Unit A: General Agricultural Machinery

Lesson 1: Machinery and Equipment

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Explain why agricultural machinery and equipment are important.
2. Identify different areas of agriculture where machinery and equipment are used.
3. Describe some of the different types of agricultural machinery and equipment used for crop production.

Recommended Teaching Time: 1 hour

Recommended Resources: The following resources may be useful in teaching this lesson:

Lee, Jasper S., et al. *AgriScience Discovery*. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2003.

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters
- Copies of student worksheets

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- Application equipment
- Baler
- Combine
- Crawler tractor
- Cultivator
- Drill
- Duster
- Geographic information system (GIS)
- Global Positioning System (GPS)
- Harrow
- Harvesting equipment
- Implement
- Mower
- Picker
- Planter
- Planting equipment
- Plow
- Sprayer
- Tillage equipment
- Tractor
- Wheeled tractor

Interest Approach:

Ask students to name ways that machinery can help them in their lives. How could growing vegetables, wheat or rice be easier if they did not have to work the soil by hand? How could the process of harvesting be easier? Just as we use different types of machinery, farmers also need the right tools to get their work done quickly and efficiently. Without the proper machinery and equipment, farmers wouldn't be able to produce enough to provide for our needs. Move from this discussion into the content of the lesson.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain why agricultural machinery and equipment are important.

Anticipated Problem: Why are agricultural machinery and equipment important?

(PowerPoint Slide 3)

I. Agricultural machinery and equipment help farmers produce the goods that consumers want and need. Without the proper machinery and equipment, farmers would not be efficient enough to provide the food, clothing, and shelter that we need.

(PowerPoint Slide 4)

A. Hundreds of years ago, the population was made up of primarily farmers and ranchers. Now, a very small percent of the population is responsible for producing the food and fiber used today. Machinery and equipment allow this to be possible.

(PowerPoint Slide 5)

B. Because of the high technology with machinery and equipment, in some countries one farmer produces enough food to feed over 100 people. Using power only from humans or horses would not produce nearly this amount.

(PowerPoint Slide 6)

C. Machinery and equipment reduce the amount of hard labor needed for farmers to do their work. Jobs are easier and take less time when machinery and equipment are used.

(PowerPoint Slide 7)

D. Machinery and equipment also help farmers produce larger amounts of higher quality livestock and grain products.

Use TM: 1-1 to cover the content of the objective. Use WS: 1-1 as a simple activity that demonstrates to students the importance of machinery and equipment in agricultural efficiency.

Objective 2: Identify different areas of agriculture where machinery and equipment are used.
Anticipated Problem: Where are machinery and equipment used in agriculture?

(PowerPoint Slide 8)

II. Different machinery and equipment are used in every area of the agricultural industry.

(PowerPoint Slides 9, 10, 11, 12, 13, 14, and 15)

A. Livestock production—Machinery and equipment can be used to help producers care for and manage their livestock. Milking machines, automated feeding and watering systems, incubators, egg candlers, tractors, computers, and many other types of machinery and equipment can be used by the producer to improve efficiency and quality of products.

(PowerPoint Slides 16, 17, 18, 19, 20, 21, and 22)

B. Horticulture—Machinery and equipment are very important in the horticulture industry. Lawnmowers, tillers, sprayers, spreaders, irrigation systems, wood chippers, lawn rollers, leaf blowers, computers, and tractors are all vital pieces of machinery and equipment used by horticulturalists.

(PowerPoint Slides 23, 24, 25, 26, 27, 28, and 29)

C. Forestry—The forestry industry relies on machinery and equipment to function. Log trucks, skidders, loaders, cutters, harvesters, chainsaws, computers, and surveying equipment are all necessary for efficient forestry operations.

(PowerPoint Slides 30, 31, 32, 33, 34, 35, and 36)

D. Crop production—Without the proper machinery and equipment, large-scale crop production would be impossible. Tilling, planting, applying pesticides and fertilizers, and harvesting all require specialized machinery and equipment. Plows, planters, drills, sprayers, spreaders, combines, balers, computers, tractors, grain trucks, and many other types of machinery and equipment are necessary to produce crops effectively.

