

# Habitat Loss

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 learning about how habitat loss, habitat degradation, and habitat fragmentation can lead to the extinction of species.

## Main Questions

- How does the size and remoteness of a habitat affect its biodiversity, ecosystem services, and resilience?
- How does the size and remoteness of habitat affect the number of species that it can support (carrying capacity)?
- To what extent are current rates of extinction affected by habitat loss and fragmentation?
- How do habitats change over time and in response to disturbances? How do these responses differ?
- How can habitat degradation affect biodiversity in ways that are similar to if that entire habitat were completely lost?
- What kinds of private and public options exist for protecting habitat?

## Weekly Schedule

### **Monday:**

- Data Dive: Habitat Fragmentation

### **Tuesday:**

- Nutshell Video & Notes
- Class discussion & revisions of explanations

### **Wednesday:**

- Habitat Fragmentation Assessment (*outside – dress appropriately*)

### **Thursday:**

- Review & Assessment

### **Friday:**

- Weekly Reflection
- Career & Community Connections

*This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program, Grant No. DGE-1424871. Additional financial support was provided by Michigan State University's College of Education and the Kellogg Biological Research Station. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.*

*This work is licensed under a Creative Commons Attribution-NonCommercial 3.0 Unported License.*



National Science Foundation  
WHERE DISCOVERIES BEGIN



KBS LTER  
Kellogg Biological Station  
Long-term Ecological Research

MICHIGAN STATE  
UNIVERSITY

## Semester Schedule

Week 0: Introduction & Lab Safety

### Atoms to Ecosystems

Week 1: Matter & Energy

Week 2: Cell Biology

Week 3: Biodiversity & Ecosystems

Week 4: Biodiversity & Habitats Lab

Week 5: Midterm Assessments

### Causes of Extinction

Week 6: Extinction

Week 7: Habitat Loss

Week 8: Invasive Species

Week 9: Land & Water Pollution

Week 10: Atmospheric Pollution

Week 11: Overharvesting

Week 12: Midterm Assessments

### Sustainable Societies

Week 13: Natural Resources Management

Week 14: Societies & Sustainability

Week 15: Individual Sustainability

