



The Mysteries & Perils
of Migratory Birds

Glossary

Aerodynamics	The science that studies moving objects' interactions with the atmosphere.
Agriculture	The science of growing crops and raising livestock; farming.
Arthropods	Animals with hard external skeletons and jointed limbs, including insects, spiders, and crustaceans. Arthropods make up a significant portion of many birds' diets.
Austral	Pertaining to south, southern, or southerly or to the Southern Hemisphere.
Bernoulli's Principle	Relates air pressure to air speed and accounts for the net upward force, or "lift," that keeps a bird or airplane airborne. Because air moves faster over the curved upper surface of a wing, pressure on that surface is less than the pressure on the undersurface of the wing-this unequal pressure results in a net upward force.
Biodiversity	The total variety of life in all its forms and all its levels of organization-from the variety of genes within populations and the traits they represent to species and on to ecosystems and the ecological processes of which these different levels are a part. One important reason for maintaining biodiversity is because variety means greater stability, especially in terms of greater ability to withstand changes in the environment.
Brood Parasitism	The laying of eggs in the nests of other birds, who then incubate and care for the offspring. Brown-headed cowbirds do this to over 200 other species of birds in North America.
Diurnal	Active during the day. See nocturnal.
Drag	The force applied to a bird (or any object) by the atmosphere as the bird tries to move forward.
Excretion	Biological process whereby wastes are removed from within an organism. The urinary system is one example, in which liquid wastes in the form of urine are passed from the body.
Forest Fragmentation	A term used to describe the breaking up of large tracts of forest into smaller fragments due to construction of houses and stores, new roads, agriculture, etc. Forest fragmentation is part of the reason bird populations are in decline, because many species need large tracts of forest in order to prosper. Forest fragmentation also allows cowbirds to spread into new areas and gives predators easier access to birds' nests, further threatening the nesting success of woodland birds.
Gonads	The sex organs of an animal; testes for males and ovaries for females.

Grassland	One of the major ecosystems of North America, found mainly between the Mississippi River and the Rocky Mountains, characterized by large open spaces with many grasses and wildflowers but few trees. Generally synonymous with “prairie.”
Hyperphagia	Just prior to migrating, migratory birds accumulate a large amount of body fat by eating a tremendous amount of food. Some birds can nearly double their body weight in a short period of time. This behavior is hormone induced, is not engaged in by nonmigratory species, and helps the birds travel long distances without having to feed enroute.
Imprinting	Scientific term used to describe the behavior of some young birds who learn to follow the first large thing they see. This phenomenon is used by ornithologists to train the young of endangered species to follow their “parents” (frequently hand-held puppets designed to look like the real parents); this helps rebuild the population in the wild.
Internal Clock	The genetic and physiological factors within an organism that control the timing of certain behaviors or actions, such as migration. This type of control is not dependent on external factors in the environment, such as weather or changes in day length, although external factors can be involved in fine-tuning the setting of the “internal clock.”
Lift	A net resultant force (air pressure) upward; i.e., the force on a bird’s wing is greater below than above, due to the curved shape of the upper wing surface.
Lipid	Scientific term for fat, as opposed to carbohydrate or protein.
Magnetic Field	The area surrounding a magnet that exhibits magnetic force. Some migratory birds appear capable of detecting the Earth’s weak magnetic field as a means of orienting themselves for migration.
Migration	A predictable, regular movement by birds and other animals, usually between summer breeding grounds in the north and wintering grounds in the south.
Mist Net	A fine nylon net stretched across an open area of a forest or field to catch small birds for banding purposes. The net is nearly invisible and does not injure the captured birds.
Navigation	Process of using a variety of cues to find one’s way from one place to another; involves orientation, which is the determination of direction. Both orientation and navigation are necessary for birds to successfully migrate to the appropriate destination.
Nearctic	A biological region of the world encompassing all of North America north of the tropics (no farther south than southern Mexico).

