

Lesson 1.1 Teacher Notes

The following notes provide information to aid in teaching the course. Refer to these notes and record ideas and methods to enhance the lesson throughout this document.

- For this course, students keep an *Agriscience Notebook*. In their notebook, students should record notes, experiences, thoughts, and other important information they acquire during their study of animal systems in this class. Students should also place all activity sheets and records of their work in the notebook.
- Make multiple copies of the **Presentation Notes** pages, found in the Teacher Resources, for students to take notes and record observations. Students should keep their *Presentation Notes* in their *Agriscience Notebook* for future reference.
- A Lesson Materials list is provided for each lesson to plan for the instruction of the upcoming lesson. Items listed on the materials list are from various vendors; therefore, ensure that you have placed equipment and supply orders well in advance of instruction. Use the CASE Store for updated order information, including prices and recommended vendors.
- The **Course Glossary** and individual lesson glossaries list all *Key Terms* identified in each lesson. Make the glossary or single lesson glossaries available to students in the classroom or instruct students to add to their *Agriscience Notebooks*.

Lesson 1.1 Defining an Issue

In preparation for teaching this lesson, review Concepts, Performance Objectives, Essential Questions, and Key Terms found in the lesson document. Prepare materials and determine evaluation procedures for the lesson. Also, review all activity, project, and problem directions, expectations, and work which students will complete during the lesson.

Introduce students to foundational terms and concepts through this lesson.

Students assemble and organize their ESI and laboratory notebooks. Students investigate a local environmental problem by testing the effects of acid rain on local soil minerals. Next, they research environmental problems on local, national, and global levels. To complete the lesson, students identify facts, problems, and environmental science issues and analyze sources for economic, political, and ethical views on those issues.

Reading Discussion

Students enrolled in *Environmental Science Issues* utilize a course textbook for multiple learning and research purposes. To provide a deeper understanding of problems and issues in the environment, students read the text, *Sustaining the Earth*. Additionally, students strengthen reading skills related to technical literacy and reading comprehension sought by industry employers.

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Chapter 1, pages 1-16

Use the questions below to facilitate a class discussion about this lesson's reading assignment on Day 4. Encourage student participation. Assess student understanding based on the discussion.

- Why is sustainability important to environmental science?
- How could the principles of sustainability be applied to everyday activities?
- Why are there ecological problems?
- How do humans influence problems and issues in the environment?
- How do environmental problems affect humans?

Activities, Projects, and Problems

Activity 1.1.1 Environmental Problems or Activity 1.1.1 Environmental Problems (Go Direct™)

Students investigate the global problem of soil acidification caused by atmospheric carbon dioxide. Students measure the localized effect of acidified water on soil nutrients. Students measure the pH and conductivity of water before acidification, after acidification, and after percolation through a local soil.

Teacher Preparation

Prepare the following items the day before the lab:

- Fill ten alcohol burners approximately 1/3 full of ethanol.
 - \circ Adjust the wicks, so $^{1}/_{8}$ inch of the wick stands above the burner.
 - o Light each burner and extinguish. If necessary, adjust the wick height.
- 1L of pH soaking solution. If a prepared solution is not available, follow the steps below.
 - Label a 1L bottle "pH Solution" with a marker and laboratory tape.
 - Pour 1L of distilled water (dH₂O) into a 1L bottle.
 - \circ Dissolve ten pH 7.0 buffer capsules in 1,000ml dH₂O.
 - Save the buffer solution after the lab in the 1L bottle to use throughout the course.
- Use one gallon of dH₂O to fill ten rinse bottles equally.
- Collect approximately ½ gallon sample of a typical local soil. The soil should be damp. A
 permeable soil, such as sandy soil, will allow quicker percolation.

The buffering capacity of the soil will influence results. Using soil with a higher buffering capacity (or higher initial pH) will increase interaction with acidified water ions, producing a more pronounced effect. Using soil with a lower buffering capacity (or lower initial pH), mimicking a soil already affected by acid rain, will not produce as pronounced an effect on the pH.

Review the Vernier Conductivity Sensor Booklet and Vernier pH Sensor Booklet for calibration and storage information, or the Go Direct[™] Conductivity Sensor, Go Direct[™] ph Sensor, and Graphical Analysis[™] application as an alternative to using the LabQuest2.

Review safety procedures from **CASE Safety Manual** and demonstrate proper PPE use. Share the **Laboratory Safety Agreement** for students to sign. The signed document should be included in the *Laboratory Notebook* later in the lesson.

Use caution for this activity as students will be using an open flame to complete the procedures. Remind students with long hair and loose clothing to secure those items before working with an open flame.

Additional	Suggestions	Resources
	Virtual Facilitation Conduct the lab virtually, providing a live or recorded video for students to review. Provide the data for student analysis.	 Video equipment
	Global Literacy and Sustainable Development Goals Research acid rain-causing factors around the world.	• Internet

Student Performance

Part One

Students prepare acidified water using a common fuel source, ethanol. They capture carbon dioxide and other combustion gases in a jar above a lit alcohol burner. It is critical to capture as much exhaust in the jar as possible; gases collect at the jar's highest part, so students must keep the jar inverted until securing the lid. Distilled water is added to the jar and mixed by shaking the jar to form carbonic acid.

