



## FOCUS QUESTIONS

- How does bird migration illustrate the interaction between biological systems and environmental factors?
- Many bird species rely on stopover habitats during migration. How might changes to urban ecosystems disrupt energy availability for migrating birds?
- Patterned window decals do not physically stop birds but significantly reduce collisions. What biological mechanisms explain why these patterns are effective?
- Migratory birds are part of complex food webs. How might a decline in bird populations due to window collisions impact the structure of ecosystems along their flyways?
- What type of data would you need to evaluate the effectiveness of a bird-safe design intervention?

## OVERVIEW

In the ***Building for Birds*** film, we explore how glass windows pose a major threat to migratory birds, with more than one billion dying from collisions in the U.S. The film features solutions from the Smithsonian's National Zoo and the Jacob K. Javits Convention Center, where bird-safe fritted glass and simple decals have reduced deaths along key migration routes. Since nearly half of collisions happen at homes, the episode shows how easy, low-cost fixes can make a big difference—and how anyone can help protect birds in their community.

## KEY CONCEPTS

- **Biodiversity:** Biodiversity refers to the variety and variability of life forms within an ecosystem, region, or the entire planet. It encompasses the diversity of species, genetic diversity within those species, and the variety of ecosystems in which they live. Biodiversity is crucial because it helps maintain ecosystem stability, resilience, and the functioning of natural processes, such as pollination, nutrient cycling, and climate regulation.
- **Conservation Biology:** Conservation biology is the scientific field dedicated to understanding and preserving biodiversity. It focuses on the protection of species, ecosystems, and natural resources from threats like habitat destruction, climate change, pollution, and overexploitation. Conservation biologists study the causes and effects of biodiversity loss and work to develop strategies to prevent further degradation of ecosystems and species populations.
- **Flyways:** A flyway is a migratory route used by birds to travel between their breeding and non-breeding areas. These routes often follow geographic features like coastlines,



mountain rangers, and river valleys, providing birds with a path rich in resources for resting, feeding, and sheltering during their long journeys. Flyways are critical for the survival of migratory species, as they connect essential habitats across vast distances. In North America, there are four primary flyways that migratory birds use:

- **Atlantic Flyway:** This path runs along the eastern coast of the U.S. and Canada, from the Canadian Arctic to the Gulf of Mexico. It includes major stopover points along the Atlantic Ocean, such as the Chesapeake Bay and Florida's wetlands.
- **Mississippi Flyway:** This flyway follows the Mississippi River and its tributaries, stretching from the Canadian border in the north down to the Gulf of Mexico. It is one of the busiest flyways, serving as a major route for birds migrating from central North America.
- **Central Flyway:** Spanning from the western Canadian provinces down through the Great Plains and into Mexico, the Central Flyway is a key route for birds migrating from the northern prairies to southern wintering grounds.
- **Pacific Flyway:** Running along the western coast of North America, the Pacific Flyway stretches from Alaska to Mexico. It includes vital coastal and wetland stopovers for birds migrating between the Pacific Northwest and Central America.
- **Habitat Fragmentation:** Habitat fragmentation refers to the process by which large, continuous ecosystems are divided into smaller, isolated patches of habitat due to human activities or natural events. These fragmented habitats are often separated by human development such as roads, cities, and agricultural fields. The resulting smaller, isolated patches can make it harder for species to find food, mates, or migration routes, which can lead to declines in biodiversity. For migratory species like birds, habitat fragmentation is a significant threat, as it disrupts the interconnectedness of habitats along flyways. Birds may struggle to find suitable stopover sites or may be forced to fly through hazardous urban landscapes, increasing their risk of collision with buildings or other human-made obstacles.
- **Migratory Species:** A migratory species is an animal that moves from one habitat to another at different times of the year, usually in response to seasonal changes in climate, food supply, or breeding needs. These migrations can cover thousands of miles and often follow the same paths each year. Migratory birds travel between breeding grounds (often in the north during spring and summer) and overwintering areas (usually farther south in the fall and winter). These seasonal journeys are crucial for their survival and reproduction. Along the way, they depend on a network of safe, resource-rich



stopover sites to rest and feed—making them especially vulnerable to changes in the environment, such as habitat loss.

- **Wildlife Corridors:** Wildlife corridors are natural routes that animals use to travel between habitats. They are crucial for species that migrate or roam, like birds, elephants, and salmon, allowing them to access food, water, and breeding areas. Human-made barriers like highways and cities can block these paths, making corridors vital for maintaining healthy, genetically diverse populations. These corridors can range from large-scale projects, like the [Yellowstone to Yukon initiative](#), to smaller ones, like the [Maya Forest Corridor in Belize](#). They help animals move across landscapes and avoid obstacles, playing a key role in conservation efforts.

## BACKGROUND

In the ***Building for Birds*** film, we're introduced to one of the most pressing yet often invisible threats to migratory bird populations: glass. Every spring and fall, millions of birds take part in long distance migrations across North America, navigating through cities, suburbs, and rural areas. However, many of these birds don't survive the journey. In the United States alone, an estimated one billion birds die each year after colliding with glass windows – a problem that is largely preventable using science-backed solutions.

