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THE JOURNAL OF MARINE EDUCATION

How Do Seaweeds Meet their Needs? A Kindergarten Investigation

ACTIVITIES AND PROGRAM MODEL

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ABSTRACT

In this primary science activity, students explored seaweed and plant samples, comparing and contrasting them, and considering how the organisms meet their needs in different environments. Using the 5E model for inquiry-based instruction, the learners worked toward a kindergarten NGSS performance expectation, setting the stage for building both scientific understandings and ocean literacy.

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KEYWORDS:
science activity; primary science; elementary science lesson; NGSS lesson plan; marine education

TO CITE THIS ARTICLE:
Marrero, M., & Crawford, K. (2022). How Do Seaweeds Meet their Needs? A Kindergarten Investigation. *Current: The Journal of Marine Education*, 36(1), pp. 3–10. DOI: https://doi.org/10.5334/cjme.64

DOI: 10.5334/cjme.64

Kindergarten science should be an opportunity for hands-on exploration, meaning making and fun! We worked with an eager group of learners, who were finishing up a unit on plants, to take their understanding to the next level by exploring seaweeds and comparing them to the true plants they had been investigating. The school in which we initially tested this lesson had been working with a marine scientist throughout the academic year, and teachers were working to make connections to waterways, including the ocean, whenever possible. Through hands-on experience and effective questioning, these young students were able to determine how seaweeds meet their needs and make connections to ocean ecosystems.

The materials we used for our lesson are outlined in Figure 1. We live in the Northeastern United States and were able to visit our local beach to collect some seaweed samples, which we placed in zip-top bags with a bit of seawater. Please note that in certain areas, you need a valid collection permit to collect samples; check local regulations before beginning this lesson. We also always return collected organisms to the original waterways. If you do not live near the coast, you can order seaweed through a scientific supply company. Our plants were seedlings from a local garden center—ensure that students will be able to observe roots, stems, leaves and flowers.

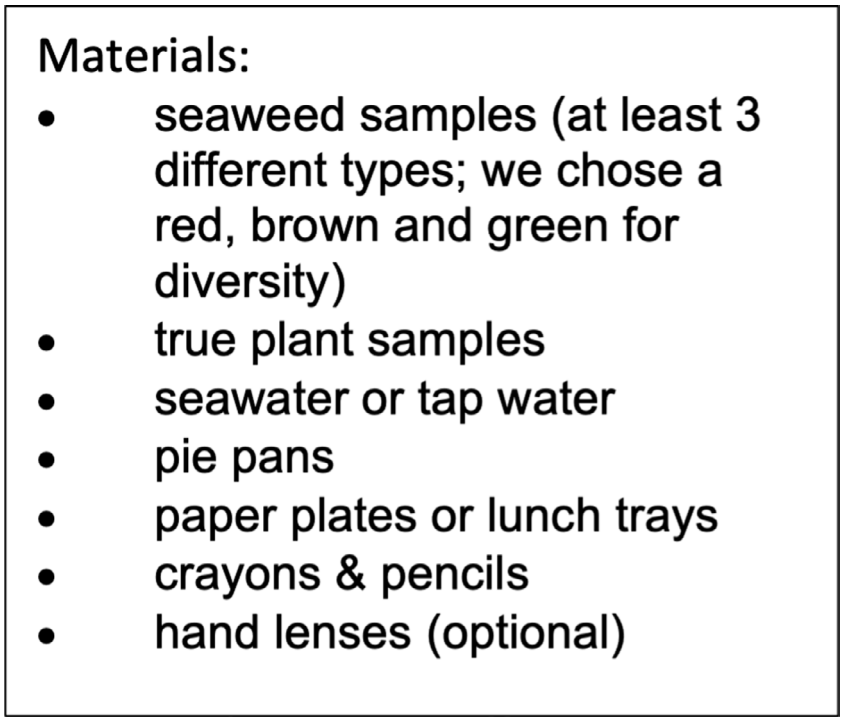

Figure 1 Materials needed to conduct this investigation.

For observation, we placed the plant and seaweed samples on cardboard lunch trays, ensuring that each table group had four different samples (two seaweed and two plants) to observe. The pie pans can be helpful to fill with a bit of seawater and allow the seaweed samples to float, better revealing the algae's structures. Students enjoyed using hand lenses to get a closer look at all of the samples, but they definitely needed some instruction on how to use them effectively.

We try to encourage young learners to record their observations in both pictures and words, so we made sure pencils and crayons were available to them. We conducted this lesson in the spring, so most of our kindergarteners had developed their writing skills, but detailed drawings also work. The simple handouts we developed are included as an appendix. When observing the seedlings, we asked students about the parts of the plant. Many students were able to identify leaves, stems, and roots.

