Close Reading of Informational Texts in Science, Technology, Engineering, and Mathematics

Learning Targets
- Cite specific textual evidence to support analysis of science and technical texts.
- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
- Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
- Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
- Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

Close Reading for Meaning
Scientific texts contain a lot of information. They are full of facts, evidence, and data. In order to make that information accessible to readers, authors of scientific texts structure their texts in certain ways. Common organizational structures for scientific texts include: cause/effect, compare/contrast, description, problem/solution, and sequencing (often chronological order). Becoming familiar with these organizational structures helps readers closely read scientific texts.

One way authors make information accessible to readers is by using subheadings to organize information. The multiple paragraphs under a subheading all contain information that is related. When reading, we can use text features, like subheadings, to help organize the information in our minds, to aid in notetaking, and to help locate important facts.

In this workshop, you will read a variety of texts and will practice close reading using strategies that will help you make meaning of the text. Your teacher will guide you through the first activity. In Activity 2, you will work in a collaborative group to read and respond to a visual text. For the third activity, you will work independently to apply close reading strategies to determine meaning in a new text.

LEARNING STRATEGIES:
- Chunking the Text,
- Diffusing, Close Reading, Marking the Text, Rereading, Previewing, Summarizing, Paraphrasing

ACADEMIC VOCABULARY
- Organizational structures refer to the way an author presents information. A subheading is a text feature that often appears in scientific texts. Subheadings divide the text into clear sections to help readers chunk information and locate information more easily.

PLAN
Pacing: Each workshop has four activities. Allow approximately two days per activity. Pacing this set of activities will be flexible based on the needs of your students and the demands of your schedule.

Materials: Lined paper, highlighters, pens or pencils for marking the text, access to dictionaries, overhead projector or interactive whiteboard.

ACTIVITY 1
Guided Practice

1. Review the learning targets to help set a context for what students will be doing in this workshop.
   Discuss the Academic Vocabulary. Note also that the reading passages include a special emphasis on vocabulary in the first two readings. Words that students might be expected to know are bolded and words that may be challenging are underlined and defined.

2. Activity 1: Guided Practice requires the teacher to guide students with explicit, direct instruction in the reading of challenging texts using oral reading, strategy instruction, and text-dependent questioning. This activity is the first of four activities: a guided activity, a collaborative activity, an activity that students complete independently, and a fourth activity that provides assessment opportunities for the entire workshop.
ACTIVITY 1 (continued)

3 Before students read the first text, have them skim the passage and note different sections in the text. Introduce or review paraphrasing as a reading comprehension strategy. As students read independently, be sure they pause at the end of each paragraph or section and put the ideas into their own words.

4 First Reading: For the First Reading, students read the passage silently and independently, diffusing vocabulary as they read for comprehension.

Text Complexity
Overall: Very Complex
Lexile: 1320L
Qualitative: High
Task: Moderate (Analyze)

Context: Students will examine a primary document about invasive plants in California, and what the state is doing to identify them and track their spread. Invasive species are animals and plants that are not native to an area, but that thrive in that ecosystem, often at the peril of native plants and animals. The text in this activity reflects what students are likely to encounter outside of the classroom while pursuing further content knowledge in the fields of biology and environmental studies. Students may benefit from a discussion about the basics of plant and animal growth in an ecosystem, but it is best to allow them to discover much of the information provided in the texts through analysis and inference. Additional background information is provided prior to the third reading of the text.

ACTIVITY 1
Guided Practice

You will read the text in this activity at least three times, focusing on a different purpose for each reading.

First Reading: First Impressions
Read the following passage silently. Your focus for this first reading is on understanding the meaning of the text. Before you read, glance at the subheadings to get a sense of what information is covered. As you read, practice paraphrasing by stopping at the end of each paragraph, thinking about what the author is saying, and putting the main ideas in your own words. You may also want to annotate the text by noting the main ideas of each paragraph in the margins. Use the definitions and synonyms in the margin to help your understanding.

Close Reading of Informational Texts in STEM (continued)

Introducing the Strategy: Paraphrasing
Paraphrasing is a strategy for close reading of text. Using this strategy, the reader reads a portion of a passage and then restates the essential information in his or her own words. Putting the author’s ideas in one’s own words helps one understand a challenging text.

ACTIVITY 1
Informational Text

From CALIFORNIA INVASIVE PLANT INVENTORY

by California Invasive Plant Council, 2006

1 The California Invasive Plant Inventory categorizes non-native invasive plants that threaten the state’s wildlands. Categorization is based on an assessment of the ecological impacts of each plant. The Inventory represents the best available knowledge of invasive plant experts in the state.

The Inventory

2 The Inventory categorizes plants as High, Moderate, or Limited, reflecting the level of each species’ negative ecological impact in California. Other factors, such as economic impact or difficulty of management, are not included in this assessment. It is important to note that even Limited species are invasive and should be of concern to land managers.

Although the impact of each plant varies regionally, its rating represents cumulative impacts.
statewide. Therefore, a plant whose statewide impacts are categorized as Limited may have more severe impacts in a particular region. Conversely, a plant categorized as having a High cumulative impact across California may have very little impact in some regions.

