Bird Migration and Climate Change

Key Concepts:
- Bird migration
- Climate
- Greenhouse effect
- Greenhouse gases
- Isotherm

WHAT YOU WILL LEARN

1. You will learn that the Earth’s temperature may be increasing due to increases in greenhouse gases.

2. You will learn the causes of bird migration.

3. You will analyze robin migration and temperature maps and predict whether or not an increase in the Earth’s temperature would affect robin migration.
**Engage Your Thinking**

How does climate change affect bird migration? Are spring migration dates changing? Are birds migrating longer or shorter distances? To answer these questions, you will look at climate change maps, migration maps, isotherm maps, bird migration data, and other websites to see if there are variations in bird migration. Answer the following questions to recall what you already know about bird migration and climate change.

1. How is climate change affecting the Earth’s temperature?

2. What determines bird migration?

3. How might climate change affect bird migration?

**Explore and Explain**

**Weather** refers to the physical conditions of the lower atmosphere: the temperature, precipitation, humidity, wind speed, and cloud cover for a short time period—, a day or a week. Although weather varies from day-to-day, the same weather patterns will recur over the years. These recurring weather patterns are known as **climate**. Climate consists of the most typical weather conditions for a location over a long time period (e.g., 30 years). Average temperature and average precipitation are the two main weather conditions that determine a location’s climate.
The Earth’s temperature changes begin in the stratosphere, 9-14 miles above the Earth’s surface. Scientists are working to document these temperature changes and to determine their causes. Temperature records indicate an increase from 1980 to the present (Figure 1).

![Graph showing average global surface temperature](http://www.iclimate.org/ccc)

Figure 1. Average global surface temperature (Source: EPA)

4. According to Figure 1, how much have temperatures increased from 1880-2006?

5. What is the temperature increase from 1980-2006?

The Intergovernmental Panel on Climate Change (IPCC) concluded that warming of the climate system is based on increases in air and ocean temperatures, rising sea levels, increasing amounts of snow, and sea ice melting. Greenhouse gases cause this warming. **Greenhouse gases** such as carbon dioxide, water vapor, nitrous oxide, and methane naturally occur in the Earth’s atmosphere. They trap radiated solar heat and re-radiate it back towards the Earth’s surface, warming it. This is called the **greenhouse effect** (Figure 2). Since the Industrial Revolution, human activities have added more greenhouse gases to the atmosphere.
6. According to Figure 2, how does the greenhouse effect work?

Are greenhouse gases responsible for climate change? Figure 3 shows the change in three of the greenhouse gases: carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).

7. Compare Figure 3 to Figure 1. How does the change in greenhouse gases compare to the change in temperature?

Why do birds migrate? **Bird migration** is the regular seasonal journey of many bird species. Birds migrate in response to changes in food availability, day length (photoperiod), habitat, and weather or a combination of these factors (for example, temperature and food availability). There are two types of migrants: short-distance migrants and long-distance migrants. Many long-distance migrants use day length while short-distance migrants use temperature to determine when to migrate.
Food availability is also an important factor causing bird migration. Insect eaters migrate while fruit and seed eaters often stay in an area during the winter because their food source is available throughout the year.

8. What cause birds to migrate?

Is climate change affecting bird migration? For many bird species, temperature influences behavior to migrate. For this reason, warmer temperatures may affect bird migration. For example, in central Europe, winter temperatures have increased and the number of migratory birds has decreased. A Kansas State University study found that the increase in temperatures from 1907-2007 (1.8-2.6° F) has affected the arrival dates of five bird species (1965 compared to 2007). Four species arrive earlier by an average of 9.4 days and one species is delayed by 4.5 days.

Is robin migration changing? Since the 1930s, Aldo Leopold recorded spring arrivals for several migrating bird species. A comparison of Leopold’s results with current bird migration data shows that the wood thrush now arrives one day earlier and the robin is arriving 21 days earlier than in the 1930s. Many robins are now spending the winter in their summer breeding grounds, switching their diets from worms to seeds and fruit. Other robins head south for the winter and seem to follow temperatures north for the spring migration. Look at the following figures to see whether or not robin migration follows temperature.

