

Animal Phyla Lab

Adapted from "Phylum Lab" produced by the National Aquarium in Baltimore

The diversity of animal life on Earth is astounding. Each animal has a unique body plan which allows it to survive and adapt to its given surroundings. With such an abundance of species, classifying animals into different categories is necessary. At first the diversity of animals can be overwhelming, but after further research and observation, many likenesses appear. These similarities become the basis for taxonomists, the biologists who specialize in classifying animals, to organize and bring order to the animal kingdom.

Animals are classified into categories called taxa and are sorted according to their phylogeny (evolutionary history), body plan and similarity of characteristics. There are seven principle levels that organisms can be placed into: Kingdom, Phylum, Class, Order, Family, Genus, Species. All animals are in the Kingdom Animalia. As you move from species to kingdom, the animals that are grouped together share fewer and fewer characteristics at each succeeding level.

The next level after Kingdom is Phyla, which is the main focus of the lab today. Even though there are approximately thirty-five phyla within the animal kingdom, 98 percent of all animals are classified into eight of them. To get even more specific, seven of the eight phyla are invertebrates. Invertebrates comprise most of the animal kingdom, with almost 75 percent of all animals on earth being insects. They out number humans by a million to one!

From Phylum, animals are then broken down into more specific categories: class, order, family, genus, species. For example, a shark, a bird, and a human are all in the Phylum Chordata. So, what similarities do these animals have? Taxonomists would agree that all these animals have similar internal skeletons. However, these animals would not be grouped in the same Class. This process would continue until the animal is classified all the way to species type. Keep in mind that sub-phyla, do exist and even though most animals are place into these eight phyla, not only are there visible difference amongst the eight phyla, but also within each phyla. The following description of each phylum are from the "Shape of Life" guide (Sea studios Foundation, 2002).

Purpose

Students will use the descriptions of the phyla (provided) to create a phylum key. By organizing characteristics into eight phyla, they will have a guide to assist them in determining which phylum is represented by preserved specimen presented to them.

Materials

Phyla Descriptions

Characteristic Cards

Answer Sheet

Teacher's transparency (answer key)

Preserved specimen from each of the eight phyla

Procedure

1. Review the phyla descriptions provided, or use your notes/test to review the key characteristics from each phylum.
2. Each card contains a main characteristic of one of the eight main phyla. Each group/student will cut apart the cards and try to arrange them appropriately on their answer sheet. The end product is a comparison of the main characteristics of each phyla.
3. Once the answer sheet has been completed, ask your teacher to check your work.
4. When you have correctly assembled your answer sheet you may glue the characteristic cards down onto the answer sheet.

Porifera

Sponges

The Phylum Porifera consists only of sponges, which is unique since these animals are entirely aquatic; with 98% found only in marine environments and a small percentage found in freshwater lakes and streams. Sponges are considered the oldest and of the animal phyla. Translated from Latin, Porifera means "pore bearer." Sponges play an important role in aquatic ecosystems, acting to filter particles out of the water especially bacteria. Sponges can be found living with coral reefs. The surface of a sponge is covered with a skin which is one cell thick. This skin is penetrated by numerous small pores and a few larger openings. These larger openings are the entrances and exits for a complex system of canals and chambers through which the sponge pumps a current of water. The body of a sponge between this system of canals is a loose assemblage of cells that secretes a supporting skeleton of collagen fibers and mineral spicules (glass or calcium carbonate) and carries out the process of growth, repair, nourishment, and reproduction.

Sponges can filter/clean water at a rate of their entire volume in less than a minute? As the sponge pumps in water at this amazing rate, it captures tiny food items as small as a single micron in diameter. Choanocytes are specialized flagellated cells, also called collar cells, that allow sponges to pump the water. Since sponges are filter feeders they often have to filter over a ton of water to secure just a single ounce of food?

Sponges reproduce asexually by fragmentation or budding, sexually (eggs and sperm), or hermaphroditic, a single species with both male and female gametes. Their commercial importance includes use as bath sponges as well as being tested for possible anti-cancer drugs or antibiotics. Sponges provide a micro habitat for other organisms and they aid in cleaning the water. Since sponges are considered the simplest of the all animal phyla, they are important subjects for analyzing the evolution of animals. Studies indicate that the Phylum Porifera is at the base of the animal tree of life.

