

# WHEN I GROW UP

## DISCOVER AG CAREERS

~ CURRICULUM FOR 6TH-8TH GRADERS ~



AMERICAN FARM BUREAU  
FOUNDATION FOR AGRICULTURE

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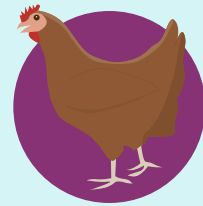
## CAREER FOCUS AREAS



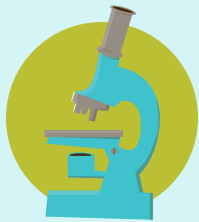
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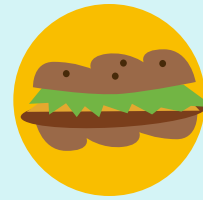
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## INTRODUCTION

**T**hanks for your interest in sharing exciting, diverse agricultural careers with your students! There is a growing demand for recent college graduates entering the workforce in the agricultural sector. There are an estimated 57,900 high-skilled job openings annually in the food, agriculture, renewable resources and environmental fields in the United States.<sup>1</sup> According to the 30th U.S. Secretary of Agriculture, Tom Vilsack, “Those receiving degrees in agricultural fields can expect to have ample career opportunities . . . These jobs will only become more important as we continue to develop solutions to feed more than nine billion people by 2050.” It is an exciting time to be preparing for a career in the agricultural industry!

This kit has been designed so you can easily incorporate this information into your curriculum in an interdisciplinary manner. The lessons and activities included in this kit have been crafted with your middle school students in mind. We hope they find these experiential lessons to be both engaging and meaningful!

## Standards

These lessons are all based on national educational standards including:

- Next Generation Science Standards<sup>2</sup>
- Common Core English Language Arts<sup>3</sup>
- Common Core Math<sup>4</sup>
- Social Science<sup>5</sup>
- Career Development Policy (National Career Development Association)<sup>6</sup>
- National Core Art Standards<sup>7</sup>

Please see the standards alignment matrix for detailed standards alignment information.

## Career Focus Areas

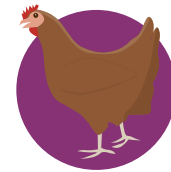
This resource follows nine career focus areas as outlined by the National FFA Organization. These areas include the eight career focus areas identified by the National Career Clusters<sup>®</sup> in addition to an area for Agricultural Education. Throughout this resource you will find references to *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)), a practical tool developed by the National FFA Organization, Discovery Education, and AgCareers.com. AgCareers.com is the strategic career success partner of the FFA. AgCareers.com was pleased to contribute the content for the agriculture career profiles featured within Ag Explorer. The platform is a robust and comprehensive career resource to help students envision a future in agricultural careers. While use of the online platform is not required, the American Farm Bureau Foundation for Agriculture encourages you to leverage this wonderful tool. This Career Kit is structured using the nine career focus areas in the agricultural industry.



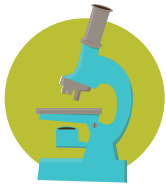
Agribusiness Systems



Agricultural Education



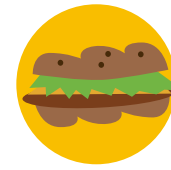
Animal Systems



Biotechnology Systems



Environmental Service Systems



Food Products & Processing Systems



Natural Resources Systems



Plant Systems



Power, Structural, & Technical Systems

## Downloadable Resources

The resources in this kit are based on each career focus area. Each area includes:

- One lesson that introduces students to the career focus area and associated career opportunities
- Three standards-based, interdisciplinary supplemental activities that each feature a different career from that area
- One take-home activity sheet that introduces students to another career from that area through a fun, engaging activity

The resources are designed to focus on one career focus area each month during the school year. If you choose to follow this structure, we recommend having a weekly career day. The main lesson is presented the first week of the month, followed by the three supplemental activities.

Additionally, this kit contains information for non-formal educators and guidance counselors at your school. The classes students take in high school can have a big impact on the careers they choose to pursue. We encourage you to connect with your local high school agriculture teacher to learn about the agriculture classes and career focus areas available to students in your area.

## Extended Learning Resources

Extend learning with a set of Agricultural Career Posters and the *Name That Ag Career!* trivia card set, available in the store at [www.agfoundation.org](http://www.agfoundation.org). Ten posters featuring information from each career focus area are included, and the card game features more than 40 playing cards that highlight careers in agriculture. Students, families, and club members can play the card game by trying to get their team members to guess the agricultural career. But watch out—there are key words that you cannot say!

**Thank you for your commitment to prepare your students for careers in agriculture. To find more educational resources about agriculture, please visit us at [www.agfoundation.org](http://www.agfoundation.org).**

1 USDA, National Institute of Food and Agriculture. (2015). One of the best fields for new college graduates? Agriculture. <https://nifa.usda.gov/press-release/one-best-fields-new-college-graduates-agriculture>

2 [www.nextgenscience.org](http://www.nextgenscience.org)

3 [www.corestandards.org/ELA-Literacy](http://www.corestandards.org/ELA-Literacy)

4 [www.corestandards.org/Math](http://www.corestandards.org/Math)

5 [www.educationworld.com/standards/national/soc\\_sci/economics/5\\_8.shtml](http://www.educationworld.com/standards/national/soc_sci/economics/5_8.shtml)

6 [www.ncda.org/aws/NCDA/pt/fli/4728/false](http://www.ncda.org/aws/NCDA/pt/fli/4728/false)

7 [www.nationalartsstandards.org](http://www.nationalartsstandards.org)

# Name that Ag Career!



## Supplies

- Timer
- Paper to keep track of points
- Name That Ag Career!* cards

## Context

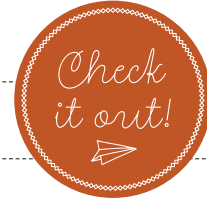
The point of the game is to guess the agriculture career that is being described. The agriculture careers are from the *AgExplorer* website. There are four cards per career focus area: agribusiness systems; animal systems; biotechnology systems; environmental service systems; food products and processing systems; natural resources systems; plant systems; power, structural, and technical systems; and agricultural education. There are also nine cards in the multi-career area. There are 45 cards in total.



## Directions

- Divide into teams. Use one set of *Name That Ag Career!* cards for every two teams that play.
- Players take turns as the “explainer,” providing clues and describing the career on the card without using the “hush” words noted on the card or saying any part of the career being described.
- If the explainer uses the hush word or the career word, the turn is automatically over, no points are awarded, and it’s now the opposite team’s turn.
- One person from the opposite team will look at the card while the explainer is giving clues to keep the teams accountable.
- The explainer has as much time as is allotted to complete a turn. If the explainer runs out of time before their team can guess the career, the opposite team is allowed one guess. If they guess correctly, a point is awarded to the team.
- Whichever team has the most points at the end wins!

# GUIDE FOR NON-FORMAL EDUCATORS



This toolkit has many applications for non-formal educators.

## 4-H or FFA Members

Think about presenting parts of this toolkit to younger or potential members to get them excited about careers in agriculture! If you are a Future Farmers of America member, talk to your agriculture teacher or FFA advisor about using these resources to do eighth-grade recruitment at a local middle school.

Formal agriculture instructors may also wish to use this in an introduction to agriculture class. While the standards alignment is for middle grades, the interest level is much more broad!

Use parts of the lesson as you need to make them work for you!

## Farm Bureau Members or Ag in the Classroom Coordinators

This toolkit is full of easy-to-use lessons that you can present in middle school classrooms. Call or email middle school teachers in your area to gauge their interest in these resources and a potential visit. Share the *Welcome Letter* with them. Work with the teacher to choose which career focus area introductory lesson would be the best to present.

Alternately, you could share these resources with local middle school teachers and encourage them to utilize them in their classrooms. Offer to set up guest speakers in the agricultural industry or job-shadowing experiences for students to supplement the in-class curriculum.



## After-School Program or Camp Coordinator

These ready-to-use, engaging, interactive lessons are a perfect fit for an after-school program or a camp! Think about having a career day every week at an after-school program. Start with the main lesson the first week of the month, then follow it with the three supplemental activities (one per week). This area-a-month structure is a fun way to get students thinking about careers. Additionally, utilize the *Name That Ag Career!* card game as a fun review activity! Check out the *Welcome Letter* for detailed instructions.

If you coordinate a camp, think about having a career theme! The main lessons are great ways to introduce students to the topics. The supplemental activities would be particularly applicable as hands-on activities at camps.

# GUIDANCE COUNSELOR INFORMATION

According to the Food and Agriculture Organization, one in three jobs worldwide are in agriculture!<sup>2</sup>

There is a growing demand for recent college graduates entering the workforce in the agricultural sector. There are an estimated 57,900 high-skilled job openings annually in the food, agriculture, renewable resources and environmental fields in the United States.<sup>1</sup> According to the 30th Secretary of Agriculture, Tom Vilsack, “Those receiving degrees in agricultural fields can expect to have ample career opportunities. . . . These jobs will

only become more important as we continue to develop solutions to feed more than nine billion people by 2050.” It is an exciting time to be preparing for a career in the agricultural industry!

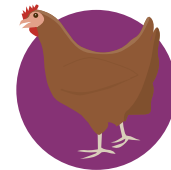
Agriculture can bring science, technology, engineering, and mathematics concepts to life! Students who are engaged in agriculture can pursue careers in nine different areas.



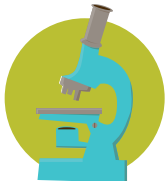
Agribusiness Systems



Agricultural Education



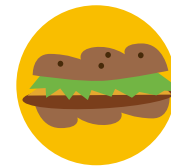
Animal Systems



Biotechnology Systems



Environmental Service Systems



Food Products & Processing Systems



Natural Resources Systems



Plant Systems



Power, Structural, & Technical Systems

The classes students take in high school can have a big impact on the careers they choose to pursue. We encourage you to connect with your local high school agriculture teacher to learn about the secondary agriculture classes and career focus areas available to students in your area.

1 USDA, National Institute of Food and Agriculture. (2015). One of the best fields for new college graduates? Agriculture. <https://nifa.usda.gov/press-release/one-best-fields-new-college-graduates-agriculture>

2 Food and Agriculture Organization of the United Nations. (2012). FAO Statistical Yearbook. 18. Retrieved from: <http://www.fao.org/docrep/015/i2490e/i2490e01b.pdf>





ESTIMATED TIME

**55**  
minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Math, Economics

CAREER FOCUS AREA

## AGRIBUSINESS SYSTEMS

### Lesson Title

## *From Farm to Fork: Careers in the Agribusiness System*

### Standards

- CCSS.MATH.7.EE.B.3. Solve multi-step, real-life, and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically.
- NSS-EC.5-8.14. Profit and the Entrepreneur.
- NCDA-7-9-3. Helping Pupils Understand Career Applications of Subject Matter.

### Objectives

1. Students will explore the goal of an agribusiness and the four types of business resources.
2. Students will identify one career of interest in the Agribusiness Systems Career Focus Area and map out a plan to pursue that career.

### Materials

- Access to a computer lab or laptops/tablets for students. One per student is ideal. Alternately, students could complete the activity in pairs.
- Copies of Career Plan handout (one per student)
- Copies of Company Ledger and Resource Roll Cards handouts (one per four students)
- Dice (one per four students)



## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Agribusiness Systems Career Focus Area.
  - Review the lesson plan and determine if any modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Introduce Agribusiness Systems Career Focus Area

- Ask students to identify one career that comes to mind when they think of agricultural business. Remind students that an agricultural business is any business involved in the production, processing, and distribution of agricultural products.
- Instruct students to pair up and brainstorm as many careers as they can think of that relate to agricultural business. After a few minutes, have two groups get together and compare their lists.
- Have groups share one example at a time, popcorn-style. Capture all the career options on the board. Instruct students not to duplicate a career that is already on the board. If needed, backfill with additional diverse agricultural business careers.
- Draw attention to the wide array of careers in agricultural business. Preview the lesson by telling students they will be exploring exciting career opportunities in agricultural business.

## Body (Main Content)

### STEP 2 >> Introduction to Agribusiness Game

- Break students into teams of four. Have them group their desks together or sit at tables.
- Tell students that their teams will be creating an agribusiness. They will need to name their company and decide the product that they will bring to market. Give them a few examples (e.g., they could sell farm machinery, seeds, animal health products, or fertilizers).
- Once all teams have created a name and chosen a product, have each team share out. Explain to students that the goal of an agribusiness is to effectively utilize their resources to make a profit. Ask a student to define “profit.”

**Profit definition:** A financial gain, especially the difference between the amount earned and the amount spent producing something.





- Tell students that in business there are four types of resources they will use to try to make a profit:
  1. People/human resources
  2. Financial resources
  3. Knowledge resources
  4. Physical resources
- Instruct students that specific careers within an agribusiness help manage each of those resources. During the next activity, students will each take on a certain role at the company and manage a certain type of resource.
  - Human resources manager: People/human resources
  - Chief financial officer: Financial resources
  - Training and learning specialist: Knowledge resources
  - Operations manager: Physical resources
- Pass out one company ledger, one set of resource roll cards, and one dice to each team. Instruct students to write their company name and product on their company ledger. Tell students this game will have four rounds, to represent the four financial quarters in a business year. In each quarter, each member of the team will roll the dice once. The roll of the dice will affect the resource points they have available. Direct students to follow the instructions on the ledger and play when they are ready.
- During game play, ensure that each member of the team is recording their own resource points on the ledger. You can either let the teams play the game at their own pace or call out when they should switch to the next quarter. Before moving on to the next quarter, make sure each team has rolled all four times.
- At the end of the game have each team calculate their total resource points and share out with the entire class. Announce and celebrate the winning team (the team with the most total resource points).

### **STEP 3 >> Career Exploration Activity**

**Note:** Students will need tablets or computers with access to the Internet for this activity. If enough computers are not available for each student to have one, break students into pairs or small groups.

- Instruct students to visit *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)) and select the Agribusiness Systems Career Focus Area. Their task is to discover three careers that interest them. Point out that they can filter the careers by working environment, required education level, salary, and job outlook. Encourage students to dig in and really think about what appeals to them about different careers.
- Pass out the Career Plan handouts. Instruct students to capture their top three careers of interest on the handout and choose one to research further.



- Utilizing the resources on *AgExplorer*, they should fill out the rest of the handout and capture the following information:
  - Why they are interested in that career
  - High school courses they should take
  - Education level required for the career
  - Potential higher education institutions that offer the required degree
  - Current job openings of interest
- After students are done working, have a few students share the careers they were interested in and why.

## **Wrap Up** (Review, Assess, Challenge)

### **STEP 4 >> Review Careers of Interest**

- Instruct each student to write their top career of interest and why they are interested in it on a half-sheet of paper. Students should not write their names on the paper.
- Instruct students to crumple the paper into a ball. At the same time, have students throw their crumpled paper across the room.
- Cue students to retrieve a crumpled paper and read it. Instruct students to walk around the room and figure out whose paper they have. Once they find the person who wrote that career, that person should explain what else they learned about the career (including potential higher education institutions and current job opportunities).
- Once everyone has discovered the author of the paper they found, students should return to their seats.

### **STEP 5 >> Assess Learning**

- Collect the handouts and assess for completeness and depth of thought.

### **STEP 6 >> Challenge**

- Remind students that agriculture is everywhere and that they could eventually play an exciting part in that industry.
- Pass out Take-Home Activity sheets and give further instructions.

### **Teaching Notes**

The Agribusiness Systems video on *AgExplorer* can be used as an additional resource to introduce students to Agribusiness Systems careers.

[www.agexplorer.com/focus/agribusiness-systems](http://www.agexplorer.com/focus/agribusiness-systems)

## People Resources

Roll	Action
1	There is corruption in your company. You have to fire employees. <b>Lose 4 people resources points.</b>
2	You recruited a great new summer intern. <b>Gain 1 people resources point.</b>
3	You lost a good employee to a competing company because they offered a better compensation package. <b>Lose 2 people resources points.</b>
4	You hired a new sales executive from a competing company. <b>Gain 4 people resources points.</b>
5	A high-ranking executive retired and moved away. <b>Lose 1 people resources point.</b>
6	An employee from within your company was promoted to a corporate suite executive position. <b>Gain 2 people resources points.</b>

## Physical Resources

Roll	Action
1	There was a fire at one of your plants. <b>Lose 4 physical resource points.</b>
2	You acquired a new company fleet of fuel-efficient vehicles. <b>Gain 1 physical resources point.</b>
3	One of your raw material suppliers went out of business. <b>Lose 2 physical resources points.</b>
4	You built a new production facility. <b>Gain 4 physical resources points.</b>
5	Two of your company vehicles were damaged in an accident. <b>Lose 1 physical resources point.</b>
6	You upgraded your production equipment to state-of-the-art technology. <b>Gain 2 physical resources points.</b>

## Financial Resources

Roll	Action
1	Your competition significantly lowered their prices and you lost business to them. <b>Lose 4 financial resources points.</b>
2	Your sales team landed a major new account and bought a significant amount of product. <b>Gain 1 financial resources point.</b>
3	One of your raw material suppliers raised their prices. <b>Lose 2 financial resources points.</b>
4	Your marketing team created a compelling ad and sales dramatically increased. <b>Gain 4 financial resources points.</b>
5	A sales manager embezzled money from the company. <b>Lose 1 financial resources point.</b>
6	You found a lower-cost supplier and bought your raw materials from them. <b>Gain 2 financial resources points.</b>

## Knowledge Resources

Roll	Action
1	A corporate spy stole proprietary knowledge from your company. <b>Lose 4 knowledge resources points.</b>
2	You trained the sales team on effective sales strategies. <b>Gain 1 knowledge resources point.</b>
3	An employee skipped a safety training and then had an accident at work. <b>Lose 2 knowledge resources points.</b>
4	You instituted a learning management system to track employee learning online. <b>Gain 4 knowledge resources points.</b>
5	An employee fell asleep in one of your trainings. <b>Lose 1 knowledge resources point.</b>
6	An employee earned a Master of Business Administration degree in night school. <b>Gain 2 knowledge resources points.</b>

# Company Ledger

Company Name \_\_\_\_\_

Product Sold \_\_\_\_\_

	<b>Financial Resources</b> Chief Financial Officer	<b>People Resources</b> Human Resources Manager	<b>Knowledge Resources</b> Training & Learning Specialist	<b>Physical Resources</b> Operations Manager
<b>Beginning of Year</b>				
<b>End of Quarter 1</b>				
<b>End of Quarter 2</b>				
<b>End of Quarter 3</b>				
<b>End of Quarter 4</b>				
<b>TOTAL RESOURCE POINTS</b>				

## Instructions

- Write your company name and product sold on the scoresheet.
- Choose which member of your team will play which employee role in the company. Pass out the appropriate resource roll cards to each employee.
- Before Quarter 1 begins, have each employee roll the dice. The number rolled represents the number of resource points the company has available for that particular resource. Each employee should record the initial points in the ledger above.
- When Quarter 1 begins, each employee will roll the dice in turn. Use the resource roll card to determine whether you gained or lost resource points. Add or subtract points and record your new balance on the ledger. Pass the dice and ledger to the next employee. All four employees should roll the dice during each quarter.
- Repeat for Quarters 2 through 4.
- At the end of the year, total all of your resource points. The team with the most total points will be the winner.

