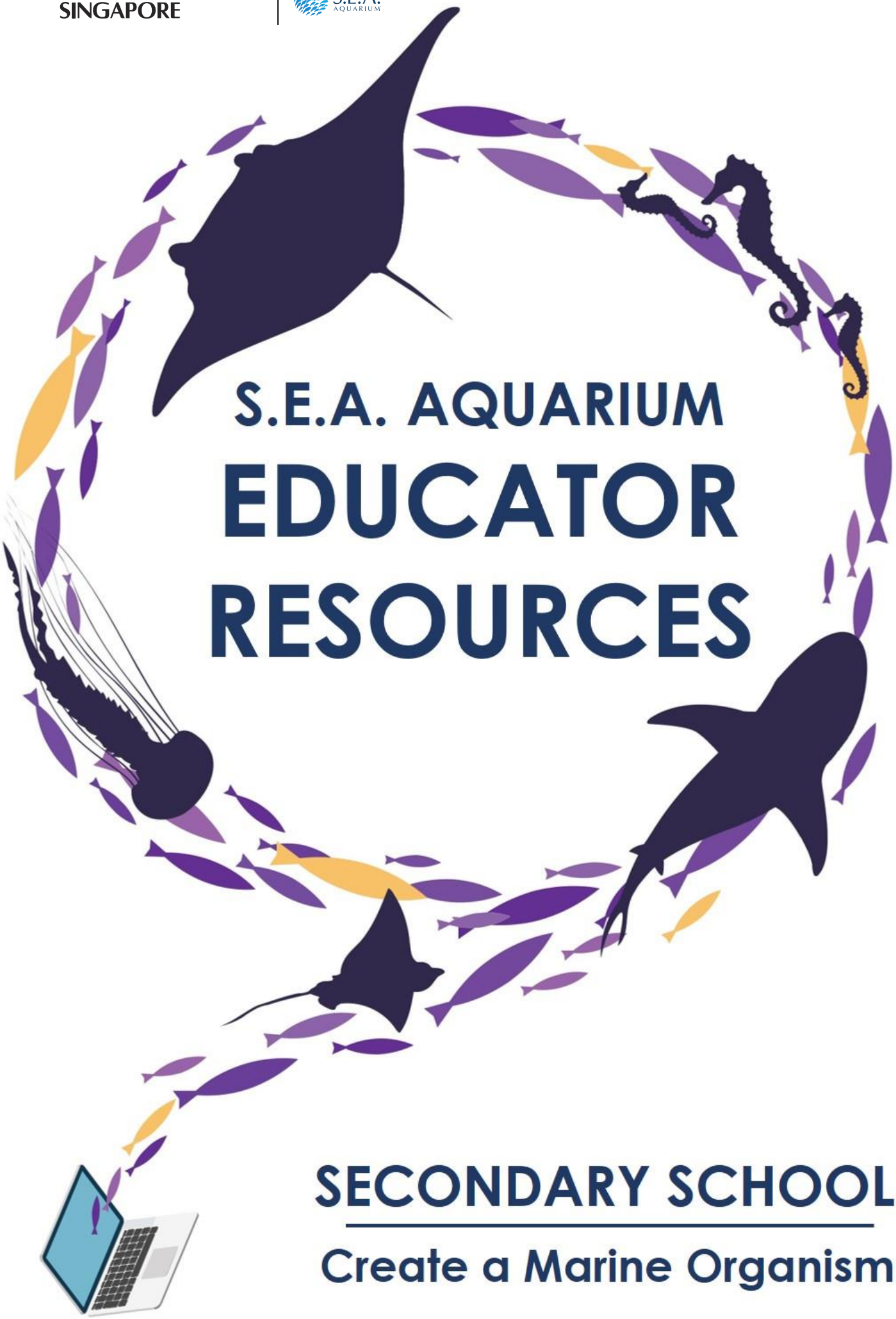
RESORTS WORLD™ SENTOSA
SINGAPORE

S.E.A. AQUARIUM



S.E.A. AQUARIUM
EDUCATOR RESOURCES

SECONDARY SCHOOL

Create a Marine Organism

Create a Marine Organism

Create a Marine Organism is a 4-part resource that builds on students' knowledge of environmental physical factors and adaptation. The aim is for students to demonstrate their understanding of various physical factors, and how adaptive traits and environmental changes affect survival of organisms.

This resource encourages students to apply their knowledge and creativity by creating their own marine organism. Students are to use their knowledge of environmental physical factors and adaption for their creation, and discuss effects of environmental changes. The resource also includes an extension activity, which focuses on the importance and effectiveness of conservation.

