

# Seagrass Bed Ecosystem

The Lesson Plan and Nature-based activities  
were developed by Dr. Aspa D. Chatziefthimiou

Edited by Ruba Hinnawi

Photo source: Jessica Bowmeester





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## The Lesson Plan and Nature-based activities

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Task 1

# **Ecosystem: Seagrass Bed Before-you-begin**

# Task 1: Before-you-begin



**The ecosystem that hugs the coral reef on its shallower side, is the seagrass bed. It gets its namesake from the plants that along with microbes are the pioneers, or first settlers of sandy patches, which grow to engineer a whole ecosystem. Although they are called seagrasses, they are true, flowering plants, the only ones known to exist in the marine environment, and are related to pondweeds.**

The seagrass bed ecosystem is distributed across temperate and tropical marine areas around the world. They are similar to coral reefs in that they act as refuges and feeding grounds for aquatic life and serve as nurseries for their young. Yet, because seagrasses are plants and not animals like corals, they engineer their ecosystem in a much different way. Once the seed germinates, it sends its root system or rhizome out horizontally, binding sediment particles in place, this way creating micro-habitats for other organisms. As a general rule, the organisms that make their living in seagrass beds have the ability to either burrow in sand, live in narrow spaces in between, or on seagrass leaves (epiphytes and epizoa). The leaves look like grass blades extending vertically up from the root.

There are about 70 different species of seagrass worldwide, with the most diverse seagrass assemblages found in the Indo-Pacific. In Qatar we find four species that are highly adapted to the extreme salinity of the Gulf: the Narrow Leaf Seagrass *Halodule uninervis*, the Oval Leaf Seagrass *Halophila ovalis*, the Broad Leaf Seagrass *Halophila stipulacea* and the Turtle Seagrass *Thalassia testudinum*. Other members of the community include crabs, polychaete worms, black sea cucumbers, pen shells, pearl oysters, sea horses, and of course an assortment of fish. Maybe the most magnificent visitors of seagrass beds are the green turtles and dugongs. This ecosystem is essential for their sustenance since seagrasses are the major nutritional source of their diet.



Photo Source: Shutterstock

**Threats:** Habitat loss and biodiversity loss due to scraping and dredging activities from coastal development. Climate change induced phenomena. Overfishing and the fishing technique dragging, which results in the whole sea floor being denuded of all life.



**Butler JD, et al. 2020.**

A high-resolution remotely sensed benthic habitat map of the Qatari coastal zone. *Marine Pollution Bulletin*. 160: 111634.

**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.

**Short F, et al. 2007.**

Global seagrass distribution and diversity: A bioregional model. *Journal of Experimental Marine Biology and Ecology*. 350: 3-20.



A decorative graphic consisting of several pink line-art shapes: a large curved line at the top left, a circle on the right, and a large U-shaped element at the bottom right.

Task 2

# Eco-schools 6-9 Years

# Introduction:



Seagrass beds or meadows follow suit coral reefs in being productive ecosystems engineered by the namesake organisms, in providing a plethora of services and in supporting a rich biodiversity. Some organisms live on seagrass leaves (epiphytes and epizoa), while others burrow in the sediment of micro-habitats created by the seagrasses' horizontal root systems.

The star organism, and the only one that depends exclusively on this ecosystem for nutrition and survival, is the dugong. This is the reason

conservation efforts for the vulnerable-to-extinction dugongs incorporate protective measures for the conservation of the habitat as well.

The lesson plan familiarizes the students with the seagrass bed ecosystem, its biodiversity and the way it has been engineered.

The learning process includes an exchange of information on the topic, classroom interaction, and presenting this topic through art.

**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 seagrass bed ecosystem, how it inter-connects to other ecosystems in the Arabian Gulf, and list threats
- Explain how seagrasses engineer an ecosystem
- Raise ecological awareness by making and exhibiting art
- Develop positive actions for the protection of seagrass beds

## Time required/ Duration:

**Classroom Session 1:** 45 minutes

(10 minutes to introduce the students to the seagrass habitat, inhabitants, and location, 15 minutes to guide the students in filling out the Seagrass Biodiversity Worksheet, 15 minutes facilitating students to color and cut out seagrass masks, 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: Shutterstock

## Resources Required: “Before-you-begin”:

### Seagrass bed ecosystem

Key concepts: overview of the seagrass bed ecosystem with a focus on those found in the Arabian Gulf; seagrass species; biodiversity; nurseries; refugia; ecosystem services; ecosystem engineers; threats.

