

## Lesson Four

# Robot Sharks: Computer Science and Robots (5th Grade)

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### Acknowledgement:

This lesson was collaboratively designed by CS Everyone Center for Computer Science Education and UFTeach at the University of Florida. We thank Dr. Meize Guo, Dr. Yongju Jeon, and Dr. Michael Johnson from the CS Everyone Center, as well as Dr. Kristen Apraiz and Dr. Gayle Evans from UFTeach at the University of Florida, for their valuable contributions in designing and reviewing the teaching materials and instructional activities for this project. We also thank Dr. Maya Israel from the CS Everyone Center for Computer Science Education for her expertise and guidance in K-12 AI education.

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## Overview of the Lesson

A quick general overview of the lesson plan.

<b>Name of Lesson</b>	Computer Science - Sphero Robots
<b>Intended Grade Level of Students</b>	We prepared multiple materials for various students' backgrounds. <b>Please consider your students' background knowledge and adjust accordingly.</b>
<b>Summary of STEM Concepts: Include any terms you want students to know.</b>	
<b>Performance-Based Learning Objectives</b>	By the end of this section, the students will be able to: <ol style="list-style-type: none"> <li>1. Read/memorize/define the grade-level terms in their own language.</li> <li>2. Describe/explain how scientists collect data from sharks.</li> <li>3. Design swimsuits to make Sphero move forward in the water.</li> </ol>
<b>Materials Needed:</b>	Printing materials in Section 2  <b>Materials are varied; customize as you need.</b>

## NGSS / MAFS / CS Standards:

Call Letters	Description
SC.5.PE.2.3	Analyze the data from a given scenario.
SC.5.PE.1.3	Create a program using arithmetic operators, conditionals, and repetition in programs.

## ENGAGE (Time: X minutes)

How will you invite students into the lesson, access prior knowledge, and excite them?

Goal	What will you say/do	Expected student responses/actions
<b>Introduce the scenario</b> of pelagic/oceanic sharks living in the open waters of seas and oceans.	<b>Activity: <a href="#">Matching Game</a></b> Have you seen animal footprints before? Where and what animals? Select 6-8 paired game cards, then mix the animal cards and the footprint	

<p>(Reef sharks inhabit shallow water coral and rocky reefs along coastlines and submerged sea mounts)</p> <p>Observing sharks and getting shark data. The location/distance is beyond what humans can directly observe, so we need tools to expand our capabilities.</p>	<p>cards, and set them in the animal group and footprint group. Let them match the animal and their footprints.</p> <p>Ask the question: How do you observe an ocean creature? What are the possible approaches? The pros and cons (frequency, device power, what kind of data, data storage, etc.)</p>	<p>Set a camera on the coast/boat to observe the sharks. Sailing and following the sharks.</p>
	<p><b>Optional Discussion:</b></p> <p>How do we know the exact location and distance when the distance is beyond human vision? For example, if you search "Walmart" in Google Maps, Google will tell you how many Walmarts are near you and which one is the closest. Why and how?</p> <p>GPS system and GPS tracker.  <a href="#">How does GPS work?</a></p> <p>If GPS can determine the location of any receiver on the earth, can we use it to locate sharks in the ocean?</p> <p>Yes, put a receiver on a shark, and now you think like a scientist.</p>	<p><b>Highlights:</b></p> <p>Students share their experiences with GPS on phones, cars, etc.</p>
<p><b>Introduce the progress of tagging a shark and link to using tags (robots/sensors) to collect data.</b></p> <p><b>Background knowledge for preservice teachers:</b></p> <ol style="list-style-type: none"> <li>1. <a href="#">Shark Tagging Video</a></li> <li>2. <a href="#">Shark Tagging Webpage</a></li> </ol>	<p><b>Background knowledge for teachers:</b></p> <p>When studying sharks, scientists should know where they are, their size, sex, how much they have grown, and when and where they were seen. This data can help them determine whether sharks were impacted by human boating, fishing, other ocean animals, etc.</p> <p><b>The process that scientists in OCEARCH use for tagging a shark:</b></p>	

