Two Legs, Four Legs, Six Legs, More!
Traveling Outreach Program
Pre- and Post-Visit Activities
Grades Pre-K - K
The National Aquarium is a nonprofit organization whose mission is to inspire conservation of the world’s aquatic treasures.

This booklet was prepared by the Education Department at the National Aquarium.

Illustration: Cindy Belcher

The educational goals of the National Aquarium are supported by funding from the Jacob and Hilda Blaustein Aquatic Education Endowment Fund.

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Two Legs, Four Legs, Six Legs, More!
A 30-45 minute traveling outreach program for Grades Pre-K–K

PROGRAM DESCRIPTION
Two Legs, Four Legs, Six Legs, More! will expose students to a variety of animals, each with different numbers of legs. Students will mimic animal locomotion and practice counting skills. Animals discussed include snakes, birds, frogs, insects, spiders and millipedes. Appropriate animal substitutions may be made on the day of the program if animals are not available.
NOTE: Snakes, birds, and spiders are puppets only.

PLANNING FOR THE PROGRAM
The Slither, Slide, Creep, and Crawl program takes place in your classroom. The students sit in a semi-circle around an Aquarium instructor. Your assistance with the children throughout the program is appreciated. Meeting and touching a live animal for the first time is exciting! Please prepare your students for this experience by discussing the following:

1. Each student will rinse his/her hands prior to touching the animals to remove any loose dirt or debris.
2. The animals are held by the Aquarium instructor. Students will have an opportunity to touch them. No one is required to touch the animals.
3. We employ the “one finger touch” rule for the safety of our animals: the students may touch the animals with one finger, gently stroking the animals and not poking them.
4. The animals in the program are gentle and cannot bite, pinch, or sting.
5. Each student will wash their hands following the animal encounters. We will provide hand sanitizer, however students should wash their hands with soap and water prior to eating.

This booklet contains basic information for teachers about the animals that could be used in the program, as well as some suggestions for related activities which can be used in the classroom. The content pages contain much more information than you will want to present to young children, but will provide teachers with excellent background information. Since this program is designed for both pre-kindergarten and kindergarten children, please modify the enclosed activities as necessary.

AAAS Benchmarks

5A-K-2 #1: Some animals and plants are alike in the way they look and in the things they do, and others are very different from one another.

5A-K-2 #2: Plants and animals have features that help them live in different environments.

12D-3-5#3: Use numerical data in describing and comparing objects and events.

MD Voluntary Curriculum

Grades PreK-2 #1 – Science- Skills and Processes
Constructing Knowledge
Seek information through reading, observation, exploration and investigations.
PRE-OUTREACH PROGRAM
The day before your program, read the Teacher Background information and share this information with your students. As a pre-activity, you may want to include a discussion of numbers and counting. Complete Activity 1– How Many Legs game found on pages 13-14.

DAY OF OUTREACH PROGRAM
On the day of your outreach programs, an Aquarium instructor will arrive at your school approximately 15 minutes prior to the start time listed on your contract. The Two Legs, Four Legs, Six Legs, More! program requires an area in your classroom large enough to fit all of your students into a semi-circle on the floor around the Aquarium instructor. Also, a power outlet is required in order to properly care for the animals used during the program.

POST-OUTREACH PROGRAM
The day after the Outreach program, complete Activity 2 – Cockroach puzzle found on pages 15-16 and Activity 3 – Number Tracing found on pages 17-22.
Despite the fact that they have no legs, snakes are very mobile animals. Snakes can live on the ground, among trees, and in the water. They have the ability to climb, swim, and some species can even “fly”. So how do these limbless creatures move? Their movement begins at the neck; a snake contracts its muscles, thrusting its body from side to side, creating a series of curves. As the snake bunches up, it presses its body against resistance points (i.e. rocks, branches, and bumps on the ground) to push off of and propel themselves forward. Scales act like the tread of a tire, gripping the surface and propelling the snake forward. Flying snakes are not actually able to “fly,” but they can glide through the air after they spring from a tree. The snake flattens its body and undulates from side to side so that it can glide down from its perch on a high tree to a lower one. Snakes “fly” to catch prey, flee predators, and efficiently move from one tree to another.

Snakes are carnivores, meaning they eat meat. Snakes will feed on a variety of prey including birds, fish, frogs, lizards, and rats. They kill their prey using one of three methods: catching and eating it immediately, suffocating it, or injecting it with venom. All snakes swallow their prey whole. They accomplish this feat by having a jaw that can dislocate and open up to 150 degrees. It is very difficult and dangerous to eat a live animal, which is why some snakes first immobilize their prey. Venomous snakes have specialized hollow teeth called fangs that are attached to venom glands. When they bite their prey, toxic venom is injected to paralyze the prey. Constrictors wrap around their prey to strangle it and then swallow it once it is motionless. All snakes have teeth, and many have teeth which are pointed backwards in their mouth in order to keep their prey from escaping. Although snakes have no taste buds, they are able to use their tongue to help them smell the air. When you see a snake flicking its tongue, it is “smelling” the air.

