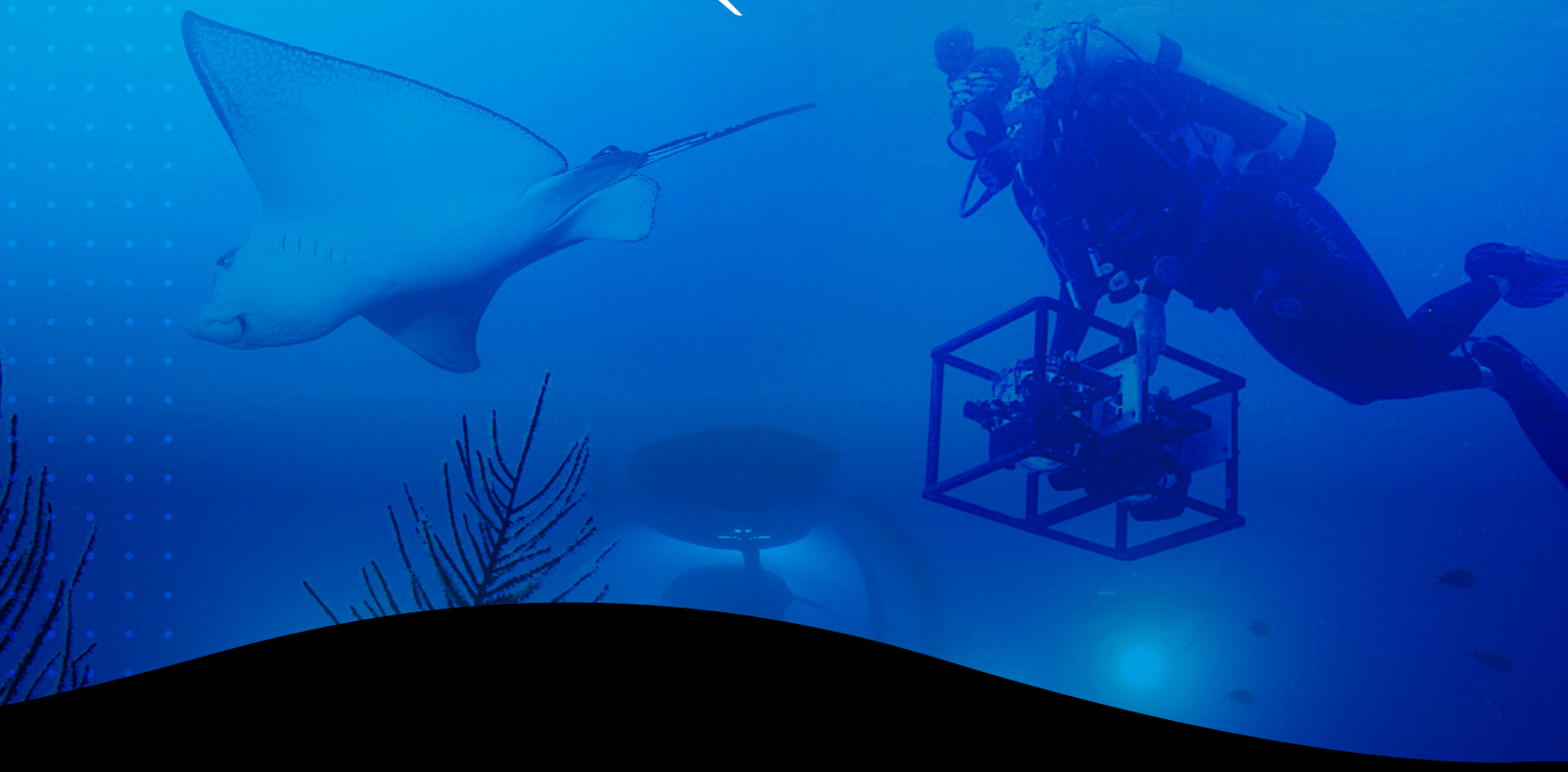
OCEANX

FLYING FISH

OCEANXPERIENCE



INSTRUCTIONAL SEQUENCE

AN INVADER IN THE OCEAN! (PRE-VISIT)

