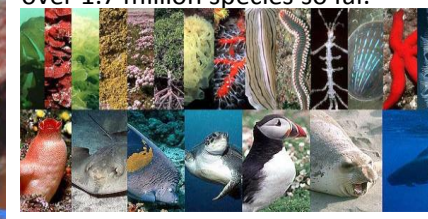
Finding Order in Diversity

Biologists have identified and named over 1.7 million species so far.

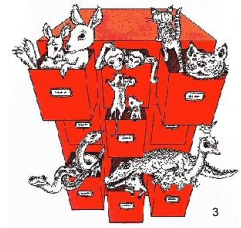


Estimates = between 2-100 million species yet be discovered

2

Classification …

the grouping of objects or organisms based on a set of criteria.

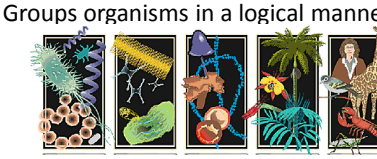


3

Why Classify?

Identifies and names organisms

Groups organisms in a logical manner



4

Why are living things organized?

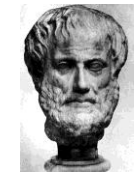
- Provides logic and organization
- Universal understanding – useful tool
- Important to economy - discoveries!
  - New sources of lumber, medicines, energy, etc.

5

I. History

A. Aristotle (384-322 B.C.)

- Greek Philosopher
- 1st method of classification
  - 2 groups: plants & animals



6

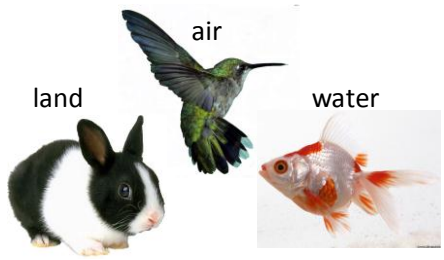
Aristotle's System

Divided organisms based on

air

land

water



7

I. History

B. Carolous Linnaeus (1707-1778)

- Swedish botanist
- Developed a classification system that organized species into taxa that formed a hierarchy or set of ordered ranks.

8

Taxonomy

***Taxa:* series of categories, each one larger than the previous one.**

- The science of ***naming*** organisms and assigning them to ***groups***.
- ***Taxa*** (Taxon) =
  - The assigned groups
- Linnaeus began ***grouping*** by morphology (***form*** and ***structure***)

9

Kingdoms

Originally there were two kingdoms:

Animalia

Plantae

By 1938 there were four kingdoms added

But there are some things that still don't fit:

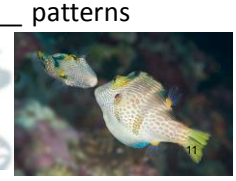
Protista

10

IV. How are living things classified?

B. Classified by similarities in:

1. Developmental stages
2. Biochemical analysis (DNA)
3. Behavioral patterns



11

Continuing with the Taxa

- Many ***Phyla*** together form a…

–Kingdom

- Kingdom Animalia includes Phyla ***Chordata, Arthropoda, Annelida, Porifera & Echinodermata, etc.***

12

Continuing with the Taxa

- Many ***classes*** are grouped together into
  - ***Phyla***
- Chordata includes the classes ***Mammalia, Reptilia, Aves & Osteichthyes,*** etc.

Continuing with the Taxa

- ***Orders*** are grouped into…
  - ***Classes***
  - Mammalia formed from orders ***Carnivora***, ***Primates***, ***Rodentia***, etc.

14

Continuing with the Taxa

- Several similar ***Families*** form an
  - ***Order***
- Carnivora is the Order containing Families:
- ***Felidae, Ursidae, Canidae***, etc.

15

Continuing with the Taxa

- Groups of similar ***Genus*** form a:
  - ***Family***
- Felidae = cat family and includes Genus
  - ***Panthera, Felis, Acinonyx*** and other cat Genera

16

Continuing with the Taxa

- What is the smallest group with the most ***similarities*** among members?
  - ***species*** = **unique to each kind of organism**
- And a group of similar species is called?
  - ***Genus*** = **group of closely related species**

17

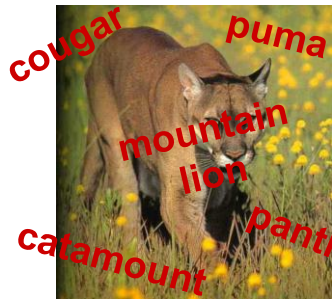
Assigning Scientific Names

- Binomial Nomenclature (2 word naming system)
- Created by Linnaeus
- System we still use today.
- Every living organism has a genus name and species name!