3 The Inventory Review Committee, Cal-IPC staff, and volunteers drafted assessments for each plant based on the formal criteria system described below. The committee solicited information from land managers across the state to complement the available literature. Assessments were released for public review before the committee finalized them. The 2006 list includes 39 High species, 65 Moderate species, and 89 Limited species. Additional information, including updated observations, will be added to this website periodically, with revisions tracked and dated.

Definitions

4 The Inventory categorizes "invasive non-native plants that threaten wildlands" according to the definitions below. Plants were evaluated only if they invade California wildlands with native habitat values. The Inventory does not include plants found solely in areas of human-caused disturbance such as roadsides and cultivated agricultural fields.

- Wildlands are public and private lands that support native ecosystems, including some working landscapes such as grazed rangeland and active timberland.
- Non-native plants are species introduced to California after European contact and as a direct or indirect result of human activity.
- Invasive non-native plants that threaten wildlands are plants that 1) are not native to, yet can spread into, wildland ecosystems, and that also 2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

Inventory Categories

5 Each plant on the list received an overall rating of High, Moderate or Limited based on evaluation using the criteria system. The meaning of these overall ratings is described below. In addition to the overall ratings, specific combinations of section scores that indicate significant potential for invading new ecosystems triggers an Alert designation so that land managers may watch for range expansions. Some plants were categorized as Evaluated But Not Listed because either we lack sufficient information to assign a rating or the available information indicates that the species does not have significant impacts at the present time.

- High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Before sharing the text with students, you may choose to investigate whether or not your state has a similar inventory to California. If so, you may want to share information with students from that inventory to make the topic more personal and relevant since it is about their surrounding environment. If there are specific plants that are in the inventory that are found on school property, you may choose to point them out to students. If available, consider consulting with a science teacher at your school about this information.

Differentiated Instruction

This text may be challenging. Providing contextual information, careful guidance through diffusing, and an examination of vocabulary and sentence structure will yield greater understanding. Some students may benefit from creating a visual representation or graphic organizer for the information in the third section to aid in comprehension of the distinctions between species that are categorized as high, moderate, or limited.

5 After the first reading, you may want to diffuse the text with your students, working with the underlined words as well as the bolded Tier 2 words. Use this as an opportunity for a lively conversation about vocabulary and meaning. This may be the time to supply students with more context information.
ACTIVITY 1 (continued)

6 Second Reading: Students will now read along as you read the text aloud as an “expert” reader. This read-aloud gives students an opportunity to hear the text read with careful consideration of meaning. During this reading, students should continue vocabulary study by circling unfamiliar and/or important vocabulary. Stop occasionally to monitor and clarify students’ understanding of words in context.

7 With selected vocabulary, conduct a think-aloud of rereading and diffusing vocabulary with definitions/synonyms. Help students work toward comprehension of both the explicit and implicit meaning of both the words and the value of diffusing itself.

8 Check Your Understanding: Have students work in pairs to chunk the text appropriately. You may choose to create strips for each paragraph that students can then manipulate to put in different chunks. Ask pairs of students to share and defend their chunks with justification from the text with another pair of students. Circulate and see how many students are using the subheadings as a way to chunk information. If few pairs are doing so, you may choose to provide additional information about the benefits of using text features like subheadings to organize information.

9 Understanding the term “invasive non-native plants” is essential to comprehension of the text. Create a class definition of the term and post it somewhere in the room so students can refer to it throughout the remainder of the workshop.

Close Reading of Informational Texts in STEM (continued)

- Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

- Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Second Reading: Vocabulary in Context

Now that you have read the passage silently, listen and follow along as your teacher reads the passage aloud. As you read along with your teacher, circle words and/or phrases (other than the underlined words) that you do not know or that you feel are important to the meaning of the passage. Diffuse these words/phrases for comprehension.

Check Your Understanding

1. Pair with another student and determine the best way to chunk the text. Pay attention to text features that can help when chunking. Discuss how chunking the text prior to paraphrasing can help make the task of paraphrasing easier.

   The passage can be chunked based on the three subheadings: The Inventory, Definitions, and Inventory Categories. Readers can read one “chunk” at a time and then put it in their own words, rather than waiting until the end of the entire text and then trying to put it in their own words.

2. Using the definitions in the margin, define the term “invasive non-native plant.” Now paraphrase the “Definitions” section of the text. According to the text, what is an invasive non-native plant?

   An invasive non-native plant is one that has spread into an area that it would not naturally grow. Invasive plants are those that are not original to the area and that threaten native ecosystems. They threaten native plants by spreading into their area, by making hybrids with native plants, and by changing the ecosystem so native plants have a hard time surviving.
Third Reading: Text-Dependent Questioning
Now read the text again, this time reading to respond to the Key Ideas and Details interpretive questions. As your class discusses the text, write your responses to each question and highlight or underline the textual evidence that supports your answer. During discussions, you may also want to annotate the text to record a new or different meaning of the text.