Target Group: Secondary 1 & 2

Duration: 2.5 hours (each part takes 35 – 40 minutes)

Learning Objectives:

- Explain how environmental physical factors and having adaptive traits influence the survival of organisms
- Discuss how changes in environmental conditions affect the ability of organisms to adapt
- Recognise the importance of conservation in protecting organisms and their habitats

Required Resources:

- Corresponding *Create a Marine Organism* slides
- *Project: Create a Marine Organism* Student Worksheet (pages 15 to 20)

Activity Outline

Part 1: Investigate physical factors of a marine habitat (40 minutes)

- Class discussion: Examine existing marine habitats
- Activity: Examine a new marine habitat

Part 2: Create your marine organism (35 minutes)

- Class discussion: Importance of adaptations for survival
- Activity: Create a marine organism

Part 3: Respond to changes in environmental conditions (45 minutes)

- Class discussion: Can your marine organism adapt well?
- Activity: Can your marine organism survive the environmental changes?

Part 4 (Extension): Conservation (35 minutes)

- Activity: Suggest a conservation plan
- Class discussion: Importance of conservation

Note for educators: Each part focuses on a different concept and may be conducted in separate sessions.

Introduction

Educators may choose to have students work in groups of 4-5 students or individually.

Slides 2 to 3:
Introduce the activity to students according to the context below:

A new marine habitat has been discovered on Earth! There are no living organisms in this habitat yet and scientists are looking at introducing some new living organisms.

Students are invited to create new marine organisms best adapted to this habitat. It is important to ensure that the marine organisms created can adapt to environmental changes. There will be a series of tests to assess ability of the marine organisms to adapt. Good luck!

Part 1: Investigate physical factors of a marine habitat (40 minutes)

Slides 4 to16:
Class discussion: Examine existing marine habitats (20 minutes)
Students are to demonstrate understanding of various physical factors using existing marine habitats.

Procedure:

1. Educators are to show some examples of physical factors using slide 4.

2. Using 2 examples of marine habitats provided (coral reefs and open ocean), students are encouraged to observe and describe the condition of their physical factors (slides 5 and 9 respectively).
    - Educators can discuss and evaluate students' responses using slides 6 and 10 for the respective habitats.

3. Educators will then introduce animals that live in these 2 examples of marine habitats (slides 7 and 11 respectively).

4. Have students observe and infer adaptive traits of the animals that live in these 2 habitats.

- Educators can discuss and evaluate students' responses using slides 8 and 12 for the respective habitats.

Educators can refer to the *Appendix* for more information on environmental physical factors and adaptations of animals used in this activity.

<u>Group/individual activity: Examine a new habitat (20 minutes)</u>
In this activity, students are required to examine physical factors of the newly discovered marine habitat.

Students will require the *Project: Create a Marine Organism* worksheet (provided below) to complete this activity.

Procedure:

1. Educators are to pick 1 of the 2 examples of newly discovered habitats provided (in slides 13 and 15).
    - The selected habitat will also be used for Part 2, where students will create their own marine organisms based on the habitat.

2. Using the picture shown, students are to observe and describe the following physical factors:
    - Temperature
    - Light availability
    - Water clarity
    - Environment colours
    - Other features

3. Students are then required to explain how the various physical factors described can affect the survival of organisms that live in these habitats.
    - E.g. Light availability allows organisms to look out for dangers, but also makes them more visible to predators.

Suggested descriptions of the 2 newly discovered habitats:
Habitat #1 (Slides 13 and 14)

- Temperature: Low (15-20°C)
- Light availability: Low (limited light reaches the habitat)

- Water clarity: Clear (low amount of sediments in water)
- Environment colours: Dull-coloured (brown, grey)
- Other features: Large rocky underwater caves, many smaller rocks form crevices around the caves

Habitat #2 (Slides 15 and 16)

- Temperature: Relatively warm (25-30°C)
- Light availability: Bright, sufficient light for photosynthesis
- Water clarity: Murky due to suspended sediments
- Environment colours: Many bright colours
- Other features: Layer of sediments at the bottom, flower-like plants of different heights

Part 2: Create your marine organism (35 minutes)

Slides 17 to 19:

Class discussion: Importance of adaptations for survival (15 minutes)

Prompt students using the following questions and pointers for them to identify characteristics to consider when creating their marine organisms.

