

Fostering Environmental Stewardship: The Great Barrier Reef Storypath

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Concerns about environmental sustainability are constantly in the news as global warming, fossil fuels, and pollutants increasingly endanger habitats worldwide. What once were uncommon extreme environmental events have become commonplace—unseasonal intense heat, year-round drought, raging wildfires, rising sea levels, severe storms, massive flooding, toxins poisoning the atmosphere, plastic waste choking oceans, and oil leaks endangering ecosystems. Although young children don't fully understand the complexities or implications of such crises, they generally are aware that the environment is at risk. To capitalize on this awareness and concern, teachers can intentionally design issue-oriented experiential lessons or units of study which make content about environmental sustainability accessible while also cultivating dispositions for civic responsibility, agency, and action to restore and care for the earth. Children at early ages can grapple with developmentally appropriate issues to establish a foundation for becoming active global citizens living as agents of change. In this article, we describe the Great Barrier Reef Storypath unit that develops knowledge about ocean ecosystems, dispositions for personal stewardship, and skills to participate in protecting and sustaining the environment.

Storypath

The C3 Framework¹ provides guidance for organizing and delivering social studies instruction that equips learners with knowledge, skills, and dispositions to meaningfully participate in democratic decision making and civic life. The Storypath approach to instruction embodies many of the standards articulated in the C3 Framework and, when implemented in elementary school classrooms, enables young learners to practice democratic decision making while grappling with content-specific issues. In particular, the Great Barrier Reef Storypath² unit enables young learners to explore and problem solve the impact of pollution on the reef. This integrated curriculum employs literacy skills (reading, writing, speaking, and listening), cooperative group work (including perspec-

tive taking), and science investigations (constructing visual representations of the reef and sea creatures and examining the impact of an oil spill) to mirror real-world activities of marine scientists and civic action critical to environmental stewardship.

Storypath embodies the constructionist theory of narrative comprehension.³ This theory suggests that information organized in a narrative format—setting, characters, and plot—enhances memory as people contextualize content through inferences and develop emotional connections to events. Storypath, however, is more than simply telling a story. Children actually experience the story by becoming characters in the setting—in this case, the Great Barrier Reef—and the plot frames specific issues to be resolved. When the characters (marine scientists) confront an oil tanker spill, they face two key issues: how best to clean up the oil and how to advocate for clean oceans. Essentially, as episodes unfold sequentially within the ongoing narrative, the Storypath approach becomes an enhanced simulation, and “the key purpose of a simulation is to bring to life the event, phenomenon, or process it is designed to represent in as accurate a way as is possible, practicable, and safe.”⁴

The pedagogical benefits of Storypath are many; we highlight a few. First, “a narrative contains all the elements necessary for a learner to stay emotionally engaged with a problem, and it allows the learner to embed every part of the problem in a useful context.”⁵ Second, children are placed at the center of experiential learning as characters in the story and, with teacher guidance, collectively grapple with issues, consider possible solutions, and mutually agree on best pathways forward as each episode unfolds. In fact, when learning is student-centered, students engage in deeper, richer learning and the context for learning becomes more collaborative as children work together to figure things out.⁶ Third, the Storypath approach fosters agency and affirms children's identities as they bring their lived experiences into story events, connecting who they are and what they know to new

information and democratic problem solving. For example, when creating characters for the Great Barrier Reef Storypath, children decide on personal attributes, talents, and skills of their own marine scientist, then they become that character in the story. Finally, the inquiry of Storypath episodes supports critical, creative, and collaborative investigations which produce new knowledge that children then apply to vexing problems and result in constructive interpersonal accomplishments. The teacher guides and prompts the inquiry process by asking key questions in ways that tap into children's identities and background knowledge, create the need to discover new information, and provide meaningful opportunities to apply learning to problem solve real-world issues. The questioning process threads together what children know and understand, how they imagine and engage their work as marine scientists, and what new information and skills will be essential for successfully resolving critical incidents that endanger the reef and ocean ecosystems.

