AMP IT UP

Advanced Manufacturing & Prototyping Integrated to Unlock Potential

Life Science Experimental Design (7EDS)

"Oil Spill Drill"

Oil Spill Challenge

<table>
<tr><td>Module Description</td><td colspan="2">Students engage as environmental engineers to develop a procedure that would remove the most amount of oil from the ocean in the shortest time possible in the event of a large-scale oil spill. The students use a scale model of an actual oil spill, test their procedure, share their data, generate histograms. The class works together to iteratively develop a procedure that controls variables and reduces error. The module covers some basic concepts on how human actions impact an ecosystem and different methods of reducing the damage of oil spills on the environment, seeding further exploration of GPS standards later in the semester or year.

Module features Dr. Joel Kostka's work in the School of Biology and Earth & Atmospheric Sciences and the work of Dr. Annalisa Bracco and the ECOGIG Research Consortium in the School of Earth and Atmospheric Sciences.</td></tr>
<tr><td>Related Georgia Performance Standards</td><td colspan="2">S7L4. Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.
c. Analyze and interpret data to provide evidence for how resource availability, disease, climate and human activity affect individual organisms, populations, communities and ecosystems.</td></tr>
<tr><td>Module Timeline</td><td>50-minute class periods:
5 days
Day 1: Section 1, 2
Day 2: Section 2
Day 3: Section 2, 3
Day 4: Section 4
Day 5: Section 4</td><td>90 minute blocks:
3 days
Day 1: Sections 1, 2
Day 2: Section 2, 3
Day 3: Section 4</td></tr>
<tr><td>Documents Included in the Download</td><td colspan="2"><u>Student Materials Folder</u>
• Student Edition (recommended to be printed double sided)
• Student Worksheet Packet (recommended to be printed single sided)
• Histogram Handout (recommended to be printed single sided)

<u>Teacher Materials Folder</u>
• Materials List
• Annotated Teacher's Edition
• Teacher Preparation Guide
• Videos</td></tr>
</table>

5E Stage	**Student Activities** How will students engage actively in the three dimensions throughout the lesson?	**Teacher Activities** How will the teacher facilitate and monitor student learning throughout the lesson?
Engage How does the lesson capture student interest, activate prior knowledge, and connect to a complex question, global issue, or real world problem?	• Students are introduced to the challenge and the reasons for using a model with their investigation *(1.3,1.4)* • Students learn about the proposed efforts to drill offshore the Georgia coast (*1.3*) • Students learn about oil spills (Deepwater Horizon) and research at Georgia Tech on cleaning up oil spills *(1.1,1.2,5.1,5.2)*	• Guide students through text to check for understanding • Discuss the importance of the challenge of cleaning up oil spills, Deepwater Horizon (students may remember it or heard of the movie) and GT's research in the field • Discuss the need to using models to represent real-life situations
Explore How does the lesson allow students to develop a common base of experiences by actively investigating the phenomenon or problem?	• Students plan their investigation and write a procedure for carrying it out *(2.1,3.2)* • Students follow their procedure and record data from their trials *(2.2,4.1)* • Students share their data with the class and record all data on a histogram *(2.3,4.2)*	• Review materials available for use and model constraints with students. • Class procedure- as you guide students focus on what variables need to be controlled. • Allow 15 minutes for students to run investigations and take note of students changing their experiment in-between trials. • Record groups' data on a class histogram that is projected so students can record it.
Explain How does the lesson allow students to develop, share, critique, and revise their own explanations before connecting those to accepted scientific explanations and terminology?	• Students analyze the histogram data, comparing the distribution of data to the procedure that was followed. *(2.4,4.3)* • Students discuss the procedural differences between groups and the need for sound procedures and variable control in order to collect consistent data (*3.1,3.2)*	• Lead a discussion about the distribution of data and how individual procedures impacted the variation & why a large spread of data is evidence of unreliable data. • Lead a class discussion comparing the 2 histograms, how the spread has changed and if there is a need for a 3rd investigation
Elaborate How does the lesson allow students to extend their conceptual understanding of the three dimensions through opportunities to apply knowledge, skills, and abilities in new experiences?	• Students will write a letter to the Georgia Tech research team explaining what they have learned about the need for writing/following clear procedures *(4.4)*	• Letter is scaffolded for students but remind them to include details of the variables they had to control and why they had to do that and the evidence that their procedure is meeting the goals of the challenge.
Evaluate How does the lesson—through both formative assessments embedded throughout the lesson and a summative assessment that might coincide with the elaborate phase—make visible students' thinking and their ability to use practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions?	**Formative:** Ongoing questioning and discussion *(all sections)* Investigation Sheet 1 (*2.1,2.2)* Results Graph 1 *(2.3)* Investigation Sheet 2 *(4.1)* Results Graph 2 *(4.2)* **Summative:** Recommendation Letter *(4.4)*	