Neotropical	Designating a biological region of the world extending from southern Mexico and the Caribbean islands to the southern tip of South America. The Neotropics have more bird species than any other region in the world.
Nocturnal	Active during the night. See diurnal.
Orientation	With navigation, necessary for birds to determine to successfully migrate to their appropriate destinations. Orientation involves setting off in the “right” direction, i.e., heading south in the fall and north in the spring.
Palaearctic	A biological region of the world that includes all of Europe, Africa north of the Sahara Desert, and Asia north of the Himalayas.
Passerine	Scientific term for birds that live on land and have feet designed for perching on branches or grass stems, such as robins, chickadees, and blue jays.
Pesticides	Chemicals used to kill animals or plants that are considered to be pests (for example, some insects and weeds). Birds and other wildlife that are exposed to these chemicals, often by eating contaminated insects or other prey, can die or suffer from other ill effects, including thin eggshells (thin shells mean that the egg will break easily before the development of the embryo is complete, leading to the failure of birds to reproduce).
Raptors	Birds of prey (hawks, eagles, falcons, and owls).
Songbird	Typically a small land bird of field, forest, or backyard that is often known for its ability to sing. Most people are familiar with these birds: robins, cardinals, blue jays, chickadees, sparrows, crows, etc.
Shorebird	Birds that have long legs for wading in mud and shallow water, such as the members of the sandpiper and plover groups of birds. Many of these species nest on the Arctic tundra and migrate long distances to winter in the Southern Hemisphere.
Tertiary	Third in place or order; said of treating waste water for a third time to remove additional impurities.
Thrust	A forward-directed force resulting from the wingbeat of a bird, which moves both down and backwards during its power stroke.
Tundra	The flat, treeless frozen plains of the far north.
Waterfowl	The group of birds that includes ducks, geese, and swans.
Zugunruhe	A German word that means “migratory restlessness,” i.e., a hormone-induced physiological state just prior to migration in which caged migratory birds have been experimentally observed to be noticeably “restless,” and who are capable of orienting themselves toward their proper destinations under artificial circumstances. See also hyperphagia.

