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Sandy beaches: the window to the ocean

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Turn a beach visit into a science adventure! Explore the animals, plants, shells, and even litter stranded on the beach to reveal the secrets of marine life and ocean dynamics.

Sandy beaches make up more than one-third of the world's coastlines[1] and are among the most cherished natural environments on our planet. Beaches also serve as our window to the ocean, offering valuable insights into the organisms that inhabit it and the processes that shape it. Yet, many people think of them only as recreational sites, overlooking their vital role as dynamic coastal ecosystems.

Here, we propose hands-on activities to be carried out on the beach, enabling students to explore marine biodiversity and the connections between land and ocean. These activities are part of marine education materials fostering ocean literacy among students who explore how human activities, climate change, and natural processes interact along the coast. Repeating these activities in annual courses will produce long-term observations that promote a deeper understanding of local changes and critical thinking in the students. An informed and engaged person is needed for making sound decisions about coastal management, conservation, and sustainability in a rapidly changing world.

Finally, these activities complement the *Understand* article "Sandy beaches: connecting land, ocean, and humans", which we recommend reading as an introduction.

Before you start:

Divide students into groups of two or three and assign each group a number. They will work together on the four activities.

Safety notes:

Beaches are dynamic environments exposed to sun, wildlife, and waves. To ensure a safe and enjoyable experience:

- Choose a beach with easy access (if possible, select one with low human use).
- Ensure students have access to drinking water and are well protected from the Sun (do not forget sunscreen and a hat!).
- Always have a responsible adult or teacher supervising the group.
- Students should stay away from large dead or living animals, or dangerous human-made objects such as medical waste, sanitary waste, or food waste.
- Students should not enter the water.

Activity 1: Beach overview

On sandy beaches, many objects can be found washed ashore. In this activity, students will learn how to record fieldwork metadata – an essential part of scientific research – and explore the variety of natural objects stranded on the beach (approximately 20 minutes). Let's see what you will discover!

Materials

- Pencil
- Data table 1

Procedure

1. Each group records the following information (metadata) in data table 1:
   - Beach name
   - City (and state, if applicable)
   - Country
   - Beach coordinates (use Google Maps to find the latitude and longitude)
   - School name
   - Group number
   - Date and time of visit
   - Temperature (use the weather application on your phone)
2. Walk around the beach for 10 minutes to explore the area. As you go, look for and mark the objects you find using data table 1.

Activity 2: Collecting small natural objects on the beach

People have long collected objects stranded on the beach, an activity known as beachcombing.[2] Beachcombing offers valuable clues about the biodiversity in nearby marine habitats and about changes occurring in the ocean. In this activity, students will collect small natural objects stranded on the beach to infer the diversity of marine life in surrounding waters (approximately 25 minutes).

Materials

- Pencil
- Permanent marker
- Timer
- Gallon resealable bag
- Data table 2: small natural objects collected on the beach

Procedure

1. Assign each group an area (approximately 25 m) along the beach.
2. Instruct the students to walk in a zigzag pattern along the beach, between the wrack line and the end of the backshore, and search for small objects for two minutes. The objects must fit in a resealable bag (figure 1).

Figure 1: Instructions on how to collect objects for activity 2
Image courtesy Ninoshka López-Xalín, Smithsonian Environmental Research Center

3. If the group does not collect 25 small, natural objects, walk in the same direction and repeat the search for another two minutes. Continue until either the group has collected 25 objects or five 2-minute cycles have been completed, whichever comes first (figure 2).

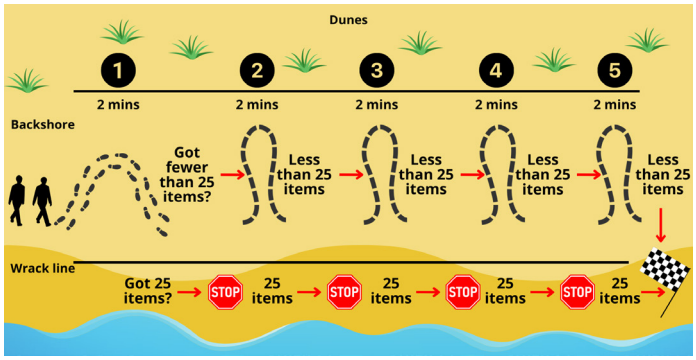

Figure 2: Instructions for carrying out activity 2
Image courtesy Ninoshka López-Xalín, Smithsonian Environmental Research Center

4. Organize the objects collected. Refer to data table 2 for the main types of natural objects.
5. In data table 2, record the total number of people in the group and the number of 2-minute cycles completed.
6. Record the number of objects in the column 'Number of objects (My data).
7. When all groups are finished, gather the class and record the total number of natural objects for each type of object in the column 'Number of objects (Entire class)'. You should sum the number of objects collected by each group.
8. Place all collected objects in the resealable bags.