	<p>Animals are caught from tenders using handlines and are guided by hand in the water on and off the lift. The animals are then brought to the submerged platform of the M/V OCEARCH vessel, and the platform is raised. Once the animals are restrained and hoses of water have been set to enable a continuous flow of fresh seawater over the gills, the science team, made up of researchers and veterinarians, begins its process. Tags such as SPOT (Satellite Positioning and Tracking), PSAT, acoustic, and accelerometer are attached, morphometrics are recorded, and samples, such as blood and tissue, are collected.</p> <ul style="list-style-type: none"><li>● SPOT (Satellite Positioning and Tracking) tag: Real-time tracking movement.</li><li>● PSAT (Pop-up satellite archival tags): Track movements, depth, and temperature profiles.</li><li>● Acoustic tag: Receiver-dependent tracking.</li><li>● Accelerometer: Track swimming behavior.</li></ul> <p>The technologies and methods used by scientists represent <b>the least invasive means of obtaining the data necessary to fill knowledge gaps regarding sharks</b>. Most studies on each shark could not be conducted on a free-swimming shark.</p> <p>There are multiple tracking resources. You can also discuss who collects these data, data sharing, efforts to get</p>	
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	<p>data from sharks, transferring the raw data into visual graphs, maintaining the website for audiences, etc.</p> <p>Additional Recources:  <a href="https://oceantracks.org/map/">https://oceantracks.org/map/</a>  <a href="https://www.ocearch.org/tracker/">https://www.ocearch.org/tracker/</a></p>	
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## EXPLORE (Time: X minutes)

How will you organize student activities and thinking as they explore the STEM concepts in this lesson?

Goal	What will you say/do	Expected student responses/actions
<p><b>Let the Sphero Swim in the bin.</b></p>	<p>Today, we will use a robot called Sphero to pretend to be a shark swimming in the ocean so we can see how scientists collect data from a tagged shark.</p> <p>First, put Sphero in the water and drive it to move. Let the kids observe and summarize what the Sphero can and cannot do in water.</p> <p>Observe how much of the Sphero is moving underwater. Is it easy to control a Sphero moving in water? What questions does this leave us with? Is there a way we can improve the movement?</p> <p>Optional: Talk about treading water vs. swimming - motion that is designed to go nowhere versus forward motion</p> <p>Second, each group designs its swimming suit for the Sphero using multiple materials that we provide.</p>	<p>Students might need help with connecting Sphero and driving Sphero.</p> <p>Sphero rolls in the water and barely moves with its smooth surface. The way motion happens within the Sphero is by moving the device internally rotating. It has the effect of keeping it in place.</p> <p>Brainstorm the solutions that can help the Sphero move forward in the water.</p> <p>Test out and revise their solutions.</p>

	<p>Test out their Sphero swimming suit in the water. Will the design of the swimsuit cause the Sphero to float differently?</p> <p>Possible Materials: bubble wrapper, EVA foam sheets, tapes, rubber bands, plastic pieces, aluminum foil, and Sphero nubby covers (optional).</p>	
<p><b>Optional Expand Knowledge - Shark Skin</b></p>	<p>Shark skin is not smooth. Sharks are covered by dermal denticles. If you touch the shark from head to tail, it is smooth, but from tail to head, you would feel that it is very rough. The dermal denticle structure reduces friction between the water and the shark's body, streamlining the shark and conserving energy by minimizing drag.</p> <p>You can also talk about walking on land vs. walking in a pool. Why is it harder to walk in a pool? Compare walking in a pool with a life jacket and a bathing suit versus trying to swim with lots of clothes on.</p>	

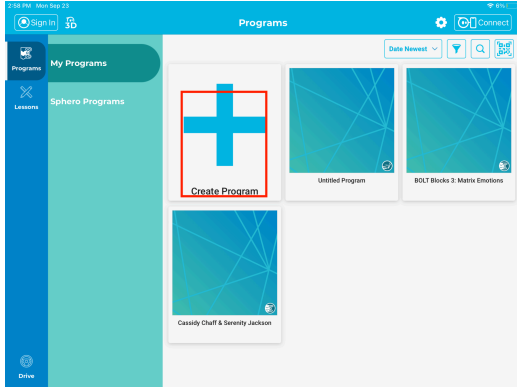
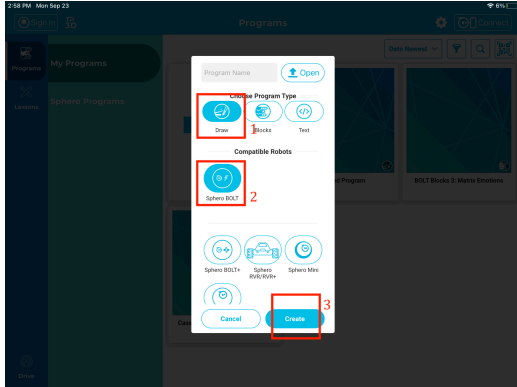