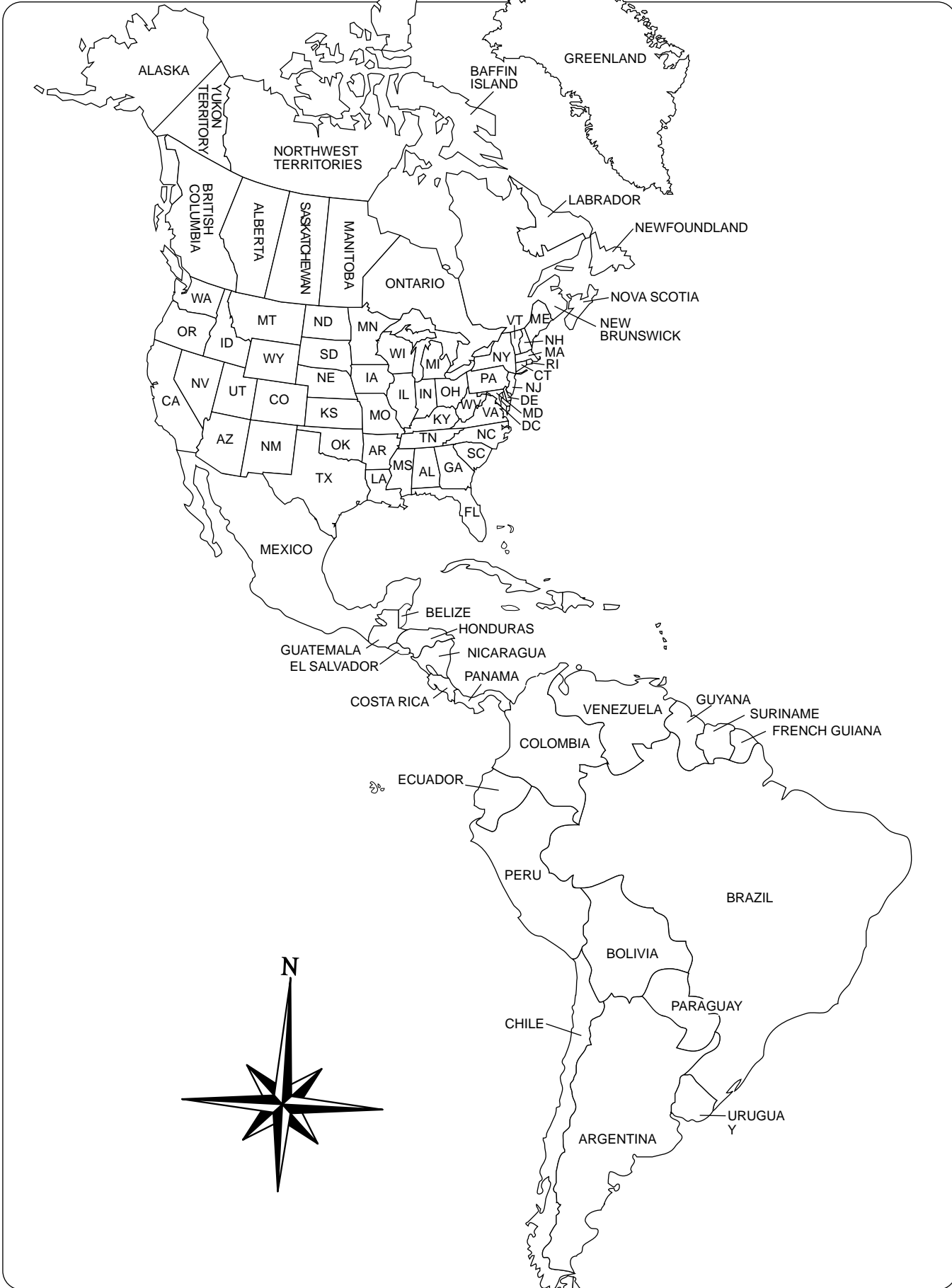
Bird Migration Activity

Perhaps no other aspect of nature captures the imagination of nature lovers more than the twice-yearly spectacle of bird migration. And it's no wonder-birds do amazing things when migrating. City parks and suburban backyards can suddenly be filled with dozens of colorful, singing warblers, tanagers, and thrushes; small land birds fly hundreds of miles over open water, seemingly without enough "fuel" to make it; thousands of individuals scarcely weeks old find their way to ancestral wintering grounds thousands of miles away and even though they've never visited them before, often without the help of adults; some hawk species can be seen migrating south on thermal air currents without flapping their wings ever, or so it seems! The list of amazing bird feats is nearly endless.

Following is an activity that allows youngsters to see what it is like to work at the U.S. Fish and Wildlife Service's Bird Banding Laboratory (BBL) in Laurel, Maryland. Scientists there are always receiving banding data from banders, research scientists, and bird watchers from all over the Western Hemisphere. They receive data on hundreds of species, not just the seven used in our activity, so what we are asking students to do here is simulate a small portion of the job of a BBL research scientist.

This activity is modified with permission from data contained in the National Wildlife Federation's "Birds, Birds, Birds!" edition of "NatureScope." Real banding data were used to create the original activity, and those data have been further modified by Mary Gustafson and colleagues at the BBL and Sean Duffy of Fairfax County Public Schools to make the activity as authentic and scientific as possible.

It has taken many scientists working together for decades, in collaboration with many amateur bird watchers and banders, to unravel some of the mysteries of bird migration: for example, where do birds go, what travel routes do they follow, when do they go, and how long does it take? Millions of birds have been banded over the years to try to answer these questions and many others, but only a small percentage of the bands have ever been recovered. Still, scientists have been able to piece together general migration patterns (both in terms of location and time) for hundreds of species by plotting banding records on a map in much the same way we are asking students to. Scientists have learned that birds are remarkably consistent in where they go and when, which makes the data presented in this activity highly representative of what most individuals of a particular species are doing when migrating. This means the students are doing what ornithologists have been doing for decades and are employing the same skills the scientists are: analyzing data, solving problems, searching for patterns, etc.



Directions:

1. Work lightly in colored pencil on your draft product; work with thin colored markers or more heavily with colored pencils only on your final product. (It's easy to make mistakes!)
2. Put a colored dot next to each separate piece of banding data. Use the same color for all the data for a particular species. For example, you should have eight dots of the same color for California gull and nine for osprey. (Notice that almost all numbered pieces of data actually contain two separate items of banding data.)
3. Cut out all the pieces of data for all the birds **after you have affixed the colored dots**. You should cut each numbered entry into the two pieces of data contained therein. Just be sure to put the colored dots in place first.
4. Mix up all the data into one big pile or bag. This is to simulate the way scientists at the BBL receive data, i.e., it comes in to them unsorted and in bunches.
5. One by one, begin plotting the data by pulling a paper out of the stack, and, using the correct colored pencil, put a dot on the map in the correct place. You may need to consult an atlas for some of the place names.
6. Continue in this fashion until all the little scraps of paper have been plotted. You may want to put a checkmark (✓) on each piece of paper once you have finished with it to keep track of things.
7. When you have finished, you can connect the dots. You should have seven fairly smooth curving lines—check your work if you have any sharp angles!