Part Two

Students prepare the samples, the LabQuest2, conductivity sensor, and pH sensor for data collection. They collect pH and conductivity measurements from distilled water and acidified water. Encourage students to work quickly once they open the jar with acidified water as carbonic acid may diffuse back into carbon dioxide and water.

Part Three

Students pass samples of distilled water and acidified water through the soil to simulate runoff. The students measure the pH and conductivity of the "runoff" and answer analysis questions related to the changes in the water and soil.

Results and Evaluation

Acidified water should have a lower pH and higher conductivity than distilled water. Results of runoff from the soil may vary from location to location based on the soil type and buffering capacity. An increase in conductivity indicates the removal of nutrients. Students should understand how acid rain, which may be caused by distant pollution sources, could have effects on local soils. Sample pH and conductivity results and potential responses to analysis questions are in Table 1.

Control Test	рН	Conductivity (µS)
Distilled Water	7.54	298.0
Runoff from Distilled Water	7.81	303.3
Change in DH ₂ O	+ 0.27	+ 5.3
Variable Test	рН	Conductivity (µS)
Acidified Water	7.00	292.8
Runoff from Acidified Water	7.54	300.8
Change in Acidified Water	+ 0.54	+ 8.0

Table 1. Sample Data* and Responses

*Please note that this runoff data was collected from an acidic soil type. Local results may vary widely based on the soil used and its buffering capacity. If you live in an area with naturally alkaline soils, acid rain may have little effect.

Ana	Analysis Questions		
Q1	Describe the pH differences between distilled water and acidified water. What process is producing this change?	The pH drops from 7.54 to 7.00 (about five times more acidic) when water mixes with the smoke. Gases from combusted fuel mix with water to create carbonic, sulfuric, and nitric acids through acidification.	
Q2	Discuss the pH change in runoff from distilled water and acidified water. How did soil filtration affect acidity?	Answers will vary according to data. Per the sample data above, soil buffering created more change in the runoff from the acidified water sample than the control sample. Both pH and conductivity readings showed greater gains.	
Q3	Describe the conductivity changes that occur when the acidified water percolates through the soil and becomes runoff. What is happening to the soil minerals? What is happening to soil fertility?	The minerals are removed from the soil and dissolves in the water, increasing the sample's conductivity. Conductivity readings have a greater change for the acidified water runoff than for the distilled water runoff. Over time the removal of minerals and change in pH negatively influence the fertility of the soil.	
Q4	Describe any other changes in pH or conductivity you observe.	Answers will vary based upon observations and local results.	

Activity 1.1.2 ESI Notebooks

Students assemble their ESI Notebook and organize their Laboratory Notebook.

Teacher Preparation

Print the following materials for distribution:

- ESI Notebook Cover Page Template ESI Notebook Spine Template
- **ESI** Table of Contents
- FFA Activity Log
- SAE for All Crosswalk

SAE Hours Log SAE Income and Expense Sheet Laboratory Notebook Guidelines Laboratory Notebook Evaluation Rubric

Additional Suggestions		Resources
	Virtual Facilitation Direct students to set up virtual portfolio for large projects and a virtual lab notebook for work throughout the course.	Virtual portfolio appVirtual lab notebook app

Student Performance

Students will assemble their *ESI Notebooks* and organize their *Laboratory Notebook* using the materials you provide. Students store all handouts and copies of activities, projects, and problems in the *ESI Notebook*. The *Laboratory Notebook* is a record of student work in the course. Students record research, calculations, lab activities, and writing assignments in the *Laboratory Notebook*. Review the *Laboratory Notebook Guidelines* for more information.

Results and Evaluation

The *Laboratory Notebook* may be graded after assignments to assess student performance and periodically to ensure student participation.

Activity 1.1.3 Shared Problems

In teams of three, students research average temperature changes locally, nationally, and globally. Teams identify problems associated with temperature changes at each level.

Teacher Preparation

Verify state, national, and global information before the activity. Suggest the following or other appropriate websites for student research. Note that some sites may not be available. Conduct an internet search to find updated links.

- U.S. Temperature Trends, Climate Central: The Heat is On
- NOAA: Extreme Events
- EPA: Climate Change Impacts by State
- EPA: Climate Change and Human Health Risks in Your State
- U.S. Global Change Research Program: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment
- NASA: Global Climate Change: Vital Signs of the Planet
- The World Bank Group: Climate Risk and Adaptation Country Profiles

Additional Suggestions		Resources
	Virtual Facilitation Facilitate group work through breakout meetings.	 Virtual meeting app with breakout capability

Student Performance

This activity should be the first entry in students' *Laboratory Notebooks*. Review the *Laboratory Notebook Guidelines* document before the activity.

Divide the class into teams of three. Each team will research the effects and problems related to climate change in their home state, country, and the world. Each student will complete research for a different part of the activity. Students research average temperature changes and related climate change problems for states, nations, and the world.

