GO WITH THE FLOW — IRRIGATION

Time required:

45 minutes

Lesson Objectives:

The student will be able to: Discover how precision agriculture uses geographic information systems (GIS) to help farmers and manufacturers make smart, efficient, and responsible decisions about how and when they plant, grow, irrigate, harvest, and transport crops.

Materials Needed:

- Increasing Production with Precision Agriculture worksheets
- Video links for activities listed below
- Water bottle, foam cup, three plastic cups, variety of straws, scissors, tape, rubber bands, paper clips, and ruler

Introduction

How many people will inhabit the world in 2050? About 9.2 billion. That's up from the 7 billion here today! And to make sure that everyone has enough to eat, global food production will need to increase by 70%. How exactly will this be done? Precision agriculture is the answer!

Agriculture has changed dramatically throughout the past years. In the past, almost everyone was a farmer. These farmers produced a variety of crops and livestock that they fed to their immediate families. Today, only 2% of the population is involved in production agriculture. These farmers have specialized operations and feed many more people.

Engineering allows us to define and solve real-world problems. Engineering concepts are changing agriculture by applying technology to improve food production. New equipment allows farmers to put in less labor to achieve larger yields. Precision agriculture is a farming management concept based on observing, measuring, and responding to variability in crops. Variable rate irrigation is a type of precision agriculture that involves applying water at a variable rate along the center pivot rather than one uniform rate along the entire length of the system. Variable rate irrigation has many uses for applying water at different rates to wet areas, different soil types, and overlapping pivots.

Engagement:

- Ask students if they know the current population of the world. (Approximately 7 billion.)
- Ask students, "Is our population increasing or decreasing?" (Increasing.) Inform students that it is estimated that we will have 9 billion people by the year 2050. Farmers will need to grow as much food in the next 50 years as they did in the past 10,000 years combined.

- Ask students, “What necessities will we need more of in order to accommodate 2 billion additional people on the earth?” (Food, water, energy, goods, and medical technologies, etc.)

Explain that in Louisiana, we will need to find solutions to feed a growing population. With limited resources (arable land, water, plant nutrients, etc.), we must do more with less without degrading our natural world. Precision agriculture is the answer to increasing yields without increasing resources. Inform students that they will be learning what precision agriculture is and how engineers develop these technologies.

Connection to Agriculture

Variable rate irrigation is made possible by the use of GPS, field computers, a rate controller, telematics, and a meter. GPS is used by farmers to create field maps to determine a field’s boundaries. Field computers allow farmers to control the application of fertilizers, herbicides, and pesticides through automated delivery systems. Farmers are able to monitor yields and moisture using computers. Rate controllers make it possible for farmers to control how much water, fertilizer, and other applications are used in a field. Telematics allows information collected in a field to be transferred through the internet.

Water Use Efficiency

Water use efficiency is calculated by determining the difference between irrigated yield and dryland yield and dividing that by the irrigation in inches. By performing these calculations, farmers will discover how much they should irrigate a section in order to increase yields and save water.

Vocabulary Words

Acre: a unit of area equal to 43,560 square feet (about the size of a football field).

Bushel: a measure of capacity usually for dry goods equal to 64 pints.

Finite resources: resources that do not renew themselves at a sufficient rate (nonrenewable).

Global Positioning System (GPS): a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth.

Irrigation: the artificial application of water to the land or soil.

Pivot: equipment used to irrigate fields (large sprinkler).

Section: square mile of land (640 acres).

Variable rate irrigation: applies exactly the right amount of water to each foot/meter of the field.

Water use efficiency (WUE): the ratio of water used in plant metabolism to water lost by the plant through transpiration.

Yield: measure of grains or seeds generated from a unit of land (agricultural output).

Activity 1

Following the interest approach, students should begin to have an idea of the significance of the projected population growth in our world. Ask students to begin thinking about the overall impact of population growth as they watch the video titled “Agriculture Is Under Pressure.”

https://youtu.be/2jF2IsicDC4

Following the video, ask the class what the overall message is or what stuck out to them. Lead the discussion to conclude that farmers need to produce more food using the same resources.