Use TM: 1-2, TM: 1-3, TM: 1-4, and TM: 1-5 to cover the content of the objective. Use WS: 1-2 to have students keep track of the machinery and equipment they see around them. Discuss with students the many different areas where machinery and equipment make our daily activities easier. Relate this to the use and importance of machinery and equipment in the agricultural industry. Stress to students that without the proper machinery and equipment, agricultural producers would not be able to provide all that we need and want.

Objective 3: Describe some of the different types of agricultural machinery and equipment used for crop production.
Anticipated Problem: What are some of the different types of machinery and equipment used for crop production?

(PowerPoint Slide 37)

III. Many different types of machinery and equipment are used in producing crops.

(PowerPoint Slides 38, 39, and 40)

A. A ***tractor*** is a motorized vehicle that is used to pull heavy loads and to provide power to operate implements. A tractor can be used for many different jobs.
   1. The first types of tractors ran on steam and were hard to maneuver.
   2. Before tractors were invented, farmers would have to use horses to pull heavy equipment.
   3. Because of their powerful engines and large tires, tractors are able to pull other pieces of machinery through fields.
   4. Tractors can be used to pull and power some implements. An ***implement*** is a tool or piece of equipment used to do work.
   5. There are two main types of tractors—wheeled and crawler.
      a. A ***wheeled tractor*** is a tractor that usually has four or more wheels that turn and move the tractor.
      b. A ***crawler tractor*** is a tractor that has steel or rubber tracks fitted around the wheels that make the tractor move.

(PowerPoint Slides 41, 42, 43, 44, and 45)

B. ***Tillage equipment*** is equipment used to plow or till the soil. It slices, breaks, or cuts the soil in order to prepare the ground, control weeds, or create mulch. The tillage equipment used depends on the type of soil and the crop that is to be grown. Tillage equipment includes plows, harrows, and cultivators.
   1. A ***plow*** is an implement used to cut, lift, and turn over soil. It is commonly used to prepare the soil for planting. There are various types of plows and the one most commonly used in many countries is the moldboard plow.
   2. A ***harrow*** is an implement with spikes or disks that is used to cultivate the soil by pulverizing and smoothing it.
   3. A ***cultivator*** is an implement used to loosen the soil and control weeds between rows of growing crops.

(PowerPoint Slides 46, 47, 48, 49, and 50)

C. ***Planting equipment*** is equipment used to place seeds in the soil for germination. It must be properly adjusted so the right amount of seed is planted at the proper depth in the soil. Planting equipment includes planters and drills.
   1. A ***planter*** is an implement used to place seeds in the soil at the proper rate, depth, and spacing.

a. The planter opens a small furrow, drops and covers the seeds, and lightly compacts the soil over the seeds.
b. Corn, cotton, and many vegetable crops are planted with planters.
c. Before this machine was invented, farmers would have to dig rows and plant the seeds by hand.

2. A ***drill*** is an implement used to plant seeds for germination.
   a. The drill opens the soil, places the seeds, and covers the seeds.
   b. Drills can be used to plant seeds in plowed or unplowed land.
   c. Soybeans, wheat, oats, and rye grass are examples of crops that are commonly planted with drills.

(PowerPoint Slides 51, 52, 53, and 54)

D. ***Application equipment*** is equipment used to apply fertilizer, pesticides, growth regulators, and other materials to crops. It must be properly calibrated and operated so the right amount of material is delivered. The equipment may use dry or liquid materials. Application equipment includes sprayers and dusters.

1. A ***sprayer*** is a piece of equipment that uses tanks, pumps, and nozzles to apply liquid materials.
2. A ***duster*** is a piece of equipment used to apply dry powder materials.

(PowerPoint Slides 55, 56, 57, 58, 59, 60, 61, and 62)

E. ***Harvesting equipment*** is equipment used to pick, reap, or otherwise gather crops. Different types of crops require different types of equipment. Harvesting equipment includes combines, pickers, balers, and mowers.