18

Assigning Scientific Names

What is the common name of this animal?



19

Assigning Scientific Names

What is the ***SCIENTIFIC*** name of this animal?

20

Assigning Scientific Names

Common names can be misleading.

Sea cucumber sounds like a plant but…

it's an animal!

21

Assigning Scientific Names

Common names can be misleading.

A jellyFISH isn't a fish,

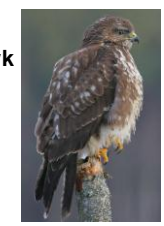
but a seaHORSE is!

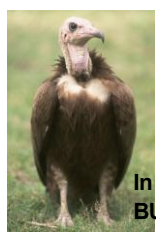
22

Assigning Scientific Names

Common names can be misleading.

In the United Kingdom, BUZZARD refers to a hawk





In the United States, BUZZARD refers to a vulture.

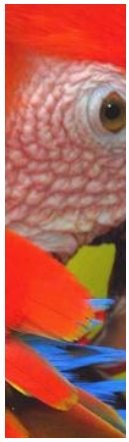
23

Why a Scientific Name?

Common Name = Confusion

1. May not accurately ***describe*** the organism.
2. Different in ***different*** regions (not universal).
3. Multiple ***names*** given to the same species
4. Same name used for more than ***one*** species

24



The Fundamentals of Binomial Nomenclature

- Each organism given a ***two*** part scientific name.
- The ***first*** word is its ***Genus*** group
- Second word is ***descriptive*** and is its ***species*** name
- Use ***Latin*** (or Greek) to compose the names.
- Why? ***Latin is a dead language***.
- Scientific names are ***universal*** (world wide), written in ***English characters***
- Scientific names are always ***italicized*** or ***underlined*** with Genus name ***capitalized***

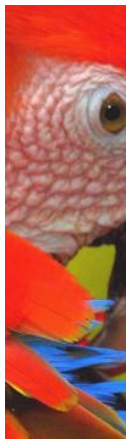
The Fundamentals of Binomial Nomenclature

1st name = Genus
- **Always capitalized**

2nd name = species
- **Always lower case**

Both names are underlined **or written in** italics **.**

26



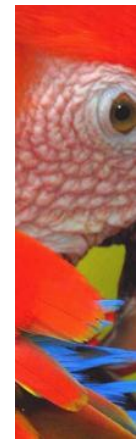
Binomial Nomenclature

some examples:

- *Homo sapien* =

Human

27



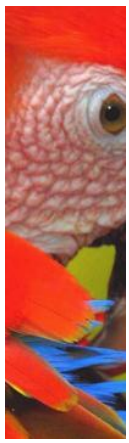
Binomial Nomenclature

some examples:

- *Felis domesticus*

Cat

28



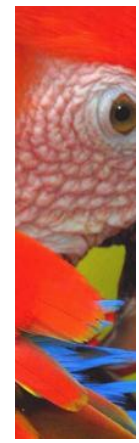
Binomial Nomenclature

some examples:

- *Canis familiaris*

Dog

29



Binomial Nomenclature

some examples:

- *Musca domestica*

House Fly

30

Binomial Nomenclature
some examples:

- *Acer rubrum*

Red Maple

Binomial Nomenclature
some examples:

- *Taraxacum officionale*

Dandelion

GENUS = group of closely related species

GENUS = *Ursus*

(Includes many kinds of bears)

Ursus arctos

Ursus maritimus

Ursus americanis

SPECIES = unique to each kind of bear

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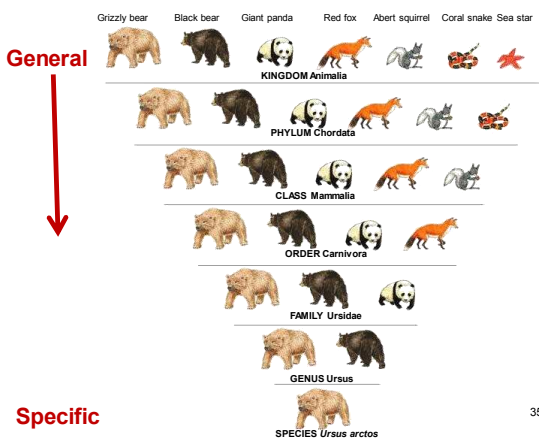
Putting It In Perspective

- The Kingdom is the ***largest*** group with the least number of common ***characteristics*** among its members.
- The ***species*** is the smallest group with the most number of common ***characteristics***.

