Lesson 3: Reef Restoration

Theme: Resilience of Florida's Coral Reef

Grade Levels: 6-8

Duration: 60 minutes

Activity: 90 minutes

Students will learn about coral reef restoration initiatives and how to create coral nurseries. They also will engage in a hands-on group activity to create their own nursery best suited to the environmental conditions.

Next Generation Sunshine State Standards:

SC.6.N.1.5	Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.
SC.7.E.6.6	Identify the impact that humans have had on Earth, such as air and water quality and changing the flow of water.
SC.8.N.4.1	Explain that science is one of the processes that can be used to inform decision making at the community, state, national and international levels.
LAFS.K12.SL.2.5	Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

OBJECTIVES

- Identify research techniques and models used in coral reef restoration practices.
- Identify different education, outreach and management options used to protect Florida's Coral Reef.
- Research the organizations behind coral conservation initiatives in Southeast Florida.
- Create a video about a specific research strategy or type of coral reef outreach.

MATERIALS

- Construction paper or copy paper.
- Color pencils and/or markers.
- Access to internet.
- Phone/camera to record video.
- Modeling clay.
- Pipe cleaners.

VOCABULARY

CORAL GARDENING:	raising corals in the ocean
GENE SEQUENCING:	the process of determining the sequence of nucleotides in a segment of DNA
MICROBIAL COMMUNITY:	groups of different microorganisms that live together in the same location
NURSERY:	set of structures in the ocean where coral fragments can be grown, cleaned and monitored; corals are grown in nurseries to be outplanted to the reef
PROPAGATE:	growing/breeding an organism through natural processes
REEF RESILIENCE:	a coral reef's ability to maintain key functions in the face of environmental stressors, like storms and human pressures, by either resisting or recovering from the impacts
SPAWNING:	eggs are released into the water column to be fertilized by sperm

Ocean Literacy Principles:

6. The ocean and humans are inextricably interconnected.

Climate Literacy Principles:

7. Climate change will have consequences for the Earth system and human lives.

Background Information:

Coral reefs are among the most threatened ecosystems on Earth due to a combination of local and global stressors that are exacerbated by climate change. Scientists and managers are working to research and implement strategies to improve the resilience of Florida's Coral Reef. Innovative techniques to protect the reef are continuously being developed, from understanding the genetic makeup of the coral microbial community to developing citizen science programs where divers and snorkelers can submit reports on reef health.

Coral propagation - or raising rare corals - can take place either on land or in the ocean. On land, coral fragments collected from the ocean are relocated to an aquarium or laboratory and raised in captivity. In the ocean, coral fragments are strategically planted or attached to specially designed surfaces near one another and cared for by divers and snorkelers. These areas are called coral nurseries, and the process is often called coral gardening. As examples, Mote Marine Laboratory in Sarasota and the Coral Restoration Foundation in the Florida Keys both maintain coral nurseries. The Florida Aquarium propagates corals on land in tanks. When the corals are large enough, they are transported to selected sites and secured to the reef substrate. This process is called outplanting.

Scientists are constantly developing different techniques to grow corals in the field and increase their survival rates. Rather than attaching the fragments directly to the seafloor, where sand and sediment could easily bury them, scientists plant the fragments on different structures that collectively become a nursery. The three main types used today are floating nurseries, block nurseries and frame nurseries.

- **Floating or mid-water nurseries**: Corals are secured to lines or frames that are suspended above the seafloor with floats and situated in place with anchors. Types of floating structures include floating underwater coral apparatus or trees made of PVC pipes.
- **Block nurseries**: Corals are secured to cinder block or concrete slabs.
- **Frame nurseries**: Metal frames, plastic mesh frames or PVC structures with corals secured to them are attached to the seafloor. Frame nurseries include A-frame, rope-table and fixed PVC nurseries.

Engage

Introduce different coral reef restoration initiatives and organizations by showing these short videos.