*Online Resources*



- 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 seagrass beds.

- Resource 1 (Seagrass Biodiversity Worksheet)
- Resource 2 (Seagrass Mask Sheet)
- Student stationary, pencils, colored markers, scissors

- Dedicated display board

# Action Plan:



## Action Plan 1

- Screen a film of your choice from the selection provided at Seagrass Watch Organization

to introduce the students to the physical habitat and the inhabitants of the seagrass beds.

- Help the students situate the neighboring ecosystems.
- Explain to the students how seagrasses engineer an ecosystem and shelter animals and their young in nurseries.

## Action Plan 2

- Use Seagrass Conservation Working Group's "What we can do"

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

## Action Plan Activity 1

- Provide the students with Seagrass Biodiversity Worksheet (Resource 1).
- Guide the students in coming up with the answers to these questions.
- Provide the students with Seagrass Mask Sheet (Resource 2).
- Facilitate the students in coloring and cutting out their mask.

## Action Plan Activity 2

- Ask the students to list one action they can take individually and as a school to help protect seagrass beds and their inhabitants

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

### 4. Inform and Involve

- Seagrass Biodiversity Worksheet should be displayed on the Eco-Schools bulletin board to inform and involve the school community.
- Colored seagrass masks can be worn in the Halloween or Ball Masque party of their school.

### Evaluation:

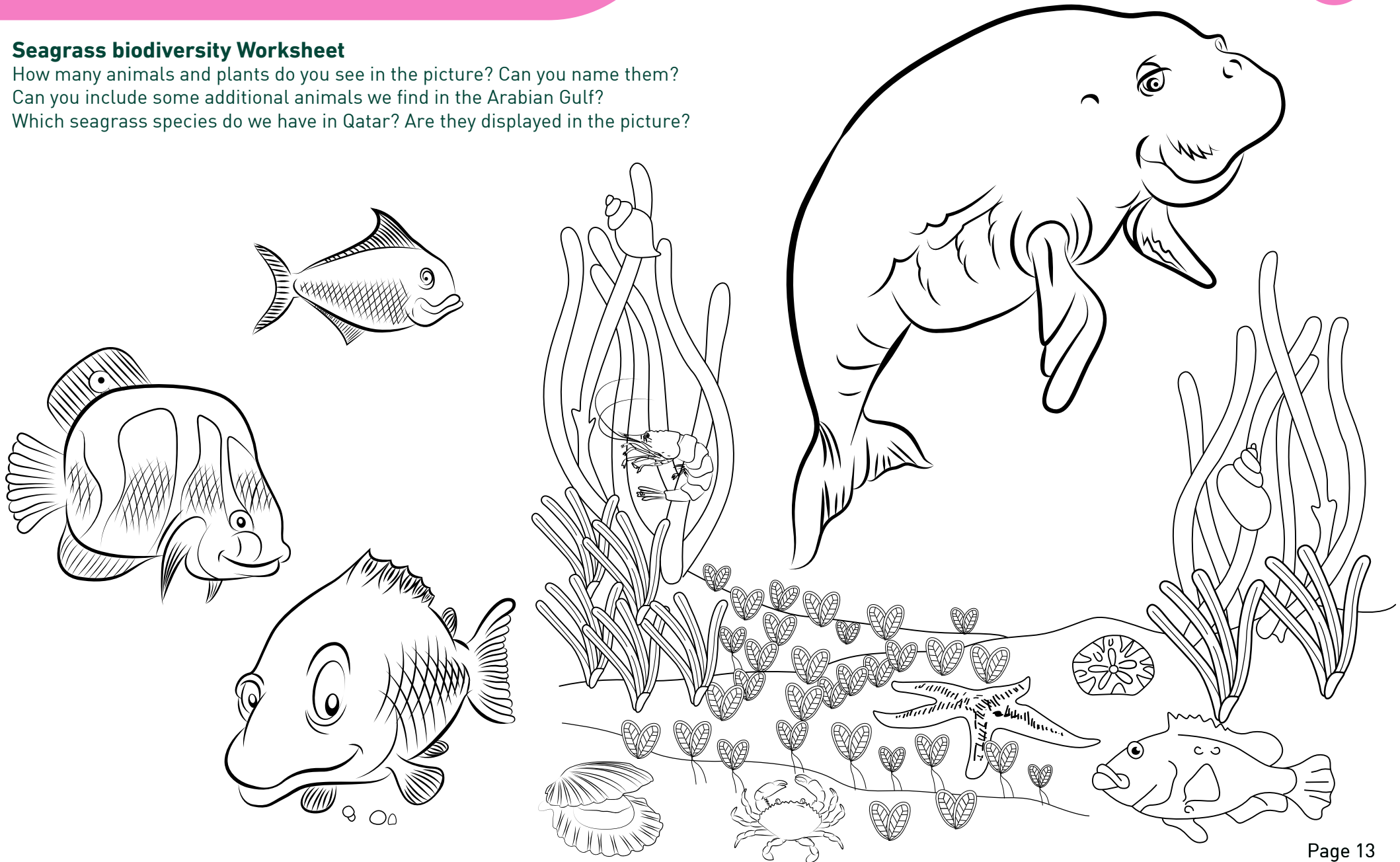
Conduct a review of the students' worksheets to determine their knowledge on seagrass bed biodiversity in general and for Qatar in particular.

