Stone Soup: Invasive Species and Cartooning

Grade	Length	Subjects	Topics
8th–9th grade (but adaptable to 4th–12th grades)	Depending on the level and how teachers adapt this lesson, time ranges from 2–3 days to 2 weeks.	Science (life science, ecology); language arts; art	Invasive species

LEARNING OBJECTIVES

- Students will be able to develop and apply science, reading, and language arts processes to analyze a comic series.
- Students will be able to use cartooning to express science content.
- Students will be able to demonstrate writing skills in creating their own comic about a local invasive species.

INTRODUCTION

Through an engaging and humorous comic strip, students will learn about biology, ecology, how invasive species are special, and the importance of learning from one's actions. Renowned cartoonist and writer Jan Eliot devoted 16 episodes of her "Stone Soup" syndicated comic strip to the story of a young girl, Alix, who releases her pet crayfish, Pinchy, into a stream near her home. Later, through a school activity, Alix learns that her crayfish is considered nonnative—or invasive—and that there are unintended consequences of releasing an invasive species. Through reading the comic strip, students learn some of the biology and ecology of invasive species and discover how humans can be both the cause of and the solution to environmental problems. Using graphic organizers, students will describe what impacts invasive species can have on the environment. After learning about biology through the lens of invasive species, students will then expand their knowledge through a group discussion on how invasive species are spread, and then discuss the role of humans as causes of and possible solutions to problems. Finally, students will have a chance to demonstrate their knowledge of biology through invasive species and demonstrate writing skills and creativity by creating their own comic strips. An alternative assessment is available if creating a comic strip is not possible.

MATERIALS

- Copies of "Stone Soup" comics series by Jan Eliot (7/31–8/3/2013 and 9/4– 9/14/2013), separated into two groupings. They are attached to this lesson or you can view them here: www.gocomics.com/stone-soup/2013/07/31#.UyNtoV7B3dQ
- Copies of invasive species primers, guides, and resources, including videos, to build content knowledge on red swamp crayfish and invasive species (see additional resource list below)
- Slips of scrap paper
- Paper and coloring pencils
- Copies of student pages (available at http://seagrant.oregonstate.edu/invasive-species/toolkit)
- Optional: Index cards for drawing and organizing comic frames
- Graphic Organizer (see example here: www.eduplace.com/graphicorganizer/pdf/persuasion.pdf)
- Tape to hang graphic organizers

ENGAGE

1. Lead a brief group discussion:
   a) Who likes to read comics?
   b) What are some of the reasons people write comics?
2. Hand out slips of paper to table groups/individuals.
3. Have students take a minute to jot down 2–3 different comics they like to look at; collect.

4. Briefly share some of the choices collected, with student participation.

5. Discuss some commonalities of structure and content of comics (e.g., 1–8 panels, familiar, odd or endearing characters, irony, presenting and resolving a problem, etc.).

EXPLORE

1. Read the first set of four cartoons from "Stone Soup," using these questions to guide a whole-class discussion:

    a. How would you describe the relationship between Alix and her Grandmother? What is your evidence of their relationship?

    b. What are some possible solutions for the crawdad or crayfish in the tub?

    c. What is the main idea that is presented in this set of cartoons? What is your evidence that this is the main idea?

    d. In the last slide, the crayfish says, "Look out below! Invasive species in the house!" Talk with your classmates and discuss what you think this means.

2. Break into small groups. Explain that you are now going to develop expertise about a crayfish to better analyze the next set of comics. Each member of the team reviews one or more references, to gather information for creating a graphic organizer that explains the red swamp crayfish and why it is successful as an invasive species. A link to a selection of graphic organizers is in the resources section.

EXPLAIN

1. Do a gallery walk to view the graphic organizers.

2. As a group, brainstorm the key characteristics of crayfish that make them successful invasive species.

EXPAND

1. Distribute the second set of "Stone Soup" comics to small groups or individuals, and have the students read through the strips.

