Citizen Science

Essential Question:
How can our community contribute to the study of environmental science?

Learning Objectives:

1. Students will understand concepts of weather and climate and describe the differences between the two.
2. Students will conduct short research projects to identify yearly changes in nature in their local areas.
3. Students will work cooperatively to analyze a problem concerning weather or climate events and propose solutions to lessen impacts to natural resources or historic buildings and structures.

Common Core Skills:

- Write informative/explanatory texts
- Produce clear and coherent writing
- Conduct short research projects
- Gather relevant information from print and digital sources

Time Required:

Three 40-minute class periods, plus homework time

Materials:

Weather or Climate? activity sheet; **Be a Resource Manager** activity sheet; **Citizen Science Vocabulary** activity sheet; **My Phenology Wheel** resource sheet; **Nature's Yearly Changes** resource sheet; **Resource Profiles** resource sheet; large sheets of paper; Internet access; pens; markers; magazines with nature images; bowls, plates, lids, or other large circular items for tracing

Vocabulary: phenology, climate, weather, inventory, monitoring, phenophase, adaptation, pollinators, decomposers, citizen science, unseasonable, ecosystem, invasive

Getting Prepared:

Collect magazines that students can use to cut out images of seasonal changes. Contact local federal land and water areas to explore the possibility of having your class interview a resource manager.

CLASS PERIOD 1

Getting Started:

1. Begin by asking: *How do we measure weather?* After students identify temperature, expand the conversation to other types of weather measurement, including humidity, precipitation, and cloudiness. Shift the conversation to the day's weather. Ask students if they think that the weather outside today is typical for the local area during the current season.
2. Ask if students have heard a meteorologist state that the weather will be "unseasonably" hot or cold. Have students explain what they think "unseasonable" means. Explain that scientists have been keeping records of weather conditions for hundreds of years. These records help scientists determine what "average" or "normal" temperatures or rainfalls are for specific areas of the country. The average weather conditions that occur on a regular basis over long periods of time are what we call climate. In other words, weather is what is happening in the environment in the moment, whereas climate is the usual weather conditions that repeat annually.
3. Pass out the **Weather or Climate?** activity sheet. After allowing students to complete the Venn diagram portion of the activity sheet, draw a large Venn diagram on the board and discuss each statement as you review the answers. *(Answers: Climate: b, d, j; weather: a, c, f, g, i; both: e, h.)*

Getting Engaged:

4. Review the concept of federal lands and waters with students. Remind them that government agencies help preserve and protect special areas of our country for public use and to manage natural resources for the future. Explain that federal land and water agencies depend on information about weather and climate to help them make decisions about land and water management.
5. Ask students how they think weather and climate conditions could affect land and water areas. Remind students that climate is an important part of ecosystems—areas in nature where plants and animals coexist. Describe how plants and animals rely on specific weather conditions to survive. Challenge students to imagine how high winds affect a forest during wildfire season or how warmer water temperatures could affect wildlife in and around coastal waters. Explain that people are also affected by weather and climate. Ask students to speculate how drought conditions would affect ranchers who depend on river water from federal lands for their cattle, or how floods caused by increasing snowfall might affect roads or bridges. Separate students into groups and ask groups to answer the **Weather or Climate?** Think it Through questions on a separate sheet of paper. Discuss their answers as a class.
6. Now that students have explored how weather and climate impact our environment, they will experience how resource managers work to protect federal lands and waters from climate impacts. Pass out the **Resource Profiles** resource sheet and the **Be a Resource Manager** activity sheet. Divide the class into groups and instruct them to review the federal land and water areas described on the **Resource Profiles** resource sheet. Answer any questions the students have. Provide time for students to work collaboratively to complete the activity sheet. Allow them to use the Internet to research how weather and climate events impact natural resources and historic structures.

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For example, students might search for news articles about how floods or droughts impact the environment or research what actions are taken to protect natural resources and historic structures from climate impacts.

