Lesson Plan - Restoring Healthy Reefs for the Future

Module Summary
This module is an immersive live dive where students will be taught about threats to coral reef ecosystems and how scientists are trying to protect and restore them. They will be given a worksheet to assist with their learning and understanding of coral restoration techniques such as fragmenting, coral nurseries and outplanting. They will also learn why healthy, biodiverse coral reefs are important on a planetary level, and how humans depend on them. Students will learn about how human activity is changing our climate and how they can all have a positive impact. It's going to be a great dive on Little Cayman!

Years 4 & 5

Learning Objectives

- Summarize some threats that coral reefs are facing
- Define why coral reefs are important to humans and the planet
- Explain the importance of reef restoration
- Describe the process of growing corals in a nursery and outplanting them onto a coral reef
- Think about a community project you can lead to help keep coral reefs healthy

The Cayman Islands - Science National Curriculum Alignment

- Recognize that environments can change and that this can sometimes pose dangers to living things (Year 4).
- Find out about other animals, including how they grow, feed, move, and use their senses (Year 4).
- Observe similarities and differences among animals and among plants (Year 4).
- Investigate local habitat, including the relationship between the animals and plants found there, and develop skills in classifying animals and plants by observing external features (Year 4).
- Investigate the conditions necessary for growth of familiar plants including light, heat and water (Year 5).

Working Scientifically Skills (Cayman Islands – Science National Curriculum):

- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate (Skill 2) (Year 4)
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs (Skill 3) (Year 5 & 6)

Ocean Literacy Principles Alignment

- Ocean Literacy Principle #3: The ocean is a major influence on weather and climate.
- Ocean Literacy Principle #5: The ocean supports a great diversity of life and ecosystems.
- Ocean Literacy Principle #6: The ocean and humans are inextricably interconnected.

Description of Live Lesson

The dive will take place on a pristine coral reef rich with marine life offshore of Little Cayman, Cayman Islands, BWI. The CCMI underwater educator will communicate constantly with the live lesson host (who will be topside on the boat) and with the engaged remote class. The educator will take the students through a series of observations, fun facts and learning objectives regarding coral reef threats, climate change, adaptation, restoration techniques and how students can help, all in alignment with the Science National Curriculum of the Cayman Islands and several of the ocean literacy principles. Students will have a worksheet to complete during the live lesson, which they are welcome to ask questions about to our underwater educator at any time during the duration of the broadcast. Pre-recorded footage and images may be used to show key examples of adaptations, coral disease and coral restoration, should these not occur naturally on camera during the live lesson.

Live Broadcast Outline (40 mins)

00:00 – 05:00	Opening video & Host welcomes students and introduces the RGL team
05:00 – 15:00	Host and Educator discuss threats to coral reefs & coral reef importance
15:00 – 18:00	Questions or comments
18:00 – 28:00	Restoration techniques including fragmenting, nurseries & outplanting
28:00 – 30:00	Questions or comments
30:00 – 37:00	Host and Educator recap the live lesson and concludes the module
37:00 – 40:00	Closing credits and video roll

In-class materials needed

- Internet connection
- laptop (or cell phone)
- projector
- speakers
- paper
- Scissors, ruler & pencils/pens
- CCMI activity sheet
- CCMI lesson place

Useful additional resources

- **CCMI YouTube tutorial 'How do scientists grow coral – outplanting coral':** https://youtu.be/1N3HNMRd56w
- **CCMI mini-module lesson plan 'How do scientists grow coral – outplanting coral':** https://secureservercdn.net/198.71.233.229/a9b.f1e.myftpupload.com/wp-content/uploads/2019/09/Mini-Module-Lesson-Plan-How-do-Scientists-Grow-Coral-Outplanting-Coral.pdf
- **Coral reefs for kids:** https://www.youtube.com/watch?v=cwJDlDZvJ-0
- **CIG - Department of Environment:** https://doe.ky/marine/coral-reefs/

“Restoring Healthy Reefs for the Future” Key Terms

The CCMI educators may refer to the below key terms, which will be defined throughout the live broadcast. Some of these terms may be used in the accompanying worksheet that can be completed during the Reefs Go Live broadcast. Listen for your opportunity to learn some new vocabulary about our coral reef ecosystems!