CALIFORNIA GULL

1. **September 11, 1989**. Bird found shot in a farm field in southwestern Saskatchewan had been banded in its nesting colony in the Northwest Territories (just north of Alberta) on **June 16, 1987**.
2. **December 15, 1991**. Of 42 gulls captured by biologists on Mexico's west coast, one had been banded before: on **September 21, 1988**, in south central Idaho.
3. **October 14, 1992**. Bird watcher observes peregrine falcon kill California gull in southwestern Nevada and retrieves band number from dead bird: it was banded on its wintering grounds on the west coast of Guatemala on **January 10, 1986**.
4. **September 30, 1994**. Bird with a six pack ring around its neck picked up dead at a garbage dump near Salt Lake City, Utah. Bird had been banded when brought back to shore in bedraggled condition after it alighted on a fishing boat off Baja, California, (Mexico) during a storm on **October 30, 1991**.

OSPREY

1. **September 24, 1985**. Immature bird captured near a lake in the Cascade Mountains was banded in the nest by a conservation biologist the previous **June 14** in northwestern Oregon.
2. **October 20, 1991**. Bird watcher takes injured bird to local zoo near San Diego, California, after witnessing collision with power line. Bird was previously banded in Costa Rica on **November 4, 1989**.
3. **November 21, 1992**. Bird found dead by local school children in central Peru had previously been banded and released six days earlier (**November 15**) after being captured by biologists during severe storm high in the Andes Mountains of Ecuador.

-
4. **October 30, 1988.** Bird that died after collision with small airplane in central Mexico had been banded on the west coast of Colombia while in migration on **November 7, 1982.**
 5. **November 23, 1990.** Previously unbanded bird is banded on the wintering grounds in west central Bolivia.

PEREGRINE FALCON

1. **September 22, 1989.** Bird found dead at base of lighthouse on Newfoundland Island, Canada, the day after a heavy fog and rain. The bird had been previously banded on coastal Long Island, New York, on **September 30, 1987.**
2. **October 12, 1983.** Immature bird observed for several days on a skyscraper in Miami had been banded in the nest on the 22nd floor of an office building in downtown Baltimore, Maryland, the previous **June 2.**
3. **October 4, 1993.** Previously unbanded bird captured at hawk-banding station on the coast of southern New Jersey (Cape May).
4. **November 1, 1991.** Bird captured by tropical biologists in central Brazil was one of three chicks banded in the nest in northeast Greenland on **June 10, 1989.**
5. **October 8, 1987.** Bird caught in a mist net at Cape Hatteras National Seashore, North Carolina, was previously banded by Canadian wildlife biologists on eastern Baffin Island on **September 12, 1986.** The bird was found in a weakened state by native fishermen the day after an early winter storm.
6. **September 28, 1985.** Unbanded bird found dead on south coastal Nova Scotia the day after a hurricane reached New England and maritime Canada.
7. **October 27, 1989.** Bird captured in eastern Venezuela was banded just the previous week (**October 18**) at a banding station in Puerto Rico.

RUBY-THROATED HUMMINGBIRD

1. **September 20, 1995.** Tropical research scientists observe hummingbird injure a wing in maneuvering away from a bat falcon. Unbanded bird subsequently died; data sent to U.S. Bird Banding Laboratory in Laurel, Maryland.
2. **August 19, 1988.** Bird seen at nectar feeder in central New Hampshire found dead below large picture window the next day, when it is discovered that it had been banded less than two months earlier on **June 25** in New Brunswick, Canada.
3. **September 8, 1992.** Bird caught by a research scientist in a wildlife refuge in southwestern Arkansas had been banded by a backyard hobbyist at a nectar feeder and mist net banding station one week previously, **September 1,** in south central Virginia.
4. **September 28, 1993.** Bird captured on its wintering grounds in central Nicaragua was previously banded on the north coast of the Yucatan peninsula on **September 12.**

WHOOPING CRANE

(Data for whooping cranes have been recorded differently from data for the other species because all individuals of the species are well known and they all have conspicuous leg bands, making sight records possible.)