# Resource 1



## Seagrass biodiversity Worksheet

How many animals and plants do you see in the picture? Can you name them?  
Can you include some additional animals we find in the Arabian Gulf?  
Which seagrass species do we have in Qatar? Are they displayed in the picture?

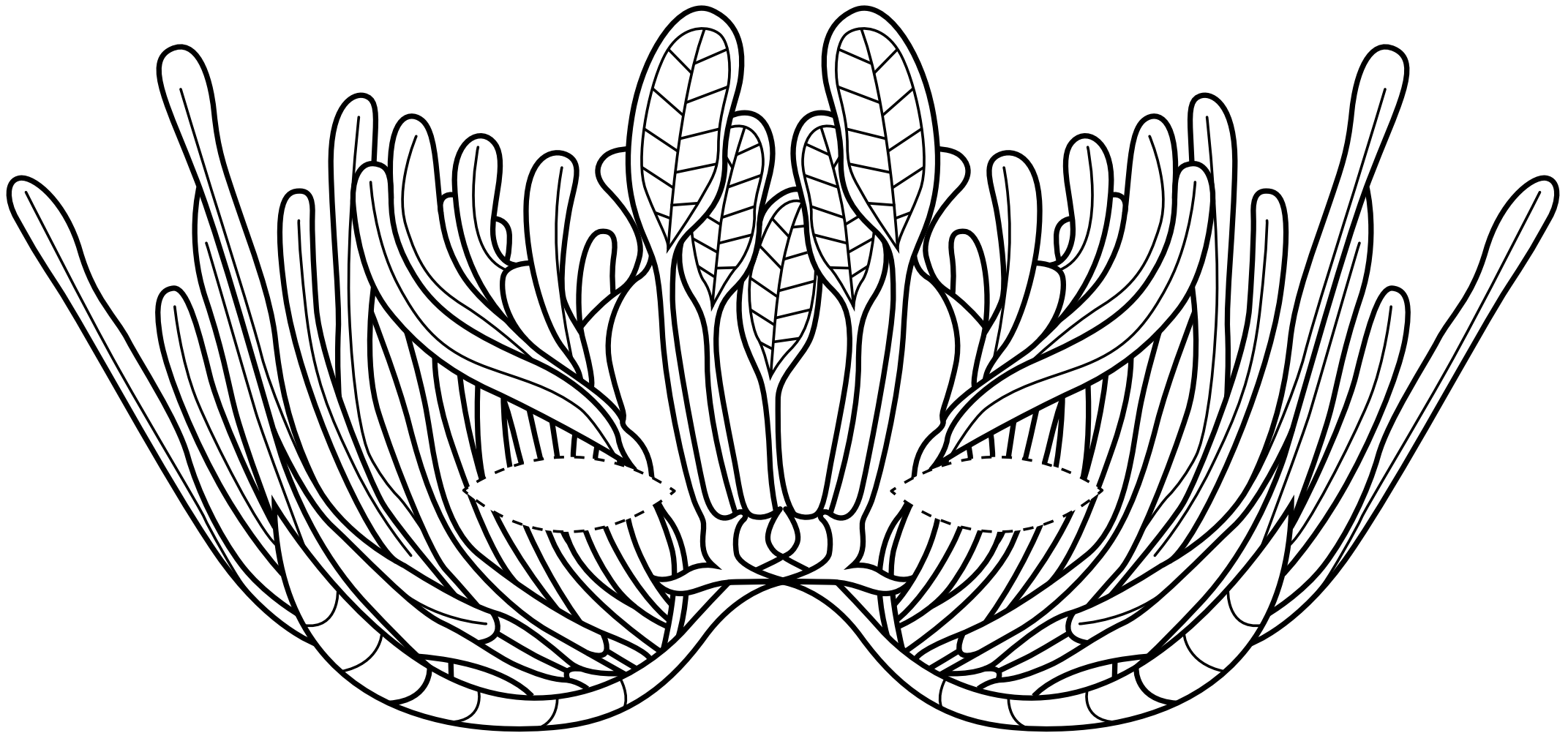


# Resource 2



## Seagrass Mask Sheet

Color and carefully cut out the seagrass mask.  
Put a ribbon on either side and wear it on Halloween!



A decorative graphic consisting of several pink line-art shapes: a large curved line at the top left, a circle on the right, and a shield-like shape at the bottom right.

Task 2

# Eco-schools 10-13 Years

# Introduction:



Seagrass beds or meadows, follow suit coral reefs, in being productive ecosystems engineered by the namesake organisms, in providing a plethora of services and in supporting a rich biodiversity. Some organisms live on seagrass leaves ((epiphytes and epizoa), while others burrow in the sediment in micro-habitats created by the seagrasses' horizontal root systems. The Star organism and the only one that depends exclusively on this ecosystem for nutrition and survival is the dugong.

This is the reason conservation efforts for dugongs, which are currently

vulnerable to extinction, incorporate protective measures for the conservation of the habitat as well.

The lesson plan familiarizes the students with the seagrass bed ecosystem, its biodiversity, the biology of the seagrasses we find in Qatar, and restoration of ecosystems.

The learning process includes researching information pertaining to the topic, class interaction, group work, brainstorming, writing, communicating the topic in a report.

**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 Seagrass bed ecosystem, and list threats
- Explain the life-cycle of seagrasses
- Brainstorm on ideas of how to restore destroyed seagrass beds
- Devise a Seagrass Restoration Strategy to conserve the ecosystem, and raise awareness