Activity 3: Human-made (litter) objects

Unfortunately, not all objects found on beaches are natural. Most beaches now contain marine litter such as plastics, metals, paper, glass, and processed wood.[3] This pollution can harm animals and affect tourism.[4, 5]
In this activity, students will assess the amount of marine litter stranded on the beach (approximately 25 minutes).

Materials

- Pencil
- Gloves
- Garbage bags
- Data table 3: human-made objects

Procedure

1. Students will work in the same area assigned before.
2. Collect all the human-made objects (figure 3) following the same methodology as used for small natural objects (figure 2).

Figure 3: Instructions for carrying out activity 3
Image courtesy Ninoshka López-Xalín, Smithsonian Environmental Research Center

3. Organize the objects collected. Refer to data table 3 for the main types of human-made objects.
4. In data table 3, record the total number of people in the group and the number of 2-minute cycle completed.
5. Record the number of objects in the column 'Number of objects (My data)'.
6. When all groups are finished, gather the class and record the total number of human-made objects for each type of object in the column 'Number of objects (Entire class)'. You should sum the number of objects collected by each group.
7. Store all human-made objects in plastic bags.

Activity 4: Buoyancy test

Objects found on the beach, whether natural or human-made, can either float or sink in seawater. Those that float have positive buoyancy and may have travelled long distances with the ocean currents,[6, 7] while those that sink have negative buoyancy and likely come from nearby areas.
In this activity, students will evaluate the buoyancy of the collected objects and discuss whether they originated from nearby or distant locations (about 30 minutes).

Materials

- The small natural objects collected in activity 2
- The human-made objects collected in activity 3
- Bucket
- Labels for buoyancy test (made by hand)
- Data table 4: buoyancy of small natural objects collected on the beach
- Data table 5: buoyancy of human-made objects collected on the beach

Procedure

1. Gather the whole class to test the buoyancy of the collected objects.
2. Prepare a bucket of sea water and a labelled sorting mat to organize the objects.
3. Each group selects two small natural objects and two human-made objects: one common and one rare object from each category.
4. Test the buoyancy of the four objects as described in figure 4.

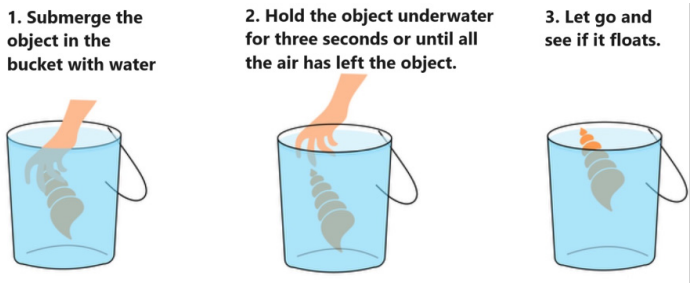

Figure 4: Instructions for carrying out activity 4
Image courtesy Ninoshka López-Xalín, Smithsonian Environmental Research Center

5. Place these objects on the sorting mat according to the test results (figure 5).
6. When all groups are finished, record the class results in data table 4 (natural objects) and data table 5 (human-made objects).

Discussion

Students had the opportunity to explore and carefully observe the objects washed ashore on their beach. This may spark curiosity and encourage them to see beaches as dynamic ecosystems, not just recreational destinations. Use this opportunity to guide a discussion about their findings. Example questions:

- What type of objects (natural or human-made) where more frequent on the beach?
- How might objects stranded on the beach benefit or affect the organisms living there?
- Did you notice any sign of a mass stranding event?
- How can human-made objects affect marine life and beach ecosystems?
- Where might these natural and human-made objects come from?
- Is your beach well preserved or highly impacted by human activities?

