

*Johnny Morris*  
**WONDERS OF WILDLIFE**  

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**NATIONAL MUSEUM &  
AQUARIUM**

# Mangroves

**Ecosystem Exploration  
Activity Workbook  
Teacher Guide**

# ECOSYSTEM EXPLORATION

## Mangrove Ecosystems



## Mangrove Ecosystem

**Subject Area:** Science – Geography, Ecosystems, Biodiversity

**Grades:** K-5

**Time:** This lesson can be completed in 1 day. (6 hours)

### Essential Questions:

- What are mangroves?
- Where are they found?
- How do they survive such harsh conditions?
- What animals live in this ecosystem?
- What are the changes they face today?
- What is the importance of mangrove forests?



### Purpose and Overview:

Classes will learn what a mangrove tree/bush is, where they are found, and why they are so important. You will lead your students using videos from our team and materials provided to engage in an expedition through Mangrove ecosystem. At the end of the lesson students will have a better understanding of the purpose mangroves serve our oceans, its inhabitants, and even us, while learning about their cool adaptations along the way. They will also learn the factors that threaten our mangrove forests today and what they can do at home to help preserve these crucial environments.

### Introduction:

With this lesson students learn about an incredibly unique forest ecosystem. Students will explore this water-based forest and meet the organisms that call it home and discover how they survive in such an interesting environment. They will also take part in discussion about the changes these regions are facing today and what the cause and effects could be in the future.

There are three different and distinct varieties of mangrove trees that each serve a different purpose in the ecosystem. Each of these mangrove trees have developed adaptations over time to thrive in an environment that would not sustain most other varieties of trees.

There are however environmental changes happening that are affecting this ecosystem causing damaging reactions. Efforts to understanding these impacts is key to helping preserve our planets diverse wildlife and habitats.

### **Objectives:**

- Locate where the Mangroves are using geographical maps.
- Compare and contrast the three different types of mangrove trees.
- Study how the organisms found in this ecosystem survive.
- Examine the challenges this ecosystem is facing today and the effects it could have over time.

### **Standards:**

#### **Next Generation Science Standards**

##### Disciplinary Core Ideas

- ESS3.B: Natural Hazards
- LS1.A: Structure and Function
- ESS2.A: Earth Materials and Systems
- ESS2.3: Biogeology
- ESS3.A: Natural Resources
- LS2.A: Interdependent Relationships in Ecosystems
- ESS3.C: Human Impacts on Earth Systems

##### Crosscutting Concepts

- Patterns
- Cause and Effect
- Systems and System Models

##### Science and Engineering Practices

- Evaluating and Communicating Information
- Constructing Explanations

## Vocabulary

**Adaptation:** A characteristic or trait that allows an organism to be better suited for survival and reproduction within a given habitat.

**Biodiversity:** When many different types of animal and plant species live in a particular ecosystem or habitat.

**Biome:** Area on earth that have similar climates, plants, and animals. Biomes are defined by their average precipitation rates and temperature.

**Carbon:** One of the chemical elements found in nature. Carbon is one of the most common elements in living things, together with oxygen, hydrogen, and nitrogen.

**Climate:** The regular prevailing weather and temperature conditions of an area over a long period of time.

**Climate Change:** Refers to the rapid increase in global temperatures. It is the result of an increase of carbon dioxide and other greenhouse gases in the atmosphere from the burning of fossil fuels.

**Ecosystem:** A community of living organisms in conjunction with the nonliving components of their environment, interacting as a system.

**Endangered Species:** A species of animal or plant that is in danger of going extinct.

**Erosion:** The process of wind, water, or other natural forces breaking down something over a period of time.

**Extinction:** Event when an entire species dies out and no longer exists.

**Habitat:** The natural home of a living thing.

**Marine Animals:** Any of numerous animals inhabiting the planets oceans and seas.

**Organism:** An individual living thing.

**Pneumatophores:** an aerial root specialized for gaseous exchange.

**Survive:** To continue to live or exist, especially in spite of danger or hardship.

**Terrestrial Animals:** Animals that live predominantly or entirely on land, as compared with aquatic animals, which live predominantly or entirely in the water.

## **Materials:**

Teacher:

- Computer, Project Printouts, Screen, Internet

Printouts:

\*Attached at the end of the lesson plan\*

Students:

- Writing Utensil
- Printouts (best for your grade level)

Individual Student Crafts: Each student will need the supplies listed below for each craft.

