October 2002
Teacher's Guide
Vol. 2 No. 2

"FOR THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE."

NATIONAL GEOGRAPHIC Explorer!™

Dear Teacher:

With Halloween just around the corner, we thought we'd give our readers some insights into how everyday masters of disguise—such as the chameleon, the flounder, and the golden tortoise beetle—use the color cells in their skin to change their appearance. This issue's cover story, **"Chameleons and Other Quick-Change Artists,"** not only explains how these masqueraders switch color; it tells why. Is it because the animals are hot or cold? Calm or angry? Hiding or showing off? The answer depends upon the moment and the creature. Your students will learn to crack the code when they crack open their magazines to pages 4-7.

The **Writing Workshop** that follows this article takes a different look at color. It teaches how to communicate feelings with colorful words and phrases.

Something kids always have strong feelings about is their hair. **"Big Hairy Deal,"** pages 10-13, explores the science of hair as well as the history of hairstyles. An illustrated time line on pages 14-15 covers several mane events, from a braided Egyptian wig of 1000 B.C. to the spiky, pink hairdo of current teen idol Kelly Osbourne.

Speaking of history, those fascinated with the past will enjoy reading **"China's Great Wall,"** pages 16-21. The Great Wall is probably the best-known symbol of China. Yet there are a lot of things we don't know about it, such as: Who built the wall? When was it built? And exactly how long does it stretch?

Three things we do know about the Great Wall are that (1) it was supposed to protect the Chinese from northern invaders; (2) the wall didn't protect them; and (3) it eventually became a cherished icon anyway. This article covers the history, mystery, engineering, and geography that make the Great Wall one of the wonders of the world.

If you haven't found this issue's wonderful fall poster yet, flip to the center of the Student Magazine. Brought to you by International Paper, this wall chart displays 55 types of leaves and needles indigenous to the United States. Turn the poster over, and kids will find several leafy activities to try.

Sincerely,

Mary Dalheim

Mary Dalheim, Editor
NATIONAL GEOGRAPHIC EXPLORER

P.S. Inside this Teacher's Guide you'll find a second bonus poster—one in which First Lady Laura Bush promotes reading.

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Chameleons

Background

A chameleon can change color in about 20 seconds. Under its outer layer of skin are chromatophores, special cells containing color pigments. To change color, these cells expand or shrink, mixing different colors together. A chemical substance in the skin called melanin helps the colors become darker.

Many people think chameleons change color to blend in with their surroundings, but scientists disagree. They think that chameleons change color in response to light, temperature, or mood.

Other animals, such as some types of beetles, spiders, and aquatic animals, also change color. Using the same type of chromatophores as chameleons, these animals usually change their colors to hide themselves from predators, or to attract and catch prey. For example, because birds like to eat beetles, but don't find ladybugs at all tasty, a type of beetle may become darker to resemble a ladybug. A flounder may turn dull colors to blend in with the environment on the sea bottom in order to catch unsuspecting animals that swim by.

Discussion Questions

- What circumstances cause chameleons to change color? (*Temperature, light, or mood*)
- Why might a chameleon turn from brown to green when the sun is bright? (*The lighter color reflects more sunlight than the darker color.*)
- What makes a chameleon appear green? (*The yellow pigment cells become larger than the blue ones.*)
- How might a male chameleon use color to attract a female? (*He might turn a bright, flashy color.*)
- How does melanin affect a chameleon's skin color? (*This chemical substance makes the skin darker.*)
- Why might a chameleon make itself darker when it is cold? (*Darker colors absorb more heat than lighter colors do.*)
- What other animals have chromatophores? (*Some types of beetles, spiders, squid, and flounder*)
- Why do most of these animals change color? (*To catch or elude prey*)
- Why might a squid change to the color of seawater? (*To hide from another animal by becoming almost invisible*)

Web Links

Chameleon Gallery: See photos of Madagascar's fascinating chameleons at *www.nationalgeographic.com/ngexplorer/teachers.*

Chameleon Rescue: Have kids play an interactive game about chameleons at *www.nationalgeographic.com/ngexplorer/games.*

Answers

"Be a Colorful Writer," pages 8-9
Responses will vary.

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China's Great Wall

Background

The Great Wall owes its existence to one of China's great fears—invasion from the north. Centuries ago the nomads of the Asian steppe periodically swept south to plunder Chinese farms and villages. To deter attackers, the Chinese built walls of densely packed earth.

