck – hauls grain and other farm inputs and products

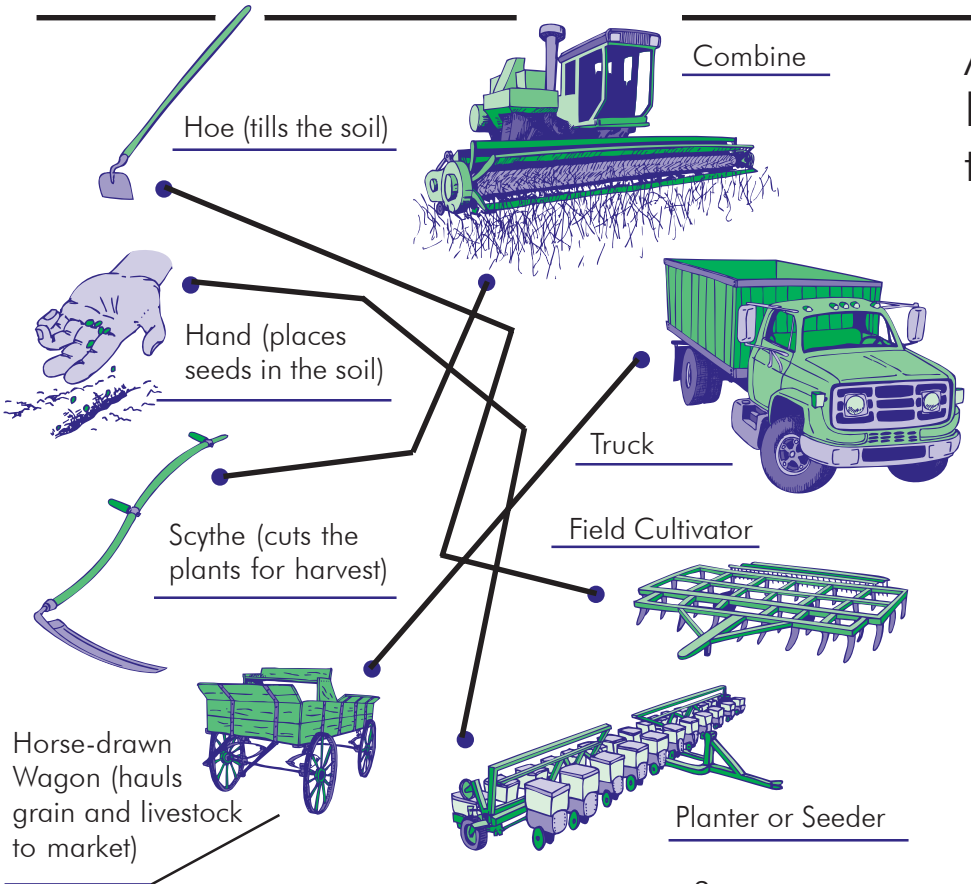
Computer – finds and stores information

Bottle filler – fills cans and bottles with food and other products

Pasta press – makes pasta and noodles

Cash register/scanner – checks out products at the store and tracks inventory

Refrigerator/freezer – keeps things cold



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

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? **40 acres**

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? **400 acres**

How many more acres can the farmer plant in a day now compared to 1900? **400 - 40 = 360 acres**

Research: How many square feet are in an acre? **43,560 square feet, about the size of a football field**

Agriculture in **Space**

Background: One of the newest technologies in agriculture is Global Positioning Systems (GPS). This involves using satellites in space that send signals to receivers on farm equipment. GPS tracks the exact position of a tractor on the face of the earth 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 and fertilizer 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 or fertilizer 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 actually steer the tractor for hands-free driving, or it can activate flashing lights on the tractor dashboard to tell the driver if the equipment is drifting off the row.

Idea: Give students a hands-on opportunity to learn about global position systems (GPS) by conducting a scavenger hunt. The following trunks with supplies and teaching guides are available through your county office of the NDSU Extension Service.

