Sorghum Research

Suggested Grade Level: 9-12

Time: 3-5 45-minute classes

Subject: English

Overview:
This lesson includes a group research component. Students work in pods of four to create a poster presentation on the uses of sorghum and its economic impact on the Kansas economy. Each group gathers information, analyzes data, and presents findings to the class.

Objectives:
1. Conduct quality research
2. Cite sources as required
3. Collaborate to deliver a poster presentation
4. Describe the uses of sorghum
5. Explain the economic impact of sorghum production in Kansas

Background Information:

Sorghum is a member of the grass family that grows wild in tropical and subtropical regions of the world. It is recognizable by its distinctive white-to-brown flower head. Sorghum is a tall plant, reaching heights of three to six (sometimes sixteen) feet. Depending upon the variety, it can be annual or perennial (Masats).

Farmers have been cultivating sorghum since around 8,000 B.C in Africa. This is because sorghum thrives in hot, dry climates, making it popular in the Sorghum Belt. That is, from South Dakota to southern Texas. Straight in the middle of the Sorghum Belt, Kansas is the largest sorghum producer in the United States, with an average of 3 million acres harvested. Following Kansas is Texas, with 1.8 million acres; Colorado, with 370 thousand acres; Oklahoma, 305 thousand acres; and South Dakota, 210 thousand acres. Sorghum is highly versatile and can be applied to various industries. Currently, sorghum supports the export, livestock feed, ethanol, pet food, and food industries the most. Exports are the primary driver for the sorghum industry at present. Countries such as Mexico, China, and Japan have used sorghum for livestock feed, food, and ethanol production. In the livestock industry, sorghum is used in feed rations for poultry, beef cattle, dairy cattle, and swine. Furthermore, almost one-third of U.S. sorghum is used for ethanol! It is interchangeable with corn and produces the same amount of ethanol per bushel. Approximately one-third of the grain used in ethanol production is subsequently used as distillers' grains, a high-nutrient livestock feed.

Finally, sorghum has recently seen some popularity in the food industry. Crucially, sorghum is composed mainly of starch and does not contain gluten. Additionally, sorghum is high in fiber and antioxidants, high in protein, iron, vitamin B6, niacin, magnesium, and phosphorus, and provides energy from 75% complex carbohydrates. These health benefits make sorghum popular for those seeking a healthy energy boost without gluten. Notably, sorghum is now found in more than 350 food products in the United States alone (Sorghum).

Kansas Connections:

Kansas accounts for 50% of the United States' grain sorghum production. Grain sorghum production in Kansas started in the early 1900s at the Kansas State University Agricultural Research Center in Hays, Kansas. It sold the first variety of grain sorghum in 1909. Around 1920, researchers developed shorter plants that could be harvested by combining rather than cutting, bundling, and threshing by hand. They also created grain sorghum varieties with different maturity rates (Kansas). This was important in Kansas due to the state's varied growing seasons. One advantageous characteristic of sorghum is that it can dry out after it has begun seed production and stall; when it rains, it can resume growth and complete seed production. A single plant can produce more than one stalk. Each stalk produces a single head, and 750 to 1,250 seeds form on the head (Kansas). The grain is ready for harvest when the seeds ripen and harden.

In Kansas, grain sorghum is harvested in the fall, between September and the end of November. However, the plant remains green and alive after producing grain until it is killed by freezing temperatures, tillage, or herbicides. Although grain sorghum is the predominant sorghum grown in Kansas, the state also produces other types of sorghum. Grassy sorghums, like sudangrass, are grown for feed and hay. Sweet sorghums are also grown to make sorghum syrup and molasses. Another type of sorghum, broomcorn, is grown for the branches and fibers of the seed clusters. It differs from other sorghums in that it produces heads with fibrous seed branches that may be as much as 36 in. long, which can be used to make whisk brooms.