Qin Shi Huang Di, the emperor who unified China in 221 B.C., ordered his army to create a "long wall." How thoroughly the soldiers carried out this command is a mystery. They may have built forts and wall segments of tightly packed earth.

In any case today's Great Wall is much younger, dating from the Ming dynasty (1368-1644). The vast costs of erecting a stone wall meant heavy taxes and simmering discontent. Frustration boiled into rebellion in the 1600s, leaving China vulnerable to, yes, an invasion from the north. The Manchu people captured Beijing in 1644, and they ruled until the last emperor abdicated in 1912.

Today the Great Wall plays a new role—symbol of China's rich history. Officials are working to restore the structure, ravaged by time, weather, and armies of tourists. Yet the Great Wall remains imperiled, and in 2002 the World Monuments Fund added it to the list of Earth's hundred most endangered historic sites.

Discussion Questions

- What is the Great Wall of China? (*A huge structure in northern China*)
- How long is the Great Wall? (*Estimates range from 1,500 to 4,000 miles.*)
- Who was Qin Shi Huang Di? (*Possible answers: China's first emperor, the leader who unified China*)
- Why did he order his army to build a "long wall"? (*To protect China against northern invaders*)
- How did China's early walls differ from the Great Wall we see today? (*Early walls were made of tightly packed dirt. The Great Wall is brick and stone.*)
- How did the building of the Great Wall help destroy the Ming dynasty? (*The high taxes needed to finance construction spurred the people to rebel. The turmoil left China open to invasion by the Manchu.*)
- How do most Chinese think of the wall today? (*It's a sign of greatness. People are proud that their ancestors could build such an amazing thing.*)
- Why is the Great Wall "endangered"? (*Time, weather, and heavy tourism continue to damage the structure.*)
- Why do people care about the Great Wall? (*Possible answers: It's one of the largest structures on Earth. It's a symbol of human history and achievement. It's a symbol of the world's most populous country.*)

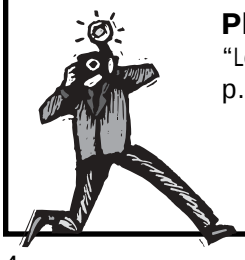
Book Link

China by Kevin Supples (National Geographic Reading Expeditions, 2002; 24 pages).

Web Links

Scale the Great Wall at *www.nationalgeographic.com/ngexplorer/teachers.*
Secrets of the Great Wall: Visit the wall via 3-D images.
World Monuments Fund: Learn more about the threats to the Great Wall and other historic sites.

NATIONAL GEOGRAPHIC Explorer!

ARTICLE / DEPARTMENT	Reading	Writing	Science	Social Studies	CONTENT OVERVIEW (L) *Literacy Skills* (T) *Topics*
 **Geo News** pp. 2-3	■		■	■	(L) Reading for information (L) Reading charts and diagrams (T) Inca mummies (T) World Series (T) Screech owls
 **Teaching Unit** "Chameleons" pp. 4-9 ■ Feature Article ■ Writing Workshop ■ Hands-on Science	■	■	■		(L) Reading for information (L) Reading a diagram (L) Developing vocabulary (L) Writing a description (T) Animal behavior (T) Animal adaptations
 **Teaching Unit** "Big Hairy Deal" pp. 10-15 ■ Feature Article ■ History Highlights ■ Hands-on Science	■		■	■	(L) Reading for information (L) Reading diagrams and a time line (L) Developing vocabulary (T) Science of hair (T) History of hairstyles
 **Teaching Unit** "China's Great Wall" ■ Feature Article ■ History Highlights	■		■	■	(L) Reading for information (L) Developing vocabulary (T) Great Wall of China (T) Geography of China (T) Chinese history
 **Explorer's Map** "Northern Exposure" pp. 22-23	■			■	(L) Reading a physical map (L) Geography of China (T) Location of the Great Wall
 **Photo Finish** "Looking Sharp" p. 24	■		■		(L) Reading for information (L) Developing visual literacy (T) Adaptations of the Tasmanian saw shark

