LIVING BREAKWATERS CURRICULUM

SCAPE

TOTTENVILLE, STATEN ISLAND, NY

Living Breakwater reef street and reef ridge. Photo © Baird.

The Living Breakwaters project is widely recognized as a model for nature-based climate adaptation infrastructure. In addition to enhancing physical resilience and restoring oyster and finfish habitat along a stretch of Tottenville's coastline, the project demonstrates how innovative, resilient infrastructure design can be paired with long-term community engagement and education. **For over a decade, SCAPE, the State of New York, and the Billion Oyster Project have worked with community members, the public, and students to build awareness of coastal adaptation and encourage shoreline stewardship through hands-on learning.** As part of this effort, they co-developed the *Living Breakwaters Curriculum*, an open-access curriculum for teachers to bring this real-world case study into the classroom.

PROJECT

- SCAPE led a large, interdisciplinary team to develop the project concept as part of the Rebuild By Design Competition, launched by the U.S. Department of Housing and Urban Development (HUD) after Superstorm Sandy.[1]
- The project consists of 2,400 linear feet of near-shore breakwaters and takes a **three-part layered approach to coastal risk reduction - enhancing physical, ecological, and social resilience** along the South Shore of Staten Island. The partially submerged stone and ecologically-enhanced concrete unit structures attenuate storm waves and reduce shoreline erosion.[1]

PROJECT

Nature-Based Climate Adaptation Infrastructure

CLIENT

NYS HCR Office of Homes and Communities

LANDSCAPE ARCHITECT

SCAPE

EDUCATOR

Billion Oyster Project (BOP)

CURRICULUM

The Living Breakwaters Curriculum (BOP)

SELF-GUIDED — **CLASSROOM-INTEGRATED**

• The breakwaters create diverse habitat spaces for key species in the New York Harbor - such as oysters, finfish, and other marine life - through innovative modifications to conventional breakwater design. These enhancements include reef ridges made of various sized stones to increase surface complexity and pore spaces, 'reef streets' that offer sheltered areas for juvenile fish to feed and seek refuge, ecologically enhanced concrete armor units and tide pools, and a variety of oyster restoration installments developed in partnership with the Billion Oyster Project (BOP) and New York Harbor School.

• SCAPE also led more than a decade of public engagement for the project, educating students and community members about coastal risk and how the Living Breakwaters will help their community adapt. This extensive outreach, in partnership with the State, BOP, and New York Harbor School, comprised the third pillar of the project's layered approach: **enhancing social resilience through education.**

• SCAPE organized and participated in many community meetings, citizen science events, and events with education partners and community groups. Key engagement efforts included:

- **The Living Breakwaters Citizen Advisory Committee (CAC):** Formed in July 2015, the CAC hosted public meetings led by the State and SCAPE. These sessions featured innovative strategies to engage residents and included educational materials focused on how the breakwater design reduces coastal risk and enables climate adaptation.[2]
- **Shore walks and site visits:** SCAPE collaborated with local teachers and community groups on site-based events that included beach grass planting, shoreline cleanups, hands-on activities, and seining. These events created opportunities for place-based learning and environmental stewardship.
- **Citizen science and classroom outreach:** SCAPE also participated in citizen science events and visited local classrooms to introduce students to the Living Breakwaters project and its risk reduction and habitat creation benefits.
- **Curriculum development:** SCAPE and BOP developed an open access Living Breakwaters Curriculum.

SCAPE visits an NYC middle school class. Photo, SCAPE.


BOP hosts a youth station at a CAC meeting. Photo, SCAPE.


SCAPE leads a group of students on a shore walk at the Living Breakwaters site. Photo, SCAPE.

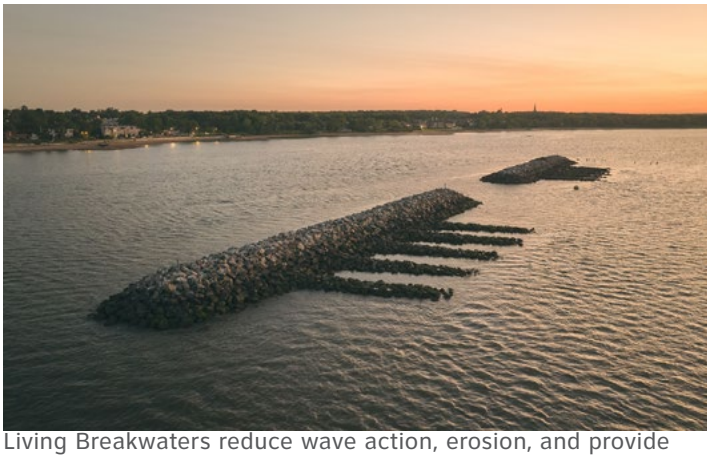

SCAPE, BOP, and student volunteers work on an oyster restoration pilot project at Lemon Creek. Photo © Billion Oyster Project.

