AMAZING BIRDS

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Before You Begin:  
Young children are naturally interested in the behavior of animals. Students especially love to watch birds and we can use this interest as a springboard for exploring physical science concepts such as sound, magnetism, flight, and simple machines. A good way to learn about these concepts is to observe birds in their natural habitat. The best time of day to watch birds is between 6 a.m. and 10 a.m., when they are most active.

You may wish to set up an informal bird learning center which students can use on a daily basis. Provide the texts included with the unit, as well as library books and field guides to look through. Leave an open notebook where students may choose to write questions they wish to have answered about birds or draw pictures of birds they may have seen. Finally, if space allows, set up a bulletin board where students can post drawings or photographs of birds they have spotted.

We have set up a companion website with links to bird sounds and videos that we recommend using in several lessons, at: www.birds.cornell.edu/physics/lessons/elementary

For lesson 3, you will be using a sound analysis program called Raven Lite. You will need to install the program on your computer and register for a free license. This can be done from the enclosed CD or at: www.birds.cornell.edu/brp/RavenLite/RavenLiteDownload.html

Materials to be Obtained Locally:
- Chart paper and markers for brainstorming ideas
- Stopwatch, paper towels – lesson 5
- Paper strips 1x11 inches – lesson 6
- Computer with internet access and LCD projector
Title: Amazing Birds

Purpose: This kit contains a series of lessons designed to teach content information and vocabulary related to the physical setting and living environment standards. It also introduces how the structures and behaviors of birds help them meet their basic needs for survival in their particular environment. The Teacher Background section contains specific content from the New York State Standards, which students are required to know.

Concepts:
- Birds need air, water, and food in order to survive.
- You must be quiet and still to observe birds.
- You can gather data on birds that come to a feeder.
- Birds share common physical adaptations.
- Birds have many unique physical and behavioral traits that help them to survive in their particular environment.
- Sound is a form of energy.
- Sound energy and matter interact.
- Interactions with forms of energy can be either helpful or harmful.
- Energy can be transferred from one place to another.
- Birds make sounds to communicate about territory, danger, food, and to locate one another.
- Birds’ beaks come in many sizes and shapes.
- Beaks are different because of the different jobs they do.
- Beaks are similar to simple machines.
- Wing shape and structure helps a bird to fly.
- Drag and gravity are forces that slow and pull birds back to the ground.
- Feathers have different functions and are a physical feature unique to birds.
- Some birds migrate when the weather changes and their energy source decreases.
- Magnetism is a force.
- Magnets have a north and a south pole.
- Magnetism works through solids, liquids and gases.

Format:

There is a teacher manual and a student activity booklet, which includes optional activity sheets. The boxed column lists the Activity Title, Concepts, Skills, Evaluation, Standards, Materials and any other helpful hints or information you might need. The main section begins with a Focus Question, to guide the teacher’s instruction towards the main idea of the activity. The focus is to be explored with inquiry and hands-on manipulation by the students. The activity includes directions for the students, illustrations and Discussion Questions (with answers in italics). These Discussion Questions can be used as a basis for class interactions.

The Standards section includes the major understandings from the New York State standards based on the grade level of the kit. The major understanding code (e.g., 5.1b) is listed at the end of the sentence that contains the information. The code is not listed in the student sections, only in the Teacher Background section.
New York State; MST Learning Standards; Living Environment and Physical Setting; Grades K-4:

1.1a: Animals need air, water, and food in order to live and thrive.
2.1a: Some traits of living things have been inherited.
3.1a: Each animal has different structures that serve different functions in growth, survival, and reproduction.
3.1c: In order to survive in their environment, plants and animals must be adapted to that environment.
3.2a: Individuals within a species may compete with each other for food, mates, space, water, and shelter in their environment.
3.2b: All individuals have variations, and because of these variations, individuals of a species may have an advantage in surviving and reproducing.
5.1b: An organism's external physical features enable its ability to carry out life functions in their particular environment.
5.2b: Animals respond to change in their environment, (e.g., perspiration, heart rate, breathing rate, eye blinking, shivering and salivating).
5.2d: Some animals, including humans, move from place to place to meet their needs.
5.2f: Some animal behaviors are influenced by environmental conditions. These behaviors may include: nest building, hibernating, hunting, migrating, and communicating.
4.1a: Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.
4.1b: Energy can be transferred from one place to another.
4.1g: Interactions with forms of energy can be either helpful or harmful.
5.1c: The force of gravity pulls objects toward the center of the Earth.
5.1e: Magnetism is a force that may attract or repel certain materials.
5.1f: Mechanical energy may cause change in motion through the application of force and through the use of simple machines such as pulleys, levers, and inclined planes.
5.2a: The forces of gravity and magnetism can affect objects through gases, liquids, and solids.

Scientific Inquiry: These are covered throughout the kit.

S1.1a: Observe and discuss objects and events and record observations.
S1.1b: Articulate appropriate questions based on observations.
S1.2a: Identify similarities and differences between explanations received from others or in print and personal observations or understandings.
S2.3a: Use appropriate inquiry and process skills to collect data.
S2.3b: Record observations accurately and concisely.
S3.2a: State, orally and in writing, any inferences or generalizations indicated by the data collected.

Skills covered in the kit:

<table>
<thead>
<tr>
<th>Manipulate materials</th>
<th>Observe</th>
<th>Analyze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report observations</td>
<td>Identify</td>
<td>Collect data</td>
</tr>
<tr>
<td>Ask questions</td>
<td>Communicate</td>
<td>Predict</td>
</tr>
<tr>
<td>Compare and contrast</td>
<td>Interpret results</td>
<td></td>
</tr>
</tbody>
</table>

Schedule:
The recommended schedule is 8 weeks, but this is flexible, depending on how many times per week you teach science, and how long your science classes are.
Lesson 1: Observing Birds

Concepts:
• Birds need air, water, and food in order to survive.
• You must be quiet and still to observe birds.
• You can gather data on birds that come to a feeder.

Vocabulary:
• Observe – To look at or study something.
• Graph – A diagram showing relationships of quantities.

Evaluation:
Students will be able to identify the basic structures of birds and begin to identify birds by their physical features.

Standards:
LE 1.1a
SI 1.1a
MA 2.1b

Materials:
Bird feeder
Birdseed
Student Bird Watching Journal pages 1-2
Activity Sheet 1
Bird poster
Bird graph and pictures
Book: What Makes a Bird a Bird?
Book: It Could Still Be A Bird
Book: The Backyard Birdsong Guide
Chart Paper*
Markers*

Focus: What do we see when we observe birds?

