Unit 11 Classification & Taxonomy Ch. 17
Test 03/08/2019
I. Early Systems of CLASSIFICATION

Classification is the grouping of items (living or non-living) based on similarities.
Benefits of Classifying

• Accurately & uniformly names organisms
• Prevents misnomers such as starfish & jellyfish that aren’t really fish
• Uses same language (Latin or some Greek) for all names

Sea"horse"??

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Aristotle’s system - Greek philosopher (384-322 b.c.)
More than two thousand years ago developed 1\textsuperscript{st} widely accepted system
Based on his view that species are distinct, separate & unchanging
Classified organisms as either ______________ or ______________.

Animals classified according to the presence or absence of “______________.”

Further classified by habitats & morphology.

Plants classified by average size & structure as ________________

Did not account for ______________________ relationships
Linnaeus’s System- Swedish naturalist (1707-1778)

Based on observational studies of the morphology & the behavior of organisms.

Example: Birds organized into 3 major groups-
birds of prey,
wading birds & perching birds.
First formal system of taxonomic organization

a. **Taxonomy** - discipline of biology concerned with **identifying, naming** & classifying species based on **natural relationships**.

Part of larger branch of Biology called **systematics** - study of biological diversity with an emphasis on evolutionary history.
Binomial nomenclature

Developed by Linnaeus- gives each species a scientific name that has two parts.

First part is the _______ name

Second part is the - _______ name that identifies the _______.

Latin is the basis used because Latin is an ____________ language
Binomial Nomenclature

Which TWO are more closely related?

Giant Panda
Ailuropoda melanoleuca

Polar Bear
Ursus maritimus

Grizzly Bear
Ursus arctos
How to write scientific name

Genus name is always ___________ capitalized
Species name is always ___________ lowercase
If ______ typed the name it should be italicized
If writing the name under the both parts should be ___________ underlined

EX: Homo sapiens
Modern classification systems
Since Darwin’s theory of evolution scientist began classify also on the basis of inferred evolutionary relationships
Today still rooted in the Linnaeus tradition, modified to reflect new knowledge about evolutionary ancestry. (DNA)
II. Taxonomic Categories - (p. 487-488)

A. Organisms are subdivided based on more specific criteria

B. Taxonomic categories are part of a nested-hierarchical system from broadest to most specific

C. Taxon (plural, taxa) - named group of organisms

1. Categories of Classification
A. Categories of Classification

a. Domain - Broadest of all categories

b. Kingdom - groups of closely related \textit{phyla}

c. Phylum - groups of closely related \textit{classes}

d. Class - groups of closely related \textit{orders}

e. Order - groups of closely related \textit{families}
A. Categories of Classification

f. Family - groups of closely related genera

g. Genus - groups of closely related species

h. Species - Smallest and most specific classification group; organisms that share closely related and can interbreed characteristics
*Memory Helper *

King
Phillip
Came
Over
For
Good
Soup

or

Kids
Play
Chess
On
Fat
Guy’s
Stomach

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How Can You Remember the 6 Taxon levels?

- **King Philip Came Over for Good Soup**
- **Kids Play Chess Over favorite Gooey Snacks**
- **Katie Please Come Over for Ginger Snaps**

😊 Can you come up with your own pneumonic?

Grizzly bear  Black bear  Giant panda  Red fox  Abert squirrel  Coral snake  Sea star

KINGDOM Animalia

PHYLUM Chordata

CLASS Mammalia

ORDER Carnivora

FAMILY Ursidae

GENUS Ursus

SPECIES Ursus arctos

Dumb
King
Phillip
Came
Over
For
Good
Soup!
• There are 13 billion known species of organisms
• This is only .1% of all organisms that ever lived!!!!!
• New organisms are still being found and identified
What is Classification?

