Shore to Sea Floor Lab: NYSSLS Alignment

Teacher guide for the student worksheet at mrsajdak.com/oceanzones (two pages, 18 questions; a low-write version has the same numbering). Environmental Science, Chapter 6, Lesson 6.3: What Are the Major Types of Marine Ecosystems? (SE pp. 180-185). Plan-book objective ES.2.6.6: "Students will be able to describe major marine ecosystems and the services they provide." It is the virtual partner of the hands-on Mangrove Wave Tank: Tab 3 runs the same test (waves against a shore, with and without roots) with real field numbers. © 2026 Ryan Sajdak. Free to use, share and change under CC BY-NC-SA 4.0 (creativecommons.org/licenses/by-nc-sa/4.0): give credit, do not sell it, share your version the same way.

Objectives

The three statements printed at the top of the worksheet, each with a box to tick.

I can	Questions
use real ocean data to describe the open sea's three zones.	1 to 6
explain why most ocean life is in the coastal zone.	7 to 10
name the services a coastal ecosystem gives people, and use numbers to argue for keeping it.	11 to 18

Performance expectations

The plan book lists HS-ESS2-5 and HS-ESS2-7 for 6.3, with SEP 3, SEP 7, CCC 6 and CCC 7. The lab gives evidence toward them; it does not fully assess either.

> **HS-ESS2-5**
> *"Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes."* Worksheet link: Tab 3 is a planned test of moving water against a shore (Q12 plan check, Q13 data, Q14 math). Tab 1 reads two properties of seawater that change with depth: how far light gets through it, and its temperature (Q1 to Q3).

> **HS-ESS2-7**
> *"Construct an argument based on evidence about the coevolution of Earth's systems and life on Earth."* Worksheet link: living things shape the coast they live on. Mangroves hold the shore and break waves; coastal algae grow where the land feeds the sea (Q8, Q9). Q18 is the argument, with the lab's numbers as evidence.

DCI ESS2.C The Roles of Water in Earth's Surface Processes; ESS2.E Biogeology. The book's own content for 6.3: aquatic and marine life zones, the coastal zone (estuaries, brackish water, coastal wetlands), the open sea and its euphotic, bathyal and abyssal zones, the services coastal zones give, and human impacts.

Opening: pick a phenomenon

The slideshow opens with a menu. Pick one opener per class. All three lead to the same Observe, Wonder, Predict slide and the driving question, "Where does the ocean's life live, and what does it do for people?", and the revisit at the end works with any of them.

Option	What happens
A. Video Into the Dark, 2 to 4 min	1. "First Descent: Midnight Zone", Nekton, 0:00 to 2:24 (youtube.com/watch?v=s7WO_M7SvQc), a research sub going down into the deep near the Seychelles; 2. "Mangrove Forest: Coastal Erosion Mitigation", Emriver, Inc., 0:00 to 1:48 (youtube.com/watch?v=cNE56Wua7bA), a wave table with a model mangrove forest; 3. "Quantifying Storm Protection Benefits of Coastal Mangroves", US Army Corps of Engineers (CORPSCONNECTION), 0:00 to 1:30 (youtube.com/watch?v=GN4ZgReug48). Mute the sound. Clip 2 shows what Part 3 tests: skip it with a class that will run the hands-on wave tank. All three embed; they were picked by title, length and description and must be previewed before class.
B. Try it How Deep Does	Dim the room. Lay a phone face up with its flashlight on. Add sheets of wax paper or thin printer paper one at a time, counting, until the light is gone. **You need:** one phone; about 20 sheets of wax paper or printer

Light Go?, 4 min	paper. Each sheet takes a share of the light that is left, the way each layer of seawater does. Do not explain it; Part 1 measures it. Ask: if each sheet were 10 meters of ocean, where would the dark start?
C. Photos Roots and a Storm, 3 min	Red mangrove prop roots standing in salt water, and Hurricane Ian on its way to Florida's coast (NASA satellite, September 28, 2022). The question: what will those roots do when the storm arrives?