	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	4.4	5.1	5.2
Engage	—	—	—	—											—	—
Explore					—	—	—			—	—	—				
Explain								—	—	—						
Elaborate														—		
Evaluate					—	—	—				—	—		—		

Section 1 – The Oil Spill Challenge *(25 minutes)*

Students are introduced to the Oil Spill Challenge. Oil Spills are a very serious pollution problem in our oceans and a recent oil spill in the Gulf of Mexico caused many deaths and injuries to the wildlife in that area. Students will find out that there is a possibility that the Georgia coast may open up to drilling. Many organizations in Georgia are against this drilling and want to have a procedure in place for clean-up in case there is an oil spill near the Georgia coast. Students will learn that they are taking on the role of an environmental engineer and in order to complete this challenge, students will need to develop a clean-up procedure that would remove the most amount of oil in the ocean in the shortest time possible. In addition to removing the oil from the ocean, students will have to try to remove the least amount of water in order not to disturb the ocean ecosystem. Students learn that they will not be performing this procedure in the actual ocean, but instead using a model of the oil spill.

Preparation

Materials	Student Pages
• **Video #1: Deep Horizon Oil Spill** • **Video #2: Oil Cleanup Methods** ○ **Optional Video:** Excerpt from 60 Minutes on Gulf Oil Spill: Poison Tide: https://youtu.be/Zlw1ANlaeWI (10:48)	• None
Prep the Day Before: Review text and videos. Think about experience with oil spills and what questions students may ask. Brainstorm a list of sample models	

Planning

GPS	***S7L4. Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.*** *c. Analyze and interpret data to provide evidence for how resource availability, disease, climate and human activity affect individual organisms, populations, communities and ecosystems.*
NGSS	**Performance Expectations:** **MS-ETS-1**: *Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.* **MS-LS2-1:** *Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.* **Disciplinary Core Idea: LS2.A:** *Interdependent Relationships in Ecosystems* **Practice:** *Analyzing and Interpreting Data* **Crosscutting Concepts:** *Systems and Models*

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Oil Spill • Ecosystem • Model • Environmental Engineer • Simulation • Oil Spill Cleanup Methods	• How do scientists solve problems? • What affect do changes in the environment have on organisms?	• Discussion Questions: **Participation**

Section 2 – Investigate an Oil Spill *(60-90 minutes)*

Students design and run a procedure to determine how to remove the most amount of oil in a one minute time period, while removing the least amount of water. Students are introduced to the idea of a scale model and the criteria and constraints of the challenge. They learn that that they will be conducting their procedure using a model of an oil spill and will be given a specific recipe on how to set-up their oil spill. Students will be assigned specific materials to use and given a short period of time to discuss and develop a procedure for removing 20 ml of oil from the spill in a one minute time period while removing the least amount of water. The students are provided with the constraint that the tray of water represents the ocean—so they cannot tip or move the tray of water. Students will then carry out their procedure and run 5 trials. They will record the number of milliliters of oil and water they removed with each trial. If students are having difficulty reading their measurements, it may be important to review the tutorial on how to read a graduated cylinder. After each group records their data, they will report and record their results on a class histogram. The class will then analyze the histogram and data through participating in a class discussion using guiding questions in the student text.