Features:

- * Asymmetrical
- * Organized as an assemblage of different kinds of specialized cells, e.g. collar cells
- * No tissues
- * Skeleton lacking or made of spicules

Cnidaria

Jellyfish, Corals, Anenomes, Hydra

The phylum cnidaria includes such animals as jellyfish, corals, sea pens, sea anemones, and hydras. This phylum contains the most venomous marine creature. It is the Australian box jellyfish. It is known to kill more people than sharks, crocodiles and stonefish combined. It can cause shock and heart failure within minutes. Sea turtles prey upon the box jellyfish but are not affected by the venom. Most cnidaria alternate between two different body forms in their life: the free-swimming form, called the medusa, and the stationary form, called the polyp. Both body types follow the same basic plan. They are radially symmetrical with three layers of tissue. Each species has a single opening that serves as both the mouth and the anus. That shared opening is usually surrounded by a ring of tentacles, allowing the animal to capture prey in all directions.

Cnidarians have a defined top and bottom and two distinct layers of tissue: an epidermis outer layer and an internal gastrodermis. Between these tissue layers is a layer called the mesoglea. In the form of a medusa, the mesoglea is an elastic, clear jelly with fibers made of protein called collagen. The mesoglea aids in locomotion by elastically recoiling in response to muscle contractions. Cnidarians' muscles and nerves are located at the base of the tissue layers. The internal space, surrounded by the layers of tissue and mesoglea, is the gut or gastrovascular cavity.

In order to capture prey, cnidarians have stinging cells. Located in their tentacles, these stinging cells, called cnidocytes, contain tiny, often toxic harpoons, called nematocysts. Triggered by touch or certain chemicals, nematocysts fire out of the cnidocyte housing at lightning speed. Some hydra can fire these harpoons with an accelerated force equal to 40,000 times the acceleration of gravity. That's 10,000 times the acceleration force of a space shuttle. Once the nematocyst hits its mark, usually lethal poisons are injected into the prey. The combination of defined tissues, muscles, nerves and a gut allowed ancestral cnidarians to be the first animals on the planet to show animated behavior. The name Cnidaria comes from the Latin word meaning "nettle."

Features:

- * Two tissue layers with nerve and muscle tissues
- * Nematocysts - structures contained in special cells called cnidocytes or cnidoblasts that can act in both offense and defense
- * Two main life forms - free-swimming medusa (e.g. jellyfish) or stationary polyp (e.g. anemone)

Platyhelminthes

Flatworms

This particular phylum is one of the lesser-known groups and includes such animals as freshwater planaria, colorful marine polycads and parasitic tapeworms and flukes. The name Platyhelminthes in Latin means "flat worm."

Fossilized worm tracks in the early Cambrian period (over 550 million years ago) hint at the origin of this body plan. While the actual classification of Platyhelminthes remains controversial, flatworms share distinctive features. They are bilaterally symmetrical with a defined head and tail region and a centralized nervous system containing a brain and nerve cords. Clusters of light-sensitive cells make up what are called eyespots. The head region of the flatworm also contains other sense organs, which are connected to the flatworm's simple brain. Like most animals, except sponges and cnidarians, flatworms possess three tissue layers making them triploblastic. The middle tissue layer, called the mesoderm, helps form true organs, including reproductive organs, such as ovaries, testes, and a penis.

Flatworms are hermaphroditic and capable of sexual and asexual reproduction. They are, as their name implies, flat. They have no circulatory system or body cavity (coelom), but they do have an excretory and digestive system. Passive diffusion through the skin supplies oxygen to their body parts. The highly branched gastrovascular (gut) cavity distributes nutrients to their cells. Most species of flatworms are parasitic having evolved protective skin coverings and elaborate attachment mechanisms to allow them to live inside their hosts.

Features:

- * Bilaterally symmetrical with a head and tail
- * Centralized nervous system
- * Three tissue layers
- * No coelom (body cavity), no circulatory system and no hard skeleton

Annelida

Polychaetes, Earthworms, Leeches & Cambrian Explosion

The Cambrian period began approximately 543 million years ago. Of the eight major phyla, two were known from fossils of this time - Porifera and Cnidaria. Shortly thereafter, a profuse radiation of fossils representing the other animal body plans occurred over a relatively brief span of about 10 million years (by some estimates, 530 million years ago.) The rest of the animal phyla all evolved during, or shortly after, this evolutionary explosion of new life forms in the Cambrian period.

