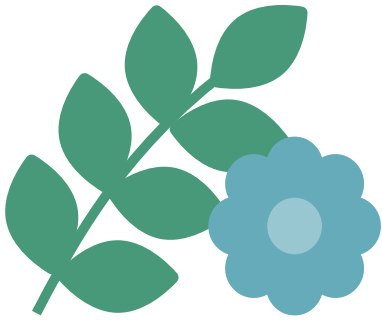




Engaging  
High School Students in

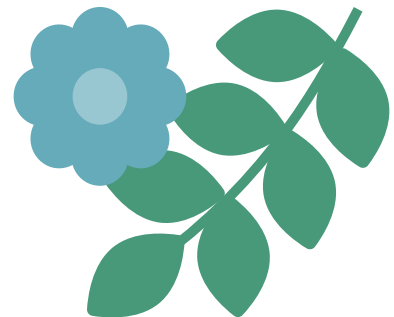
# SCIENTIFIC DISCOVERY

Citizen Science Lessons and Activities



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# What is Citizen Science?

Citizen Science is a public initiative that involves non-scientists participating in scientific research projects, typically by collecting or analyzing data. It allows individuals to contribute to real scientific research and discoveries. Participating in citizen science helps advance our collective knowledge of topics and solve problems.

Integrating citizen science into the classroom can enrich the learning experience, promote scientific literacy and empower students to become active participants in the scientific process. Some of the benefits citizen science activities provide include:

- **Engagement:** Citizen science projects can spark interest and engagement in science by providing students with hands-on experiences and opportunities to contribute to real research.
- **Critical Thinking:** Participating in citizen science encourages critical thinking, as students will need to analyze data, identify patterns and draw conclusions based on their observations in order to complete activities.
- **Interdisciplinary Learning:** Citizen science projects often span multiple STEM disciplines, providing opportunities to introduce and reinforce various subjects such as biology, ecology, environmental science and mathematics.
- **Teamwork Skills:** Citizen science projects can foster a sense of community involvement as students work together to address scientific questions and contribute to understanding and protecting the natural world.

The following activities were designed to nurture the curious minds of students while building their research and data analysis skills. There are lesson plans to guide educators through leading the activities as well as interactive worksheets for students to complete.

Happy exploring!

# Exploring Weather Patterns: A Citizen Science Adventure

**GRADE LEVEL:** 9-12

**DURATION:** 2 class periods (90 minutes each)

This citizen science lesson plan, aligned with Next-Gen Science Standards, engages students in hands-on exploration of weather patterns. Using weather instruments, EBSCO's Science Reference Source database and online platforms, students will actively collect and analyze data to gain a deeper understanding of meteorology and the role they can play in contributing to real scientific research.

## Objectives

By the end of the lesson, students will:

- Engage in hands-on learning about weather patterns and phenomena
- Understand the concept of citizen science and its role in contributing to scientific research
- Actively participate in data collection and analysis related to weather
- Use the library's science database (Science Reference Source) to enhance their understanding and research

## Materials Needed

- Thermometers
- Barometers
- Anemometers
- Rain gauges
- Cloud identification guide (use What'sThisCloud or print and distribute this handout: <https://observer.globe.gov/documents/19589576/51873111/GLOBECloudIDChartEnglish.pdf>)
- Notebook and pens
- Access to the library's Science Reference Source database

## Alignment to Next-Gen Science Standards

### Performance Expectations

- MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
- MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

### Science and Engineering Practices

- Developing and using models
- Analyzing and interpreting data
- Obtaining, evaluating and communicating information

### Crosscutting Concepts

- Patterns
- Cause and effect
- Systems and system models

## Lesson Outline

### Introduction (15 minutes)

Begin by discussing the importance of understanding weather patterns and their impact on daily life. Introduce the concept of citizen science and provide examples of successful projects. Emphasize Science Reference Source as a valuable resource for research.

### Activity 1: Setting Up Weather Instruments (20 minutes)

Divide students into small groups and distribute weather instruments. Guide them on how to set up each instrument and emphasize the importance of consistency. Encourage them to explore Science Reference Source to understand the scientific principles behind the instruments. Connect this activity to the performance expectation MS-ESS2-5.