1. A ***combine*** is a machine used to harvest crops as it moves across a field.
   a. The head of the combine runs through the crop rows and cuts the stalks of the plants. The plants are then pulled through the machine and the grain is separated from the plant material.
   b. Corn, soybeans, wheat, barley, and rice are typically harvested with combines.
2. A ***picker*** is a machine used to harvest crops by picking. Cotton is the most common crop harvested with a picker.
3. A ***mower*** is a piece of equipment used to cut standing vegetation. Mowers are used to harvest forage crops, such as grass and alfalfa. After mowing, the crop may be left in rows to dry and be picked up by a baler.
4. A ***baler*** is a piece of equipment used to harvest forage crops that have been cut, dried, and placed in rows. The baler is pulled behind a tractor and picks the dried vegetation up off the ground. Inside the baler, the material is tightly packed or wound into round or rectangular bales. When the bale reaches the proper size, the machine wraps the bale with wire or twine to secure it.

(PowerPoint Slides 63, 64, and 65)

F. A ***Global Positioning System (GPS)*** is a system that uses satellites and computers to tell a farmer his or her exact location in a field.
   1. The earth is continually circled by 24 GPS satellites. At least four of these satellites are visible from any one point on Earth.
   2. GPS uses three satellites that are connected by an electronic signal with a receiver on the ground. (A fourth satellite is used to verify that the information is accurate.)
   3. Distances from satellites to the receiver can be quickly measured. Computers calculate the exact location of the receiver.
   4. GPS receivers are generally located on equipment that moves over a field.
   5. GPS systems can precisely guide tractors and equipment through a field and program computers to deliver precise amounts of seed, fertilizer, or herbicide to plants in variable amounts.

(PowerPoint Slides 66 and 67)

G. A ***Geographic Information System (GIS)*** is a system used with GPS to make maps or grids of a field. These maps give a farmer data about soil conditions, crop yield, and other information so he or she can make decisions needed to improve the crops in the field.

Use TM: 1-6, TM: 1-7, TM: 1-8, and TM: 1-19 to discuss the different types of machinery and equipment used for crop production. Use WS: 1-3 as an activity to help students become more familiar with some of the different types of machinery and equipment.

Review/Summary: Use the student learning objectives to summarize the lesson. (**PowerPoint Slide 68**) Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Use observations as the basis for re-teaching areas where student mastery may need improvement.

Application: Students can apply the knowledge gained from the lesson as they complete WS: 1-1, WS: 1-2, and WS: 1-3.

Evaluation: Focus the evaluation of student achievement on mastery of the objectives as stated in the lesson. A written test can also be used to assess student achievement of the objectives. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1. D
2. A
3. E
4. B
5. C
6. F

Part Two: Completion

1. Labor
2. Combine
3. Tillage equipment
4. Mower
5. Application equipment

Part Three: Short Answer

Answers will vary. Use Objective 2 to score this statement.

Machinery and Equipment

Name: _____

Matching: *Match each word with the correct definition*.

a. implement
b. harvesting equipment
c. Global Positioning System (GPS)
d. cultivator
e. tractor
f. sprayer

_____ 1. An implement used to loosen the soil and control weeds between rows of growing crops.

_____ 2. A tool or piece of equipment used to do work.

_____ 3. A motorized vehicle that is used to pull heavy loads and to provide power to operate implements.

_____ 4. Equipment used to pick, reap, or otherwise gather crops.

_____ 5. A system that uses satellites and computers to tell a farmer his or her exact location in a field.

_____ 6. A piece of equipment that uses tanks, pumps, and nozzles to apply liquid materials.

Fill-in-the-blank*: Complete the following statements*.

1. Machinery and equipment reduce the amount of hard _____ needed for farmers to do their work.

2. A(n) _____ is a machine used to harvest crops as it moves across a field.

3. _____ _____ is equipment used to plow or till the soil.

