beetles
Science and Teaching for Field Instructors

Student Activity Guide

Beach Exploration

Many students love to check out cool objects when they're on a beach! That's what students get an opportunity to do in *Beach Exploration.* This routine also gives students time for unstructured play—an important part of visits to the beach with youth!

In *Beach Exploration*, students think about the unique aspects of a beach environment, and the instructor offers thinking tools, perspectives, and ideas to support students in observing, asking questions about, and making explanations about the cool objects and "nature mysteries" they'll find at the beach. At the beach, students get an opportunity to move around and check out objects they find interesting—seaweed, shells, crab exoskeletons, leaves, driftwood, seeds, bones—and then choose one to study in depth. Students record their observations and ideas in a journal entry and make explanations about unique features of the object or where their object may have come from. An optional discussion focusing on one or two especially interesting mystery objects engages students in thinking about ocean literacy more deeply as a group. The process of studying found objects on the beach supports students' understandings of beach and marine environments and offers students a mindset they can use anytime in the future to explore and learn at the beach or any other place.

Students will...

- **Play and explore on a beach.**
- **Observe and explore beach artifacts that are interesting to them.**
- **Practice making explanations based on evidence.**
- **Accurately record observations and explanations through drawing and writing in their journals.**
- **Build visual literacy and communication skills.**

Grade Level:
Grades 3–8. Adaptable for younger or older students.

Timing:
Approximately 45–100 minutes

Related Activities:
I Notice, I Wonder, It Reminds Me Of; Discovery Swap; NSI: Nature Scene Investigators; What Lives Here?; Interview an Organism

Materials:
See page 3 of the Materials and Preparation section for details.

Tips:
To ensure a successful experience, review the teaching tips found on page 2 and throughout this guide.

Setting:
Any beach where students can safely move around and explore natural objects.

Equity, Inclusion, and Cultural Relevance (informed by Youth Outside)**:**
This activity has been designed to demonstrate how to create an equitable, inclusive, and culturally relevant teaching and learning experience. Read more on page 14.

NEXT GENERATION SCIENCE STANDARDS

For additional information about NGSS, go to page 16 of this guide.

FEATURED PRACTICE	FEATURED CROSSCUTTING CONCEPT	DISCIPLINARY CORE IDEAS
Constructing Explanations	Cause and Effect	Earth's Systems, Biogeology

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UNIVERSITY OF CALIFORNIA, BERKELEY

Beach Exploration

ACTIVITY OVERVIEW

Beach Exploration	Learning Cycle Stages	Estimated Time
Introducing the Activity	Invitation	15 minutes
Playing and Exploring	Exploration	15-25 minutes
Journaling About Finds	Concept Invention, Application	10-20 minutes
Optional: Using Local Field Guides	Application	5 minutes
Optional: Discussing Finds	Application	5-15 minutes
Optional: Discussing Objects from Humans	Application	5-15 minutes
Reflecting and Wrapping Up	Reflection	5 minutes
TOTAL		45-100 min

TEACHING TIPS

Read the Instructor Support Section. Beginning on page 12, you'll find more information about pedagogy, equity and inclusion, student misconceptions, science background, and standards.

Sharing information. There's lots of interesting stuff on beaches and lots of information an instructor could potentially share with students about what they find. Think carefully before introducing information. Sharing information about a cool find before students get the chance to check it out themselves can shut down their curiosity. As students explore, ask questions and be a co-explorer. Then, after students have had the chance to check out an object, ask them to share about what they've noticed. Then, consider sharing a little bit of information that might nudge students to make more observations or ask more questions about what they're looking at.

Time for play. This activity begins with some time for unstructured play at the beach. There's value in giving students time as soon as they get to the beach to build sand structures, look at what is interesting to them, or just move around—especially if students in your group haven't spent much time at the beach before. Offering play time right away also supports students to be more focused on learning experiences later on.

Different types of beaches. While this activity is written to focus on a sandy ocean beach ecosystem, it could easily be adjusted to have students explore a rocky beach or a beach at a lake or river.

Field card. At the end of this activity write-up, you'll find a condensed, pocket-sized version to use in the field.

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Find the latest activities and information at http://beetlesproject.org.

PREPARATION

Before the day you will lead the activity:

1. **Decide when to offer the instructions from the" Introducing the Activity" section.** Offer the instructions for *Beach Exploration* at the time when your students are most likely to be focused. It's ideal to do this in a classroom or at another place with few distractions before students arrive on the beach so students can focus on listening to the instructions and then know exactly what to do when they arrive at the beach. If it's not possible to give instructions until the group arrives at the beach, try to find a place for sharing instructions away from distractions of the beach, such as on a bluff or in a parking lot.
2. **Print out and briefly read through the About Stuff on Beaches chart (pages 19–21).** You will bring this chart with you when you go to the beach. This chart includes some content and suggestions for ways to engage students in discussion about the objects they find. Don't lecture students on the content in the chart; rather, engage with students in exploration, inviting them to make observations and share their ideas. Then, perhaps offer one piece of information and follow up by inviting students to take their observations and ideas deeper.
3. **Decide whether to do the optional discussions (and be willing to adjust your plan in the moment).** The optional discussion questions in this activity (Using Local Field Guides, Discussing Finds, and Discussing Objects from Humans) can take students deeper in their thinking about beach artifacts or lead them to think about how humans interact with beaches and the ocean. The beach is an exciting place to be and can be a challenging place to slow down and focus on large-group discussions. Waves and wind can also make it difficult to hear. Only include these discussions if it works for your context and for your students. Be ready to make adjustments in the moment in order to meet the needs of your group.
4. **Find a cool object from a beach or from the ocean.** You will need an object from a beach for introducing the activity and modeling how to make observations and explanations. Find an interesting beach artifact, such as a bone from a marine animal, a cool rock, a large shell, some kelp, etc. The artifact should be large enough so students can make their own observations from where they're sitting in the group, and it should be interesting and intriguing enough to inspire students to get out and explore.
5. **Find out in advance whether the tide is going out or coming in when you will be at the beach.** Use this information to decide where to set boundaries for students. If it's a beach where it's dangerous for students to be near the water, set up boundaries so students will be away from the water throughout your whole time there. If it's safe for students to interact with the water and it's allowed in your program, set up boundaries so students can interact with the water. Be prepared to communicate how far into the water students can go and to move boundaries back as the tide comes in or if waves get bigger. See the Instructor Support section for more specifics about beach safety (on page 12).

On the day of the activity:

1. **Share beach safety rules with adults and chaperones.** It's important that adults are on the same page about safety and student expectations during beach trips. Communicate rules and safety measures to each adult who will be responsible for students at the beach so they can be consistent in maintaining boundaries and helping keep students safe.
2. **At the beach, mark off two large boxes: a Play Area and an Exploration Area.** Just before your students get onto the beach, ask one or

MATERIALS

For the instructor:

- ❑ 1 interesting object from the ocean
- ❑ whiteboard or chart paper
- ❑ marker
- ❑ 1 copy of About Stuff on Beaches chart (pages 19–21)
- ❑ optional: loud whistle or other signal-maker

For each student:

- ❑ journal (or sheet of paper)
- ❑ pencil
- ❑ a few cups (clear, different sizes)
- ❑ nets for catching critters
- ❑ optional: hand lens
- ❑ optional: field guide to local beach/marine organisms
- ❑ optional: garbage bags or sit pads
- ❑ optional: clipboards or cardboard with binder clips

Other Exploration Routines first. Before this activity, it's ideal for students to do another BEETLES Exploration Routine such as *I Notice, I Wonder, It Reminds Me Of* or *NSI: Nature Scene Investigators* since both of these activities scaffold observation skills students can use in *Beach Exploration.* If students have already done one or more of these routines, remind them of their observation skills and then give them a few moments to practice with the object in front of them.