## Careers I'm interested in:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

**Draw a star next to the one you want to explore in depth!**

Why I'm interested in this career:

High school courses I should take:

Education level required for career:

2-3 potential institutions I could attend (include name, location, and program of study):

### Current job opening I'm interested in:

Company \_\_\_\_\_

Job title \_\_\_\_\_

Location \_\_\_\_\_

One key duty \_\_\_\_\_

One job requirement \_\_\_\_\_

Why I'm interested in this job \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Current job opening I'm interested in:

Company \_\_\_\_\_

Job title \_\_\_\_\_

Location \_\_\_\_\_

One key duty \_\_\_\_\_

One job requirement \_\_\_\_\_

Why I'm interested in this job \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



### ACTIVITY #1 TITLE

## *Designed to Sell*

**Estimated Time:** 25 minutes

**Content Area:** Art

**Standard:** Art: Interpret Art<sup>1</sup>

### Objective

1. Students identify the elements of graphic design that appeal to them in advertisements and learn about the work graphic designers do in agriculture.

### Materials

- Internet access (on computers, laptops, or phones) and/or magazines

### Activity Sequence

1. Using magazines or the Internet, instruct students to choose an advertisement that appeals to them. Instruct students to capture notes about why they like the advertisement and what about it appeals to them. Ask them to think specifically in terms a graphic designer might use (e.g., color, texture, space, balance, proportion).
2. Break students into pairs and have them share their advertisement and what about it appeals to them.
3. Ask students what industries are being promoted in the ads they found. Make the point that all industries need qualified, specialized graphic designers. In the agriculture industry, the employment prospects for graphic designers are excellent. Share the following information about graphic designers:
  - a. Graphic designers in agriculture fall into the Agribusiness Systems career focus area.
  - b. Graphic designers can work independently, or may work for companies or organizations as well as marketing agencies.
  - c. They develop creative concepts for business marketing needs.
  - d. They work through various media platforms to produce promotional materials.
4. Working individually or with their partners, instruct students to find an advertisement on the Internet from an agricultural company that utilizes the same graphic design principle or elements they appreciated about their first choice.
5. Alternatively, students could create their own advertisement for a fictional agricultural company using the design principles explored in this activity.
6. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.





**Discussion**

*What did you enjoy about this activity?*

*What might be enjoyable about a career as a graphic designer in agriculture?*

*What other careers in the Agribusiness Systems Career Focus Area are related to the sales, marketing, or promotion of products?*

- Communications specialist, marketing specialist, public relations specialist, social media strategist, brand manager

**Learn More**

- For a quick refresher on the basics of graphic design, check out Graphic Design Basics for Beginners (<http://1stwebdesigner.com/graphic-design-basics-elements>).
- To dig deeper into the featured career, review *AgExplorer, Graphic Designer* ([www.agexplorer.com/career/graphic-designer](http://www.agexplorer.com/career/graphic-designer)).

**ACTIVITY #2 TITLE**

***I’m Just a Bill!***

**Estimated Time:** 45 minutes

**Content Areas:** Social Studies, Government

**Standard:** Principles of Democracy: What does the national government do?<sup>2</sup>

**Objective**

1. Students engage in a simulation of drafting, lobbying, and voting on legislation that affects agriculture.

**Materials**

- Three blank tear sheets and markers
- Internet access

**Activity Sequence**

1. Tell students they will get firsthand experience in the complex process of creating and passing legislation. Break the class into groups and assign them roles:
  - a. Farmers
  - b. Commodity group
  - c. Lobbyists
  - d. House of Representatives
  - e. Senate
  - f. Executive branch





## AGRIBUSINESS SYSTEMS ACTIVITIES

2. Instruct students that they will focus on three issues:
  - a. The minimum wage
  - b. Water and air quality regulations
  - c. Farm subsidies
3. **Phase 1—Discovery:** Their first task in their groups is to determine what stance they'd like to take on each issue. Each small group should come to a consensus regarding whether they would recommend an increase or no change to each of the topics. Have students work in their small groups to come to a consensus. Have one student capture the thoughts of the group. Make sure they record their stance and why for each issue. Time allowing, students could research their issues on the Internet.
4. **Phase 2—Drafting Legislation:** In this phase, farmers, the commodity group, and lobbyists meet. The farmers and commodity group need to come to a consensus on their stance for each issue. They need to explain their position to the lobbyists, so the lobbyists can take their opinions to Capitol Hill. While they are meeting, the House of Representatives and the Senate meet to draft one piece of legislation for each topic. Have students write the final draft of each of the bills on a tear sheet. The executive branch can provide suggestions for their legislation. The bills should include specifics on the proposed increase or decrease and their reasoning.
5. **Phase 3—Lobbying:** Facilitate phases 3-5 with the entire class watching. The authoring congressman or congresswoman reads each bill to the entire class. The lobbyist group meets with the House and the Senate to share the opinion of the farmers and commodity group, trying to convince them to vote a certain way on each of the bills.
6. **Phase 4—The Votes:** First, the House of Representatives votes on each bill. Have the students in the House and the Senate stand up on different sides of the room. Members of the House should be called on one at a time to vote "yea" or "nay." Have a student record the vote of each member. Each bill that passes the congressional vote with a simple majority in the House then moves to the Senate for a vote. Have a student physically walk the written bills to the Senate for the vote. Repeat the voting process for the Senate.
7. **Phase 5—The President's Desk:** Each bill that passes the Senate with a simple majority is sent to the president to be signed. The president decides to sign each bill, making them law, or vetoes them. Congress can override a veto if both chambers repass the bill with at least a two-thirds majority.
8. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.



**Discussion**

*What did you enjoy about your role in this process?*

*What specifically was the lobbyist’s role in the process?*

- Work to develop—and coordinate with—grassroots efforts
- Build relationships with elected officials and their staff
- Educate and inform officials on issues in agriculture and how certain pieces of legislation or regulations could affect the industry

*What other careers in the Agribusiness Systems Career Focus Area might relate to creation of laws?*

- Ag lawyer, ag journalist, ag broadcaster, advisor, government/stakeholder relations, agricultural literacy and advocacy specialist, agriculture legislative assistant

**Learn More**

- To review the featured career, review *AgExplorer*, *Ag Lobbyist* ([www.agexplorer.com/career/agricultural-lobbyist](http://www.agexplorer.com/career/agricultural-lobbyist)).
- For a fun, retro look at how a bill becomes law, share this video with your students: “I’m Just a Bill—Schoolhouse Rock” at <https://www.youtube.com/watch?v=tyeJ55o3EI0>.

**ACTIVITY #3 TITLE**

***Lights, Camera, Action—The Nightly News***

**Estimated Time:** 50 minutes

**Content Area:** English Language Arts

**Standard:** Presentation of Knowledge and Ideas<sup>3</sup>

**Objective**

1. Students research current events in small groups and create videos or presentations where they take on the role of broadcasters, field reporters, and eyewitnesses.

**Materials**

- Newspapers
- Internet access



### Activity Sequence

1. In groups of three, have students research a local or national news topic that interests them. They can use the Internet or newspapers you have provided.
2. Their task is to synthesize the information and present it to the class. They can either create a video or present in-person to the class. Students take on the roles of news broadcaster, field reporter, and eye witness. The news broadcaster should introduce the topic, then the field reporter should interview the eyewitness. Lastly, the field reporter should turn the presentation back to the broadcaster to close the segment. Their presentations/videos should be one to two minutes long.
3. Tell students there are certain news broadcasters who focus only on agriculture. Share the following details:
  - a. Agriculture broadcasters use radio or television to report on stories that are relevant to agriculture viewers, but may also be used by regional and national news outlets who reach non-agriculture viewers.
  - b. They collect and organize agriculture from news wires and other sources to share with viewers and listeners.
  - c. They also help determine editorial content of network programming and assist with the production of audio promotional, commercial, and value-added information.
4. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

### Discussion

*What did you enjoy about this activity?*

*What might be enjoyable about a career as an agriculture broadcaster?*

*What other careers in the Agribusiness Systems Career Focus Area are related to keeping people informed about agriculture?*

– Ag journalist, agricultural literacy and advocacy specialist

### Learn More

- To explore the featured career, review *AgExplorer, Agriculture Broadcaster* ([www.agexplorer.com/career/agriculture-broadcaster](http://www.agexplorer.com/career/agriculture-broadcaster)).

- 1 National Arts Standards: Visual Arts – Responding – 7th: VA:Re8.1.7a. Interpret art by analyzing art-making approaches, the characteristics of form and structure, relevant contextual information, subject matter, and use of media to identify ideas and mood conveyed.
- 2 Social Science: Civics – NSS-C.5-8.3. Principles of Democracy: How Does the Government Established by the Constitution Embody the Purposes, Values, and Principles of American Democracy? – What does the national government do?
- 3 CCSS.ELA-LITERACY.SL.7.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.  
CCSS.ELA-LITERACY.SL.7.5. Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

## Social Media Strategist Scavenger Hunt

There are tons of exciting careers in the Agribusiness Systems Career Focus Area! This scavenger hunt introduces one!

Step 1. Choose an agricultural company that interests you.

Step 2. Locate the company's social media accounts. Write their handles below.



Step 3. Choose two posts that appeal to you. The posts can be from any of the platforms. Describe the posts and explain why they appeal to you! Would you change anything about them?

Post 1:

Post 2:

Check out [www.agexplorer.com/career/social-media-strategist](http://www.agexplorer.com/career/social-media-strategist) for more information about becoming a social media strategist!



ESTIMATED TIME

90  
minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Instruction,  
Community  
Development



CAREER FOCUS AREA

## AGRICULTURAL EDUCATION

### Lesson Title

### *Teaching the Future: Careers in Agricultural Education*

### Standards

- Economics Standard 15: Investment in factories, machinery, and new technology; and in the health, education, and training of people can raise future standards of living.
- CCSS.ELA-LITERACY.RH.6-8.7. Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

### Objectives

1. Students will understand that all careers and industries need trained, skilled workers, and this requires specialized training.
2. Students will indicate knowledge of where Agricultural Education instructors can work in order to share their skills and passion.

### Materials

- Access to a computer lab or laptops/tablets for students. One per student is ideal. Alternately, students could complete the activity in pairs.
- Paper and writing utensil (one per student)
- Candy, at least four varieties (Learning Station 2)

## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Agricultural Education focus area.
  - Review the lesson plan and determine if any modifications are required.
  - Set up three learning stations (Step 3). Place a learning station card and the respective materials at each station.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> We are All Teachers

- Ask students to brainstorm something that they like to do. This can be anything, such as swimming, playing video games, cooking, etc. Have them write down the topic at the top of a piece of paper, and then write a more specific skill within that topic below.

*Example:* Topic: Swimming  
Skill: A cannonball with a huge splash

- Have students write a short how-to paragraph to teach their skill within the topic.
- Students will pair up with a classmate and teach them their skill. Alternately, select a few students to teach their skill to the class.

## Body (Main Content)

### STEP 2 >> The Art of Instruction

- Share with students the “why” of instruction.

In order to share knowledge, there have to be teachers! Just like you shared your skills, teachers go through lots of training to be able to share their knowledge and skills within their interest areas. Each career path has a specific set of instructors to best prepare the learners for that job, especially in high school and college. For example, if you want to have a job in business, you take classes that are taught by teachers trained in business skills. If you have an interest in agriculture, you take classes taught by teachers who have been trained in Agricultural Education. People who have been trained in Agricultural Education, commonly called Ag Ed, can share their skills and passion for agriculture in many different ways. They can teach at the high school level, the collegiate level, or even in the community through land-grant university extension programs. Teachers trained in Ag Ed can also work with universities to recruit students interested in agricultural education.

- Have students react and discuss the following questions:
  - Think back to the activity we just did—teaching a skill to your classmate. What did you realize about teaching, even in that short exercise?
  - Why do we need education positions in agriculture?
  - How does that benefit the U.S., our communities, and us as individuals?
- Instruct students that a career in the Agricultural Education focus area is key to encouraging future generations to be successful and engaged in the agriculture industry.



### **STEP 3 >> Exploring the Three Circles**

- Inform students that the Ag Ed model is based on three circles: classroom instruction, Supervised Agricultural Experiences (SAEs), and FFA involvement.
  - Think of a three legged stool: If you take one leg away, it will be hard to keep the stool standing. All three legs are equally important. Just like this stool, Ag Ed is unique because it is made of three important components: classroom instruction, Supervised Agricultural Experiences (SAEs), and FFA involvement. Let's jump in and see what it feels like to be an ag educator in each of these circles.
- Inform students that three learning stations have been set up. Depending on class size, you may wish to replicate the learning stations to minimize group size.
  - Students will rotate to each station to see what it feels like to be an ag educator, practicing each circle.
  - At each station students will find a prompt card and necessary materials.
  - Provide clarification for how much time students will have at each station.
- Break students into three equal groups and dismiss to learning stations. See the learning station cards for specific instructions.
- After groups have completed their rotations, transition to the career exploration activity.

### **STEP 4 >> Career Exploration Activity**

**Note:** Students will need tablets or computers with access to the Internet for this activity. Students can share access within their groups.

- Break the class into four equal groups. Assign each group to an Ag Ed category: high school teacher, collegiate, extension/community, and college recruiter. Allow students access to [www.agexplorer.com/focus/agricultural-education](http://www.agexplorer.com/focus/agricultural-education) to research their group's specific assignment.
- Within their groups, students will think of a way to creatively share their career path with the rest of the class. Examples include a skit, a mural or poster, a news broadcast, a podcast, etc. The representation must include:
  - The title of the career
  - Responsibilities of the job
  - Training required
  - Personal qualities or skills that may complement a career in this focus area
- Give students time to brainstorm and develop their projects.
- The four groups of students will present the careers within their focus area.





## Wrap Up (Review, Assess, Challenge)

### STEP 5 >> Review

- Instruct students to write a short sentence on a scrap piece of paper—without writing their name on the paper—about how a teacher inspired them. Collect their papers and redistribute them.
- Have students read the comments one-by-one.
- Remind students that in the same way they were inspired by a teacher, agricultural instructors—at each level—inspire their students to be part of the global solution for agriculture.

### STEP 6 >> Assess Learning

- Pass out the Agricultural Education handout and have students complete it. Assess for learning.

### STEP 7 >> Challenge

- Remind students that agriculture is everywhere and they could eventually play an exciting part in that industry.
- Pass out Take-Home Activity sheets and give further instructions.

### Teaching Notes

The Agricultural Education video on *AgExplorer* can be used as an additional resource to introduce students to Agricultural Education careers.

[www.agexplorer.com/focus/agricultural-education](http://www.agexplorer.com/focus/agricultural-education)



## Agricultural Education Handout

In each quadrant below, write an example of a career in the Agricultural Education career focus area and a brief definition.

<p><b>Career</b> _____</p> <p><b>Definition</b></p>	<p><b>Career</b> _____</p> <p><b>Definition</b></p>
<p><b>Career</b> _____</p> <p><b>Definition</b></p>	<p><b>Career</b> _____</p> <p><b>Definition</b></p>

### Learning Station 1: Classroom Instruction

**What is it?** Agriculture is taught in middle and high school classrooms across the country. Today, more than 1,000,000 students participate in agriculture education classes in the U.S. Classes vary by state but may include courses such as introduction to agriculture, agriculture biology, agriculture mechanics, floriculture, veterinary science, and many more!

**What do you do?** As an ag educator, you get to teach agriculture classes at your school!

**Let's try it!** Work as a team to brainstorm a fun way to teach kids about what plants need to grow (sunlight, nutrients, water). Come up with a cool idea and share!

### Learning Station 2: FFA

**What is it?** Future Farmers of America (FFA) is a national organization of students interested in agriculture. It is inter-curricular, which means that you have to be in an agriculture class at school to be a part of FFA.

**What do you do?** As an ag educator, you can also be an FFA advisor! You get to coach students in leadership development.

**Let's try it!** Judging contests are a fun Career Development Event in FFA. Students get to judge animals, dairy products, and even produce! Today you get to judge candy. Look at the four pieces of candy. Put them in order from your favorite to your least favorite. Tell your friends why you put the candy in this order! Explaining your placing is called "giving reasons."

### Learning Station 3: SAE

**What is it?** The acronym SAE stands for Supervised Agricultural Experience. Each student in an agriculture class has an opportunity to have an SAE, which is like a special project. According to the National FFA Organization ([www.ffa.org](http://www.ffa.org)), SAEs can be in these categories:

- Exploratory: Students can explore a short project to learn about agriculture outside of class.
- Ownership/Entrepreneurship: Students own the project and make management decisions.
- Placement/Internship: Students work for—or intern with—someone who has a job in agriculture.
- School-Based Enterprise: Students work outside of class time on an agricultural project at school.
- Service-Learning: Students plan a program that supports a service organization.

**What do you do?** As an ag educator, you get to help each of your students identify an SAE that is just right for them!

**Let's try it!** As a team, brainstorm an SAE in each of the categories listed above.



ACTIVITY #1 TITLE

## *Recruiting for Agriculture*

**Estimated Time:** 35 minutes

**Content Areas:** Communications, Marketing

**Standard:** Text Types and Purposes<sup>1</sup>

### Objective

1. Students will engage in the creation of a marketing flyer or handout for a college or university that offers an agriculture major.

### Materials

- Paper and writing utensil/markers (per person)
- *Optional:* access to a computer design program

### Activity Sequence

1. Instruct students to research a college or university of their choice that has an agriculture major or an agriculture program. While researching, have the students note the following:
  - a. Name of the college/university
  - b. Three to five key points that distinguish the college/university's agriculture program
2. The students are to create a promotional flyer or handout that effectively markets the agriculture major at their chosen school.
3. Once created, students will partner and share their marketing material as they try to recruit their partner to their school.
4. If time permits, allow a few groups to share in front of the class.
5. *Optional:* For additional homework, have students research other colleges and universities that offer agriculture majors, and look at their online marketing resources.
  - a. How do they advertise their program?
  - b. In your opinion, is it effective? Why or why not?

### Discussion

*How do companies benefit from hiring college recruiters?*

*What are some qualities and skills that would be characteristic of a college recruiter position?*

### Learn More

- To dig deeper into the featured career, review *AgExplorer, College Recruiter* ([www.agexplorer.com/career/college-recruiter](http://www.agexplorer.com/career/college-recruiter)).