4. A(n) _____ is a piece of equipment used to cut standing vegetation.

5. _____ _____ is equipment used to apply fertilizer, pesticides, growth regulators, and other materials to crops.

***Short Answer**: Answer the following question*.

List three examples of machinery and equipment that can be used in each of the following areas of agriculture:

Livestock production:

Horticulture:

Forestry:

Crop production:

TM: 1-1

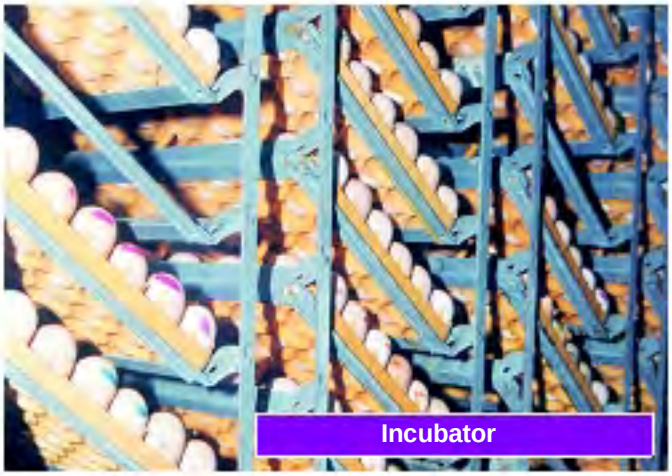
IMPORTANCE OF AGRICULTURAL MACHINERY AND EQUIPMENT

- Because of machinery and equipment, only 1 to 2 percent of the population is able to produce all of the food and fiber used today.
- Because of high technology with machinery and equipment, in some countries one farmer produces enough food to feed over 100 people. Using power only from humans or horses would not produce nearly this amount.
- Machinery and equipment reduce the amount of hard labor needed for farmers to do their work. Jobs are easier and take less time when machinery and equipment are used.
- Machinery and equipment also help farmers produce larger amounts of higher quality livestock and grain products.

TM: 1-2

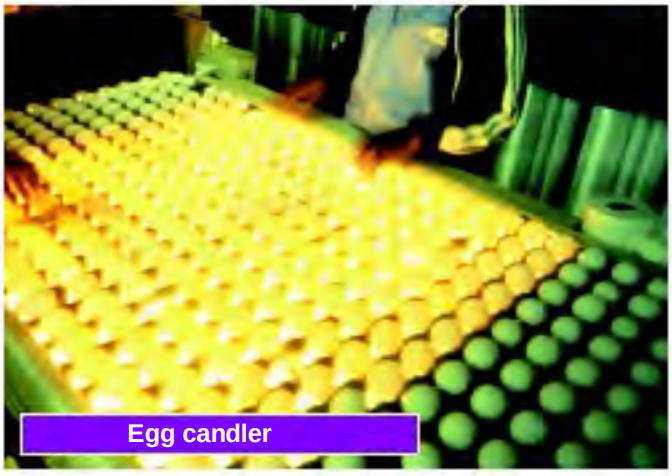
LIVESTOCK PRODUCTION

Automated feeding system


Incubator

Milking machines

Loader (hauling manure)


Egg candler

Automated watering system

TM: 1-3

HORTICULTURE

Pesticide sprayer

Lawnmower with utility cart

Greenhouse irrigation system

Wood chipper

Rotary tiller

Rotary spreader

TM: 1-4

FORESTRY

(Courtesy, Heikki Suomala, Partek Forest LLC, Gladstone, Michigan)

(Courtesy, U.S. Fish and Wildlife Service)