TEACHING NOTES

PREPARATION

more staff or chaperones to mark off two large areas (boxes) in the sand by dragging their feet to make an outline. (If the beach is rocky, use some sort of markers to designate the two areas instead.) The boxes should be near each other and large enough so students can roam without getting in one another's way, but not so large that it's difficult to supervise or contain the group. (The size of the boxes will vary based on the size of your group, the beach, and the number of adults you have with you.)

- Play Area: Students will first have free time to play, dig in the sand, and explore as soon as they arrive.
- Exploration Area: After students have some time in the Play Area, you will give a signal, and they will move to the Exploration Area where they will focus on exploring, finding cool beach objects, and making observations.

Setting up two designated areas allows students to have free play in one area without covering or moving things (e.g., animal tracks, beach objects) since those things will be in the Exploration Area. Two designated areas also makes the transition from playing to exploring easier. (When you've started building a sand castle, it can be tough to stop!)

3. **Decide on a signal to use.** Plan a way to signal when students should transition from the Play Area to the Exploration Area. This could be a loud whistle, a coyote howl, or signs that say "Time to Play" and "Time to Explore." Prepare materials necessary for your signal.

4. **Set out exploration tools in the area between the Play Area and the Exploration Area.** As students transition from the Play Area to the Exploration Area, invite them to pick up any exploration tools they want to use (e.g., cups for catching sand crabs, nets, hand lenses). Clear cups are ideal because students can put an object in a cup and then observe the object from different perspectives. It's also ideal to have cups of different sizes and some with wider mouths so students can use the cups to observe larger objects or get close enough to the object,using a hand lens.

Introducing the Activity

1. **In a *Thought Swap* (formerly known as *Walk & Talk*) or *Turn & Share*, invite students to discuss:**
   - *What are some things you know or have heard about beaches?*
   - *What are some things you think you might find at the beach and how might they have arrived there?*
2. **Build students' ecosystem literacy by describing some forces that affect beaches and then inviting students to think about how these forces might affect objects, organisms, and artifacts found on the beach.**
   - *The beach is a unique environment. There are constant waves that can bring things onto the beach, including pieces of dead organisms such as seaweed; crabs; shells; driftwood; and things humans have made, such as trash.*
   - *Things that end up on beaches might get pounded by waves (~8,000 per day!) and pushed against rocks and sand, over and over again, all day and night.*
   - *How might forces such as constant wave pounding and being rubbed against the sand and rocks affect something like a rock or shell?* [Students might say that things could get smaller, broken, and smoother.]
   - *Let's think together: How might these forces, as well as sitting in sunlight for a long time, affect things that end up on a beach? Think about what you have observed on beaches before or imagine what might happen if you have not been to a beach.* [Students might say that colors fade or some things break down in the sun and get more brittle, so they break more easily.]
3. **Share that each object found on a beach can be a mystery—where it came from, what it is, or what has happened to it over time—and model your own excitement about exploring beach objects.**
   - *We can look at each thing we find as a mystery and wonder about it. Where did it come from originally, the land or the ocean? Is it from somewhere close by or far away?*
   - *We can ask ourselves what happened to this object over time. Is there evidence of change over time such as holes, smooth patches, or broken-off bits that we could try to use to explain what happened to it?*
   - *We can also look at shells, kelp, or other parts of living things that have come from the ocean and think about how their structures (body parts) might help them survive in the ocean.*
4. **Share that you will model some observation skills and an approach that students can use to learn about things they find on the beach.**
5. **Hold up an interesting object from a beach, model making observations about it and then invite students to *Turn & Share* to make more observations about it with a partner.**
   - *Here's an example of an interesting thing found on a beach. We can start by making observations about it. Observations are things you notice with your senses—such as seeing, touching, smelling, or listening. We might observe an*

TEACHING NOTES

Logistics of the *Thought Swap* routine. See the BEETLES activity *Thought Swap* (formerly known as *Walk & Talk*) for the logistics of this discussion routine. Wondering why we changed the name from *Walk & Talk*? We received feedback from community partners on how we can use more inclusive language, and we decided to change the name so we were not normalizing walking as the only way of moving and talking as the only way of communicating.

Offering a common access point. Sharing some content about beach environments at the beginning of the activity and inviting students to think about how those conditions might affect objects found on the beach offers students a common access point to support their participation in the activity. The group's further discussion and learning can build on this initial discussion. To learn more about creating an inclusive learning experience, see page 14 of the Instructor Support section.

One way, not the only way, to observe. Sharing with students that you are offering an approach they can use to learn at the beach frames the skills students will use as one way to observe, not the *only* way to observe.

TEACHING NOTES

Modeling observations and explanations. *Beach Exploration* includes scaffolding to support students' participation and to promote literacy and language acquisition. When the instructor breaks down scientific drawing into steps and uses Think-Alouds to show how students might respond to a discussion question, they are modeling learning behaviors that students can apply during the activity and in future experiences. These strategies support emerging multilingual learners and increased opportunities for all students to participate successfully.

object's size; shape; color; or any unique things, such as holes or marks.

- *For example, I'm noticing that it feels rough, and it's light gray in most places and a little darker in other places.*
- *Now, turn to someone next to you and discuss your own observations of this object.*

6. **Get the group's attention, model making explanations for what you observed, and then invite students to *Turn & Share* and practice making explanations about the object with a partner.**
   - *It's fun to make explanations about what you find on a beach. For example: "I think the holes in this could have been made by worms in the ocean, or maybe the holes were caused by waves."*
   - *You might try to explain the mystery of where the object came from or what it is. You might look at parts of the object, such as holes or marks, and try to make explanations for what might have caused them.*
   - *For example: "I think maybe the holes were caused by insects that live on land, and my evidence is that I've seen holes like that from insects in stuff on land."*
   - *Or: "I think that this object might be from the ocean, and my evidence is that it doesn't look like anything I've ever seen on land, and it doesn't feel like wood from a land plant."*
   - *Today we're practicing using evidence, so make sure you base your explanations on evidence. For example: "I think this has been on the beach a long time, and my evidence is that it is smooth, and maybe it got that way from being in crashing waves for a long time."*
7. **Offer the perspective that this is just one object and that there are hundreds of cool and interesting things students will see on the beach, and the group will get to look at and learn as much as possible about them.**
8. **Draw two boxes on a whiteboard—the Play Area and the Exploration Area. Share that students will get to explore and look at cool objects, but first they will get to play and have free time in the Play Area.**
   - *We will spend time exploring, observing, and making explanations about different objects, but when we first arrive, you'll have free time to play. You can build sand castles, dig holes, run around, find interesting things to look at, or just enjoy the view.*
   - *During this free time, you'll need to stay in a box drawn in the sand called the Play Area.*
   - *Please stay within the boundaries of the Play Area.* [State your chosen boundaries for the beach you are visiting.]
   - [If you're not already at the beach] *We will show you the boundaries when we arrive.*

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9. **Share how students will move to the Exploration Area when they hear your signal and how they will then move around, find at least five cool things, and make observations and explanations about those things.**
   - *When you hear my signal, it will be time to stop playing and to move to the Exploration Area. In the Exploration Area, find, pick up (if appropriate), check out, and observe interesting things you've found. Think of the things as mysteries and make observations and explanations about them, like we just practiced.*
   - *Try to find at least five different things and look for cool stuff that catches your attention.*

10. **Share: After students have had the chance to look at objects, you will give a signal, and they will pick one interesting object to focus on, study, and draw and/or write about in their journals.** Invite students to find out as MUCH as possible about their objects and then to record that in their journals.

