

Ask®

Color Your World

In his poem “Colors,” Shel Silverstein marvels, “... all the colors I am inside have not been invented yet.” This issue of ASK delves into the physical creation of color, the scientific uses for color in nature, and the physics behind our ability to perceive color.

CONVERSATION QUESTION

How are colors created?

TEACHING OBJECTIVES

- Students will learn about the pigments and binders used by early artists to create color.
- Students will learn how Isaac Newton became the first scientist to accurately understand the nature of color.
- Students will learn why cephalopods are the fastest quick-change artists on the planet.
- Students will classify information.
- Students will collect evidence to support a claim.
- Students will obtain information from a nonfiction article.
- Students will contribute a page to a class book that details accidental discoveries.
- Students will practice speaking and listening skills in small groups.
- Students will participate in a camouflage learning activity.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and cross-curricular activities.

SELECTIONS

- **Crazy for Color**
Expository Nonfiction
- **Newton Discovers the Rainbow**
Expository Nonfiction
- **Body Talk Beneath the Sea**
Expository Nonfiction

Crazy for Color

pp. 6–13, Expository Nonfiction

Early artists didn't have the luxury of simply going to a store to purchase paint. From burning bones to crushing lapis lazuli, readers will learn how colors were once created using only natural resources.



RESOURCES

- Classifying Information: Color My World

OBJECTIVES

- Students will learn about the pigments and binders used by early artists to create colors.
- Students will classify information.
- Students will contribute a page to a class book that details accidental discoveries.

KEY VOCABULARY

- pigment (p. 6)** a substance that gives color to something else
- binder (p. 6)** a material that is used to hold things together
- synthetic (p. 6)** not natural

ENGAGE

Conversation Question: How are colors created?

Display the following questions from the article: 1. *Got the blues?* 2. *Do you ever see red?* Ask students to discuss the meanings of the color words as used in these questions. Then ask them what emotions they associate with green, black, and yellow. Present the article “Crazy for Color” and tell students that they will learn how innovative artists resourcefully created the colors they needed in order to convey certain sentiments in their artwork.

INTRODUCE VOCABULARY

List the three key terms on the board and have pairs of students define each word. Then post the definitions provided so that students may check their work. Have pairs choose at least seven additional words from the article and procure definitions. Instruct them to create a mini crossword puzzle using all ten words. Share puzzles with another class for use as a pre-reading activity for the article.

READ & DISCUSS

Reinforce comprehension of the concepts presented in the article by using the following questions to direct discussion:

- What are the two basic ingredients of paint?
- How did early artists make pigments?
- How did chemistry greatly improve the artist's paintbox?
- What did prehistoric artists use to make browns and oranges?
- What problem did adding arsenic to green pigments solve? What problem did arsenic create?

SKILL FOCUS: Classify Information

INSTRUCT: Elicit from students that the main idea of the article is to provide readers with knowledge about how colors were created from natural resources. Present the *Classifying Information: Color My World* graphic organizer. Tell students they will use information from the article to determine whether the statements in the organizer are attributed to the color red (R), yellow (Y), blue (B), or purple (P).

ASSESS: Review worksheet. Discuss how color affects our moods, purchases, and performance. (Note: Color theory is fascinating and could be a topic for ongoing research as the class reads this issue of ASK.)

EXTEND

Science: Explain that many important discoveries involved a combination of wisdom and accident. Remind students that a German chemist accidentally discovered a new chemical blue pigment and another chemist working on a cure for malaria came up with a vivid magenta pigment. Have students research and write a one-page report on an accidental discovery. Reports should include illustrations and *who/what/when/where/why/how* details about the accidental discovery. Collect reports in a “Happy Accidents” class book.

Color My World

Classifying Information Use information from the article to determine if the sentence pertains to the color red (**R**), yellow (**Y**), blue (**B**), or purple (**P**). Mark each sentence accordingly.