Part by part

Part	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	What students do
1. Dive down Q1 to 3 explore, Q4 to 6 apply	SEP 4 Analyzing and interpreting data	ESS2.C	Scale, Proportion, and Quantity	Lower a probe from a ship near Station ALOHA, north of Hawaii, to 4,700 m. Record light, temperature and pressure at five depths. The Learn It box then names the euphotic, bathyal and abyssal zones, photosynthesis, phytoplankton and food that drifts down, and the zone names appear on the drawing.
2. Coast or open sea Q7 and 8 explore, Q9 to 11 apply	SEP 4 Analyzing and interpreting data	ESS2.E; LS2.B	Patterns	Tap seven places on a real satellite map of chlorophyll. Record each site's chlorophyll and sea floor depth, find the pattern (shallow and near land: 4 to 12; open sea: 0.03 to 0.09), then reveal the names. Learn It teaches the coastal zone, why it is rich, estuary and brackish water, coastal wetland, kelp forest and ecosystem services.
3. Roots against waves Q12 to 14 explore, Q15 to 17 apply	SEP 3 Planning and carrying out investigations; SEP 5 Using mathematics; SEP 2 Developing and using models (Q16)	ESS2.C	Structure and Function	Send 100 cm storm waves through a young, thin forest and an old, dense one at 0, 100, 200 and 500 m wide. Record the waves at the houses and work out the percent smaller. Learn It teaches how roots take the waves' energy, the measured 13% to 66% per 100 m, the Hurricane Ian estimate and the other services a seawall cannot give.
Wrap it up Q18	SEP 7 Engaging in argument from evidence	ESS2.E	Stability and Change	Argue for or against clearing 200 m of mangroves for houses and a seawall, with two numbers from the lab and one service a wall cannot give.

Also in play

- **Explore, then explain, then apply:** each part opens with data questions. A READ FIRST line sends students to the green **Learn It** box under the lab, which opens, glows and offers "Take me there" once its steps are done. Euphotic, bathyal, abyssal, phytoplankton, coastal zone, estuary, brackish water, coastal wetland and ecosystem service are all taught there before they are asked.
- **With the hands-on day:** Tab 3 is the same test as the Mangrove Wave Tank at real scale. In the 6.3 lesson the class uses Tab 2 for the Elaborate (a new case: real places, real data); the whole lab works as a choice-day lab, a make-up, or a second day.
- **Misconceptions:** "the deep ocean is empty" (Q5, Q6: animals live in every zone, fed from above); "the open sea is where most ocean life is" (Q8: 100 times less chlorophyll); "a swamp is wasted land" (Q17, Q18); "roots stop the waves" (Q13: they shrink them, and the young forest lets half through at 500 m).

- **Additions beyond the district doc:** the district list for 6.3 has no lab. The satellite chlorophyll map, the Station ALOHA profile and the mangrove wave model are additions. The coastal-zone line ("less than a tenth of the ocean, most of its kinds of living things") follows the book's family of texts; check the exact wording on SE p. 181.
- **Nature of models:** Tab 1 uses one light-fading rate (1% left at 113 m); real deep water lets a little more blue light through, which is why the bathyal zone is "dim", not black. The drawing stretches the top 1,000 m. Satellite chlorophyll reads muddy coastal water a little high, and the Sundarbans site is averaged over the 5 months the satellite could see through monsoon clouds. Tab 3 repeats the measured 100 m cut for each 100 m; real forests depend on water depth, tide and storm size, and a storm surge needs a forest a kilometer or more wide.
- **Builds on:** the Case Study (coral reefs, acidification) and the Chapter 5 sea otter lab (kelp forests). **Leads into:** 6.4, freshwater systems.

Standards text quoted from the New York State P-12 Science Learning Standards (NYSED). Data: NOAA NCEI World Ocean Atlas 2023, objectively analyzed annual mean temperature, 1° square at 22.5° N, 158.5° W. Letelier, R. M., and others (2004), Light driven seasonal patterns of chlorophyll and nitrate in the lower euphotic zone of the North Pacific Subtropical Gyre, Limnology and Oceanography 49(2): the 1% light depth at Station ALOHA moves from about 105 m in winter to 121 m in summer. NASA Aqua MODIS chlorophyll-a, Level 3, 4 km, monthly composites for 2021 (Science Quality), served by NOAA CoastWatch ERDDAP (erdMH1chlamday); NOAA ETOPO1 depths (ERDDAP etopo180). McIvor, A. L., Möller, I., Spencer, T. and Spalding, M. (2012), Reduction of wind and swell waves by mangroves, Natural Coastal Protection Series Report 1, The Nature Conservancy and Wetlands International: 13% to 66% over 100 m of mangroves. Narayan, S., and others (2025), Cell Reports Sustainability: Florida's mangroves cut property losses from Hurricane Ian (2022) by about $4.1 billion and from Irma (2017) by about $725 million. The answer key is a separate file, kept off the public site.