11. **Offer guidance and suggestions for journaling, making a quick model sketch on a whiteboard as you do to show how students could structure their journal page.**
   - *In your journal, you can make a sketch of the object you choose and use words and numbers to show your observations, ideas, and explanations.*
   - *It's not about making a pretty picture, it's about showing your observations on the page.*
   - *If you are more comfortable drawing, you can draw more. If you're more comfortable using words and writing, you can write more. Use drawing and writing together to show what you notice.*
   - *Some observations might be easier to show in a drawing—such as the shape of a crab's shell—but other observations might be easier to show in writing or through labels, such as the pattern of colors or a dent on a shell.*
   - *Record as many observations, questions, and ideas in your journal as you can. You might also choose to include a small map showing where you found your object.*

12. **Share your program's rules, expectations, and safety concerns for beach time.**

Playing and Exploring

1. **When you arrive at the beach, show students the boundaries of the Play Area and the Exploration Area.**
2. **Give students around 10–15 minutes to play and explore in the Play Area.**
3. **Use your signal for switching to the Exploration Area and give a quick review of the instructions.** Briefly remind students of the task while keeping their momentum and energy going.

TEACHING NOTES

Choose a quiet and gathering signal ahead of time. Wave noise can make it difficult to raise your voice to gather students or offer instructions. Offering instructions ahead of time can help. So can picking a loud signal (e.g., a single whistle blast) and sharing about it ahead of time so students will know it's time to move to the new area.

Journal instructions later. If it will be better for your group, you could choose to offer the instructions for journaling later, after students have finished the step of the activity where they look at objects in the Exploration Area. If you do give journal instructions later, make sure students can hear you over wind or wave noise. If you are offering journaling instructions on the beach, encourage students to bunch up close to you so they can hear well (instead of standing or sitting in a circle in which they're farther apart).

Safety at the beach. Most programs have safety protocols for setting boundaries, keeping students out of the water, and keeping an eye on the tides. Make sure you have appropriate safety measures for the beach and that these expectations are communicated very clearly with students and any responsible adults. For more on beach safety, see page 12 of the Instructor Support section.

TEACHING NOTES

Encourage students to follow their interests. The goal at this stage of the activity is for students to observe and focus on what is interesting to them. If a student seems excited about catching and observing organisms, ask them questions about that. If a student is focused on figuring out where objects came from, engage them in conversation about that. There are many different ways to think about found objects at the beach, and if students get the chance to follow their own curiosity, they'll be more likely to find a way of exploring that is authentic for them.

Questions for chaperones. If you will have chaperones assisting you at the beach, consider giving them a sheet of paper with a set of questions and encouraging them to use the questions to engage students at this phase of the activity. For more on how to set up chaperones to support students' science learning experiences, see the BEETLES resource Preparing Chaperones for Outdoor Science.

Supporting the journaling process. To support students in engaging in the process of creating their journal entries, circulate and ask what students have noticed.

Introducing content. It's useful to have some knowledge about the things students regularly find at the beach—such as crabs, seaweed, etc.—and to use this knowledge to engage students in conversation. Sharing some content AFTER students have explored and thought about an object can be a way to build on and deepen their thinking, especially if you follow up the content with a different interesting related question. For example: Instructor: *"What have you noticed about this crab?"* Student: *"I noticed it was digging in the sand!"* Instructor: *"Cool! I read that these kinds of crabs spend most of their lives in the sand. Can you make any explanations about how the crab's body structures might help it survive there?"*

4. **When students move to the Exploration Area, offer them tools such as cups for catching sand crabs and hand lenses.** Set out exploration tools in the area between the two boxes and then invite students to stop by to pick up any tools they want to use.

5. **Give students approximately 10 minutes to explore, find interesting objects, and make observations and explanations.**

6. **Circulate and check in with individual students about what they've found and support students to stay engaged.** Use one or more of the following types of questions to engage students in conversations about their discovered objects:

   - **"What" questions about identity or causes of distinctive features:** *What might this object be? What might have caused those holes? What are some things we can say that might have happened to this bird since it died? What's our evidence?*
   - **Questions about structure and function:** *How do you think it uses that structure, body part, or behavior to survive?*
   - **"When" questions about time:** *Has this object been on the beach a long time or a short time? When do you think the shell was broken—before it wound up on the beach or after? What information would we need to find out how long this bird has been dead?*
   - **"Where" questions about origin:** *Where might this object have come from? Was it originally in the ocean or on land? Do you see any evidence of where this object may have been in the past?*
   - **General questions for any conversation:** *What do you notice? What makes you think that? Can you say more about that? What's your evidence?*

Journaling About Finds

1. **After students have time to check out a few different objects, but before they lose interest, use your quiet signal, distribute student journals or paper to write on, pencils, and give a brief reminder of the instructions.** Offer a reminder that students can choose one interesting object to focus on and then use words and pictures to record observations and questions in their journals. Invite students to find a place to sit away from others but still in the designated Exploration Area. (Optional: If the sand is wet, offer sit pads or garbage bags for students to sit on.)

2. **Circulate as students are journaling and engage them in conversation. Ask them about what they are noticing and encourage students to add details, observations, questions, and connections.**

3. **After about 10 or 15 minutes, call the group together and invite students to find a partner with whom they were not exploring and to share about what they discovered.**

OPTIONAL: Using Local Field Guides

1. **Share that students will get to use field guides to continue to learn about their objects. Model how to use a field guide for identification and finding out information.** One way for students to learn more about the organisms in your area is to offer them some local field guides. This step should only take place after students have had plenty of time to explore and ask questions on their own. Field guides can then be a resource for students as they pursue their questions. If you choose to offer field guides, here are some suggestions for how to introduce them:

   - *You've made some cool observations and asked some great questions during your Exploration time, and now you'll have the chance to use a tool to keep learning about your objects.*
   - *One way scientists get more information is through text, and we have some texts available for you now.*
   - [Hold up a field guide.] *Field guides can be a great source of information about types of organisms as well as about relationships between organisms. Most field guides have information that helps you identify organisms and also includes information like what organisms eat or where they tend to live. Some field guides are helpful for figuring out if organisms that look similar are related or not.*

2. **Using the kind of field guide you have available, model how to use it to identify a nearby organism or object and to find out a little more information about the object.** (This process will vary depending on the type of field guide you share with students—if it's a dichotomous key or a pictorial key.) Share:

   - *Field guides may help answer some of your lingering questions or help you observe something more closely that you hadn't noticed before.*

3. **Invite students to find at least one piece of information in the field guide that helps answer a question they had or is a new idea about the object they journaled about.** Give students about 5–10 minutes to explore the field guides and add information to their journals.

4. **After students have had some time to look through the field guides, invite them to Think-Pair-Share about one or two interesting things they learned from the field guides.**

OPTIONAL: Discussing Finds

1. **Choose a mysterious object that a student found that is genuinely interesting to your group. Lead a discussion about it, focusing on one of the following topics: where the object might have come from, students' explanations of unique features, or students' questions.** Follow student interest. An object that is genuinely intriguing to students will be most effective. It might be a cool find such as a bird skeleton or an interesting piece of kelp, or it could be a human-made object that is intriguing. Invite students to observe the object as a group and then discuss what they

TEACHING NOTES

For information about some common categories of things students might find on the beach, see the table in the Instructor Support section (on page 19).

If students share something with you that they haven't recorded in their journals yet, invite them to add to the journal page what they've shared with you.

Engaging directly with nature. Centering learning on students' in-the-moment observations of nature creates an inclusive learning experience by focusing it on a shared experience to which every student has access. This sets up a collaborative learning context in which students' ideas and observations drive the learning experience, and students recognize themselves and one another as sources of expertise. This is in contrast to science learning in which participation requires prior knowledge about science ideas, and students who have had more exposure to science tend to have an advantage.

