UNIT 5

PROKARYOTES

16.1 Prokaryotes have inhabited Earth for billions of years

Prokaryotes

Remain the most numerous and widespread organisms today

Survive in environments too extreme for _____________________________

Despite being small, prokaryotes have an immense impact on life

Cause serious _________________________

Have beneficial __________________________ with other organisms

Are essential in the ___________________________ of dead organisms

16.2 Bacteria and archaea are the two main branches of prokaryotic evolution

Domains Bacteria and Archaea

Probably evolved from a ____________________________

Differ in

Peptidoglycan present in bacteria but not ____________________________

Archaea are more like ___________________________ than like bacteria

16.8 Some bacteria cause disease

Pathogenic bacteria cause about half of human disease, mostly by producing poisons

______________________________

Secreted by cells

Produce some of the most ____________________________ known

Harmless bacteria can also develop ____________________________ strains

Components of the outer membrane of gram-negative bacteria

All induce fever, aches, sometimes shock

Sanitation, antibiotics, and education have greatly reduced the incidence of bacterial disease

16.9 Bacteria can be used as biological weapons

16.10 Prokaryotes help recycle chemicals and clean up the environment

Prokaryotes are indispensable components of chemical cycles

Contribute to ____________________________

Release _______to the atmosphere

Fix ____________________________

Decompose __________________________ and dead organisms to inorganic chemicals
PROTISTS
16.11 The eukaryotic cell probably originated as a community of prokaryotes
   Eukaryotic cells evolved from prokaryotic cells more than 2 billion years ago
   Endosymbiotic theory

Symbiosis:

Endosymbiosis:

Mitochondria and chloroplasts probably evolved from

Supported by evidence from molecular systematics
16.12 Secondary endosymbiosis is the key to protist diversity

16.13 A tentative phylogeny of eukaryotes includes multiple clades of protists
   The taxonomy of protists remains a work in progress
   The names, boundaries, and placement of clades will continue to change as
   genomes of more protists are sequenced and compared

PLANT, FUNGI, AND THE COLONIZATION OF LAND
PLANT EVOLUTION AND DIVERSITY
17.1 Plants have adaptations for life on land
   Green algae called charophytes are the

   Unique characteristics of algae
     The whole organism performs _______________________
     Algae absorbs all water, CO2 and minerals from _______________________
   What about land plants?
   Challenges of terrestrial life

Why move onto land?

Adaptations
   Maintaining moisture

   Obtaining resources
Supporting the Plant Body

Reproduction and Dispersal

17.2 Plant diversity reflects the evolutionary history of the plant kingdom
Four key adaptations for life on land distinguish the main lineages of the plant kingdom

____________________ are considered your nonvascular plants and the most primitive

_______________________________ are the first of two groups of vascular plants

_______________________________ are broken into 2 groups

Gymnoperms

Angiosperms

17.8 The flower is the centerpiece of angiosperm reproduction
Flowers contain separate male and female ____________________ and ____________________
Flowers usually consist of sepals, petals, stamens (which produce pollen), and carpels (which produce eggs)

Sepals

Petals

Male reproductive structures

Female reproductive structures
THE EVOLUTION OF INVERTEBRATE DIVERSITY
ANIMAL EVOLUTION AND DIVERSITY

18.1 What is an animal?

Most adult animals are diploid, producing short-lived gametes by meiosis.
The life cycle of most animals includes a blastula, gastrula, and larval stage.

18.2 The ancestor of animals was probably a colonial, flagellated protist.

542 million years ago, an adaptive radiation known as the ____________________
produced a varied and complex animal fauna.
Many animal plans and new phyla appeared in a short time span.

18.3 Animals can be characterized by basic features of their “body plan.”

Body Symmetry
With radial symmetry

Animals with bilateral symmetry

Animal body plans vary in organization of tissues.
Sponges ___________ true tissues.
In other animals, cell layers formed during gastrulation give rise to tissues and organs.
Some animals have only ____________ and ______________, but most animals also have
__________________________
The body cavities of animals vary.
Flatworms have a solid body and lack a ____________________
A ____________________ is partially lined by tissue derived from mesoderm.
A ____________________ is completely lined by tissue derived from mesoderm.

18.4 The body plans of animals can be used to build phylogenetic trees.
A phylogenetic tree is a
INVERTEBRATE DIVERSITY
18.5 Sponges have a relatively simple, porous body
____________________ (phylum Porifera) are simple, sedentary animals without true tissues
Sponges are ____________________, filtering food particles from water passed through food-trapping equipment
Adult sponges are ___________________________ and cannot escape from predators
   They produce defensive toxins and antibiotics that deter pathogens, parasites, and predators
18.6 Cnidarians are radial animals with tentacles and stinging cells
   Cnidarians (phylum Cnidaria) have ___________ tissue layers
   Cnidarians use tentacles to capture prey and push them into their mouths
   __________________________ on tentacles sting prey and function in defense
   Cnidarians have two kinds of radially symmetrical body forms ___________ and ___________
   Some cnidarians have alternating polyp and medusa forms in their life cycle, while others exist only as polyp or medusa forms
18.7 Flatworms are the simplest bilateral animals
   Flatworms (phylum Platyhelminthes)