- Why do living organisms require adaptations?
  - Become more suitable to live in various environmental conditions and increase chances of survival
  - Obtain nutrients/catch food
  - Hide from predators

- What are some adaptive traits that can help them to survive? (refer to some examples in slide 18)
  - Body shape
  - Mouth type and position
  - Body patterns and colouration
  - Size
  - Defense mechanism
  - Specialised body feature (e.g. appendages, spines)

Group/individual activity: Create a marine organism (20 minutes)

Students can use the *Create Your Marine Organism* section of the *Project: Create a Marine Organism* worksheet (provided below) to complete this activity.

This activity allows students to be creative and illustrate their own marine organism based on physical factors of the newly discovered habitat in Part 1.

Students are to take note of the following pointers for this activity:

- Ensure that the organism can adapt to the newly discovered habitat selected in Part 1.
- Created organism needs to be able to adapt to potential environmental changes.
- The marine organism does not need to be an animal – it can be a plant or algae too!

Part 3: Respond to changes in environmental conditions (45 minutes)

Slides 20 to 28:

Class discussion: Can your marine organisms adapt well? (15 minutes)

Educators to name a few physical factors and have students share how their marine organisms adapt to those physical factors.

Class activity: Can your marine organism survive the environmental changes? (30 minutes)

Procedure:

1. Educators are to gather illustrations of the created marine organisms from students and display them together on a screen.

2. Educators will then introduce human-related environmental events and discuss potential changes to the physical factors using slides 21 to 26.

3. Discuss the changes in physical factors with students and have them note down in their worksheets.
    - More details on the changes can be found in the *Appendix*.

4. Students will then identify and note down possible effects on their own organisms, and suggest responses for them to survive.
    - E.g. Colour loss in the environment makes colourful animals easily spotted by predators. Smaller animals may respond by hiding in crevices or sediments for a longer period of time to survive.
    - Encourage students to share and justify whether the marine organisms they have created can survive.

5. Educators are to remove any organisms from display if it cannot adapt.
    - Take a look at how many and which species are left after all the environmental events have been played out.

6. Conclude with these points by prompting the questions on slide 28:
    - Environmental events change the physical factors of a habitat and make original adaptations of organisms less effective for survival.
    - The events affect a variety of organisms – animals, plants and algae.

Part 4 (Extension): Conservation (35 minutes)

Slides 29 to 35:

Group/individual activity: Suggest a conservation plan (20 minutes)

Students are to suggest a brief conservation plan for the species that are unable to adapt in Part 3. A brief description can be written in the worksheet.

While detailed plans are not necessary, encourage students to share their suggestions and discuss feasibility of implementing them.

Class discussion: Importance of conservation (15 minutes)

Discuss the effectiveness of conservation efforts for vulnerable species by using examples provided in slides 30 to 34. Educators may also refer to the *Appendix* for more information on these examples.

Educators to conclude by explaining the importance of conservation by prompting the questions on slide 35. Educators may refer to interrelationships between organisms in an ecosystem to discuss the questions below:

- What would happen to vulnerable species if these efforts are not initiated?
- If some species become extinct, what are the effects on the other species and ecosystem?

Appendix

Additional information for Educators

Part 1: Investigate physical factors of a marine habitat

Class discussion: Brief descriptions of habitats

Coral reefs

Coral reefs support approximately 25% of marine life. They are located in tropical and subtropical regions, and are usually found on rocky substrates. Coral reef habitats are well-exposed to sunlight for microalgae (known as zooxanthellae) living in tissues of corals to undergo photosynthesis. This process provides nutrients for the algae itself and the coral tissues.

Zooxanthellae is also responsible for the many colours observed in corals. The colourful environment in coral reefs allows vibrantly coloured fishes to camouflage and avoid predators. Coral and rock structures create crevices of various shapes and sizes, which serve as shelters for many reef animals. Corals themselves and surrounding algae growth are also nutrient sources for many animals.

- Water temperature: Relatively warm (23 to 27°C)
- Light availability: Brightly lit and has sufficient light for photosynthesis
- Water clarity: Relatively clear water with considerable light penetration
- Environment colours: Variety of colours on corals
- Other features: Coral and rock structures of various shapes and sizes, with algae growth in the surroundings

Open ocean

The open ocean consists of waters away from coasts and many animals that live here are adapted to not being in contact with the shore. The deepest known point is in the Mariana Trench, which is about 11 000m deep.

The water column of the open ocean consists of 5 main zones that are defined by their depths and unique characteristics. The epipelagic zone stretches from the surface to 200m deep and has sufficient sunlight penetration to support a high biodiversity. Beyond the depth of 200m is where light availability starts to

decrease. Here, animals may adapt by producing their own light or rely on other senses besides their vision to hunt.