7. Have the teams present their resource management plans to the rest of the class and explain what they determined were the potential threats and how they plan to preserve or protect their land or water areas. *(Answers: Lighthouse: 1. Rising seawater due to both seasonal hurricanes and climate change; 2. Marine mammals, endangered turtles, migrating fowl, vacationers, and residents; 3. Hurricane sea rise is related to weather; long-term change in ocean levels is related to climate. River: 1. Unusually heavy snowfall can make the river rise too high; 2. Trout, fishermen, kayakers, hikers, rafters, ranchers, cattle; 3. Unusually heavy snowfall is related to weather; a decline in average snowfall is climate related.)*

Extending the Learning:

8. Discuss with your class what the term "citizen science" means. Explain that people (including kids!) can contribute to the study of weather and climate by participating in citizen science projects. The Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) is a project sponsored by the National Oceanic and Atmospheric Administration (NOAA) and the National Science Foundation (NSF) to collect and map precipitation data for use in scientific research and analysis. Visit cocorahs.org to learn more about the project. Your class can sign up to participate in the project by gathering data on rain, hail, and snowfall and recording their findings on the CoCoRaHS website.

CLASS PERIODS 2 AND 3

Getting Started:

1. Tell students that they will continue to study weather and climate changes by exploring seasonal changes in plants and animals. Ask students how they know what time or season it is without looking at a clock or calendar. Students should provide answers such as daylight or darkness to determine time of day and whether it is warm or cold to indicate what season it is. Ask students what happens in nature over the course of a year. Make sure that students consider changes in both plants and animals.

2. Write the word "phenology" on the board. Explain that phenology comes from the Greek root words "pheno," which means to show or display, and "ology," meaning a branch of study or knowledge. So phenology is the study of how nature displays itself over the course of seasons and years. Each year, plants and animals experience seasonal changes. Those changes differ from region to region. In most regions, flowers bloom in spring and insects emerge in summer. For semitropical or more arid regions, the changes in the foliage and insect activity may be subtler. In cold weather climates, acorns may litter the ground in autumn and animals may grow thicker coats in winter. In warmer climates, animals may migrate to the region to escape a colder winter elsewhere. Explain that these changes in animals are called "adaptations."

3. Lead the class in a discussion about how plants and animals react to changes in the seasons. Under the word "phenology" on the board, list the four seasons: spring, summer, autumn, winter. Have students provide examples of what happens during each of the four seasons in your region, regarding:

a. Length of daylight during the day

b. Temperature

c. Amount and kind of precipitation (rain, hail, snow)

d. Changes in plants (budding, full leaves, fruit, color change, leaves fall)

e. Changes in animal behavior (migration, birth of young, mating, hibernation)

f. Changes in animal appearance (insect metamorphosis, fattened up for winter, bird or reptile molting, shedding of coats)

4. Project the **Nature's Yearly Changes** resource sheet on the board and have students answer the following questions in their science notebooks:

a. What time of year is it in each photo? What clues do you have that indicate the season?

b. What changes do you see in each species?

c. Why do you think these changes occur?

d. What weather or climate conditions could affect these changes?

5. Explain that resource managers at federal land and water areas monitor the yearly changes in plants and animals to track changes in their condition, numbers, or behavior. The collection of scientific data for study is called an inventory and the review of the collected data over time is known as monitoring. Have students speculate as to why resource managers maintain data collections about phenology and what decisions they might make based on analysis of the information. Resource managers develop information that helps explain the changes that are occurring in the area and develop a plan to help correct any issues. Some examples of the work

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resource managers do are: determining if a nonnative plant species is crowding out native plants and removing the invasive plants; identifying a food shortage and moving some animals to a new area so that there aren't more animals than food; and discovering that a species is suffering from a disease and working to control the spread of the disease while monitoring the animals who have contracted the disease. Resource managers also use data collection and inventory to monitor the numbers of animals or plants in an area. If animal populations are falling, resource managers might try to determine whether there have been reproductive problems for the species while also bringing pairs of breeding animals to the area or limiting human access to the area so animals have undisturbed space in which to breed and raise their young.