Decide whether or not to continue with the discussion. At this point, students might be ready to move on. Also, in areas with louder waves or wind, large group discussions are challenging. Only use these steps if your students still seem excited to discuss their ideas as a group and if they will be able to hear one another.

Connections to NSI: Nature Scene Investigators. This discussion follows a similar set of steps that appears in NSI: Nature Science Investigators. Check out the student activity for more on engaging students with nature mysteries.

are interested in exploring further (e.g., debating the objects' origin if it is unknown, studying specific features, etc.).

- *What's an interesting object you found? What are your questions about it?*
- *What can we notice about this? What are some possible explanations for the features we see (e.g., holes, broken-off patches, etc.)*
- *Where do we think this comes from? Land or ocean? If it came from the ocean, do you think it originally came from somewhere close by or far away? What is your evidence for that?*

2. **Continue the discussion, introducing some content (using discretion) from the About Stuff on Beaches chart and asking questions to take students' explanations deeper.** Encourage students to continue to discuss the intriguing object, focusing on making explanations for interesting features or where the object came from. Add appropriate content a bit at a time with the goal of taking students' thinking further. Introduce a piece of information from your printed copy of the About Stuff on Beaches chart and then give students the opportunity to discuss the new information and include it in their explanations. Avoid oversharing content or lecturing.

OPTIONAL: Discussing Objects From Humans

1. **Pick up or point to a piece of trash and ask: Did someone leave this here, or is it trash from somewhere else that ended up in the ocean and was brought up here by waves?** Listen to students' ideas, reminding them to use evidence.
2. **Listen to students' thoughts and ideas and ask follow up questions to probe their thinking.**
3. **After a few students share their thoughts, share that a large amount of the trash found on beaches has traveled the ocean on currents and ends up washing up far from where it was thrown away.** Explain that lots of our trash ends up in the ocean, is moved around by currents to other places, and gets washed up on the beach. There's a lot more trash in the ocean than ends up on beaches.
4. **Ask students how trash, toxic chemicals, and other things that end up in the ocean might affect organisms that live on the beach or in the ocean?** Listen to students' ideas, asking follow up questions and encouraging them to share their thinking.
5. **Share that you've brought a garbage bag to pick up trash and then together, work to pick up the trash and put it in the bag.** Make this moment nontrivial and share that one goal we can all focus on is managing trash better so the stuff doesn't end up at the beach in the first pla

TEACHING NOTES

Switching topics. If students lose interest in looking at one object, switch to another one or switch the focus of their discussion about the object (e.g., shift from trying to explain features or holes on the object to sharing some content about how ocean currents move objects around the globe and then start to make possible explanations for the origin of the object).

Using the About Stuff on Beaches chart—offer information and then time to process it. The information on the About Stuff on Beaches chart (on pages 19-21) isn't a set of answers to be given to students. Offer these small pieces of information a bit at a time and then give students time to discuss it and use the new information to build on their thinking or to support an explanation. For example, if students are trying to figure out where an object came from, you might say, "In 1992, a shipping container carrying rubber duckies fell into the middle of the Pacific Ocean. Since then, the ducks have washed ashore in Hawaii, Alaska, South America, Australia, and even as far as Scotland. They are still being washed ashore today. Take a moment to discuss. In light of this information, do you have any new ideas or explanations about where this piece of trash could have come from? Use evidence to support your idea."

Microtrash. If it seems appropriate, this could be a good time to discuss microtrash—tiny pieces of trash and plastic that are less than 5 millimeters in size. Microplastics and other forms of microtrash can come from larger pieces of trash that have broken down or originally began as microplastics (e.g., microbeads in exfoliants). These materials are so small that they slip through water filtration systems and easily end up in the ocean or have broken down into hard-to-remove pieces once they are already in the ocean or on the beach. You can find more information on microplastics in the ocean here (https://oceanservice.noaa.gov/facts/microplastics.html) or in the Instructor Support section (on page 12).

Reflecting and Wrapping Up

1. **Before students lose steam, wrap up the discussion and then share: Objects we find on a beach come from many different places and are affected by many different forces.**
   - *What we find on the beach doesn't just come from the beach. Some things are brought up from the nearby ocean by the waves, like this kelp, that winds up becoming food for other organisms on the beach.*
   - *Trees, branches, trash, and other things travel in rivers to the ocean and are then carried around and washed up on other beaches.*
   - *There are strong ocean currents that move trash, organisms, plants, and other things, all around the world, and then waves deposit these objects on beaches.*
   - *There are forces, such as waves, wind, and other organisms, that shape and affect what is on the beach.*
   - *What you find on the beach might have been affected by its time in the ocean, by being worn to be very smooth or waterlogged, or to have holes in it from organisms.*
2. **Share that students have been using Cause and Effect as a thinking tool to understand the beach.**
   - *You've been thinking about how things got to be on a beach environment.*
   - *This is something you can think about at any beach you go to, and it's an interesting way to think about things at the beach because the ocean brings things from many different places.*
   - *It's interesting to go to a beach and wonder, "Where did this come from? How did it get here? What has happened to it? How can I explain some of the mysterious features I see?"*
   - *Looking at something in nature and thinking about what caused it to be that way is one of the ways that scientists think about and understand the world.*
3. **Ask students to *Thought Swap* or *Turn & Share* about some of the following reflection questions:**
   - *Find someone who wasn't exploring near you and share with them what you found and learned.*
   - *What did it feel like to use science observation skills to explore and learn?*
   - *If you were to bring your family to this beach, are there any skills you could share with them that they could use to learn more about what is here?*

TEACHING NOTES

Listening and responding to students. How you respond to students' observations and comments matters. Create a culture in which students feel safe sharing ideas by frequently asking broad questions that have multiple acceptable responses and by giving all students neutral, accepting responses to your questions. When we react to students' responses to broad questions by showing a preference for some responses over others (e.g., Yes, that's right. Or No, but keep thinking.), we're sending the message that only some student thinking is acceptable. When we give neutral, accepting responses (e.g., Hmm . . . interesting. Can you say more? Or Thank you for sharing. What do others have to say?), we encourage a group culture of participation and sharing. To learn more about creating an inclusive learning experience, see page 14 of the Instructor Support section.

Don't skip the partner discussions. Discussion gives students authentic opportunities to process content, formulate and share ideas, and make meaning. Partnered discussions in *Pair Shares, Think-Pair-Shares, Turn & Shares,* and *Thought Swaps* give every student in the group the chance to share and process their ideas and to listen to those of their peers. Partner discussions also help create an equitable and inclusive learning space. The opportunity to think through ideas and "rehearse" what to share with the whole group in a low-stakes situation is particularly beneficial for emerging multilingual learners and provides increased opportunities for all students to participate successfully. To learn more about creating an inclusive learning experience, see page 14 of the Instructor Support section.

TEACHING NOTES

Instructor Support

Teaching Knowledge

Supporting student autonomy. Beach Exploration offers a common set of inquiry and observation skills for students to use to explore and learn. It also offers students the opportunity to have autonomy and choice in what they focus on studying at the beach. This is an important part of supporting student success and engagement, as autonomy and choice are critical factors in supporting internal motivation to participate in a learning experience.

Introducing content. In this activity, students construct their own understandings through making observations, asking questions, and peer discussion. It's helpful if instructors have a general knowledge of beach ecosystems and some familiarity with organisms that students are likely to find. It's also important for instructors to strive to be a "guide on the side," encouraging students to make their own observations and gain new knowledge by using resources such as field guides instead of immediately telling students the names of organisms or information about them. Instructors can share content that they think will stimulate further student curiosity and hold off on introducing it until after students are well on their way to finding out and discussing information themselves.