Activity 1: Observing, Journaling, and the Bird Feeder
❖ Teacher’s choice: To begin, have the students help or construct a bird feeder on your own. Included in the kit is one feeder that sits on a post. You will be responsible for getting your own post. Check with your custodian about an agreeable location for the feeder so that the students can begin birdwatching! We have included a small bag of birdseed to start, but it is important for you to continue to feed the birds throughout the winter or stop early enough that they find other sources of food. Remind students that birds, along with all animals, need air, water, and food in order to survive (LE1.1a). For more information about bird feeders and types, see:
http://www.birds.cornell.edu/AllAboutBirds/attracting
❖ Begin a discussion with students about ways to observe birds. Most students have had experience chasing birds only to watch them fly away. Discuss how it is important to be very quiet and still while watching birds. A bird feeder is a great way to bring the birds closer.
❖ Students should use a Bird Watching Journal (included, make as many copies as necessary) to observe the birds that come to the feeder. These pages can also be used at home as a home connection project. Keep a bird identification poster, field guide, and The Backyard Birdsong Guide (all included) nearby for reference. As students observe the different birds that come to the feeder, have them generate a bar graph with the enclosed materials. This activity can be continued throughout the unit. We also encourage students, teachers, and classrooms to collect bird data to help scientists. For details, see:
http://birds.cornell.edu/LabPrograms/CitSci/index.html

Activity 2: Introducing Birds
❖ Introduce more about birds by collectively brainstorming and listing on chart paper what the students already know, have learned by watching the birds, and may want to know about birds. This list will be revisited at the end of the unit. Ask; “What are some of their features?” “What do they have in common?” “What do you think they eat?” “How do they fly?” In other words - what makes a bird a bird?
❖ Read the book, What Makes a Bird a Bird? by Mary Garelick, focusing on the questions above. You could use the book, It Could Still be a Bird by Allan Fowler, as a lower reading level book. Using Activity Sheet 1: Bird Parts, have the students label the parts of the bird. A coloring book of feeder birds is located at: www.birds.cornell.edu/bbimages/PDFs/ColoringBook.pdf for your use. To help with coloring and information, you could use the BirdSleuth Focus Cards.
**Lesson 2: Physical Adaptations of Birds**

**Concepts:**
- Birds share common physical adaptations.
- Birds have physical adaptations that help in their survival.

**Vocabulary:**
- **Traits** – Certain characteristics that define an organism.
- **Features** – A part of something that defines it.
- **Adaptation** – A change or adjustment in an organism that increases its chance of survival.

**Evaluation:**
Students will identify the basic features, traits and behaviors of birds that help them survive.

**Standards:**
LE 3.1a
LE 5.1b

**Materials:**
Activity Sheet 2
Book: Eyewitness: Bird
Computer with internet access and LCD projector*

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**Focus: What are a bird’s physical adaptations?**

Note: This is an extension of lesson 1 to help guide students' observations.

**Background:**
What makes a bird a bird? There are more than 9,000 different kinds of birds in the world. Each bird has different structures that serve different functions in growth, survival, and reproduction (LE 3.1a). Some birds are very colorful to attract mates, while others are drab, which helps protect or hide them. Some are very big, and others are very small. Birds’ external physical **features** can enable them to carry out life’s functions in their particular environments (LE 5.1b). For example, some birds have very long wings that help them soar through the air, while some cannot fly at all. The differences are endless, but there are a few **adaptations or traits** that all birds have in common. All birds have beaks, two legs, and feathers.

The best way to learn about birds is to go bird-watching. If you really pay attention to what they are doing, you’ll see certain adaptations and habits that you might have never seen before!

**Activity 1: Observing Birds**

With guided questions, discuss with students the different types of adaptations they’ve seen with birds while watching them at the feeder. Discuss how they grab onto branches, walk, eat, fly, their colors, etc. Using the Eyewitness: Bird book, explore and discuss the similarities and differences of the parts of different birds. We recommend discussing the following topics and pages:

- Feathers 22-23
- Camouflage 30-31
- Feet 32-33
- Beaks 36-37
- Nests 48-49
- Eggs 54-55

Discuss some of the adaptations that birds have to survive in their environments. The book library in the kit can help.

After reviewing the basic features of birds from lesson 1, Activity Sheet 1 and the book, have students view actual video clips over the internet to observe different birds and their behaviors. Observe their beaks, feet, and wings to see how they eat, walk, and fly. Compare how one bird may probe in trees or the dirt for insects or worms and others peck at seeds and berries. Have students observe the movements of birds including swimming, hopping, flying, climbing, and digging. The table below clarifies some characteristics of the birds on suggested webpage to help you guide the students’ observations. Use Activity Sheet 2: Adaptations to help.

Additional Venn diagrams can be created.

**Website for videos:**
www.birds.cornell.edu/physics/lessons/elementary/adaptations
<table>
<thead>
<tr>
<th>BIRD</th>
<th>FEET</th>
<th>MOVEMENT</th>
<th>BEAK</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burrowing Owl</td>
<td>Long talons for catching and holding food.</td>
<td>Hooked for tearing food.</td>
<td>Brown like the earth they dig in.</td>
<td></td>
</tr>
<tr>
<td>Hudsonian Godwit</td>
<td>Legs are long to get above the water and see food.</td>
<td>Long strides, walking.</td>
<td>Long, pointed beak for probing.</td>
<td></td>
</tr>
<tr>
<td>American Woodcock</td>
<td>Legs are long to get above the water and see food.</td>
<td>Long strides, walking.</td>
<td>Long, thin beak for probing in dirt for food.</td>
<td>Browns and camouflaged to forest floor.</td>
</tr>
<tr>
<td>Common Ostrich</td>
<td>Big, wide feet so the bird won’t sink in to the ground.</td>
<td>Long, walking or running strides.</td>
<td>Large, wide, strong.</td>
<td></td>
</tr>
<tr>
<td>Pileated Woodpecker</td>
<td>Two toes point opposite others for grip.</td>
<td>Long, strong for pecking into tree for insects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roseate Spoonbill</td>
<td>Large, wide, spoon-shaped to scoop small food items from the water.</td>
<td></td>
<td>Pink for attracting a mate.</td>
<td></td>
</tr>
<tr>
<td>Mallard</td>
<td>Wide, webbed for swimming</td>
<td>Waddles, swims, flies.</td>
<td>Male is colorful, female is brown and camouflaged.</td>
<td></td>
</tr>
<tr>
<td>White-tailed Ptarmigan</td>
<td>Feathered feet to deal with snow.</td>
<td></td>
<td>White in winter for camouflage with snow.</td>
<td></td>
</tr>
<tr>
<td>Crested Caracara</td>
<td>Large talons to hold the food down.</td>
<td>Sharp, curved for tearing food.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Yellowthroat</td>
<td>Grasping branch.</td>
<td></td>
<td>Bright yellow chest to attract mate.</td>
<td></td>
</tr>
<tr>
<td>White-throated Sparrow</td>
<td>Uses its feet to kick up leaves to find food.</td>
<td>Hopping and kicking up the leaves.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golden Eagle</td>
<td>Talons grab fish.</td>
<td>Flying, soaring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Discuss:** Ask some open-ended questions while watching the videos. “What are the different ways that birds get around?” “What are the different ways that birds get food?” “Which birds have you seen around your house?” “Other than eating, what do birds use their beaks for?” “What colors are the birds?” “Have you seen any of these behaviors in the birds at our feeder?”
Lesson 3: Sound is Energy

Concepts:
- Sound is a form of energy.
- Sound energy and matter interact.
- Interactions with forms of energy can be either helpful or harmful.
- Energy can be transferred from one place to another.

