Bird Migration and Climate Change

Grade Level: High School

Performance Expectations: Students' ability to complete the following performance expectation(s) will be supported by participation in this activity.

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 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.

HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Dimension	NGSS Code	Corresponding student task in activity
Disciplinary Core Idea	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience:** ● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2, HS-LS2-6)	Students explore: ● how migratory animals are a component of, and interact with, multiple ecosystems throughout their lives, as they move across vast distances, even between continents. ● how migration patterns are affected by changes in food availability in both breeding and wintering grounds and along migration routes. ● how birds are migrating earlier to their breeding grounds because spring is happening earlier. ● how human-caused environmental changes (e.g. deforestation, climate change) are affecting the availability of resources for birds.
	ESS3.D Global Climate Change ● Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.(HS-ESS3-6)	Students learn how scientists are mapping the earlier arrival of spring due to climate change through measurement of plant leaf-out timing with remote sensing data and using patterns of bird migration to understand how this human impact is affecting ecosystems (advancing plant phenology is leading to complex changes in the arrival times of migratory birds).

		Students are introduced to the tools and technology that scientists are using to better understand bird migration patterns.
Practice	Developing and Using Models ● Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. ● Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.	Students interpret graphs and figures to explore relationships between phenology and timing of bird migration. Students use data from graphs and figures to construct explanations about changes in timing of bird migration.
	Analyzing and Interpreting Data ● Analyze data using tools, technologies, and/or models (e.g. computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	Students interpret remotely-sensed data to evaluate changes in phenology.
	Using Mathematics and Computational Thinking ● Use mathematical representations of phenomena or to describe and/or support claims and/or explanations.	Students use measures of central tendency and trend lines in graphs to determine if birds migration patterns are changing.
	Construction Explanations and Designing Solutions ● Construct and revise an explanation based on valid and reliable evidence obtained from sources (including the students' own experiments, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Students construct an explanation, using data and evidence from the lesson, to answer the driving question "Are bird migration patterns changing?" They are then presented with data to evaluate their expectation and are asked to revise accordingly.

	Obtaining, Evaluating, and Communicating Information ● Compare, integrate, and evaluate sources of information presented in different media or formats (e.g. visually, quantitatively) as well as in word in order to address a scientific question.	Students synthesize and evaluate a variety of sources of information (graphs, videos, figures) to answer the driving question “Are bird migration patterns changing?”
Crosscutting Concept	Patterns ● Mathematical representations are needed to identify some patterns ● Empirical evidence is needed to identify patterns.	Students explore how scientists use remotely-sensed data to study and understand changes in phenology and long-term bird arrival timing data to understand annual variability and long-term trends
	Stability and Change of Systems ● Much of science deals with constructing explanations of how things change and how they remain stable.	Students examine how phenology and bird migration patterns change over time including addressing the difference between short-term variability and long-term trends.

Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods and tools to make measurements and observations.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurements and observation.

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Science is a Way of Knowing

- Science is both a body of knowledge and the processes and practices used to add to that body of knowledge.
- Science knowledge is cumulative and many people, from many generations and nations, have contributed to science knowledge.