ADVENTURE aquarium® | New Jersey Academy for Aquatic Sciences

Exhibit COMPANION

Exhibit Companion

Grades 4 – 5

Topic: Adaptations

Created by the New Jersey Academy for Aquatic Sciences
Education Partners of Adventure Aquarium

1 Riverside Drive
Camden, NJ 08103-1037
www.njaas.org

For more information, visit AdventureAquarium.com
Call 800.616.JAWS to make a group reservation

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About this Guide:

Thank you for booking a trip to Adventure Aquarium! This Exhibit Companion contains information and activities to enhance your visit, adding more educational value to an already exciting experience for you and your students. This companion was created to reinforce topics you are already studying in your classroom and stimulate conversations before, during and after your trip to the Aquarium. It is recommended that you read over the packet in its entirety, and distribute the "**At the Aquarium**" section to your chaperones. This section contains discussion questions to be asked at various exhibits throughout the Aquarium, as well as "Not to Miss" exhibits and shows.

For many of your students, this is their first visit to Adventure Aquarium and they may be interacting with animals that they have never seen before. With the help of you and your chaperones, their visit will be filled with fun and learning, and will be an experience they will never forget.

Adventure Aquarium is divided up into four areas, called Zones, to help you easily find your way around the building. This Exhibit Companion is also set up by Zone. The sections of the guide refer to exhibits found in each Zone and how they relate to the topic of this Companion. You may find other exhibits that also relate to the topic while touring the Aquarium. Please have your students and chaperones stop at each one to discuss the animals and their exhibit. Your students will gain more from your trip by taking the time to look, listen, and experience each exhibit, rather than racing through the building!

Adventure Aquarium is constantly updating and adding to our exhibits and collections. Please refer back to these documents prior to each visit, as they will also be updated to reflect changes at Adventure Aquarium.

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This Guide Includes:

- Activities to prepare your students for their visit and to reinforce topics addressed after they have visited.
- Descriptions of the exhibits that will be the focus of this Exhibit Companion and the animals they contain. Please note: while we make every effort to keep the animal list up to date, we are always adding to and adjusting our collections. Please ask an Adventure Aquarium cast member if you are unsure about the identity of a particular animal. We are always happy to help.
- Discussion questions about the animals in the exhibits and adaptations they have for survival in their habitats.

Objectives:

After the visit, students will be able to:

- Define adaptation and describe reasons that animals have developed adaptations (adaptations can be used for feeding, defense, reproduction, locomotion, etc).
- Understand the difference between a physical and behavioral adaptation.
- Describe some physical and some behavioral adaptations that animals can utilize.

Standards:

New Jersey	5.1B, 5.1C, 5.1D, 5.3A, 5.3B, 5.3D
Pennsylvania	3.1.4.A2, 3.1.5.B1, 3.1.4.C2, 3.1.5.C2, 4.1.4.A, 4.1.5.C, 4.5.4.D, 4.2.4.C
Delaware	SS, SS7, SS8

Background Information - Adaptations

An ADAPTATION is a physical feature an animal has or behavior that an animal uses to help it survive in its habitat. Examples of adaptations include migration (behavioral) or camouflage (physical). Humans also have adaptations, whether we are aware of them or not. Our teeth are designed to help us eat a variety of foods; we shiver when we are cold and sweat when we are hot; our hands are designed to grasp and our feet to help us walk upright.

Many adaptations help an animal to find food, or prevent it from becoming food. A strong sense of smell allows a shark to find injured prey in the water. Sonar allows bats to find insects in the dark. Migration gives birds a better chance of finding food during different times of the year. The striped pattern of a zebra helps it escape a lion by confusing the lion's eyes and letting the zebra blend in with other members of the herd. An opossum will play dead when threatened by a predator.

There are countless examples of adaptations that animals display. Some animals, like deer and foxes, cope with cold weather by growing a thicker coat. Others simply leave the cold weather behind and migrate, like robins and geese. Still others, like groundhogs and chipmunks, hibernate.

Adaptations often take thousands of years to become evident within a population. Those that increase the animal's chance of survival are passed on to future generations, while those that do not eventually fade away.