2. **Discussion questions:**

    a. *What is the main idea* of this set of comics?

   • What evidence do you have that supports that idea?

o In your own words, *state the author's point of view* about what happened. What evidence do you have to support this?

o *Identify some vocabulary words* you learned to understand the other words so you'd know what was being said. How were you able to clarify the meaning of those words?

o *Comparison:* How do the characters' roles change from the first set to the second set of comics?

o *Give an example* of an illustration that supports the text, emphasizing a point or making it easier to understand.

o *Explain:* What method did the students use to survey the population of crayfish? What did the students observe in the stream (e.g., find or not find)?

o *What are some examples of how the author uses humor* in talking about invasive species?

o *Prediction:* What do you think would happen if they left the crayfish named "Pinchy" in the stream instead of taking it back to school?

o *Explain:* Why does the teacher have the letters NOAA on her vest?

o Research: What crayfish (if any) are native to your region? Are these native crayfish still present in the community you live in? If not, why not? How would you find out? What crayfish native to the Pacific Northwest has become the dominant invasive crayfish in California? How did this crayfish arrive in California? What are some alternatives to releasing unwanted animals from your home or school into the wild?

o *Evaluation:* The cartoonist Jan Eliot contacted Oregon Sea Grant to check her facts before completing

these strips. Why was that important for her as an artist?

o *Summarize:* What are the main themes and lessons from the comic strip series? Who are the main characters and what are their roles? What did Alix and her grandmother learn? What did you learn and how would you share it with others?

o *Analysis:* If you had to change some of this set of strips, how would you revise it? Please explain why you would make that change.

o *Commentary:* Did you find it interesting to learn from a comic strip? Why or why not?

• Select one character from the strip and write a narrative of what happened in the comic from that character's point of view. Include the overall theme of the comic in your writing. You can use the background information from your research to add details that weren't included in the comic.

EVALUATE

OPTION 1: Comic Challenge!

Create a comic that tells the story of the threat of an invasive species.

1. You can use the student hand out created for this lesson to help guide your students.

2. Students can use any species that is currently known to be invasive where you live, and *create a comic* that shows the threat of this invasive species to the local ecosystem(s).

3. Use the Comic Strip Organizer provided in this lesson. It will help to integrate four key elements: (1) Setting the Stage, (2) Problem, (3) Resolving the Problem, and (4) Looking Forward.

4. *Components* students need to include in their comic are
   • a title slide that includes the writer/artist
   • both the common and the scientific name of the species
   • the method of transport into the local ecosystem—vector(s)
   • the location(s) where the species has been found
   • the characteristics that make it successful as an invasive species
   • the problems the species causes by invading the area

• identify whether anyone is involved in solving this problem, and actions they are taking to prevent or control invasives

5. *Vocabulary*/terms students might want to include:
   • Habitat
   • Invasive
   • Introduced
   • Competition
   • Biodiversity
   • Adaptation
   • Vectors
   • Predators
   • Reproduce
   • Ecosystem
   • Prevention
   • Early Detection and Rapid Response
   • Management

6. Tell students to *develop your characters well,* and have your work edited before turning the final comic in; *show your work* to at least one other person for a critique and suggestions.

7. Students can include *research citations* on a separate page.

8. Specify the **Artistic Comic Format** you would like students to follow: For example, you can ask students to plan spacing carefully. The text in the cartoon has to fit into a word bubble on the top of each frame, be legible, and not touch the drawings. In addition, the main character should be drawn consistently in each frame.

9. Teacher can use the scoring guide for 8th-grade level, attached at the end of this lesson.

In some cases it is not feasible to ask your students to create a comic strip. Feel free to use these questions as an alternative assessment to developing the comic strip.

