BIRDS
FORM & FUNCTION

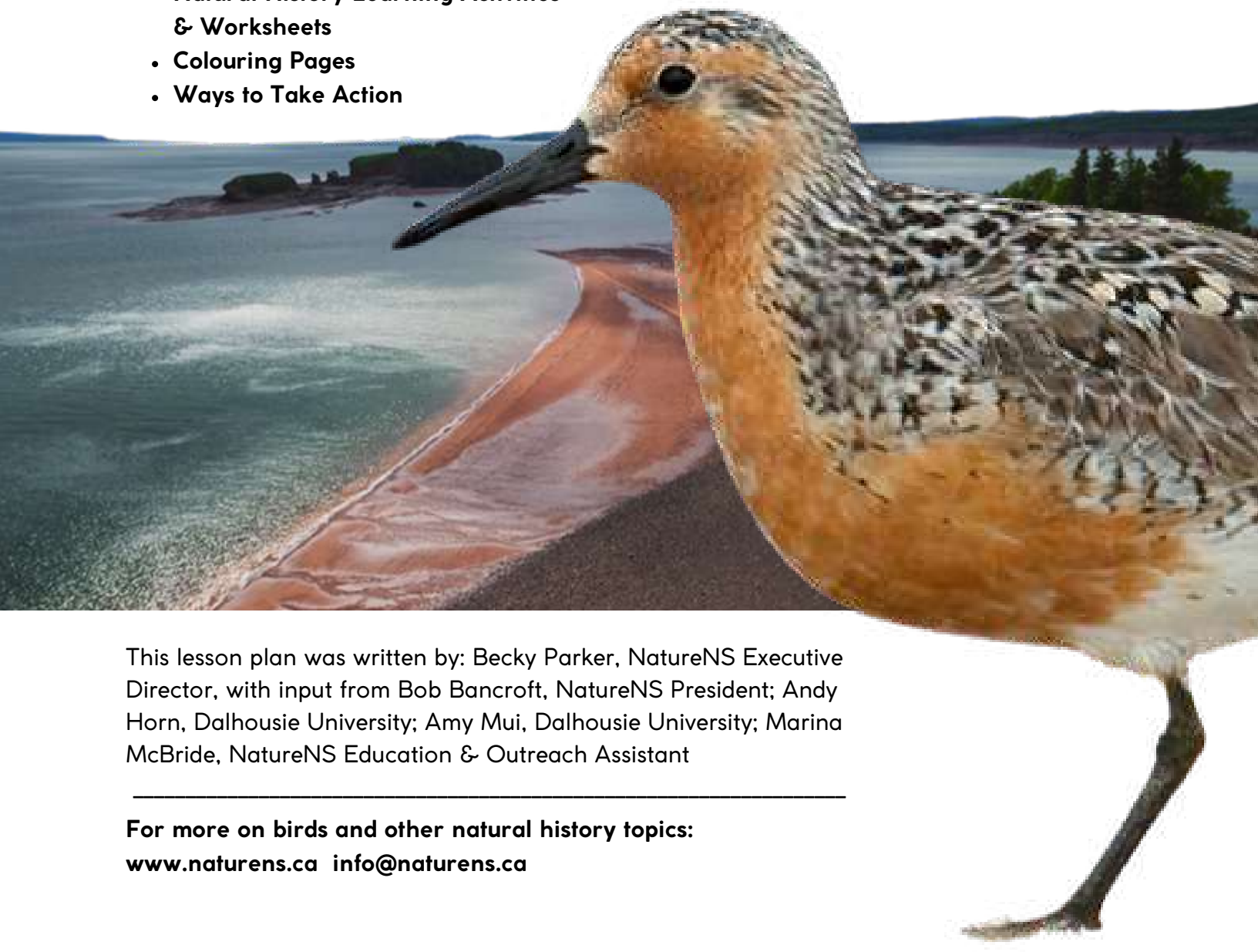
Lesson Plan
grades P-3

Themes
Birds, Habitats, & Protected Areas
Hands On Learning
Inquiry Based Learning

Concepts
Making Observations
Gathering Evidence
Scientific Reasoning
Patterns
Interconnectivity
Stewardship & Sustainability

Learning Outcomes
Learners will:
Compare living things
Construct a structure in response to a design challenge
Expand observations through the use of tools like binoculars

CONTENTS



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For more on birds and other natural history topics:
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BACKGROUND

On Migratory & Non-Migratory Birds in Nova Scotia: for the benefit of the educator's understanding and for helping to facilitate class discussion.

This backgrounder serves as a short, high-level introduction to bird form and function. The following pages have visual references you can share with students, as well as print-outs and instructions for activities students can do individually or in groups.

WHAT ARE BIRDS?

Birds are feathered theropod dinosaurs. That's right, dinosaurs! Birds are the only dinosaurs still living today! They belong to the evolutionary Class Ornithurae, which belongs to the Clade Theropoda, a branch of Dinosauria, making them not only descended from dinosaurs, but from a taxonomic perspective, dinosaurs themselves. They share many things in common with their dinosaur ancestors, including the ability to walk on two legs, egg-laying, a wishbone, and feathers. Birds have evolved many adaptations that allow them to live in the environments they do, to get around, find mates, and to eat different kinds of food. Some birds have similar anatomies because they are closely related to each other, like goldfinches and purple finches, and some birds have similar anatomies because of convergent evolution (where they develop the same adaptations independently), like hawks and falcons. But, whether adapted for running, swimming, hunting, or hiding, most birds share the same general body plan.

In flying birds, a specialized sternum (or "keel") supports powerful flight muscles. In some non-flying birds, like the penguin, the keel supports swimming muscles. Other non-flying birds, like ostriches and emus, don't have a keel at all. There are no flightless birds in Nova Scotia, though you might find that some seabirds, like the puffin, share some traits with penguins! Many flying birds, like chickadees, have hollow bones, making their skeletal systems light enough for flight, while some diving birds, like puffins, have tough and thick bones that anchor strong swimming muscles.

Birds have the largest eyes relative to their size in the whole animal kingdom! They also have very keen eyesight, thanks partly to a structure called the pecten oculi, partly to their ability change the shape of the lens very quickly, allowing them to switch focus from near to far very quickly, and partly to the flatter shape of their eye, allowing more of their view to be in focus. Forward facing eyes allow hunting birds to calculate distance. Side-positioned eyes allow birds to see more around them.

Bird wings also take many forms. All wings are made up of the same components (primaries, coverts, secondaries, etc) but in different relative sizing. Passive soaring wings have long primary feathers that catch rising warm air. Active soaring wings are long and narrow, good for catching wind currents. Elliptical wings are shorter and thicker, allowing for fast take off and quick maneuvers. High-speed wings are not quite a long as soaring wings and not quite as thick as elliptical wings, allowing for fast flight but also fast maneuvering, especially good for catching

fast prey. Hovering wings are small and light. Hovering birds also typically have specialized muscles allowing them to move their wings rapidly.

Feathers are specialized keratin structures that fulfill a number of needs, from insulation to flight capabilities to showy reproductive displays. They are surprisingly complex, arranged in a branching structure with overlapping segments that give the feather strength and flexibility. Birds also have scales, mostly found on their feet. Ruffed grouse grow specialized scales on the edges of their toes called pectinations that expad the surface area of the foot, acting like snowshoes.

Like many reptiles, birds tend to be uricotelic, meaning their kidneys extract and excrete waste as uric acid instead of urea or ammonia, as in mammals. They do not have bladders or urethras, so uric acid and faeces are expelled together as a semi-solid mass (or “guano”). Did you know that people used to harvest seabird guano for agricultural fertilizer? In fact, we still do in some places! The United States had a guano law that partly prompted the country’s annexation of several Pacific islands, where seabird colonies provided an ample guano supply. Countries have gone to war over bird poop!

BIRD LIFE HISTORIES

In ecology, “life history” refers to an organism's overall strategy for survival and reproduction throughout its life, and usually refers to organism’s at the species level, as a generalization of how all or most individuals behave. It encompasses the traits that influence an organism's development, reproduction, and survival. Essentially, it's the "story" of how an organism lives, from birth to death.

All birds are oviparous, meaning they reproduce by laying eggs outside their bodies. Most birds share the work of raising young, typically with a female staying close to the nest and a male foraging for food for the family. In Red-necked Phalaropes, though, it’s the opposite, and the males tend to the young and the females forage. In some bird species, like hummingbirds, only one parent takes care of a nest and the other parent isn’t involved at all. Some birds will pair with others of the same sex, even raising young from other birds’ nests. Some birds pair for life and some just for the season. Some birds are regular brood parasites, meaning they lay their eggs in other birds’ nests and leave them to be raised by the other bird, even birds of other species! Some bird species are more likely than others to engage in cooperative breeding, where helpers, usually older young, stick around to help raise the youngest birds in the family. Every now and then, researchers will spot an intersexed bird displaying a combination of male and female traits and participating in various roles within their families. The bird world is extremely diverse and fascinating, just like ours!