BIRDS

Because of their ability to fly and travel great distances, birds have colonized every continent and every habitat on Earth. Members of the bird family have adapted to move easily on land, water, and sky.

The main mode of transportation for most birds is flight. Birds’ bodies have adapted very well for flight. Lifting one’s body off the ground becomes easier the lighter you are,
Because birds can live and move around in many different places, the types of food they eat are varied. Birds can be carnivores, insectivores, others are scavengers, and some specialize in eating nuts, seeds, fruit and nectar. Birds beaks are specialized just as their feet are. A parrot has a thick hard beak to crack open nuts, herons have long thin beaks to pluck unsuspecting fish out of the water, and ducks have flattened beaks to strain food out of the water.

**Frogs**

There are over 4000 species of frogs. They live on every continent except for Antarctica. Frogs come in all shapes and sizes; the smallest being the Cuban tree toad which is less than half an inch long and the largest being the goliath frog which can grow up to 15 inches and weigh up to 7 pounds. Frogs, toads, and salamanders are **amphibians**. The word amphibian comes from the Greek word amphibios meaning “double-life” which refers to the switch from aquatic larvae to land-dwelling adults. Frog eggs are usually laid in water or in a moist place. After hatching, most frogs begin life as fish-shaped **tadpoles**. Tadpoles look very different from the adult frog. They have gills instead of lungs. The have a tail, but no legs, so they must undulate like a fish to move about. After a period of time, which varies from species to species, the tadpoles undergo a drastic change known as metamorphosis. During this stage they develop into frogs. They reabsorb their tails and gills, as well as develop lungs, forelimbs, and hindlimbs. Adult frogs breathe through their moist skin as well as their lungs. Frogs can live on land as well as in water.

Frogs are able to walk slowly, but their main mode of locomotion is jumping. They have very powerful hindlimbs and weak forelimbs. Many frogs are able to jump up to twenty times their own body length. However not all frogs can jump. Aquatic frogs have webbed feet to propel them through water. Some ‘flying’ tree frogs actually glide from tree to tree. Most tree frogs have special sticky pads on the ends of their fingers and toes for climbing and walking on smooth, shiny leaves.

Frogs eat live prey that includes insects, spiders, worms, snails, and small fish. In order to catch their prey, frogs shoot out their sticky tongue. The sticky end catches the prey item and pulls it into their mouth. To aid in swallowing their prey, frogs will push their eyeballs into their heads and force the prey down into their throat.
Frogs have vocal cords and are able to produce sounds. These sounds are what usually alert us to a frog’s presence. While both males and females can call, females are generally not as loud or emphatic as males. It is usually the male frog that is heard calling. Vocalization is an important part of courtship behavior. When you hear the familiar ‘jug-o-rum’ call of a bullfrog, it is likely the male announcing his presence to the female bullfrogs in the area. In addition, many frogs have vocal sacs that increase the volume of the sounds they make. Tiny frogs, therefore, are capable of producing sounds that are surprisingly loud for such small creatures. Frogs exhibit a wide range of colors from earthtone shades of green, gray, and brown to jewel-like colors of blue, green, orange, yellow, and red. In addition they may have dark stripes or spots. Frogs that are dull in color blend well with the natural environment including leaf litter, tree bark, and plants. This is called camouflage. Bright colored frogs on the other hand, stand out to warn predators that they are poisonous to eat.

SEA STARS

Sea stars, formerly known as starfish, are related to sand dollars, sea cucumbers, and sea urchins. The name “starfish” was changed to sea star since the animal is not a fish. Unlike fish that swim using fins, they crawl on the ocean floor using their arms lined with tube feet. Whereas fish are vertebrates (animals with backbones), sea stars are invertebrates since they lack an internal skeleton. There are 1,600 species of sea stars found worldwide.

All sea stars have a similar body form. Typical sea stars have five arms, but some, like the sunflower star found on the West Coast, have as many as forty! A light sensitive eye is located at the end of each arm. The back of the sea star is rough with a spiny appearance due to the presence of small spines and ridges. Located on the back of the sea star is a dark spot called the madreporite. Students often incorrectly think this is an eye, nose, or mouth of a sea star. The madreporite is an organ that acts like a straw to suck up water into the sea star’s body to move the tube feet located on the underside. The tube feet are hollow with suction cup tips. When water is squeezed through the hundreds of tube feet, they extend and allow the sea star to move, climb, and hold onto objects. The suction cups at the end of the tube feet can firmly attach the sea star to rocks and allow them to stay attached when pounding waves hit. The mouth is located in the center of the body on the same side as the tube feet.