Adaptation - how a living being changes to be better able to survive in its environment

Anthropogenic – human impacts on the environment, ecosystems, biodiversity, and natural resources, caused directly or indirectly

Biodiversity – the variety of life in a particular area/ecosystem, in this case referring to different species

Climate Change – change in global weather patterns over time, largely due to increased carbon dioxide in the atmosphere as a result of human activities

Coral Nursery - a place where scientists grow corals underwater on specialized structures

Ecosystem – a community of living organisms in conjunction with the non-living parts of their environment, interacting as a system

Fragmenting - a process which mimics asexual reproduction where pieces of coral are carefully broken, with the goal of growing each piece into a new individual coral

Genotype – the specific DNA sequence within the genetic makeup of a cell that determines an individual organism or group of organisms

Hermatypic coral - stony coral; a coral that helps build the reef and becomes limestone over time

Outplanting – transplanting of corals from a nursery onto a reef or other structure in the ocean

Photosynthesis – process by which green plants or algae convert sunlight, carbon dioxide and water into nutrients and oxygen

Reef Health – a simple observation of the status of coral reefs using key indicators, scientific measurements, and the presence or absence of certain organisms

Resilience - the ability to recover from or respond to a stressor or disturbance

Worksheet - Restoring Healthy Reefs for the Future

Fill in the blanks using the keywords:

restoration - grow – underwater structures
White Band Disease - disease resilience - outplanted

1) In the 1980s, a disease called White Band Disease, spread throughout the Caribbean, wiping out 85-95% of the staghorn and elkhorn.

2) Coral nurseries are underwater structures, used to grow endangered corals in areas where coral populations have declined due to major environmental events or disease.

3) Nurseries provide a safe environment with reduced predation and competition, providing corals the best conditions to grow.

4) Once corals have grown large enough in the coral nursery, they are outplanted back onto the reef. This is known as coral restoration.

5) Two key characteristics CCMI scientists are selecting for when we are looking to outplant corals from our nursery are heat tolerance and disease resilience.

Give two examples of human activities that are contributing to climate change:

1) _____
2) _____

What is one action that you can take to protect coral reefs?

_____

_____

_____

Worksheet - Restoring Healthy Reefs for the Future

Fill in the blanks using the keywords:

restoration - grow – underwater structures White Band Disease - disease resilience - outplanted

1) In the 1980s, a disease called _____ _____ _____, spread throughout the Caribbean, wiping out 85-95% of the staghorn and elkhorn.

2) Coral nurseries are _____ _____, used to grow endangered corals in areas where coral populations have declined due to major environmental events or disease.

3) Nurseries provide a safe environment with reduced predation and competition, providing corals the best conditions to _____.

4) Once corals have grown large enough in the coral nursery, they are _____ back onto the reef. This is known as coral _____.

5) Two key characteristics CCMI scientists are selecting for when we are looking to outplant corals from our nursery are heat tolerance and _____ _____.

Give two examples of human activities that are contributing to climate change:

1) _____
2) _____

What is one action that you can take to protect coral reefs?

_____

_____

_____

Teachers Lesson Plan

How Do Scientists Grow Coral?

Mini-Module Summary

This lesson introduces students to CCMI's coral restoration programme and allows them to "dive" into one of the Little Cayman coral nurseries. In this live lesson, our CCMI Educators will give an introduction to coral biology and ecology before explaining why reef restoration is so important to the marine environment, what CCMI is doing to facilitate restoration efforts, and how the students can get involved and help with restoration. In this lesson, students learn what corals actually are, how they are grown in a nursery environment, and some of the methods scientists use to take care of them, such as cleaning. Students and teachers will be given an activity sheet to assist with understanding the importance of these corals, coral reef ecosystems, and coral nurseries.

Curriculum Aims: Key Stage 1 and 2

Learning Objectives

- Define a coral and a coral nursery
- Explain why coral nurseries are so important
- Summarize the scientific method scientists use to grow coral
- Report on the difficulties and challenges scientists face with coral nursery work
- Organize a volunteer effort to assist with a local coral nursery

The Cayman Islands - Science National Curriculum Alignment

- Performing simple tests and investigations (Years 1 and 2)
- Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on one another (Year 2)
- Find out about and describe the basic needs of animals, including humans, for survival (Year 2)
- Identify that animals, including humans, need the right types and amount of nutrition, and they cannot make their own food; they get nutrition from what they eat (Year 3)
- Recognise that environments can change and that this can sometimes pose dangers to living things (Year 4)
- Describe the life process of reproduction in some animals and plants (Year 5)
- Give reasons for classifying plants and animals based on specific characteristic (Year 6)

Necessary materials

Internet connection, YouTube.com classroom account, computer, note paper, pencils or pens, activity sheet, plain paper, 4 paper straws [or: wood sticks (x8), popsicle sticks (x8), skewer sticks (x8), pieces of paper(x8) toothpicks (x16)], tape, nylon thread [or: dental floss, yarn, string, twine]