Background Information: Invasive species are those that were introduced to a certain area through human contact. They can be plants or animals. In many instances, a plant or animal is brought to an area to control the growth of a different species. However, these invasive species can also cause harm to the native populations. The California Invasive Plant Council studied plants around the state and categorized invasive plants based on their negative impact to the ecology. Some invasive species are more harmful than others. This passage explains what an invasive plant is and how California categorizes invasive species.

from “California Invasive Plant Inventory”
bY California Invasive Plant Council, 2006

The California Invasive Plant Inventory categorizes non-native invasive plants that threaten the state’s wildlands. Categorization is based on an assessment of the ecological impacts of each plant. The Inventory represents the best available knowledge of invasive plant experts in the state.

The Inventory

The Inventory categorizes plants as High, Moderate, or Limited, reflecting the level of each species’ negative ecological impact in California. Other factors, such as economic impact or difficulty of management, are not included in this assessment. It is important to note that even Limited species are invasive and should be of concern to land managers. Although the impact of each plant varies regionally, its rating represents cumulative impacts statewide. Therefore, a plant whose statewide impacts are categorized as Limited may have more severe impacts in a particular region. Conversely, a plant categorized as having a High cumulative impact across California may have very little impact in some regions.

The Inventory Review Committee, Cal-IPC staff, and volunteers drafted assessments for each plant based on the formal criteria system described below. The committee solicited information from land managers across the state to complement the available literature. Assessments were released for public review before the committee finalized them. The 2006 list includes 39 High species, 65 Moderate species, and 89 Limited species. Additional information, including updated observations, will be added to this website periodically, with revisions tracked and dated.

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10 Third Reading: During this reading, students should focus on the Key Ideas and Details questions. These interpretive questions lead students into textual analysis by posing interpretive questions about the passage. Students should answer by annotating and noting textual evidence with underlining or highlighting.

Key Ideas and Details The purpose of the plant inventory is to evaluate how harmful an invasive species is by categorizing it as High, Moderate, or Limited. The inventory is a place to compile information from several experts on many different species and have it all in one place.
ACTIVITY 1 (continued)

Key Ideas and Details  A native ecosystem is one that remains as it was before Europeans came to California. The word “wildland” helps one understand what a native ecosystem might look like because of the picture it evokes: a place untouched by humans. The phrase “as a direct or indirect result of human activity” also helps me understand what a native ecosystem might look like because it helps one realize that for it to free from even indirect human activity, it must be a very wild or remote place.

Key Ideas and Details  The section builds on information from earlier in the text about categorizing plants as High, Moderate, or Limited in their invasiveness by giving detailed explanations and features for each category. For example, a species that is designated as “High” severely impacts its surrounding ecology, establishes itself and spreads quickly, and is widely distributed throughout the state of California.

Definitions 4  The Inventory categorizes “invasive non-native plants that threaten wildlands” according to the definitions below. Plants were evaluated only if they invade California wildlands with native habitat values. The Inventory does not include plants found solely in areas of human-caused disturbance such as roadsides and cultivated agricultural fields.

- Wildlands are public and private lands that support native ecosystems, including some working landscapes such as grazed rangeland and active timberland.
- Non-native plants are species introduced to California after European contact and as a direct or indirect result of human activity.
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Inventory Categories 5  Each plant on the list received an overall rating of High, Moderate or Limited based on evaluation using the criteria system. The meaning of these overall ratings is described below. In addition to the overall ratings, specific combinations of section scores that indicate significant potential for invading new ecosystems triggers an Alert designation so that land managers may watch for range expansions. Some plants were categorized as Evaluated But Not Listed because either we lack sufficient information to assign a rating or the available information indicates that the species does not have significant impacts at the present time.

- **High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- **Moderate** – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- **Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
Check Your Understanding

Now that you have read closely and worked to understand challenging portions of the text, consider how California might benefit from having the Invasive Plant Inventory. Explain in your own words why having the Inventory is a good idea.

Many people in California were involved in creating the Inventory. They identified around 200 invasive plants that are threatening the wildlands of the state. They can now keep tabs on the plants to find out if they are becoming more or less invasive over time and which plants are the most worrisome. The Inventory is a place they can keep data and use it to study the impacts on the local ecology.

Synthesizing Your Understanding

Now that you have read the passage three times and studied the vocabulary and ideas, synthesize your understanding by examining the elements of subject, purpose, and tone. Respond to the following questions as a way of bringing all your knowledge together.

What is the subject of the text—the general topic and main ideas? Be as specific as you can in identifying and summarizing the subject of the passage.

The text explains that California has an inventory, or list, of invasive plants. It defines what non-native invasive plants are and explains how they are categorized in California according to how much they negatively impact the ecosystem.

What is the purpose of the text? What is the reason behind the creation of this piece of writing? What do you suppose the writer wants the audience to think or do as a result of reading the text?

The text is written to describe, explain, and inform readers about the Inventory. It explains that the Inventory is a list of invasive plants created by several groups of people who assessed plants. Readers understand how the council defined invasive plants, and how they are categorized—High, Moderate, and Limited.

What is the author’s attitude toward the subject? Tone describes the attitude of the author about the subject being discussed. Now that you have identified the subject and the purpose, explain how the tone is established.

The author takes an objective tone to describe the Inventory, how it was created, and the categories it uses to rate invasive plants. The article is not persuasive and merely describes the Inventory rather than making an argument about invasive plants. The author uses unemotional language to objectively deliver information about the Inventory.