Week 16: Personal Campaigns

Week 17: Personal Campaigns



# Day 1: Data Dive – Habitat Fragmentation

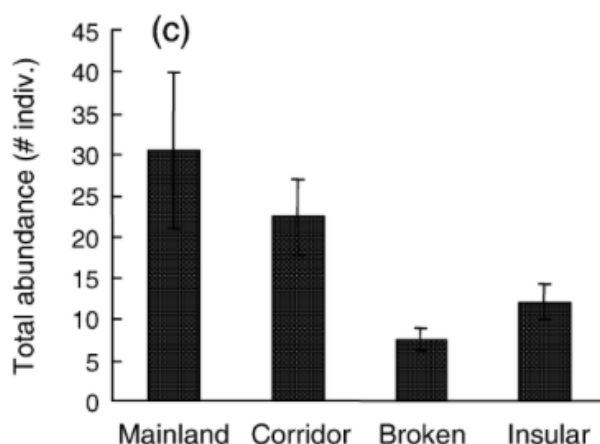
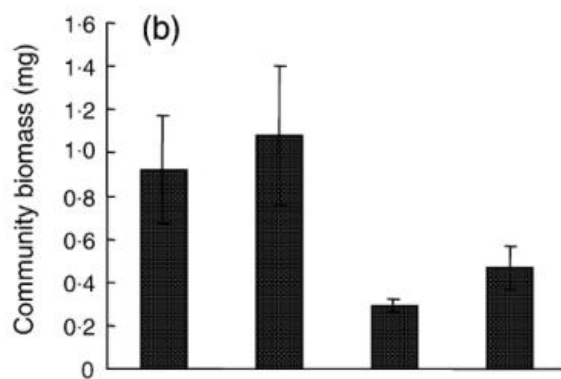
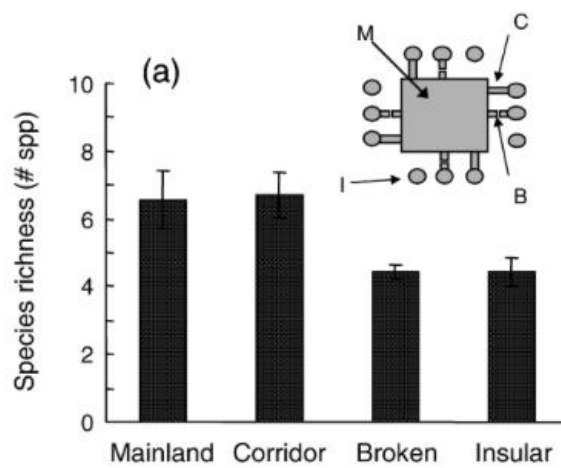
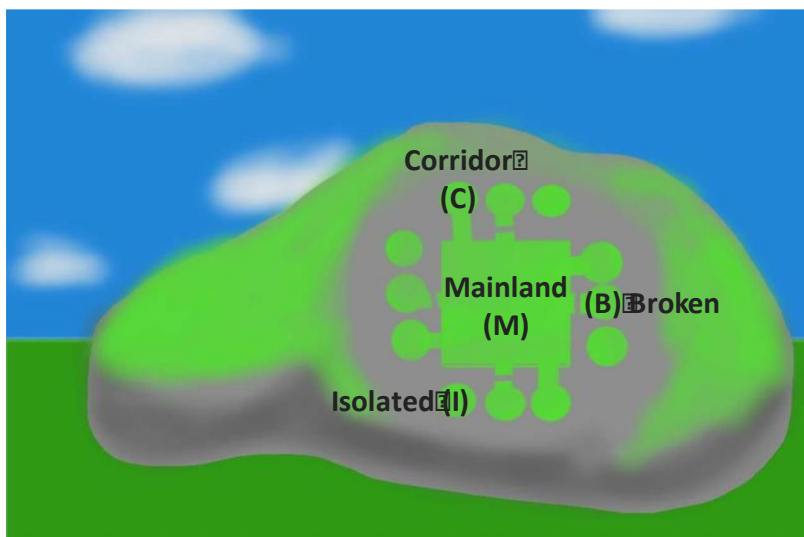
**Intro Video:** <https://www.youtube.com/watch?v=Su26shax0AA>

**Overview:** In this activity, your group will review data in order to identify patterns and trends that you will use to develop an explanatory model. You will then compare your observations and explanations to those of other groups in order to check your accuracy and refine your explanatory model.

**Directions:** look at the data provided below. Then use the data provided to you to answer the questions on the following page. If you are unsure about how to interpret the data, work with your group and seek help from your instructor if necessary. (Data source: Gonzalez, A. and Chaneton, E. J. (2002), *Heterotroph species extinction, abundance and biomass dynamics in an experimentally fragmented microecosystem*. *Journal of Animal Ecology*, 71: 594–602. doi:10.1046/j.1365-2656.2002.00625.x)

**Summary of Research:** to measure the impact of habitat fragmentation (or the division of a habitat into smaller isolated pieces), researchers removed mossy vegetation from 8 boulders to create a fragmented habitat for macroinvertebrates (such as spiders, mites, and insects). This resulted in four kinds of habitat – 1) unfragmented mainland habitat (*Mainland*); 2) fragmented habitat connected by a narrow strip of corridor habitat (*Corridor*); 3) fragmented habitat connected by a partially broken corridor (*Broken*); and 4) fragmented habitat that is isolated and completely unconnected to the main habitat (*Isolated or Insular*). This pattern of habitat fragmentation is shown below.

After 12 months, researchers measured **species richness** (number of species), **community biomass** (mg of biological tissue), and **total abundance** (total number of individual organisms) in each of the four treatments. The data is shown in the graphs to the right.





Use a notebook, scratch paper, or a dry erase board to record your ideas and thoughts about the following questions. Be prepared to discuss these questions as a group and as a class.