Vocabulary:
- **Sound** - A form of energy.
- **Vibrate** - To move back and forth quickly.
- **Waves** - A vibration that transfers energy.
- **Frequency** – The number of back-and-forth vibrations per unit of time.
- **Pitch** – How we perceive frequency, as high or low tones (e.g., soprano versus bass).

Evaluation:
Students will understand that sound is a form of energy and is made when something vibrates.

Standards:
LE 4.1a, b, g
PS 5.2a

Materials:
- Book: The Backyard Birdsong Guide
- Book: A World of Sound
- 12 tuning forks and strikers
- 1 Microphone/headset
- 12 Jars, salt packets
- 1 Plastic wrap
- 12 Rubber bands
- Activity Sheet 3
- 1 Spray Bottle
- Plush Birds

Focus: How do birds make sound?

**Teacher Background:** Sounds are all around us: kids talking, dogs barking, or sirens blaring! **Sound** is a form of energy [PS 4.1a]. A sound is made when something moves back and forth very quickly or **vibrates**. When an object vibrates, it pushes and pulls on nearby air molecules. They in turn bump into the next layer of air molecules, creating alternating bursts of high and low pressure. We hear sounds when the energy of the object that is vibrating interacts with the surrounding air, making it vibrate, and the disturbance transfers or moves sound **waves** to our ears [PS 4.1b]. Think about a rubber band or guitar string that has been strummed. The vibrating band moves the air, which in turn makes a noise.

Sound waves can travel through solids, liquids or gases and in all directions [PS 5.2a]. The more sound energy that reaches your ear, the louder the volume is. This can be harmful if it is too loud and hurts your ears. Sound energy can also be helpful if we are listening for news or instructions for safety [PS 4.1g].

**Activity 1: How is sound made?**

- Go to www.teachersdomain.org/resource/phy03.sci.phys.howmove.collage and watch the video on the explanation of pitch and vibration. This is a great introduction to sound. You can also discuss how sound travels in all directions with this video clip. The book: A World of Sound could be read.

**Activity 2: Sound Vibrations**

- Have students place their index and middle fingers on their voice box (“Adam’s apple”) and say “Who, Who, Who” in a deep (tenor or bass) voice. They should be able to feel the vibrations on their fingers. Vibrating membranes (not really “cords”) make the air in the windpipe (or trachea) vibrate. The voice box of a bird is similar to that of a human’s, except that it can make two different sounds at once, because its membranes are located further down towards the two passageways to the lungs (the bronchi).

- Stretch a piece of plastic wrap over a 16 oz plastic jar and secure with a rubber band. Sprinkle a few grains of salt on the plastic wrap. Strike the tuning fork and hold it near the salt without touching it. Observe the action of the salt and discuss your observations. Students may need to hold fork tines parallel to the top of the lid or compare a parallel to a perpendicular orientation to have the vibrations move the salt. Students may want to touch the plastic wrap – the salt will jump!
Wipe the salt into the garbage. Spray a few drops of water onto the plastic wrap (large bubbles work better) and repeat the process (it may help if students put the tines on each side of the water droplet). Observe the action of the water and discuss. You can also fill the jar with water and touch the vibrating fork to the water and see waves.

**Activity 3: Seeing Sound**

- Discuss with students how sound can’t be seen, so scientists have discovered a way of plotting how loud, long, or high a sound is on a graph. Students will have the opportunity to record their own voices and see how sound looks using a spectrogram.
- **In advance:** Download Raven Lite from the CD or website and register your free license. If you don’t have a microphone built into your computer, plug in the one included in the kit.
- Open the Raven Lite program.
- Your window may open with a blue screen. Click on the microphone icon on the top left menu bar. On the bottom left of the new window that opens (called something like “Recorder 1”), click on the green arrow at the bottom left that says “Not recording.” This will begin recording, and students can visualize sound by speaking into the microphone.
  
  The *waveform* is the top line graph (blue on white) and the *spectrogram* is the bottom picture graph (oranges and pinks on black). The height of the waveform tells you how loud a sound is. The spectrogram also shows how loud something is by how intense its color is, but it makes it easier to see the frequency or pitch by how high the sounds appear on the graph. As you’ll probably notice, both graphs show time on the x-axis.
- Once students have played a bit with their voices, go to the “File” menu at the top left and choose “Open Sound Files.” There should be a folder called “Examples” in the same place where you installed Raven. Choose the “ChesnutSidedWarbler.wav” file. Click the gray play arrow in the upper right. The cursor will travel across and you will see and hear the song of the warbler. Try different birds and other animals so students can visualize the songs. Go to the “Window” menu and choose “Tile Windows” or “Cascade Windows” so you can more easily compare and contrast different sounds. Compare the students’ waveforms and spectrograms to the birds’!
- Close all the windows except for Recorder 1 and one bird sound (by clicking the “X” in the upper left or right of each window). Go to the “Window” menu again and choose “Tile Windows” so the two windows are arranged right on top of each other. In the bottom left of the Recorder 1 window, start recording by again clicking on the green arrow that says “Not recording.” Students can try to copy the sounds of the bird. They will need some practice adjusting their volume and pitch to copy the sounds, but just have fun with it! See how humming compares to whistling. Try the plush birds and see how they compare to the real thing!
- **Complete Activity Sheet 3: Sound.** Students may need help writing their thoughts. A list of words may help.

**Website:** [www.birds.cornell.edu/physics/lessons/elementary/energy](http://www.birds.cornell.edu/physics/lessons/elementary/energy)
Lesson 4: Why Birds Sing

Focus: Why do birds sing?

Background: Birds have special body parts similar to a person’s vocal cords that allow them to sing (LE 3.1a). Birds use songs (which are longer) and calls (which are shorter) to communicate about territory (space), danger, food, to attract mates, and to locate family members or other birds of the same species (LE 3.2a). Each species of bird has its own song. Some birds are born knowing how to sing (inherited) and some learn their songs from their parents (LE 2.1a). Birds that live in different habitats have different kinds of songs and places to sing their songs (LE 3.1c, 5.2f).

Vocabulary:
- **Inherited** – A trait you are born with.
- **Species** - Organisms of the same type.
- **Habitat** - The place an animal or plant lives.

Evaluation: Students will begin to learn how to identify birds based on their songs and know the reasons why birds sing.

Standards:
LE 2.1a
LE 3.1a, 3.1c, 3.2a
LE 5.2f

Materials:
- Poster: Bird Call
- Bird Call copy master for 24 copies
- Transparency of calls
- Toy plush birds
- Activity Sheets 4 - 6
- Book: The Backyard Birdsong Guide

Optional:
- Chart paper, markers*, Card Set – Blackline Masters

Activity 1: Identifying Bird Calls

Display the poster “Bird Calls” and pass out the small version of the poster that you have copied (a transparency is included). Have students practice each sound or call, one at a time with your help. Show the students that in some cases the sound is also the name of the bird! On the web site: www.birds.cornell.edu/physics/lessons/elementary/singing you will find songs of Eastern and Western United States birds. Note that most birds have more than one sound, including songs and calls. You may also use the plush birds in the kit. Choose those that are on the Bird Call Poster and activity sheet. Allow the students to hear the calls and look at the mnemonic spellings. When you are ready to proceed, have students put the bird call papers away.