Songbirds and most seabirds have altricial young, meaning the hatchlings are helpless and dependent on their parents for care. They remain in a nest for some time while their parents feed and protect them. Precocial species, including many ducks and shorebirds, are hatched fully

feathered and mobile and they tend to spend less time in a nest, though their parents may continue to care for them as they learn about their environments.

Some birds live in Nova Scotia all year round. Some birds migrate south in the winter and north in the summer. Many warblers, for example, go South to Central and South America in the winter, while many Arctic-breeding ducks spend their winter vacation along the coasts of "Southerly" Nova Scotia. Some birds migrate only over short distances, either to slightly milder conditions or to inland or coastal locations where there is more food. Common loons in Nova Scotia, for example, spend the winter along the coast and the summer breeding season on inland freshwater lakes. Some species are also partly migratory, with some individuals migrating and some staying in the same area year-round, like the American robin. Climate change is altering these patterns.

The route that many migratory birds take on their Northerly or Southerly trips is called the Atlantic Flyway and it goes as far as Greenland in the North to the tropics of South America. Most birds follow the coast, but some may migrate directly over the ocean, flying hundreds or thousands of kilometres before stopping. The Atlantic Flyway contains important feeding and stopover habitats for migrating birds so it is crucial that the countries the route intersects cooperate with each other to protect birds throughout every life stage.

MONITORING BIRDS

Birds are interesting enough on their own to warrant scientific research, but they're also useful environmental indicators. Birds are ubiquitous throughout the landscape, with many different species occupying different habitats, some with continent-wide ranges, and some have very specialized needs, so observing changes in their populations can tell us something about our shared environments.

Scientists monitor bird populations in many ways. Sometimes researchers track individual birds, using technology like leg bands, tiny GPS units or satellite transmitters, and sometimes researchers monitor specific locations, looking for birds passing through. Motus Stations help researchers study birds carrying miniaturized tags that transmit their location information as they move. There are Motus Stations across Nova Scotia, picking up tagged birds' signals and helping scientists understand bird movements. Learn more about Motus at www.motus.org

Citizens can play an important role in monitoring bird populations by reporting sightings and volunteering on monitoring and stewardship projects. New to bird identification? You might try an app like Merlin, which can help identify birds by sight and sound. You can then report the birds you observe to eBird, where hobby birders and scientists alike keep track of local and global bird populations. Learn more at www.ebird.org

PROTECTING BIRD HABITATS

Bird habitats are protected through a number of legal and procedural processes and at varying levels of government.

The federal government adopted the Kunming-Montreal Global Biodiversity Framework (KMGBF) in December 2022, at the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15), and with it a set of goals and targets to work towards over the next few years. A major focus of the KMGBF mission is halting and reversing biodiversity loss by 2030 and restoring biological diversity levels by 2050. Canada's goals within the GBF include protecting 30% of lands and waters by 2030, respecting the rights and roles of Indigenous peoples, and addressing key drivers of biodiversity loss.

The Important Bird and Biodiversity Areas Program is a global initiative to conserve birds and their habitats, predating the KMGBF. Important Bird Areas (IBAs) play a critical role in national bird conservation efforts, encouraging legal protections, habitat stewardship, and promoting nature appreciation. IBAs are not legally protected in their own right, but, because they are vital for the conservation of many species, many IBAs do contain formal protected areas and infrastructure for public education, so they are important for achieving the goals of the KMGBF. View them online at: www.ibacanada.com

An older key conservation area-identifying effort, the Ramsar Convention, binds Canada and all other signed parties to work towards the wise use of all their wetlands through national land-use planning, appropriate policies and legislation, management actions, and public education. It was adopted as the first of the modern global nature conservation conventions and, today, is a highly regarded and active multilateral environmental agreement. Canada joined the Convention in 1981 and has had made strides in peatlands and carbon conservation, grasslands wetland restoration, economic valuation, and resolving mitigation issues in the time since. Canada has designated 37 Wetlands of International Importance (Ramsar sites) under the Convention, 3 of which are in Nova Scotia: the Musquodoboit Harbour Outer Estuary, Southern Bight-Minas Basin, and the Chignecto National Wildlife Area. Like IBAs, Ramsar sites aren't necessarily given legal protections but do tend to contain national, provincial, or other formal protected areas.

The protected areas system in Nova Scotia includes National Parks, National Wildlife Areas, Migratory Bird Sanctuaries, Provincial Parks, Wilderness Areas, Nature Reserves, and private Conservation Lands stewarded by land trusts. Each of these areas has a legal status as a protected area and receive varying levels of protection from development and human use that could threaten birds and other wildlife. You can explore protected areas in Nova Scotia using the province's online viewer at: www.novascotia.ca/parksandprotectedareas/plan/interactive-map

In Canada, a law called the Species At Risk Act (SARA) requires the federal government to study and protect species that committees of scientists consider to be at risk of extinction. Nova Scotia also has a provincial law called the Endangered Species Act (ESA) which mandates government to create reports outlining our current understanding of these rare species and to make plans for how we can all work together to save them. These laws also prohibit anyone from harming listed species at risk or their habitats. In addition to the ESA, bird populations in Canada and Nova Scotia are supported by several long-standing protections, including the federal Migratory Birds Convention Act, which safeguards migratory birds and their nests, and provincial laws such as the Wildlife Act and Beaches Act, which help conserve important habitats. Under both SARA and the ESA, Critical (also called "Core) Habitat must be identified for listed Species At Risk. This habitat is considered crucial for species recovery but, to date, no regulations or orders protecting species at risk critical habitat have ever been issued under the Nova Scotia ESA. As more species are listed under SARA and federal and provincial processes for protecting rare species are increasingly criticized, consensus has emerged on the need for a prioritized, multi-species, stewardship-based approach to better focus on recovery outcomes and undertake needed actions in an effective and timely manner. The federal government, provinces and territories, Indigenous Peoples, and other conservation partners have been working together to implement this approach, called the Pan-Canadian Approach, since 2018, concentrated on priority places, species, and sectors. Eleven priority places have been established that are hotspots for species at risk, one of which is located in Nova Scotia: Kespukwitk / Southwest Nova Scotia. You can learn more about these priority places and species at https://environmental-maps.canada.ca/CWS_Storylines/index-ca-en.html#/en/priority_places-lieux_prioritaires

