Topic: Robotic Fish Population Tester

Teacher: Krumgalz, Fattah, Ferraro, Lei
Genre: Science (with Math extension)
Unit: Ecology
Grade Level: 6th   Duration: 90 min

Essential Question (**Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction**)	
How do limiting factors affect carrying capacity in a population? How can we construct graphs to identify trends and patterns?	

Background Knowledge
Students should know what populations and communities are. Students should be able to plot the points on a graph paper using given coordinates. Collaborate with the math teacher to make sure that students are familiar with plotting coordinates on the grid. Students should be comfortable in using Lego EV3 robots.

Background Summary: Students will be taught a mini lesson on limiting factors and how they affect the carrying capacity of the ecosystem for a specific population. To reinforce the lesson students will conduct an activity in which they will be using robots that will be collecting data on the size of the sharks population in local waters. Students will be able to see in the activity how different conditions (limiting factors) increase or decrease the size of the population. Robots will display the name of the limiting factor and a set of coordinates that will allow students to create a graph representing carrying capacity. Students will be asked to construct a graph with appropriate axes and plot ordered pairs as given by the robot. Students will analyze the meaning of each ordered pairs, any patterns or trends recognized, and make inferences related to the impact of limiting factors on a population. Based on the graph, students will identify the approximate value of the carrying capacity of a population in an environment.

Lesson Objectives:
- **Science** : Students will be able to explain what carrying capacity is.
- Students will be able to predict how certain limiting factors will affect the size of the population.
- Students will be able to analyze the graph representing carrying capacity of a population
- **Math Extension Objectives** (students should be pre-assessed for basic understanding of creating and interpreting graphs)
    - Students will be able to construct a graph with x and y axes with accuracy and precision.
    - Students will be able to discuss the meaning of the x and y values of an ordered pair.
    - Students will understand and plot ordered pairs as locations on a coordinate plane.
    - Given information related to limiting factors in a situation, students can construct viable arguments to explain changes in population as demonstrated in their graph.

Standards
(**Domain 1: Planning and Preparation- Component 1a:Demonstrating Knowledge of Content and Pedagogy**)

NYS Science Standards

7.1a: A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem.

7.1b: Given adequate resources and no disease or predators, populations (including humans) increase. Lack of natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

CCSS RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

NEXT GENERATION SCIENCE STANDARDS FOR GRADES 6-8 All human activities are driven by natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.   The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Technology use varies over time and from region to region.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.6.NS.C.6: Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.

- ● b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
- ● c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

CCSS.MATH.CONTENT.6.NS.C.

8: Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate

CCSS.MATH.PRACTICE.MP2: Reason abstractly and quantitatively.

CCSS.MATH.PRACTICE.MP3: Construct viable arguments and critique the reasoning of others.

CCSS.MATH.PRACTICE.MP4: Model with mathematics.

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Vocabulary (Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)	Prep Work/Materials (Domain 1 Planning and Instruction-Component 1e: Designing Coherent Instruction, Domain 3 Instruction-Component 3c: Instruction Engaging Students in Learning)	Cross Curricular Connection (Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)
Population Limiting factors Carrying capacity Population Oil Spill X-axis Y-axis Quadrants Ordered Pair Origin Independent variable Dependent Variable Line graph	**5 Lego EV3 robots**(preassembled) **Students worksheet** 1/group **Construction paper** that is cut out with shapes that represent different environmental factors :Oil Spill: **black** **green** will be abundance of food source , **red** will be overfishing including harvesting their	Science: Ecology **Math:** ● Graphing on the Coordinate Plane ● Interpret the meaning of the coordinates in an ordered pair ● Identify patterns ● Meaningful data collection & statistics **ELA: CCSS.ELA-LITERACY.RL.6.1** ● Cite evidence from observations to support analysis of data and inferences drawn from the data.

| | fins ,**blue** will be **breeding grounds, yellow** will be warmer waters | |

Differentiation
(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)

Students should be flexibly assigned group roles to share responsibility and support collaboration among peers. Knowledge of and consideration for learning preferences and needs should influence selection of roles. Students will work in groups of 5-6; one robot is distributed to each group.