Safety Knowledge

Finding and safely exploring beach sites. Beaches can be exciting and dynamic places for students to experience. Beaches can also be dangerous, and it's important to make safety a high priority when bringing students there.

Tides and swells. Look up the tides and the predicted swell (the size of the waves) ahead of when you'll visit the beach. Use this information to decide where you will need to draw boundaries. On a day when the tide is coming in during the time that your group is at the beach, set boundaries a good way back from where the waves will be coming up on the sand to keep students a safe distance away from breaking waves. If the surf is large, watch waves for a few minutes and look at a few sets of waves to get a sense of how large they really get before making a decision about where to put your boundaries. When the tide is going out, you can put the boundary closer to where waves are coming in on the beach or, over time, move the boundary as you see fit. Surf can be unpredictable. Even on a calm day when the tide is going out, keep an eye on waves so you can move students quickly in the event of an unexpected big wave. Even a beach you have visited safely many times could one day be much more dangerous depending on the tides and swells. Be conservative and highly vigilant about safety and keep students back if there is any doubt about the conditions. Don't be afraid to shift the placement of the Play Area and Exploration Area in the moment, if you notice conditions shift.

Beach structure. The structure and shape of the beach can affect how waves break and how safe or unsafe it is for students. Waves tend to break harder on beaches with steeper slopes and also have a danger of an undertow as outgoing waves pull back toward the ocean. Rocky beaches can be slippery

All materials created by BEETLES™ at The Lawrence Hall of Science.
Find the latest activities and information at http://beetlesproject.org.

and challenging surfaces on which to move. Take beach structure into consideration as you set boundaries.

Managing students and setting boundaries at the beach. Some programs allow students to take off their shoes and walk in the sand or water when the surf is low, and other programs don't. Make a decision that is best for your context. We recommend only allowing students to take off their shoes and walk in the water on a beach that you have been to multiple times before so you're familiar with typical wave and surf patterns and to set a clear boundary for how deep students can go in the water (e.g., asking students to go no more than ankle deep). It's generally best to only invite students to take off their shoes on flat, sandy beaches on calmer days.

Explain rules and boundaries beforehand. Explain rules, boundaries, and expectations for beach time before going to the beach and remind students of these expectations upon their arrival. Make sure all adults responsible for students' safety are aware of safety precautions and are enforcing them consistently with students. If conditions change quickly and you need to change an expectation or move a boundary back farther from the water, don't hesitate to do so.

Content Knowledge

Where can you find interesting things on the beach? Look at the strand line. The strand line—the previous high-tide line on the shore—is a place where many different objects are left behind as the tide goes out. Waves bring in many things from the ocean—seaweed, algae, shells, crab exoskeletons, leaves, driftwood, seeds, bones. This is often called wrack or beach wrack.

Wrack, and especially patches of kelp or algae, attract sand crabs, isopods, flies, and other organisms. Since most plants can't anchor in the sand, this beach wrack is a main source of food to many organisms that live on the beach. Some flies, isopods, and other organisms feed directly on the algae, seaweed, and other parts of the wrack. As these seaweed and algae break down into smaller pieces, other organisms that live in the sand feed on the particles that end up distributed between sand grains.

Rocks, shells, dead organisms, trash, and other human-made objects also end up on beaches. Some of these objects travel from miles away, while others are from nearby. Waves (and, to a lesser extent, wind) shape the sandy shore on a large scale, causing erosion and movement of sand/rocks, other sediments, algae, and kelp. Waves also affect individual objects on the beach, causing weathering over time by objects rolling around in the sand, wearing them smoother or creating holes.

Students can observe each object they find and make explanations about where it might have come from, whether it has interacted with any organisms, and how forces such as waves or wind might have affected it. For more information and ideas on how to engage students in exploring beach objects, see the About Stuff on Beaches chart (on pages 19–21).

TEACHING NOTES

Supporting Equitable, Inclusive, and Culturally Relevant Learning Experiences

This BEETLES student activity has been intentionally designed to create an equitable, inclusive, and culturally relevant learning experience for a community of learners. BEETLES design principles [http://beetlesproject.org/about/how-do-we-approach-teaching/] ensure that each student activity is student-centered and nature-centered. This enables all learners to access, participate, and engage in the learning experience.

"Classroom studies document the fact that underserved English learners, poor students, and students of color routinely receive less instruction in higher order skills development than other students." (Allington and McGill-Franzen, 1989; Darling-Hammond, 2001; Oakes, 2005) –Zaretta Hammond, *Culturally Responsive Teaching & the Brain*

When learners engage directly with nature, they all have access to learning, regardless of their prior knowledge or experiences. Centering learning on students' in-the-moment observations of nature builds an inclusive learning experience by focusing the conversation on an experience shared by every student, as opposed to relying on students' prior knowledge or past experiences. As students engage with nature, instructors are in the role of the "guide on the side." This approach shifts power from the instructor to learners, challenges the typical learning situation in which the instructor is the only expert, encourages students to share their ideas and experiences, and makes learning a more decentralized and collaborative experience.

When learners think like a scientist and practice academic language, they develop critical thinking skills that support them to become more independent learners—learners who have skills and thinking tools they use to learn, regardless of the level of support available from a teacher or instructor. Giving students the opportunity to think like a scientist by making observations, asking questions, and constructing explanations supports students' growth as learners, offering them the opportunity to build critical thinking skills and learning behaviors they can apply in any context. Many students in schools that have historically been under-resourced due to racist school-funding policies, redlining, income inequality, and police profiling have fewer opportunities to develop as independent learners. Specifically ensuring that students in these kinds of schools have opportunities to develop as independent learners is an issue of equity. Learning and practicing critical thinking skills in an engaging outdoor context supports students to succeed back in their classrooms, in science, and in other academic disciplines. Offering opportunities for students to discuss ideas with their peers and knowledgeable adults makes science more accessible by connecting it to students' own actions and discoveries in the moment—not to knowledge they may not have or experiences they may not have had.

Through discussion, learners make connections to prior knowledge, share their lived experiences, listen to different perspectives, and have time to process the material. Productive discussions in which many voices are heard, and the group builds off one another's ideas, create an experience in which students see themselves and one another as sources of expertise. This ensures that instructors don't fall back on positioning themselves as the only source of accurate or important information. Participating in discussions also supports students to develop cognitive rigor and the ability to take on more advanced learning tasks. Discussions make student thinking and ideas visible to the instructor. When instructors value, appreciate, better understand, and connect to students' lived experiences, they create a more inclusive

and culturally relevant learning space. Finally, multiple opportunities for discussion provide time and space for neurodiversity—allowing students to process information in different ways. Using discussion strategies such as *Turn & Share* or *Thought Swap* that are part of every BEETLES student activity can help ensure that students have these kinds of opportunities for discussion.

Specifically, this activity promotes an equitable, inclusive, and culturally relevant learning experience by:

- Offering opportunities for students to have choice and autonomy in how they choose to participate during the learning experience.
- Using broad questions to invite students to share their observations, prior knowledge, and experiences with one another and with the instructor.
- Offering curiosity tools, an inquiry mindset, and critical thinking skills that students can use to learn in any context, which supports students in becoming more independent learners.
- Providing space for students to come up with connections between what they are observing and prior experiences and knowledge, which supports their learning and retention.
- Focusing the group's learning on a common experience to which everyone has access.
- Providing a lesson structure in which the instructor acts as a "guide on the side" and builds a collaborative learning environment in which students make observations, share ideas, and see themselves and one another (not just the instructor) as sources of expertise.
- Engaging students in meaning-making discussions, making observations, and other practices that prepare them to take on increasingly rigorous learning tasks in the future.

