

Grade Level: 4

Title: What's with the Water? (Aug. - Oct.)

Purpose:

The purpose of this lesson is for students to develop an understanding of how water is necessary for plant survival.

Subject Area(s) Addressed:

ELA, Math

Common Core/Essential Standards:

ELA

4. ELA. RIT.3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

4. ELA. RIT.9. Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

4.ELA.W.8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

4.ELA.SL.3. Identify the reasons and evidence a speaker provides to support particular points.

Math

4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Vocabulary:

dripline
drought
erosion

flooding
irrigation
pivot

Materials Provided:

“Strawberry Field” photo (at end of this lesson)
Farm/irrigation/erosion photos (see Photos folder)

Materials Needed:

small samples of dripline (A sample may be available from your local farmer; sample also available from the NC Strawberry Association; see the file "Suggested Resources for NCSI" in the "Resources" folder.)
drinking straws
sharp object for punching holes in straws (adult use only)
cups
soil
modeling clay
droppers
paint pans
water
Internet access
science notebook/journal

Teaching Strategy:

Part 1:

Show students the picture at <http://ga.water.usgs.gov/edu/pictures/irrigation.jpg> or http://water.usgs.gov/ogw/gwrp/images/photos/cent_pivot_corn1.jpg.

Some students may have seen the "giant sprinklers" in the fields at some point. Ask students, "What is going on in this picture?" "Why is this necessary?" Allow students to discuss the concept of irrigation. They should determine that irrigation is necessary in NC during times of drought or too little rain. Take time to discuss drought conditions and the impact it has on crops. Students can learn this by observing an un-watered plant for a period of time. They will see the plant eventually die and the soil become dry and "dusty."

Share with students that strawberry farmers mostly use this type of irrigation – overhead irrigation -- for two purposes: (1) to help set the plants and (2) for frost protection, though they do not use the central pivot irrigation systems shown in the photos above. (There is a lesson on Weather – including Frost Protection - in the 5th grade curriculum.) Show pictures of each using:

- setting plants:

<http://flastrawberry.com/wp-content/uploads/2012/10/Watering-the-Strawberries.jpg>

- frost protection:

<http://ncstrawberry.files.wordpress.com/2013/04/frostprotectionhallfamilyfarm2013-2.jpg>

There are also pictures of newly set strawberry plants and irrigation in the "Photos" folder in the subfolder "Irrigation and Erosion".

Next, tell students they are going to learn about another type of irrigation that occurs underground. The teacher will use a small sharp object, such as a needle or thumbtack to punch holes, about 1/2 an inch apart, in a drinking straw. The teacher will need to prepare these ahead of time. Ask students to observe the

straws. They should see that the straws have holes in them. Next, tell students to place a piece of clay on one end of the straw and then insert the straw in a cup and then surround the straw with soil. Now, have them use a dropper to fill the straw with water. Instruct students not to over fill the straw. They should observe the water disappearing. Have students answer the following questions in their science journals:

- Why did you cap one end of the straw with clay? (Simply, it is to prevent the water from passing straight through the dripline instead of "dripping" water along the way. If the end of the tube is open, the water will follow that easier path. The teacher may wish to refer to the resources for a more technical answer.)
- Why do you think strawberry farmers choose this type of irrigation? (Student answers will vary. After their discussion, have students read How Irrigation Works - Sub-Surface Irrigation at <http://home.howstuffworks.com/irrigation4.htm>. They should include environmental and economical reasons for this type of irrigation. Have students include a summary of how dripline irrigation helps prevent erosion and excessive run-off.)
- If you have a strawberry garden at your school, this would be the best irrigation method to include. It needs to be placed in the "ground" as the bed is being filled with soil. Students would need to research the appropriate amount of water strawberry plants receive each day. As part of their garden "chores," they should collect precipitation and rainfall data on a daily basis. They will be able to determine based on the rainfall estimates whether or not irrigation is necessary for their garden. Add the appropriate amount of water at the base of the plant. Let students infer why it is not as effective to water from the top based on what they have learned in the lesson.

Part 2:

Below is a table showing the amount of water used to irrigate one acre of squash. This will give the students a good idea of the difference in water usage of these two systems. Using the table, students will calculate the number of gallons of water saved by using the drip tape versus the overhead system. Students may then research the average cost of water per gallon in their town to determine the estimated cost of the water used and water saved. Explain to students that many fruits and vegetables use irrigation.

Table 1. Amount of water (gallons) used to irrigate 1 acre of winter squash in 2001-2003.

Irrigation System	2001	2002	2003
Overhead	147,042	459,000	441,285
Drip Tape (T-tape)	87,557	274,605	142,139

¹% of overhead irrigation

Table from <http://agsyst.wsu.edu/IrrigationSystems.html>

Have students research and create a comparison of the number of gallons of water used by various types of irrigation practices. Students can calculate number of gallons per minute using the information from the following website on strawberries. <http://strawberries.ces.ncsu.edu/strawberries-plasticulture-considerations-equipment/>

General information on agricultural irrigation:

<http://en.wikipedia.org/wiki/Irrigation>

<http://www.cdc.gov/healthywater/other/agricultural/types.html>

<http://www.readbag.com/ces-ncsu-depts-hort-consumer-agpubs-ag-489> (This says it is for vegetables but is also good for strawberries. See page 7 for drip irrigation.)