1. Based on the graphs on the next page, what is one conclusion that would be supported by this data?
  - a. How is this conclusion supported by this data?
  - b. What specifically suggests that your claim is accurate?
2. What is a second conclusion that would be supported by this data?
  - a. How is this conclusion supported by this data?
  - b. What specifically suggests that your claim is accurate?
3. Based on these graphs, how would you describe the relationship between biodiversity and habitat fragmentation?

*I think that as habitat becomes more fragmented, biodiversity is **reduced/increased/unaffected** because:*

---

---

4. Why do you think habitat fragmentation has this effect on biodiversity? *I think that this occurs because:*

---

---

*I think that this hypothesis is accurate because* \_\_\_\_\_

---

---

5. Use a notebook, scratch paper, or a dry erase board to record your ideas and thoughts about the following questions. Be prepared to discuss these questions as a group and as a class.
  - a. The “habitat” in this study was moss on a rock, and the biodiversity consisted of insects and other arthropods. Can this tell us anything about “real habitat” like a forest or a prairie?
  - b. If a road is constructed through a habitat, it would likely only reduce the total area of the available habitat by a small percentage. Based on the data from this study, what impact might this have on the biodiversity of that habitat? Would biodiversity be minimally affected as well?
  - c. Often farms have forested areas among their fields. To reduce erosion, the edges of these fields (or “fencelines”) have small strips of trees that connect these forested areas. What might the data from this study suggest about these strips of trees and their impact on biodiversity?
  - d. What does this data suggest about the effects of habitat loss and habitat fragmentation on biodiversity? Is it just the total amount of available habitat that matters?
  - e. Given what you know about the impact on biodiversity, how would habitat loss & fragmentation affect ecosystem services, ecosystem resilience, and the carrying capacity of a given area?



# Day 2: Notes & Discussion

---

**Introduction & Directions:** In this activity, you will begin by watching a short video about habitat loss. This will help to clarify some of the questions you may have had yesterday. After the video, you will look at a short slideshow presentation that will provide you with specific information about this topic. Your instructor may decide to deliver the presentation as a classroom lecture or they may allow you to read the notes individually or in small groups (depending on your previous experience and capabilities with this content). After you have watched the video and finished with the slideshow, you will work in small teams to answer the questions listed below. You should take notes in a notebook, on a dry erase board, or on scratch paper so that you are prepared to deliver your responses during the class discussion that will follow. *Note: your instructor may assign your group to answer specific questions if time is limited.*

## URL Links

YouTube Video: <https://www.youtube.com/watch?v=tEBRnD8cHUK>

Also consider: <https://www.youtube.com/watch?v=j9Xgg4YOLHo> ;  
<https://www.youtube.com/watch?v=KxXQdM5wCO8>

Slideshow Presentation: [https://www.factsnsf.org/uploads/1/4/0/9/14095127/2018-5-28\\_facts\\_habitats.pdf](https://www.factsnsf.org/uploads/1/4/0/9/14095127/2018-5-28_facts_habitats.pdf) (or visit factsnsf.org and use the menu bar).

## Discussion Questions:

1. What is a habitat? Why is it important to biodiversity?
2. What is a carrying capacity of a habitat? What three key factors determine the carrying capacity of a habitat? How do these factors affect carrying capacity?
3. What is the Island Biogeography Model? How does this concept relate to habitat loss and habitat fragmentation?
4. To what extent does habitat loss/fragmentation affect the current rates of extinction?
5. How do the choices and lifestyles of Americans affect habitat loss both within the US and internationally?
6. What is a habitat disturbance? What is habitat succession? How are these concepts similar and how are they different?
7. How are natural habitat disturbances similar to human-caused disturbances? How are they different?
8. What is habitat degradation? How is it different from habitat loss? How is it similar?
9. Briefly summarize both desertification and ocean acidification, describing their causes and impacts.
10. Define habitat fragmentation, habitat edge, and habitat interior. Describe how habitat fragmentation can lead to isolation and loss of biodiversity even with minimal habitat disturbances.
11. Summarize how habitat can be protected through both public and private efforts.
12. Define a habitat corridor and summarize how it can be used to reduce losses to biodiversity.