## Time required/ Duration:

**Classroom Session 1:** 45 minutes

(10 minutes to screen the film on seagrass biology and the species we find in Qatar, 5 minutes to discuss ecosystem services provided by seagrasses, 25 minutes to brainstorm on restoration ideas with the students and develop restoration plans, and 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”:

### Seagrass bed ecosystem

Key concepts: overview of the seagrass bed ecosystem with a focus on those found in the Arabian Gulf; seagrass species; biodiversity; nurseries; refugia; 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  
(Descriptions of Seagrass species of Qatar)  
(Copyright Aspa D. Chatziefthimiou)
- Resource 2  
(Seagrass Restoration Strategy Plan)
- Student stationary, pencils, colored markers
- Dedicated display board

# Action Plan:



## Action Plan 1

- Screen a short film of your choice from the selection provided at Seagrass Watch Organization

showcasing the biology of seagrasses, reproduction, adaptations, how they engineer the ecosystem, etc.

- Introduce the students to the four seagrass species we find in the Arabian Gulf (Resource 1).
  - Visit Project Seagrass
- 
- Discuss with the students the ecosystem services that the seagrass bed ecosystem provides.

## Action Plan Activity 1

- Let the students break into teams
- Provide the students with Seagrass Restoration Strategy Plan Worksheet (Resource 2).
- Brainstorm with the students for ideas on how they can restore seagrass bed ecosystems that have been destroyed. What strategies would they follow based on what they know about seagrass biology, sub-stratum needed for establishment, flowering season etc.? Who stands to benefit from the restoration?
- Chart the students' responses on the white board, and have students note these down in their worksheets.

# Action Plan:



## Action Plan 2

- Use Seagrass Conservation Working Group's "What we can do"

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

## Action Plan Activity 1

- Ask the students to list one action they can take individually and as a school to help protect seagrass beds and their inhabitants, in addition to restoration.

