

Inland Voyage

Open Ocean Habitat Program

A discovery-based program for K-12 grade
EDUCATOR'S GUIDE

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Marine Science Institute's Educational Philosophy

As you plan an Inland Voyage Habitat Program with the Marine Science Institute, please consider how this opportunity fits within your overall instructional objective. What learning outcomes do you desire from the experience? What do you need MSI to make happen during the program? How well is the class positioned to move your desired outcomes toward a reality?

One strength of the Marine Science Institute's programs is their flexible role within the learning cycle. Is your group just beginning to generate interest in marine science (**engage**)? Or, are they "hooked" and, instead, are ready to actively experience, to form predictions and make observations (**explore**)? Have your students been developing understandings for some time, and are now ready to speak the language of marine science (**explain**)? Or, does your group have a mature understanding of marine science, perhaps including aspects that are far afield from the habitats covered in the Inland Voyage Habitat Program, and now the students are ready to relate that knowledge to their own backyard (**apply**)? Regardless of where you place your group on the learning cycle, there is a rich experience and a measurable success awaiting your program!

But...what you do before, during and after the MSI Inland Voyage Habitat Program will determine to a very large extent how strong of a partner the Inland Voyage Habitat Program will be in helping you meet your learning objectives.

Introduction to the Inland Voyage Habitat Program

This program guide is intended to further understanding of Marine Science Institute's Inland Voyage Habitat program curricula and program logistics. Through the use of this guide, teachers will know what to expect from our program and will gain a better understanding of the open ocean habitat. A "Creature Feature" section is included within the habitat description. This section is designed to help your students prepare and generate excitement for the open ocean habitat. The goal of the program is to instill in the students an appreciation for this widely unexplored habitat and an understanding of how humans interact with the environment.

PROGRAM LOGISTICS

The Inland Voyage program is delivered to a school, library or camp by a vehicle called the Marine Science Mobile. The Marine Science Mobile is a paneled van that pulls a trailer-mounted, mobile aquarium behind it. Since this unit is both transport and life support for the marine organisms, the programs are presented outside and/or close to the Marine Science Mobile. We need an area accessible to the van that is large enough to set up a two-station program for up to 40 students. This area can be grassy or paved, and shade is always appreciated. If the area is separated from recess activities or any other traffic, the students will be more focused and attentive. Ultimately they will get more out of the experience if these factors are considered. Special arrangements due to weather conditions can be made if necessary.

There are seven different and exciting Inland Voyage programs that the Marine Science Institute offers to schools and groups. Five of these programs focus on marine habitats: Rocky Intertidal, Sandy Beach, Kelp Forest, Marshes and Mudflats, and Open Ocean. The

two additional programs focus on groups of animals in or near the San Francisco Bay Estuary: Bay Fish and Bay and Ocean Invertebrates. Activities for all of these programs are designed to be grade appropriate for Kindergarten to High School grade levels. The programs are all "hands-on" and discovery based, meaning that we give students the animals and equipment necessary to discover sensory or factual information about the animals and their habitats. Two instructors will guide the group through a fun-packed, fifty-minute exploration of these fascinating worlds. One class can experience more than one habitat on a given day, but due to van space and set-up needs, we can only offer two different types of programs per each visit to the school.

Our marine science instructors are specially trained to teach all ages with interesting and innovative methods that encourage interaction and problem solving. Our basic curriculum for each program is described in detail here and should prove to be quite challenging. However, we encourage you to tailor your program by telling us about a particular *theme* that your class has been studying and what level your class is at-engage, explore, explain, or apply. **Please fill out the student assessment form and return via mail or fax.**

PROGRAM LENGTH, GROUP SIZE, AND GRADE

Each program allows up to 40 students to participate and is 50 minutes in total length. The two instructors will give a five-minute introduction and then the class will divide into two groups, with each group participating in two 20-minute stations. To expedite this transition, we ask that the class be divided in half prior to our arrival. The program will wrap up with a brief five-minute closing discussion. We also schedule a ten-minute window between programs. The ten-minute intermission is essential to the well-being of the animals and enables staff to set-up for the next program.

ROLE OF ASSISTING ADULTS

In order to keep program costs at a minimum, we require the participation of at least two adults. The adults are encouraged to participate in various facets of the program such as group management, animal handling, and small group activities.

