# Phenology and Climate Change: Lesson 3b

## Body Size, Migration Distance, and the Nature of Science



**Subject** Science

**Course** Biology, Environmental Science

## Essential Question

## Summary

This lesson is a direct continuation of Lesson 3a. Rather than an Engage, it begins with the final Explore activity.

## Snapshot

**Explore 3**

Students discover the relationship(s) between body size, migration distance, and climate change.

**Explain 3**

Students discuss why body size and distance impact migration under climate change conditions.

**Extend**

Students learn how well the models they explored match scientific data, and discuss some of the challenges of collecting and analyzing scientific data.

**Evaluate**

## Standards

*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-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

## Materials

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# Explore 3

Now that students have developed an understanding of phenological mismatch, they will now investigate factors which might impact a species' ability to respond to changing temperature. For the next activity, students will return to the Shiny app to explore the "Warbler Arrival" and "Aerial Insectivore Migration" pages. At this point they should turn their attention to the data tables included with these models. Using these tables as a starting point, students will compare species based on their body sizes and migration distances.

Split the class into four groups. Assign two of the groups to investigate body size and two to investigate migration distance. Each group has focus questions to guide their investigations, but if there are relevant DQB questions, they should investigate those at this point as well.

Groups should create a Research Poster to present their information. Their poster should include the following:

- Question and hypotheses
- Model Exploration (how and what data they explored)
- Results/Interpretation
- Conclusion (how their variable - body size or migration distance - could contribute to phenological mismatch)

Ask students to look at the "Temperature" page of the Shiny app. "Does this data set provide evidence of climate change? If so, what is the evidence?"

Class discussion of big-picture questions about climate change and its impacts on phenology

**Teacher's Note**

# Explain 3

- General climate change overview (?)
- Misconceptions about science throughout history
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**Teacher's Note: Nature of Science**

This is a good place to explore the nature of science in more detail. See the NoS lesson.

- Highlight the leaf hopper data set to talk about limits to data. List some of the discussion questions they've already addressed from Lesson 1. (What limits your ability to address these questions? Can you find situations where there are so many missing data that it becomes impossible to reach any conclusions?) Share with students that

# Extend

Using a modified Four Corners strategy, have students break into groups to evaluate different models from the Shiny app. Each group should identify strengths and weaknesses of their model (e.g., what can the model *not* tell us, how easy is it to interpret the data, etc.)

NoS in this unit: what are some of the things we/scientists are uncertain about, what are complications of data, what do we need to keep in mind, etc.

**Teacher's Note: Nature of science discussions**

- What can we infer about how scientists conduct their research from these data sets? (e.g., scientists collaborate with each other, answering big questions requires more data than a single person/lab could collect on their own)
- How much data is “enough” data to answer your questions?
- What is the best way to evaluate arrival time for a species? Why?
- How do we decide what temperature data to use (e.g., local vs. regional; time scale of days to years for averages; straight temperature or anomaly)? Why

# Evaluate

## Resources

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