Lesson A8–3

Understanding Monitoring Systems

Unit A. Mechanical Systems and Technology

Problem Area 8. Technology Systems

Lesson 3. Understanding Monitoring Systems

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: **IX:** Use the variety of tools available in computer systems to accomplish fast, accurate production in the workplace.

Benchmark: **IX-A:** Identify and explain various types of hardware systems to show their applications potential.

Performance Standard: **1.** Identify and describe individual components of each system. **2.** Discuss various types of diagnostic equipment. **3.** Be able to show aptitude in use of various equipment. **4.** Demonstrate competency on cable though put and set up.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Understand how monitors work.
2. Understand what decisions can be made using data from monitors.
3. Understand what role monitors play in precision agriculture.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Brandau, Patricia. "Precision Agriculture" Unit U4074. Urbana, Illinois: ITCS Instructional Materials.

Johnson, Donald M., et al. *Mechanical Technology in Agriculture*. Danville Illinois: Interstate Publishers, Inc., 1998.

Morgan, Mark, and Dan Ess. *The Precision-Farming Guide for Agriculturalists,* John Deere Publishing, 1997.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet

Terms. The following terms are presented in this lesson (shown in bold italics):

Control monitor
Flow monitors
Geographic Information System
Impact force sensor
Monitor
Population
Radiometric sensor
Yield monitors

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Describe the following scenario to the students: A farmer states that their 80 acre field yielded 185 bushels per acre. Did every acre yield exactly 185 bushels? If some parts of the field were better than others, how can we tell what parts yielded best, and what areas did not yield well? What could we do to determine how each acre did?

Recommend that we could harvest each acre separately, and use a weigh wagon to determine how each acre yielded. Would that tell us how each acre did? Yes. Would it be time-efficient? No. How else could we measure yields more efficiently? A yield monitor would allow us to do that.

Summary of Content and Teaching Strategies

Objective 1: Understand how monitors work.

Anticipated Problem: What is a monitor, and how does it work.

I. A ***monitor*** is a computer that calculates the intake of a product, controls its output, or reports on the status of an operation. Monitors can be used in combines as yield monitors, in planting operations to show planting population, in hay balers to monitor bales as they are being made, and in fertilizer and pesticide applicators to control the rates that are applied to the soil.

A. Monitors that report on the status of an operation are used in many planter monitors and in hay baler monitors. These types of monitors have sensors that send information to the monitor, which is viewed by the operator of that equipment. Baler monitors accurately report on the progress of a bale being made, allowing the operator to make bales that are evenly produced, which allows for better storage and transportation of the bale, resulting in better feed quality for the animals that will be fed by those bales. Planter monitors have sensors that collect data on seed as it is dropped from the seed box on the planter into the seed furrow. If no seed is falling in any box, an alarm sounds alerting the operator of the problem so that it can be corrected without leaving ground unplanted. The monitor then calculates what the seeding ***population***, or number of seeds planted per acre, is and can track how many acres have been planted in a particular field, and how many acres per hour are being planted.

B. Monitors that control the application rates of products that are used in fertilizer and crop protection chemical applications are often referred to as ***flow monitors***. Anhydrous ammonia applicators, pesticide sprayers, and fertilizer spreaders use these type of monitors, which are also called controllers, to deliver the correct rates of a product over entire fields. In all of these instances, the speed of the application vehicle and the output of the product being applied determine consistent delivery of these products. If a vehicle must travel 15 miles per hour to deliver the desired rate of 200 lbs. of fertilizer per acre, what happens if the vehicle drives faster than 15 miles per hour? Not enough product will be delivered, and the fertilizer will be under-applied, resulting in lower yield potential. The ***control monitor*** varies the rate of fertilizer applied depending upon the speed of the vehicle, and delivers a consistent desired rate per acre.

C. Monitors that measure intake of products are called ***yield monitors***. Yield monitors display how a crop is yielding as it is being harvested. The yield monitor makes constant calculations to determine the yield at a given point. Information needed to make these calculations includes harvesting width, which indicates how much area is being harvested at a given time. Speed of the combine is needed in combination with this harvested width to determine how much area is being covered over a given time. Speed can be determined using drive shaft sensors, radar sensors that measure ground speed, or by using GPS information to calculate speed. When the harvested area over a given time is

known, a measurement of how much grain was harvested in that time must be known in order to calculate yield. Several types of sensors can determine the amount of harvested grain. One type is the ***impact force sensor***, which measures the pressure exerted upon a plate through electrical current to calculate total grain coming into the combine. A ***radiometric sensor*** system uses an isotope to produce radiation, and has a sensor on the opposite side of the tube that the grain flows through. The sensor compares the radiation that reaches it to what was emitted, and can calculate total grain based on that information. More grain absorbs more radiation, and thus does not reach the sensor. Moisture is an important factor in determining yield as well, and yield monitors have built-in moisture sensors that can provide the operator with information regarding the moisture content throughout the field. These sensors use electrical current that flows between two plates. As the grain flows between the plates the sensors measure the electrical conductivity of the grain. The more moisture within the grain, the more moisture within the sensor.