OPEN OCEAN HABITAT PROGRAM DESCRIPTION

During this 50-minute program, students will discover how large pelagic animals are adapted to the open ocean. A short introduction to the open ocean habitat will be given to your group as a whole. Then the students will be divided into two equal groups, and they will rotate between two stations, guided by MSI's Marine Educators. The "stations" will focus on both sharks and marine mammals in the open ocean. Students will view and touch live sharks, shark artifacts, whalebones, baleen, Orca and Porpoise skulls, and more!

Basic Ecological Concepts

Ecology is the study of the relationships between organisms and their environments. An ecologist asks questions. Where does this organism live? What characteristics make it particularly suited for that location? How does this organism get its food? What other organisms eat it? By asking questions such as these, some basic principles emerge. Understanding the following basic ecological concepts will help us appreciate the complexity of life residing in the various aquatic habitats covered in the Inland Voyage Habitat program.

Everything is connected to everything else!

Perhaps the easiest place to see interdependence in the environments is to look at food. All of the food on this planet is made available initially by plants through the process of photosynthesis. Herbivores are animals which depend directly on plants for food. Carnivores eat herbivores. Take away all the plants and there would be no more animals. Is it possible for a plant, then, to exist independently of all other organisms? No. Although it does not eat animals, a plant needs nutrients and is dependent on decomposers (bacteria and fungi) to break down dead organisms, thereby releasing these nutrients for use by the living plant.

Everything depends on something else!

All organisms are also dependent on factors in the physical environment. They must have a source of water. Animals must have oxygen to breathe. Plants must have sunlight to perform photosynthesis, so if there were no sun, there would be no life. You can probably think of many more examples of how organisms are interdependent on their environments.

Everything must go somewhere!

No object ever disappears completely from the face of the earth. It may be broken down into atoms and be used to build something else, but those atoms are still there. In this way, nature deals with waste recycling. Any plant or animal that does not become food for some animal becomes food for decomposers when it dies. Decomposers free the nutrients so they may be used again. Anything that cannot be decomposed must remain in the environment as it is. What are some examples of this kind of waste? The next time you throw something away, you might remember that there is no "away" to throw it to.

Earth's resources are limited!

How often do you run out of time to do what you want or need to do? Everyone knows that each day only has so much time in it, and that we have to be careful how we use it if we are going to accomplish everything we need to do. The earth's available resources are like time in that we have to be careful how we use them, or they might run out. There is only so much gold, so much petroleum, so much fresh water, so much food, and so much space. All organisms are limited by the availability of resources, but humans have a special opportunity and a special responsibility. Although a plant cannot make a decision to conserve clean water, humans can. To do this intelligently we must find out how much of each resource is available, and then we must monitor our use. We must also think about recycling. The earth can recycle its components naturally but humans must make special efforts to preserve the natural resources.

Open Waters: The Pelagic Ecosystem

Background Information

The term *pelagic* refers to open waters. Close and accessible beaches and rocky tide pools give most everyone some familiarity with our coastal shore and the algae and animals that live in coastal waters. The great open waters of the oceans on earth though are not as easy to access. Only those who have been whale watching or on cruises may have been exposed to the vastness of the pelagic ocean.

The portions of the ocean that are not in close proximity to the shore constitute the pelagic ecosystem. These open waters encircle the planet and hold more than 97% of our planet's three-dimensional living space. The open ocean environment is divided into two zones, the neritic and oceanic. The neritic zone is influenced by interactions with the seafloor and supports different plant and animal communities. The oceanic zone includes the open waters beyond the continental shelf.

Physical and chemical changes in the open ocean create boundaries in an otherwise featureless space. There are large, stable circulation patterns (currents) in both the Atlantic and Pacific oceans. These currents account for physical differences over a horizontal portion of the open ocean but do not account for vertical stratifications. Physical characteristics involved in vertical stratification of the oceans such as temperature gradients, salinity gradients, and changes in light penetration are all important factors that govern the lives of the organisms that live there.

There are two different groups of open water dwellers: plankton (drifters) and nekton (swimmers). The swimmers include animals such as whales, sharks, swordfish, and tuna. Plankton, on the other hand, are something that will 1) drift or weakly swim and 2) are unable to swim against the currents. These "drifters" range in size from microscopic plants (diatoms) to gelatinous animals measuring three meters in diameter (jellies and siphonophores).