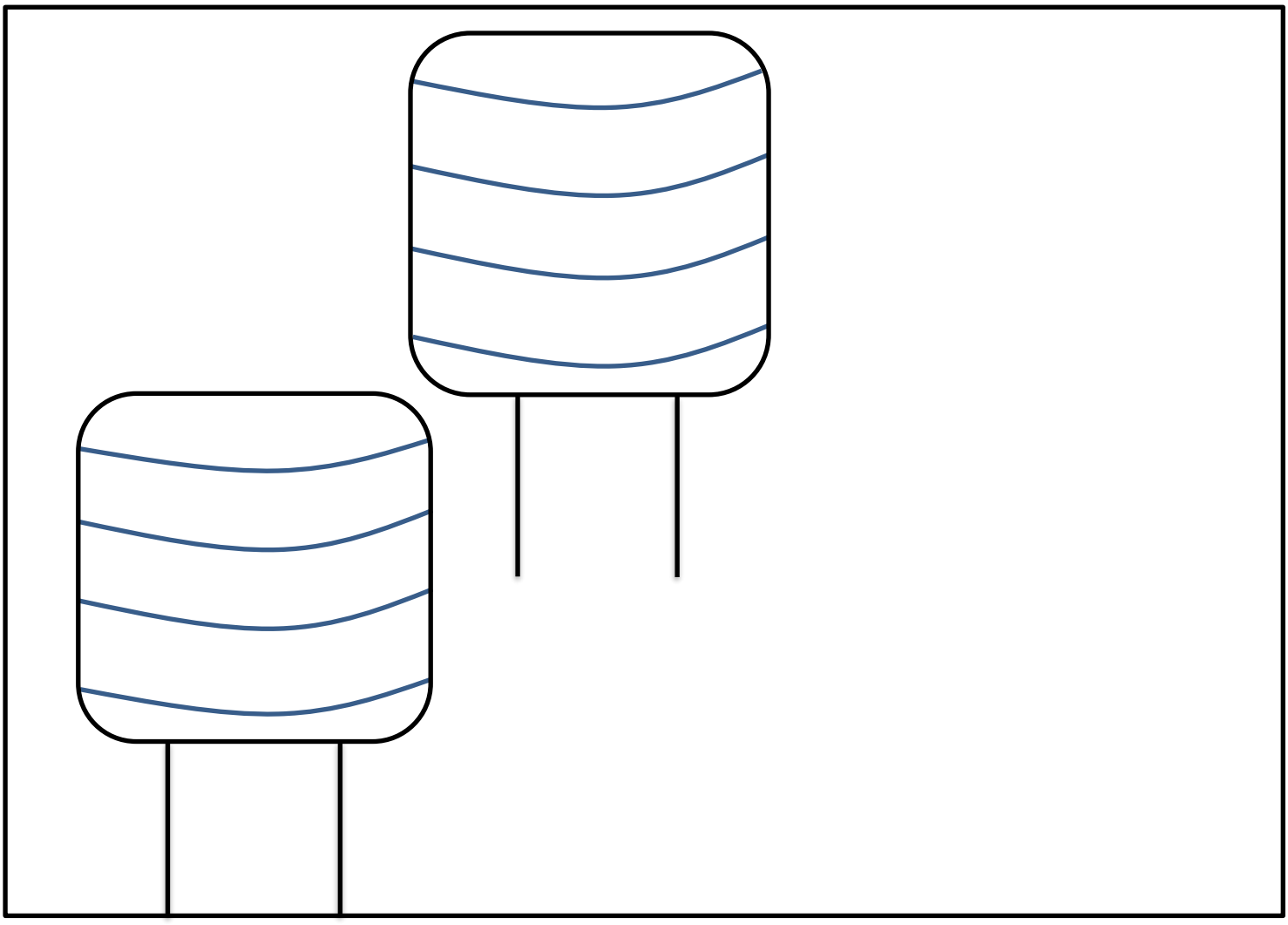
Useful resources

- www.reefresearch.org/reefs-go-live
- www.projectaware.org
- www.doe.ky
- www.education.gov.ky/education/curriculum
- www.caymanecodivers.com/cayman-coral-nursery-program/

Student Activity Sheet

How Do Scientists Grow Coral? – Coral Nursery

Today, you're the scientist! In the space below, create your own coral nursery! We have provided you with two coral frames to get started. Use the blank space to the right of the two coral frames to design your own structure for growing corals on in your nursery. A coral nursery is not complete without the coral! On the coral frames and your coral structure draw your staghorn coral (*Acropora cervicornis)*. Make sure you leave space between each coral fragment, so they have room to grow. Organisms other than coral also live in and around coral nurseries. Just like a coral reef you can find many species of fish swimming around. Many of these fish species help the coral nursery by eating the macroalgae that grows on the frames. Draw some fish and other marine organisms in your coral nursery. Remember that even though the fish help clean some of the macroalgae, they don't eat it all. It is important that our scientists clean the nursery completely of macroalgae at least once a week so the corals can stay healthy and continue to grow! Good luck creating your own healthy coral nursery!