A variety of teaching strategies can be used to enhance student learning. Assign students to read the suggested chapter in the recommended resource text. It contains good basic information on the content of this objective. Use TM: A8–3A to show examples of monitors. LS: A8–3A will help students understand how yields are calculated.

Objective 2: Understand what decisions can be made using data from monitors.

Anticipated Problem: What management decisions can be made using data from monitors?

II. Using monitors allows producers to make a number of management decisions quickly to maximize time efficiency.

A. Yield monitors can collect on-farm testing results with no disruption of the harvest operation. They allow producers to instantly decide where the grain should be stored. For example, grain with high moisture content needs to be dried and therefore, would receive a dock at the local elevator. The moisture reading from the monitor would tell a producer if the grain should go to the grain dryer or to town. Monitors eliminate the need to moisture-test grain samples from each load.

B. Yield monitors can be used with mapping software to create maps that show yield from a field based on data that is collected every second. Producers can then compare that data to soil test maps, weed pressure maps, or any other type of information to determine what could make those yields better or more uniform in future years. This type of information all fits together in a Geographic Information System (GIS) to allow producers to make management decisions. A ***Geographic Information System*** uses layers of data to make decisions based on precise information.

A variety of teaching methods will enhance student learning. Students should be assigned reading in the recommended resource text. It contains good information on this topic. TM: A8–3B provides an example of raw field data and how it can be enhanced with a GIS database. These readings were taken once per second.

Objective 3: Understand what role monitors play in precision agriculture.

Anticipated Problem: What role do monitors play in precision agriculture?

III. When monitors are used in combination with GPS (Global Positioning System) equipment, they can enhance data collection and control the rate at which agricultural products are applied.

A. Variable Rate Application (VRA) of agricultural products, such as seed, fertilizer, and pesticides can be achieved through the monitor on the application equipment. The control monitor in combination with the GPS system changes the application rate of the product based on data entered into the computer. Certain parts of the field get more or less fertilizer or seed based on the maps generated. As the application equipment travels through the field, the GPS receiver "reads" its own position, and applies the desired amount of material automatically.

B. Yield monitors help create data layers that can be used in a geographic information system. As the yield monitor collects and displays information, it can be saved as often as once per second. This data can be downloaded into a computer to create maps and data sets that help determine how much fertilizer should be used the next time, and at what population the crop should be planted.

A variety of teaching strategies can be used to enhance student learning. Have students read the suggested chapter in the recommended resource text. The readings will be helpful to students in fully comprehending the content. TM: A8–3C shows how precision agriculture utilizes equipment that operates with monitoring systems.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used to determine which objectives need to be reviewed or taught from a different perspective.

Application. Application can involve the following student activity using the attached lab sheet:

LS: A8–3A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance, on the application activity.

Answers to Sample Test:

Part One: Matching

1 = c, 2 = a, 3 = b, 4 = d, 5 = e

Part Two: Completion

1. monitor
2. alarm
3. population
4. Speed
5. grain harvested

Part Three: Short Answer

1. Sprayer and Fertilizer monitors work with computers to control the output of the applicator. The computer will vary the rates of the fertilizer or chemical based on what is programmed into the computer.
2. Yield monitors provide a data layer that is used in geographic information systems to pinpoint exact needs of small pieces of ground.

Sample Test Name_____

Test

Lesson A8–3: Understanding Monitoring Systems

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. sprayer monitor b. yield monitor c. baler monitor
d. impact force sensor e. radiometric sensor

_____ 1. A monitor that reports on status of operation.

_____ 2. A monitor that controls the output of a product.

_____ 3. A monitor that calculates the intake of agricultural commodities.

_____ 4. Measures pressure of incoming grain upon a plate to calculate total grain coming in.

_____ 5. Uses an isotope to produce radiation, which is absorbed by grain to calculate grain intake.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. A _____ is a computer that calculates the intake of a product, controls its output, or reports on the status of an operation.
2. If no seed is falling when the planter moves through the field, an _____ will alert the operator to stop to check the box.
3. The planter monitor can calculate seeding _____, which is how many seeds per acre are planted.
4. _____ of application vehicles and output of the product determine consistent delivery rates of fertilizers and pesticides.
5. Yield can be calculated when the harvested area and _____ _____ are known.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What role do monitors play in precision farming?