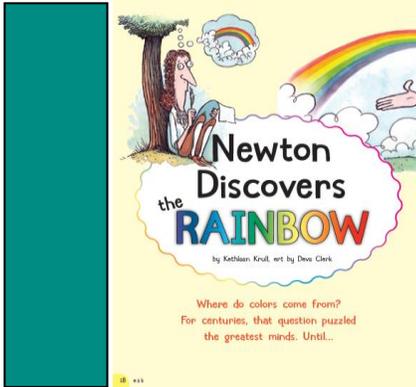
- _____ 1. Making this dye was expensive because thousands of snails were needed.
- _____ 2. This pigment was made by grinding up a gemstone called lapis lazuli.
- _____ 3. Vermillion was an expensive and poisonous pigment used to make this color.
- _____ 4. This bright color was rumored to come from dried cow urine.
- _____ 5. An accidental discovery in 1704 made this color more affordable for artists.
- _____ 6. Egyptians made this color brighter by grinding up toxic volcanic rock.
- _____ 7. Today this color is usually made by mixing synthetic blue and red pigments.
- _____ 8. The richest pigment of this color comes from grinding up cochineal bugs.
- _____ 9. In ancient Rome, only nobility was allowed to wear this color stripes on their togas.
- _____ 10. Impressionist painters used this color instead of black.



Newton Discovers the Rainbow

pp. 18–21, Expository Nonfiction

For centuries the greatest minds wondered where colors came from. This article explores the strategies Isaac Newton used to answer this question once and for all.



RESOURCES

- Collecting Evidence: Rainbow Discovery

OBJECTIVES

- Students will learn how Isaac Newton became the first scientist to accurately understand the nature of color.
- Students will collect evidence to support a claim.
- Students will practice speaking and listening skills in small groups.

KEY VOCABULARY

- prism** (p. 19) a transparent glass or plastic object that usually has three sides and separates light that passes through it into different colors
- spectrum** (p. 20) the group of colors that a ray of light can be separated into, including red, orange, yellow, green, blue, indigo, and violet

ENGAGE

Conversation Question: How are colors created?

In order to see a rainbow you need two ingredients: sunlight and raindrops. Present a glass prism and tell students that in nature, the raindrops act like tiny prisms. Allow students to observe that when sunlight passes through the prism, some of the light is bent (refracted) more than the other portions. Light leaving the prism spreads out to a continuous band of colors called a spectrum. Ask students to name all the colors on the spectrum. Then introduce the article.

INTRODUCE VOCABULARY

Post and discuss the two key vocabulary terms. Have students make connections by asking them how these two words are related (Example: the study of color, rainbows, etc.). Next, have the students engage in “rainbow writing.” Instruct them to fold a white piece of paper in half horizontally and use a pencil to write the word *prism* across the top and *spectrum* along the bottom. Then they will use the colors of the rainbow in order (ROYGBIV), to trace over the words.

READ & DISCUSS

Post and discuss questions prior to reading.

- What did Newton buy at the annual market near his college?
- Why did Newton think Aristotle’s and Hooke’s ideas were wrong?
- How did using a prism help Newton explain color and light?
- What did Newton notice was the same about rainbows made with a prism and those made with a pan of water?
- What was Newton’s most important experiment? Why?

SKILL FOCUS: Collecting Evidence

INSTRUCT: This article presents information about the science of color. Distribute the *Collecting Evidence: Rainbow Discovery* graphic organizer. Tell students they will review the article and highlight sentences that provide evidence to support each of the claims stated in the organizer. Remind students to cite information and details using page numbers.

ASSESS: Have students peer-review their work by sharing completed worksheets with a partner. Circulate and guide as they discuss.

EXTEND

Speaking and Listening: Remind students that the article describes Newton as “solitary” and “unsociable.” It also points out that Newton lived in a time and place with no distractions and was isolated due to a bubonic plague pandemic. Have students work in small groups to discuss how and why Newton’s personality traits and circumstances played a role in his discoveries about light and color. Review good communication skills: active listening, constructive feedback, taking turns. Visit each group’s discussion.

Rainbow Discovery

Collecting Evidence Gather evidence from the text to support each claim. Include details and cite your findings by using page numbers.

Claim: Newton’s prism was the perfect tool for experimenting with light.

Supporting evidence (P. _____)

Claim: The color that you see is made by the combined colors of reflected light.

Supporting evidence (P. _____)

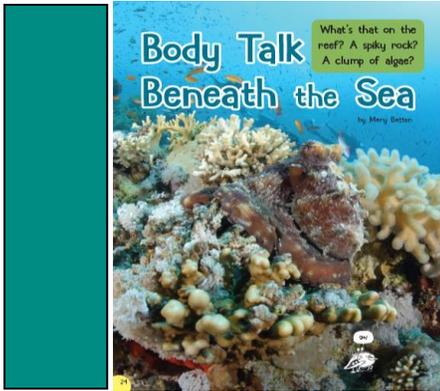
Claim: Newton became the first person to really understand the rainbow.