Issue at a Glance

DIRECTED ACTIVITY	SMALL GROUP ACTIVITY	INDEPENDENT ACTIVITY
■ Read and discuss the items on pp. 2-3. **20 minutes** 		■ Examine an Inca mummy bundle at *www.nationalgeographic.com/ngexplorer/adventures.*
■ Read the article. ■ Discuss the questions on p. TG 2. **60 minutes** 	■ The chameleon is a lizard. Have student groups report on other lizards, such as the gecko, Western skink, Komodo dragon, basilisk, and anole. **Time will vary.**	■ Complete the "Be a Colorful Writer" writing activity on pp. 8-9. ■ Play the "Chameleon Rescue" game at *www.nationalgeographic.com/ngexplorer/games.*
■ Read the article and time line. ■ Discuss the questions on p. TG 6. **75 minutes** 	■ Have student pairs complete the "Pulling Its Load" science activity on p. TG 7. **60 minutes** 	■ Watch an online cartoon about hair at *www.nationalgeographic.com/ngexplorer/quickflicks*.
■ Read the article. ■ Discuss the questions on p. TG 3. **60 minutes** 		■ Complete the "Long Story" history maze on p. 21.
■ Review and discuss the map on pp. 22-23. **15 minutes** 	■ China has many types of landforms. Have student groups report on some of them, including the Qin Ling (mountains), the Gobi (desert), and the Yangtze River valley. **Time will vary.**	■ Get a 3-D perspective of the Great Wall at *www.nationalgeographic.com/ngexplorer/articles.*
■ Study the picture and discuss the question on p. 24. **10 minutes** 		

PAGES 10–15

Big Hairy Deal

Background

All hairs, whether they are on the head or on the rest of the body, have the same structure. The hair root, the living part of a hair, is located within the pocket-like follicle in the skin. The root produces new layers of cells, which eventually push the old, dead cell layers, or hair shafts, out of the skin. Each hair shaft is covered with a cuticle, a protective coating of cells. The cortex, under the cuticle, holds protein cells that make the hair flexible and pigment to give the hair its color.

All mammals have hair, which serves many purposes. In humans, hair offers protection from the weather; helps to regulate skin temperature; and prevents bits of dirt from getting into the eyes, nose, and ears. Other mammals depend on hair for warmth, for self-defense, and to communicate. Regular grooming and a nutritious diet promote healthy hair.

Discussion Questions

- If you cut your finger, it hurts. But if you cut your hair, it doesn't hurt. Why doesn't cutting your hair hurt? (*The part of your hair that can be seen–and cut–is dead.*)
- What is a hair root? (*A cluster of cells inside a follicle*)
- What does the root do? (*Produces new layers of hair cells*)
- You have about 100,000 strands of hair on your head, and every day you lose about 100 hairs. After about 1,000 days, why aren't you bald? (*Usually when you lose a strand of hair, it's because a new hair pushed the strand out and took its place.*)
- If your hair shafts are flat, what type of hair will you probably have? (*Curly*)
- What determines your natural hair color? (*Pigment or coloring matter in the cortex*)
- What type of hair offers the best protection from hot weather? Why? (*Short, wiry hair shields the head from the sun's burning rays.*)
- What type of hair offers the best protection from cold weather? Why? (*Long, straight hair traps body heat.*)
- How do goose bumps help the skin from getting too cold? (*Goose bumps occur when tiny muscles attached to hairs pull the hairs straight up. This reaction helps to trap heat.*)
- How does the hair on your head help protect you if you fall off a ladder? (*It cushions the scalp from bumps.*)
- In what other ways does your hair help protect your body? (*Eyebrows shield the eyes from sweat. Eyelashes keep out bits of dirt.*)
- Give examples that show how a mammal's hair can be used for warmth, for protection, and to communicate. (*The muskox has two layers of hair for warmth. A porcupine's sharp quills protect it. A wolf can raise the hair on its neck and back to communicate that it is a large and fierce enemy.*)
- What are two important ways to take care of your hair? (*Eat a diet that includes protein, B vitamins, iron, copper, and iodine. Shampoo your hair regularly.*)

Web Link

Wild and Chilly: Learn about hairy mammals that lived during the Ice Age at *www.nationalgeographic.com/ngexplorer/teachers.*

Answers

"Pulling Its Load," page TG 7
Predict Section: Stretchy; stronger; answers will vary
Test Section: 8. While every hair will be different, many will support about 78 paper clips or 39 grams.
Conclude Section: 10. Answers will vary based on student results for #8. Using the answer supplied in #8, it would take three hairs to support the candy bar (100 ÷ 39).