2. How do yield monitors provide input in precision farming?

TM: A8–3A

UNDERSTANDING MONITORS

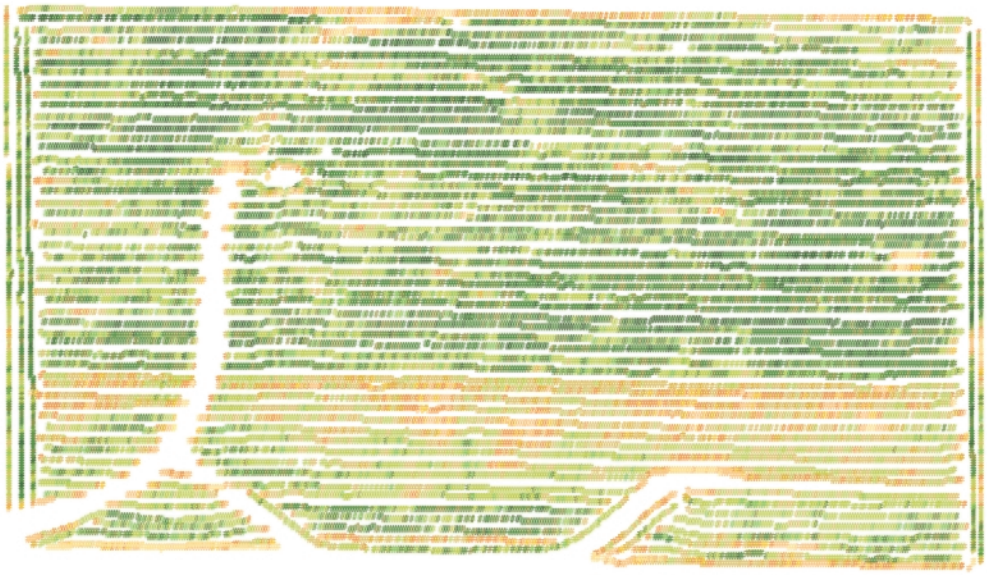
Monitor—A computer that calculates the intake of a product, controls its output, or reports on the status of an operation.

Examples—

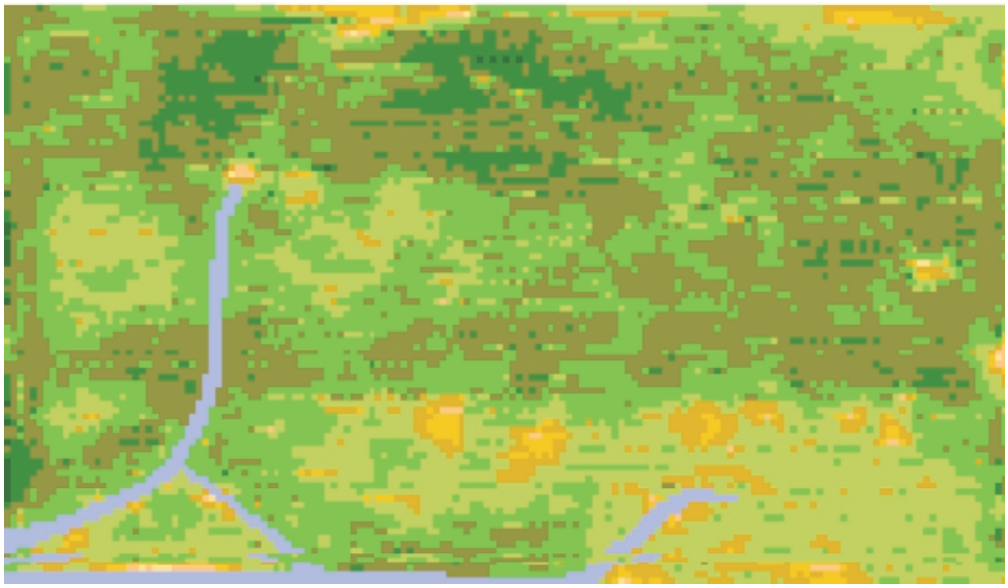
- **Yield monitors in combines—calculate on-the-go yield information.**
- **Planter monitors—monitors seed drop.**
- **Fertilizer/pesticide monitor—controls output of fertilizer or pesticide to deliver consistent rate regardless of speed.**
- **Baler monitor—delivers information on status of a bale as it is being produced. Alerts operator when desired size and shape are reached.**