Episode 1: The Great Barrier Reef Setting

Storypath begins when the teacher invites children to pretend they are on an airplane traveling to the Great Barrier Reef. Simulating this experience, children participate by sitting in chairs arranged in rows like on a plane, tickets in hand, ready to fly. The teacher becomes the pilot, saying:

Welcome! This is your captain speaking. Look out your window to see in the distance a jagged line just under the surface of the water. This is the Great Barrier Reef, the largest coral reef in the world. It rises up like a wall from the ocean floor and stretches hundreds of miles. Notice in some places the jagged line of the reef is above the water and small islands appear to sit on top. Oh, look; I see a pod of dolphins swimming near the reef! Every few feet they jump out of the water. If you were underwater, you would see brightly colored fish and sea creatures of all shapes and sizes.⁷

Children also watch a short video on the Great Barrier Reef, one of many available online, further piquing interest and capturing imagination as they build background knowledge for the story. Children recall what they heard and saw—sea creatures and coral shapes, sizes, colors, textures, and so forth. This becomes the basis for constructing a classroom mural to visually represent the reef, purposely placing children at the center of learning as they make decisions about what to include in the mural and how to design it. Using a range of art materials, each child contributes, and, through negotiation, everyone completes the task by together deciding where to place objects. This involves give-and-take compromise, establishing early on the expectation for cooperative problem solving needed by marine scientists in subsequent

episodes. Children also typically display enthusiasm as they meaningfully engage in creating the story's setting, learn that all contributions belong, and easily differentiate tasks based on interest and skill, reinforcing that everyone is capable, included, and plays an important role in the story.



Figure 1. Great Barrier Reef mural with vocabulary used in inquiry

Integrating literacy also enables children to learn new vocabulary by naming sea creatures and describing the reef (see Figure 1). One teacher guided children to write descriptive sentences like these: "The bright spiky fish swim through the beautiful coral reef" and "I was amazed when I saw the transparent floating jellyfish with sharp stinging long tendrils." The teacher then connected classroom learning to sharing at home by making a postcard showing a photograph of the mural; on the reverse side, children wrote their descriptive sentences. The postcard also prompted family members to ask questions about the setting, thereby reinforcing children's reading, writing, and speaking about the reef.

Episode 2: Characters for the Story

Next, children imagine themselves as marine scientists working in the Great Barrier Reef. Through questioning, the teacher threads together what children know and understand about scientists, what they can imagine as they consider the work of marine scientists, and new information needed to create a realistic character they will become in this story. This leads to constructing a visual representation of their marine scientist, providing a concrete context for imagining the roles their characters will play as the story unfolds. To accomplish this, children create paper-doll cut-outs, deciding what they will look like and wear as marine scientists (see Figure 2). Completing a job application for their character also provides context for learning about marine scientists, identifying needed knowledge and skills, and understanding what "doing your best" means to be hired. Asking key questions stimulates thinking about attributes of successful marine scientists and, if children don't know, directs them toward seeking useful



Figure 2. Students' paper-doll cut-outs of themselves as marine scientists

information in books or online sources. Guiding questions might include “What education do you need to be a marine scientist?” “What are previous jobs that might be helpful?” and “What skills do you need to work with others?” Here’s what the questioning process might sound like:

TEACHER. What types of past jobs or life experiences might prepare you to become a marine scientist?

STUDENT. Maybe living near the ocean or visiting beaches lots. Maybe reading or watching movies about the ocean. Maybe taking care of a fish tank at home. Maybe working at an aquarium.

TEACHER. All of those might be helpful. So, what previous work will you choose for your marine scientist character’s job application?

STUDENT. I worked in an aquarium.

TEACHER. How do you think working in an aquarium could be helpful to a marine scientist?

STUDENT. I had to look after the fish and feed them.

TEACHER. Why do you think having knowledge about a healthy diet for fish would be important?

In this exchange, the teacher introduced the need for marine scientists to know about a healthy diet for marine life, thereby leading the child to make connections between what was already known to what new information is needed for the Storypath, capturing content knowledge about marine life and skill qualifications for a job as a marine scientist. This manner of questioning by the teacher is an effective strategy for transmitting knowledge.⁸ It also supports children in creating a realistic character for participating in the story.