Manatee Hand Puppet

- Paper Lunch Bag
- Manatee Cut Out Page
- Scissors
- Crayons/Colored Pencils/Markers
- Glue/Glue Stick/Tape

Mangrove Triarama Activity

- Scissors
- Triarama Base Page and Animal Cutout Page
- Crayons/Colored Pencils/Markers
- Glue/Glue Stick/Tape

## **Classroom Discussion & Activities:**

- I. To begin, start off by asking your students some engaging questions. They can either be in a group discussion or asked and have answers written down for later reference to see what they have learned after the lesson. Here are some questions you can ask...
  - a. Why do you think they are called the Mangroves?
  - b. Where in the world do you think they are found?
  - c. What types of animals and plants do you think live there?
  - d. How do you think the Mangroves help the environment?

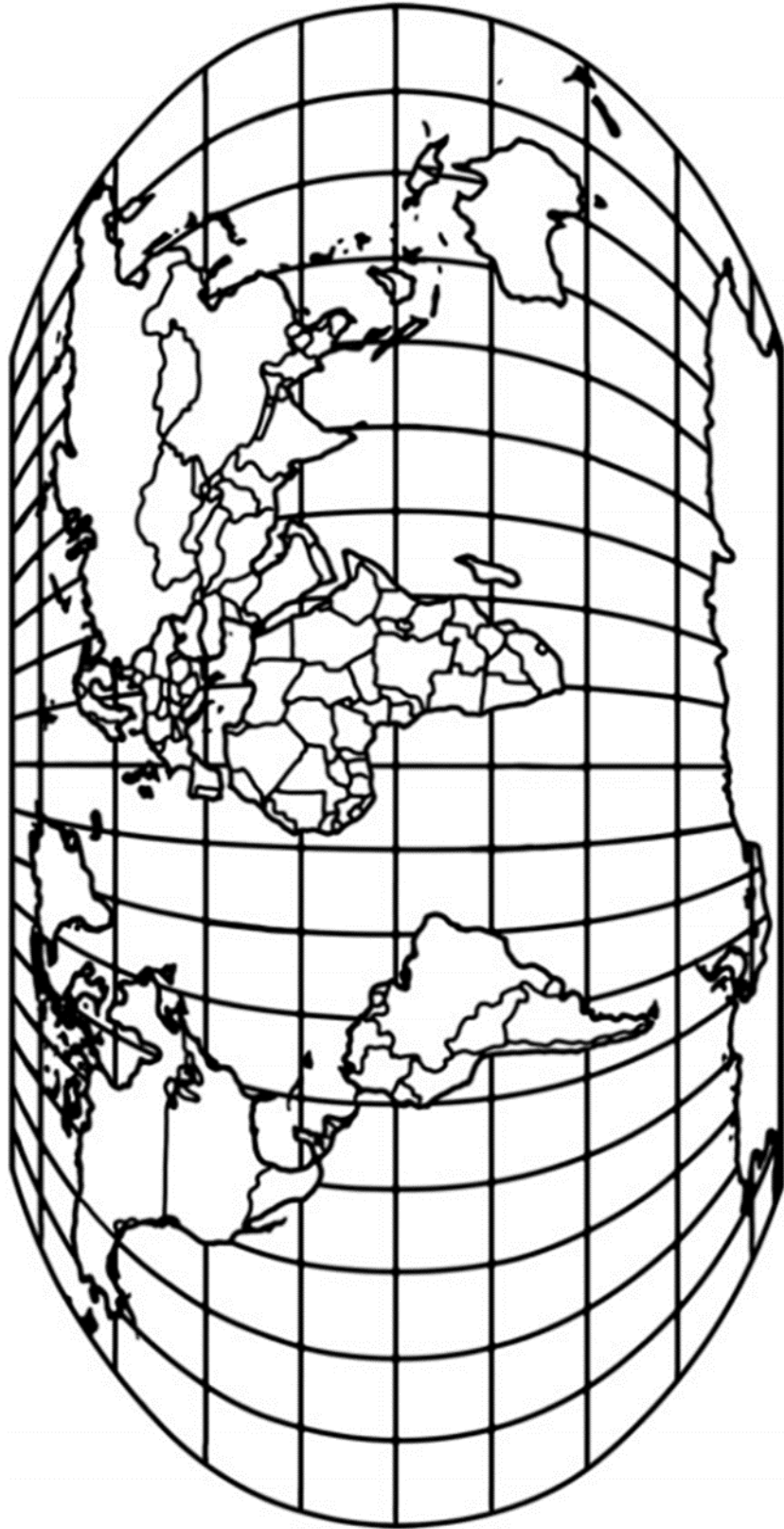
## What & Where

- II. What are mangroves and where are they found?
- a. Mangroves are unique forests composed of trees and woody shrubs. There are over 50 different species of mangrove trees that make up this lush and diverse ecosystem. Mangrove forests are found in tropic and subtropic zones, typically along isolated saltwater coastlines. These forests thrive on warmer temperatures, so you will not find them too far away from the equator. Using a globe or printout map, show students where they are located.
    - i. Provide students with the definition of a biome. A biome is an area on earth that has similar climates, plants, and animals. Biomes are defined by their average precipitation rates and temperature.
    - ii. Provide students with the definition of climate. The regular prevailing weather and temperature conditions of an area over a long period of time.
    - iii. Provide students with the definition of ecosystem. A community of living organisms in conjunction with the nonliving components of their environment, interacting as a system.
  - b. With all the different species of mangroves, they have been categorized into three categories of true mangroves. Buttonwood trees share many of the same characteristics of mangrove trees, are classified as false mangroves, and will not fall into any of three categories.
    - i. Red mangroves can easily be identified by the recognizable prop roots that grow above the water, as well as the distinct red wood underneath their bark. These roots elevate the tree above the harmful waves, as well as providing a haven for small creatures that would be vulnerable otherwise.
    - ii. Black Mangroves have a distinctly different root system than the red mangroves. Their roots grow horizontally underground due to them growing further upland than red mangroves. These roots have small root-like growths called pneumatophores, which grow above the surface off the roots. These have small openings that bring oxygen into the roots. These trees often have dark and scaly bark and grow in areas with frequent tide changes.
    - iii. White Mangroves are unique in the fact that their root systems are completely underground most of the time. These trees will grow the furthest inland from the other mangroves where there is typically not standing water. These trees will develop their own variant of aerial roots, known as peg roots, if there is an extended flood in their habitat.
  - c. Have students color in on their map the regions where mangrove forests are located.