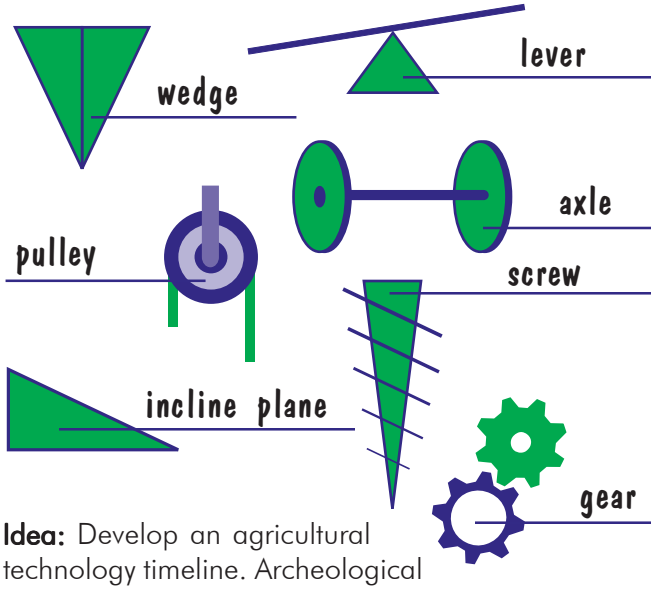
Garmin III GPS Trunk teaches the basics of geospatial positioning. It includes 10 hand-held GPS units and 10 laminated instruction sheets on how to facilitate an elementary scavenger hunt.

Garmin eTrex Legend GPS Trunk includes 10 hand-held Garmin eTrex Legend 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 Garmin eTrex 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. An example of a cache is provided in the trunk. Go to www.geocaching.com for more information.

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

Answers to **Name** That **Tool**



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 **Then** to **Now**

4 small tractor

7 satellite in orbit

1 hoe

6 tracked combine

3 horse-drawn plow

2 walking cultivator

5 four-wheel drive tractor

Plant Technology

Idea: Discuss how people first gathered wild plants for food, then cultivated gardens and began selecting plants for bigger seeds and sweeter fruits. There's evidence that 10,000 years ago people realized if they planted the biggest and best seeds from a plant, they would produce bigger and better plants.

Idea: Show students how plants produce seeds by pollination. Using a flower, show students how pollen from one plant is transferred to another plant, creating a seed that is a mix of traits of the parent plants. Use the "Buzzy, Buzzy Bee" lesson from the Project Food, Land & People Resources for Learning that has students pretend to be honey bees and apple trees to learn about plant pollination.

Biotechnology

Biotechnology, the newest way to develop new plants, takes pollination to a new level.

Idea: Introduce the concept of biotechnology by exploring the two words that are combined in its name:

Biology – the science of plants and animals

Technology – tools, machines, materials, techniques and sources of power; the application of science

Rather than manually crossing pollen from one plant to another, scientists who are using biotechnology take DNA from the cell of one plant and transfer it into another plant's cell. The genetically modified cell grows and produces a whole new plant with characteristics of both parents.

Scientists are especially excited about the potential of biotechnology because the two plants don't have to be alike to produce a new seed. They can in theory move some of the genes from a wheat plant to a corn plant or from a carrot to spinach. They can even move genes from bacteria or an animal into a plant. Already scientists have developed a rice variety that contains high levels of vitamin A, which helps prevent blindness; a tomato that keeps its just-picked flavor and texture longer; corn that is resistant to certain insects; and soybeans that aren't damaged by herbicides that kill weeds in the same field.

Idea: For 9th-12th grade students, use the lesson "Bacillus thuringiensis: Sharing Its Natural Talent with Crops" by Iowa State University at www.biotech.iastate.edu/publications/bt_curriculum

Idea: Ask students to brainstorm a totally new fruit or vegetable that would combine two or more traits they like about their favorite foods – a banana that is crunchy like an apple or carrots that already have the dip in them or broccoli that tastes like watermelon. How would they go about developing such plants? What plants would they combine to make a new food?

Idea: Use the Project Food, Land & People lesson "Banking on Seeds" to explore the role seeds play in the world and to compare the uses of seeds.

Idea: To experience biotechnology, conduct these in-class activities:

Have Your DNA and Eat It Too – Students build an edible model of DNA while learning basic DNA structure and the rules of base pairing.

