RESOURCES

BOOKS

Crenson, Victoria. *Horseshoe Crabs and Shorebirds: The Story of a Food Web*, New York: Marshall Cavendish, 2003.

Dunlap, Julie. *Extraordinary Horseshoe Crabs,* Minneapolis: Carolrhoda Books, 1999.

Harrington, Brian and Flowers, Charles. *The Flight of the Red Knot: A Natural History Account of a Small Bird's Annual Migration from the Arctic Circle to the Tip of South America and Back*. New York: W. Norton & Company, 1996.

Willis, Nancy Carol. *Red Knot: A Shorebird's Incredible Journey*. Middletown, Del.: Birdsong Books, 2006.

WEB SITES

Friends of the Red Knot (site started by kids to conserve red knots) — *www.friendsoftheredknot.org*

Horseshoe Crabs
www.chesapeakebay.net/info/horseshoe_crab.cfm

Horseshoe Crabs: A Living Fossil (Maryland Dept of Nat'l Resources) — *www.dnr.state.md.us/education/horseshoecrab*

Horseshoe Crab: Printout — *www.enchantedlearning.com/subjects/invertebrates/arthropod/Horseshoecrab.shtml*

"Horseshoe Crabs' Decline Further Imperils Shorebirds" (article) — *www.washingtonpost.com /wp-dyn/content/article/2005/06/09/AR2005060901894.html*

The Horseshoe Crab: Natural History, Anatomy, Conservation, and Current Research — *www.horseshoecrab.org/*

Journey North — *www.learner.org/jnorth*

Life Cycle of the Horseshoe Crab
www.chesapeakebay.net/horseshoe_crab.html

Red Knot (Audubon Watchlist)
audubon2.org/watchlist/viewSpecies.jsp?id=173

Red Knots (Wildlife Conservation Society)
www.wcs.org/international/northamerica/knotandcrab/181917

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Publisher: Robert A. Miller
Editor: David Reisman, Ed.D.
Design: Trina H. Sultan
Writer: Jordan Brown
Business Manager: Bob Adleman

Vice President and Director of Education: Ronald Thorpe

Consultant: Bob Berwick, Science Head, New Canaan Country School

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FOR THE NATURE SERIES

Executive Producer: Fred Kaufman
Series Producer: Bill Murphy
Series Editor: Janet Hess
Supervising Producer: Janice Young
Senior Producer: Laura Metzger
Executive in Charge: William Grant

NATURE SCHEDULE

February-May 2008

February 10	Crash: A Tale of Two Species
February 17	Arctic Bears
February 24	Raptor Force
March 2	Deep Jungle: New Frontiers
March 9	Deep Jungle: Monsters of the Forest
March 16	Deep Jungle: The Beast Within
March 23	Animals Behaving Worse
March 30	Cuba: Wild Island of the Caribbean
April 6	What Females Want and Males Will Do (part 1)
April 13	What Females Want and Males Will Do (part 2)
April 20	The Gorilla King
April 27	Penguins of the Antarctic
May 4	Superfish
May 11	Prince of the Alps
May 18	Rhinoceros
May 25	Killers in Eden

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VIDEO ORDERING INFORMATION

To purchase copies of *Crash: A Tale of Two Species* and other NATURE titles on DVD, go to *www.questarhomevideo.com/nature*.

Eyes on Yellowstone is made possible by Canon. It assists with important scientific research and breaks new ground in conservation, endangered species protection and the application of cutting-edge science and technology that is essential to managing park wildlife and ecosystems. Canon technology is used for education to increase access to the wonder and magic of one of the most recognizable and popular parks in the world (www.windowsintowonderland.org) and raises awareness about the importance of environmental protection and conservation.

450 West 33rd Street
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NATURE℠

CRASH

A TALE OF TWO SPECIES

TEACHER'S GUIDE

Major corporate support for NATURE is provided by Canon U.S.A., Inc., and Toyota. Additional support is provided by the Corporation for Public Broadcasting and the nation's public television stations.

INTRODUCTION

This Teacher's Guide accompanies the NATURE program, *Crash: A Tale of Two Species*. The program looks at the interconnection between two very different animals — the horseshoe crab and the red knot — and the threats to their survival.

