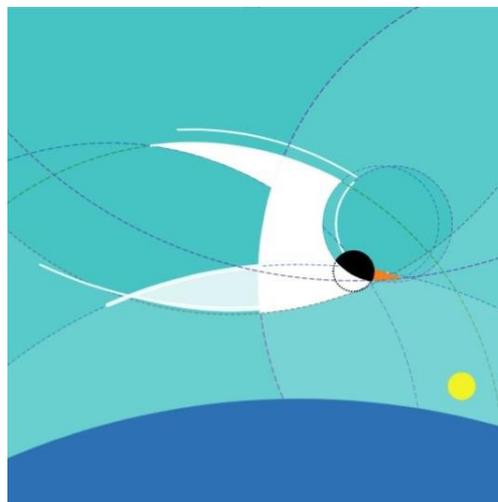


Expository – Biomagnetism and Migration

Migration in the animal kingdom is the seasonal movement of animals from one region to another. Migration is most commonly associated with birds. Our understanding of bird migration has evolved greatly since the 1700s and through modern technology, such as GPS Tracking, scientists have been able to learn more about the migratory patterns of birds. About 4,000 species of birds participate in some form of migration every year, but scientists are still seeking to fully understand the mechanisms behind migration.

Scientific research in this area has shown that birds use the following mechanisms to assist with migration:



- **Magnetoreception:** A relatively new scientific explanation for bird migration. Biologists have long wondered whether migrating animals such as birds and sea turtles have an inbuilt magnetic compass, enabling them to navigate using the Earth's magnetic field. Until late in the 20th century, evidence for this was essentially only behavioral: many experiments demonstrated that animals could indeed derive information from the magnetic field around them but gave no indication of the mechanism. In 1972, Roswitha and Wolfgang Wiltschko showed that migratory birds responded to the direction and inclination (dip) of the magnetic field. In 1977, M. M. Walker and colleagues identified iron-based (magnetite) magnetoreceptors in the snouts of rainbow trout. In 2003, G. Fleissner and colleagues found these iron-based receptors in the upper beaks of homing pigeons, both seemingly connected to the animal's trigeminal nerve. More studies need to be done, but it is clear that the earth's magnetic field plays an important role in animal migration.
- **Sun-Compass:** Studies have also shown that birds have an inner biological clock which allows them to compensate for the daily movement of the sun across the sky, so they can accurately determine compass direction at all times of the day. Like sailors, many migrating creatures use objects in the sky as a directional guide.
- **Star-Compass:** Birds; especially ones that travel nocturnally, also use stellar navigation as a directional guide. In the 1970's, researchers released garden warblers inside of a planetarium and then spun the stars on the screen. The birds faithfully headed "south" depending on what star configuration was projected above them. This showed that night-migrating birds use the Pole Star to determine their northward direction, regardless of the time of night.

Learning Target: Students will write a five-paragraph essay describing the migratory pattern of their bird as well as the migratory mechanism that researchers believe is used by that bird.

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Essay Instructions

1. Research the bird you chose for your bird art project. Make sure you answer the following questions:
 - a. What do we know about this bird?
 - b. What is their migratory pattern?
 - c. How and when was this information discovered?
 - d. What mechanism for migration do researchers believe is used for their migration (see above)?
 - e. Include history of the discovery as well as present-day research that led researchers to this understanding.
2. Write an outline and include the following:
 - i. Introduction with a hook
 - ii. Thesis statement
 - iii. Body
 - iv. Conclusion
3. Write Your Essay
4. Peer Review
5. Revisions
6. Cite your resources using [MLA9](#), such as:

Weir, Andy. *Martian: Classroom Edition*. Broadway Books, 2016.

Suggested Resources

- <https://www.audubon.org/news/lost-birds-rely-earths-magnetic-field-get-back-track>
- <https://www.vox.com/down-to-earth/22901324/birds-migration-navigation-earth-magnetic-field>
- <https://link.springer.com/article/10.1007/s00359-021-01529-8>
- <https://wildlife.org/watch-how-do-birds-use-earths-magnetic-field/>
- <https://www.sciencedirect.com/science/article/pii/S0960982220307260>
- [Birds' Flawless Flight Plan | Answers in Genesis](#)