Kansas is historically an agricultural state. Manufacturing and services have surpassed agriculture as sources of income, but farming remains crucial to the state's economy, and Kansas ranks only behindTexas and Montana in total agricultural acreage. Kansas produces $1.2 billion in sorghum annually. The grain sorghum industry employs almost 5,000 Kansans, and Kansas produces more grain sorghum than any other state in the country. Farmers plant approximately 2.6 million acres of sorghum annually for flour, biofuels, pasta, baked goods, molasses, syrup, and as a popped snack (Kansas). The Kansas Grain Sorghum Commission (KGSC) is dedicated to advancing the sorghum industry through targeted research, market development, and promotional efforts, both domestically and internationally. According to the KGSC's 2024 Annual Report, Kansas producers harvested approximately 2.8 million acres of sorghum, achieving an average yield of 65 bushels per acre. In recent years, the Kansas sorghum industry has contributed an economic impact estimated at billions of dollars, underscoring its role as a vital component of the state's rural economy and theglobal grain supply (About).

Materials:

- Five or more stalks of sorghum, enough for one per group
- Poster paper or the equipment to print a poster
- iPads or computers for research

Instructional Format:

1. Review background information.
2. Lead a class discussion.
3. Complete the activity.
4. Conduct an assessment activity.

Start Teaching Here

Engagement:

Share this 8.57-minute video with the class.

20.9 Billion Pounds Of Sorghum: How American Farmers Revolutionize Harvesting

Ask Students: What are the uses of sorghum? Are there different types of Sorghum?

1. Group students in pods of three or four. Place one sorghum stalk in each group.
2. Ask students to examine the grain and discuss within their group what they already know about sorghum (where it grows, what it is used for, etc.).

Review with students the uses for sorghum and explain that grain sorghum is primarily used as a cereal grain and feed grain, as well as for ethanol production.

Activity:

1. Student groups or pods will create a poster presentation. The class could use this presentation opportunity to teach a younger group of students and/or display their posters at the school for others to see (you could combine this project with a poster competition). You could use mini-lessons to provide instruction on preparing the project, such as learning the vocabulary, conducting a quick search, refining a search, taking notes, keeping references, citing sources, editing, working as a group, and supporting each other's work.
2. Provide students with technology to conduct research and ask them to explore the uses and production of sorghum in Kansas.
3. Each student in the group will be responsible for researching one way to utilize sorghum and incorporating the information into their group project. Students can choose from the following questions:
    - Where is sorghum produced in Kansas, and what is the value?
    - What products are Kansas sorghum used for?
    - How does the sorghum produced in Kansas contribute to the Kansas economy?
    - What are the main sectors of the Kansas economy?
4. As a group, the students will create a poster presentation.
    a. Review the assignment
    b. Assign group roles
    c. Research the topic
    d. Develop a clear message (decide on a title and 2-4 main points)

    e. Plan the poster layout
    f. Write and edit the content
    g. Practice the presentation
5. Plan a schedule for student presentations
6. As students listen to the presentations, they should be able to answer the following questions.
    - What are some uses of sorghum?
    - Why is sorghum important to Kansas?
    - How does sorghum contribute to the Kansas economy?

Vocabulary:

- **Sorghum:** A widely cultivated cereal native to warm regions of the Old World. It is a significant source of grain and feed for livestock, although some varieties are used for flour production.
- **Awn:** a stiff bristle, especially one growing from the ear or flower of barley, rye, and many types of grass.
- **Tillering:** the production of lateral shoots by a plant, especially grass or cereal plants, from the base of the stem.
- **Glume:** each of two membranous bracts surrounding the spikelet of a grass (forming the husk of a cereal grain plant) or one covering the florets of a sedge.
- **Panicle:** a loose branching cluster of flowers, as in oats. A stiff bristle, especially one growing from the ear or flower of barley, rye, and many types of grass.
- **Third-world countries:** countries with high poverty rates, a lack of resources, and unstable finances.
- **Economy:** The process or system by which goods and services are produced, sold, and bought in a country or region, contributing to the area's wealth.