Overall, these factors contribute to creating a student-centered approach in which "the ultimate goal . . . is to help students take over the reins of their learning." (Zaretta Hammond, *Culturally Responsive Teaching & the Brain*). This approach to teaching supports students in becoming independent learners who are able to succeed, regardless of any individual teacher or learning context. BEETLES has intentionally designed the sequence and structure of this activity to support learning experiences where all students feel capable of success and have the tools to carry that success into other domains.

Using student-centered and nature-centered learning approaches is just one piece of the work we can do to create equitable, inclusive, and culturally relevant learning experiences. Instructors must also work to become more aware of their own unconscious biases and triggers around culture, identity, and race that impact their interactions with students and affect their students' sense of inclusion.

TEACHING NOTES

Resources on unconscious bias. There are many great resources on understanding and shifting unconscious bias. Here are a few that we have looked to consistently to work on our own unconscious bias and to better understand how it can affect teaching and learning in the outdoors:

- *White Fragility* by Robin DiAngelo
- *Culturally Responsive Teaching and the Brain* by Zaretta Hammond
- Youth Outside [http://www.youthoutside.org/]
- The Avarna Group [https://theavarnagroup.com/]
- Center for Diversity & the Environment [https://www.cdeinspires.org/]

TEACHING NOTES

About the Next Generation Science Standards (NGSS). The development of the Next Generation Science Standards followed closely on the movement to adopt nationwide English language arts and mathematics Common Core standards. In the case of the science standards, the National Research Council (NRC) first wrote a *Framework for K-12 Science Education* that beautifully describes an updated and comprehensive vision for proficiency in science across our nation. The *Framework*–validated by science researchers, educators and cognitive scientists–was then the basis for the development of the NGSS. As our understanding of how children learn has grown dramatically since the last science standards were published, the NGSS has pushed the science education community further towards engaging students in the practices used by scientists and engineers, and using the "big ideas" of science to actively learn about the natural world. Research shows that teaching science as a process of inquiry and explanation helps students to form a deeper understanding of science concepts and better recognize how science applies to everyday life. In order to emphasize these important aspects of science, the NGSS are organized into three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas (DCI's). The DCI's are divided into four disciplines: Life Science (LS), Physical Science (PS), Earth and Space Science (ESS) and Engineering, Technology and Applied Science (ETS). Read more About the Next Generation Science Standards at http://www.nextgenscience.org/ and http://ngss.nsta.org/

Connections to the Next Generation Science Standards (NGSS)

BEETLES student activities are designed to incorporate the three-dimensional learning that is called for in the Next Generation Science Standards (NGSS). Three-dimensional learning weaves together Science and Engineering Practices (what scientists do), Crosscutting Concepts (thinking tools scientists use), and Disciplinary Core Ideas (what scientists know). Students should be exploring and investigating rich phenomena and figuring out how the natural world works. The abilities involved in using Science and Engineering Practices and Crosscutting Concepts—looking at nature and figuring things out, using certain lenses to guide thinking, and understanding ecosystems more deeply—are mindsets and tools students can take with them and apply anywhere to deepen their understanding of nature, and they're interesting and fun to do!

In *Beach Exploration*, students engage in the practice *Constructing Explanations* and apply the Crosscutting Concept *Cause and Effect*. Students have the opportunity to build understanding of Disciplinary Core Ideas related to *Earth's Systems* and *Biogeology*.

Featured Science and Engineering Practices

Engaging students in Constructing Explanations. According to the National Research Council's A Framework for K–12 Science Education, a major goal of science is to deepen human understanding of the world through making explanations about how things work. Students should develop their understanding of science concepts through making their own explanations about natural phenomena.

- In *Beach Exploration*, the instructor helps students build key skills of the practice of making explanations by guiding students to observe a beach artifact and then attempt to explain features they see.
- Students build on this as they find, observe, and make explanations about objects they find on the beach. During this phase of the activity, students have opportunities to construct explanations in discussion with their peers, in their journals, and in conversation with an instructor or chaperone.
- In each optional section of *Beach Exploration*, students would continue to engage in constructing explanations as a group either about a found mystery object or the impacts of trash on beaches. These large-group discussions are an opportunity for the instructor to coach students to use evidence in their explanations and to build on one another's ideas.

Featured Crosscutting Concepts

Learning science through the lens of Cause and Effect. Crosscutting concepts are useful thinking tools in science that are applicable across disciplines. When scientists make explanations for how or why something happens, they are thinking about the connection between cause and effect. Much of what we can observe of the natural world are the effects of many potential causes. Understanding cause-and-effect relationships leads to a

deeper understanding of the world, which is helpful in making predictions and scientific explanations about what might happen as a result of similar conditions in the future.

- In *Beach Exploration,* students apply the lens of *Cause and Effect* by looking at beach artifacts as mysteries, observing interesting features such as holes (effects), and trying to figure out what might have caused them.
- Students also might attempt to explain what caused an object to arrive at the beach, where it came from, or how forces such as waves or wind might have affected it.
- Approaching beach objects in this way gives students a transferable mindset they can use when visiting other beaches or areas to find interesting things and make explanations about possible causes and effects.
- The step where the instructor points out *Cause and Effect* as a thinking tool is a key part of students recognizing and applying this lens in the future.

Featured Disciplinary Core Ideas

Building a foundation for understanding Disciplinary Core Ideas. Students need multiple learning experiences to build their understanding of NGSS Disciplinary Core Ideas. *Beach Exploration* gives students opportunities to build some understanding of some Earth science core ideas related to *Biogeology* (ESS2.E), *Earth's Materials and Systems* (ESS2.A), and, through the optional section on trash, *Human Impacts on Earth Systems* (ESS3.C).

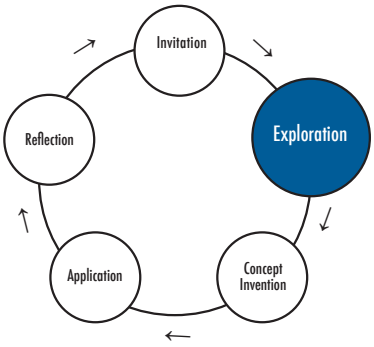
- As students observe rocks, remnants of organisms, and other beach artifacts while thinking about what forces might have caused characteristics such as holes or smoothness, they build some understanding of the idea that water, ice, wind, living organisms, and gravity break down rocks and sediments into smaller pieces and move them around (ESS2.A).
- As students observe the beach environment, rocks, shells, driftwood, and other artifacts and attempt to explain characteristics such as holes, they may begin to build understanding of the idea that living things affect the physical characteristics of their regions (ESS2.E).
- If students take part in the optional sections and discuss possible impacts of trash on marine organisms and beach environments, they can build some understanding of how human activities have effects on land, vegetation, ocean, and organisms (ESS3.C).

You can informally assess student understanding of these concepts during different stages of the activity through individual interactions with students and by listening carefully during the group discussions. This information can help decide which ideas to focus on in future lessons, so follow-up activities or discussions can be used to further student understanding.

Translating the codes used in the NGSS. Each standard in the NGSS is organized as a collection of performance expectations (PE) for a particular science topic. Each PE has a specific code, provided here so that they can be easily referenced in the NGSS documents. The first number or initial refers to the grade level: K - kindergarten, 1 - first, 2 - second,etc...MS - middle school, and HS - high school. The next letters in the code refer to the science discipline for the standard: LS, PS, ESS, ETS. The number following the discipline denotes the specific core idea within the discipline that is addressed by the PE, and the last digit identifies the number of the PE itself.