The eating habits of sea stars are often seen as intriguing. All sea stars are predators and eat snails, crustaceans, worms, fish, and other sea stars. Many sea stars have the ability to eat bivalves like clams, oysters, and mussels. The two shells of bivalves are held closed by muscles. The shells do not fit perfectly and leave small gaps around the edge of the shells. The sea star attaches its tube feet to the shells of its prey. The sea star pushes out its stomach through its mouth and inserts it into the small gaps between the shells. Digestive juices are released, which dissolve the flesh of the bivalve. The liquefied food is absorbed by the sea star’s stomach lining. When finished, the sea star pulls its stomach back through its mouth. Some sea stars lack tube feet and swallow their prey whole.

INSECTS

Insects are the most abundant animals on earth; there are about one million species! In fact, if you totaled the weight of all of the insects in the world and compared that weight to the total weight of all of the elephants in the world, the insects would greatly outweigh the elephants! They have
populated most habitats on Earth. They are found on land and in water, including deserts, rainforests, freshwater ponds, and even in the arctic. Insects’ diets vary from species to species. They will eat anything from pollen, to carrion (the rotting carcass of a dead animal), to wood.

Insects have an exoskeleton. This means that they have a hard skeleton on the outside of their body rather than having bones on the inside as we do. Insects have three body sections: the head, thorax, and abdomen. The head contains complex eyes, mouth parts (mandibles), and antennae. The thorax is the area where the legs and wings are attached. The abdomen is the area that contains most of the organs. All insects have six legs. Insects move three legs at a time, one leg on one side of the body and two legs on the other.

Some species of insects hatch from an egg into a miniature adult or a nymph. However, in almost 90% of insect species newly hatched young are known as larva, and look completely different from the adult form. As they grow, the larva periodically sheds its exoskeleton which enables it to grow larger. This process is called molting. When an insect goes from the larval stage to the next developmental stage they are said to be metamorphosing. Therefore a caterpillar larva metamorphoses into an adult butterfly.

Madagascar hissing cockroaches are an interesting insect. They get their name from their unique ability to produce hissing sounds by squeezing air through holes in their abdomen. As the air comes out it, the hissing sound is created. The cockroach hisses when disturbed or alarmed and males also hiss when they encounter each other. Like all cockroaches, Madagascar hissing cockroaches have two brains, stomach teeth (tooth-like plates in their stomach which break up food for digestion), and ears on their legs. Cockroaches eat fallen fruit and other rotting vegetation, as well as carrion.

SPIDERS

Spiders belong to a group of animals called arachnids. Contrary to popular belief, spiders are not insects. Unlike insects, they only have two body sections: a cephalothorax (a head and a thorax together), and an abdomen. The cephalothorax contains the eyes, legs, and jaws (called chelicerae). The abdomen contains most of the organs including the digestive tract, the heart and the specialized glands that produce silk. Another way to distinguish spiders from insects is that spiders have eight legs whereas insects have six. Also, unlike insects, spiders do not have mandibles or antennae.

Although they have eight eyes, spiders do not have great eyesight. They rely mostly on another sense altogether. Spiders have small sensitive hairs that cover their entire body. Their legs are especially hairy. These hairs pick up vibrations from what the spider is standing on. Spiders do not have ears; they can “hear” using these hairs on their legs.

Spiders are carnivorous animals. In most cases spiders build elaborate webs of silk in order to trap unsuspecting insects. Almost all spiders are venomous. Like snakes, they possess fangs to inject venom in their prey. The fangs of most spiders are too small to penetrate human skin, so they are not really a threat to humans.

Some spiders, like the bird-eating spider, eat larger prey. As their name suggests, they are able to eat small birds such as hummingbirds (although this is not their main prey), as well as large insects, small rodents, lizards, and frogs. The bird-eating spider is a type of tarantula. Tarantulas are a group of large, hairy spiders that live either in burrows in the ground or in trees. They come out at night to hunt. Tarantulas can bite, but usually defend themselves by flicking hairs from
Once the shell is broken open, the crab backs out of the old exoskeleton. The crab then draws in water, forcing its new soft shell to swell. The crab's new exoskeleton will be about one-third larger than the old one. The newly exposed exoskeleton is soft and the crab is extremely vulnerable and weak. During this time, crabs hide in protected areas such as marshes and grass beds. It takes about two days for the new exoskeleton to completely harden.