**ACTIVITY #2 TITLE**

## *Managing the Online Farm*

**Estimated Time:** 45 minutes

**Content Areas:** Communications, English Language Arts

**Standard:** Production and Distribution of Writing<sup>2</sup>

**Objective**

1. Students engage in creation of a social media site/handle and strategy for non-formal agricultural education.

**Materials**

- Paper and writing utensil (one per student)
- *Optional:* computer access for each student
- Large paper or poster board (one for each student)
- Markers or paint

**Activity Sequence**

1. Tell students that agricultural education can be formal and non-formal. It can take place in a classroom or in the community, at events, and even on social media!
2. Students will create an online social media handle and strategy for promoting agriculture literacy.
  - a. To begin, have students brainstorm an appealing handle name.  
Example: @IStandForAg, @AgricultureMoreThanEver, etc.
  - b. Tell students they need to define the following:
    - Target audience
    - Target age
    - Area in agriculture for which they want to advocate
    - Strategy for getting their message out
    - Response strategy to criticism or conflict
3. Using the large paper or poster board, each student will create a post for their social media site of choice. The post may include text and/or pictures. The post must effectively convey their stance on their chosen topic in a positive and creative way.  
*Optional:* Limit the number of characters the students are able to use (Example: Twitter is restricted to 140 characters per tweet).
4. Present or share the posts as appropriate.



## Discussion

*Do you think it is easier or harder to advocate for agriculture online? Why?*

*What can you do to positively promote agriculture in your current online space(s)?*

## Learn More

- To dig deeper into the featured career, review *AgExplorer, Agricultural Literacy and Advocacy Specialist* ([www.agexplorer.com/career/agricultural-advocacy-literacy-specialist](http://www.agexplorer.com/career/agricultural-advocacy-literacy-specialist)).

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### ACTIVITY #3 TITLE

## *Advising for Agriculture on Capitol Hill*

**Estimated Time:** 25 minutes

**Content Areas:** Social Sciences, English Language Arts

### Standards:

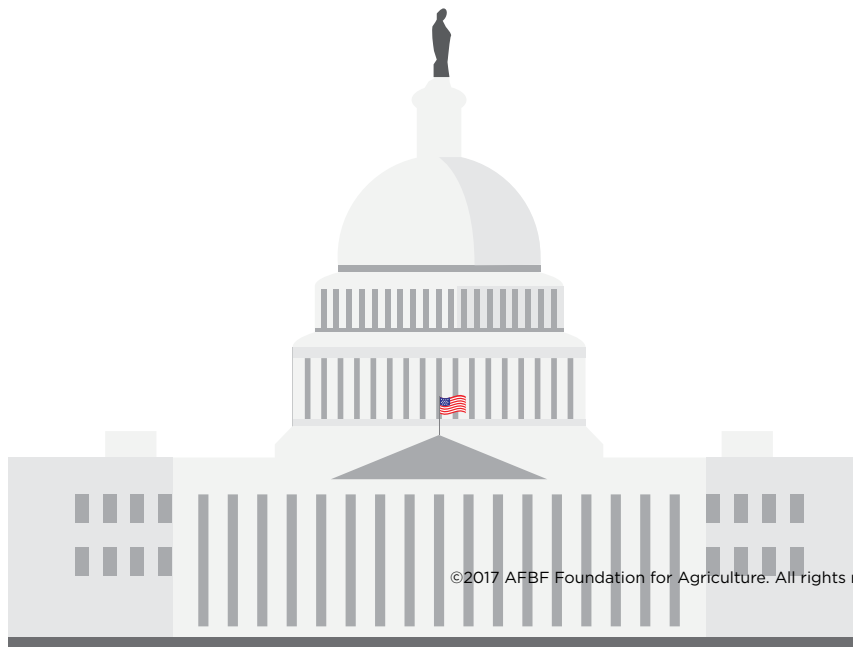
- Key Ideas and Details<sup>3</sup>
- Craft and Structure<sup>4</sup>
- Integration and Knowledge of Ideas<sup>5</sup>

### Objectives

1. Students will understand how advisors are essential for government and stakeholders to make informed decisions.
2. Students will research both sides of an issue and prepare comments for one side.

### Materials

- Current newspapers
- Access to the Internet
- Paper and writing utensil (for each student) or individual access to a computer





## Activity Sequence

1. Students will use a current newspaper or a reputable news website to choose a current event article that relates in some way to agriculture.
2. Tell students that they will analyze the key points of the article and briefly research any points that are unfamiliar. After researching, students are to choose whether they agree or disagree with the article and action involved in the article. Students will write up their key points for or against the action in the article.
3. Students will create a 30-second pitch to persuade someone toward their viewpoint on the article and action. Have students time themselves silently to ensure their pitch is approximately 30 seconds long.
4. Remind students that advisors sometimes only have a short time to influence people on their decision.
5. Select a few students to share their pitch with the class.

## Discussion

*What did you enjoy about this activity?*

*What is important to remember when you are condensing a lot of important information into a small amount of time?*

*Why is it important for advisors to remain up to date on current events that affect their industry?*

## Learn More

- To explore the featured career, review *AgExplorer, Advisor: Government/Stakeholder Relations* ([www.agexplorer.com/career/advisor-government-stakeholder-relations](http://www.agexplorer.com/career/advisor-government-stakeholder-relations)).

- 1 CCSS.ELA-LITERACY.WHST.6-8.2.A—Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
- 2 CCSS.ELA-LITERACY.WHST.6-8.6—Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
- 3 CCSS.ELA-LITERACY.RH.6-8.1—Cite specific textual evidence to support analysis of primary and secondary sources.
- 4 CCSS.ELA-LITERACY.RH.6-8.4—Determine the meaning of words and phrases as they are used in a text, including vocabulary specific to domains related to history/social studies.
- 5 CCSS.ELA-LITERACY.RH.6-8.8—Distinguish among fact, opinion, and reasoned judgment in a text.

## Research for Agriculture!

Step 1. Visit the PBS Learning Media website and check out the agricultural education video, "Fast Forward Launch Pad, Georgia Mountain Research and Education Center."

Video Link: <http://bit.ly/2cY7SCw>

Step 2. While watching the video, listen for answers to the following questions. Write down what you hear!

- What do they do at a research and education center?
  
  
  
  
  
  
  
  
  
  
- Why is it important for these agricultural educators to continue to research?

Step 3. What things do they research at a land-grant research and education facility like the one in the video? Check all that apply:

Disease resistance

Taste

Drought tolerance

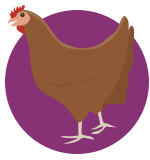
Durability of plant

Pest resistance

If you could research anything related to agriculture or food production, what would it be? What would you hope to discover? Write your thoughts below:

**Check out [www.agexplorer.com/focus/agricultural-education](http://www.agexplorer.com/focus/agricultural-education) for more information about becoming an Agricultural Educator!**





ESTIMATED TIME

55

minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Life Science,  
Math



CAREER FOCUS AREA

## ANIMAL SYSTEMS

### Lesson Title

## *An Interconnected World*

### Standards

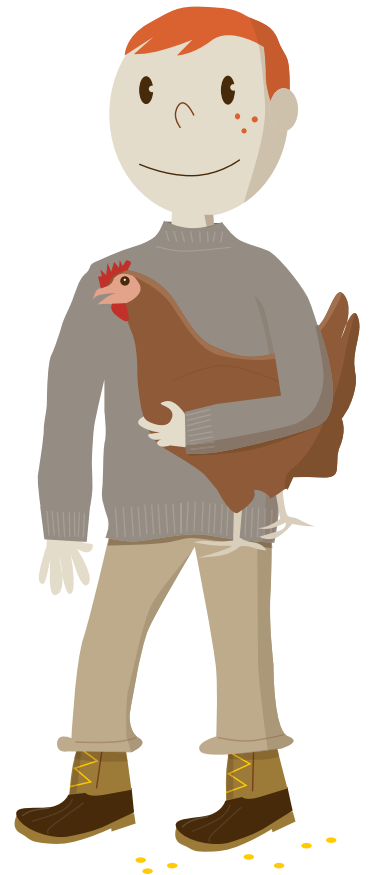
- MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

### Objectives

1. Students will understand the scope of careers in the Animal Systems Career Focus Area and the skill set necessary for a career in this career focus area.
2. Students will use probability to consider animal traits and survivability.

### Materials

- Animal Systems handout (one per group)
- Dice (one per group)
- Paper and writing utensil (one per group)
- Access to the Internet on a computer or tablet
- *Optional:* Playdough or modeling clay





## Teacher Preparation

- Visit *AgExplorer* by National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Animal Systems Career Focus Area.
  - Review the lesson plan and determine if any setup or modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Animals in Our Lives

- Ask students to brainstorm jobs that involve animals. Take their ideas and record them on the board as they are named. If needed, backfill with additional diverse Animal Systems careers. Use various colored markers/indicators to separate careers into two categories: those working directly with animals, and those working indirectly with animals.
- Have students discuss the following questions:
  - How do animals add value to our lives?
  - How do we, as humans, work to help animals (directly and indirectly)?
  - How do we categorize animals (i.e., pets vs. for food), and how does that differ by culture?
  - How have animals changed or evolved over time?

## Body (Main Content)

### STEP 2 >> Animals Over Time

- Break students into small groups of three to five. Give each group a piece of paper and writing utensil (Playdough/modeling clay is optional).
- Instruct the students to draw, illustrate, or mold an animal of their choice. This can be any type of animal—living or extinct. List three to five qualities of that animal on their paper.
- Have the students write the numbers one through six vertically on the bottom of their paper. Give each group a dice and the Animal Systems handout. Instruct students that in a moment, their group will roll the dice up to five times. Each time they roll, they are to compare the number they roll with the numbers one through six on their handout.
  - If the statement pertains to the animal, students are to place a check by the corresponding number (1–5) on their paper.
  - If the statement does not pertain to the animal, they are to place an X by the corresponding number (1–5) on their paper.
  - If they get a total of three Xs at any point, they are to stop the game—their animal may be extinct!
- Have students begin the game. Be available for questions and clarification.
- Divide the class based on the results of the game (extinct vs. not extinct). Have each group reflect on the following question and then nominate a spokesperson to share to the entire class: How have animals changed over time with/without human influence?



### **STEP 3 >> Career Exploration Activity**

- Provide background and connectivity for the students by relaying the following information:  
An animal geneticist is part of the Animal Systems Career Focus Area. Geneticists study the genes in animals to help discover why they act certain ways. They also research survivability—what causes animals to either thrive or die off in certain environments.
- Using their animal from the previous activity, have students individually reflect and write on the following questions:
  - If I were an animal geneticist, what would I research with my animal?
  - What qualities or traits would I want my animal to gain (or lose)? How could I influence these qualities in a controlled, ethical way?
- Have students go to the animal geneticist webpage on *AgExplorer* at [www.agexplorer.com/career/animal-geneticist](http://www.agexplorer.com/career/animal-geneticist) to research career-specific facts.
- Students will choose one “Responsibility” from this page on the career as an animal geneticist and research it to understand it clearly.
  - Have students list three to five key points to clarify their chosen responsibility.
  - Students will research independently.
  - After researching, students will form groups based on their responsibility choice and discuss their answers.
- As time allows, groups will share out.

## **Wrap Up** (Review, Assess, Challenge)

### **STEP 4 >> Review**

- Remind students that their decisions can play a part in the ability of animals to survive and thrive.

### **STEP 5 >> Assess**

- Have students individually think of the answer to the question and then share with a partner. Afterwards, take answers from the group as time allows.
  - If you are interested in a career in Animal Systems, how could you prepare right now in middle school?

### **STEP 6 >> Challenge**

- Remind students that agriculture is everywhere and that they could eventually play an exciting part in that industry.
- Pass out Take-Home Activity sheets and give further instructions.

### **Teaching Notes**

The Animal Systems video on *AgExplorer* can be used as an additional resource to introduce students to Animal Systems careers.

[www.agexplorer.com/focus/animal-systems](http://www.agexplorer.com/focus/animal-systems)

## Animal Systems

Use the numbers below to help determine the survivability of your animal of choice!

- 1 – Your animal can swim and/or live in water.
- 2 – Your animal can survive in a hot environment.
- 3 – Your animal can survive in extreme cold and icy conditions.
- 4 – Your animal is an omnivore.
- 5 – Your animal does not need direct human care to survive.
- 6 – Your animal can use predatory skills to find food.

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- 6 – Your animal can use predatory skills to find food.

**ACTIVITY #1 TITLE**

## *Animals Helping Humans*

**Estimated Time:** 25 minutes

**Content Area:** Communications

**Standard:** Texts Types and Purposes<sup>1</sup>

**Objectives**

1. Students will identify how equestrian therapy can be a part of a career as a horse trainer/instructor or a part of a degree in equine studies.
2. Students will practice writing alternate directions for a task based on set limitations.

**Materials**

- Paper and writing utensil (per person)

### **Activity Sequence**

1. Begin the activity by watching a PBS Learning Media video on equine therapy: “Career Connections, Equestrian Therapist” (<http://bit.ly/2cInZSO>)
2. Instruct students on how animals—in this case horses—can be used to encourage people to try new things and increase their skill level for some basic tasks.
3. Have students work in pairs to research other ways that animals can influence human performance of tasks and skills. Example: service animal, reading support dog, etc.
4. Students will briefly write about their research and then present to the class.
5. Conclude the activity with discussion questions below.

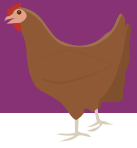
**Discussion**

*What did you learn from this activity?*

*How else could you use animals to encourage and help people?*

**Learn More**

- To dig deeper into the featured career, review *AgExplorer, Horse Trainer/Instructor* ([www.agexplorer.com/career/horse-trainer-instructor](http://www.agexplorer.com/career/horse-trainer-instructor)).
- To see more specific details on opportunities within therapeutic riding, visit the Professional Association of Therapeutic Horsemanship International at [www.pathintl.org](http://www.pathintl.org).



ACTIVITY #2 TITLE

## *Managing the Farm*

**Estimated Time:** 30 minutes

**Content Area:** Art

**Standard:** Art: Creating Art<sup>2</sup>

### Objective

1. Students engage in creation of a farm or ranch and identify the responsibilities of caring for the animals and the land.

### Materials

- Large roll of paper (bulletin board paper or something similar)
- Markers or paint

### Activity Sequence

1. Students will create a farm or ranch as the herdsman. Ask for the definition of a herdsman.

**Definition:** The daily manager of a farm/ranch who is responsible for the care and well-being of the animals.

2. Divide the class into small groups of two to four students. Give each group a large piece of paper and markers/paint.
3. Instruct the class that in their small groups, they are to create an aerial view of their farm or ranch. Below are some items listed they may include (use these ideas to spark imagination if the group is stagnant):
  - a. Barns and outbuildings
  - b. Pastures
  - c. Animals
  - d. Water sources
  - e. Working facilities
  - f. Transport vehicles
4. Give students time to create their project. After completion, allow groups to present their farm/ranch and give an overview of what their herdsman is responsible for on a daily or weekly basis.

### Discussion

*How do you think a herdsman's duties change on a seasonal basis?*

*Why is it important to have a herdsman if you have a farm/ranch with animals?*

### Learn More

- To dig deeper into the featured career, review *AgExplorer, Herdsmen* ([www.agexplorer.com/career/herdsmen](http://www.agexplorer.com/career/herdsmen)).

**ACTIVITY #3 TITLE*****Sold! Life as a Livestock Auctioneer*****Estimated Time:** 45 minutes**Content Areas:** Business, Math**Standard:** Markets—Price and Quantity Determination<sup>3</sup>**Objectives**

1. Students will understand how livestock auctioneers are a valuable part of the livestock market.
2. Students will use math to help understand market prices specific to cattle.

**Materials**

- Access to the Internet
- Paper and writing utensil (for each student)
- Calculator (for each student)
- *Optional:* local auctioneer to visit the class

**Activity Sequence**

1. Begin the activity by showing a cattle auctioneering video from PBS Learning Media on cattle auctioneering, “America’s Heartland,” at <http://bit.ly/2ckENQh>.
2. Have students choose a personal item that is readily available. In pairs, have them try to auction off their item to their partner.
3. Have each pair choose a winner. Winners will pair up and auction off their item again to their new partner. Continue until the class names their best auctioneer.
4. Bring the class back to auctioneering within the agriculture realm. Discuss how markets affect trading with many commodities, including livestock. Bring up [www.agweb.com/markets](http://www.agweb.com/markets) to view live market results for agriculture. View the “Markets” tab on the right-hand side of the page, click “Livestock” and scroll down to the “Live Cattle” category.
  - a. Write down the market value for the current month for live cattle.

Example: Oct-2016 106.050

This number represents the current price per 100 pounds for live-weight cattle. So, for example, the number above (106.050) means that for every 100 pounds of live weight, a seller would get \$106.05. Or, to calculate per pound, divide the market price by 100 to get the per pound weight.

Example:  $106.050 / 100 = \$1.06$  per pound



5. Have students individually choose a number between 1,000 and 1,200. Inform them that they just chose their cow's weight that they will take to the sale! Have them calculate the amount their cow would bring at market price.

*Optional:* Have students calculate market prices for any projected month's data available.

### Discussion

*What did you enjoy about this activity?*

*Why is it important that a livestock auctioneer know current market trends and prices?*

### Learn More

- To explore the featured career, review *AgExplorer, Livestock Auctioneer* ([www.agexplorer.com/career/livestock-auctioneer](http://www.agexplorer.com/career/livestock-auctioneer)).
- To hear an interview with the 2007 Women's International Auctioneer Champion, visit NPR at <http://www.npr.org/templates/story/story.php?storyId=17808018>.

- 1 CCSS.ELA-LITERACY.WHST.6-8.2—Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments or technical processes.
- 2 National Core Arts Anchor Standards: Creating: Conceiving and developing new artistic ideas and work—Generate and conceptualize artistic ideas and work; organize and develop artistic ideas and work; refine and complete artistic work.
- 3 NSS-EC.5-8.7 Markets—Price and Quantity Determination - Markets exist when buyers and sellers interact. This interaction determines market prices and thereby allocates scarce goods and services.





## All Abuzz for Agriculture!

Step 1. Bees are an important part of the food system and life for humans as major pollinators! If you like to eat, you'll like what bees have to contribute to your plate! Watch this video of a beekeeper-turned-apiary-inspector to learn a bit more about the importance of bees. Find the video at PBS Learning Media, Career Connections, Agricultural Inspector (<http://bit.ly/2cyBxON>).

Step 2. Bees help pollinate many of the foods that we eat! Using the list below, circle the foods that you would like to eat and then draw them on the plate below!