# Where in the WORLD are the Mangroves?!

Color on the map which regions Mangrove Forests can be found!

Hint: Mangroves do not like cold weather!



## Who lives here?

- I. Now that you have located the Mangroves, let us look at what organisms you could find there. Provide students with the definition of organism, an individual living thing.
  - a. Explain to students that the mangroves are critical providers in this ecosystem, giving both food and shelter to the organisms that call it home. In addition to providing a home to vulnerable species in their root systems, mangroves store water in their leaves, providing a source of fresh water in which there would normally be little of. This adaptation helps to create a thriving and diverse ecosystem in conditions that would not normally support these species.
    - i. Provide students with the definition of biodiversity. When many different types of animal and plant species live in a particular ecosystem or habitat.
    - ii. Provide students with the definition of adaptation. A characteristic or trait that allows an organism to be better suited for survival and reproduction within a given habitat.
  - b. Discover some of the marine and terrestrial animals that call this biome home. Talk with students about what these organisms do to survive, as well as what they might provide to the ecosystem. See the included activity sheets in the next few pages. These have been separated by recommended grade level, but feel free to use your own discretion!
    - i. The **Mangrove Tree Crab** is a funny little crab known for climbing over many surfaces, including up and down the Mangrove Trees. These crabs feast on leaves, small insects, and small aquatic animals. They even can eat other species of crabs unlucky enough to be caught. When they consume the leaves of the mangrove tree, the tree will replace that leaf, and have room to store more fresh water for other creatures that would need it. These crabs are often mistaken for spiders, due to their strange, spider-like appearance.
    - ii. The **mud lobster** is like the plumber of the mangrove system. This animal digs underground and forms expansive underwater tunnels. As the lobster digs, it pushes the soil and sediment above ground into mounds. These mounds can sometimes grow to over 3 meters tall! This action aerates the soils and greatly improves water drainage, while also providing a home for snakes, insects, and even new mangroves in the newly formed mounds.
    - iii. The **mudskipper** is a unique fish that spends quite a bit of time out of water. These fish “breathe” out of water by storing air in their mouth and gill chamber and keeping their skin damp. They are so good at holding in air, some mudskippers can stay out of water for up to 36 hours. The mudskipper can also use its pectoral fin to climb trees!
    - iv. The **Royal Bengal Tiger** is one of the larger terrestrial animals to call the mangroves home. This tiger can be found in the Ganges Delta in India and

Bangladesh, where roughly 500 of these big cats call home. The Royal Bengal Tiger has adapted to live in this treacherous habitat by including fish, frogs, and even lizards into its' diet. This tiger has also earned the nickname "man eater" due to it hunting humans who may wander into its' territory.

