Phenology: Spring Leaf Index

A Carolina Essentials™ Activity

Overview

The study of related events, particularly between plants and animals that occur on a predictable or periodic cycle, is called **phenology**. Phenology studies are crucial to determining disruptions in environmental relationships as climate patterns shift, and phenology studies provide evidence of environmental changes.

In this activity, students interpret a Spring Leaf Index Anomaly map from the National Phenology Network and determine the areas of the country with the greatest anomalies. Then they identify the seasonal relationships between blue jay food gathering and ripening fruit on the northern red oak using an activity curve. After examining data from the different sources, students should be able to support or refute claims of climate change and its possible effects.

Life Science
Grades: 9–12

Phenomenon

Every spring, ruby-throated hummingbirds migrate from Central America to the southern and eastern part of the United States. Before migrating, a hummingbird consumes enough nectar and small bugs to store half its body weight in fat. During migration, the birds fly nonstop across the Gulf of Mexico, about 500 miles in about 20 hours. On an average day, hummingbirds consume double their weight.

Watch the short video and think about this question: What would happen if a late spring freeze killed the flowers? Jot down your thoughts.

Hummingbird feeding on Salvia

Essential Question

How can nationwide data be used to support claims of environmental changes?

Activity Objectives

1. Interpret a Spring Leaf Index Anomaly map.
2. Interpret activity curves for the blue jay and northern red oak.

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TIME REQUIREMENTS

PREP	ACTIVITY
15 min	30–45 min

Teacher Prep: 15 min
Student Activity: 30-45 min

SAFETY REQUIREMENTS

No PPE is required for the activity.

MATERIALS

Spring Leaf Index Anomaly Map (June 2018)

Activity curves for blue jays and fruiting northern red oaks (2017)

HELPFUL LINKS

UC Davis Hummingbird Health and Conservation Program (HHCP)

USA National Phenology Network

USA National Phenology Network: Status of Spring

REFERENCE KITS

Carolina Biokits®: Natural Selection

Carolina Biokits®: Emdangered Species

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Next Generation Science Standards* (NGSS)

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increase in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. **Analyzing and Interpreting Data** • Analyze data using computational models in order to make valid and reliable scientific claims.	**LS4.C: Adaptation** • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. **ESS3.D: Global Climate Change** • Though the magnitudes of human impacts are greater than they have ever been, so too are the human abilities to model, predict, and manage current and future impacts.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Stability and Change** • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Safety Procedures and Precautions

No PPE is required for the activity.

Teacher Preparation and Disposal

Prepare colored copies of the student pages if the activity is not delivered digitally. If copying is limited, copy a class set or project the map and chart for student use.

Student Procedure

A. Map—Spring Leaf Index Anomaly

1. Examine the map for patterns and relationships between the onset of spring and geography, biomes, regional weather, ground cover, water availability, and anything else you can think of that may affect the onset of spring.
2. Make a list of your patterns and relationships and the evidence for each. Share your findings with the class.

B. Graph—Activity Curves for Blue Jays and Fruiting Red Oaks

1. Using the activity curves for the northern red oak and blue jay, describe the annual cycle of acorn production (ripe fruit) for the northern red oak. What evidence supports your claim?
2. Describe the annual feeding pattern (nut gathering) for the blue jay. What evidence supports your claim?
3. Make a list of your descriptions and share them with the class.

Teacher Preparation and Tips

1. *Review with students what the term anomaly means and that when working with climate data, averages or means are calculated over a 30-year period. That means the spring leaf index of the current year is being compared to the average of spring leaf indices of 1981 to 2010.*
2. *Students can share ideas orally, on a master list or spreadsheet, or possibly as a gallery walk.*
3. *Make certain that students are identifying the curves correctly.*
4. *Students can share ideas orally, on a master list or spreadsheet, or possibly as a gallery walk.*

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Data and Observations

See the map and the activity curves.

Analysis and Discussion

1. Summarize the onset of spring for the contiguous Unitied States. Address the regions of the country, whether spring was early, late, or on-schedule, and the evidence that supports your claim.