The following link will not take you directly to the article. Copy and paste the following into your Google Search box and it will show the link to the article titled "Some irrigation methods." This is on the USGS Water Science School Page which has lots of other great information.

ga.water.usgs.gov/edu/irquicklook.html

Part 3:

Show "Strawberry Field" picture attached to this lesson plan (also in the Photos folder in "Irrigation and Erosion" as "Young field with ryegrass and overhead irrigation risers" and in the NCSI Teaching Prints set). Ask students what they notice growing between the rows. Establish that it is ryegrass. Ask students "Why do farmers plant ryegrass between the strawberry rows?" Allow students to record their thoughts in their journals. (In the photo, you can also just barely see one of the aluminum pipes next to the bed, leading to the risers.)

Experiment: Obtain 3 flat paint pans for an experiment. Fill the top of pan #1 with soil only. Fill the top of pan #2 with soil covered with straw or hay. Fill the top of pan #3 with a square of sod or grass. Have students predict, if water is poured into the pan, which pan will collect the least amount of water in the bottom of the pan and why. Next, have students pour one cup of water in each pan, one pan at a time, and record their observations. Ask students if their predictions were correct. (Note that the initial moisture level of the soil/sod, plus how densely packed it is, will also have an impact on the runoff.) Discuss the concept of how excess rain or flooding affects the strawberry farm. Have students revisit their initial response to why farmers use ryegrass in the rows. Have them add additional information they learned from the experiment.

Part 4:

Ask students to think about how the amount of water affects strawberry production. Too little water requires the use of irrigation. Does irrigating add to the cost of strawberries for consumers? How does a dry season affect the quality and quantity of berries produced? If strawberries have too much water, what happens to the crop? What type of preventative measures can a farmer take, if any, during a wet season? What happens to the quality and quantity of berries during a wet season? After researching the preceding information, invite a local strawberry grower to the classroom to share answers with the class. If unable to

have a farmer, engage in a blog conversation with a strawberry farmer at <http://wegrowstrawberries.blogspot.com/>. After all activities are completed, have students write a summary of how water affects strawberries. Students should include the concepts of product scarcity and surplus.

Extension Activity:

1. Reading Comprehension Passages are available at K12reader.com. Water Carves the Land is about weathering and discusses the formation of landforms. It also discusses dams and that they are used for generating electricity as well as irrigation.
http://www.k12reader.com/readingcomprehension/Gr4_Wk17_Water_Carves_the_Land.pdf.
2. Discovery Education has a lesson plan that allows students to explore the four types of erosion with this hands-on activity. It takes students through 4 different stations. <http://app.discoveryeducation.com/search?Ntt=erosion>

Background Information:

Strawberry farmers using the plasticulture system typically use overhead irrigation ONLY to help establish newly set out plants, for frost protection, and sometimes for evaporative cooling during hot weather in spring. All the rest of the time, they rely on drip irrigation. This is partly because of the efficiency of drip irrigation, and because it does not get foliage and fruit wet. But it is also because once they have committed to using black plastic mulch, they must use a method that puts the water under the black plastic, as neither rain nor overhead irrigation will put the water at the plants' root zone where it is needed. For overhead irrigation, strawberry farmers typically use large diameter (4-6 inch) aluminum pipes set between the rows through the field, with risers (1-3 feet high) coming off these pipes at intervals. Each of these risers is topped with a rotating sprinkler head. Farmers set up the pipes in the field after the plastic beds have been made. The pipes are usually removed from the field on a PYO farm by the time harvest starts, as they are a hazard to customers, but they may be left if the farm intends to use them to cool down the plants on very hot spring days.

Ryegrass is planted between the plastic-covered beds to control erosion. Without it, erosion can be quite severe in a plasticulture system, especially on hilly terrain, as the raised plastic beds tend to channel run-off from rain and overhead irrigation between the beds. The ryegrass is broadcast over the field after the plastic is laid but before holes are punched in the plastic for the plants. The seed that falls on the beds is usually blown off the plastic by wind by the time plants are set out and doesn't sprout in the planting holes.

Drip irrigation is used throughout most of the growing season to provide moisture to the plants. Liquid fertilizers are also applied through the drip system, especially after plants start to grow in the spring. An additional benefit of drip is that it does not get foliage or berries wet, which reduces the spread of diseases.

Strawberry plants that don't get enough water produce smaller berries, lower total yields, and lower quality berries that may have poor flavor, color, or shape. They are more susceptible to infestation with mites and generally more stressed. Plants that get too much water (usually because of rain) produce soft fruit that spoils easily and lacks flavor, and fruit rot diseases tend to spread quickly through the field.

Additional Resources:

NC Strawberries:

General information on Strawberries in NC provided by the NC Cooperative Extension: <http://strawberries.ces.ncsu.edu/strawberries-plasticulture-production/>

Erosion:

Bill Nye Science Guy has a video that shows erosion and uses a good bit of humor to teach. The first 12-1/2 minutes are the best for giving students a different learning approach.

http://www.teachertube.com/viewVideo.php?video_id=274944

Irrigation:

This article provides excellent information for developing an understanding of why farmers, especially fruit and vegetable growers, use the dripline as opposed to other irrigation

methods. <http://dripirrigation.org/images/Using%20drip%20for%20more%20than%20just%20irrigation%20COMBO.pdf>

Also: <http://home.howstuffworks.com/irrigation2.htm>.

Assessment:

Part 1: Journal entries and completion of experiment

Part 2: Math calculations and chart comparing irrigation systems

Part 3: Journal entries and completion of experiment

Part 4: Summary of how water affects strawberry plants

North Carolina Strawberry Association – www.ncstrawberry.com

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Strawberry Field