In this unit, we were working toward the Next Generation Science Standards (NGSS) Performance Expectation K-LS1-1, as shown in Figure 2 (National Research Council, 2013). The figure outlines the science & engineering practices, disciplinary core ideas, and crosscutting concepts we employed to create a three-dimensional learning experience for the students.

NGSS Performance Expectation K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Analyzing and Interpreting Data Record information (observations, thoughts, and ideas). Use and share pictures, drawings, and/or writings of observations. Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems **Constructing Explanations and Designing Solutions** Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	LS1.C: Organization for Matter and Energy Flow in Organisms All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)	**Structure and Function** Students observe the shape and stability of structures of natural and designed objects are related to their function(s)

Figure 2 NGSS for this lesson.

Our learning objectives for this lesson were as follows:

Students will be able to:

- Record observations (in words and drawings) of different types of seaweed
- Infer how seaweeds meet their needs based on their structures
- Compare and contrast seaweeds and green plants based on their structures and patterns of survival.
- Give examples of ways in which seaweeds meet their needs

We used the 5E model for lesson planning (Bybee et al, 2006) to ensure that our lesson was inquiry-based and allowed students to build their own understandings after exploring the samples. In the paragraphs below, we describe how we conducted the activity, including key questions we asked students and their answers so that you can use this lesson with your own students. The entire lesson took us approximately one hour, but could certainly be divided among a few class periods.

ENGAGE

We invited students to sit on the rug in their classroom, telling them that we had brought some very important samples for them to observe, piquing their interest. First, we activated their prior knowledge by reviewing some of the content they learned by observing true plants and their growth over a few weeks. We reviewed the different structures of true plants and their functions, i.e., roots absorb water and nutrients from the soil, leaves absorb the sun's energy, and stems provide stability and carry materials throughout the plant. We also reviewed comparisons between plants and animals, such as that plants capture energy from the sun to provide for the plant, whereas animals must eat for energy. During our discussion, we wrote key words on the board for students to reference, creating an anchor chart useful for the remainder of the lesson. These conversations were important to remind students of the similar and different needs of living things and modeling how to make comparisons, which they would ultimately do as they compared the seaweed samples to true plants.

DOI: 10.5334/cjme.64

Next, we showed them the different seaweed samples we brought, holding them up so everyone could see. We asked students to say what they were observing—seaweed! Students shared some examples of where they had observed seaweed before; some of their answers included, "*At the beach*," and "*In a seaweed salad*!" They were able to tell us that seaweed lives in the ocean, and some students noted that probably fish and other animals eat seaweed.

We shifted the focus to review how scientists make observations, stressing that we try to use as many senses as possible. We asked students to make a few observations of what they saw; some noticed that the seaweeds seemed to have "leaves" and "stems," and that the "leaves" looked different in the different samples. Children made some predictions about how the seaweeds might feel (*slimy, wet, soft*) and smell (*fishy, salty*). We introduced the handout, explaining to students that they would find samples on their tables, and would draw and label the images with as many details as possible. We demonstrated how to use the hand lenses, stressing that they would allow students to see even more details on their samples.

EXPLORE

Students moved back to their tables and excitedly began observing their samples (Figure 3). We had them work in their table groups, which are heterogeneous groupings. As we circulated among the tables, we assisted students in making their drawings more detailed, helping them through questioning to notice specific features, such as the shape of the seaweed's blades, or the color patterns in the pansies' flowers. We also encouraged students to label their drawings with words, particularly on the true plants, the structures of which were a review for them. Asking our learners to pay closer attention to the structures was a critical part of this lesson, as kindergarteners can easily get off track and distracted from the task at hand (Figures 4, 5 and 6).

Figure 3 Plant and seaweed samples ready for student observation.