Apples

Peaches

Cocoa

Grapes

Celery

Green Beans

Eggplant

Cranberries

Avocados

Pears

Coconut

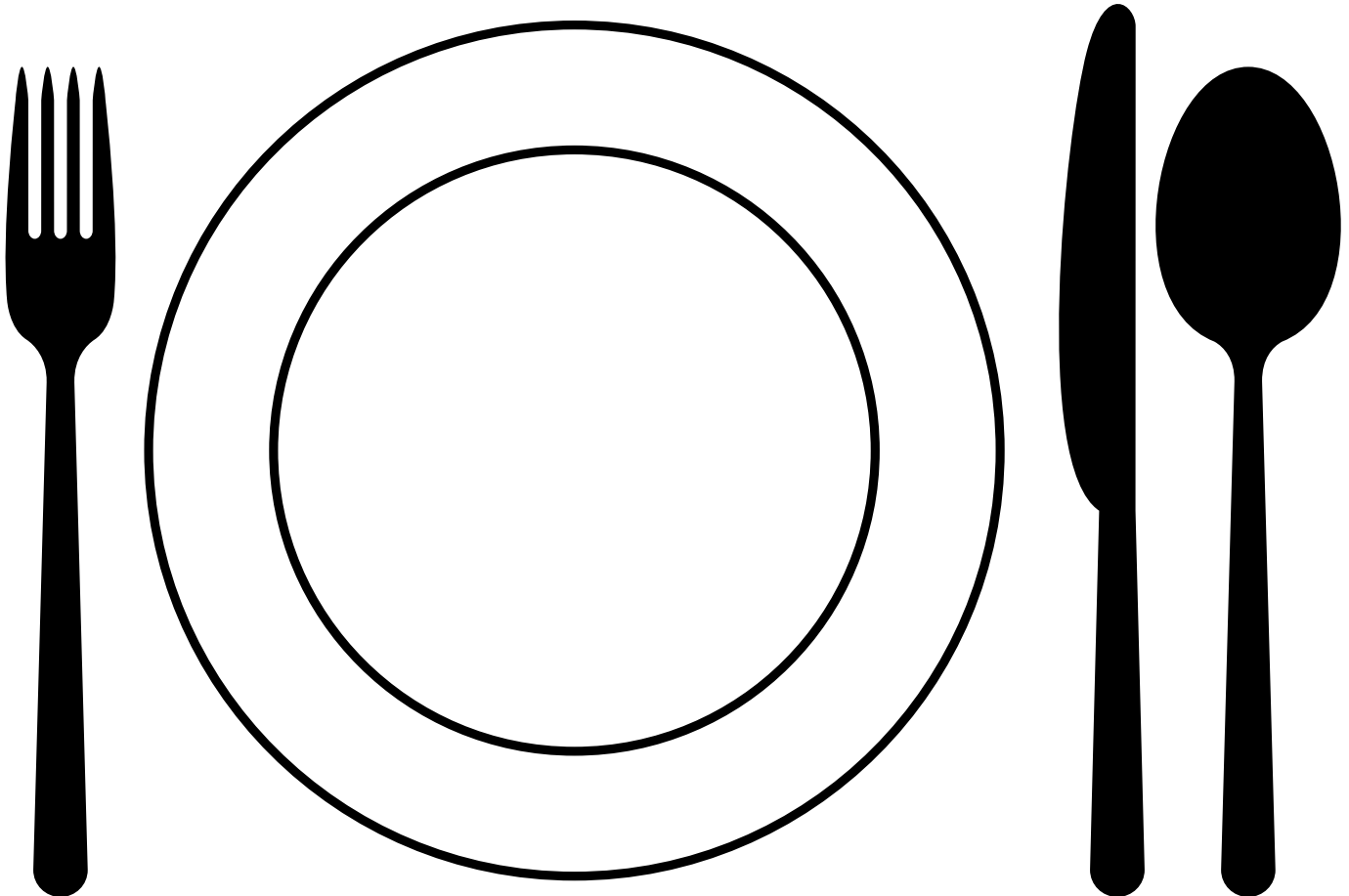
Green Peppers

Walnuts

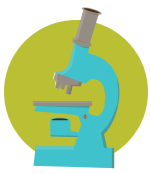
Strawberries

Cucumber

Papaya



Check out [www.agexplorer.com/focus/animal-systems](http://www.agexplorer.com/focus/animal-systems) for more information about becoming a beekeeper!



ESTIMATED TIME

**60-70**  
minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Science,  
Language Arts



CAREER FOCUS AREA

## BIOTECHNOLOGY SYSTEMS

### Lesson Title

## *Feeding the World with Biotechnology Careers*

### Standards

- NGSS: MS-ESS3-3. Earth and Human Activity: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- NGSS: MS-ESS3-4. Earth and Human Activity: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- NGSS: MS-ESS3-5. Earth and Human Activity: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- NCDA-7-9-3. Helping Pupils Understand Career Applications of Subject Matter.
- CCSS.ELA-LITERACY.SL.7.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details and examples; use appropriate eye contact, adequate volume and clear pronunciation.

## Objectives

1. Students will present evidence of how natural resource constraints, climate change and a growing population make it difficult to feed the world.
2. Students will create a model of a new plant species that can thrive under particular environmental conditions.
3. Students will identify one career of interest in the Biotechnology Systems Career Focus Area and relate it to the challenge of feeding the world.

## Materials

- Access to a computer lab or laptops/tablets for students. One per student is ideal. Alternately, students could complete the activity in pairs.
- Copies of the Issue Briefs (six total—one per group)
- Tear sheets or poster paper and markers
- Challenges of Feeding the World handout and teacher key
- Environment Scenario cards (six total—one per group)

## Teacher Preparation

- **Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Biotechnology Systems Career Focus Area.**
  - **Review the lesson plan and determine if any modifications are required.**
- 

## Introduction (Set Context for Activity)

### **STEP 1 >> Introduce the challenges associated with feeding the world.**

- Show students the “Challenge of Feeding a Growing Planet” video (1:37)  
<https://www.youtube.com/watch?v=m3c9e21bqTo>
- Preview the lesson by telling students that they will be discovering some of the challenges associated with feeding the world and what their role could be in helping to feed the world!
- Tell students they will be digging deeper into the issues presented in the video. Break students into six even groups and have groups select one of the six issues listed below. Issues should not be duplicated across groups.
  - Growing population
  - Urbanization/land conversion
  - Land degradation
  - Water scarcity
  - Water quality
  - Climate change



- Each group is to read their Issue Brief and present the information they learn to the class. Groups should include a visual aid such as a poster, a PowerPoint slide, or different media. Include expectations about the length of the presentation, the number of students who need to be involved, and the amount of time they have to prepare.
- Have groups present. After each presentation, instruct students to capture a few notes in their Challenges of Feeding the World handout.

## Body (Main Content)

### STEP 2 >> Introduce Biotechnology Systems Career Focus Area

- Food biotechnology uses what is known about plant science and genetics to improve the food we eat and how it is produced. The tools of food biotechnology include traditional breeding techniques such as crossbreeding, and more modern methods, which involve using what we know about genes (or instructions for specific traits) to improve the quantity and quality of plant species. Modern food biotechnology allows scientists to modify or move desirable traits from one plant to another with increased precision and efficiency.

### STEP 3 >> Crop Research and Development Activity

- Tell students they will take an active role in solving the challenges facing the world. In their groups, students will act as a research and development team to design a new plant species that can thrive in specific conditions.
- Each group will receive an Environmental Factors card. They will use the information on that card to create their new species. They should produce a visual aid that includes the traits of the plant and a visual representation of the plant.
- Tell students that at the end of the lesson they will be presenting their projects. Monitor student progress while they are working and answer questions.

### STEP 4 >> Career Exploration Activity

**Note:** Students will need tablets or computers with access to the Internet for this activity.

- Instruct students to visit *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)) and select the Biotechnology Systems Career Focus Area.
- Tell students that each member of their group needs to pick a different career. Together they should make a complete research and development team.
- As part of their presentations, each student will share what career they chose and how their career specifically would contribute the research and development team. If students need a hint, point them to the career description and responsibilities sections.



## Wrap Up (Review, Assess, Challenge)

### STEP 5 >> Review and Assess Learning

- Set the context for the student presentations. Include expectations about presentation length, specify that all students need to have a speaking part, and let students know the amount of time they have to prepare. Remind them to include:
  - Information about their scenario
  - Description of the crop they created
  - How it addresses the challenges of feeding the world
  - Each of the careers they chose and how those careers contribute to the research and development team
- Have each group present. Ask follow-up questions as needed.

### STEP 6 >> Challenge

- Remind students that their generation will be responsible for figuring out how to increase the food supply by 70 percent by 2050, and that by pursuing a career in the Biotechnology Systems Career Focus Area, they can contribute to that goal!

### Teaching Notes

The Biotechnology Systems video on *AgExplorer* can be used as an additional resource to introduce students to Biotechnology Systems careers.

[www.agexplorer.com/focus/biotechnology-systems](http://www.agexplorer.com/focus/biotechnology-systems)



## Climate Change

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

Climate change is the change in global climate patterns, attributed largely to increased levels of greenhouse gases produced by the use of fossil fuels. The expected changes in rainfall, temperature and elevated levels of carbon dioxide will impact land and water resources. The effects on crop productivity and the agriculture sector will vary by location. In many areas the climate change impacts are expected to decrease yields and increase risks for farmers. In some cases, climate change might increase yields of certain crops. It is estimated that the number of undernourished people could increase by anywhere from 10 million to 150 million people due to climate change. Climate change will increase the need for irrigation worldwide. Additionally, cropping patterns—where certain crops are planted—are likely to change.

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## Land Degradation

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

Land degradation refers to the decline of soil quality. It is more than soil erosion or loss of soil fertility—it is the deterioration of a balanced ecosystem and the loss of ecosystem services, or the benefits that ecosystems provide. Land degradation affects agriculture in many ways. Soil quality decreases through the loss of soil organic matter and nutrient depletion. Additionally, soil erosion can occur by wind and water moving good quality soil. Salinization is when salt accumulates in soil and makes it impossible to grow plants.

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## Population Growth

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

The global population is expected to grow from the current seven billion to nine billion people by 2050. Current trends show that consumers will be eating more meat and dairy products. By 2050, the world will demand almost an extra billion tons of cereal grain annually and 200 million additional tons of livestock products. The world needs to increase agricultural production significantly with degraded land and other natural resource constraints.

## Urbanization/Land Conversion

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

Urbanization is the conversion of farmland and rural areas to urban areas. It is also called urban sprawl. Less land makes it harder to meet the increasing global food demand.

The Food and Agriculture Organization defines land suitability for agriculture in terms of capacity to reach potentially attainable yields for a basket of crops.

- Twelve percent of the land in the world is used for agriculture
- Twenty-eight percent is forests
- Thirty-five percent is grasslands and woodlands ecosystems

There is increased pressure on land and water resources in all countries, but especially in developing countries.

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## Water Pollution

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

The most important water pollution problems related to agriculture are excessive nutrient accumulation and pesticide pollution. Both of these types of pollution harm ecosystems.

Common agriculture practices that pollute water are:

- An increased use of mineral fertilizers running off and seeping into the groundwater
- Higher concentrations of livestock
- Pesticides running off and seeping into the groundwater

Too many nutrients in the water can cause algal blooms and other serious environmental problems.

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## Water Scarcity

Food and Agriculture Organization of the United Nations (2011). “The State of the World’s Land and Water Resources for Food and Agriculture.”

Water resources are very unevenly distributed, with some countries having an abundance of water and some having an extreme scarcity. Water scarcity has three dimensions:

- Physical—When the available supply does not satisfy the demand
- Infrastructural—When the infrastructure in a place doesn’t allow for all users to get water
- Institutional—When institutions and governments fail to ensure a reliable, secure and equitable supply of water to all users

Agriculture accounts for 67 percent of water use. It is a critical resource for food production.

## Challenges of Feeding the World

Capture your notes from the presentations here!

What is it?	Effect on agriculture?
<b>Climate Change</b>	
<b>Land Degradation</b>	
<b>Population Growth</b>	
<b>Urbanization/Land Conversion</b>	
<b>Water Pollution</b>	
<b>Water Scarcity</b>	



# Challenges of Feeding the World

Capture your notes from the presentations here!

What is it?	Effect on agriculture?
<b>Climate Change</b>	
<ul style="list-style-type: none"> <li>Changing global climate patterns due to increased levels of CO<sub>2</sub></li> </ul>	<ul style="list-style-type: none"> <li>Effects on agriculture will vary with climate zone</li> <li>Reduce or increase yields</li> <li>Increase irrigation</li> <li>Change cropping patterns</li> </ul>
<b>Land Degradation</b>	
<ul style="list-style-type: none"> <li>It is more than soil erosion or loss of soil fertility; it is the deterioration of a balanced ecosystem and the loss of ecosystem services that come with that.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of soil organic matter, nutrient depletion, erosion, salinization and all decrease yields</li> </ul>
<b>Population Growth</b>	
<ul style="list-style-type: none"> <li>Population is expected to reach nine billion by 2050</li> </ul>	<ul style="list-style-type: none"> <li>Need to increase output significantly with degraded land and other natural resource constraints</li> </ul>
<b>Urbanization/Land Conversion</b>	
<ul style="list-style-type: none"> <li>The conversion of farmland and rural areas to urban areas, urban sprawl</li> </ul>	<ul style="list-style-type: none"> <li>Less land makes it harder to meet the increasing global food demand</li> </ul>
<b>Water Pollution</b>	
<ul style="list-style-type: none"> <li>Excessive nutrient accumulation and pesticide pollution harm ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>Common ag practices that pollute water: increased use of mineral fertilizers, higher concentrations of livestock, agrochemical pollution</li> </ul>
<b>Water Scarcity</b>	
<ul style="list-style-type: none"> <li>Three dimensions of water scarcity: physical, infrastructural, institutional</li> </ul>	<ul style="list-style-type: none"> <li>Agriculture accounts for 67 percent of water use</li> <li>It is a critical resource for food production</li> </ul>

**Scenario #1**

- Drought conditions are present and will continue to worsen with climate change
- Low yields are an issue
- A fungus attacks the plants at harvest time
- Urbanization is threatening the community and there is less available farmland

**Scenario #4**

- The area experiences frequent floods, and that will continue to worsen with climate change
- Low yields are an issue
- A fungus attacks the plants at harvest time
- Land is degraded by the accumulation of salts in the soil

**Scenario #2**

- The area experiences frequent floods, and that will continue to worsen with climate change
- The population is growing and yields need to increase
- A beetle attacks the crops and damages them
- Land is degraded by soil erosion

**Scenario #5**

- Drought conditions are present and will continue to worsen with climate change
- Low yields are an issue
- Many members of the community have a vitamin A deficiency, which leads to numerous health problems
- Land is degraded with the loss of soil organic matter and nutrients

**Scenario #3**

- Drought conditions are present and will continue to worsen with climate change
- The population is growing and yields need to increase
- Many members of the community have a vitamin B deficiency, which leads to numerous health problems
- The local water is polluted

**Scenario #6**

- The area experiences frequent floods, and that will continue to worsen with climate change
- The population is growing and yields need to increase
- A pest attacks the plants at harvest time and destroys many of the crops
- Urbanization is threatening the community and there is less available farmland

**ACTIVITY #1 TITLE**

## *It's in the Genes!*

**Estimated Time:** 50 minutes

**Content Area:** Science

**Standard:** Inheritance and Variation of Traits<sup>1</sup>

**Objective**

1. Students explore the difference between asexual and sexual reproduction in plants and connect that to a career as a plant geneticist.

**Materials**

- A house plant that is easy to propagate by taking cuttings

*Examples (See resources for additional examples.):*

Begonia

Geranium

Philodendron

Coleus

Hedera (Ivy)

Pilea cadierea (Aluminum Plant)

Crassula (Jade Plant)

Impatiens

Plectranthus (Swedish Ivy)

- Potting media and pots
- Pruning shears or scissors
- Water and spray bottle

**Activity Sequence**

1. Demonstrate how to propagate the plant you have selected by taking a stem or tip cutting.
  - a. Put potting media into a small pot and moisten.
  - b. Cut off either the tip of the plant or a section of the stem.
  - c. Insert the cutting into the potting media.
  - d. Keep the cutting moist and spray with spray bottle several times a day to increase humidity.

2. Have students work in pairs to propagate their own cuttings.

*Alternate option:* Cut the base off of a bunch of celery or a head of lettuce, and it will take root if left in the water.

3. Explain to students that vegetative propagation is asexual reproduction in plants. They have created a new plant that is genetically the same as the parent plant.
4. Introduce (or review) sexual reproduction in plants with SciShow's "Great Minds—Gregor Mendel" (10:54) <https://www.youtube.com/watch?v=GTiOETaZg4w>.
5. Have students create a diagram or drawing that illustrates the difference between asexual and sexual reproduction in plants. Instruct them to use text and pictures to complete their explanation.



6. Connect activities to the career of a plant geneticist. Share the following information about the career:
  - a. Plant geneticists conduct research to understand, improve or create new varieties of plants or crops.
  - b. Looking at a plant's DNA, they can examine ways to improve shape, size, production level, pesticide, and disease tolerance.
  - c. Plant geneticists can work for agricultural seed and chemical companies.
  - d. Some also work in the university setting conducting research and teaching.
  - e. There are also opportunities to work in the nonprofit sector conducting research to benefit those in areas where it is difficult to grow plants and crops.
7. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

### Discussion

*What did you enjoy about this activity?*

*What might be enjoyable about a career as a plant geneticist?*

*What other careers in the Biotechnology Systems Career Focus Area are related to plant or animal genetics?*

- Animal geneticist, embryologist, laboratory technician, microbiologist, molecular biologist, plant biologist, plant breeder, research and development manager, research associate, research technician, seed production technician, product development manager/demand planner

### Learn More

- For an in-depth guide to vegetative propagation, do a title search for “propagating foliage and flowering plants from Texas A&M AgriLife Extension.
- To dig deeper into the featured career, review *AgExplorer*, Plant Geneticist ([www.agexplorer.com/career/plant-geneticist](http://www.agexplorer.com/career/plant-geneticist)).

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### ACTIVITY #2 TITLE

## *From Grocery Store to Garden: An Experiment in Seed Saving*

**Estimated Time:** 30 minutes

**Content Area:** Science

**Standard:** Biodiversity and Humans<sup>2</sup>

### Objective

1. Students explain the importance of biodiversity and have a hands-on experience saving seeds.



## Materials

- Plants with harvestable seed
  - To ensure the seeds are harvestable, collect them when the seeds are fully mature.
  - For beans, this is evident when the pods dry out and the seeds rattle inside the pod when shaken. Plants like lettuce, kale, and mustard will “bolt” and the seed heads will be apparent. Fruits with seeds inside them may need to be allowed to ripen on the plant beyond the time that they would normally be harvested for eating. Let the fruits stay on the vine until the fruits reach full size and vines begin to dry down.
  - Consider reaching out to a local farmer, school or community garden to see if they have harvestable seed. Alternately, you can purchase fruits like pumpkins and squashes from the grocery store to complete the activity.
- Envelopes for storing seed
- Butcher paper to extract seed onto and to act as drying sheets
- Knife to cut open fruits
- Bowl of water

## Activity Sequence

**Preparation:** Review the detailed protocol for saving the specific type of seed you have at [www.howtosaveseeds.com](http://www.howtosaveseeds.com).