Distribute Activity Sheet 4: Bird Calls, which has 5 bird call mnemonics with a picture of the birds for matching. Do not tell the students which bird call you will be playing. Play each song that is listed on the “Bird Call” activity sheet and have the students guess which bird and call it is. Have them draw a line connecting them as in a matching worksheet. (Cardinal -- “Wha-cheer” songs, Chickadee – “Chickadee” calls) If students are getting good at this, you can try Activity Sheet 5: Bird Calls 2, which has more birds and calls on it. Be sure to listen to the Mourning Dove and American Goldfinch too.

Optional Activities:

A. Bird Activity Sheets
You may choose to use Activity Sheet 6: Quick Sketch (2 pages) as a follow up to the lesson, as part of an ELA lesson, or part of the science lesson. After reading the content, direct students to add the indicated parts for each illustration. Guide them on how to
“quick draw” a bird. This means using basic shapes to sketch the bird, (not a “work of art”). Ex:

B: Bird Walk or Watching Videos of Behavior
Sometimes it is easier to understand why birds are making the sounds they are if you can also see their behaviors. If possible, take your class outside and listen quietly for as many bird songs or calls as possible. Upon returning to the classroom, make a list of birds heard and compare them to the songs on the websites or the Bird Songs book.
If time or weather doesn’t permit this, you may also wish to show a few different examples for some general categories of why birds communicate (alarm, contact, territoriality or attracting mates). We have put videos on the website: www.birds.cornell.edu/physics/lessons/elementary/singing

C: The Bird Call Game – Find your partner!
This adventurous activity allows students to continue learning bird calls by imitating the songs on the Cornell Lab of Ornithology website, plush birds, or the Bird Songs book.
There are twenty-four cards, two sets of twelve (located in the Blackline masters, you will have to cut them apart). Each student will imitate the bird song or call (similar to the bird call poster) prompted on his/her card. Their partner should recognize the call and call back, also naming the bird they are imitating.

D: “Where Are You?” Game
In nature, when many birds are singing or calling at the same time, it may be difficult for birds to find one another. Using 24 eggs (or covered containers such as milk cartons) in two paired sets of twelve, place various items inside that make noises. Each pair of students has a matching egg sound. Give each participating student an egg, and direct all those participating to begin shaking their eggs all at the same time (or if this is too loud or confusing, do only a few students at a time!). The goal of the activity is for partners to find each other in the midst of all the bird calling. After the activity, have students reflect on their experience thinking and discussing how difficult it may be for birds to find one another in the wild.
Focus: Why are birds’ beaks so different?

Teacher Background: As with all animals, birds need air, water and food to survive. (LE 1.1a) One trait of all birds is that they have a beak or bill. A bird’s external features, such as a beak, can help it to carry out life functions (like eating) in its environment (LE 5.1b, 3.1a). However, beaks come in many different sizes and shapes.

Beaks are like simple machines. They help make the work of cracking seeds and getting food easier (PS 5.1f). For example, a long pointed beak like a woodpecker’s is similar to a wedge. The wedge makes it easier to probe a hole in a tree for insects and worms. A cardinal’s beak is similar to a lever and used to pinch and crack seeds.

The type of beak gives a good clue to what the bird eats. Some are designed for opening seeds, while others are designed for catching fish or eating small animals. Since birds have no teeth they either swallow the food whole, or bite, crack, or tear it into pieces.

The following introductory activity will help students understand how birds’ beaks can be compared to simple machines they might use in their own homes.

Activity 1:

Give each student a gumball and Activity Sheet 7: Simple Machines. Ask each student to try to break the ball open using two fingers to pinch it (not using books, blocks, or other objects to hit it). Answer question 1 on Activity Sheet 7.

Hand each pair of students a nutcracker and have them crack open the gumball. Answer question 2 on the activity sheet comparing it to their fingers.

Ask which they thought was easier and why. Compare the nutcracker to a bird’s beak. Complete question 3.

The nutcracker is a simple machine called a lever. It uses a force, in combination with your muscles and the lever, to crack open the gumball. Students may say that beaks are like the nutcracker when they crack seeds and nuts, or something similar.

Activity Sheet 8: Natural Tools can be used as reinforcement or review for beaks and simple machines. You can discuss how and what those types of birds might eat in the real world and how the beak shape helps them. This will help with the next activity (which was age-adapted by Anne James-Rosenberg of the Cornell Lab of Ornithology, from the New York State Department of Education Regents lab, “Beaks of Finches”).
Activity 2: Beaks as Levers

In order to better understand the function of birds’ beaks, students will discover how basic tools are used in a similar way to beaks. Students will use the simple machines (levers and wedges) as birds’ beaks to try to catch different types of food at their station. Students will use Activity Sheet 9: Birds’ Beaks to collect data. You may want to create a summary chart to collect class data on the amount of food each beak was able to pick up.

1. Set up six (6) identical stations with four (4) students at each station. Next to each student, place a flat dish to serve as the bird’s “stomach.” In the center of the four students, place a pulp tray. This will hold the types of “food.” For each group, distribute one of each of the four tools: chopsticks, toothpick, tongs, and clothespin. Choose which students will use which tools (allowing students to decide within their groups may create hurt feelings). The toothpick and chopsticks may be frustrating, so choose some tolerant students! You may need to give guidance on these, or replace the toothpick if it breaks. If you have time, you can switch tools within a group.

2. With each trial, students should only pick up one piece of food at a time and place it in the dish that represents the “stomach.” Students should not use their free hand. Although most birds do use their feet to help eat and hold things, it is easier to keep this out of the activity.

3. Place a cupful of pony beads (these might simulate larger seeds) into the tray in the center of the students. Allow the students 30 seconds to pick up as many as possible, one “seed” at a time, with their tool and place them in their dish (“stomach”).

4. Allow students to count the number of beads they “ate”, document it on Activity Sheet 9, and then discuss which of the four types of “beaks” worked better in gathering that food. Discuss what might happen if a bird did not get enough food. You may want to add the data to the class summary chart.

5. When students are done discussing the pony beads, have them pour the beads from the tray and stomachs back into the zip-lock bag they came from. Then put the rubber bugs (this simulates worms, bugs, and small rodents that birds of prey might eat) on the tray. Repeat the 30-second trial, collect data, and discuss. The bugs can be placed back into the Ziploc when you are done with them. Finish the activity with the leaves (grasses and leaves).

