We’ve got a new look, and more!
Now there’s an edition written for your grade level.

Pioneer, Grade 2

Trailblazer, Grade 3

Pathfinder, Grade 4

Adventurer, Grade 5
Summary

• Some living things use chemical reactions to make their own light. This light is called **bioluminescence**.

• Organisms create light for several reasons. The light can help them to hunt or fool predators or prey. It can help them flee from predators. Some organisms use the light to warn others of their kind or as a form of camouflage that allows them to blend in with the environment.

Curriculum in This Article

Common Core State Standards

• Determine the meaning of words and phrases in a text relevant to a grade 2 topic or subject area. (RI.2.4)

• Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area. (RI.3.4)

• Recall information from experiences or gather information from provided sources to answer a question. (W.2.8)

• Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (W.3.8)

• Use a known root word as a clue to the meaning of an unknown word with the same root. (L.2/3.4.c)

Next Generation Science Standards

• Disciplinary Core Idea: Adaptation—For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Materials Needed


• plain white paper


• the National Geographic photo gallery "Luminous Life" at: [http://ngm.nationalgeographic.com/2015/03/luminous-life/liittschwager-photography](http://ngm.nationalgeographic.com/2015/03/luminous-life/liittschwager-photography)


• the National Geographic video "Bioluminescence on Camera" at: [http://channel.nationalgeographic.com/videos/bioluminescence-on-camera/](http://channel.nationalgeographic.com/videos/bioluminescence-on-camera/)

Additional Resource

• See more luminous organisms:
  ► [http://biolum.eemb.ucsb.edu/organism/photo.html](http://biolum.eemb.ucsb.edu/organism/photo.html)

To access the projectable edition of this article, go to the Teacher tab for this magazine at: [ngexplorer.cengage.com](http://ngexplorer.cengage.com).
Flash, Glimmer, and Glow: Background

Fast Facts

- Bioluminescent animals that live in the ocean typically produce a blue-green light. Most marine animals can only see within the blue-green portion of the visible light spectrum.

- When a brittle star is threatened, it detaches a glowing arm. The arm crawls one way and the animal goes the other. It can regrow the arm.

- Fireflies use their bioluminescence to attract mates.

- The glow of bioluminescent bacteria on the ocean is sometimes bright enough to be spotted by satellites orbiting Earth.

• Bioluminescence is an adaptation in which light is produced through a chemical reaction in a living organism. Most bioluminescent organisms live in the ocean. This includes fish, bacteria, and jellies. Fireflies and some species of fungi are bioluminescent organisms that live on land.

• The light created through bioluminescence is known as "cold light." This means that less than 20 percent of the light generates heat.

• The color of this light depends on how molecules in the light-producing compound are arranged. A firefly's light is yellow. In a lanternfish, it's green.

• Bioluminescence can help animals defend themselves. Using light, they can fool other animals, hide, and escape from predators.

• Squid that live near the ocean surface squirt out dark ink so they can hide and escape predators. Many that live in deep ocean waters eject a sticky bioluminescent substance to get away.

• Counterillumination is a kind of camouflage created with bioluminescence. The hatchetfish uses this. It has downward-pointing organs that not only produce light but can adjust the amount of light produced to match sunlight coming from above. This disguises shadows and makes the fish invisible to predators looking up from deeper waters.

• Some animals use bioluminescence to hunt. The anglerfish, for example, is armed with a mouth full of sharp teeth. It's also got a long filament growing out of the top of its head. At the end of that filament is a glowing ball. Unwitting prey are attracted to the light.
Activate Prior Knowledge
Recognizing Bioluminescence


2. Display the video with the sound off for the class. When the video is over, challenge students to describe what they saw. Ask questions to lead them in the right direction, such as: Where was this video taken? Why did it suddenly become black? What were the blue and green things? Invite students to share their ideas.

3. Display the video again, but with the sound on. Encourage students to share what they learned. Invite them to compare these animals of the deep-sea to organisms they've seen on land.

Vocabulary
Making Connections Between Words

1. Tell students that good readers use a variety of strategies to help them understand a text. One strategy is to make connections between words. For example, does a word identify a category? If so, do any of the other terms belong to that category? Is a word an example? If so, is it an example of another term?

