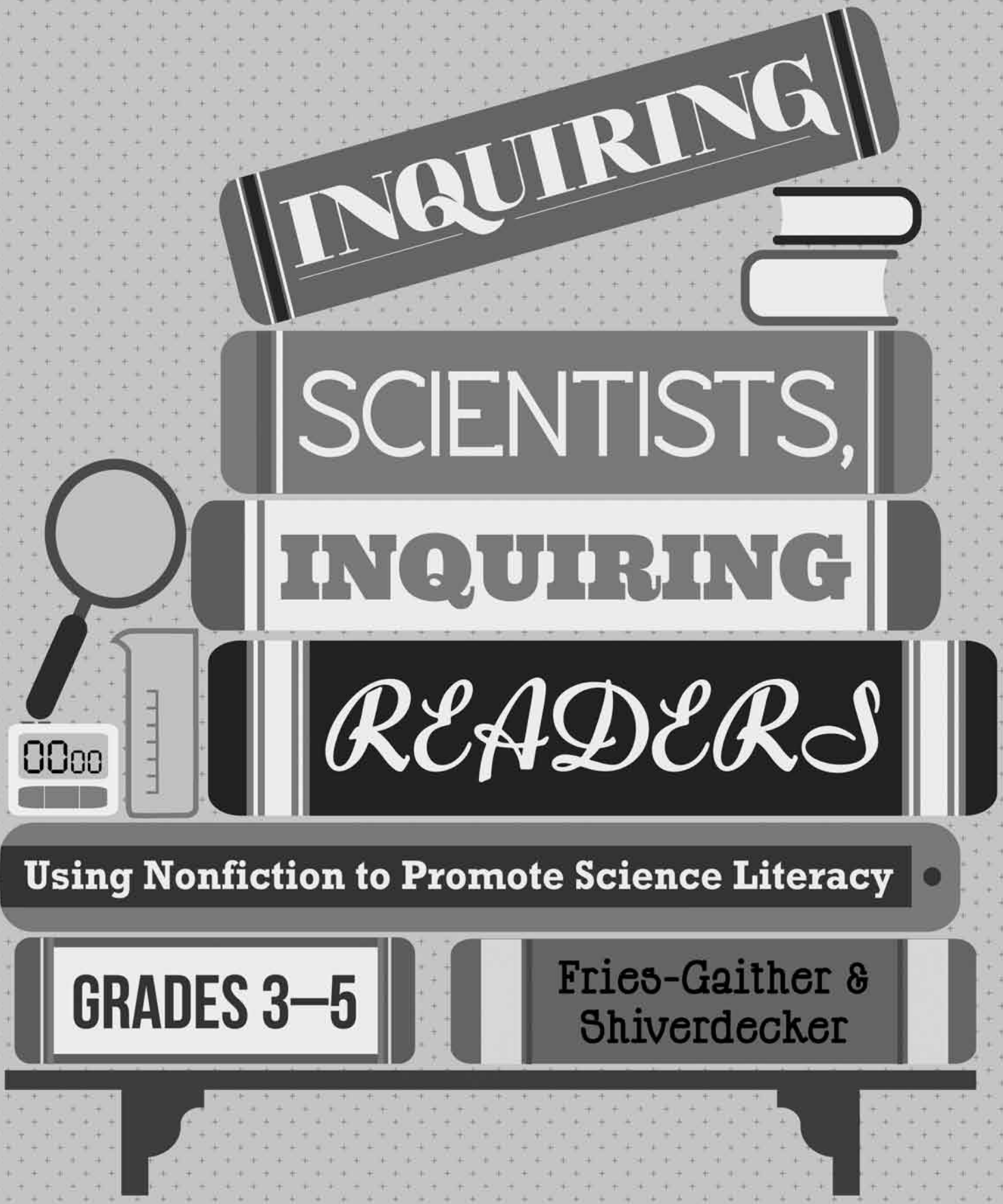
INQUIRING SCIENTISTS, INQUIRING READERS

Using Nonfiction to Promote Science Literacy

GRADES 3–5

Fries-Gaither & Shiverdecker

NSTA press
National Science Teachers Association



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Jessica Fries-Gaither
Terry Shiverdecker

NSTApress
National Science Teachers Association
Arlington, Virginia

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CONTENTS

CONTENTS

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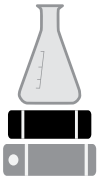

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ABOUT THE AUTHORS

Jessica Fries-Gaither is the Lower School science teacher at Columbus School for Girls (CSG) in Columbus, Ohio, where she teaches science to grades 1–5. Prior to working at CSG, she was an education resource specialist in the School of Teaching of Learning, College of Education and Human Ecology at Ohio State University, where she served as the project director for two National Science Foundation–funded projects: *Beyond Penguins and Polar Bears* and *Beyond Weather and the Water Cycle*. Both projects support elementary teachers as they integrate science and literacy instruction. Jessica earned bachelor's degrees in the biological sciences and anthropology from the University of Notre Dame. She received her MEd from the University of Notre Dame's Alliance for Catholic Education program. Jessica taught middle school math and science in Memphis, Tennessee, and a variety of grade levels, ranging from eighth-grade science to fourth-grade self-contained, in Anchorage, Alaska.

Terry Shiverdecker is the science content specialist at the Ohio Resource Center located at Ohio State University. She provides teachers of science in grades K–12 best-practices resources and professional development opportunities. Terry received a bachelor's degree from Wright State University, a master's degree from Miami University (Ohio), and an EdD in curriculum and instruction from the University of Cincinnati. She taught high school science for 12 years at Russia Local School in west central Ohio and has experience teaching both physical and life sciences. Terry also worked at the Shelby County (Ohio) Educational Service Center as Director of Secondary Curriculum and Instruction.