- v. The **Proboscis Monkey** is another terrestrial creature who makes it home in the mangroves. This monkey spends almost all its time in the branches of the mangrove trees but can dive into the water if it needs a quick escape. The proboscis monkey is one of the best primate swimmers, and belly flops into the water when it needs to swim.
  - vi. The **Pygmy Three-Toed Sloth** is a species of sloth exclusive to the tiny island of Escudo de Veragua, making its home in the red mangroves surrounding the island. The Pygmy Three-Toed Sloth was only discovered as a distinct species in 2001. Although the sloth may spend most of its time in the trees, it is also a great swimmer, being able to hold its breath for up to 40 minutes! This sloth feeds on the leaves of the mangroves, which are a great source of fresh water and other nutrients.
  - vii. The **Manatee** is large marine animal that calls the mangroves a vacation home. Manatees are migratory animals, meaning they will spend summer months in one place, and then move to a new place in winter. These aquatic mammals will grow to 10 feet long, and weigh between 800 and 1200 pounds. These gentle creatures move slowly through the water, eating a mostly plant-based diet. However, they will consume small fish and invertebrates on occasion. Manatees will often use the roots of the red mangroves to hide their young from predators.
- c. Included below are several activities for students to learn more about some of the animals that live in the mangroves. These activities have been separated by grade level, but feel free to adjust or complete more activities based on the needs of your classroom.

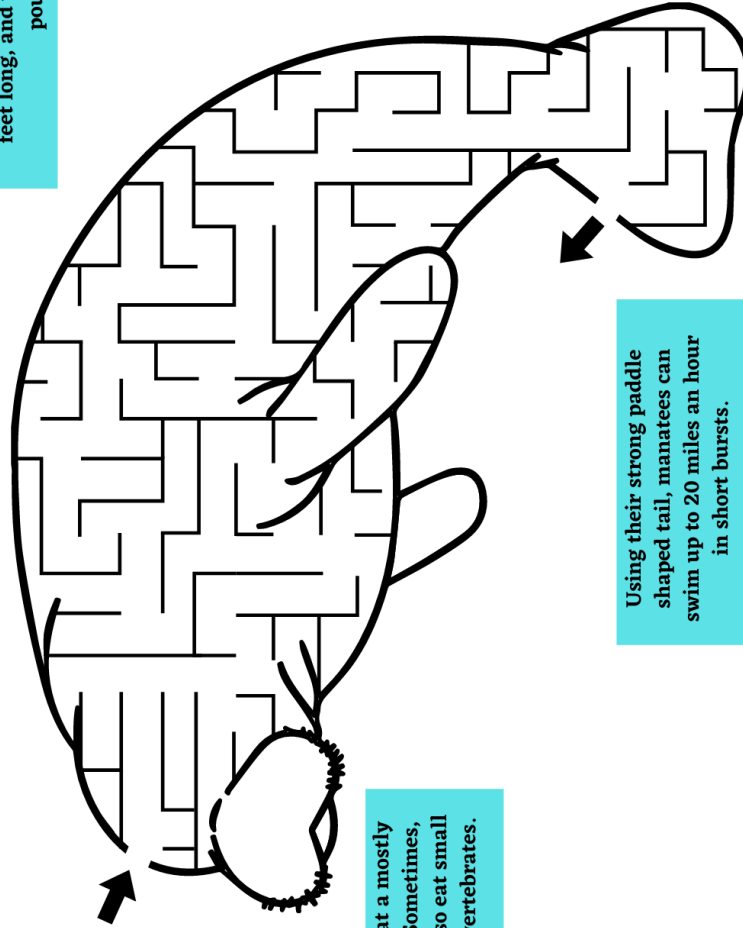
## **Grades K-1 – Draw your own Manatee**

# Grades 2-3 – Manatee Maze

## MANATEE MAZE

LEARN ABOUT THE MANATEE AS YOU MAKE YOUR WAY THROUGH THE MUSEUM.

An adult manatee can grow up to 10 feet long, and weigh over 1000 pounds!