*Be sure to revisit your explanations from the previous day's activity and add details or corrections as needed.*



# Day 3: Habitat Fragmentation Assessment

---

**Overview:** In this activity, you will be visiting a habitat and/or using satellite images to identify features of habitat fragmentation.

**Directions:** Depending on factors such as weather, time, and distance, your instructor may have you visit a habitat in person or use satellite images (such as those available on Google Maps) to assess a habitat. If you do visit a habit in person, your instructor will provide you with details about the specific area you are visiting prior to leaving for this lab. They may allow you to also use a device to find satellite image of the area to help you to understand how human development in the surrounding area may affect your habitat.

Whether you visit a habitat in person or use satellite images to assess it, you should complete the questions below and on the next page based on your observations of this particular ecosystem. Be prepared to discuss your findings and defend your conclusions using evidence during a whole-class discussion. If time is limited, your instructor may assign specific topics to your group.

1. Habitat Succession: do you see any evidence of habitat succession occurring in this area? Yes / Possibly / No

What evidence supports this conclusion? \_\_\_\_\_

---

---

---

2. Habitat Disturbances: do you see any evidence of habitat disturbance occurring here? Yes / Possibly / No

What evidence supports this conclusion? \_\_\_\_\_

---

---

---

3. Habitat Fragmentation: do you see any evidence of habitat fragmentation occurring here? Yes / Possibly / No

What evidence supports this conclusion? \_\_\_\_\_

---

---

---



4. Habitat Corridors: do you see any evidence of habitat corridors in this area? Yes / Possibly / No

What evidence supports this conclusion? \_\_\_\_\_

---

---

---

5. Habitat Isolation: do you see any evidence of isolation or reduced species mobility here? Yes / Possibly / No

How would this affect biodiversity in this area? \_\_\_\_\_

---

---

---

6. Habitat Edge vs. Interior: which is more prevalent, habitat edge or interior? \_\_\_\_\_

How would this affect biodiversity in this area? \_\_\_\_\_

---

---

---

7. Recommendations: based on topics that you covered earlier this week, what are two ways in which the habitat in this area could be changed or improved in order to support more biodiversity and increase the carrying capacity of this ecosystem?

Recommendation #1: \_\_\_\_\_

How it could help: \_\_\_\_\_

---

---

Recommendation #2: \_\_\_\_\_

How it could help: \_\_\_\_\_

---

---





## Day 4: Review & Assessment

---

**Directions:** you will begin by reviewing the unit objectives in your small groups. For each objective, rank it as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comfort with that objective. After a few minutes of review, your instructor will lead a whole-class review. This is your chance to ask any questions you still might have about the concepts in this unit. Begin with anything you ranked as a “1”.

After you have completed the unit review, you will be taking an individual multiple choice quiz and/or a group short answer quiz. These quizzes may be graded in class to help you better understand the question and the correct answer.

### Unit Objectives:

1. What is a habitat? Why is it important to biodiversity?
2. What is a carrying capacity of a habitat? What three key factors determine the carrying capacity of a habitat? How do these factors affect carrying capacity?
3. What is the Island Biogeography Model? How does this concept relate to habitat loss and habitat fragmentation?
4. To what extent does habitat loss/fragmentation affect the current rates of extinction?
5. How do the choices and lifestyles of Americans affect habitat loss both within the US and internationally?
6. What is a habitat disturbance? What is habitat succession? How are these concepts similar and how are they different?
7. How are natural habitat disturbances similar to human-caused disturbances? How are they different?
8. What is habitat degradation? How is it different from habitat loss? How is it similar?
9. Briefly summarize both desertification and ocean acidification, describing their causes and impacts.
10. Define habitat fragmentation, habitat edge, and habitat interior. Describe how habitat fragmentation can lead to isolation and loss of biodiversity even with minimal habitat disturbances.
11. Summarize how habitat can be protected through both public and private efforts.
12. Define a habitat corridor and summarize how it can be used to reduce losses to biodiversity.

