

Zoology I and II

Zoology I - Invertebrates

1 Evolution Z00.1

Conceptual Understanding: Evolution results from the interaction of four factors: (1) the potential for a species to increase in number, (2) genetic variation occurring within a species due to mutations and sexual reproduction, (3) limited supply of resources needed for survival resulting in competition, and (4) organisms that are better adapted for an environment survive and reproduce. Genetic information provides evidence of evolution. DNA sequences vary among species, but some similarities remain. By comparing the DNA sequences of different organisms, multiple lines of descent may be inferred. The ongoing branching into multiple lines of descent may also be derived by comparing the amino acid sequences and by examining the anatomical and embryological evidence.

A Students will develop a model of evolutionary change over time. Z00.1A

- 1 Develop and use dichotomous keys to distinguish animals from protists, plants, and fungi. Z00.1A.1
- 2 Describe how fossil records document the history of life on Earth. Z00.1A.2
- 3 Recognize that the classification of living organisms is based on their evolutionary history and/or similarities in fossils and living organisms. Z00.1A.3
- 4 Construct cladograms or phylogenetic trees to show the evolutionary branches of an ancestral species and its descendants. Z00.1A.4
- 5 Design models to illustrate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations. Z00.1A.5
- 6 Enrichment: Use an engineering design process to develop an artificial habitat to meet the requirements of a population that has been impacted by human activity. * Z00.1A.6

2 Phyla Porifera and Cnidaria Z00.2

Conceptual Understanding: Phyla Porifera and Cnidaria are two of the most primitive of animal phyla. They distinguish themselves from other metazoans by their lack of bilateral symmetry. Each phylum has its own anatomy, physiology, and unique role in aquatic ecosystems.

- A** Students will understand the structure and function of phylum Porifera and phylum Cnidaria and how each adapts to their environments. **Z00.2A**
- 1** Differentiate among asymmetry, radial symmetry, and bilateral symmetry in an animal's body plan. **Z00.2A.1**
 - 2** Identify the anatomy and physiology of a sponge, including how specialized cells within sponges work cooperatively without forming tissues to capture and digest food. **Z00.2A.2**
 - 3** Describe the importance of phylum Porifera in aquatic habitats. **Z00.2A.3**
 - 4** Create a model, either physical or digital, illustrating the anatomy of a sponge, tracing the flow of water. **Z00.2A.4**
 - 5** Enrichment: Use an engineering design process to determine the quantity of water that may be absorbed per unit in a natural sponge versus a synthetic sponge. * **Z00.2A.5**
 - 6** Contrast the polyp lifestyle of most Cnidarians with the medusa lifestyle of jellyfish, including how they both utilize a single body opening. **Z00.2A.6**
 - 7** Describe how nematocysts (stinging cells) of Cnidarians are used for capturing food and for defense. **Z00.2A.7**
 - 8** Enrichment: Utilize an engineering design process to create a simulated nematocyst, including possible biomimicry use. * **Z00.2A.8**
 - 9** Describe the ecological importance of and human impacts on coral reefs. **Z00.2A.9**
 - 10** Create a digital or physical model illustrating the anatomy of a cnidarian, citing similarities and differences between polyps and medusas. **Z00.2A.10**

3 Phylum Mollusca **Z00.3**

Conceptual Understanding: Phylum Mollusca is one of the most diverse phyla on Earth, occupying almost every type of ecosystem. Despite their diversity, mollusks share a basic body plan and are well adapted to their niches within their environments.

- A** Students will understand the structure and function of phylum Mollusca, and how they adapt to their environments. **Z00.3A**
- 1** Considering the diversity of mollusks, explain how they all share a common body plan (i.e., mantle, visceral mass, and foot). **Z00.3A.1**
 - 2** Describe why mollusks are classified as eucoelomates. **Z00.3A.2**
 - 3** Explain how the mantle is used in forming the shell. **Z00.3A.3**
 - 4** Describe how the radula is used in feeding. **Z00.3A.4**
 - 5** Develop a dichotomous key to contrast characteristics of gastropods, bivalves, and cephalopods. **Z00.3A.5**
 - 6** Examine how the unique characteristics of cephalopods lead to survival. **Z00.3A.6**
 - 7** Create a model comparing the anatomy of gastropods, bivalves, and cephalopods. **Z00.3A.7**
 - 8** Enrichment: Use an engineering design process to model the jet propulsion utilized by cephalopods in mechanical design of fluid systems (e.g., improving hydraulic systems). * **Z00.3A.8**

4 Phyla Platyhelminthes, Nematoda, and Annelida **Z00.4**

Conceptual Understanding: Although the term “worms” may refer to an organism with a long, slender, soft body with bilateral symmetry, worms may be subdivided into phyla based on their unique body plan. These include phyla Platyhelminthes, Nematoda, and Annelida.