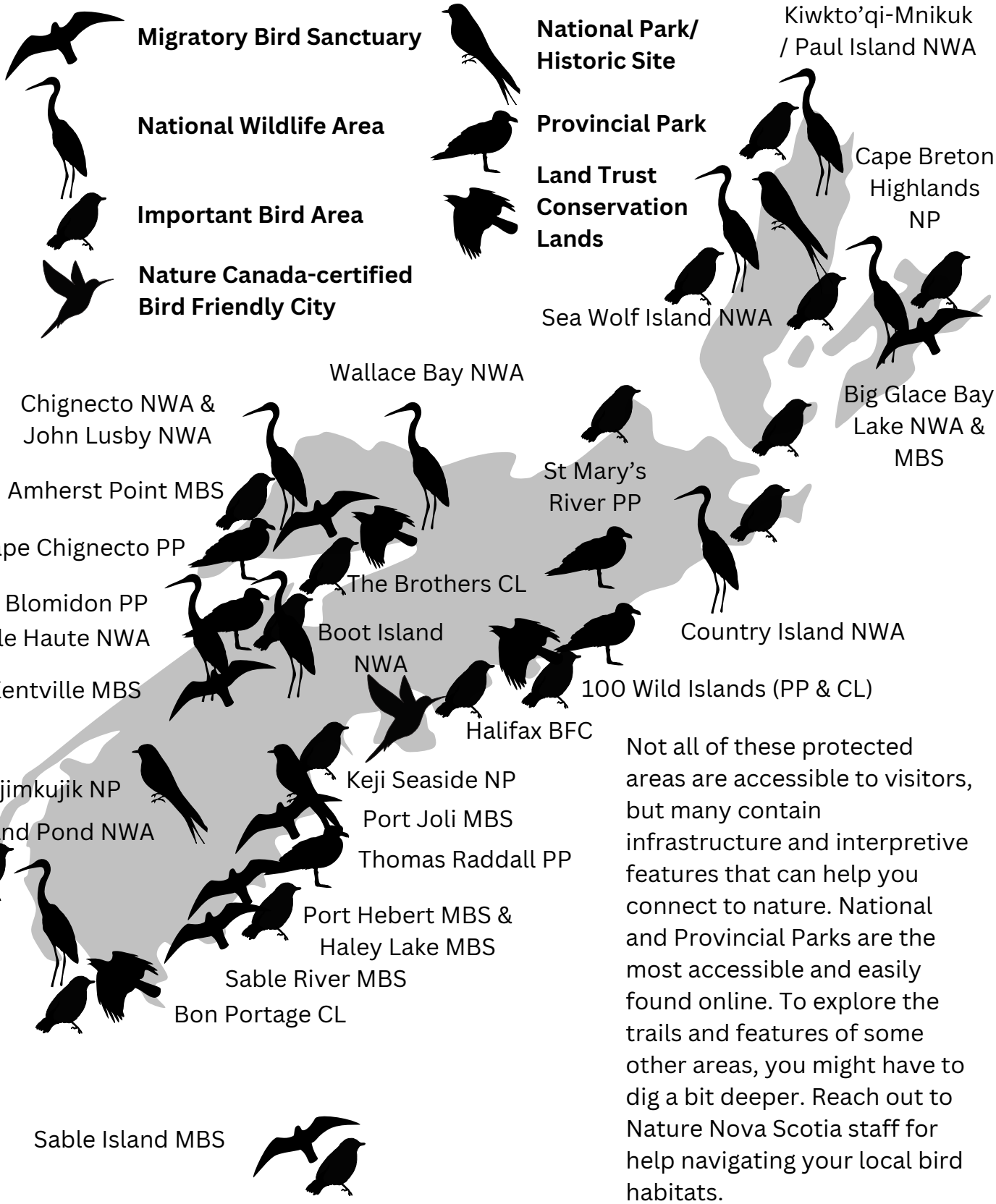
SPOTLIGHT ON NATIONAL WILDLIFE AREAS & MIGRATORY BIRD SANCTUARIES

Environment and Climate Change Canada (ECCC) establishes National Wildlife Areas under the authority of the Canada Wildlife Act and Migratory Birds Sanctuaries (MBS) under the Migratory Birds Convention Act. National Wildlife Areas (NWAs) are created and managed for the purposes of wildlife conservation, research, and interpretation and selected based on a combination of factors related to their unique biodiversity, habitats supporting large proportions of a species' population in Canada, and/or for cultural heritage. Migratory Bird Sanctuaries (MBSs) provide similar refuge for migratory birds in terrestrial and marine environments. The Canadian Wildlife Service is the agency responsible for NWAs and MBSs, although the sanctuaries can be located on federal, provincial or private land, and they are often stewarded by local community and conservation groups. We're lucky to have 10 NWAs and 8 MBS in Nova Scotia. Did you know that, altogether, the Port Joli, Port L'Hebert, and Sable River MBSs in Kespukwitk/Southwest Nova Scotia support 4,000 - 5,000+ Canada geese each year; over 40% of the birds of this species that spend the winter in the Atlantic Provinces! American black ducks are also present in large numbers during the fall and winter months, when they are attracted to the rich eelgrass beds, sometimes exceeding 1,000 birds!

BIRD MAP

Nova Scotia is located on unceded Mi'kmaq territory. Mi'kma'ki is part of the Dawnlands, or Wabanaki, a name given to the broader North East at least by the time of the Wabanaki Confederacy.

Nova Scotia contains some great bird habitats! Here are just a few places the birds in this book call home:

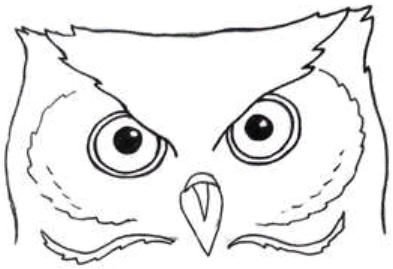


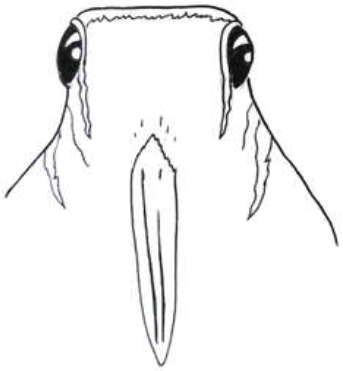
Not all of these protected areas are accessible to visitors, but many contain infrastructure and interpretive features that can help you connect to nature. National and Provincial Parks are the most accessible and easily found online. To explore the trails and features of some other areas, you might have to dig a bit deeper. Reach out to Nature Nova Scotia staff for help navigating your local bird habitats.

REFERENCE IMAGES

Diversity in Bird Eyes

Great Horned Owl



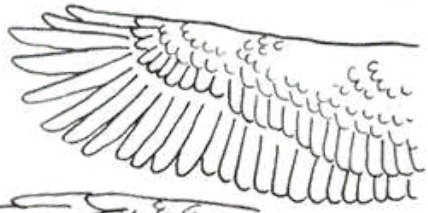


American Woodcock

Wings

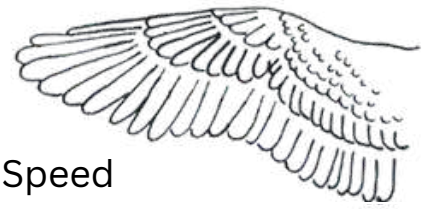
Passive Soaring

Active Soaring



Elliptical

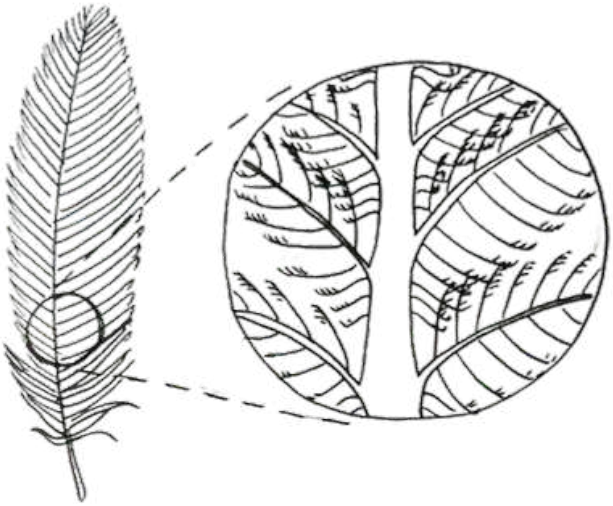
High-Speed



Hovering

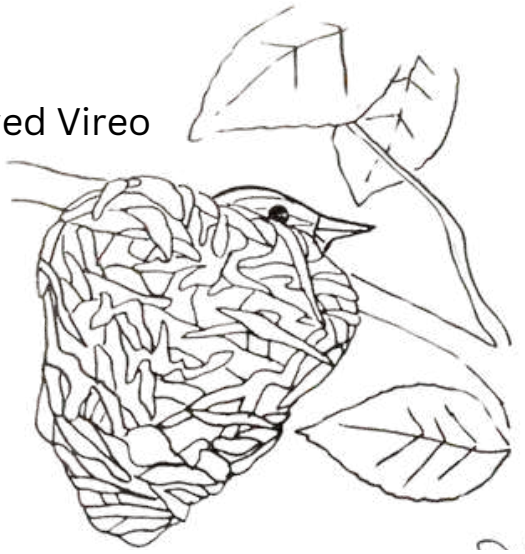
Scales

Feathers



Nests

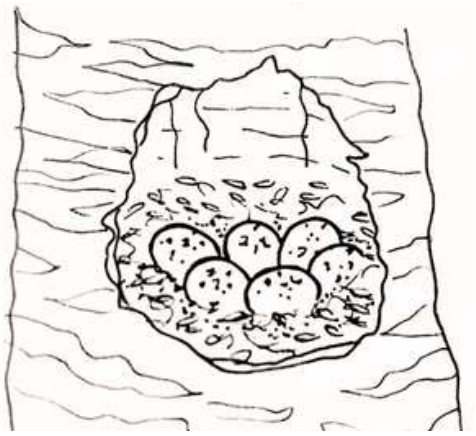
Red-eyed Vireo



Goldfinch

Barn Swallow

Black-capped Chickadee



How to Use Binoculars

- Look first at the thing you want to see, without your binoculars
- Bring the binoculars up to your eyes while still looking at your target
- If the image is blurry, use the knob on top of the bincoulars or the right eye piece to adjust the focus
- The image is in focus when it becomes clear!
- Now do the same for an object closer or further away from you than your first target. Can you get it in focus?

