High-Tech Farming

Grade Level(s)

Middle School

Estimated Time

45 minutes

Purpose

Students will discover technologies that are used on farms to increase efficiency and yields and decrease costs and environmental impact.

Materials

▪Links:

- Website with videos, resources and activities www.linncoag.com -2020/21 drop down tab-November
- Instructional video: https://www.youtube.com/watch?v=nkitG0kfCNw
- Milking at the 1850 Farm https://www.youtube.com/watch?v=FTk-FdlOUJY
- Robotic milkers 360 video https://vimeo.com/241077451
- Future of farming video https://www.youtube.com/watch?v=Qmla9NLFBvU
- Ag Engineer video https://www.youtube.com/watch?v=ozIUJsnBDLY

▪Worksheets:

- Agricultural Technology Timeline (1 set per student or 1 set per small group)
- Farming challenges

▪Other:

- Local Drone FarmChat link https://www.youtube.com/watch?v=35Tpi4mCNmE
- Poster or paper
- Markers

Vocabulary

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

Autonomous vehicle: a vehicle that can guide itself without a human operator

Drone: an unmanned aircraft guided by remote control or onboard computers

Laser: a device that produces a narrow and powerful beam of light

Precision agriculture: an information technology-based, site-specific farm management system that collects and responds to data ensuring that crops receive exactly what they need for optimum health and productivity

Robot: an automatically operated machine used to do work usually performed by humans

Self-driving tractors: autonomous farm vehicle that uses GPS and other wireless technologies to farmland
Sensor: a device that detects or measures a physical property and records, indicates, or otherwise responds to it
Variable rate application: a method of applying varying rates of a material in appropriate zones throughout a field based on the precise location or qualities of the area

Interest Approach – Engagement

Lead into a discussion of technology on the farm by showing the milking at the 1850 farm video first without saying anything and then show the robotic milking video. Ask the students to compare the two videos (links above).

Background - Agricultural Connections

In the 1940s, one farmer in the United States produced enough food to feed 19 people. Today, one US farmer produces enough to feed 165 people. The increase in U.S. food production is directly related to the advancement of agricultural technology.

The Food and Agriculture Organization (FAO) of the United Nations (UN) projects the world population to reach 9.7 billion people by the year 2050. With 9.7 billion people on Earth, the world's farmers will need to grow about 60-70 percent more food than what is now being produced. As the global production increases, farmers will need to utilize innovative technologies to produce more food with fewer resources.

Procedures

1. Watch the instructional video- link provided above and on website.

2. Agricultural Technology Timeline: Lead a discussion about the development of agricultural technology. Integrate the following points into the discussion:
   - Agriculture began around 10,000 BC when humans started domesticating plants and animals to ensure a more reliable food source when compared to hunting and gathering. At that time, most work was accomplished by hand with few tools available.
   - The introduction of powered machinery replaced work previously performed by people and animals (horses, mules, and oxen).
   - Throughout history, scientific and technological advancements have impacted the agricultural industry by increasing food production and farm efficiency.

3. Organize the students into small groups. Provide each group with a set of Agricultural Technology Timeline card (this can also be done individually).

4. Have each group create a timeline of agricultural technology by ordering the cards and placing the year card in the space provided on the corresponding technology card.

5. After the groups have completed their timelines, check to make sure the order is correct.

- **1701:** Jethro Tull introduced the seed drill, a device that cuts trenches and drops in seeds.
- **1793:** Eli Whitney invented the cotton gin, a machine that separates seeds from fiber.
- **1834:** Cyrus McCormick patented the McCormick reaper, a grain harvesting machine.
- **1837:** John Deere invented the steel plow, which was stronger, sharper, and more efficient.
- **1842:** Joseph Dart invented and built the first grain elevator, a wooden structure with buckets used to load and unload ships.
- **1873:** Silos, structures that store grain, came into use.
- **1874:** Glidden barbed wire, an inexpensive fencing used for livestock on rangeland, was patented.
- **1884:** The horse-drawn combine, used to harvest wheat, came into use on West Coast farms.
- **1892:** The first gasoline tractor was built by John Froelich.
- **1959:** The mechanical tomato harvester, used to harvest, sort, and load tomatoes, was developed.
- **1980:** Farmers began using computers to manage farm operations and monitor weather conditions.
- **1994:** Farmers began using satellite technology to track and plan their farming practices.
- **2003:** Farm equipment manufacturers install GPS systems in tractors.
- **2012:** The first self-driving, autonomous tractor was unveiled at the Big Iron Farm Show in North Dakota.
- **2013:** Widespread use of drone technology by farmers.

6. Watch the future of farming & agriculture video, link provided above. Ask the students to identify the different types of technology showcased in the video.

7. Watch the Agricultural Engineers video, link above, to discover what agricultural engineers do and what types of problems they are trying to solve.

8. Arrange students into groups of 4-5. Give each group one of the *Farming Challenges* cards so that at least two different groups have the same scenario. Ask the groups to work as agricultural engineers to propose a solution for their challenge.

9. Provide each group with poster paper. Have the groups draw a picture/diagram of their technology or invention on the poster paper.

10. Invite each group to share their challenge and propose their solution with the class.

11. Discuss the proposals, pointing out that there can be more than one solution to a problem, and that, typically, an idea must be tested and revised several times before it is successful. Even when ideas are not successful, much can be learned from the process. Use the following questions to guide the discussion:

- How were the different solution proposals for the same challenge similar or different?
- What are the pros and cons of the proposed solutions?
- What type of technology (robots, drones, lasers, etc.) were utilized in the proposed solutions?

12. Optional: watch a local FarmChat about drones! Link is above.
13. For additional learning, have the students choose one form of ag technology to research.
    - Autonomous pickers
    - Robotic weed/pest eliminator
    - Weed-eliminating lasers
    - Agriculture sensors
    - Robotic soil-sampler
    - Drone-assisted crop monitoring
    - Aerial crop imaging
    - CubeSat whole farm imaging
    - Agriculture data analytics
    - Agriculture data-sharing collectives
    - High density vertical farming
    - Livestock activity monitors
    - Livestock breath analysis
    - Livestock automated thermal imaging analysis
    - Livestock 3-D camera measuring
    - Livestock health monitoring
    - Automated behavior analysis
    - Inland saltwater fish farms
    - Zero waste fish farming
    - Bacteria-based fish food
    - Insect flour and protein powder
    - Cultured meats
    - CRISPR

Organization Affiliation

The original lesson plan "High-Tech Farming" can be found on the National Ag in the Classroom website.
https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=691&search_term_lp=high%20tech

Agriculture Literacy Outcomes

Science, Technology, Engineering & Math
- Discuss how technology has changed over time to help farmers/ranchers provide more food to more people (T4.6-8.d)
- Identify specific technologies that have reduced labor in agriculture (T4.6-8.h)

- Provide examples of science and technology used in agricultural systems (e.g., GPS, artificial insemination, biotechnology, soil testing, ethanol production, etc.); explain how they meet our basic needs, and detail their social, economic, and environmental impacts (T4.6-8.i)

Iowa/ Common Core Standards

SS.6.22. Explain multiple causes and effects of events and developments in the past.

SS.7.13 Identify social, political and economic factors that can influence our thoughts and behaviors.

SS.7.23 Explain how global changes in population distribution patterns affect changes in land use in an area.

SS.8.16. Analyze the role of innovation and entrepreneurship in institutions throughout early American history in a market economy.

MS-ETS1-1. Define the criteria and constraints of a design problem with enough precision to ensure a successful solution, taking into account the relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.