6. Finally discuss which beaks were the best for which types of food. Have an overall discussion on beaks and how they help birds get the food they need. If you would like, visit the website below and show these videos to help students see how birds use their beaks in action! http://www.birds.cornell.edu/physics/lessons/elementary/beaks

<table>
<thead>
<tr>
<th>BIRD</th>
<th>BEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Woodcock</td>
<td>Long, thin, probing beak (woods)</td>
</tr>
<tr>
<td>Hudsonian Godwit</td>
<td>Long, thin, probing beak (water bird)</td>
</tr>
<tr>
<td>Downy Woodpecker</td>
<td>Medium, strong, sharp for chiseling in wood</td>
</tr>
<tr>
<td>Peregrin Falcon</td>
<td>Sharp, strong beak for tearing</td>
</tr>
<tr>
<td>Crested Caracara</td>
<td>Sharp, strong beak for tearing</td>
</tr>
<tr>
<td>American White Pelican</td>
<td>Large, scooped for catching fish</td>
</tr>
<tr>
<td>Roseate Spoonbill</td>
<td>Flat, large area for straining food</td>
</tr>
<tr>
<td>American Goldfinch</td>
<td>Short, strong for cracking open seeds</td>
</tr>
<tr>
<td>Anna’s Hummingbird</td>
<td>Long and very thin for sipping nectar</td>
</tr>
</tbody>
</table>
Focus: How do a bird’s wing shape and structure help it to fly?

Background: A bird’s wing is similar to a wing of an airplane. It has a thick, rounded edge that points forward and thins out at the back or end of the feathers. This helps the wind or air glide over the wing more easily. The pressure above the wing is reduced and the greater pressure from below lifts it up. This is called lift and is the same kind of movement that lifts a bird’s wings as they move through the air. Drag and gravity help slow the bird and pull it back to the ground. Gravity is the force that pulls the bird’s body towards Earth [PS 5.1c]. Drag is the force or friction that pushes against the bird as it flies through the wind. It is similar to putting your hand out a car window while in motion. If you have your palm turned towards the front of the car you will feel the drag of the wind on your arm. If the palm is down or flat, the wind goes over it more easily.

Birds are the only animals with feathers [LE 3.1a, 5.1b]. Feathers are light, yet strong and help keep birds warm on cold days and cool when it is hot. There are different types of feathers for different jobs. Contour feathers give the bird’s body its shape, and help it to fly, steer, and swim. Down feathers lie close the bird’s body and keep it warm or cool. The brightly colored feathers, usually on male birds help to attract mates, while the dull colored feathers, usually on females help to camouflage the bird when it is caring for young.

Activity 1: Lift

Help students experience how the principle of lift works in bird flight. Have each student hold a strip of copy paper approximately 1 inch wide and 11 inches long between the thumb and index finger. Blow over the top of the paper and watch as the paper is lifted up. Blowing makes the air rush over the paper. The pressure above the paper is reduced and the greater pressure from below lifts it up. This is called lift and is similar to the force that lifts a bird’s wings as they move through the air.
Activity 2: Wing shapes, sizes, and uses!

✈ Included in the kit are 5 different templates of bird wings. These templates have patterns on both sides and are scaled to actual size. Please copy these templates onto cardstock, oak tag or craft paper, either on the copier in sections, or by taping the paper together and pencil drawing them. If you copy both sides on separate paper, you will have a right and left wing pattern.

✈ Place students in 5 groups (there are 5 patterns) and give each group one of the copied templates (if you copy both sides onto single sided pages, students can separate into twice as many groups). Have them observe the size and shape of the wing and hypothesize which type of flight that type of bird is most likely to perform (you may need to give keywords such as soaring, hovering, rapid). Afterwards, if you wish and have time, have students color the wing based on the coloring of the type of bird they have. You will have to check the field guide, BirdSleuth cards, or the All About Birds website to see realistic coloring. Display the wings in the classroom or hallway. You could hang the wings from the ceiling to show the wingspan!

✈ To demonstrate why the longer wings are for gliding, have students stand with their arms straight out from their sides, shoulder height. Have them flap their arms as wings for 30 seconds and count the number of flaps. Next have them pick up a heavy book in each hand and flap again. This will show that the big, heavy wings of birds such as albatross and vultures make it difficult to keep flapping, therefore they instead use them to glide or soar using the air currents. Complete Activity Sheet 11.

Activity 3: Wings and Flight

✈ On the website listed below, observe the way different birds fly. You will see 5 types of birds. Using Activity Sheet 12, have students match the type of flying the birds are doing to the wing type. Website: http://www.birds.cornell.edu/physics/lessons/elementary/flight

Optional: Feather Structure:
1. Have students work in partners or teams. Provide each grouping with contour feathers, down feathers, and hand lenses for observation.

2. Have them separate the feathers into groups: down feathers are soft and fluffy, and contour feathers are longer and more defined in shape.

3. Examine a contour feather with a hand lens and have students identify the shaft, vane and barbs. Have students complete scientific drawings (detailed sketches) of the feathers in their Activity Sheet 13. Label these parts: rachis (hard, hollow center tube), the barbs (the perpendicular feathery parts) and the barbs (smaller interlocking zipper-like structures). If possible, use an overhead projector to show the silhouette of the feather, showing the rachis, barb and barbules.

4. The barbs in feathers come apart easily and birds must repair them. To repair a feather, a bird pulls the feather gently through its beak to zip
together any barbs that have pulled apart. Students can repair or preen a contour feather by holding the hollow shaft in one hand and pinching the feather between a finger and thumb on the other hand. Run the finger and thumb up the feather to zip up the separated barbs.

5. Preening or feather care is very important to good bird health. Preen glands are found on most bird’s backs and contain oil which is rubbed over the feathers to keep them flexible and waterproof. Test a feather for waterproof properties by spraying a few drops of water on the feather. If the water does not bead up and run off, lightly apply baby oil to the feather. Spray again to see how the water beads up. Gently wipe off the feather.

**Bones:**
1. A bird’s bones are hollow, which makes the bird lighter. Compare the inside of bird bones with those of other animals. Bring in clean, dry chicken bones as well as beef bones. Your local supermarket usually has beef bones and will cut them for you if requested. Cut the chicken bones in two and compare the two.
Lesson 7: Magnetic Migration

Concepts:
- Some birds migrate when the weather changes and their energy source (food) decreases.
- Magnetism is a force.
- Magnets have a north and south pole.
- Magnetism works through solids, liquids and gases.

Vocabulary:
- Migration – When birds move from one environment to another in response to changes in food and the seasons.
- Scarcе – In short supply.
- Magnetism – A force that attracts or repels certain materials.

Evaluation:
Students will be able to describe the reasons behind migration and the need for the wetlands as stopovers.

Standards:
LE 5.2b,d
LE 3.1a
PS 4.1g
PS 5.1e
PS 5.2a

Materials:
Activity Sheet 14
48 magnets labeled N & S
24 magnets not labeled
12 object sets
6 laminated bird pictures
1 migration map

Focus: How do birds migrate?

Note to teachers: The Cornell Lab of Ornithology website has an informative section on migration if you wish to use it as a resource to investigate further information. Go to: www.birds.cornell.edu/AllAboutBirds/studying/migration/

Background: When you think of migration, the first thing that comes to mind is probably watching large flocks of geese flying in a V formation. Birds respond to changes in their environment and move from place to place to meet their needs [LE 5.2b,d]. When geese migrate in the spring, they fly north where there is more space to breed. In the fall, when the weather gets colder and the food gets scarce, geese fly south.

