



# 9-12 High School Science Enrichment

## Southern California Coastal Systems, Ecology, and Conservation

These mixed-grade high school (grades 9-12) enrichment classes allow students to investigate coastal topography, seafloor mapping, engineering, tidepool and bay ecology, watershed-to-ocean connections, environmental monitoring, and conservation work through structured fieldwork and art-based projects over the course of 12 weeks. The 12-week course is broken down into three 4-week sessions that can be taken independently or as a full 12-week course that builds upon the previous session.

Independently, each 4-week session can be used as a science enrichment elective. As a lab, it includes documented field work and lab-style investigation. However, students may need to complete the 12-week course, rather than 4-week standalone sessions to meet their school's science elective or lab credit. A UC "A-G" laboratory science class would require the student's teacher-of-record's approval that our course design that meets UC/CSU expectations

The 1.5 hour-long classes are held each Friday, in 4-week sessions. They are team-taught by an established marine biologist and a seasoned educator who assures the curriculum is aligned with California NGSS High School Earth and Life Science standards. The sessions also include literacy and arts integration.

### Course Rationale

Across La Jolla, Mission Beach and Mission Bay, and Torrey Pines State Beach students repeatedly investigate how coastal topography, man-made engineering, erosion, biodiversity, water conditions, and human policy interact. The full 12-week sequence stacks evidence-based learning. Each session builds on the students' learning in a new coastal system, in both natural and man-made landforms. Students will do evidence-based environmental monitoring, learn to read and evaluate topography maps, learn the reasons for conservation and environmental planning decisions in San Diego county, and get information about the organizations that make those decisions.

Students will be introduced to a wide-range of careers that are related to marine science, coastal areas, and conservation. They will also do creative projects that focus on natural elements, or the reuse of waste that is found in marine areas.

### Lab Work

Because the course includes repeated investigations, structured data collection, field notebooks, and the use of scientific equipment, it may support a school's lab-work expectation. Students will be expected to document their field work accurately and provide evidence of learning with a tangible project.

## Instructor Value

Our team-teaching structure strengthens both scientific authenticity and educational instruction. A seasoned marine biologist with 20 years of experience will support the students in career-connected learning, current field practices, and site-specific expertise, while a veteran educator with a M.Ed. in Learning and Instruction facilitates the mixed-grade instruction and ensures grade-level writing and assessment.

## All Grade 9-12 Learning

The session can be used as an environmental science enrichment or marine science elective that serves grades 9-12 in:

- Environmental literacy or interdisciplinary science-and-arts enrichment course.
- Lab-work with practice of hands-on investigations, safety procedures, field/lab notebooks, data analysis, and performance assessments.

## Mixed-Grade Differentiation

**Grades 9-10:** An emphasis on accurate observation, structured note-taking, basic graphing, supported Claim, Evidence, and Reasoning (CER) writing, and guided interpretation of maps and datasets.

**Grades 11-12:** And increased independence in data analysis, policy discussion, gathering of information from multiple sources, and higher grade-level Claim, Evidence, and Reasoning (CER) expectations and higher-level field note-writing for older students.

## Essential Questions

1. How do topography, seafloor shape, erosion, and engineered structures influence coastal habitats?
2. How can students use field data to compare ecosystem health across beaches, bays, tidepools, bluffs, and watershed-connected shorelines?
3. How do Marine Protected Areas, coastal engineering, and watershed management reflect tradeoffs we make in regards to access, safety, and biodiversity resilience?
4. How can visual art and public communication strengthen conservation messages and the relaying of public information?

## Key Learning Targets

1. Understand coastal ecology and terrain through coastal topography.
2. Discuss natural erosion processes, connect watersheds to shore erosion,
3. Identify plants and animals, and develop field questions.
4. Collect field data, test water quality differences, and do water comparison.
5. Measure relative wave energy, identify water movement, compare organism diversity, record structured data, and discuss coastal and watershed monitoring.
6. Evaluate ecosystem stability, analyze evidence of coastal change, discuss erosion.
7. Review field data. Use writing and art to communicate learning in a tangible way.
8. Connect findings to careers found in coastal communities.

## Course Outcomes

1. Interpret coastal and seafloor maps and connect landforms to habitat patterns and management decisions.
2. Collect, organize, and analyze field data using scientific equipment and protocols.
3. Use field data to compare beaches, bays, tidepools, bluffs, and watershed-influenced shore systems.
4. Explain how human engineering, erosion, access, and conservation policy influence ecosystem functioning.
5. Create visual products that convey scientifically grounded evidence of learning.
6. Present claims about ecosystem health and stewardship using claim-evidence-reasoning.
7. Learn about careers that are related to marine science, conservation, and/or land planning in coastal communities.