INTRODUCTION

Every now and then you happen on an idea that ties multiple lines of thought together into a unified whole. An idea that paints a clear picture, answers questions, and leads you in a new direction. We encountered such an idea when we read the article "Science Text Sets: Using Various Genres to Promote Literacy and Inquiry," by Margaretha Ebbers (2002). Ebbers describes how multiple genres of nonfiction (including biographies, field guides, reference books, and journals) present scientific information in different ways. Collections of these books, known as text sets, can be used to support inquiry-based instruction by assisting students as they pose questions, design investigations, and confirm and extend the knowledge they've learned through direct investigation.

This article transformed our thinking and got us excited about the possibilities for elementary science education. Jessica, an elementary school teacher and the project director of two elementary science and literacy projects, was thrilled to discover a new way to promote the use of nonfiction and informational texts in the elementary grades. Terry, a science content specialist and former high school science teacher, was pleased to find a way to integrate science and literacy instruction without sacrificing the science. As we planned a three-day workshop on the subject for elementary teachers, we became increasingly convinced that this approach held great promise. We received very positive feedback from the workshop and from several additional presentations at local conferences. We knew that we wanted to share this approach with as many teachers as possible—and the idea for this book was born.

ABOUT THIS BOOK

In this book we will weave together best practices in literacy and science instruction in a way that makes sense for classroom practice. Inquiry is at the heart of best practices in science instruction. The units in this book are inquiry-based units, involving testable questions and the use of evidence to construct conclusions. In most cases, the teacher provides students with a question and a procedure. In some cases, the teacher supports students as they pose questions, design an investigation, and collect evidence. We designed teacher-led inquiries in an effort to support teachers new to inquiry. In Chapter 2 we have provided general suggestions for moving the units toward being student directed.

Our inquiry units have been designed using the learning cycle framework, a process that incorporates hands-on investigations, reading science text, directed discussion, and problem solving. The hands-on investigations and reading of science texts are seamlessly integrated, supporting both science and literacy. Sometimes the inquiry units start with a hands-on investigation, other times they start with an engaging nonfiction text. Either way, they follow the learning cycle framework. In terms of literacy, the units emphasize the use of nonfiction text, a genre that has traditionally been underrepresented in the elementary grades. They also provide authentic contexts for reading, writing, and discussion through

read-alouds, collaborative activities, graphic organizers, and writing prompts. Uniting the best practices in science and literacy instruction elevates learning in both areas.

We begin with a review of the literature on science and literacy instruction. We look at inquiry-based instruction and the history and application of the learning cycle. We review some best practices in literacy and how these practices manifest themselves in the units. The foundational chapters also include information about nonfiction genres and text sets.

This research is then applied to the units that follow. This is where the theory is turned into practice. We know that for many teachers this will be the most enticing part of the book. We have included units that encompass life, physical, and Earth and space science as well as two on the nature of science. Each inquiry unit includes scientific background information, common misconceptions that are associated with the content, an annotated list of the texts in the text set, safety considerations, supporting documents (e.g., graphic organizers, writing prompts), and suggested assessments. The units have been tested in classrooms to ensure their effectiveness.

WHY THIS BOOK IS IMPORTANT

As former teachers and current professional development providers, we know that the elementary curriculum has become increasingly crowded over the past few years. An intense focus on literacy and mathematics, due in part to mandated standardized testing, has left little time for science instruction. Much to our dismay, studies indicate that only a limited amount of science is being taught in the elementary grades. From the perspective of science educators, this is problematic. We need to have good science instruction in these formative years for some of the same reasons we need good literacy and mathematics instruction early in a child's formal education. One potential remedy to the problem is to integrate science into literacy instruction. It seems like a good idea, but this approach often leads to reading about science rather than engaging in scientific inquiry. Another potential pitfall with this approach is that the children's literature selected for science reading may be scientifically inaccurate or fiction. While fiction is engaging and plays an important role in early literacy instruction, we believe that scientific content and the nature of science are best conveyed through nonfiction and informational genres.

Science is an active process that must be experienced to be fully understood. Just reading about science is inadequate and cannot be substituted for effective science instruction. Yet it is clear that children must be able to make meaning from text and visual representations of scientific ideas; they must be able to write to express their understanding of science; and they must have the skills to engage in discourse around scientific ideas and processes. It is impossible to help a child develop a strong foundation in science content and processes without drawing on these literacy skills. Science education has struggled with how to build science and literacy skills concurrently in a cohesive manner that honors the best practices of both disciplines.

Teaching nonfiction text comes with its own set of challenges. These challenges include available instructional time, identification of appropriate reading materials, and providing authentic contexts within which the reading can occur. It could be argued that some sci-

ence time could be "borrowed" for instruction in nonfiction text. The process we propose in this book does not require that time be borrowed from either discipline to support the other. This approach supports both equally well. It also reflects what scientists do. Reading and writing is an integral part of science. The issue of identifying appropriate reading materials tends to take care of itself once the topic has been selected. The caveat here is that the reading material must present science content accurately. The issue of providing authentic contexts for reading and writing is also resolved with the careful selection of inquiry topics and tasks. This approach is a win-win for both disciplines.