Ecosystems: Interactions and Dynamics

GRADE LEVEL: 6-8

ARIZONA SCIENCE CENTER

Never stop wondering.
Never stop imagining.™

Presented for Australian audience by:

WESTERN AUSTRALIAN MUSEUM

PURPOSE

Sometimes, humans can have a negative impact on their surrounding environment. One of the ways humans impact their environment is by introducing an invasive species. These invasive species can disrupt an ecosystem and threaten the survival of its native species.

OBJECTIVE

Students will analyze the effect of introducing an invasive species to a healthy marine ecosystem.

YEAR 4

SCIENCE

Science understanding – Biological sciences:
WA4SSUB1 – Producers, consumers and decomposers have roles within an ecosystem and interact in ways that can be represented by food chains.

YEAR 6

SCIENCE

Science understanding – Biological sciences:
WA6SSUB1 – The growth and survival of living things are affected by the changing conditions in their environment and the influence of human activities.

Science Inquiry Skills - Questioning and predicting:
WA6SSIQ1 Pose testable questions that include variables to be measured and changed, and apply science knowledge to make predictions.

Science Inquiry Skills – Evaluating:
WA6SSIE1 - Compare findings with those of others, and to predictions; evaluate the fairness of an investigation and suggest improvements; and pose questions for further investigation.

Science Inquiry Skills – Communicating:
WA6SSICM1 - Communicate ideas in a variety of ways, including scientific reports with appropriate language features.

YEAR 7

SCIENCE

Science understanding – Biological sciences:
WA7SSUB2 – Food chains and food webs can be used to represent energy flow in ecosystems and predict possible impacts of human activity.

Science Inquiry Skills - Questioning and predicting:
WA7SSIQ1 - Propose investigable questions and make predictions based on scientific knowledge to explore scientific models, identify patterns and test relationships.

Science Inquiry Skills – Processing, modelling and analysing:
WA7SSIPR1 - Construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information.

Science Inquiry Skills – Evaluating:
WA7SSIE1 - Reflect on scientific investigations, including evaluating the quality of the data collected, and identifying improvements.

WA7SSIE2 - Construct evidence-based arguments to support conclusions or evaluate claims.

Science Inquiry Skills – Communicating:
WA7SSICM1 - Communicate ideas, findings and information for specific purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate.

YEAR 8

SCIENCE

Science Inquiry Skills - Questioning and predicting:
WA8SSIQ1 - Propose investigable questions and make predictions based on scientific knowledge to explore scientific models, identify patterns and test relationships.

Science Inquiry Skills – Evaluating:
WA8SSIE1 - Reflect on scientific investigations, including evaluating the quality of the data collected, and identifying improvements.

Science Inquiry Skills – Communicating:
WA8SSICM1 - Communicate ideas, findings and information for specific purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate.

YEAR 9

SCIENCE

Science understanding – Biological sciences:
WA9SSUB1 – Plants and animals have structural, behavioural and physiological adaptations that enable their survival in their environment.

WA9SSUB3 - Population size and species diversity can be affected by abiotic and biotic factors; sampling techniques can be used to monitor abiotic factors and estimate numbers of organisms; ecological monitoring can be used to inform ecosystem health and impacts of human activity.

Science understanding – Earth and space sciences:
WA9SSUE2 - Changes to global systems can be used to explain patterns of global climate change.

Science Inquiry Skills - Questioning and predicting:
WA9SSIQ1 - Propose investigable questions and hypotheses to test relationships and develop explanatory models.

Science Inquiry Skills – Evaluating:
WA9SSIE1 - Evaluate validity and reliability of methods and validity of conclusions, including identifying possible sources of error, and describe specific ways to improve the quality of the data.