**3. Curriculum Linkages:** Environmental Science, Biology, Ecology, Restoration

## 4. Inform and Involve

- Seagrass Restoration Strategy Plan Worksheets should be displayed on the Eco-Schools bulletin board as part of inform and involve the school community.

## Evaluation:

Review students' worksheets to determine whether they synthesized their knowledge on the biology and ecology of seagrasses in developing their plans.

# Resource 1



## Descriptions of Seagrass species of Qatar (Copyright: Aspa D. Chatziefthimiou)

**1. Name:** Narrow leaf seagrass, or manatee-grass

**Scientific name:** *Halodule uninervis*

**Habitat:** Marine neritic, including sandy sub-stratum of inter-tidal and sub-tidal habitats up to a maximum depth of 10-20 m.

**Size:** Maximum height of plant at 25 cm and wide leaf width variability of 1.1-7 mm.

**Growth form:** Marine perennial herb, with narrow ribbon-like leaves. Although they are called sea grasses, these are flowering plants closely related to pondweeds. Their stems or rhizomes are buried and extend horizontally. Every few centimeters, the rhizome thickens to form a node bearing a rosette of leaves which emerge through the sand. *Halodule uninervis* is highly adapted to hyper saline conditions.

**Flowering:** Unknown

**Habitat & distribution:** *Halodule uninervis* inhabits sandy sub-strata in intertidal and subtidal areas all around the coastline in Qatar.

**Sources:**



Photo source: Aspa D. Chatziefthimiou

# Resource 1



**2. Name:** Oval leaf seagrass, paddle weed, dugong grass

**Scientific name:** *Halophila ovalis*

**Habitat:** Marine neritic, including sheltered sandy sub-stratum sub-tidal habitats up to a maximum depth of 28 m.

**Size:** Maximum height of leaf at 2.5 cm and maximum leaf width 1.5 cm.

**Growth form:** Marine perennial herb, with oval shaped leaves, whose basal portion makes a slender stalk. Although they are called sea grasses, these are flowering plants closely related to pondweeds. Their stems or rhizomes are buried and extend horizontally. Every few centimeters, the rhizome thickens to form a node bearing a rosette of leaves which emerge through the sand. *Halophila ovalis* is highly adapted to hyper saline conditions.

**Flowering:** Spring and summer, and the flowers form at the base of the shoot.

**Habitat & distribution:** Marine neritic, including sheltered sandy sub-stratum sub-tidal habitats up to a maximum depth of 28 m. It is rarely found in inter-tidal habitats. It is found all around the coastline in Qatar.

**Sources:**



# Resource 1



**3. Name:** Broad leaf seagrass

**Scientific name:** *Halophila stipulacea*

**Habitat:** Marine neritic, including sandy sub-stratum of inter-tidal and sub-tidal habitats up to a maximum depth of 70 m, more recently found as deep as 145 m.

**Size:** Maximum plant height at 25 cm, maximum leaf height at 8 cm and leaf width at 1 cm.

**Growth form:** Marine perennial herb. Although they are called sea grasses, these are flowering plants closely related to pondweeds. Their stems or rhizomes are buried and extend horizontally. Every few centimeters, the rhizome thickens to form a node bearing a rosette of leaves which emerge through the sand. *Halophila stipulacea* is highly adapted to hyper saline conditions.

**Flowering:** July to August

**Habitat & distribution:** Marine neritic, including sandy sub-stratum of inter-tidal and sub-tidal habitats up to a maximum depth of 70 m, more recently found as deep as 145 m. It is found all around the coastline in Qatar.

**Sources:**



# Resource 1



## 4. Name: Turtle Seagrass

**Scientific name:** *Thalassia testudinum*

**Habitat:** Marine neritic, including sandy sub-stratum of inter-tidal and sub-tidal habitats, usually up to a maximum depth of 10-12 m, yet it has also been recorded in depths of up to 20 m.

**Size:** Maximum height of plant at 30 cm and leaf width at a maximum of 2 cm.

**Growth form:** Marine perennial herb, with narrow ribbon-like leaves. Although they are called sea grasses, these are flowering plants closely related to pondweeds. *Thalassia testudinum* is a clonal seagrass with rhizomes extending horizontally below the surface of the sub-stratum at a maximum depth of 25 cm. The branches, also called short shoots, are vertical and regularly spaced, and they extend from the rhizome into the water column. As many as five leaves or grass blades emerge from some of the short shoots and new rhizomes branch out from old short shoots. *Thalassia testudinum* is adapted to saline water, and in times of freshwater infiltration it suffers losses.