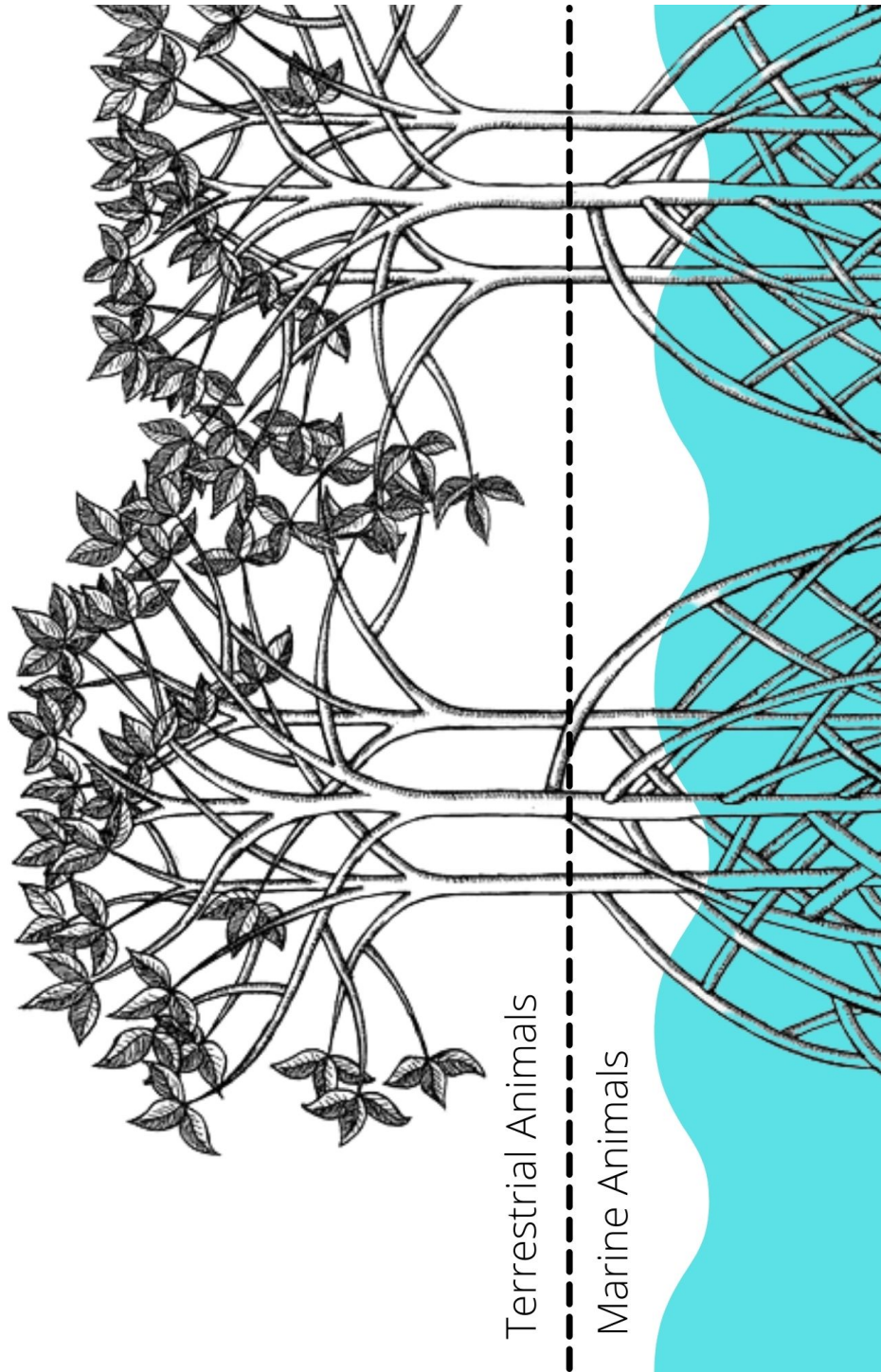
Manatees eat a mostly plant diet. Sometimes, they will also eat small fish and invertebrates.

Using their strong paddle shaped tail, manatees can swim up to 20 miles an hour in short bursts.

## Grades 4-5 – Where in the Mangroves

In this activity, students will be sorting animals of the mangroves into either Marine Animals or Terrestrial Animals. Students will cut out and place the animals into the two categories. Students will then place the nametags alongside the corresponding animals.

# WHERE IN THE MANGROVES?



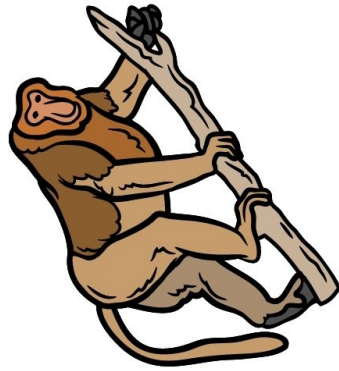
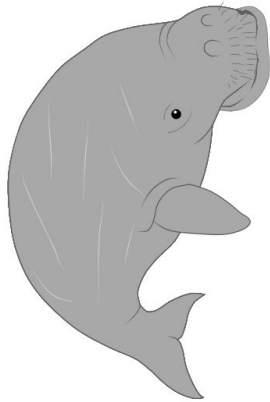
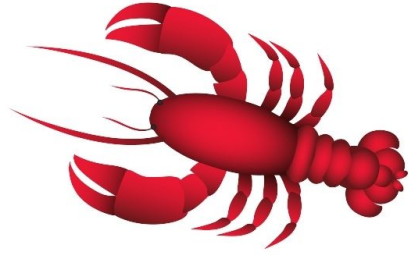


Proboscis  
Monkey

Mud  
Lobster

Pygmy Three  
Toed Sloth

Manatee



## Additional Activity

This additional wordsearch can be used as you see fit with your individual class. The word search includes words specific to mangrove trees and the ecosystem itself!

