Bee Bot Saves the Ocean!

A Kindergarten Exploration into Reducing the Impact of Oil Spills

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How This Activity Addresses Both the ETS and ESS Standard:

Engineering Design Standard (ETS)

- **ETS1.C**: Optimizing the Design Solution - Because there is always more than one possible solution to a problem, it is useful to compare and test designs
    - In kindergarten → **K-2-ETS1-1**: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool
- In this activity, students will be making observations about the impact of oil spills. Through a combination of literature (*Oil Spill!*) and inquiry activities (studying the properties of oil), the class will record what they notice ("make observations") and wonder ("ask questions") in an OWL chart. Over the course of the project, students will revise their thinking and use what they learned to articulate why oil spills are a problem. Then, students will use what they discover to design and test a solution to this problem in the form of a tool that can be used to clean up an oil spill.

Disciplinary Core Idea (DCI)

- **ESS3.C**: Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impact on the land, water, air, and other living things
    - In kindergarten → **K-ESS3-3**: Communicate solutions that will reduce the impact of humans on the land, water, air and/or other living things in the local environment
- Throughout this project, students will work to answer the following guiding questions: (1) how are oil spills harmful to animals?, and (2) how can humans reduce the impact of oil spills. To answer these questions, students must meet the kindergarten expectations for ESS3.C. The "Explain" phase of our project gives them the opportunity to do this. Before they use tools to clean-up the oil spill impacting their Bee Bot, students must be able to explain (1) why it is important for humans to clean up oil spills (in other words, the negative effects that oil spills have), (2) the reasoning behind their tool design (why they chose to include certain materials and exclude others), and (3) how our classroom scenario relates to oil spills in the real world (for instance, how the materials they use relate to materials actually used to clean up oil spills). All of these expectations are included in the rubric used to formatively and summatively assess students throughout the project. By meeting these expectations, students will not only be communicating solutions to reduce the

impact of humans on water and living things, but also communicating how these solutions work and why they are important.

Crosscutting Concept (CCC)

- **Cause and Effect**: Events have causes that generate observable patterns
  - This lesson shows a cause and effect relationship between oil spills and animals, as well as, humans' efforts to clean up oil spills and the impact that has on marine life habitats.
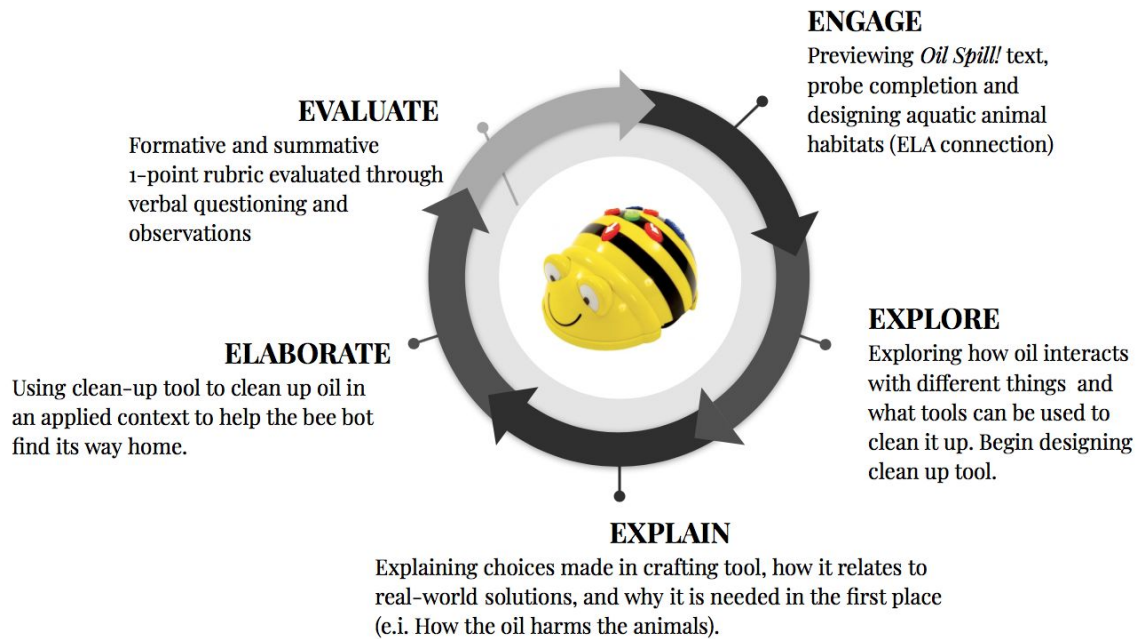
Science and Engineering Practices (SEP)