34



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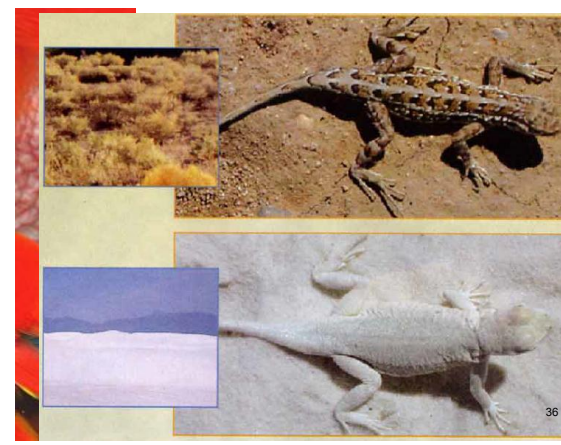


36

Problems with Traditional Classification

- Linnaeus grouped organisms strictly according to similarities and differences.
- Scientists today try to assign species to a larger group in ways that reflect how closely members of those groups are related to each other.

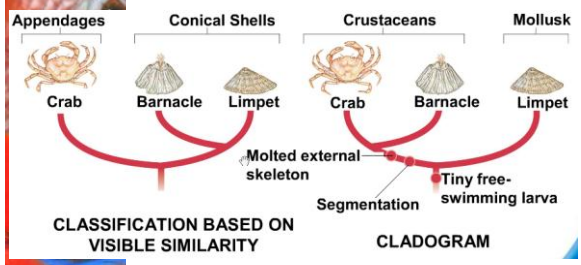
37

Problems with Traditional Classification

Problems can arise when species are classified based on easily observed traits.

38

Problems with Traditional Classification



39

Cladistics is classification based on common ancestry.

Similar traits between species are often the result of sharing a common ancestor, such as the ancestor shared by dogs and wolves.

40

Phylogeny

The evolutionary history for a group of species is called a ***phylogeny***.

Phylogenies can be shown as branching tree diagrams – kind of like family trees.

The glyptodon lived more than 10,000 years ago and is the common ancestor to about 20 modern armadillo species.

41

Fossil Record

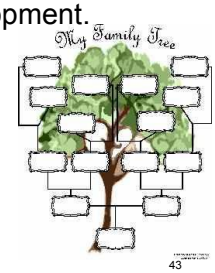
Information about past life, including the structure of organisms, what they ate, what ate them, in what environment they lived, and the order in which they lived.

42

Phylogenic Trees (Cladograms)

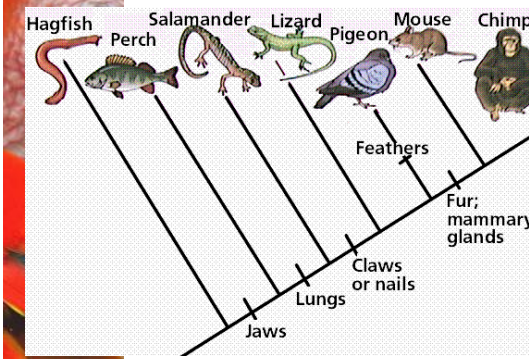
__Ancestry__ is the history of an organism's development.

It can be represented by a __branching__ tree.



43

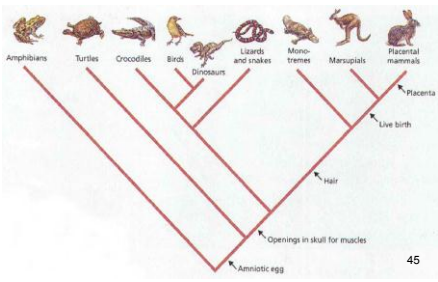
Phylogenic Trees (Cladograms)



44

Cladogram

A ***cladogram*** is an evolutionary tree that proposes how species may be related to each other through common ancestors.



45

Cladogram

A ***clade*** is a group of species that shares a common ancestor.

The glyptodon and all of its descendants form a clade.