Writing Prompt: Based on your current understanding of the passage, explain how California is affected by invasive species that are categorized as Limited. Be sure to:

• Write a topic sentence that explains what “Limited” means when it comes to invasive plants.
• Paraphrase information in the passage.
• Provide several pieces of textual evidence.

Possible topic sentences:
• Invasive plants that are categorized as Limited are those that have a minor impact on the ecology or those that are in a contained area and spread slowly.
• Although an invasive plant that is categorized as Limited does not do as much damage as one categorized as High, even Limited plants should be monitored because they are concerning to the ecology.

ASSESS

For the writing prompt, check that students have a correct understanding of the term “Limited” as it is used to describe invasive plants. Students should express the idea that even though species identified as limited may only be in a small area or do not currently impact the environment very negatively, they can still pose a problem, especially if they are not managed.

ADAPT

Consider asking students to use the paraphrasing they did during their multiple readings of the text to complete a written summary of the text. Students can work independently on their written summaries, but can then share or consult with a classmate to make sure that all key information is included in the summary.
Stages of Biological Invasion

**ARRIVE**
Species introduced from external environment

**PREVENT**

**ESTABLISH**

**ERADICATE**

**REPRODUCE AND SPREAD**

**CONTAIN**

**DISPLACE NATIVES**

**CONTROL**

**DOMINATE ECOSYSTEM**

**MAINTAIN**

Non-native species invade through a five stage invasion process. Eradication becomes increasingly difficult, and eventually impossible, as the invasion advances.

ACTIVITY 2
Collaborative Practice

Look carefully at the charts that follow. These visuals were published by the California Department of Fish and Wildlife.

PLAN

This activity provides an opportunity for students to practice analyzing visual texts and comparing them to written texts using collaborative strategies. It is important to understand that this activity is part of a flexible suite of close-reading activities, so depending on your students and their needs, this could be a teacher-guided activity that further prepares students to succeed on the last independent activity.

TEACH

1. Review the information about the charts with the class before they begin the activity.

2. Introduce or review the First Reading, Second Reading, Third Reading strategy, clarifying each of the components for students before they begin their work. The strategy requires students to examine a visual text three separate times, focusing on different information with each reading and going deeper with each reading, much as they would in a written text.
In early stages of establishment, most invaders either go unnoticed or appear harmless. However, rapid reproduction and spread over time lead to exponential increases in both the total area infested and associated control costs. While prevention is the most effective and cost-efficient strategy for managing invasive species, early detection and rapid response methods are necessary to prevent infestations and control costs from reaching unmanageable levels.

**First Reading: What do you see?**
As you look at the charts, what details you notice? To answer this question, base your answers only on what you can see in the graphics. Next, read to understand the meaning of the captions underneath each chart.

The first chart shows the stages of an invasion by an invasive species along with control measures. The second chart shows that over time, an invasive species takes over more land and gets more expensive to control.
ACTIVITY 2 (continued)

4 The purpose of the **Second Reading** is for students to go a little deeper in understanding the visuals. Students are expected to make inferences and interpretations. Students should draw conclusions about the meaning of the visuals.

5 In the **Third Reading**, students take a metacognitive approach and describe how the visuals support their interpretations. Students are expected to use the visuals as textual evidence in support of their conclusions.

**ELL Support**
For students who need additional support with writing topic sentences, you may want to provide a sentence starter for the writing prompt; for example, “The visuals support the text by showing that...”

**ASSESS**
For the writing prompt, check that students have shown their understanding by making a connection among the details in the visual texts, the inferences that can be made from those details, and the text excerpts. Students should demonstrate understanding of the idea that invasive species have different impacts on ecosystems depending on the degree of their invasiveness.

**ADAPT**
You may want to assess by asking students to synthesize information from the visuals and the text in order to create their own, new, visual interpretation of the data. Suggest formats such as the arrows or the graph for students to display their understanding.

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Close Reading of Informational Texts in STEM (continued)

**Second Reading: What does it mean?**
Now that you have examined the charts carefully, what inferences can you make? How do you interpret what you see? In other words, what do these charts have to say about invasive species?

The first chart shows that once a species has invaded and established itself, it can no longer be eradicated, but rather must be controlled or contained. So, even though we think about getting rid of invasive species, this is not realistic once they have become established and reproduced. The second chart shows that the public generally does not know about an invasive species until it is too late to eradicate it. At that point, controlling it is the most likely outcome.

**Third Reading: How do you know?**
Explain the connection between the details you notice and your interpretation of these details. How might you use the details in the charts as textual evidence to support the ideas or inferences you have made?

The first chart indicates that it is not realistic to remove invasive species after a certain period of time. The evidence in the chart that supports this inference is the words “contain,” “control,” and “maintain.” These words make it clear that the invasive species is still there, but people are working to stop its further spread. Three of the five stages of biological invasion show only methods of mitigating the impact of the invasive species, while only two imply complete removal. In the second chart, the placement of the words “Public awareness typically begins” towards the top of the curve and in between the phrases “Eradication UNLIKELY, intense effort required” and “Local control and management ONLY,” shows that by the time people find out about the problem, eradication is no longer possible. The two charts together show that the five stages of biological invasion and methods of repair are connected to both the total area affected as well as cost.

