



## WaterWays

### Context for Lesson 1:

In Lesson 1, students are introduced to the Digital Science Journal (DSJ) and Augmented Reality (AR) components of WaterWays.

They will view the anchoring phenomenon of a shark eating plastic trash and will learn from an expert ecologist how she tags and tracks sharks off the coast of New York City.

Students begin by learning about shark anatomy and then tag and track their own shark while making observations about its movement as it intersects with potential plastic pollution. Students make a hypothesis, collect data to test it, and connect local ecosystems with plastic pollution that travels through the storm drains and outfalls of coastal cities.

The lesson extends student knowledge on how human actions affect places and organisms beyond their immediate area. Students complete mazes illustrating the path our trash takes before entering local water, where it may be eaten by marine life. This prepares students to understand and describe the impact of human actions on local ecosystems.

### Teaching Notes:

The following considerations will maximize student experience:

- Headphones for audio
- Pairing students based on any known ability and/or specialty needs
- Utilizing the Partnership/Class Discussion Questions as listed in the Activity Learning Experience Guide (found below)
- Students may use a chat function to send and receive messages with the teacher. Student chats are not public, and students cannot chat with each other.

### Student Prior Knowledge:

Before beginning this lesson, students should know:

- What devices they will be using throughout this experience
- The locations of their laptops/iPads
- The routine for distributing and collecting devices
- Navigation and response process for DSJ
- Familiarity with the concept of adaptations
- Familiarity with the concept of the scientific process, including making and testing hypotheses

### Students who demonstrate understanding can:

- Identify shark anatomy
- Connect shark anatomy's structure to function (adaptations)
- Describe how humans can use GPS tags to track shark movement
- Observe both natural and abnormal contents of a shark's stomach
- Form a hypothesis from observations
- Collect, organize, and interpret data
- Construct an explanation based on evidence
- Identify examples of 3Rs: Reduce, Reuse, Recycle, as well as less common 3Rs: Reform, Reclaim, Refuse
- Explain a personal pledge to prevent plastic pollution



Following the NGSS standards, students entering 3rd grade should have prior experiences with Properties and Patterns of Water and Structures of Living Things (external adaptations for survival). A student entering 4th grade should have prior experiences with the Interdependence of Organisms and their Environment. A student entering 5th grade should have prior experience linking structure/function (adaptations). In 5th grade, students will have experience with Human Impacts on Earth’s environment. All students should have previous experience with aspects of engineering and design and forming claims from evidence.

WaterWays is designed for students to play independently, in pairs, or together. It is recommended that students are allowed to personally experience AR/VR. That said, the following chart is meant as a pacer and pinpoints Whole Class or Partner Discussion moments to maximize learning throughout the game.

**Potential Misconceptions:**

The path of trash in storm drains is likely unfamiliar to most students. While the idea of trash floating in local waterways may not be new, the pathway through storm drains to outfalls likely is.

The idea that recycling alone does not prevent plastic pollution may be uncomfortable for young students.

Activity	Learning Experience	Duration
Getting Started	Students are introduced to WaterWays and how to use the buttons, DSJ, and AR on their devices.	5 min.
Introducing...	Students are introduced to an expert ecologist who researches sharks. They watch a video about how sharks are tagged.	3 min.
Class/Partner Discussion Questions	What do you know about sharks? What are some things you wonder about sharks? What do you think an ecologist might study?	
AR Experience: Shark Anatomy	Students are guided through the structure and function of shark anatomy. Next, they learn about gastric eversion and experience the anchoring phenomenon of a plastic bottle being in the stomach of the shark. This provides context for their research as they place a GPS tag on their own shark.	5 min.
DSJ: Welcome Back!	Students are asked to name and explain an adaptation that helps sharks. They will also identify the objects in the shark's stomach.	1 min.
DSJ: Tracking the Shark	Students drag icons to investigate the movement of the shark they tagged.	1 min
DSJ:	Students are introduced to three sources of plastic pollution:	3 min.