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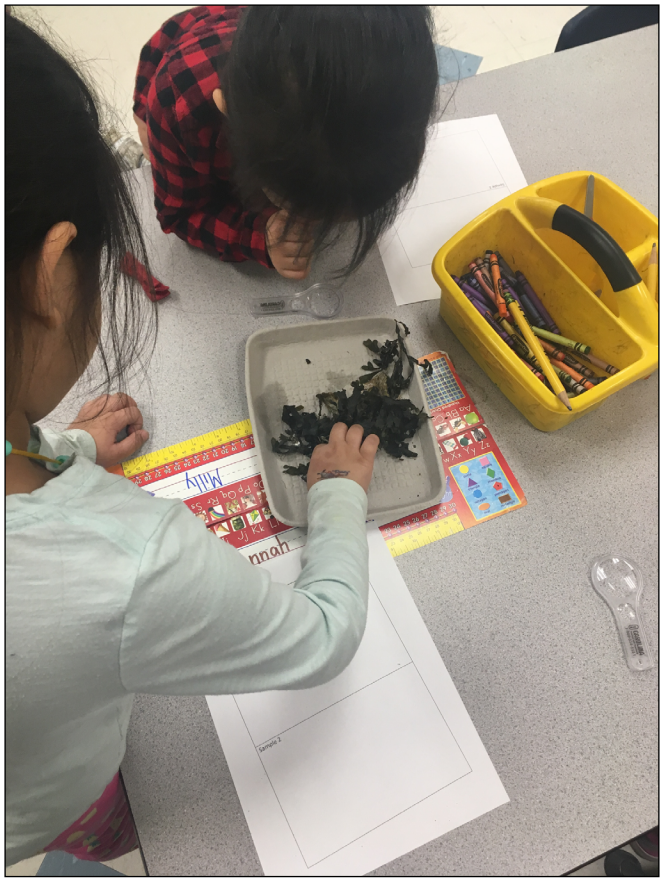

Figures 4, 5 & 6 Kindergarten students observing samples. Student recording observations on her worksheet.

EXPLAIN

After ample time for exploration, we began a discussion to support students as they discussed their observations. First, we encouraged students to share some of their drawings, and we discussed some similarities and differences we observed among the different types of seaweeds, and shared some of their observations. During this discussion, we also introduced the terms *blade, stipe, and holdfast* as structures of the seaweeds, as shown in Figure 7 which are analogous to the *leaf, stem,* and *roots* structures that they had studied in their examination of plants. We drew a simple diagram on chart paper so that students could refer back to this anchor chart as well. A few of the seaweed samples were attached to small rocks, which we used to allow students to observe the holdfasts.

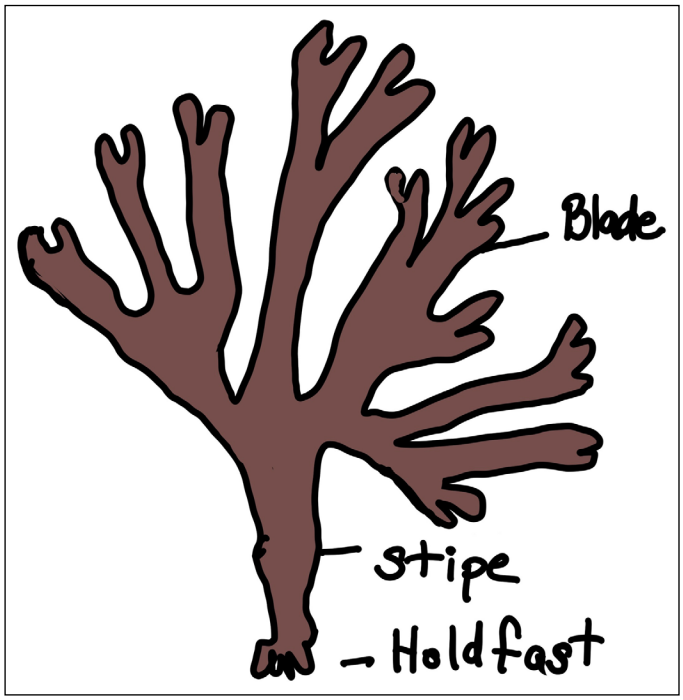

Figure 7 Diagram of basic structures of seaweed.

The students made a lot of excellent observations. They noted, for instance, that our red seaweed, beautyweed (*Callithamnion tetragonum*), had very thin blades, and that when these samples were taken out of the water they felt "mushy" and clumped together. In the water, however, they floated easily and the blades spread out "like feathers." They used words like "soft" to describe the beautyweed and "tough" and "hard" to describe the rockweed (*Fucus vesiculosus*) samples. They also noticed that the sea lettuce (*Ulva lactuca*) samples were thin and floated easily, but did not have the stem and leaf-like structures that we observed in the other samples.

ELABORATE

For the Elaborate portion of our lesson, we shifted to asking students to compare and contrast the plant and seaweed samples, with a focus on how these organisms meet their needs and how the structures of the samples relate to their functions. We were very impressed with the connections that our young learners were able to make!

In order to meet the performance expectation, we first focused on the question, "What do plants need to survive?" From the exploration of the true plants, students knew that plants needed sunlight and water to survive. We then posed the question, "What about the seaweed?" Students discussed how the blades of the different samples, like the leaves of the plants, spread out to allow them to better capture the sun's energy, providing energy for the seaweed. They also stated that since the seaweed is in water, they have what they need.