PLANKTON:

Plankton can be either animals OR plants, and can exist in the open ocean, as well as abundantly in near shore waters, lakes, streams, rivers, and estuaries. Plant plankton are called *phytoplankton* and are generally smaller than the animals. It has been said that approximately 200,000 plant plankton can fit on the period at the end of a sentence. Wow, that is small! Phytoplankton will absorb light energy from the sun to create organic compounds from CO_2 and other inorganic compounds. This is the chemical process known as *photosynthesis*. These primary producers, like other organisms, have some basic needs for survival in the open water. They need

both sunlight and nutrients for photosynthesis; therefore phytoplankton have adapted to living in the uppermost layers of the ocean, *the photic zone*, to receive optimal levels of sunlight. Nutrients needed for photosynthesis, such as nitrates and phosphates, are easily absorbed from the water, BUT these nutrients are present in fairly low concentrations in the open ocean. Consequently, there are usually lower concentrations of phytoplankton in the open ocean because of the low concentrations of available nutrients. In comparison, larger quantities of phytoplankton are present in coastal waters because there are large quantities of nutrients washing up from the bottom (*upwelling*).

Also present drifting in the open waters are the animal plankton, called *zooplankton*. Most zooplankton are herbivorous grazing on phytoplankton in the water near the surface. Other zooplankton are predators, which feed on grazers and other predators. These plankton are therefore not tied as closely to the photic zone. Some zooplankton are omnivores, which feed on plants or animals depending what food is available. A well known example of zooplankton in the open ocean is krill (not ALL krill are considered plankton). These tiny crustaceans gained their fame by being the main food source for some whales.

NEKTON:

There is a great diversity of plankton in the open waters, but there are relatively few nekton. Nekton, which is the scientific term for creatures that can actively swim against the oceans currents, are in essence the swimmers. Some examples of nekton include schooling fish, such as salmon and tuna, pelagic sharks, marine mammals, and sea turtles. The fore mentioned creatures are all vertebrates, however some pelagic nekton are invertebrates. The invertebrate species include squid, cuttlefish, some euphausiids (krill), and the pelagic crab.

Sharks

Pelagic sharks, such as blues, great whites, threshers, bulls, whale and basking sharks, not only have many of the adaptations mentioned above, but also have characteristics that are specific only to sharks. For example:

1. Sharks have six senses: the ability to see, hear, taste, smell, and feel vibrations and electrical pulses. These senses are used for prey location, feeding, movement patterns, escape response, schooling and solitary behaviors.
2. They have powerful fins for speed. Students are often aware that if a pelagic shark stops swimming it will sink and may even suffocate. This is because some species have lost the ability to pass oxygenated water over their gills when they stop swimming.
3. Sharks do NOT have an air bladder, but they do have a large liver (containing oil) to provide them some buoyancy. The liver may take up to 90% of the shark's body cavity!!

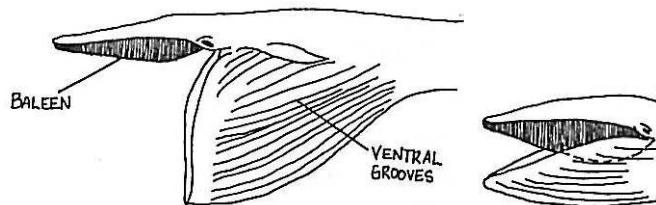
4. All sharks have a cartilaginous skeleton providing flexibility to aid in feeding and maneuverability.
5. Pelagic sharks are mainly viviparous (live placental birth) or ovoviviparous (live birth from an egg). This promotes their reproductive success in the open waters where hiding and anchoring spots for eggs are nonexistent. Female blue sharks have an additional strategy to ensure success when reproducing. They can store sperm after mating until their eggs are mature and ready for fertilization.

Whales

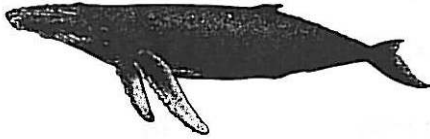
Most whales are well adapted to life in the open ocean. Some, however, such as gray whales (bottom feeders), have feeding characteristics that bind them to the coastal areas. Whale adaptations for life in the open ocean include the basic marine mammal characteristics (blubber, live birth, etc.), strong fins and muscles for swimming, and some unique adaptations for getting food.

Though all whales are classified in the order Cetacea, two different groups of whales exist. Whales with baleen are grouped in the suborder Mysticeti, and whales with teeth are grouped in the suborder Odontoceti.

The Baleen whales have a comb-like or sieve-like apparatus, which allows them to strain millions of small shrimp-like crustaceans from the water. Baleen fibers are made of the same material as our fingernails or a cat's claw. The baleen plates hang in rows from the upper jaw of the whale. The plates fray toward the inside of the mouth and overlap to form a dense net. After a whale swallows a mouth full of food and water, it closes its jaws. With a thrust of the tongue, the water is expelled through the baleen, leaving the prey trapped inside. A baleen whale that uses this method of feeding is called a strainer. A Gray Whale is an example of a strainer.