Career Information: Research Technician
A research technician works in a laboratory setting (which includes field or farm work) to assist a research scientist. They could research sorghum, wheat, corn, livestock, and other relevant topics. Research technicians commonly operate and maintain laboratory equipment, record and input laboratory data, assist in seeding and harvesting crops, identify damage caused by pests and diseases, and provide crop treatments. Research technicians typically require a bachelor's degree in agronomy, horticulture, animal science, poultry science, aquaculture, or laboratory technology. They often work at universities or for seed, animal health, or pharmaceutical companies.

Assessment:
A daily formative assessment will help students stay on track. These may include an exit slip, a teacher check-in with each student, a list of group accomplishments, observations, student notes, and related materials. Informing students at the beginning of class about the type of assessment helps them be more productive.

A rubric could be used to assess student projects. Find rubric templates at Rubistar, PBL checklist, or RubiMaker. There are also customizable rubric makers and premade rubrics available online.

Kansas Standards:

Language Arts

9th-10th Grade

RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
RI.9-10.2 Determine a central idea of a text and analyze its development over the course of the text; provide an objective summary of the text.
RI.9-10.3 Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed and the connections that are drawn between them.
RI.9-10.7 Analyze various accounts of a subject told in different mediums, determining which details are emphasized in each account.
RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.
RI.9-10.9 Analyze documents of historical and literary significance, including how they address related themes and concepts.
SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9-10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.
SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats evaluating the credibility and accuracy of each source.
SL.9-10.3 Evaluate a speaker's point of view, reasoning and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.
SL.9-10.4 Present information, findings and supporting evidence clearly, concisely and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and task.
SL.9-10.5 Make strategic use of digital media in presentations to enhance understanding of findings, reasoning and evidence and to add interest.

11th-12th Grade

RI.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
RI.11-12. 2 Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.
RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas or events interact and develop over the course of the text.
RI.11-12.7 Integrate and evaluate multiple sources of information presented in media or formats as well as in words in order to address a question or solve a problem.
RI 11-12.8 Delineate and evaluate the reasoning in seminal U.S. and world texts, including the application of constitutional principles and use of legal reasoning and the premises, purposes and arguments in works of public advocacy.
RI.11-12.9 Analyze foundational documents of historical and literary significance for their themes, purposes and rhetorical features.
SL.11-12.1 Initiate and participate effectively in a range of collaborative discussion (one-on-one, in groups and teacher-led) with diverse partners on grades 11-12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.

SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
SL.11-12.3 Evaluate a speaker's point of view, reasoning and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis and tone used.
SL.11-12.4 Present information addressing opposing viewpoints and using supporting evidence, clearly, concisely and logically for a specific purpose, audience and task.
SL.11-12.5 Make strategic use of digital media in presentations to enhance understanding of findings, reasoning and evidence and to add interest.

National Agricultural Literacy Standards:
Agriculture and the Environment
- Discuss the value of agricultural land (T1.9-12 d.)

Plants and Animals for Food, Fiber, and Energy
- Discuss reasons for government's involvement in agricultural production, processing, and distribution (T2. 9-12 c.)

Food, Health, and Lifestyle
- Identify how various foods can contribute to a healthy diet (T3.9-12 g.)

Science, Technology, Engineering and Mathematics
- Provide examples of how processing adds value to agricultural goods and fosters economic growth both locally and globally (T4. 9-12 g.)

Culture, Society, Economy, and Geography
- Compare and contrast the economic challenges facing developed and under-developed countries (poverty, population, and hunger) (T5.9-12 c.)

Companion Resources:
Sorghum Fun Facts Poster,
Grain Sorghum Growth Stages,
Grain Sorghum Plant Part Labeling,
Kansas Connections Sorghum Magazine Connection
Sorghum Byproducts Poster
Exploring Economic Sectors

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