We then moved on to compare the structure of the plants and the seaweed that also helps with survival. The important finding was that unlike the true plants, the seaweeds did not have roots. We asked students, "Why don't they have them?" Through some probing questions, the students were able to tell us that plant roots help plants get water and nutrients from the soil, but because seaweeds are completely surrounded by water, they don't actually need roots! The students were able to make a comparison to the holdfast of the seaweed and the roots of a true plant. Similarly, the sea lettuce did not have stipes, which students likened to stems. A student pointed out that a main job of the stem is to get water to a plant's leaves, but if the seaweed is surrounded by water, it doesn't require movement of materials.

We also discussed how stems provide structure for plants, but in the water, the water can actually help out with this function. We demonstrated this process to students by showing the beautyweed sample in the zip-top bag with water and noticing how the stipes and blades spread out and were held up by the water itself. When we took the sample out of the water, it had no structure and formed a clump.

We also had a terrific and unplanned discussion thanks to some unexpected visitors in our samples. Our kindergarteners noticed that some of the seaweeds had organisms, including shrimp and tiny snails, attached to them. These observations led to a discussion of how seaweeds provide habitat for other living things.

These discussions began to lay a foundation for students' understandings of the unique adaptations that ocean organisms display. For instance, in the ocean many organisms use the weight of the water for structure, just like these students observed with the seaweeds. Through this discussion, students were working toward Ocean Literacy Fundamental Concept 5d, "Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land," (Carley et al, 2013).

EVALUATE

Rather than having a formal evaluation of student learning, we used the discussion as a way to assess their understanding. We also reiterated the performance expectation with students by asking them, "How does seaweed meet their needs to survive?" If you have more time for the lesson, we would suggest asking students to annotate their diagrams to reflect some of the class discussions. The addition of a word bank on the board or on a separate sheet of paper can help students to complete this task.

In conclusion, our learners enjoyed working with the seaweed and plant samples, and were able to use their higher order thinking skills to make comparisons and consider how both types of organisms meet their needs. At the same time, they built their scientific knowledge and ocean literacy.

IDEAS FOR DIFFERENTIATION FOR DIVERSE POPULATIONS AND EXTENSIONS

In this article, we described the activity as we conducted it together in three different kindergarten classrooms in a suburban school setting, where students were primarily White and AAPI. These classrooms were general education settings that included a few students with disabilities and English as a New Language (ENL) learners. One of the authors also conducted the same activity with kindergartners at two urban schools, in which there were mostly Black and Latinx learners, and many more ENL students. Class sizes ranged from about 18 to 26 students, with larger classes including a teaching assistant. We were impressed with all of the students' high-level connections, particularly that they were able to determine why seaweeds, unlike land plants, do not need roots or stems.

We found that students of all ability levels and stages of English language proficiency were engaged and able to participate in the lesson. By encouraging students to draw *and/or* use words, students could show their observations in ways that felt comfortable to them. We used anchor charts with the parts of a plant and seaweed to support vocabulary development and aid students in labeling their own diagrams. Having several adults in the room (authors, teacher, teaching assistant) also gave us the luxury of spending more time with each group of learners, asking them questions and supporting them to make more detailed observations and drawings. In several cases, teaching assistants and teachers were able to speak Spanish to some of the Latinx ENL learners, ensuring that they were fully involved in discussions.

At a kindergarten level, this lesson is a terrific opportunity to lay the groundwork for young learners about the needs of living things on land *and* in the ocean. The authors have conducted a similar lesson with fourth graders, meeting NGSS standard: *4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.* In this lesson, the students focused more on seaweed adaptations and how structures such as air bladders on rockweeds allow them to float, thus able to best access sunlight.

As NGSS (National Research Council, 2013) suggests, the following Common Core Connections can be made as an addition to this lesson:

> ELA/Literacy –
>
> W.K.7 Participate in shared research and writing projects.
>
> Students can use their observations for inspiration to write an informational piece about the three types of seaweeds they have learned about. In kindergarten this will be three sentences.
>
> Mathematics –
>
> K.MD.A.2- Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference.

While students are comparing the two samples of seaweeds and plants, they can count the number of leaves or blades that each sample has. The classroom teacher can create a classroom tally of each table's results. Students can discuss how these numbered variations can help the plant or seaweed meet its needs.

COMPETING INTERESTS

The authors have no competing interests to declare.

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Marrero, M., & Crawford, K. (2022). How Do Seaweeds Meet their Needs? A Kindergarten Investigation. *Current: The Journal of Marine Education*, 36(1), pp. 3–10. DOI: https://doi.org/10.5334/cjme.64

Submitted: 14 July 2021
Accepted: 24 July 2022
Published: 16 December 2022

Current: The Journal of Marine Education is a peer-reviewed open access journal published by Ubiquity Press.