-
1. **September 20, 1991.** Six young birds color-banded on the breeding grounds in the Northwest Territories on **June 8**, who stop to feed in eastern Saskatchewan with the rest of the flock, are observed by International Crane Foundation biologists tracking their migration.
 2. **October 28, 1987.** Local bird watchers observe cranes feeding and resting near the Red River on the southeastern border between Oklahoma and Texas.
 3. **October 7, 1983.** Migrating cranes put down in farmer's field during high winds in south central Manitoba. The farmer observes the conspicuous color bands and calls the local game department office.
 4. **October 24, 1981.** Bird found shot in farm field in east central Kansas.
 5. **October 24, 1993.** Local bird club members observe whooping cranes feeding with sandhill cranes along the Missouri River in east central South Dakota.
 6. **November 5, 1988.** Ecotourists in Corpus Christi on the Texas gulf coast observe flock of 40 cranes while on boat ride at Aransas National Wildlife Refuge.

YELLOW WARBLER

1. **September 15, 1995.** Bird caught in a mist net by tropical biologists in central Panama had been banded the previous year (**September 7, 1994**) in El Salvador.
2. **September 28, 1987.** One bird out of 217 individual birds representing 62 species caught at a tropical banding station in northern Peru already had been banded: a yellow warbler banded in central Mexico one month earlier on **August 28**.
3. **August 9, 1993.** Bird killed by a pet cat in central North Dakota had been banded in the nest as part of a bird population study in Prince Albert National Park, Saskatchewan, less than two months earlier on **June 19**.
4. **September 15, 1990.** Bird found dead on the coast of western Columbia the day after heavy rains had been banded in central Kansas as part of a brown-headed cowbird nest parasitism study, on **August 14, 1989**.

BOBOLINK

1. **August 15, 1990.** Seven bobolinks are banded on the North Carolina Outer Banks, including one banded previously on November 8, 1989, by biologists on the central Argentine pampas.
2. **August 7, 1981.** A bird found dead on a central Illinois farm, probably from pesticide poisoning, had been banded less than two months earlier as a hatch-year bird in southeastern South Dakota on **June 20**.
3. **August 28, 1994.** Dozens of birds from 14 species, including a bobolink banded in north central Brazil on **September 21, 1993**, are found dead on a Puerto Rican beach after a hurricane moves through the Caribbean.
4. **October 15, 1989.** Previously unbanded bird caught in a mist net at a research station in a grain field in central Paraguay.

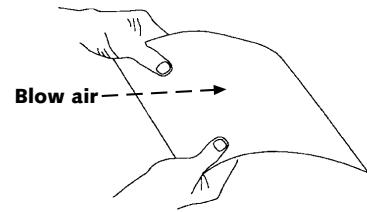
Bernoulli's Principle

Bernoulli's principle holds that moving air exerts less pressure in a perpendicular direction than stationary air and that the faster the air moves, the less pressure it exerts. The thickened leading edge of wings and their curved upper surfaces accelerate the rate of airflow over a wing relative to the flow of air under a wing. Since the air is traveling faster over the wing than under it, the air pressure down on top of the wing is less than the air pressure up on the underside of the wing. The result is a bigger push up than down, so birds and airplanes achieve lift in a relatively effortless fashion merely because of wing structure.

Following is a simple demonstration of Bernoulli's principle. It is an apt demonstration because the piece of paper, when held properly, approximates the leading edge of a bird's wing.

DIRECTIONS

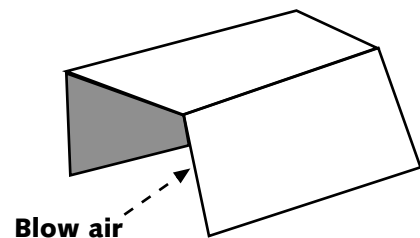
1. Using both hands, hold a piece of loose-leaf paper at two corners.
2. Allow the paper to hang below your hands. (See diagram.)
3. Blow air, gently at first, and then more vigorously, at the curved surface of the dangling paper.
4. Observe what happens, especially as you increase the velocity of the air stream. (Paper flutters **up**; pressure above has been reduced.)
5. Explain your results in terms of Bernoulli's principle and high- and low-pressure areas.



ADDITIONAL DEMONSTRATIONS

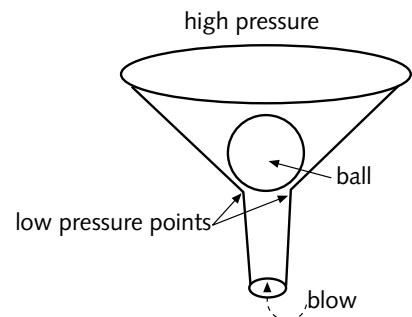
A.