1. Introduce students to the importance of biodiversity and its relationship to seed saving by showing the video “Saving the Planet’s Biodiversity—Millennium Seed Bank Project” (5:25) at <https://www.youtube.com/watch?v=r4U3EEkkVoM>.
2. Define biodiversity. Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health.<sup>3</sup>
3. Demonstrate the seed saving process for the type of seeds you’ve procured. You will explain steps four and five instead of demonstrate since they cannot happen until the seeds have dried.
  - Step 1: Collect seeds
  - Step 2: Clean seeds
  - Step 3: Allow to dry
  - Step 4: Store properly
  - Step 5: Germination test
4. Break students into pairs or small groups and have them follow the same seed-saving protocol. Students should write their names on the drying sheets so they can track their specific seeds.
5. Tell students that in a few days after seeds have been appropriately dried, they will pack their seeds in envelopes. Inform students that in future lessons they will be designing a research trial to test the germination rates and will have a chance to test out their seeds.



6. Connect activities to the career of a seed production technician. Share the following information about the career:
  - a. Seed production technicians manage the planning, strategy and production of seed for a company.
  - b. They assist growers with planting, scouting seed fields, and the operation of seed-related equipment.
  - c. A career in seed production will also include work inside a warehouse facility sorting, bagging and participating in other operational duties.
  - d. Seed production technicians are typically employed by seed production companies, biotechnology companies, government or universities, cooperatives and research firms.
7. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

### Discussion

*Why is biodiversity important?*

*How does saving seeds contribute to biodiversity?*

*What is appealing about a career as a seed production technician?*

*What other careers in the Biotechnology Systems Career Focus Area are related to the research and multiplication of seeds?*

- Plant biologist, plant breeder, plant geneticist, research and development manager, research associate, research technician, laboratory technician, product development manager/demand planner

### Learn More

- For in-depth information about how to save seeds by crop, visit [www.howtosaveseed.com](http://www.howtosaveseed.com).
- To review the featured career, review *AgExplorer, Seed Production Technician* ([www.agexplorer.com/career/seed-production-technician](http://www.agexplorer.com/career/seed-production-technician))

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### ACTIVITY #3 TITLE

## *Time to Sprout!*

**Estimated Time:** 30 minutes

**Content Area:** Science

**Standard:** Growth, Development and Reproduction of Organisms<sup>4</sup>

### Objective

1. Students test the germination rates of their saved seeds and connect this to a career in biotechnology.



## Materials

- Saved seeds from the previous activity
- Small plastic sandwich bags and paper towels (one per student)
- Water-resistant marker for labeling
- Spray bottle filled with tap water

## Activity Sequence

1. Tell students it is time to revisit their saved seeds and test the germination rates. Ask students to define germination, then ask them why it might be important to test the germination rates.
2. Demonstrate the steps in the germination test process.
  - a. Get a paper towel and write your name and the date on it in water-resistant marker.
  - b. Use the tap water in the spray bottle to moisten, but don't soak the paper towel. Flatten the paper towel and press on it with one finger. If water wells up around your finger, it is too wet.
  - c. Students should test between five and 25 seeds, depending on the number of seeds they harvested. They should have some leftover seeds to use in the take-home activity.
  - d. Line up seeds on the paper towel about an inch from the top and at least an inch apart. Fold the bottom of the paper towel up (in half), then loosely roll up the paper towel from side to side.
  - e. Place the roll in a plastic bag and leave the top open. For warm-season crops, leave in a warm area. For cool-season crops, choose a cooler area. Don't place either in direct sunlight.
3. Break students into work pairs to complete the activity, but have each student save their own seed.
4. Instruct students that they should check the moisture level of their paper towels every day and spray with water as necessary.
5. After three days, revisit the experiment and set up the data collection protocol.
  - a. Students should check their seeds every day. They should remove seeds that are moldy and record them as dead. If they do not remove moldy seeds, the mold could spread to other seeds.
  - b. Healthy seedlings should be counted and removed as they germinate.
  - c. Students should track how many seeds germinate each day. The experiment is over when all of the seeds have germinated or when the normal number of days to germination for that crop is reached.
6. When the experiment is over, have students calculate the germination rate by dividing the number of healthy seedlings by the total number of seeds in the test and multiplying by 100.  
(Healthy seedlings/Total seeds) x 100 = Germination %



7. Connect the activity to the career of a laboratory technician. Share the following information about the career:
  - a. Laboratory technicians collect and prepare samples, carry out experiments, make measurements with scientific equipment, record and present results for critical analysis.
  - b. They perform diagnostic and other scientific tests on specimens such as animal and plant tissues, food and water for chemical or cellular constituents, bacterial content and/or chemical contamination.
  - c. Technicians can work in an academic, government or company setting.
  - d. Seed, chemical, biotech, and animal health companies are examples of companies that hire laboratory technicians.
8. Pass out Take-Home Activity sheets and provide further instructions.
9. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

### Discussion

*What environmental conditions were required for the seeds to germinate?*

*Why did some seeds not germinate?*

*Why was it important to record accurate data in this activity?*

*What might be enjoyable about a career as a laboratory technician?*

*What other careers in the Biotechnology Systems Career Focus Area require being able to conduct investigations or research trials?*

- Animal geneticist, embryologist, microbiologist, molecular biologist, plant biologist, plant breeder, research and development manager, research technician, seed production technician, product development manager/demand planner, analytical chemist, bioinformatics scientist, biological technician, biostatistician, formulation chemist, plant geneticist, plant pathologist, regulatory scientist

### Learn More

- To explore the featured career, review *AgExplorer, Laboratory Technician* [www.agexplorer.com/career/laboratory-technician](http://www.agexplorer.com/career/laboratory-technician).
- For a more detailed germination test protocol, visit [http://www.seedsavers.org/site/pdf/HomeGermTests\\_LAFrevised.pdf](http://www.seedsavers.org/site/pdf/HomeGermTests_LAFrevised.pdf).

- 1 Next Generation Science Standards: MS-LS3-2 Heredity: Inheritance and Variation of Traits. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
2. NGSS: MS-LS4.D: Biodiversity and Humans: Changes in biodiversity can influence humans' resources, such as food, energy and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.
- 3 LS2.C: Ecosystem Dynamics, Functioning and Resilience
- 4 NGSS: MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.



# Plant Biologist in Action!

## Materials

- The seeds you saved from class
- A place to plant them outside in the soil
- A pot full of potting soil
- Water

Step 1. Divide your seeds in half. Plant half outside directly into the soil. Plant them as deep as they are big. Gently cover the seeds with soil and water them. Be careful not to over-water or they might float away!

Step 2. Fill your pot or pots with potting soil to about three-fourths full. Plant your seeds the same depth as the seeds you planted outside. Water the pot until water runs out the bottom of the pot. Wait a few minutes and repeat this.

Step 3. Water your germinating seeds every day and make observations. Capture your notes below!

## Observations

1. Which plants germinated first? How many days did it take the plants outside to germinate? How many days did it take the plants inside to germinate?
  
2. What environmental factors led to this?
  
3. A week after germination, which plants look healthier and more vigorous? What indicators did you use to make that determination? How about two weeks after germination?

**Check out [www.agexplorer.com/career/plant-biologist](http://www.agexplorer.com/career/plant-biologist) for more information about becoming a plant biologist!**



ESTIMATED TIME

55  
minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Science



CAREER FOCUS AREA

## ENVIRONMENTAL SERVICE SYSTEMS

### Lesson Title

## *Stewarding Our Natural Resources with Environmental Service Careers*

### Standards

- NGSS: MS-ESS3-3. Earth and Human Activity: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- NCDA-7-9-3. Helping Pupils Understand Career Applications of Subject Matter.
- CCSS.ELA-LITERACY.SL.7.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

### Objectives

1. Students will describe environmental management strategies utilized by farmers to minimize human impact on the environment.
2. Students will design a farm system that minimizes human impact on the environment.
3. Students will describe one career in the Environmental Service Systems Career Focus Area and how it relates to mitigating environmental impact.

## Materials

- Access to a computer lab or laptops/tablets for students. One per student is ideal. Alternately, students could complete the activity in pairs.
- Copies of Farm Plan handout (one per student)
- Copies of Environmental Management Strategies handouts (nine total)
- Poster paper and markers

## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Environmental Services Systems Career Focus Area.
  - Review the lesson plan and determine if any modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Human Impact on the Environment

- Instruct students to think of at least three ways that humans impact the environment. Have students share out and capture ideas on the board.
- Connect this statement to agriculture: Most human activity has an impact on the environment. Farming by its very nature alters natural ecosystems to produce food, fiber and fuel for humans. Agriculturists work hard to ensure they are minimizing the impact they have on the environment. In some cases, they are even working to improve soil and water quality as well as creating habitat for wildlife.
- Preview today's lesson by telling students they will explore some strategies that farmers use to steward their land and make their own environmentally conscious farm plan.





## Body (Main Content)

### STEP 2 >> Environmental Management Presentations

- Break the class into eight groups. Give each group an Environmental Management Strategies handout, a piece of poster paper and markers.
- Tell the class their group has five minutes to read about the Environmental Management Strategy they were assigned and to create a poster that explains the strategy to the rest of the class.
- At the conclusion of five minutes, each group will present their strategies to the class. Each presentation should be one to two minutes long. After each group presents, hang the posters around the room so that students can use them as a reference point for the next activity.

### STEP 3 >> Create your own Farm

- Tell students that they will now have a chance to try the balancing act for themselves and create their own farm.
- Pass out one Farm Plan handout to each student. Instruct students to work independently to make the decisions listed on the front of the handout. Monitor student progress and answer questions.
- When the first few students have completed the front page of the handout, instruct students to draw a diagram of their farm. Tell them to describe how and why they will use each strategy. Cue them to use the posters for clues if they need help. Set expectations about the length and depth of thought you expect. If students don't finish in the allotted time, assign as homework.

### STEP 4 >> Introduction to Environmental Service Systems Career Focus Area

- Farmers and ranchers work hard every day to protect the environment. They work with experts who work in careers in the Environmental Service Systems Career Focus Area to protect our natural resources. Scientists, technicians and engineers in this career focus area are focused on minimizing human impact on the environment. Professionals in this career focus area may be involved with recycling, water and air pollution control, waste disposal and public health issues. They use knowledge of science and engineering to meet environmental regulations and develop new methods to prevent accidents or dangerous situations.



### **STEP 5 >> Career Exploration Activity**

**Note:** Students will need tablets or computers with access to the Internet for this activity. If enough computers are not available for each student to have one, break students into pairs or small groups.

- Instruct students to visit *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)) and select the Environmental Service Systems Career Focus Area. Their task is to discover a career that might help them implement the farm plan they created.
- Instruct students to capture the career that they chose and why it will be helpful to them when they implement their farm plan.

### **Wrap Up** (Review, Assess, Challenge)

#### **STEP 6 >> Review Careers of Interest**

- Have a few students share the careers they chose and why they think they will be helpful.

#### **STEP 7 >> Assess Learning**

- Collect the Farm Plan handouts and assess for completeness and depth of thought.

#### **STEP 8 >> Challenge**

- Remind students that there are many exciting career opportunities in the Environmental Service Systems Career Focus Area if they are excited about stewarding our natural resources and creating sustainable farming systems.
- Pass out Take-Home Activity sheets and provide further instructions.

### ***Teaching Notes***

The Environmental Service Systems video on *AgExplorer* can be used as an additional resource to introduce students to Environmental Service Systems careers.

[www.agexplorer.com/focus/environmental-service-systems](http://www.agexplorer.com/focus/environmental-service-systems)

## Biodiversity Fact Sheet

### What is biodiversity?

Biodiversity is the variety of life in the world, or in a particular habitat or ecosystem.

### How does it affect the environment?

- Critical ecosystem services are dependent on biodiversity:
  - Pollination
  - Decomposition of organic matter
  - Pest and disease regulation

### How does it affect agriculture?

- Farming a wide variety of plant species can protect a farm from total crop loss if a drought or pest infestation occurs.
- Pollination is critical for plant reproduction and, therefore, food production.
- Decomposing organic matter makes nutrients available for plants to use.

(Food and Agriculture Organization of the United Nations, n.d.)

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## Conservation Tillage Fact Sheet

### What is conservation tillage?

Conservation tillage is any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop.

### How does it affect the environment?

- Reduces soil erosion by 60–90 percent
- Conserves water by reducing evaporation
- Conserves energy (less tractor trips across the field)
- Reduces air pollution (dust and diesel emissions)
- Crop residue provides food and cover for wildlife
- Improves soil quality, which reduces runoff of agriculture chemicals

### How does it affect agriculture?

- Fewer trips across fields saves time and money (lowers fuel, labor, and machinery maintenance costs) and reduces soil compaction that can interfere with plant growth.
- It optimizes soil moisture, enhancing crop growth in dry periods.
- Improved soil fertility increases yields.

(Minnesota Department of Agriculture, 2013)

## Cover Crops Fact Sheet

### What are cover crops?

Cover crops are planted to reap a wide variety of environmental and agronomic benefits. They are generally not harvested for a profit. They are often legumes—plants that fix atmospheric nitrogen into the soil, making it available for other plants to use.

### How do they affect the environment?

- Protect the environment from nitrate leaching
- Cover the soil to prevent erosion, reduce soil compaction, add organic matter and increase water infiltration
- Increase biodiversity

### How do they affect agriculture?

- Reduce weed pressure, leading to reduced use of herbicides
- Improved soil fertility leads to increased yields
- Increased nitrogen in the soil leads to decreased use of synthetic fertilizers

(Sundermeier, 2009)

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## Integrated Pest Management (IPM) Fact Sheet

### What is IPM?

Integrated Pest Management is a process used to solve pest problems while minimizing risks to people and the environment. With IPM, pests are prevented from becoming a problem. This is done by growing healthy crops that can withstand pest attacks, using disease-resistant plants, or addressing the environmental factors that allow pests to thrive.

### How does it affect the environment?

- Minimizes the use of pesticides, reducing air and water contamination
- Takes into account the complex relationships in ecosystems

### How does it affect agriculture?

- Reduced use of pesticides lowers farming costs
- Biological, cultural, physical and mechanical pest controls lead to healthier farms with minimal pest problems

(University of California, 2013)

## Precision Agriculture Fact Sheet

### What is precision agriculture?

Precision agriculture is comprehensive approach to farm management that utilizes technology to determine exactly what inputs the land needs. The field is broken up into management zones, which are all treated differently depending on their needs. This is more precise than a whole field approach. GPS technology allows farmers to apply inputs in exact locations.

### How does it affect the environment?

- Reduced pesticide use leads to surface and groundwater protection
- Reduced synthetic fertilizer use leads to improved soil fertility
- Improved irrigation efficiency leads to water and energy conservation

### How does it affect agriculture?

- Reduced pesticide and synthetic fertilizer use leads to lower farm costs
- Improved irrigation efficiency leads to lower fuel and water costs

(Grisso, 2009)

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## Rotational Grazing Fact Sheet

### What is rotational grazing?

Rotational grazing is the process of moving a herd of livestock from one pasture to another and allowing each pasture a period of rest before it is grazed again.

### How does it affect the environment?

- Increases nutrient recycling, keeping more nutrients on the farm and leading to improved soil fertility
- Reduces overgrazing, which is damage to a plant that reduces its ability to function normally

### How does it affect agriculture?

- Allows ranchers to graze more animals per acre for a longer period of time, which increases efficiency
- Improves animal health and reduces parasite problems
- Decreases labor costs

(Lathrop & Freking, 2013)



## Water Use Efficiency Fact Sheet

### What is water use efficiency?

Improvements to irrigation scheduling, delivery systems and management are all ways to improve water use efficiency. Here are a few innovative strategies:

- Re-using water to raise two products, such as fish and crops.
- Sub-surface drip irrigation systems supply controlled amounts of water to crops with little waste.

### How does it affect the environment?

- Reduces water loss due to evaporation
- Reduces agricultural runoff
- Reduces soil salinity, a severe form of land degradation

### How does it affect agriculture?

- Improves yields by reducing the incidence of disease and weeds
- Reduces farm costs associated with water and energy

(SARE, 2006)

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## Manure Compost Fact Sheet

### What is manure compost?

Animal manure is full of plant nutrients and can improve the health of the soil. However, adding raw manure directly to a plant can burn the plant. Also, manure should be handled and used with caution because it contains E. coli bacteria and other disease agents. The best way to avoid the negative effects of manure is to compost it first. The heat of the composting process will kill bacteria. If you choose not to compost it, you should mix it with some dry material like straw, rice hulls, dry leaves and stems or sawdust, which will make it less potent and less likely to burn the plants. Spread this mixture of manure over your topsoil.

### How does it affect the environment?

- Adds organic matter to the soil which improves aeration and water-holding capacity

### How does it affect agriculture?

- Makes the soil more fertile by releasing nutrients as it decays and thickens top soil, thus increasing yields

(Denney, 2008)

# Farm Plan Handout

Name of Farm \_\_\_\_\_

What will you produce? (Circle one)                      Crops                      Livestock                      Both

What crops and livestock will you produce? (Star each one)

- |              |                |   |
|--------------|----------------|---|
| Dairy cattle | Sheep          | Grains (corn, wheat, oats, rice, barley)        |
| Beef cattle  | Poultry        | Oilseeds (soybeans, sunflowers, peanuts)        |
| Hogs         | Hay and silage | Horticulture (vegetables, citrus, fruits, nuts) |

How many acres of your 430-acre farm will you devote to each crop? To each animal species? How many acres will you set aside for wildlife habitat? Fill out the chart below.

Crop, Livestock or Wildlife Use	Acreage
<b>Total (should equal 430 acres)</b>	

When you design your farm, your goal is to make a profit while stewarding your natural resources. Which environmental management strategies will you use on your farm? (Star each one)

- |                    |                            |
|--------------------|----------------------------|
| Mulch              | Conservation tillage       |
| Biodiversity       | Precision agriculture      |
| Cover crops        | Water use efficiency       |
| Rotational grazing | Integrated pest management |

On the back of this handout, draw a diagram of your farm. Label where you will use each strategy. Describe how and why you will use the strategy.

**ACTIVITY #1 TITLE**

## *Turning Manure into Money!*

**Estimated Time:** 25 minutes

**Content Area:** English Language Arts

**Standard:** Key Ideas and Details<sup>1</sup>

**Objective**

1. Students read and evaluate an article about a dairy farm tackling pollution and connect it to a career as a nutrient management specialist.