Many other species of birds migrate as well. Some birds fly just a short distance, from high in the mountains to the lower mountainsides. Some species fly over one or more states, and some even fly to other countries or across large bodies of water, thousands of miles away! How do they do this?

One current theory is that the Earth’s magnetic poles help to guide the birds in their migrations, as though the birds have a compass or magnet in their heads. Other ideas are that that birds can orient themselves by the use of landmarks such as mountains, large rivers, or coastlines. In addition, wind direction over the seas, and the location of the Sun, Moon and stars may help.

Magnetism is a force that may attract (pull) or repel (push) objects depending on what they are made of [PS 5.1e]. The force of magnetism can work through solids, liquids and gases [PS 5.2a]. This is due to the magnet’s magnetic poles. All magnets have a north pole and a south pole. When the north pole of one magnet is brought near the south pole of a second magnet, the magnets attract each other. If the two north poles or the two south poles come together, the magnets repel each other. When a bird migrates, it is thought that the bird’s “magnetic sense” helps guide it along the Earth’s magnetic fields to the North or South Pole.

Activity: Magnetic Migration

First, give groups of students two small magnets with labeled ends (north and south). Show students the labeled ends and discuss the idea that magnets have forces that either push the same poles away or pull the opposite poles together. Have them experiment! This is a good time for reviewing what objects attract to a magnet
(iron or steel) and what objects do not. Give each group a bag of objects to test. Predict which of the objects in the bag are attracted to a magnet and which are not attracted; note this on **Activity Sheet 14: Attracts or Repels**. Have students test each of the objects using both ends of the magnet, to see if their predictions were correct. Finish the activity sheet.

**Discussion Questions:**

1. Did any of the items surprise you? The magnetite rock may have surprised them. It contains iron ore, which is attracted to a magnet.
2. Why did you use the ends of the bar magnet instead of the middle? The ends (poles) of a bar magnet are stronger than the center. The center often has very little if no magnetic strength since the north and south cancel each other at that point.
3. What do the objects attracted by a magnet have in common? Objects that are steel or contain iron will be attracted. Other metals such as aluminum or copper will not. Plastic, rubber, wood and other materials will not be attracted to the magnet.
4. Are there any metals not attracted to a magnet? Aluminum and copper.
5. If the rocks do not come up in conversation, ask the students why one of the rocks was attracted and one was not. Students should realize that one rock (lodestone or magnetite, the darker one) contains iron!
6. If students wanted to sort these objects into two groups, what would the property be? Hopefully students will indicate that the objects could be sorted into “attracted to a magnet” and “not attracted to a magnet.”

Clean up the test objects and one of the labeled magnets. Give students one magnet without the poles labeled. Have them determine which pole is north and south using the other labeled magnet. Complete the **Activity Sheet 15: The Poles**.

**Activity 2: Magnetic Migration**

*NOTE: This can be done at the science center or as a demonstration.*

There is one set of six types of laminated bird pictures in the kit, West Coast migrants (California Gull, Red Knot, Willet), and East Coast Migrants: (Baltimore Oriole, Ruby-throated Hummingbird, Common Loon). Display them along with the migration map of North America. The students will choose a bird with the magnetic strip attached to it and slide it along the two migration routes labeled on the map. These represent the Pacific and Atlantic Flyways. If the magnet pushes away from the bird, then that is not the route this bird would take to migrate. If the magnet pulls the bird to it, this is the route it would take for migration. Have students test each migration route with all the birds to determine each bird’s route. Complete **Activity Sheet 16: Migration**.

**Discussion Questions:**

1. What allows the birds to help find their way in this activity? The magnetism.
2. Did all the birds fly the same path? No, some migrated along the west coast and others the east coast.
3. Why might a bird fly along the eastern border of the US instead of the western? The birds’ habitats are located along the eastern border.

*NOTE: Here are some useful web resources to explore migration and stopover points further.*

[www.nationalzoo.si.edu/scbi/migratorybirds/education/kids_stuff/woth_game/](http://www.nationalzoo.si.edu/scbi/migratorybirds/education/kids_stuff/woth_game/)

Focus: How can we learn more about our favorite birds?

Background: Birds can be very interesting to watch and learn about. Each bird has different physical traits, or structures, that serve different functions in growth, survival, and reproduction depending on their environment (LE 3.1a, 5.1b). For example, birds are not the only animals that have wings and fly, but they are the only animals that have feathers. Feathers help a bird to fly, swim, or steer, and keep the bird warm or cool as needed. Beaks are another example of physical traits that varies depending on the bird’s environment. A bird’s behaviors also help it to survive in its habitat. Birds sing or call to communicate with each other. Some birds migrate to warmer climates when it gets cold and food becomes scarce. Identifying and watching birds can be a fascinating hobby.

Activity: Bird Review

As an overall unit review, show the video, All About Birds. This video serves as a great overall review of all unit concepts. Review the original KWL chart for questions and answers. This may help in the sections below.

Within teams or with partners, either assign a bird to research, or have students choose a bird they find interesting and would like to learn more about. The BirdSleuth cards are excellent resources for this.

As a culminating activity, have students become experts on their particular bird and present it to the class. Use What is a Bird?, Eyewitness Birds, or the other bird books as the primary resource. The websites, http://allaboutbirds.org and www.enchantedlearning.com, have information and drawings about individual birds as well, in a kid-friendly format. Depending on the ability of your group, have students use books from the school library as a third source.

Use the Bird Information Outline to gather information on the following topics:

- Physical traits of the bird, including size, coloring, and unique markings, such as a crest, beak, wing or tail shape.
- Song and call information; use the website, plush birds or Bird Songs book as part of the research and presentation.
- Flight: How birds fly and the types of wing structure that enables them to do so.
- Beaks: How they are similar to a simple machine and the functions they serve.
- Other interesting facts.
Students may choose from the following formats for presentation:
(But don’t limit them to just these; allow any reasonable, creative ideas!)
• Poster
• Write a field guide for that type of bird
• PowerPoint slide presentation
• Kidspiration outline (if available in your district)
• Podcast/news report/interview with a famous birdwatcher
Focus: How do a bird’s physical traits and behaviors help it meet its basic needs for survival?

Background: Bird watching is a great hobby that can last a lifetime. Included in this lesson are several activities that you may choose to include as part of the unit or to extend the unit if your bird watchers just cannot seem to get enough of the amazing birds.

Optional Activities may be incorporated into science or ELA lessons. Choose from the following ideas. Activity sheets are included for many of these ideas.

Bird Feeder Activities: Choose from the many feeder activities on the “Feed the Birds” sheet. Remember that if food is provided beginning in the fall, it should be continued throughout the winter until spring. Birds in the area will come to depend on it. During November-April, you may also wish to participate in citizen science by doing Project FeederWatch: www.birds.cornell.edu/pfw/
Count the highest number and type of birds that come to the feeder. Also keep notes on what type of foods the birds seem to be most interested in. You can find more activities to complement Project FeederWatch at: www.birds.cornell.edu/pfw/Members/EduHomeSchoolResources.htm

Paper Plate Bird: This is a fun, creative activity. Directions and an activity sheet are included.

