

Coral Reef Ecosystem

The Lesson Plan and Nature-based activities
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Photo Source: Jessica Bowmeester

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Task 3: Nature-based Activities

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10-13 Years

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- Resource

14-17 Years

- Introduction
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Task 1

Ecosystem: Coral Reef Before-you-begin

Task 1: Before-you-begin



As we move from the open Arabian Gulf towards land, the first ecosystem we stumble upon is the colorful coral reef. Coral reefs are distributed 30 degrees on either side of the equator and are prime real estate in the marine environment because they provide shelter and nursery grounds in their nooks and crannies.

They also offer an abundance of food resources amidst an otherwise bare sea floor. Twenty five percent (25%) of all the living marine organisms known to humans live in coral reefs, each with their own life history and function, making coral reefs biodiversity hotspots.

Corals themselves, are small animals. At the beginning of their life-cycle, fertilized coral embryos develop into pelagic larvae, freely floating in seawater. When the larvae find a suitable substrate, they quickly attach and metamorphose into coral polyps. Polyps replicate to form colonies that with time become coral reefs. This is the reason we call corals ecosystem engineers, because they help construct a whole vibrant ecosystem one polyp at a time. The subset of 60 coral species we find in the Gulf, is one of the most resilient out of the 600 species present in the Indo-Pacific coral triangle. They are able to grow and thrive in the harsh conditions of the Gulf due to their successful symbiosis (living together) with hardly

microscopic algae housed inside the tentacles at the head of their polyp. There they carry out photosynthesis, much like plants, and their sugar byproducts provide about 90% of the coral's nutrition. The rest of their nutrition comes from ingesting free-floating luminescent phytoplankton.

Other members of the community found in coral reefs are diving cormorants, feeding on fish, and hawksbill turtles chewing on sponges. Sea slugs, sea urchins, sea cucumbers, sea stars, shrimp, lobsters, and crabs also live on reefs, as do a myriad of seaweed and fish. The clownfish and surgeon fish, popularized by the depiction of their adventures in the Pixar films "Finding Nemo" and "Finding Dory", are also found in the Gulf reefs. They play an important role in the health of reefs, by "gardening" their anemones and corals, chewing off the seaweed that would otherwise cover them whole and block off sunlight, a necessary energy source for their symbiotic algae.



Photo Source: Shutterstock

Threats: The coral reef is considered an ecosystem under threat, and about one third of all known coral species are critically endangered. In Qatar, heatwaves, coastal development and the creation of artificial channels have led to the loss of shallow corals, once known as some of the most diverse and colorful in the region, dominated by *Acropora* table corals and *Porites* understories. Other threats include noise and chemical pollution, overfishing, and improperly managed tourism activities that physically damage the reef structures and lead to disturbance of aquatic life.



Buchanan JR, et al, 2015.

Living on the edge: Vulnerability of coral-dependent fishes in the Gulf.
Marine Pollution Bulletin. 105(2): 480-488.

Burt JA, et al. 2015.

An assessment of Qatar's coral communities in a regional context.
Marine Pollution Bulletin. 105(2): 473-479.

Fanning LM, et al. 2021.

Applying the ecosystem services - EBM framework to sustainably manage Qatar's coral reefs and seagrass beds. Ocean and Coastal Management. 205:105566.

UNEP-WCMC, Biodiversity a-z. 2014.

Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project.



Task 2

Eco-schools 6-9 Years

Introduction:



The coral reef is one of the most colorful and productive of the ecosystems in the marine environment. It is of great value to the diverse organisms that find refuge and food sources in reefs, and of economic value to communities for all the ecosystem services they provide, including seawater filtration, fisheries, eco-tourism etc. The coral reefs in the Gulf are famous for being resilient to hot temperatures, an adaptation that stems from their symbiosis with heat tolerant micro-algae.

The lesson plan familiarizes the students with the coral reef ecosystem, its biodiversity and environmental conservation.

The learning process includes an exchange of information on the topic, classroom interaction, brainstorming, presenting this topic through art, and amplifying the message through the creation of a memory game.

