Diving Deep

Using Machines to Explore the Ocean

ACTIVITY KIT

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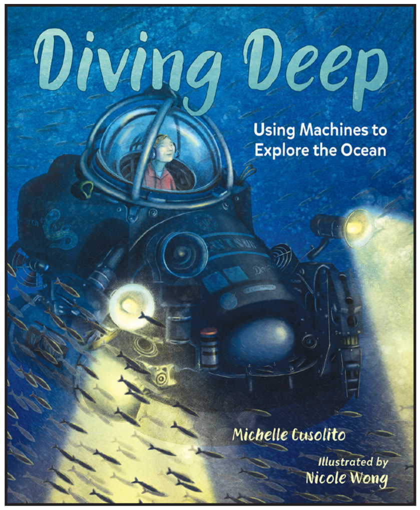

Michelle Cusolito
Illustrated by Nicole Wong
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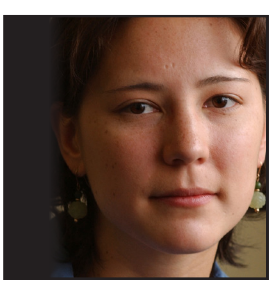
About the Book

What compels humans to dive deep into the sea, Earth's last unexplored wilderness?

From snorkeling to freediving, SCUBA, submarines, and Challenger Deep, discover the different technologies scientists use to explore the ocean in this deep-sea STEM picture book. For fans of ALVIN from *Flying Deep, Diving Deep* introduces all the ways humans have figured out how to engage with, explore, and learn from the oceans.

About the Author

Michelle Cusolito is the author of *Flying Deep: Climb Inside Deep-Sea Submersible Alvin*, which also won the 2016 PEN New England Susan P. Bloom Children's Book Discovery Award. She has worked as a fourth grade teacher, a curriculum specialist, and an adjunct professor. She lives in Rochester, MA.



About the Illustrator

Nicole Wong has illustrated many books for children, including *Flying Deep, To the Stars!*, and *No Monkeys, No Chocolate.*

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Discussion Guide

Use these questions to kick off classroom discussion, guide pre-thinking and post-reading responses, or inspire a writing or drawing assignment!

Questions for Grades K-1

1. What are some big questions that your students have about the ocean? How would they find the answers? Have scientists figured out the answers to any of these questions?
2. A submersible has to both sink and float on command in order to get humans to the bottom of the ocean and back. What makes an object sink or float? Consider some familiar examples: A student who is swimming might float when they're spread out like a starfish but sink when they do a cannonball dive. A coconut that floats might weigh the same as a rock that goes straight to the bottom.
3. If students wanted to swim with fish, what technology would they use? If students wanted to explore a coral reef, what technology would they use? If students wanted to study the ocean floor, what technology would they use?
5. Do students have a favorite spread in the book? What species do they recognize in the illustrations? Are there species they don't recognize? Where can students go to learn more about ocean life forms?
6. Did students encounter new words in this book? If so, how did they figure out what the words meant?

Questions for Grades 2-3

1. What do students think Michelle Cusolito means by "We're wired for wonder. We delight in discovery." (page 3)? What does that have to do with the ways humans explore the sea?
2. Why do scientists study the ocean? What discoveries have we made about life in the deep sea? How do these discoveries affect students' daily lives?
3. Do any of the deep-sea exploration technologies remind students of other exploration technologies? (For example, the similarity between an atmospheric diving suit and a space suit.) Why do you think these similarities exist?
4. Who creates the technology used to explore the ocean? How old are some of these technologies?
5. Why do students think that measurements in this book are given in metric first with US measurements in parentheses?
6. Do students recognize any of the names of scientists and explorers that appear in this book?

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Activity Kit

Will it Sink?

With this in-class experiment, students will explore the concept of buoyancy and practice making and testing hypotheses. Suitable for grades K–2.

Materials

- A large bucket or waterproof storage tub, preferably clear plastic
- A towel or tarp to place wet objects on
- A whiteboard, easel pad, or poster paper and marker
- An assortment of heavy objects (a bowling ball, a metal necklace, a dumbbell, a rock, etc.)
- An assortment of lightweight objects (a sheet of aluminum foil, a feather, a sheet of paper, etc.)
- An assortment of buoyant objects (an empty mixing bowl, a block of wood, a coconut, a toy ship, a small swimming inflatable, an empty plastic bottle, etc.)

