# Teacher Guide

Middle School Edition, Issue 2
**Science**

## Why Agriculture?

Teaching about agriculture in Iowa is an ideal way for students to learn what their state is all about and provide real-life connections to science, math, and social studies concepts. Agriculture is a topic that students can easily connect to because they encounter it often. Who doesn't enjoy talking about food? Nearly everything we eat, wear, use -- even the fuel that powers the cars and buses we ride in -- comes from plants and animals grown on farms. Agriculture provides perfect real-world connections and makes learning relevant to students.

Helping students understand the farm-to-table connection is important in our consumer-driven society. Teaching students to be agriculturally literate connects their learning to everyday life. That is what the *Iowa Ag Today* series is all about.

## About Iowa Ag Today

*Iowa Ag Today* is a great supplement to your curriculum. Each issue is chock-full of discussion topics, new vocabulary, and other materials that you can easily integrate into lessons. Major highlights of each issue include:

Issue 1: **Culture & Society**
- Economics
- Trade & global impact
- Agriculture through history
- Innovation in agriculture
- Careers

Issue 2: **Science**
- Science and technology
- Sustainable systems for a growing population
- Renewable & non-renewable energy sources
- Careers

Issue 3: **Food & Nutrition**
- Nutrition
- Food safety
- Food processing
- Careers

## Extension Ideas

- Using the Question Formulation Technique™ (QFT), display the phrase "Science and technology can reduce the impact that the growing human population has on the Earth" and have students generate questions about this topic. This process can be used to kick off a unit, prepare for a debate, or as starting point for additional research. An overview of the QFT is found at: https://goo.gl/zj9gVb
- Ask students to create a drawing or other model to show how matter is cycled within a pasture ecosystem.
- Create a list of agriculture businesses in your community and across Iowa. What science-related jobs do they provide?
- Invite a farmer to your classroom to discuss science and technology on their farm (conservation practices, automated systems in animal barns, genetically-modified and hybrid seed, precision agriculture, etc.)
- Use the student page to have students decode the DNA of a turkey. Does the turkey have white or brown feathers?

## Alignment with Standards and Lexile

| Code | Standard Lexile Measure = 940L<br>7th Grade Iowa Core Science Standards |
|---|---|
| MS-PS3-2 | Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. |
| MS-LS1-4 | Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. |
| MS-LS1-5 | Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. |
| MS-LS2-3 | Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem |
| MS-LS2-4 | Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. |
| 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 to the structure and function of the organism. |
| Additional Science Standards | 6th Grade: MS-ESS2-2, MS-LS1-1; 8th Grade: MS-PS1-3; MS-ESS-4; MS-ESS3-4; |

# Glossary

Some words in *Ag Today* may be unfamiliar to your students. These words often appear in bold type. Many are defined in the articles. Words you might wish to review with your students after reading the magazine are:

**sustainability, heredity, genetics, legumes, nitrogen fixation, ethanol, fermentation, distillers grains, ruminant digestive systems,** (pg. 1); **matter, pasture, fertilizers, germinate, ruminant** (pg. 2); **genetics, mutagenesis** (page 3); **eroding, terraces, antibiotics (**pgs. 4-5); **field corn, grain bins, enzymes, starch molecules, distilled, renewable resource** (pg. 6)**; pollination, self-pollinated, cross-pollinated** (pg. 7); **natural selection, artificial selection, dressed, melanin pigments, myoglobin, selective breeding** (pg. 8).

# Discussion Prompters

**Cover** (Science and Agriculture)

1. What will farms look like 20 years from now? List, sketch, and describe your ideas for how crops and livestock might be raised in the future.
    - It is possible that unmanned aerial vehicles (drones) will apply all the fertilizer and pesticides.
    - It is possible that farms will raise insects as alternative sources of protein.
    - It is possible that dairy cattle will be genetically polled (hornless).
    - It is possible that crop yields will have increased because of genetic improvements.

**Student Page 2** (What's the matter?)

1. If you were one nitrogen atom or one water molecule, how many places might you cycle through in a cattle pasture? *(In the air, converted to a different form by lightning. In the soil used by grasses as a nutrient. In the grass, eaten by cattle and turned into amino acids. Undigested grass passed as manure. As manure broken down by bacteria in the field.)*