Winter Residents

Goldfinch

Red Knot

Harlequin Duck

Black-capped Chickaee

Birds in Nova Scotia all year long

The Atlantic Flyway

Blackpoll Warbler

Canada Warbler

Piping Plover

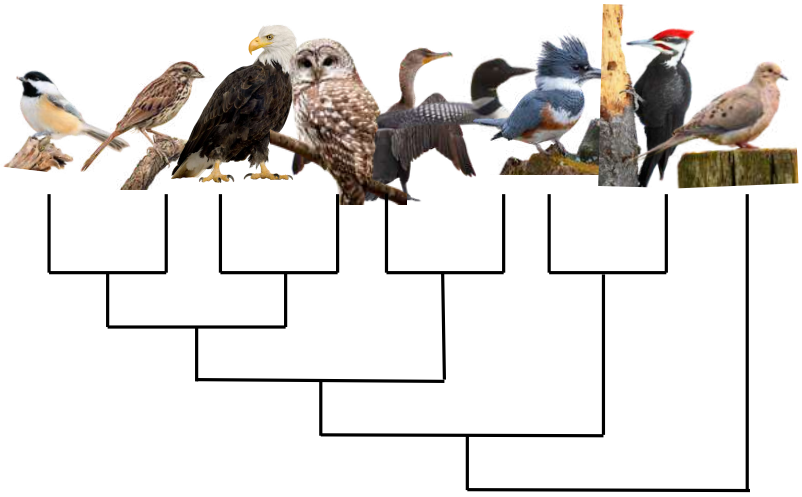
Summer Residents

ANSWERS TO ACTIVITIES AND WORKSHEETS

ANSWERS: Bird Anatomy

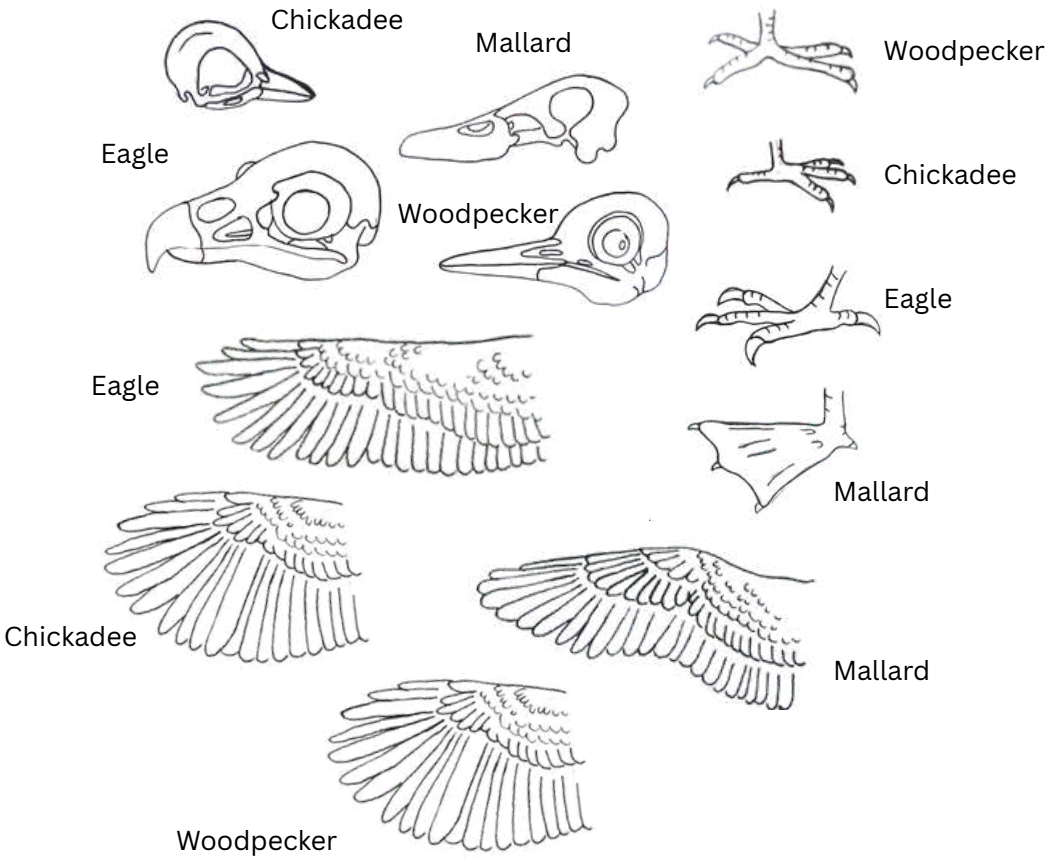
1. Eye
2. Beak
3. Throat
4. Breast
5. Belly
6. Crown
7. Median Coverts
8. Primary and Greater Coverts
9. Tail
10. Rump
11. Secondaries
12. Tarsus
13. Toe

ANSWERS: Make a Cladogram

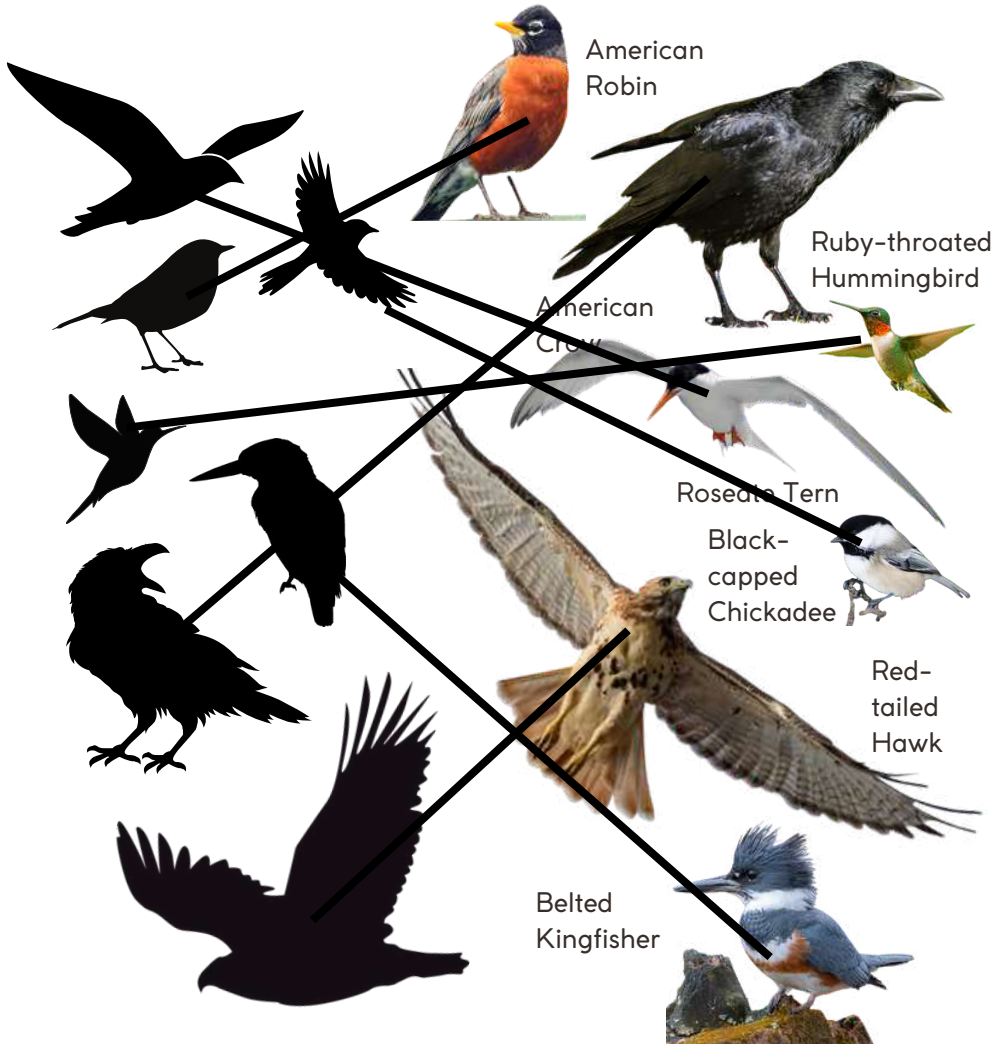


*This tree reflects actual evolutionary closeness. Your tree may look different depending on the traits you chose to focus on. That's ok! It's a thought exercise!