Supporting evidence (P. _____)

Body Talk Beneath the Sea

pp. 24–28, Expository Nonfiction

Cephalopods are the only animals we know that can move anywhere on a reef, sand plain, or mud plain and camouflage themselves. Readers will discover that cephalopods, once considered simple animals, are emerging as creatures of intelligence.



RESOURCES

- Obtain Information: Hiding in Plain Sight

OBJECTIVES

- Students will learn why cephalopods are the fastest quick-change artists on the planet.
- Students will obtain information from a nonfiction article.
- Students will participate in a camouflage learning activity.

KEY VOCABULARY

- **morphing** (p. 25) gradually changing from one thing to another
- **neuromuscular system** (p. 27) the human body system that includes all muscles throughout the body and the nerves that connect them
- **iridescent** (p. 27) shining with many different colors when seen from different angles

ENGAGE

Conversation Question: How are colors created?

Have students discuss *how* animals can camouflage themselves or change their appearance (color matching, mimicry, active camouflage, etc.). Next, discuss *why* animals employ these strategies (preying, protection, etc.). Finally, present the article “Body Talk Beneath the Sea” and tell students they will learn how changes in appearance can also be a form of communication for animals.

INTRODUCE VOCABULARY

Post and discuss the three vocabulary words and definitions. Have students Think-Pair-Share with a partner. Give them the following directives, one at a time:

1. Discuss examples of **morphing** creatures in science fiction books and movies.
2. What activities engage your **neuromuscular system**?
3. Why do dance costumes often use **iridescent** embellishments? Where else have you seen objects that are iridescent?

READ & DISCUSS

As a post-reading activity, discuss the following questions:

1. What are cephalopods?
2. Explain the three basic camouflage patterns that cuttlefish use.
3. Why is iridescence considered a color trick?
4. How do cephalopods use their quick-changing skin to communicate with each other?
5. Why do scientists believe that most cephalopods are color blind?

SKILL FOCUS: Obtaining Information

INSTRUCT: Have students obtain information from the text, captions, and photos in the article. Remind them that the article was written to teach readers about the types and purposes of camouflage. Introduce the *Obtain Information: Hiding in Plain Sight* worksheet and instruct students to underline the words that accurately complete the sentence.

ASSESS: Review and discuss completed worksheets. Then have students complete the **Think Tank** activity.

EXTEND

Science: Divide the class into small groups to work on an outdoor color experiment. Lead groups to a grassy area outside your school and give each group 40 paper clips in different colors. Ask students to predict which colors will be easiest to see in the grass and which will be most difficult. Then have one student in each group sprinkle the paper clips in the grass and count to 30 while the other members pick up as many as they can. Have students record their findings. Discuss the results and talk about how camouflage can help animals survive in the wild. (Note: If you do not have a grassy area, this activity can easily be adapted by substituting the materials to work with a different environment.)

Hiding in Plain Sight

Obtain Information Read the sentences and answer choices below. Complete each sentence by underlining the correct answer. Reread the article if you need to.

1. Surrounding each chromatophore are thin (**muscles/tentacles/scales**) that pull out or squish up the color sacs.
2. The name “cephalopods” means (**large head/quick-change/head-foot**).
3. Scientists have discovered that most cephalopods are probably (**deaf/color blind/blind**).
4. Cephalopods’ first line of defense is (**poison ink/camouflage/quick getaway**).
5. Cephalopods use their amazing morphing ability to startle predators, to attract mates, and to (**hide/hunt/play**).
6. Under the pigment sacs is another layer of color cells called (**uniform/cores/iridophores**).
7. Cephalopods also use their quick changing skin to (**shed/communicate/swim**).
8. Cephalopods are a group of (**mollusks/fish/mammals**) that includes octopuses, cuttlefish, squid, and nautilus.
9. Cephalopods can change their appearance in less than a (**minute/hour/second**).
10. With a combination of (**air/pigment/scales**) and iridescent cells, an octopus, squid, or cuttlefish can display stripes, streaks, bars, and blotches on various parts of its body.

Think Tank What kind of camouflage abilities would **you** like to have? Why? Discuss your ideas with a partner.