**Materials**

- Copies of the article from *Fortune* magazine at <http://fortune.com/fair-oaks-dairy-manure-fuel-farming>

### Activity Sequence

1. Instruct students to read the article about how Fair Oaks Dairy Farm tackles farm pollution.
2. On a piece of paper to be turned in, have students:
  - a. Identify the central idea of the text
  - b. Describe how it is conveyed through particular details
  - c. Summarize the text without using personal opinion
3. Connect the article to the career of a nutrient management specialist. Share the following information about the career:
  - a. Nutrient management specialists develop appropriate methods for removing and managing animal and food waste from the environment
  - b. They monitor processes that remove or destroy harmful materials, chemicals and microorganisms from water or land
  - c. They analyze the fertilizer value of applied manure
  - d. They are often employed by food animal production, crop and chemical companies, and the government
4. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

**Discussion**

*What was interesting about the article?*

*What might be enjoyable about a career as a nutrient management specialist?*

*What other careers in the Environmental Service Systems Career Focus Area are related to nutrient management?*

- Climate change analyst, environmental compliance officer, environmental engineer, environmental science protection technician, environmental scientist, water treatment technician



## Learn More

- To dig deeper into the featured career, review “Nutrient Management Specialist” on *AgExplorer* ([www.agexplorer.com/career/nutrient-management-waste-management-specialist](http://www.agexplorer.com/career/nutrient-management-waste-management-specialist)).

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### ACTIVITY #2 TITLE

## *Curious About the Climate? Analyze This!*

**Estimated Time:** 30 minutes

**Content Areas:** Science, English Language Arts

**Standard:** Earth and Human Activity<sup>2</sup>

### Objective

1. Students research climate change, ask clarifying questions and connect this to a career as a climate change analyst.

### Materials

- Access to computers for students to research articles
- *Optional:* Credibility Checklist found in the resources section of “Addressing Misconceptions” at <http://www.agfoundation.org/resources/addressing-misconceptions>

### Activity Sequence

1. Instruct students to find two reputable articles or websites online that have information about the factors that cause climate change. Have students read each article. You can help students identify what makes a website or article reputable by using the Credibility Checklist found in “Addressing Misconceptions.”
2. On a piece of paper to be turned in, have students describe why they believe their articles are reputable. Have students make a list of 10 questions they have about each article.
3. If time allows, have students choose the question that interests them the most and do further research to try to answer that question.
4. Connect activities to the career of a climate change analyst. Share with students that an interest in climate science and an innate sense of curiosity are key to being a climate change analyst. Share the following information about the career:
  - a. Climate change analysts look at research and data about our planet’s climate.
  - b. A career in this field can include looking at temperatures, polar ice caps, ocean conditions and greenhouse gases.
  - c. They utilize mathematical models and data to predict the future climate and determine how to use data and those predictions to make recommendations for environmental practices.
  - d. Climate change analysts also propose new policies in regard to alternative fuels, transportation and other factors related to climate change.



5. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

### Discussion

*What questions came out of your articles?*

*What did you discover from your research?*

*What is appealing about a career as a climate change analyst?*

*What other careers in the Environmental Service Systems Career Focus Area are related to climate science?*

- Ecologist, geologist, hydrologist, environmental engineer, environmental science protection technician, environmental scientist, nutrient management specialist, research and development manager, research technician, restoration specialist, wind turbine technician, wind substation technician

### Learn More

- To review the featured career, review *AgExplorer, Climate Change Analyst* ([www.agexplorer.com/career/climate-change-analyst](http://www.agexplorer.com/career/climate-change-analyst)).

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### ACTIVITY #3 TITLE

## *Project Restoration*

**Estimated Time:** 50 minutes

**Content Area:** Science

**Standard:** Ecosystems: Interactions, Energy and Dynamics<sup>3</sup>

### Objective

1. Students design solutions to restore an ecosystem to its natural state and connect this to the career of a restoration specialist.

### Materials

- Poster paper
- Markers

### Activity Sequence

1. Break students into teams of four. Explain to them that today they will be exploring an ecosystem and will compete to create a restoration solution for that ecosystem.
2. Tell students one member of their team should be the scribe and remind them to bring something to write with and on with them.



3. Take students on a mini field trip to an outdoor area on the school campus. Tell them their task is to design a solution that will restore the ecosystem to its natural state. Tell them to consider the biodiversity of plant and animal species they'd like to see and the ecosystem services the area will provide. After students have had ample time to explore, brainstorm and take notes, return to the classroom.
4. Give students a set amount of time to make a poster that details their design solution. Monitor team progress and answer questions.
5. Have teams share their posters. After all teams have shared, have students individually vote for which solution they like best. Instruct them to write at least two specific reasons they believe that solution will work the best.
6. Connect the activity to the career of restoration specialist. Share the following information about the career:
  - a. Restoration specialists investigate the connections between organisms and the environment in a variety of settings and make recommendations for improvements to re-establish natural ecosystems.
  - b. This work will typically include assisting in the implementation of those recommendations.
  - c. Restoration specialists are typically employed by seed companies, crop protection companies, universities, government agencies, consulting firms, research laboratories, museums, field stations, parks and recreation areas.
7. *Optional homework:* Have students choose a related career and research it on *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)).

### Discussion

*What was fun about this activity?*

*What might be enjoyable about a career as a restoration specialist?*

*What other careers in the Environmental Service Systems Career Focus Area are related to ecosystem management?*

- Ecologist, geologist, hydrologist, environmental engineer, environmental science protection technician, environmental scientist

### Learn More

- To explore the featured career, review Restoration Specialist on *AgExplorer* ([www.agexplorer.com/career/restoration-specialist](http://www.agexplorer.com/career/restoration-specialist)).

- 1 CCSS.ELA-LITERACY.RI.6.2. Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- 2 NGSS.MS-ESS3-5. Earth and Human Activity. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.  
Common Core: ELA. RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts. Common Core: ELA. WHST.6-8.8. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- 3 NGSS: MS-LS2-5 Ecosystems: Interactions, Energy and Dynamics. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

## Discover Your Watershed as a Hydrologist!

Hydrologists study the physical characteristics of water. They study how it is distributed and how it moves above and below the earth's surface. Hydrologists research how water moves in certain environments and how that affects ecosystems. In particular, they study watersheds. A watershed is all of the land that drains into the same location or body of water. Follow the steps below to learn more about the watershed where you live!

Step 1. Visit the U.S. Geological Survey website and click on your water resource region at [http://water.usgs.gov/wsc/map\\_index.html](http://water.usgs.gov/wsc/map_index.html).

Step 2. Keep clicking on the map to zoom in until you discover your watershed. Write your watershed number down here:

Step 3. Click on "Additional Information for this Watershed" and explore the links. What can you learn about your watershed? Capture your notes below!

**Check out [www.agexplorer.com/career/hydrologist](http://www.agexplorer.com/career/hydrologist) for more information about becoming a hydrologist!**



ESTIMATED TIME

55

minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Life Science,  
Economics



CAREER FOCUS AREA

## FOOD PRODUCTS & PROCESSING SYSTEMS

### Lesson Title

## *The Future of Food*

### Standards

- MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial or neutral effects.
- LS3.A: Inheritance of Traits: Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- NSS-EC-8.2 Effective decision-making requires comparing the additional cost of alternatives with the additional benefits. Most choices involve doing a little more or a little less of something; few choices are an all-or-nothing decision.

### Objectives

1. Students will identify future careers in the Food Systems Career Focus Area.
2. Students will examine the use of technology in food products and processing.





## Materials

- Writing utensils or markers (per student)
- Food Products and Processing Systems handout (one per student)

## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Food Products and Processing Systems Career Focus Area.
  - Review the lesson plan and determine if any modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Looking into the Future of Food

- Introduce students to this career focus area with some background information on the Food Products and Processing Systems Career Focus Area, which may sound like this:  
Do you like to play with your food? If so, this may be the career focus area for you! Jobs in Food Products and Processing Systems use the products from farms as ingredients to make things that show up on the grocery store shelves. They work hard to keep our food safe and top-quality. They also use science and math to figure out the nutritional value of food. Working in this career focus area could even include making new flavors and food combinations!
- Give each student the Food Products handout and say:
  - You have been tasked with looking into the future of food production. What do you see?
  - To clarify, tell students that their idea should address the following:
    - What idea, product or process could you develop that would benefit food production or food processing in some way?
    - What technology would you need to make this happen? Is it available today?
- Students will write or draw in the visual field of the binoculars what they “see” in the future of food production and processing. Allow students to be as creative as they like, with real or imagined food products and processing techniques.
- Have a few students volunteer to share their vision for the future of food

## Body (Main Content)

### STEP 2 >> The Future is Now

- Instruct students that food systems and food production have come a long way, even in the past 10 years! Although the basics of growth are still the same, technology has evolved so that plants and even animals can benefit from its use.
- Watch the PBS Learning Media video “Can New Rice Improve Health in the Philippines?” at <http://bit.ly/2cqdkis>.



- Ask students the following reflective questions:
  - What do you think about the use of this technology?
  - What are the benefits of using this rice? What are the perceived issues?
- Ask students to refer back to their “Look Into the Future” food products handout. Ask them:
  - Do we currently have technology to make your idea happen, or has it yet to be developed?
  - What would we need to develop to get your idea off the ground?
  - Would your idea be controversial? If so, how? What are both sides of the issue?

### **STEP 3 >> Career Exploration Activity**

**Note:** Students will need tablets or computers with access to the Internet for this activity. Students can share access within their groups.

- Students will partner up and look online at the Food Products and Processing Systems Career Focus Area ([www.agexplorer.com/focus/food-products-processing-systems](http://www.agexplorer.com/focus/food-products-processing-systems)).
- Instruct students to discover a career of someone that might help them implement their vision (handout) for the future of food.
- Instruct students to capture the career that they chose and describe why that person will be helpful to them if they implement their food vision.

## **Wrap Up** (Review, Assess, Challenge)

### **STEP 4 >> Review Careers of Interest**

Have a few students share the careers they chose and why they think they will be helpful.

### **STEP 5 >> Assess Learning**

Collect the Food Products handouts and assess for completeness and depth of thought.

### **STEP 6 >> Challenge**

- Remind students that there are many exciting career opportunities in the Food Products and Processing Systems Career Focus Area if they are excited about the future of food.
- Pass out Take-Home Activity sheets and give further instructions.

### **Teaching Notes**

The Food Products & Processing Systems video on *AgExplorer* can be used as an additional resource to introduce students to Food Products and Processing careers.

[www.agexplorer.com/focus/food-products-processing-systems](http://www.agexplorer.com/focus/food-products-processing-systems)

**ACTIVITY #1 TITLE**

## *A Label of Love*

**Estimated Time:** 45 minutes

**Content Areas:** Nutrition, Math

**Standard:** Reason about and solve one-variable equations and inequalities<sup>1</sup>

**Objectives**

1. Students will understand that all food—raw and processed—has a nutritional makeup.
2. Students will investigate food labels and their role in promoting healthy food choices.

**Materials**

- Access to the Internet/computer for viewing a video
- Sample food products that have nutrition labels (optimal: one per student)
- Paper and writing utensils/markers (per person)

**Activity Sequence**

1. Instruct students that all foods—both raw and processed—have a nutritional makeup. Nutritionists and dietitians work to help others with food selections, and also research food nutrition and health conditions.
2. Have students watch the PBS Learning Media video “Label Reading Part 2” at <http://bit.ly/2chh7KV>. The video explains food labels and serving sizes. Invite a registered dietitian to watch the video with the students.
3. Instruct students that as they view the video, they should write down the equation they see.  
$$\text{Calories} \times \text{amount of servings} = \text{total calories}$$
4. Pass around sample food products to students or small groups of students. Briefly explain the information available on a food label.
5. Have students calculate the total calories in their food product based on the equation from the video.
6. Use the following reflective questions to guide discussion:
  - a. Why is it important to understand how many calories are in food?
  - b. Do we need food labels? Why or why not?
  - c. What would you like to see on a food label?
7. Use the last discussion question (c) to transition students to the second part of the activity.



8. Instruct students that they are to create a food label for their favorite food. Encourage students to think creatively about their label.
  - a. The label may include common items such as calories, total fat, cholesterol, sodium, protein, etc.
  - b. The label may also include creative items students choose to add, such as yumminess factor, flavor quality, etc.
9. Review and share.

### Discussion

*How do nutritionists and dieticians advocate for human wellness?*

*Do food labels promote healthy food choices? Why or why not?*

### Learn More

- To dig deeper into the featured career, review Nutritionist/Dietician on *AgExplorer* ([www.agexplorer.com/career/nutritionist-dietitian](http://www.agexplorer.com/career/nutritionist-dietitian)).

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### ACTIVITY #2 TITLE

## *Flavor Savor!*

**Estimated Time:** 45 minutes

**Content Areas:** Communications, English Language Arts

**Standard:** Matter and its Interactions<sup>2</sup>

### Objectives

1. Students will research and test new flavor products in experimental trials.
2. Students will record and present data.

### Materials

- Paper and writing utensil (one per student)
- Small cups (three per student)
- Club soda (approximately one-half to one pint per student)
- Popsicle sticks or coffee stirs (two per student)
- Plastic spoons (six per student, plus extra)
- The following flavorings (enough for each student to use in their experiment)
  - Fresh strawberries (washed, hulled and cut in half)
  - Strawberry jam
  - Strawberry gelatin
  - Strawberry syrup
- Spoons or scoops for the above items, as needed



## Activity Sequence

**Note:** Use or substitute ingredients based on class dietary and allergy needs.

1. Tell students that today they get to be a flavor technologist! Their challenge is to design a drink that tastes just like real strawberries.
2. Instruct students that they will be able to make two different flavor combinations, but they will only be able to choose one for final product testing.
3. Students will each receive two small cups (filled halfway with club soda), two stirrers, six plastic spoons and access to the flavoring ingredients.
  - a. Instruct students that each time they taste-test their flavor combination, they must use a clean plastic spoon!
  - b. Note: If needed, set limits on flavorings or amounts allowed for use in trials.
4. Have students create their two flavor combinations and choose their best/favorite for final product testing.
5. Give students one clean cup. Ask them to write a number on the outside of the cup, and then write that same number on the top of their paper.
6. Have students pour a small amount (< 1 Tablespoon) of their favorite product into the new numbered cup. This will be their final product-testing entry.
7. Have students draw the following chart on their paper:

Product Number	Tastes like strawberries	Smells like strawberries	Total Score
	1 2 3 4 5	1 2 3 4 5	

8. Instruct students that they will work with a partner to taste-test another final product and rate it based on the criteria of taste and smell.
  - a. Students will calculate a total score.
  - b. *Optional:* Have students pour their final products into two new numbered cups, and have more than one student rate their final product or an adult serve as a guest judge.
9. *Optional:* Have students create a visual representation of their final product testing results.

### Discussion

*What skills do you need to have to be a great flavor technologist?*

*How important are things like accuracy and attention to detail for a flavor technologist? Why?*

### Learn More

- To dig deeper into the featured career, review Flavor Technologist on *AgExplorer* ([www.agexplorer.com/career/flavor-technologist](http://www.agexplorer.com/career/flavor-technologist)).



### ACTIVITY #3 TITLE

## *Pack it in!*

**Estimated Time:** 35 minutes

**Content Area:** Engineering

**Standard:** Engineering Design<sup>3</sup>

### Objective

1. Students will create packaging for a product as a packaging engineer.

### Materials

- Variety of recycled and craft materials (scrap paper, paper towel rolls, wood craft sticks, plastic bags, foam, etc.)
- Adhesive items (glue, tape, etc.)
- Breakable item (one per student or group) (e.g., egg or glass item—cup, plate, etc.)

### Activity Sequence

1. Inform students that they get to be a packaging engineer for the day! Have students work individually or as partners/small groups.
2. Explain the challenge: Students will create packaging for a breakable item. Each group's packaging will need to keep their breakable item safe and unbroken from a drop of 3 feet.

*Optional:* Give further challenge restrictions such as total amount of materials used, time to complete challenge, etc.

3. Give students access to the construction and adhesive items, then begin the challenge.
4. Once all packages have been created, bring the class back together as a whole group.
5. One at a time, have groups explain their design process and rationale prior to testing with a drop from 3 feet. Examine item for completeness after drop.
6. Discuss results.

### Discussion

*What did you enjoy about this activity?*

*How would you alter your design if you did it again?*

*Think outside the box. How could your packaging design help in another area (e.g., padding/safety equipment for sports players)?*

### Learn More

- To explore the featured career, review Packaging Engineer on *AgExplorer* ([www.agexplorer.com/career/packaging-engineer](http://www.agexplorer.com/career/packaging-engineer)).

- 1 CCSS.MATH.CONTENT.6.EE.B.6—Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specified set.
- 2 NGSS: MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- 3 NGSS: MS-ETS1-2 Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

## It's Fun to Play with Your Food!

Step 1. Think of one of your favorite food recipes. Brainstorm ways you could change the ingredients, seasoning or flavor. Write in your new recipe below! Now let's experiment! With an adult's permission (and maybe even their help!), try out the new recipe below. Good luck!



**YOUR RECIPE:**

Step 2. Visit PBS Learning Media and watch the video "Career Connections: Food Scientist" at <http://bit.ly/2gyz0bl>.

Step 3. While watching the video, answer the following questions:

- What are some challenges faced while producing new foods?
  
  
  
  
  
  
  
  
  
  
- What are some specific areas or careers in which a person with a food science degree can work?

**Check out [www.agexplorer.com/focus/food-products-processing-systems](http://www.agexplorer.com/focus/food-products-processing-systems) for more information about becoming a food scientist!**



ESTIMATED TIME

55  
minutes

GRADE LEVELS

Middle School  
(6–8)

CONTENT AREAS

Science, Math



CAREER FOCUS AREA

## NATURAL RESOURCES SYSTEMS

### Lesson Title

### *Saving the Earth for Generations to Come*

### Standards

- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- CCSS.MATH.CONTENT.6.RP.A.1 Understand the concept of a ratio, and use ratio language to describe a ratio relationship between two quantities.
- CCSS.MATH.CONTENT.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems; e.g., by reasoning about tables of equivalent ratios, tape diagrams, double-number line diagrams or equations.

### Objectives

1. Students will understand the definition and value of Earth's natural resources.
2. Students will use ratio and proportion skills to help understand limitations of natural resources in relation to human population.