- **Obtaining Evaluation and Communicating Information:** Obtaining evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information
  - Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas
- Throughout the project, students will be observing the properties of oil and materials that can clean oil spills up. They will use what they learn through these inquiries to communicate a solution for cleaning up an oil spill. They will explain the reasoning behind selecting certain materials for their tool and how their tool solves the problem that oil spills create.

Bee Bot

ENGAGE
Previewing *Oil Spill!* text, probe completion and designing aquatic animal habitats (ELA connection)

EVALUATE
Formative and summative 1-point rubric evaluated through verbal questioning and observations

EXPLORE
Exploring how oil interacts with different things and what tools can be used to clean it up. Begin designing clean up tool.

ELABORATE
Using clean-up tool to clean up oil in an applied context to help the bee bot find its way home.

EXPLAIN
Explaining choices made in crafting tool, how it relates to real-world solutions, and why it is needed in the first place (e.i. How the oil harms the animals).

Engage-

The teacher will launch this project by giving the adapted probe titled, "How Are Animals Affected by Humans?" The goal of this is to see what students already know about the impact of oil spills to help guide the "L" part of the OWL chart and make sure to directly address any misconceptions. After the probe is administered, the teacher will read the first few pages of *Oil Spill!,* the children's literature connection. [More explained in the children's literature section] The students will then make inferences about how the oil could be harming the animals depicted in the illustrations on pages 10-13. These observations and wonderings will be added to the OWL chart that will anchor the entire exploration.

Questions	O	W	L
1. How does oil harm animals?	Ex: It sticks to bodies.	Ex: Why does it hurt them when it sticks to their bodies?	(to be fill in during "explain"
2. How can humans help?	Ex: They can use sponges	Ex: How do humans find big enough sponges?	(to be fill in during "explain"

After reading *Oil Spill!* [more details below], the students will bring out the habitats they created for their assigned animal that will serve as their Bee Bot board later in the lesson. The class will make the connection between this new science lesson and what the students are learning in ELA about animal habitats. In ELA, the students will have been learning about animals, their habitats and the impact humans have on these habitats. In this STEAM lesson, the students are diving deeper into a specific human impact, oil spills, and ask questions, make observations and create a tool to address a solution for how to decrease this human impact. The habitat of their designated animal will soon be affected by an oil spill later in this lesson. Lastly, the students will decorate their Bee Bot to look like their animal, using what they know about its physical characteristics from their ELA research.


Explore-

During the explore phase, the students will explore how oil interacts with different things, such as their skin, feathers and water. Students will first make observations about how the oil feels on their skin, the feathers and the water. It may feel sticky, hard to get off, slimy etc.. The students will make inferences and add these observations to the OWL chart under "Question 1- How does oil harm animals?", along with any wonderings they spark.

The students will then begin to explore what kind of materials help them clean up the oil. Students will be given materials such as.... (this can be adapted to what your classroom has, but the bolded materials are ones you want to make sure to have. Also, you can know ahead of time that some of these will not work, since that is part of the exploration!)

- **Cotton balls**
- Tissue paper
- Q-tips
- Paper towels
- Aluminum foil
- Felt
- **Pipettes**
- **Sponges**

As students explore these materials, they will now add their observations and wonderings to the OWL chart under Question 2- How can humans help?" They will begin to brainstorm with their partner which materials would be most helpful to humans wanting to clean up an oil spill.