Gulper and bubble net feeders are variations of the strainer technique. A "gulper" baleen whale is one that has ventral plates on the lower jaw. Ventral plates are slits that can expand out to allow the whale to take in huge mouthfuls of water. Scientists classify this type of feeder in the family of Rorqual whales. Blue whales have more than 40 throat grooves that extend from the throat to the navel. During the breeding season, blue whales must eat 2-4 tons of krill a day. Some Rorqual whales can take in over 2 tons of water at once.



Bubble net feeding is a strategy unique to Humpback whales. It is a method where one or several whales blow a ring of bubbles with their blowhole that "net" the krill or fish that they are feeding on. The whales then swim through the "net" with their mouths agape, taking in large amounts of food.

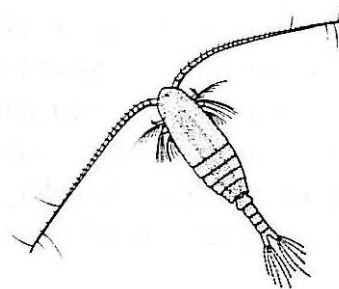
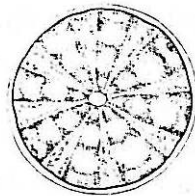
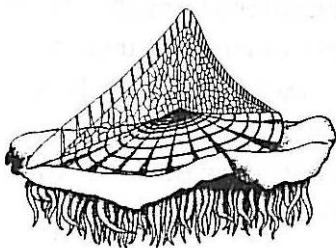
Toothed whales search far and long in the open waters to find the fish, squid or seals that may be their preferred food. All toothed whales use echolocation to assist in hunting. This technique is a unique adaptation. Echolocation describes the release of sound waves into the water. These sound waves will eventually hit an object and echo back. As soon as the whale receives the echo it can determine the size, shape, direction of movement, and distance of an object in the water.

ADAPTATIONS FOR LIFE IN THE OPEN WATERS:

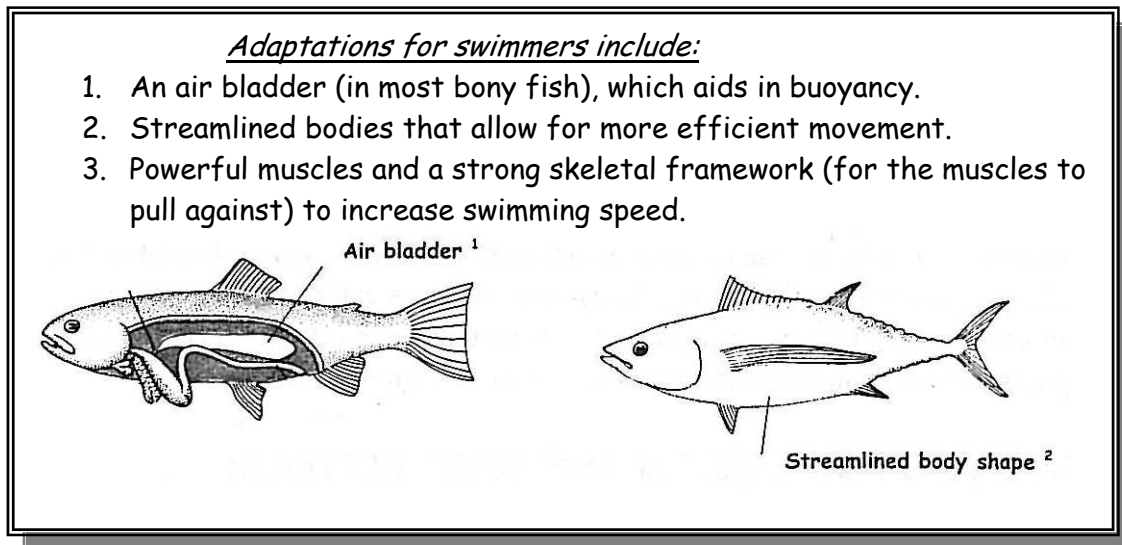
The open waters can be a difficult place to survive for plankton and nekton. One of the problems creatures of the open waters face is controlling their buoyancy. The smaller the object, the greater the surface area is, in relation to its volume. Larger objects have a smaller surface area in relation to their volume and therefore sink more quickly. Some of these organisms have developed specific adaptations to control their buoyancy. For example, larger forms have irregular shapes or appendages, which increase their resistance to sinking. Most plankton, because of their small size, are already buoyant but encounter suspension problems for different reasons. They cannot remain perfectly suspended because they will run out of food and/or will find themselves surrounded by their own waste. Evolved behaviors to deal with this problem include plankton's ability to swim, sink, or float to a new patch of water. Plankton are also in luck because the water near the surface rarely remains still. Wind creates currents that move surface waters horizontally while daily solar heating and nightly cooling creates vertical movement.