## Materials

- Paper and writing utensil (per student)
- Computer access
- Large paper and/or poster board
- Markers

## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Natural Resources Career Focus Area.
  - Review the lesson plan and determine if any set-up or modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Natural Resources

- Ask students to brainstorm examples of natural resources. Have them call out their answers popcorn-style and record them on the board.
  - Natural resources are defined as materials or substances that occur in nature (such as minerals, timber, water, soil, natural gas, etc.) and are useful for humans.
- Ask students the following questions:
  - What do all natural resources have in common?  
*They exist without help from humans; they occur naturally.*
  - Define “renewable” and “non-renewable” in relation to natural resources.  
**Renewable:** A resource that can or will be replenished naturally over the course of time  
**Non-renewable:** A resource that cannot be replenished naturally over time on a level equal to its consumption by humans
  - What is our duty as humans to these natural resources?  
*We have to use our renewable resources sustainably and conserve our non-renewable resources.*





## Body (Main Content)

### STEP 2 >> Natural Resource Plan

- Prior to starting the activity, show students the following webpage:  
<http://www.census.gov/popclock>. Use the page to guide discussion:
  - What effect does the growing U.S. and world population have on our natural resources?  
*Listen for examples such as: Urban sprawl converts land to developed areas, more people need more water and food, etc.*
  - How are resources available in specific regions of the world integrated into international relations and trade?
- Instruct students to write down a natural resource of their choice on the top of their paper; then group students according to similar resources/categories.  
*If groups are not evenly distributed, the teacher may reassign as needed.*
- Ask the following question for groups to discuss amongst themselves:
  - Thinking about your group’s specific resource, how will it be affected by human population in five years? Fifteen years? Fifty years?
- Wrap up the discussion and have groups select and write down a challenge facing their resource.
- Their goal, as a team, is to design a solution to the challenge facing their natural resource while keeping the world’s growing population in mind.
- Using a design method of their choice (paper, computer program), each team will design a solution for their natural resource while addressing the following items:
  - Name and use for natural resource
  - Challenge affecting chosen natural resource
  - Design solution for the challenge

**Note:** Design can be as complex and creative as the group permits. The lesson may also address U.S. or global resources.
- Give students a timeframe and allow them to create their plan.
- *Optional:* To continue the lesson, or if time allows, have students put their plan into a presentation. This may include a multimedia presentation, skit, news report, blog post, etc.

### STEP 3 >> Career Exploration Activity

- Using their challenge plan from the previous activity, have each student go online to [www.agexplorer.com/focus/natural-resources-systems](http://www.agexplorer.com/focus/natural-resources-systems) and choose a career from the Natural Resources Systems Career Focus Area that could help solve their challenge.
- Invite students to share out as time permits.



## Wrap Up (Review, Assess, Challenge)

### STEP 4 >> Review

- Remind students that their decisions can play a part in the development and management opportunities in Earth's natural resources.

### STEP 5 >> Assess

- Have students think of the answer to the question individually and then share with a partner. Afterward, take answers from the group as time allows.
- If you are interested in a career in natural resources, how could you prepare right now in middle school?

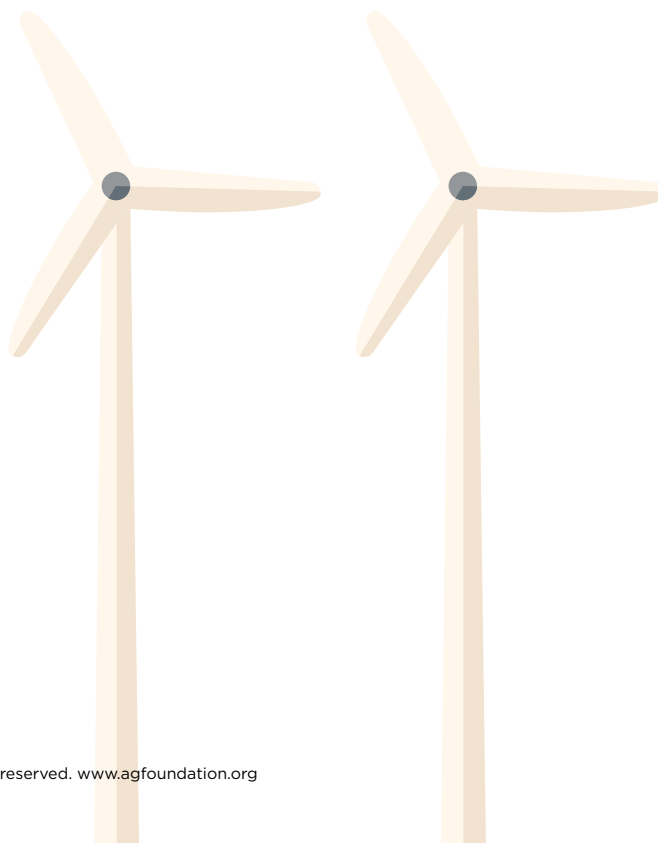
### STEP 6 >> Challenge

- Remind students that agriculture is everywhere and that they could eventually play an exciting part in that industry.
- Pass out Take-Home Activity sheets and provide further instructions.

### Teaching Notes

The Natural Resources Systems video on *AgExplorer* can be used as an additional resource to introduce students to Natural Resources Systems careers.

[www.agexplorer.com/focus/natural-resources-systems](http://www.agexplorer.com/focus/natural-resources-systems)





ACTIVITY #1 TITLE

# Waste Not, Want Not

**Estimated Time:** 25 minutes

**Content Area:** Life Science

**Standards**

- Earth and Human Activity<sup>1</sup>
- Economics: Scarcity<sup>2</sup>
- Research to Build and Present Knowledge<sup>3</sup>

**Objective**

1. Students will identify how to best use and conserve limited natural resources, including food.

**Materials**

- Paper and writing utensil (per person)

## Activity Sequence

1. Begin the activity with a look at the PBS Learning Media video “Turning Food Waste into a Resource” at <http://bit.ly/2cyIM9d>.
2. Review the video content with written or verbal reflection on the following questions:
  - a. One out of seven truckloads of perishables delivered to grocery stores will go to waste. That’s a lot of food! What factors contribute to this waste?
  - b. Describe how food is a natural resource
  - c. The video describes food scraps as a resource; not waste. Do you agree or disagree? Why?
3. Inform the students that food waste doesn’t just happen at stores, although that is a contributor. Food waste can also happen during harvest at the farm, in transport, at restaurants and even in our homes!
4. Have students brainstorm a way that they will record their personal and/or family food waste over the next week. They may create a chart that looks similar to this:

Date	Meal/food	Amount/quantity of food not eaten or thrown away	Measurement of wasted item(s)
10/15/16	Example: Breakfast, cereal and yogurt	Example: finished yogurt, didn’t drink milk on cereal (poured it down the drain)	Example: ¾ cup milk

5. *Optional:* Review the lesson once students have collected data. Analyze trends over time and make a visual representation (chart, graph, etc.) of their data.
6. *Optional class extension:* With school permission, collect food waste from one meal time at school. Have students wear aprons, gloves and other protective equipment as they separate the waste into categories: food, drink, recyclable and other. Weigh each category and use results to process data, such as average amount of waste (in pounds) per student, etc. If possible, complete the project on multiple days and compare results.



## Discussion

*What did you learn from this activity?*

*How will you use this activity and reflection to improve your home, school or community in the area of food waste?*

*Describe how an ecologist—or another career in the Natural Resources Career Focus Area—could help alleviate the challenge of food waste.*

## Learn More

- To dig deeper into the featured career, review *AgExplorer, Ecologist* ([www.agexplorer.com/career/ecologist](http://www.agexplorer.com/career/ecologist)).

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### ACTIVITY #2 TITLE

## *Best Practices in Agriculture*

**Estimated Time:** 45 minutes

**Content Area:** Life Science

**Standard:** Earth and Human Activity<sup>4,5</sup>

### Objective

1. Students engage in creation of a farm or ranch and identify the opportunities for best practices through a natural resources lens.

### Materials

- Large roll of paper (bulletin board paper or something similar)
- Markers or paint
- Brightly colored sticky notes
- *Optional:* guest presentation by a local United States Department of Agriculture Natural Resources Conservation Service conservationist

### Activity Sequence

1. Ask students what a conservationist might be responsible for and capture ideas on the board. If needed, backfill with additional responsibilities, including:
  - a. Study forage plants and their growth requirements
  - b. Develop new and improved activities that aid conservation
  - c. Maintain soil stability and decrease erosion
  - d. More responsibilities can be found at [www.agexplorer.com/career/conservationist](http://www.agexplorer.com/career/conservationist).



2. Instruct students that they will work in small groups to create a farm or ranch of their choice. Their farm/ranch can include any or all of the following:
  - a. Natural resources such as water sources
  - b. Livestock
  - c. Crops
  - d. Equipment
  - e. Barns, houses and other outbuildings
  - f. Additional items students come up with
3. Students will use the large paper and markers to design their farm/ranch and its attributes. After completion, give each group a pad of brightly colored sticky notes. Tell students that they need to put a sticky note next to each area/item on their farm that could use some advice or consulting from a conservationist. On the sticky note, students will write the advice they think a conservationist may give.
4. Review the created farms/ranches and offer constructive feedback and correction as necessary.
5. Groups may share their farm/ranch with the whole class.
6. *Optional:* Have a local USDA NRCS conservationist visit the class and speak about their day-to-day activities.

As an alternative, view the USDA NRCS video “Conservation . . . Our Purpose, Our Passion” at <http://bit.ly/2cRtWni>.

### Discussion

*How do you think a conservationist’s duties change on a seasonal basis?*

- Discuss seasonality relevant to your region of the U.S. and how that may affect a conservationist’s job.

*Why is it important to have a conservationist if you have a farm/ranch?*

- Examples may include—but are not limited to—preserving the land for future generations, helping to do your part of keeping public waterways clean, etc.

### Learn More

- To dig deeper into the featured career, review *AgExplorer, Conservationist* ([www.agexplorer.com/career/conservationist](http://www.agexplorer.com/career/conservationist)).

**ACTIVITY #3 TITLE**

## *Exploring Ecology*

**Estimated Time:** 45 minutes

**Content Area:** Science

**Standard:** Ecosystems: Interactions, Energy, and Dynamics<sup>6</sup>

**Objective**

1. Students will experience how ecologists document observations in a given area.

**Materials**

- Yarn—approximately 3 feet (one per group)
- Ruler (one per group)
- White piece of paper (one per group)
- Notepaper (one per group)
- Pencil (one per group)
- *Optional:* Digital camera (one per group)

**Activity Sequence**

1. Share the definition of ecology: According to the Merriam-Webster Dictionary, ecology is a science that deals with the relationships between groups of living things and their environments.
2. Ask students to work in pairs to brainstorm three groups of living things and write down what they know about the living things' environments. Students can make a quick mind map by drawing the living thing in a circle, with branching notes about the organism's environment around the circle.
3. Inform students that becoming an ecologist is an important job in the Natural Resources Career Focus Area. Ecologists capture data about living things and the environment. This helps farmers, ranchers, developers and others make important decisions about how land is used and cared for.
4. Break students into lab groups of three to five students. Have each team pick up the following supplies: one piece of yarn (approximately 3 feet), one ruler, one white piece of paper, one notepaper and pencil or one digital camera (optional).



5. Take students to an outdoor area such as a football field, garden, landscaped walkway, etc., and provide the following directions:
  - Each team is to select an area in the given environment.
  - Teams are to tie the two ends of their piece of yarn in a knot, forming a large circle.
  - Place the circle on the ground and observe only life within this circle.
  - Document all living things found within this circle by placing a ruler next to the item and taking a digital picture or illustrating to scale. Place the white piece of paper behind the item for contrast when photographing.
  - Challenge students to find at least five different living things within their circle sample.
6. Return to the classroom and share findings. Inform students that ecologists take similar samples of areas to begin their environmental assessment.
7. You may wish to extend learning by having students research organisms they found or document class findings with tables and graphs.

### Discussion

*What did you enjoy about this activity?*

*How would you explain the importance of an ecologist to someone who is unfamiliar with the job?*

### Learn More

- To explore the featured career, review: *AgExplorer, Ecologist* ([www.agexplorer.com/career/ecologist](http://www.agexplorer.com/career/ecologist)).

- 1 MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- 2 NSS-EC.5-8.1 Productive resources are limited. Therefore, people cannot have all the goods and services they want. As a result, they must choose some things and give up others.
- 3 CCSS.ELA-LITERACY.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related focused questions that allow for multiple avenues of exploration.
- 4 NGSS: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- 5 NGSS: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- 6 MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.



## It's a Beautiful Day in the Neighborhood!

Step 1. Draw an aerial map of your neighborhood or area surrounding your house. Think about and incorporate the following items as applicable:

- Water source(s)
- Slope of land/water runoff
- Landscape items (trees, shrubs, etc.)
- Trash collection sites

Step 2. Put a star next to any of the items above that are potential challenges in your neighborhood. Think about how you could create a plan for your neighborhood that would positively and proactively address any challenges. List or describe your plan below:

Step 3. What can YOU do to help? Talk to your parents or an adult, and using your list above, put your plan into action! You can help conserve natural resources right where you are!

**Check out [www.agexplorer.com/focus/natural-resources-systems](http://www.agexplorer.com/focus/natural-resources-systems) for more information about what you can do to help conserve natural resources!**



ESTIMATED TIME

**55**  
minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Science



CAREER FOCUS AREA

## PLANT SYSTEMS

### Lesson Title

*Careers in the Plant Systems Career Focus Area:  
Doctor, Plant Scientist or Both?*

### Standards

- NGSS: MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
- NCDA-7-9-3. Helping pupils understand career applications of subject matter.

### Objectives

1. Students will design a biofortified crop that can cure a disease or nutrient deficiency.
2. Students will identify careers of interest in the Plant Systems Career Focus Area.

### Materials

- Access to a computer lab or laptops/tablets for students
- Small sheets of poster paper and markers

### Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Plant Systems Career Focus Area.
- Review the lesson plan and determine if any modifications are required.

## **Introduction** (Set Context for Activity)

### **STEP 1 >> Introduce the concept of biofortification**

- Play the USAID Feed the Future video “Agricultural Technologies: Wheels for Change in Mozambique” at <https://feedthefuture.gov/video/agricultural-technologies-wheels-change-mozambique>.
- Ask students what innovation they saw in the video that was designed to solve a human health challenge.
  - Listen for students to reference the biofortification of orange-flesh sweet potato that provides vitamin A.
- Explain to students that biofortification is the process of breeding crops to increase their nutritional value. This can be done through conventional breeding or genetic engineering.
- Preview the lesson by telling students that they will be scientists today, using plants to solve human health issues!

## **Body** (Main Content)

### **STEP 2 >> Introduce Plant Systems Career Focus Area**

- Professionals who work in the Plant Systems Career Focus Area help feed the growing population by developing crops that are resistant to insects and improve models to grow more food with less space. They also work to preserve our natural resources and even help cure diseases!
- Introduce the career of a bioinformatics scientist. Share the following information:
  - Bioinformatics scientists use technology and computer science to study and find solutions in the area of biology.
  - They collaborate closely with scientists from a variety of disciplines including microbiologists, computer scientists and plant biologists to identify opportunities for accelerating product development.
  - Bioinformatics scientists use databases of genetic information to find ways to identify and treat human, animal and plant diseases, as well as other issues.

### **STEP 3 >> Biofortified Crop Development Activity**

- In pairs or small groups, students will research a disease or nutrient deficiency and design a biofortified crop that can help cure or address that disease. Their final projects should contain the following information:
  - The disease or deficiency they are addressing. If they choose a deficiency, they should include the human health repercussions of the deficiency.
  - A place in the world where that disease or deficiency is prevalent and the staple crops eaten in that region.
  - The crop they will biofortify. Does that crop already have some of the element to be fortified, or will it be a new nutrient? Is the crop eaten in that part of the world?
  - The project should include a visual representation of their crop.



- Set expectations around time students have to work, depth of thought and creativity. Tell students they will be creating a poster to showcase their biofortified crop that will be judged by their peers.

#### **STEP 4 >> Career Exploration Activity**

**Note:** Students will need tablets or computers with access to the Internet for this activity.

- Tell students that while engineering crops, it takes teams of people with a wide range of expertise to help make sure the crop meets its goals, is safe and reaches market.
- Tell students that each member of the group is responsible for choosing a career from the Plant Systems Career Focus Area that could assist them with the development of their crop.
- Instruct students to visit *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)) and select the Plant Systems Career Focus Area.
- Tell students that each member of their group needs to pick a different career. They will be responsible for sharing their career and why the career is important in their presentation. If students need a hint, point them to the career description and responsibilities sections.

### **Wrap Up** (Review, Assess, Challenge)

#### **STEP 5 >> Review and Assess Learning**

- Set context around what is expected from the presentations, including what needs to be shared and how long students will present. Have groups share their crops and visual aids. Ask follow-up questions as needed.

#### **STEP 6 >> Challenge**

- Tell students that if growing plants, being outside and solving problems appeals to them, a career in the Plant Systems Career Focus Area might be for them!
- Pass out Take-Home Activity sheets and provide further instructions.

#### **Teaching Notes**

The Plant Systems video on *AgExplorer* can be used as an additional resource to introduce students to Plant Systems careers.

[www.agexplorer.com/focus/plant-systems](http://www.agexplorer.com/focus/plant-systems)



**ACTIVITY #1 TITLE**

## *Thrive or Die? An Experiment in Plant Environments*

**Estimated Time:** 45 minutes

**Content Area:** Science

**Standard:** Growth, Development and Reproduction of Organisms<sup>1</sup>

**Objective**

1. Students conduct an experiment to determine how environmental factors influence plant growth and connect this to the career of an agronomist.

**Materials**

- At least 16 potted seedlings of the same type of plants
- Water and a way to measure it
- Rulers
- Plant fertilizer
- Paper to label plants

**Activity Sequence**

1. Tell students they will be conducting an experiment to see how plants grow best. There will be four different environments tested:
  - a. Control: Set amount of water; no fertilizer; set amount of light
  - b. Dark: Set amount of water; no fertilizer; grown in a closet or under a box
  - c. Fertilizer: Set amount of water; fertilizer applied; set amount of light
  - d. Drought: Half as much water as the other plants; no fertilizer; set amount of light
2. Have students create data collection sheets in their notebooks. There should be a column for environment, initial height, final height, height change and other observations.
3. Break students into lab groups. The number of groups depends on how many plants you purchase.
4. Give each group at least four plant seedlings. Instruct students to label their four plants with environment names. Demonstrate the experiment protocol and then set students to work:
  - a. Use the ruler to take initial height measurements of all plants and record heights on the data table. Record any other observations about the plants' appearance in the other observations column.
  - b. Carefully measure water and distribute equal amounts of water to plants. Give half the allotted amount of water to the "drought" plant.
  - c. Apply fertilizer to the "fertilizer" plant.
  - d. Place the "dark" plant in a closet or under a box.
5. Have students water plants every day. After a week or two, have students take final plant measurements and record the information in their data tables. Have students make other observations of the plants' physical appearance. Instruct students to calculate the change in height for each of the environments. As a class, average the height-change data. Instruct students to draw conclusions from the data about which environment the plants preferred and why.