So... 3-LS4-4 means it's part of a third grade standard (3) for life science (LS), addressing the fourth core idea (4), Biological Evolution: Unity and Diversity, within the life science standards, that deals with Biodiversity and Humans. It's also the fourth performance expectation (4) that makes up the complete LS4 standard at this grade level.

TEACHING NOTES



Performance Expectations to Work Toward

No single activity can adequately prepare students for an NGSS Performance Expectation. Performance Expectations are designed as examples of things students should be able to do to demonstrate their understanding of content and big ideas in science after engaging in multiple learning experiences and instruction over a long period of time. They are not the curriculum to be taught to students. Below are some of the Performance Expectations that this activity could help students work toward:

- **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- [If you do the optional sections] **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.

Activity Connections

This activity could build on other Exploration Routines such as *I Notice, I Wonder, It Reminds Me Of* or *NSI: Nature Scene Investigators*. For an activity that would get students looking at one organism and thinking about how its structures and behaviors help it survive in a beach or intertidal environment, try *Interview an Organism*. Another routine you could use to structure beach explorations is *Discovery Swap*.

Learning Cycle. As a part of a sequence focused on beach environments, this activity fits in the Exploration phase.

About Stuff On Beaches

Where things on the beach might have come from

Waves and currents bring things to the beach. What you find on a beach could have come from nearby or from very far away. Ocean currents move all over the world, taking organisms, detritus such as driftwood, and trash with them. In the famous Rubber Duck Spill of 1992, a shipping container of rubber duckies spilled into the middle of the Pacific Ocean. Since then, the duckies have washed up on the shores of Alaska, Oregon, South America, Hawaii, Australia, as far as Scotland, and have been found frozen into arctic sea ice! They are still washing up today. This taught scientists a lot about ocean current circulation.

If students are trying to figure out where something comes from:

- Ask them whether it looks similar to or different from other objects in the same category from the area.
- Consider introducing some content about ocean currents. For example, the main giant circular ocean currents in the Northern Hemisphere move in a clockwise direction; in the Southern Hemisphere they move in a counterclockwise direction. Ask students if they see any evidence that their object could have traveled a long distance or might be from a very different environment.
- Remind students that if they find something that isn't familiar to them, that doesn't necessarily mean it came from really far away—but it might have.
- Encourage students to base their explanations of where the object came from on evidence.

Forces that affect things on the beach

On the beach, you can see interactions between abiotic forces (such as wind, water, and sun bleaching), objects, and organisms. Animals might move dead animals or plants as they eat them. As the tides rise and fall, they will move sticks, rocks, kelp, and other dead organisms to different places along the beach. Pounding waves and rubbing against sand can also weather objects on the beach, smoothing edges and breaking them down into smaller pieces. If an object has been on a beach (or in the ocean) a long time, sunlight can cause bleaching. Holes or broken parts of objects might have been caused by animals or might have been caused by being slammed by waves or weathered in the ocean.

If students are looking at any artifact they find on the beach:

- Remind students that waves, wind, and organisms can impact the objects they've found on the beach.
- Point to a feature the students have (such as a hole in a shell or a smooth patch on a rock) and ask them to make explanations about what, specifically, might have caused it.
- Add in some content about sand polishing shells and rocks through wave motion, decomposition of kelp, organisms using kelp to survive, etc., and ask students if they see any evidence of these things.

Trash and human-made objects

Trash and other human-made objects circulate throughout the ocean around the world. Plastics, in particular, have been found in the stomachs of many marine organisms, including whales, birds, and sea turtles. These plastics break down and become tiny particles of plastic that float through the ocean and might also be ingested by smaller, filter-feeding organisms such as plankton or crustaceans.

Toxic chemicals from land, runoff from agricultural fields or production factories can also interact with organisms in the ocean, causing impacts.

Students can think about local rivers that enter the ocean near where you are exploring and how those rivers might affect the local organisms. Students can also look for evidence of organisms' interactions with human trash or other human-made objects.

Microplastics: Microplastics are tiny pieces of plastic or trash that fit through water filtration systems and collect in the ocean. Currents can collect these microtrash pieces in giant gyres as large as the state of Texas, such as the Great Pacific Garbage Patch. Microtrash can be mistaken as food by ocean organisms and can cause significant health problems for the animals who ingest them and possibly those further up the food chain. They are very hard to clean up.

If students are looking at trash or human-made objects, ask:

- Where could it be from? How do you think it got here?
- Do you see any evidence of living things interacting with this object?
- As this sits here a long time over years, it might slowly break down into smaller and smaller pieces. How might this affect organisms in this area or in the ocean?
- How do you think living things on this beach might be affected by toxic materials getting into a local river?

Dead animals, kelp, and other beach artifacts

Local organisms—such as kelp, jellyfish, fish, and birds—might wash up on beaches. Washed up kelp is food for flies, crustaceans, etc., and sustains a lot of life on the beach. As it breaks down into smaller parts, it also gets worked into the sand, and very small sand crabs and molluscs will eat it.

If there is a LOT of one thing, such as kelp or jellyfish, there might have been a die-off or interesting event that affected nearby populations, which may point to local issues impacting the ocean environment. Talking to local scientists, state or regional park employees, or researchers can be a way to learn more and to share information with students.

It's worth looking in a local field guide to familiarize yourself with the local algae, kelp, fish, and other organisms so you can discuss them with students.

If students are looking at artifacts such as shells, kelp, bones, or dead organisms:

- Students can look at kelp and organisms for signs of decomposition; evidence of animals eating them; looking at specific features such as holes, tears, or rot; or organisms actually interacting with what is on the beach.
- Ask students to use evidence to think about how long the organism might have been on the beach or in the ocean.

Structure and function of sandy shore animals such as crabs, shellfish, etc.

Waves are intense, and they are a big factor with which organisms that live in beach environments must deal.

Small sand crabs and other invertebrates that live on the sandy shore in an area that is impacted by waves must burrow since there isn't anything solid to hold on to. Sand crabs tend to stay in the part of the sand that is washed over with waves, and they will stick out feathered antennae into the water to filter feed on plankton and bits of dead organisms.

If students are looking at an organism that lives in the sand, such as a sand crab or other critter:

- Ask students to look at it by using the perspective of structure and function, thinking about how a small organism's structures might help it camouflage, burrow, or feed.
- You might introduce some content and ask students to think about an organism's structures or behaviors:
    - For example: There are no large rocks on this beach for a crab or other small animal to hold on to when waves come, so they often dig into the sand to keep from being washed away. Look at this organism's body parts or structures. How might they help it to survive here and not get washed away by waves? What else might it need to deal with living here?

FIELD CARD

Cut out along outer lines and fold along the centerline. This makes a handy reference card that will fit in your pocket.