Next, children introduce their marine scientists to classmates, which further authentically develops speaking and listening skills while reinforcing disciplinary knowledge related to the topic. These introductions occur over several days, allowing the teacher and classmates to ask each presenter questions. This not only makes the introductions more meaningful, but it also is engaging, reinforces speaking and listening skills, highlights important information, and acknowledges that each marine scientist is important to the story. Modeling for children how to ask questions about the marine scientists and their work creates the opportunity for the teacher to interject new information or reinforce information already introduced. For example, one teacher asked, “Why is it important to work well with others?” This question and others like it underscore that working well with others is desirable for marine scientists who will be interacting to accomplish tasks together.

Episode 3: Creating an Underwater Sea Lab to Enhance Context

Living and working in an underwater sea lab captures children’s imagination as they consider what their lab community will want or need. Again, children’s agency is in play as they make decisions, guided by the teacher’s questions, such as, “How would an underwater sea lab look?” “What rooms or spaces will be needed?” and “What special equipment will be important for living underwater and studying sea creatures?” Such inquiry sparks children’s discourse in explaining their ideas, considering new information, and thinking more deeply about the Great Barrier Reef ecosystem. This prepares children to construct a lab by working in small groups, each responsible for one room. The final product might be a two-dimensional floor plan of all rooms combined (see Figures 3, 4, and 5) or three-dimensional structure made from boxes, LEGO® blocks, or other materials. Constructing the lab reinforces learning and grounds children in the place (context) for their story. It also further develops disciplinary vocabulary associated with the topic. Through this process, authentic problems can emerge, such as children in one class discovering an important omission—bathrooms. This was their problem, so a marine scientist meeting was called to figure out a solution. Guiding



Figure 3. Floor plan of an underwater sea lab

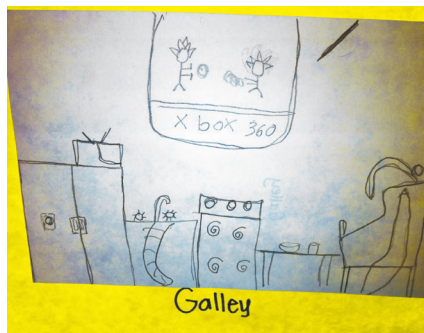


Figure 4. Floor plan of the galley for an underwater sea lab

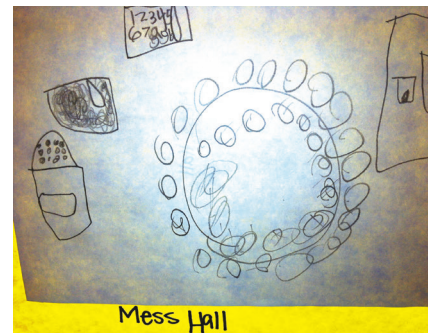


Figure 5. Floor plan of the mess hall for an underwater sea lab

children through democratic problem-solving processes affirms that they are capable and that they own their learning through inclusive decision making. Sometimes problems are resolved through consensus, other times by voting, but always children deliberate together—hearing, including, and honoring all voices and ideas.

Episode 4: The Plot Thickens with Trouble in the Sea Lab

Children relate to a messy sea lab, which frames civic responsibility in Storypath for living and working together. Civic education standards, such as “describe how communities work to accomplish common tasks, establish responsibilities, and fulfill roles of authority,”⁹ are addressed when complaints about a messy lab provide the context for the marine scientists to establish rules. Teachers use content knowledge to facilitate the constitutional principle of “We the People” through democratic practices, developing student agency to engage with real-world events.¹⁰ In essence, children figure out how to make their lab a better place for all to live and work. In one class, sea lab rules that emerged were “everyone cleans up their own mess,” “keep your own bedroom area clean,” and “don’t leave your own stuff around.” Children also decided they needed to create “reminder signs” and did so. Such activities emphasize the importance of creating a community of learners who can capably solve problems together.

Episode 5: Continuing to Develop Content Knowledge of the Reef

Children as marine scientists continue to learn about reef sea creatures through activities informed by science standards (see Next Generation Science Standards).¹¹ These activities engage children in researching, observing, and discussing creatures. Ultimately, each child chooses one creature, creates a life-size model, and writes a report that highlights details. Again, this strengthens literacy skills as children read about their creatures, write reports, and engage interactively with classmates in presentations. The excitement of displaying and discussing visual models further connects children to the storyline in meaningful ways.