### Mangrove Word Search

V F A C N P P R O P A G U L E S C O  
S N U R S E R Y S W G H L S M P N P  
C Z I N M T A Z K L B Z T V W K J I  
O P R O P R O O T S J D P L E Q T F  
N S A L T E X C R E T I O N R X W L  
E P Y R E D L R W J Z K N K V W Z Z  
R O W D V L S I X N J N C K O J R K  
O E H V V R Q K F D U K B V B Y M F  
O O I E B L U E C A R B O N Q A P M  
T H T Z P R O O T A E R A T I O N R  
S X E W C B L A C K E C H I T K V F  
B G S V M E S T U A R Y D A T O F Y

Find the following words in the puzzle.  
Words are hidden → ↓ and ↘ .

BLACK  
BLUE CARBON  
CONE ROOTS  
ESTUARY

NURSERY  
PROPAGULES  
PROP ROOTS  
RED

ROOT AERATION  
SALT EXCRETION  
WHITE

# What is changing in the Mangroves?

- I. Mangrove forests face several threats today that could lead to the loss of this important and unique ecosystem. Talk with students about some of the negative issues that we are facing in nature, and which ones they think might apply to the Mangroves.
  - a. Shrimp farming is by far the biggest threat to the mangroves, accounting for 35% of the overall loss of mangrove forests. Farmers will clear out mangrove forests near a coast and create artificial ponds to raise shrimp. Once the shrimp have matured, they drain these ponds into the surrounding ecosystem. These ponds are full of the toxic waste from the shrimp, as well as various pesticides and other chemicals used, which is deadly to the surrounding areas.
  - b. Rising sea levels as a result of climate change also pose a great threat to the mangroves. Typically, as water levels rise, mangroves use mud buildup from rivers to slowly migrate inland. With an excess of human development taking place, the mangroves do not have anywhere to go, which is resulting in a reduction of these forests.
    - i. Provide students with the definition of climate change. Refers to the rapid increase in global temperatures. It is the result of an increase of carbon dioxide and other greenhouse gases in the atmosphere from the burning of fossil fuels.
- II. Why is this ecosystem important? Why should we work to save it from destruction? Aside from providing homes to many creatures, mangrove forests are vital to the habitats they are in. Mangrove trees use their prop roots to trap sand and sediment from the incoming waves. This buildup of materials gives a stable ground for the roots to dig into and helps to build and stabilize the surrounding coastline. Mangrove forests can do quite a bit to counter erosion! Additionally, mangrove trees can absorb quite a bit more carbon than other types of trees. When these mangrove trees die, they take the carbon they have absorbed with them underwater, turning that carbon into “blue carbon.” It gets this name because the carbon becomes buried underwater as well. With this method, mangrove trees account for 10-15% of global carbon burial.
  - a. Provide students with the definition of carbon. One of the chemical elements found in nature. Carbon is one of the most common elements in living things, together with oxygen, hydrogen, and nitrogen.
  - b. Provide students with the definition of erosion. The process of wind, water, or other natural forces breaking down something over a period of time.

## Taking Action

- I. Engage with your students and ask them what are some sustainable practices that they can do to help their environment and to explain how they would go about it.
  - a. Provide students with the definition of sustainability. Use of the earth's resources without destroying or depleting them.
  - b. Here are some practices to help get them going if they are having a difficult time thinking of something.
    - i. Educate
    - ii. Volunteering
    - iii. Alternative energy
    - iv. Reduce, reuse, recycle
    - v. Reduce landfill waste
    - vi. Sustainable agriculture
    - vii. Protect wildlife
    - viii. Conserve water
    - ix. Regulations
    - x. Sustainable fishing
    - xi. Manufacturing practices
    - xii. Speaking up, raise your voice
- II. Evaluate your students and see what they have learned.
  - a. Pass out remaining chosen printout worksheets and have them complete them.
  - b. If you had the students write down the first questions and answer them, have them go back and answer the questions again to see if their answers have changed or stayed the same.
  - c. Additional post lesson questions to choose from to have students answer.
    - i. Why are mangroves important? What roles do they play?
    - ii. Name and explain 1 thing mangroves are in danger of.
    - iii. Name 3 things that you learned about mangroves that you did not know before.
    - iv. Name and describe the three categories of mangroves and what makes them unique.
    - v. Describe at least one animal found in the mangroves. What does this animal do to support the mangrove ecosystem?
    - vi. List 3 things you can do to help your world around you.