2. Display the Wordwise words on page 8 of the projectable edition. Have volunteers read aloud each vocabulary term and its definition. Challenge students to make logical connections between the words.

3. Revisit the vocabulary after reading the article. Based on what they've learned, challenge students to make more meaningful connections between the words.

ELL Connection
Framing Vocabulary Terms

1. Create a diagram like the one below on the board:

2. Display page 8 of the projectable edition. Invite a volunteer to read aloud the definition of the term adaptation. Invite another volunteer to add the word and its scientific definition to the graphic organizer on the board.

3. Encourage students to give examples of this term. Have a volunteer add that information to the organizer. Invite two more volunteers to write a sentence correctly using the vocabulary word and to draw a picture that shows what the word means.

4. Then give each student a piece of plain white paper. Instruct them to draw three diagrams like the one on the board. Direct students to copy the information from the board in the first diagram.

5. Divide the class into small groups. Encourage students to work together as they repeat this process with the remaining words. When all groups are finished, rejoin as a class to discuss how looking at the words in different ways helps readers understand what they words mean.
Explore Reading
Understanding Words and Phrases

1. Display pages 2-3 of the projectable edition. Invite a volunteer to read aloud the headline and text. Then zoom in on the headline. Point to the words flash, glimmer, and glow. Invite volunteers to read the three words aloud as you do.

2. Ask students if they’ve ever heard these words. If so, what do they think the words mean. Ask questions to help students recognize how examining these three words can help them gain a better understanding of the text. For example: How are the word similar? How do they relate to the topic? How do they relate to any of the Wordwise words on page 8?

3. Guide students to recognize that asking questions about words and analyzing how they relate to the rest of the text can help them figure out what unfamiliar words mean.

4. Instruct students to read the article with in small groups. As groups read, tell them to make a list of words they don’t understand. Encourage them to ask questions about the words and search for ways to connect each to the overall topic. Invite students to share what they learned with the class.

Explore Writing
Write About Animals that Make Light

1. Display each image in the article on the projectable edition. As you do, ask students to identify an organism that they’ve seen before. Which ones have more students seen? (fireflies) Why? (They are common insects that live on land.)

2. Invite students to tell about times they’ve seen fireflies. How would that be like seeing one of other organisms in the article? How would it be different?

3. Give each student a copy of the Activity Master. Divide the class into small groups. Instruct group members to take notes describing what it’s like to see fireflies. Then have each group select one organism from the article and identify it on their Activity Masters. Instruct them to conduct research to learn more about the organism, specifically how and why it glows. Remind students to identify each source they use.

4. When groups are finished, encourage them to write a short report answering the question: How are animals that make light alike and different?

Explore Language
Getting to the Root of a Word

1. Display page 4 of the projectable edition. Zoom in on the introduction and highlight the words bioluminescence and adaptation.

2. Point out that both of these words are in bold type. Both are Wordwise words. Challenge students to identify another way the two words are alike.

3. Underline lumin in the first word and adapt in the second. Explain to the class that both of these are root words. Lumin means "light." Adapt means "to fit." Look up both of the larger words in a dictionary. Discuss how the root words gave clues to their meanings.

4. Encourage students to identify other words in the article that can be defined with the help of their root
Explore Science
Understanding Bioluminescence


2. Display the projectable edition, quickly reviewing the images and subheads. Encourage students to think of questions they have about the article. List their questions on the board.

3. Display the video. After watching, review the list of questions on the board. Cross off each question students can now answer. Encourage the class to conduct research to find the answer to any questions that remain.

Making Light to Survive

1. Prior to conducting this activity, download the National Geographic photo gallery "Luminous Life" at: http://ngm.nationalgeographic.com/2015/03/luminous-life/liittschwager-photography

2. Display the photo gallery. Invite students to click the button each time an On/Off option is given. Challenge them to explain why the organisms look different when they click the switch.

3. Guide students to recognize that each of these organisms is bioluminescent. You can only see them glow when the lights are off.

4. Challenge students to identify ways that light helps them when it’s dark. Do they think light helps these organisms in the same way? Brainstorm ideas about how making light could help organisms survive.