CLIENT

- The State of New York is the client and owner of the Living Breakwaters project. For most of the project, the Governor's Office of Storm Recovery (GOSR) managed design and implementation. During construction, GOSR transitioned to the Office of Resilient Homes and Communities under New York State Homes and Community Renewal (NYS HCR).
- From the outset, the Living Breakwaters concept included a focus on enhancing social resilience through education. The New York Harbor School and BOP were identified as a partner during the competition phase and played a role in the proposal that secured federal funding, and later additional funds from the state. This partnership solidified education as a core component of the project, and the engagement and curriculum development were funded through the project's budget.

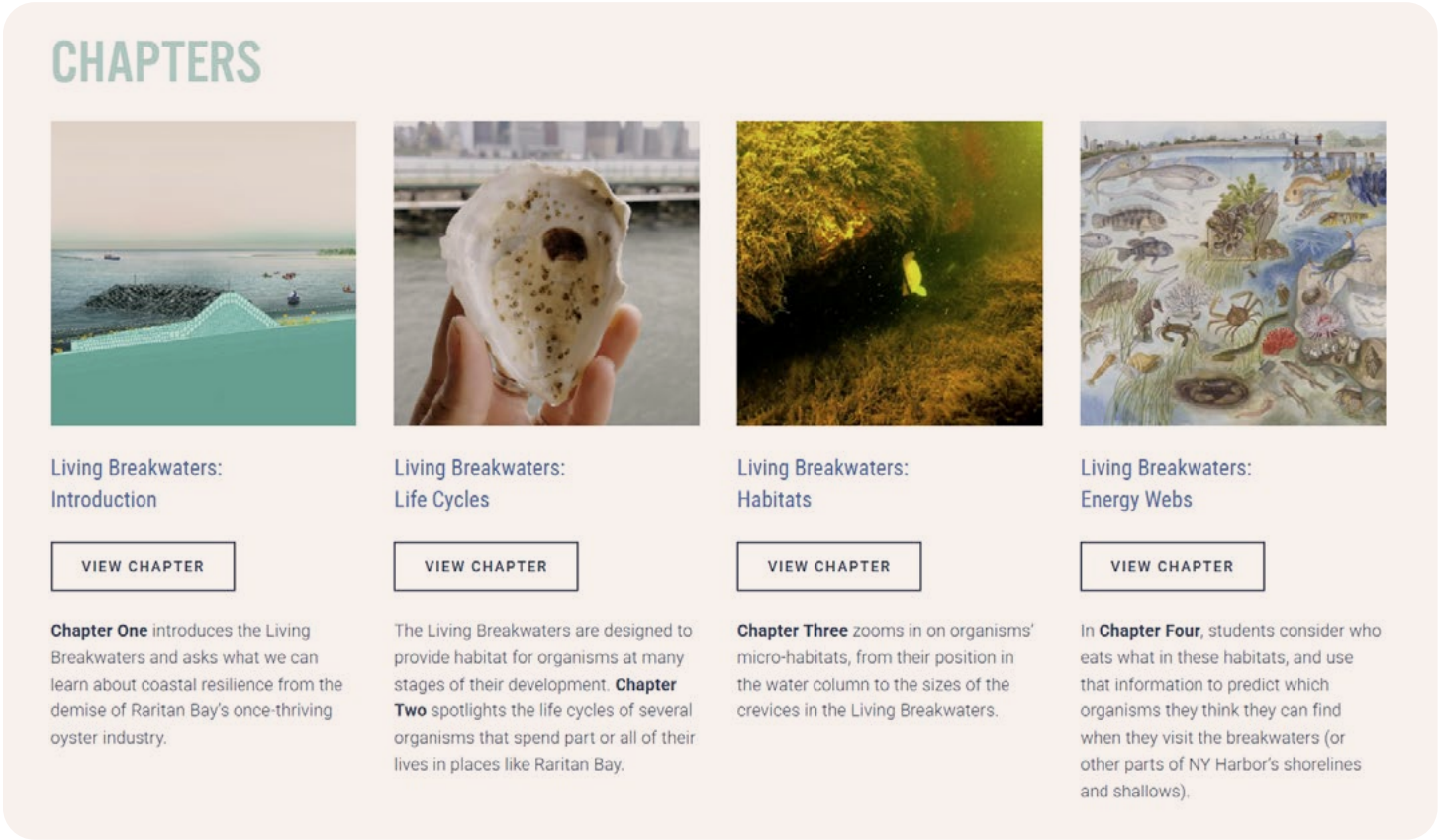
CURRICULUM

- The Living Breakwaters Curriculum **contextualizes the project as a case-study in coastal adaptation in the New York Harbor.** The curriculum is designed to help students "investigate the ecosystems supported by different habitats in the Raritan Bay, with and without the breakwaters."[3]



Living Breakwaters reduce wave action, erosion, and provide habitat. Photo © Ty Cole.

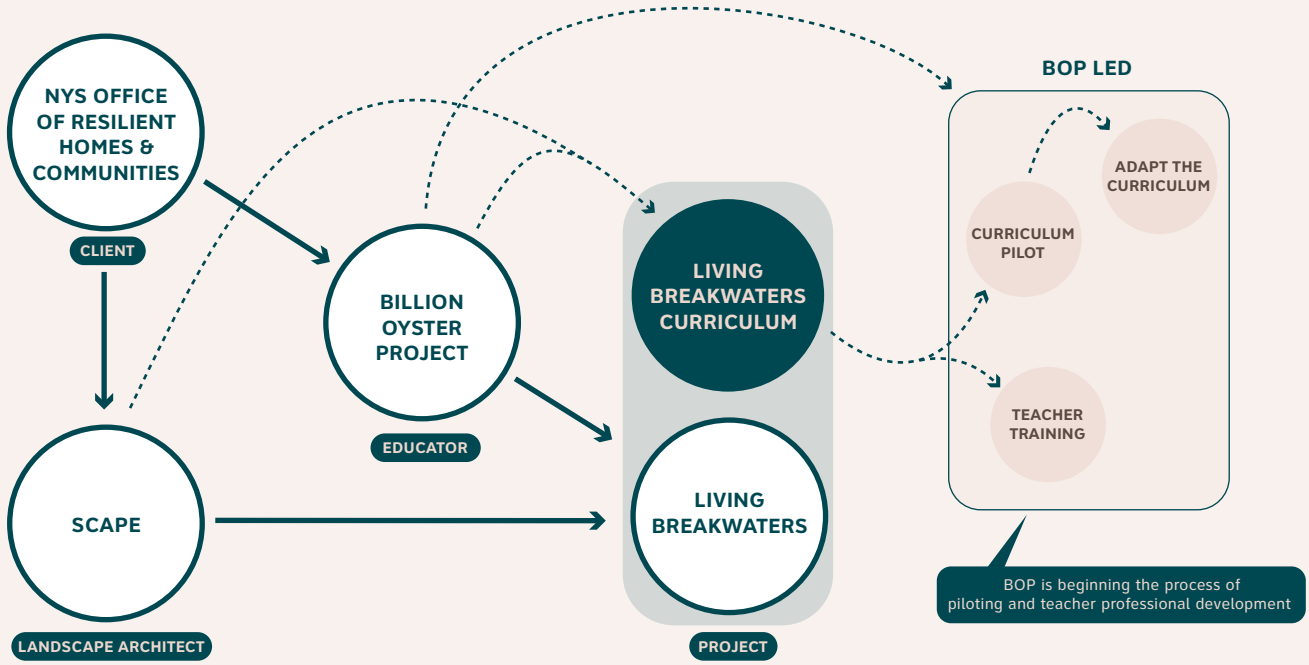
A blue crab spotted on a breakwater. Photo, SCAPE.



The curriculum includes four chapters with downloadable lesson plans and graphics. https://www.billionoysterproject.org/living-breakwaters-curriculum