Age Group: Eco-Schools 6-9 years

Eco-Schools Steps: Environmental Review, Action Plan, Curriculum Linkages, Inform and Involve, Monitoring and Evaluation



Objectives:

Students will be able to:

- Describe the coral reef ecosystem, and list threats
- Explain concepts of biodiversity hotspots, nurseries, and refugia
- Illustrate the organisms in coral reefs
- Create a coral reef card game to raise awareness
- Develop positive actions for the protection of coral reefs

Time required/ Duration:

Classroom Session 1: 45 minutes

[5 minutes for the film screening, 10 minutes to explain to the students the importance of coral reefs, 20 minutes to complete the coral reef inhabitants coloring sheet and create the memory cards, 5 minutes to devise positive actions for ecosystem protection].

It is left up to the facilitator's discretion to expand the timings as needed to allow students to better assimilate the information and to properly devise positive actions.

Environmental Review:

Photo Source: Jessica Bowmeester

Resources Required: "Before-you-begin":

Coral Reef ecosystem

Key concepts: overview of the coral reef ecosystems with a focus on those found in the Arabian Gulf; coral species; coral symbiont; biodiversity hotspots; nurseries; refugia in the bare sea floor; ecosystem services; threats.

Online Resources

www.reefrelief.org

Key concepts: biogeography of coral reefs; actions to protect coral reefs.



- Brainstorm with the students ideas on why this ecosystem is important, how and which human activities threaten the health of this ecosystem, and what we can do to help protect coral reefs.
- Resource 1 (Coral Reef Inhabitants Coloring Sheet)
- Student stationary, pencils, colored markers, scissors
- Dedicated display board

Action Plan:



Action Plan 1

- Screen the film, “Coral Reef Lesson for Kids”

to help students visualize the life in the coral reefs.

(Please note that you will need to create a free account to access this video).

- Screen the live feed from the coral reef at the California Academy of Sciences

to help students visualize the species interactions.

- Using the available resources, explain to the students the concepts of biodiversity hotspots, nurseries, and refugia in the bare sea floor.
- Discuss with the students the specific animals, plants and microbes that live in the coral reef, emphasizing the ones we find in Qatar and the Arabian Gulf, i.e., cormorants, green turtle etc.

Action Plan Activity 1

- Provide the students with the Coral reef inhabitants coloring sheet (Resource 1). Ask the students to color and name the organisms on the sheet in double.
- Explain to the students that these drawings will be used for a memory card game.
- Help the students identify the species.
- Facilitate the students with cutting out the colored organisms.
- Encourage the students to draw and color additional species we encounter in the coral reef.

Action Plan:



Action Plan 2

Use Reef Relief's "Guide to Coral Reefs"

and EPA's "Best Practices Guide"

to showcase and provide ideas to the students of the possible positive actions they can take individually and as a school to protect coral reefs locally.

Action Plan Activity 2

- Ask the students to list one action they can take individually and as a school to help protect the coral reef ecosystem locally.

3. Curriculum Linkages: Environmental Science, Ecology, Conservation, Arts & Crafts

4. Inform and Involve

Drive the message that education is one way to help conserve any ecosystem. That by creating this memory card game to play at home, we create a knowledge transference and raise awareness about this ecosystem to the whole family.

The memory game can be produced by the students and made available as a sale item in a bazaar, which helps raise funds for a conservation initiative in their school.