Preparation

Materials	Student Pages
• Newspaper • Aluminum tray (per group) • Plastic beaker (per group) • Foam tray (per group) • Graduated cylinder (per group) • Water • Oil • Plastic spoon (per group) • Paper towels/baby wipes (as needed) • Wide popsicle stick (per group) • Stopwatch/timer (per group or class) • Gloves (per student) • Aprons (per student, as needed) You will need to use the beakers, graduated cylinders, and funnels again in each class period. You can use new trays, spoons, popsicle sticks, cups per class and do cleanup at the end of the day! Students should dispose of all oil in the buckets at the end of each class period. You can then dump the oil outside at the end of the day. You will have to reuse the trays for the second iteration—so don't throw them out.	• Oil Challenge Investigation Sheet • Oil Challenge Results Graph
Prep the Day Before: Sort materials by group; Download class histogram on computer for projection; Perform the investigation as practice (if needed). Create set-ups for each group to bring back to their tables—You may even want to pre-measure the oil in cups (paper or plastic) if you have extra in your class and allow students to pour the oil from a cup into their graduated cylinder. If you do not do this---you probably want to pour the oil for the students during or before class. You also want to have newspaper available for students to cover their desks/ work area. This investigation has the potential to be very messy—however with good management, you can limit the mess and have effective cleanup methods.	

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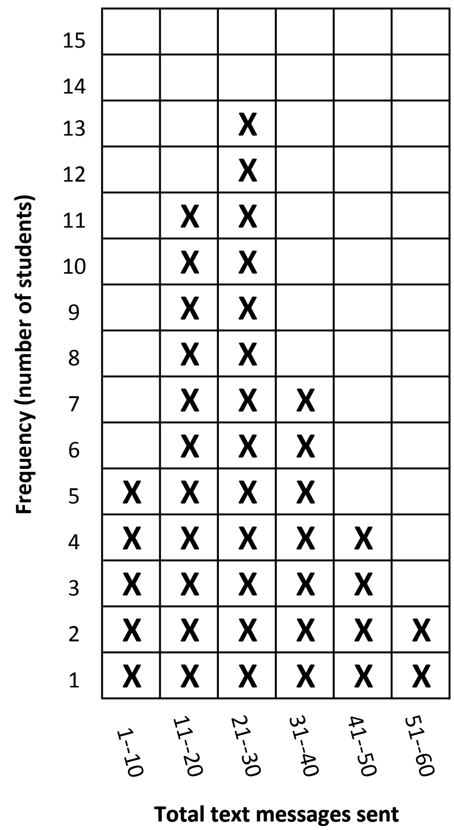
Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Model • Procedure • Graduated cylinder • Histogram • Oil cleanup vocabulary: Skimmer, Boom, Absorber, Dispersant	• How can consistent procedures be developed?	• Procedure and Data Collection: **Formative** • Student histograms: **Formative** • Class Discussion Questions: **Participation**

