



Teaching Manual for Mangrove Education

(Teaching Material for 6 Hours / Lessons)

> HIGH SCHOOLS <



HIGH SCHOOL - Plan for at least six lessons on mangroves

The following table gives you an overview on the topics of mangrove education and the exercises, worksheets and inputs you can use from the [education kit](#) to teach it. Going through all these exercises in high school will take you approximately five to six hours. Feel free to change and modify this lesson plan at any time and ask the students for their feedback!

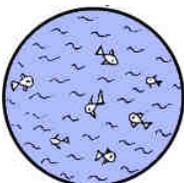
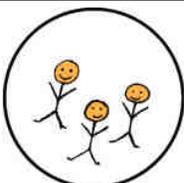
1. introduction and coastal ecosystems	Exercise 16 - <i>Visualizing the Topic with the Help of Pictures</i> Input I (1.2) - <i>Talking About Ecosystems (1.2)</i> Worksheet 3 a) - <i>One Coastal Line - Many Ecosystems</i> Input II (2.1) - <i>Coastal and Marine Resources in the Philippines (2.1)</i> Worksheet 3 b) - <i>What happens when...?</i>
2. mangroves and their benefits	Input III (2.2) - <i>The Mangrove Forests Ecosystem (2.2)</i> Exercise 17 - <i>No One Likes Salty Water - Except for Mangroves</i> Worksheet 4 a) - <i>What is a Mangrove?</i> Exercise 6 - <i>The Ocean-Bowl Experiment</i> Input IV (2.2.1) - <i>Why do we Need Mangroves? (2.2.1)</i> Exercise 9 - <i>The Tree of Life</i> Exercise 5 - <i>Everything is Connected</i>
3. mangroves in danger	Input V (2.2.2) - <i>An Ecosystem Under Threat? (2.2.2)</i> Worksheet 2 b) - <i>Something has Changed</i> Exercise 8 - <i>Waste and a Seedling</i> Exercise 10 - <i>Visualizing Threats to Mangroves</i>
4. getting involved	Input VI (3.1) - <i>Conservation and Protection (3.1)</i> Exercise 15 - <i>What Comes Next? - Steps for Reforestation</i> Input VII (3.2) - <i>Experience from San Agustin (3.2)</i> Worksheet 4 b) - <i>What Can I Do?</i> Exercise 12 - <i>What Can I Do? - Finding Solutions</i> Exercise 18 - <i>Visual Summary - Create a Poster for Class</i>
5. evaluation	<ul style="list-style-type: none">▪ A short test on the topic to check the students' understanding▪ General discussion and open questions▪ Comments from the students: What did they like? / What did they not like?▪ Interest: Do students want to learn more about mangroves and get involved?▪ Feedback from teachers and other persons involved

Material needed	<ul style="list-style-type: none">▪ worksheets 2; 3 and 4▪ big paper, normal paper, markers and pens, cardboard in green and in different colours, strong cardboard, scissors, tape▪ a transparent plastic bowl or box, plastic bags, box / sand and water▪ string straw rolls / two bottles of water, glasses and salt▪ mangrove seedlings from a nursery and plastic bags▪ various pictures from mangroves, their environment, benefits and threats
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* Numbers in () refer to the chapters used in the mangrove education kit.

English - Romblomanon

This translation provides the Romblomanon words for some important English terms in mangrove education. This will help to increase the students' understanding.

Ecosystem Mangroves		Threats to Mangroves			
	bird brackish water environment food freshwater habitat purification salt / salty soil shellfish species	pis-pis alat tabang palibot pagkaon tubig pamayay paglimpyo asin / ma-asin duta kayog klasi		damage destroy diseases firewood fishpond plastic bags pollute (v) threat waste	guba (n) / distrosa (v) sira-on sakit kahoy palaisdaan plastik bag higko hadlok basura
The Weather		Fishing			
	climate rain (v/n) storm typhoon weather wind	klima uyan bagyo bagyo panahon hangon		boat (paddle) boat (motor) dynamite fishing bouy fish (n) / (v) fishcage fishnet overfishing	baroto motor pag gamit ng dilameta buya isda / bunit likom pukot sobrang parging isda
The Mangrove Tree		Raising Awareness			
	leaf / leaves mangrove plant (n/v) root seed seedling	dahon bakawan tanum gamot busoy tubo-an		awareness education educate maintain monitoring	pag-aman educasyon tudloan mintenar pag aubay-bay
Conservation and Protection		In the Sea			
	conservation nursery protect (v) reforestation sanctuary	pag-plaga punlaan protektahan pagtanom sanktuaryo		coral reef low tide high tide surface waves	koral hunas taob ibabaw humback
Coastal Communities		Human Activities			
	building coast community construct dike erosion house	bilding baybayon komunidad human diki panas bayay		farm (n) fishing plant (v) swimming	uma pagbunit tanum langoy