**Flowering:** Summertime in Western Atlantic Ocean.

**Habitat & distribution:** *Thalassia testudinum* inhabits sandy sub-strata in intertidal and subtidal areas around the coastline in Qatar.

**Sources:**





## Seagrass Restoration Strategy Plan Worksheet

**Names of students in the team:**

**Instructions:** use the space below to tabulate your strategy and actions towards the restoration of the seagrass bed ecosystem.



A decorative graphic consisting of several pink line-art shapes: a large curved line at the top left, a circle on the right, and a large shield-like shape at the bottom right.

Task 2

# Eco-schools 14-17 Years

# Introduction:



Seagrass beds or meadows, are similar to coral reefs in being productive ecosystems engineered by the namesake organisms, in providing a plethora of services, and in supporting a rich biodiversity. Some organisms live on seagrass leaves (epifauna and epizoa), while others burrow into the sediment in micro-habitats created by the seagrasses' horizontal root systems.

The star organism and the only one that depends exclusively on this ecosystem for nutrition and survival is the dugong. This is the reason

conservation efforts for dugongs, which are currently vulnerable to extinction, incorporate protective measures for the conservation of the habitat as well.

The lesson plan familiarizes the students with the seagrass bed ecosystem, the inter-connectedness of its food web, and the threats it faces.

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

**Age Group:**  
Eco-Schools 14-17 Years

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

**Curriculum Linkages:**  
Environmental Science, Ecology



## Objectives:

Students will be able to:

- Describe the seagrass bed ecosystem, and list threats
- Explain the energy flow in a food web
- List the organisms in seagrass beds, and how they are inter-connected in the trophic web
- Illustrate this information for awareness raising
- Develop positive actions for the protection of the seagrass bed ecosystem

## Time required/ Duration:

**Classroom Session 1:** 45 minutes

(20 minutes to introduce the students to the seagrass bed ecosystem and to discuss with them the concepts of the food web, 20 minutes to facilitate the students in creating their seagrass food webs, 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: Shutterstock

## Resources Required: “Before-you-Begin”:

### Seagrass bed ecosystem

Key concepts: overview of the seagrass bed ecosystem with a focus on those found in the Arabian Gulf; seagrass species; biodiversity; nurseries; refugia; ecosystem services; ecosystem engineers; threats.

## Online Resources

- 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 seagrass beds.
- Resource 1 (Seagrass Food Webs Figure)
- Resource 2 (Seagrass fill-in Fill-in Food Webs)
- Student stationary, pencils, colored markers
- Dedicated display board



# Action Plan:



## Action Plan 1

- Provide the students with the Seagrass Food Webs Figure (Resource 1).
- Introduce the students to the seagrass habitat and community of organisms with a focus on those we find in the Arabian Gulf.
- Discuss with the students the concepts of energy flow and trophic interactions/ webs among the organisms in the figure, i.e. producers, consumers, omnivores, carnivores, herbivores, predators/prey.

## Action Plan 2

- Use Seagrass Conservation Working Group's "What we can do"

to showcase and provide ideas to the students about the possible positive actions they can take individually and as a school to protect seagrass beds.

## Action Plan Activity 1

- Provide the students with the Seagrass Food Web Worksheet (Resource 2).
- Facilitate the students to choose animals and plants and microbes from the Arabian Gulf seagrass beds and to assign their correct placement in the food web.

## Action Plan Activity 2

- Ask the students to list one action, in addition to restoration, they can take individually and as a school to help protect seagrass beds and their inhabitants.

## 3. Curriculum Linkages: Environmental Science, Ecology

### 4. Inform and Involve

- Student worksheets should be displayed on the Eco-Schools bulletin board to inform and involve the school community.