The Annelida body plan is equal in complexity to that of chordates. Far from being lowly worms, these creatures are impressively powerful and capable animals. Annelids are bilaterally symmetrical. They also contain three tissue layers and a true body cavity) or coelom. The coelom surrounds a one-way muscular digestive tract that runs from the mouth to the anus and includes a pharynx, intestine, and other structures. Annelids have a closed-circulatory system with capillaries connecting to arteries and veins, as well as a segmented central nervous system that includes a simple brain located in the head region.

One of the distinctive traits of an annelid is that it has many segments, or rings, that comprise its body. In fact, Annelida means "little ring" in Latin. Each segment has a number of bristles, called setae, which help the worm move. The evolution of segmentation is an important step for the annelids because it provides an opportunity for separate regions of the body to specialize in different tasks. The fluid-filled coelom was another important innovation for annelids, as it insulated the gut from body locomotor muscles and provided a hydrostatic fluid skeleton against which the muscle system could work quite effectively.

Features:

Elongate and bilateral with segmented true body cavity (coelom)

* Complete circulatory system with capillaries, arteries and veins

* Continuous gut running from mouth to anus with own musculature

* Bristle-like structures, called setae, projecting from body (except in leeches)

Arthropoda

Crustaceans, Spiders, Millipedes, Centipedes, Insects

Of all the phyla in the animal kingdom, Arthropoda is by far the largest and most diverse. All arthropods have segmented bodies and are covered in a hard, yet flexible, protective armor called an exoskeleton. Their body muscles attach to the inside of the exoskeleton. The name Arthropoda means "jointed foot" and refers to their jointed appendages. In order to grow, arthropods must shed their chitin-filled exoskeleton periodically, engaging in an activity called molting. When an arthropod passes through specific developmental stages during molting, it is said to be metamorphosing. Radical changes in body design can come from metamorphosis. For example, an arthropod like a dragonfly can start life in a pond as a swimming larva and then metamorphose into a completely different-looking, winged adult.

Arthropods, like all animals, first appeared in the sea, yet became the first animal group to invade land and even take to the skies. (Our direct ancestors, the chordates, didn't invade land for another 100 million years.) Once on land, arthropods adapted superbly to the new environment. The incredible diversity and success of the arthropods can be attributed to their extraordinarily adaptable body plan. A key feature of this plan lies in the development of myriad types of appendages (antennae, claws, wings, shields, mouthparts) that allowed arthropods to exploit nearly every niche on Earth.

Features:

- * Hard exoskeleton made of chitin and protein
- * Possess numerous jointed appendages and a segmented body
- * Must molt to grow

Mollusca

Clams, Snails, Slugs, Nautilus, Octopus

Animals in this phylum, including chitons, snails, slugs, clams, squid, and octopus, show an amazing degree of diversity. All molluscs have soft bodies. In fact, the name Mollusc means “soft” in Latin. Most molluscs are covered by a hard shell, which is secreted by a layer of tissue called the mantle that overlays the internal organs of the mollusc. Molluscs also have a strong muscular foot, which is used for movement or grasping. They have gills, a mouth and an anus. One feature unique to molluscs is a file-like, rasping tool called a radula. This structure allows them to scrape algae and other food off rocks and even to drill into prey or catch fish.

The diversity of molluscs demonstrates how a basic body plan can evolve into a variety of different forms that allow survival in specific environments. For example, the hard shell in a land-dwelling snail is relatively large and serves to protect the animal. In the fast-swimming squid, however, the shell has been reduced to a small pen-shaped structure.

Features:

- * Rasping organ called a radula- present in all groups except bivalves and Aplousobranchia
- * Muscular foot- used for locomotion and other tasks
- * A sheath of tissue called the mantle that covers body and can secrete the shell (if there is one)
- * A mantle cavity that houses the gills or lungs
- * A calcium shell present in most mollusks- some mollusks have greatly reduced their shells, e.g., squid; while others have completely lost it, e.g., slugs, nudibranchs, and octopus

Echinodermata

Sea stars, Sea Lilies, Sea Urchins, Sea Cucumbers, Brittle Stars

There are about 6000 living species belonging to the phylum Echinodermata. The bodies of echinoderms are made of tough, calcium-based plates that are often spiny and covered by a thin skin. This tough body is how they get their name- Echinoderms (echino-spiny, derm-skin).