Worksheets - Questions and Suggested Answers

Worksheet 1

a) *Have you ever seen mangroves?*

The students' answers may vary here. If they have seen mangroves, talk about roots, leaves, other species around and the environment they live in. If they haven't seen any, let them think about why this is the case? Do they live near the coast? If so, what is the environment like?

b) *Trees of life*

Some possible answers:

- Mangroves protect coastline from erosion and floods
- Young fish need the mangroves to grow up
- Many species get their food in mangrove forests
- Mangroves are a rich source of fishery products
- Mangroves are a source of firewood
- Mangroves protect houses from storms and flooding

Worksheet 2

a) *What does a mangrove look like and where does it grow?*

Students can draw their tree in the middle of the paper - partly under water. Explain that various mangrove species exist under different conditions. Focus attention to roots and the leaves; and discuss with the students what the ideal environment of a mangrove should be like.

b) *Something has changed...*

- (1) more houses / (2) a dike / (3) less birds /
(4) dead mangroves / (5) less fish / (6) sea level rise

Worksheet 3

a) *One coastline - many ecosystems*

- Mangroves: prevents erosion / nursery area / pollution sink
- Sea-grass: nursery feeding area / stops sediments
- Coral Reef: habitat for many fish / buffer for shoreline

b) *What happens when...*

No mangroves = no protection from storm, erosion, floods / fish lose nursery
No sea-grass = sediments reach coral reefs, strong waves damage mangroves
No coral reefs = Fish lose their habitat / increased erosion

Worksheet 4

a) *What is a mangrove?*

1. Mangrove forests grow at the margins of tropical and subtropical coastlines around the world. They grow in saline coastal habitats.
2. Mangroves need slow currents, no frost and plenty of fine sediment for root attachment. They grow in brackish water.
3. Mangroves provide habitat and food for other species. They are a nursery for fish. Mangroves clean the water, prevent the coastline from erosion and human settlements from destruction.

b) *What can I do?*

- Keep the water clean! - Don't dump your waste into the sea.
 - Look for the planting sites! - Keep them clean, protect them from animals.
 - Watch the mangroves! - Monitor their growth and survival.
 - Talk to people! - Confront them with the benefits of mangroves.
 - Get involved! - Help planting and maintaining the mangroves.
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Evaluation - Feedback Sheet

The reason for doing workshops on mangrove education is to let you know more about this fascinating ecosystem. To improve our workshops we want to know what you liked and what not. Now it's up to you! Please give us your feedback!

1) How did you like the workshop?

The workshop consisted of different parts with various activities. Tick what expresses best your feelings and thoughts about the following components. Make only one tick in each line!

	☺☺ very much.	☺☹ only a bit.	☹☹ not really.	☹☹ not at all.
1.1) I liked the different experiments...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2) I liked the activities outside the room...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3) I liked the lectures and inputs...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Look at the following statements and indicate if you agree or not.

	☺ (agree)	☹ (disagree) ☹
1.4) I could follow the workshop easily.	<input type="checkbox"/>	<input type="checkbox"/>
1.5) I learned new facts about mangroves.	<input type="checkbox"/>	<input type="checkbox"/>
1.6) I want to learn more about mangroves.	<input type="checkbox"/>	<input type="checkbox"/>

1.7) My favourite exercise: _____

1.8) This was the worst part: _____

1.9) This was easy to understand: _____

1.10) I had problems to understand: _____

2) What do you want to learn more about?

I want to learn more about...

- 2.1) ...the mangrove forests ecosystem in general.....
- 2.2) ...the benefits of mangroves.....
- 2.3) ...the threats mangroves are exposed to.....
- 2.4) ...how I can get involved to protect mangroves.....
- 2.5) ...anything else about mangroves (please specify!!!) _____

3) Any other Comments!?