A Students will describe the evolution of structure and function of phylum Platyhelminthes, phylum Nematoda, and phylum Annelida. **Z00.4A**

- 1** Define and describe the closed circulatory system of an annelid. **Z00.4A.1**
- 2** Differentiate between parasitic and free living. **Z00.4A.2**
- 3** Compare and contrast the characteristics and lifestyles of flatworms, roundworms, and segmented worms. **Z00.4A.3**
- 4** Create a model comparing acoelomate, pseudocoelomate, and eucoelomate body plans of Platyhelminthes, Nematoda, and Annelida. **Z00.4A.4**
- 5** Describe the evolutionary importance of the segmented body plans of annelids. **Z00.4A.5**
- 6** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.4A.6**
- 7** Enrichment: Design, conduct, and communicate results of an experiment demonstrating the importance of flatworms, roundworms, and annelids for human use (e.g., the earthworm in agriculture and the leech in medicine). **Z00.4A.7**
- 8** Enrichment: Use an engineering design process to design and construct a system to utilize flatworms, roundworms, or annelids to meet a human need.
* **Z00.4A.8**

5 Phylum Arthropoda **Z00.5**

Conceptual Understanding: Arthropods are the most successful of animal phyla, inhabiting land, sea, and air. Despite their differences, all arthropods share some characteristics enabling them to be united as one phylum.

A Students will understand the basic structure and function of phylum Arthropoda, and how they demonstrate the characteristics of living things. **Z00.5A**

- 1** Describe the evolutionary advantages of segmented bodies, hard exoskeletons, and jointed appendages to arthropods and how they contribute to arthropods being the largest phyla in species diversity and the most geographically diverse. **Z00.5A.1**
- 2** Explain how exoskeletons are used in locomotion, protection, and development. **Z00.5A.2**
- 3** Enrichment: Use an engineering design process to develop a biomimicry of an arthropod's exoskeleton to meet a human need. * **Z00.5A.3**
- 4** Identify organisms and characteristics of chelicerates, crustaceans, and insects. **Z00.5A.4**
- 5** Describe the importance of toxins for arachnids, (i.e., spiders and scorpions). **Z00.5A.5**
- 6** Describe the importance of chela for decapods, (i.e., lobsters and crabs). **Z00.5A.6**
- 7** Differentiate between complete and incomplete metamorphosis in insects' life cycles. **Z00.5A.7**
- 8** Explain the importance of eusociality in insects, such as ants, bees, and termites. **Z00.5A.8**
- 9** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.5A.9**

6 Phylum Echinodermata **Z00.6**

Conceptual Understanding: Phylum Echinodermata contains complex organisms exhibiting pentaradial symmetry and a sophisticated water vascular system.

- A** Students will understand the structure and function of phylum Echinodermata, and how they demonstrate the characteristics of living things. **Z00.6A**
- 1** Recognize that the echinoderms have spines on their skin that are extensions of plates that form from the endoskeleton. **Z00.6A.1**
 - 2** Explain how the starfish inverts its stomach for external digestion of food. **Z00.6A.2**
 - 3** Describe sea urchins' and sea cucumbers' defense structures and behaviors. **Z00.6A.3**
 - 4** Describe the sexual and asexual reproduction of starfish. **Z00.6A.4**
 - 5** Describe how the water vascular system is used for locomotion, feeding, and gas exchange. **Z00.6A.5**
 - 6** Research, analyze, and communicate implications of applying the regeneration of starfish to human medicine. **Z00.6A.6**
 - 7** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.6A.7**
 - 8** Enrichment: Use an engineering design process to model the water vascular system in hydraulic systems to meet a societal need. * **Z00.6A.8**
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- 3** Recognize that the classification of living organisms is based on their evolutionary history and/or similarities in fossils and living organisms. **Z00.1A.3**
- 4** Construct cladograms or phylogenetic trees to show the evolutionary branches of an ancestral species and its descendants. **Z00.1A.4**
- 5** Design models to illustrate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations. **Z00.1A.5**

7 Phylum Chordata, Classes Chondrichthyes and Osteichthyes **Z00.7**

Conceptual Understanding: Of the members of phylum Chordata, fish species are most numerous. These aquatic vertebrates have gills throughout their lives and either have or are descended from ancestors with scales or armor.

A Students will understand the structure and function of phylum Chordata, classes Chondrichthyes and Osteichthyes, and how they demonstrate the characteristics of living things. **Z00.7A**

- 1** Students will understand why evolutionary changes lead to the diversity of fish and how they have adapted to the different aquatic environments. **Z00.7A.1**
- 2** Compare and contrast the characteristics of class Chondrichthyes and Osteichthyes. **Z00.7A.2**
- 3** Identify specific fish species and characteristics that differentiate class Chondrichthyes (e.g., sharks, skates, and rays). **Z00.7A.3**
- 4** Describe how the body and jaw design of sharks make them adept predators. **Z00.7A.4**
- 5** Label and describe functions of the anatomical features of bony fish, including internal organs, lateral line system, operculum, swim bladder, and external fins. **Z00.7A.5**
- 6** Research, analyze, and communicate the effects of urbanization and continued expansion by humans on the biodiversity of fish species (e.g., overfishing, and invasive species). **Z00.7A.6**
- 7** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.7A.7**
- 8** Enrichment: Use an engineering design process to design a “balloon fish” that has neutral buoyancy (i.e., does not sink or float). Report which materials were used to create the “fish,” and predict which materials should be added to make the “fish” sink and which materials would make the “fish” float. * **Z00.7A.8**

8 Phylum Chordata, Classes Amphibia, and Reptilia **Z00.8**

Conceptual understanding: The two groups of ectothermic tetrapods—amphibians and reptiles—are similar in appearance but differ drastically in development and body structure.