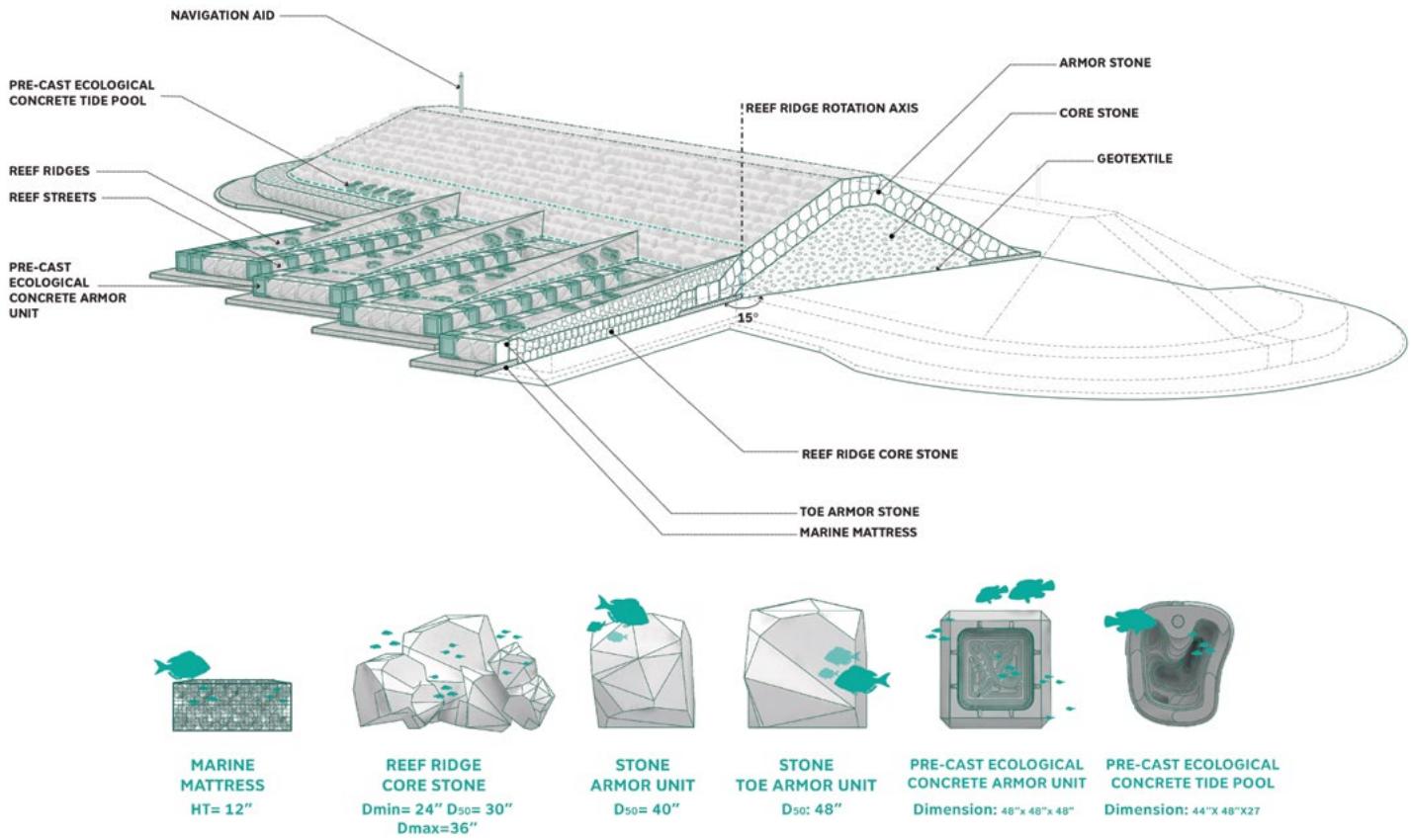
- The curriculum is designed to be sequential, classroom-based, and tailored specifically for teachers in grades 6-8 in New York City public schools and is designed to meet STEM requirements. BOP's education team created the curriculum to be taught in the classroom, and each chapter has suggestions for related on-site, hands-on activities.[4]
- The curriculum includes four chapters:
  - ***Introduction:*** Introduces the project and examines coastal resilience in Raritan Bay following the depletion of the naturally occurring oyster reefs in the area.
  - ***Life Cycles:*** Examines the various species that the Living Breakwaters create habitat for and spotlights their lifecycles in the Raritan Bay.
  - ***Habitats:*** Provides more detail on the structured habitat designs of the Living Breakwaters.
  - ***Energy Webs:*** Examines the food webs on the breakwater habitats and asks students to predict what organisms they might find on the breakwaters and in other places in the New York Harbor.
- Each chapter in the curriculum includes lesson plans and resources for educators, such as activities, games, and graphics from SCAPE. [3]
- Lesson plans within the four curriculum chapters are available as downloadable PDFs and designed to occur within 1-2 class periods. Each lesson plan contains an overview, list of materials and supplies needed for in-class and field activities, resources and vocabulary definitions for educators, handouts, information for educators to prepare for the lesson, and an instruction plan.[3]
- The curriculum is **science-focused and outlines the NYC Scope and Sequence Science Standards and Next Generation Science High School Standards** (NGSS) each lesson plan aligns with.[3]
- **The curriculum is now moving into the pilot phase.** BOP will prioritize site visits to the breakwaters and use insights from these experiences to refine and adjust the on-site activities in the curriculum. The piloting process will also help identify how in-class activities may need to be adapted to improve student/educator experience and learning outcomes.[4]