## Day 5: Career Connections

---

**Directions:** Begin with a group and class discussion about the topics of this week. What is still unclear? What is still confusing? What seemed most important to remember? How does this relate to Natural Resources? How does this relate to your potential future career?

Then complete your Cover Letters. To complete this activity, see the Cover Letters section of the Supervised Career Experience Packet.



# Habitat Loss Individual Quiz

---

Name: \_\_\_\_\_ Hour \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / \_\_\_\_\_

**Directions:** This quiz should be completed on an individual basis. A 3x5 notecard with handwritten notes can be used on this quiz.

1. **A species' habitat is** \_\_\_\_\_  
\_\_\_\_\_
  
2. **The carrying capacity for a population of deer in a wooded area would be...**
  - a. The average population of deer over an extended period of time.
  - b. The maximum number of deer that can exist in the wooded area before ecological degradation occurs.
  - c. The highest number of deer found in that area in a given time period.
  - d. The number of deer that exist after losses from predation.
  
3. **Which of the following does NOT determine the carrying capacity of a habitat?**
  - a. The capacity for a given area to satisfy the biological needs of the species in that area.
  - b. The size of a habitat.
  - c. The proximity of the habitat to other habitats.
  - d. The amount of sunlight, warmth, and moisture in the given area.
  - e. All of the above are determinants of a habitat's carrying capacity.
  
4. **Which of the following best summarizes the Island Biogeography Model?**
  - a. The more isolated the island, the more diverse the species are.
  - b. The smaller the island, the more diverse the species are.
  - c. Islands that are near the equator have more diversity.
  - d. Islands and other habitats that are larger and closer together tend to have more biodiversity.
  
5. **Habitat loss is \_\_\_\_\_ of extinction.**
  - a. The leading cause.
  - b. one of the leading causes
  - c. not a major cause
  
6. **Which of the following most accurately describes the impact of American lifestyles and choices on habitat loss?**
  - a. Unlike other regions, Americans have preserved most of the natural habitat in the US.
  - b. Americans have utilized most natural areas in the US for human development; furthermore, Americans consume 30% of the world's natural resources, which depletes habitats elsewhere.
  - c. Americans have utilized most natural areas in the US for human development but consume resources at a relatively low rate in comparison to other countries in order to preserve other habitats.
  
7. **This is when the function of a habitat is disrupted due to a rapid naturally-occurring change (such as a fire). Recovery is often rapid.**
  - a. Habitat Succession
  - b. Natural Disturbance
  - c. Human Disturbance
  - d. Habitat Degradation
  
8. **This is a slow change to a habitat due to slow transitions in the vegetative species in an area.**
  - a. Habitat Succession
  - b. Natural Disturbance
  - c. Human Disturbance
  - d. Habitat Degradation