HOW TO USE THIS BOOK

This book is composed of two distinct sections: the research section and the inquiry units. In a perfect world, the reader would begin by reviewing the research background we've provided and follow that by trying some of the units. But we know what we would do with this book if we were still in the classroom: We'd start with the units. And we know from our research into reading nonfiction and informational text that this makes perfect sense. After all, if you start with a lesson, you will then have an authentic context in which you can place the research. Research always makes more sense when you can put it into a meaningful context.

Even if you choose to start with the units, please go back and read the research review we've provided. Digging into the lessons may be more exciting but your understanding of why the lessons are laid out as they are, why specific practices are suggested, and why certain texts have been selected will be enhanced if you become familiar with the research. The research foundation will also be helpful if you find you need to modify the units to better meet the needs of your students.

Embedding multigenre nonfiction text sets into inquiry instruction is the logical next step toward uniting the two into a cohesive whole. This approach honors the best practices of both disciplines, provides an authentic context for literacy instruction, and supports inquiry into concepts that cannot be easily investigated directly. It is our hope that you will feel empowered and impassioned after reading this book, that you will feel compelled to try all of the lessons that fit your curriculum, and that you will be inspired to develop your own multigenre nonfiction text sets and associated inquiry investigations.

We began this introduction by talking about how the Ebbers article painted a clear picture, answered questions, and led us in a new direction. We hope this book does the same for you.

REFERENCE

Ebbers, M. 2002. Science text sets: Using various genres to promote literacy and inquiry. *Language Arts* 80 (1): 40–50.

Chapter 10

Beaks and Biomes: Understanding Adaptation in Migrating Organisms

OVERVIEW

In this unit, students conduct direct and indirect investigations to answer the question, *How is the sanderling adapted to survive in two different environments*? The unit focuses on the sanderling, a shorebird that migrates from warm, sunny beaches to the Arctic tundra to breed each year. The direct investigation in this lesson involves students in simulations of the sanderlings' feeding habits. In the indirect investigation, students take part in idea circles in which they work in collaborative groups to learn about the tundra through informational texts.

This unit uses an electronic book to set the stage for learning and build students' interest in sanderlings. The book is used again at the end of the lesson to confirm students' knowledge and paint a complete picture of the sanderlings' complex life history. The unit also includes a RAFT (**R**ole, **A**udience, **F**ormat, **T**opic) prompt as a means of assessing student understanding. More information about idea circles and RAFT prompts can be found in Appendix 1.

OBJECTIVES

- Explain the concept of adaptation as it relates to the sanderling
- Describe the shore and tundra environments
- Practice the following science process skills: predicting, observing, and collecting and analyzing evidence
- Read and discuss informational text to locate information
- Write nonfiction text in journal format

STANDARDS ALIGNMENT

National Science Education Standards

SCIENCE AS INQUIRY

- K–4, 5–8 Abilities Necessary to Do Scientific Inquiry

LIFE SCIENCE

- K–4 Characteristics of Organisms
- 5–8 Diversity and Adaptations of Organisms

Common Core State Standards for English Language Arts

WRITING

- Grades 3–5 Text Types and Purposes
- Grades 3–5 Production and Distribution of Writing
- Grades 3–5 Research to Build and Present Knowledge

For a detailed standards alignment, see Appendix 3 (p. 282).

TIME FRAME

- Six 45-minute class periods

SCIENTIFIC BACKGROUND INFORMATION

The sanderling, a small sandpiper, is one of the most widespread wintering shorebirds in the world. Sanderlings are typically 7.1–7.9 in. (18–20 cm) in length and weigh 1.4–3.5 oz. (40–100 g). They are distinguished from other species of sandpipers by their pale nonbreeding plumage, white face, black bill and legs, and a broad white wing stripe, bordered in black, which is visible in flight. Sanderlings have a long, thin, and pointed beak, which is used to probe for food.

During the winter months, the birds live on temperate and tropical sandy beaches along the coasts of North and South America. They feed on aquatic and terrestrial invertebrates such as mole crabs. Sanderlings can be seen running along the water's edge, darting in and out of the waves as they feed.

Beginning in March, adult birds migrate to the Arctic tundra to breed during the summer months, traveling thousands of miles to a vastly different environment. Instead of warm temperatures and sandy beaches, they find cooler temperatures and land covered by small shrubs, grasses, and mosses. Rather than mole crabs, the birds feed on insects and some plant material. The sanderlings build nests on the ground, each of which typically holds three to four dull green, spotted eggs. Eggs are incubated for approximately 24 days. Within 12 hours of hatching, the chicks leave the nest to join the adults in feeding. The chicks begin to fly within two weeks of hatching. The adult sanderlings begin their southward migration in July and early August, but the juveniles do not leave the breeding grounds until August and September. After the juveniles migrate south, they remain at the winter grounds for at least a year.

Learn more about the sanderling, listen to its call, and watch video at The Cornell Lab of Ornithology's All About Birds website: *www.allaboutbirds.org/guide/Sanderling/id* (QR Code 1).

QR Code 1

MISCONCEPTIONS

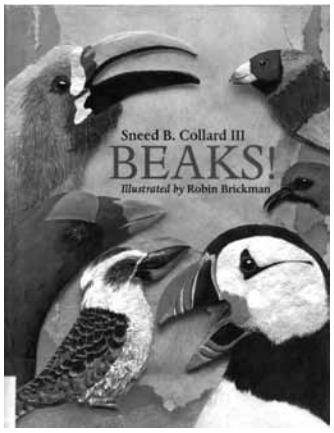
The concept of adaptation is difficult, and one about which students may have scientifically inaccurate preconceived notions, or misconceptions. Table 10.1 lists some documented misconceptions about adaptations along with a brief scientifically accurate concept.