PARTNERSHIP DIAGRAM



LANDSCAPE ARCHITECT'S ROLE

SCAPE led the interdisciplinary design team for the Living Breakwaters project, from concept through implementation. SCAPE and BOP held multiple curriculum workshops over the course of a year. During these sessions, BOP shared lesson plan drafts while SCAPE provided the design and science background on the Living Breakwaters, helping the BOP education team translate complex concepts into engaging lessons for grade 6-8.[5]



Illustrations of the breakwaters (above) are included in the curriculum. Image, SCAPE.

Students learn about oysters in the New York Harbor. Photo, SCAPE.

Oyster growth after one year at the Lemon Creek pilot. Photo, Billion Oyster Project.

Ann Fraioli (BOP) teaches local students about oysters. Photo, Billion Oyster Project.

- With the curriculum complete and the Living Breakwaters project now constructed, BOP will also launch teacher professional development training. This includes virtual sessions that explore the curriculum content, help educators understand what to expect, and how to integrate the material into their classrooms.[4]

EDUCATOR

- The Billion Oyster Project (BOP) is a nonprofit organization focused on restoring oyster reefs in New York Harbor through education and community engagement. They are the organization responsible for designing and implementing the oyster restoration on the breakwaters. Their education department specializes in working with NYC teachers and students, with staff experienced in curriculum development and classroom support.[4]

- BOP partnered with SCAPE and the State of New York to develop the Living Breakwaters curriculum. They authored the curriculum under contract with the State, and project funds compensated them for their time and resources.

- A core mission of BOP's education team is to help teachers see the city as an extension of their classroom. Their approach goes beyond the typical field trip model. Instead of simply taking over instruction, BOP actively involves teachers in the on-site learning process. Their goal is to encourage educators to adopt place-based, outdoor teaching methods in their own classrooms.[4]

- Curriculum pilots are standard practice at BOP. Within a few years of publication, the organization runs a formal curriculum pilot, compensating teachers at the standard per-session rate for their participation. Teachers provide feedback to BOP staff, and the team may also conduct classroom visits to observe the curriculum in action.[4]

KEY LESSONS

1 Embedding the goal of building social resilience through education in the project from the start enabled the development of the curriculum.

The curriculum is one of many long-term educational partnerships, engagement, and initiatives funded through the project's $111 million design and construction budget.

2 The curriculum carries the project's decade-long educational mission forward beyond design and construction.

The project is built on years of engagement and education during the competition, design, and implementation phases, the curriculum extends this engagement with the project through BOP's leadership in education, outreach, and on-site oyster restoration, even as SCAPE steps back after the project is built.

3 The success of the curriculum depends on BOP's relationships and programming for educators.

Simply delivering a curriculum designed to be this integrated in the classroom at the end of the project is not sufficient. Its sequential, classroom-integrated design relies on BOP's leadership in teacher outreach, piloting, and professional development. BOP has a large network of teachers and has a long history of working with them - essential relationships for this project.

4 The SCAPE–BOP partnership was essential to the curriculum's development.

SCAPE contributed design expertise and graphics, while BOP provided knowledge of what teachers need, wrote the curriculum, and built up a large network of teachers over the years - key ingredients to deliver a curriculum based on a landscape project.

5 Aligning lessons with state science standards makes the curriculum more usable for teachers.

Each lesson clearly identifies the relevant standards the lesson addresses, helping educators integrate the curriculum into their classrooms and reinforcing its value as a legitimate, place-based teaching tool.

RESOURCES & REFERENCES

1 The Living Breakwaters, SCAPE

2 The Living Breakwaters Project Information, NYS HCR

3 The Living Breakwaters Curriculum, BOP

PROFESSIONALS INTERVIEWED

4 Ann Fraioli, Director of Education, Billion Oyster Project

5 Lee Altman, Principal, SCAPE Landscape Architecture

***Landscapes are Learning Labs**, 2025.*

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