Why Do Organisms Produce Light?

1. Prior to conducting this activity, download the National Geographic interactive "Why Do Some Living Things Glow?" at: http://ngm.nationalgeographic.com/2015/03/luminous-life/strategies-graphic

2. Point out to students that while producing light helps organisms survive, it does that in several different ways. Instruct student to scan the subheads in the article to identify four reasons animals produce light. (hunt, scare, warn, hide) Invite students to share their ideas about how each way could help animals survive.

3. Display the interactive. Click each animation. Discuss how each example could relate to one of the four reasons identified in the article. Challenge students to spot additional reasons that animals make light. Discuss how each example shows how the light some animals produce helps them survive where they live.

Extend Science
Applying Knowledge of Bioluminescence

1. Download the National Geographic video "Bioluminescence on Camera" at: http://channel.nationalgeographic.com/videos/bioluminescence-on-camera/

2. Display the video for the class. After watching, encourage students to identify different organisms they saw. Discuss how making light helped each animal survive where it lived.
**Write About Animals that Make Light**

Write about fireflies. Find facts about another animal that makes light. Tell how they are alike and different.

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<th>Tell About Fireflies</th>
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<th>Write About Both</th>
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Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. How do fireflies get light?
   A They catch it.
   B They find it.
   C They make it.

2. Why do glowing animals live in the deep ocean?
   A It's wet.
   B It's dark.
   C It's salty.

3. What type of animal would make light to hunt?
   A predator
   B prey
   C fungi

4. How are all animals that make light alike?
   A Their light blinks off and on.
   B They have an adaptation.
   C All of their body parts glow.

5. What part does the anglerfish use to make light? How does the light help the fish survive?
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
# Flash, Glimmer, and Glow

## Activity Master

Name: Answer Key

**Write About Animals that Make Light**

Write about fireflies. Find facts about another animal that makes light. Tell how they are alike and different.

<table>
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<td>Students should write what it's like to see fireflies.</td>
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<td>Students should identify another animal from the article.</td>
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<th>Facts</th>
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<tr>
<td>Students should take notes telling how and why the animal makes light.</td>
<td>Students should identify each source they use.</td>
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<tr>
<th>Write About Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students should identify how fireflies and the other animal they chose are alike and different.</td>
</tr>
</tbody>
</table>
Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. How do fireflies get light?
   A They catch it.
   B They find it.
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2. Why do glowing animals live in the deep ocean?
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4. How are all animals that make light alike?
   A Their light blinks off and on.
   B They have an adaptation.
   C All of their body parts glow.

5. What part does the anglerfish use to make light? How does the light help the fish survive?
   Possible responses: The anglerfish has a long rod that looks like a worm above its head. On the end is a lighted ball. The anglerfish waves the ball like a fishing lure when it hunts. Smaller fish see the light. They swim to it. The anglerfish eats them.
Summary

• The Gorongosa National Park was a casualty of a 15-year war in Mozambique, Africa. The ecosystem, which had previously teemed with life, was nearly destroyed.

• Ten years ago, a philanthropist funded a group of scientists to restore the park to its former glory. Although they still have a ways to go, the scientists have seen increased biodiversity among the plants, animals, and other organisms living here.

Materials Needed

• the timeline from the Gorongosa National Park site at: http://www.gorongosa.org/our-story/timeline


• "Explore an Ecosystem” poster

• "Visit Some Ecosystems” poster

• Gorongosa National Park’s article "Aerial Wildlife Count” at: http://www.gorongosa.org/blog/park-news/aerial-wildlife-count

Curriculum in This Article
Common Core State Standards

• Identify the main purpose of a text, including what the author wants to answer, explain, or describe. (RI.2.6)

• Distinguish their own point of view from that of the author of a text. (RI.3.6)

• Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section. (W.2.2)

• Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (W.3.2)

• Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe. (L.2.6)

• Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships. (L.3.6)

Next Generation Science Standards

• Disciplinary Core Idea: Biodiversity and Humans—Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
Mozambique is located between South Africa and Tanzania on the southeastern coast of Africa. The Indian Ocean lies between Mozambique and the island of Madagascar.