Set Up

1. Before class time, position the bucket or tub where students can gather to observe. Fill the bucket or tub with water, leaving several inches of headroom so as not to spill.

2. Arrange your heavy, lightweight, and buoyant objects on a table or towel for students to see.

Procedure

1. **Preview the activity and review essential concepts.** Invite students to gather around the bucket or tub and guess what their next activity will be. Do students recognize the objects on display? What are some ways that students could group or sort these items? Why do students think the bucket or tub is full of water?

2. **Pretesting.** One by one, select an item to test and pass it around to the students so they can all examine it closely. Do they think it will sink or float? Why? Once students have come to a consensus (or voted on whether they think it will sink or float), test the object by putting it in the water.

3. **Posttesting.** As a class, observe the results of the experiment. Did it sink or float? Was there an ambiguous result (like an object that floated for a while and then sank, or in the case of the bowl, an item that floated when empty and sank when full of water)?

4. **Documentation.** Use the whiteboard, easel pad, or poster paper to record the findings of each test.

5. **Repeat.** Do steps 2–4 until all items have been tested.

6. **Debrief.** What have students learned about sinking and floating? What do the sinking objects have in common? What do the floating objects have in common? Were students surprised by any of the results? Why is it important to still do the test even if they're confident they know what the result will be?

Diving Deep

Using Machines to Explore the Ocean

Activity Kit

DIY Submersible

With this in-class experiment, students will explore the concepts of gravity, friction, buoyancy, and displacement that power real-life submersibles. Suitable for grades 3–4.

Materials

For each submersible kit, you will need:

- Two empty plastic bottles, such as soda or water bottles
- Two bendable plastic straws
- One mini marshmallow
- Half a roll of nickels
- Masking tape
- A fish tank or plastic tub large enough to submerge one bottle

You will also need:

- A sharp tool, like scissors or an exacto knife

Set Up

1. Before class time, use a sharp tool to cut a small hole in each bottle cap, just wide enough for one straw to fit tightly through. For each submersible kit, use the sharp tool to pierce four holes around the bottom end of one bottle. Each kit should have one unpierced bottle, one pierced bottle, and two pierced bottle caps.
2. Distribute your submersible kits around the room. There should be enough kits for students to work in small groups. Alternatively, depending on the abilities and supervision needs of your students, you can have one large submersible kit at the front of the room to demonstrate while students watch.
3. Fill each tank or tub with enough water to submerge one bottle.

Procedure

1. **Preview the project and review essential concepts.** Today, students will learn about the science behind real-life submersibles. Use question 2 from the "Grades K–1" section of the discussion guide on page 2 to introduce or review the concepts of *gravity, friction, buoyancy,* and *displacement*. Write these words on the board. Introduce students to their experimental kits; ask them to guess what each portion of the kit will be used for and write their guesses in their science journal. As a class, review everyone's guesses. Students may or may not guess correctly that the bottles will be their submersibles, the coins will be used as weights, the straws will be used for ventilation, the tape will be used in assembly, and the mini marshmallow will serve as a stand-in for their passenger. Of course, the passenger can't come aboard until their submersible passes a safety test!

DIY Submersible (cont'd)

With this in-class experiment, students will explore the concepts of gravity, friction, buoyancy, and displacement that power real-life submersibles. Suitable for grades 3–4.

Procedure (cont'd)

2. **Build the first submersible.** Invite students to tape their nickels together in stacks of five. These will serve as weights. Direct student attention to the word *gravity* on the board and emphasize that when they add the weights to their submersible, they are affecting how gravity will interact with it. Students should tape three groups of nickels to one side of the pierced bottle, not covering the holes. Then, they should thread a straw through the cap and screw the cap on. They may find it necessary to apply a tight seal of tape around the base of the straw. Once everyone's submersible is assembled in this way, it's time for a safety test.
3. **Operate the first submersible.** Invite students to place their submersibles in the water with one hand and hold the end of the straw above water with the other. Ask students to observe what happens and document it in their science journals.
4. **Discussion.** Do students think their submersible passed its safety test? Point out that it did what submersibles are supposed to do: it submerged and went to the bottom of the tank. What do students think would happen to their mini marshmallow if it got in this submersible? What do they think would happen if a person got into a submersible that was constructed like this?
5. **Experiment with the first submersible.** Real engineers don't just throw away failed projects—they keep them and study them to find out what went wrong. Encourage students to blow air through the straw into the bottle and see what happens. The introduction of air should displace the water and allow the bottle to float back up towards the surface. Direct student attention to the words *gravity* and *buoyancy* on the board; these are the properties that they are affecting when they change what's inside the submersible.
6. **Discussion.** Do students think they can create a submersible that's both safe for their mini marshmallow passenger and does what a submersible is supposed to do? Such a craft would have to be heavy enough to sink, but still watertight to protect its passenger.
7. **Build the second submersible.** Invite students to tape nickel weights to their unpierced bottle. How many? Well, they'll have to experiment and find out. Encourage them to write down their first guess at how many nickel weights they'll need, and document later attempts in their journal as they add or subtract groups of five nickels. As with the first submersible, students will need to thread a straw through the cap and apply a tape seal before screwing the cap on. Remember, this submersible still needs to pass its safety test before the marshmallow can come aboard.