## Grades 9-12 Primary California Standards Alignment

Area	Code	Short Description	Relevance to 12-Week Course
CA NGSS	HS-ESS2-2	Analyze geoscience data about interactions and feedbacks among Earth systems.	Coastal topography, erosion, bluff-to shore relationships, and watershed-to-ocean connections
CA NGSS	HS-LS2-2	Use mathematics or computational thinking to support explanations about ecosystems.	Organism counts, habitat comparisons, wave-energy observations, and water-condition datasets
CA NGSS	HS-LS2-6	Evaluate claims, evidence, and reasoning about ecosystem stability and change.	Marine Protected Area (MPA) comparisons, engineered vs, natural ecosystem health
CA NGSS	HS-LS2-7	Design, evaluate, and refine solutions that reduce impacts of human activities on biodiversity.	Conservation efforts, wildlife protection, and pros of man-made change
CA NGSS	HS-ESS3-1	Construct explanations for how natural resources, hazards, and climate-related changes influence human activity.	Coast-line loss, erosion, water quality, coastal infrastructure, and resource-use decisions
CA NGSS	HS-ESS3-6	Use computational representations to illustrate relationships among Earth systems modified by human activity.	Use of maps (bathymetry) seafloor imagery, and importance of published coastal models
EP&Cs	Principles I-V	California Environmental Principles and Concepts.	Ecosystem evaluation, human-nature interactions
ELA	RST.9-10.1 / RST.11-12.1	Cite specific textual evidence from science and technical sources.	Analysis of scientific maps, expectation to discern accurate scientific info, materials, and policy texts
ELA	WHST.9-10.2 / WHST.11-12.2	Write informative and explanatory science or technical texts.	Students maintain field journals and produce evidence-based written explanations/presentation
Arts	Prof.VA:Cr2.1 / Prof.VA:Pr6	Develop artistic work and convey meaning through presentation.	Supports conservation through recycled paper-making, landscape modeling, and coastal painting or sustainable art

## 12-Week Sequence Overview

4-Week Session Focus	Primary Sites	Main Science Lens	Culminating Product
La Jolla coastal ecology, MPAs, and wildlife protection	La Jolla Shores, Dike Rock, Ellen Browning Scripps Park, Children's Pool	Topography, tidepools, ecosystem comparison, MPA effectiveness	Field journal + recycled paper (conservation project) + Claim, Evidence, and Reasoning (CER) on MPAs
Mission Beach and Mission Bay engineering and habitat comparison	South Mission Beach, Mission Point Park, Crown Point, De Anza Cove	Coastal engineering, bay/ocean systems, water conditions, habitat effects	Water testing data summary + bay vs beach landscape model + CER on impact of manmade vs. natural habits
Torrey Pines terrain, erosion, watershed connections, and coastal change	Torrey Pines bluff/shore sites	Erosion, watershed influence, wave energy, coastal change evidence	Coastal painting/message art + CER on erosion, coastal change and/or watersheds

## Key Course Learning Goals

Focus	Key Learning Targets
Coastal ecology and topography	Interpret coastal topography and seafloor mapping, discuss MPA policy, identify plants and animals, explain how topographic information helps scientific decision-making.
Field data collection	Use scientific tools to collect samples and data. Measure wave period, conduct organism counts, record structured data, evaluate habitat differences, and discuss monitoring methods.
Conservation through art	Study recycled-material art, learn two handmade paper methods, produce paper for a field journal, and brainstorm waste-to-useful-product ideas.
Protected vs. nonprotected comparison	Evaluate ecosystem health, discuss MPA effectiveness, present scientific claims, and connect to marine careers.
La Jolla Coastal engineering & ecology	Use maps to observe underwater topography, discuss management agencies, measure water conditions, and generate field questions.
Mission Beach/Bay ecosystem analysis	Compare bay and ocean systems, evaluate ecosystem health, discuss how human engineering influences habitat, present scientific claims, and connect findings to coastal engineering.
Tidepools	Conduct organism counts, record data, evaluate animal and plant habitat differences, and discuss coastal monitoring methods.
Landscape modeling	Enter field data, use maps and observations to draft an idea, construct a simple creative model related to coursework, and defend the design.

## Assessment and Evidence of Learning

Assessment	Description	Standards Emphasis
Field notebook / journal	Observations, species notes, maps, sketches, data tables, and reflections collected across all three sessions.	SEP 3, 4, 8; WHST.9-12.2
Structured field datasets	Wave period or relative wave energy, organism counts, habitat comparisons, and water-condition records.	HS-LS2-2; HS-LS2-6
Map and topography analysis	Interpretation of bathymetry, topography, erosion, and coastal engineering features using published maps and site observations.	HS-ESS2-2; HS-ESS3-6
Creative projects	Handmade paper using recycled waste and natural elements, Mission Bay coastal model, and Torrey Pines art that reflects coastal-change.	Visual Arts + EP&Cs
Claim-Evidence-Reasoning presentations	Oral or written claims about MPA effectiveness, engineered coastlines, erosion impacts, or ecosystem stability.	HS-LS2-6; HS-LS2-7; ELA speaking/writing