TM: 1-5

CROP PRODUCTION

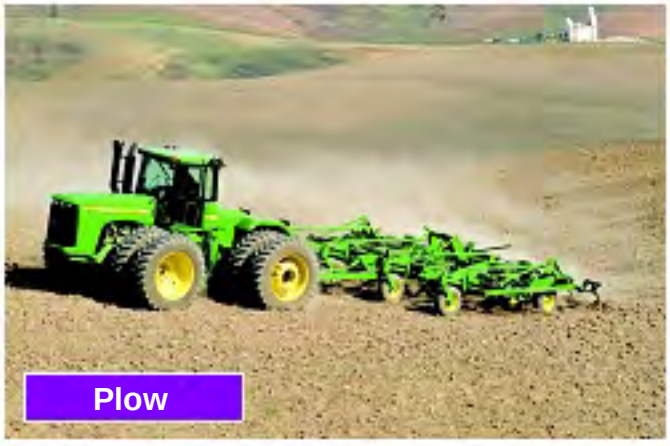
Tractors

Planter

GPS receiver

Spreader

Combine


Plow

TM: 1-6

TRACTOR

A tractor is a motorized vehicle that is used to pull heavy load and to provide power to operate implements.

TM: 1-7

PLOW

A plow is an implement used to cut, lift, and turn over soil.

TM: 1-8

HARROW

A harrow is an implement with spikes or disks that is used to cultivate the soil by pulverizing and smoothing it.

TM: 1-9

CULTIVATOR

A cultivator is an implement used to loosen the soil and control weeds between rows of growing crops.

TM: 1-10

PLANTER

A planter is an implement used to place seeds in the soil at the proper rate, depth, and spacing.

TM: 1-11

DRILL

A drill is an implement used to plant seeds for germination.

TM: 1-12

SPRAYER

A sprayer is a piece of equipment that uses tanks, pumps, and nozzles to apply liquid materials.

TM: 1-13

DUSTER

A duster is a piece of equipment used to apply dry powder materials.

TM: 1-14

COMBINE

A combine is a machine used to harvest crops as it moves across a field.

TM: 1-15

PICKER

A picker is a machine used to harvest crops by picking.

TM: 1-16

MOWER

A mower is a piece of equipment used to cut standing vegetation.