Once students have decided which objects work best, they will use them to make their own tool that will help them clean up the oil spill in their animal's habitat. The teacher will give the students the scenario of, "Oh no!! There has been an oil spill in your animal's habitat! How can you use your new knowledge to clean up the water and help them get back home?" Students will begin making their tool.
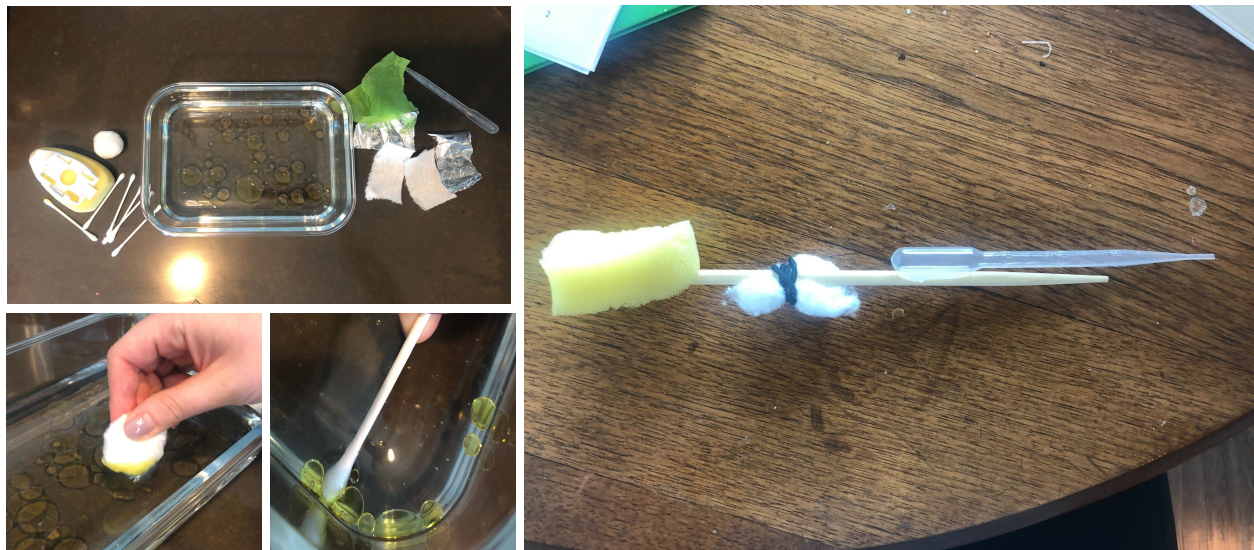
Explain-

After students have made their tool, they will explain their material choices with the group, providing reasoning for why each material was used based on their observations and information gathering.

Once the students have shared, the teacher will begin some direct instruction and the class will begin to fill in the "**L**" part of the OWL chart. The teacher will use the rest of the *Oil Spill!* text (Berger & Mirocham, 1999) to help answer students' wonderings and address any misconceptions. This is also where the information gathered from the probe will come in handy [more on the probe explained below]. Here it is important that the teacher makes explicit, direct connections between the materials the students used in their tools to clean up oil and what real adults use to clean up large oil spills mentioned in the text. For example, people use "skimmers" that act as a vacuum to suck the oil from the water. The teacher can ask the students, "Which part of your tool does this?" in which the response will be, "the pippett!"
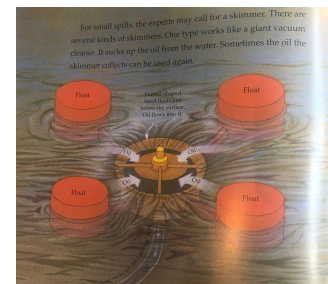
Elaborate-

        In the "Elaborate" phase, students will apply their understanding of what kinds of materials clean up oil and the design of their tool to the real-world context scenario mentioned above. The students will find oil spilled on a path on their Bee Bot animal's habitat. They must clean up the oil using their tool, so the Bee Bot can complete the pathway necessary to get back home.

