KANSAS CORN STEM

Kansas Corn: Water Quality

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KANSAS CORN COMMISSION

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Kansas Corn: Water Quality
Grade Level: Middle School

Overview
Water is an important commodity in the American culture. The U.S. Department of Agriculture estimates that agriculture accounts for approximately 80 percent of the nation's water use. In agriculture, water is used to grow fruits, vegetables and crops as well as raise livestock. Even further, water in agriculture is used for irrigation and the application of pesticides and fertilizers. In Kansas, 29 percent of corn acres are irrigated.

Maintaining good water quality is something farmers strive for to help maintain a healthy ecosystem and to preserve the water that we drink. Farmers practice proper natural resource management to meet domestic water quality standards. Cooperation between agriculture and domestic water users is necessary to provide adequate water quality for both parties.

In this lab, students will test water quality from difference sources of water. This lab is best suited to be delivered right after the Soil Erosion Lab. Preventing soil erosion is the number one way that Kansas farmers can protect from fertilizers and pesticides getting into the water supply. Farmers are not the only ones who impact water quality in our communities. Consumers, businesses and industries can also impact water quality. Fertilizer and pesticides could all be applied on golf courses, lawns and parks and all have an impact on water quality. This lab is designed to get students thinking about how

Kansas College and Career Ready Standards
Science
- **MS-LS2-1.** Analyze and interpret data to provided evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- **MS-ESS2-2.** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- **MS-ESS3-1.** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

English
- **W.7.1.** Write arguments to support claims with clear reasons and relevant evidence.
- **W.7.10.** Demonstrate command of the conventions of Standard English grammar and usage when writing.
- **W.8.1.** Write arguments to support claims with clear reasons and relevant evidence.

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Learning Objectives
- Students will construct a scientific explanation, based on evidence, for how the uneven distributions of groundwater resources are the result of past and current geoscience processes.
- Students will analyze data on how management practices can impact the quality of surrounding groundwater.
- Students will plan and conduct an investigation of the properties of water and its effect on Earth's materials and surface processes.
- Students will research ways farmers are protecting water supplies by controlling the amount of soil runoff.

Materials
- Water Quality PowerPoint (available at www.kansascornstem.com)
- 6 canning jars for storage of water samples (1 jar per lab group)
- Water samples from different sources (you can obtain samples from a local lake, pond, park, faucet, etc.)
- Total dissolved solids, temperature, and electrical conductivity meter (1 kit per group)
- Leaf Luster testing kit (1 kit per group)
- Bacteria Test Strips

Procedures for Instruction
Length of Time for Preparation: 1 day
Gather your materials for each lab group. Obtain a water sample for each lab group. You can either have them test the same water sample to check for accuracy or you can have each lab group test a different sample and share their results with the class.

Length of Time for Classroom Teaching: 1-2 days
- Day 1: Students perform lab through observations, record data and comparisons.
- Day 2: Lab review and report.

Background Information
For this lab, we will test water supplies from various locations looking for key deficiencies or overabundance for potassium, phosphorus, nitrogen, pH, total dissolved solids and electrical conductivity.

Electrical conductivity (EC) will show the presence of salts in the water. The higher the salt content, the higher the conductivity reading. An EC test can provide results indicating growth damage due to nutrient deficiencies and lower water uptake by the crop.

Total dissolved solids (TDS) is a measure of all the dissolved substances in water. This is usually closely related to

EC levels and has the same plant growth problems as EC.
Potassium is important for the strength of the plant. It helps to promote protein synthesis inside the plant. High levels of potassium in water may indicate contamination from fertilizer runoff.

Phosphorus plays a major role in plant genetics and seed development. Elevated levels in water indicates fertilizer runoff and can also deter other nutrients from functioning properly.

Nitrogen is directly responsible for leaf production and color. The presence in water for irrigation can be beneficial but must be regulated into the fertilizer program for the crop. Fertilizer runoff is the main source of nitrogen in the water and can be a concern for both human and animal consumption.

pH measures the acidity and alkalinity of water. The correct pH is vital to the growth of plants as it controls the utilization of nutrients. pH levels that are too high can cause serious deficiencies in vital nutrients needed for optimal growth and development.

Bacteria Test Strips mark the presence of bacteria in your sample such as E. coli, Psuedomonas, Species of Shigella, and other forms forms of coliform bacteria. This is only for the presence of bacteria not to determine which type is present. If you have a positive test, you could try an culture depending on the level of your students.

Farmers and ranchers work hard to ensure they have a successful crop by reducing potential pollutants and decreasing the availability of:

- soil to become sediment, primarily through the use of agronomic practices, such as cover crops, residue management, and rotations that include close-grown crops;
- nutrients for transport, by accounting for all nutrients available, regardless of source, method of incorporation, and application rate and timing; and
- pesticides through integrated pest management, including crop rotations, cultivation, biological pest control, scouting, and selecting pesticides that are more environmentally friendly as well as through reducing the use of pesticides in their operations.

