

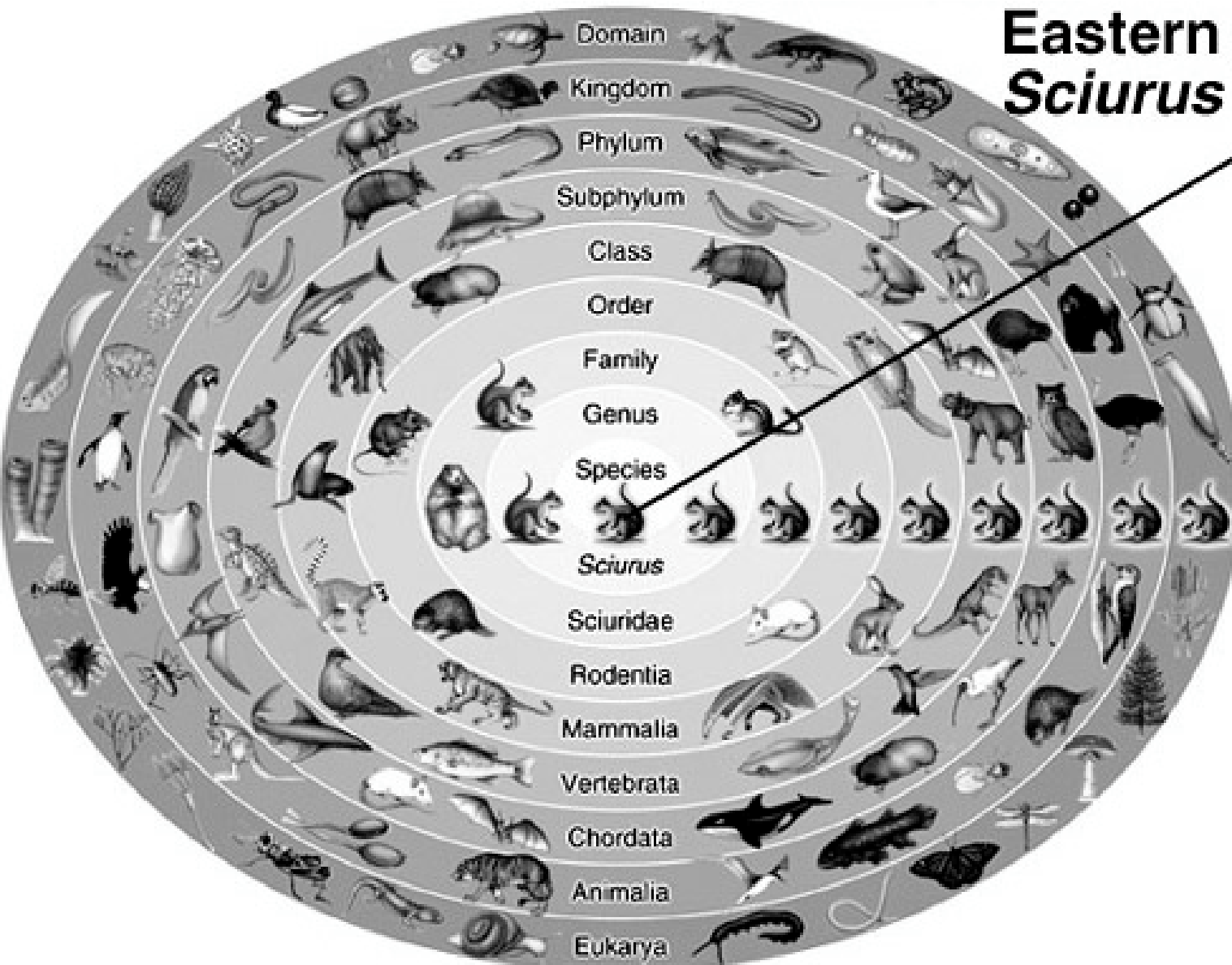
Diversity of Life

Classification - an organized scheme for grouping organisms
- a tool for communication -

