

Lesson Title: How Can We Make Every Drop Count?

Grade Level: 9-12

Subject Area: Horticulture

Duration: Two class periods, 45-60 minutes each

Standards Addressed: CTE Agriculture and Natural Resource Standards C2.1, F2.1, F2.4, F5.1;
CC ELA: W.9-12.4, W.9-12.9

Activity/Lesson Objectives:

- Students will observe and compare the water distribution and flow rates of various irrigation methods used in horticulture.
- Students will measure and calculate flow rates to evaluate the water efficiency of drip irrigation, hand watering, and sprinkler systems.
- Students will evaluate the sustainability of different irrigation methods and recommend appropriate systems based on efficiency, plant needs, and environmental impact.

1. Engagement Activity: Irrigation Methods (15 minutes)

Materials:

- [How Can We Make Every Drop Count? Google Slides Presentation](#) (slides 2-4)

Procedure:

1. Begin by asking: *“If you had to water 100 plants using as little water as possible, how would you do it?”* Let a few students share ideas. Explain that today's focus is on how different irrigation methods impact water use. Emphasize that horticulturists make decisions about watering systems not just based on convenience, but also on factors like water efficiency and long-term sustainability.
2. Show students the slides featuring different irrigation methods. For each method, ask:
 - What do you notice about how this method applies water?
 - Would you label this as efficient, wasteful, or does it depend? (Students can respond by raising their hands, moving to different sides of the room, or using digital polls.)
 - Why might someone still choose this method?
3. After each image, briefly share one advantage and one disadvantage of the method. For example, “Drip irrigation uses less water but can be expensive to install.” Have students predict which system will use the least amount of water and why. They can revisit their predictions later in the lesson.

2. Explore: Irrigation Comparison (45-60 minutes)

Instructors may choose to divide the class into three groups, assigning each group a different irrigation method to test and collect data. Alternatively, the entire class can work together to set up and evaluate each method sequentially, or the class can be divided into smaller groups that test each method concurrently. The materials listed below are for one group; adjust quantities as needed based on the number of groups. Each student will need a copy of the [Irrigation Comparison Lab Worksheet](#) (page XX).

Guiding Questions:

- How does flow rate vary between different irrigation methods?
- Which irrigation method appears to be the most water-wise and efficient based on our data?
- How can understanding flow rate help us make sustainable irrigation choices?

Method: Drip Irrigation

Materials:

- 4 feet of polyethylene drip tube
- Drip emitters (0.5 GPH, 1 GPH, 2 GPH)
- Female hose thread compression fitting
- Figure 8 hose end closure
- Drip punch tool
- Garden hose
- Plastic cups, 12 to 16-ounce
- Beaker or liquid measuring cup
- Towels or trays (to manage spills)
- Timer or clock

Procedure:

1. Gather supplies ensure the group has all materials and understands how to safely use the punch tool.
2. Students assemble their drip lines:
 - a. Cut a 4-foot length of polyethylene tubing.
 - b. Use the punch tool to insert an emitter approximately every foot, starting with 0.5 GPH, then 1 GPH, and ending with 2 GPH at the far end.
 - c. Attach the female hose thread fitting to one end and close the other with the figure 8 end closure.
 - d. Walk around to check emitter placement and connections. Make sure no holes are too close to the end of the tubing where leaks might occur.
3. Students place a plastic cup under each emitter. Each cup should be held in place by a student to prevent tipping and spills.
4. Run the test:
 - a. Connect the drip line to the hose.
 - b. Start the water and timer simultaneously. Let run for 10 minutes (0.17 hours).

- c. Watch for disconnected emitters or leaks. Encourage groups to observe if any emitter is dripping faster or slower than expected.
5. After 10 minutes, instruct students to measure the water collected in each cup by carefully pouring each amount into their measuring device (beaker or liquid measuring cup). Record all three measurements (in gallons) on the data sheet.

Method: Hand Watering

Materials:

- Garden hose nozzle
- Garden hose
- Four 5-gallon buckets (marked with gallon levels)
- Towels or trays (to manage spills)
- Timer or clock

Procedure:

1. Gather supplies and pre-check. Ensure the group has all materials and understands how to operate the hose and nozzle attachment.
2. Set up the garden hose nozzle test:
 - a. Attach the nozzle to the garden hose.
 - b. Place the 5-gallon buckets in a location where they can be easily filled and measured without spilling.
3. Run the test with the garden hose nozzle set to “jet” or something similar.
 - a. Start the water and timer simultaneously.
 - b. Run the jet setting for 5 minutes, filling the bucket. Only begin filling the next bucket once the first bucket is completely filled. Monitor carefully to avoid overflow or spills.
 - c. At the end of 5 minutes, measure and record the amount of water collected in the buckets (in gallons) on the data sheet. Use the bucket markings for measurement.
4. Set the garden hose nozzle to “shower” or something similar. Empty the buckets and repeat the test. Measure and record the water collected (in gallons) on the data sheet.

Method: Sprinkler Watering

Materials:

- Pop up spray head (10' radius)
- Impact sprinkler (10' radius)
- Rotor sprinkler (10' radius)
- Sprinkler manifold system (pre-assembled)
- Garden hose
- Nine 5-gallon buckets (marked with gallon levels)
- Tape measure
- Towels or trays (to manage spills)

- Timer or clock

Procedure:

1. Gather supplies and pre-check. Ensure the group has all materials and understands how to safely attach and operate the manifold and sprinkler heads.
2. Set up sprinkler system:
 - a. Attach the pop up spray head, impact sprinkler, and rotor sprinkler to the manifold system, one on each riser.
 - b. Connect the manifold to the garden hose.
 - c. Using the tape measure, place the 5-gallon buckets at 1 foot, 5 feet, and 10 feet distances from each sprinkler head, on either side of the sprinkler line.
3. Run the test:
 - a. Turn on the water and start the timer simultaneously.
 - b. Let the sprinklers run for 5 minutes.
4. At the end of 5 minutes, measure the amount of water in each bucket using the gallon markings. Record the water collected (in gallons) on the data sheet.

3. Explain: How Can We Make Every Drop Count? (30 Minutes)

Materials:

- [How Can We Make Every Drop Count? Google Slides Presentation](#)
- [How Can We Make Every Drop Count? Guided Notes](#)

Procedure:

1. Begin by reviewing the slideshow and ensuring familiarity with the content. Hand out the guided notes to each student.
2. As you present each slide, pause periodically to allow students to fill in their guided notes. Highlight key points, provide additional context, and encourage student interaction by asking questions or prompting discussion.
3. At the end of the slideshow, review the key concepts covered in the presentation. Go over the notes with the class, ensuring that students have accurately filled in their guided notes.

4. Evaluate: Water Efficiency Report (15 minutes)

Materials: [Irrigation Comparison Lab Analysis](#) (page XX)

Procedure:

1. Introduce the assessment activity: *“Now that you’ve learned about water conservation methods and collected data from different irrigation systems, it’s time to analyze what*

your results mean. We are going to return to our lab worksheet and look closely at our findings.”

2. Have students complete the analysis questions, using the data they collected during the lab and information from the slide presentation to summarize their findings and form recommendations. Circulate to check for understanding and to support student success.

Criteria for Success:

- Data summaries are complete, accurate, and clearly organized.
- Analysis connects quantitative findings to water efficiency and sustainability.
- Recommendation paragraph includes data-based reasoning and at least one practice from the slide presentation.