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Water Quality and Shark Tracking in the Long Island Sound **Grades 6-8**
Time Frame: 2 Weeks

Background:

We are a middle school in Flushing, Queens within 2 miles of ocean (the Long Island Sound) in 3 directions. We have a school wide recycling initiative and a go green team that is aiming closer to a zero-waste school and educating our student population on the dangers of pollution, overuse of resources and not taking care of the environment. Our students in 6th and 7th grade complete a modified compacted curriculum so that more students are eligible to take Living Environment in the 8th grade.

Because of the proximity of the school to local waterways, as well as the school's overarching goals towards ecofriendly practices, this lesson will focus on water quality, the dead zones in the Long Island Sound and Watersheds / Estuaries. The main measure of dead zones in the Long Island sound is hypoxia (lack of dissolved oxygen). There are many components that affect the level of dissolved oxygen. Students will research and measure varying components, will collect data using USGS Water Watch https://waterwatch.usgs.gov/wqwatch/. They will evaluate and present this data to determine cause and effect relationships leading to the dead zones within the Long Island Sound. Students will then track movements of Great White sharks using Ocearch or Sharktivity to find connections between the quality of water in the Sound and movements of sharks.

The lessons would be further supported by a trip to Alley Pond Environmental Center where the students would further explore during the program "Water cycles and watersheds" covering estuaries, watersheds and performing water quality testing. The program allows students to "Investigate the steps of the water cycle and explore how water travels through a watershed system. Focus on the chemical, biological, and physical properties of water, as well as the social implications of water use as we explore NYC's water systems" (alleypond.com).

Some students (SWD or ENL) may need some vocabulary frontloading. May include but not limited to:

Nitrogen

Phosphorus

Carbon

Dissolved Oxygen

Eutrophication

Hypoxia

Justification:

We teach our students a unit on human impact on the environment. Students are frequently made aware of issues of global warming and pollution, but not specifics of how the quality of the water may be affected in a way that is not generally visible. Many ecosystems across the globe have been affected by various types of human activities. There are various ways to analyze the human impact on the environment. For example, human activities have had a major impact on the quality of water bodies around the world. When the quality of water is not optimal, life within that body of water is affected. Animals, plants, fungi, protists and bacteria can all be affected by a change in the quality of the water in which they reside. As one organism is affected, it can trigger a collapse of that ecosystem.

The data sources being use is USGS Water Watch https://waterwatch.usgs.gov/wqwatch/ and Ocearch shark tracker or Sharktivity shark tracker. Waterwatch provides real time water quality data. You can also access past data and future projected data.
Students can use USGS water quality data to investigate the effect of various factors of water quality. Their investigations will analyze the relationships between water temperature, dissolved oxygen (D.O.), pH, turbidity, and nitrate levels. Scientists use several methods to assess the quality of different types of water bodies. These factors are used by scientists to help identify the overall quality of a body of water. Students would use the USGS water quality database to collect data from water samples at 5 locations, log the data into a spreadsheet, and create a chart to compare the relationship between 2 of these factors. I chose this data source because it is easy for students to access and use, it uses color coded symbols and has a map interface to help students visualize the data. The various components that are measured at each site allow students to investigate numerous cause effect relationships in the water quality, as well as add outside research to help explain these observations.
Ocearch and Sharktivity are two apps that can be used to track real time locations of Great White sharks, a large scale predator. Ocearch also uses social media (Tweets) which will be used as an engaging phenomena to introduce the topic.

Research questions addressed: How are the two factors studied correlated? What is the cause/effect relationship between the two chosen water quality factors? What is the overall effect of these factors on the body of water and life within that body of water? How is marine animal movement related to water quality?

This investigation will shed light on how what specific human activities affect water on earth, what is the exact effect of human activities on water quality, and how life is affected within the body of water. Students will use tracking data as well as water quality data to make connections between the “health” of the body of water and the movement of marine animals. Also, this can lead to future investigations which can address how we can prevent negative changes to water quality. The use of this investigation can enhance learning within this unit by providing students with a real world application of the concepts covered in class. Students can also further

explore species that are living in the chosen areas, factories, cities or waste disposal sites that are near by and affects on drinking water.