Taxonomists are scientists that identify & name organisms
Confusion in Using Different Languages for Names
Latin Names are Understood by all Taxonomists

Mephitis mephitis!
Hierarchical System of Organism Classification

Eastern gray squirrel

Sciurus carolinensis
<table>
<thead>
<tr>
<th>Classification Category</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain Eukarya</td>
<td>Cells with nuclei</td>
</tr>
<tr>
<td>Kingdom Animalia</td>
<td>Multicellular, motile, ingestion of food</td>
</tr>
<tr>
<td>Phylum Chordata</td>
<td>Dorsal supporting rod and nerve cord</td>
</tr>
<tr>
<td>Class Mammalia</td>
<td>Hair, mammary glands</td>
</tr>
<tr>
<td>Order Primates</td>
<td>Adapted to climb trees</td>
</tr>
<tr>
<td>Family Hominidae</td>
<td>Adapted to walk erect</td>
</tr>
<tr>
<td>Genus <em>Homo</em></td>
<td>Large brain, tool use</td>
</tr>
<tr>
<td>Species <em>Homo sapiens</em></td>
<td>Body proportions of modern humans</td>
</tr>
</tbody>
</table>
III. Determining Species- (p. 490-491) It’s not always easy to define a species. As knowledge increases, definitions change. The concept of a species today is much different than it was 100 years ago. There are three different ways to look at the species concept:

The term phylogeny is used in one concept- phylogeny is the evolutionary history of a species
IV. Phylogenetic Reconstruction (p. 495-498)

A. Cladistics - method that classifies organisms according to the order that they diverged from a common ancestor.

1. Ancestral traits (character) - found within the entire line of descent of a group of organisms.
2. Derived traits (character) - are present in members of one group of the line but not in the common ancestor.

   a. EX. Looking at birds & mammal the ancestral trait would be the backbone

   b. Derived trait for mammals would their fur and for birds their feathers.
B. Cladograms- Branching diagram that represents the proposed phylogeny or evolutionary history of a species or group. It’s a model similar to a pedigree- branches show direct ancestry; cladogram’s branches indicate phylogeny.
Construction of a cladogram

Clades- one branch of the cladogram

Outgroup- is the species or group of species that has more ancestral traits with respect to the other organisms being compared.

Nodes- where branches originate represent a common ancestor.
Common ancestor is generally not a known organism, species, or fossil, its hypothesized based on the traits of its descendants.

Constructed by sequencing the order in which derived characters evolved with respect to the outgroup.

Closeness of clades indicate the number of characters shared.
A Cladogram of Plant Groups
V. Domains & Kingdoms (p. 499-503)

A. Domain – Added in 1990; based on research showing that the ribosomal RNA nucleotide sequences of organisms fell into 3 groups.

1. Domain Bacteria – Includes the ______________

2. Archaea – Includes all remaining prokaryotes or the ______________

3. Domain Eukarya – Includes all eukaryotic kingdoms - Protista, Fungi, Plantae, & Animalia
A. Kingdom Archaebacteria

1. Cell Type - prokaryotic
2. Cell Structure - cell wall without peptidoglycan; cell membrane, ribosomes, DNA, cytosol present
A. Kingdom Archaebacteria

3. Body Form - all unicellular (single-celled)

4. Nutrition - autotrophic or heterotrophic

5. Other Characteristics - Considered to be the most ancient of organisms; live in very harsh conditions like extreme temperatures, high salt concentration, etc. Another group of Archaebacteria live in the digestive system of animals and produce methane gas.
A. Kingdom
Archaebacteria
B. Kingdom Eubacteria

1. Cell Type - prokaryotic

2. Cell Structure - cell walls with peptidoglycan, cell membrane, ribosomes, DNA, cytosol present

3. Body Form - all unicellular
4. Nutrition – Mostly heterotrophic; some are autotrophic

5. Other Characteristics – Most common bacteria. They are ubiquitous which means they are everywhere!! Very important decomposers. Some are pathogenic (disease-producing), but most are harmless or even helpful.

6. Examples – E. coli, Strep, Staph
B. KINGDOM EUBACTERIA
C.  Kingdom Protista

1. Cell Type - **eukaryotic**

2. Cell Structure - May have **cell wall**; may have **chloroplasts**; May be **motile** and have **cilia** or **flagella**.