**Writing Prompt:** Now that you have carefully examined the charts and come to conclusions about these visual texts, write a paragraph that makes a connection between the charts and the text in Activity 1. Be sure to:

- Write a topic sentence that connects the visuals to the informational text.
- Include textual details and explain how they support your connection.
- Write a conclusion that follows from your explanations.

Possible topic sentences:

- The visuals support the idea that High invasive plants have a strong negative impact on the ecology.
- The charts are representations of how plants that are classified as Limited can become problematic and hard to eradicate over time.
ACTIVITY 3
 Independent Practice

As you did with the first text, you will read this text at least three times, focusing on a different purpose for each reading.

Background Information: The following article from National Geographic News describes how bullfrogs are so successful at surviving, even in their non-native environments.

First Reading: First Impressions
Read the following passage silently. Your focus for the first reading is on understanding the meaning of the passage. Before you read, glance at the subheadings to get a sense of what information is covered. As you read, diffuse difficult vocabulary by replacing unfamiliar words with synonyms or definitions for the underlined words. Practice paraphrasing by stopping at the end of each paragraph and putting the ideas in your own words. Use subheadings to break the text into chunks. Use the definitions and synonyms in the margin to help your understanding.

INVADING BULLFROGS APPEAR NEARLY UNSTOPPABLE

From National Geographic News, by John Roach

1. The North American bullfrog population is booming. That may sound like good news, but it isn’t—not when the frog has leaped far beyond its native habitat.

2. "They are one of the most successful amphibians in the world, and they are causing trouble in several countries," said Cecil Schwalbe, a biologist with the U.S. Geological Survey at the University of Arizona in Tucson.

3. Native to North America east of the Rocky Mountains, bullfrogs are now found throughout the world. In many areas outside their native range, the frogs are outcompeting—and eating—just about everything in their path.

4. On wildlife refuges in Arizona where Schwalbe studies the amphibian, bullfrogs have nearly eliminated the Mexican garter snake and the Chiricahua leopard frog. Even during a recent trip to Japan, Schwalbe said he heard the frog’s familiar croak everywhere he went.
Frog Leap

According to biologists, bullfrogs began their leap around the world in 1898, when they were imported to California to satiate a consumer appetite for frog legs. Similar importations spread the croakers to Asia, Europe, and South America.

In their native habitat, predators such as large water snakes, alligators, and snapping turtles keep adult bullfrogs in check, while fish slurp tadpoles. But in western North America and other regions of the world, effective bullfrog predators are absent.

In the absence of predators, the bullfrogs' prolific nature allows them to flourish. “A bullfrog may lay, in a single clutch, 20,000 eggs. Our native [Arizona] frogs are laying 2,000 to 3,000,” Schwalbe said. “Bullfrogs have an order of magnitude advantage from the get-go.”

Bullfrog tadpoles are also less palatable to [Arizona’s] native and most non-native fish than the native tadpoles, according to Phil Rosen. A biologist at the University of Arizona, Rosen studies what insects and fish prey on bullfrog tadpoles.

“Some tadpoles are so successful that our [Arizona] ecosystem is completely overrun with small and large bullfrogs,” Rosen said. “Most native predatory fish will eat leopard frog tadpoles but not [the] bullfrogs.”

Studies of bullfrog intestines reveal the amphibians eat just about anything they can fit into their mouths: birds, rats, snakes, lizards, turtles, fish, other frogs, and especially each other. In southern Arizona the most common vertebrates found in bullfrogs are other bullfrogs, Schwalbe said.

Other frog species are also cannibalistic. But adult bullfrogs are acutely so, Schwalbe said. As long as tadpoles and young bullfrogs have enough algae and insects to eat, adult bullfrogs can subsist on the younger frogs. With such a reliable food source, the adult populations can grow well above what would normally be possible, putting additional pressure on the ecosystem.

Dennis Suhre is a graduate student who works with Schwalbe and Rosen at the University of Arizona. Suhre said this cannibalism, combined with competition for other food resources, gives younger bullfrogs incentive to leap far away from their hungry elders. And leap they do.

By marking and recapturing bullfrogs on and near the Buenos Aires National Wildlife Refuge in Arizona, Suhre has found that the young amphibians can move at least 6 miles (9.6 kilometers) in a few weeks.

To travel from one big pond to the next, the bullfrogs hop between small ponds interspersed throughout the arid landscape covered in grass and mesquite. “The wetter the year, the farther they will go,” Suhre said.
Bullfrog Control

Their lack of predators, prolific nature, and incentive to relocate make bullfrogs a difficult invasive species to eradicate. No single method has proved effective in eliminating them, according to Schwalbe.

Rotenone and other toxic chemicals can be applied to ponds to effectively kill fish and frog tadpoles. But bullfrogs have a simple defense to the tactic: They hop out of the water. Schwalbe also noted that such toxins kill indiscriminately and, thus, are a problematic approach for areas with endangered native species.