The American robin
(Source: *The Journey North*)
9. Looking at Figure 4, describe where the robins were sighted?

Using Figure 4, draw a line of best fit that separates half of the robins (area) to the north and half to the south of the line.

10. What is the latitude of the line you drew?
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Figure 5: Average isotherms (temperature line) for 2/5-18, 2007
(Source: NOAA)

11. Look at Figure 5, which temperature range does your robin migration line best match?
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Figure 6. Locations of robins for 2/22-3/21, 2007 (pink and red circles) (Source: The Journey North)

12. Compare Figure 6 to Figure 4; describe the change in Robin migration. Use the pink and red circles for 2/22-3/21.

Using Figure 6, draw a line of best fit for the 2/22-3/21 data that separates half of the robins to the north and half to the south of the line.

13. What is the latitude of the line you drew?
14. Look at the isotherms for 2/22-3/21, 2007 (Figure 7). Which temperature range does your line best match?
15. Compare Figure 8 to Figure 6; describe the change in robin migration. Use the blue circles for 3/22-4/18 (Figure 8) and the pink and red circles for 2/22-3/21 (Figure 6).

Using Figure 8, draw a line of best fit for the 3/22-4/18 data that separates half of the robins to the north and half to the south of the line.

16. What is the latitude of the line you drew?
Figure 9. Average temperature for 3/22-4/18, 2007 (Source: NOAA)

17. Figure 9 shows the average temperatures for 3/22-4/18, 2007. Which temperature does your line best match?

Some scientists say that robin migration follows the 36 degree Fahrenheit isotherm (temperature line). Scientists believe that robins follow this temperature line because of the availability of food and open water.

18. According to your maps and lines of best fit, does your data agree with the 36 degree Fahrenheit robin migration pattern? Explain your answer.
Extend Your Thinking

Because climate systems are so complex, scientists are unsure about how much the Earth’s temperature will be affected by the emission of greenhouse gases. Projections about future warming are tentative and subject to change (either upward or downward) as scientists learn more about the Earth’s climate. IPCC temperature projections indicate that the Earth’s temperature is likely to increase by 2.5 to 10.4°F (1.4-5.8°C) by the end of the century (Figure 10).

![Figure 10. The range in temperature projections (Source IPCC)](image-url)

19. How might an increase in the Earth’s temperature affect robin migration? On the map below, draw lines of best fit that predicts the April robin migration north for the years 2020, 2060, and 2100. (Note: use Figures 8 and 10 to help you make your predictions.)
Explain your predictions; why did you draw the lines you did?
If global warming is influencing bird migration, how might that affect competition for nesting sites? An important aspect of bird migration is finding nesting sites; early arrivals often have less competition for nesting sites than late arrivals. The Great Crested Flycatcher (a long-distance migrant) and the European Starling (a short-distance migrant) both use existing nesting holes previously carved out by woodpeckers. In Wisconsin, the population of Great Crested Flycatchers is declining while the population of European Starlings is increasing. Scientists think this is because the European Starlings are arriving before the Great Crested Flycatcher and therefore have first access to the nesting holes.

20. Why are the European Starlings nesting before the Great Crested Flycatcher?

21. How might global warming be causing the decline in the Great Crested Flycatcher population? Explain.

22. How could global warming affect the migration of short-distance migrants?

Apply What You Learned

On a separate sheet of paper, draw a concept map using these terms:

- greenhouse gases
- short distance migrants
- climate change
- migrating factors
- global warming
- long distance migrants
- human activities
- habitat change
- isotherms
- weather
- food sources
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Reflect on What You Have Learned

Now that you’ve learned about greenhouse gases, global warming, and bird migration, think about the questions you answered at the beginning of this activity and discuss changes in your ideas. How is climate change affecting the Earth’s temperature?

23. What determines bird migration?

24. How might climate change affect bird migration?