Beach Exploration

Introducing the Activity

1. *Thought Swap* or *Turn & Share*:
   - ▶ *What are some things you know or have heard about beaches?*
   - ▶ *What are some things you think you might find at the beach and how might they have arrived there?*
2. Describe forces that affect beaches & invite students to think about how these might affect objects, organisms, & artifacts on the beach.
   - ▶ *Waves can bring things onto a beach, including pieces of dead organisms like seaweed; crabs; shells; driftwood; & things humans have made, like trash.*
   - ▶ *Things on beaches might get pounded by waves (~8,000 per day!) & pushed against rocks & sand, over & over again.*
   - ▶ *How might forces like constant wave pounding and being rubbed against sand & rocks affect something like a rock or shell?*
   - ▶ *How might these forces, as well as sitting in sunlight for a long time, affect things that end up on a beach? Think about what you have observed on beaches before or imagine what might happen if you have not been to a beach.*
3. Share: each object found on a beach can be a mystery—where it came from, what it is, what has happened to it over time—& model excitement about exploring beach objects.
   - ▶ *Each thing we find is a mystery. Where did it come from originally, land or the ocean? Is it from somewhere close or far away?*
   - ▶ *What happened to this object over time? Is there evidence of change over time like holes, smooth patches, or broken-off bits that we could use to try to explain what happened to it?*
   - ▶ *We can look at shells, kelp, or other parts of living things from the ocean & think about how their structures (body parts) might help them survive in the ocean.*
4. Hold up an interesting beach object, model making observations, then invite students to *Turn & Share* to make more observations about it with a partner.
5. Get the group's attention, model making explanations for what you observed, and then invite students to *Turn & Share* and practice making explanations about the object with a partner.
   - ▶ *It's fun to make explanations about what you find on a beach. For example: "I think holes in this could've been made by worms in the ocean, or maybe the holes were caused by waves."*
   - ▶ *You might try to explain where the object came from or what it is. You might look at parts of the object, such as holes or marks, & try to make explanations for what might have caused them.*
   - ▶ *For example: "I think maybe the holes were caused by insects that live on land, & my evidence is that I've seen holes like that from insects in stuff on land."*
   - ▶ *Or: "I think this object might be from the ocean, & my evidence is that it doesn't look like anything I've seen on land, & it doesn't feel like wood from a land plant."*
   - ▶ *Base your explanations on evidence. For example: "I think this has been on the beach a long time, & my evidence is that it is smooth. Maybe it got that way from being in crashing waves for a long time."*
6. This is just one object & there are hundreds of cool & interesting things on the beach, & we'll get to look at & learn as much as possible about them.
7. Draw two boxes on a whiteboard—the Play Area and the Exploration Area. Share that students will get to explore and look at cool objects, but first they will get to play and have free time in the Play Area.
8. Share how students will move to the Exploration Area when they hear your signal & how they will then move around, find at least five cool things, & make observations & explanations about those things.
9. Share: After students have looked at objects, you'll give a signal, & they'll pick one object to focus on, study, & draw &/or write about in journals.
10. Offer guidance for journaling, making a quick model sketch on a whiteboard as you do to show how students could structure their journal page.
    - ▶ *Use sketching, words & numbers to show your observations, ideas, & explanations.*
    - ▶ *It's not about making a pretty picture, it's about showing your observations on the page.*
    - ▶ *If you are more comfortable drawing, you can draw more. If you're more comfortable using words and writing, you can write more. Use drawing & writing together to show what you notice.*
    - ▶ *Some observations might be easier to show in a drawing—like the shape of a crab's shell. Other observations may be easier to show through writing or labels, like the pattern of colors or a dent on a shell.*
    - ▶ *Record as many observations, questions, & ideas as you can. You might also include a small map showing where you found your object.*
11. Share your program's rules, expectations, & safety concerns for beach time.

Playing & Exploring

1. When you arrive at the beach, show boundaries of the Play Area & the Exploration Area.
2. Give students 10–15 minutes to play & explore in the Play Area.

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FIELD CARD

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3. Use your signal for switching to the Exploration Area & give a quick review of the instructions.
4. When students move to the Exploration Area, offer tools like hand lenses & cups for catching sand crabs.
5. Give 10 minutes to explore, find interesting objects, & make observations & explanations.
6. Circulate & check in with individual students about what they've found & support students engagement with questions:

   ▶ **"What" questions about identity or causes of distinctive features:** *What might this object be? What might have caused those holes? What are some things we can say that might have happened to this bird since it died? What's our evidence?*

   ▶ **Questions about structure and function:** *How do you think it uses that structure, body part, or behavior to survive?*

   ▶ **"When" questions about time:** *Has this object been on the beach a long time or a short time? When do you think the shell was broken—before it wound up on the beach or after? What information would we need to find out how long this bird has been dead?*

   ▶ **"Where" questions about origin:** *Where might this object have come from? Was it originally in the ocean or on land? Is there any evidence of where this object may have been in the past?*

   ▶ **General questions for any conversation:** *What do you notice? What makes you think that? Can you say more about that? What's your evidence?*

Journaling About Finds

1. After students check out a few different objects, but before they lose interest, use your quiet signal, distribute student journals or paper to write on, pencils, & give a brief reminder of instructions.
2. Circulate as students are journaling & engage them in conversation. Ask about what they are noticing & encourage students to add details, observations, questions, & connections.
3. After 10–15 minutes, call the group together & invite students to find a partner with whom they were not exploring & to share discoveries.

OPTIONAL: Using Local Field Guides

1. Share students will get to use field guides to learn more about their objects.
2. Model how to use a field guide for identification & finding information.
3. Invite students to find at least one piece of information in the field guide that helps answer a question they had or is a new idea about the object they journaled about.
4. After students have had time to look through field guides, invite them to *Think-Pair-Share* about 1–2 interesting things they learned from the field guides.

OPTIONAL: Discussing Finds

1. Choose a mysterious object a student found that is genuinely interesting to your group. Lead a discussion about it, focusing on one of the following topics: where the object might have come from, students' explanations of unique features, or students' questions.

   ▶ *What's an interesting object you found? What are your questions about it?*

   ▶ *What can we notice about this? What are possible explanations for features we see (e.g., holes, broken-off patches, etc.)*

   ▶ *Where do we think this comes from? Land or ocean? If it came from the ocean, do you think it originally came from somewhere close by or far away? What is your evidence?*
2. Continue discussion, introducing some content (using discretion) from the About Stuff on Beaches chart & asking questions to take students' explanations deeper.

OPTIONAL: Discussing Objects From Humans

1. Pick up or point to a piece of trash & ask: Did someone leave this here, or is it trash from somewhere else that ended up in the ocean & was brought here by waves?
2. Listen to students' ideas & ask follow up questions to probe their thinking.
3. After a few students share thoughts, share that a large amount of trash on beaches traveled the ocean on currents & ends up washing up far from where it was thrown away.
4. Ask how trash, toxic chemicals, & other things that end up in the ocean might affect organisms on the beach or in the ocean?
5. Share that you've brought a garbage bag to pick up trash, then together, pick up trash & put it in the bag.

Reflecting & Wrapping Up

1. Before students lose steam, wrap up the discussion then share: Objects we find on a beach come from many different places and are affected by many different forces.

   ▶ *What we find on the beach doesn't just come from the beach. Some things are brought from the nearby ocean by waves, like this kelp, that winds up as food for other beach organisms.*

   ▶ *Trees, branches, trash, & other things travel in rivers to the ocean & are then carried around & washed up on other beaches.*

   ▶ *Strong ocean currents move trash, organisms, plants, etc., around the world, then waves deposit these objects on beaches.*

   ▶ *Forces, like waves, wind, & other organisms, shape & affect what is on the beach.*

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2. Share that students have been using Cause & Effect as a thinking tool to understand the beach.
   - *You've been thinking about how things got to be on a beach.*
   - *You can think about this at any beach, & it's interesting because the ocean brings things from many different places.*
   - *It's interesting to go to & beach and wonder, "Where did this come from? How did it get here? What has happened to it? How can I explain some of the mysterious features I see?"*
   - *Looking at something in nature and thinking about what caused it to be that way is one of the ways that scientists think about and understand the world.*
3. *Thought Swap* or *Turn & Share* some of the following reflection questions:
   - *Find someone who wasn't exploring near you & share what you found & learned.*
   - *What did it feel like to use science observation skills to explore & learn?*
   - *If you were to bring your family to this beach, are there skills you could share with them that they could use to learn more about what is here?*

ABOUT BEETLES™

BEETLES™ (Better Environmental Education Teaching, Learning, and Expertise Sharing) provides environmental education programs nationally with research-based approaches and tools to continually improve their programs.

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