Researchers have had some success controlling bullfrogs at Buenos Aires National Wildlife Refuge, however. They have drained bullfrog-infested ponds during the dry season, killing bullfrog tadpoles and enabling researchers to capture and dispose of adult bullfrogs that attempt to escape.

The drained ponds fill back up when the monsoon rains arrive. Biologists can then reintroduce native leopard frogs.

The problem, Suhre said, is that the bullfrogs travel great distances. Unless eradication programs are done on a large enough scale to encompass whole landscapes, the bullfrogs return.

“All you need is two bullfrogs, a male and a female,” Suhre said. “A female lays about 20,000 eggs. … Once that happens, it’s very difficult to get the frogs out.”

Second Reading: Vocabulary in Context

Now that you have read the passage silently, listen and follow along as your teacher reads the passage aloud. As you read along with your teacher, circle words and/or phrases (other than the underlined words) that you do not know or that you feel are important to the meaning of the document. Using context clues and reference resources, determine the meaning of any new words you need to define. Diffuse these words/phrases for comprehension.

Check Your Understanding

1. Choose a section from the text and paraphrase it. Put the most important ideas from the section in your own words.

Possible response:
Frog Leap: Bullfrogs are successful at survival for many reasons. While having natural predators in their native environments, bullfrogs have few predators in non-native environments. Bullfrogs lay thousands of eggs, and their tadpoles do not taste good to fish and other animals in their non-native environments, so many tadpoles mature to adult bullfrogs. Bullfrogs eat pretty much anything, including younger bullfrogs, so they never are at a lack for food. In fear for their lives, younger bullfrogs often hop to nearby ponds. This allows the species to spread throughout an area.
ACTIVITY 3 (continued)

6 Review the directions for the vocabulary work and remind students of similar work they’ve done with the excerpts in Activity 1. You may provide students with an opportunity to share the summary sentences they wrote using the new vocabulary.

7 Third Reading: Review the directions for responding to the Key Ideas and Details questions to ensure that students understand questioning the text as a close-reading strategy. Monitor reading and annotation as students respond to the questions.

Differentiating Instruction

You may want to place students in pairs or small groups to collaboratively discuss and respond to the Key Ideas and Details questions if you think they are not quite ready for independent analysis and response.

Key Ideas and Details   Answers may vary. By using words like “booming” and “successful” the author shows a tone of admiration for bullfrogs, or possibly surprise at how successful they are as a species. The use of colloquial language and word play, such as “bullfrogs began their leap around the world” give the passage a tone of familiarity with both the subject and the audience. The author then goes on to discuss that the growth of bullfrog populations is a bad thing, not something about which readers should be pleased.

Key Ideas and Details   The author states that in Arizona the Mexican garter snake and the Chiricahua leopard frog have been nearly eliminated due to bullfrogs. He also states that he heard frogs croaking in Japan. He also uses direct quotations from scientific authorities as evidence to support his claims.

Close Reading of Informational Texts in STEM (continued)

2. Choose six words from the vocabulary that has been underlined, bolded, and/or you have circled in the passage. Paraphrase the definitions to show your understanding. Then choose two or three of the words you have examined that you think are significant to understanding the text and use those words in sentences as part of a summary explaining the central ideas in the text.

Possible choices:
- predators
- effective
- prolific nature
- flourish
- palatable
- cannibalistic
- subsist
- incentive

Bullfrogs flourish for several reasons: they are not palatable to many animals and they are cannibalistic, which gives younger bullfrogs an incentive to move to new areas, which helps spread the species.

Third Reading: Text-Dependent Questioning

Now read the passage again, this time reading to respond to the Key Ideas and Details text-based questions. As your class discusses the text, write your responses to each question and highlight or underline the textual evidence that supports your answer.

“Invading Bullfrogs Appear Nearly Unstoppable”
From National Geographic News, by John Roach

1 The North American bullfrog population is booming. That may sound like good news, but it isn’t—not when the frog has leaped far beyond its native habitat.

2 “They are one of the most successful amphibians in the world, and they are causing trouble in several countries,” said Cecil Schwalbe, a biologist with the U.S. Geological Survey at the University of Arizona in Tucson.

3 Native to North America east of the Rocky Mountains, bullfrogs are now found throughout the world. In many areas outside their native range, the frogs are outcompeting—and eating—just about everything in their path.

4 On wildlife refuges in Arizona where Schwalbe studies the amphibian, bullfrogs have nearly eliminated the Mexican garter snake and the Chiricahua leopard frog. Even during a recent trip to Japan, Schwalbe said he heard the frog’s familiar croak everywhere he went.
Frog Leap

5 According to biologists, bullfrogs began their leap around the world in 1898, when they were imported to California to satiate a consumer appetite for frog legs. Similar importations spread the croakers to Asia, Europe, and South America.

6 In their native habitat, predators such as large water snakes, alligators, and snapping turtles keep adult bullfrogs in check, while fish slurp tadpoles. But in western North America and other regions of the world, effective bullfrog predators are absent.

7 In the absence of predators, the bullfrogs’ prolific nature allows them to flourish. “A bullfrog may lay, in a single clutch, 20,000 eggs. Our native [Arizona] frogs are laying 2,000 to 3,000,” Schwalbe said. “Bullfrogs have an order of magnitude advantage from the get-go.”