   "Spring leaf out has arrived in all of the Continental United States and most of Alaska. Spring arrived 1 to 3 weeks late in the Southeast, northern Great Plains, Midwest and Northeast, and 1 to 3 weeks early across the central Great Plains, Ohio Valley and mid-Atlantic, compared to a long-term average (1981–2010). The west is a patchwork of early and late arrivals." USA National Phenology Network. 2018. "Status of Spring." Accessed June 14, 2018. https://www.usanpn.org/news/spring.

2. Using the activity curves, describe the blue jay's annual feeding relationship with the northern red oak. What evidence supports your claim?

   The peak of blue jay nut gathering is in November, slightly after the peak of northern red oak ripe fruit from about mid-September to mid-November. In early spring (mid-March), a smaller peak in northern red oak ripe fruit coincides with a gathering peak in the blue jays.

3. How might the blue jay have to adapt its feeding habits if there is an unusually early spring? What impacts might this have on the food web?

   If the northern red oak produced nuts that ripened early, the blue jay may not have an adequate food supply. The blue jay population would have to seek nuts of other trees. The food web would be altered as the northern red oak nuts would be removed as a link in the blue jay's food chain. Students may say that some blue jays may starve to death.

4. How might the blue jay have to adapt its feeding habits if there is an unusually late spring? What impacts might this have on the food web?

   If there is an unusually late spring (mid-May), northern red oaks would be producing ripe fruit during a time when blue jays were not gathering. Maybe fallen nuts could produce sapling trees; maybe other birds would eat the nuts ripening later. The blue jays, however, would not have spring northern red oak nuts to gather. Blue jays are not normally gathering the northern red oak nuts during late spring, so their food chain would be unchanged. Other bird or small mammal species may add a link to the northern red oak nuts, increasing the number of links in the food web.

5. If spring were to come 3 weeks early to the southern and mid-Atlantic states for the next 20 years, how might it affect the hummingbird? What far-reaching effects could it have on the ecosystem? Use evidence to support your claims.

   If spring were to come 3 weeks early for 20 years, the migrating hummingbirds would have to find new food sources that were blooming when they would normally arrive, they would have to adjust the time they migrated, or they would have to adjust their destination and migrate further north where spring is "on schedule."

   The hummingbirds rely on tubular flowers that hold nectar, and the flowers rely on the hummingbirds for pollination. If the flowers and birds are not in sync, then new relationships between flowers and hummingbirds will have to be established. Other animals could replace the hummingbirds as pollinators, and the birds could find alternate food sources. If altering the relationship is not possible, it may be that both the flower species and hummingbird species go extinct in their original location.

   If the birds move farther north, they may displace other birds or insects as pollinators or may have to share food supplies. Less than adequate food supplies may result in a decrease in population for the hummingbirds and the displaced species. Individual food chains and food webs will be disturbed as relationships change.