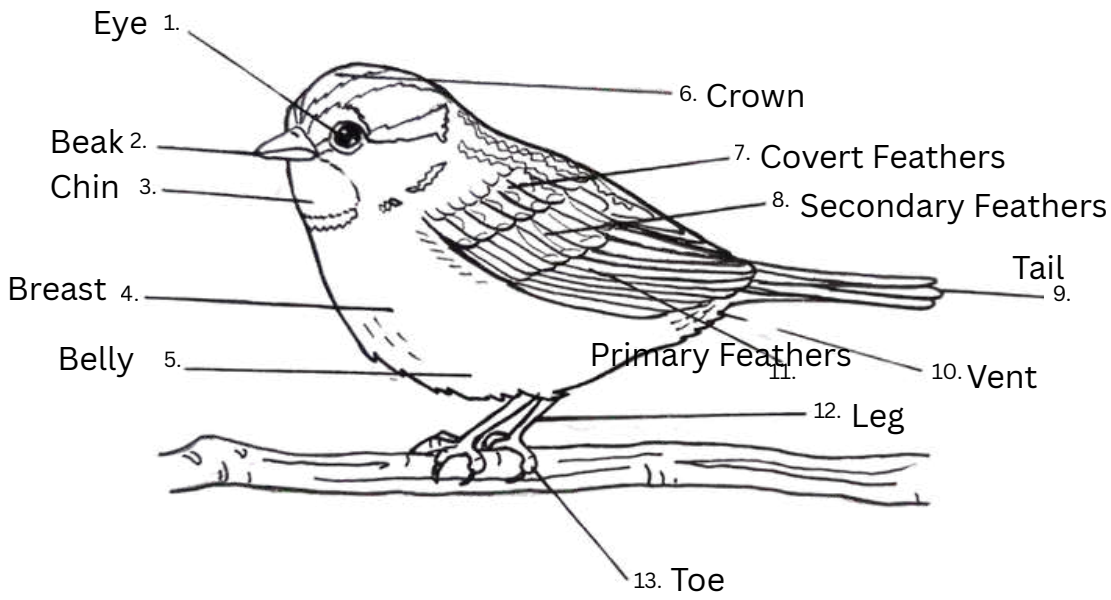
ANSWERS: Anatomy Adaptations



ANSWERS: Bird Silhouettes



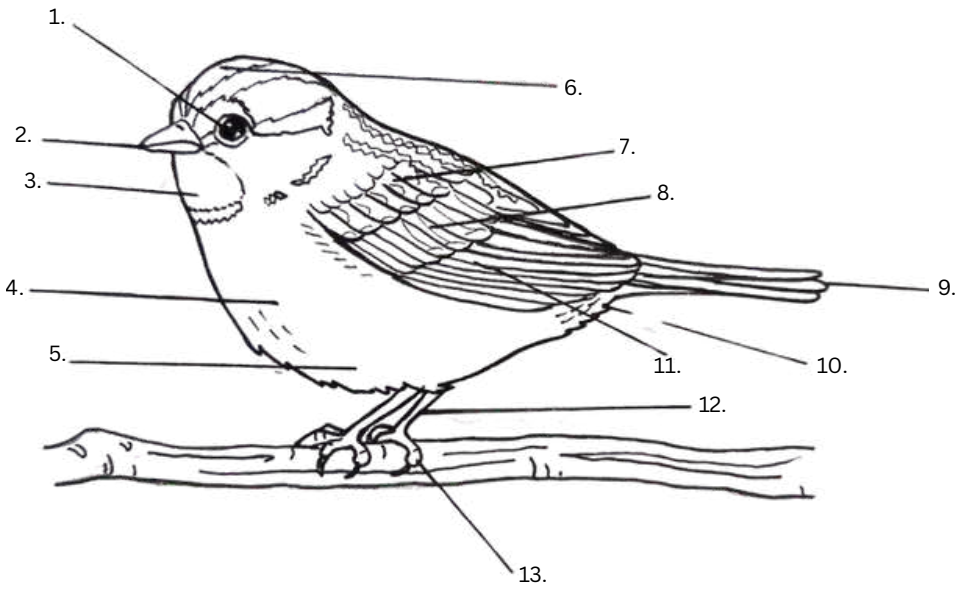
ANSWERS: Bird Anatomy



WORKSHEET

BIRD ANATOMY

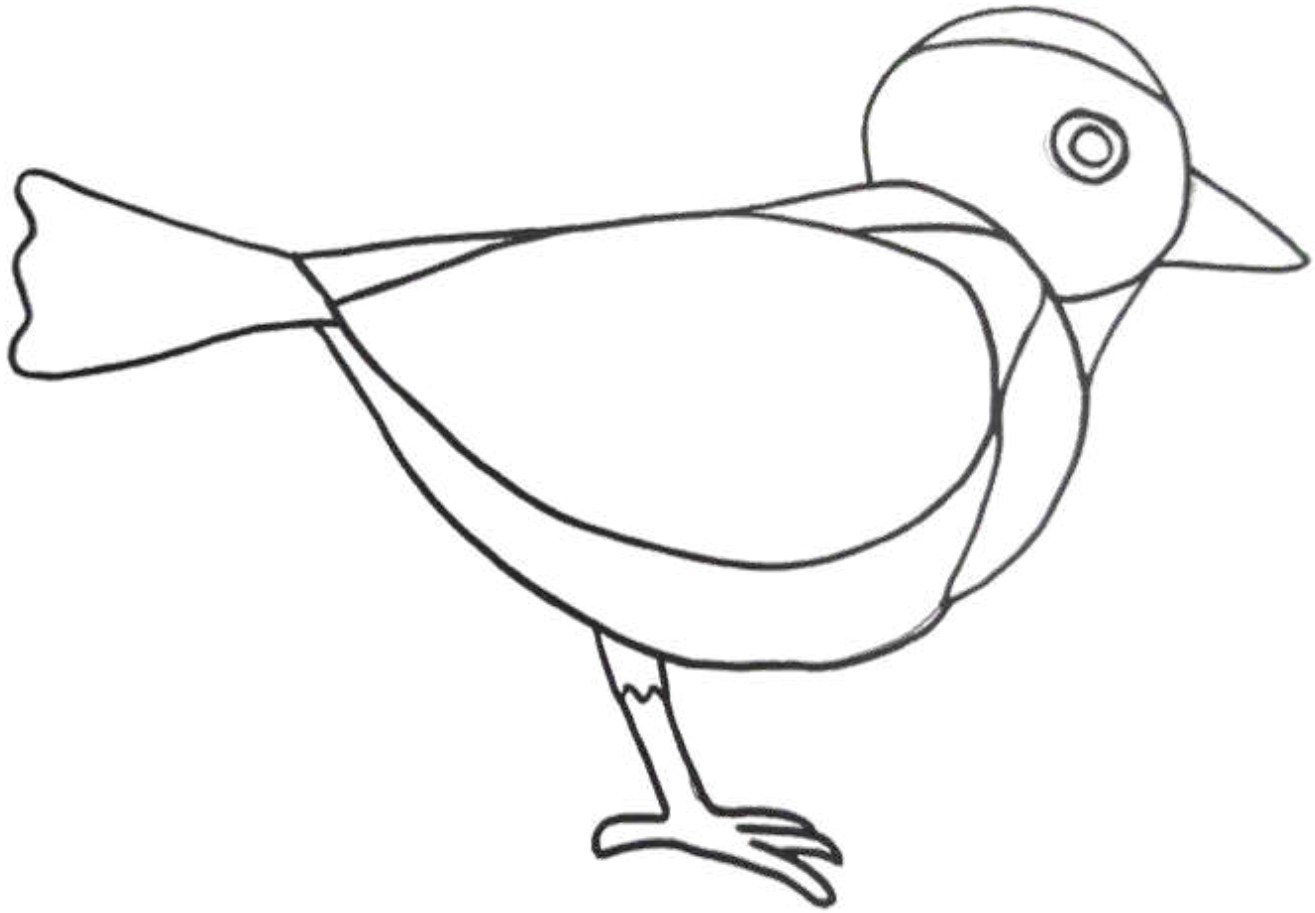
When trying to identify a bird, it's helpful if you can name the different body parts. Parts like the crown, the rump, the wing, etc. may contain defining patterns or colours that allow to you identify the bird species! Provide students with bird body diagram and provide possible labels in a central location (on the black board, scrambled in a printed listed, etc) and ask them to label each numbered bird body part. Take the lesson further by asking them to compare the shape, size, or placement of these parts with another kind of animal. For younger students, replace labels with simpler ones like "head, wing, beak" etc.