8 Bullfrog tadpoles are also less palatable to [Arizona’s] native and most non-native fish than the native tadpoles, according to Phil Rosen. A biologist at the University of Arizona, Rosen studies what insects and fish prey on bullfrog tadpoles.

9 “The tadpoles are so successful that our [Arizona] ecosystem is completely overrun with small and large bullfrogs,” Rosen said. “Most native predatory fish will eat leopard frog tadpoles but not [the] bullfrogs.”

10 Studies of bullfrog intestines reveal the amphibians eat just about anything they can fit into their mouths: birds, rats, snakes, lizards, turtles, fish, other frogs, and especially each other. In southern Arizona the most common vertebrates found in bullfrogs are other bullfrogs, Schwalbe said.

11 Other frog species are also cannibalistic. But adult bullfrogs are acutely so, Schwalbe said. As long as tadpoles and young bullfrogs have enough algae and insects to eat, adult bullfrogs can subsist on the younger frogs. With such a reliable food source, the adult populations can grow well above what would normally be possible, putting additional pressure on the ecosystem.

12 Dennis Suhre is a graduate student who works with Schwalbe and Rosen at the University of Arizona. Suhre said this cannibalism, combined with competition for other food resources, gives younger bullfrogs incentive to leap far away from their hungry elders. And leap they do.

13 By marking and recapturing bullfrogs on and near the Buenos Aires National Wildlife Refuge in Arizona, Suhre has found that the young amphibians can move at least 6 miles (9.6 kilometers) in a few weeks.

14 To travel from one big pond to the next, the bullfrogs hop between small ponds interspersed throughout the arid landscape covered in grass and mesquite. "The wetter the year, the farther they will go," Suhre said.

Key Ideas and Details

In paragraph 3, the author states that bullfrogs are eating “just about everything in their path.” How does the author expand on this later in the text?

KEY IDEAS AND DETAILS

According to the author, what are the reasons biologists are draining ponds at Buenos Aires National Wildlife Refuge?

KEY IDEAS AND DETAILS

They are draining ponds so they can kill bullfrogs. Also, when the ponds fill back up, biologists reintroduce the native leopard frog. It is also implied that draining the ponds has very little impact on the ecosystem, as the author says “the drained ponds fill back up when the monsoon season arrives.” One can assume that the ponds drain and refill naturally as the seasons change.
**ACTIVITY 3 (continued)**

**Key Ideas and Details** The author uses subheadings to organize information. The section “Frog Leap” discusses the spread of bullfrogs. The section “Bullfrog Control” discusses what is being done to control bullfrogs.

The subheadings are helpful to the reader because they organize the information in the passage. They provide some chunking for the reader. The titles of the subheadings give readers a clue about the content of that section. When annotating, the reader can focus on the main idea of that section. Finally, the reader can stop at the end of each section and paraphrase the information to get the main ideas in the section.

**Check Your Understanding:** You may need to review the terms fact, reasoned judgement, and speculation with students in order for them to be successful in completing this question. Students may benefit from a class discussion or debate prior to putting their ideas in writing.

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**Close Reading of Informational Texts in STEM (continued)**

**Bullfrog Control**

- **15** Their lack of predators, prolific nature, and incentive to relocate make bullfrogs a difficult invasive species to eradicate. No single method has proved effective in eliminating them, according to Schwalbe.

- **16** Rotenone and other toxic chemicals can be applied to ponds to effectively kill fish and frog tadpoles. But bullfrogs have a simple defense to the tactic: They hop out of the water. Schwalbe also noted that such toxins kill indiscriminately and, thus, are a problematic approach for areas with endangered native species.

- **17** Researchers have had some success controlling bullfrogs at Buenos Aires National Wildlife Refuge, however. They have drained bullfrog-infested ponds during the dry season, killing bullfrog tadpoles and enabling researchers to capture and dispose of adult bullfrogs that attempt to escape.

- **18** The drained ponds fill back up when the monsoon rains arrive. Biologists can then reintroduce native leopard frogs.

- **19** The problem, Suhre said, is that the bullfrogs travel great distances. Unless eradication programs are done on a large enough scale to encompass whole landscapes, the bullfrogs return.

- **20** “All you need is two bullfrogs, a male and a female,” Suhre said. “A female lays about 20,000 eggs. … Once that happens, it’s very difficult to get the frogs out.”

**Check Your Understanding**

Analyze Dennis Suhre’s statement in paragraph 12, “…cannibalism, combined with competition for other food resources, gives younger bullfrogs incentive to leap far away from their hungry elders.” Is this statement a fact, a reasoned judgement based on research findings, or a speculation? How can you tell?

Suhre’s statement is reasoned judgement based on research findings. He is saying that several factors give young bullfrogs motivation to relocate. Since we don’t know for sure that these are the factors young bullfrogs consider, we cannot say it is a fact. However, after researching bullfrogs and knowing that older bullfrogs want to eat younger bullfrogs, it does not seem pure speculation to guess that young bullfrogs might leave to avoid getting eaten. Therefore, the statement is a reasoned judgement based on the research findings about bullfrogs’ behavior.
**Synthesizing Your Understanding**

Now that you have read the text three times and studied the vocabulary and ideas, synthesize your understanding by examining the elements of subject, purpose, and tone. Respond to the following questions as a way of bringing all your knowledge together.