Echinoderms are exclusively marine animals. This phylum includes sea stars, sea lilies, urchins, sea cucumbers, sand dollars and brittle stars. Echinoderms do not have a bilateral body plan with a distinct head and tail. Instead, many Echinoderms begin life as bilateral larvae and later develop into radial organisms with five-part symmetry. The mouths of most Echinoderms are located on the underside of their bodies. Echinoderms move, feed, and respire with a unique water-vascular system ending in tube feet. Sea stars use their tube feet to slowly pry open clams, mussels, or other prey. Some sea stars can even extrude their stomachs from their bodies and insert them into the tiny openings between the two shells of bivalves and digest the soft parts inside.

An interesting ability of both sea stars and sea urchins is that of regeneration. If body parts such as legs, tube feet, and spines are lost to a predator they can grow back. While most echinoderms are either stationary or slow-moving, methodical animals, they are nevertheless prominent members of the marine environment.

Features:

- * Internal skeleton made of little calcium plates
- * Five-part symmetry
- * Special fluid-filled system (called a water vascular system) that operates the tube feet

Chordata

Tunicates, Lancelets, Vertebrates (including Amphibians, Reptiles, Mammals)

The Phylum Chordata includes a wide range of animals from tunicates that look superficially more like sponges, to vertebrates, including fishes, frogs, snakes, birds, and humans. Despite this diversity virtually all chordates share certain features at some point in their lives. These include a stiffening rod, called a notochord, that in many members (e.g. the vertebrates) is later replaced by a bony, vertebral column. In most adult vertebrates, the notochord only remains as a disk between the vertebrae. Another chordate feature is a hollow nerve structure called a dorsal nerve cord that in most members becomes the spinal cord and brain. Also included in the chordate body plan are structures called pharyngeal gill slits, or clefts. These skeletal elements function as jaws and jaw supports, and in some animals take on a variety of other functions.

The most conspicuous group of Chordates is the subphylum Vertebrata. Vertebrates include a wide range of animals, from the jawless fishes to the more familiar mammals and birds. Unlike arthropods that wear their skeletons on the outside, chordates have their skeletons on the inside. This design, as in the echinoderms, allows chordates to grow continuously with no need for molting. Such a robust internal skeleton helps vertebrates grow to the size of an African elephant, or support the powerful movements of swimming fish.

Another major innovation in the evolution of vertebrates is the appearance of jaws and a bony skull. A quadrupling of genetic information and the appearance of a special population of migratory cells, called neural crest are correlated with the emergence of the all-important vertebrate jaws and skull. These new features offered a host of new opportunities. Vertebrates fall into two main categories: fishes and a group of animals called tetrapods. Tetrapods developed from a distinct lineage of fishes that possessed unique internal fin bones. These structures eventually aided in supporting the weight of animals on land and laid the foundation for arms and legs and the first amphibians. The development of a shelled, water-retaining egg, the amniotic egg, enabled tetrapods to remain on land and develop into reptiles, birds, and mammals.

From an ancient reptilian ancestor, two groups of animals, mammals and birds, independently developed the capacity to maintain constant body temperature. Mammals evolved earlier than birds, more than 220 million years ago, and are represented today by more than 4, 500 species, including humans.

Features:

- * Notochord- an elongate rod-like structure located above the gut and below the nerve cord
- * Dorsal nerve cord- a hollow tube that in most differentiates into a brain anteriorly and a spinal cord posteriorly
- * Gill clefts- structures located behind the mouth and in front of the esophagus
- * Segmented muscles (except for tunicates)
- * Post-anal tail