Adaptations for plankton include:

1. Hair-like appendages and/or coat of oil (only plants) aid in buoyancy.
2. Cilia or flagella used for movement also aid in buoyancy.
3. Irregular body shapes which increase surface area.



"Swimmers" face the same challenges as drifters for life in a fluid, open water habitat. However, swimmers meet those challenges differently.



Many pelagic fish, including anchovies and sardines, can change their buoyancy by adjusting the amount of gas in their air bladders. Additionally, some fish have deposits of fat that help make them more buoyant than they would otherwise be. Some marine mammals, including blue whales and harbor seals, combat the buoyancy challenge in two ways. First, they possess a layer of blubber just under the skin, which also aids in insulating the beast. Second, they have air in both their lungs and in special air sacs.

How do pelagic swimmers protect themselves against predation? Predation in the pelagic world is fierce because there are no hiding places in these transparent waters. Nekton can employ some of the following adaptations for protection:

1. **Camouflage coloration:** Counter-shading coloration describes fish with a dark back, which blends in with the color of the water below the fish, and a light colored belly, which is often silver and blends in with the color of the surface waters as they appear from below. Likewise, the shape of a fish can provide camouflage. For example, a fish, which has flat sides that taper down to a v-shaped belly, will be nearly invisible from below. Both predators and prey use these methods of protection.
2. **Schooling behavior:** Schooling offers defense against predators because there is safety in numbers. It makes it difficult for a predator to make a surprise attack. Likewise, there are many eyes alert for danger. Many schooling fish, which have reflective silvery scales, flash as they maneuver, making it difficult for predators to see. Schooling predators can launch a coordinated attack to confuse their prey and separate individuals from the school.

3. Fast swimming: Nekton have streamline shapes that are built to swim. Their teardrop shaped bodies and crescent shaped tails, which provide maximum thrust, provide speed by eliminating turbulence and drag. Many pelagic fish have fins that will lie flat against the body in special grooves and eyes that lie flush with the skin to eliminate drag and resistance while swimming.



It is important to remember, when studying the pelagic ecosystem, that the vast size of the pelagic habitat and the difficulties we face in studying it leave many of our questions about the lives of these animals unanswered.

Classroom Activity Ideas For Open Ocean Studies

ACTIVITY #1: OPEN OCEAN CREATURE FEATURE

Objective:

The objective of this activity is to familiarize and excite students about the creatures that live in the open ocean.

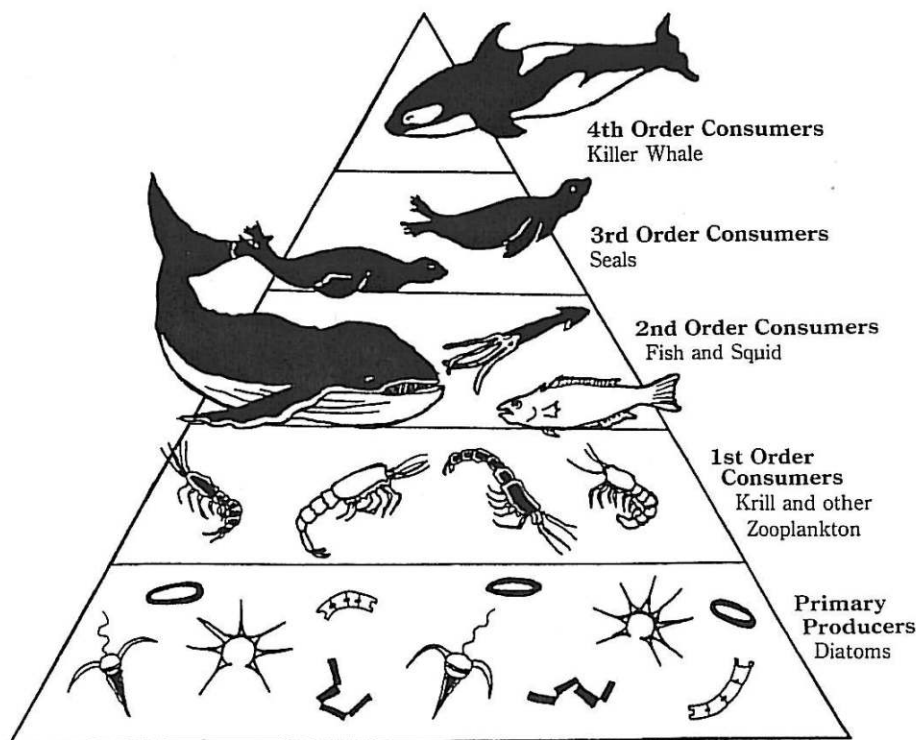
Procedure:

There are many possibilities for classroom activities using the "Creature Feature" information cards.

You may wish to conduct an "Each One - Teach One" with your students. Make enough copies of the creature information cards so that there is one featured animal per student when pages are cut apart. Let students choose a creature card randomly. Give students time to read the card or further research their chosen organism. Props and pictures are fun additions to this activity. Then, let the each one - teach one begin. Set up teaching "stations" around the room. Devise an organized way to have the students teach and learn from each other as they move between teaching stations.

Alternate activities could include:

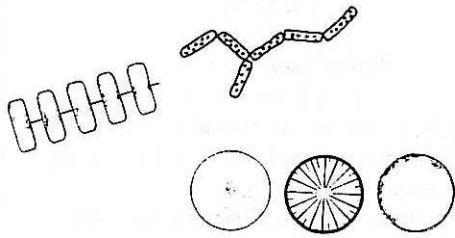
1. The creation of an open ocean food web using the creature information cards and poster boards.
2. Creature classification: use these cards in conjunction with ACTIVITY 3 on page 16.
3. Human Impact Activity: Have students pick a creature information card and research the impacts that humans have on that specific organism.



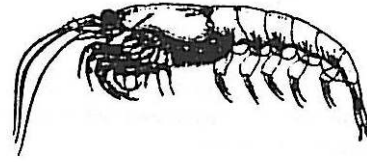
Courtesy of Seattle Aquarium



OPEN OCEAN CREATURE FEATURE



DIATOMS
Phytoplankton



KRILL
Zooplankton



Carl Roessler/Bruce Coleman, Inc.

GREAT WHITE SHARK
Carcharodon carcharias



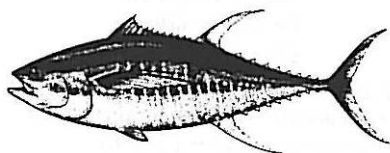
NORTHERN RIGHT WHALE
Eubalena glacialis



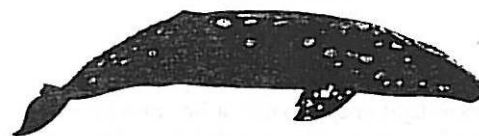
BLUE WHALE
Balenoptera musculus



SPERM WHALE
Physeter macrocephalus



YELLOWFIN TUNA
Thunnus albacares



GRAY WHALE
Eschrichtius robustus

Krill

Kingdom Animalia
Phylum Arthropoda
Class Crustacea

Description: Small shrimp-like crustaceans. Exoskeletons are translucent and pink in color.
Food: Mostly phytoplankton.
Predators: Fish, squid, sea birds, and mammals like seals and baleen whales.
Facts: Days are spent deep in the ocean to avoid predators. Nights are spent near the surface to feed on phytoplankton.

Diatoms

Kingdom Protista
Phylum Bacillariophyceae
Class Euphausiacea

Description: Diatoms are typically golden-brown in color and have cell walls made of silica. Many are single-celled.
Food: Diatoms photosynthesize to make their own food..... sugar (C₆H₁₂O₆)!
Predators: Zooplankton and fish
Facts: It is estimated that up to 80% of the oxygen in the world is made by phytoplankton.

Northern Right Whale

Kingdom Animalia
Phylum Vertebrata
Class Cetacea

Description: Black in color, up to 55 feet in length, long plates of baleen. Has a V-shaped spout up to 16 ft high.
Food: Plankton and crustaceans
Predators: Humans have almost hunted this animal to extinction.
Facts: Right Whale numbers have dropped from tens of thousands to about 220 animals total.