Episode 6: The Oil Spill Disaster

The teacher now introduces disturbing news through an intercom announcement to provide a sense of drama and convey urgency—a tanker ship has spilled oil on the reef! This triggers a search for real-life examples of ocean oil spills, readily available on the Internet. It also evokes a range of emotions—concern, surprise, sadness, desire to “do something”—because children are attached to the place they have imagined, researched, and created. This leads to investigating ways to clean up oil from saltwater—an authentic response to the disaster. Teams each receive a tub of water with vegetable oil, then submerge materials like feathers, rocks, and shells (from ocean environments) to examine effects (see Figure 6). Next, children experiment with various options for removing oil from the saltwater, recording results, then mutually recommending the best solution. Emotional investment in finding solutions to this disaster drives and deepens authentic learning, as illustrated by the following verbatim responses by children who wrote what they learned about the Great Barrier Reef.

- When a little oil spreads, a lot of animals die because from a tiny oil spill. It seems tinier than it looks, but when it goes in the ocean it can be really big and 10,000 can die. If they breathe in the oil, their lungs can get very, very damaged and I think it will not breathe.
- There are more oils spills in the world than I thought. Soap takes the oil and blends it with the water. Ocean crabs need saltwater to stay alive. There are at least one oil spill a day in the whole entire world.
- A oil spill can be very dangerous. I know it isn’t for us. But it is for the ocean animals. Now don’t go thinking it only happens at the Great Barrier Reef, it happens in other places.

Episode 7: Advocating for Clean Oceans

The final episode culminates in role-playing an international

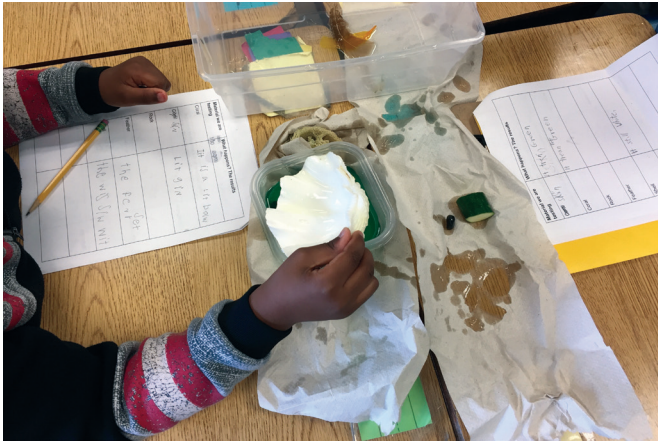


Figure 6. A student submerges a shell in a tub of water with vegetable oil to examine and record the effects.

ocean advocacy conference. Children eagerly prepare and present statements that reveal what they learned and what they found personally meaningful. In addition, this episode can reinforce the role of teamwork in environmental problem solving. One teacher, for example, asked children about the value of working together. Written responses repeatedly focused on the oil spill episode and the importance of collaborating to solve problems, as the following verbatim excerpts illustrate:

- We can accomplish goal by learning about the Great Barrier Reef and we would know a lot about our topic. We would not be able to accomplish goals by not working together and we wouldn't know anything about the Great Barrier Reef.
- So when we have a problem we will have tons of ideas to solve it. If you have a problem and do not know how to solve it, no one else will be there to help you if that happens. That is why you need to grab a friend and let them share their ideas to help you solve your problem.
- I think it is important for people to work together to solve problems because if we don't the world would have like maybe a oil spill and no one would work together to fix the oil spill.

Conclusion

In many ways, the teacher's role in Storypath is one of directing a play—guiding children as story characters through episodic events. (See the Table on pages 23–25 for a summary of episodes, activities, and corresponding standards.) The power of Storypath's narrative framework is that it threads together inquiry in ways that create meaningful lived experiences. In fact, teachers have shared that once the Great Barrier Reef Storypath is underway, children arrive asking if they are going to be working as marine scientists today!