## Relevant Articles:

- “Thermometers” by Diana C. Coe (AN: 149778574)
- “Weather Forecasting” by Susan Koehler (AN: 48382112)
- “The Cloud Conundrum” by Kate Marvel (AN: 126127596)

### Activity 2: Daily Weather Observations (20 minutes)

Instruct each group to make daily weather observations for the next five days. Encourage them to record data using the cloud identification guide. During this activity, guide students to Science Reference Source to supplement their observations with scientific explanations. Connect this to the performance expectation MS-ESS2-5 and the science and engineering practice of analyzing and interpreting data.

### Discussion (15 minutes)

Gather the students and discuss their observations. Encourage them to share any patterns or trends they notice in the weather data. Emphasize how Science Reference Source can provide additional insights. Connect this discussion to the crosscutting concepts of patterns and cause and effect.

### Activity 3: Data Analysis and Submission (20 minutes)

Guide students in analyzing their data, discussing averages, trends and anomalies. Encourage them to use Science Reference Source to explore any scientific papers or studies related to their observations. Introduce online platforms for data submission, connecting this to the science and engineering practice of obtaining, evaluating and communicating information.

Citizen scientists can submit their weather observations to mPING, a crowdsourcing weather reports app created by the NOAA National Severe Storms Laboratory. The weather reports submitted in the app help meteorologists track and predict weather patterns in the U.S. and around the world.

### Conclusion (10 minutes)

Wrap up the lesson by discussing the impact of citizen science on weather research and the importance of using reliable scientific databases. Encourage ongoing observations, participation in other citizen science projects, and continued use of the library’s resources.

## Assessment

**Formative Assessment:** Monitor group discussions during activities to ensure students are engaged and understand key concepts.

**Summative Assessment:** Evaluate the completeness and accuracy of students' data analysis, their ability to connect findings to the Next-Gen Science Standards, and their use of the library's science database in their research.

**Peer Evaluation:** Have students provide constructive feedback on their peers' presentations during follow-up research presentations, including the incorporation of library resources.

## Follow-Up (Homework or Extended Activity)

Assign students to further explore Science Reference Source for in-depth research on a specific weather phenomenon or historical weather event. Additionally, encourage them to investigate other citizen science projects related to weather using the library's resources and share their discoveries in the next class.

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

# Weather Observations Worksheet

Use the following chart to record your weather observations and their scientific explanations.

Day 1 | Date: \_\_\_\_\_

Time of Observation	Weather Description	Scientific Explanation (Why is this weather happening?)

Day 2 | Date: \_\_\_\_\_

Time of Observation	Weather Description	Scientific Explanation (Why is this weather happening?)




Day 3 | Date: \_\_\_\_\_

Time of Observation	Weather Description	Scientific Explanation (Why is this weather happening?)

Day 4 | Date: \_\_\_\_\_

Time of Observation	Weather Description	Scientific Explanation (Why is this weather happening?)


Day 5 | Date: \_\_\_\_\_

Time of Observation	Weather Description	Scientific Explanation (Why is this weather happening?)

# Taking Flight: Discovering Local Bird Species and Migration Patterns

**GRADE LEVEL:** 9-12

**DURATION:** 2 class periods (90 minutes each)

This lesson provides students with the opportunity to explore the art of birdwatching and the importance of studying migration patterns through research from Science Reference Source and a hands-on field activity. Students will learn how to identify bird species native to their region and have the opportunity to record their findings for use by other birdwatchers and scientists.

## Objectives

By the end of the lesson, students will be able to:

- Identify local bird species.
- Understand the concept of bird migration and its significance.
- Analyze bird migration patterns and the factors influencing them.
- Use scientific inquiry to conduct research and field observations.