Other Answers

"Looking Sharp" (page 24)
c. Tasmanian saw shark

"End of the Line" (page TG 8)
The Great Wall ends at the Yellow Sea.

Name:_____

Pulling Its Load

Think

Long ago the Japanese used ropes made of human hair to lift heavy loads. Exactly how strong is hair? Try this test to find out how much weight a single hair can support.

Predict

How many standard paper clips do you think a single hair can support without breaking—1, 5, 10, or more? If you're not sure, pull a strand of hair from your head.

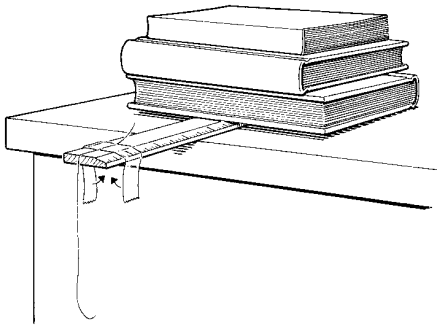
- Does it feel stretchy or brittle?
  _____
- Is being stretchy likely to make a hair stronger or weaker? _____
- Now use what you observed to predict how many clips a single hair can support. My prediction: ___ clips

Materials

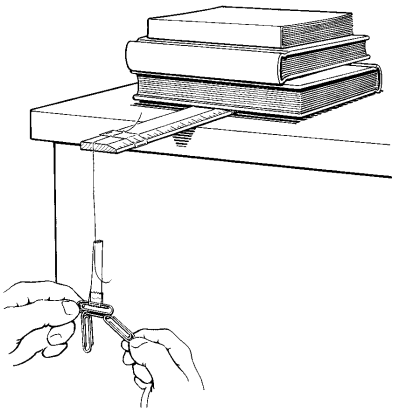
1 hair, at least 6 inches long
Box of standard-size steel paper clips
Clear tape
Table
Ruler
Stack of books

Test

1. Cut off a three-inch-long piece of tape. Hold it horizontally. Lay one end of the hair on the center of the sticky side. Now stick the tape across one end of the ruler.
2. Set the ruler on the table so the hair dangles over the edge. Anchor the ruler with a stack of books.



3. Hold a paper clip so it's horizontal. Cut off a second piece of tape that's three inches long. Thread the tape, sticky side up, through the clip. Fold the very end of the tape around the clip.
4. Place the free end of the hair on the sticky side of the tape that's holding the clip. Fold over the edges to seal.
5. Slip more paper clips onto the clip, one at a time, so they dangle from the hair.



6. If the clip becomes full before the hair breaks, add a clip hook. To do this, spread apart the two ends of a paper clip to form a "V." Loop one end through a dangling clip. Continue adding more paper clips to this hook.
7. Keep adding hooks and paper clips until the hair breaks.
8. How many paper clips did the hair support? _____

- One standard paper clip weighs 0.5 gram. Multiply the number of clips times 0.5 gram. _____ x 0.5 gram=_____ grams

9. Now you have the weight the hair supported. To be sure your answer is likely to happen every time, repeat this test with two other hairs from the same head. Compare the results.

Conclude

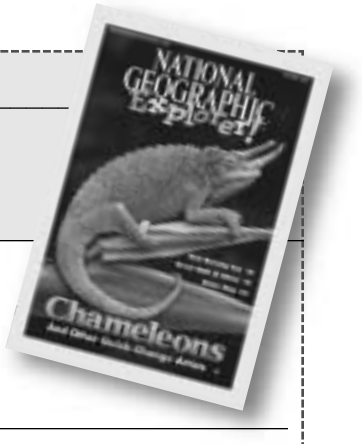
10. Think about what you discovered. How many hairs do you think it would take to lift a 100-gram candy bar? _____

- How did you conclude this? _____
  _____

REVIEW

Name:_____

End of the Line



Where does the Great Wall of China reach its eastern end? Don't hit the wall on this question! Cross out the words that match the descriptions below. Rearrange the remaining words, and you could make an important breakthrough!