1. The character Alix (a young girl and "budding" scientist) in the comic strip "Stone Soup" brought home a crayfish ("crawdad"), which she named "Pinchy," from a field trip far away from her home. Pick the **most environmentally risky behavior** that describes what's happening in this comic strip:

   a) She removed a wild animal from a stream, far away from its home, for a pet.

   b) She needed to use her bathtub to make a new home for Pinchy.

   c) She took food away from a hungry raccoon.

   d) She could raise Pinchy's babies herself and return them to the wild.

2. Keeping a crawdad in their bathtub created many problems, so Alix and her Grandma released Pinchy the Crawdad into a convenient creek in a park near their home. This is a **problem for that habitat** because (circle one answer):

   a) the crawdad would not be able to find others of its own species to socialize with

   b) predators might eat the crawdad before it can reproduce

   c) the native crawdads in the stream might not be able to compete with Pinchy and her babies for food and habitat space (note: Pinchy comes from a stream that is far away)

   d) the crawdad Alix found is the same as the native ones, and there will be one too many of the same species in the stream

3. *Procambarus clarkii* (the red swamp crayfish, native to Louisiana) is an invasive species in other parts of the United States. It displaces other crawdad populations. The underlined word here **means** (pick one answer):

   a) transmits   *c) takes the place of*

   b) takes in   d) irritates or annoys

4. What is **NOT** one reason why Ms. Erma says, "Alix, the #1 rule of a biologist is never move something from one habitat to another"? (Choose one answer.)

   a) Moving species from one habitat to another may kill them.

   b) Organisms could become invasive if there are too many of them and they are "too successful" in a foreign environment.

   c) Moving organisms around will affect the food-web relationships; they "belong" where they were born.

   d) Organisms that are released back into the wild will always adapt to survive, benefiting their environment.

5. Sometimes comic artists use small details in their panels to help emphasize the ideas in their stories. Why would cartoonist Jan Eliot's character Ms. Erma wear a vest with the letters **NOAA**? (Choose one.)

   a) The National Oceanic & Atmospheric Administration, a federal government agency, educates the public about oceans, lakes, rivers, and everything that affects them.

   b) Both NOAA and comics can be useful in educating the public about important ideas.

   c) NOAA runs programs that protect fragile coastal ecosystems from harm by invasive species.

   d) All of the above.

6. The most-effective and least-ecologically disruptive way to keep invaders like Pinchy and her species from taking over local ecosystems in which they are not native is by (circle ONE):

   a) reducing the number of classroom and household pets that are released into the environment

   b) mechanically removing them (by hand) from streams, lakes, and rivers

   c) going door-to-door and asking for owners to give up their pets

   d) poisoning the water to kill off the invaders

7. When Jan Eliot shows Pinchy thinking human thoughts, what literary device is she using to keep the reader amused and interested? (Choose one best answer.)

   a) oxymoron   *b) personification*

   c) alliteration   d) onomatopoeia

8. Science teachers sometimes use invasive species in their classrooms to teach students about biology, ecology, and related sciences. But then they have to de-

cide what to do with them after the lesson or school year. What are some options that teachers have for live crayfish that are no longer needed in classrooms? What does the teacher Ms. Erma in "Stone Soup" decide to do with the crawdad and her babies?

a) Give them to a responsible pet owner that won't release them.

b) Consult a veterinarian on humane ways to euthanize them.

c) Give them to another teacher to study.

d) Eat the crawdads.

e) All of the above

9. The crayfish in the story was not native and was invasive in the environment where it was released, but not all alien species become invasive. What characteristics (adaptations) could allow nonnative species to successfully invade a habitat?

a) Have many offspring each time they reproduce, be able to live in a wide range of temperatures, eat only one type of food, have many predators

b) Reproduce often, live in a narrow range of temperatures, eat many types of food, have no predators

c) Have only a few offspring at a time—and rarely, live in a wide temperature range, eat one type of food, have many predators

d) Have many offspring at a time—and often, be able to live in a wide range of temperatures and habitat conditions, be able to eat all types of food, have no predators

10. Invasive species have the ability to significantly alter the __*biodiversity*___ of ecosystems by reducing the number of species that can live in the affected environment.

