Phenology and Climate Change: Lesson 3b
Body Size, Migration Distance, and the Nature of Science

Essential Question

Summary

This lesson is a direct continuation of Lesson 3a. Rather than an Engage, it begins with an Explain that provides additional context and scientific background for the Extend activity completed in the previous lesson.

Snapshot

Explain

Students learn about phenological mismatch and discuss the possible biological consequences.

Explore

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

Explain

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

Materials

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Engage

Return to any remaining student questions and determine if they can be answered.

Collective brain dump over what the class knows about climate change.

Engage

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Collective brain dump over what the class knows about climate change.

Explore 1

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 1

- General climate change overview (?)
- Misconceptions about science throughout history

Explain 1

- General climate change overview (?)
- Misconceptions about science throughout history

Explore 2

Scientific instruments NoS activity

Explain 2

NoS video and tweets

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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