- 9. This is a when the function of a habitat is disrupted due to a human-induced change; Recovery is generally slow and/or delayed.**
- a. Habitat Succession
  - b. Natural Disturbance
  - c. Human Disturbance
  - d. Habitat Degradation
- 10. This occurs when a habitat is reduced in quality but not necessarily in size.**
- a. Habitat Succession
  - b. Natural Disturbance
  - c. Human Disturbance
  - d. Habitat Degradation
- 11. Which of the following would be examples of habitat degradation?**
- a. When a 40-acre habitat is split into four isolated 10-acre areas due to human activity.
  - b. When a habitat undergoes slow transition from an open meadow to a brushy area.
  - c. When a habitat experiences acidification or desertification.
  - d. When a habitat is replaced by human development.
- 12. Which of the following would be examples of habitat fragmentation?**
- a. When a 40-acre habitat is split into four isolated 10-acre areas due to human activity.
  - b. When a habitat undergoes slow transition from an open meadow to a brushy area.
  - c. When a habitat experiences acidification or desertification.
  - d. When a habitat is replaced by human development.
- 13. In an ideal habitat...**
- a. The amount of interior is *minimized* and the amount of edge is *maximized*.
  - b. The amount of interior is *maximized* and the amount of edge is *minimized*.
  - c. Both edge and interior are *maximized*.
  - d. Both edge and interior are *minimized*.
- 14. Which of the following could be caused by habitat fragmentation?**
- a. Species are unable to reach sources of food and water.
  - b. Species are unable to have sufficient access for mating.
  - c. Species are more likely to suffer from reduced genetic diversity and inbreeding.
  - d. All of the above are likely to be caused by fragmentation.
- 15. Which of the following best summarizes the role that state and national parks play in habitat preservation?**
- a. State and national parks now comprise most of the land area of the United States and are sufficient in protecting vital habitat.
  - b. State and national parks usually do not protect critical habitat and do little to prevent habitat loss or fragmentation.
  - c. While state and national parks preserve many critical habitats that are often unique and fragile, they only represent less than 4% of the land area and do not fully achieve habitat preservation.
- 16. Briefly summarize how a private rural landowner could use CRP and corridors to maximize biodiversity and ecosystem services on their property.**

---

---

---

---



# Habitat Loss Group Quiz

Names (F&L): \_\_\_\_\_

\_\_\_\_\_ Hour \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / \_\_\_\_\_

**Directions:** This quiz should be completed in your assigned groups. A 3x5 notecard with handwritten notes can be used on this quiz. Each person should take turns writing an answer. Those not writing should be actively working together to create their group's answer. Those who are not actively involved in answering every question may be asked to complete this quiz alone. Record the writer's name after each question.

1. **As an adult, you finally achieved your dream of purchasing a plot of forested land. Your goal is to maximize the amount of wildlife on this property. Begin by defining carrying capacity and explaining how it connects to this goal. Then describe how carrying capacity can be maximized.**

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

Writer's Name:



2. A state park is considering building a new road through the center of the park in order to more easily enable visitors to access more remote portions of this park. While this road would essentially split the park in two, it would only reduce the amount of habitat by a very small percentage. Would biodiversity also be reduced by only a small percentage? Explain. In your explanation, briefly define and summarize the most important aspects of the *Island Biogeography Model* as it applies to this question.

---

---

---

---

---

---

---

---

---

---

*Writer's Name:*

3. A farm has two areas designate for use as CRP land. These areas are on either side of the fields on this farm, and a line of fences and trees runs from each of these designated areas between the fields. These trees and fences also happen to make it more challenging to plant and harvest these fields and the farmer is considering removing them so that the fieldwork can be completed more quickly and easily. Would this have any impact on biodiversity if the CRP areas are left untouched? Be sure to define CRP in your response.

---

---

---

---

---

---

---

---

---

---

*Writer's Name:*



4. A forest fire in a western state clears out a habitat. A department store plans to buy some of this land to expand its parking lot. They justify this by stating that the habitat had been destroyed by a fire already and that it might as well be put to good use for their store as it will no longer be able to be a forest again. Is this accurate? In your response, be sure to address the terms *succession* and *disturbance*.

---

---

---

---

---

---

---

---

---

---

*Writer's Name:*

5. Rising levels of atmospheric carbon dioxide have changed precipitation patterns while also increasing the concentration of carbonic acid in oceans. Briefly describe how increased levels of atmospheric carbon dioxide affects extinctions due to habitat loss and habitat degradation by describing how the processes of desertification and acidification affect biodiversity.

---

---

---

---

---

---

---

---

---

---

*Writer's Name:*



## Appendix: Data Dives / Case Studies

---

**Overview:** Data Dives and Case Studies are exercises in which students are presented with data from experiments or scenarios, and are asked to identify trends and develop explanatory models in a process that is very similar to what actual scientists do on a regular basis.

