Phenology and Climate: Lesson 2

Timing of Bird Migration

Grade Level	10th – 12th Grade
Subject	Science
Course	Environmental Science

Essential Question

How do bird activity and migration change seasonally? Why is the timing of seasonal bird activity and migration important?

Summary

Building upon their understanding of insect migration phenology, students will explore the phenology and life history of a variety of bird species. Through scaffolded analysis of graphical data, the use of an interactive digital model, and life history descriptions, students will develop an understanding of (1) trends in bird migration, and (2) how bird life history influences migration patterns. From these activities they will draw conclusions about the biological significance of the data sets, and draw connections between bird and insect migration. Additionally, the will learn about how scientists collect bird migration data in general and specific to the data models they explored.

Snapshot

Engage

Students examine a model of migration timing of several species of warblers.

Explore

Students explore a model of species-specific bird migration patterns.

Explain

Students investigate the life history of birds and connect their annual cycle to changes in migration timing.

Extend

Students continue investigating the model of bird migration, identifying patterns over time and among species.

Evaluate

Students create visual representations of the relationship between insect and bird migration.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD401: Select data from a complex data presentation (e.g., a phase diagram)
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Oklahoma Academic Standards (Biology)

B.LS2.2 : Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
B.LS4.4 : Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Oklahoma Academic Standards (Biology)

EN.LS2.2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Attachments

- Lesson slides—Phenology and Climate Change 2.pptx
- Life History—Phenology and Climate 2.docx
- Warbler and Aerial Insectivore Guide—Phenology and Climate 2.docx
- Window Notes—Phenology and Climate 2.docx

Materials

- Lesson slides
- Sticky notes
- Poster paper (optional)
- Colored markers (optional)
- Colored pencils (optional)
- Blank white paper (optional)
- Life History handout (attached, 1 per student)
- Window Notes handout (attached, 1 per student)

Engage

Use **slides 2-4** to introduce the lesson's title, essential questions, and objectives.

Go to **slide 5**. Begin by asking students to explain some ways birds and insects are related. Specifically, you are helping students connect the previous lesson to the activities in which they are about to engage. After asking for student ideas, go to **slide 6** to provide context for the birds they will be investigating. If necessary, remind students that a "trophic level" indicates an organism's location in a food web.

Teacher's Note: Understanding the Graphs

Before turning students loose to freely investigate the data set, take time to walk them through how to interpret the graphs the model will generate. As part of this explanation, it is important to point out that the y-axis on the Arrival Date graph will change depending on the parameters they select. A detailed explanation can be found in the **Warbler and Aerial Insectivore Arrival Guide** handout or "Read Me!!" tab in the Shiny app.

Go to **slide 7** and direct students to use the link or QR code to access the "Warbler Arrival" page of the Shiny app. Go to **slide 8** to review the instructions for the I Notice, I Wonder strategy. Give students some time to explore the data and record their questions on sticky notes. If students need help finding a starting place, consider un-hiding **slide 9** and suggesting the listed focus areas.

After the students have had time to make some observations (I notice) and ask questions (I wonder), bring the class together to discuss their findings. First, ask for volunteers to share out what they noticed, and guide them to share their observations in terms of patterns. Then go to **slide 10** and answer the questions together as a class.

Teacher's Note: Guiding Questions

- Are there any species that show evidence of changing arrival times? If so, are they coming sooner or later and what is your evidence?
- How is warbler arrival changing over time, in general?
- What factors might impact birds' migration arrival time?

Conclude the activity by going to **slide 11** and having students add their questions to the Driving Question Board.

Explore

Following the discussion of bird arrival, students should direct their attention to the "Aerial Insectivore Migration" page of the Shiny app. Go to **slide 12**. Make sure students understand which variables they can change, before releasing them to answer the following question: "Which species tends to be the earliest to complete its northward migration?" For simplicity, they only need to use one map for this exercise, though they are welcome to use both. The students can ignore the data table below the maps for now.

After students have had time to figure out which species "gets to the north first," go to **slide 13** and ask each group to share out how they reached their conclusion. They should conclude that Tree Swallows tend to be the earliest arrivals north. Some groups may come to a different answer, depending on what data they explored within the model, but this is okay provided they can justify it.

Next, go to **slide 14**, and ask students to engage in a Collective Brain Dump to brainstorm some factors that would affect the timing of birds' migration north. Depending on your class, you can either do this informally, or have students turn their speculations into questions for the Driving Question Board. Encourage them to think about biotic and abiotic factors and to be specific. For example, if they offer climate as an answer, probe them for what aspect of climate they think is affecting birds (e.g., warmer spring temperatures). If they struggle to come up with ideas, prompt them to think about some of the factors that affected insects as a place to start.

