Chapter 6

Classification
- Scientific name
- Heirarchy
- Taxonomic theory

Nutrition
- Autotroph vs heterotroph

Cell types
- prokaryote, plant, animal

Domain and Kingdom overview

Classification putting organisms into **groups** based on similarities and differences

groups are called taxa (sing. taxon)

study of how groups are organized is called:

Taxonomy

Taxonomy

Use Latin

Doesn't change

"Everyone" speaks it

Taxonomy

Example:

Apis pubescens, thorace subgriseo, abdominae fusco, pedibus posteuis, glabris, utrinque margine ciliatis

Bee with soft short hairs, gray chest, dark brown abdomen, legs with no hair, and small sacs with hair-like outgrowths along the edge

---

Picture of honey bee

Bee with soft short hairs, gray chest, dark brown abdomen, legs with no hair, and small sacs with hair-like outgrowths along the edge

---

Carl von Linné

Binomial nomenclature:
- Two-part scientific name
- Genus and species

Carolus Linneaus

"type specimens" in museums

(species don't change)

Example:

Apis pubescens, thorace subgriseo, abdominae fusco, pedibus posteuis, glabris, utrinque margine ciliatis

Apis mellifera

Binomial nomenclature

Genus	capitalized
species	not capitalized
Both	*italicized* or <u>underlined</u>

Scientific name*:* *Apis mellifera*

Common name: honey bee

Taxonomy: Hierarchy

But...what is a species?

A group of reproductively isolated organisms

an example:

Equus equus
62 chromosomes

Equus asinus
64 chromosomes

Equus hemionus
? chromosomes

Fig. 5.14

Taxonomy: **Hierarchy**

general ↓ specific

Domain	3 (Archeae, Bacteria, Eukarya)
Kingdom	A group of related phyla
Phylum	A group of related classes
Class	A group of related orders
Order	A group of related families
Family	A group of related genera
Genus	A group of related species
species	Reproductively isolated organisms

Taxonomy: Hierarchy

Domain	
Kingdom	Kings
Phylum	Play
Class	Chess
Order	On
Family	Fine
Genus	Green
species	sand

Fig. 6.1

Taxonomy: Hierarchy

general ↓ specific

Domain	Eukarya	
Kingdom	Animalia	
Phylum	Chordata	
Class	Mammalia	*Homo sapiens*
Order	Primate	*H. sapiens*
Family	Hominidae	human
Genus	*Homo*	
species	*sapiens*	

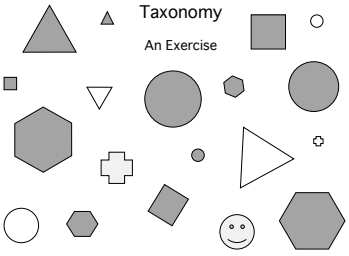
Taxonomic theory

How do you decide who goes into what group?

Look at characteristics
Try to figure out which are the most "important"

Taxonomy

An Exercise



Taxonomy

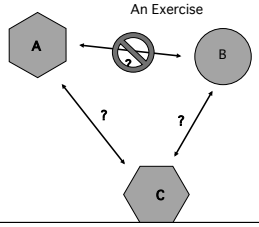
Shape ?	5
Color ?	4
Size ?	3
??	

parsimony

the simplest explanation

Taxonomy

An Exercise



C

Taxonomic theory

How do you decide who goes into what group?

birds, fishes, roses, insects, . . .

based on similarities and differences

anatomy, molecular biology (DNA etc...)

Taxonomic theory

How do you decide who goes into what group?

Describe evolutionary relationships

Looking at descendents

A group with a common ancestor would be a clade

(Greek, branch)

Study of groups and ancestry is cladistics

Fig. 5.1

Box 6.1(1)

Box 6.1(2)

One of the main characteristics we use to divide organisms into different groups is:

cell type

prokaryotic

before nucleus

eukaryotic

true nucleus

Box 6-2(1-4)

Another question is:

nutrition

Nutrition:

Where does an organism get it's energy?

(glucose)

Some organisms are self-feeding

autotrophic:hemosynthetic

Photosynthetic

Sunlight (energy) + CO_2 + H_2O ----▸ Glucose + O_2

Chemosynthetic

Nutrition:

Where does an organism get it's energy?

(glucose)

Some organisms are other-feeding

heterotrophic:

Cellular respiration (includes Kreb's cycle):

Glucose + O_2 ----▸ CO_2 + H_2O + ATP (energy)

Nutrition:

Where does an organism get it's energy?