Group Roles: Data Collector, Data Recorder, Data Analyst, Presenter, Project Manager
- Field Scientist: Operates robot, explains (narrates) what robot is doing; reports data to group
- Data Recorder: Double-checks Field Scientist's procedures, records data in group table
- Data Analyst: Leads group discussion on meaning of ordered pairs and evidence of trends (should ask group guiding questions)
- Research Presenter: Summarizes findings from group-work, analysis of graph, and answers to guiding questions. (1+ people can present, given group size)
- Project Manager: Monitors time remaining to work, ensure that group members work productively and respectfully; point person for teacher(s).

Support Diverse Learners with Content: For students that need additional support when graphing, order colored visual markers by ascending order of x values. Provide increased small-group instruction and support in response to in-class observational data.

Multimedia Resources: Introductory video (shark tagging) **(Extension:** Khan Academy Population Ecology Video Series: https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-ecology-2/v/crash-course-ecology-02**)**

Multiple Learning Approaches:
- Visual: Visual color-coded markers to symbolize events, worksheet
- Auditory: Mini-Lesson, Group Discussion, Class Share-Out/Summary
- Kinesthetic: Hands-on activity; robot as manipulative and interactive data provider

Push-In Related Service Provider / Paraprofessional: According to demonstrated student need, repeat and/or model directions; additionally, provide positive reinforcement and encouragement.Provide proximity, monitoring and guided questioning for a focus group during the activity, based on previous in-class formative and/or summative assessments.

Procedure **(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)**	**Student Engagement (Teacher Assessment)**

● Begin the lesson with a Do Now activity (5min) : Make a list of living and nonliving factors that are part of the shark's community ● Go over the do now and share out the answers ● Teach a minilesson on limiting factors and carrying capacity ● Divide students into groups of 5 (or 4/6) ● Explain the task : Scenario : the particular population of endangered shark species was spotted in local waters. Students are in charge of making a presentation on limiting factors that affect the size of that population. In order to prepare for the presentation they will be collecting quantitative data provided by a robotic equipment that communicates with electronic chips embedded in sharks and qualitative data gathered by observing the environmental conditions at the same time. After all the data is recorded students will plot their graphs, analyze them, and while answering the questions provided will write a conclusion of their findings . ● Provide students with the worksheets and materials ● Reinforce the rules and make sure students are clear about their roles ● Help students stay on time by updating them on how much time is left ● Move around the classroom and observe students while they are working ● Provide assistance to those who are struggling	WCS shark tag video https://www.youtube.com/watch?v=KmzGRcSQQus.
Assessment *(Formative or Summative)* **(Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Engaging Students in Learning, Domain 3 Instruction- Component 3d: Using Assessment in Instruction)**	**Student Engagement (Teacher Assessment)**
Formative assessment - teacher's observations **Summative assessment -** worksheets will be collected .	
Additional Resources	
Shark tag video NYA Graph paper	

Student worksheet

Your Mission: You are a marine scientist studying changes in the population of an endangered shark. You created a special robotic shark that follows the living sharks that measures and reports their population. The robotic shark reports the readings once a year for five years. The robotic shark also reports environmental factors that exist that year that could affect the shark population that it is recording.

Procedure:

1. Place all five color cutouts on the floor
2. Place your robot in front of cutout 1, any distance
3. Select the _____program and hit the center button
4. When the robot stops over a color, record the readings in your data table
5. Repeat steps 2-4 for the remaining cut-outs
6. Using your graph paper the x - axis time in years and y- axis as population size in hundreds
7. Plot all 6 coordinates, Label each point with appropriate letter, connect the points in order
8.
9. Answer the remaining questions to complete your analysis

Name of the shark robot _____

Task Assignments

Data Analyst	Field Scientist
Data Recorder	Research Presenter
Project manager	Lego block finder