Evaluate-

        Students will be evaluated using a 1-point rubric formatively and summatively during the STEAM lesson project. In a 1-point rubric, the middle is "Meets Expectations" and if the student shows areas above or below expectations the teacher fills in comments on either side of the rubric. The student's understanding will be observed as well as recorded during oral questioning.

Rubric for Student Understanding:

	Student can articulate which materials worked best to clean up the oil and why.	
	Student can explain what materials they used in making their tool and why they used those materials.	
	Student can articulate how oil harms animals.	
	Student can articulate how humans can help clean up their negative impact.	
	Student used trial and error to persevere in cleaning up oil in their Bee Bot's habitat	

Before students can communicate solutions for reducing the impact of humans on the environment (K-ESS3-3), students must first understand the problem that makes these solutions a necessity. In this project, students must understand why oil spills are a problem before they can learn about and communicate ways that humans can reduce the impact of oil spills. The purpose of the probe adapted for this project ("Do They Need Air?") is to elicit student thinking about the problem (Keeley, 2013). Oil spills harm living things in many ways, however a common misconception that students of this age often have might hinder their ability to understand this. Young children only recognize the needs of living things that they can concretely observe (for instance, eating and drinking water) (Keeley, 2013). However, living things have needs that are not observable, such as regulating their body temperature and breathing both above and under water. In order for students to understand that oil spills impact animals in both observable and unobservable ways, this misconception must be tested for. Only when students understand all of these impacts can they start to create and communicate solutions for them.

The original science probe elicits student thinking about whether or not living things need air (an unobservable need) (Keeley, 2013), but to make it more relevant to this project, we put this need into the context of an oil spill. Furthermore, we generalized the need of air to the unobservable impacts of oil spills on animals. Despite these changes, the probe still addresses the misconception students often have at this age, that not all living things' needs are observable.

   The children's literature to be used with this STEAM exploration is titled, *Oil Spill!* By Melvin Berger and illustrated by Paul Mirocha. This text will first be used in the "Engage" section to hook the students in. The first couple pages provide students with a look into what an oil spill is and how it affects some of their favorite animals and the animals they have been learning about in ELA. During the "Engage" section, only read the text on the first couple pages, pages 5-9. These pages give a scenario of an oil spill happening. The next few pages, pages 10-13 begin to introduce some of the animals that are impacted by this oil spill. Only show the students the pictures on this page and have them begin to make inferences about how the oil may be harming these animals. Students will continue to make these predictions when they explore real oil and both will be filled into the OWL chart.