University of Utah
http://learn.genetics.utah.edu/units/basics/print-and-go/eat_DNA.cfm

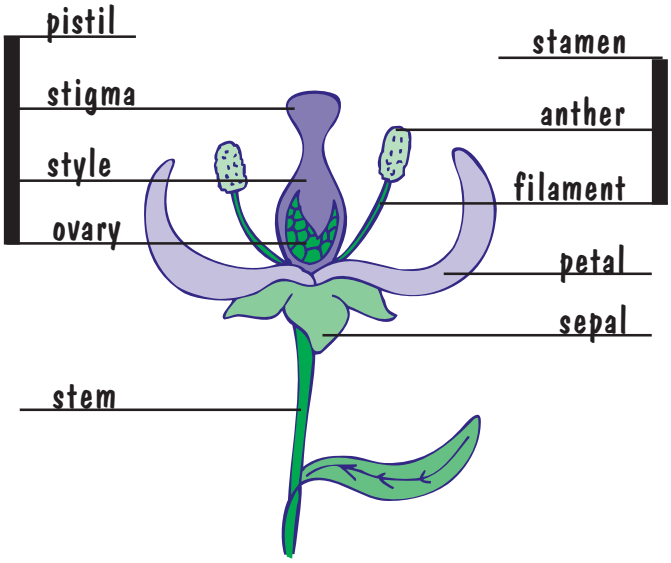
The Incredible Edible Cell – Students produce a cell model from various food items. Each food item represents a specific part (organelle) of the cell. When the lab is completed, the cell model is edible.

National Health Museum
http://www.accessexcellence.org/AE/ATG/data/released/0251-NickHoffman/

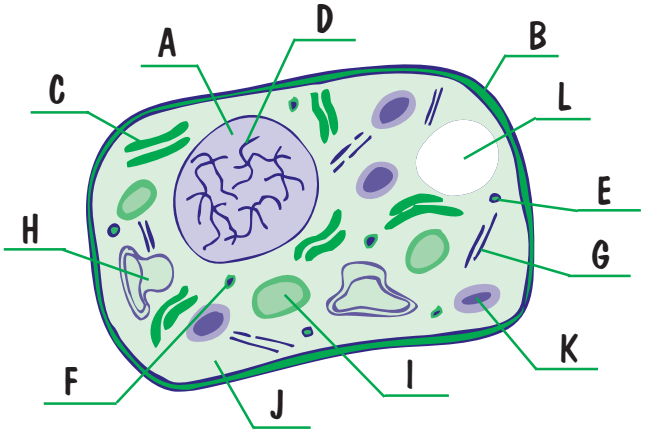
Fruit Cup DNA Extraction from Kiwi – Use household equipment and store supplies to extract DNA from kiwi in sufficient quantity to be seen and spooled.

Iowa State University
http://www.biotech.iastate.edu/lab_protocols/DNA_Extraction_fruit_cup.pdf

Answers to **Plant Parts**



Answers to **Plant Cells**



Protecting Plants

Technology also helps farmers protect plants from bugs, diseases and weeds. Farmers usually try to use natural methods to control pests, but sometimes chemicals are required. The chemicals that rid plants of these pests are called pesticides. Match the specific chemical to how it protects plants. Discuss how the first part of the word describes what kind of plant pest the products protect plants against.

Fungicides – Protect plants from diseases
Herbicides – Protect plants from weeds
Insecticides – Protect plants from insects

Integrated Pest Management (IPM) emphasizes other tools to reduce plant pests. Pesticides are generally considered after other options have been explored and only when economic thresholds have been exceeded. Other options include cultural control, such as selecting resistant varieties and rotating crops. IPM options also include biological control, such as introducing insects that feed on pest insects or insects that eat weeds. These options are often less expensive for the farmer and protect the environment better than using pesticides.

Idea: Use the Project Food, Land & People lesson "Investigating Insects" to allow students to become entomologists by observing insects.

Animal Technology

Idea: Introduce the concept that animals are different from each other, just like people are different from one another. One cow may be tall, another short; one pig may be fat and another thin; one sheep may produce a lot of milk and another not as much.

As with plants, farmers learned a long time ago that their strongest, biggest, healthiest animals had the strongest, biggest and healthiest offspring, too. By carefully selecting the best male and female animals for breeding, they increased the number of healthier and stronger animals. These animals produced more milk, meat or eggs for people than weaker animals.

Better **Livestock**

One of farmers' and ranchers' technologies is embryo transfer. They remove the embryos from a superior animal and place them in surrogate females, where pregnancy continues normally and the females give birth to offspring with the characteristics of the superior animal. Rather than one superior animal, the farmer ends up with several.