3. Body Form - Mostly **unicellular**, may be ** multicellular**
C. Kingdom Protista

4. Nutrition - autotrophic or heterotrophic

5. Other Characteristics - Nicknamed
   “catch-all” kingdom or “junk drawer of life! 😊”. Contains eukaryotes that don't “fit” into other kingdoms. Protists are sub-grouped according to which eukaryotic kingdom they're most like; for example, animal-like, plant-like, or fungus-like.

6. Examples - amoeba, paramecium, molds, algae
C. KINGDOM PROTISTA

Protista (Amoeba)

flagellum

stigma

Trypanosomes

Eualena

Trichomonas

Dittulgia

Achinophrys

vorticella

Paramecium

Coleps

Stentor

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D. Kingdom Fungi

1. Cell Type - **eukaryotic**

2. Cell Structure - Have **cell walls** made of **chitin**. Fungi do not have **chloroplasts**!

3. Body Form - Mostly **multicellular**; may be **unicellular**. Single-celled fungi are known as **yeasts**.
D. Kingdom Fungi

4. Nutrition – All _____________! Obtain nutrients through a process called ________, meaning food is digested ______________ by secretion of ________, then absorbed by fungi.

5. Other Characteristics – Principle ________. Also important in _________ and _______. All _____________.

6. Examples – _____________
D. KINGDOM FUNGI
E. Kingdom Plantae

1. Cell Type - **eukaryotic**

2. Cell Structure - Have **cell walls** made of **cellulose**; **chloroplasts** present.

3. Body Form - All **multicellular**

4. Nutrition - All **autotrophic**
E. Kingdom Plantae

5. Other Characteristics – Most contain **organs** and **organ systems**. All **non-motile** with specialized **reproductive** structures.

6. Examples **Trees, mosses, ferns, etc**
E. KINGDOM
PLANTAE
F. Kingdom Animalia

1. Cell Type - **eukaryotic**

2. Cell Structure - Never have **cell walls**!

3. Body Form - All **multicellular**

4. Nutrition - All **heterotrophic**

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F. Kingdom Animalia

5. Other Characteristics – Most complex of all kingdoms. Most organisms contain organs and organ systems. All members are capable of movement sometime during lifetime. Most animals are invertebrates meaning they do not have a backbone. All vertebrates belong to Phylum Chordata.

6. Examples - sponges, coral, insects, ect
III. TAXONOMY
<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Organization</th>
<th>Type of Nutrition</th>
<th>Representative Organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protista</td>
<td>Complex single cell, some multicellular</td>
<td>Absorb, photosynthesize, or ingest food</td>
<td>paramecium, euglenoid, slime mold, dino-flagellate, protozoans, algae, water molds, and slime mold</td>
</tr>
<tr>
<td>Fungi</td>
<td>Some unicellular, most multicellular filamentous forms with specialized complex cells</td>
<td>Absorb food</td>
<td>black bread mold, yeast, mushroom, bracket fungus, molds, yeast, and mushrooms</td>
</tr>
<tr>
<td>Plantae</td>
<td>Multicellular form with specialized complex cells</td>
<td>Photosynthesize food</td>
<td>moss, fern, pine tree, nonwoody flowering plant, mosses, ferns, nonwoody and woody flowering plants</td>
</tr>
<tr>
<td>Animalia</td>
<td>Multicellular form with specialized complex cells</td>
<td>Ingest food</td>
<td>coral, earthworm, blue jay, squirrel, invertebrates, fishes, reptiles, amphibians, birds, and mammals</td>
</tr>
</tbody>
</table>

c. Domain Eukarya

Eukaryotes, structurally diverse and organized into the four kingdoms depicted here.
Basis for Modern Taxonomy

• **Homologous structures** (same structure, different function)
• **Similar embryo development**
• **Molecular Similarity in DNA, RNA, or amino acid sequence of Proteins**
Dichotomous Keying

• Used to identify organisms
• Characteristics given in pairs
• Read both characteristics and either go to another set of characteristics OR identify the organism
Example of Dichotomous Key

1a Eight Tentacles - Octopus
1b More than 8 tentacles - 2

2a Tentacles hang down - Jellyfish
2b Tentacles upright - go to 3

3a Oval-shaped body - Sea Anemone
3b Body NOT oval-shaped - Hydra
1. a. The beak is relatively long and slender........*Certhidea*
b. The beak is relatively stout and heavy........... Go to 2

