MNLA Curriculum Unit C, Lesson 4

UNIT TITLE: Water in the Landscape

LESSON 1: Rain Sensors- Turn off the Sprinkler When It's Raining - It's the Law; 30-40 minutes

MINNESOTA ACADEMIC STANDARDS IN SCIENCE:

3.1.1.2.4 Scientific inquiry is a set of interrelated processes incorporating multiple approaches that are used to pose questions about the natural world and investigate phenomena.

3.1.3.2.2 Men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry.

4.3.4.1.1 In order to improve their existence, humans interact with and influence Earth systems.

MINNESOTA ACADEMIC STANDARDS IN MATH:

3.4.1.1 Collect, organize, display, and interpret data. Use labels and a variety of scales and units in displays.

4.1.1.2 Demonstrate mastery of multiplication and division basic facts; multiply multi-digit numbers; solve real-world and mathematical problems using arithmetic

4.1.1.3 Demonstrate mastery of multiplication and division basic facts; multiply multi-digit numbers; solve real-world and mathematical problems using arithmetic

4.2.2.1 Use number sentences involving multiplication, division and unknowns to represent and solve real-world and mathematical problems; create real-world situations corresponding to number sentences.

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GRADE LEVEL/SUBJECT: 3 -4 Science; 3-4 Math

OVERVIEW: This lesson will expand and/or reinforce third and fourth grade students' knowledge of strategies to conserve and use water wisely. This lesson also reinforces the students' ability to calculate area and acquire information from a table.

OBJECTIVE:

Students will be able to:

- Calculate the area of a lawn
- Explain the importance of using rain sensors with sprinkler systems
- Read a table to determine how much water is used to water a specific area

MATERIALS:

- various sprinkler heads to show students
- rain sensor to show students
- a gallon milk jug half full of water and an empty pail for discarded water
- a plastic liquid measuring cup
- a clear 8" x 8" baking dish
- ruler

ACTIVITIES AND PROCEDURES:

1. Introduce yourself and briefly tell what you do. Use the titles of your position and those of your colleagues to provide students with a vision of career opportunities. Suggest that some of them may want to become a specialist like you when they get older. Explain that an important part of your work is to help people use water wisely. You are going to share some information with them about the importance of irrigation and using water wisely so it is not wasted.

2. Ask students why water is important on Earth. Provide hints if necessary. Write a list on the board. Look for student comments to include:

   - water is needed for humans, animals, and insects to survive
   - water is needed for plants to grow, including food crops and landscape plants that hold the soil in place and help to use up the carbon dioxide in the atmosphere
   - clean water is essential for the health of lakes and rivers and all aquatic life
   - water is used to manufacture things including plastics, paints, soaps, cosmetics, fabrics, etc.

3. Write the word IRRIGATION on the board and ask students to define it. Summarize their comments by suggesting *that irrigation is when humans decide that the plants do not have enough water to grow and some mechanical method is used to provide water to the plants*. Ask students to provide examples of what humans use to water plants. Be sure they mention: a watering can for house plants, a garden hose for outdoor plants, sprinklers on the lawns and gardens and big sprinklers on fields for crops.

   Show the students various examples of sprinkler heads to stimulate their interest and to help them visualize the concept of irrigation. Explain that because we cannot control when it will rain; irrigation is critical to make sure that plants have the water they need in order to stay alive. Ask students what would happen if the plants didn't get the water they need. Be sure the students understand that without irrigation many plants could die, the amount of food produced would be lower and there would be more soil erosion. The presence of plants is also important in keeping people feeling happy.

4. Explain that when irrigation water gets to the soil where the plants are growing, the water helps the plants to grow better. However, when the irrigation water lands on the sidewalk or street instead of the grass, that water is being wasted. Explain that irrigation specialists plan where the sprinklers should go so that the water goes on the plants only. Good irrigation systems planned by professionals don't waste water.

   Ask students to raise their hands if they've ever noticed sprinklers running when it's raining. Ask the students if they think the sprinklers need to come on when it's raining. Show the students a rain sensor and describe how the sensor can tell if it is raining outside. The sensor will not let the sprinklers run if it is raining. Explain to students that in the state of Minnesota it is the law that all new sprinkler systems must have a rain sensor installed. This law helps everyone save water by watering only when it does not rain enough. Some old systems that were installed before the law was passed may still not have rain sensors on them, but all the new systems must have them. It is possible, and even encouraged, to add rain sensors to the older systems to help save water.

5. Ask students why it is important to save water. Below are other facts that you may want to add.
   - there is a limited supply of clean water on earth
   - only 3% of the earth's water is fresh water and only about 1% is available to people via rivers, lakes and aquifers
   - according to the U.S. Environmental Protection Agency's Water Sense program, the average person in the U.S. uses 100 gallons of water per day
   - many people in the world do not have access to enough fresh water

6. Tell the students that they can calculate how much water is saved every time the sprinkler does not come on when it is raining. Describe how most sprinklers will provide 1/2" of water to the lawn if they are allowed to run for a full hour.