Cross Out:

1. disguise

2. color matter found in a cell

3. dead part of a hair

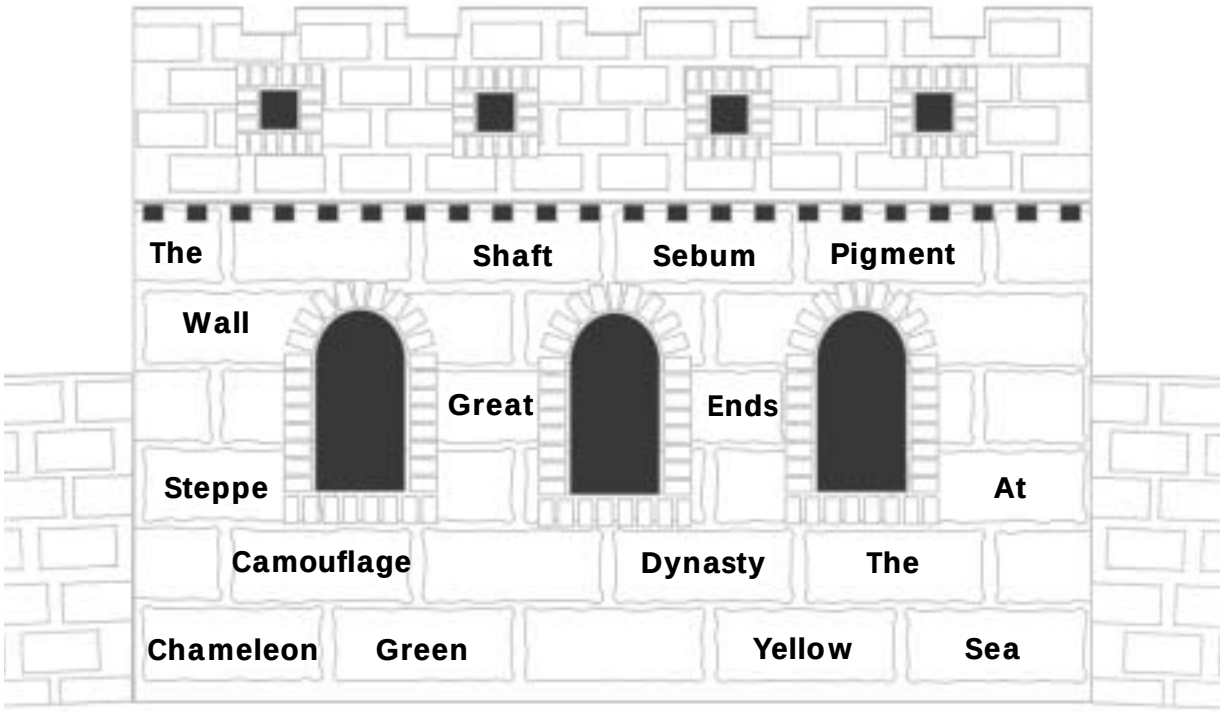
4. dry grassland

5. line of emperors

6. color a sunbathing chameleon might turn

7. oil

8. type of lizard



Question:

Where does the Great Wall of China reach its eastern end?

Answer (write one word on each line):

_____ _____ _____ _____ _____ _____ _____ _____ .

Answer Key

Mummy Bundles

NATIONAL GEOGRAPHIC EXPLORER ■ Online Adventure Scavenger Hunt

Student Form: www.nationalgeographic.com/ngexplorer/adventures
Source for Answers: www.nationalgeographic.com/channel/inca/

1. Mummy bundles had false heads with elaborately painted faces.
False: The false heads had no faces, though they sometimes wore masks or wigs.

2. A mace was an Inca farming tool.
False: A mace was a weapon and a symbol of power.

3. Archaeologists found feathers in the Cotton King mummy bundle, so they think he was a big shot.
True: Only high-ranking Inca could wear or display feathers.

4. Only Inca servants wore sandals.
False: Only nobles wore sandals. Most Inca had no shoes.

5. The Inca made plates and bowls out of gourds (dried squashes and melons).
True: Their descendants, moreover, do the same today.

6. Inca families considered beads the most sacred thing to place in a grave.
False: *Spondylus* oyster shells were the most sacred grave offering.

7. Archaeologists had never before found corn in an Inca grave.
False: Corn has been found in many Inca graves.

8. The Cotton King mummy bundle contained 300 pounds of raw cotton.
True: Cotton native to that part of Peru was generally tan or brown, not white.

9. The Inca used cactus spines to make combs.
True: Inca tied the spines to pieces of wood to make combs for smoothing yarn.

10. Experts suspect that the Cotton King was murdered.
False: The Cotton King's cause of death is a mystery. In fact, his body appears very healthy.