One teacher's experience also suggests that children transfer learning, as she witnessed when her class visited a nearby saltwater beach after the unit ended. Children immediately noticed what looked like oil scum on the water and litter on the seashore. Voicing concerns, they began picking up the litter on their own. Such unprompted actions bode well for cultivating environmental stewardship, suggesting that seeds planted early through integrated experiential learning positively impact hearts and minds. Storypath is an instructional approach that meaningfully immerses children in grappling with sustainability issues, thereby also addressing goals of the C3 Framework: “Now more than ever, children need the intellectual power to recognize societal problems; ask good questions and develop robust investigations into them.... Engagement in civic life requires knowledge and experience; children learn to be citizens in working individually and together as citizens.”¹²

Acknowledgements

The authors thank Kristi Pihl, Edmonds School District, Edmonds, Washington, Brooke DeVlieg, Northshore School District, Bothell, Washington, and Kerrie Foord, Cartwright Public School, New South Wales, Australia for their student work examples and photos.

Notes

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9. NCSS, *College, Career and Civic Life (C3) Framework*, 32.
10. Educating for American Democracy (EAD), *Educating for American Democracy: Excellence in History and Civics for All Learners* (Cambridge, MA: iCivics, March 2, 2021), www.educatingforamericandemocracy.org.
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Table. Summary of Episodes, Activities, and Corresponding Standards

<p>Connections to C3 Framework</p> <p>The Storypath instructional approach uses compelling and supporting questions to guide learners through each of the episodes.</p> <p><i>Dimension 1: Developing Questions and Planning Inquiries</i> is threaded throughout the Storypath as students imagine and create the Great Barrier Reef and identify disciplinary concepts associated with a compelling question.</p> <p><i>Dimension 2: Applying Disciplinary Concepts and Tools</i> is accomplished through tasks related to writing rules for working together effectively, drawing on civic learning, and examining the habitat of the Great Barrier Reef by considering connections between the physical environment (the reef), economic activities (oil tankers transporting oil across oceans), and the impact on oceans when an oil spill occurs.</p> <p><i>Dimension 3: Evaluating Sources and Using Evidence</i> takes place through a science investigation on how oil impacts the environment, how best to clean up the oil, and how to make and support evidence-based claims for a clean ocean.</p>	
<p>Great Barrier Reef (GBR) Storypath Episodes and Activities</p>	<p>Standards Focus</p>
<p>Setting: Great Barrier Reef <i>Learners create a visual representation (mural) of the setting.</i></p> <ul style="list-style-type: none"> • Introduce the Storypath unit using a description, video, and photos. • Ask questions to connect known information to new. • Introduce and reinforce new vocabulary. • Organize cooperative groups to create the setting. • Facilitate discussion about the setting, affirming student agency and contributions. • Facilitate the creation of a word bank for writing activities related to the setting. <p>(Estimated time: three to four lessons)</p>	<p>Common Core: Literacy Standards Comprehension and Collaboration SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. Vocabulary Acquisition and Use L.6 Acquire and use accurately a range of general academic and domain-specific words. (Note: This standard applies to all the episodes.)</p> <p>National Core Arts Standards VA:Cr3.1.3a Elaborate visual information by adding details in an artwork to enhance emerging meaning.</p>
<p>Characters: Marine Scientists <i>Learners imagine themselves as adults studying the GBR, then play those roles throughout.</i></p> <ul style="list-style-type: none"> • Facilitate a job application to work as a marine scientist and develop understanding about such roles. • Guide the visual and written construction of characters and reinforce connections to children's lives. • Guide introduction of scientists to apply speaking and listening skills and reinforce understanding of the GBR. <p>(Estimated time: three to four lessons with introductions spread over a number of days)</p>	<p>Common Core: Literacy Standards Text Types and Purposes W.2 Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (Job application) Presentation of Knowledge and Ideas SL.4 Present information... that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.</p> <p>National Core Arts Standards VA:Cr3.1.3a Elaborate visual information by adding details in an artwork to enhance emerging meaning.</p>