Hierarchical - a series of successive and inclusive rankings

- Domain - the highest rank - contains one or more kingdoms
- Kingdom - contains one or more phyla
- Phylum - contains one or more classes
- Class - contains one or more orders
- Order - contains one or more families
- Family - contains one or more genera
- Genus - contains one or more species
- Species - a group of potentially interbreeding organisms that are reproductively isolated from all other organisms

Hierarchical System of Organism Classification

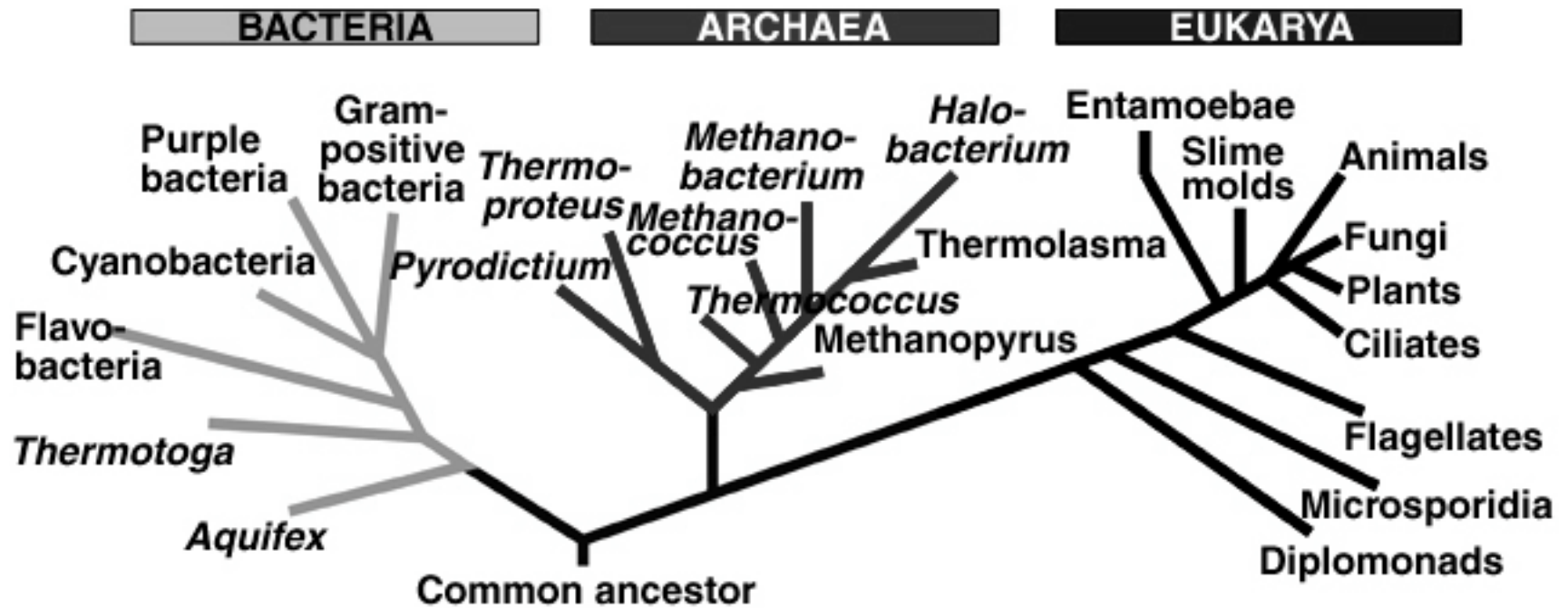


Eastern gray squirrel
Sciurus carolinensis

Hierarchies can be represented as trees:

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Tree of Life

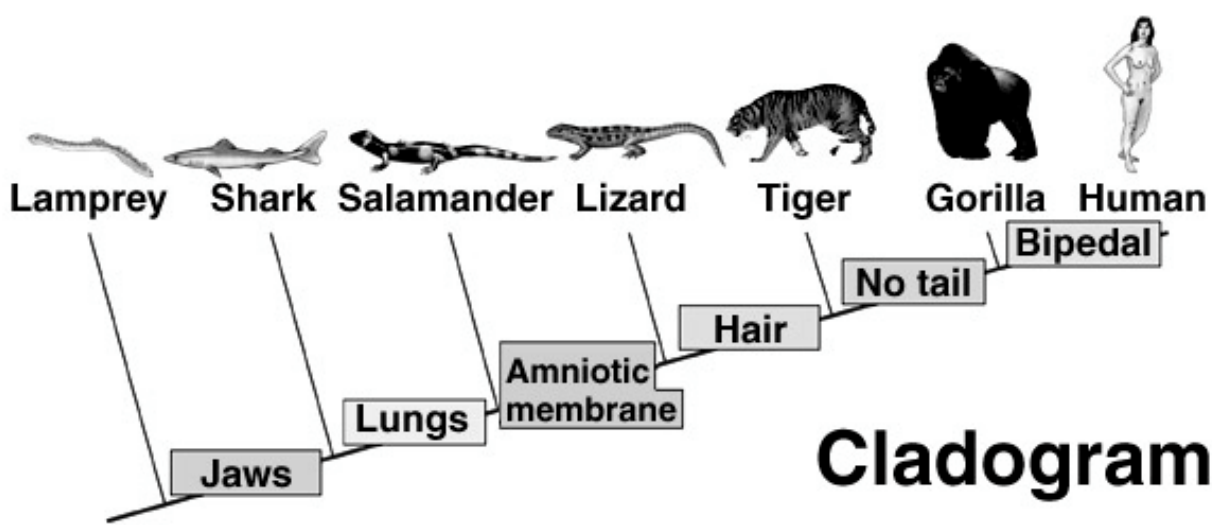


Trees and classifications can be based on estimates of evolutionary relatedness.

The modern method bases estimates on shared derived characteristics (synapomorphies).

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Traits: Organism	Jaws	Lungs	Amniotic membrane	Hair	No tail	Bipedal
Lamprey	0	0	0	0	0	0
Shark	1	0	0	0	0	0
Salamander	1	1	0	0	0	0
Lizard	1	1	1	0	0	0
Tiger	1	1	1	1	0	0
Gorilla	1	1	1	1	1	0
Human	1	1	1	1	1	1



This method assumes that complex characteristics evolve rarely. Thus, the presence of characteristics like amniotic development or lungs is an indication of descent from the original species that possessed them.