Lessons in the guide use the programs as a starting point for discussions and activities that focus on adaptations that help these animals survive, the ways that human activity can endanger different species, and the varieties of wildlife in your own community. This guide includes **teacher's pages** and **student activity masters** that can be used with the program. **Please photocopy the pages and hand them out to students in class.**

USING NATURE VIDEOS IN THE CLASSROOM

You may wish to use questions on the teacher's page to spark discussion about *Crash: A Tale of Two Species*. By posing these questions to students before they watch the video, you can help focus their viewing experience. You may stop the video periodically, so students can discuss the subject matter while it is fresh in their minds.

If you are going to use the program in school, please prescreen it to find the segments you'd like to use. The program is one hour. If time is limited, consider using clips that relate directly to the questions and activities that best meet your needs.

TEACHING NATURE WITH STANDARDS

National Science Education Standards, Grades 5-8
http://www.nap.edu/readingroom/books/nses/html/6d.html
SCIENCE AS INQUIRY: Content Standard A — Identify Questions That Can Be Answered Through Scientific Investigations; Use Appropriate Tools and Techniques to Gather, Analyze, and Interpret Data.
LIFE SCIENCE: Content Standard C — Diversity and Adaptations of Organisms
HISTORY AND NATURE OF SCIENCE: Content Standard G — Science as a Human Endeavor
National Council of Teachers of English Standards apply when using these materials:
Standard 8: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and communicate knowledge. For more information on the Web, go to *www.ncte.org/about/over/standards/ 110846.html*

CONTENTS

WEB RESOURCES

In addition to using the video and this guide, please ask your students to look at the NATURE Web site (*pbs.org/nature*). It may be helpful to copy and distribute other Web addresses we've included, or to have your students do Web searches on topics we've covered.

VIDEOTAPING RIGHTS

You have the right to tape the program and play it for instructional purposes for one year after it is broadcast.

BROADCAST DATES

Most PBS stations are broadcasting *Crash: A Tale of Two Species* on February 10, 2008. Broadcast times and dates vary in some areas. Please check your local TV listings to confirm when your PBS station will show the program.

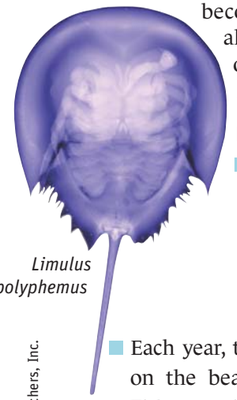
CRASH: A TALE OF TWO SPECIES

NATURE®

BROADCAST DATE:
February 10, 2008
VIEWING TIME:
One hour
(brief video segments may also be used)
FOR GRADES 5-8

AT A GLANCE

Theme: Each year the red knot makes one of the longest migrations of any bird, traveling from South America to the Arctic,with stops at Brazil and Delaware Bay for rest and "refueling." Ornithologists and ecologists are very concerned that the red knot population is plummeting. Red knots rely on horseshoe crab eggs as a key food source during migration, but the eggs are becoming scarce because the crabs along the Atlantic Coast have been overharvested. What can be done to help save these intertwined species?



Limulus polyphemus

© Edward Kinsman/Photo Researchers, Inc.

PROGRAM HIGHLIGHTS

- Scientists collect data on the red knots that winter in Chile. They have discovered the disturbing news that the red knot population has dropped by 70% over the past two decades.
- Each year, thousands of horseshoe crabs spawn on the beaches along the Eastern Seaboard. Fishermen in South Carolina gather crabs for use in laboratories, where some of the crabs' blue, copper-based blood is removed for research. Later, the crabs are returned to the ocean.
- In Brazil, red knots prepare for the second and longest leg of their migration. For four days and nights, they fly over the open ocean using the moon, stars and the sun to navigate.
- Each spring, during the high tides of new and full moons, thousands of horseshoe crabs crawl onto the beach to spawn. After the females lay eggs deep in the sand, the males fertilize them. As the crabs return to the ocean, some of the eggs are unearthed. Later, red knots eat many of these exposed eggs as they bulk up their bodies for their big journey north. The eggs are their only source of nutrition before arriving in the Arctic.