Preparing for Your Visit:

In addition to using this guide, you can enhance your visit with a specially themed educational program. Ask about scheduling a classroom program such as ***Sharks!****,* ***No Bones About It****,* ***Built for Change****, or a* ***Behind-the-Scenes Tour****.*

A little preparation before the day of your field trip can set expectations and prepare your students to make the most of the visit. Visit www.adventureaquarium.com and view our interactive map. Familiarize yourself with the layout of the Aquarium, and advise your chaperones to do the same. It is easier to find the exhibits you will be focusing on if you know where you will be going and what shows and classes you will be attending. A handout of the daily show schedule is available at check-in and the Information Desk.

Adventure Aquarium has a variety of animals with amazing adaptations on display. Most of them are aquatic (water-dwelling) animals such as sharks, hippos, stingrays and fish.

Since many of the animals you will be observing are fish, review the characteristics that set apart a fish from another animal. Animals that are fish have fins, gills, and a backbone. Without all three, an animal cannot be considered a fish. Jellyfish, cuttlefish, and starfish do not have fins, gills, or a backbone so they are not considered fish, despite having "fish" in their names. Whales and dolphins have body shapes similar to fish, and even have "fins" (more properly called flippers), but are mammals and must surface to breathe air.

Use the Internet to find pictures of different fish and animals that are not fish. Below is a list of some suggested animals to get you started and a special adaptation that they have. Discuss with your class if the animals are indeed fish. Many fish have different body styles to help them survive. Eels have long, skinny bodies for slinking through coral reefs, while tuna are streamlined to help them swim quickly through the water. Sharks and stingrays are also fish but have a skeleton made of cartilage, unlike bony fish such as clownfish or goldfish which have a skeleton made of bone.

- Moray Eel – is a fish. This fish does not have scales, but is instead covered with a slimy mucous that protects their skin. The Green Moray Eel actually has blue skin, but is covered with a yellow slime, making them look green.
- Clownfish – is a fish. Clownfish have a special relationship with anemones that allows them to swim in the anemone without getting stung by their many stinging tentacles.
- Catfish – is a fish. Catfish have whiskers, called barbels, which they use to feel around in the mud to help them find food.
- Starfish – is not a fish. They do not have fins, gills and a backbone. At the Aquarium, we call them seastars (because they live in the sea and are shaped like a star).
- Great White Shark – is a fish. See the section on the "Shark Realm" exhibit in this guide to learn about shark adaptations.
- Jellyfish – is not a fish. Jellyfish are invertebrates and use stinging cells to stun their food. You can see several species of jellyfish at the Aquarium in the Jules Verne Gallery during your visit.
- Sword fish – is a fish. This billed fish will use its sword-like nose by shaking its head back and forth in a school of fish, stunning them.

- Flounder – is a fish. This flattened fish is often found on the bottom, hiding under the sand. Both of its eyes are located on the top (dorsal) side of its body.
- Tuna – is a fish. The streamlined body of the tuna makes it the fastest fish in the ocean.
- Dolphin – is not a fish. Dolphins are mammals and have a blowhole located on the top of their heads. They must breathe air using lungs, and therefore swim to the surface of the water to take a breath.

Discuss the differences between behavioral adaptations and physical adaptations. Have students use what they already know about the animals above to determine other adaptations not mentioned, and whether they are physical or behavioral.

At the Aquarium:

While at the Aquarium, your students will be examining different animals and the adaptations they display. Below are some different exhibits you will find at the Aquarium and questions (indicated by a "light bulb") that you can ask your students while looking at the exhibits. The exhibits are broken down by Zone.

Zone A – Caribbean Currents and Ocean Realm

The Tidal Zone – Horseshoe Crabs are amazing animals that have been around for millions of years but they are not crabs. They are more closely related to spiders or scorpions. According to the fossil record, they look almost the same now as they did millions of years ago. Look closely at the top of the horseshoe crab and you will see several sets of eyes. The two most prominent eyes are compound eyes, and see multiple images, much like the eyes of a fly or bee. Moving towards the front, there is a second set of visible simple eyes that help the animal see light and dark. They also have these special light sensors on their tail and underside.

Horseshoe Crabs are scavengers, and primarily eat scraps of dead animals on the sea floor. A Horseshoe Crab's mouth is located on the bottom in the middle of its body. It has special claws that it uses to put the scraps of food into its mouth.