Is there anything you heard about in the workshop you would like to learn more about?

①

Introduction and Coastal Ecosystem

Copy or print the following pages from the [education kit](#) for this section:

- page 69 (Exercise 16 - Visualizing the Topic with the Help of Pictures)
 - page 49 (Worksheet # 3)
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⇒ Input I - Talking About Ecosystems

- Mangrove forests are a fascinating ecosystem that needs to be protected!
- But who takes care of mangroves? > YOU!
- First step to get involved with mangroves: Learning about them!
- Workshops: to tell you the benefits of mangroves + tell you how to get involved

ARE YOU READY???

- Five parts: 1) What are ecosystems all about?
2) What is so special about mangroves and why do we really need them?
3) What are the major threats for mangroves?
4) How can YOU help to protect mangroves and get involved in reforestation?
5) What do YOU think? - Feedback on the workshop

Start translating key words such as “protect” or “threat” right from the beginning). Let the students write on the blackboard. Also use visuals for the table of content (five parts).

Exercise 16 comes here!

- First: impossible to talk about mangroves without knowing what is around these trees
- Two levels: the mangrove ecosystem itself + neighbouring ecosystems
- Talking about mangroves, coastal resources, interactions between us and this environment: in the scientific field of **ecology**

Explain “ecology” (from “oikos” (household) and “logy” (the study of) = the study of the household). Different sciences like biology or behaviour. Ask the students of any plans for university.

- Ecology is a very broad field (us and the environment we live in)
- When ecology in trouble: “**ecological crisis**” > species fail to adapt to changes in their environment - physical (water, soil, rain etc.) or living components (predators, other plants)
- Which species has more influence in the environment than any other? > YOU
- Ecosystem is the unit ecologists deal with: Specific environment and interaction of all species
- Definition: Ecosystem = “*Dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.*”
- All ecosystems with 3 basic components: Producers (plants), consumers, abiotic component
- Ecosystems vary greatly in size and number of species living in there (dessert, rainforest etc.)
- Borders of an ecosystem always hard to define - same with coast and mangroves (> example: fish grow up in mangroves, get food in sea grass and return to coral reefs etc.)

⇒ Input II - Coastal and Marine Resources

- Philippines: huge variety of marine and coastal resources (not surprising with 7,107 island)
- Amazing facts:
 - Philippines with one of the longest coastlines worldwide (36,000km)
 - 60% of all Filipinos live in coastal communities
 - Marine resources are an important economic and employment factor
 - Some of world's richest ecosystem in Filipino coastal areas and water
- negative trends:
 - < 75% of all mangroves in the Philippines destroyed (still declining!)
 - Most fish stocks show severe signs of **overfishing** (less fish for everyone) (2003: More than 30kg of fish available for every Filipino / 2010: 10kg!)
 - Currently 30 - 50% more fish caught than nature can produce
 - > fish stocks fails to recover, many fish are already driven to extinction!
- Have a closer look at the coastal ecosystems!

Worksheet 3 a) comes here!

- concentrate on three important and **interconnected** ecosystems

*Explain and visualize **Interconnectivity**.*

- changes in one of these ecosystems will affect the others as well
- various species of fish pass, feed and spawn in each of these ecosystems
 - o mangroves: protects coasts from storms + erosion; feeding site for fish and shellfish
 - o sea grass: buffer between sea and land; reduce strong waves; hold back sediments
 - o coral reefs: protect mangroves from waves and current

Worksheet 3 b) comes here!

②

Mangroves and Their Benefits

Copy or print the following pages from the [education kit](#) for this section:

- page 70 (Exercise 17 - No One Likes Salty Water - Except for Mangroves)
 - page 50 (Worksheet # 4 - a) only!)
 - page 59 (Exercise 06 - Erosion: The Ocean-bowl Experiment)
 - page 62 (Exercise 09 - The Tree of Life)
 - page 58 (Exercise 05 - Everything is Connected)
-

⇒ Input III - The Mangrove Forests Ecosystem

- 1918: 500.000 ha of mangrove forests in the Philippines > 1995 only 117,000ha left

Make sure the students understand hectare (1 hectare = 100m x 100m = 10,000m²).