SYNTHESIS (CC Reading Standards for Literacy in Science & Technical Subjects 6–8.2):

1. (a) What are some main ideas that "Stone Soup" artist and author Jan Eliot wants you to consider in the comic series from this lesson? State two possible choices for main ideas, and explain these by coming up with at least two specific examples for each from the comic series shown here. (b) If Pinchy had been left to survive in the water where she was released, would that have changed either of the main ideas you chose? Why or why not?

a) Answers will vary; main ideas include: "It's a good idea to be able to identify species you find so you can deal with them properly." "It's not a good idea to remove wild animals from their homes." "People / teachers should not release living organisms into their local habitats." "Invasive species are changing ecosystems in a bad way." "One invader might not be an issue, but many at once could be." The supporting facts for these are found throughout the series.

b) Again, answers will vary. Students may not change their opinions, regardless of the effect of location of one animal. Pinchy turned out to be a pregnant female, and this may affect their choices for ideas. Also, students might be thinking about how many organisms are released by people that are never found, and how this might have a greater effect on local ecosystems.

EVALUATE (CC Reading Standards for Integration of Knowledge & Ideas 8.7):

2. The printed medium of a comic strip is one way to bring a message to public attention, and there are many other methods. Choose one other from the following list:

• Website
• Blog
• Audiobook
• TV commercial
• Children's play
• Radio commercial

a) State at least three advantages and three disadvantages in using these two methods (comic plus other) to bring a message about invasive species to the public. Consider type of audience, numbers of people reached over time, cost, and any other issues you think are important.

b) Think about how effective the message would be if you shared in different ways; if you had to spend government or private money on only one of these two methods, which one would you choose and WHY?

(a) Student answers will vary; a lot of the advantages and disadvantages depend on design, formatting, timing, venue, audience, marketing, etc. Students generally have a bias toward digital media, but this might not be the comparison to the comic. Also, comics are published online as well as in printed newspapers.

(b) Some students may look to spend the least amount of money, and some the most. The "effectiveness" of public information sharing can be subjective, or objective if you can measure outcomes. To present a clear argument for or against a different method, students should tie their choice to a positive outcome of some kind.

EXTENSION

1. Identify other media used to communicate invasive species messages.

2. Investigate the different skills needed to create a comic strip (writer, researcher, artist, inker, printer, publisher, etc.).

3. Research and clarify your own ideas about artists having a role in addressing problems in our environment or society.

ADDITIONAL RESOURCES

1. Comics and crayfish. http://blogs.oregonstate.edu/wise/2013/09/03/comics-and-crayfish/

2. Invasion of the shelter snatchers: behavioural plasticity in invasive red swamp crayfish, *Procambarus clarkii*. http://onlinelibrary.wiley.com/doi/10.1111/fwb.12002/abstract

3. Classroom Culprits: Invasive Crayfish Threaten Western Waterways. PBS/Oregon Public Broadcasting www.pbs.org/newshour/bb/science/jan-june11/pledge_03-10.html

4. Crayfish ID Guide. http://seagrant.oregonstate.edu/sgpubs/e-11-013

5. Louisiana crawfish released in wild from classrooms across the nation. www.nola.com/environment/index.ssf/2012/08/louisiana_crawfish_released_in.html

6. Louisiana crawfish wreaking havoc around the world. www.dailycomet.com/article/20120818/articles/120819625

7. Invasive species could be transmitted by school teachers releasing critters into the wild. www.oregonlive.com/environment/index.ssf/2012/08/invasive_species_could_be_tran.html

8. UW professor leading efforts to eliminate invasive crayfish. http://sammamishreview.com/2013/03/06/uw-professor-leading-effort-to-eliminate-invasive-crayfish-in-pine-lake

9. Crayfish turf wars of the Pacific Northwest. http://earthfix.kuow.org/flora-and-fauna/article/crawfish-turfwars-of-the-northwest/