- Each species in a clade has some traits that ***have not*** changed from its ancestor.
- However, each species has traits that ***have*** changed over time.

46

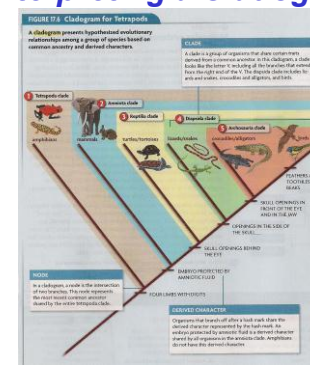
Cladogram

The traits that can be used to figure out evolutionary relationships among a group of species are those that are shared by some species but are not present in others. These traits are called ***derived characters***.

The more closely related species are, the more derived characters they will share.

47

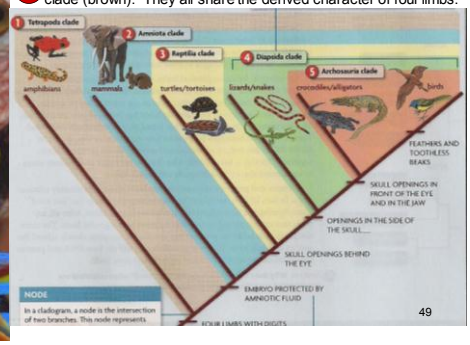
Interpreting a Cladogram



48

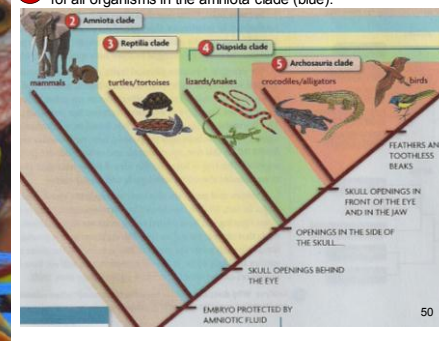
Interpreting a Cladogram

1 All of the organisms in this cladogram belong to the tetrapoda clade (brown). They all share the derived character of four limbs.



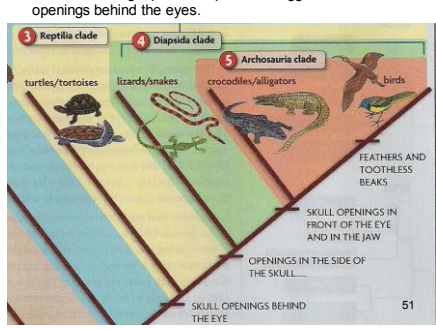
Interpreting a Cladogram

2 An embryo protected by a fluid filled sac is a derived character for all organisms in the amniota clade (blue).



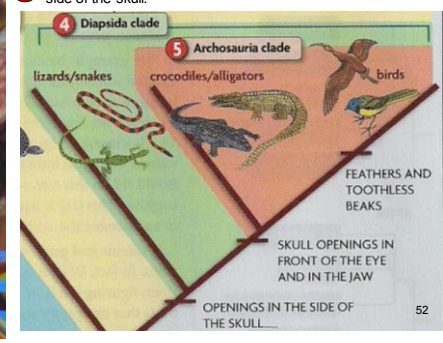
Interpreting a Cladogram

3 Organisms in the reptilia clade (yellow) have a common ancestor that had four legs, produced protected eggs, and had a skull with openings behind the eyes.



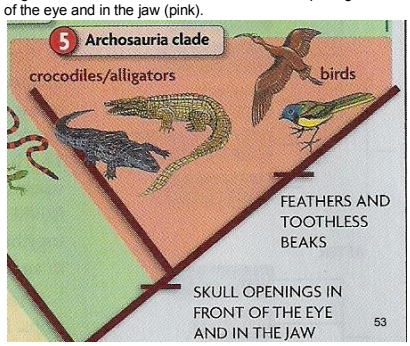
Interpreting a Cladogram

4 Organisms in the diapsida clade (green) have openings in the side of the skull.



Interpreting a Cladogram

5 Organisms is the archosauria clade have skull openings in front of the eye and in the jaw (pink).



VI. Domains

- Organisms are classified into domains according to *cell type* and *structure*.
- Organisms are classified into kingdoms according to *cell type*, *structure*, and *nutrition*.