- Massive decline with negative effects for the environment and the coastal communities
- Mangroves not only in the Philippines > grow all over the world in tropical /subtropical areas
- Very important trees along the coastlines around the world
- Only trees growing in salty water
- Estimated, that about 70 mangrove species exist around the world
- They all look different > size, leaves, roots etc. (1,5 to 30 meters high)
- Reason: adaptation to the environment and certain conditions (water, soil etc.)
- Definition: “Mangrove forests are tree wetlands located on the coastlines in tropical climates.”
- Mangroves grow on almost every substrate (rocks, sand, broken corals)
- On shorelines and riverbanks close to the sea
- This is important:
 - Warm tropical temperature all year round
 - Moderate freshwater
 - Regular surface-water flushing
- One is very important: - Salty or brackish water (no other plant can do this)

Explain and visualize “brackish water” (mixture of fresh and salty water)

Exercise 17 comes here!

- How do mangroves survive under these extreme living conditions?
 - o Mangroves storage water in leaves // seeds develop to seedlings on mature trees
 - o Roots can filter the salt from the water to keep it outside the plant
 - o Roots grow from the ground upwards to reach the surface to breath (up to 3 meters)
- Mangroves are a unique ecosystem - many, many species depend on them, including us!

Explain “ecosystem”! (all animals and plants in a certain area + their interaction, e.g. pond, desert)

Worksheet 4 a) comes here!

⇒ Input IV - Why do we Need Mangroves?

- What does a mangrove look like? Think about leaves, roots etc. - Have you ever seen a mangrove?
- Mangroves are a **multi-function resource**
- >>> many, many benefits both for the environment (1) and for us (2)

Find the benefits together with the class - based on the benefits learned in the introduction

- Ecological importance (1):
- Mangroves filter coastal water and help to keep it clean
 - Mangroves protect coasts from storms and floods
 - Important feeding site for fish and other species
 - Function as a nursery for fish (1.08t fish per 1ha mangroves/year)

Visualize a hectare! (100m x 100m = 10.000m²) - How many classrooms fit in there?

- Play an important role in the **food chain** (leaves, crabs, fish etc.)

Explain "food chain", give a visual example. (Algae on roots, shellfish, small fish, bigger fish, bird)

- Important for people (2):
- Resource for typical forests' products such as firewood
 - Mangroves protect human settlements from storms and typhoons
 - Rich source of fishery products and shellfish (**nursery**)

Explain "nursery"! (Young fish hide and grow up in mangroves before living elsewhere...)

Exercise 06 comes here!

Exercise 09 comes here!

Exercise 05 comes here!

③

Mangroves in Danger

Copy or print the following pages from the [education kit](#) for this section:

- page 48 (Worksheet # 2 - b) only!
 - page 61 (Exercise 08 - I need protection! Waste and a Seedling)
 - page 63 (Exercise 10 - Visualizing Threats to Mangroves)
-

⇒ Input V - An Ecosystem Under Threat

- Mangroves in almost every tropical and subtropical country
- But what do they look like and where do mangroves usually grow?

Worksheet 2 a) and b) both come here!

- BUT: 50% lost during the last years // in the Philippines even 75% from 1918 to 1995
- Decline from 500.000ha to 117.000ha during this time; still decreasing!

Let the students simply visualize the decline on the blackboard, e.g. by drawing 12 (6 / 4) dots.

- Why is this the case and where are all the mangroves gone?
- Reasons mostly because of human destruction and interference

Exercise 08 comes here!

- direct human intervention:
 - Housing and infrastructure projects close to the shoreline
 - Pollution and siltation (water gets saltier)
 - Dikes and other constructions on the shoreline
 - Overexploitation (e.g. for firewood)
 - Conversion of mangrove forests into large **fishponds**
(productive only for three to five years, useless because of many chemicals / even mangrove reforestation not possible)
- indirect (natural) threats:
 - Pests and diseases
 - Typhoons and very strong storms
 - Sea-level rise due to climate change
- >>> Natural threats become more frequently and stronger because of **human activities!**

Exercise 10 comes here!