DIY Submersible (cont'd)

With this in-class experiment, students will explore the concepts of gravity, friction, buoyancy, and displacement that power real-life submersibles. Suitable for grades 3–4.

Procedure (cont'd)

3. **Operate the second submersible.** Once students have applied enough nickel weights that their bottle will sink, invite them to place it in the tub with one hand, still holding the straw above water with the other hand. Ask them to write down their observations. Is the submersible sinking? Is water leaking in? Did they pass the safety test?

4. **Introduce the mini marshmallow passenger.** If students approve of their submersible's safety test, they can bring it out of the water, unscrew the cap, and insert their mini marshmallow passenger for a trip to the bottom of the tub.

5. **Observe the passenger.** Does the mini marshmallow stay dry inside?

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Activity Kit

Deep-Sea Discoveries

In this collaborative research project, students will learn about the layers of the ocean and the different life forms found in each zone. Suitable for grades 2–4.

Materials

- Butcher paper
- Index cards
- Tape
- A projector

Set Up

1. Tack a large piece of butcher paper vertically on the classroom wall, covering it from the floor to the ceiling.

2. Print a copy of the apparatus images on page 9 and cut out each one. Alternately, write the name of each apparatus on a colored index card or piece of colored paper.

Procedure

1. **Preview the project.** Students are about to go on a virtual deep-sea excursion! What sorts of life forms will they find in the deep? How will they learn about them? Invite students to spend some silent writing time describing what they think such an excursion would be like.

2. **Learn about the light zones.** One way to classify the ocean is by the three light zones: *sunlight*, *twilight*, and *midnight*. Watch "Let's Learn the Ocean Zones!" by SciShow Kids as a class. Discuss: What is it like in each zone? Visit the National Oceanic and Atmospheric Administration/National Weather Service Layers of the Ocean page and point out each zone to your students. Why do students think this source uses different names and describes more layers of the ocean?

3. **Make your ocean zone chart.** As a class, draw out the three light zones of the ocean to scale on the large piece of butcher paper, checking against the NOAA/NWS chart. Include depth marks in meters. The diagram should be large enough that it takes up much of the space from floor to ceiling.

4. **Review the technology students would use to visit the deep ocean.** Open your classroom copy of *Diving Deep* to the depth chart on pages 28–29 and use a projector to show the class. What zone could you visit with each apparatus? Invite volunteers from the class to tape each cutout apparatus to the zone where it belongs.

5. **Assign research subjects.** When students go on this virtual trip, what animals, plants, and other life forms do they expect to find in each zone? Assign students to research one life form for each light zone of the

Deep-Sea Discoveries (cont'd)

In this collaborative research project, students will learn about the layers of the ocean and the different life forms found in each zone. Suitable for grades 2–4.

Procedure (cont'd)

5. (cont'd) ocean. Using both print and digital sources, they should make an index card for each of their three research subjects, including the common and scientific name of the subject, the zone where it is found, and three bullet-point facts about it (for example: its diet, its life cycle, its range in the wild, etc.). On the reverse of the card, they should draw as accurate an image of it as they can. This may be assigned as an in-class or at-home project.

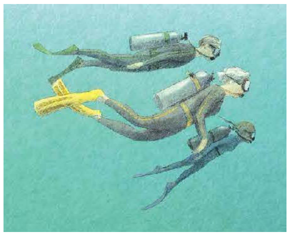
6. **Populate your ocean zone chart.** Collect students' cards and tape them to the appropriate zone of the chart. Then invite students to visualize a trip through the zones of the ocean with you. At each zone, read aloud the scientific names of the life forms you encounter and invite students to guess their common name.