**Directions:** Students should consider the data or scenario in their assigned groups. They should work with their group members to make sense of the information provided and try to determine the conclusions that can be drawn from it. Students may struggle with this, especially in their first attempts and particularly if your students have limited experience reading graphs and data tables. It may be necessary for you to project the data onto a large screen and guide students by explaining the steps that you would use to make sense of what is being reported. This may be difficult; just like explaining the steps of tying your shoes can be challenging because you rarely have to think about it, it can be exceptionally challenging for someone who is scientifically literate to identify the thought processes that they use to make sense of data. It may be helpful to jot down your ideas in advance and have them ready prior to the start of this class.

Students are likely to struggle to varying extents. That is ok! Be sure to float from group to group to assist. Be sure to remind group members to help each other out. It might ideal to assign groups with a mix of abilities. Encouraging struggling students to work with their better-prepared peers, and conversely, encouraging high performing students to advance their abilities by working with individuals with different skill sets helps to prepare students for the kinds of situations they will encounter in their careers and personal lives.

Plan to allow for about 15-20 minutes to introduce the activity and review how to interpret this information with your students. About a third to half of the class period should be reserved for allowing students to work in their individual groups. The remaining time should be reserved for intergroup or whole-class discussion so that students can engage in scientific debate and argumentation.

It would a good idea to remind students that the term *argumentation* is used differently between scientists and the general public. While argumentation generally has a negative connotation (such as a “heated argument”), argumentation among scientists is generally very good-natured and polite. The goal is not to “win” an argument but rather to expand the understanding of the phenomenon by all involved. Often scientists on opposing sides of an issue will both change their stance as a result of the improved understanding that results from engaging in argumentation. Similarly, students should not be trying to disprove each other or prove that they have the “right” answer. Rather, students should be examining the differences in their conclusions, the manner in which each conclusion was reached, and the similarities and agreements that exist among different conclusions.

Students may reach a conclusion that is not entirely supported by evidence. The temptation may be to point out errors in their reasoning. However, when students are struggling, they are also likely improving their abilities in evidence-based reasoning, which is one of the most important goals of this kind of instruction. Try to resist the urge to correct student errors; rather, try to probe their understanding and challenge them to re-examine the evidence to check the validity of their conclusions and the conclusions of other groups. Consider using the 9 Talk Moves (next page) to support productive classroom dialogue.

Remember – students should re-visit their explanations and models repeatedly over the course the week. If they don’t get it right on the first try, they will have more opportunities to do so.



## Goals for Productive Discussions and Nine Talk Moves

**Goal: Individual students share, expand and clarify their own thinking**

**1. Time to Think:**

Partner Talk

Writing as Think Time

Wait Time

**2. Say More:** “Can you say more about that?” “What do you mean by that?” “Can you give an example?”

**3. So, Are You Saying...?:**

“So, let me see if I’ve got what you’re saying. Are you saying...?” (always leaving space for the original student to agree or disagree and say more)

**Goal: Students listen carefully to one another**

**4. Who Can Rephrase or Repeat?**

“Who can repeat what Javon just said or put it into their own words?” (After a partner talk) “What did your partner say?”

**Goal: Students deepen their reasoning**

**5. Asking for Evidence or Reasoning:**

“Why do you think that?” “What’s your evidence?” “How did you arrive at that conclusion?” “Is there anything in the text that made you think that?”

**6. Challenge or Counterexample:**

“Does it always work that way?” “How does that idea square with Sonia’s example?”  
“What if it had been a copper cube instead?”

**Goal: Students think with others**

**7. Agree/Disagree and Why?:**

“Do you agree/disagree? (And why?)” “Are you saying the same thing as Jelya or something different, and if it’s different, how is it different?” “What do people think about what Vannia said?”

“Does anyone want to respond to that idea?”

**8. Add On:**

“Who can add onto the idea that Jamal is building?”

“Can anyone take that suggestion and push it a little further?”

**9. Explaining What Someone Else Means:**

“Who can explain what Aisha means when she says that?” “Who thinks they could explain in their words why Simon came up with that answer?” “Why do you think he said that?”