TABLE 10.1 COMMON MISCONCEPTIONS ABOUT ADAPTATION

Common Misconception	Scientifically Accurate Concept
Organisms choose to adapt to their environments.	Adaptations are inherited traits that are passed from parent to offspring. They enhance an organism's ability to survive and reproduce.
Adaptations are acquired during the lifetime of the organism.	
Organisms adapt to changing environments. These adaptations are then inherited.	

Pay careful attention to the language students use in their conversations and writing throughout the lesson. Language that suggests that adaptations are the result of an organism consciously selecting one adaptation over another may indicate that the student does not understand that adaptations are inherited traits that enhance survival or reproduction. Language that suggests that an adaptation occurs within an individual organism's lifetime is another indicator that the student does not understand that adaptations are passed from generation to generation. When it appears that students have these misconceptions, provide additional evidence through hands-on investigations or informational texts that supports the accurate concept.

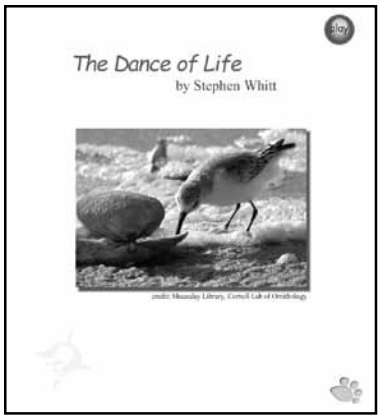
TEXT SET



Beaks! by Sneed B. Collard III (Watertown, MA: Charlesbridge, 2002); explanation, Flesch-Kincaid reading level 4.2.

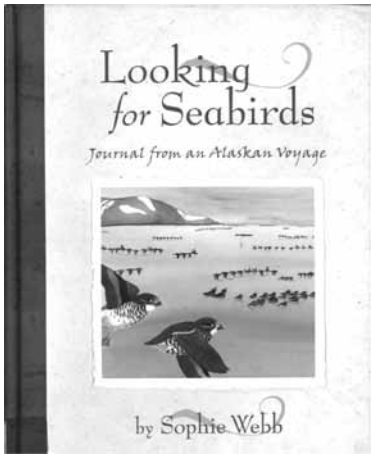
Bird beaks come in a variety of shapes and sizes, depending on the type of food the bird eats and the manner in which it gathers or hunts its food. Learn about the many varieties of beaks and test your "beak-ability" by matching birds' beaks to their foods. Colorful painted cut-paper illustrations vividly depict bird species and their food sources.

QR Code 2



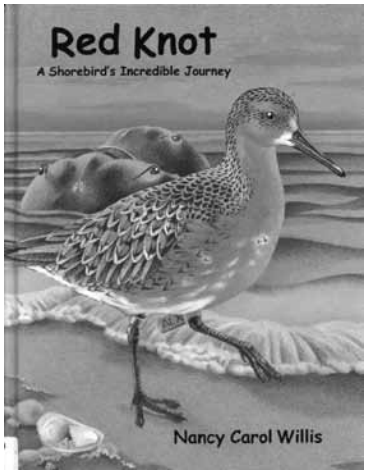
The Dance of Life by Stephen Whitt (Columbus: Ohio State University, 2009); narrative expository, Flesch-Kincaid reading level 5.1. *http://bit.ly/th6TrM* (QR Code 2).

This nonfiction text describes the life cycle, migration, and behavior of the sanderling. The article is available at three grade levels: K–1 (reading level 1.8), 2–3 (reading level 3.1), and 4–5 (reading level 5.1). Each grade level is available in three formats: a text-only document (PDF file), a full-color illustrated book (PDF file), and electronic books with recorded audio narration.



Looking for Seabirds: Journal From an Alaskan Voyage by Sophie Webb (Boston: Houghton Mifflin, 2004); journal, Flesch-Kincaid reading level 7.4.

Author and artist Sophie Webb spent a month working as a seabird observer along the Aleutian Island chain in Alaska. Experience her journey through her detailed writing and colorful, lifelike watercolor illustrations. Webb authored a similar book, *My Season With Penguins*, which details a research expedition in Antarctica.



Red Knot: A Shorebird's Incredible Journey by Nancy Carol Willis (Middletown, DE: Birdsong Books, 2006); diary (journal), Flesch-Kincaid reading level 4.4.

Follow the 20,000 mile annual migration of a shorebird called a red knot as it travels from the tip of South America to the Arctic tundra and back. Short dated entries complement large colorful illustrations. Readers will notice many similarities between the red knot and the sanderling.

MATERIALS

Per Student

- 1 pair of tweezers of an appropriate size to pick up the smaller items in the environment
- Copies of the Venn diagram graphic organizer and RAFT writing prompt

Per Small Group

- Two 8″ square aluminum pans
- Walnut halves
- Sand
- Spanish moss (available at craft stores)
- A variety of stones and pebbles
- A variety of shells
- Items to represent insects and larvae (e.g., pom-poms, wooden beads or buttons, foam insects)
- Larger items to represent lemmings and other small rodents (e.g., wooden spools)
- Copies of the "Idea Circle Graphic Organizer"

Per Class

- Chart paper and markers
- A set of books about the tundra (at least one per student)
- Computer with internet access and speakers
- Bird field guides
- Interactive whiteboard (optional)
- Copies of supporting documents

SUPPORTING DOCUMENTS

- "Idea Circle Graphic Organizer"
- Venn diagram
- RAFT writing prompt

SAFETY CONSIDERATIONS

Make sure that students do not have food allergies before using food items in this lesson. Instruct students to not eat any of the food items used in the lab. Demonstrate how to use the tweezers to mimic the sanderling's feeding behavior. Monitor students to ensure that they are using the forceps appropriately.