   Ask for one student to come and help you demonstrate how much water that is. Measure and pour 2 cups of water into an 8" X 8" clear baking dish. Have the student hold the ruler in the water to measure the depth. State that this is what a 1/2" of water would look like over the surface of the lawn if it was put on all at once. The sprinkler will put that same amount of water on every part of the lawn, but it will take one hour.

   Tell students that the roots of the grass grow in the top 2-3" of the soil. Ask students how deep they think the water needs to go into the soil each time the grass is watered in order to get all of the roots watered. Then, tell students that at least 1/4" of water is needed to wet the entire root zone. Therefore, many sprinklers may only need to run for 30 minutes at a time. Emphasize that irrigation specialists need to understand soil, plants, water and math in order to install sprinkler systems properly.

7. Ask students how to calculate the area of a rectangle or square. If they don't understand or remember how to calculate area, ask them to look at the top of their desks and think about the length and width. How would they determine the area of their desktop? Review that Length X Width = Area.

Hand out the rain sensor worksheet. Follow the steps below to find out how much water would be saved by using a rain sensor:

1. Determine or verify how much water the sprinkler is delivering every hour. (Make reference back to the dish of water) Common in the industry is 1/2" of water every hour which is what will be used for these calculations.
2. Calculate the area (square feet) of the lawn (length X width)
3. Using the table on the worksheet, look up how many gallons of water would be used to cover that amount of lawn with 1/2" of water. This is the number of gallons of water that would be saved every time it rained and the sprinkler did not come on.

Have students work on the worksheet with a partner or individually. Check with the teacher to see what would work best. Read the first problem together and ask students what they need to do in order to solve the problem. Challenge students by encouraging them to try the bonus questions when they complete the two questions in the problem set. Move around the room to assist students while they are working. If time remains, correct/discuss the answers on the worksheet together as a class.

**Note to Instructors*: The table is based on 0.04 ft = 1/2" of water delivered per hour. Multiplying 0.04ft by the square footage of the area equates to 40 cu ft of water per hour per 1000sq ft.

1000 sq ft area of lawn x 0.04 ft. of water = 40 cu ft. of water used

There are 128 oz in one gallon, therefore:

40 cu ft. = 38,300 ounces = 299.22 gallons which was rounded to 300 gallons

Extension / Optional Activity:

Ask students for other ideas about things they can do to save water in their everyday lives. Write the list on the board. Encourage students to make a record of every time they use water in the next 24 hours.

Several internet sites have great lists of water saving facts. For example, National Geographic has numerous tips and facts about water conservation and how much water is used per person or activity at:
http://environment.nationalgeographic.com/environment/freshwater/water-conservation-tips/

ASSESSMENT:

Students will complete the Rain Sensor Worksheet

HANDOUTS AND WORKSHEETS:

Worksheet: "Don't Waste Water -- Turn Off the Sprinklers When It's Raining!!!"

Don't Waste Water:

Turn Off the Sprinklers When It's Raining!!!

Calculate how much water can be *saved* by using a rain sensor on a sprinkler system.

Sarah's sprinkler delivers 1/2" of water on her lawn every hour. Her front yard is 25 feet wide and 80 feet long. It rained for an hour on Tuesday when the sprinkler would have normally watered the grass. Because there was a rain sensor on her sprinkler system, the sprinkler did not turn on when it rained. How much water did Sarah save on Tuesday?

a. Calculate the area of Sarah's lawn. ***Answer:*** Sarah's lawn is _____ square feet.

b. Use the table to find how many gallons of water Sarah's sprinkler used when watering her lawn for one hour.

Answer: Sarah's sprinkler uses _____gallons of water every time it waters the lawn for one hour.

c. How many gallons of water did Sarah save on Tuesday when it rained and the rain sensor prevented the sprinkler from turning on?

Answer: Sarah saved _____ gallons of water on Tuesday because she had a rain sensor.

Jason's sprinkler delivers 1/2" of water on his lawn every hour. His back yard is 100 feet wide and 50 feet long. Because there was a rain sensor on his sprinkler system, the sprinkler did not turn on last Wednesday when it rained for an hour. How much water did Jason save last Wednesday because he had a rain sensor?

a. Calculate the area of Jason's lawn. ***Answer:*** Jason's lawn is _____square feet.

b. Jason's sprinkler uses _____gallons of water every time it waters the lawn for one hour. (Use the table)

c. Jason saved _____ gallons of water on Wednesday because he had a rain sensor.

Gallons of Water Used Per Hour by a Lawn Sprinkler*

Square Feet of Lawn	Gallons of Water the sprinkler delivers per hour
1000	300
2000	600
3000	900
4000	1200
5000	1500
6000	1800
7000	2100
8000	2400
9000	2700
10000	3000

* Sprinkler delivers 1/2" of water on the lawn per hour

Bonus Problems:

1. **How much water did Sarah and Jason save altogether?**
2. **How much water would Sarah save if her sprinkler system was on for 30 minutes instead of one hour each time she watered?**
3. **If Jason and all of his 16 neighbors saved the same amount of water on one day, how much water would the neighborhood save?**
4. **Estimate how much water would be saved in one rainfall if the sprinkler system for the lawn where you live had a rain sensor.**