2.3 COMMUNICATE YOUR RESULTS- Histogram Tutorials

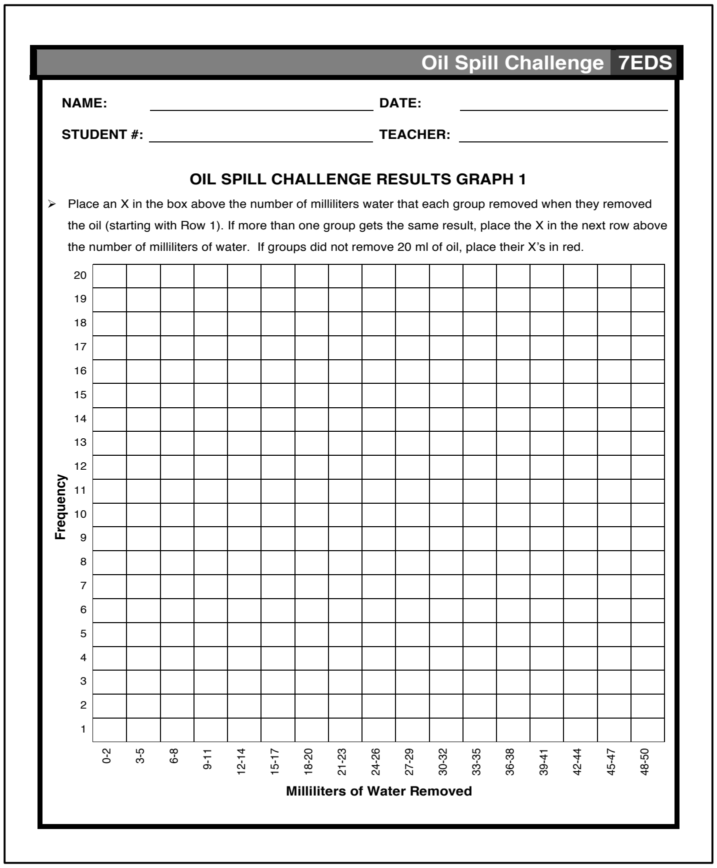
Tutorial: Graphing a Histogram

A histogram is a type of graph that shows the **frequency** (number of times) that a specific outcome occurred.

For instance, suppose you wanted to see the number of text messages that the students in your class sent last week. You could count the number of students that the sent 0-10 messages, the number of students that sent 11-20 messages, etc. If four students sent 0-10 messages, then the frequency of 0-10 messages is four. A hypothetical graph of these data is on the right. *Text messages sent* is on the X-axis and *Frequency (number of students)* is on the Y-axis. How many students sent between 31-40 text messages?



When a group reads their results, you will also ask if they removed 20 milliliters of oil. <u>If they did not remove the minimum amount of oil, you will mark that X with a ***red*** pencil</u>



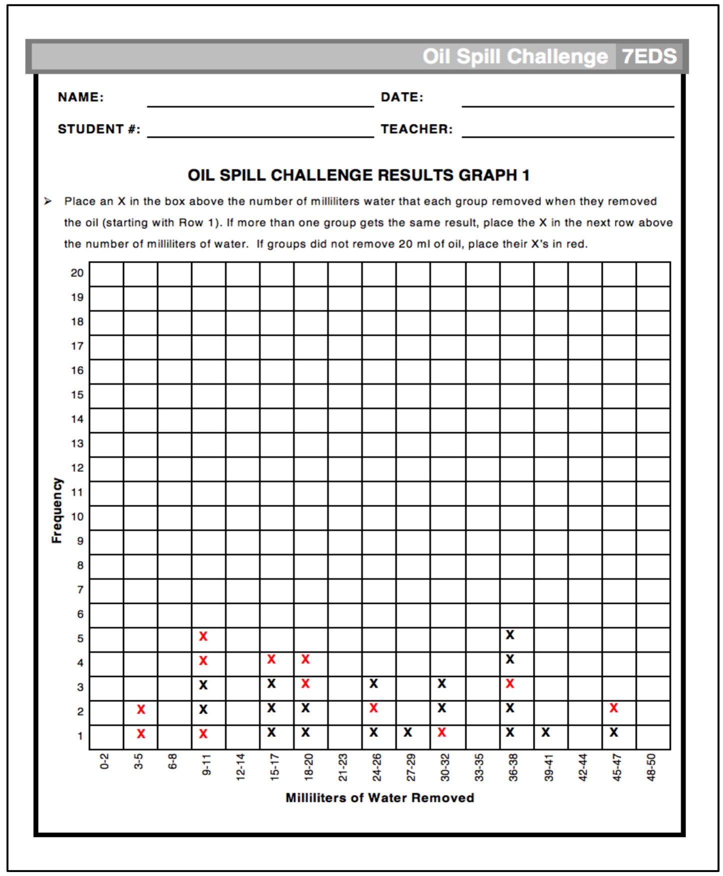
Oil Spill Challenge 7EDS

NAME: DATE:

STUDENT #: TEACHER:

OIL SPILL CHALLENGE RESULTS GRAPH 1

- Place an X in the box above the number of milliliters water that each group removed when they removed the oil (starting with Row 1). If more than one group gets the same result, place the X in the next row above the number of milliliters of water. If groups did not remove 20 ml of oil, place their X's in red.



