Habitats & Biodiversity

Future of Agriculture Curriculum for Teaching Sustainability

Name: _____   Hour_____ Date: _____

Date Packet is due:_____   Why late? _____   Score: _____
Day of Week   Date   *If your project was late, describe why*

Overview: in this unit, you will be investigating how biodiversity changes in different parts of a habitat near your school.

Main Questions
- How do scientists reliably answer questions about the natural world?
- How does biodiversity change in the edge of this habitat in comparison to the interior of this habitat?
- How can we collect data in a reliable fashion to answer this question?
- How can we analyze our data to reach a sound and valid conclusion?
- How can we be sure that our results are sound, valid, and representative?

Weekly Schedule
Monday:
- Introduction to the Habitats & Biodiversity Lab
- Introduction to Designing and Conducting Research

Tuesday:
- School Habitat Data Collection – Habitat Quadrat Lab (Edge)

Wednesday:
- School Habitat Data Collection – Habitat Quadrat Lab (Interior)

Thursday:
- Data Analysis and Report Preparation

Friday:
- Delivery of Reports
- Career Connections/Make-up Day

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Semester Schedule
Week 1: Introduction & Lab Safety

Atoms to Ecosystems

Week 2: Matter & Energy

Week 3: Cell Biology

Week 4: Biodiversity & Ecosystems

Week 5: Biodiversity & Habitats

Week 6: Midterm Assessments

Causes of Extinction

Week 7: Extinction

Week 8: Habitat Loss

Week 9: Invasive Species

Week 10: Land & Water Pollution

Week 11: Atmospheric Pollution

Week 12: Overharvesting

Week 13: Midterm Assessments

Sustainable Societies

Week 14: Natural Resources Management

Week 15: Societies & Sustainability

Week 16: Individual Sustainability

Week 17: Personal Campaigns

Week 18: Personal Campaigns

Day 1: - Introduction to Conducting Research

Overview: the job of a scientist is to answer unknown questions about the world. To do so, scientists must
- Ask questions and clearly define the problem.
- Plan and carry out an investigation that reliably addresses their question.
- Collect, analyze, and interpret data from their investigation using mathematics and computational thinking.
- Construct explanations and design solutions to problems.
- Recognize patterns and trends in data in order to develop an explanatory model that helps to simplify and explain the natural phenomenon central to the investigation (and other similar natural phenomena).
- Engage in argumentation and debate based on the evidence and conclusions.
- Communicate the conclusions, data, and evidence from an investigation in order to help advance the work of all people in that field.

In this activity, you will be participating in a scaled-down replica of this process. In your assigned teams, you will be measuring the biodiversity of different parts of a habitat near your school. You will compare the levels of biodiversity on the edge of the habitat to the interior of that habitat in order to see if there is a difference, and if so, to what extent those differences exist.

Once you have collected your data, you will compile all of the data collected by your class, determine the average amount of biodiversity for each of the different locations that were sampled, and then develop a presentation that you will deliver either to your instructor or to the class as a whole.

Before you begin, you will do a brief activity to help you become more familiar with data collection and analysis. You will end today's class with an overview of the work that you will be doing later this week. Be sure to dress appropriately. Unless there is severe weather you will be going outside for at least two days this week. Be sure to bring appropriate clothing for the weather as well as close-toed shoes and a jacket if necessary.

Day 1: - Conducting Research Activity

Introduction: in this activity, you will be provided with data from a separate activity. Your group will be calculating the average temperature from two different treatments and then will prepare a mini-report. You will also identify different components of the experiment based on the information provided to you.

Background: in this experiment, the student researchers filled two 1000 ml sealed beakers with 400 ml of water. The beakers were fitted with a sealed lid containing heater, thermometer, and airlock to remove excess pressure (*see image to the right*). Two tablets of Alka-Seltzer were added to one of the sealed beakers in order to increase the amount of CO_2 in the air above the water. The other beaker was left untreated and served as a comparison. The water and air was then heated to 45° C in both beakers. This temperature was maintained for five minutes, at which time the heaters were turned off and the contents of each beaker were allowed to cool back to room temperature. After 20 minutes, the temperature of the air was recorded in both beakers. This protocol was repeated 5 more times for a total of 6 trials. The data from the experiment is shown in the table on the next page.