In 1975, Mozambique became an independent country. This event marked the end of nearly five centuries as a Portuguese colony. But just a few years later, civil war broke out. It lasted for 15 years. The war had many casualties, including Gorongosa National Park.

Gorongosa National Park is a 4,067-square km nature reserve that lies relatively midway between the country's northern and southern borders. It is located at the end of Africa's Great Rift Valley. The park's ecosystem includes savannahs, woodlands, and rain forests.

Before the war, Gorongosa was one of the richest wildlife refuges in the world. Between war, hunters, poachers, and logging, the park was devastated. Habitats were destroyed, and many of the park's large animal populations plummeted by 90 percent or more.

Losing so many large animals had a ripple effect on the entire ecosystem. Grasses, shrubs, and some forests grew thicker. Food chains were disrupted. With so many missing pieces, the food web was in disarray.

The park lingered in this state for nearly a decade. Then, with the backing of American philanthropist Greg Carr, a team of scientists set out to restore Gorongosa’s ecosystem. There is still a long way to go, but now—just over a decade later—the park is on the road to recovery.

Fast Facts

In 1976, there were about 500 lions in Gorongosa National Park. Today, between 30-50 lions live within the park’s borders.

Much of the water that sustains the Gorongosa ecosystem trickles down from Mount Gorongosa, a 1,863-meter peak that only became an official part of the park in 2010.

Gorongosa did have one large predator escape the war with its population intact—crocodiles. The park’s extensive network of rivers and lagoons is the perfect home for thousands of crocs.
**Activate Prior Knowledge**

**Visualizing the Impact of War**

1. Divide the class into small groups. Instruct students to imagine that they are going on an African safari. Tell groups they have five minutes to write a short description of the landscape they expect to see. They must also create a list of all of the animals they expect to encounter.

2. Invite groups to share their ideas with the class. Note how their descriptions are alike and different. Tally the total number of animals named.

3. Then tell the class that you forgot to mention one important detail: The place they are going was nearly destroyed by a long civil war. For the past decade, scientists have been trying to rebuild the ecosystem. This place is now safe to visit. But looking around, you can see that it’s still struggling to recover from the war.

4. As a class, discuss how this news changes students’ expectations about the trip.

**Vocabulary**

**Exploring Words With Examples**

1. Display the Wordwise words on page 17 of the projectable edition. Review each word and its definition with the class. Make sure all students have a thorough understanding of the terms.

2. Divide the class into small groups. Instruct students to make a logical connection between each photo and one or more vocabulary words. For example, students may say that a praying mantis is a species of insect that lives in a rain forest habitat.

3. Once groups have identified their examples, pair up two groups so they can share their ideas. Are any of their examples alike? Which ideas are different? For those examples that are different, do both ideas manage to successfully convey an accurate definition of each term?

4. When groups have finished comparing their results, rejoin as a class. Discuss with students how attaching each word to an example helped them better understand each term.

**ELL Connection**

**Connecting Vocabulary Words**

1. Invite students to share what they know about each vocabulary word. Brainstorm with students ways in which some or all of the vocabulary words are connected. Help them find as many links as possible.

2. Guide students to understand that the more species of plants and animals there are in a habitat, the more biodiversity there will be throughout the ecosystem.
Explore Reading
Finding the Point

1. Remind students that writers always have a purpose for writing a text. It may be to inform, persuade, or entertain. Discuss specifics of each to help students distinguish between the three purposes.

2. Display pages 10-11 of the projectable edition. Invite volunteers to read aloud the headline and deck. Then give each student a piece of paper. Based on the information in here, have students write why they think the writer wrote this article—to inform, persuade, or entertain. Then have students each write a sentence or two identifying exactly what the writer wanted to tell. Instruct students to keep these papers for a class discussion after reading the article.

3. Divide the class into small groups. Have students read the article in their groups. As they do, tell them stop periodically to discuss the writer's purpose what he is specifically trying to relate.

4. When groups are finished, rejoin as a class. Ask students to take out their papers and review what they wrote before reading the article. Do they still agree with their initial thoughts? What, if anything, did they learn that changed their opinions?