- Water temperature: About 30°C in tropical surfaces and 4°C in deeper waters
- Light availability: Highest near the surface and decreases with depth. No light beyond 1000m, except for light produced by animals
- Environment colours: Monotonous environment with a lack of colours
- Other features: Mostly featureless with rocks on the seabed

<u>Class discussion: Animal adaptations</u>

Coral reefs

- **Reef fish:** Vibrantly coloured bodies allow them to camouflage in the colourful environment of coral reefs and avoid predators.
- **Triggerfish:** They can be easily spotted in brightly lit environments, hence they hide in crevices when threatened. They can extend spines on dorsal fins to anchor in crevices, making it difficult for predators to grab them.
- **Moray eels:** They ambush their prey while hiding in crevices, and are adapted to moving on rough coral and rock surfaces by having a layer of mucus on their skin for protection.

Open ocean

- **Manta rays:** A flat body and large pectoral fins allow them to swim and forage in the spacious ocean efficiently. Their mouths are located at the front to draw in plankton near the water surface as they swim.
- **Sharks:** Countershading allows sharks to camouflage themselves in the water column and hide from their prey. A darker colouration on the top of their bodies blends in with the darker seabed, while a lighter colouration at the bottom blends in with the brighter water surface.
- **Groupers:** A dull-coloured body blends into the featureless environment. They tend to hover motionlessly in the water column and near the seabed so as to not catch the attention of their prey.

Part 3: Respond to changes in environmental conditions

Class discussion: Changes to physical factors due to environmental events

Water pollution

- **Light availability:** Items floating on water surface and suspended particles reduce light exposure and penetration.
- **Water chemical composition:** Chemical discharge can change chemical composition (chemicals may be toxic to living organisms).
- **Water clarity:** Suspended particles from surface runoffs inland reduce water visibility.
- **Oxygen availability:** Agricultural runoffs containing fertilisers contribute to additional nutrients in the water. These nutrients may lead to plankton blooms, which increase oxygen usage and reduce oxygen availability for other organisms.
- **Vegetation cover:** Toxic components from land discharges may affect survival of plants in the vicinity, leading to reduction in vegetation cover.

Global warming

- **Temperature:** Water temperature increases (can lead to coral bleaching)
- **Light availability:** Excessive amount of light available (photosynthesising organisms may be less efficient)
- **Oxygen availability:** Increased amount of light and warm environment favour excessive plankton and algae growth, and eventually leads to oxygen depletion in the water.
- **Environment colours:** Coral bleaching occurs as corals lose their colours and turn white.

Ocean acidification

- **Acidity:** Increase in acidity (results in weakened coral skeleton and animal shells, affecting the growth and survival of these animals)
- **Other features:** Less coral structures (unable to provide shelter for living organisms)

Part 4 (Extension): Conservation

Class discussion: Examples of existing conservation efforts

Create a sanctuary

- Singapore's first marine park: Sisters' Islands Marine Park

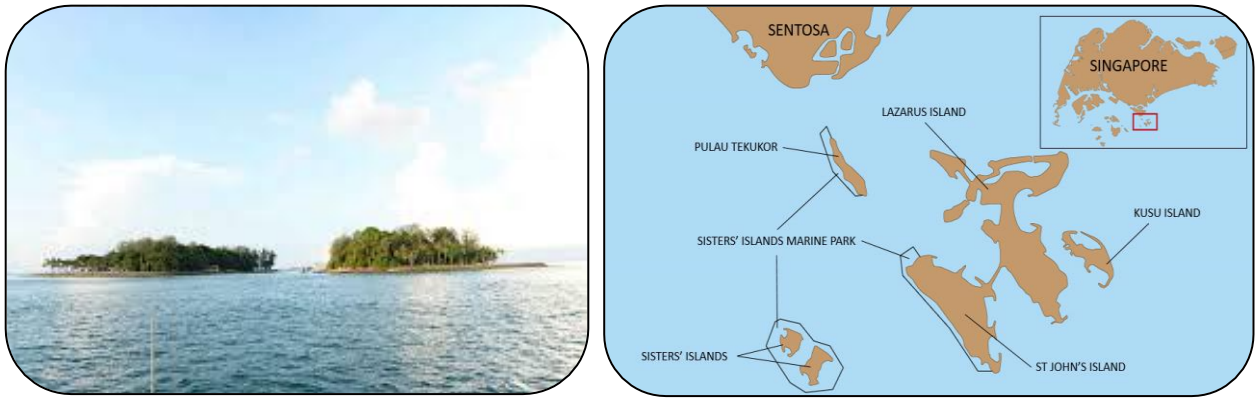


Photo of Sisters' Islands and area within Sisters' Islands Marine Park demarcated on the map