(glucose)

Some organisms are other-feeding

heterotrophic:

digestion

outside **inside**

Absorptive heterotroph **Ingestive heterotroph**

Box 6-2

Possible origin of three cell types:

Fig 6-2

Prokaryotic organisms all are unicellular

Eukaryotic organisms some are unicellular
others are multicellular

Reproduction

asexual reproduction
genetic uniformity

sexual reproduction
genetic diversity
(advantage with natural selection)

History

Pre 1800

3 kingdoms: animal, mineral or vegetable ?

1802

Biology - animal and plant kingdoms Lamarck

1963

5 kingdoms: Monera, Protista, Fungi, Plantae, Ani

2006

6 kingdoms with three domains

Fig 6-3

6 kingdoms and three domains

Archaea (kingdom and domain)
aka., Archaebacteria
prokaryotic, unicellular
Live in special environments
(cow gut, thermal vents, hot springs)

(many are chemosynthetic)

6 kingdoms and three domains

Fig 6-4

6 kingdoms and three domains

Eubacteria (kingdom and domain)
- common bacteria
- blue-green bacteria (cyanobacteria)
  - prokaryotic, unicellular (may live in colonies)
  - many cell shapes
    - rod, spheres, spirals
  - many cell arrangements
    - single, chains, clusters

6 kingdoms and three domains

Eubacteria (kingdom and domain)
- common bacteria
- blue-green bacterial (cyanobacteria)
  - prokaryotic, unicellular (may live in colonies)
  - many cell shapes
    - rod, spheres, spirals
  - many cell arrangements
    - single, chains, clusters
  - different cell walls

Symbiosis: Living together

Bacteria	Humans	type of symbiosis
benefit	neutral	skin
benefit	benefit	*E. coli*
benefit	harmed	*tuberculosis*

bacteria and humans

Many can cause diseases:
pneumonia, STD, TB, anthrax, strep, etc., . . .

But many are beneficial:
decompose dead material (recycle chemicals)
food production: butter, cheese, coffee
nitrogen fixation:
genetic engineering:

Third domain

Eukarya (Eucarya)
Contains four kingdoms

Domain (kingdom) (kingdom) Domain

Fig 6-3a

Domain: Eukarya

all eukaryotic cells (cell type)

Four Kingdoms:

	(cell arrangement)	(nutrition)
Protista	unicellular	all types*
Plantae	multicellular*	photosynthetic
Mycota (Fungi)	multicellular	absorptive hetero-
Animalia	multicellular	ingestive hetero-

Domain Eukarya

Kingdom Protista

Single-celled (eukaryotic) organisms

Protozoa (Gr. early animals) ingestive heterotrophs

Movement:

pseudopod	*Amoeba*	
cilia	*Paramecium, Tetrahymena*	
flagellum	*Trypanosoma*	(sleeping sickness)
none	*Plasmodium*	(malaria)

Algae (photosynthetic) *Euglena* (plant kingdom

Fig. 6-5

Domain Eukarya

Kingdom Protista

Single-celled (eukaryotic) organisms

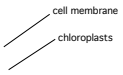
Protozoa ingestive heterotrophs

(G. early animals

Algae photosynthetic *Euglena* (plant kingdom?)

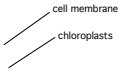
Algae

Euglena



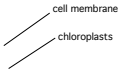
Algae

Euglena



Algae

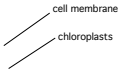
"red tide"



Algae

"red tide"

diatoms

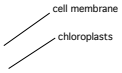


Algae

"red tide"

diatoms

"seaweeds"



Skip plants

Domain Eukarya
Kingdom Plantae **the "producers"**

eukaryotic cells:
with chloroplasts (chlorophyll; photosynthetic)
and cell wall (containing cellulose)

Domain Eukarya
Kingdom Plantae the "producers"

aquatic algae and seaweeds

Domain Eukarya
Kingdom Plantae the "producers"

aquatic algae and seaweeds
non-vascular bryophytes (mosses etc.,)
small
moist climates

Domain Eukarya
Kingdom Plantae the "producers"

aquatic algae and seaweeds
non-vascular bryophytes (mosses etc.,)
small
moist climates