Beaks and Biomes Inquiry Unit

ENGAGE

In the engage phase, students are introduced to the sanderling and its life history and migratory patterns.

1. Engage students by playing the first six pages of the grades 4–5 electronic book *The Dance of Life* as a read-aloud. The electronic book works well with an interactive whiteboard, or it could be played on a computer equipped with speakers. Alternatively students might read and listen to the first six pages at individual computers or at a listening center. Paper versions of *The Dance of Life* are also available (text-only and illustrated book) if computers are not available. The paper versions could be printed, copied, and distributed to individual students.
2. Discuss the first six pages with students as they read, focusing on understanding the vocabulary terms used as well as the images and diagrams. Ask students to describe the shape of the sanderling's beak: long, thin, and pointed. Ask students to think-pair-share* about why the shape of the sanderling's beak might be important. Allow a few pairs to share their thinking with the class.
3. Read *Beaks!* aloud, focusing on the relationship between each bird's beak and its diet. The bright and colorful illustrations invite students to carefully observe the shape of each bird's beak. Allow students to freely share observations and ideas, but keep them focused on the purpose for reading the text with guiding questions such as:
   - What did you notice about the birds' beaks and the types of food each bird eats?
   - How do birds with long pointy beaks get their food?
   - What types of foods do birds with short strong beaks eat?

Listen for answers focusing on how the beak seems to work well with the type of food the bird eats or the method the bird uses to obtain food. When students come to the realization that the shape of the beak determines how it functions, introduce the term *adaptation.* Work with the students to develop a definition for this term, and post it in a prominent location.

4. Return to *The Dance of Life* and reread pages 5 and 6. Ask students to think-pair-share about how the sanderling might be adapted to two very different environments. This discussion serves as a transition into an exploration of the sanderling's diverse habitats.

* Think-pair-share is a three-step process that begins with students independently thinking about the prompt. Students then pair up to discuss their thinking and identify the best response. The process concludes with each pair sharing their thinking with the whole group.

***Assess this phase*:** At this point, only formative assessment is needed. Monitor student comprehension of *The Dance of Life* during the class discussion. Students should take away three main ideas from the first six pages: the shore habitat of the sanderlings, mole crabs as a food source, and that the sanderlings migrate to the Arctic each year. If students struggle with these concepts, consider rereading with additional emphasis on these points or adding supplemental videos of sanderlings at the beach. You might also use the modified versions of *The Dance of Life*, if appropriate.

After listening to *Beaks!* students should make the connection between the shape of a bird's beak and the food it eats. If students are having trouble with this concept, you might consider demonstrating a variety of tools that represent beak shapes and how they obtain food. An aquarium net or slotted spoon can represent a beak that filters food from the water, a straw represents a beak (like a hummingbird's) that sips, and a nutcracker represents a beak that cracks open the hard shells of nuts or seeds. Further conversation around these tools will help students master the needed concepts before moving on to the explore phase.

EXPLORE

In the explore phase, students investigate the two environments, comparing their characteristics and identifying potential food sources for the sanderlings. Begin with the more familiar of the two environments: the beaches that serve as the wintering grounds for the birds.

Advance preparation: For the shore feast, partially fill 8" square aluminum cake pans with sand (one pan per small group) and add a variety of items to represent food for the sanderling. We used walnut halves to represent mole crabs, shells to represent various mollusks, wooden beads to represent insects, and pebbles and rocks of various sizes (which simply represent rocks typically found in a shore environment). Prepare a key so that students will know what each element represents.

For the tundra feast, partially fill 8" square aluminum cake pans with Spanish moss (one pan per small group) and add a variety of items to represent food for the sanderling. We used pom-poms, wooden buttons, foam insects, and gummy worms to represent insects and larvae, and wooden spools to represent lemmings and other rodents. We also included pebbles and rocks of various sizes. Prepare a key so that students will know what each element represents.

Idea Circle

For the idea circle, gather a wide variety of reference books about the tundra. The books should represent varied reading levels and formats; see a suggested list of books below. This list supports both reader choice and differentiation. Give a copy of the "Idea Circle Graphic Organizer" to each group.

Suggested Tundra Books
Add or substitute additional titles as necessary. Be sure to include a variety of reading levels and formats to allow for student choice.

- *Arctic Appetizers: Studying Food Webs in the Arctic* by Gwendolyn Hooks (Vero Beach, FL: Rourke, 2009); reference, Flesch-Kincaid reading level 5.8.
- *Discovering the Arctic Tundra* by Janey Levy (New York: Rosen, 2008); reference, Flesch-Kincaid reading level 5.5.
- *Explore the Tundra* by Linda Tagliaferro (Mankato, MN: Capstone Press, 2007); reference, Flesch-Kincaid reading level 5.1.
- *The Frozen Tundra* by Philip Johansson (Berkeley Heights, NJ: Enslow, 2004); reference, Flesch-Kincaid reading level 4.2.
- *Living in the Tundra* by Carol Baldwin (Chicago: Heinemann Library, 2004); reference, Flesch-Kincaid reading level 4.9.
- *Tundra* by Aaron Frisch (Mankato, MN: Creative Education, 2008); reference, Flesch-Kincaid reading level 2.4.
- *Tundra* by Colleen Sexton (Minneapolis, MN: Bellweather Media, 2009); reference, Flesch-Kincaid reading level 2.9.
- *A Tundra Food Chain: A Who-Eats-What Adventure in the Arctic* by Rebecca Hogue Wojahn and Donald Wojahn (Minneapolis, MN: Lerner Publications, 2009); reference, Flesch-Kincaid reading level 5.4.
- *A Walk in the Tundra* by Rebecca Johnson (Minneapolis, MN: Carolrhoda Books, 2001); reference, Flesch-Kincaid reading level 4.3.