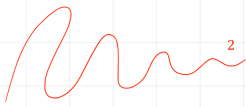
**EXPLAIN (Time: X minutes)**

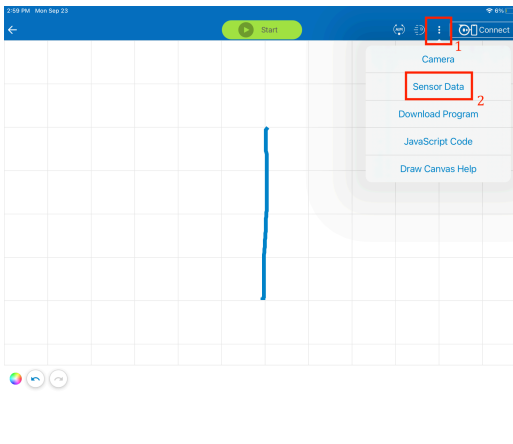
How will you help students make sense of the experiences they had in the exploration?

Goal	What will you say/do	Expected student responses/actions
<p>Students will look back at the processes of designing a swimsuit and summarize the challenges and successes.</p>	<p>Reflect upon how your 'naked' Sphero moved in the water, the process of designing your Sphero's 'swimsuit,' and the strategies used to adjust/change the swimsuit design.</p> <p><b>What works well and what does not?</b></p>	

**ELABORATE (Time: X minutes)**

How will you connect this experience with other ideas or real-world applications?

Goal	What will you say/do	Expected student responses/actions
<p>How can we gather data while Sphero is swimming?</p>	<p>How can we collect data from Sphero in a way similar to how scientists collect data about sharks?</p>	
<p>Collect data with sensors in Sphero EDU.</p> <p>A shark with a tag is like a Sphero with a sensor.</p> <p><a href="#">Example of Surfaces</a></p>	<p>Use Sphero with your designed suit to collect data while it is moving.</p>    	<p>Run their Sphero and observe the collected data.</p>

		
<p>Check the location and distance data when Sphero moves in different paths.</p> <p><b>Example of Paths</b></p>	<p>Reading the data in the Sphero Edu App</p> <ul style="list-style-type: none"> <li>• Where and how?</li> <li>• What do the X and Y mean in location and distance figures?</li> </ul>	
	<p>Compare the data with different surfaces.</p> <ul style="list-style-type: none"> <li>• Smooth surface with stable location figure.</li> <li>• Paddle surface with sway location figure.</li> </ul>	<p>Describe observable similarities and differences from visualized data.</p>
	<p>Compare the data with different paths.</p> <ul style="list-style-type: none"> <li>• Pattern: The number of waves in the figure and the number of edges</li> <li>• Pattern: The changes of X and Y values.</li> </ul>	<p>Describe observable similarities and differences from visualized data.</p>
<p><b>Depending on the surface type, when Sphero moves in water, some data might be very hard to read. You can also do land-shark. Let the Sphero move on the ground as an abstraction of an ideal underwater movement.</b></p> <p><b>If this part is too much for you or your students, skip it to avoid the confusion.</b></p>		

**EVALUATE (Time: X minutes)**

How will you assess the extent to which learning goals are met during/by the end of the lesson?