Make a Hypothesis	outfalls, beach litter, and fishing industry litter, and asked to make a hypothesis by choosing the source that contributed the largest amount of plastic waste to the ocean. Students then respond to the <b>pop up</b> question, “Explain your reasoning. Why do you think [the choice] is the most likely source of plastic bottles like the one in the shark’s stomach?”	
Class/Partner Discussion Questions	What are some of the plastic items you use in your everyday life? Have you ever seen plastic in the rivers, lakes, or oceans near you? How do you think they got there?	
DSJ: Testing the Hypothesis, Conclusion	Students use a boat drone to collect data on plastic waste at four self-selected points. Students then analyze the data and reflect on whether the data provides evidence for the source they chose in their hypothesis.	5 min.
DSJ Game: Amazing Journey, Another Journey, The Final Journey	Students complete three mazes that highlight the twisted, yet common, pathways for trash to enter our waterways and investigate how actions can prevent plastic from entering the trash stream. Students answer a <b>pop up</b> question, “What could we do to stop the bottle from getting to the ocean?”	3 min.
Class/Partner Discussion Questions	How do you dispose of your plastic trash? Do you think something you have thrown away could end up in an outfall? How might that be possible?	
DSJ Game: R Verbs, Plastic Drop	Students review the classic 3Rs: Reduce, Reuse, Recycle and match icons. Next, students learn about less common 3Rs: Reform, Reclaim, Refuse, and match images to these terms. Students will then practice and play a game that illustrates how each of the Rs has different strengths and weaknesses.	8 min.
Class/Partner Discussion Questions	What were the differences between the 6R’s? Which action had the greatest impact? Which R was the least impactful? What makes some R actions more difficult to implement? What might be an example of each R?	
DSJ: The Pledge	Students make a pledge to change their personal plastic usage and illustrate how they would enact their pledge.	3 min.
DSJ: Recap	A review page shows how students tagged a shark, tested hypotheses, observed plastic entering the ocean, and generated ideas for solutions.	1 min.
Class/Partner Discussion Questions	Teacher facilitates a summative discussion around the key learning points from the WaterWays experience: tagging sharks for research, testing a hypothesis, observing plastic entering the ocean, generating ideas that help. Possible extension would be to create an action project in class.	



**VOCABULARY:**

- **Adaptation** (Noun) : A body part or feature or a behavior that helps a living thing survive and function better in its environment.
- **Conservation** (Verb) : Conservation is a plan to care for and protect natural resources.
- **Digest** (Verb) : To break down food into simpler forms that can be taken in and used by an organism.
- **Ecologist** (Noun) : An ecologist is a scientist that studies the relationships between living things and their environment.
- **Evert** (Verb) : To turn an organ, like a stomach, inside out.
- **GPS tag** (Noun) : GPS stands for 'Global Positioning System.' A GPS tag sends signals to satellites in space. An animal or object with a GPS tag can be tracked over long distances.
- **Hypothesis** (Noun) : An idea or explanation for something that is based on known facts but has not yet been proved.
- **Migrate** (Verb) : To move from one region to another according to the seasons.
- **Observation** (Noun) : The gathering of information.
- **Outfall** (Noun) : The place in a CSO system where wastewater and litter from a sewer pipe goes into nature.
- **Prediction** (Noun) : What you expect to happen, based on evidence.
- **Reclaim** (Verb) : To take plastic that was littered or thrown in the garbage and find a way to use it.
- **Recycle** (Verb) : Separate plastic from other trash so that it can be remade into new products.
- **Reduce** (Verb) : Use less plastic.
- **Reform** (Verb) : To change the rules about how we use and throw away plastic.
- **Refuse** (Verb) : Say 'no thank you' to plastic products.
- **Reuse** (Verb) : Use an item more than once.
- **Sewage** (Noun) : The used water and waste that flows down the drain or toilet from homes and businesses.
- **Sewer** (Noun) : The pipe underground that carries used water and waste away from homes and businesses.

**Standards:**

SEPS	DCI	CC
Developing and Using Models	LS1.A Structure and Function	Systems and System Models
Analyzing and Interpreting Data	ETS1.B Designing Solutions to Engineering Problems	Cause and Effect
Constructing Explanations and Designing Solutions	ESS3.C Human Impacts on Earth Systems	
Obtaining, Evaluating, and Communicating Information		

**Connections to Excellence in Environmental Education - Guidelines for Learning (K-12)**



Strand 1 ( Analysis and Interpretation Skills): A, C, E, F, G

Strand 2 (Environmental Processes and Systems): 2.1 A, B. 2.2 A. 2.3 A

Strand 3 (Skills for Understanding and Addressing Environmental Issues): 3.1 A, B, C

Strand 4 (Personal and Civic Responsibility): B, C

**Making Sense of the Student Data:**

The goal of the Student Data Guide is to highlight how AR/VR experiences connect the game-play with recognition, recall, and application of scientific concepts and provides information on student understanding.

There are three levels for qualifying performance on any single data point: *Novice*, *Competent*, and *Expert*. *Novice* performance is one that indicates a student has responded in a way that is free of context or inaccurate. *Competent* answers show a higher level of reasoning where students have made context-based decisions using evidence and reasoning. *Expert* answers show not only a level of understanding but also a high degree of situational involvement/elaboration of reasoning.