Part I: Shore Investigation

1. Engage students in a whole-class discussion of the beach environment, using the following guiding questions:

   - Have you ever been to the beach?
   - What did you notice while you were there?
   - What was the weather like?
   - What kinds of earth materials (sand, rocks, soil) were present?
   - What kinds of plants and animals did you see?

Record student responses on chart paper that can be clearly displayed throughout the remainder of the lesson. If students have not personally been to the beach, they may have seen the beach on TV or in movies or read about it. If not, read an appropriate nonfiction book or provide images for students to observe as a means of building background knowledge.

2. Invite students to participate in a "shore feast" simulation. Before beginning the shore feast, hold up a pair of tweezers. Ask the class how the tweezers compare with the sanderling's beak. Model how the tweezers can be used to mimic the probing behavior of the sanderling as it feeds.
3. Show students one of the prepared cake pans and, using the key for reference, review what each item represents. Explain to students that they will pretend that they are sanderlings, using the tweezers to determine what types of food they are able to eat at the beach environment. This is also a good time to review guidelines for successful collaborative group work.
4. Students will then work in collaborative small groups to snatch up food items with their tweezers, perfecting their "feeding" technique. While small groups are working, walk around and discuss the activity with students, using the following guiding questions:

   - What food is the easiest for the sanderling to eat?
   - What food is the most difficult for the sanderling to eat?
   - How do the foods that the sanderling is able to eat compare with those it cannot eat?
   - How does the sanderling's beak help it capture its food?
   - Have you noticed anything about the sanderling's beak that keeps it from eating certain types of food?
   - How would you describe the sanderling's feeding behavior?
5. Once students have completed the shore feast, conduct a brief whole-class discussion to debrief, using the following guiding questions:

- Were you able to successfully find food using the tweezers?
- What kinds of food were the sanderlings able to eat?
- What kinds of food were they not able to eat?

Record student findings on chart paper.

Part II: Tundra Investigation

1. Return to the map of the sanderling's migration shown on page 5 of *The Dance of Life* electronic book. Ask students to first identify where the beach environments are located, and then reread the text on that page. Point out the Arctic on the map, and explain that the environment that the sanderlings migrate to is called the tundra. While most students will have some prior experience or knowledge of a beach environment, they will most likely not know as much about the tundra. Lead a class discussion about the tundra, using the following guiding questions:

   - What do you know about the tundra?
   - What might sanderlings eat there?
   - How can we learn more about the tundra?

2. Explain to students that they will be using reference books and working in collaborative groups to learn more about this environment. Introduce the idea circle activity to the students. Explain that in the idea circle, they will read and discuss a variety of books in small groups to answer the following questions: What is the tundra like? What would you find there? What might sanderlings eat?

3. Begin the idea circle by organizing students into small groups. Each group member will then select and read a different text. If students have difficulty selecting appropriate texts for themselves, you may want to review the "five finger rule" first. To apply this rule, students should open a text to a random page and read it, holding up a finger each time they encounter an unknown word. If they have five fingers up before the end of the page, the book is most likely too difficult. Some students might need to select from a limited number of choices that are most appropriate for their reading level. Ideally, titles are not repeated within a small group, although they may be necessarily repeated within the class as whole. It is not necessary for students to take notes at this time, although some might prefer to do so. Consider allowing students to use slips of paper or sticky notes to bookmark pages with helpful information.

4. Students should read their books individually. When all students have finished reading their books, they should gather in their small groups and share what they've learned. Each group should complete the "Idea Circle Graphic Organizer," which provides spaces for students to record information along with the contributing text and group member.
5. Conclude the idea circle with a whole-class discussion in which groups share their findings. Record this information on chart paper and post it in a prominent location.
6. Now that students have learned about the tundra environment and made predictions about what the sanderlings might eat, it is time for a tundra feast. Just as in the shore feast, students work in cooperative groups to "feast" using the tweezers. A whole-class discussion at the conclusion of the activity confirms that the sanderlings were able to eat the insects. Student findings can be recorded on the chart paper begun with the idea circle.
7. Return to *The Dance of Life*. Finish reading and listening to the electronic book, using questions like "How does the text compare with what you learned from the tundra feast and the idea circle?" to help students link their hands-on experiences with the information presented in the text. Record student ideas on chart paper.

***Assess this phase*:** Again, only formative assessment is needed. Monitor students' involvement during the shore and tundra feasts. Ensure that they are using the tweezers to properly mimic the sanderling's beak and that they are correctly identifying food sources in both the shore and tundra environments. During the idea circle, observe students as they read to ensure that all have selected an appropriate text. As they share information with their small groups, circulate and listen to their conversations. Ask guiding questions to help students extend their comprehension. Provide support to individual students and groups if they have difficulty locating information about the tundra or completing the graphic organizer. Finally, monitor students' comprehension of the remainder of *The Dance of Life*. Student responses to your questions will help you determine if they are able to link their hands-on experiences to the text. It is essential that students have a clear understanding of the two environments and the sanderlings' food sources in each before moving on to the explain phase.

EXPLAIN

In the explain phase, students draw from their experiences with the feasts and the texts to explain how the sanderling's adaptations allow it to survive in both environments.

