

Honors Biology – Unit 3 – Chapter 15a

“TRACING EVOLUTIONARY HISTORY – PHYLOGENY AND THE TREE OF LIFE”

1. binomial nomenclature: *Genus species*
2. levels of taxonomy:
 - Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species
 - Dumb King Philip Came Over For Good Spaghetti
3. evolution of the various domains and kingdoms
4. invertebrate evolution
5. vertebrate evolution
6. phylogenetic trees / dichotomous keys

Honors Biology – Chapter 15a Word Roots

“TRACING EVOLUTIONARY HISTORY – PHYLOGENY AND THE TREE OF LIFE”

amphi- = both; **-bio** = life (*amphibian*: a type of vertebrate that inhabits both aquatic and terrestrial habitats)

analog- = proportion (*analogy*: a similarity between two species that is due to convergent evolution rather than to descent from a common ancestor with the same trait)

anthro- = human; **-oid** = likeness (*anthropoid*: a member of the primate group including apes and monkeys, all of which resemble humans in certain characteristics)

arachn- = spider (*arachnid*: a member of the arthropod group that includes scorpions, spiders, ticks, and mites)

arthro- = jointed; **-pod** = foot (*arthropod*: segmented coelomates with exoskeletons and jointed appendages)

austral- = southern; **-pithekos** = ape (*australopith*: one of the first hominids; scavenger-gatherer-hunters who lived on African savannas between about 4.4 million years ago and 1.5 million years ago)

bi- = two; **nom-** = name (*binomial*: a two-part Latinized name of a species)

bi- = two (*bivalve*: a member of the group of molluscs with two paired shells, including clams, mussels, scallops, and oysters); **later-** = side (*bilateral symmetry*: an arrangement of body parts such that an organism has mirror-image right and left sides; *bilaterian*: the branch of eumetazoans possessing bilateral symmetry)

blast- = bud, sprout (*blastula*: a hollow ball of cells that forms the early embryo in animal development)

cephal- = head; **-pod** = foot (*cephalopod*: a member of a group of molluscs, including squids and octopuses, whose body appears to be its head)

cheli- = a claw (*chelicerate*: a group of arthropods, including horseshoe crabs, scorpions, ticks, and spiders, with claw-like feeding appendages)

choano- = a funnel; **-cyte** = cell (*choanocyte*: a flagellated feeding cell with a collar-like ring for trapping food particles found in sponges)

chondr- = cartilaginous; **-ichthy** = fish (*chondrichthyan*: the group of fish that have cartilaginous skeletons, including sharks and rays)

Honors Biology – Chapter 15a Word Roots

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chord- = a string (*chordates*: the group of organisms that possess a notochord and other characteristics at some point in their lives)

clado- = branch (*clade*: a group of species that includes an ancestral species and all its descendants; *cladistics*: an approach to systematics in which common descent is the primary criterion used to classify organisms by placing them into groups called clades)

cnido- = a nettle (*cnidarian*: a phylum of invertebrates named for stinging cells called cnidocytes found in their bodies); **-cyte** = cell (*cnidocytes*: unique cells that function in defense and prey capture in cnidarians)

crani- = the skull (*craniate*: a chordate with a head)

cuti- = the skin (*cuticle*: the exoskeleton of an arthropod)

deutero- = second (*deuterostome*: one of two lines of coelomates characterized by radial, indeterminate cleavage, formation of the coelom from outpockets of mesoderm, and development of the anus from the blastopore)

echino- = spiny; **-derm** = skin (*echinoderm*: sessile or slow-moving animals with a thin skin that covers an exoskeleton; the group includes sea stars, sea urchins, brittle stars, crinoids, sea cucumbers, and sea daisies)

ecto- = outside; **-derm** = skin (*ectoderm*: the outermost of the three primary germ layers in animal embryos)

ecto- = outside; **-therm** = heat (*ectotherm*: an animal that warms itself mainly by absorbing heat from its surroundings)

endo- = within (*endoderm*: the innermost of the three primary germ layers in animal embryos; *endoskeleton*: a hard skeleton located within the soft tissues of an animal)

endo- = inner; **-therm** = heat (*endotherm*: an animal that derives most of its body heat from its own metabolism)

eu- = true (*eumetazoan*: a group of organisms that have true tissues)

eu- = good (*eutherian*: one of the mammals whose young complete their embryonic development within the uterus, joined to the mother by the placenta)

exo- = outside (*exoskeleton*: a hard external skeleton that protects an animal and provides points of attachment for muscles)