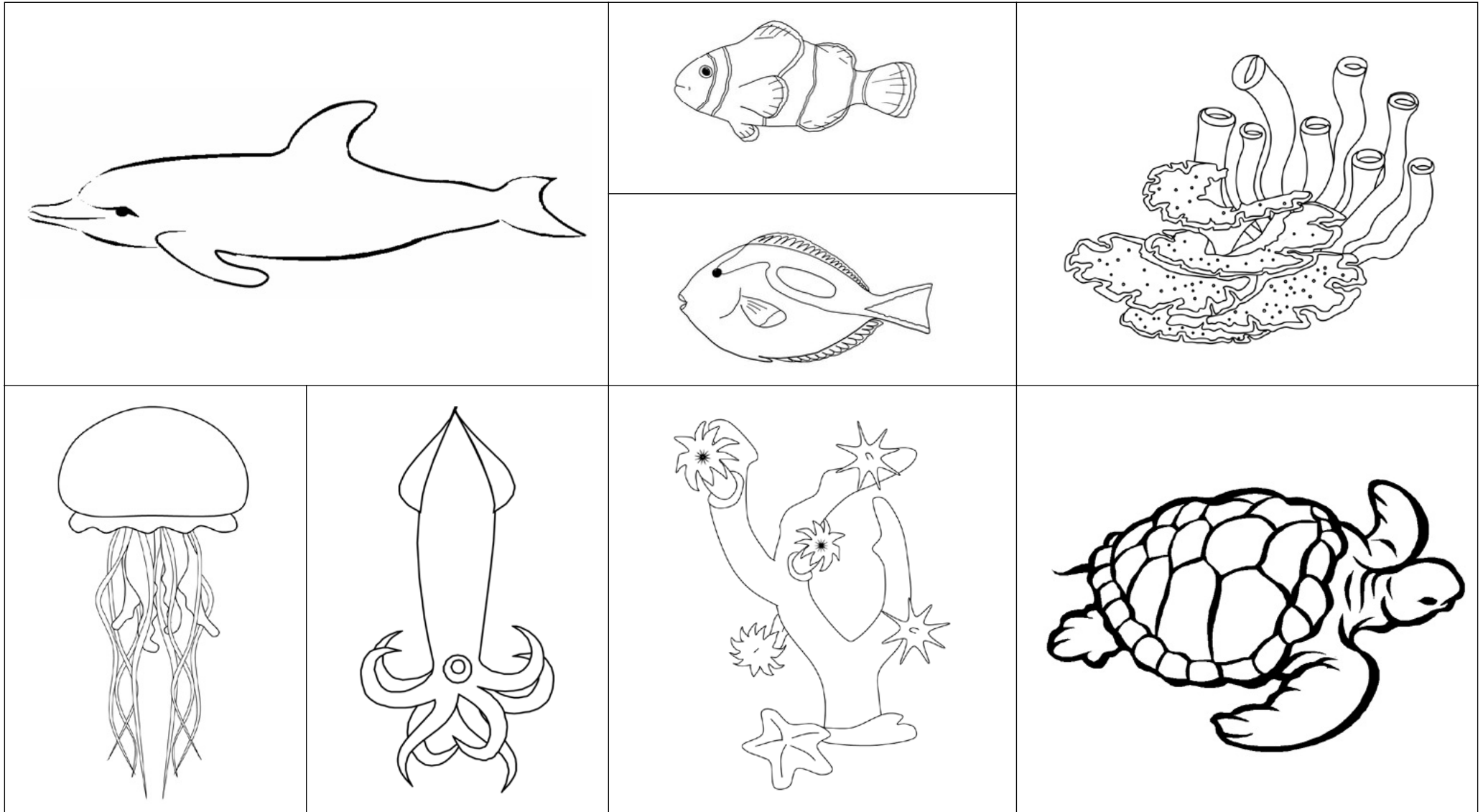
Evaluation:

Check the coloring sheets to determine the level of understanding of the students when it comes to concepts of biodiversity hotspots, nurseries, refugia and the organisms that inhabit them.

Resource 1



Coral Reef Inhabitants Coloring Sheet





Task 2

**Eco-schools
10-13 Years**

Introduction:



The coral reef is one of the most colorful and productive ecosystems in the marine environment. It is of great value to the diverse organisms that find refuge and food sources in reefs, and of economic value to communities for all the ecosystem services they provide, including seawater filtration, fisheries, eco-tourism etc. The coral reefs in the Gulf are famous for being resilient to hot temperatures, an adaptation that stems from their symbiosis with heat tolerant micro-algae.

The lesson plan familiarizes the students with the coral reef ecosystem, its biodiversity and environmental conservation.

The learning processes include researching information pertaining to the topic, class interaction, creative writing, communicating the topic in a creative form.

Age Group: Eco-Schools 10-13 Years

Eco-Schools Steps: Environmental Review, Action Plan, Curriculum Linkages, Inform and Involve, Monitoring and Evaluation



Objectives:

Students will be able to:

- Describe the coral reef ecosystem, and list threats
- Explain the ecosystem services provided by this ecosystem
- Describe the community of organisms and their trophic web
- Develop a food menu for coral reef organisms to raise awareness
- Develop actions for the protection of coral reefs

Time required/ Duration:

Classroom Session 1:

[5 minutes for the film screening, 10 minutes to explain to the students the importance of coral reef ecosystem and community, 20 minutes to discuss trophic interactions and complete Coral reef menu worksheet, 5 minutes to devise positive actions for ecosystem protection). It is left up to the facilitator's discretion to expand the timings as needed to allow students to better assimilate the information and to properly devise positive actions.