Explain

Next, place students in groups of 3-4 to learn about of the bird species from the data they just explored. There are 10 bird species available in the Shiny data, and each group should be assigned or self-select one. Go to **slide 15** and provide students with the **Life History** handout. Direct students to use the link or QR code to first visit the All About Birds Guide website. They should search for their selected species, read over the Life History information, and fill out the graphic organizer.

After visiting the site, they can (1) return to the Shiny app to make more detailed notes about their species' range, or (2) visit the Audubon Guide to North American Birds website (**slide 16**) for additional life history information.

Teacher's Note: Further research

Under the "Life History" tab of the All About Birds Guide there is a link on the left sidebar that says "Learn more at Birds of the World." If students click on the link it will take them to a significantly more detailed overview of their bird. Depending on time and student interest, you might direct students to read the Historical Changes to the Distribution (under the Distribution heading), Movements and Migration, and Breeding. This overview is written at a higher reading level with more scientific vocabulary, so be aware that it may challenge some students.

Additionally, students should investigate some of the factors they brainstormed at the end of the Explore. These can be assigned to different groups, or students can explore whichever they are specifically interested in learning about. Go to **slide 17** and return to the Driving Question Board to facilitate this part of the exploration.

Ask student groups to share out what they learned about their species' life histories and any answers to the Driving Question Board questions they explored.

Slides 18-20 briefly describe basic bird life history, the annual cycle, and migration. It is up to your discretion whether to have students take notes over this information. Continue to **slides 21-25**. These slides provide an overview of some common ways bird data is collected. Detailed information and explanations to share with students are provided in the notes section of these slides.

Return students attention to their Shiny observations. Lead them in a discussion over the questions on **slides 26-27** to connect life history with the patterns they identified in the data.

Go to **slide 28**. Take a few minutes to add new concepts to the Big Ideas list before continuing to the next activity.

Extend

Go to **slide 29** and give each student a copy of the **Window Notes** handout. For the next data exploration, students will continue to use the Aerial Insectivore Migration page. They should select a bird species for Map 1 and compare the arrival timing for the species across several different years. They should make notes about any trends or patterns they see in the data. Students should record their findings using a modified Window Notes format, with the following categories: *trends within a year, trends between years, trends between species*, and *other interesting trends*.

Next they should repeat this process for a different species on Map 2, looking again for trends and patterns in this data set. After making their initial observations of the data, students are free to compare the maps in whatever way they want in order to gather more observations. This may include comparing the same species for two different years, comparing two species across the same year(s), or examining more species. Encourage students to make specific observations (e.g., patterns in latitude, timing, etc.).

If there are relevant Driving Question Board questions for students to explore with this model, have the class attempt to answer these as well.

Teacher's Note

If students are struggling to identify trends or patterns across the data, encourage them to start small with simple comparisons. A good starting place would be to examine a single year on both maps, comparing two species with very similar ranges and/or two species with very different ranges.

Have students share out some of their findings from the Shiny app activity and as a class discuss the significance of these results. Extend the discussion to answer the questions on **slide 30**.

Evaluate

To conclude the lesson, ask students to create a visual representation of how insect arrival/activity and bird arrival are related to one another, including how they are changing over time. This could take a variety of forms, including but not limited to: graphs or tables, flow charts, concept maps, illustrations, etc. Additionally, have them include a 1-3 sentence explanation of their representation. Modify **slide 31** to reflect the specific guidelines you want students to follow to complete the activity.

Provide students with poster paper, printer paper, colored markers, colored pencils, or other materials as necessary to the format you choose.

Teacher's Note: Optional Strategies

The following strategies would be appropriate for this activity if you feel your students need more structure to complete their representations. These can be used as written or combined/modified as you see fit.

- Cognitive Comics
- Concept Card Mapping
- Mind Maps
- One Pager

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Resources

- Birds, Bugs, and Phenology https://aeroecology.shinyapps.io/Birds_Bugs_and_Phenology/
- All About Birds Guide https://www.allaboutbirds.org/guide/
- Audubon Guide to North American Birds https://www.audubon.org/bird-guide
- Birds of the World https://birdsoftheworld.org/bow/home
- K20 Center. (n.d.). Collective brain dump. Strategies. https://learn.k20center.ou.edu/strategy/111
- K20 Center. (n.d.). I notice, I wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.) Window Notes. Strategies. https://learn.k20center.ou.edu/strategy/189
- K20 Center. (n.d.). Cognitive comics. Strategies. https://learn.k20center.ou.edu/strategy/198
- K20 Center. (n.d.). Concept card mapping. Strategies. https://learn.k20center.ou.edu/strategy/123
- K20 Center. (n.d.).Mind maps. Strategies. https://learn.k20center.ou.edu/strategy/1277
- K20 Center. (n.d.). One-pager. Strategies. https://learn.k20center.ou.edu/strategy/72