Goal	What will you say/do	Expected student responses/actions
The students can identify or describe how scientists tag a shark to collect data.	<p>Why is it valuable to track sharks and collect data from them?</p> <p>When the sharks are free and swimming in the ocean, how can scientists track them?</p>	<p>To protect sharks from human impacts, some shark species' migration habit changes are clear indicators and proof of climate change!</p> <p>Tagging sharks with sensors.</p>
The students can design a swimsuit for Sphero and drive the Sphero to move forward in the water.	Describe your Sphero swimsuit. What did you use? How did it work for the Sphero? What worked well and what did not?	Describe their design. What worked well?
The students can simulate collecting data via shark tags using Sphero.	<p>Sphero collects data while moving, just like tagging sharks with sensors, and both read the data from the sensors.</p> <p>What can the data be used for?</p>	<p>Where can you see the sensor data in Sphero Edu?</p> <p>Using shark data to protect sharks from human impacts, showing changes in migration patterns, indicators of global warming</p>

## Section 2 Worksheets Index

### **[ENGAGE] Games**

- [Matching Game](#)


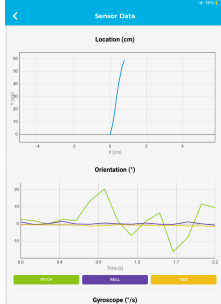



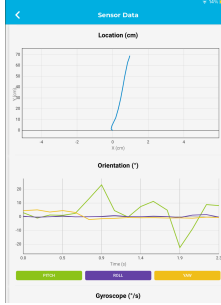

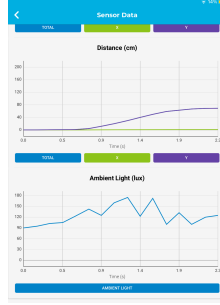
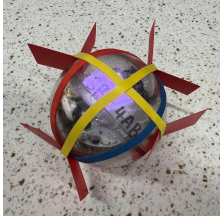
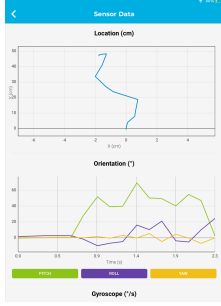
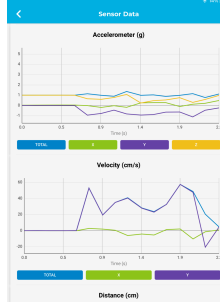
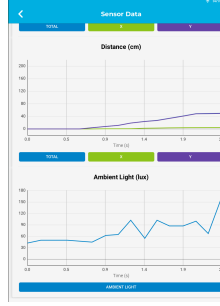
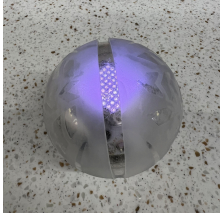
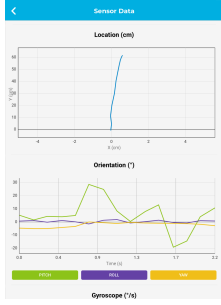
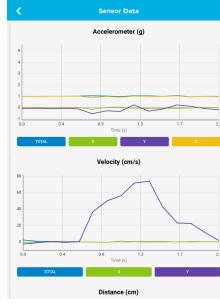
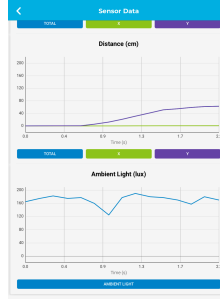
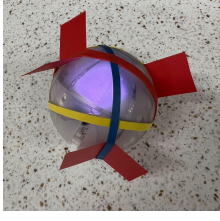
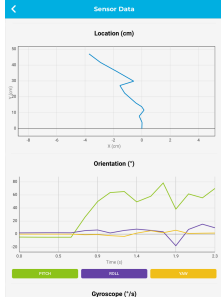

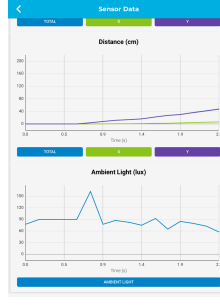
### **[EXPLORE] Example**

- [Example of Different Surfaces](#)