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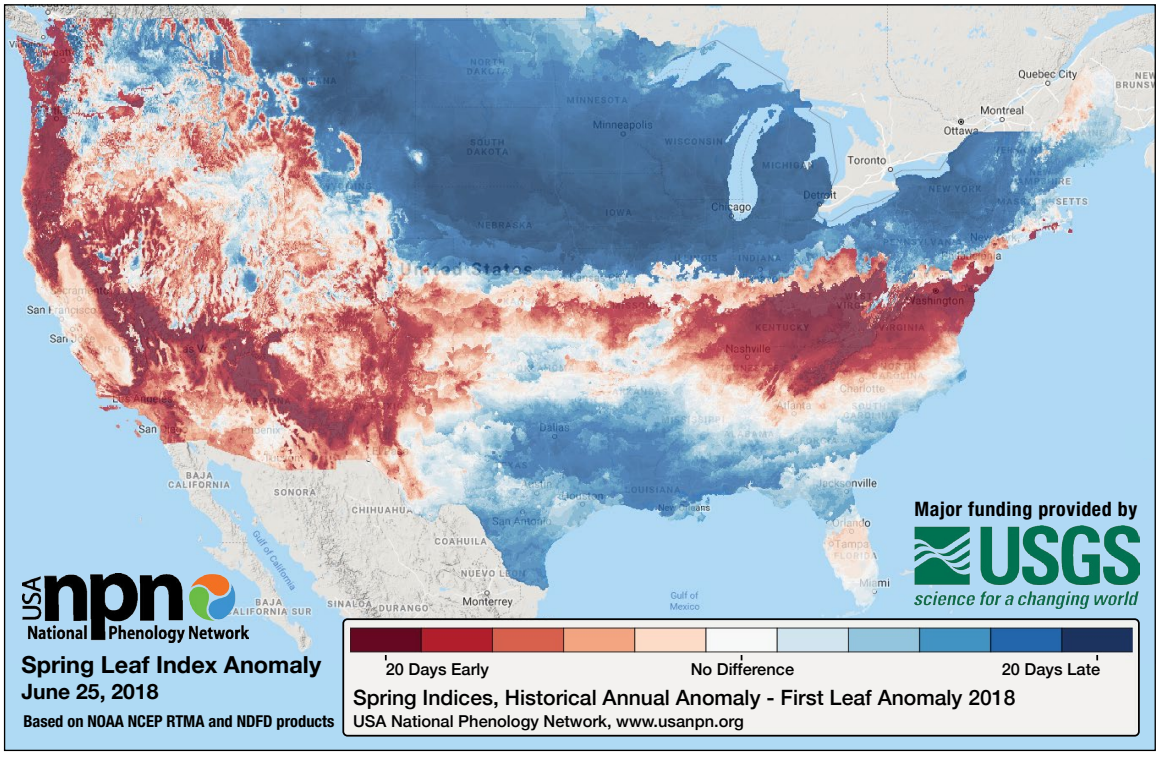

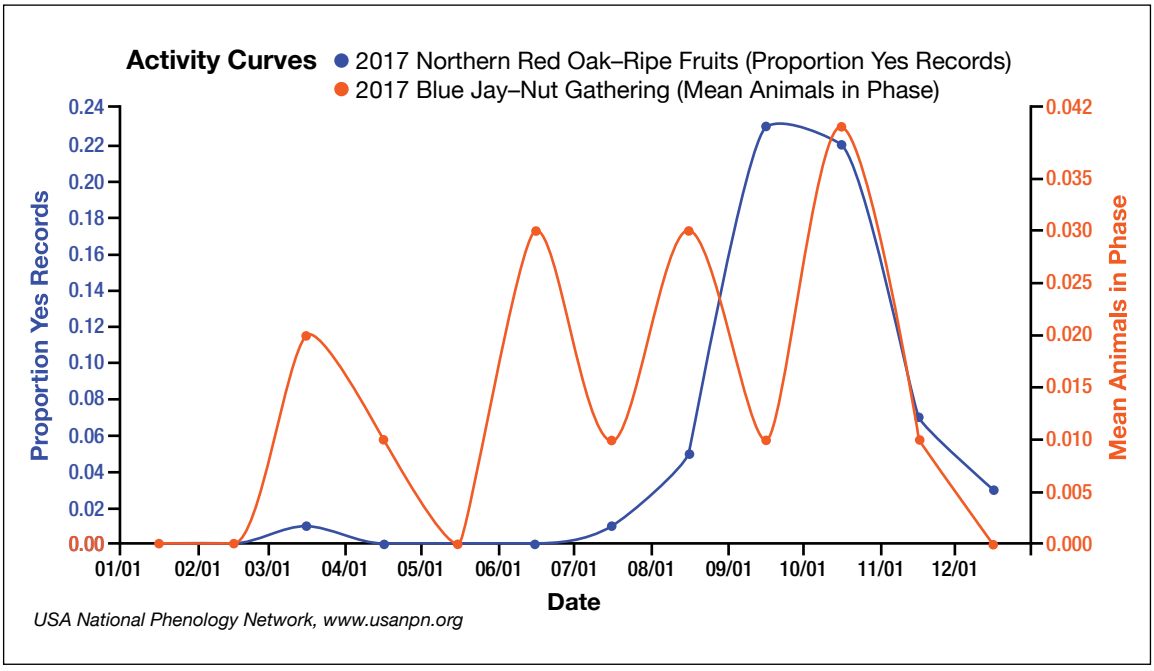

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