1. Fold a small piece of paper in thirds.
2. Blow under the paper, perhaps with a straw.
3. Observe what happens to the paper. (Collapses because the pressure below has been reduced.)
4. Explain your results in terms of Bernoulli's principle and high- and low- pressure areas.



B.

1. Place a ping-pong ball in a funnel. The inverted neck of a plastic soda bottle works well.
2. Try to blow the ball out of the funnel by blowing up through the funnel from below.
3. Observe what happens to the ball and try to explain your results in terms of Bernoulli's principle and high- and low-pressure areas.



Books

Nonfiction Titles

The Audubon Society Encyclopedia of North American Birds. John K. Terres. Alfred A. Knopf, Inc. 1991. ISBN-0517032880.

A comprehensive reference book in dictionary format, this book is indispensable for any bird student.

Bird Migration. Donald R. Griffith. Natural History Press. 1964. ISBN-0844650404

Still a classic in the field of migration.

The Birds. Time-Life Books. 1979.

An excellent introduction to bird biology, covering most of the topics in the previous two titles.

Manual of Ornithology. Noble S. Proctor and Patrick J. Lynch. Yale University Press. 1993. ISBN-0300057466.

The beautiful line drawings make this book a new standard choice for introductory ornithology students of all ages, although the text is a bit dense.

Ornithology. Frank B. Gill. W. H. Freeman and Co. 1994. ISBN-0716724154.

Geared more to upper-level high school students and students in introductory college courses, but useful for the general student as well. A good book for interested adults without much of a biology background.

Sharing the Wonder of Birds With Kids. Laura Erickson. Pfeifer-Hamilton Publishers. 1997. ISBN-1570251290

A new title in the crowded field of bird books but clearly one of the best out there. Covers all the basics of birds: biology, watching, feeding, ecology, and conservation.

Words for Birds. Edward S. Gruson. Quadrangle Books. 1972.

This delightful book explains the origins of the names of every bird in North America, and is therefore very useful to the student who is curious about the sometimes obscure names of birds, both common names and scientific names.

Fiction Titles

Using the novels of Jean Craighead George is an excellent way to expand your unit on migratory birds from science and social studies into the language arts. All her books deal with some aspect of nature, many of them specifically with the interactions of people and birds, including migratory birds. Following are brief annotations for a few of her more popular “bird” novels, as well as one annotation for a novel by another author.

Books by Jean Craighead George

Summer of the Falcon. Harper Trophy. 1979. ISBN-0064400956.

The story of a 13-year-old girl who is given the task of training a falcon to hunt. An excellent look at responsibility, discipline, and adolescence.

Who Really Killed Cock Robin? HarperCrest. 1991. ISBN-0060219815.

Written at the height of the environmental movement in the early 1970s, this book has an eighth grade boy investigating the death of a robin. He links a number of environmental clues to the death of the bird.

Books by Other Authors

Wheel on the School. Meindert DeJong. Harper Trophy. 1989. ISBN-0064400212.

This is another excellent book in which migratory birds are central to the story line. In this novel, a bunch of Dutch school children wonder why storks (who winter in Africa) no longer nest on the roofs of the houses in their rural village and then spend the rest of their time attempting to bring them back. Probably more suitable to sixth grade because of the young age of the students in the book.

Also by Jean Craighead George, but not specifically about migratory birds.

The Cry of the Crow. HarperTrophy. 1988. ISBN-0064401316.

An adolescent girl secretly raises an orphan crow even though the other members of her farming family shoot crows on sight.

Dipper of Copper Creek. Puffin. 1996. ISBN-0140376224.

A boy discovers a most unusual bird while spending the summer with his grandfather in the Rocky Mountains.

Julie of the Wolves. Harpercrest. 1987. ISBN-0060219440

An Eskimo girl, who is lost on the tundra and is adopted by a pack of wild wolves, encounters all kinds of arctic wildlife, including a plover she keeps as a pet.

Three other Jean Craighead George books that feature birds as main parts of their stories are: *There's an Owl in the Shower* (about the spotted owl controversy; for younger or weaker readers), *My Side of the Mountain*, and *On the Far Side of the Mountain* (a book and its sequel about a boy training a falcon to hunt).