Environmental Review:

Resources Required: "Before-you-begin":

Coral Reef ecosystem

Key concepts: overview of the coral reef ecosystems with a focus on those found in the Arabian Gulf; coral species; coral symbiont; biodiversity hotspots; nurseries; refugia in the bare sea floor; ecosystem services; threats.

Online Resources

- Brainstorm with the students, ideas on why this ecosystem is important, how and which human activities threaten the health of this ecosystem, and what we can do to help protect coral reefs.
- Resource 1 (Coral reef menu worksheet)
- Student notebooks, pencils, colored markers
- Dedicated display board



Photo Source: Jessica Bowmeester

Action Plan:



Action Plan 1

- Screen the film, “Coral Reefs 101 | National Geographic”

to help students understand how coral reefs are developed.

- Screen the live feed from the coral reef at the California Academy of Sciences

to help students visualize the species interactions.

- Using the available resources, introduce the students to the concepts of biodiversity hotspots, nurseries, and refugia in the bare sea floor.
- Ask the students to name some of the specific animals, plants and microbes that live in the coral reef, emphasizing the ones we find in Qatar and the Arabian Gulf, i.e., cormorants, green turtle etc. Tabulate their answers on the white board.
- Discuss with the students the trophic interactions among the organisms they have come up with, i.e., filter feeders, omnivores, carnivores, herbivores.
- Assist the students in making connections here between threats to habitat, and availability of resources for the organisms.

Action Plan Activity 1

- Provide the students with the Coral reef menu worksheet (Resource 1).
- Give the students the following instruction for this activity:
prepare an “a la carte menu” for the wildlife that lives and frequents the coral reefs. Prepare a few dishes and new recipes based on what you know about microbes, plants and animals who live there. What dish would the green sea turtle enjoy? What would you offer to plants? etc.”
- Facilitate the students with coming up with organisms and menu items.

Action Plan:



Action Plan 2

Use Reef Relief's "Guide to Coral Reefs"

and EPA's "Best Practices Guide"

to showcase and provide ideas to the students of the possible positive actions they can take individually and as a school to protect coral reefs.

Action Plan Activity 2

- Ask the students to list one action they can take individually and as a school to help protect the coral reef ecosystem.

3. Curriculum Linkages: Environmental Science, Ecology, Conservation

4. Inform and Involve

- Drive the message that education is one way to help conserve any ecosystem.
- The coral reef menus can be displayed on the Eco-Schools bulletin board to create knowledge transference and raise awareness of this ecosystem to the whole school community.

Evaluation:

Review the coral reef menu worksheets of the students to understand their knowledge retention on the trophic food webs, and organisms of the coral reef.



Coral Reef "A la Carte Menu" Worksheet

Names of students in the team:

Instructions: prepare an "a la carte menu" for the wildlife that lives and frequents the coral reef, based on what you know about microbes, plants and animals who live there. What dish would the green sea turtle enjoy? What would you offer to plants? etc."



Task 2

Eco-schools 14-17 Years

Introduction:



The coral reef is one of the most colorful and productive ecosystems in the marine environment. It is of great value to the diverse organisms that find refuge and food sources in reefs, and of economic value to communities for all the ecosystem services they provide, including seawater filtration, fisheries, eco-tourism etc. The coral reefs in the Gulf are famous for being resilient to hot temperatures, an adaptation that stems from their symbiosis with heat tolerant micro-algae.

The lesson plan familiarizes the students with the coral reef ecosystem, its biodiversity and environmental conservation.

The learning process includes researching information pertaining to the topic, class interaction, conceptualization, creative writing, and communicating the topic in a creative form.