10. Our crayfish are better than yours. http://blogs.seattletimes.com/allyoucaneat/2013/06/13/our-crayfish-are-better-than-yours/

11. The state of crayfish in the Pacific Northwest. www.invasivespecies.wa.gov/documents/Fisheries_2011a_Cray.pdf

12. Fighting the Bay Area Invasion of Signal Crayfish, by Joe Eaton, special to *The Planet*. www.berkeleydailyplanet.com/issue/2005-05-17/article/21428

13. Understanding the invasion ecology of invasive crayfish in California. www.csgc.ucsd.edu/BOOKSTORE/documents/Kats-Lafferty.pdf

14. The "Nab the Aquatic Invader" website contains learning resources and tools developed for teachers to incorporate invasive species learning into lesson plans. The website also includes a poster with "Don't Let it Loose" information and an "Adoption Pledge for Classroom Pets." www.iisgcp.org/NabInvader/Atlantic/admin/classroom.html

Cartoon Generators:

15. Beliefs Comics includes tips, ideas, and additional curriculum for teachers: www.makebeliefscomix.com/Comix/

16. Read Write Think offers an easy platform for quick comic making: www.readwritethink.org/files/resources/interactives/comic/

17. Make comic strips in seconds with this easy-to-use resource: http://cambridgeenglishonline.com/Cartoon_Maker/

Graphic Organizers:

www.eduplace.com/graphicorganizer/pdf/persuasion.pdf

STONE SOUP BY JAN ELIOT (7/31-8/3/13)

GRAMMA, GUESS WHAT? OUR SCIENCE TEACHER IS TAKING US ON A FIELD TRIP TO THE PARK.

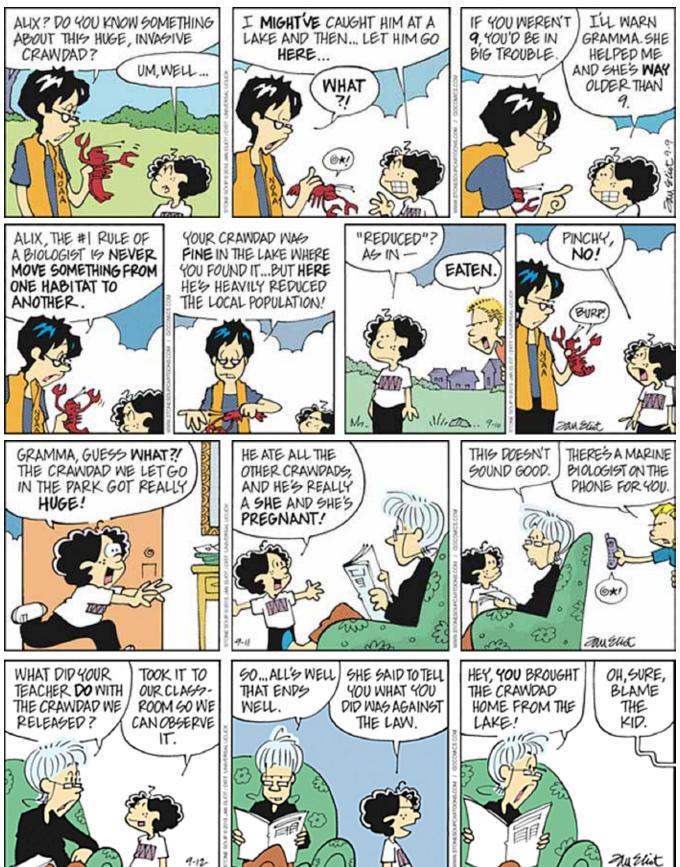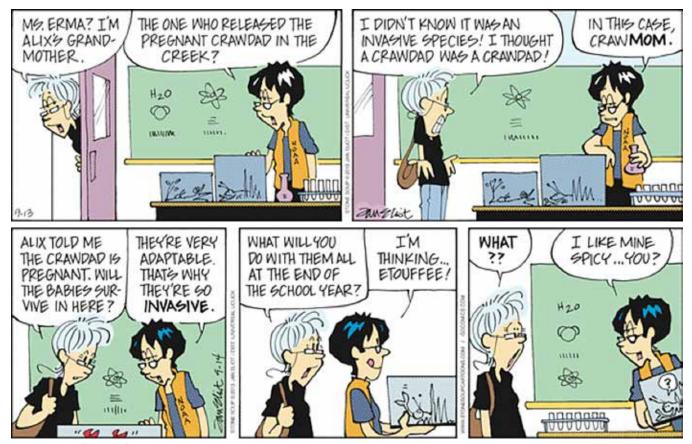WE'RE GOING TO STUDY CRAWDADS.