Science Inquiry Skills – Communicating:
WA9SSICM1 - Communicate scientific ideas and information for specific purposes and audiences, including constructing evidence-based arguments and selection of appropriate content, language and text features, using digital tools as appropriate.

VOCABULARY

BIODIVERSITY
The variety of living things in a given place, such as plants, animals, and microscopic organisms

COMPETITION
A relationship between organisms that both use the same resources for food, shelter, etc.

ECOSYSTEM
A given area that includes living and nonliving things, and the interactions that take place between them

INTERDEPENDENCE
How living things depend on each other

INVASIVE SPECIES
A non-native species that is introduced to an ecosystem that disrupts the natural flow of energy/food chains that are established

POPULATION
The number of organisms of a species living in a specific place

ADAPTATION
A characteristic of a living thing that helps it survive in its environment

CAMOUFLAGE
The ability of an organism to blend into its surroundings

MATERIALS

CORAL REEF ECOSYSTEM INTERDEPENDENCE CARDS
HOLE PUNCH
YARN
CLOTHESPINS

ONLINE RESOURCES

THE DEEP SEA INTERACTIVE

MARINE LIFE FACTS

ENDANGERED SPECIES CONSERVATION

ENGAGE

DEEP SEA EXPLORATION

Ask students to brainstorm a list of organisms that they think might live in the deep sea. Students share ideas aloud.

Project the **website**. As you scroll through, stop and notice what organisms live at certain depths of the ocean. Keep going until you arrive at the bottom of the web page.

Ask students to record their observations as you scroll. After you get to the bottom, have a class discussion allowing students to share their interesting observations.

It is important to point out to students that not all of the depicted organisms live full-time at the depths they are displayed on this website. For example, some organisms are air-breathing and must come up to the surface, like the orca whale. For a more in-depth look at many of the organisms depicted in the deep sea graphic above, consider this **website**.

Prompt students to think about the killer whale's maximum depth and guess about how long 109 meters actually is. Possible student responses- as wide as the classroom, as wide as the cafeteria, etc. Have students convert 109 meters to about 357 feet. Take students to the football field and use tape measures to show students what 357 feet actually looks like (students will have to do this in phases as a typical tape measure is 50 feet).

Choose a different animal from the website to explore how much their maximum depth is, depending on how much space is available, or amount of measuring equipment.

Optional extension: Students can choose an animal that exists at a deeper depth, and use their Google maps app to 'drop a pin' that is equal to the distance of the animal they chose.

EXPLORE

INTERDEPENDENCE ACTIVITY

Prep ahead: Print and cut out the Coral Reef Ecosystem Interdependence cards for each group of students. Hole punch the cards and thread yarn through the holes to make the cards into lanyards that can be worn by the students.

Divide students into groups of five.

Pass out the applicable card lanyards to each student in small groups. Have each student read their own card to themselves and then have each student read their card aloud to the group.

Pass out six clothespins to each student.

Explain that the clothespins represent all the individuals of the organism identified on their card found in a specific area. Each clothespin may represent more than one individual.

Once students have their cards and clothespins, model the activity using the two of the limiting factors from the Interdependence: Limiting Factors list. Explain to students that anytime a statement is read that limits/reduces the chance of survival for the organism card around their neck, the students should take off one clothespin and put it on the floor in front of them.

- Example: "A new species has been brought into your habitat and is using a food source that you depend on." Everyone should place one clothespin on the floor as all living things require food.
- Example: The seagrass you normally hide in has been overused due to competing organisms in your environment.

Discuss with students what kind of organisms might use the seagrass to hide from predators.

Students who have the sea star card should put their clothespins down.

Students with the sea turtle should place one clothespin on the floor as they would have less sea stars to use as a food source. Students who have the reef shark card should also remove a clothespin, because less sea turtles means less food for them as well.

