Dive In!: Human Impacts on Watersheds

Grade: 6-8, 9-12	Implementation Practice: Obtaining, Evaluating, and Communicating Information
Subject Area: Earth Science	Estimated Duration: Two 45-minute class periods with one 30-minute homework
Learning Objective Students will be able to: - **design** a comic strip that illustrates the watershed concept and gives specific examples of human impacts to watersheds	

Standards Supported

NGSS	Performance Expectations **MS-ESS3-4**. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.		
	Disciplinary Core Idea(s)	Science and Engineering Practices	Crosscutting Concept(s)
	● ESS3.C: Human Impacts on Earth Systems	● Engaging in Argument from Evidence ● Constructing Explanations and Designing Solutions	● Cause and Effect ● Influence of Science, Engineering, and Technology on Society and the Natural World

Note to Instructors Regarding Use of Technology

This learning experience guides students to demonstrate their knowledge of human impacts on watersheds by using Google slides to create a narrative comic. If you are not familiar with using Google Slides, there are many useful tutorials online. In addition, many aspects of Google Slides are intuitive, especially to students. Google Slides was chosen for use in this project because it is free and facilitates work between students (if you were to choose to complete this learning experience in small groups) and between students and the instructor. It is also easy to publish and display student work using Google Slides. However, other tools exist including online comic generators built specifically for student produced comics. In addition, a student could choose to draw her/his/their comic by hand.

Materials Needed
- Internet enabled devices with keyboard
- Dive In! Student Sheet

Suggested Implementation Timeline
Have students complete the Engage, Explore, and Explain portions in the first class period. If time permits, have them begin work on the Elaborate. Students should work on the Elaborate at home by planning out their comic. Specifically, they should be able to explain the characters and narrative. They should also view an online tutorial on how to use Google slides to make a comic.

On the second day of class, give students 25 minutes to design their comic and spend the remaining time viewing and commenting on peer work. It is suggested that each student view and provide feedback on at least two other comics. Some students will want to spend a long period of time designing their comic; it has been our experience that some students get really into this task. Make students aware of the time constraint upfront, or adjust as you see fit. Reinforce that the goal of this learning experience is not to become an expert in Google slides or comic design, but to apply their scientific knowledge in a creative and novel way. OFE would love to see what your student design. Please feel free to send student work to info@oceanfirsteducation.blue.

Instructor Notes

When students are using Google slides to design their comic, consider the following tips:

- Use images in PNG format because they have transparency. For example, the clipart of the alligator below has transparency and allows the viewer to see the background.
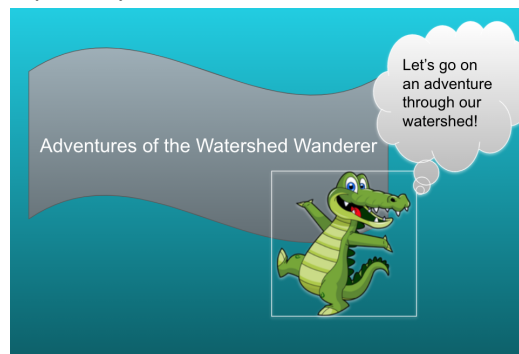
- Setting the slide transition "slide from right" mimics how the eyes move when reading a comic.
- "Inset" → "Shape" → "Callouts" is an easy way to insert speech bubbles.
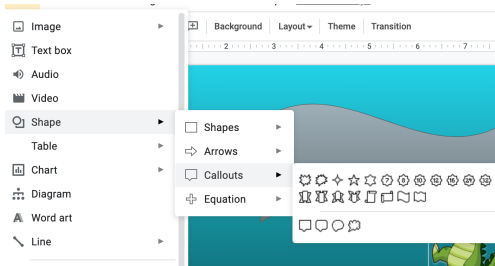
- Animations allow different aspects of the panel to appear at different times.

Teacher Background Information

What is the Everglades watershed?
A watershed is a defined area of land where precipitation and runoff, water from various sources that don't infiltrate the ground, are channeled to a stream or river. Watersheds can be various sizes. Some inland watersheds span thousands of square miles and may contain streams, rivers, lakes, reservoirs, and the underlying groundwater.