Explore Writing
Create a Timeline of Gorongosa's Success

1. Prior to conducting this activity, download the timeline from the Gorongosa National Park site at: http://www.gorongosa.org/our-story/timeline

2. Display pages 10-11 of the projectable edition. Read the headline aloud. Then have students scan the subheads in their magazines. Discuss how the subheads work together to tell how the park was nearly destroyed and how it is now on its way back to life. Display the timeline. As a class, discuss how the timeline does this same thing, but in an interactive way.

3. As a class, select one specific area of Gorongosa to study. Instruct students to conduct research to learn how it has been brought back to life. Work together to create a timeline of events. Then, using that timeline as a foundation, write a short documentary script focusing on this aspect of the park's recovery.

4. Provide guidance as the class works to ensure that students include facts, definitions, and details. Encourage them to wrap up the documentary with a solid concluding statement that clearly conveys the purpose of the documentary.

Explore Language
Using Accurate Words and Phrases

1. Display pages 10-11 of the projectable edition. Then introduce the appropriate grade-level language objective and activity as outlined below.

**Common Core Grade-Level Differentiation**

**Grade 2:**
- After identifying the writer's purpose, brainstorm ways the writer accomplished this purpose and related the information he really wanted to tell.

**Grade 3:**
- Point out to students that the article's headline is "Back to Life." Ask: Do you think the writer really feels like he's bringing this ecosystem back to life? Why or why not? Once students have a firm grasp on the writer's point of view, challenge them to express their own views, distinguishing what they think from the author's perspective.

**Common Core Grade-Level Differentiation**

**Grade 2:**
- Invite students to describe the grasshopper and how it might hop. Explain that the words they used are adjectives and adverbs. Discuss these parts of speech. Encourage students to find adjectives and adverbs in the article.

**Grade 3:**
- Read the headline and deck. Review words that signal spacial and temporal relationships. Challenge students to find an example in the deck. (now) Scan the article for more words that tell where or when.
**Explore Science**

**Problems and Solutions for Biodiversity**

1. Give each student a copy of the Activity Master. Then display pages 10-11 of the projectable edition. Based on the information here, challenge students to identify the main problem (War destroyed one of the world’s richest ecosystems.) and solution (My team and I are trying to rebuild it.) identified in this article. Instruct students to record this information on their Activity Masters.

2. Invite students to scan their magazines. Where can they find a description of Gorongosa before and after the war? (page 12, “A Look Back”) Invite a volunteer to read the information aloud. Instruct students to record details on their Activity Masters.

3. Point out to the class that the past is important, but the focus of this article is on the solutions that can change Gorongosa’s future. Divide the class into small groups. Challenge groups to review the article to identify specific solutions and tell how they are changing the park now. Rejoin as a class to share results.

**Appreciating Organisms Big and Small**


2. Display page 12 of the projectable edition. Zoom in on the photo of the lion. Discuss what a lion needs to survive. Do the same for the remaining photos in the article. Then poll the class to see which animal they think is most important to the park’s recovery.

3. Display the National Geographic video. Discuss why it’s important to bring large animals back to Gorongosa. Display the second video. Discuss why the smallest creatures are important, too.

**Exploring Nonliving Parts of an Ecosystem**

1. Display pages 10-11 of the projectable edition. Highlight the headline. Inform students that this article may be called “Back to Life,” but living things are not all that matter in an ecosystem. Nonliving things are important as well.

2. Display the “Explore an Ecosystem” poster. Invite volunteers to read the information aloud. Discuss reasons why the four nonliving things identified are important in any type of ecosystem.

3. Then display the “Visit Some Ecosystems” poster. Invite a volunteer to read aloud the information at the top of the poster. Review each ecosystem to see how climate, altitude, and rocks determine the kinds of living things that can live there.

4. Encourage students to scan the article to find examples of each element in Gorongosa National Park. Challenge the class to identify things people can do—or have done in Gorongosa—to change the nonliving elements of the ecosystem. Discuss how these changes can affect the biodiversity of the ecosystem.