   There are three major groups of flatworms
   __________________________ (planarians)
   Flukes and tapeworms are parasitic flatworms with complex life cycles
   Flukes live as ____________________, with suckers to attach to their hosts
   Tapeworms inhabit the digestive tracts of vertebrates
18.8 Nematodes have a pseudocoelom and a complete digestive tract
   __________________________ (phylum Nematoda) have bilateral symmetry and three tissue layers
   They are abundant and diverse, with an estimated 500,000 species
   The body cavity is a ___________________________ (only one)
   The 1st to have a ___________________________
   Humans host at least 50 species of nematodes
18.9 Diverse molluscs are variations on a common body plan
   Molluscs (phylum Mollusca) have a true coelom and a circulatory system
   Four unique characteristics found only in molluscs

   Three major groups of molluscs
   __________________________ are the largest group of molluscs and include the snails and slugs
   __________________________ have shells divided into two halves that are hinged together
   Most bivalves are sedentary suspension feeders, attached to the substrate by strong threads
Cephalopods are fast, agile predators and include squids and octopuses.

Cephalopods have large brains and sophisticated sense organs, including complex image-focusing eyes.

In most cephalopods, the shell is small and internal (squid) or missing (octopuses).

18.10 Annelids are segmented worms

Annelids (phylum Annelida) have a closed circulatory system in which blood is enclosed in vessels.

The true coelom functions as hydrostatic skeleton.

Three major groups of annelids:

Ingest soil and extract nutrients, aerating soil and improving its texture.

Are the largest group of annelids.

Each polychaete segment has a pair of fleshy appendages with stiff bristles or chaetae.

Are free-living carnivores, but some suck blood.

Blood-sucking leeches use razor-like jaws, secrete an anesthetic and an anticoagulant, and suck up to 10 times their own weight in blood.

18.11 Arthropods are segmented animals with jointed appendages and an exoskeleton

There are over a million species of arthropods (phylum Arthropoda) such as crayfish, lobsters, crabs, barnacles, spiders, ticks, and insects.

The diversity and success of arthropods are due to segmentation, a hard exoskeleton, and jointed appendages.

Arthropods have an open circulatory system.

The body of most arthropods includes a head, thorax, and abdomen.

Major groups of Arthropods:

Include horseshoe crabs and arachnids, such as spiders, scorpions, mites, and ticks.

Most are terrestrial.

Millipedes and centipedes are identified by the number of jointed legs per body segment:

2 in herbivorous millipedes, 1 in carnivorous centipedes.

Are nearly all aquatic.

They include crabs, shrimps, and barnacles, which feed with jointed appendages.

Are the last example.

18.12 Insects are the most successful group of animals.

70% of all animal species are insects.

There may be as many as 30 million insect species.

The body of an insect includes a head, thorax, and abdomen; three sets of legs; and (in most insects) wings.

The success of insects is due to:

Body segmentation, An exoskeleton, Jointed appendages, Flight, A waterproof cuticle, A complex life cycle with short generations and large numbers of offspring.

Protective color patterns.

Many insects have protective color patterns and disguises, including modifications to antennae, wings, and bodies.
18.13 Echinoderms have spiny skin, an endoskeleton, and a water vascular system for movement (phylum Echinodermata) include slow-moving or sessile radially symmetrical organisms such as sea stars and sea urchins.

The _____________________________ has water-filled canals branching into tube feet, which is used for respiration, feeding, and locomotion.

Echinoderms have an _____________________ of hard calcareous plates under a thin skin.

Echinoderms and chordates belong to a clade of bilateral animals called ____________________.

18.14 Our own phylum, Chordata, is distinguished by four features:

**Chordates** (phylum Chordata) have

Chordates are split into three groups:
- Two are considered _________________ and the third group are known as the ____________

The chordate invertebrates
- The simplest chordates are **tunicates** and **lancelets**, which use their pharyngeal slits for suspension feeding.

**THE EVOLUTION OF VERTEBRATE DIVERSITY**

**VERTEBRATE EVOLUTION AND DIVERSITY**

19.1 Derived characters define the major clades of chordates:
- A phylogenetic tree for chordates is based on a sequence of ____________________________.

19.2 Hagfishes and lampreys lack hinged jaws:
- Hagfishes and lampreys are craniates but lack hinged jaws and paired fins (jawless fishes).
  - In hagfishes, the notochord is the body’s main support in the adult.
  - Lampreys have a supportive notochord but also have rudimentary vertebral structures, making them vertebrates.

Hagfishes (class ___________________________) are deep-sea scavengers that produce slime as an antipredator defense.

Lampreys (Class _______________________________) are parasites that penetrate the sides of fishes with their rasping tongues.