6. If time permits, pass out the **Citizen Science Vocabulary** activity sheet. Instruct students to start by using dictionaries or Internet searches to look up the meaning of each word on the activity sheet. Once they've defined each of the words, they can complete the crossword puzzle. You may choose to send this activity sheet home for homework.

Getting Engaged

7. Separate students into groups and provide them with time to research the local seasonal changes of the plants and animals in your area or region. Instruct students to look for such changes as: when trees and flowers bud and bloom, when pollination occurs, when animals birth their young, when leaves change color and/or fall from trees, and when birds and animals migrate into or out of your area. You may choose to have students complete this research for homework and recommend that group members choose one or two seasons to focus on.

8. When the research is complete, have students use the **My Phenology Wheel** resource sheet as a guide to create posters that illustrate local seasonal changes. To fill in their phenology wheels, students can use drawings, written descriptions, or pictures pasted in the wheel to describe the monthly seasonal events. Students can also use satellite images of their local areas to illustrate the center of their phenology wheels. Completed wheels can be displayed in the classroom or hallway.

Extending the Learning

9. Visit **everykidinapark.gov** and locate a federal land or water area near your school. Inquire at your selected federal land or water area if they conduct inventory and monitoring of the natural resources in the area. Find out if they will allow students to interview resource managers about their jobs and the resources they protect. Interviews could be done in person if a resource manager can travel to your school. If you select a federal land or water area outside of your local area, investigate the possibility of a video interview or a written interview by email. For live or video interviews, have students prepare questions for the resource manager in advance and record the responses.

10. Extend the learning further by having students share what they learned through a student-produced newscast or a newspaper article reporting on their interview. Make sure students explain who the interview subject is and what area is protected as well as provide information about the natural resources that are managed in that area.

Weather or Climate?

Place the letter from the following statements into the correct areas of the Venn diagram.

A. It snowed five inches last night.

B. Determining appropriate clothing for an upcoming trip to Alaska in August.

C. There has been no rain in our area this month.

D. There is typically less than two inches of rain in our area in June.

E. This winter should be colder than normal.

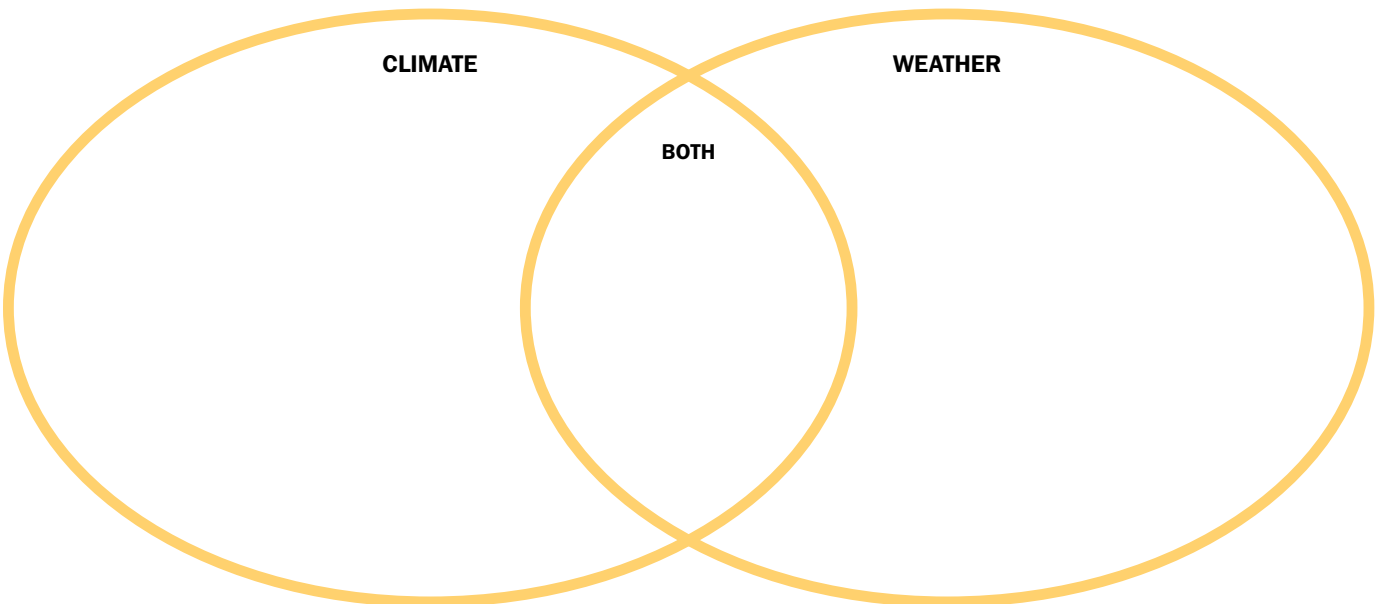
F. Deciding what clothes to wear today.