**Extend Science**

**Signs of Progress**


2. Read and review the article as a class. Discuss what results of this aerial study mean for the future balance of the Gorongosa ecosystem. How did relocating animals and transplanting plants contribute to the results of this study?
Problems and Solutions for Biodiversity

Record the main problem and solution mentioned in the article. Tell what Gorongosa was like before and after the war. Tell how the solutions are changing the park now.

Name:
Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. Why did so many animals disappear from Gorongosa during the war?
   A The animals walked away.
   B People ate the animals.
   C People took the animals to zoos.

2. What did many organisms that survived the war have in common?
   A They were green.
   B They were big.
   C They were small.

3. Which of these animals are scientists relocating to the park?
   A lions
   B elephants
   C spiders

4. What kind of habitat do zebras need to survive?
   A rain forest
   B desert
   C grassland

5. How do dung beetles help lions survive?
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________
War destroyed one of the world's richest ecosystems. Fifty years ago, Gorongosa thrived. It was one of the largest and most famous national parks in Africa. Thousands of animals lived here.

The park was no longer protected. Soldiers fought battles here. Poachers roamed the land, killing animals. The rhinos, elephants, antelopes, and many other animals disappeared. The park had been destroyed.

Scientists counted the plants and animals to know what they had left. They relocated zebras from another part of Africa. They are rebuilding the plant and animal populations. Keeping them in a pen until the herd grows big and strong. Then it will be safe to release them.

Piotr Naskrecki and his team are trying to rebuild it. After the war. Tell how the solutions are changing the park now.

Record the main problem and solution mentioned in the article. Tell what Gorongosa was like before and after the war.

Problems and Solutions for Biodiversity

Activity Master

Name: Answer Key
1. Why did so many animals disappear from Gorongosa during the war?
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   A. rain forest
   B. desert
   C. grassland

5. How do dung beetles help lions survive?

   Possible response: Dung beetles remove waste, which allows grass to grow. Antelopes eat grass.

   Lions eat antelopes.
Space Lab: Overview

Summary

- Astronauts working at the International Space Station use technologies that help people on Earth. For example, they can take infrared images that show farmers where healthy plants are growing. They can also pick up signals from ships, allowing them to track vessels' movement on the open ocean.

- Some of the technologies used in space can also be used on Earth. People living in remote areas are now using the same portable ultrasound machine that astronauts use in space. This allows them to get medical help when doctors are far away.

Curriculum in This Article

Common Core State Standards

- Explain how specific images contribute to and clarify a text. (RI.2.7)

- Use information gained from illustrations and the words in a text to demonstrate understanding of the text. (RI.3.7)

- Write narratives in which they recount a well elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure. (W.2.3)

- Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences. (W.3.3)

- Form and use the past tense of frequently occurring irregular verbs. (L.2.1.d)

- Form and use the simple verb tenses. (L.3.1.e)

Next Generation Science Standards

- Disciplinary Core Idea: Asking Questions and Defining Problems—Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Materials Needed

- plain white paper

- NASA’s instructions for creating a Do-It-Yourself Podcast at: http://www.nasa.gov/audience/foreducators/diypodcast/index.html

- NASA’s podcast site about the International Space Station at: http://www.nasa.gov/audience/foreducators/diypodcast/space-station-index-diy.html#.VRmaLcaWZm0

- index cards

- the Casis Academy’s "ISS Tour" page at: http://casisacademy.org/ISSTour.htm

- the Casis Academy’s "Space to Innovate" site at: http://www.casisacademy.org/SpaceToInnovate.htm

- NASA’s "Trace Space Back to You!" interactive at: http://www.nasa.gov/externalflash/nasacity/index2.htm

Additional Resources

- Learn more about ISSAC: ► http://www.nasa.gov/mission_pages/station/research/experiments/81.html

- Learn more about ADUM: ► http://www.nasa.gov/mission_pages/station/research/experiments/133.html

- Learn more about the Vessel ID system: ► http://www.nasa.gov/mission_pages/station/research/experiments/750.html

To access the projectable edition of this article, go to the Teacher tab for this magazine at: ngexplorer.cengage.com.
The International Space Station is a laboratory that orbits Earth. Since the first mission to the ISS, which launched on October 31, 2000 and reached the space station on November 2, humans have continuously inhabited the space station.

