FORESTRY

Ecosystem Exploration iNaturalist Activity

Advisor Guide

SUMMARY

In this activity, students will take to the field to explore four different ecosystems with diverse plant communities. Using iNaturalist, students will make observations and identify plant species at each site, taking note of species abundance. Students will explore why certain species occur in certain areas, and they will hypothesize the effects of disturbance on their study ecosystems.

TIME

About 40 to 60 minutes per site, varies with number and diversity of plants

GRADE LEVEL

Grades 9 – 12
(Adaptable for younger ages)

MATERIALS NEEDED

- Camera (smartphone camera preferable)
- Access to iNaturalist (mobile app or desktop website)
- Membership with NCFE iNaturalist Project
- Measuring tape of at least 5 meters (about 16 feet)
- Field guides for identifying plants
- Forestry Ecosystem Exploration Site Data Sheet
- Forestry Ecosystem Exploration Site Comparison Sheet
- *Optional:* metersticks for percent cover

OBJECTIVES

Explore

Students will:

1. Gather ecological data at four sample sites.
2. Differentiate between various ecosystem types.
3. Explore connections, similarities, differences, and trends between different ecosystems

Identify

Students will:

4. Categorize major biotic and abiotic factors in different ecosystems.
5. Identify plant species using iNaturalist and field guides.
6. Become more comfortable identifying plants without use of a guide.

Apply

Students will:

7. Apply the concepts of species richness, species abundance, and species evenness to their sample plots.
8. Explain the differences between generalist species and specialist species and apply these terms to the data they have gathered.

Synthesize

Students will:

9. Explain what adaptations make plant species successful in the ecosystems in which they are found.
10. Explain the role of disturbance in ecosystems and predict how disturbance would affect a particular system.
11. Perform independent research on an interesting species or phenomenon that they observed, and they will share their findings with their teammates and advisor.

CORRELATIONS

Next Generation Science Standards
HS-LS2-6 Ecosystems: Interactions, Energy, and Dynamics
HS-LS4-2 Biological Evolution: Unity and Diversity
HS-LS4-4 Biological Evolution: Unity and Diversity

SKILLS

- Identifying
- Differentiating
- Classifying
- Data Gathering
- Analyzing
- Hypothesizing
- Extrapolating

CONNECT WITH INATURALIST!

iNaturalist is one of the largest citizen science projects in the world. It is an excellent tool to facilitate hands-on outdoor learning, whether your students can gather together or are working independently.

Learn more about the NCF-Envirothon iNaturalist Project, and join the project here!

This Forestry activity incorporates iNaturalist as a way for students to make observations about their samples sites and to hone their identification skills.

Encourage your students to work together on the iNaturalist platform, even if they may be completing the activity from a distance!

KEY TERMS

Abiotic Factor – A non-living parameter that influences the presence, wellbeing, and survival of an organism, population, or community. *Examples include: temperature, level of sunlight, amount of available water, type of soil, et cetera.*

Biotic Factor – A living or previously living parameter that influences the presence, wellbeing, and survival of an organism, population, or community. *Examples include: abundance of predator species and prey species, presence of competing species, organic nutrients, symbiotic species, et cetera.*

AP Environmental Science Curriculum
Unit 1 – The Living World: Ecosystems
- 1.1 – Introduction to Ecosystems
- 1.2 – Terrestrial Biomes

Unit 2 – The Living World: Biodiversity
- 2.1 – Introduction to Biodiversity
- 2.4 – Ecological Tolerance
- 2.5 – Natural Disruptions to Ecosystems
- 2.6 – Adaptations

Unit 3 – Populations
- 3.1 – Generalist and Specialist Species
- 3.5 – Population Growth and Resource Availability

Unit 9 – Global Change
- 9.8 – Invasive Species

9.10 – Human Impacts on Biodiversity

NAAEE Environmental Education Strands
Strand 1 – Questioning, Analysis, and Interpretation Skills
Strand 2 – Knowledge of Environmental Processes and Systems
- 2.2 – The Living Environment

ACTIVITY

Part A: Site Observation and Inventory:

Have the students (as teams or individuals) identify four different plant communities that can be used as investigation sites. Sites should be accessible by the students. Examples of different communities could be: a pine forest, a hardwood forest, a mixed stand, an open field, edge habitat, a marsh, a meadow, a swamp, a desert, a rangeland, a tundra, et cetera.

For each site, have the students:

1. Designate a circular sample plot with a radius of 5 meters (about 16 feet) in each location.

2. Observe the ecological factors found in the plot. Conditions to note include:
   - What are the biotic and abiotic factors affecting this ecosystem?
   - How much sunlight is there (direct, indirect, full sun, shaded, partial)?
   - Is there water nearby (stream, pond, ephemeral source)?
   - Are the plants crowded together or spaced out?
   - How open is the canopy?
   - Are there different layers of vegetation?
   - What is the texture of the soil?
   - Is there leaf litter or other organic matter?
   - What name would you give this type of ecosystem?

3. Note any evidence of disturbance at the site (such as fire, erosion, human development, et cetera).

4. Identify and record the Species Richness of the site by identifying the plant species found in the plot. *Students may use a field guide to help in their identifications*. Students will then need to:
   - Upload their observations to the NCF-Envirothon iNaturalist Project using a mobile device or take pictures to upload using a desktop later.

