Instructor Guide

Fall Day 9: Data Analysis I

Overview

Students will review their fall monitoring data using their Field Guide data sheets and the Fall Analysis worksheet. They'll spot patterns, connect site conditions to their results, and practice using claim-evidence-reasoning to explain water quality. This session sets the stage for comparing results in the spring and building stronger data interpretation skills.

Standards Alignment

AFNR Natural Resource Systems Career Pathway Standards, Common Career Technical Core (CCTC)

NRS.02. Analyze the interrelationships between natural resources and humans.

> **NRS.02.02.** Assess the impact of human activities on the availability of natural resources. (NRS.02.02.01.a., NRS.02.02.01.b., NRS.02.02.03.b., NRS.02.02.01.c., NRS.02.02.03.c.)

Michigan Science Standards, High School Performance Expectations

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Learning Objectives

- Students will analyze their collected water chemistry, E. coli, and macroinvertebrate datasets from the fall field days to identify trends and patterns related to stream health.
- Students will construct evidence-based explanations of stream health by applying the claim, evidence, and reasoning (CER) framework.
- Students will synthesize their fall field observations and data to draw conclusions and make informed predictions about spring stream conditions.

Materials

- Stream Team Field Guide (1 per student)
- Fall Day 9 Data Analysis worksheet: *What Does Your Fall Data Say About Your Stream?* (1 per student)
- Computer or tablet (optional)

Advanced Preparation

1. Make sure all student data sheets from the fall sampling are complete and gathered.
2. Print copies of or share links to the fall data analysis worksheet, "What Does Your Fall Data Say About Your Stream?"
3. Have CER anchor charts or examples ready if students need a refresher.

Lesson Sequence

Engage: Introduction to Claim, Evidence, Reasoning Approach (10-15 minutes)

1. Let students know that they are analyzing their own data to find patterns and think like stream scientists using the Claim, Evidence, Reasoning (CER) approach.
2. Review the approach if needed.
    a. Define the Terms
        - Claim: A clear statement that answers the question.
        - Evidence: Data or observations that support the claim.
        - Reasoning: Explanation that connects the evidence to the claim using scientific principles.
    b. Guide students through a practice run of this process:
        - Discussion Question: *Why is the water quality lower downstream from the agricultural fields?*
          Example Claim: The water quality is lower downstream because runoff from the agricultural fields is entering the stream.
        - Discussion Question: *What evidence would be useful to determine whether agriculture affects the stream?* Encourage students to think of the data they collected at their study sites.
          Example Evidence: Water samples downstream show higher nitrate levels, higher turbidity, and higher conductivity compared with upstream samples.
        - Discussion Question: *What scientific ideas help explain how runoff impacts water quality?*
        - Example Reasoning: Fertilizers and soil from fields can wash into nearby streams. Extra nutrients (like nitrates) can promote algal growth, and increased sediment reduces water clarity and affects aquatic organisms. These pollutants lower overall water quality.
3. Remind students that they are working with *their own field data* and that their task is to think and act like stream scientists. Emphasize that scientists look for patterns, relationships, and possible explanations rather than single "right answers."

Encourage students to compare results across sites and sampling dates and to consider how field conditions may have influenced the data.

Sample guided discussion questions:

- *What kinds of patterns might a stream scientist look for in water chemistry, E. coli, or macroinvertebrate data?*
  Sample responses:
  - Differences between upstream and downstream data.
  - When certain levels go up or down, for example, after it rains or by the season
  - Fewer sensitive macroinvertebrates where pollution is higher.
- *Why is it important to look at trends over time rather than one data point?*
  Sample responses:
  - A single measurement is only a snapshot and could have an error.
  - Trends may show if water quality is improving or declining.
  - More evidence makes claims more reliable.
- *How might weather, flow, or habitat conditions influence our results?*
  - Rain can wash pollution into the stream.
  - High or low flow can change how concentrated pollutants are.
  - Habitat (like shade or plants) affects water conditions and the organisms living there.

4. Apply the CER framework
   Sample guided discussion questions:
   - *What would a strong claim about our stream's health sound like?*
   - *What types of data count as valid evidence for that claim?*
   - *How does reasoning connect the evidence to the claim using what we know about streams and water quality?*
5. Remind students that effective CER explanations use multiple data sources (chemistry, biology, and observations) and clearly explain their thinking, which is a process that professional scientists use in their work.

Explore: Independent or Small Group Data Analysis (20-25 minutes)

1. Individually or in teams, students will use their Field Guide sheets to answer questions on the fall data analysis worksheet, "What Does Your Fall Data Say About Your Stream?"
2. Before students begin, briefly review the key components of the Field Guide to aid students in recalling where their data and observations were recorded in the field and in the classroom following field work.

3. While students work on their fall data analysis, encourage them to add detail by incorporating responses to the "Think About" prompts and comparing results within their group.
4. As students work, circulate among the groups to facilitate discussions where students can explain the evidence behind their answers and have the opportunity to ask you clarifying questions.

Explain: Class Discussion and Wrap-Up (15-20 minutes)

1. Have groups share one interesting finding or claim about their site's water quality.
2. Facilitate a class discussion using the following sample discussion questions.
    - What did students notice?
    - What claim did they make about their water chemistry data?
    - What claim did they make about their water macroinvertebrate data?
    - What predictions do they have for spring sampling?
3. If you are not completing the optional elaborate section below, collect all student Field Guides and fall data analysis worksheets to save them in a secure place for the spring season.

Elaborate: Optional Extension (15-20 minutes or longer for more detailed visuals)

1. Ask students to create a simple visual (sketch, diagram, or concept map) that shows how their water chemistry and macroinvertebrate results connect to stream health.
2. Encourage students to include key evidence from their data in their visuals.
3. Have students post their visuals around the room and lead a brief gallery share. Students can walk around to view other students' work and to note similarities and differences between their analyses and visual representations.
4. Facilitate a class discussion to highlight recurring patterns and student insights about stream health.
5. Collect all student Field Guides and fall data analysis worksheets to save them in a secure place for the spring season.