2. a. The bottom surface of the lower beak is flat and straight.................................*Geospiza*
b. the bottom surface of the lower beak is curved... go to 3

3. a. The lower edge of the upper beak has a distinct bend..............................................*Camarhynchus*
b. The lower edge of the upper beak is mostly flat......*Platyspiza*
III Plant Classification

Plants are divided into two basic groups based on whether they contain vascular tissue:

A. Bryophytes (pp. 556-559)

Bryophytes, or mosses, are the only group of plants that lack vascular tissue. This limits both the size and location of this group of plants. Mosses are small and typically live in moist areas. In addition, a moist climate is required because mosses have swimming sperm. The sperm must swim to the egg cell in order for fertilization to take place.
Tracheophytes are vascular plant which allows them to grow larger. The tracheophytes are further subdivided based on the presence or absence of pollen, seeds, and fruit:

- **Pterophytes** - No pollen, no seeds, no fruits

  Pterophytes are commonly called *ferns*. Although ferns contain vascular tissue, they are still found predominantly in moist climates because the sperm must *swim* to the egg cell.
C. Tracheophytes with Seeds

All other *tracheophytes* produce seeds. Seeds provide a tremendous reproductive advantage. A seed consists of an *embryo* surrounded by a tough protective coat.

- **Advantages of Seeds**
  - **Protection**
  - **Nourishment** - Starch is stored in the seed for developing *embryo*
  - **Dispersal** - Easily spread by wind, animals, water; reduces competition for nutrients
  - **Dormancy** - Seeds remain dormant or inactive until conditions are favorable
• Types of Seed Plants

2. Gymnosperms- Have pollen and seeds, no fruit.

   The word “gymnosperm” means “naked seed” because the seed is not protected by a fruit. A unique characteristic of gymnosperms is the presence of cones. The largest and most common phyla is conifers which includes pines, spruce, cedar. Confiers have characteristic leaves called needles, which are modified to prevent water loss and minimize ice build-up. In addition, gymnosperms (and angiosperms) have “flying sperm” or pollen. So they are no longer tied to water for reproduction.

3. Angiosperms- Have pollen, seeds, and fruit
Angiosperms are the most complex and adaptable of all plant groups. They are also the most successful due to two important modifications:

A. Fruit- A fruit is a mature ovary that contains one or more seeds. It provides the embryo with greater protection and nutrients than found in gymnosperm seeds. The fruit also increases seed dispersal because fruits are eaten by animals, seeds pass through the digestive tract and are eliminated. Some fruits are not intended to be edible.
B. Flower

The flower is the reproductive system of the angiosperm. It enhances pollination, which occurs as a first step to fertilization.

1. The male reproductive organ is the stamen, which consists of the anther and filament. Pollen, is produced by the anther and contains the sperm cells.
2. The female reproductive organ is the **pistil**, which consists of the sticky top called the **stigma**, the neck called the **style**, and the base called the **ovary**. The ovary contains the female gametes **ovules or eggs**. During pollination, pollen is transferred from the **anther** to the **stigma**. When a pollen grain lands on a stigma, it sends out a **pollen tube** that grows through the style to the **ovary**. Once the sperm reached the egg cell, fertilization take place.
3. The **petals** are usually colorful to **attract** pollinators.

4. The **sepals** are protective green **modified leaves** at the base of a flower. They **protect** the bud before the flower blooms.
Basic Flower Structure

- stamen
  - anther
  - filament
- carpel or pistil
  - stigma
  - style
- ovary
- ovule
- petal (corolla)
- locule
- peduncle (pedicel in an inflorescence)
- receptacle
- sepal (calyx)

perianth: sepals + petals
C. Types of Angiosperms

1. Angiosperms are further classified into two groups based on characteristics.
   • Monocots include plants such as grasses, corn, lilies. Monocot seeds have one cotyledon (seed leaf). These are seeds that cannot be split in half, like a piece of corn.
   • Dicots are more abundant and include plants such as roses, oak trees, etc. Dicots have two cotyledons. These seeds can be split in half like peanuts and beans.