### Evaluation:

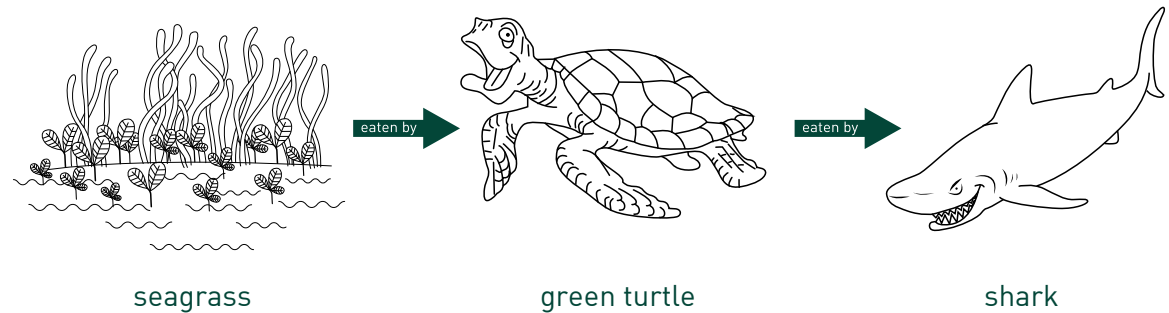
Review the students' worksheet to assess their understanding of the energy flow concept in the context of the seagrass ecosystem.



## Seagrass Fill in Food Web Worksheet

### Seagrass Food Webs

In a seagrass meadow as elsewhere, all the living things are connected to each other. Let's look at an example. In a reef lagoon green turtles eat seagrass, and sharks eat the green turtles. This is called a food chain.



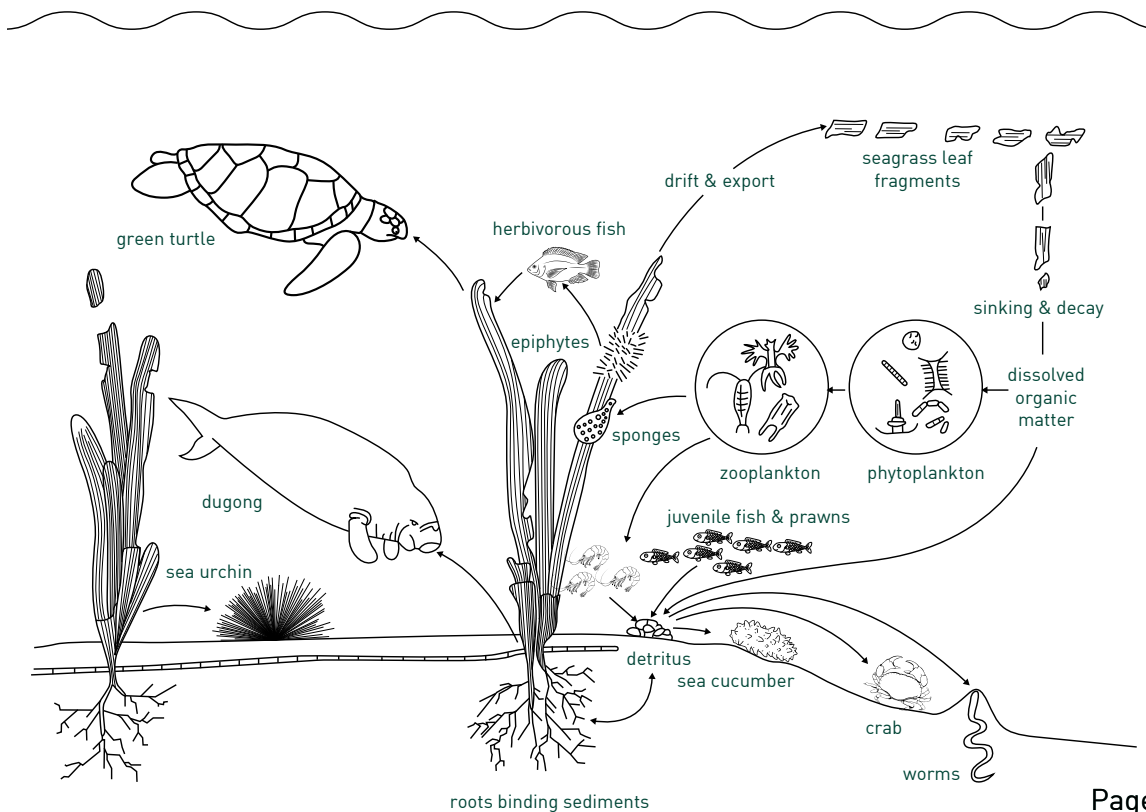
### Energy

Energy in a food chain moves from the plant to the first animal, and on to the second animal. At each stage energy is used by many organisms. Seagrass uses some of its energy to produce flowers and seeds. The dugong uses energy to breed and move about.