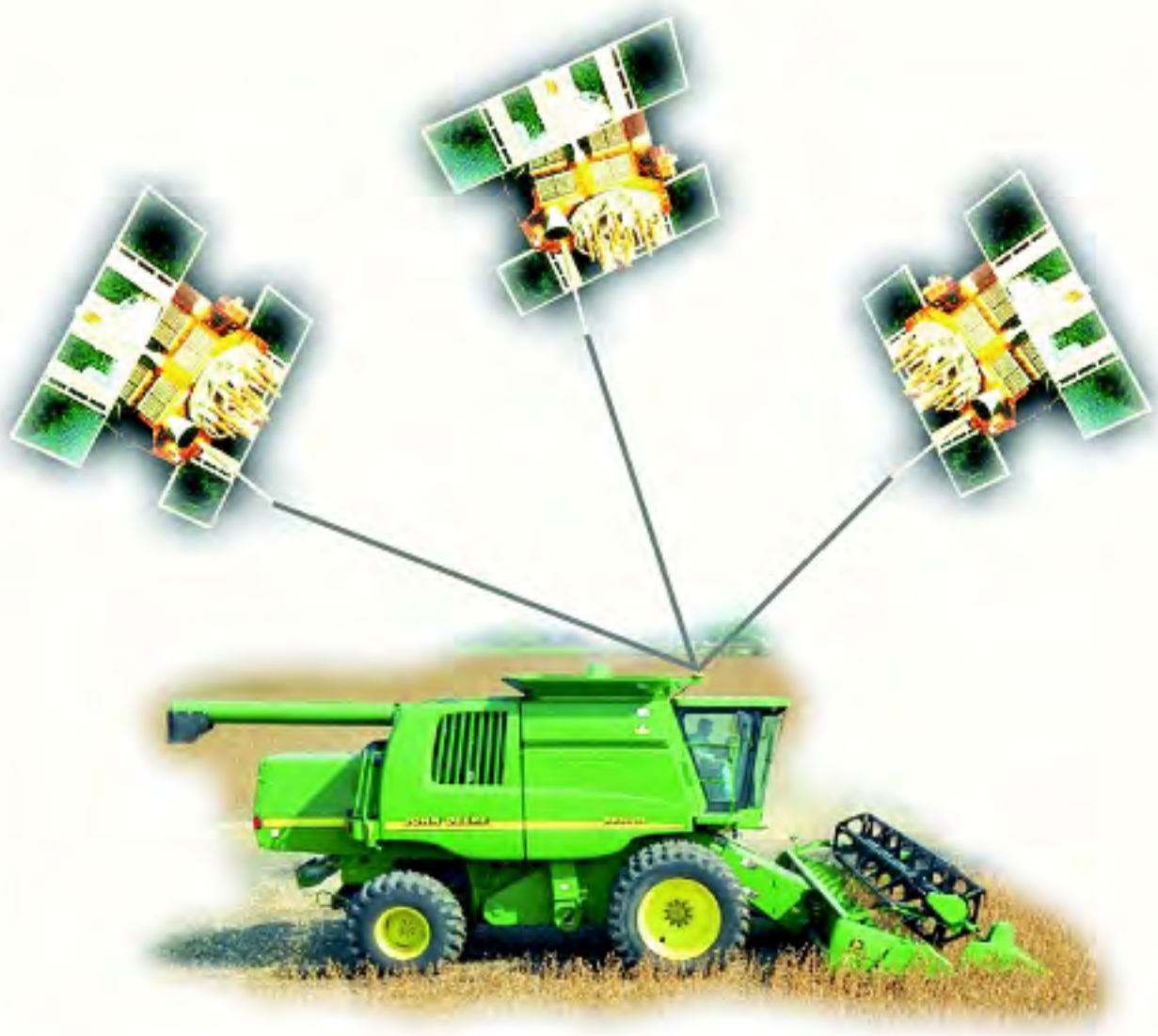
TM: 1-17

BALER

A baler is a piece of equipment used to harvest forage crops that have been cut, dried, and placed in rows.

TM: 1-18

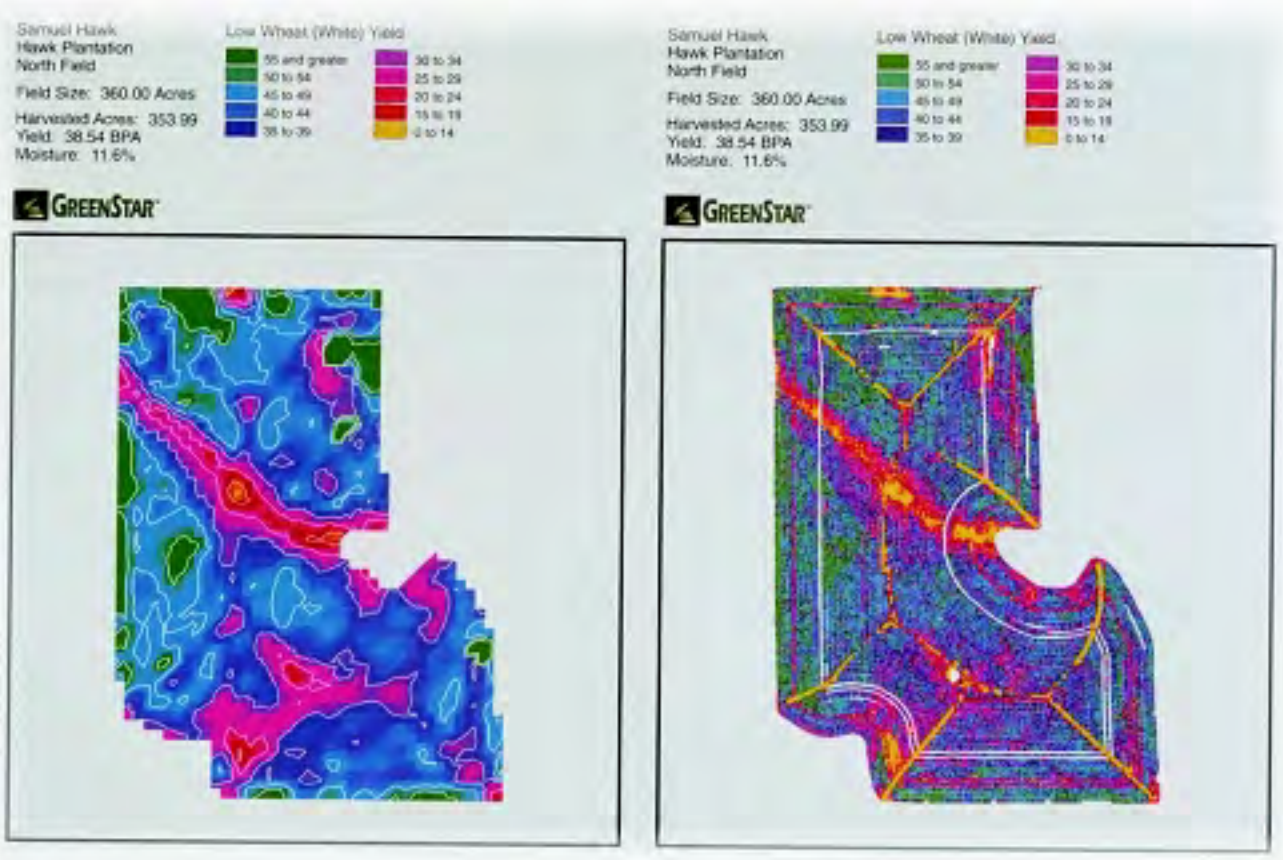
GLOBAL POSITIONING SYSTEM (GPS)