Optional Extension: Art Connection

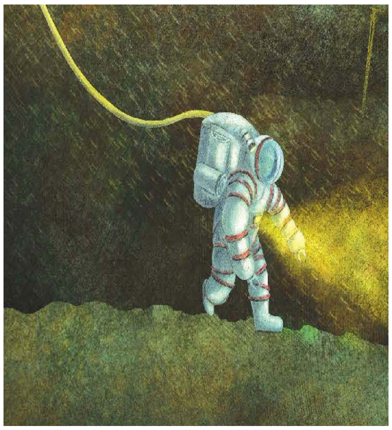
Once students have created their index cards from step 5, invite them to pick one research subject for a larger artistic portrait project. In collaboration with the school's art teacher, encourage students to pick an appropriate medium (paint, collage, sculpture, etc.) and depict their subject with as much scientific accuracy as possible.

Apparatus Images

scuba gear

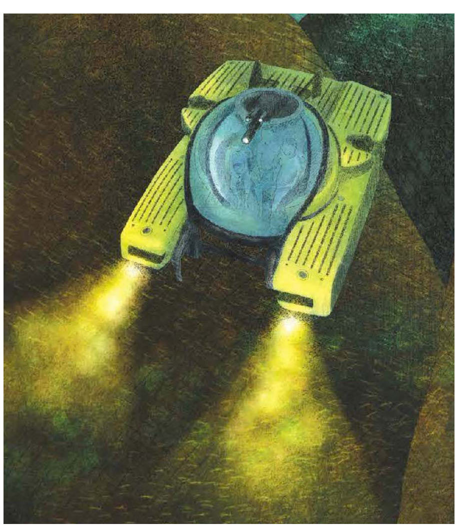


atmospheric diving suit



DeepWorker

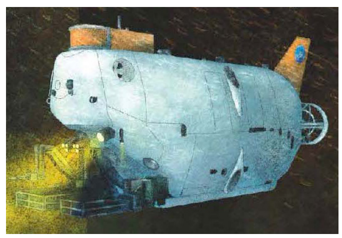
Triton 3300



snorkeling gear

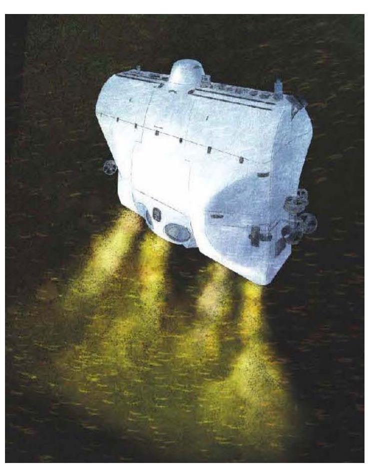
Alvin

Shinkai 6500

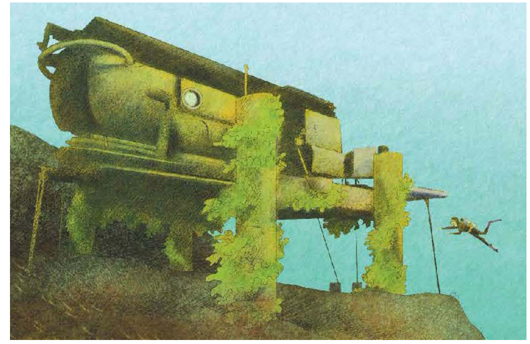


freediving gear

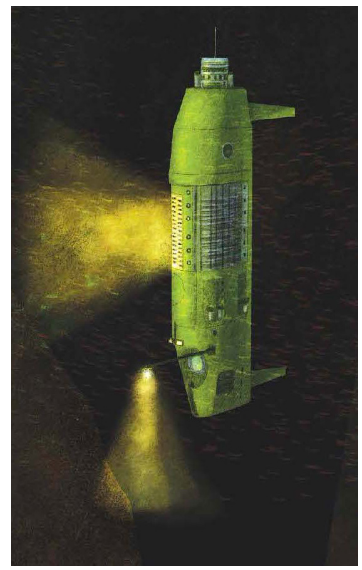
Limiting Factor



Aquarius Reef Base



Deepsea Challenger



Trieste