Astronauts aboard the ISS conduct research stemming from all areas of science. They study the impact of space travel on the human body, and they test new technologies that may aid in future missions. Many of the technologies they investigate help people on Earth. Some are even used by people on Earth.

The International Space Station Agricultural Camera (ISSAC), for example, takes infrared and visible-light images of forests, grasslands, and agricultural fields in the North American Great Plains. Farmers and ranchers analyze the images to make informed decisions about their crops and livestock.

With the Advanced Diagnostic Ultrasound in Microgravity (ADUM), crew members can take high-quality ultrasound scans if they become injured or ill. They can send the scans to Earth, where a ground flight surgeon can evaluate the scans and diagnose the problem. Doctors on Earth can use this same technology to help people who live in remote areas far from medical care.

The Vessel ID System is a space-based radio receiver attached to the external handrails of the space station. This device makes it easier to monitor the location of ships on the ocean. The system collects signals from ships on Earth and bounces them back to a receiver on the ground. It has relayed position reports tracking more than 22,000 ships in one day.

Experiments with the Vessel ID System also help astronauts. The adaptor connecting the system to the ISS is new. If successful, it would give astronauts a new way to attach payloads to the ISS when they are working outside the space station.

Fast Facts

- The ISS is about the size of a football field.
- Although developed to primarily take images of agricultural areas, ISSAC has also taken images of natural hazards and disaster areas.
- Many people lack access to clean drinking water. Using advanced water filtration and purification systems developed for the space station, they can now tap into a safe water supply.

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Space Lab: Prepare to Read

**Activate Prior Knowledge**

**Recognizing Science in Space**

1. Display pages 18-19 of the projectable edition, covering the article's headline and deck, for three seconds. Then ask: *What is the man doing?* Instruct students to raise their hands if the first thought that popped into their heads was either "floating in space" or "waving to the camera."

2. Display the pages again, revealing the headline and deck. Invite a volunteer to read the text aloud. Challenge students to answer the following questions:
   - Where is this lab?
   - What kind of experiments might the man do there?
   - How can the man's work help people on Earth?

3. Invite students to share their ideas. Encourage them to share what they know about an astronaut’s work in space.

**Vocabulary**

**Exploring Words In Small Groups**

1. Divide the class into small groups. Instruct students turn to page 23 in their magazines. Tell students they will explore the vocabulary words for this article with their groups.

2. To do this, tell students to go through the words one by one. First, read the word and its definition. Then each group member should share what he or she knows about the term. This could include examples, personal experiences, or even drawing a picture of the term, if appropriate.

3. Rejoin as a class and invite groups to share what they learned about each word.

**ELL Connection**

**Crossword Wordwise Words**

1. Display the Wordwise words on page 23 of the projectable edition. Review the terms with students.

2. Give each student a piece of plain white paper. Direct them to create a crossword puzzle that contains the five Wordwise words on page 23 of the article. Provide an example of a crossword puzzle if necessary.

3. Once students have completed their puzzles, instruct them to trade with a partner. Give them time to solve the puzzle.
**Explore Reading**

**Using Illustrations to Clarify Understanding**

1. Display the diagram on pages 20-21 of the projectable edition. Ask students what they see. Then invite volunteers to read aloud the captions one at a time.

2. Guide students to understand that the large structure floating above Earth in the main image is the International Space Station. The ISS is a space lab where astronauts conduct experiments and use technology to help people on Earth.

3. Draw students' attention to the image in the circle. Reread the caption to help students understand what this image shows. Tell students that this image will make more sense as they read the article.

4. Divide the class into small groups. Have students read the article together. As they do, encourage them to pay particular attention to each image and think about how it helps them better understand the text.

**Common Core Grade-Level Differentiation**

**Grade 2:**
- Ask groups to identify the one image or text feature that was the most useful in clarifying the text.

**Grade 3:**
- Challenge groups to identify the illustration that was the most useful in clarifying the text. Specifically, ask them to explain how the illustration clarified for them where, when, why, or how key events occurred.