Oil Spill Challenge 7EDS

NAME: DATE:

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OIL SPILL CHALLENGE RESULTS GRAPH 1

- Place an X in the box above the number of milliliters water that each group removed when they removed the oil (starting with Row 1). If more than one group gets the same result, place the X in the next row above the number of milliliters of water. If groups did not remove 20 ml of oil, place their X's in red.

Section 3 – Redesign Your Investigation *(35 minutes)*

Students identify factors in their procedures that led to inconsistent results, and then design a more precise class procedure to control these factors. They design a class procedure that is detailed and replicable, controlling each factor they identified. Students reflect on their new procedure by comparing it to the original procedure and they see how their ability to plan an investigation has improved. In Part 1, students will learn about trustworthy procedures and the process of developing a standardized procedure. Students will review the challenge and develop a list with teacher facilitation on procedural differences between groups. As a class, students will develop a standardized procedure and record on a second Oil Spill Challenge investigation sheet. In Part 2, students will review and answer discussion questions based on their new procedures.

Preparation

Materials	Student Pages
• Copy of Histogram from Section 2 • Oil Challenge Investigation Sheet from Section 2	• Oil Challenge Investigation Sheet
Prep the Day Before: Review the Class Histogram from Section 2. Develop categories for designing the new procedure	

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Standardized Procedures • Histogram • Variation • Data • Consistency	• How can consistent procedures be developed?	• Oil Challenge Investigation Sheet (Revised Procedure): **Formative** • Class Discussion Questions: **Participation**

Section 4 – The Oil Spill Challenge with a New Procedure *(60 minutes)*

Students run their revised Oil Spill Challenge procedure and collect data, which they will share on a class histogram. Comparing the spread of data on the histogram to the initial histogram from Section 2 will allow the class to evaluate their new procedure and determine if the class results are reliable. Students will be using the same model for their oil spill set-up with the new class procedure If the data is clustered on the histogram, students can determine that they have evidence to show that they have developed a precise and standard procedure that can accurately and repeatedly remove oil from the water. Students should review the final section summary and understand that well designed procedures control variables to reduce error.

Preparation

Materials	Student Pages
• Newspaper • Aluminum tray (per group) • Plastic beaker (per group) • Graduated cylinder (per group) • Water • Oil • Plastic spoon (per group) • Wide popsicle stick (per group) • Wide mouthed plastic cup (per group) • Stopwatch/timer (per group or per class) • Paper towels/baby wipes (as needed) • Gloves (per student) • Aprons (per student)	• Oil Spill Investigation Sheet • Oil Spill Results Chart • Recommendation Letter
Prep the Day Before: Sort materials by group; Download blank class histogram along with class histogram from Section 2 on computer for projection.	

Planning

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NGSS	Performance Expectations: MS-ETS1-4: *Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.* MS-LS2-1: *Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.* Disciplinary Core Idea: LS2.A: *Interdependent Relationships in Ecosystems* ETS1.B: *Developing Possible Solutions,* ETS1.C: *Optimizing the Design Solution* Practice: *Analyzing and Interpreting Data, Developing and Using Models* Crosscutting Concepts: *Systems and Models*

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Standardized Procedures • Histogram • Variation • Consistency • Variable • Controls (controlled variable)	• How can consistent procedures be developed?	• Oil Spill Investigation Sheet: **Formative** • Oil Spill Results Graph: **Formative** • Recommendation Letter: **Summative**