6. Connect the activity to the career of an agronomist. Share the following information about the career:
  - a. Agronomists are knowledgeable about the production of field crops, including all the variables involved such as soil and land management, nutrient and water needs, pest control and minimizing environmental impact.
  - b. They provide knowledge and leadership to growers in their assigned market while performing job duties such as field scouting, soil management and market analysis
7. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

### Discussion

*Which group of plants grew the most? Why?*

*Were there differences in the physical characteristics of the plants besides height?*

*Which plants appeared the healthiest? Why?*

*What might be enjoyable about a career as an agronomist?*

*What other careers in the Plant Systems Career Focus Area involve time studying plants?*

- Crop advisor, entomologist, viticulturist, horticulturalist, plant biologist, plant breeder, plant geneticist, plant pathologist, plant scientist/field agronomist, regulatory scientist, research and development manager, research technician, seed production agronomist, weed scientist

### Learn More

- To dig deeper into the featured career, review *Agronomist* on *AgExplorer* ([www.agexplorer.com/career/agronomist](http://www.agexplorer.com/career/agronomist)).

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### ACTIVITY #2 TITLE

## *Dream it, Design it*

**Estimated Time:** 50 minutes

**Content Area:** Art

**Standard:** Visual Arts<sup>2</sup>

### Objective

1. Students create a garden design for an area of the school and connect it to a career as a landscape designer.

### Materials

- Paper
- Colored pencils or markers
- Access to the Internet



## Activity Sequence

1. Tell students they will be working in pairs to create a garden design to beautify an area of the school's campus. Set expectations around the final report, including media to use (drawn, created on the computer, etc.). Instruct students that their final report should show the use of some combination of perennials, annual color, edibles, containers and outdoor furniture.
2. Pair up students and take them to a predetermined potential garden location on campus. Have them estimate the dimensions of the garden and brainstorm potential designs with their partners.
3. Once back in the classroom, students can research particular plants and design ideas they'd like to use. The Sunset Garden website is a great resource ([www.sunset.com/garden](http://www.sunset.com/garden)). Monitor student progress and answer questions.
4. Connect the activity to the career of a landscape designer. Share the following information about the career:
  - a. Landscape designers typically work for companies or groups that provide landscaping design and maintenance services for companies or individuals.
  - b. They plan, propose, and oversee the development of landscapes.
  - c. They are employed by greenhouses, nurseries, individual homeowners, large and small companies, government agencies, golf courses, athletic venues and universities.
5. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

## Discussion

*What did you enjoy about creating your garden design?*

*What is appealing about a career as a landscape designer?*

*What other careers in the Plant Systems Career Focus Area might help you install your garden design?*

— Horticulturalist, landscape technician

## Learn More

- To review the featured career, review *AgExplorer, Landscape Designer* ([www.agexplorer.com/career/landscape-designer](http://www.agexplorer.com/career/landscape-designer)).

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### ACTIVITY #3 TITLE

## *Name that Tree!*

**Estimated Time:** 30 minutes

**Content Areas:** Science, Art

**Standard:** Growth, Development and Reproduction of Organisms<sup>3</sup>



### Objective

1. Students identify a species of tree using a diagnostic tool and connect that to the career of an arborist.

### Materials

- Internet access for students to visit the Arbor Day Foundation website ([www.arborday.org/trees/whatTree](http://www.arborday.org/trees/whatTree)).

### Activity Sequence

1. Guide students on a nature walk around the school grounds. On the nature walk, instruct students to choose a tree they will try to identify.
2. Have each student draw a sketch of their chosen tree and collect a leaf sample.
3. When back in the classroom, have students log on to the Arbor Day Foundation website and choose the Tree Identification Tool. Have students walk through the questions to identify their tree. Monitor progress and answer questions.
4. Connect the activity to the career of an arborist. Share the following information:
  - a. Arborists plant, grow, maintain and remove trees.
  - b. They help identify the health of tree species and determine and prescribe needed care.
  - c. They prepare estimates for clients and potential customers.
  - d. Arborists are employed by greenhouses, nurseries, logging firms, landscaping companies, government agencies, residential communities, paper and packaging companies, or they may be self-employed.
5. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

### Discussion

*Why is it important to be able to identify tree species?*

*What might be enjoyable about a career as an arborist?*

*What other careers in the Plant Systems Career Focus Area are related to non-food-producing plants?*

- Athletic turf manager, florist, golf course superintendent, landscape designer, landscape technician

### Learn More

- To explore this career, review *AgExplorer, Arborist* ([www.agexplorer.com/career/arborist](http://www.agexplorer.com/career/arborist)).

- 1 NGSS. MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- 2 VA: Cr1.1.6a Combine concepts collaboratively to generate innovative ideas for creating art.
- 3 Common Core: RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph or table).



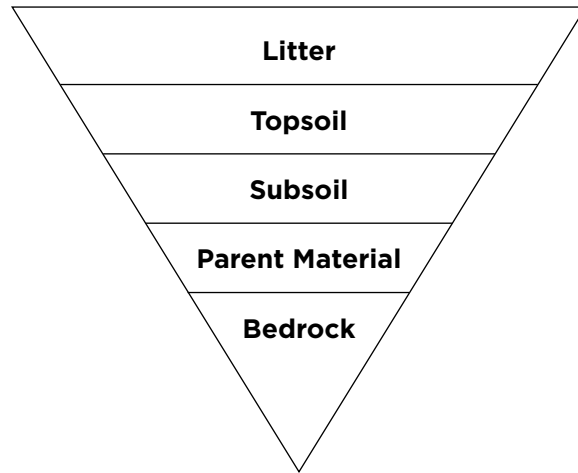
## Create Your Own Edible Soil as a Soil Scientist!

Soil is one of our most important natural resources! Healthy, fertile soil produces healthy, high-yielding crops. Soil scientists study soil characteristics, map soil types and investigate responses of soils under certain conditions.

Step 1. Collect the materials:

- Clear plastic or glass cup
- Oreos (or other cookies)
- Vanilla and chocolate pudding
- Sprinkles

If you don't have the snack foods listed, be creative and think of other food items to use. Represent the layers!



Step 2. Build your edible soil!

- Put an Oreo cookie at the bottom of the cup to represent the bedrock. Bedrock is solid rock and is at the bottom of the soil profile.
- Next, crush up some Oreos and layer them in the cup. They represent weathered rock, which is called the parent material.
- Add in vanilla pudding to represent subsoil.
- Add in chocolate pudding to represent topsoil. It is darker than the subsoil because it has more organic material in it.
- Top with sprinkles to represent a layer of organic matter litter. The organic matter decomposes and enriches the soil!

Step 3. Take a picture to document your work, and then enjoy your delicious creation!

Check out [www.agexplorer.com/career/soil-scientist](http://www.agexplorer.com/career/soil-scientist) for more information about becoming a soil scientist!



ESTIMATED TIME

55

minutes

GRADE LEVELS

Middle School  
(6-8)

CONTENT AREAS

Science



CAREER FOCUS AREA

## POWER, STRUCTURAL, & TECHNICAL SYSTEMS

### Lesson Title

## *Designing Solutions: Careers in Power, Structure, and Technology*

### Standards

- NGSS: MS-ETS1-2 Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- NGSS: MS-ESS3-3 Earth and Human Activity: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- NCDA-7-9-3. Helping pupils understand career applications of subject matter.

### Objectives

1. Students will design an app to help farmers increase their efficiency while monitoring and minimizing their impact on the environment.
2. Students will evaluate solution designs to help farmers be more efficient.
3. Students will identify careers of interest in the Power, Structural, and Technical Systems Career Focus Area.

## Materials

- Access to a computer lab or laptops/tablets for students. One per student is ideal. Alternately, students could complete the activity in pairs.
- Tear sheets or poster paper and markers

## Teacher Preparation

- Visit *AgExplorer* by the National FFA Organization ([www.agexplorer.com](http://www.agexplorer.com)) and preview the careers in the Power, Structural and Technical Systems Career Focus Area.
  - Review the lesson plan and determine if any modifications are required.
- 

## Introduction (Set Context for Activity)

### STEP 1 >> Introduce the Concept of Efficiency

- Ask students to think of an example of someone or something that is very efficient. Ask them why they believe that person or thing is efficient.
- Introduce the definition of efficiency from a systems perspective and write it on the board.
  - Efficiency: Achieving maximum productivity with minimum wasted effort or expense.
- In pairs, have students think about how that definition connects to agriculture. Have them brainstorm and write down their answers to these questions:
  - How do farmers measure productivity (yield)?
  - What are efforts or expenses that farmers try not to waste?
    - Soil—through soil conservation practices like conservation tillage
    - Water—through water-saving techniques like drip irrigation
    - Energy—minimizing passes across the field in tractors
    - Fertilizer—by applying fertilizer just where it is needed with precision-agriculture techniques
    - Pesticides—by using seeds that are resistant to certain diseases
- Have students share out answers until the five main answers listed above are covered. If necessary, supplement student answers with that information.
- Preview the lesson by telling students that they will be using technology and innovation today to help farmers be more efficient so that they can feed the growing world while preserving our natural resources.



## Body (Main Content)

### STEP 2 >> Introduce Power, Structural and Technical Systems Career Focus Area

- Professionals who work in the Power, Structural and Technical Systems Career Focus Area use technology, engineering, hydraulics, pneumatics, electronics and computer systems to help the agricultural industry be more efficient. As technology becomes more complex, it is even more critical that there are trained professionals who can design, build and maintain this technology!

### STEP 3 >> App Development Activity

- Tell students they will be diving into the world of information technology and taking on the role of software developers. Break students into groups of three.
- Instruct students that their task in their group is to design an app that will help farmers be more efficient. Refer to the definition of efficiency and the list of expenses or resources farmers try not to waste. Ensure teams cover the following information while designing their app:
  - What it does
  - How it is used
  - How it helps farmers be more efficient
  - How it helps farmers monitor and minimize their impact on the environment
- Set expectations around time students have to work, depth of thought and creativity. Tell students they will be creating a poster to showcase their apps that will be judged by their peers. The poster should be designed to replicate the preview screens available for apps in the App Store. Have students review preview screens for popular apps to help spur their creativity.

### STEP 4 >> Career Exploration Activity

**Note:** Students will need tablets or computers with access to the Internet for this activity.

- Tell students that while developing software falls squarely on the shoulders of IT software developers, it takes teams of people with a wide range of expertise to help make sure the apps are relevant and correct.
- Tell students that each member of the group is responsible for choosing a career from the Power, Structural and Technical Systems Career Focus Area that could assist them with the development of their particular app.
- Instruct students to visit *AgExplorer* ([www.agexplorer.com](http://www.agexplorer.com)) and select the Power, Structure, and Technical Systems Career Focus Area.
- Tell students that each member of their group needs to pick a different career.
- On their posters, have students capture the three careers their team chose and why they are needed for their particular app. If students need a hint, point them to the career description and responsibilities sections.



## Wrap Up (Review, Assess, Challenge)

### STEP 5 >> Review and Assess Learning

- Set context for the poster evaluation session. Tell students they will be the evaluators of the design solutions created by their peers. Draw a sample scoresheet on the board and have students copy it in their notebooks. It should have a column for the name of the group, a place to rate the solution on the following criteria, and a place to explain their reasoning:
  - Efficiency: Does it help farmers create more yields or save money and resources?
  - Creativity: Does it creatively use technology and innovation to solve a problem?
  - Environmental Impact: Does it help farmers monitor or minimize their environmental impact?
- Each student should be responsible for individually assessing all of the poster design solutions.

### STEP 6 >> Challenge

- Tell students that if working with their hands, thinking about how things work, or designing new technology appeals to them, a career in the Power, Structural and Technical Systems Career Focus Area might be for them!
- Pass out Take-Home Activity sheets and provide further instructions.

### Teaching Notes

The Power, Structural and Technical Systems video on *AgExplorer* can be used as an additional resource to introduce students to careers.

[www.agexplorer.com/focus/power-structural-technical-systems](http://www.agexplorer.com/focus/power-structural-technical-systems)





**ACTIVITY #1 TITLE**

## *Discover, Evaluate and Design!*

**Estimated Time:** 35 minutes

**Content Area:** English Language Arts

**Standard:** Literacy<sup>1</sup>

### **Objective**

1. Students research agricultural technology companies, evaluate their websites and connect it to a career as an IT web developer.

### **Materials**

- Access to computers for students to research

### **Activity Sequence**

1. In pairs, have students research agriculture technology companies online. Students are responsible for finding three companies that work in the field of agricultural technology.
2. Have students prepare and submit a report with the following information:
  - a. A paragraph description of what the company does, properly citing the website
  - b. How the company relates to the Power, Structural and Technology Systems Career Focus Area
  - c. What they find appealing about the layout and design of the website
  - d. What they would change about the layout and design of the website
  - e. A citation list that lists the three websites they used in a standard format
3. If time allows, pairs can share their work.
4. Connect the activity to the career of an information technology web developer. Share the following information about the career:
  - a. Information technology (IT) web developers build and maintain websites to fit the needs of companies or customers.
  - b. The work of a web developer requires layout and writing code.
  - c. They plan, direct and execute measurable and continuous improvements to corporate and regional website HTML5/CSS/JavaScript development and site production, otherwise known as hand code.
5. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

### **Discussion**

*What did you enjoy about this activity?*

*What might be enjoyable about a career as an IT web developer?*

*What other careers in the Power, Structural and Technical Systems Career Focus Area relate to web development?*

- IT analyst, IT specialist, IT programmer, IT software developer, IT configurator, graphic designer, brand manager



## Learn More

- To dig deeper into the featured career, review IT Web Developer on *AgExplorer* ([www.agexplorer.com/career/web-development](http://www.agexplorer.com/career/web-development)).

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### ACTIVITY #2 TITLE

## *AgBots: The Future of Agriculture?*

**Estimated Time:** 50 minutes

**Content Area:** Science

**Standard:** Engineering Design<sup>2</sup>

### Objective

1. Students design a robot that will add automation to the food production or processing industry and connect this to a career as an automation technician.

### Materials

- Poster paper and markers

### Activity Sequence

1. Tell students that they will be working in small groups to design an AgBot! Their robot will add automation to some aspect of the food production or processing sector. Give a few examples of sectors of the industry:
  - a. On the farm, they could add automation to tractors or harvesters.
  - b. Their innovation could apply to the transportation of raw commodities from the farm to the processor.
  - c. It could be related to the processing of commodities such as turning apples to applesauce, or cattle to ground beef patties.
  - d. It could be related to the packaging and distribution of food products.
2. Break students into groups. Set expectations around time students have to work, depth of thought and creativity. Tell students they will be creating a poster to showcase their AgBots that will be judged by their peers.
3. Time allowing, groups can present their posters to the class.
4. Ask students by which criteria the automations should be judged. Come to a consensus on the top three criteria. Have students work in their groups to judge the posters of their peers.



5. Connect activities to the career of an automation technician. Share the following information about the career:
  - a. Automation technicians are responsible for the installation, operation and maintenance of computer and robotic systems used in a variety of agricultural sectors.
  - b. They must be proficient in multiple skill clusters including electricity and electronics, fluid power, mechanical systems and manufacturing processes.
  - c. Automation technicians perform the administration, configuration, design, maintenance, programming and qualification of various systems, while also troubleshooting any issues that might occur.
6. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

### Discussion

*What did you enjoy about designing your AgBot?*

*What is appealing about a career as an automation technician?*

*What other careers in the Power, Structural and Technical Systems Career Focus Area are related to the automation of the agriculture industry?*

- Electrical engineer, electrical technician, hydraulic technician, IT analyst, IT specialist, IT configurator, IT programmer, IT software developer, logistics and supply chain management, maintenance/service technician, mechanical engineer, parts manager, process engineer, supply chain manager, welder

### Learn More

- To review the featured career, review Automation Technician/Coordinator on *AgExplorer* ([www.agexplorer.com/career/automation-technician-coordinator](http://www.agexplorer.com/career/automation-technician-coordinator)).

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### ACTIVITY #3 TITLE

## *Saving Resources and Increasing Profit with Precision Ag*

**Estimated Time:** 50 minutes

**Content Area:** English Language Arts

**Standard:** Reading<sup>3</sup>

### Objective

1. Students read about Global Positioning System technology utilized in precision agriculture and create a diagram or model that shows different uses of the technology.

### Materials

- Paper and markers
- Copies of the article about Agriculture and the use of GPS for each student ([www.gps.gov/applications/agriculture](http://www.gps.gov/applications/agriculture))





## Activity Sequence

1. Instruct students to read the article about the use of GPS technology in agriculture. While they are reading, have students underline or highlight the different ways that farmers utilize this technology.
2. Have students create a diagram or visual that shows four different uses of this technology. They can break a piece of paper into quadrants and diagram a different technology in each quadrant.
3. Have students share their work with a partner and explain what they drew.
4. Connect the activity to the career of precision agriculture specialist. Share the following information about the career:
  - a. Precision agriculture specialists provide support and technical assistance to growers who are using precision technologies on their farms.
  - b. They implement the actual work of grid and contour differential global positioning systems for soil sampling, as well as developing informational and recommendation maps.
  - c. There is an opportunity to work for precision equipment/software providers, agricultural retailers, cooperatives or even extension offices.
5. *Optional homework:* Have students choose a related career and research it on *AgExplorer*.

## Discussion

*What is exciting about precision agriculture technology?*

*What might be enjoyable about a career as a precision agriculture specialist?*

*What other careers in the Power, Structural and Technical Systems Career Focus Area are related to precision agriculture technology?*

- Electrical engineer, electrical technician, hydraulic technician, IT analyst, IT specialist, IT configurator, IT programmer, IT software developer, maintenance/service technician, mechanical engineer, process engineer

## Learn More

- To explore the featured career, review Precision Agriculture Specialist on *AgExplorer* ([www.agexplorer.com/career/precision-agriculture-specialist](http://www.agexplorer.com/career/precision-agriculture-specialist)).
- More information is available about precision agriculture from the USDA's National Institute of Food and Agriculture website (<https://nifa.usda.gov/program/precision-geospatial-sensor-technologies-programs>).

- 1 Common Core: MS-ETS1-1-WHST.6-8.8. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- 2 NGSS. MS-ETS1-2 Engineering Design. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- 3 Common Core: RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph or table).

## Engineering Agriculture!

Step 1. Visit the PBS Learning Media website and check out the Agricultural Engineering video at <http://bit.ly/2cUxexC>.

Step 2. While watching the video, look out for examples of agricultural engineers doing the following and capture the examples below:

- Helping farmers become more efficient and waste less
- Discover new ways to use crops or agricultural products
- Create new technology to create energy

Step 3. What types of agricultural engineers did you see in the video? Star each type you saw and give an example.

### Electrical Engineers

- Responsible for using sophisticated technology to service, install, repair and design electrical systems

### Mechanical Engineers

- Work with the generation, distribution and use of energy
- This could be a part of the control and automation of manufacturing systems, the design and development of machines or the solutions to environmental problems.

### Process Engineers

- Study the production and manufacturing of a product to look at factors like efficiency, quality and safety
- Help measure sustainability and profitability

Check out [www.agexplorer.com/focus/power-structural-technical-systems](http://www.agexplorer.com/focus/power-structural-technical-systems) for more information about becoming an agriculture engineer!





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[www.agfoundation.org](http://www.agfoundation.org)