A Global Positioning System (GPS) is a system that uses satellites and computers to tell a farmer his or her exact location in a field.

TM: 1-19

GEOGRAPHIC INFORMATION SYSTEM (GIS)



A Geographic Information System (GIS) is a system used with GPS to make maps or grids of a field.

WS: 1-1

MANUAL LABOR VERSUS MACHINERY AND EQUIPMENT

Materials:

- 200 pieces of 15 cm long straw
- Small shovel
- Two containers (large enough to hold 100 pieces of straw)

Directions:

1. Place 100 pieces of straw in a pile next to one of the containers. Place the other 100 pieces of straw in a separate pile next to the other container.
2. Divide into two teams. One team will represent the use of manual labor, and the other team will represent the use of machinery and equipment.
3. One at a time, one member from each team will race to see who can pick up all the pieces of straw the quickest. Keep track of the winner each round.
4. The manual labor team can only use their fingers to pick up the pieces of straw and place them in the container one at a time.
5. The machinery and equipment team can use the small shovel to scoop up the pieces of straw and place them in the container.

Conclusions:

Which team won the most rounds? What does this tell you about the use of machinery and equipment to get a job done? If the pieces of straw were crops, how much more food would you be able to provide by using machinery and equipment?

WS: 1-2

HUNT FOR MACHINERY AND EQUIPMENT

Directions:

Machinery and equipment are used all around us. They help us get our work done more quickly and efficiently than if we had to do the work by hand. Without the machinery and equipment, we would not be able to accomplish nearly the amount of work that we do! Keep track of the machinery and equipment that you see being used around your house, neighborhood, and school for a day. This might include machinery and equipment used for construction, transportation, lawn care, business, and/household use. Record all of your citings in the table below. For each piece of machinery and equipment, also list what the alternative would be if the machinery and equipment were not available. Compare your list with the rest of the class and discuss what you found.

Machinery and Equipment	Where used	Alternative

WS: 1-3

MACHINERY AND EQUIPMENT IDENTIFICATION

Directions:

Write the name of the piece of machinery or equipment on the line under its photo.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

WS KEY: 1-3

MACHINERY AND EQUIPMENT IDENTIFICATION KEY

1. Baler
2. Cultivator
3. Sprayer(s)
4. Combine
5. Drill
6. Duster
7. Planter
8. Plow
9. Tractor(s)
10. Mower