Great White Shark

Kingdom Animalia
Phylum Vertebrata
Class Chondrichthyes

Description: Up to about 20 ft in length, conical snout, with a white belly and gray/black back.
Food: Large, open water fish, sharks, marine mammals, garbage, and dead animals of all sorts.
Predators: Humans kill 10-20 great whites off the California Coast yearly.
Facts: During feeding, the eyes roll back into it's head to protect itself from its victim's claws.

Sperm Whale

Kingdom Animalia
Phylum Vertebrata
Class Cetacea

Description: Largest of toothed whales. Have a huge head filled with spermaceti oil (used in echolocation and deep diving scientists think) and large conical teeth in lower jaw only.
Food: Fish and squid are preferred food.
Predators: Humans. Were over hunted in the 1800 and 1900's for their blubber and meat!
Facts: Can dive to depths of 0.6 - 1 mile or more!

Blue Whale

Kingdom Animalia
Phylum Vertebrata
Class Cetacea

Description: Blue-gray mottled body. Largest ever recorded was 110 feet.
Food: Mainly krill and other crustaceans
Predators: Humans
Facts: Endangered due to over hunting in the early to mid 1900's. Blue whales typically spend up to 30 minutes under water. Can live up to 100 years.

Gray Whale

Kingdom Animalia
Phylum Vertebrata
Class Cetacea

Description: Gray in color with splotches of white or light gray. No dorsal fin. Skin often covered with barnacles and whale lice. Up to 46 feet in length.
Food: Crustaceans, mollusks, bristle worms, etc.
Predators: People, orca whales hunt young grays.
Facts: Whales migrate about 13,000 miles each year as they travel from Alaska to Baja and back.

Yellowfin Tuna

Kingdom Animalia
Phylum Vertebrata
Class Osteichthyes

Description: Tapered, streamlined bodies with dark dorsal area and light underside. Yellow elongated second dorsal and anal fin.
Food: Juvenile fishes, crustaceans, and squid.
Predators: Humans are the greatest & most dangerous predator. In 1990, over 183,000 tons of tuna were fished in the Atlantic Ocean alone!!
Facts: Tunas are capable of traveling 48 km/h.

Activity #2 WHALE BLUBBER ACTIVITY

Objective:

Introduce students to the benefits of having blubber.

Background Information:

Blubber is an adaptation, which helps marine mammals maintain homeostasis. Most whales have a thick, insulating layer of fat, which we call blubber. Their layer of blubber serves many functions including retaining body heat, increasing the whale's buoyancy, and supplying energy when food is scarce.

An insulating layer is extremely important for whales, as heat loss in water is 27 times greater than in air at the same temperature. A blubber layer just beneath the skin is made up of fat cells and a fibrous tissue. Blubber makes up nearly a third of a whale's body weight. It can reach a thickness of nearly 20 inches, which translates to 50 centimeters.

Blubber helps to make a whale streamlined and torpedo-shaped. This body form is energy efficient for swimming. The streamlined body in combination with reduced limb size ultimately decreases the surface area exposed to the water.

Additionally, whales have a special circulatory system that helps maintain their core body temperature. The animal is able to conserve or dissipate body heat. When a whale is overheated, the outer blood vessels dilate to allow warm blood to flow out to cooler fins and flippers. In a chilled animal, the blood vessels constrict to reduce blood flow to extremities. This process is called shunting. Shunting is particularly important during deep dives, when the whale needs to keep warm oxygenated blood flowing to its vital organs. The process of maintaining body temperature is called thermoregulation.

You'll Need

- A few buckets of ice water
- A few buckets of room temperature or even warm water
- Sturdy 1 Quart size zip-lock bags
- 1 can of vegetable shortening such as Crisco
- Duct tape
- Towels

Procedure:

Partially fill one bag with shortening. Turn the second bag inside out and put it in the first bag. Zip the edges of the two bags together so that the shortening is enclosed between the two bags. Seal with duct tape to ensure that shortening stays in the "glove". You are now ready to use the "Blubber Glove" to explore how blubber works.

Break students into small groups of 2-4 people. Assign a bucket of warm water and a bucket of cold water to each small group. Give each group two blubber gloves.

Ask students if they would be able to survive in the ocean they way they are? Make a hypothesis before beginning the activity. Which type of water would be best for a marine mammal without blubber?