Domain Eukarya
Kingdom Plantae

another
bryophyte

Domain Eukarya
Kingdom Plantae the "producers"

aquatic algae
non-vascular bryophytes (mosses etc.,)
vascular specialized tissues/organs
no seeds ferns
"naked" seeds gymnosperms
covered seeds angiosperms

Domain Eukarya
Kingdom Plantae the "producers"

aquatic algae
non-vascular bryophytes (mosses etc.,)
vascular specialized tissues/organs
no seeds ferns etc.,
"naked" seeds gymnosperms
covered seeds angiosperms

fern horsetail

family pictures

"how I spent my summer vacation"

Domain Eukarya
Kingdom Plantae — the "producers"

- aquatic — algae
- non-vascular — bryophytes (mosses etc.,)
- vascular — specialized tissues/organs
  - no seeds — ferns etc.,
    - seeds: embryo, food, protective covering
  - covered seeds — angiosperms

Domain Eukarya
Kingdom Plantae — the "producers"

- aquatic — algae
- non-vascular — bryophytes (mosses etc.,)
- vascular — specialized tissues/organs
  - no seeds — ferns etc.,
  - "naked" seeds — gymnosperms
  - covered seeds — angiosperms

fern horsetail gymnosperm (pine tree)

Domain Eukarya
Kingdom Plantae — the "producers"

- aquatic — algae
- non-vascular — bryophytes (mosses etc.,)
- vascular — specialized tissues/organs
  - no seeds — ferns etc.,
  - "naked" seeds — gymnosperms
  - covered seeds — angiosperms (flowering plants)

Domain Eukarya
Kingdom Plantae — the "producers"

- aquatic — algae
- non-vascular — bryophytes (mosses etc.,)
- vascular — specialized tissues/organs
  - no seeds — ferns etc.,
  - "naked" seeds — gymnosperms
  - covered seeds — angiosperms (flowering plants)
    - seeds covered by fruit (from ovary of flower)

Figs. 6-8 to 6-10

Domain Eukarya
Kingdom Plantae

benefits:
- food/O_2
- fiber
- wood/paper
- coal
- medicines

long , thin cylinders of cytoplasm
hyphae form a mycelium

Domain Eukarya

Kingdom Mycota (fungi) the "decomposers"

eukaryotic cells
absorptive heterotrophs
hyphae
spores dispersal

Domain Eukarya

Kingdom Mycota (fungi)

benefits/harms
food
diseases (human, plant)
decompose waste

SOME REVIEW/PERSPECTIVE

Chapter 6
Taxonomy

A. Hierarchy

Domain
Kingdom
Phylum
Class
Order
Family
Genus
species

scientific name:
binomial, Latin
commom name

B. Taxonomic Theory

different groups (taxa)
cladistics
anatomical / molecular /evolutionary relationships

C. Different Cell types

Prokaryotic
Eukaryotic
Animal
Plant
Table of comparison (pg 171)

D. Different nutritions

Autotrophic vs. heterotrophic
Ingestive vs. absorptive
Cellular respiration vs. photosynthesis

$Glucose + O_2 \longrightarrow CO_2 + H_2O + ATP$ (er

Sunlight energy $+ CO_2 + H_2O \longrightarrow Glucose + O_2$

E. Three domains: Six Kingdoms

Archaea	Archaea
Eubacteria	Eubacteria
Eukarya	
	Protista
	Plantae
	Mycota
	Animalia

Make a table showing major differences

F. Archaea

Bacteria that live in unusual environments

G. Eubacteria

common bacteria
different shapes/arrangements/cell walls
symbiosis (examples)
benefit/ harm

H. Protista

Single cell eukaryotic
Protozoa grouped by locomotion
Amoeba, Paramecium, Tetrahymena, Euglena
(red tides, diatoms, seaweeds)

I. Plantae the "producers"

Eukaryotic cells with cell walls and chloroplasts

1. Aquatic (seaweeds and algae)
2. Non-vascular Bryophytes (mosses)
   Vascular
3. Non-seeded Pterophyta (ferns)
   Seeded
4. Uncovered seeds gymnosperms
5. Covered seeds angiosperms
   Seed dispersal

J. Mycota (Fungi)

Eukaryotic cells, hyphae
Absorptive heterotrophs (the "decomposers")
Examples/Benefits/Harms

Domain Eukarya

K. Kingdom Animalia

eukaryotic cells, multicellular

ingestive heterotrophs "consumers"

lots of diversity

- symmetry
- digestive system
- layers
- cavities
- cephalization, embryo, organization, segmentation