19.3 Jawed vertebrates with gills and paired fins include sharks, ray-finned fishes, and lobe-finned fishes.

- Novel vertebrate features arose 470 million years ago:
  - Paired fins, tail, and Hinged jaws

Where did jaws come from?
- They arose as modifications of skeletal supports of the anterior pharyngeal gill slits (originally used for trapping suspended food particles).
- The remaining gill slits remained as sites of gas exchange.
There are three lineages of jawed fishes

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Sharks and rays have a flexible skeleton made of cartilage
Electrosensors on their heads and a lateral line system aid them in locating prey
Most rays are adapted for life on the bottom, with dorsoventrally flattened bodies and
eyes on the top of their heads

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Lobe-fins have muscular pelvic and pectoral fins, supported by rod-shaped bones
Three lineages of lobe-fins survive
Coelacanths, Lungfishes, Tetrapods
19.4 New fossil discoveries are filling in the gaps of tetrapod evolution
During the late Devonian, a line of lobe-fin fishes gave rise to

19.5 Amphibians are tetrapods—vertebrates with two pairs of limbs
**Amphibians** (Class Amphibia)

This group includes frogs, salamanders, and caecilians
Salamanders walk on land with a side-to-side bending
Frogs hop with powerful hind legs
Caecilians are blind and legless, burrowing in moist tropical soil

19.6 Reptiles are amniotes—tetrapods with a terrestrially adapted egg

**Reptiles** (Class ___________) (including birds) and mammals are amniotes
The major derived character of this clade is an amniotic egg with an amnion, a private
pond in which the embryo develops
Amniotic reptiles include lizards, snakes, turtles, crocodilians, and birds
Terrestrial adaptations of reptiles include scales

Nonbird reptiles are ________________________, but regulate their temperature by
basking or seeking shade

19.7 Birds are feathered reptiles with adaptations for flight

**Birds** (Class Aves) evolved from a lineage of small, two-legged dinosaurs called ___________
*Archaeopteryx* is the oldest bird (150 million years old), with feathered wings
It resembled a small bipedal dinosaur, with teeth, wing claws, and a long tail with many
vertebrae
Birds are reptiles with feathered wings, _________________ metabolism, and a number
of adaptations for flight
Flight is very costly, and birds are ___________________ with a high rate of metabolism
Birds have relatively large brains and display complex behaviors

19.8 Mammals are amniotes that have hair and produce milk

Mammals (Class Mammalia) are endothermic amniotes with ____________, which insulates their bodies, and _________________, which produce milk

Mammalian generally have larger relative brain size than other vertebrates and a relatively long period of parental care

The first true mammals arose 200 million years ago as small, nocturnal insectivores

Marsupials diverged from ______________ (placental mammals) 180 million years ago
They underwent an adaptive radiation following the Cretaceous extinction, giving rise to large terrestrial carnivores and herbivores, bats, and aquatic whales and porpoises

__________________________________________ are egg-laying mammals

Living monotremes include the duck-billed platypus

Unlike monotremes, the embryos of marsupials and eutherians are nurtured by a __________ within the uterus

The placenta allows nutrients from the mother’s blood to diffuse into the embryo’s blood
________________________________________ have a brief gestation

They give birth to tiny, embryonic offspring
The offspring complete development attached to the mother’s nipples, usually inside a pouch or _________________

______________________________ bear fully developed live young

They are commonly called placental mammals, because their placentas are more complex than those of marsupials

UNIFYING CONCEPTS OF ANIMAL STRUCTURE AND FUNCTION
THE HIERARCHY OF STRUCTURAL ORGANIZATION IN AN ANIMAL
20.1 Structure fits function at all levels of organization in the animal body
20.3 Tissues are groups of cells with a common structure and function
20.4 Epithelial tissue covers the body and lines its organs and cavities
Epithelial cells come in three shapes

________________________________—like a fried egg
________________________________—as tall as they are wide
________________________________—taller than they are wide

20.5 Connective tissue binds and supports other tissues

________________________ can be grouped into six major types

20.6 Muscle tissue functions in movement

______________ muscle causes voluntary movements
______________ muscle pumps blood
______________ muscle moves walls of internal organs, such as the intestines
20.7 Nervous tissue forms a communication network

20.8 Organs are made up of tissues
Each tissue performs _____________________________________________
The heart has epithelial, connective, and nervous tissues
   Epithelia line the heart chambers
   Connective tissues make the heart elastic
   Neurons regulate contractions

20.10 Organ systems work together to perform life’s functions
An organ system usually consists of many _________________________
Each organ system has one or more functions
   ____________________________ system controls body functions
   ____________________________ systems support and move the body
   ____________________________ system transports the food and oxygen
   ____________________________ system absorbs oxygen and releases carbon
dioxide
   ____________________________ system covers and protects the body
   ____________________________ systems protect the body from infection and
cancer
   ____________________________ system disposes of certain wastes
   ____________________________ system absorbs food
   ____________________________ system perpetuates the species
   ____________________________ system controls body functions