Classroom Discussion

Pre-lab Questions

Introduce the topic and assess students for prior understanding. Let students discuss their ideas, and guide the discussion without telling them if they are right or wrong.

Our job is to investigate the water quality of the source of water collected.

- Why is the quality of water important?

- What do you do to preserve good water quality?
- How about your community? What practices are used to preserve water quality?
- Why would farmers improve their management practices to preserve water?
  - Note that farmers not only want to preserve water quality, but they want to keep the fertilizer and pesticides that they apply to the field on their field as it cost a lot of money to apply. Also, farmers are regulated and have to watch their management practices to preserve our water quality and environment.

Procedure for Lab

Station Setup

1. Gather water samples from various sources. Label each source for accuracy. You can call a local farmer or rancher to have access to a water source, if needed.
2. You can have each lab test a different source and report to the rest of the class their findings or have every group test the same sources for accuracy.

Perform the Lab

1. Take the lid off of your first sample.
2. Turn on the TDS/EC/TEMP meter and put the probe side of the meter into the sample. When the ppm unit starts flashing, push the on/off button once. This will hold the reading on the screen. Record your TDS reading in your lab book.
3. Push the mode button once to switch to the EC reading. Record this number in your lab book.
4. Push the mode button again and record the temperature in Celsius in your lab notebook. (Note: If you push the mode again it will give you the Fahrenheit reading.)
5. Get the pH test comparator. Cut the top off of the green pH capsule (be careful as the powder will fall out) and put the powder in the left compartment. With your pipette, add water to the fill line. Put the cap on tightly and shake the solution. Let it sit for about a minute and then record your findings in your lab book.
6. Get the nitrogen test comparator. Cut the top off of the purple nitrogen capsule (be careful as the powder will fall out) and put the powder in the left compartment. With your pipette, add water to the fill line. Put the cap on tightly and shake the solution. Let it sit for about a minute and then record your findings in your lab book.
7. Get the potash test comparator. Cut the top off of the orange potash capsule (be careful as the powder will fall out) and put the powder in the left compartment. With your pipette, add water to the fill line. Put the cap on tightly and shake the solution. Let it sit for about a minute and then record your findings in your lab book.
8. Get the potassium test comparator. Cut the top off of the blue potassium capsule (be careful as the powder will fall out) and put the powder in the left compartment. With your pipette, add water to the fill line.

Put the cap on tightly and shake the solution. Let it sit for about a minute and then record your findings in your lab book.

9. Open the foil pack of the Bacteria Test. Using a clean pipette, place exactly ONE pipette full of your water sample into the test vial. Gently swirl the vial and let stand for 5 minutes. Swirl vial again and return vial to flat surface. Place a test strip into the sample with arrows pointed down. Wait 10 minutes. Reddish lines will appear on the test strip. Read a reddish line at numbers 1 and 2 is a positive test. A reddish line at line 2 only is a negative test. No line means the test was invalid.

Lab Analysis

Post-lab questions

Do a Google search to find out what the optimal water quality for your water source should be. This will vary depending on the purpose of your water supply.

- What do results of the testing of pH, dissolved solids, nitrates and phosphates tell us about the health of a source?
- What ideas do you have that would help improve the quality of water for that water source location?

Research Agriculture Water Quality Management Practices

- Buffer strips
- No till
- Cover crops
- Variable application rates

Click on the link to watch a video on how water quality is important for the applications of the vital nutrients and why farmers are working hard to help prevent any loss of nutrients to water runoff. https://h2knowlearning.org/sections/agricultural-research-and-management-practices/

- What are some of the best practices that farmers are using to help maintain the quality of our water supplies?

Take it further

Make plans to outline what you would do to help fix and/or maintain the optimal water quality for your source. Use Google Slides to create a presentation outlining your suggested plan for your water source. This is an opportunity for students to think about how they and their communities can work harder to preserve water quality.

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Teacher Resources
Visit www.kansascornstem.com for a video to assist with this lab.

Reflection and Conclusion
Have students reflect on the observations they made in the lab.

- How can you play a role in preserving water quality?
- What did you learn about agriculture water quality management practices?
- What surprised you the most about your lab findings?

Science and Agriculture Careers
- Agricultural inspector
- Agricultural specialist
- Water quality specialist
- Crop production specialist

To learn more about agriculture careers, visit www.agexplorer.com. You can also find career profiles at www.kansascornstem.com.

Any educator electing to perform demonstrations is expected to follow *NSTA Minimum Safety Practices and Regulations for Demonstrations, Experiments, and Workshops*, which are available at http://static.nsta.org/pdfs/MinimumSafetyPracticesAndRegulations.pdf, as well as all school policies and rules and all state and federal laws, regulations, codes and professional standards. Educators are under a duty of care to make laboratories and demonstrations in and out of the classroom as safe as possible. If in doubt, do not perform the demonstrations.