Characteristic Cards

A1 Bilateral phylum that added segmentation	A2 Most have a calcium-carbonate shell	A3 Five-part radial symmetry	A4 Specialized cells, but not organized into organs or tissues	A5 Mantle of tissue covering the body
B1 Hollow body cavity for food	B2 Three tissue layers, but no body cavity	B3 Fluid-filled compartments used for locomotion	B4 Jaws and skulls important in their evolution	B5 Complete digestive tract with two ends
C1 Most members are parasitic	C2 Water flows through its body, full of canals	C3 Pioneered jointed legs	C4 First phylum to venture into the air	C5 Some have stinging structures (nematocysts)
D1 Increased complexity made possible by much more DNA	D2 Body design basically a tube within a tube	D3 Tube feet used for locomotion	D4 First muscle and nerves	D5 Most have inside skeleton of bones
E1 All members live in the ocean	E2 Some of the simplest animals with bilateral symmetry	E3 Digestive tract with the entrance being the exit	E4 All have notochord; most have backbone	E5 Champions of variations in appendages
F1 More species than any other phylum	F2 Some spines are little pincers (pedicellaria)	F3 Some non-swimming polyps	F4 Some free-drifting medusae	F5 Some propel, using their siphon as a water jet
G1 Muscular "foot" used to slide, dig or jump	G2 No locomotion; stationary animal	G3 Tubular mouth (pharynx) at mid-body	G4 Phylum to which humans belong	G5 Hard but flexible bodies with interlocking plates under their skin
H1 Spicules act as a skeleton to give it structure	H2 Feeding device like a toothed, rasping tongue (radula)	H3 No symmetry or consistent body shape	H4 Exoskeleton (outside skeleton) made of chitin and protein	H5 Their active burrowing has affected global climate
B5 Complete digestive tract with two ends	B5 Complete digestive tract with two ends	B5 Complete digestive tract with two ends	B5 Complete digestive tract with two ends	E3 Digestive tract with the entrance being the exit
A1 Bilateral phylum that added segmentation	A1 Bilateral phylum that added segmentation	-----	-----	-----

Animal Phyla Lab—Answer Key for Teachers

<p>Porifera (5 cards) H3 No symmetry or consistent body shape C2 Water flows through its body, full of canals H1 Spicules act as a skeleton to give it structure G2 No locomotion; stationary animal A4 Specialized cells, but not organized into organs or tissues</p>	<p>Cnidaria (6 cards) D4 First muscle and nerves C5 Some have stinging structures (nematocysts) F4 Some free-drifting medusae F3 Some non-swimming polyps B1 Hollow body cavity for food E3 Digestive tract with the entrance being the exit</p>	<p>Platyhelminthes (5 cards) E2 Some of the simplest animals with bilateral symmetry G3 Tubular mouth (pharynx) at mid-body B2 Three tissue layers, but no body cavity E3 Digestive tract with the entrance being the exit C1 Most members are parasitic</p>	<p>Annelida (5 cards) A1 Bilateral phylum that added segmentation B5 Complete digestive tract with two ends B3 Fluid-filled compartments used for locomotion H5 Their active burrowing has affected global climate D2 Body design basically a tube within a tube</p>
<p>Arthropoda (7 cards) E5 Champions of variations in appendages H4 Exoskeleton (outside skeleton) made of chitin and protein C4 First phylum to venture into the air C3 Pioneered jointed legs F1 More species than any other phylum B5 Complete digestive tract with two ends A1 Bilateral phylum that added segmentation</p>	<p>Mollusca (6 cards) H2 Feeding device like a toothed, rasping tongue (radula) A2 Most have a calcium-carbonate shell G1 Muscular "foot" used to slide, dig or jump F5 Some propel, using their siphon as a water jet A5 Mantle of tissue covering the body B5 Complete digestive tract with two ends</p>	<p>Echinodermata (6 cards) A3 Five-part radial symmetry D3 Tube feet used for locomotion F2 Some spines are little pincers (pedicellaria) G5 Hard but flexible bodies with interlocking plates under their skin E1 All members live in the ocean B5 Complete digestive tract with two ends</p>	<p>Chordata (7 cards) E4 All have notochord; most have backbone D1 Increased complexity made possible by much more DNA D5 Most have inside skeleton of bones G4 Phylum to which humans belong B4 Jaws and skulls important in their evolution B5 Complete digestive tract with two ends A1 Bilateral phylum that added segmentation</p>

Name _____ Date _____

Class Period _____

Animal Phyla Lab—Answer Sheet for Students

Porifera (5 cards)	Cnidaria (6 cards)	Platyhelminthes (5 cards)	Annelida (5 cards)
Arthropoda (7 cards)	Mollusca (6 cards)	Echinodermata (6 cards)	Chordata (7 cards)