This episode highlights how two major institutions— the Smithsonian's National Zoo and Conservation Biology Institute in Washington, D.C., and the Jacob K. Javits Convention Center in New York City— have become leaders in developing bird-friendly solutions. Both are located in densely populated urban areas situated along key migratory pathways (flyways). Birds migrating through these areas are particularly vulnerable to glass collisions. Reflective or transparent glass can appear to be open sky or habitat, causing birds to fly into them at full speed.

At the National Zoo, scientists and staff have implemented a straightforward yet effective solution: patterned decals on glass surfaces. These decals break up the reflective appearance of windows, allowing birds to recognize them as barriers. The patterns must be spaced closely enough— generally two inches apart— to be effective for small birds. This low-tech approach has significantly reduced collisions on the Zoo's campus and serves as a replicable model for other institutions.

In contrast, the Jacob K. Javits Center faced a more daunting challenge. Once one of the deadliest buildings for birds in New York City due to its vast glass facade, the convention center underwent a massive renovation that included the installation of bird-safe glass and the



creation of a rooftop green space. These changes not only drastically reduced bird collisions but also transformed the building into an unexpected refuge for urban wildlife.

Both of these success stories have helped inspire broader conversations about bird-friendly design and have even contributed to the development of new legislation aimed at making cities safer for wildlife. However, the film also emphasizes that individual buildings like these, while influential, represent only part of the solution. Nearly 50% of bird-window collisions occur at residential homes, where glass doors, windows, and sunrooms are ubiquitous and largely unregulated.

The good news is that anyone can take action. Educators, students, families, and communities can all be part of the movement to make our urban environment safer for birds. Simple, inexpensive interventions— such as drawing patterns on windows with soap, applying decorative decals, or using specially designed bird-safe tape— can prevent countless bird deaths each year.

### BIODIVERSITY THREATS

The five biggest threats caused by humans on biodiversity can be listed (in order of severity) using the easy to remember acronym **H.I.P.P.O.**: **H**abitat destruction and fragmentation, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**verharvesting.

In ***Building for Birds***, we see how urban development— especially the widespread use of glass— disrupts bird migration and contributes to biodiversity loss. Birds often mistake reflective windows for open sky or habitat, leading to fatal collisions.

### DISCUSSION QUESTIONS

- **[Before showing the film]** Have students brainstorm what they know about birds and their migration patterns. What are some reasons birds migrate, and what challenges might they face along the way?
- **[Before showing the film]** Have students discuss what they know about how animals interact with human-made environments. Have them provide examples where humans unintentionally harm wildlife.
- **[During or After the Film]** In the film, we learn that glass is an invisible threat to birds. Have students research another human-made threat to wildlife (e.g., light pollution, roads, noise) and compare how it impacts animal behavior or survival.



- **[During or After the Film]** Ask students to go online and search “great monarch butterfly migration.” How are the threats faced by monarchs compared to those faced by migratory birds? What do both species need to survive their long journeys?
  - Possible resources:
    - [The Great Monarch Migration– World Wildlife Fund](#)
    - [Monarch Butterfly Migration– U.S. Forest Service](#)
    - [Five Super Stops Monarch Migration Trail– U.S. Fish & Wildlife](#)
    - [Interactive Monarch Migration Map– National Wildlife Federation](#)

### POTENTIAL CLASSROOM ACTIVITIES

- **[During or After the Film]** Ask students to create a visual model or infographic that shows the migration journey of a single bird species, including stopover points, habitats, and other species that may use the same flyway. Have them include potential threats like major cities, etc.
- **[During or After the Film]** Challenge students to design their own bird-safe window decals, emphasizing the importance of the “2-inch rule.”
- **[After the Film]** Using a [Live Bird Migration Map from the Cornell Ornithology Lab’s BirdCast](#), have students identify the four major North American flyways: Atlantic, Mississippi, Central, and Pacific.
  - Ask students to choose one flyway and research:
    - What types of habitats are on that route
    - What kinds of birds rely on that route
    - Major cities or human developments birds must pass through
  - Discuss how urban development along these flyways might impact migratory birds? What kinds of conservation strategies could help protect birds on their journey?

### Curriculum Connections

#### [NGSS](#)

- HS-LS2: Ecosystems: Interactions, Energy, and Dynamics
  - 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.
  - LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.





- LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- HS-LS4 Biological Evolution: Unity & Diversity
  - LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- HS-ESS3
  - ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

#### [AP Biology \(2021\)](#)

- Big Ideas
  - Systems Interactions (SYI)
    - 8.3 Population Ecology
    - 8.6 Biodiversity
    - 8.7 Disruptions to Ecosystems
  - Evolution (EVO)
    - 8.7 Disruptions to Ecosystems
  - Energetics (ENE)
    - 8.2. Energy Flow Through Ecosystems
    - 8.5. Community Ecology

#### [IB Biology \(2025\)](#)

- A. Unity and Diversity. Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.
  - A4.2 Conservation of biodiversity
    - A4.2.3– Causes of anthropogenic species extinction
    - A4.2.4– Causes of ecosystem loss
    - A4.2.5– Evidence for a biodiversity crisis
    - A4.2.6– Causes of the current biodiversity crisis
    - A4.2.7– Need for several approaches to conservation of biodiversity
- C. Interaction and Interdependence. Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.
  - C4.1 Populations and communities



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