Student Activity Sheet

How Do Scientists Grow Coral? - Coral Nursery

Today, as a scientist, you have drawn and created your own great coral nursery. Now, you are going to create and build your own 3-D coral frame. Once you have created your frame you can draw your own coral and hang them on your 3-D structure. You can create multiple frames and form your own 3-D nursery!

For this activity you will need: 4 paper straws [or: wood sticks (x8), popsicle sticks (x8), skewer sticks (x8), pieces of paper(x8) toothpicks (x16)], tape, nylon thread [or: dental floss, yarn, string, twine].

First Step: Building the Frame

- You will need four straws. These will be the main structure of your frame. You can also decide to use an equal number of wooden sticks, popsicle sticks or skewer sticks. If you don't have any of these items, you can tape together toothpicks or simply roll pieces of paper and tape them.
- Lay the four sticks down to form a square. (If using toothpicks, lay four in a group to form each side. Tape the four of each side together.)
- Connect the four corners of the square with tape.
- Now you have your frame!

Second Step: Build the Lines

- Cut three pieces of nylon thread so they are slightly longer than the length of you frame. If you do not have nylon thread you can use dental floss, yarn, string, or twine.
- Lay your frame down and place the first piece of thread across the frame so it is slightly below the top stick.
- Tape the nylon thread to the two vertical sticks of your frame. You have made the first line of your frame! This line is what your corals will hang from.
- Tape the remaining two threads to your frame.
- *Make sure there is enough space between each thread for your corals to hang*

Third step: Hang the Corals

- On a blank sheet of paper, draw and colour nine corals.
- Cut out your coral drawings and tape them to the lines of your frame.
- You must keep a maximum number of three corals on each line, so the corals are not too crowded. It is important to leave enough space between the corals so they can continue to grow.

You can create multiple 3-D structures to form your own coral nursery! Use your creativity to create your own 3-D structures as well. Happy building!

Lesson Plan

How Do Scientists Grow Coral? – Outplanting Coral

Mini-Module Summary

This lesson introduces students to CCMI's coral restoration programme and allows them to "dive" into one of the Little Cayman coral nurseries. In this live lesson, our CCMI educators will give an introduction to coral biology before explaining the importance of coral reef ecosystems, the various services they provide for humans and other organisms, and their role as a vital organism in various food chains. In this lesson, students review what corals actually are, how they are grown in a nursery environment, and some of the methods scientist use to outplant corals back onto the reef. Students and teachers will be given an activity sheet to assist with understanding the importance of these corals, coral reef ecosystems, and coral nurseries.

Curriculum Aim – Key Stage 1 and 2

Learning objectives

- Define a coral and a coral nursery
- Explain why corals reefs are extremely important ecosystems
- Describe some of the services coral reefs provide to humans
- Organize simple coral reef food chains
- Summarize the scientific method scientists use to outplant corals

The Cayman Islands - Science National Curriculum Alignment

- Identify and name various common animals that are carnivores, herbivores and omnivores (Year 1)
- Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other (Year 2)
- Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food (Year 2)
- Identify that animals, including humans, need the right types of nutrition, and that they cannot make their own food; they get nutrition from what they eat (Year 3)
- Recognise that living things can be grouped in a variety of ways (Year 4)
- Recognise that environments can change and that this can sometimes pose dangers to living things (Year 4)
- Construct and interpret a variety of food chains, identifying producers, predators and prey (Year 4)
- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution (Year 6)

Necessary materials

Internet connection, YouTube.com account, computer or tablet, speakers, note paper, pencil or pen
Activities: #1- activity sheet (one per student), scissors, toothpicks (or alternatives listed below), and tape
#2- activity sheet (one per student), scissors, paper, markers, crayons, or colored pencils, tape or glue stick

Useful resources

- www.reefresearch.org/reefs-go-live
- www.projectaware.org
- www.doe.ky
- www.education.gov.ky/education/curriculum
- www.caymanecodivers.com/cayman-coral-nursery-program/

Student Activity Sheet

How Do Scientists Grow Coral? - Build a Coral Dome

Today, you're the scientist! You are going to create your own coral dome! At CCMI we have started to use a new method of outplanting. We have built our own 3-D dome structures which we are able to attach the corals onto. Once they are attached to the dome, we can outplant the entire dome out onto the reef! Today you are going to build one of these domes and help outplant some coral!