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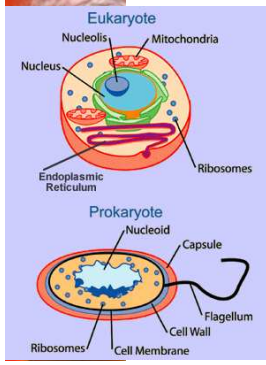
Two Cell Types:

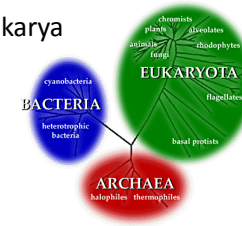


- Eukaryotic cells = have a membrane bound nucleus and organelles; usually more complex than prokaryotic cells.
- Prokaryotic cells = does NOT have a nucleus or other membrane-bound organelles.

55

3 Domains:

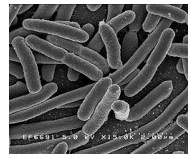
1. Bacteria
2. Archaea (pronounced - ar KEE uh)
3. Eukarya



56

A. Bacteria :

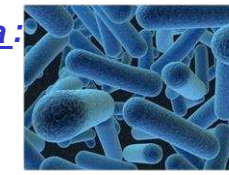
- Prokaryotes
- Cell walls contain peptidoglycan (polymer of sugars)
- Contains Kingdom Bacteria



E. Coli

57

B. Archaea :



- More ancient than bacteria
- Prokaryotes
- Cell walls DO NOT contain peptidoglycan
- Live in extreme environments
  - Boiling hot springs, salty lakes, thermal vents on the ocean's floors, mud of marches where ther is NO oxygen.

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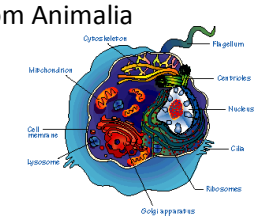
C. Eukarya :

- Eukaryotes
- Contains Kingdom Protista, Kingdom Fungi, Kingdom Plantae, Kingdom Animalia



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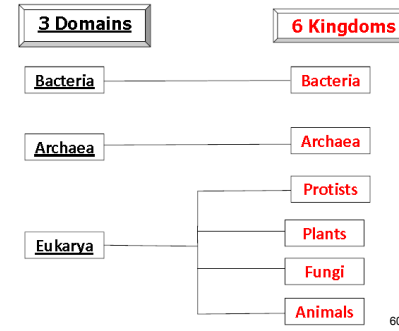
Flow Chart of Domains & Kingdoms



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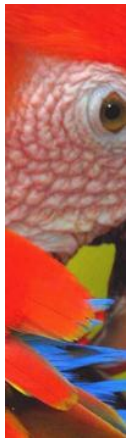
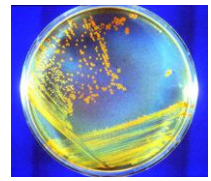


A. BACTERIA:

- Cell type - prokaryote
- Cell walls with peptidoglycan
- Unicellular
- Autotroph or heterotroph



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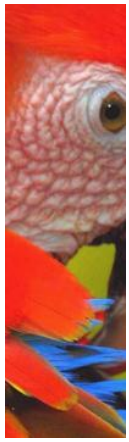
BACTERIA: (contd)

- Common bacteria
  - Ex: bacteria you on your skin
  - Ex: streptococcus causes strep throat
  - Ex: Eschericia coli

62



B. ARCHAEA:

- Cell type - prokaryote
- Cell walls DO NOT contain peptidoglycan
- Unicellular
- Autotroph or heterotroph

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C. PROTISTS:

- Most diverse group
- Cell type – eukaryote
- Unicellular and multicellular
- Some plant-like, animal-like and fungus-like
- DO NOT have organs
- Usually live in moist environments
- Ex: paramecium, slime mold, kelps

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D. FUNGI:

- Cell type – eukaryote
- Most multicellular
- Heterotrophic - absorb nutrients obtained by decomposing dead organisms and wasts in environment.
- Cell walls with chitin (polymer)
- Ex: mushrooms, molds

65

E. PLANTS:

Cell type – eukaryote

Multicellular

Photosynthetic - (autotrophs)

Most have cellulose in their cell walls.

Tissues organized into organs (roots, stems, leaves)

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F. ANIMALS:

Cell type – eukaryote

Most multicellular

Consumers that eat and digest other organisms for food

No cell walls

Have tissues organized into complex organ systems.

