The Kingdom Animalia is divided into two groups: invertebrates and vertebrates, with 98% of all animals being invertebrates. Animals share common characteristics such as being multicellular eukaryotes, heterotrophic, and lacking cell walls. The body plan and symmetry of animals vary, with some having radial symmetry and others having bilateral symmetry. Different types of animal tissue include epithelial, nervous, muscle, and connective tissue. The Phylum Chordata is divided into subphyla, including Tunicata, Cephalochordata, and Vertebrata. Vertebrates have a body cavity that holds the body systems, with organs made of four types of tissue. Classes of vertebrates include Agnatha, Osteichthyes, Chondrichthyes, Amphibia, Reptilia, Aves, and Mammalia, which are diverse in morphology and habitat.

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| **Main Ideas** | **Notes** |
| Animal Diversity |  |
| Kingdom Animalia | - Kingdom Animalia is divided into two main groups: - Invertebrates - Vertebrates - Invertebrates - An animal without a backbone. - About 98% of all animals are invertebrates. |
| Kingdom Animalia | - Vertebrates - Only 2% of animals are vertebrates which fall into the Phylum Chordata. This means they have a backbone or notochord (a flexible rod of nervous tissue). |
| Characteristics of Animals | - All animals share the following characteristics: - They are heterotrophic. - They are multicellular eukaryotes. - They lack cell walls. - Most animals: - Are motile. - Have differentiated tissues. - Reproduce sexually with the diploid stage dominating the life cycle. |
| Typical Animal Life Cycle |  |
| Body Plan and Symmetry | - The arrangement of an animal’s body parts is called its symmetry. - Animals that do not have an orderly body plan are called asymmetrical. - Radial symmetry means that the body parts are arranged in a circle around a central point. - In bilateral symmetry, the body consists of two similar halves. |
| Body Plan | - The gut is the digestive tract. - It enables an animal to digest food outside of its cells. - In animals without a gut, food is digested inside of their cells. - Complex animals also have a body cavity that holds the gut and other organs. |
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| Phylum Porifera | - These ‘pore bearing’ organisms are commonly known as sponges. - They are typically asymmetrical and lack tissues or a body cavity. - Adult sponges are sessile but their larvae are motile. - Sponges are diverse in shape but all possess a canal system through which water is pumped. Nutrients can then diffuse into the sponge cells. |
| Phylum Cnidaria | - This phylum includes jellyfish, sea anemones, coral, and hydra. - They have radial symmetry and no body cavity. They can be sessile or motile. - Cnidarians have differentiated cells that are organized into two layers of tissues and nerves that form a network. - Most cnidarians have cnidocytes, specialized stinging cells to capture food or defend themselves. |
| Worms! | - Flatworms - Flatworms (planarians) belong to the Phylum Platyhelminthes and are the simplest animals having bilateral symmetry. - The have a sac-like gut but no body cavity. They secrete digestive enzymes onto their food and suck it into their gut. - Roundworms  - Roundworms belong to the Phylum Nemotoda and  - are the simplest animals with a complete gut that  - runs from mouth to anus. - Segmented Worms - Segmented worms (earthworms) belong to the Phylum Annelida and have bodies divided into individual segments. - They all show bilateral symmetry and have a true  - body cavity. |
| Phylum Mollusca | - Snails, clams, and squids are all members of this phylum. - Mollusks have bilateral symmetry and a true body cavity. - The body of a mollusk typically has a foot, gut, mantle, and shell. - Their nervous systems can range from very simple (clam) to complex (octopus). |
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| Phylum Arthropoda | - This phylum includes insects, spiders, and crustaceans.  - Arthropods have segmented bodies, jointed limbs, an exoskeleton, and well-developed organ systems. - Like annelids, arthropod bodies are segmented. They have a head, thorax, and abdomen. |
| Phylum Echinodermata | - The echinoderms include starfish, sea urchins, and sea cucumbers. - They have radial symmetry, a body cavity, an internal skeleton and spiny skin. - Echinoderms possess a water vascular system that drives respiration, circulation, and movement. |
| The Water Vascular System |  |
| Animalia Phylogenetic Tree |  |
| Protostomes vs Deuterostomes |  |
| Phylum Chordata | - All chordates have a notochord.  - There are three subphyla: - Tunicata – includes salps and sea squirts - Cephalochordata – includes lancelets - Vertebrata – includes fish, amphibians, reptiles, birds, and mammals |
| Phylum Chordata |  |
| Subphylum Vertebrata | - All vertebrates have a body cavity that holds the body systems. - The thoracic cavity that holds the heart and lungs. - The abdominal cavity that holds the digestive, excretory, and reproductive organs. - Vertebrate organs are made of four types of tissue: - Epithelial - Nervous - Muscle - Connective |
| Types of Animal Tissue |  |
| Class Agnatha, Osteichthyes, and Chondrichthyes | - Class Agnatha are the jawless fish. Only two groups still exist today, the lampreys and the hagfish. - 2 chambered hearts - External fertilization and development |
| Class Agnatha, Osteichthyes, and Chondrichthyes | - Class Chondrichthyes are the cartilaginous fish. Members include sharks, rays, skates, sawfish, and chimaeras.  - 2 chambered hearts - External fertilization (internal for sharks) and development |
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| Class Agnatha, Osteichthyes, and Chondrichthyes | - Class Osteichthyes are the bony fish. They comprise the largest class of vertebrates. - All fish are ectothermic organisms with fins, gills, and two-chambered hearts. Most are oviparous (lay eggs).  - They were the first vertebrates and first appeared about 500 million years ago. |
| Class Amphibia | - The surviving amphibians include frogs, toads, and salamanders. - Most amphibians are ectothermic, (mostly) tetrapod (4 limbs), oviparous (egg laying) organisms with three-chambered hearts. They inhabit a wide range of habitats. They can be aquatic, terrestrial, or arboreal. - Amphibians display a characteristic life cycle. |
| Amphibian Life Cycle |  |
| Class Reptilia | - Reptiles include turtles, crocodilians, snakes, and lizards. - Reptiles are ectothermic, (mostly) tetrapod, (mostly) oviparous organisms. They generally have three-chambered hearts. They differ from amphibians in their physical characteristics, life cycle, and the role of water in their niches. |
| Class Aves | - Birds are endothermic, oviparous organisms with a four-chambered heart. They are the largest class of tetrapods. - Birds are also classified by the presence of feathers, beaks, unique skeletal adaptations, and a specialized breathing system. |
| Avian Breathing System |  |
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| Class Mammalia | - Mammals are endothermic, tetrapod, (mostly) viviparous organisms (live young) with four-chambered hearts, hair/fur, and mammary glands. - The earliest mammals appeared about 200 million years ago. - Oviparous mammals include the echidna and the platypus. - The viviparous mammals can be loosely categorized as placental or marsupial.  - Mammals are very diverse in their morphology and their habitats. |
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