What is the **subject** of the text—the general topic and main ideas? Be as specific as you can in identifying and summarizing the subject of each passage.

The text examines why bullfrogs are such a threatening invasive species. Their populations grow rapidly, they spread quickly, and they have few predators in their non-native environments. Once bullfrogs are in an area, it is very hard to remove them.

What is the **purpose** of the text? What is the reason behind the creation of this piece of writing? What do you suppose the writer wants the audience to think or do as a result of reading the text?

The text is written to provide information to the reader on the topic of the invasive species, bullfrogs. The author gives the reasons for bullfrogs’ success as a species.

What is the author’s attitude toward the subject? **Tone** describes the attitude of the author about the subject being discussed. Now that you have identified the subject and the purpose, explain how the tone is established.

While the author clearly understands the harm that bullfrogs cause in their non-native environments, he is also somewhat in awe of how successful the species is in terms of reproducing and taking over an area. Words like “successful” and “outcompeting” show that the author thinks bullfrogs are astounding or is surprised by their success in these new environments.

**Writing Prompt:** Now that you have studied John Roach’s article, “Invading Bullfrogs Appear Nearly Unstoppable,” write a response in which you make connections between all of the texts in this workshop. Be sure to:

- Write a topic sentence that identifies a common idea in the texts.
- Choose several pieces of appropriate textual evidence from multiple texts.
- Write an appropriate conclusion that ties the information together.

Possible Topic Sentences:

- The passages and the charts are all about invasive species.
- Identifying and stopping the spread of invasive species is important because they can be harmful to the ecology of an area.
- It is important to keep an eye on an invasive species, such as the North American bullfrog, to monitor its spread and the impact it is having on its new habitat.

**ASSESS**

Have students complete the writing prompt, which can be used as a formative assessment of each student’s ability to write a topic sentence, choose textual evidence, and explain its significance. Encourage students to use evidence from all three texts if possible.

**ADAPT**

For students who struggle with writing, you may choose to offer them the option of creating a presentation for the class. They should write pieces of textual evidence on notecards to be used during the presentation. Remind them that like an essay with a topic sentence, body, and conclusion, the presentation should have an opening, body, and conclusion.
ACTIVITY 4
Synthesis Questions

This activity is intended for whole class involvement. The assessments can be used for homework or in-class timed writings or multi-day presentations.

These prompts can be used as optional assessments to determine students’ skills in synthesizing texts from the entire close-reading workshop.

Each of these assessments builds on a unique skill: writing, debate/discussion, or using multimedia to present an idea or perspective. You can adjust these options to be individual or group assignments, allow students to choose, or assign specific prompts to individual students or to the whole class.

ASSESS

For the writing activity, assess by making sure students are using subheadings appropriately. Provide students with examples of scientific or other informational texts that use subheadings to study and emulate.

Reflection

Allow students time to reflect on both the topics and the close-reading strategies that best helped them learn to read and understand meaning in both written and visual texts.

Close Reading of Informational Texts in STEM (continued)

ACTIVITY 4
Synthesis Questions

Your teacher may choose, or ask you to choose, one of the following assessments to demonstrate your understanding of the texts you have read.

Writing Prompt: Revisit what you have learned about categorizing invasive species, the stages of biological invasion, and management strategies for invasive species. Consider how the authors use text features like subheading and labels to present information. Prepare a summary report on the topic of invasive species, using subheadings to organize information. Make sure to include supporting textual evidence from the articles you read and images you viewed. Be sure to consider your audience when writing.

Debate/Discussion: Conduct a Socratic Seminar. Work with a small group of students to revisit the texts in this unit and create two or three open-ended questions for each written and visual text. Remember that your open-ended questions should not have a “yes” or “no” answer, but should be questions that will encourage a rich discussion. With your questions and your annotated text in front of you, engage with your peers in a Socratic Seminar in which you share your questions and respond to the questions that other students have generated.

Multimedia Presentation: Choose an invasive species. It can be either a plant or an animal. Consider using the California Inventory of Invasive Plants if you choose a plant. Conduct research to investigate the history of the species in the non-native area, the impact the species is having, and what is being done to limit the harm the species is causing. How was the invasive species first introduced? When was the public informed of the situation? Does the timing of public awareness contribute to the level of impact the species has on the local ecology? Use a multimedia presentation tool to arrange and present your findings and data.

Reflection

Think about what you have learned from your close reading and analysis of the text passages you have read in this workshop.

1. Scientists must inform the public about scientific topics of concern. How can scientists organize their writing to make difficult topics more understandable to readers?

    Scientists, or writers of scientific texts, can use subheadings and other text features to organize their writing. Readers can use subheadings to chunk information. When annotating text, readers can focus on the main idea of each section and then paraphrase each section to get a summary of the main ideas of the entire article.

2. In this workshop, you have learned to make meaning of three different texts. How can you use what you have learned to help you as you encounter challenging texts in the future? What strategies helped you as a learner during this workshop? When and why would you use these strategies in the future?