G. Barometric pressure is falling.

H. The low temperature last night was 10 degrees above normal.

I. There was golf ball–sized hail two times during storms this month.

J. The temperature has never been higher than 100 degrees in the month of May in this area.



Think It Through

Answer these questions on a separate sheet of paper.

What effects would changes in climate have on humans living, working, or visiting in a particular area?

What effects would changes in climate have on plants, animals, or the environment?

What might federal land and water resource managers do with the weather and climate data?

Be a Resource Manager

Team members' names: _____

Your team has been assigned to make resource-management decisions for a federal land or water area. Read about the two areas on the Resource Profiles sheet and choose one to focus on, then answer the questions below.

Which land or water area will your group make decisions about?

Lighthouse **River**

ASSESS THE THREAT

1. Which climate- or weather-related issues threaten your area?

_____

_____

_____

_____

2. How could these threats impact the usage of the area?

_____

_____

_____

_____

3. Of the two issues identified on the resource sheet, which issue is related to weather conditions and which issue is related to changes in climate?

_____

_____

_____

_____

Photo: Courtesy of National Park Service.

PLAN TO ACT

On a separate sheet of paper, write a plan describing what actions could help preserve or protect the area your group selected?

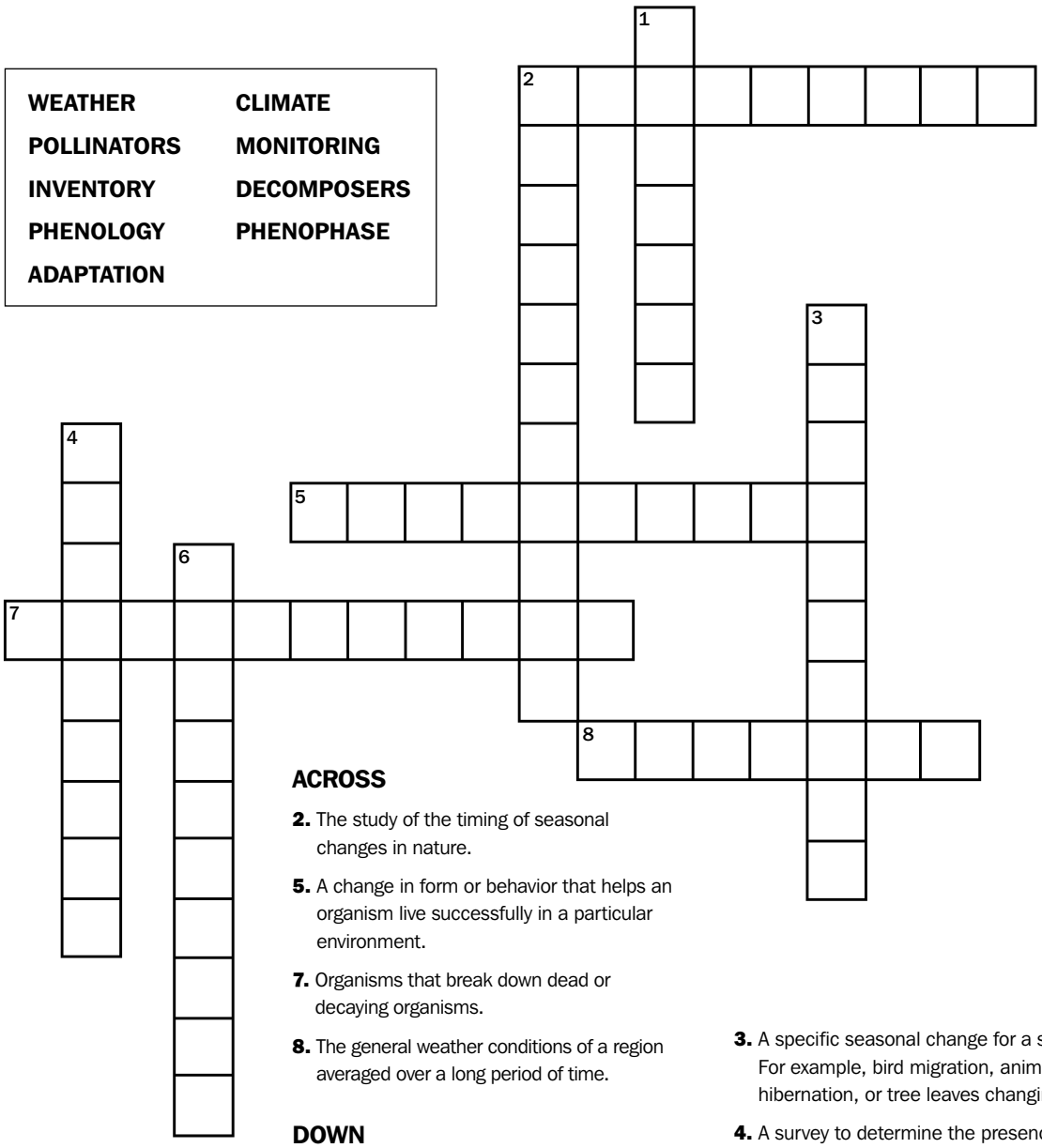
When you detail your plan, please consider the following:

- Buildings, roads, and structures;
- People living, working, or visiting in the area;
- Fish, birds, and animals in the area;
- Land or water uses, such as recreation, agriculture, or wildlife habitat;
- Changes in the land or water area, such as erosion or water level.