A Students will understand the structure and function of phylum Chordata, classes Amphibia and Reptilia, and how they demonstrate the characteristics of living things. **Z00.8A**

- 1** Understand the evolution of tetrapods and the development of the structure and function of body systems and life cycles. **Z00.8A.1**
- 2** Describe the constraints that require amphibians to spend part of their lives in water and part on land, including the morphological and physiological changes as they pass from one stage of their life cycle to the next. **Z00.8A.2**
- 3** Describe adaptations that have led to reptiles living on land successfully. **Z00.8A.3**
- 4** Define what it means to be ectothermic and identify ways in which reptiles regulate their body temperature. **Z00.8A.4**
- 5** Describe how snakes use chemosensory to locate and track prey. **Z00.8A.5**
- 6** Enrichment: Use an engineering design process to model biomimicry of ectothermic temperature regulation or chemosensory detection to meet a societal need. * **Z00.8A.6**
- 7** Compare and contrast living and extinct reptiles. **Z00.8A.7**
- 8** Explain the importance of tetrapod evolution. **Z00.8A.8**
- 9** Identify the amniotic egg as the major derived characteristic of reptiles. **Z00.8A.9**
- 10** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.8A.10**

9 Phylum Chordata, Class Aves **Z00.9**

Conceptual understanding: Class Aves, including birds, are endothermic, egg-laying vertebrates with bodies covered in feathers. Although they are descendants of dinosaurs, they have evolved a unique physiology, making most capable of flight.

- A** Students will understand the structure and function of phylum Chordata, class Aves, and how they demonstrate the characteristics of living things. **Z00.9A**
- 1** Trace the evolutionary history of modern birds beginning with the theropods. Relate how today's birds have adapted to changing environments. **Z00.9A.1**
 - 2** Describe the fossil evidence that indicates that birds evolved from two-legged dinosaurs called theropods. **Z00.9A.2**
 - 3** Define the term endothermic and describe how birds regulate body temperature in extreme environments. **Z00.9A.3**
 - 4** Enrichment: Use an engineering design process to model biomimicry of endothermic temperature regulation to meet a sustainable need. * **Z00.9A.4**
 - 5** Explain how birds of prey use their keen sense of sight to locate and attack prey. **Z00.9A.5**
 - 6** Describe how corvids use their intellect for problem solving and locating food storage. **Z00.9A.6**
 - 7** Explain the importance of the evolution of flight and feathers, including the morphological and physiological adaptations needed to sustain flight. **Z00.9A.7**
 - 8** Enrichment: Use an engineering design process to utilize a bird's flight adaptations in the development of a flying aircraft (e.g., glider, plane). * **Z00.9A.8**
 - 9** Demonstrate how different adaptations of the bird beak and feet allow them to feed and survive in different environments. **Z00.9A.9**
 - 10** Enrichment: Based on an understanding of biomimicry, use an engineering design process to develop a tool based on a bird's beak/feet to meet a human need. * **Z00.9A.10**
 - 11** Describe the parenting behavior used by different birds to incubate their eggs and care for hatchlings. **Z00.9A.11**
 - 12** Enrichment: Use an engineering design process to design and construct an incubator for hatching abandoned eggs. * **Z00.9A.12**
 - 13** Explain the reasons for bird migration and the innate behavior of migratory birds. **Z00.9A.13**
 - 14** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.9A.14**

10 Phylum Chordata, Class Mammalia **Z00.10**

Conceptual Understanding: Class Mammalia consists of endothermic organisms with hair, a four-chambered heart, a diaphragm, and mammary glands. As inhabitants of every continent, they are successful in a variety of ecosystems.

A Students will understand the structure and function of phylum Chordata, class Mammalia, and how they demonstrate the characteristics of living things. **Z00.10A**

- 1** Understand the characteristics and behaviors that distinguish mammals from other phyla and use characteristics and behaviors to distinguish the major orders, including primates. Explain how human impact has changed the environments of other organisms. **Z00.10A.1**
- 2** Describe the characteristics of the first true mammal. **Z00.10A.2**
- 3** Distinguish between monotremes, marsupials, and eutherians, and describe the importance and differences in the placenta in marsupials and eutherians. **Z00.10A.3**
- 4** Describe characteristics that make primates unique, including investigating how the center of gravity relates to the evolution of bipedalism. **Z00.10A.4**
- 5** Dissect representative taxa and compare their internal and external anatomy and complexity. **Z00.10A.5**
- 6** Explain how human impacts have changed the environment of aquatic and terrestrial organisms (e.g., habitat destruction, urbanization, and climate change). **Z00.10A.6**
- 7** Enrichment: Use an engineering design process to develop a possible solution to an environmental issue that currently exists in an ecosystem.
* **Z00.10A.7**