Pass out the Interdependence: Limiting Factors list and Interdependence: Group Discussion Topics to each small group.

Instruct students to stand in their groups, put all six clothespins on their lanyards and to take turns reading the limiting factors aloud to their group.

Inform students when they have only two clothespins remaining, they must sit down and say "I am the (organism name) and I am now in trouble!"

Once seated, students may still remove clothespins if the limiting factor shared impacts them. If students have to remove all of their clothespins they must remain seated and say "I am the (organism name) and I am now gone!"

Tell students that they have to listen very carefully to all of the statements read, since some statements may impact the organism indirectly. For example, if a limiting factor causes an organism to drop to two or fewer clothespins, organisms in their food chain must also offer up one clothespin.

- Example: If the student with the sea turtle card sits down, any organism (ex: reef shark) that relies upon it directly to fulfill a need, they must also give up a clothespin regardless of whether the limiting factor that was read affected them.

Have students utilize the Interdependence: Group Discussion Topics sheet to discuss ideas and share responses after many of their group members are seated.

Monitor that the appropriate students are dropping clothespins based on their assigned organism. Continue to do so until everyone is sitting with two or fewer clothespins.

EXPLAIN

INTERDEPENDENCE ACTIVITY DEBRIEF

Provide each group an opportunity to share their organism cards with the whole class. As organisms are shared aloud, find the applicable cards and tape them to the chart paper/whiteboard to reference later.

Be intentional about the card arrangement; structure the cards in trophic levels, the producers on the bottom, the primary consumers next and so on.

Conduct a whole group discussion while students remain seated on the floor with their remaining clothespins, summarizing key ideas and introducing relevant vocabulary:

- *What do you notice is the same about all the organisms in our simulation?* All organisms are affected by changes in their environment/access to resources. All organisms live in relationship with other organisms in a particular area (interdependence). All organisms require plants, even if they don't directly eat them.
- *What do you notice is different about the organisms in our simulation?* Some organisms are more easily affected by certain changes in the environment. Some organisms are connected to many other organisms in the environment while other organisms are only connected to a few.
- *What did the loss of clothespins simulate/mean?* A decrease in population.
- *What factors influenced the survival of your population?* Access to food, shelter.
- *What impact would a decrease in the populations of organisms have on the remaining organisms?* The populations of other organisms would also change, generally decreasing. Populations would be forced to adapt or move in order to survive in the long term.
- *What term do we use to describe populations that are in danger of dying out? How do we recognize those populations in this simulation?* Endangered means the species is at risk for extinction, or the loss of that species forever. Students with two clothespins who sat down and said "I'm in big trouble!"
- *What happened to the organisms which have no clothespins remaining?* Those organisms became extinct.
- *Why should we be concerned about decreasing populations?* There are benefits to preserving endangered species. Some examples are: Endangered species usually indicate a bigger problem and can lead to investigation and preservation programs. Humans benefit from different species, perhaps in ways research has not yet shown. All life is connected and dependent on one another (interdependence).

Encourage students to record definitions and ideas in their science journals as needed to clarify understanding.

Consider showing this quick **video** from NOAA about the Endangered Species Act to show students that humans can have a positive impact on the environment.

EXTEND

AN UNWANTED GUEST ACTIVITY

Instruct students to get back into their Interdependence groups, with the exception of group six.

Students in groups one to five will briefly review their organism cards and summarize how each organism in the group interacts with one another (interdependence).

Remind students that organism interactions and relationships are not limited to solely feeding relationships; organisms rely on one another for structure/shelter, and space.

During this time, give students from group six an Invasive Species card. Note: Do not label these organisms as invasive at this time. Students will draw this conclusion later in the activity.

Instruct these students to become familiar with their new organism and to consider how their organism might influence the other organisms in the other groups.

Disperse the group six members to each of the remaining five groups. The group six member then shares their organism and the group determines how they are impacted by the introduction of this new species into the ecosystem.