The use of data in any unit, either collected by students or from other sources is an invaluable way to teach science concepts. First, with the use of secondary data, students are able to see that many times scientists are not doing an “experiment” to get the answers, they are simply looking at data that already exists and trying to make connections. Second, students are using crosscutting concepts from NGSS to use this data to explain cause and effect relationships. Rather than a teacher saying, “A makes B happen”, students examine the data and look for these connections themselves. Through the use of secondary data, students are able to see that data is not always clean, providing a clear “straight line graph”. But rather, typically a bit messy, requiring careful analysis and explanation of data that does not quite fit in. Students are also able to experience first hand the NOS tenet that new information is obtained and sometimes scientific explanations are revised. Even while looking at the same data, students may come up with different conclusions. Discussing these differences in a classroom helps students experience the true nature of science.

There are clear interdisciplinary connections to the use of data in science. Math and technology (in the sense of the use of computer programs to organize and analyze the data) are evident throughout. Math standards are addressed even from how the data is presented, much of it is ranges or < or > a specific value. When analyzing the data, students would use google spreadsheet or excel to organize, evaluate and graph their data.
The most used skills within this unit would be deciding which data to evaluate, choosing the data sets that the student feels show a correlation and explaining clear cause and effect relationships based upon that data.
However, less touched upon connections can also be made. The unit lends itself to student problem solving, technology and engineering design. Students could use this data to design and create solutions for the improvement of water quality in the areas affected, to look for the sources of the problems for specific areas and to make wider connections in the future effects if left unaddressed.

The tasks within this unit also incorporate ELA components in that students will be required to conduct research, select relevant vs. irrelevant information and present it in varying ways to their audience – both peers and teachers. They will also be required to share the information gained from their secondary research on factors affecting dissolved oxygen through the format of a lab report. This skill is one many of our students struggle with and typically having them focus their research but still answer a research question in depth is difficult and something that needs to be practiced to have students improve.

Ultimately, the goal of this unit would be for students to have a more concrete and relevant experience when learning about human impact on the environment. We as educators, do not want them to just think momentarily about these effects and to see them in far away places, but to see how these are local and widespread issues affecting all of us every day. We also want them to become passionate pioneers looking to effect change and invent solutions for future generations to come.

Objectives:

Students will be able to:

- Conduct simple water quality testing.
- Organize, represent and interpret data from multiple sources (testing, data from USGS Water Watch, animal tracking data).
- Research and learn about components affecting DO in water through individual, group and field study research (Alley Pond).
- Use evidence to support and explain a cause effect relationship between variables.
- Explain changes in the water quality (if any) over a period of years.
- Explain connections between water quality data and animal tracking data.
- Report their findings.

Standards:

Science and Engineering Practices:

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena.

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle

nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

Crosscutting Concepts:

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Common Core State Standards Connections:

Mathematics –

6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS2-3)*

ELA/Literacy –

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. *(MS-LS1-5)*

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5)

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-LS2-3)*

5E Lesson Plan	
Engage The purpose for the ENGAGE stage is to pique student interest and get them personally involved in the lesson, while pre-assessing prior understanding. (1 period)	Developing Student Questions: Show students tweet of Great White Shark tracked in Long Island Sound, have students come up with 5 questions they would ask OCEARCH about this or other sharks.  Students will share their questions in their small groups and decide which are the "best" 4-5 questions to ask. During this time they will try to refine questions as a group to make them higher level. Groups will share out and discuss their questions and place them on post its on a class