- Waters, seabed and reefs within the marine park are legally protected from activities such as unauthorised fishing, coral collections and boat mooring.
- A protected area provides safe refuge for marine biodiversity in Singapore waters.
- A platform for researchers to monitor changes in the physical factors of Singapore's marine environment and responses of marine species
- Serves as a platform to introduce and monitor conservation plans, and enhance survival chances of marine species

Population restoration

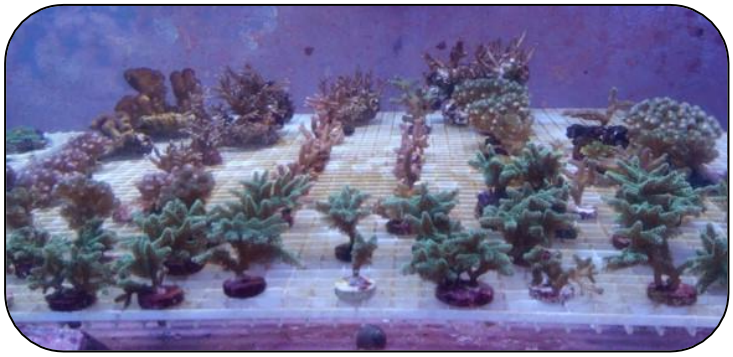
- To restore reefs, artificial structures made of pre-fabricated concrete and recycled rocks were placed within the Sisters' Islands Marine Park.

Illustration and actual image of artificial structure from a collaboration between JTC and NParks

- Structures provide hard surfaces that encourage coral growth, which in turn can attract fishes and other marine life.
- Corals are grown in an external nursery and transplanted on to hard structures when they have reached a suitable size.

Aquarium breeding programmes

- Aquariums provide safe and controlled environments for marine animals to breed and for juveniles to develop.
- Successful breeding can be followed by exchange with other aquariums to ensure genetic diversity in the species bred. Genetic diversity is important for ensuring population resilience during environmental changes.
- Such programmes also allow research that are difficult to study in nature. Results from these research provide important information for conservation efforts.
- Examples of animals successfully bred in aquariums include sea jellies, stingrays and sharks - some are considered endangered in the ocean.

Juvenile zebra sharks and coral fragments respectively bred in S.E.A. Aquarium

PROJECT:
CREATE A MARINE ORGANISM

A new marine habitat seemingly devoid of life has been discovered on Earth.

You are invited to join our project to introduce living organisms to this habitat.

We need your help to create a marine organism that can adapt to and survive environmental changes.

Kindly fill in the details of your creation accordingly in the subsequent pages.

Be creative and think out of the box!

Creator name: _____

Class: _____

Part 1: Investigate physical factors of a marine habitat

Describe physical factors of the newly discovered habitat and explain how they may affect the survival of living organisms.

Temperature: _____

_____

_____

Light availability: _____

_____

_____

Water clarity: _____

_____

_____

Environment colours: _____

_____

_____

Other feature(s):

_____

_____

_____

_____

Part 2: Create your marine organism

Fill in the profile of your marine organism below. Please ensure that the organism can adapt to the environment and environmental changes that may occur.

Name: _____

Type of organism: Animal / Plant / Algae / Microorganism / Others: _____

Size: _____

Location within habitat: Sediments / Vegetation / Others: _____

Diet: _____

Fun fact: _____

Describe adaptive traits of the organism and how these traits can help it adapt to the environment.

Trait 1: _____

_____

_____

_____

Trait 2: _____

_____

_____

_____

Trait 3: _____

_____

_____

_____

Illustrate the marine organism and label its features in the space below.

Part 3: Respond to changes in environmental conditions

Write down the environmental events that may occur. Describe the corresponding changes to the habitat's physical factors (where applicable) and possible responses made by your created organism to survive.

Environmental event 1: _____

Changes in physical factors

Temperature: _____

Light availability: _____

Water clarity: _____

Oxygen availability: _____

Environment colours: _____

Other features: _____

Effects on marine organism and responses to adapt (if any):

_____

_____

Environmental event 2: _____

Changes in physical factors

Temperature: _____

Light availability: _____

Water clarity: _____

Oxygen availability: _____

Environment colours: _____

Other features: _____

Effects on marine organism and responses to adapt (if any):

_____

_____

Environmental event 3: _____

Changes in physical factors

Temperature: _____

Light availability: _____

Water clarity: _____

Oxygen availability: _____

Environment colours: _____

Other features: _____

Effects on marine organism and responses to adapt (if any):

_____

_____

Part 4: Conservation

Briefly describe a conservation plan to protect the species that are unable to adapt to the environmental changes.

_____

_____

_____

_____

_____