OBJECTIVES

Students will:

- analyze some of the evolutionary adaptations that have allowed horseshoe crabs and other "living fossils" to survive for many millions of years.
- discuss how the fate of the red knot is connected to that of another animal, the horseshoe crab.
- observe, keep field notes on, and formulate questions about plants and animals in local areas.

VOCABULARY

biometrics the use of mathematics to measure and analyze changes in a species' population or characteristics

evolution the theory that various forms of life have their origins in preexisting types and that differences are due to changes in successive generations

harvest in the case of animals, gathering and/or killing for human use

"living fossil" an organism (such as the horseshoe crab) that has remained almost unchanged for many millions of years

spawning producing and depositing eggs in large numbers (by fish and other aquatic animals)

migration when a breeding animal travels seasonally from one location to another in search of food, a mate, and a more suitable climate

molt when an animal (such as the horseshoe crab, or the red knot) sheds its shell, skin or feathers; usually done as the animal grows

moratorium a law prohibiting a particular activity for a set period of time, such as fishing or hunting a threatened species

preening process by which a bird uses its beak to groom its feathers

BEFORE VIEWING THE PROGRAM

Show students color photographs of the following five animals (printed from the Internet, or from library books): shark, Komodo dragon, coelacanth, cockroach, and horseshoe crab. Ask students to hypothesize what all these animals have in common. Record their ideas on the board. After a brief discussion, explain that all five animals have been on our planet for many millions of years; so long that they are sometimes called "living fossils." Ask students to recall what a fossil is — evidence of a plant or animal that lived long, long ago. While many animal species, such as dinosaurs, became extinct millions of years ago, other animals have remarkable "survival power." Ask students to brainstorm why they think these five animals have survived for so long. (Possible responses might include these animals' ability to catch their prey, ways they protect themselves from predators, their remote habitats, and so on.)

Tell the class they will now learn more about one of these animals: the horseshoe crab. Show the class a picture of a horseshoe crab and ask them how they think it got its name. Tell students that — based on fossil evidence — scientists know that horseshoe crabs have been around for 350 million years. Ask students to guess the purpose of its long, pointy tail. Explain that while the tail might look like it is used as a weapon, its actual purpose is to help the horseshoe crab to steer, and flip itself over. They may be surprised to learn that, despite its name, the horseshoe crab is more closely related to spiders and scorpions than to true crabs. As a focus for viewing, encourage students to look for reasons why the horseshoe crab has survived for so long — and why its population is declining so rapidly in the United States.

DISCUSSION QUESTIONS

1. What are some adaptations that have helped the horseshoe crab to survive for 350 million years? *(Its hard shell deters most predators; copper-based blue blood clots if bacteria tries to enter its body; compound eyes on top of shell to see the cycles of the moon; each crab lays thousands of eggs.)*
2. How does the red knot prepare for its long migration from South America to the Arctic? *(In South America, red knots feed for days on end to bulk up their bodies; they molt and grow new feathers that enhance their flying abilities. Then, further north, in Delaware Bay, they eat as many as 18,000 horseshoe crab eggs a day on the beach.)*
3. What are some of the reasons why the horseshoe crab population is declining? *(Fishermen were overharvesting horseshoe crabs to use as bait.)*
4. Do you think the red knot would survive if the horseshoe crab became extinct? Why or why not? *(Answers will vary.)*

There are lots of ways to help the horseshoe crab, like the Just flip 'em" Program. For ideas, see *www.horseshoecrab.com/act/flipem.html*

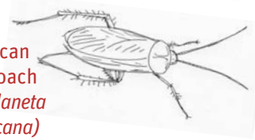
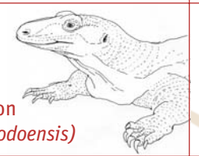
NATURE® SUPER SURVIVORS

ACTIVITY TIME: ABOUT 2 CLASS PERIODS

WHAT TO DO

Here is a chart of five "living fossils" — animal species alive today that closely resemble their ancestors from many millions of years ago. As you watch the video, fill in the chart about the horseshoe crab. Then use the Internet and other library resources to fill in the rest of the chart.