Southeast Florida lies within the Kissimmee, Okeechobee, Everglades (KOE) watershed. It begins around Orlando in the areas that drain into the Kissimmee River which feeds directly into Lake Okeechobee. Historically, water flowed slowly from Lake Okeechobee and spread across the Everglades. As the water flowed south to Florida Bay, the flat terrain of the KOE watershed allowed

water filtration by wetlands and recharging of the Biscayne Aquifer, the drinking water source of one in three Floridians.

As early as the 1880's plans were in place for large-scale draining of the wetlands so that the land could be developed for residential and agricultural use. Enormous infrastructure projects have been undertaken in order to control and divert the flow of water from Lake Okeechobee through the southern Everglades. The 20th century saw the construction of a dike to regulate the flow of water both into and out of the lake. Currently, the dike almost completely encloses Lake Okeechobee. In addition, hundreds of miles of canals were built to divert water from its natural flow pattern to serve the interests and needs of humans. In addition, highways were built through the Everglades, further blocking the life-sustaining flow of water. As a result, freshwater flow into Florida Bay is less than 50% of pre-diversion levels.

How do humans impact watershed health?
As the water moves through the watershed, it often picks up pollutants, which may have negative effects on the water quality. Runoff carrying nutrients and chemicals from the use of fertilizers and pesticides in agricultural and landscaped areas can stimulate algal growth, which limits the amount of oxygen in the water and results in the die-off of fish and other organisms. Urban development results in extensive areas of impervious surfaces that prevent water from seeping into the ground. Instead, the stormwater runs off into man-made drainage systems which flow directly into bodies of water bypassing the natural filtration provided by wetlands. Untreated stormwater introduces nutrient pollution, metals, motor oil, bacteria, fertilizers, pesticides, and sediment into bodies of water. Runoff even introduces trash into waterways. Ultimately, all watersheds drain to the ocean. As a result, all of these potentially harmful substances that are picked up as water moves through the watershed eventually find their way to the ocean, having serious consequences for ocean health. The Everglades watershed drains to both the Biscayne and Florida Bays. Higher salinity due to decreased flow combined with nutrient pollution, high concentrations of nitrogen and phosphorus in runoff carrying agricultural fertilizers, have caused massive seagrass die-offs, deadly red tides, and decreased coral health.

The ways we care for our watershed, even if we live thousands of miles away from the ocean, can make a huge difference. People can try to use water more efficiently and plan ways to reuse water. People can educate themselves on how to dispose of household waste properly. Proper waste disposal and recycling keeps pollution out of local waterways. People can evaluate ways to reduce runoff from their homes and consider using permeable surfaces that allow precipitation to soak into the ground. One way is to position rain gutters so that they drain to the yard, not the street. Lastly, people can choose to use fertilizers and pesticides sparingly or choose ways of enriching soil and controlling pests that don't result in potentially harmful substances entering local waterways.

Dive In!: Human Impacts on Watersheds
Rubric

Name:

Glows: Student meets or exceeds performance standard	Performance Standard	Grows: Improvement needed in order to meet performance standard
	- Student can explain the concept of a watershed.	
	- Student can explain how human activities negatively impact watersheds.	
	- Student can explain how people can reduce their impact on watersheds.	
	- Student's comic clearly communicates human impacts on watersheds to an elementary-age audience.	
	- Student's comic has a title panel and at least five narrative panels.	
	- Student's panels each have an engaging visual element and text.	
	- Student's comic includes two characters.	
	- Student's comic makes use of animations and transitions.	
	- Student can give constructive feedback to others about their comics	

Comments:

Dive In! Student Sheet

Guiding Expectations

In this learning experience, you will demonstrate your knowledge of human impacts on watersheds by designing a comic strip for elementary aged students. Comics are powerful tools in science communication, capitalizing on people's natural interest in illustrated stories. Your comic will be shared with your peers. Your peers will provide feedback on your comic and you will provide feedback to your peers.

Engage

Examine the image below of litter in a wetland. Be prepared to discuss the questions below with a partner and then the whole group.

1. How do you think the litter ended up in the stream?
2. Other than litter, what are some other potentially harmful things that could end up in bodies of water?
3. How do you think litter and other pollutants affect the environment and organisms?

Explore

1. Work with a partner to come up with a working definition for each of the following terms: **watershed**, **wetland**, **runoff**, **stormwater**, **nutrient pollution**. A working definition is one that will change as your knowledge develops. Record your definitions in the table included on the next page.