MAYBE I'LL SEE **MY** CRAWDAD!

THAT BIG ONE YOU BROUGHT HOME FROM THE LAKE AND THEN RELEASED IN THE CREEK? I WONDER HOW HE'S DOING?

YUM. THOSE LITTLE GUYS LOOK **TASTY.**

CLASS, EVERY YEAR I BRING STUDENTS HERE TO COUNT CRAWDADS.

WE'VE FOUND THAT THE NUMBERS CHANGE BASED ON WEATHER AND THE PRESENCE OF PREDATORS.

EVERYONE FAN OUT, AND LEAVE NO STONE UNTURNED!

I HATE FIELD TRIPS.

MS. ERMA? WE CAN'T FIND ANY CRAWDADS AT ALL!

REALLY? LAST YEAR WE COUNTED **57**!

YOU MUST NOT BE LOOKING IN THE RIGHT PLACES. LET'S MOVE THIS BIG ROCK.

HEL-LO!

PINCHY!

YOU NAMED IT ALREADY? NO FAIR!

THIS IS **STRANGE**... THIS CRAWDAD ISN'T NATIVE TO THIS AREA.

PROCAMBARUS CLARKII IS **INVASIVE!** IT DISPLACES OTHER CRAWDAD POPULATIONS.

★!!@

HOW DID IT GET **HERE?**

I PLEAD THE FIFTH.

ASK HER.

COMIC PROJECT SCORING GUIDE

KEY: 6 = Exemplary, Meets, 5 = Excellent, Meets, 4 = Very Good, Meets, 3 = Good, Almost Meets,
2 = Developing, Does Not Meet, 1 = Poorly Developed, Does Not Meet, 0 = Not Submitted

Score	CC Content Standards	Creative Standards (optional)
5/6	Used art and narrative to develop imagined events using effective or highly effective technique, relevant descriptive detail, and well-structured event sequences that evaluate the impacts of human activities on the environment and biodiversity, including ALL elements as listed at bottom of scoring guide.	• Artistic comic format (teacher defined) completely followed, with extra design elements and/or exemplary technical skill • Content requirements complete • Panels completed (and possible extra) • Storyline makes a good argument~Storyline comes to a natural conclusion that includes (sophisticated) humor • Main characters well developed and all connected with action of story, as well as minor characters
4	Used art and narrative to develop imagined events using mostly effective technique, some relevant descriptive detail, and event sequences that evaluate an impact of human activities on the environment and biodiversity, including ALL elements as listed at bottom of scoring guide.	• Artistic comic format (teacher defined) completely followed • Panels completed • Storyline made sense • Story comes to a natural conclusion, and may include humor • Main characters developed in association with action of story, possibly some minor characters
3	Used art and narrative to develop imagined events using some effective technique, a few relevant descriptive details, and event sequences that evaluate an impact of human activities on the environment and biodiversity, including some or all elements as listed at bottom of scoring guide.	• Artistic comic format (teacher defined) mostly or completely followed • Panels mostly or totally completed • Storyline mostly makes sense • Story comes to a natural conclusion • Main characters mostly connected with action of story
1/2	Use art and narrative to begin to develop imagined events using somewhat or non-effective technique, few to very few relevant descriptive details, and event sequences that evaluate an impact of human activities on the environment and biodiversity, including a few or some elements as listed at bottom of scoring guide.	• Artistic comic format (teacher defined) not or mostly not followed • Panels not completed • Storyline somewhat or mostly confusing • Panels' storyline does not come to a natural conclusion • Difficult to identify relationship of main characters to action of story
0	Not Submitted	Not Submitted