Animalia Phylum	Feature:	ID #	* body cavity	cephalization	** digestive plan	* embryo type
Annelida	Seg. worms	1	yes	yes	tube	protostome
Arthopoda		2	yes	yes	tube	protostome
Chordata		3	yes	yes	tube	deuterostome
Cnidaria		4	none	yes	sac	-
Echinodermata		5	yes	no	tube	deuterostome
Mollusca		6	yes	no	tube	protostome
Nematoda	Round worms	7	false	no	tube	-
Platyhelminthes	Flat worms	8	none	some	sac	-
Porifera		9	none	no	sac	-

Animalia Phylum	Feature:	ID #	** layers	** organization	segmentation	* symmetry
Annelida	Seg. worms	1	3	organ systems	yes	bilateral
Arthopoda		2	3	organ systems	yes	bilateral
Chordata		3	3	organ systems	yes	bilateral
Cnidaria		4	2	tissues	no	raidal
Echinodermata		5	3	organ systems	??	biradial
Mollusca		6	3	organ systems	no	bilateral
Nematoda	Round worms	7	3	organ systems	no	bilateral
Platyhelminthes	Flat worms	8	3	organ systems	no	bilateral
Porifera		9	none	cellular	no	asymmetry

ID #	Chordates	____-blooded	# of heart chambers	gas exchange	skeleton	Jaws
10	amphibians	cold	3	gills/lungs	bony	yes
11	birds	warm	4	lungs	bony	yes
12	bony fish	cold	2	gills	bony	yes
13	cartilagenous fish	cold	2	gills	cartilage	yes
14	jawless fish	cold	2	gills	cartilage	none
15	mammals	warm	4	lungs	bony	yes
16	reptiles	cold	3(4)	lungs	bony	yes

Annelida: Earthworms

Fig 30.14

Other Annelids

leeches

clam worms

Annelida: leeches

Fig. 30A

Arthropod: diversity

Fig 30.19

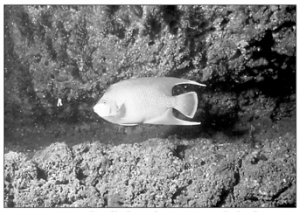
Arthropod: diversity

Fig 30.15

Chordata: Amphibians

Chordata: Birds

Chordata: Bony fish



Queen angle fish (class Osteichthyes)

Figure 6-18 (1) Biology Today, 1/e (© 2004 Garland Science)

Chordata: Cartilagenous fish

sharks

Chordata: Cartilagenous fish

skates

Chordata: Cartilagenous fish

skates

Chordata: Cartilagenous fish

rays

Chordata: Jawless fish

Chordata: Jawless fish

lamprey

Chordata: Mammals

Sub-class: monotremes

duckbill platypus spiny anteater

Chordata: Mammals

Sub-class: marsupials

koala bear kangaroo

opposum

Chordata: Mammals

Sub-class: placentals

Chordata: Reptiles

Chordata: Reptiles

Chordata: Reptiles

Cnidaria

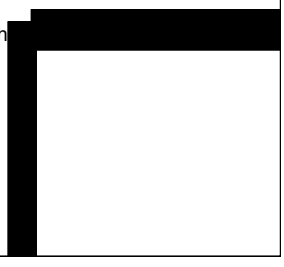
- sea anenome

Cnidaria

- *Hydra*

Cnidaria

- jellyfish



Cnidaria

- coral

Cnidaria

Echinodermata

Examples:

sea star

Echinodermata

Examples:

sea star
sea urchin

Echinodermata

Examples:

sea star
sea urchin
sand dollar

Echinodermata

Examples:

sea star
sea urchin
sand dollar
sea cucumber

Mollusca diversity

Mollusca diversity

Nematoda (Roundworms)

Nematoda (Roundworms)

Acaris

Fig 30.9

Nematoda (Roundworms)

Trichinella pork

Fig 30.9

Nematoda (Roundworms)

Filarial worm elephantiasis

Fig 30.9

Nematoda (Roundworms)

Filarial worm elephantiasis

Fig 30.9

Platyhelminthes: (flatworms)

Platyhelminthes (flatworms)

Three classes:

Free living: planarians
Parasitic: flukes
tapeworms

Platyhelminthes (flatworms)

Three classes:

Free living: planarians
Parasitic: flukes
tapeworms

Platyhelminthes (flatworms)