2. Join up with another partnership and discuss your working definitions. Revise your definitions as necessary.

3. Perform an Internet search for the definitions of each of these terms. Revise your definitions again as needed. Be prepared to ask your instructor any clarifying questions you have about these terms.

Term	Working Definitions
Watershed	
Wetland	
Runoff	
Stormwater	
Nutrient pollution	

Explain

1. Read the text below about the Everglades watershed. Then, write a three sentence summary about what you learned in the space provided.

What is the Everglades watershed?

A watershed is a defined area of land from which precipitation and runoff, water from various sources that don't infiltrate the ground, are channeled to a stream or river. Watersheds can be various sizes. Some inland watersheds span thousands of square miles and may contain streams, rivers, lakes, reservoirs, and the underlying groundwater.

Southeast Florida lies within the Kissimmee, Okeechobee, Everglades (KOE) watershed. It begins around Orlando in the areas that drain into the Kissimmee River which feeds directly into Lake Okeechobee. Historically, water flowed slowly from Lake Okeechobee and spread across the Everglades. As the water flowed south to Florida Bay, the flat terrain of the KOE watershed allowed water filtration by wetlands and recharging of the Biscayne Aquifer, the drinking water source of one in three Floridians.

As early as the 1880's plans were in place for large-scale draining of the wetlands so that the land could be developed for residential and agricultural use. Enormous infrastructure projects have been undertaken in order to control and divert the flow of water from Lake Okeechobee through the southern Everglades. The 20th century saw the construction of a dike to regulate the flow of water both into and out of the lake. Currently, the dike almost completely encloses Lake Okeechobee. Furthermore, hundreds of miles of canals were built to divert water from its natural flow pattern to serve the interests and needs of humans. In addition, highways were built through the Everglades, further blocking the life-sustaining flow of water. As a result, freshwater flow into Florida Bay is less than 50% of pre-diversion levels.

Three Sentence Summary

2. The Everglades watershed has been severely negatively impacted by human activities. Fortunately, people have recently begun to insist that steps be taken to protect the watershed. Use the Internet to investigate how humans can both negatively and positively impact watersheds. Make sure your sources are credible and cite them by including the name of the website and the URL. Record your research in a table like the one below. You may choose to copy this table into another document. Write information in your own words; do not copy/paste from the source.

Human Impacts on Watersheds Research	
Explain at least three ways human activities negatively impact watersheds.	
Explain at least three ways humans can reduce their negative impact on watersheds.	

Explain how reduced water flow and water quality in the Everglades watershed affect Florida and Biscayne Bays.	
Questions for my instructor.	
Citations	

Elaborate

Use your knowledge of human impacts on watersheds to design a comic strip that teaches elementary aged students about this important topic. Your comic should illustrate at least one way humans negatively impact watersheds and one way they can help protect watershed health.

Your comic must include a narrative with at least two characters and be at least five panels, not including a title panel. A panel is an illustration depicting a frozen moment. Each panel should have an engaging visual element and text. In addition, each panel should make use of animations and there should be a transition between each slide.

It is recommended that you use Google slides to produce your comic. In this case, each slide represents one panel. However, upon discussion with your instructor, you may choose to design your comic by hand or using some other program. Keep in mind that your comic will need to be able to be displayed when choosing how to create it.

There are many useful tutorials available online for how to use Google slides to animate comics.

Evaluate

1. Display your comic either as a printed or digital version. If you used Google slides to design your comic, click "File" → "Publish to the web". The dialogue box below will appear:

Make sure to click "Start slideshow as soon as the player loads" and "Restart the slideshow after the last slide".

2. Participate in the "gallery walk" as directed by your instructor. Be prepared to provide feedback on each comic you view. Use the feedback table below to guide you. Use a different table for each comic you view.

Comic Feedback	
Something I like	
A suggestion	

3. Complete the Self Reflection on the next page.

Dive In! Self Reflection

Glows: Things I can do well	Standard	Grows: Things that I need to improve
	I can explain the concept of a watershed.	
	I can explain how human activities negatively impact watersheds.	
	I can explain how people can reduce their impact on watersheds.	
	My comic clearly communicates human impacts on watersheds to an elementary-age audience.	
	My comic has a title panel and at least five narrative panels.	
	My panels each have an engaging visual element and text.	
	My comic includes two characters.	
	My comic makes use of animations and transitions.	

My favorite part of the Dive In! was…

The most important thing I learned is…

Something I'd like to know more about is...