Answers to **Embryo Transfer**

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

If 10 embryos from the prize-winning cow are transferred to 10 other cows each year, how many calves from the prize-winning cow will there be in 5 years? **50 calves from the surrogate mothers**

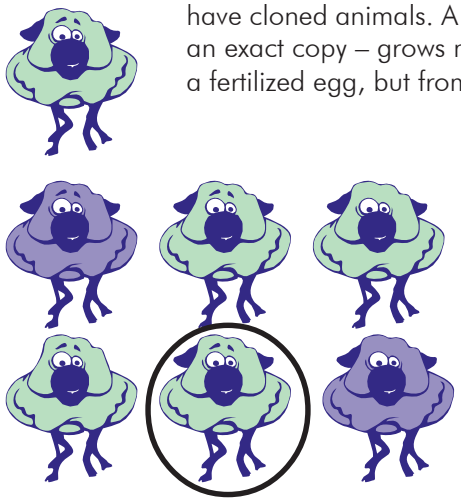
Technology for **Food Safety**

Idea: Talk about the many ways students and adults can practice food safety. How does technology help keep our food safe?

Idea: Help students learn the difference between food spoilage and food contamination, and more about food safety with the "Could It be Something They Ate?" lesson from the Project Food, Land and People Resources for Learning.

Answer to **Cloning**

Cloning is another new technology in animal science. Farmers aren't using it yet, but scientists have cloned animals. A clone – an exact copy – grows not from a fertilized egg, but from a cell.



Answers to **More Milk**

If a cow produces 100 1-cup glasses of milk a day and giving her a hormone will increase her production 10%, how many glasses of milk will she produce? **100 + 10% = 110**

How many gallons of milk is that?
110 cups ÷ 16 cups/gallon = 6.875 gallons

That cow can produce milk for about 300 of the 365 days in a year, so how many cups of milk will she produce in one year?
110 cups/day X 300 days = 33,000 cups

How many gallons of milk is that?
33,000 cups ÷ 16 cups/gallon = 2,062.5 gallons

Technology and You

Nutritionist – Studies the nutrition of foods

Geneticist – Studies the genetic makeup of plants and/or animals and breeds for different traits

Agronomist – Grows and studies plants and recommends improvements

Chemist – Studies the makeup of plants and animals and how they might be altered, and how products affect them

Entomologist – Studies insects and other tiny creatures

Idea: Discuss with students the variety of careers related to agricultural technology. Have students select a career and research it, writing a short report or presenting the information orally to other students. Or imagine all students are agricultural scientists. Have each student or small teams invent something that would make their lives easier or produce more food.

Idea: Invite a plant breeder, agronomist, agricultural and biosystems engineer, grain elevator manager, crop consultant, farm implement dealer or other ag technology professional to your class to talk about what they do. Staff from North Dakota State University and its county Extension offices and Research Extension Centers across the state are good sources.

Why **Technology** in **Agriculture** is Important

Idea: Discuss world population trends and the need to be able to produce more food. The world currently has about 6½ billion people. In 20 years, the population is expected to grow to almost 9 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 37 or 38. 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?

Resources

Biotechnology

Field of Genes:
Making Sense of Biotechnology in Agriculture
http://fog.n4h.org/

Teaching Science:
A Resource for Discovering and Teaching Biotechnology
http://199.89.233.43/biotech/teachscience.nsf

Council for Agricultural Science and Technology
www.cast-science.org

National Agricultural Biotechnology Council
http://nabc.cals.cornell.edu/

Council for Biotechnology Information
www.whybiotech.com

Cloning

Surfing the Net with Kids
www.surfnetkids.com/cloning.htm
(An excellent site for all topics related to teaching kids)

Farm Machinery and Technology

Agriculture and Farm Innovations
http://inventors.about.com/library/inventors/blfarm.htm

The Machinery Garage
www.kids.organics.org/machinery_garage.htm

World Population

World Population Clock
www.census.gov/main/www/popclock.html
(Site ticks off world and U.S. population)

Surfing the Net with Kids
www.surfnetkids.com/population.htm
(Contains several links for kids on world population)

North Dakota Agriculture in the Classroom Council

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N.D. Agriculture Commissioner

Wayne Sanstead –
N.D. Superintendent of Public Instruction

Doug Vannurden –
N.D. Dept. of Career and Technical Education

Judge Barth –
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Kim Alberty –
Agassiz Seed and Supply, West Fargo

Ted Johnson –
Kindred High School, Kindred

Mary Lou Klemisch –
Prairie View Elementary School, New Salem

Ginger Deitz –
Bennett Elementary School, Fargo

Steven Edwardson –
North Dakota Barley Council

Shannon Berndt –
North Dakota Dry Pea and Lentil Association

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