## Materials

- Laptops/tablets
- Access to library's Science Reference Source database
- Binoculars
- Field guide to birds
- Identifying Birds and Migration Patterns Worksheet
- Maps of bird migration routes
- Camera (optional)

## Alignment to Next-Generation Science Standards

- HS-LS2-7: Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

## Procedure

### Day 1

1. Introduction to Bird Migration (20 minutes):
  - Begin with a discussion on bird migration: What is migration? Why do birds migrate? What are some common bird species that migrate?
2. Research Activity (30 minutes):
  - Divide students into small groups.
  - Assign each group a specific bird species known for migration.
  - Students research their assigned bird species including its migration patterns, routes, breeding and wintering grounds, and factors influencing migration.
  - Students can use the following resources from Science Reference Source as well as the maps of bird migration routes.
    - "Field Guide" by Audubon (AN: 159118472)
    - "Aviation Migration: The Ultimate Red-Eye Flight" by Paul Bartell & Ashli Moore (AN: 84204124)
    - "Essential Birds" by Arnold Ringstad (AN: 3122005)
    - "The Evolution of Birds" by Carol Hand (AN: 1895134)
3. Discussion (15 minutes):
  - Lead a class discussion based on the research findings.
  - Encourage students to share interesting facts and observations about the bird species they researched.
  - Discuss the significance of observing birds and studying their migration patterns and wildlife monitoring.

## Day 2

### 1. Field Activity (60 minutes):

- Take students on a field trip to a nearby park or natural area known for birdwatching.
- Provide binoculars, field guides and worksheets.
- Instruct students to observe and record bird species, behaviors and any evidence of migration. If you choose to bring cameras, encourage students to take photos of the bird species they find.
- Help students make connections between their field observations and research from Day 1.

### 2. Combining Research and Field Observations (30 minutes):

- After returning to the classroom, students should meet in their small groups to compile their field observations and research findings into a visual presentation. They can include photos taken during the field activity, compare and contrast research to their observations and reflect on the importance of bird migration and conservation efforts.

## Extension Activities

- Each group presents their visual presentations to the class. You can also invite the school community or local conservation organizations to attend.
- Have students submit their observations and findings to [eBird](#). This website can also be used by students for their research in the first part of the activity.

## Assessment

### Formative Assessment

Assess students while they conduct research in small groups and in the class discussion after.

### Summative Assessment

Evaluate the visual presentations and students' analyses of field observations, comparisons with research findings and reflections on bird behavior and migration patterns.

# Identifying Birds and Migration Patterns Worksheets

## PART 1: Research

Use Science Reference Source to research a migratory bird species and answer the following questions.

1. Name of Bird Species:
2. Location:
3. List 3 elements of your bird species' ecosystem (i.e. climate, food source, predators, habitat)
  - 1.
  - 2.
  - 3.
4. List five distinct behaviors and/or physical characteristics of your bird species.
  - 1.
  - 2.
  - 3.
  - 4.
  - 5.



## PART 2: Field Observation

After locating a bird and identifying it using the field guide, observe the bird and complete the chart below.

Bird Species	Description (color, size, etc.)	Behavior	Is this bird a migratory species?



# Flora and Fauna: Plant Biodiversity in U.S. National Parks and Locally

**GRADE LEVEL:** 9-12

**DURATION:** Three 90-minute class periods or equivalent

In this unit, high school students will use the library's Science Reference Source database to investigate and analyze the diversity of plant species in a U.S. National Park of their choice. They will then use what they learned to assess and document plant biodiversity in a local area, contributing to a larger scientific understanding of plant life. Educators can select a greenspace location within walking distance of school grounds or take students to a local park or conservation area.

## LESSON 1: BIODIVERSITY OF U.S. NATIONAL PARKS

### Objectives

By the end of this lesson, students will:

- Develop research skills by navigating and utilizing the Science Reference Source database to gather information on plant species in a chosen U.S. National Park.
- Understand the ecological role of different plant species within an ecosystem and the impact of human activities on biodiversity.
- Apply critical thinking skills to analyze and interpret data related to plant biodiversity, recognizing patterns and trends.
- Communicate scientific concepts effectively through the creation and delivery of a presentation on the importance of plant biodiversity, challenges faced by plant species, and potential conservation strategies.