Each group will then use large whiteboards or butcher paper to map out the relationships between their organisms, including feeding relationships, structure/shelter, water, space, and air. Students should illustrate the ecosystem prior to the introduction of the new organism and after the introduction of the new organism.

Provide an opportunity for each group to present their ideas to the class. Discuss with students trends or similarities between the new organisms and their impact on ecosystems.

Introduce the term invasive species (a species that did not exist in that area before humans introduced it) and discuss why the introduction of invasive species can be harmful to an environment.

EVALUATE

Have students consider the animals and plants in their school or home communities.

- What species would be considered invasive?
- How are they impacting the ecosystem?
- How have the populations of those organisms been affected by human population growth and building construction?
- What suggestions do you have to help reduce the impact of the invasive species?
- Students should prepare a presentation of their findings/suggestions i.e.; brochure, PSA, video, skit, etc.

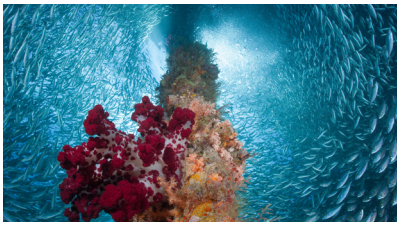
MARINE ALGAE (ZOOXANTHELLAE)

EATS: Produces own food via photosynthesis

EATEN BY: Parrotfish, crabs, sea slugs, snails, sea turtles, and some sea stars

DEFENSE: Can give off a bad tasting chemical to deter some predators from eating it

OTHER: Provides energy for corals by capturing sunlight and converting it to energy that is absorbed by the coral



CORAL

EATS: Plankton, small crustaceans, and feeds off of the nutrients that the algae provides

EATEN BY: Fish, barnacles, crabs, sea stars

DEFENSE: Creates a hard exoskeleton around itself

OTHER: Coral serves as a home for many marine species, and is very sensitive to changes to the environment, such as temperature and chemical changes in the water

SEA STARS

EATS: Sea snails, oysters, clams, marine worms

EATEN BY: Crabs, lobsters, other sea stars, seagulls, sea turtles

DEFENSE: Hides by using seaweed as camouflage (blending in to environment)

OTHER: Changes in water temperature and reduced coral habitat are also threats to the sea star population

SEA TURTLES

EATS: Algae, seagrass, small crabs, sponges, sea stars, jellyfish

EATEN BY: Reef sharks

OTHER: Sea turtles are threatened by plastic in the ocean- they sometimes mistake plastic for food. Consuming plastic is very harmful for the sea turtle and can cause death.

REEF SHARKS

EATS: Fish and crustaceans

EATEN BY: Larger sharks like hammerheads, humans hunt their fins for shark fin soup

OTHER: Reef sharks need a spacious, healthy coral reef ecosystem to survive. Overfishing is also a major threat to the reef shark population.

This page is for marketing to see image source. Marketing- feel free to change images as needed.

CORAL REEF ECOSYSTEM INTERDEPENDENCE: LIMITING FACTORS

1) A new organism has been brought into the reef and is using a food source that you depend on.

2) Pollution is entering the coral reef because humans have built a factory nearby.

3) Humans are fishing too much in your area.

4) Some organisms in your area have been taken out of the habitat to live as "pets."

5) Humans have started a preservation program to protect the marine animals and plants in your area.

6) The coral reef has been damaged due to an increase in fishing activity- lots of pollution from fishing gear has littered the reef.

7) The human population has grown in your area.

8) A nearby farm uses pesticides that soak into the soil. When it rains, runoff causes the chemicals to trickle into the ocean.

9) Humans have started an organization that regularly cleans up the beaches near your coral reef.

10) Increasing global temperatures has warmed the ocean and caused parts of your coral reefs to turn white (coral bleaching). Now, your coral reef ecosystem is struggling to grow and survive.

11) Your coral reef has gained popularity and is now a popular snorkeling spot.