Honors Biology – Chapter 15a Word Roots

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gastro- = stomach (*gastrula*: the developmental stage in animals that follows the blastula stage); **-vascula** = a little vessel (*gastrovascular cavity*: the central digestive compartment, usually with a single opening that functions as both mouth and anus)

homin- = man (*hominid*: a member of the family Hominidae, which includes *Homo sapiens* and our ancestors); **-oid** = likeness (*hominoid*: a term referring to great apes, including humans)

hydro- = water; **-static** = lack of movement (*hydrostatic skeleton*: a skeletal system composed of fluid held under pressure in a closed body compartment)

in- = into; **-gest** = carried (*ingestion*: the act of eating; the first main stage of food processing)

in- = without (*invertebrate*: an animal that lacks a backbone)

koilos- = a hollow (*coelom*: a true animal body cavity that is completely lined by mesoderm)

later- = side (*lateral line system*: a row of sensory organs along each side of a fish's body that is sensitive to changes in water pressure)

macro- = large (*macroevolution*: evolutionary change on a grand scale, encompassing the origin of new taxonomic groups, evolutionary trends, adaptive radiation, and mass extinction)

marsupi- = a bag, pouch (*marsupial*: a mammal, such as a koala, kangaroo, or opossum, whose young complete their embryonic development inside a maternal pouch called the marsupium)

meso- = middle; **-derm** = skin (*mesoderm*: the middle primary germ layer of an early embryo)

meta- = boundary, turning point; **-morph** = form (*metamorphosis*: the resurgence of development in an animal larva that transforms it into a sexually mature adult)

mono- = one (*monotreme*: an egg-laying mammal, such as the duck-billed platypus)

mono- = one (*monophyletic*: a taxon derived from a single ancestral species that gave rise to no species in any other taxa)

nemato- = a thread (*nematode*: a phylum of invertebrates including roundworms)

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opercul- = a covering, lid (*operculum*: a protective flap that covers the gills of fishes)

paleo- = ancient; **anthrop-** = man; **-ology** = the science of (*paleoanthropology*: the study of human origins and evolution)

phylo- = tribe (*phylum* [plural, *phyla*]: the taxonomic category above class); **-geny** = origin (*phylogenetic tree*: a branching diagram that represents a hypothesis about the evolutionary history of a group of organisms; *phylogeny*: the evolutionary history of a species or group of related species)

post- = after (*post-anal tail*: a structure in vertebrates found behind the anus; *posterior*: toward the rear of an organism)

proto- = first; **-stoma** = mouth (*protostomes*: a member of one of two distinct evolutionary lines of coelomates characterized by spiral, determinate cleavage, formation of the coelom as splits in solid masses of mesoderm, and development of the mouth from the blastopore)

pseudo- = false (*pseudocoelom*: a body cavity that is not completely lined by mesoderm)

radia- = a spoke, ray (*radial symmetry*: characterizing a body shaped like a pie or barrel, lacking a left and right side, but having a top and bottom)

tetra- = four; **-podi** = foot (*tetrapod*: a vertebrate with two pairs of limbs, such as a mammal, amphibian, or reptile)

tunic- = a covering (*tunicates*: one of a group of invertebrate chordates)

PROPERTY OF:

HONORS BIOLOGY – UNIT 3 – CHAPTER 15a NOTES

TRACING EVOLUTIONARY HISTORY – PHYLOGENY AND THE TREE OF LIFE

Why classify?

- 2.5 million identified species
- estimated 20 million additional species (rain forests, oceans, microorganisms)
- common language (Latin)
- place organisms into groups with real biological meaning

Binomial Nomenclature

- developed by Carolus Linnaeus – Swedish botanist
- 2 part scientific name: *Genus species* (note capital and underline/italics)
- genus = group name, species = name that describes main characteristics
- EX: *Acer rubrum* = red (rubrum) maple (acer)
Acer palmatum = hand-like (palmatum) maple (acer)

Taxonomy

- taxonomy = the science of naming organisms and placing them in groups
- **Dumb King Phillip Came Over For Good Spaghetti**
- ***Species*** = smallest taxon, defined as organisms with similar characteristics that can successfully breed with each other
EX: *Felis domesticus* (house cat) & *Felis concolor* (mountain lion)
- ***Genus*** = next largest taxon, defined as organisms with many similar features that are clearly different species
EX: *Panthera leo* (lion) & *Panthera tigris* (tiger)
- ***Family*** = next largest taxon, contains related genera (plural of genus)
EX: Felidae (cats) & Canidae (dogs)
- ***Order*** = next largest taxon, contains related families
EX: Carnivora (meat-eaters) & Primata (primates)
- ***Class*** = next largest taxon, contains related orders
EX: Mammalia (mammals) & Reptilia (reptiles)
- ***Phylum*** = next largest taxon, contains related classes, major grouping within a kingdom
EX: Nematoda (roundworms) & Chordata (vertebrates)
- ***Kingdom*** = second largest taxon
Linnaeus described only 2 kingdoms: Animalia and Plantae
- ***Domain*** = largest taxon
most modern way of classifying organisms (Bacteria, Archaea, Eukarya)