Results and Evaluation

Students should find the average temperatures increasing in virtually all environments. Extreme weather events vary from place to place, depending on local weather. They will discover local, national, and global environmental problems with similarities. Students should understand how the effects of environmental problems may vary and are dependent upon regional differences. Cultural and economic conditions in an area can determine how climate change affects the human population. Each set of questions may have similar answers, but answers should reflect specific state, national, or world climate change. The information below is from the *Sustaining the Earth* text, pages 261-268 (Miller & Spoolman, 2015).

Q1	How has the average temperature changed over the past 100 years?	Increase
Q2	Which types of extreme weather are occurring?	An increased number of weather events such as hurricanes and tornadoes Extreme droughts and rainfall events Increased record high and record low temperatures Major weather events out of season
Q3	What are two problems caused by climate change?	Acidification of water bodies, including the ocean Agricultural disruptions, resulting in famine or food shortage Droughts Economic threats Extreme weather Floods Loss of biodiversity Melting glaciers, ice caps, and permafrost Mudslides Rising sea levels
Q4	How will climate change affect people?	Human comfort: increased need for air conditioning and heating Human health: increased skin cancer, hunger, and lung disease incidence

Table 2. Research Questions and Potential Responses

Activity 1.1.4 What's the Issue?

Students use a flowchart to identify facts, problems, and issues. Then, students apply those labels to topics related to environmental science.

Teacher Preparation

Become familiar with the flowchart in the activity. Prepare three posters by labeling one poster *Facts*, the second *Problems*, and the third *Issues*. Place the posters in a visible spot in the room.

Additional Suggestions		Resources
	Virtual Facilitation Direct students to meet in small groups via breakout rooms. Utilize an online collaborative bulletin board app for students to submit their facts, problems, and issues.	 Virtual meeting app with breakout capability Interactive bulletin board app
	Global Literacy and Sustainable Development Goals Encourage students to discuss environmental topics which span multiple countries or regions.	• n/a

Student Performance

Students analyze nine statements and categorize them as facts, problems, or issues. Then students select an environmental topic to research. They identify two facts, problems, and issues associated with the topic. Encourage students to search using their topic, followed by the term facts, problems, or issues. For example: "logging facts" or "biodiversity issues." Discussions may arise concerning whether a statement is a fact, a problem, or an issue. Refer students back to the flowchart in Part One. Remind students that issues are associated with disagreements.

Next, students examine and categorize the results of two other student pairs. Student pairs place their six notes on one of the three posters labeled *Facts*, *Problems*, or *Issues*. Each poster should have two notes from each pair of students. Review the notes on the *Issues* poster. Direct students to record the issues on a page in their *Laboratory Notebook*. You may have a student transcribe the issues onto a piece of paper on a document camera to improve visibility and record the issues. Use this list in the next activity.

Results and Evaluations

Students should understand how to identify a statement as a fact, problem, or issue. Table 2 provides properly categorized statements.

Facts	Problems	Issues
There are 1000 chickens in this henhouse.	Producers have found the avian influenza virus in the barn.	It is acceptable to raise chickens in the smallest space possible.
The water level in my groundwater well is at 202 feet.	The water level in my groundwater well has been dropping for years.	State leaders should divert groundwater from agriculture to industrial use.
The D.O. concentration is 8 mg/l.	The sewage plant leaks.	Cleaning polluted water is not worth the cost.

Table 3. Part One Responses

Activity 1.1.5 Analyze the Issue

Students learn the process of stating and analyzing an issue. They practice by analyzing an assigned issue and then analyze an issue of their choosing.

Teacher Preparation

Display the *Issues* poster from *Activity 1.1.4 What's the Issue* for students to review.

Additional Suggestions		Resources
	Global Literacy and Sustainable Development Goals Expand research to include pesticide use around the world to reflect broader perspectives regarding pesticides.	• n/a

Student Performance

Students use the internet and *Sustaining the Earth* text to research the issue of pesticide use. Then students choose an issue from *Activity 1.1.4 What's the Issue* to analyze on their own. They record the analysis, including the history, risks and benefits, and terms in their *Laboratory Notebooks*. If a student has difficulty researching an issue, encourage the student to choose a new issue. Remind students to leave space for additional information/research to conduct during the next activity.

Results and Evaluation

Students should be able to state an issue and analyze the risks and benefits associated with the issue.

Activity 1.1.6 Issue Information

In this activity, students research specific sources of information regarding economic, political, and social views of environmental issues. No teacher preparation is necessary for this activity.

Student Performance

Students research and record the economic, political, and ethical views of pesticide use to practice the issues analysis process. Students repeat the process with the unique issue they researched during *Activity 1.1.5 Analyze the Issue*. Then they summarize their research and opinions in their *Laboratory Notebook*.

Results and Evaluation

Student *Laboratory Notebooks* will contain recorded environmental risks and benefits related to their unique issue. The risks and benefits should include labels for social and economic viewpoints. Also, students should identify two laws related to their selected issue.

Assessment

Lesson 1.1 Check for Understanding

Lesson 1.1 Check for Understanding is included for you to use as an assessment tool for this lesson. Use Lesson 1.1 Check for Understanding Answer Key for evaluation purposes.