Food chains tell us about one feeding relationship.

In place like a seagrass meadow there are many different feeding relationships which are connected together to form a food web.

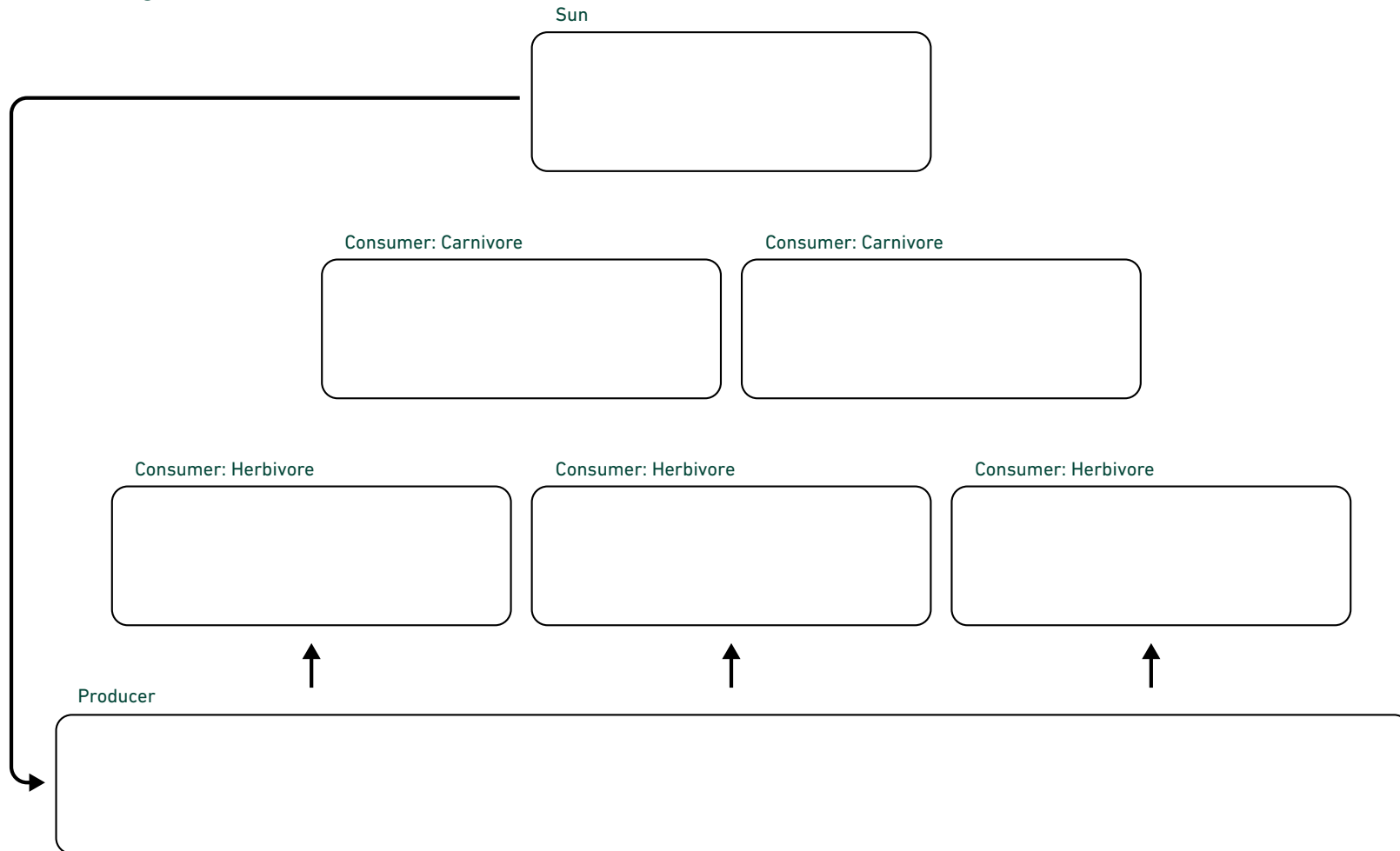
Food webs are not fixed because feeding relationships can change. In the food web on the right, many of the plants and animals depend on each other.



# Resource 2



## Seagrass Food Webs Figure



Reference: Roth J and Reynolds LK. 2020. Engaging students in seagrass-focused activities. Science Activities.