Trial	Temp (C) at 20 min	
	Treated	Untreated
Trial 1	34	30
Trial 2	31	29
Trial 3	34	31
Trial 4	34	28
Trial 5	33	31
Trial 6	32	30
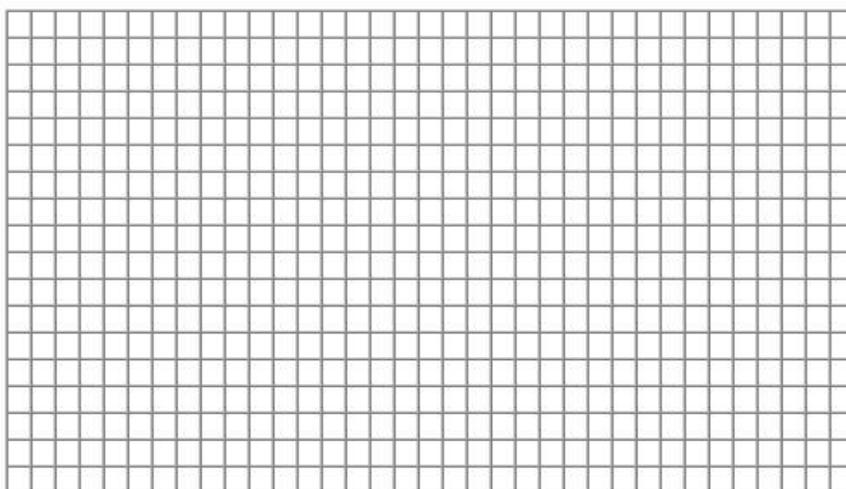
What is the average temperature for each treatment? (Add up all of the values in each column, and divide each sum by 6).

Treated Avg: _____ Untreat. Avg: _____

1. In the section of graph paper to the above right, create a bar graph showing the average difference between the treated and untreated beakers. Be sure to label your x-axis (horizontal) and y-axis (vertical).

2. What question was this experiment trying to address? _____

_____

3. How did this experiment address this question? _____

_____

4. An **independent variable** is the thing that is changed in an experiment to see what impact it has. What was the independent variable in this experiment? (*HINT: this is the only thing that is different between the two beakers.*)

_____

5. A **dependent variable** is the thing that is measured to determine the impact of the independent variable. What was the dependent variable in this experiment?

_____

6. A **control** is the untreated part of the experiment that serves as a basis for comparison. What was the control in this experiment?

_____

7. What would be the most reasonable conclusion that could be reached from this experiment's data?

_____

Be prepared to discuss your answers as a class.

Day 1: - Introduction to the Lab

Overview: In this lab you will be performing quadrat sampling to gauge the level of biodiversity of different components of the same habitat. "Quadrat sampling" is a term for sampling portions of an ecosystem to indicate the health of the overall habitat. To perform this procedure, a series of squares (quadrats) of a certain size are placed at random or along a straight line in a habitat. The species within those quadrats are identified, counted, and recorded.

To conduct the sampling within your quadrat, simply count the number of species and the number of individuals. Our basic biodiversity score is calculated by dividing the number of species found by the square root of the number of individuals found. These scores from the whole class will be averaged for each section.

Direction: for this lab you will need your research team and a quadrat. A quadrat is simply a square; PVC pipe, meter sticks, or broomsticks can work as well as any piece of fancy equipment as long as they are consistent in size. Our quadrats are made from pieces of PVC pipe and nylon rope. It is important for you to ensure that your quadrat is evenly square; if it looks more kite-shaped, adjust the cables to even out your sides.

Each group will be assigned a portion of a nearby habitat. After receiving your assigned location, move one pace (roughly a meter or 3 feet) from the outside towards the interior of the habitat (step carefully! Do not damage any vegetation). Lay down your quadrat and begin counting all the plant species that have stems within your square. Using this sheet, each person should record the total number of species and the total number of individuals within the quadrat (overhanging vegetation with stems outside of the square DO NOT count; only count species with stems within the square). To determine the biodiversity score for that area, divide the total number of species by the square root of the total number of individuals. For example, if you counted 25 individuals and identified 10 species, you would perform the following calculation:

$$(\text{\# species} \div \sqrt{\text{\# individuals}}) = 10/\sqrt{25} = 10/5 = 0.5$$

On the second day, move to a location in the interior of the habitat (as determined by your instructor) and repeat the procedure.

On the third day, you will share your data with the class. You will compile the data for each of the sections in which you collected the biodiversity data, determine the average biodiversity score for the edge and interior sections, and then determine the difference in biodiversity between the edge and interior of the habitat. Using this information, you will compile a report that you will present on the following day using the questions in this packet as a guide. On the final day, you will present your report to either your instructor or to the whole class.

Use the remainder of the time in this class to listen to your instructor's specific instructions in regards to what to wear, what to bring, where to meet, and other important details. Remember to dress appropriately!

Lastly, you should have a **hypothesis** and **rationale** before beginning this lab. Complete the sections below:

1. Which do you think will have the greatest biodiversity, the edge or the interior? _____

2. Why do you think that this section will have greater biodiversity? _____

Day 2: Habitat Edge Assessment

Directions: After receiving your assigned location, move one pace (roughly a meter or 3 feet) from the outside towards the interior of the habitat (step carefully! Do not damage any vegetation). Lay down your quadrat and begin counting all the plant species that have stems within your square. Using this sheet, each person should record the total number of species and the total number of individuals within the quadrat (overhanging vegetation with stems outside of the square DO NOT count; only count species with stems within the square). To determine the biodiversity score for that area, divide the total number of species by the square root of the total number of individuals. For today, only record the data for your group. If time is available, speak with your instructor to see if you can collect data for a second quadrat (more data = more accuracy).

Number of individual plants: _____ Number of different plant species: _____

Edge Biodiversity Score: _____ (# species ÷ √# individuals)

Day 3: Habitat Interior Assessment

Directions: repeat the protocol from the previous day for your new assigned location in the center of the habitat.