- Restoring Coral Reefs in The Florida Keys: Jack and Colton, from ABC's Rock The Park, are in the Florida Keys learning about the ways in which coral that has been damaged by climate change and disease is being restored (5:44 minutes).[1]
- The Florida Aquarium's Coral Conservation (1:25 minutes).[2]
- If time allows, show How do you get coral to spawn? Learning about Project Coral at the Horniman Museum and Gardens (4:26 minutes).[3]

Explore

Students will work together in groups of three to four to build a nursery best suited to the environmental conditions.

Give each group a copy of the comparison of nursery types chart (page 6), five pipe cleaners and a cup of modeling dough.

Each group decides how to build a Southeast Florida coral nursery. It must be an in-situ nursery, but they may choose among a floating nursery, block nursery or frame nursery. They may research existing structures but must modify them to make it their own while keeping in mind the conditions listed on the comparison chart.

Explain

Each group presents their model to the class, including why they chose their structure, the name of the design and an explanation of the design.

Nursery Design Rubric

Name of design	Design defined as either floating, block or frame nursery	Innovative design; group enhanced or modified existing models	Nursery design meets given scenario parameters	Presentation includes explanations for design choices
5	5	15	10	15

[1,2,3] *hyperlinks can be found on page 5*

Extend

Divide students into groups of four to five. Each group will represent coral reef scientists or resource managers who are competing for a grant to fund their coral reef outreach or research. Assign any of the following:

- SEAFAN BleachWatch.
- Coral gene sequencing.
- Staghorn coral propagation and restoration.
- Coral tree nursery.
- Outplanting corals.
- Aquarium induced spawning.

Students will craft information and graphics as appropriate for their research initiatives and will record a "sign-holding video" about why their work is meaningful. In a sign-holding video, people hold a series of signs with information about a topic. Videos should be no longer than three minutes. Students are encouraged to make creative videos that possibly include:

- Graphics and visual aids.
- Different backgrounds (filmed in different locations).
- Time-lapse or slow-motion.
- Background music.

Once students receive their assigned topic, they should research the following to include in their videos:

- What is the goal of the assigned initiative?
- What is the name of a local organization that is developing this initiative?
- How will this initiative help coral reef restoration in Florida?
- Could this same research be expanded to other coral reefs in the world?

Evaluate

Once students submit their videos, host a watch party. Allow each student to vote for their favorite video (Students are not allowed to vote for their own group).

Video Rubric

Video states the goal of the initiative	Video identifies an organization in Florida that is developing this initiative	Video describes how the initiative advances coral reef restoration in Florida	Video describes how the same research/outreach could be expanded to other coral reefs in the world	Use of effects (graphics, visual aids, time-lapse, soundtrack, etc.)
10	10	10	10	10

Box 4: Comparision of Nursery Types

There are multiple parameters to consider when choosing a nursery design. Below is a comparison of three types of nurseries.

Comparison of Nursery Types	Line	Block	Frame
Use of vertical space	Better	None	None
Predation	Lower Rates	Higher Rates	Higher Rates
Water flow and circulation	Better	Reduced	Reduced
Can be raised or lowered in the water column to respond to weather events	Yes	No	No
Can be relocated prior to storms	Yes	Yes (with difficulty)	Yes (with difficulty)
Inexpensive and easy to set up (all materials are readily available)	Yes	Yes	Yes
Maintenance	Low	High	High
Growth rates	Higher	Lower	Lower
Hazard to marine life	Higher Potential	Low Potential	Low Potential
Suitable for shallow areas	No	Yes	Yes
Can be deployed in sand or rubble	No	Yes	Yes
Long-lasting	Yes	Yes	Yes
Ease of anchoring	Yes	Yes	Yes
Provides immediate habitat for fish and invertebrates	No	Yes	Yes
Macroalgae accumulation	No	Yes	Yes

Hyperlink Web Addresses

Page 3

[1] YouTube.com/watch?v=GQO1kDHdL_s

[2] YouTube.com/watch?v=VNenKTGjEC0

[3] YouTube.com/watch?v=E9lTuAKLRuY