Source: [https://inquiryproject.terc.edu/shared/pd/TalkScience\\_Primer.pdf](https://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf)





# Appendix: Habitat Extinction Risk Assessment

---

**Overview:** In this activity, students will be assessing a habitat in your community by either visiting that habitat in person and/or viewing satellite images of the habitat.

**Materials:** a local habitat; access to Google Maps (for satellite images) or other aerial photographs. You could also choose to have students assess their own property if it contains wildlife habitat (particularly farms or private forested areas).

**Directions:** a school forest or prairie would be ideal for this activity, but any habitat near your classroom to which you have access will be an option. If you lack this option, you may choose to use a satellite image of a local habitat.

If you are able to visit a habitat, the distance of the habitat from your classroom may limit the extent to which your students can complete all components of this lab. If your habitat is a considerable walking distance, you may opt to limit the number of considerations that your students assess or focus instead on using only satellite images of the area.

Students should use their observations to answer the accompanying questions. Encourage students to use their class resources (particularly their notes) to work in teams to answer the lab questions. If time allows, it would be ideal to have students report their findings and conclusions and discuss the validity of their conclusions, as well as their level of confidence in their findings.

Be sure to remind students to dress appropriately and to be aware of the weather forecasts for the day of the activity. Make sure that administrators and parents are informed of in advance; your school board or administrators may require permission slips to leave the school building. Make sure to take into account students with special needs and students with medical considerations (particularly those with stinging allergies). You should carry a cell phone or other means of communication while outside of the school building, and school administrators and secretaries should know how to reach you on this device.



# Appendix: Review and Assessment

---

**Introduction:** In this section, we will discuss strategies to guide your students during review and assessment for a vocabulary-intensive unit.

While recent reforms to science education (as outlined by the NRC’s *K12 Framework* and NGSS) minimize the emphasis on having students learn vocabulary, we have found that we cannot completely eliminate vocabulary from ecological instruction for a number of reasons. Most importantly, we have found that in order for students to sufficiently engage in reasoning and sense-making about ecological phenomena, they need to have an appropriate language with which to develop explanations and solutions.

However, in the FACTS curriculum, we view vocabulary as a *means to an end* and not as a central objective to the curriculum. In other words, we don’t care very much whether students have memorized the definitions of terms, but whether they can accurately use those terms to describe and understand phenomena, and ultimately create evidence-based arguments, explanations, and solutions. We view vocabulary as part of a “sense-making toolkit” that enables students to organize their reasoning and argumentation.

As such, we recommend that you provide students with opportunities to practice mastering the vocabulary in this course while also recognizing that mastery of vocabulary is a secondary objective in these units. This means that assessing vocabulary can work as a formative assessment but is not ideal by itself as a summative assessment. The primary goal of this curriculum is to enable valid evidence-based reasoning and sense-making, and your summative assessments should reflect this.

**There are a few strategies you might considering adopting to support these objectives:**

- While multiple-choice assessments are provided in the weekly packets, we take the stance that these options should not be used by themselves as a final summative assessment.
  - o You might consider assigning this as optional homework, allowing students to use a 3x5 card with handwritten notes, and/or assigning completion points in lieu of scores based on the percent correct.
- Teachers have also created hybrids of the multiple choice and short answer assessments, selecting some questions from each option. Their experiences suggest that the multiple-choice assessments help to prepare students for the more intellectually rigorous short answer questions.
- You might also consider having a space on a chalkboard/dry-erase board for publicly posting course vocabulary or hanging a large sheet of paper and adding vocabulary and definitions if students start to struggle.
- Teachers have also used vocabulary practice as an option for a bell-ringer activity, using options such as short, ungraded online quizzes to start class.

You as the instructor are best positioned to decide what will be most effective for your classroom. Feel free to use or disregard these suggestions as you see fit. However, we do strongly recommend that you avoid positioning memorization of vocabulary as one of the primary objectives of this course, and instead emphasize valid reasoning and sense-making about ecological phenomena as your top priority.