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	board to organize questions by category – students will select the categories as a class (for example – about the body of the animal, feeding, habits, danger, environment, etc.) The teacher can help the class arrange the questions and lead discussion to develop categories or improve questions for struggling students. Students can also use DOK question stems to help develop questions: See below
Explore The purpose for the EXPLORE stage is to get students involved in the topic; providing them with a chance to build their own understanding. (1-2 periods)	Teacher introduces the topic: Some scientists think that seeing a Great White shark shows how healthy the ocean is. (Possible HW article: https://www.washingtonpost.com/science/2019/05/21/great-white-shark-was-tracked-long-island-sound-first-time-thats-good-news/?noredirect=on&utm_term=.333f2ce16e94) Other scientists think this means the ocean is not healthy as the animal is having to go to new places to look for food. We will look at water quality in the Long Island Sound to determine if the Sound is "healthy," what issues it still has, what causes these issues and how we can solve them. The students will use map on google earth to locate the school and last tracking of Great White shark https://earth.app.goo.gl/ZWeZ5A JHS 185 Edward Bleeker JHS Coordinates: 40.7751° N, 73.8185° W Shark tracked off coast of Greenwich, CT 41.0262° N, 73.6282° W They will then compare to maps of water quality in the Long Island Sound: Using EPA Waters KMZ dataset https://www.epa.gov/waterdata/viewing-waters-data-using-google-earth#Download OR optional can use preprinted or google classroom loaded maps. Map Source: http://www.iec-nynjct.org/sites/default/files/2018-08/LIS%202017%20IEC%20CTDEEP%20Combined%20Report%20.pdf Students will make observations answering: What do you see? What does it mean? The class will discuss observations of maps to show that closer to the city (our school) there is more red -indicating higher levels of hypoxia (less dissolved oxygen in the water). How does that compare with the location of the shark? Students will hypothesize in small groups – what do you think is leading to less DO in the water? Do you think sharks need DO or not?

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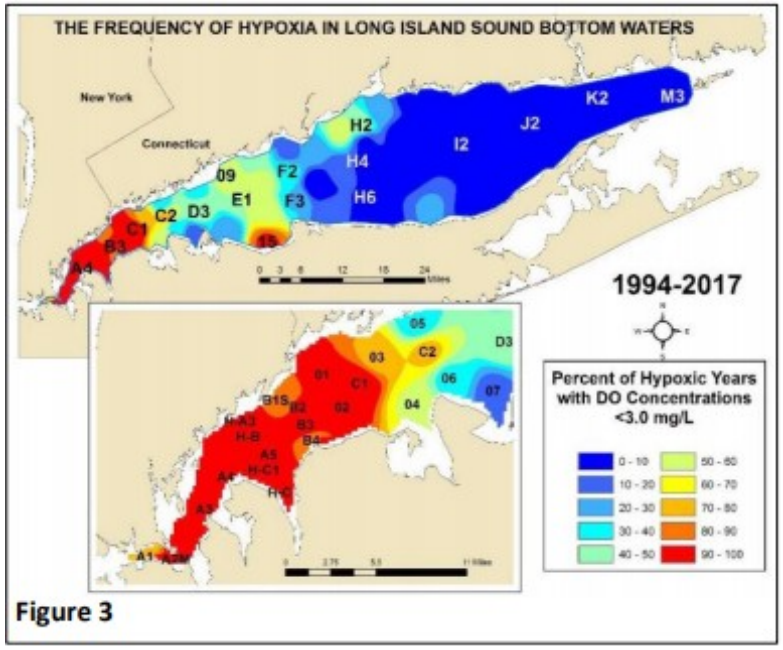
FIELD TRIP	 Figure 3 On day 3 students will attend a field trip to Alley Pond Environmental Center where they will further explore during the program “Water cycles and watersheds” covering estuaries, watersheds and performing water quality testing. The program allows students to “Investigate the steps of the water cycle and explore how water travels through a watershed system. Focus on the chemical, biological, and physical properties of water, as well as the social implications of water use as we explore NYC’s water systems” (alleypond.com).
Explain The purpose for the	Students will conduct research to evaluate the importance of water quality on the environment/ecosystems. Students will create an infographic to display their information regarding water quality:

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EXPLAIN stage is to provide students with an opportunity to communicate what they have learned so far and figure out what it means. (3-4 periods, includes presentation)	https://docs.google.com/document/d/1m-rFyLwesRTqkOw6JSrirktPzT7TpY20LMxCme64Y8k/edit?usp=sharing Rubric: https://docs.google.com/document/d/1hL0RB0NBJV4-zp5lxZMYD7uTJBPGn5W8mb_o53CYIcM/edit?usp=sharing
Elaborate/Extend The purpose for the EXTEND stage is to allow students to use their new knowledge and continue to explore its implications. (3-4 periods) **Shark Tracking**	Groups will select a component of water to evaluate the as an IV – What is the effect of IV on Dissolved Oxygen in the water? How do you think this affects the life in those bodies of water? They will complete inquiry as a lab report via google docs: https://docs.google.com/document/d/1ngfdFS2xuiVGlNa6U_kcQg2AqZ2pLuyZtrV-l_hogKM/edit?usp=sharing Schoolwide Lab Rubric: See Below Students will track a specific great white shark using Ocearch or Sharktivity app (on their phone or school ipads). They will compare this sharks movements to water quality data collected to draw conclusions. **Closing writing task**: Do you think the water quality in the Long Island Sound is improving or declining? Use evidence from your infographic, lab report and animal tracking to explain how water quality in the sound connects to the Great White Shark movements.
Evaluate The purpose for the EVALUATION stage is for both students and teachers to determine how much learning and understanding has taken place.	Formative assessment is ongoing through group – teacher discussions and classroom questioning. The infographic will be used as both a formative and summative assessment to evaluate which students need more support with making connections between the cause and effect components of water quality in the lab report task. The lab report assessment will be summative. The students will be informally assessed as a closing in making connections between the Great White tracking and its visit to the

5E Lesson Plan	
	Long Island Sound.

DOK Question Stems

DOK 1	DOK 2
• Can you recall_____? • When did ____ happen? • Who was ____? • How can you recognize____? • What is____? • How can you find the meaning of____? • Can you recall____? • Can you select____? • How would you write___? • What might you include on a list about___? • Who discovered___? • What is the formula for___? • Can you identify___? • How would you describe___?	• Can you explain how ____ affected ____? • How would you apply what you learned to develop ____? • How would you compare ____? Contrast_____? • How would you classify____? • How are____alike? Different? • How would you classify the type of____? • What can you say about____? • How would you summarize____? • How would you summarize___? • What steps are needed to edit___? • When would you use an outline to ___? • How would you estimate___? • How could you organize___? • What would you use to classify___? • What do you notice about___?

DOK 3	DOK 4
• How is ____ related to ____? • What conclusions can you draw _____? • How would you adapt____to create a different____? • How would you test____? • Can you predict the outcome if____? • What is the best answer? Why? • What conclusion can be drawn from these three texts? • What is your interpretation of this text? Support your rationale. • How would you describe the sequence of____? • What facts would you select to support____? • Can you elaborate on the reason____? • What would happen if___? • Can you formulate a theory for___? • How would you test___? • Can you elaborate on the reason___?	• Write a thesis, drawing conclusions from multiple sources. • Design and conduct an experiment. Gather information to develop alternative explanations for the results of an experiment. • Write a research paper on a topic. • Apply information from one text to another text to develop a persuasive argument. • What information can you gather to support your idea about___? • DOK 4 would most likely be the writing of a research paper or applying information from one text to another text to develop a persuasive argument. • DOK 4 requires time for extended thinking.

From Depth of Knowledge – Descriptors, Examples and Question Stems for Increasing Depth of Knowledge in the Classroom Developed by Dr. Norman Webb and Flip Chart developed by Myra Collins

Lab Rubric:

	4	3	2	1	0
Design an Experiment	Experimental design uses most of the hints in it and clearly relates to the testable question. An IV, DV and constants are presented.	Experimental design uses 2-3 of the hints in it and somewhat relates to the testable question. An IV, DV and at least 1 constant are presented.	Experimental design relates to the testable question but does not use any hints. An IV, DV or constants are not clear.	Experimental design not relevant to the testable question. An IV, DV and constants may or may not be present.	Not present
Hypothesis	States complete hypothesis, If… then…because…format and appropriate for the investigation based on the experimental design created.	States hypothesis appropriate for the investigation with some details from the experimental design created. If…then…because format present.	States complete hypothesis, that is partially appropriate for the investigation, with an incomplete if…then…because format and/or not related to the experimental design created.	States hypothesis that is not in the If…then…because…format or relevant to the investigation or the experimental design created.	Not present
Materials	A list of materials relevant to the experimental design are explicit and detailed. Amounts or measurements are presented.	A list of materials relevant to the experimental design are present. Amounts or measurements are present but not explicit.	Materials are appropriate to the experiment presented but not listed appropriately. No amounts or measurements are included in the list.	Materials not appropriate for the experimental design created are listed or stated. Measurements may or may not be present.	Not present
Procedures	Procedures are presented as steps. Detailed in an appropriate order with measurements and explicit instructions to follow.	Procedures are presented as steps. Details are implied or partially stated. Measurements are presented.	Procedures are stated in paragraph format and not as steps. Amounts may or may not be presented.	Procedures are not relevant to the materials list or experimental design.	Not present
Organization and Presentation of Data	Shows appropriate relationship between variables (IV & DV). Created a table or chart that accurately displays data collected.	Attempts to show appropriate relationship between variables (IV & DV). Attempts to create a table that displays the data collected.	Attempts to show a relationship between variable although it is incorrect. Created a data table of chart with incorrect data or no data entered.	Relationship between variables is not present. Unlabeled, unclear data table presented with no information on it.	Not present
Analyze Data	Explanation of the trend is detailed and matches the data table created.	Explanation of the trend is general and matches most of the data in the data table created.	Attempts to explain the trend in the data table with little use of evidence.	Describes what the table looks like but does not explain the trends.	Not present
Conclusion: Apply what you learned	Clearly explains how the investigation tested the hypothesis. Clearly explains why the experiment yields reliable data and why the variables are isolated and controlled. Explains possible sources of error clearly.	Adequately explains how the investigation tested the hypothesis. Partially explains why it yields reliable data and why the variables are isolated and controlled. Somewhat explains possible sources of error.	Explains what happened in the investigation but does not explain how it helped test the hypothesis. Limited explanation of either why the investigation yields reliable data or why the variables are isolated and controlled. Unclear or incorrect explanation of possible sources of error.	Limited description of how the investigation connects to the hypothesis or only repeats the experimental design. Does not address reliable data, variables being isolated and controlled or sources of error.	Not present

Resources:

Twitter OCEARCH https://twitter.com/ocearch?lang=en

USGS Water Watch https://waterwatch.usgs.gov/wqwatch/

Depth of Knowledge – Descriptors, Examples and Question Stems for Increasing Depth of Knowledge in the Classroom Developed by Dr. Norman Webb and Flip Chart developed by Myra Collins

Google Earth: https://earth.app.goo.gl/ZWeZ5A

EPA Waters KMZ dataset https://www.epa.gov/waterdata/viewing-waters-data-using-google-earth#Download

Map Source: http://www.iec-nynjct.org/sites/default/files/2018-08/LIS%202017%20IEC%20CTDEEP%20Combined%20Report%20.pdf

Student Research Websites:

http://www.iec-nynjct.org/sites/default/files/2018-08/LIS%202017%20IEC%20CTDEEP%20Combined%20Report%20.pdf
https://www.epa.gov/waterqualitysurveillance
https://www.americangeosciences.org/critical-issues/faq/what-affects-quality-surface-and-groundwater
https://www.wshu.org/post/report-water-quality-long-island-sound-continues-improve#stream/0
http://longislandsoundstudy.net/get-involved/teaching-resources/getting-out-and-on-the-sound/

Apps:
Ocearch
https://apps.apple.com/us/app/ocearch-shark-tracker/id570772231
https://play.google.com/store/apps/details?id=org.ocearch.SharkTrackerAndroid&hl=en_US

Sharktivity
https://apps.apple.com/us/app/sharktivity/id1097933510
https://play.google.com/store/apps/details?id=com.io.conserve.sharktivity&hl=en_US