Bird Binoculars: This is another fun, creative activity. Use two empty toilet paper tubes. Have students decorate them, and then tape them together with masking or other colorful tape. Punch holes in the sides of the tubes near one end, and then add a string or yarn neck strap. They don’t really magnify, but they will help students focus on birds they see.

Bird Bop: This activity is for the class that loves to dance and move. The goal is to imitate the ways different birds move. If you are very adventurous, you may bop to music. You may choose to watch videos from the website in Lesson 2, and imitate various birds, or choose from the following descriptions:

- Pigeon or Chicken Strut: These birds move their heads in and out as they walk. Have students put their hands behind their backs, take short steps, and move their heads.

Materials:
Feed the Birds sheet
My Bird Watch chart
Paper Plate Bird sheet

Optional Materials to be obtained locally:
- paper plates
- toilet paper tubes
- **Turkey Vulture Soar**: These birds are easily identified by the way they fly. As they soar, they hold their wings in a slight v-shape and rock gently from side to side on air currents. Have students spread their arms and gently tip their arms and bodies back and forth. Play calm, slow, graceful music for these birds.

- **Penguin Shuffle**: Have students hold their arms at a slight angle away from their bodies and shuffle with small steps and feet close together. A little swaying adds to the waddle.

- **Hummingbird Flit**: Hummingbirds are amazing flyers. They are like little helicopters, hovering in one position, or flying up or down, or even side-to-side. Have students flap their arms from their elbows as fast as possible.

- **Sparrow or Robin Hop**: These birds spend a lot of time hopping around on the ground, looking for food. Have students hold their arms next to their bodies and hop around.

### Bird’s Eye Story

This is an ELA activity, involving listening and creative writing. Familiarize students with the idea of bird’s eye view perspective. Have them listen to a made-up story of what they might see as they fly across the schoolyard in search of food or nesting material or location. Have students illustrate what they heard. Continue further by having them write their own stories.

### Silly Bird Descriptions

Some birds have descriptive names, such as the Red-tailed Hawk, or the Yellow-belled Sapsucker. Have students make up their own descriptive and fun bird names, then draw what they would look like.

### Local Field Guide

Have students make their own field guide for local birds. Take photos or make accurate drawings of neighborhood birds. Use a bird guide to identify each and write a short description.

### Bird Garden or Nature Center

If your school allows, plant a bird-friendly garden or nature center. Place feeders, suet, nest boxes and bird baths in it. Research what plants attract certain birds. Then wait and observe who comes!

### Audubon Society

Find out about local bird watching organizations, such as the Audubon Society. There may even be student-level organizations for those interested to join.

### Review Activities

If you choose to include a review lesson, you may wish to use unused optional activity sheets or even extension activities from previous lessons. Some may be adapted for work in centers. Also consider using websites listed in the Resources Section.
Glossary

- **Adaptation** – A change or adjustment in an organism that increases its chance of survival.
- **Behavior** - The way a living thing acts.
- **Camouflage** - A protective appearance that conceals an organism and enables it to blend into its surroundings.
- **Drag** – The force that opposes or slows an object’s movement.
- **Features** – A part of something that defines it.
- **Frequency** – The number of cycles per second of a wave.
- **Graph** – A diagram showing relationships of quantities.
- **Gravity** – A force that attracts two objects.
- **Habitat** - The place an animal or plant lives.
- **Inherited** - A trait you are born with.
- **Lift** – An upward force acting on an object.
- **Magnetism** – a force that attracts or repels certain materials.
- **Migration** – When birds move from one environment to another in response to changes in food and the seasons.
- **Observe** – To look at or study something.
- **Physical trait or characteristic** - A body part which is unique to that particular organism.
- **Pitch** – Perceived frequency that indicates whether a sound is high or low (soprano vs. bass).
- **Scarce** – In short supply.
- **Simple Machine** – Tools that help you do work with less effort.
- **Sound** - A form of energy.
- **Species** - Organisms of the same type.
- **Traits** – Certain characteristics that define an organism.
- **Vibrate** - To move back and forth quickly.
- **Waves** - A vibration that transfer energy.
Resources:

Feeding Birds
www.allaboutbirds.org/attributingbirds-feeding
www.birds.cornell.edu/pfw/AboutBirdsandFeeding/FeederTypes.htm

Migration
www.nationalzoo.si.edu/scbi/migratorybirds/education/kids_stuff/woth_game/ - This has a great migration game on it that asks questions and has great information about the migration resting points.
www.rspb.org.uk/youth/learn/migration/route/index.asp - Good interactive site for migration
www.birdnature.com/migration.html - The flyways of the North American birds are shown here with some great information about migration.

Song
files.dnr.state.mn.us/publications/volunteer/young_naturalists/birdsong/birdsong.pdf - There is a great PDF information booklet on this site about songbirds!

General
www.allaboutbirds.org - Articles, videos, and online field guides from the Cornell Lab of Ornithology.
www.birds.cornell.edu/education - Cornell Lab of Ornithology has some great teaching resources and activities for kids and families.
www.birds.cornell.edu/bbimages/PDFs/ColoringBook.pdf - From Lesson 1, this has the coloring book of birds.
beyondpenguins.ehe.osu.edu/issue/arctic-and-antarctic-birds/ - A bird-themed issue of the award-winning journal Beyond Penguins and Polar Bears, with K-4 reading, science, and technology integration activities.
www.abcteach.com/directory/basics/science/animals/birds/ - This has some great interactive worksheets including coloring pages, vocabulary, KWL and other graphic organizers – worth the look!
www.pbs.org/lifeofbirds/ - This PBS-sponsored site has many great links with good pictures and information.
animals.nationalgeographic.com/animals/birds.html - National Geographic has a fact-filled site with great pictures.
www.audubon.org/ - The National Audubon Society has great information about birds.

Books:
• The Little Big Book of Birds by Natasha Tabori Fried, Lena Tabori, and Kenn Kaufman (Hardcover - April 24, 2007)
• The Audubon Backyard Birdwatcher: Birdfeeders and Bird Gardens by Robert Burton and Stephen Kress (Hardcover - May 1, 2002)
• The Burgess Bird Book for Children (Dover Science Books) by Thornton W. Burgess (Paperback - April 23, 2003)
• Birds (True Books : Animals) by Melissa Stewart (Paperback - Aug 2000)
• Zoobooks: Birds of Prey, Ducks, Geese & Swans
• Ehlert, Lois. Feathers for Lunch. Harcourt Brace, San Diego, CA; 1996
• Eye Wonder: Birds - ISBN 0789485508 | 03 May 2002
CONTENT STANDARD A: Science as Inquiry

ASK A QUESTION ABOUT OBJECTS, ORGANISMS, AND EVENTS IN THE ENVIRONMENT. This aspect of the standard emphasizes students asking questions that they can answer with scientific knowledge, combined with their own observations. Students should answer their questions by seeking information from reliable sources of scientific information and from their own observations and investigations.