After you watch the episode, answer the two questions about horseshoe crabs.

Species	Species' Age (based on fossils)	Habitat	Adaptations that have helped it survive	Threats to its future survival
 Horseshoe Crab *(Limulus polyphemus)*				
 Frilled Shark *(Chlamydo-selachus anguineus)*				
 American Cockroach *(Periplaneta Americana)*				
 Komodo dragon *(Varanus komodoensis)*				
 Coelacanth *(Latimeria chalumnae)*				

Drawings: David Reisman

What are some ways that human activities have caused the horseshoe crab population to decline?

How have humans taken action to prevent the horseshoe crab from being overharvested?

NATURE® NORTHWARD BOUND
TRACKING BIRDS AND BUTTERFLIES

ACTIVITY TIME: ABOUT 2-3 CLASS PERIODS

WHAT TO DO

The red knot is one of many species that migrate. Each spring, birds including whooping cranes, robins and orioles, as well as insects such as monarch butterflies, fly northward for thousands of miles.

1 Select one of the animals below, and visit its "Journey North" Web page.

- Monarch Butterfly *http://www.learner.org/jnorth/tm/monarch/AboutSpring.html*
- American Robin *http://www.learner.org/jnorth/robin/*
- Whooping Crane *http://www.learner.org/jnorth/crane/index.html*
- Oriole *http://www.learner.org/jnorth/oriole/index.html*
- Common Loon *http://www.learner.org/jnorth/loon/index.html*
- Barn Swallow *http://www.learner.org/jnorth/swallow/index.html*
- Red-Winged Blackbird *http://www.learner.org/jnorth/rwbb/index.html*

2 Click "Get Started" or, if not available, use other resources on the Web to learn more about this animal's habitat, eating habits, and migration patterns.

3 Explore the links on the "Get Started" page or other Web sites about the animal you've chosen. On "Journey North," you can read profiles of specific animals that have been tagged and are being tracked, "booklets" that describe the animal's habits and how scientists study them, and daily migration updates from naturalists.

4 Use the Web site and other library resources to help you answer these questions about the animal you chose:

- Where does the animal start its migration in the winter?
- Where is the animal's northern destination in the spring?
- What kinds of food does the animal rely on to give it energy for the long journey?
- What predators does the animal face along the way?
- Is this animal endangered or threatened? If so, what actions are people taking to help out?

FUN FACTS

- **Every year, the red knot migrates about 10,000 miles from South America to the Arctic.**
- **Horseshoe crabs are more closely related to spiders, scorpions and ticks than to true crabs.**

INTO THE FIELD

ACTIVITY TIME: ABOUT 2 CLASS PERIODS

WHAT TO DO

It is one thing to read about, or watch a video about a species that you find fascinating. It is quite another to observe that species in the wild. Biologists and other naturalists spend many hours outdoors looking closely at animals that spark their curiosity.

In this activity, you and a classmate will create a field journal about an animal that lives in your area. You will sketch pictures of it, write down details such as the time of day you saw the animal, what the weather was like, if any other animals interacted with it (hopefully not eating it!), and more. THEN… you and your classmate will use your field journals to create a Nature Report to share with others. Perhaps your teacher can help you organize a special Nature Night at your school, at which everyone in your class can share and compare your findings.

Grab a small notebook and pencil (and maybe a magnifying glass if possible), and find a place near your school or home (such as a park, playground or yard) to make your observations.

Some Tips to Help You Observe and Record Your Data:

- Use your senses to describe sights, sounds, smells, and tactile experiences
- Log all the details about the date, time and weather conditions
- Keep track of questions that spark your curiosity (especially why, what and how)
- Estimate sizes of unfamiliar animals with those you do know "e.g. bigger than an ant"
- Use the Internet, field guides and other resources to learn more about the animals you've observed. Then, if possible, return to gather more information.

FUN FACTS

- **The horseshoe crab has ten eyes and can see ultraviolet light.**
- **A quart of horseshoe crab blood is worth about $15,000.**