### Curriculum Alignment to Next-Gen Science Standards (NGSS)

1. HS-LS2-7: Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
2. HS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy and groundwater resources are the result of past and current geoscience processes.

## Materials

- Access to Science Reference Source, specifically the National Park Infographics contained in the database
- Computers or tablets with internet access
- Notebooks or digital devices for notetaking
- Writing and drawing materials for presentations

## Procedure

### Day 1

#### **Introduction (10 minutes)**

Discuss the importance of plant biodiversity in maintaining healthy ecosystems. Introduce the NGSS standards and explain the connection between biodiversity, human activities and environmental impacts.

#### **Selecting National Parks (15 minutes)**

Provide a list of national parks and their locations. Each student or group selects a National Park they find interesting for their research.

#### **Research (60 minutes)**

Students use the Science Reference Source database to gather information about the plant species in their selected National Park. Encourage them to take notes on the types of plants, their roles in the ecosystem, and any threats to their survival.

### Day 2

#### **Analysis and Presentation (60-90 minutes)**

In groups or individually, students analyze their findings and prepare a short presentation. Presentations should include information on the importance of plant biodiversity, challenges faced by plant species in their chosen National Park, and potential solutions for conservation.

#### **Assessment**

Evaluate student understanding through their presentations, emphasizing accurate information, clear communication and relevance to biodiversity concepts. Use a rubric to assess research skills, critical thinking and the ability to connect scientific concepts to real-world issues.

## LESSON 2: PLANT BIODIVERSITY STUDY

Citizen science activities are a great way to engage high school students in hands-on learning and contribute valuable data to scientific research.

### Objective

To assess and document plant biodiversity in a local area, contributing to a larger scientific understanding of plant life.

### Materials

- Field notebooks
- Plant Biodiversity Study Worksheet
- Plant identification guides or apps
- Digital cameras or smartphones
- Tape measures
- Small flags or stakes
- Optional: GPS devices for geotagging locations

### Procedure

#### Day 3

#### Introduction (Classroom)

- Briefly explain the concept of biodiversity and its importance.
- Introduce the specific goals of the plant biodiversity study.

#### Field Trip

- Take students to a nearby natural area (park, forest or even the school grounds).
- Divide the area into manageable plots using tape measures.

#### Training

- Provide basic training on plant identification using guides or apps.
- Emphasize the importance of accurate data collection.

## Data Collection

- In each plot, students identify and document all plant species.
- Use flags or stakes to mark each identified plant for further observations.

## Additional Data

- Record environmental factors (temperature, soil type, etc.) in the Plant Biodiversity Study Worksheet.
- Optionally, use GPS devices to geotag locations for a spatial aspect.

## Photography

- Take pictures of each identified plant for further verification.

## Assessment

Assessment should emphasize both the process of data collection and the critical thinking applied in drawing conclusions from the study. Consider the following:

- Accuracy of plant identification
- Completeness and clarity of data collected
- Student engagement and participation in fieldwork
- Depth of student reflections
- Quality of summary report

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

# Plant Biodiversity Study Worksheet

## Plot Information

<b>Location:</b>	
<b>Environmental Factors:</b>	

## Plant Observations

### Plant 1

<b>Common Name:</b>	
<b>Scientific Name (if known):</b>	
<b>Description:</b>	
<b>Photo:</b> [Insert, attach or describe]	

### Plant 2

<b>Common Name:</b>	
<b>Scientific Name (if known):</b>	
<b>Description:</b>	
<b>Photo:</b> [Insert, attach or describe]	

## Plant 3

<b>Common Name:</b>	
<b>Scientific Name (if known):</b>	
<b>Description:</b>	
<b>Photo:</b> [Insert, attach or describe]	

## Environmental Data

<b>Outdoor Temperature:</b>	
<b>Soil Type:</b>	
<b>Other Observations:</b>	

## Reflection

What challenges did you face in plant identification?

How might the identified plants contribute to the overall biodiversity of the area?

## Conclusion

In 2-3 typed, double-spaced pages, summarize the key findings of your plant biodiversity study. Attach this worksheet to the back of your paper for full credit.