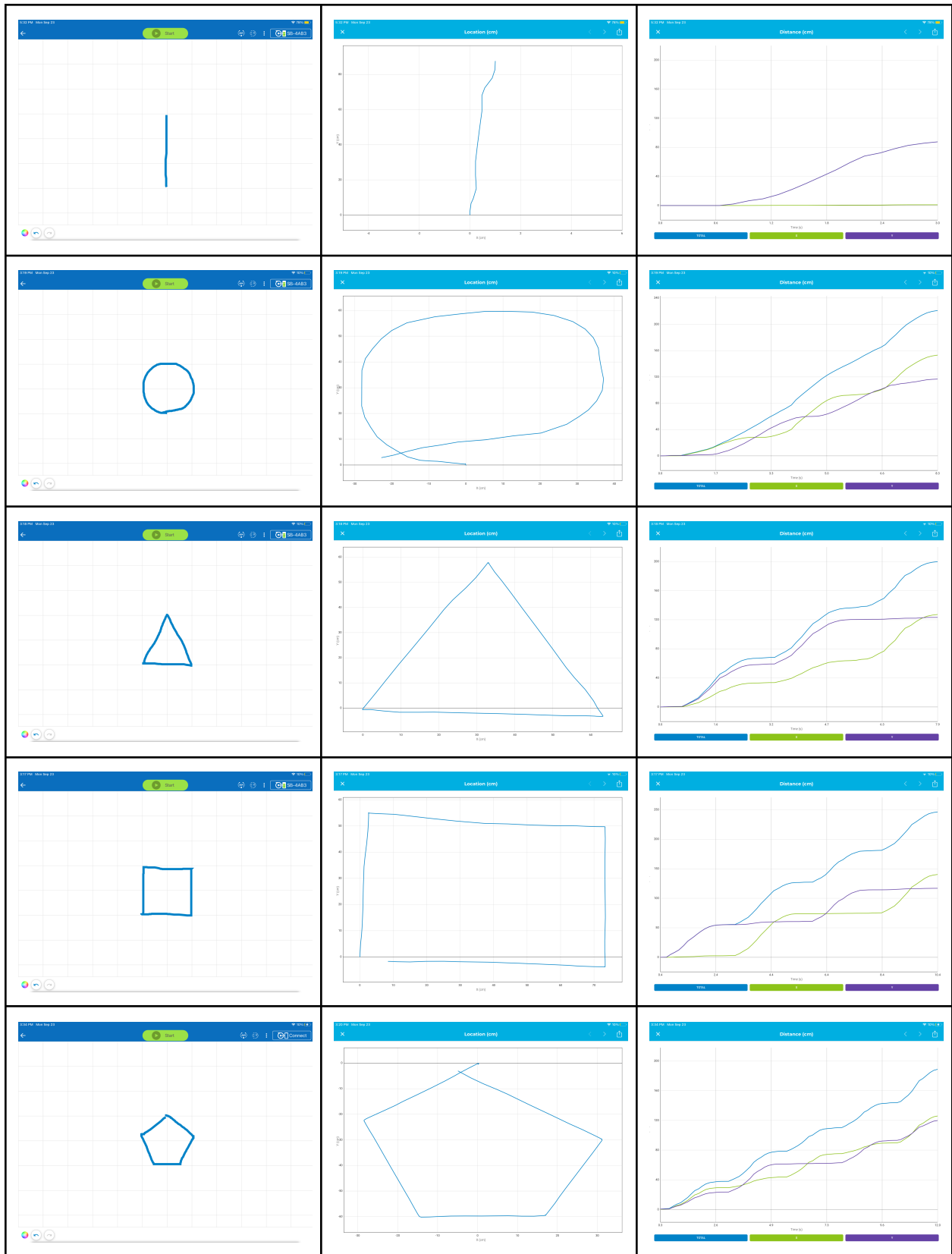
### **[ELABORATE] Example**

- [Example of Different Paths](#)

# Example of Sensor Data with Different Surfaces

 <p><a href="#">P1 Video</a></p>			
 <p><a href="#">P2 Video</a></p>			
 <p><a href="#">P3 Video</a></p>			
 <p><a href="#">P4 Video</a></p>			
 <p><a href="#">P5 Video</a></p>			

# Examples of Location and Distance Data with Different Paths



## Section 3 Reference

Eslvault.com. (n.d.). Animal Tracks Matching Game. Retrieved March 12, 2025, from <https://eslvault.com/animal-tracks-matching-game/>