## **Student Activities**

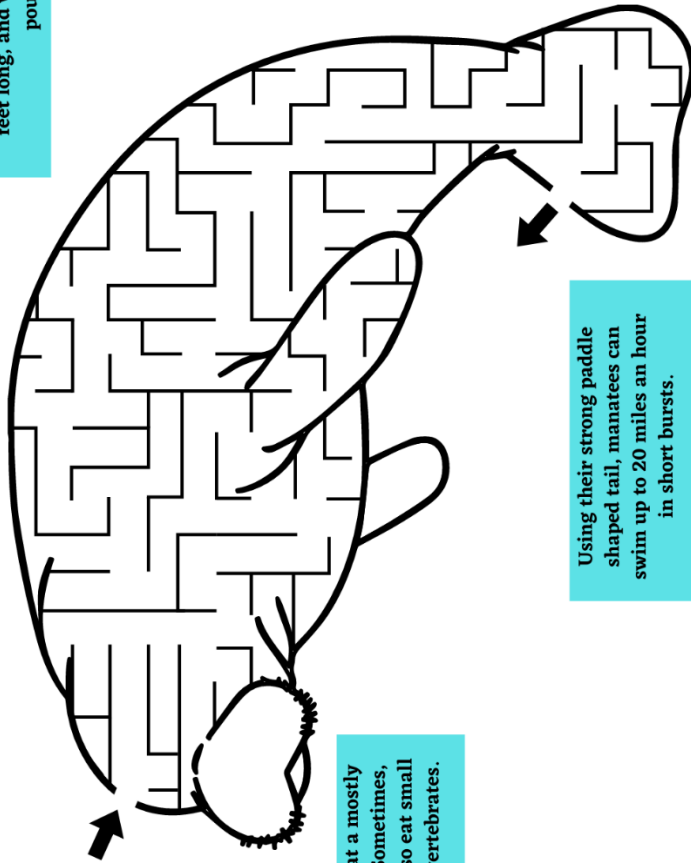
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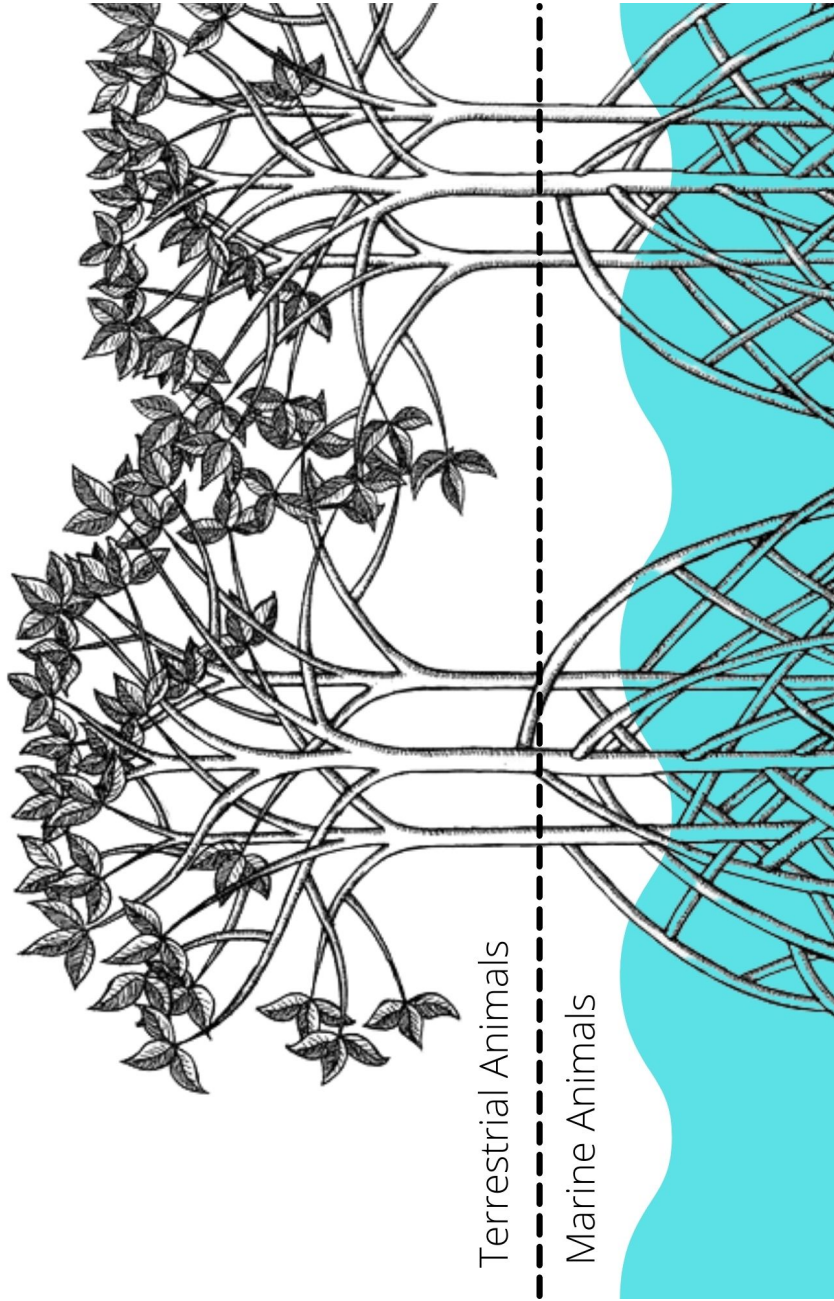
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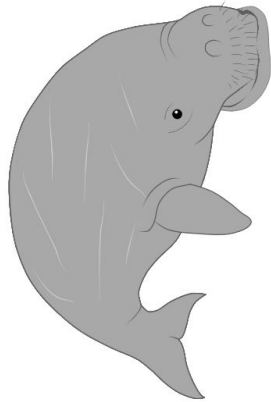
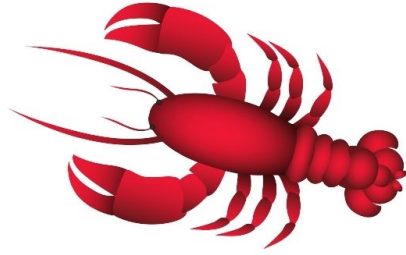