Three classes:

Free living: planarians
Parasitic: flukes
tapeworms

Porifera (Sponges)

Animalia Phylum	Feature:	ID #	** body cavity	cephalization	** digestive plan	* embryo type
Annelida	Seg. worms	1	yes	yes	tube	protostome
Arthopoda	"jointed legs"	2	yes	yes	tube	protostome
Chordata	"vertebrates"	3	yes	yes	tube	deuterostome
Cnidaria	stinging cells	4	none	yes	sac	-
Echinodermata	"spiny skin"	5	yes	no	tube	deuterostome
Mollusca	soft bodies	6	yes	no	tube	protostome
Nematoda	Round worms	7	false	no	tube	-
Platyhelminthes	Flat worms	8	none	some	sac	-
Porifera	sponges	9	none	no	sac	-

Make a tree with groups, subgroups, etc., with simple on bottom, more complex as you move up

Animalia Phylum	Feature:	ID #	** layers	** organization	segmentation	* symmetry
Annelida	Seg. worms	1	3	organ systems	yes	bilateral
Arthopoda	"jointed legs"	2	3	organ systems	yes	bilateral
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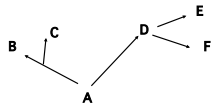
Cnidaria	stinging cells	4	2	tissues	no	raidal
Echinodermata	"spiny skin"	5	3	organ systems	??	biradial
Mollusca	soft bodies	6	3	organ systems	no	bilateral
Nematoda	Round worms	7	3	organ systems	no	bilateral
Platyhelminthes	Flat worms	8	3	organ systems	no	bilateral
Porifera	sponges	9	none	cellular	no	asymmetry

Draw a diagram showing relationships between different groups (similar groups should be close together...)



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12	bony fish	cold	2	gills	bony	yes
13	cartilagenous fish	cold	2	gills	cartilage	yes
14	jawless fish	cold	2	gills	cartilage	none
15	mammals	warm	4	lungs	bony	yes
16	reptiles	cold	3(4)	lungs	bony	yes

3 Chordates
5 Echinoderms

2 Arthropoda
2 Annelida
6 Mollusca

7 Nematoda
8 Flatworms
4 Cnidaria
9 Sponges

ID #	Chordates	____-blooded	# of heart chambers	gas exchange	skeleton	Jaws
10	amphibians	cold	3	gills/lungs	bony	yes
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14	jawless fish	cold	2	gills	cartilage	none
15	mammals	warm	4	lungs	bony	yes
16	reptiles	cold	3(4)	lungs	bony	yes

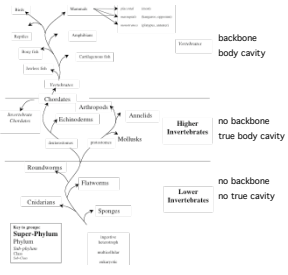
11 birds
16 reptiles
10 amphibians
12 bony fish
13 cart. fish
14 jawless fish

15 mammals

3 Chordates
5 Echinoderms

2 Arthropoda
2 Annelida
6 Mollusca

7 Nematoda
8 Flatworms
4 Cnidaria
9 Sponges



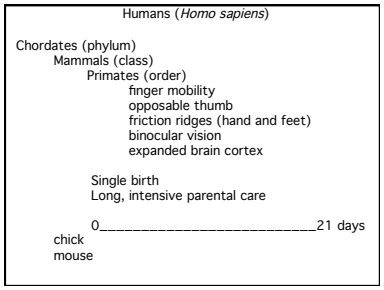
K. Animalia

Eucaryotic cells
Ingestive heterotrophs

Some basic characteristics:
Symmetry (3 types)
Digestive system (2 types)
Layers (none, 2 or 3)
Cavity (none false, real)
Organizational level (cells, tissues, organs)
Cephalization
Segmentation
Embryo organization

K. Animalia

Nine Phyla
Distinctive characteristics and examples from each
Porifera
Cnidaria
Flatworms (Platyhelminthes)
Roundworms (Nematoda)
Mollusca
Annelida
Arthropoda
Echinodermata
Chordata
(7 classes too)


Humans (*Homo sapiens*)
Chordates (phylum)
Mammals (class)
Primates (order)
finger mobility
opposable thumb
friction ridges (hand and feet)
binocular vision
expanded brain cortex
Single birth
Long, intensive parental care
0_____21 days
chick
mouse