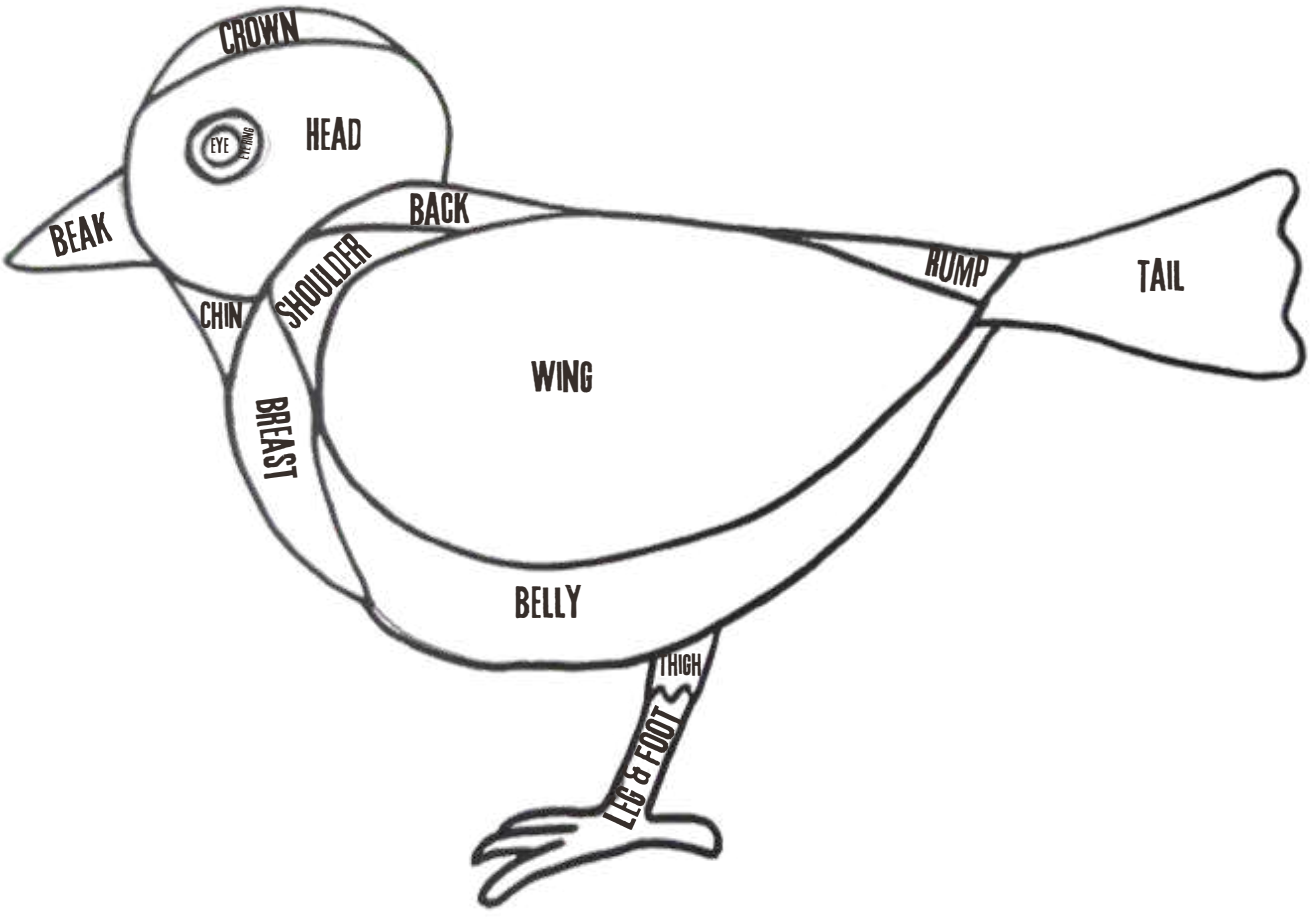


ACTIVITY

BIRD ANATOMY PUZZLE

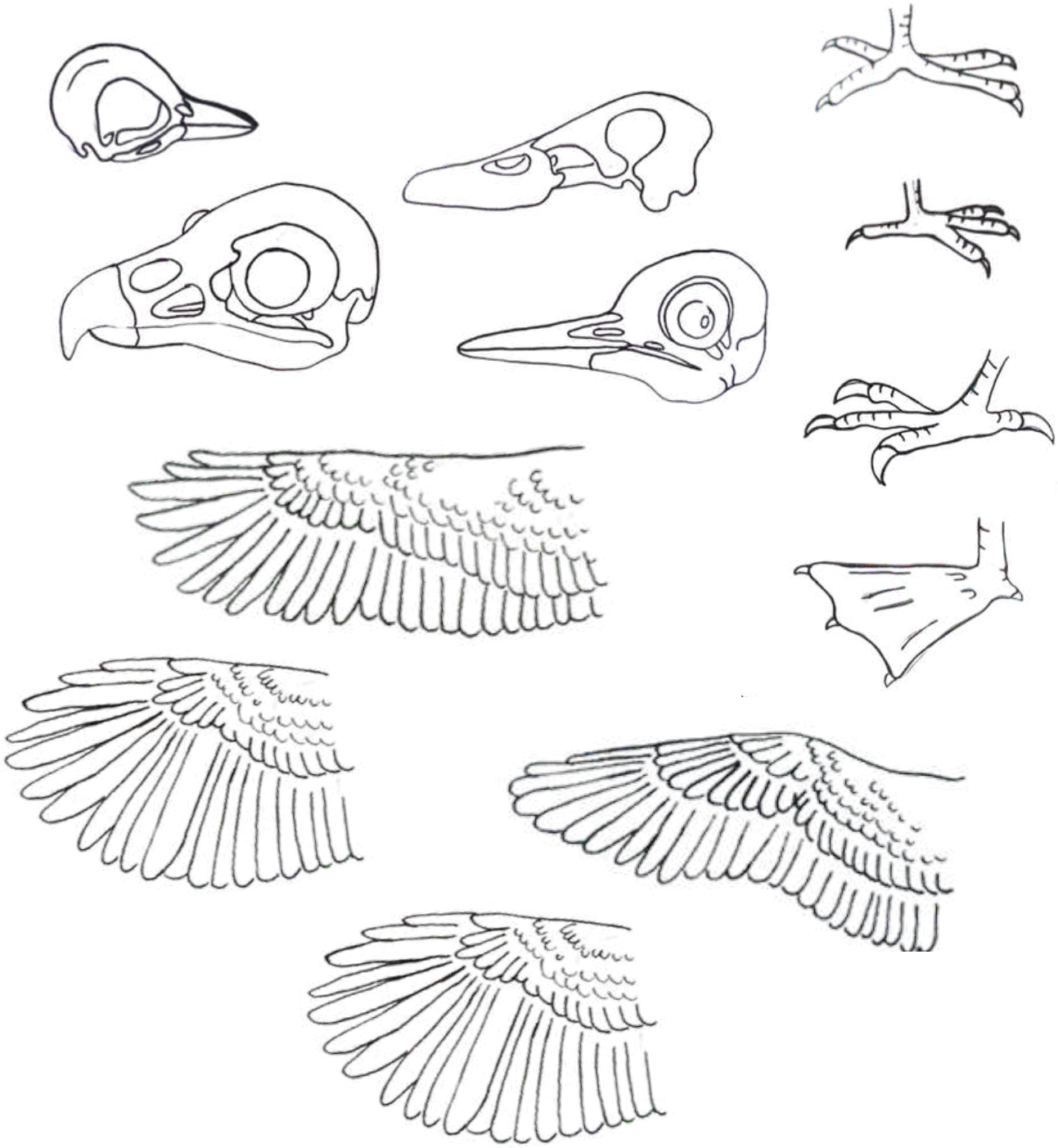
Print out the puzzle pieces below, cut them out, and have students put the bird back together. Or, transfer this puzzle onto felt or large pieces of cardstock, and have students complete a giant floor/wall puzzle. The back of the bird is labeled, to help students understand the parts and to help you put it back together!




CROWN
EYE
EYE RING
HEAD
BEAK
BACK
RUMP
TAIL
CHIN
SHOULDER
WING
BREAST
BELLY
THIGH
LEG & FOOT

ACTIVITY
ANATOMY ADAPTATIONS

Provide students with already cut-out skulls, feet, and wings or have them cut them out themselves. Arrange species photos around the room (taped to the wall, for example) and ask students to place the skeleton components at the corresponding species station (they may tape them, place them in a collection bowl, etc) Once placed, ask students why they made the connections they did. Discuss as a group.

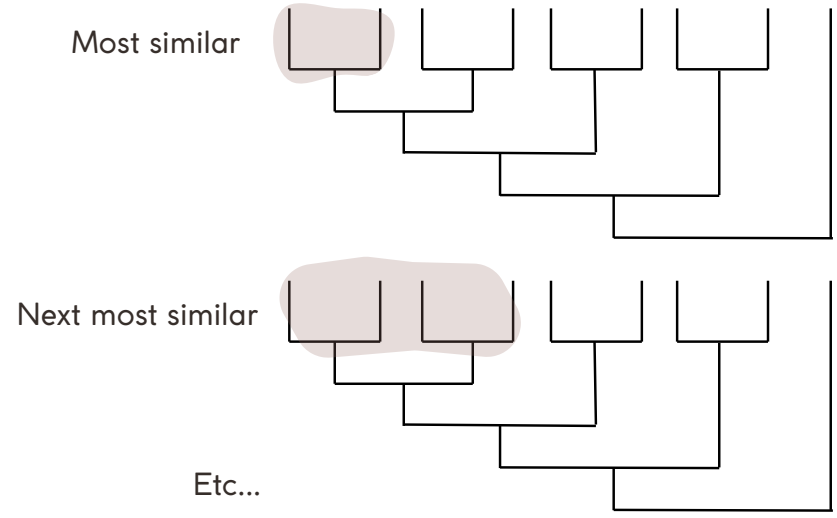


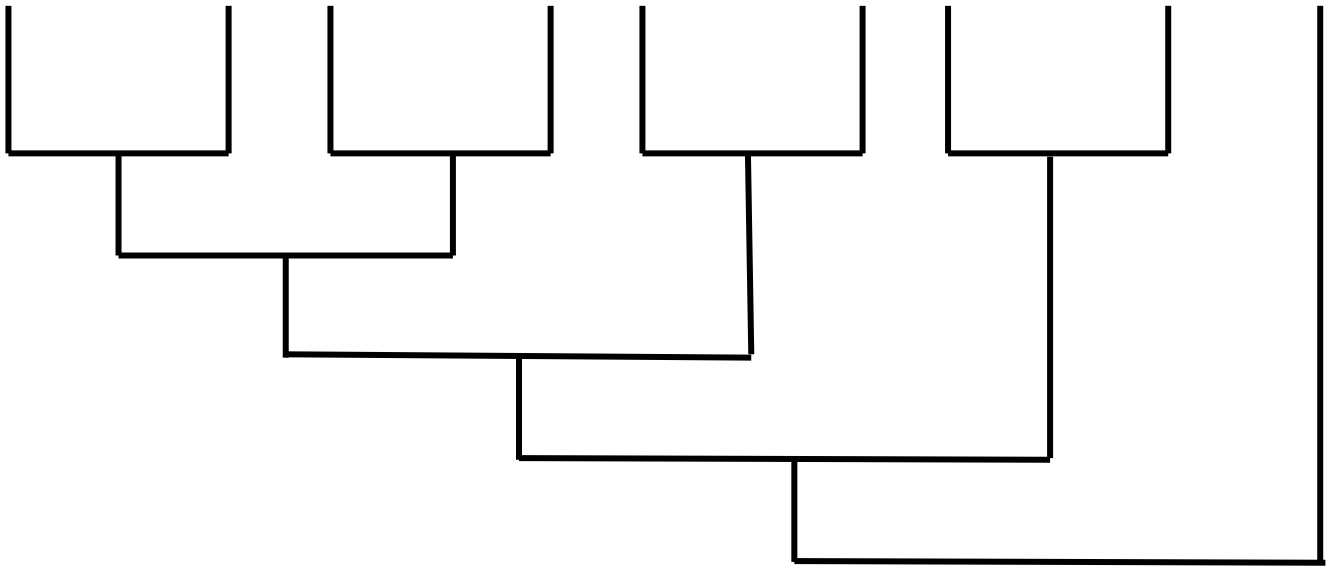
ACTIVITY

MAKE A CLADOGRAM (EVOLUTIONARY TREE)