1. Have students complete the Venn diagram (or other graphic organizer) to compare and contrast the sanderling's behavior on the beach and the tundra. Encourage students to refer back to the texts and feasts as needed.
2. Once students have completed the Venn diagram, they are ready to share their understanding

in a more formal way. Present the students with the writing prompt. This writing prompt is written as a RAFT prompt. RAFT stands for Role, Audience, Format, and Topic—four needed components of any effective writing prompt. We've found that the specificity found in RAFT prompts support students as they communicate their understanding of a new topic. We've also found that using boldfaced type to present the elements of a RAFT help students focus on the necessary components in their writing.

> You are a **scientist** who studies sanderlings by observing them in the wild. Write a **journal** for other **scientists** that describes your **observations of the behaviors that help sanderlings survive in these two different environments**. Include at least two entries.

3. Read over the prompt with students, answering questions as needed. This is a good time for a mini-lesson on the format of a diary or journal. Read excerpts from *Looking for Seabirds* and *Red Knot*, explicitly discussing the characteristics the texts share (dated entries that are presented in chronological order). Also discuss the use of first-person narration in *Looking for Seabirds*. The books should be readily available for student use during their work on the RAFT prompt. The books serve as mentor texts, supporting students as they write in the journal format. Encourage students to include illustrations with their journal entries.

***Assess this phase*:** The Venn diagram is meant as a pre-writing tool, and should only be used for formative assessment. We recommend taking the time to collect and review the completed Venn diagrams to ensure that students have developed sufficient understanding and will be successful with the RAFT writing prompt. At this point, students should be able to explain that the sanderling migrates from the beach to the tundra and that while it eats different types of food in each place, it uses its beak to obtain food in each. If students struggle to complete the Venn diagram, consider returning to the hands-on activities and idea circle texts in a teacher-led activity.

Student responses to the RAFT writing prompt serves as summative assessment for this inquiry unit. Student responses should include the same information as the Venn diagram. The "Science and Literacy Rubric" in Appendix 2 (p. 276) can be used to assess student performance, and the "Achievement Grading Standards" (also in Appendix 2, p. 277) can translate this into a numerical grade. If students fall below 75%, return to the explore phase for additional work before returning to the writing prompt.

EXPAND

In the expand phase, students will further their understanding by investigating the adaptations of local birds. It is not necessary to be a birding expert to engage students in this activity. The goal is for students to apply what they have learned about adaptations to local wildlife. It is not necessary to identify the birds, but some students may want to know the identity of the birds they are observing. Have some field guides on hand for their use.

1. Begin by observing local birds. Students are likely to notice birds' physical characteristics first. Encourage them to pay attention to the birds' behaviors as well. Students should record their observations in a field journal or science notebook in words or in illustrations. They may observe feeding behaviors, nest building, flight patterns, and other behaviors and characteristics. Alternatively, students could observe birds in online videos or bird cams offered by zoos. Use these guiding questions to help students sharpen their observations:

   - What do you notice about the bird?
   - What does the bird appear to be doing?
   - What else is present in the bird's environment?
   - How does the adaptation you have observed help the bird survive?

2. Ask students to make predictions about what the bird will do next based on the pattern of behavior they have observed. After careful observation and data collection, the students might be able to draw some conclusions about the relationship between the birds' behavior and their physical characteristics. They may for example observe a bird repeating the pattern of flying out a short distance from a perch and then returning to the perch. From their observations they might draw the conclusion that the bird is catching flying insects.

3. To further enrich this study, you might elect to participate in eBird, a citizen scientist project run by The Cornell Lab of Ornithology. In the eBird program, students and adults across the country record bird sightings and submit their findings to the scientists at Cornell. Your bird counts help ornithologists study migration and other bird behaviors. Learn more at *http://ebird.org/content/ebird* (QR Code 3).

QR Code 3

***Assess this phase*:** At this point, assessment focuses on student observations of the birds' behavior. This is a time to assess science process skills: predicting, observing, and collecting data. Students are not only expanding their understanding of bird adaptations, but also developing their expertise with these process skills. Assessment should be focused not on a correct answer but on the process skills themselves. We recommend using the "Science Process Skills Rubric" in Appendix 2 to assess student abilities in this area.