Ask the students to test their hypothesis by placing their hands in each bucket. How does it feel? How long does it take for their hand to get cold? Now have the students try out each bucket of water with the aid of the blubber glove. Now, how does the water feel? How long does it take for their hand to get cold while wearing the glove? Calculate the difference in time ($t_1 - t_2$). Why do whales have blubber? Which whales do you think have the thickest blubber? Why? Accept all logical answers. (*Bowhead whales can have a 20-inch layer of blubber.*)

Conclusion:

Make a connection to California Gray Whales by linking this activity to whale migration. Gray whales spend May-November feeding in waters off of Alaska (that is cold water!). In the winter, they migrate to Baja California where mating takes place. The gray whale makes one of longest migrations of all mammals, averaging 10,000 - 14,000 miles round trip. The northward journey takes 2-3 months, allowing calves to build up a thick layer of blubber to sustain them during the migration. It will also keep them warm in colder waters. Adult whales have a blubber layer measuring 10 inches.

ACTIVITY #3: CREATIVE CLASSIFICATION

Objective:

To create an animal by using physical characteristics to categorize that animal in a classification system.

You will need

- Clay
- Paper
- Markers
- Reference materials

Procedure:

1. Each student chooses a phylum, class, order, and family in the animal kingdom after which to model their animal. Write down main characteristics. You may want to limit choices.
2. Separate clay into medium sized balls.
3. Give time to design an imaginary animal following the main characteristics of the chosen phylum, class, order and family.
4. Name animal with an original genus species name. Genus is a larger group for similar species. Species category is for organisms with similar structures.
5. Compare "new critters" to the others in the same families.
6. Discuss differences between animal characteristics, habitats, and diets that create *biodiversity*.

NOTE: You may change this lesson by asking the students to create an animal based on the physical parameters of a given habitat. They can use the same materials and assign their critter a genus & species name as before!

ACTIVITY #4: OCEANS ACROSS THE GLOBE

Objective:

Students will learn the locations and names of the world's oceans.

Background:

The oceans cover 70 percent of the earth's surface and over 100 times MORE living space than the continents themselves. In addition, only a fraction of the world's species has been discovered and many of these undiscovered species live in our oceans. It is important to understand the vast nature of the watery world in which we live. This understanding begins with the basics of such things as size, name, and location of the oceans in relation to the continents.

You'll need:

- A large round piece of fruit, such as honeydew melon, grapefruit, etc (one piece of fruit per person).
- A globe
- 2-3 world maps
- Non-toxic pens
- Paper

Procedure:

1. Ask students to bring a large, round piece of fruit such as a honeydew melon, grapefruit, orange, or apple from home.
2. Give students access to globes and/or world maps.
3. Students draw and label the world's oceans on their piece of fruit. If there is room, students label seas, major straits, and bays.
4. Have students pair up. Write the questions on the board or give as a handout.
5. How do you get from the Caribbean Sea to the Arctic Ocean?
6. What is the best way to get to the Mediterranean Sea from the North Pacific?
7. Describe the route from the Sea of Japan to the tip of Baja California?
8. You are a Gray Whale traveling from the Arctic to the Sea of Cortez to mate. How would you get there?
9. Have each pair work together to write down the travel directions. Remind them to use directional terms like "travel south", "turn left", etc.
10. When everyone has finished, ask students to share their answers with the class. (Remember that there is usually more than one way to get from one place to another.)
11. At the end of the activity, invite students to eat their fruit globe.

GLOSSARY

Biodiversity: The richness, abundance and variety of life across all trophic levels of which all ecological systems, including the planet Earth, are comprised.

Echolocation: The use of echoes to navigate or locate prey; sonar used by toothed whales.

Nekton: Swimming animals of the open water; the adjectival form of nekton is nektonic.

Neritic Zone: The area of the open water that lies over the continental shelf and where there are commonly interactions with seafloor organisms.

Oceanic Zone: The area that encompasses the open water that lies beyond the continental shelf.

Ovoviviparous: Reproductive strategy where mother bear young that develop internally but are unattached to a placenta inside the mother (born live from an egg).

Pelagic: Living or occurring in the open ocean.

Plankton: Drifting aquatic plants and animals; the adjectival form of plankton is planktonic, and a planktonic organism is called a plankter.

Phytoplankton: Algae, usually microscopic, which freely drift in the sunlit portions of the water column.

Photic Zone: Upper sunlight portion of the water column. The depth of the photic zone in the ocean ranges from 30 to 200 meters.

Siphonophores: A siphonophore is a relative of jellies. It is a translucent chain of specialized parts, each of which carries out a unique function. Siphonophores can reach lengths of up to 95 feet or more !

Viviparous: Reproductive strategy where mothers bear young that are nourished through a placental attachment (live birth).

Zooplankton: Animal plankton

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