   During the "Explain" phase, the class will revisit the book and fill in the "L" part of our OWL chart. Everyone will revisit the students' inferences from the pictures on pages 10-13, their observations of the oil, their wonderings after exploring how the oil interactions with their skin, feathers and water and their ideas about how humans can help based on what materials best clean up the oil. The text will now be used to help fill in the gaps and answer the students wonderings about how oil harms animals and how humans can help. The teacher will now read words that went with the pictures of the animals that lead the students to make inferences, as well as the rest of the pages that discuss different tools humans use to clean up large, ocean oil spills. The teacher will make explicit connections between real contraptions adults use that are mentioned in the book and the materials the students used to make their tools to clean up their oil spill in the "Elaborate" section.
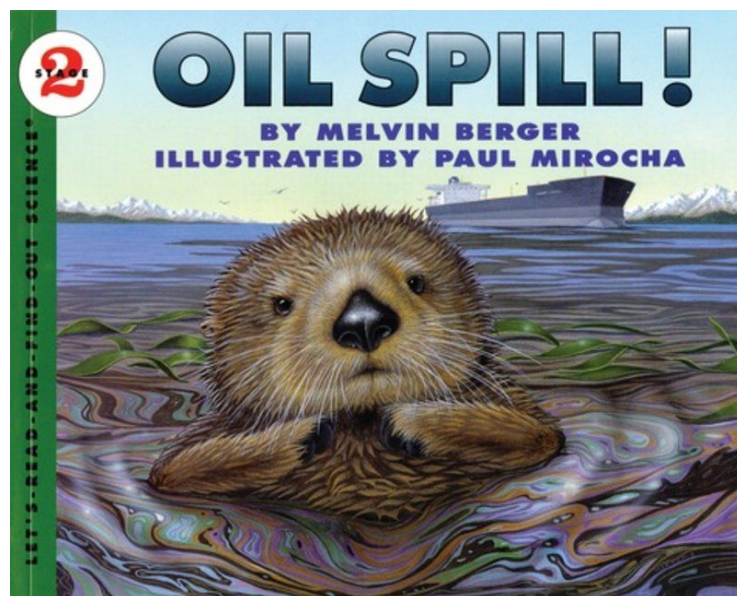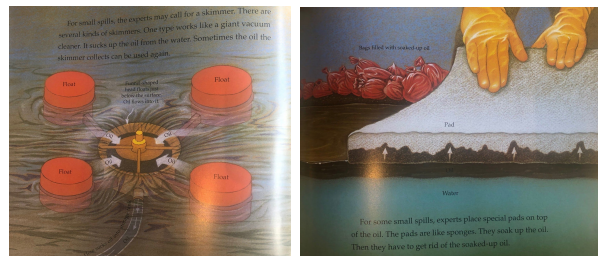
Example pages from text to emphasize:

Impact on Animals:
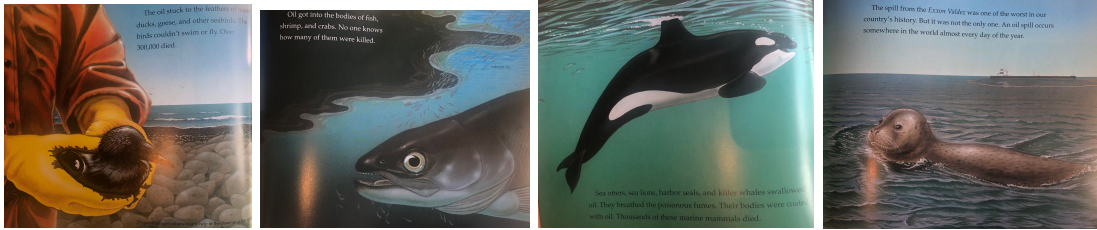
Solutions for human impact:

(Berger & Mirocha, 1999)

<mark>Gifted and Talented Modifications</mark>

1. Students that need enrichment could be given constraints when creating their tool. For example, this could mean limiting the amount of materials the students can use or how much of each material. You could tell these students that they can only use 2 of the materials they explored to clean up oil in their tool. You could also say students can only use "so much" of the cotton balls or sponges. This helps prepare these students for the ETS standards in later grades (particularly 3-5) where constraints and limitations are put on students to make situations more difficult and real world applicable.

2. A second modification could be to have these students discuss with a partner how their clean up is affecting the environment and how environmentally conscious/efficient their tool is. For example, using the pipette is very environmentally conscious, because one pipette can be continuously used to clean up a large amount of oil. The cotton ball on the other hand need to be replaced every time it fills up with oil. In this case, the cotton ball produces more waste and will have a larger negative impact on the environment compared to the pipette.

3. The last modification is to give the students a second obstacle that their Bee Bot must navigate to get home. This second obstacle would be trash in the water, because that is also a negative impact humans have on marine environments. Since the trash is in

the way, the students will not be given a set path that is covered in oil for the Bee Bot to navigate. Instead, the students would need to create their own route that the Bee Bot can take, after cleaning up the oil, that weaves its way through the trash.

Sources

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Keeley, P. (2013). *Uncovering student ideas in primary science* (Vol. 1). Arlington, VA: NSTA.

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