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<p>Context Building: Underwater Sea Lab <i>Learners create a visual representation of where characters live, work, and gather. They research aspects of the community and environmental context.</i></p> <ul style="list-style-type: none"> • Discuss basic needs of living and working in an underwater sea lab. • Organize cooperative groups and teach skills for team investigations to develop rooms for the lab. • Facilitate student presentations of their rooms reinforcing knowledge of basic needs and cooperative skills of working together. • Facilitate problem solving to ensure needs and wants are met in the underwater sea lab. <p>(Estimated time: two to three lessons)</p>	<p>C3 Framework Geography D2.Geo.9.K-2. Describe the connections between the physical environment of a place and the economic activities found there.</p> <p>Civics D2.Civ.10.K-2. Compare their own point of view with others' perspectives. D2.Civ.11.K-2. Explain how people can work together to make decisions in the classroom. (GBR setting)</p> <p>Common Core: Literacy Standards Comprehension and Collaboration SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. Presentation of Knowledge and Ideas SL.4 Present information... that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.</p>
<p>Critical Incident: Messy Sea Lab <i>Learners are confronted with a messy lab and decide how to address the problem, which results in collaboratively writing rules for living and working together in the lab.</i></p> <ul style="list-style-type: none"> • Facilitate cooperative group problem solving. • Promote examination of alternative viewpoints. • Guide the writing of rules for living and working together. <p>(Estimated time: two to three lessons)</p>	<p>C3 Framework Civics D2.Civ.3.K-2. Explain the need for and purposes of rules in various settings inside and outside of school. D2.Civ.9.K-2. Follow agreed-upon rules for discussions while responding attentively to others when addressing ideas and making decisions as a group. D2.Civ.10.K-2. Compare their own point of view with others' perspectives. D2.Civ.11.K-2. Explain how people can work together to make decisions in the classroom. (Sea lab)</p> <p>Common Core: Literacy Standards Production and Distribution of Writing W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Rule-writing)</p>
<p>Context Building: Scientists at Work <i>Learners research and make models of sea creatures, write reports, and present to the class.</i></p> <ul style="list-style-type: none"> • Guide the selection of sea creatures. • Facilitate research, model construction, and report writing. • Facilitate student presentations and discussion of their sea creatures. <p>(Estimated time: five to six lessons with the presentation of sea creatures spread over a number of days)</p>	<p>Common Core: Literacy Standards Craft and Structure R.5 Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently. Text Types and Purposes W.2 Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section. Presentation of Knowledge and Ideas SL.4 Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.</p>

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<p>Critical Incident: Oil Spill <i>Learners are confronted with an oil spill and investigate the best method for removing the oil.</i></p> <ul style="list-style-type: none"> Facilitate cooperative group problem solving. Organize and facilitate the investigation of various strategies for removing oil from water and materials (e.g., shells/rocks/feathers). Guide discussion of impact on ocean pollution and the need to protect our oceans. <p>(Estimated time: two to three lessons)</p>	<p>C3 Framework</p> <p>Civics D2.Civ.9.K-2. Follow agreed-upon rules for discussions while responding attentively to others when addressing ideas and making decisions as a group. D2.Civ.11.K-2. Explain how people can work together to make decisions in the classroom.</p> <p>Geography D2.Geo.5.K-2. Describe how human activities affect the cultural and environmental characteristics of places or regions. D2.Geo.12.K-2. Identify ways that a catastrophic disaster may affect people living in a place. (Ocean)</p> <p>Next Generation Science Standards</p> <p>Interdependent Relationships in Ecosystems 2. Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Make observations (firsthand or from media) to collect data which can be used to make comparisons.</p> <p>Common Core: Literacy Standards</p> <p>Research to Build and Present Knowledge W.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p>
<p>Concluding Event: Ocean Advocacy <i>Learners participate in an “international conference” to advocate for clean oceans, reinforce learning, and bring closure to the unit.</i></p> <ul style="list-style-type: none"> Guide learners’ reflection on their learning, reinforcing advocacy skills for clean oceans. Present the invitation to an “international conference” (classroom simulation) and understanding for such conferences. Facilitate presentations of students’ learning about the GBR and strategies for advocating for clean oceans. <p>(Estimated time: three to four lessons)</p>	<p>C3 Framework</p> <p>Geography D2.Geo.12.K-2. Identify ways that a catastrophic disaster may affect people living in a place. (Ocean)</p> <p>Civics D2.Civ.11.K-2. Explain how people can work together to make decisions in the classroom. (Advocate for clean oceans)</p> <p>Common Core: Literacy Standards</p> <p>Presentation of Knowledge and Ideas SL.4 Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.</p>

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