Introduce the word efficiency. Discuss the definition and give real-life examples of efficiency that students will relate to. Point out that farmers will need to be more and more efficient to keep up with the demand for food.

Ask students what type of resources farmers need in order to produce our food. As you discuss the following resources, point out that they are limited. We can’t obtain more. Therefore, we need to be more efficient in our use of them.

- Open space to grow crops or raise livestock.
- Water.
- Arable soil (soil containing adequate nutrients that has an appropriate soil texture for plant growth and is located in a proper growing climate).

Point out that farmers have become more efficient in previous years through the use of technology. Ask students, “What are some examples of technology that farmers are using today?” (Students may discuss GPS, maps, cellphones, automated irrigation systems, computers, large machinery (tractors) with automated features, etc.)

Introduce the concept of precision agriculture. Explain that precision agriculture implements various technological instruments to make agriculture more precise and efficient. As an example, show the video clip titled "Kinze Autonomy Project: Harvesting System." As the video clip plays ask students what they notice is different about the tractor. (There isn't a driver.) Explain that this tractor is operated using robot and GPS technology. This allows a single worker to harvest an entire field.

https://youtu.be/YFy6ZAjbeew

Introduce a second example of precision agriculture, variable rate application or (VRA). With VRA, different rates of an input, such as water, seed or fertilizer, can be applied to a field to match the needs of each specific area. Show the first three minutes of the video clip "Precision VRI" to explain and illustrate the unique components in each field that impact the water needs.

https://youtu.be/qfuMtWioS6A

Summary Activity 1

- Following the video, summarize why farmers would want to use variable rate irrigation.
- Increase crop yields. Too much or too little water decreases plant health and crop yield.
- Conserve water.
- Provide exact and precise watering for each soil type and slope within a field. (Soil type can vary within a field. Clay soil holds high amounts of water, which allows the roots to soak in the water for a longer time. In sandy soils, water can quickly run through the soil without penetrating the roots.)

Activity 2

Worksheet: Give each student one copy of the Increasing Production with Precision Agriculture student handout. Complete Part 1 of the handout. This section can be completed as a class, in groups, or individually.

Move on to Part 2 of the handout. Guide students through the instructions for the variable rate irrigation activity in the student handout. Form students into groups of three. Distribute a 16-ounce water bottle, three cups, scissors, and a choice of straws or other materials to each group. Discuss the engineering design process with students and have them complete page 4 of the handout. Give students 10 minutes to construct a device to simultaneously divide the water into three different amounts. Allow students to test their design and share it with the class. After their designs have been tested, instruct students to complete page 5 of their handout.

Reflection

Was your design successful? What could you do to improve your design? What career could you choose that uses these skills to develop instruments used in precision agriculture? Why is precision agriculture important?

- Technology has developed and improved through time. It helps farmers/ranchers provide more food to more people. Using technology in agriculture decreases negative environmental impacts in our world.

References

http://www.un.org/en/development/desa/news/population/un-report-world-population-projected-to-reach-9-6-billion-by-2050.html.
http://www.fao.org/news/story/en/item/35571/icode/.
Producing Fruits: The Technology of Farming, 2013.
Modified from the National Agriculture in the Classroom Agricultural Literacy Curriculum Matrix available at https://www.agclassroom.org/matrix/lesson/513/.

Louisiana Standards Covered In This Lesson

3-LS4-4

Performance Expectation—Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Clarification Statement—Examples of environmental change(s) could include changes in land characteristics, water distribution, temperature, food, and other biological communities. Louisiana-specific examples could include impact related to levees, dams, crop rotations, irrigation systems, hunting limits, diversion canals, or sea level rise.

4-ESS3-2

Performance Expectation—Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Clarification Statement—Examples of solutions could include designing flood, wind, or earthquake-resistant structures and models to prevent soil erosion.

5-LS2-1

Performance Expectation-Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Clarification Statement-Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms and ecosystems of the Earth, not including molecular explanations.

Authors:
Kim Deville and Brandi Folse Frey
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William B. Richardson, LSU Vice President for Agriculture
Louisiana State University Agricultural Center, Louisiana Agricultural Experiment Station, Louisiana Cooperative Extension Service, LSU College of Agriculture

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