A cladogram is like a family tree, but based more on shared characteristics than genetic relation (a phylogenetic tree, on the other hand, more accurately depicts true evolutionary lineage). Cladograms can be fun and useful diagrams, making us think about bird adaptations and the possible pathways for evolution. Cladograms place most similar species close together, on branches side by side, and dissimilar species further apart. Copy this tree to your blackboard or reproduce it in whatever way works for your class, print out the species photos, then work together to add the following species to the branch ends. Ask students why they think birds are similar or different:

Black-capped Chickadee
Song Sparrow
Double-crested Cormorant
Common Loon
Bald Eagle
Barred Owl
Kingfisher
Pileated Woodpecker
Mourning Dove

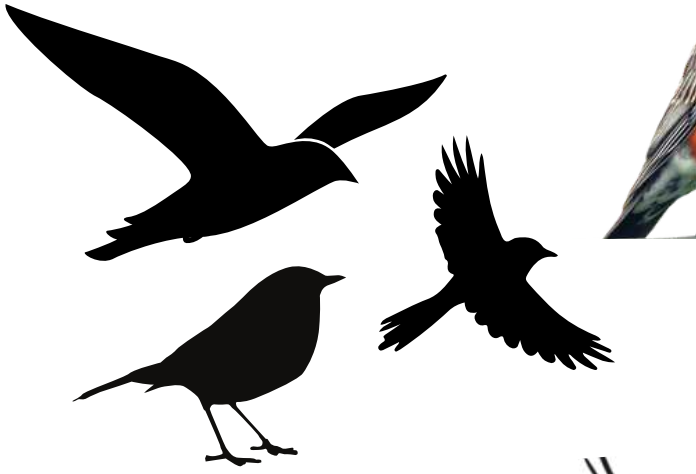




WORKSHEET

BIRD SILHOUETTES

Sometimes we can't see birds well enough to describe their colours or markings, but you can distinguish by bird species, or at least type of bird, by the shape of their silhouette. Draw a line from the birds' pictures to their silhouettes.



American Robin

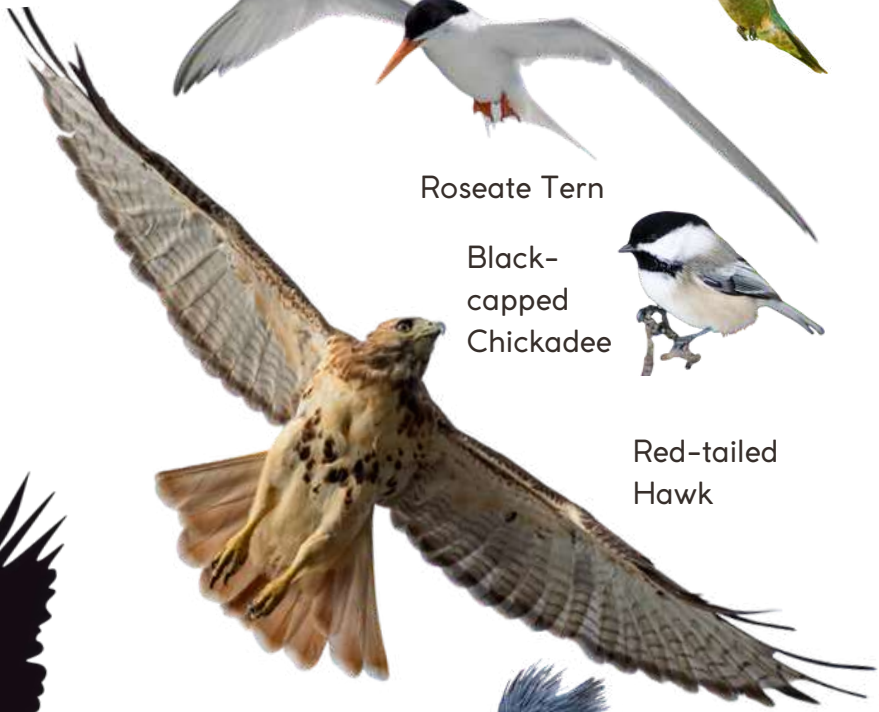
American Crow

Ruby-throated Hummingbird

Roseate Tern

Black-capped Chickadee

Red-tailed Hawk



Belted Kingfisher

ACTIVITY

NEST BUILDING DESIGN CHALLENGE

As a class, in groups, or individually, have students attempt to build a birds' nest from provided natural building materials (this is great to do outside if you have access to lots of sticks, clay, grass, and other potential building materials!) The nests can be small or the whole class can work on one giant nest, big enough for a kid! Show students reference nest photos for inspiration. You may choose to instruct them to build a particular species' nest or give them freedom to design something unique.

BIRD FRIENDLY WINDOWS DESIGN CHALLENGE

Collisions with windows on residential and commercial buildings kill more than 25 million birds in Canada every year. You can prevent these avoidable bird deaths by keeping bird feeders away from windows, making your windows more visible to birds by using solutions like Feather Friendly tape, and by turning off lights at night, especially during migration season. Visit www.flap.org for more information on the threat of window strikes. Work as a team/whole class to locate a window at school that could present a risk to birds (because it is large or close to natural vegetation or because you know a bird has already hit it) and implement a solution.

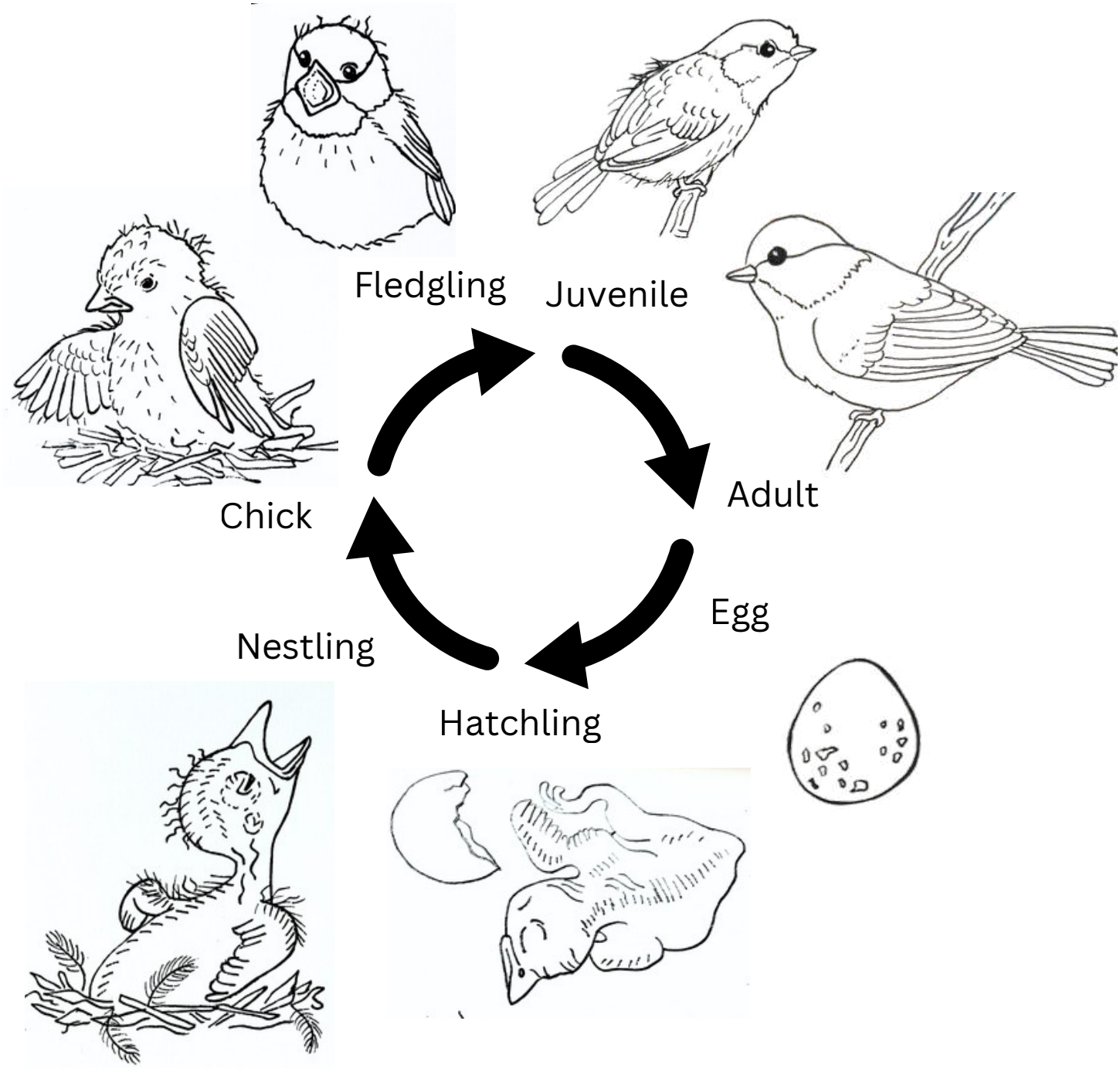
You can implement several solutions that help birds recognize the window and avoid collisions, including using specifically-designed bird tape, one-way transparent films, or beautiful paint/glass marker designs. See www.birdscanada.org/you-can-help/make-windows-safer-for-birds for tips on designing an effective window strike solution.