TM: A8–3B

YIELD DATA



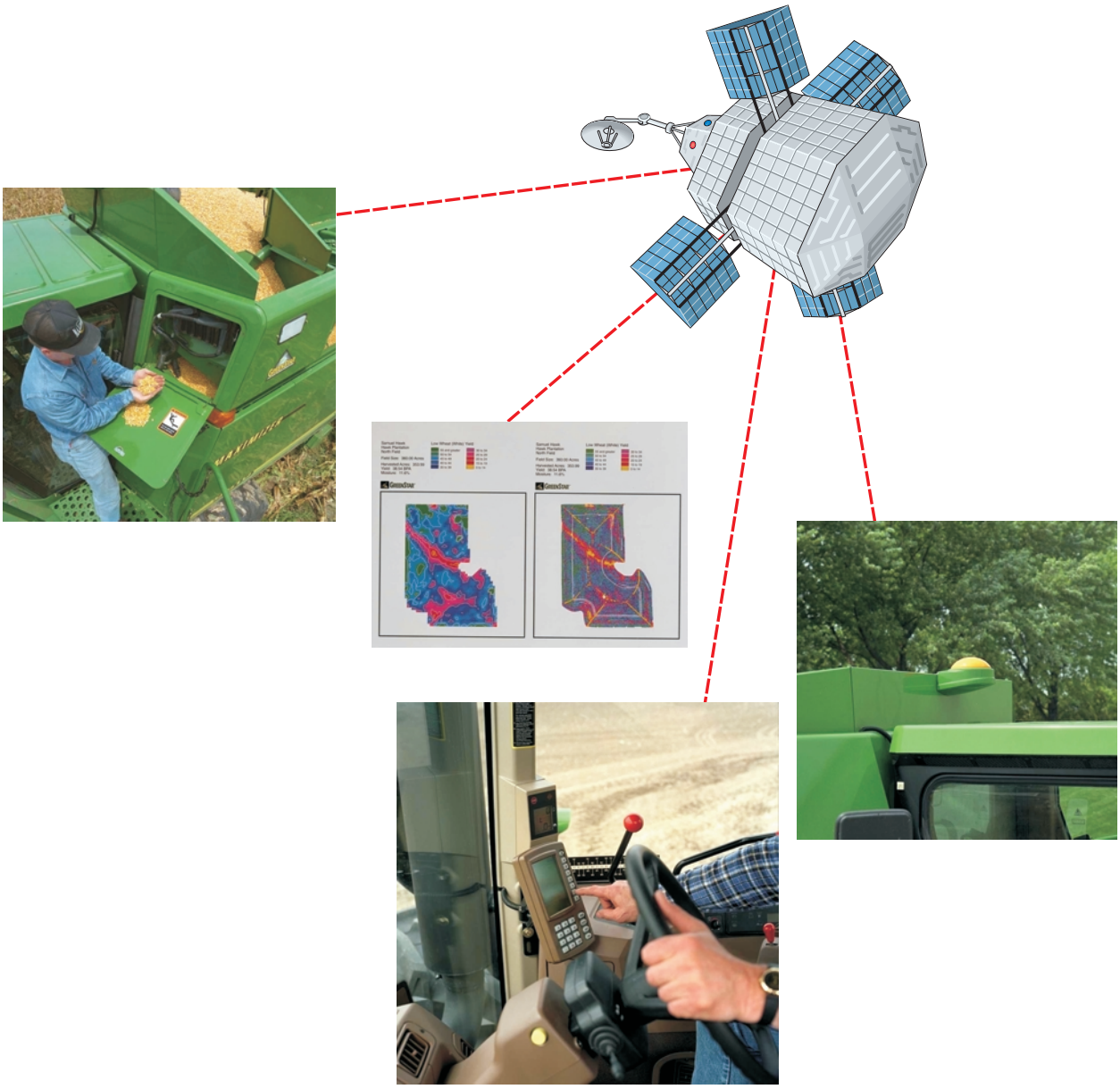
**Raw soybean flow data—
Dark green depicts highest yields.**



Interpolated soybean yield derived from a GIS database. Darker colors indicate higher yields.

TM: A8–3C

APPLICATION OF MONITORING EQUIPMENT



LS: A8–3A Name_____

Lab Sheet

This exercise will help students understand how yields are calculated. These are similar steps that yield monitors perform every second. For additional practical application, contact a representative from a seed company, and assist them in harvesting a test plot.

Formula for figuring yield—bushels/acres. To find bushels of corn, divide lbs. by 56 (there are 56 lbs. of corn in a bushel. To figure acres, take length × width / 43,560 (sq ft. per acre). Your width will be 20 feet, the width of your 8 row corn head. Round numbers to nearest 1.

1. 8400 lbs. harvested, 2178 ft. harvested. Yield = _____

2. 3800 lbs. harvested, 1500 ft. harvested. Yield = _____

3. 16000 lbs. harvested, 3000 ft. harvested. Yield = _____

4. 2000 lbs. harvested, 600 ft. harvested. Yield = _____

Answers:

1. 150
2. 98.4
3. 204.1
4. 119