Number of individual plants: _____ Number of different plant species: _____

Interior Biodiversity Score: _____ (# species ÷ √# individuals)

Day 4: Data Analysis & Report Preparation

Directions: begin by reporting your biodiversity scores on a whiteboard, chalkboard, or wherever the whole class can see your data depending on your teacher's instructions. Then record the data from the rest of the class in the space below.

	Edge Biodiversity	Interior Biodiversity
Group 1		
Group 2		
Group 3		
Group 4		
Group 5		
Group 6		

Calculate the average biodiversity for each region of the habitat. To do so, add up all of the scores for each section and divide by the number of scores that you have.

E.g. if you have six scores that add up to 3, you would divide 3 by 6 to get an average score of 0.5

Edge Avg:____ Int. Avg:____

Next you will be compiling a report. This can be in an oral format, PowerPoint, poster, or paper. Your instructor will determine which format will be most appropriate for your situation.

In your report, you should address the following:
1. What was the question you were trying to answer?
2. What was your original hypothesis? What was your rationale for that hypothesis?
3. How did you conduct this experiment and collect your data?
4. What trends did you notice in your data?
5. What conclusions did you reach as a result of your data?
6. Does the data support or refute your hypothesis? Or is more data needed to reach a valid conclusion?
7. What are the limitations of this experiment? How much trust can we put in the results of this work?
8. What would be the best options for our next steps in regards to answering our original question? Is this enough to reach a sound conclusion in regards to our question, or is more data necessary? If so, what would be the best option for getting the data needed to answer our question more accurately?

Day 5: Presentations

Directions: You will be delivering your presentations on this day. Your instructor will use this rubric (or something similar) to grade your presentations.

Item	*Plus (100%)*	*Check (70-90%)*	*Redo (0%)*
Accuracy	No errors were detected in this presentation	This presentation contained a few errors, but overall was very accurate.	This presentation contained considerable errors.
Thoroughness	No important information was omitted.	A few more details would have enhance this work.	Major topics were omitted that should have been included.
Professionalism	This presentation's quality exceeds expectations for high school students.	This is acceptable work for high school students but room exists for improvement.	The professionalism of this group needs significant improvement.
Group Involvement	Every member was involved with the development of the presentation as well as its delivery.	At least one more group member could have been more involved than they were.	Multiple group members clearly could have been more involved.
Effort	Effort exceeds what would be expected of a high school student.	Effort is acceptable for a high school student but room exists for improvement.	Level of effort could have been much greater than what was presented.

Comments:

Appendix: Setting up the Biodiv. & Habitats Lab

Introduction: In this activity, students will be assessing the biodiversity of the edge and interior portions of a habitat near your school. School forests or prairies can work well for this. As long as you have a natural habitat within walking distance of your classroom that you have permission to use, it would be a suitable candidate for this activity.

It is best to assign students to equally-separated areas within sight of each other (for purposes of supervision). Quadrats can be assembled from four equally-sized sections of PVC pipe and rope. The size of the quadrats depends somewhat on the amount of vegetation and your available time. For example, if you have a dense prairie, 24-inch sections of PVC pipe would provide plenty of plants to count and identify in the available time. If you have a forest with minimal understory, you would probably want quadrats that are at least 1x1 meter.

Students should count every stem of every living plant that exists inside the quadrat. It is not important that they identify the exact species (although this is an option for more advanced students). Rather, it is only necessary that they identify the total number of different species in addition to the total number of living individuals.

It may be helpful to have a satellite image (such as those available on Google Maps) of your habitat so that you can point out exactly where you will be collecting data on each day prior to the start of the activity. It also would be recommended to have students meet in your classroom first and then move to the habitat rather than have students leave the school building without supervision. It would also be recommended to check with your administration and to send letters home to parents in advance informing them that class will be meeting outside. This is especially important for students with medical needs (particularly stinging insect allergies) as medical precautions may need to be taken prior to the lab.

Depending on the mathematics abilities of your students, they may need assistance with calculating averages. Similarly, students may need help developing their presentations. While a PowerPoint or Google Slides presentation would be ideal, students with limited abilities may find that an oral presentation may be sufficiently challenging.

While students can present to the whole class, you may find that this will lead to classroom management problems after they have heard the same presentation for the 5th or 6th time. What may work best is to have students deliver their presentations to the instructor while the rest of the class finalizes their preparation and/or works on other assignments. This may be an especially valuable time to inform students of missing work and have them complete this missing work after they have completed their presentation.

The order of presentations can be assigned or determined at random. It may be encouraging to offer a rounded-up score to the first or second group that volunteers as a means of encouragement.

Be sure to ask questions of different group members as they present as a means of checking the level of engagement of each group member. Similarly, be sure to float among groups as they are working to check to make sure all members are equally involved. Pointing out that full group involvement is part of the rubric may be helpful in encouraging less engaged members to pull their weight (ditto for offering to have unengaged students work alone instead of in a group unless they can become more invovled).