Criteria: Invasive Species Content Elements for Completion of Project

NOTE: Teacher must determine how many of the elements listed must be shown by student(s) to achieve specific grade levels 1 through 3. Grade levels 4 through 6 should include all elements.

1) Known, local invasive species that poses a threat to local ecosystem
2) Scientific & common names of invasive *(continued next page)*

3) Local habitat in which found
4) Characteristics that make species successful
5) Problems caused in local habitat
6) Identity of those trying to solve problems caused by this invader, and the actions they took

COMMON CORE STANDARDS—COMIC

READING STANDARDS FOR INFORMATIONAL TEXT

Key Ideas and Details

6th grade
2. Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

7th grade
2. Determine a theme or central idea of a text and analyze its development over the course of the text; provide an objective summary of the text.

8th grade
2. Determine a theme or central idea of a text and analyze its development over the course of the text, including its relationship to the characters, setting, and plot; provide an objective summary of the text.

9th–10th grade
2. Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.

11th–12th grade
2. Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

5. Analyze how an author's choices concerning how to structure specific parts of a text (e.g., the choice of where to begin or end a story, the choice to provide a comedic or tragic resolution) contribute to its overall structure and meaning as well as its aesthetic impact.

Craft and Structure

4th grade
5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

5th grade
6. Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent.

6th grade
6. Explain how an author develops the point of view of the narrator or speaker in a text.

7th grade
6. Analyze how an author develops and contrasts the points of view of different characters or narrators in a text.

8th grade
6. Analyze how differences in the points of view of the characters and the audience or reader (e.g., created through the use of dramatic irony) create such effects as suspense or humor.

Reading Standards for Informational Text

6th grade
6. Determine an author's point of view or purpose in a text and explain how it is conveyed in the text.

7th grade
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to the development of the ideas.
6. Determine an author's point of view or purpose in a text and analyze how the author distin¬guishes his or her position from that of others.

8th grade
1. Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
6. Determine an author's point of view or purpose in a text and analyze how the author acknowledges and responds to conflicting evidence or viewpoints.

Integration of Knowledge and Ideas

4th grade

7. Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

5th grade

9. Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

6th grade

7. 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.

8th grade

7. Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea.

WRITING STANDARDS

Text Types and Purpose

4th–5th grades

3. Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally.

b. Use dialogue and description to develop experiences and events or show the responses of characters to situations.

e. Provide a conclusion that follows from the narrated experiences or events.

6th–8th grades

3. Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

a. Engage and orient the reader by establishing a context and point of view and introducing a narrator and/or characters; organize an event sequence that unfolds naturally and logically.

b. Use narrative techniques, such as dialogue, pacing, and description, to develop experiences, events, and/or characters.

e. Provide a conclusion that follows from and reflects on the narrated experiences or events.

9th–12th grades

3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

a. Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

c. Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).

e. Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

4th–5th grades

5. With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of language standards 1–3 up to and including grade 4–5.)

6th–8th grades

5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 6–8.)

9th–12th grades

5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most sig-

nificant for a specific purpose and audience. (Editing conventions should demonstrate command of language standards 1–3 up to and including grades 9–12.)

Research to Build Knowledge

4th–5th grade

7. Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

6th–8th grades

7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

9th–12th grades

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

SPEAKING AND LISTENING SKILLS

4th grade

2. Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

5th grade

2. Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS

Key Ideas and Details

6th–8th grades

2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

9th–10th grades

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

NEXT GENERATION SCIENCE STANDARDS

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.