The Horseshoe Crab's body has three segments. The last is its telson, or tail. This is an important adaptation that helps the Horseshoe Crab when it travels onto the beach. Often, it is knocked over by waves, and when upside down, can fall predator to gulls and other shore birds, or dry out from the heat of the sun. To prevent this, it uses its telson to dig into the sand to flip itself over.

- Why do you think Horseshoe Crabs have so many light-sensing eyes?
  - *Eyes on the ventral (bottom) side of the Horseshoe Crab help it to find food when it is young. Young Horseshoe Crab spend much of their time swimming upside down in the water. The light sensors help the crab detect sunlight and the surface of the ocean, where the food is located.*
- What do you think would happen to a Horseshoe Crab without a tail?
  - *Since the tail is necessary to flip the Horseshoe Crab over if it gets flipped upside-down, Horseshoe Crab without tails are unlikely to survive. Although they have a hard shell on the top to protect them, between the dangers of drying out (they have gills that they use to breathe that are located on the bottom) or falling prey to birds, their soft underbelly is unprotected.*

Horseplay – Seahorses are the slowest swimming fish in the ocean. While they have a different body arrangement than fish you might see in other exhibits, they are fish. Their special body plan helps them survive in their grassy ocean habitat. Because they are such slow swimmers, it is possible for them to get carried away by ocean currents. They have developed a prehensile tail (much like a monkey's) that they can use to wrap around the grasses and keep from drifting away.

The male seahorse is responsible for carrying the eggs until they hatch. He has a special pouch, called a brood pouch, into which the female deposits her eggs. He will hold onto the eggs in the pouch until they hatch.

- Look closely at the seahorse's skin. Does it have scales or does something else cover its skin? If it doesn't have scales, is it truly a fish?
  - *Seahorses do not have scales, but instead are covered with bony plates. However, they are fish! Remember, as long as it has fins, gills and a backbone, it is a fish. Other fish, like eels and catfish, are covered with slime instead of scales.*
- Although they are slow swimmers, seahorses do swim. Observe the animals in the exhibit for a few moments. How do they swim?
  - *Seahorses flutter their dorsal fins (located on their back) to propel them through the water, and use their pectoral fins (located near their eyes) to help them to steer.*

Zone B – Stingray Beach Club

Stingrays – Stingrays are a cartilaginous fish related to sharks. They have a flattened body design, with their gills and mouths located on the ventral (bottom) side of their bodies. They are mostly bottom feeders, preferring food like clams, mussels, and crabs and use flat, crushing teeth to crush the shells of these prey items.

Most rays are solitary, and spend much of their time buried under the sand. Others, like the Cownose ray, swim throughout the middle of the water column in large schools.

The most notable adaptation of the stingray is the barb located on the tail. It is used for protection against predators such as sharks. It is sharp, often serrated, and sometimes venomous. However, stingrays are very docile and usually when humans get "stung," it is due to startling the ray. Most often, humans are stung in the foot, leg or ankle because they step on rays hiding underneath the sand.

- What is the purpose of the holes located behind the stingrays' eyes?
  - *The holes behind the eyes of the stingray are called spiracles. Because the stingray's gills are located on their ventral (bottom) side and they spend much of their time buried in*

or laying on the sand, they use these spiracles to draw water from above them, rather than sucking up sand when they breathe.

- What is an example of a behavioral adaptation that the stingray exhibits?
  - *Stingrays will cover themselves with sand to hide from predators. They wriggle their wing-like pectoral fins until a layer of sand covers them, leaving their spiracles and eyes exposed. Some rays, like the cownose rays, swim in large schools. Schooling gives them more eyes to see predators, prey, and potential mates.*

Zone C – KidZone

Flashlight Fish – Flashlight fish are a small, somewhat deep water fish that use bioluminescence as their adaptation for survival. The bioluminescence is created by bacteria that live under the eyes of the fish. It is used to attract food, confuse predators, and to communicate with other flashlight fish.

The flashlight fish is nocturnal and active in dark waters. They have a dark body which makes their shape harder to see in the darkness. The light produced by the bacteria attracts small plankton, which quickly get eaten by the flashlight fish. The plankton also attracts smaller fish that also soon become prey to the flashlight fish.