KEY TERMS (CONTINUED)

Canopy – Dense vegetation that forms a "roof" over an area. *For example, tree branches forming a canopy in a forest.*

Community – The collection of all living organisms in an ecosystem, including plants, animals, fungi, and microorganisms.

Disturbance – Any change, natural or human-caused, that impacts an ecosystem, particularly through the removal of organisms or alterations to available space. *Examples of natural disturbances include: hurricanes, natural fires, and flooding. Examples of human-caused disturbances include: habitat destruction, pollution, and erosion from roads.*

Diversity – A measure of difference between communities that incorporates Species Richness and Species Evenness.

Ecological Factors – The combination of biotic and abiotic factors that shape the structure and function of an ecosystem.

Ecosystem – The collection of all living species (communities) in a region and the abiotic factors that influence them.

Generalist Species – A species which does not have strict habitat requirements and can be found in many different types of ecosystems. Generalist species are also typically adaptable to new environments.

Percent Cover – The area occupied by a particular species relative to the total area of a given sample plot. *Percent Cover = Area of Species / Total Plot Area*

Population – The collection of all organisms of a particular species.

Quadrat – A sampling tool (usually rectangular) of a specific area. *For example: a 1-meter by 1-meter square.*

- For larger plants (like trees and shrubs) one observation should be made for each individual.
- For smaller plants that serve as groundcover, one observation can be made per patch of the same species (for example, one patch of clover).
- Remind students to be sure to take multiple photos to capture all the major identifying characteristics of a species.
- The **total number** of plant species identified is the plant Species Richness of that site

5. Record Species Abundance of the site. Students should:

- Perform a rough population survey for the plot.
    - For larger plants (like trees and shrubs), tally each individual.
    - For smaller plants (like grasses and clover), an approximate percentage cover of the plot area will suffice (for example, the 10-meter diameter plot is covered in approximately 40 percent broomsedge). A sampling quadrat of known size (1 meter by 1 meter) can be used to help estimate percent cover. The quadrat does not need to be fancy – four metersticks taped together to form a square will suffice.
    - **Percent cover = area covered by a species / total plot area**
    - *See this video for an overview of Percent Cover*

6. Record Species Evenness of the site. Students should be able to answer the following:

- Do all species present have roughly the same number of individuals, or do certain species dominate the landscape? Which species? Why do you think this is?

7. Using the information collected and recorded about each site, students should answer the following questions:

a. Using your knowledge of all the species found in your sample plot, explain why these particular species occur here.
b. What adaptations do the most common species have that make them successful in this ecosystem?
c. Are there any species that you found that you did not expect? Why do you think these species are present?
d. What are some types of disturbance that you might expect in this ecosystem (both natural and human-caused)? What effects do you think these disturbances would create in the ecosystem?
a. Write down any other observations that you have about this ecosystem.

12. Students should repeat the above steps for each chosen site.

Part B: Bringing It All Together – Site Comparison

Have students to review all of the information gathered from their different sites. Facilitate connections between their observations and the Envirothon learning resources. Discuss with the students the ecological themes and principles present in their observations.

Ask students to use the following open-ended questions to explore the relationships and trends that they noticed among their different ecosystems. They may answer on their own or work together as a team:

KEY TERMS (CONTINUED)

Specialist Species – A species with very specific and narrow habitat requirements, such as diet or shelter. Specialist species have often coevolved with their habitat or food source, and have difficulty adapting to new environments.

Species Evenness – The relative abundance of species in an area or ecosystem as compared to each other.

Species Richness – The number of distinct species found in an area or ecosystem.

Species Abundance – The number of individuals of a particular species found in an area or ecosystem.

1. Which of your sites were the most ecologically similar based on observed biotic and abiotic factors?
    a) Between your most similar sites, which ecological factors varied the least?
    b) Which ecological factors varied the most?

2. Which of your sites were the most ecologically different based on observed biotic and abiotic factors?
    a) Between your most different sites, which ecological factors varied the most?
    b) Which environmental factors varied the least?

3. What do you think are the top three ecological factors that helped you to easily differentiate one ecosystem from another? Why are these three factors important?

4. How did the similarities and differences among your different sites affect which species were found there?

5. What species were found at multiple sites?
    a) Were there species found at every site?
    b) Why do you think these species were so common?

6. Were there any species unique to only one site?
    a) What factors do you think limited the range of this species?
    b) What are its habitat requirements?

7. Define the terms generalist species and specialist species. Using your answers from Questions 5 and 6 above, answer the following:
    a) Which species identified were generalists?
    b) Which were specialists?
    c) Which species were in-between?

8. What adaptations were common among species in the similar sites?
    a) Why do you think organisms with these adaptations thrive in these ecosystems?

9. Which site had the greatest plant species diversity? Why do you think this is?

10. Which site had the least plant species diversity? Why do you think this is?

11. Which ecosystem was your favorite, and why?

12. What was something unexpected that you observed?

    a) *(Optional)* Independently research the unexpected observation and share with your teammates why you think you observed it during your investigation.