For this activity you will need: 12 toothpicks [or wood sticks (x6), popsicle sticks (x6), skewer sticks (x4), plastic straw (x4), or piece of paper (1 sheets)], tape or hot glue gun, scissors, your own coral drawings

Refer to the pictures below as reference for each stage

Stage One: Building the Top of the Dome

1. Take six of your toothpicks. This will form the top of your dome. If you do not have toothpicks there are other materials which you can decide to use. You can choose to use an equal amount of any of the other materials listed above, however keep in mind the dome structure will be much larger than the toothpick design. If you would like to make the structure similar in size to the toothpick design the following lists how many of each other material to use. If using wood sticks or popsicle sticks cut 3 sticks in half so you now have six smaller sticks. If using skewer sticks or straws cut two into three equal pieces so you will now have six total smaller pieces. If using paper, cut a single piece of paper in half horizontally. Then cut that half sheet into six equal strips horizontally. Roll those strips into tight tubes and tape them shut. When using scissors and trying to cut difficult materials such as some of those listed above, please be extremely careful and ask an adult for help if you need it!
2. Lay your six toothpicks down tip to tip in a hexagon shape. A hexagon is a shape with six equal sides. If using other materials, lay your six pieces down tip to tip in the hexagon shape.
3. Connect the six points of the hexagon by taping them or gluing them with a hot glue gun. If using a hot glue gun, make sure you have help from an adult!

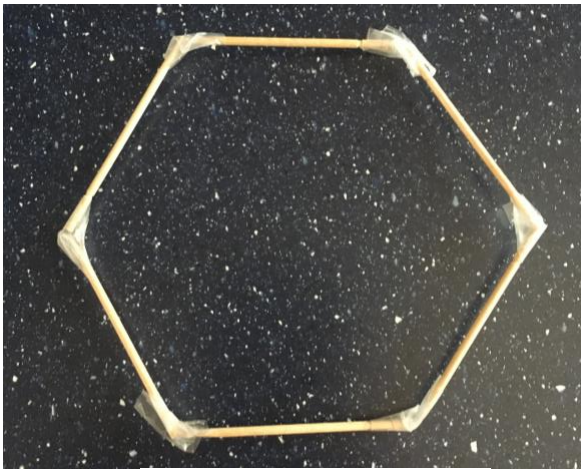
Stage Two: Building the Dome Legs

1. Grab your last six toothpicks. If you are using other materials follow the first step in Stage One to make six smaller pieces of your material.
2. Use tape or hot glue to connect one toothpick end to the connection point between two toothpicks on our original hexagon. The toothpick should not lay flat with the hexagon but stick down at a slight angle.
3. Repeat the process with your five remaining toothpicks at the other intersection points.
4. Now you have your standing outplant dome!

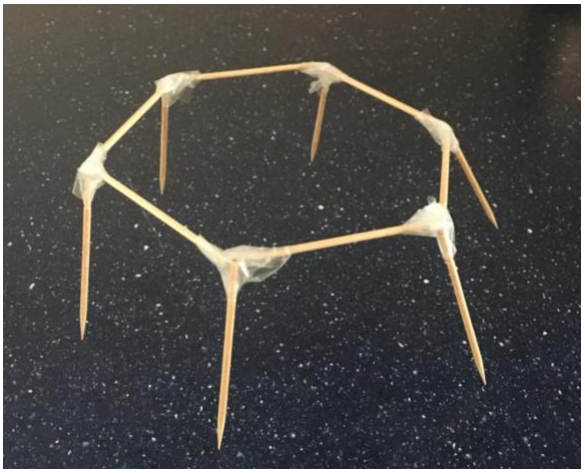
Stage Three: Attach the Corals

1. Now it's type to create and attach your own corals! Start by drawing and coloring your own corals! Then cut out your corals.
2. Now, using tape or hot glue attach your corals to your dome.
3. It is okay if some parts of one coral overlap another. Make sure your entire dome is covered in coral!
4. Now your coral dome is ready to be outplanted!

You can create multiple 3-D domes to be outplanted at different sites around the reef! Happy building!



Stage 1: Hexagon



Stage 2: Dome Legs

Stage 3: Attach Corals