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Classification

Classification of Living Things

DOMAIN	Bacteria	Archaea	Eukarya			
KINGDOM	Eubacteria	Archaebacteria	Protista	Fungi	Plantae	Animalia
CELL TYPE	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
CELL STRUCTURES	Cell walls with peptidoglycan	Cell walls without peptidoglycan	Cell walls of cellulose in some; some have chloroplasts	Cell walls of chitin	Cell walls of cellulose; chloroplasts	No cell walls or chloroplasts
NUMBER OF CELLS	Unicellular	Unicellular	Most unicellular; some colonial; some multicellular	Most multicellular; some unicellular	Multicellular	Multicellular
MODE OF NUTRITION	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or heterotroph	Heterotroph	Autotroph	Heterotroph
EXAMPLES	*Streptococcus*, *Escherichia coli*	Methanogens, halophiles	Amoeba, *Paramecium*, slime molds, giant kelp	Mushrooms, yeasts	Mosses, ferns, flowering plants	Sponges, worms, insects, fishes, mammals

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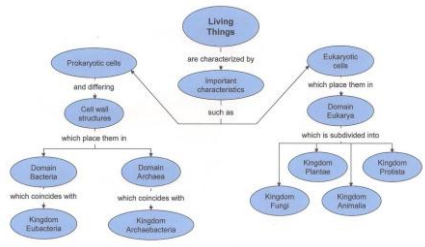
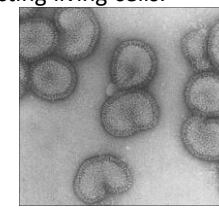
Classification



69

Viruses vs. Living Organisms

- A virus is a nonliving particle made of proteins, nucleic acids, and sometimes lipids.
- Viruses can reproduce only by infecting living cells.



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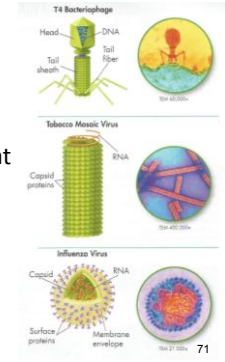
Structure & Composition

- Viruses differ widely in terms of size and structure.
- The protein coat surrounding a virus is called a capsid.



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Structure & Composition

- Viruses must bind precisely to proteins on the host cell surface and then use the host's genetic system.
- Most viruses infect only a very specific kind of cell

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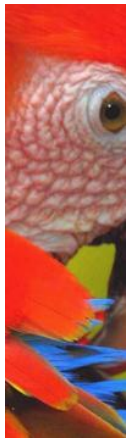
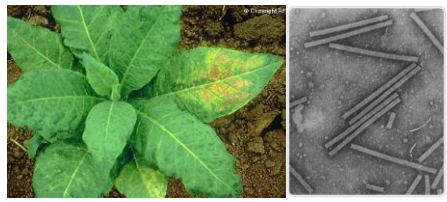


Structure & Composition

- Plant viruses infect plant cells



Tobacco mosaic Virus

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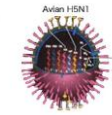
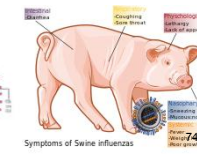
Structure & Composition

- Most animal viruses infect only certain related species of animals.





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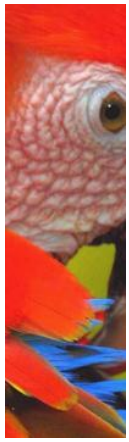
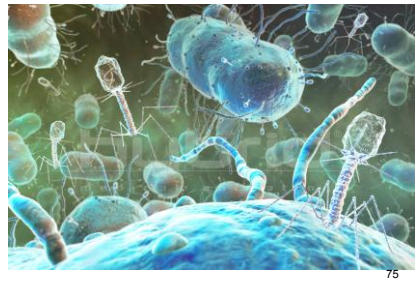


Structure & Composition

- Viruses that infect bacteria are bacteriophages.



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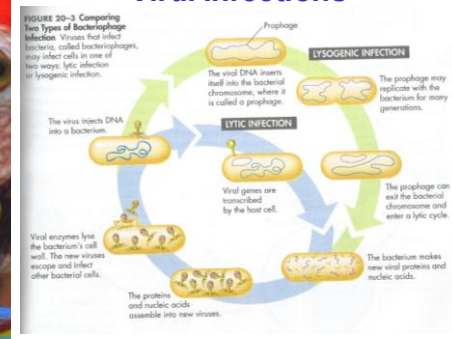
Viral Infections



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