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**Explore Writing**

**Explore Language**

**Explore Verbs and Verb Tenses**

1. Prior to conducting this activity, create a list of verbs from the article. For second graders, include regular and irregular verbs. For third graders, include verbs written in the simple past, present, and future tenses. Include examples of our own to extend the list. Then conduct the grade-level activity outlined below.

**Common Core Grade-Level Differentiation**

**Grade 2:**
- Review regular and irregular verbs. Then give each student two index cards. Tell them to write "regular" and "irregular" on the cards. Invite students to raise the correct card as you read words from your list.

**Grade 3:**
- Review the simple verb tenses. Then give each student three index cards. Instruct them to write "past," "present," and "future" on the cards. Read the words from your list. Challenge students to raise the correct card.
Explore Science
ISS Research and Technology

1. Prior to conducting this activity, download the Casis Academy's "Space to Innovate" site at: http://www.casisacademy.org/SpaceToInnovate.htm

2. Divide the class into small groups. Give each student a copy of the Activity Master. Challenge students to review the article answer questions about the three technologies written about in the article: ADUM, ISSAC, and the Vessel ID system.

3. Then display the Casis Academy site. Explore the site with the class. As you do, encourage students to select and answer those same questions about one other type of technology with a connection to space. Discuss how the different things astronauts do in space affect people on Earth.

Solve Problems for Astronauts in Space

1. To conduct this activity, download the Casis Academy's "ISS Tour" page at: http://casisacademy.org/ISSTour.htm

2. Divide the class into four groups. Assign each group one video to watch. As they do, challenge them to identify problems that lack of gravity might cause for astronauts in space. For instance, how do you keep your toothbrush from floating through the space station?

3. Encourage each group to identify one problem, describe it in detail, and explain how astronauts currently deal with this issue. Challenge them to come up with a better solution.

Extend Science
How Does Space Exploration Affect You?


2. Point out to the class that the research and technology identified in the article helps specific people: farmers; doctors and patients; and people on ships. How many students think that the experiments conducted in space affect them? Discuss the possibilities.

3. Then display the interactive. Take students on a tour of the home and city to introduce them to everyday products they use that originated in space. After a complete tour, encourage students to share their thoughts on how people in space can affect life on Earth.
Answer questions about one more example from the video.

Answer questions about the three examples of ISS Research and Technology from the article. Answer

<table>
<thead>
<tr>
<th>What is it?</th>
<th>Who does it help?</th>
<th>How does it help?</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSAS</td>
<td></td>
<td></td>
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<tr>
<td>ADUM</td>
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<td>Vessel ID</td>
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<tr>
<td>System</td>
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Space Lab

Assessment

Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. What kind of data does ADUM collect?
   A) weather
   B) health
   C) location

2. Which technology collects data about plant growth?
   A) ISSAC
   B) ADUM
   C) the Vessel ID system

3. How do astronauts get data to Earth?
   A) They create it.
   B) They monitor it.
   C) They transmit it.

4. Which technology can save lives on Earth and in space?
   A) ISSAC
   B) ADUM
   C) the Vessel ID system

5. Which of these statements is true?
   A) Astronauts only study space.
   B) Astronauts never get sick.
   C) Astronauts do lots of experiments.
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<td>The International Space Station monitors the health of crops in space.</td>
<td>The Advanced Diagnostic Ultrasound in Microgravity is a portable ultrasound machine.</td>
<td>The system collects data from ships and identifies them by their ID.</td>
</tr>
</tbody>
</table>

**How does it help?**
- ISSAS: Helps farmers and ranchers monitor the health of crops in space.
- ADUM: Helps people in space and on Earth get medical help.
- Vessel ID: Helps people on ships in the middle of the ocean get rescued.

**Who does it help?**
- ISSAS: Farmers and ranchers in space.
- ADUM: People in space and on Earth.
- Vessel ID: People on ships in the middle of the ocean.

**What is it?**
- ISSAS: The International Space Station.
- ADUM: The Advanced Diagnostic Ultrasound in Microgravity.
- Vessel ID: The system that picks up signals from ships.

**Who does it help?**
- ISSAS: Farmers and ranchers in space.
- ADUM: People in space and on Earth.
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