Is your solution in place? Let us know! Contact Nature Nova Scotia staff at info@naturens.ca

COLOURING SHEET

BIRD LIFE CYCLE

Colour the chickadees, from egg to adult! What do you think the birds are eating at each of these life stages?

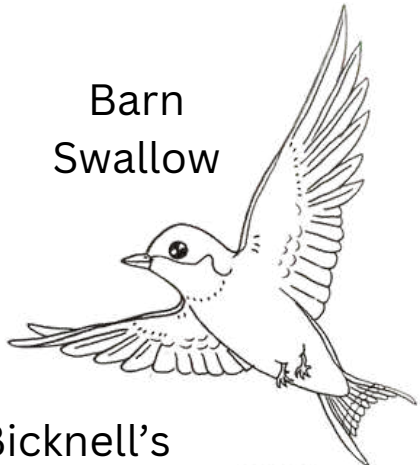


COLOURING SHEET

BIRDS AT RISK

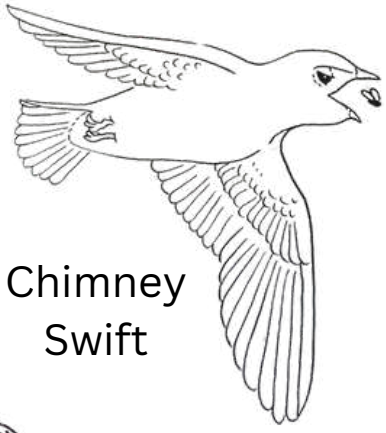
Nature NOVA SCOTIA

Colour the bird species at risk. Talk about these birds with your teacher and friends. What can you do at school or home to help these species?



Barn Swallow

Bank Swallow

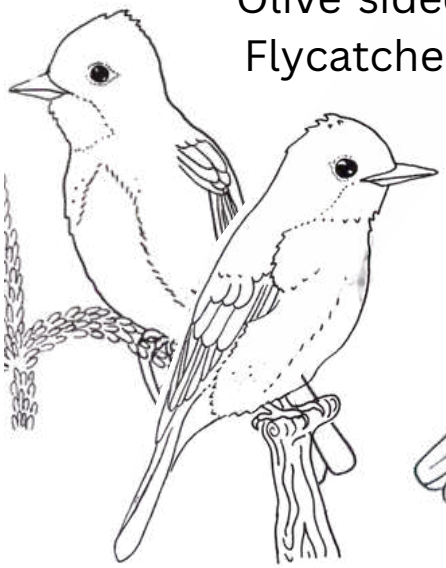


Chimney Swift

Bicknell's Thrush

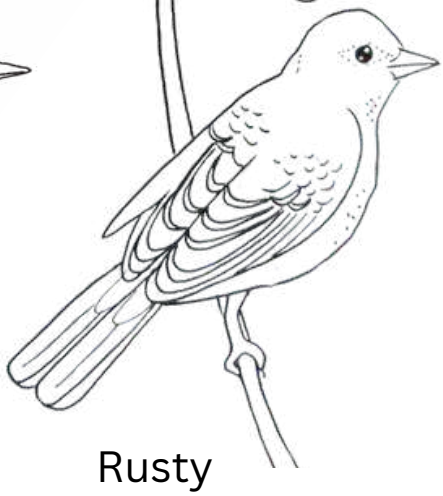
Bobolink

Canada Wabler

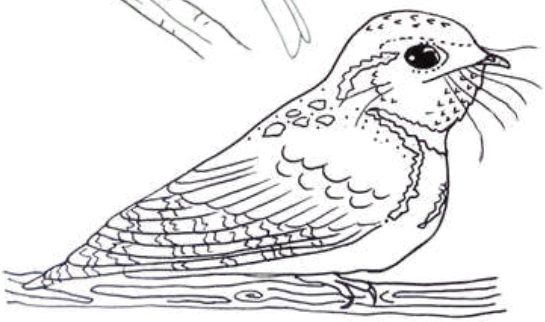


Olive-sided Flycatcher

Evening Grosbeak



Rusty Blackbird



Eastern Wood Pewee

Eastern Whip-poor-will

TAKE ACTION

FEEDERWATCH

Project FeederWatch is a joint research and education project of Birds Canada and the Cornell Lab of Ornithology that relies on volunteer observations to collect data on bird numbers over the winter feeder season (November 1 through April 30 each year.) Participants identify and count the birds they see at their feeders, and submit bird observations to Project FeederWatch. Your bird counts help keep track of birds at your own feeders, and help scientists track long-term trends in bird distribution and abundance.

If your school doesn't already have one, get a bird feeder you can place in a central, easy to access location that isn't dangerous for the birds (not too close to a window, not in an area with lots of outdoor cats, etc) Make sure you're following good bird feeder stewardship practices, cleaning the feeder regularly and taking it down in the warm season to avoid the risk of spreading diseases between birds. Then sign up for Feederwatch and report your students' seasonal observations to Birds Canada! Learn more at https://www.birdscanada.org/discover-birds/bird-friendly-schools/citizen-science-at-school

SEND BIRD ART TO YOUR MP, MLA, OR COUNCILOR

Members of Parliament, Legislative Assembly, and City/Town Council can take your concerns and desires for birds to the departments, committees, and other places they need to go to achieve action. Instruct students to choose a bird they learned about recently and draw a picture of it. Include features from it's habitat or life history, like where it lives, what it eats, etc. Mail your artwork to your decision maker with a thank you note for what they've done already for birds and a request to do more. For example, you might write to your MP to thank them for the federal governments' adoption of the KMGBF Framework and a reminder that they have committed to protecting 30% of land and water in Canada by 2030. You can write individual letters or one letter from the whole class. Here's an example letter addressed to your MP.

"Honourable [name],

My name is [name] and I am a [grade] student at [school]. I just learned about the Kunming-Montreal Global Biodiversity Framework and Canada's commitment to protecting 30% of lands and waters by 2030. I also just learned about [bird]. Did you know they [cool bird fact]? The Protected Areas System in Nova Scotia is important for protecting the [bird] so I wanted to thank you for Canada's commitment to further land protections in Nova Scotia and to tell you that I hope you will meet this important goal.

Sincerely, [name]"

Decision makers with the power to help birds in Nova Scotia

Federal Government

Your Member of Parliament (MP): www.ourcommons.ca/members/en
The Minister of Environment and Climate Change: www.canada.ca/en/environment-climate-change/corporate/contact.html

Band Governments

Annapolis Valley (Kampalijek) Chief and Council: www.avfn.ca/chief-and-council
Bear River (L'setkuk/Muin Sipi) Chief and Council: www.bearriverfirstnation.ca/services/band-hall
Eskasoni Chief and Council: www.eskasoni.ca
Glooscap (Pesikitk) Chief and Council: www.glooscapfirstnation.com/staff
Millbrook (We'kopekwitk) Chief and Council: www.millbrookband.com
Pictou Landing Chief and Council: www.plfn.ca/chief-and-council
Paqtnkek Chief and Council: www.paqtnkek.ca/contact-us
Potlotek Chief and Council: www.potlotek.ca
Sipeknekatik: www.sipeknekatik.ca/directory
Membertou (Maupeltuk) Chief and Council: www.labrc.com/first-nation/membertou
Wagmatcook Chief and Council: www.wagmatcook.com
Wasoqopa'q (Acadia) Chief and Council: www.acadiafirstnation.ca/chief-council-contact-us.html
We'koqma'q Chief and Council: www.wekoqmaqproud.com/contact

Provincial Government

Your Member of the Legislative Assembly (MLA): www.nslegislature.ca/members/profiles
The Minister of Environment and Climate Change: www.novascotia.ca/nse/contact.asp
The Minister of Natural Resources: www.beta.novascotia.ca/contact/natural-resources

Municipal Government

Your Mayor and Council: www.nsfm.ca/membership-directory.html