Crabs are opportunistic feeders or scavengers. They catch and eat live prey including fish, mussels, clams, and other crabs, but will also eat carcasses of dead animals. They are not strictly carnivores, they eat plant material when they come across it. Just as crabs prey on many things, they also fall prey to many animals. They are eaten by fish, birds, other crabs, and people. The blue crab is important to the Maryland commercial fishery. Maryland has one of the largest blue crab fisheries in the United States.

Although the crabbing industry is heavily regulated, blue crab populations continue to decline in the Chesapeake Bay. Many factors have affected their population, including over fishing and habitat loss. Pollutants such as car exhaust, plant and animal waste, and fertilizer are the main factors impairing the blue crab's habitat. These pollutants release excess nutrients into the Bay, which can reduce the amount of oxygen in the water. They also can produce algal blooms, which in turn damage the underwater plants that the crabs use for food, shelter, and as nursery areas for their young.

Crabs have ten legs. They belong to a group of animals called decapods, deca=ten poda=leg. The first pair of legs has sharp claws which are used for defense or to hold and capture food. Usually the next four pairs of legs are for walking. These walking legs have pointed tips which allow the crabs to move around easily on substrates such as sand and rocks. Most crabs' legs are distributed on either side of their body. When they walk, one set of legs leads and the other follows and the crabs therefore walk sideways. Some crabs such as the spider crab have legs radiating out from all sides of their body. These crabs can move in any direction (back and forth as well as sideways). Other crabs such as the blue crab have paddle-like legs. These paddles on their fifth pair of legs allow the crab to swim up and down in the water column.

Crabs, like insects, have complex eyes. Their eyes are perched on stalks. This allows the crabs to see in many directions at once. Also, just as insects have a hard exoskeleton, crabs do too. This rigid outer skeleton is made of chitin and calcium. Exoskeletons must be shed and replaced periodically by a new, larger outer skeleton. During this process, called molting, the old shell cracks just below the crab's eyes and all the way to the points of the shells. The shell also cracks along the backside and along the tops of the claws.
MILLIPEDES

The name millipede literally means “one thousand legs” (milli = 1000, ped = leg). Contrary to what their name implies, millipedes do not actually have one thousand legs—they usually have between one hundred and four hundred legs. The record for the most legs on a millipede goes to a species in California known as Illacme plenipes which has 750 legs.

The millipede is easily distinguished from its cousin, the centipede, because the millipede has two pairs of legs on each body segment whereas the centipede has only one pair of legs per segment. Millipedes are found in dark moist places such as under logs, stones, rotting leaf litter, and in moist soil where they often burrow. They are herbivores; their diet consists of a variety of rotting vegetation. Since millipedes require a moist environment, they are more active at night when there is less danger of drying out. Millipedes have extremely poor eyesight so they must sense their way by continuously tapping their antennae on the ground as they walk.

One might think that having hundreds of legs would enable an animal to move very quickly, but actually having so many small legs really slows the millipede down. However having many legs gives millipedes a lot of power to muscle their way through dirt and debris. They are great at bulldozing through rotting vegetation.

Female millipedes lay eggs in nests that they carefully guard. When a millipede hatches out of its egg it has only three pairs legs. Every time they molt, or shed their exoskeleton, they add more segments and thus more legs. Until completing their first two molts, they do not eat and they are blind. Before going into molt, the millipede must find a safe place to hide, because during this time, they are vulnerable to predation. When threatened, the millipede's main line of defense is to coil into a tight ball in order to protect its soft underbelly. They can also excrete a foul-tasting and smelling fluid from specialized stink glands.

The giant African millipede is found in tropical and sub tropical forests in Africa. They are one of the largest millipedes in the world. They can grow to be twelve inches long and can be as thick as a person's thumb. On average they have about one hundred legs.
Glossary

**Abdomen** – the end segment of the body of an insect or spider that is attached to the thorax which contains most of the organs

**Amphibian** – a cold-blooded animal that typically lives on land but breeds in water. Aquatic larvae undergo metamorphosis in order to become mature adults

**Antennae** – moveable sensory organs attached to the head of insects, typically sensitive to touch and taste

**Bivalve** – an animal characterized by two hard shells which incase a soft body, for example clams and oysters

**Carnivore** – an animal which feeds on the flesh of other animals

**Carrion** – the carcass of an animal that is fed upon by scavengers

**Cephalothorax** – the fused head and thorax of an arachnid (i.e. spider) or crustacean (i.e. lobster) containing the brain, stomach, eyes and mouth