④

Getting Involved

Copy or print the following pages from the [education kit](#) for this section:

- page 68 (Exercise 15 - What Comes Next? - Steps for Reforestation)
 - page 50 (Worksheet # 4 - b) only!
 - page 65 (Exercise 12 - What Can I Do? - Finding Solutions)
 - page 72 (Exercise 18 - Visual Summary - Create a Poster for Class)
-

⇒ Input VI - Conservation and Protection

- Mangroves produce many seeds - easily re-establish after natural threats like storms
- But: **Natural Regeneration** not enough to compensate massive human destruction
- >>> That is why: **Reforestation Projects** all over the world, especially in the Philippines
- *Mangrove reforestation takes place where natural regeneration has failed!*

Explain the difference between natural regeneration and reforestation projects.

- Why reforestation?
 - 1) To regain mangrove ecosystem's services (nursery, food chain...)
 - 2) To protect coastal areas from destruction, storms, erosion etc.
 - 3) To restore a natural resource to use it in a sustainable way
- Advantages:
 - Most appropriate species can be selected for planting
 - Number and distance of seedlings can be easily regulated
 - Heavily destructed areas can be restored easier and faster
- Disadvantages
 - Hard to restore a forest that will be similar to the original one
 - Reforestation is expensive and labour-intensive
 - Projects are likely to fail because of many reasons and factors
- Reasons for failure can be varying greatly; in general, 95 percent of all projects fail!!!
- Only 50 out of 1,000 planted mangrove seedlings survive!
 - o Mangroves are planted in areas where there have never been mangroves before (sounds stupid, but is unfortunately true especially for the Philippines)
 - o Only "Rhizophora" planted > easy to handle, but needs certain conditions!
 - o Wrong species for the natural conditions (no knowledge about former mangroves)
 - o Concentration on mangrove planting! (community not involved, no monitoring)

*Be creative and try to visualize each of these reasons on the blackboard. After every type of failure **get the class involved** and ask them what they would do instead.*

- >>> *Implementing a mangrove reforestation is much more than only planting mangroves!*

Exercise 15 comes here!

Steps needed for Reforestation

- Step 1: Get informed and inform the community!
- Step 2: Mobilize locals for stronger support!
- Step 3: Collect information on the planting site!
- Step 4: Choose what species fits best!

- Step 5: Collect seeds /grow seedlings in a nursery!
- Step 6: Plant the mangrove seedlings!
- Step 7: Maintain and monitor the project site!
- Step 8: Learn lessons and adjust the project!

⇒ Input VII - Experience from San Agustin

- Three questions have to be considered when planning a mangrove reforestation project:
 - o 1) Have there ever been mangroves before at the project site?
 - o 2) What are the conditions like and what species would grow best under these conditions (substrate, low tide and high tide, intensity of the sun etc.)?
 - o 3) Do the coastal communities acknowledge and support reforestation activities?

Ask the students what they think the situation is like in San Agustin and then proceed.

- Various mangrove sites and reforestation projects on Tablas Island and around San Agustin
- Many organisations and people support this (locals, the Agricultural Department in San Agustin, foreign volunteers etc.)
- But above all: fishermen (mangroves as breeding area for fish), shellfish gatherers (mangroves as feeding area) and people living near the coast (protection from storms)

Ask if some of the students' parents are fishermen or involved in mangroves in any other way.

- What is special about San Agustin?
 - o There are no brackish water fishponds (60% of all mangrove destruction in the Philippines)
 - o Most mangroves lost for firewood and charcoal
 - o Especially riverbank mangroves were cut down on Tablas (made responsible for floods because mangroves hold sediments back in the rivers)
 - o The island is a typhoon prone area!!! (make reference to **typhoon Frank 2008**)

Successes!!! :-)

- Establishment of a Marine Sanctuary (2002)
- Raised awareness of the local communities
- Some locals with close relationship to mangroves

Failures :-)

- Animal grazing (goats)
- Poor location choice for seedlings
- Fishermen cut down mangroves for access points
- Waste destroys mangroves and seedlings

Draw the symbols “:-)” and “:-)” on the blackboard, say any success or failure and let the students decide where to put the argument. Discuss it afterwards.

Worksheet 4 b) comes here!

- Community involvement very important! - Everyone can support the project!
- When people know the benefits of mangroves, it is more likely that they will protect them!!!

Exercises 12 and 18 come here!

The Feedback Sheet comes here!!!