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Color - Limiting Factor	time	population	Coordinates (time, population)
■	0	100	A(0, 100)
			B(___,___)
			C(___,___)
			D(___,___)
			E(___,___)
			F(___,___)
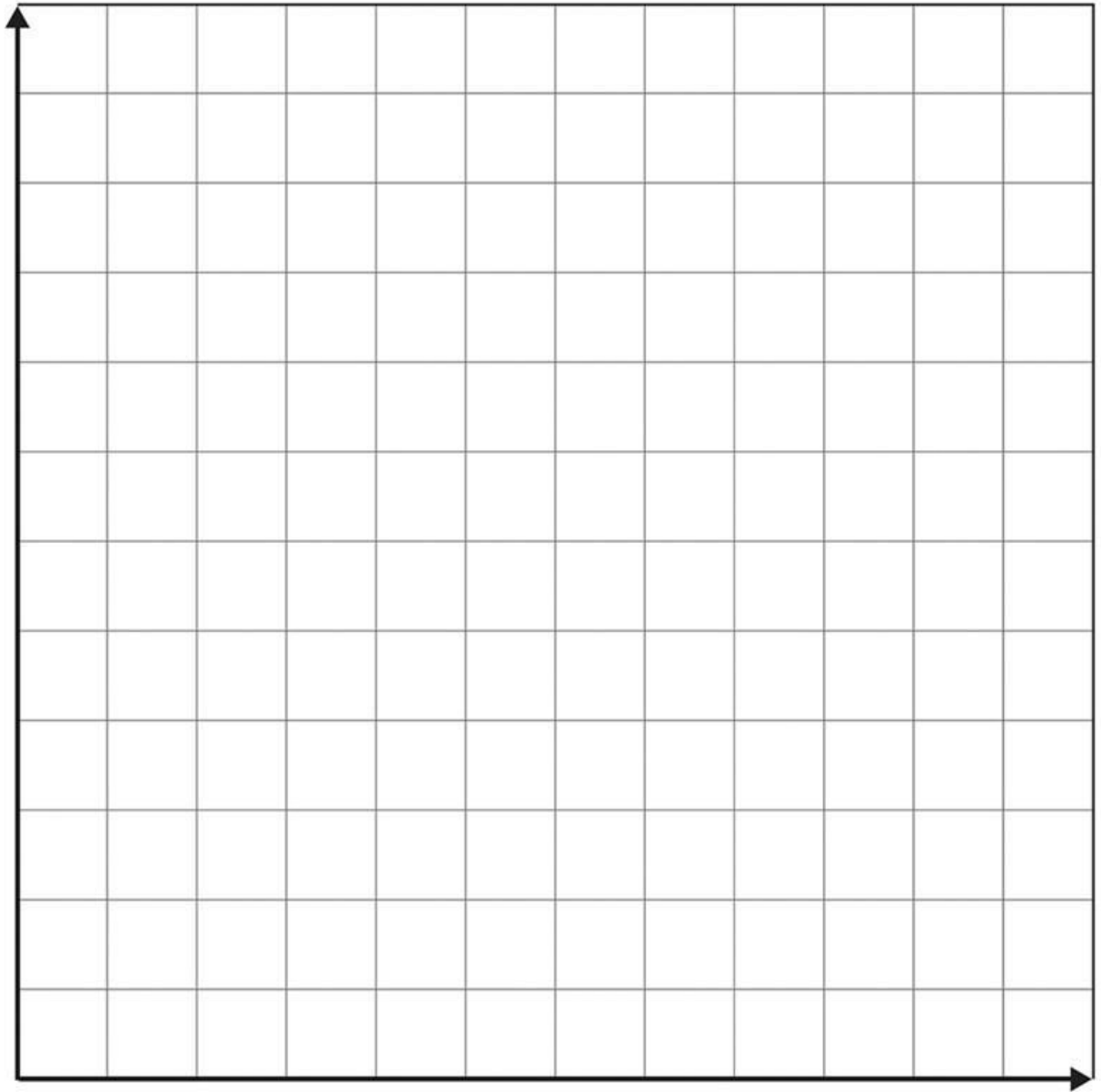
Analysis Questions

1. During which years were the shark population decreasing?
2. What limiting factors were responsible for this change?
3. During which years were the shark population increasing?
4. What limiting factors were responsible for this change?
5. What would happen to the shark population if the ocean water temperature between years 4 and 5 not increase