Age Group: Eco-Schools 14-17 Years

Eco-Schools Steps: Environmental Review, Action Plan, Curriculum Linkages, Inform and Involve, Monitoring and Evaluation



Objectives:

Students will be able to:

- Describe the coral reef ecosystem, list and discuss threats
- List the biodiversity and the ecosystem services provided by coral reefs
- Explain how the symbiosis between the coral and the microalgae, is an adaptation to life in extreme conditions
- Develop a word search puzzle to raise awareness on the organisms of this ecosystem, and threats
- Develop actions for the protection of coral reefs

Time required/ Duration:

Classroom Session 1: 45 minutes

(15 minutes to discuss with the students the characteristics of corals and coral reefs, including distribution and microalgae adaptations. 10 minutes to conceptualize the community on coral reefs. 20 minutes to assist students in creating clues and facilitating the word puzzle building, 5 minutes to devise positive actions for ecosystem protection). (multiple groups may work simultaneously). It is left up to the facilitator's discretion to expand the timings as needed to allow students to better assimilate the information and to properly devise positive actions.

Environmental Review:

Resources Required: "Before-you-begin":

Coral Reef ecosystem

Key concepts: overview of the coral reef ecosystems with a focus on those found in the Arabian Gulf; coral species; coral symbiont; biodiversity hotspots; nurseries; refugia in the bare sea floor; ecosystem services; threats.

Online Resources

www.reefrelief.org

Key concepts: biogeography of coral reefs; actions to protect coral reefs.

- Brainstorm with students ideas on why this ecosystem is important, how and which human activities threaten the health of this ecosystem, and what we can do to help protect coral reefs.
- Crossword puzzle builder
- Student notebooks, pencils, and colored markers
- Dedicated display board



Action Plan:



Action Plan 1

- Screen the film, “Coral Reefs 101 | National Geographic”

to help students understand how coral reefs are formed, and what makes them biodiversity hotspots.

- Screen the live feed from the coral reef at the California Academy of Sciences

to help students visualize the species interactions.

- Provide the students with a general overview of coral animals, the number of species that exist in the world and in the Arabian Gulf, and their distribution.
- Help students understand that the coral species we find in Qatar and in the Arabian Gulf, are able to survive the extreme conditions, in big part due to their symbiotic micro-algae. Explain to the students how the microalgae function to service the coral (e.g., they provide the coral with photosynthate, they increase the survival of corals in extreme temperatures because they are thermo-tolerant, etc.).
- Discuss with the students the concepts of biodiversity hotspots, nurseries, refugia, ecosystem services and ecosystem engineers. Ask them to name some other ecosystem engineers in the Arabian Gulf environment.



Action Plan Activity 1

- Conceptualize with the students the different organisms that make up the coral reef community, and write their suggestions on the white board. Ideally, help the students make food chain associations, for example, placing the clownfish next to the anemone etc.
- Discuss some of the threats that coral reefs face, i.e., bleaching, climate change, etc.
- Have the students create clues for the inhabitants of the coral reef that you have up on the white board, as well as the threats.
- Students can work individually or in groups.
- Share with the students some examples of clues:
 1. They may be soft or hard, but always colorful. They survive the extremes of the Arabian Gulf with the help of their symbiotic microbes. (What is coral)
 2. I am the greatest gardener of anemones, and a whole animated film depicted my adventures in the USA. (What is clownfish)
- Facilitate the students in creating the word puzzle including clues and key using the puzzle builder.

Action Plan:



Action Plan 2

- Use Reef Relief's "Guide to Coral Reefs"

and EPA's "Best Practices Guide"

to showcase and provide ideas to the students of the possible positive actions they can take individually and as a school to protect coral reefs.



Action Plan Activity 2

- Ask the students to list one action they can take individually and as a school to help protect the coral reef ecosystem.

3. Curriculum Linkages: Curriculum Linkages: Environmental Science, Ecology, Conservation, Climate Change

4. Inform and Involve

- Drive the message that education and sharing stories about this ecosystem with others is one way to help protect and conserve it.
- Word puzzles can be displayed on the Eco-Schools bulletin board, as well as used for a class-based school-wide competition to raise awareness of coral reefs and their colorful inhabitants in Qatar and the world.

Evaluation:

Display the word-puzzle on the board, and solve it with the students. Assess their knowledge based on their responses to the clues.

Resource 1



Create a word puzzle including clues for the inhabitants of the coral reef as well as the threats that they face. Use puzzle builder.