Students may notice large numbers of the same natural objects, which could indicate a mass stranding event. They may also observe living organisms using natural stranded objects for food or shelter. Conversely, finding many human-made (litter) objects suggests a beach affected by pollution. After the buoyancy test, students can discuss how different objects might have travelled and what this reveals about the beach's connection to the wider ocean. «

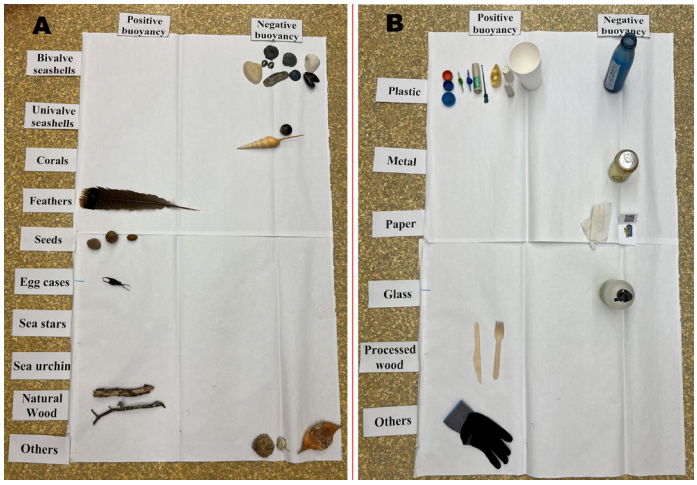

Figure 5: The left image shows a mat for small natural objects, and the right image shows a mat for human-made objects.
Image courtesy Ninoshka López-Xalín, Smithsonian Environmental Research Center

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Resources

- Discover what waves, shells or litter tell us about marine life in the accompanying article: Corte G et al. (2026) Sandy beaches: connecting land, ocean and humans. *Science in School* **76**.
- Learn more about beach zones.
- Take a look at this handy guide to discover the natural objects you can find on the beach.
- Read about scientific examples of mass stranding events.
- Check out the travel of floating objects in the ocean.
- Try these hands-on activities to introduce your students to microplastics: Realdon G (2015) Microplastics: small but deadly. *Science in School* **25**: 32-35.
- Explore the Ocean Literacy principles 1–3 in part 1 of this article: Realdon G (2023) Practical ocean literacy for all: Earth science. *Science in School* **63**.
- Learn about the ocean and how it affects our lives through engaging classroom activities: Realdon G (2023) Practical ocean literacy for all: ecology and exploration. *Science in School* **64**.
- Dive into the European Atlas of the Seas and find a user-friendly interactive educational tool on the ocean: Van Isacker N (2023) The European Atlas of the Seas: an interactive tool for ocean literacy. *Science in School* **61**.
- Learn about how ocean acidification affects sea life: Ribeiro CI, Ahlgren O (2021) An ocean in the school lab: carbon dioxide at sea. *Science in School* **55**.
- Try some classroom activities related to the thermal expansion of water: Ribeiro CI, Ahlgren O (2021) An ocean in the school lab: rising sea levels. *Science in School* **53**.
- Understand the role of the oceans in climate change: Harrison T, Khan A, Shallcross D (2017) Climate change: why the oceans matter. *Science in School* **39**: 12–15.
- Discover how the unique characteristics of seagrasses are vital for the health of our planet: Crouch F (2024) Seagrass the wonder plant! *Science in School* **67**.
- Learn how scientists deconstruct past climates through seashells: Korn A (2016) Opening seashells to reveal climate secrets. *Science in* School **35**: 12–14.
- Find out what our planet would be like without the moon: Tranfield E (2013) Life without the Moon: a scientific speculation. *Science in School* **26**: 50–56.

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Ninoshka López-Xalín is a passionate biologist of marine ecosystems from Guatemala. She has worked with participatory science for the last three years, involving schoolchildren, teachers, volunteers, and scientists around the world to collect scientific data about marine debris and marine life on beaches.

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Holly Durham-Guckian is a passionate teacher of math and marine and natural sciences at Spring Street International School in Friday Harbor, Washington, USA. She helps her students connect to and explore the natural world through hands-on, inquiry-based science, immersed in the oceans, out in the field, and in the classroom.

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