Taxonomy Today

- blurred lines between species, genera, or families
- taxons change as soon as new evidence is discovered
- species are now grouped by close evolutionary relationships, not necessarily by similar physical features
EX: homologous structures (similar body parts that evolved from a common ancestor) vs. analogous structures (similar body parts that evolved from different origins)
- genetic similarities = similarities in DNA or protein sequences
EX: cytochrome c = a protein found on the electron transport chain, found in all organisms, but in slightly different forms

The Six-Kingdom System

- all organisms classified as prokaryotes (smaller; no nucleus or other membrane-bound organelles) or as eukaryotes (larger; contains a nucleus and other membrane-bound organelles)
- other classification terms: unicellular (contains 1 cell), multicellular (contains 2 or more cells), heterotrophic (cannot make its own food), autotrophic (makes its own food using photosynthesis)
- ***Archaeobacteria*** = “ancient bacteria”
can live in harsh environments
prokaryotic cells
EX: methanogens (live in anaerobic environments, such as digestive tracts, produce methane), thermophiles (live in hot springs or in volcanoes), halophiles (live in extremely salty environments)
- ***Eubacteria*** = “true bacteria”
prokaryotic cells
EX: soil bacteria, infectious bacteria, cyanobacteria (perform photosynthesis, produce oxygen and glucose)
NOTE: most bacteria are completely harmless
- ***Protista*** = single-celled eukaryotic organisms, heterotrophic or autotrophic
EX: plant-like protists, animal-like protists, fungus-like protists
protists are the “link” between bacteria and fungi/plants/animals
Modern evolutionary biologists do not agree on the classification of protists.
- ***Fungi*** = contains cell walls that do not contain cellulose, heterotrophic, multicellular, decomposers
EX: molds, mushrooms
- ***Plantae*** = contains cell walls that contain cellulose, autotrophic, multicellular
EX: algae, mosses, ferns, flowering plants
- ***Animalia*** = does not contain cell walls, heterotrophic, multicellular

THE ----- SIX ----- KINGDOMS ----- OF ----- LIFE

ARCHAEBACTERIA

“ancient bacteria”

live in extremely harsh environments

- EX: - very hot areas: thermophiles
 - anaerobic areas: methanogens
 - strong acid areas: acidophiles
 - very salty areas: halophiles

- unicellular
- prokaryotic (no nucleus)
- cell wall
- some are autotrophs and some are heterotrophs

EUBACTERIA

“true bacteria”

common, everyday bacteria

- EX: - infectious bacteria that cause illnesses
 - bacteria that live in the soil
 - bacteria found in the house, on the body, or in food

- unicellular
- prokaryotic (no nucleus)
- cell wall
- some are autotrophs and some are heterotrophs

PROTISTA

protists are the evolutionary link to fungi, plants, and animals
microscopic (like archaeobacteria and eubacteria)

- EX: - Some protists are “fungus-like”.
 - Some protists are “plant-like”.
 - Some protists are “animal-like”.

- unicellular
- eukaryotic (has a nucleus)
- some have a cell wall and some do not
- some are autotrophs and some are heterotrophs

FUNGI

usually decomposers (eats dead material in the environment)

NO PHOTOSYNTHESIS

- EX: - molds
 - mushrooms
 - yeast

- multicellular
- eukaryotic (has a nucleus)
- cell wall
- heterotrophs

PLANTAE

photosynthetic (absorbs sunlight and turns carbon dioxide and water into glucose and oxygen gas)

- EX: - algae
 - moss
 - trees
 - flowering plants

- multicellular
- eukaryotic (has a nucleus)
- cell wall
- autotrophs

ANIMALIA

non-photosynthetic – must eat to acquire nutrients
many animals (but not all) are capable of movement

- EX: - Annelida - Mammalia
 - Amphibia - Aves
 - Porifera - etc...

- multicellular
- eukaryotic (has a nucleus)
- no cell wall
- heterotroph

Evolution of Phylum Chordata

(Continued From Previous Tree)