Citizen Science Vocabulary

Research the definitions of the vocabulary words in the box below, then complete the crossword below.

WEATHER	**CLIMATE**
POLLINATORS	**MONITORING**
INVENTORY	**DECOMPOSERS**
PHENOLOGY	**PHENOPHASE**
ADAPTATION	



ACROSS

2. The study of the timing of seasonal changes in nature.

5. A change in form or behavior that helps an organism live successfully in a particular environment.

7. Organisms that break down dead or decaying organisms.

8. The general weather conditions of a region averaged over a long period of time.

DOWN

1. The state of atmospheric conditions at a specific place and time with regard to heat, dryness, sunshine, wind, and precipitation.

2. Animals that move pollen within a flower or between flowers of the same species that lead to successful fertilization and seed or fruit production.

3. A specific seasonal change for a species. For example, bird migration, animal hibernation, or tree leaves changing color.

4. A survey to determine the presence, number, condition, and distribution of a species of plant or animal in a particular habitat.

6. The systematic collection of data over a period of time that provides information on changes in environmental conditions of the subject being studied.

Resource Profiles

THE RIVER

Photos: Courtesy of National Park Service.

Resource: A river that runs through mountains and forests. The river and surrounding landscapes are managed by a federal agency.

Usage: The gravelly bottom and clear water of the river provide ideal spawning grounds for three species of trout that are prized by sport fishermen. Vendors rent rafts to families and groups for rafting trips. The rapids sections of the river are popular with kayakers. Trails along the river provide hikers with close-up views of spawning trout and access to pools and scenic overlooks.