- What benefits do you think the bacteria get from their relationship with the flashlight fish?
  - *The bacteria get protection, as well as nutrients and oxygen, from the flashlight fish's blood.*
- How do you think the flashlight fish uses its bioluminescence to outsmart predators?
  - *Flashlight fish will use their bioluminescence to confuse predators. They are often found in groups ranging from 20 to 200, and when predators approach, will flash and dart around, making it harder for predators to distinguish individual animals.*

Clownfish – The clownfish is one of the most recognizable fish in the ocean. They are a brightly colored, coral reef dwelling fish, and have a special symbiotic (mutually beneficial) relationship with anemones. Clownfish are slow swimmers, and depend upon the anemone for protection from predators. The anemone, in return, gets cleaned of parasites, increased water circulation (by the clownfish swimming in and out of it), and food – sometimes other fish are lured into the anemone by the clownfish's presence, other times the clownfish will actually bring food to the anemone and feed it.

The clownfish is protected from the anemone's stinging cells by a mucus coating on their skin. They must acclimate to the anemone by rubbing their bodies against its tentacles until they become immune to the stinging.

- Is the relationship between the clownfish and the anemone an example of a behavioral or physical adaptation? Why?
  - *It is actually both! The clownfish's choice to live within the anemone is an example of behavioral, while its ability to become immune to the stinging of the anemone's tentacles is an example of physical.*

- Do you think that anemones that have clownfish living with them are better off than anemones that do not have clownfish partners? What about clownfish that do not have anemones?
  - *Scientists have observed that anemones do better with a host fish than without. The many benefits increase the anemone's chance of survival, and juvenile clownfish strongly depend upon finding an anemone in which to live.*

Zone D – West African River Experience, Jules Verne Gallery and Shark Realm

African River Experience – Porcupines are the third largest rodent (behind the capybara and beaver) and the African Crested Porcupine is the largest rodent in Africa. They are covered with spines, or quills, which are an adaptation that both protects and camouflages the animal. If something bothers the porcupine, it will grunt and stomp its feet. If that doesn't succeed in scaring off the attacker, the porcupine will rattle its tail, which is covered in special short, fat, hollow "rattle quills." These quills rattle together to make noise, much like a rattlesnake's tail. If the predator still doesn't go away, the porcupine will spread its quills out and charge at the attacker- backwards! A lot of people think that porcupines can shoot their quills, but that isn't true. Their quills are covered in tiny barbs, or hooks, so if a quill sticks into a predator's skin, it won't come back out very easily. Also, the quills aren't attached to the porcupine very well, so once the quills are stuck into their enemy, the porcupine can release the quills and escape. The porcupine will then grow new quills to replace the lost ones.

If you're having trouble seeing our porcupine, look behind the log in the upper part of the hippo exhibit. Because porcupines are nocturnal, our porcupine spends much of his day resting or sleeping in the corner of the exhibit. They are herbivores, eating mostly roots, bulbs and other vegetation.

- What are other animals that have quills as an adaptation?
  - *Sea urchins, hedgehog, Echidna. None of these animals are related to porcupines, however. Sea urchins are an invertebrate (animal without a backbone) and live in the water. Hedgehogs are insectivores (eat insects), not rodents, and Echidnas are monotremes (mammals that lay eggs).*
- Why is it an advantage for the porcupine to be nocturnal?
  - *Many predators hunt during the day, as do many other herbivores. By adapting to a nocturnal lifestyle, porcupines do not have to compete with other herbivores for food, and have less of a chance of falling victim to daytime hunters.*

Weedy Sea Dragon – Weedy Sea Dragons are another fish with an unusual body plan. Related to sea horses, these slow swimmers mimic the seaweed in their habitat with their leaf-like fins. They tend to drift in the water, camouflaging from predators by blending in with seaweed and other plant life.

- Why does the sea dragon have a horse-shaped head?
  - *Sea dragons have a narrow snout, almost like a drinking straw, that they use to suck up very small prey items like krill.*
- What is the biggest noticeable difference between the sea dragon and sea horse?
  - *The sea horse has a prehensile tail that it uses to grip onto the grasses, while the sea dragon does not.*

Shark Realm – The Shark Realm exhibit will surround you with 30 sharks – Nurse sharks, Sand Tiger sharks, Sandbar sharks, and Green Sawfish. There are over 375 known species of sharks that range in size from the 6-inch Cigar shark to the 60-foot Whale shark. Sharks are some of the best-adapted animals on earth. They come in different shapes and patterns, and their teeth are continuously replaced throughout their lives.