**Student Page 3** (Genetics)

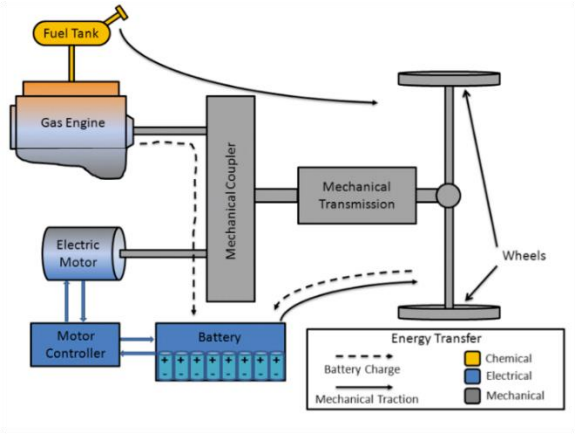
1. What are the methods of genetic modification? *(cross breeding, polyploidy, mutagenesis, protoplast fusion, genome editing, and transgenesis.)*
2. What other factors could influence where crops or livestock are raised? Are all factors environmental, or are some economic? *(Many factors are environmental – day length, temperature, soil, rainfall, etc. Some influencers are economic. For instance, to make ethanol, corn needs to be grown in a 50-mile radius to a processing plant or the cost of transportation will be too high. Pigs, chickens, and cattle are raised in the Midwest because it is close to their major feed supplements, like corn and soybeans.)*

**Student Pages 4 and 5** (Careers)

1. There are more than 300 different career fields in agriculture. What others are you familiar with? *(Visit https://www.agexplorer.com/ to explore more.)*

**Student Page 6** (Corn to Power Vehicles)

1. Can you diagram the transfer of energy in a car engine from piston to wheels?




**Student Page 7** (Plant structures)

1. What are examples of specialized plant structures that vary from species to species? What is their function? *(Taproots like in carrots to store energy. Tubers like in potatoes to store energy. Stolons like in strawberries to reproduce asexually. Rhizomes like in grasses to reproduce asexually. Bracts like in poinsettias used in conjunction with the true flower. Thorns like on a rose to protect the plant. Bark like on a tree to protect the plant.)*

**Student Page 8** (Birds of a Different Feather)

1. What other domestic and wild animals have color differences? How are the color differences beneficial or harmful to the animal? *(Wild pigs are usually black or brown as camouflage in the forest. Domestic pigs are often light colored. Wild geese are usually brown, black, or grey. Domestic geese are usually white.)*

# Show what you know - Key

1. The industry provides food, clothing, shelter, and fuel from plants and livestock.
2. Meeting the needs of the present without compromising the needs of the future. Sustainable practices must consider environmental, economic, and social needs.
3. Improved genetics in livestock; producing ethanol, a renewable fuel, by fermenting corn; using by-products of ethanol production for cattle feed.
4. Organic matter (manure, decayed plants, etc.) provides nutrients for grass in the pasture to grow. Cattle eat the grass to produce meat for us and manure that returns to the pasture.
5. Corn, soybeans, pork, eggs, and ethanol.
6. Soil conservationist, product engineer, agricultural engineer, animal science professor, geneticist, etc.
7. A biofuel made from high starch plants, like corn. It is used in cars and other gasoline engines.
8. False: Corn is wind pollinated and soybeans are self-pollinated.
9. Brown feathers provide camouflage, but turkeys with brown feathers have darker skin with brown spots, which is not desirable to consumers.

# Decoding DNA - Key

1. Arginine, Threonine, Leucine, STOP
2. White feathers

Name: _____ Circle one: **Pretest** **Post-test**

# Show what you know!

Take this short quiz before you read Ag Today, then again after reading the magazine.

1. What human needs does the agriculture industry help meet and provide for?

2. Define sustainability. What are the three components of sustainability that farmers must consider?

3. Name one way that science and technology has improved the agriculture.

4. Give an example of how matter is changed and redistributed in a pasture.

5. Iowa usually ranks number one in the production of 5 agricultural products. Name 3 of them.

6. Name and describe a science-related career in agriculture.

7. Define and describe ethanol.

8. True or False: Corn and soybean flowers are pollinated by insects.

9. Why are brown feathers beneficial to wild turkeys? Why do most turkeys raised domestically for meat have white feathers?

Name: _____

# Decoding DNA

*You have a short DNA sequence of a turkey. Using this information, find out if it has white feathers or brown feathers.*

Each group of three nitrogenous bases is a **codon**. It codes for one amino acid. Match the codons up with the amino acid and compare the amino acid sequence to the key below to determine the color of your turkey.

A turkey with white feathers has the amino acid sequence **arginine, threonine, leucine, STOP.**

A turkey with brown feathers has the amino acid sequence **arginine, threonine, phenylalanine, STOP.**

Your turkey:
CGC ACC CTT TAG

| Amino Acid | Possible DNA Codons |
|---|---|
| Leucine | CTT, CTC, CTA, CTG, TTA, TTG |
| Phenylalanine | TTT, TTC |
| Alanine | GCT, GCC, GCA, GCG |
| Threonine | ACT, ACC, ACA, ACG |
| Arginine | CGT, CGC, CGA, CGG, AGA, AGG |
| Glutamine | CAA, CAG |
| STOP | TAA, TAG, TGA |

1. What is the amino acid sequence of your turkey?

2. Does your turkey have white or brown feathers?

3. Design a sequence of DNA different from the one above. Give your designer turkey white feathers.

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