12) More trash has been emptied into your habitat.

13) Humans are building homes in the coastal communities near your coral reef.

14) A disease has spread throughout the group of organisms you eat.

15) The coral you use as a home has died.

16) People are afraid of you so they hunt, poison or trap you and relocate you from your habitat.

17) The seagrass you normally hide in has been overused due to competing organisms in your environment.

CORAL REEF INTERDEPENDENCE: GROUP DISCUSSION TOPICS

Directions: After most of your group members are seated, discuss the questions below.

1) Although the organisms in your group are different, what is similar about them?

2) How are the organisms in your group connected to one another?

3) How did you know organisms in your group were *"in trouble"*?

4) What factors impacted the survival of the organisms in your group?

5) How did the loss of one organism affect the rest of the organisms in your group?

LIONFISH

EATS: Lionfish eat more than 70 species of fish and crustaceans that live near the coral reef. They have a large head and mouth so they can eat prey up to half the size of their own body. They easily corner their prey using their large fins.

EATEN BY: Almost nothing! Lionfish are very rarely eaten by larger predators like sharks and groupers because of their powerful defense system.

DEFENSE: Lionfish have 18 venomous spines that inject a very painful neurotoxin.

OTHER: Lionfish eat so many fish native to the coral reef that they are causing rapid declines in coral reef fish populations. They reproduce in mass quantities all year long.

LIONFISH

EATS: Lionfish eat more than 70 species of fish and crustaceans that live near the coral reef. They have a large head and mouth so they can eat prey up to half the size of their own body. They easily corner their prey using their large fins.

EATEN BY: Almost nothing! Lionfish are very rarely eaten by larger predators like sharks and groupers because of their powerful defense system.

DEFENSE: Lionfish have 18 venomous spines that inject a very painful neurotoxin.

OTHER: Lionfish eat so many fish native to the coral reef that they are causing rapid declines in coral reef fish populations. They reproduce in mass quantities all year long.

Marketing: Link to lionfish creative commons image (feel free to change as needed):
https://openverse.org/image/8cc94f96-048b-4d27-9c93-bd6db0d77ffd?q=lionfish

THIS GUIDE IS INTENDED FOR THE USE OF EDUCATORS, GROUP LEADERS, AND FAMILIES IN CONJUNCTION WITH THE *OCEANXPERIENCE* EXHIBITION. IT IS PROVIDED ON AN "AS IS" BASIS, AND FLYING FISH AND OCEANX DISCLAIM ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, REGARDING THE GUIDE. BY UTILIZING THIS GUIDE YOU RELEASE FLYING FISH AND OCEANX, ALONG WITH THEIR OFFICERS, EMPLOYEES, DIRECTORS, TRUSTEES, AGENTS, AND VOLUNTEERS, FROM ANY AND ALL LIABILITY, CLAIMS, ACTIONS, COSTS, EXPENSES, DAMAGES, ATTORNEY FEES, BREACH OF CONTRACT ACTIONS, AND ANY OTHER CAUSES OF ACTION THAT YOU MAY CURRENTLY HAVE OR MAY ACQUIRE IN THE FUTURE. THIS RELEASE PERTAINS TO ANY LOSS, DAMAGE, OR INJURY THAT MAY OCCUR TO YOU, THE INDIVIDUALS YOU ARE EDUCATING, OR ANY PROPERTY ASSOCIATED WITH YOU OR THE INDIVIDUALS YOU ARE EDUCATING AS A RESULT OF USING THE GUIDE. THE EXHIBITION, BASED ON A FORTHCOMING TELEVISION SERIES PRODUCED BY BBC STUDIOS NATURAL HISTORY UNIT AND OCEANX IN ASSOCIATION WITH EARTHSHIP PRODUCTIONS FOR NATIONAL GEOGRAPHIC, IS CREATED AND TOURED INTERNATIONALLY BY FLYING FISH.