Based on what they eat, their teeth can be:

- Dagger-like -- like the Sand Tiger, for catching fish,
- Triangular and serrated -- like the Great White, for biting off chunks of seals, or
- Flattened -- like those of the Smooth Dogfish, for crunching shellfish.

- Look closely at the shark's coloration. Why do you think the sharks have light bellies and dark backs?
  - *This pattern of light bellies and dark backs is called countershading, which is like a two-tone camouflage. If an animal swims beneath the shark and looks up, the light belly blends in with the sunlight, making them harder to be seen. If an animal is swimming above them and looks down, its dark back blends in with the dark ocean floor. This makes it harder for the shark to be seen by its prey, or in the case of smaller sharks, its predators.*
- Sharks' skeletons are made out of cartilage, the same thing that your ears are made of. Is this hard like a bone, or flexible? Why do you think having a skeleton made out of cartilage would be an advantage?
  - *A shark's cartilage skeleton makes them extremely flexible. When chasing prey, they can turn quickly, almost bending their bodies in half. A cartilage skeleton also makes them lighter than they would be if they had bony skeletons, making it easier for them to stay buoyant in the water. Cartilage also heals faster than bone, so if a shark is injured, he's back on his fins more quickly.*

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Don't Miss:

Touch Exhibits

- Please Note: Touch exhibits close for 15 minutes every hour to give our animals a well-deserved break. If the exhibit is closed upon your arrival, please check with a cast member at the exhibit to see when it will be re-opened.
- Review with your students prior to arrival the best way to touch our animals. For all exhibits, we encourage a "two-finger" touch, gently on the animal's back. Listen for more tips from cast members at the exhibit.

Touch-A-Shark – Our touchable sharks are bottom-dwelling carpet sharks. These species have flat teeth, like your molars, that are good at crushing the shells of the animals that they eat, such as crabs, snails and clams. They are nocturnal (active at night) and most never grow larger than three feet.

Gill's Grotto – In Gill's Grotto there are three touch exhibits to experience. Here you can touch small sea stars, cleaner shrimp, anemones, and other coral reef dwellers as well as horseshoe crabs and lobsters.

Stingray Beach Club – Touchable stingrays glide past this multi-level exhibit, with touch areas for both tall and small visitors.

Creature Feature – This touch pool is teeming with creatures from the rocky shores of the Pacific Northwest. On the second floor of Adventure Aquarium, next to Irazu Falls, students will have the chance to see and touch slick, slimy and all-around cool invertebrates, such as several species of exotic and colorful seastars (including the beautiful Purple Ochre Star), anemones, crabs, snails and so much more.

Shows and Feedings – *please check your show schedule for times and locations*

Hippo Feed and Talk – Watch as our biologists provide a Q & A and toss treats to Nile Hippos, Button and Genny.

Meet the Divers! – Meet members of Adventure Aquarium's dive team and find out what keeps them moving through the water.

Ocean Realm Odyssey – Hear from an Adventure Aquarium cast member, as they introduce you to the inhabitants of Ocean Realm, including sea turtles, Shark Rays, Great Hammerheads and more!

Penguin Feeding & Talk – Penguins eat 20 percent of their body weight in one sitting! Watch it happen live during one of our daily feeds and hear our biologists talk about these fascinating creatures.

Secrets of Shark Realm - Learn from a cast member all of the secrets of our second largest exhibit and the sharks that inhabit it.

After Your Visit: Questions to Ask and Things to Do:

1. Have students give five examples of the adaptations of ONE animal they have observed on their visit. They can choose mammals, birds, fish, or invertebrates for their featured animals.

2. Pick a particular habitat (ocean, desert, underground, grassland, tidepool, lake) and list what adaptations an animal may have to optimize survival in this habitat.

3. Do you think vertebrates like mammals, birds, reptiles, amphibians, and fish have developed more sophisticated adaptations that invertebrates like arthropods and mollusks? Ask each student to select an animal for his/her choice and list all the adaptations (behavioral AND physical) for the animal they choose. See a sample worksheet on Page 15. They can also draw their animal and habitat on the reverse side of the form.

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ADAPTATIONS FORM

ANIMAL NAME: _____

HABITAT DESCRIPTION: _____

_____

ADAPTATION	BEHAVIORAL OR PHYSICAL	HOW IS THE ADAPATION USED?