PLAN AND CONDUCT A SIMPLE INVESTIGATION. In the earliest years, investigations are largely based on systematic observations. As students develop, they may design and conduct simple experiments to answer questions. The idea of a fair test is possible for many students to consider by fourth grade.

EMPLOY SIMPLE EQUIPMENT AND TOOLS TO GATHER DATA AND EXTEND THE SENSES. In early years, students develop simple skills, such as how to observe, measure, cut, connect, switch, turn on and off, pour, hold, tie, and hook. Beginning with simple instruments, students can use rulers to measure the length, height, and depth of objects and materials; thermometers to measure temperature; watches to measure time; beam balances and spring scales to measure weight and force; magnifiers to observe objects and organisms; and microscopes to observe the finer details of plants, animals, rocks, and other materials. Children also develop skills in the use of computers and calculators for conducting investigations.

USE DATA TO CONSTRUCT A REASONABLE EXPLANATION. This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations. After students propose an explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others.

COMMUNICATE INVESTIGATIONS AND EXPLANATIONS. Students should begin developing the abilities to communicate, critique, and analyze their work and the work of other students. This communication might be spoken or drawn as well as written.

Content Standard B: Physical Setting

POSITION AND MOTION OF OBJECTS

- Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration.
THE CHARACTERISTICS OF ORGANISMS

- Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.
- Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.
- The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues.

LIFE CYCLES OF ORGANISMS

- Many characteristics of an organism are inherited from the parents of the organism, but other characteristics result from an individual's interactions with the environment. Inherited characteristics include the color of flowers and the number of limbs of an animal. Other features, such as the ability to ride a bicycle, are learned through interactions with the environment and cannot be passed on to the next generation.

ORGANISMS AND THEIR ENVIRONMENTS

- All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.
- An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

Content Standard F: Science in Personal and Social Perspectives

TYPES OF RESOURCES

- Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources are basic materials, such as air, water, and soil; some are produced from basic resources, such as food, fuel, and building materials; and some resources are nonmaterial, such as quiet places, beauty, security, and safety.
- The supply of many resources is limited. If used, resources can be extended through recycling and decreased use.
CHANGES IN ENVIRONMENTS

- Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive and their quality of life.
- Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad. Pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans.
- Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods.

New York State Elementary Science Core Curriculum, Grades K-4

Inquiry and Science Process Skills

It should be the goal of the instructor to foster the development of science process skills. The application of these skills allows students to investigate important issues in the world around them.

Inquiry-based units will include many of most of the following process skills. These process skills should be incorporated into students’ instruction as developmentally appropriate.

Classifying
arranging or distributing objects, events, or information representing objects or events in classes according to some method or system

Communication
giving oral and written explanations or graphic representations of observations

Comparing and contrasting
identifying similarities and differences between or among objects, events, data, systems, etc.

Creating models
displaying information by means of graphic illustrations or other multi-sensory representations

Gathering and organizing data
collecting information about objects and events, which illustrate a specific situation

Generalizing
drawing general conclusions from particulars

Identifying variables
recognizing the characteristics of objects or factors in events that are constant or change under different conditions

Inferring
drawing a conclusion based on prior experiences, constant or change under different conditions

Interpreting data
analyzing data that have been obtained and organized by determining apparent patterns or relationships in the data
Making decisions

identifying alternatives and choosing a course of action from among the alternatives after basing the judgment of the selection on justifiable reasons

Manipulating materials

handling or treating materials and equipment safely, skillfully, and effectively

Measuring

making quantitative observations by comparing to a conventional standard (or extensions of the senses)

Observing

becoming aware of an object or event by using any of the senses (or extensions of the senses) to identify properties

Predicting

making a forecast of future events or conditions expected to exist

Content Standard 1: Analysis, Inquiry, and Design

Mathematical Analysis:

Key Idea 2: Deductive and inductive reasoning are used to reach mathematical conclusions.

M2.1a Explain verbally, graphically, or in writing the reasoning used to develop mathematical conclusions
M2.1b Explain verbally, graphically, or in writing patterns and relationships observed in the physical and living environment

Scientific Inquiry:

Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.
S1.1a Observe and discuss objects and events and record observations
S1.1b Articulate appropriate questions based on observations
S1.2a Identify similarities and differences between explanations received from others or in print and personal observations or understandings

Key Idea 2: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.
S2.3a Use appropriate "inquiry and process skills" to collect
S2.3b Record observations accurately and concisely
S3.2a State, orally and in writing, any inferences or generalizations indicated by the data collected
Content Standard 4: Physical Setting

Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved.

4.1a Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.
4.1b Energy can be transferred from one place to another.
4.1e Electricity travels in a closed circuit.
4.1g Interactions with forms of energy can be either helpful or harmful.

Key Idea 5: Energy and matter interact through forces that result in changes in motion.

5.1c The force of gravity pulls objects toward the center of the Earth.
5.1e Magnetism is a force that may attract or repel certain materials.
5.1f Mechanical energy may cause change in motion through the application of force and through the use of simple machines such as pulleys, levers, and inclined planes.

5.2a The forces of gravity and magnetism can affect objects through gases, liquids, and solids.

Content Standard 4: Living Environment

Key Idea 1: Living things are both similar to and different from each other and nonliving things.

1.1a Animals need air, water, and food in order to live and thrive.

Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.

2.1a Some traits of living things have been inherited (e.g., color of flowers and number of limbs of animals).
2.1b Some characteristics result from an individual's interactions with the environment and cannot be inherited by the next generation (e.g., having scars; riding a bicycle).

Key Idea 3: Individual organisms and species change over time.

3.1a Each animal has different structures that serve different functions in growth, survival, and reproduction.
   • Wings, legs, or fins enable some animals to seek shelter and to escape predators.
   • The mouth, including teeth, jaws, and tongue, enables some animals to eat and drink.
   • Eyes, nose, ears, tongue, and skin of some animals enable the animals to sense their surroundings.
• Claws, shells, spines, feathers, fur, scales, and color of body covering enable some animals to protect themselves from predators, and other environmental conditions, or enable them to obtain food.
• Some animals have parts that are used to produce sounds and smells to help the animal meet its needs.

3.1c In order to survive in their environment, plants and animals must be adapted to that environment.
• Animal adaptations include: coloration for warning or attraction, camouflage, defense mechanisms, movement, hibernation, and migration.

3.2a Individuals within a species may compete each other for food, mates, space, water, and shelter in their environment.
3.2b All individuals have variations, and because of these variations, individuals of a species may have an advantage in surviving and reproducing.

**Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.**

5.1b An organism's external physical features can enable it to carry out life functions in its particular environment.
5.2b Animals respond to change in their environment, (e.g., perspiration, heart rate, breathing rate, eye blinking, shivering and salivating).
5.2d Some animals, including humans, move from place to place to meet their needs.
5.2e Particular animal characteristics are influenced by changing environmental conditions including: fat storage in winter, coat thickness in winter, camouflage, shedding of fur.
5.2f Some animal behaviors are influenced by environmental conditions. These behaviors may include: nest building, hibernating, hunting, migrating, and communicating.