Downstream from the federal management area, local ranchers use the river for watering cattle. The river also promotes a healthy grassland for the cattle to graze.

Threats: This river receives water from melting snow in the mountains every spring. Its resource managers have been monitoring snowfall in the nearby mountains for more than 50 years. An unusually heavy snowfall last winter made the river unsafe for recreational activities. It also impacted the trout-spawning and cattle-watering areas, as a flooded river can cause mudslides or collapse riverbanks. Resource managers have found that the average snowfall in the area has declined by eight inches during the past 50 years.

Needs: Your team needs to determine what might be in danger from the melting snow and what actions you recommend to preserve or protect the area.

Background Information:

Wild and scenic rivers: nature.nps.gov/water/wsr.cfm

Trout species: nps.gov/yell/learn/nature/fish_images.htm

THE LIGHTHOUSE

Resource: A lighthouse on the shore of the Atlantic Ocean. The lighthouse and the surrounding land and water are managed by a federal agency.

Usage: People visit this area to swim, play on the beach, ride bikes, picnic, and go fishing. A visitor center, bathrooms, small shops, and restaurants are within walking distance of the beach. There are also homes nearby that people use for summer vacations or to live in all year.

The ocean has many varieties of saltwater fish, and endangered sea turtles nest along the seashore. Several species of ducks (mallards, scoters, pintails, redheads, and mottled) and geese (snow, blue, Canada, and white-fronted) live in the area. Large marine mammals like seals rest along the beaches during the winter and early spring. Other marine mammals like dolphins or whales are visible from the shore.

Threats: Resource managers for this lighthouse have been monitoring average sea levels for nearly 100 years. Every few years a hurricane threatens to raise water levels high enough to flood the lighthouse. Additionally, the data collection has determined that for the past 50 years, sea levels have risen approximately one inch every five years. If the sea level continues to rise, the water may reach the lighthouse base in the next 25 years.

Needs: Your team needs to determine what might be in danger from the rising seawater and what actions you recommend to preserve or protect the area.

Background Information:

Sea turtles: nps.gov/caha/learn/nature/seaturtles.htm and nature.nps.gov/biology/migratoryspecies/leatherbackturtle.cfm

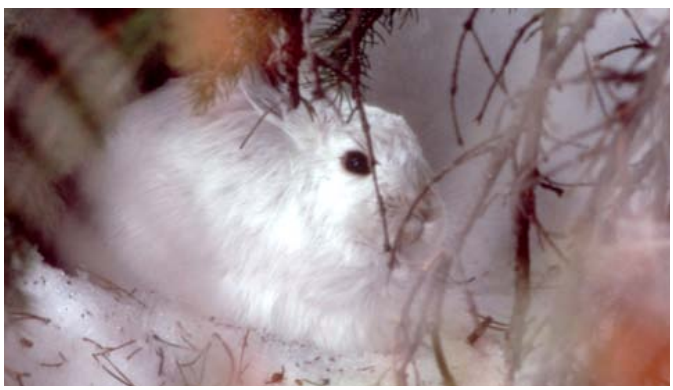
Migratory waterfowl: nps.gov/calo/planyourvisit/loader.cfm?csModule=security/getfile&PageID=61366 and digitalmedia.fws.gov/cdm/singleitem/collection/document/id/2116

Marine mammals: nps.gov/calo/learn/nature/loader.cfm?csModule=security/getfile&PageID=316402

Migration: nature.nps.gov/biology/migratoryspecies/index.cfm

Nature's Yearly Changes

Study the groups of photos below and determine how each group demonstrates phenology.



Photos: snowshoe hare on left,© cookiesfordevo/Fotolia; all other photos Courtesy of National Park Service.

My Phenology Wheel

After you have researched the seasonal changes in your area, use the diagram below as a guide to create a poster of your own large-scale phenology wheel. Complete your wheel with descriptions, drawings, or photographs of seasonal changes.