Name_____ Date_____

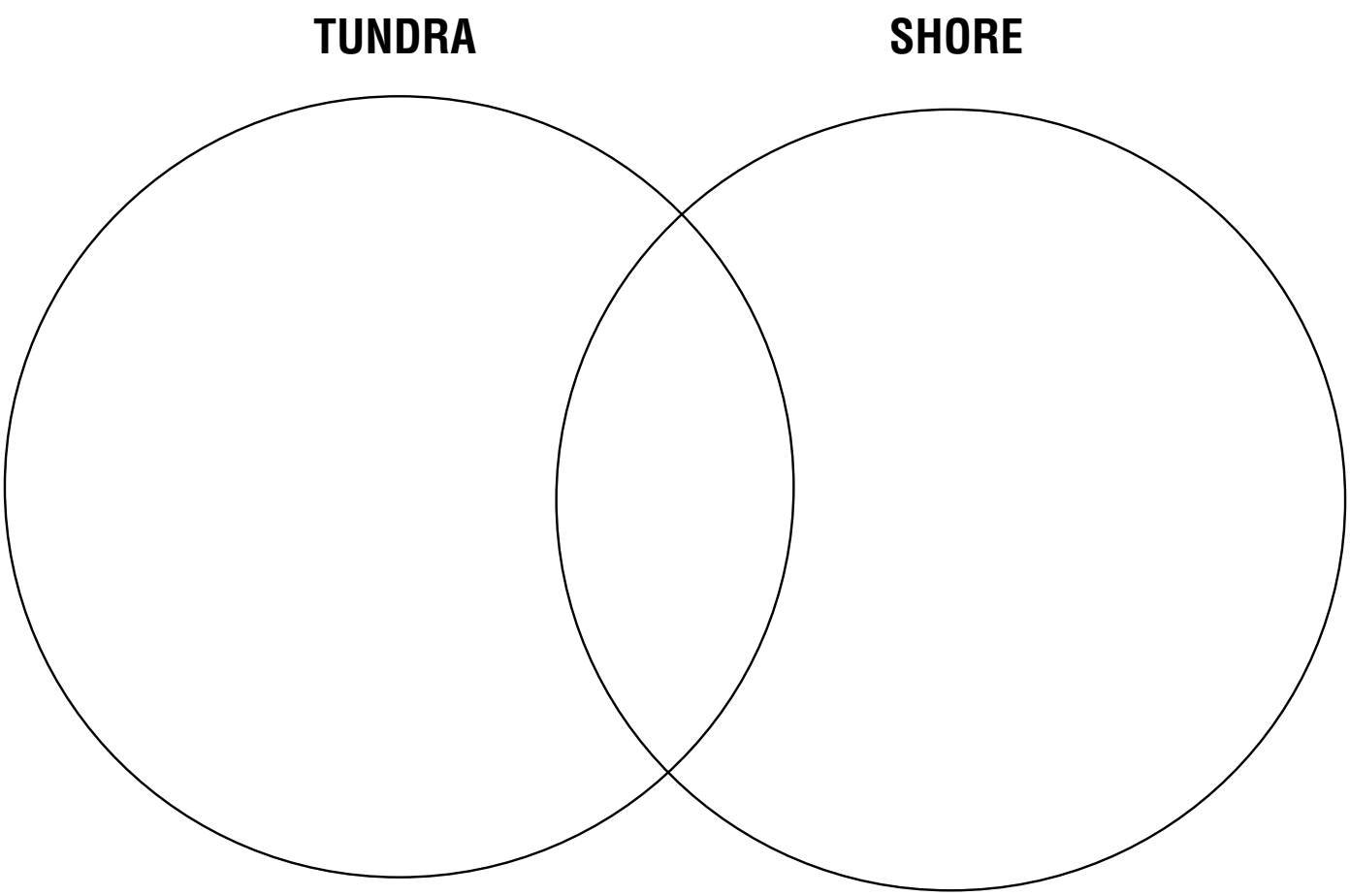
IDEA CIRCLE GRAPHIC ORGANIZER

What We Learned About the Tundra	Where We Found It (title, team member)

Name_____ Date_____

VENN DIAGRAM

Compare and contrast the sanderling's behavior on the shore and in the tundra. How do its adaptations help it to survive in both places?



Name_____ Date_____

RAFT WRITING PROMPT

Use what you've learned from your investigations with the feasts and the texts to answer the following prompt.

You are a **scientist** who studies sanderlings by observing them in the wild. Write a **journal** for other **scientists** that describes your **observations of the behaviors that help sanderlings survive in these two different environments**.

Index

*Page numbers printed in **boldface** type refer to tables and figures.*

Index

C

Index

D

Index

Index

G

H

Index

Index

Index

Index

N

Index

Index

Index

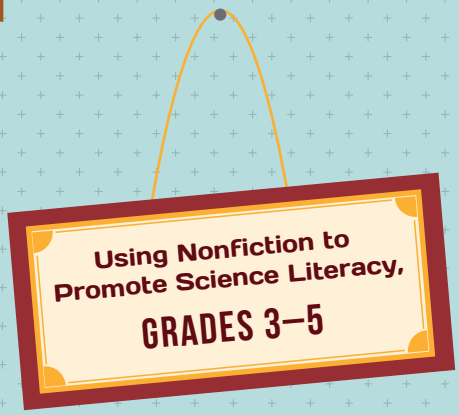
Index

Index

Y

Z

INQUIRING SCIENTISTS, INQUIRING READERS



In *Inquiring Scientists, Inquiring Readers*, science educators Jessica Fries-Gaither and Terry Shiverdecker help teachers blend literacy into elementary science instruction. This unique book will show teachers how to teach science using a variety of nonfiction text sets (such as field guides, reference books, and narrative expository texts) and replace individual lessons with a learning-cycle format (including hands-on investigations, readings, directed discussion, and problem solving).

Research-based and teacher-friendly, *Inquiring Scientists, Inquiring Readers* shows how inquiry can engage your students in reading nonfiction texts, discussing important science concepts, and writing to both develop under-standing and share information. Here are some of the book's special features:

- Eight units covering life, physical, and Earth and space science—from "Beaks and Biomes: Understanding Adaptation in Migrating Organisms" to "Classroom Curling: Exploring Forces and Motion" to "Drip Drop Detectives: Exposing the Water Cycle." Two additional units cover the nature of science. All units have been classroom-tested for effectiveness and align with the national science standards and the common core state standards for English language arts.
- Detailed scientific background, common misconceptions associated with the content, an annotated list of the books in the text set, safety considerations, reproducible student pages, and suggested assessments.
- Authentic, inquiry-based contexts for reading, writing, and discussion through read-alouds, collaborative activities, graphic organizers, and writing prompts.

Inquiring Scientists, Inquiring Readers will change the way you think about engaging your students. The authors show that it's possible to integrate literacy into elementary-level science instruction without sacrificing quality in either area.

Grades 3–5

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