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O P R O P R O O T S J D P L E Q T F  
N S A L T E X C R E T I O N R X W L  
E P Y R E D L R W J Z K N K V W Z Z  
R O W D V L S I X N J N C K O J R K  
O E H V V R Q K F D U K B V B Y M F  
O O I E B L U E C A R B O N Q A P M  
T H T Z P R O O T A E R A T I O N R  
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PROP ROOTS  
RED

ROOT AERATION  
SALT EXCRETION  
WHITE

# **Hands On Activities**

## **Manatee Hand Puppet**

### **Supplies:**

Paper Lunch Bag

Manatee Cut Out Page

Scissors

Crayons/Colored Pencils/Markers

Glue/Glue Stick/Tape

### **Steps:**

1. Cut out the manatee body parts from the cutout page.
2. Glue the head to the “bottom” part of the lunch bag
3. Glue the flippers to either side
4. Glue the mouth under the heads, towards the fold
5. Glue the fluke to where the lunch bag would open



# Mangrove Triarama Activity

## Supplies:

Scissors

Triarama Base Page and Animal Cutout Page

Crayons/Colored Pencils/Markers

Glue/Glue Stick/Tape

## Steps:

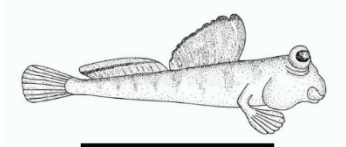
1. Starting with the Triarama Base Page, make a cut along the **SOLID** black line.
2. Using the coloring supplies, color the mangrove tree for its new habitat.
3. Make a fold along both **DOTTED** lines.
4. Apply glue or tape to the triangle portion labeled "GLUE". Layer the other triangle on top to form the Triarama shape.
5. Cut out as many animals as you would like to include inside of your triarama.
6. Using your coloring supplies, color the animals for their new home.
7. Fold along the top of the box labelled "GLUE" for the animal cutouts so that the animals can stand up.
8. Apply glue or tape to the base of these animals and add them to your triarama.

## Triarama Base Page



**GLUE**

# Animal Cutout Page



GLUE



GLUE



GLUE



GLUE



GLUE



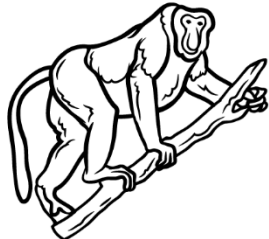
GLUE



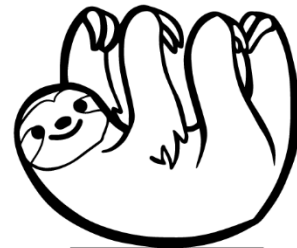
GLUE



GLUE



GLUE



GLUE