**Chelicerae** – appendages located on the cephalothorax of a spider which contain the fangs

**Constrictor** – a snake that coils around and asphyxiates its prey before swallowing it whole

**Cold-blooded** – an animal that cannot regulate its own body temperature and is subject to the surrounding temperature

**Decapod** – an animal that has ten legs such as the crab

**Exoskeleton** – the hard outer “shell” of an animal such as an insect or crustacean that provides support and protection

**Invertebrate** – an animal that does not have a backbone including insects, spiders, and crustaceans

**Larva** – the early, immature stage of an animal before metamorphosis takes place

**Mandibles** – mouth parts or “jaws” of an insect or spider

**Molting** - the process of shedding an outer layer such as the exoskeleton, permitting growth in the case of arthropods such as crustaceans

**Nymph** - an insect that emerges from the egg as a miniature adult as opposed to emerging as a larva

**Reptile** - an animal that is cold-blooded, has scales, breathes air and lays eggs

**Tadpole** - the aquatic larva of a frog or toad

**Thorax** - the middle segment of an insect that bears the legs and wings

**Venom** - a toxic substance that is actively transferred to another organism to either incapacitate, paralyze, or cause pain

**Vertebrate** - any animal that has a backbone including birds, fish and mammals
NATIONAL AQUARIUM, BALTIMORE, MD
aqua.org
The National Aquarium in Baltimore's website provides information about many animals. The website also includes useful information pertaining to other teacher resources.

ANIMAL DIVERSITY WEB
animaldiversity.ummz.umich.edu
The University of Michigan Museum of Zoology's Animal Diversity Web is an online database of animal natural history, distribution, classification and conservation biology written by students.

SHAPE OF LIFE
shapeoflife.org
A revolutionary eight-part television series that reveals the dramatic rise of the animal kingdom through the breakthroughs of scientific discovery. The Shape of Life website features activities and resources, animal facts, and scientist biographies.

ANIMAL PLANET
animalplanet.com
This website contains a great list of web links to find information about animal facts and conservation.
Activity 1 — How Many Legs?

DESCRIPTION
During the Two Legs, Four Legs, Six Legs, More! program, your students will learn about many animals. In this activity your students will practice their counting and matching skills. They will also become familiar with the animals that they will be seeing during the program.

PROCEDURE
1. Read the Teacher Background information provided in this booklet on pages 5-12 and share it with your students.
2. Photocopy the How Many Legs? Activity Sheet found on page 14 for each student. Provide your students with crayons or markers to color in the pictures of the animals and the numbers.
3. Tell the students that they must draw a line from the animal to the number that corresponds with the number of legs the animal has. For example the students will draw a line from the bird, which has two legs, to the number two.
4. This activity can also be used as a matching game. Have the students color and cut out the pictures of the animals and numbers. Then have them pair up the animals and the correct numbers.
Activity 1 – How Many Legs?

How many legs does the spider have? Match the animal to each number by drawing a line to the right answer.
Activity 2 — Cockroach Puzzle

DESCRIPTION
The Cockroach puzzle activity will allow your students to review what they learned by matching the animals they learned about with their legs.

PROCEDURE
1. Photocopy the Cockroach puzzle on page 16. There should be one page for each student.
2. Have your students color the puzzle pieces.
3. Have your students cut out the puzzle pieces (you may want to cut these out for them).
4. Have your students fit the pieces of the puzzle together explaining the different parts of the animal and what each part is for:
   - Antennae — moveable sensory organs attached to the head of insects, typically sensitive to touch and taste
   - Head — contains the eyes and mouthparts.
   - Legs — the knees of cockroaches are where their ears are!
   - Body — contain the stomach, where the legs attach.
5. Your students may glue the pieces together or they may save the pieces to use the puzzle again.
Activity 2 — Cockroach Puzzle

Cut along the dotted lines, then paste the bug together so it looks like the picture below. How many legs does this animal have? How many pieces are there?
Activity 3 — Number Tracing

DESCRIPTION
The Number Tracing activity lets your students review what they learned about the animals, while practicing their writing skills.

PROCEDURE

1. Review with your students the animals that they learned about during the Two Legs, Four Legs, Six Legs, More! program. These may include birds, frogs, sea stars, hissing cockroaches, spiders.
2. Make a copy of each of the Number Tracing Activity Sheets found on pages 18-22. There are five Activity Sheets: bird, frog, sea star, hissing cockroach, and spider.
3. Provide your students with crayons or markers to color the sheets.
4. Have your students trace the number which corresponds to the number of legs the animal has (i.e. For a frog, trace the number four).
Activity 3 — Number Tracing

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