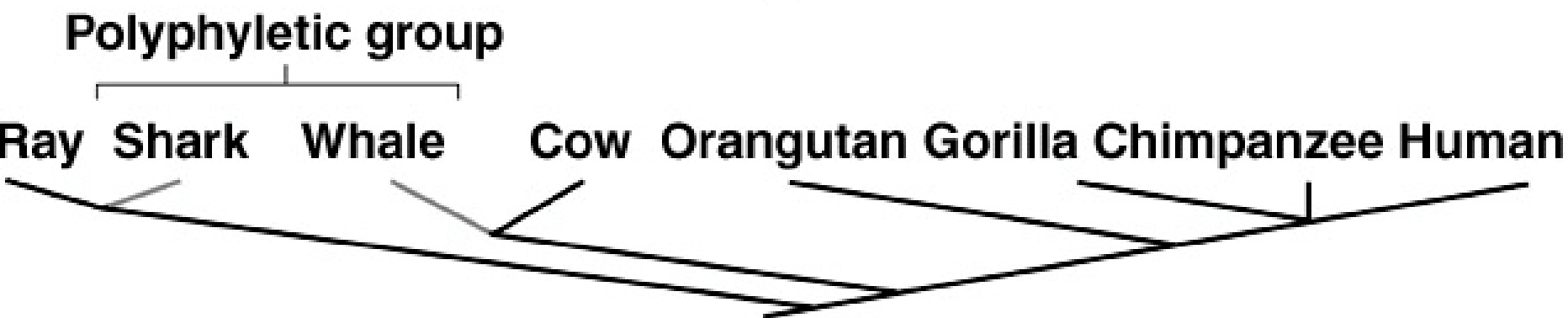
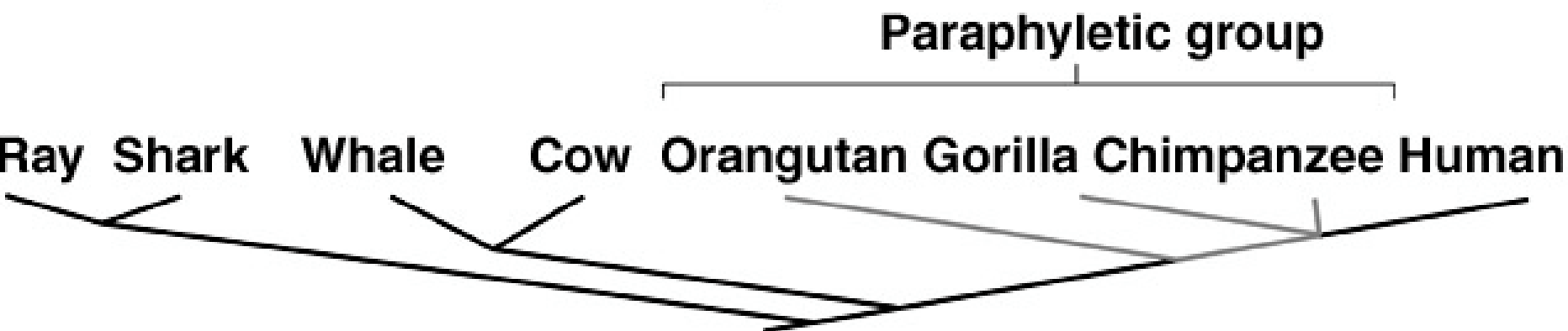
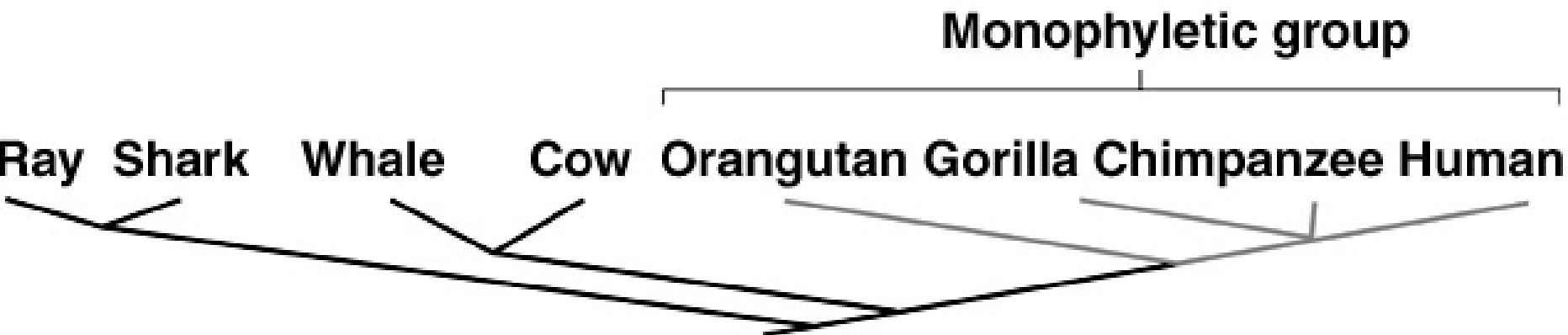
A tree that represents an estimate (hypothesis) of evolutionary relatedness is called a phylogeny

Classifications can be based on groupings within a phylogeny

Groupings can be categorized

- monophyletic - a group that includes all of the descendants of a single common ancestor
- paraphyletic - a group that includes some, but not all, of the descendants of a single common ancestor
- polyphyletic - a group that is not based on common ancestry

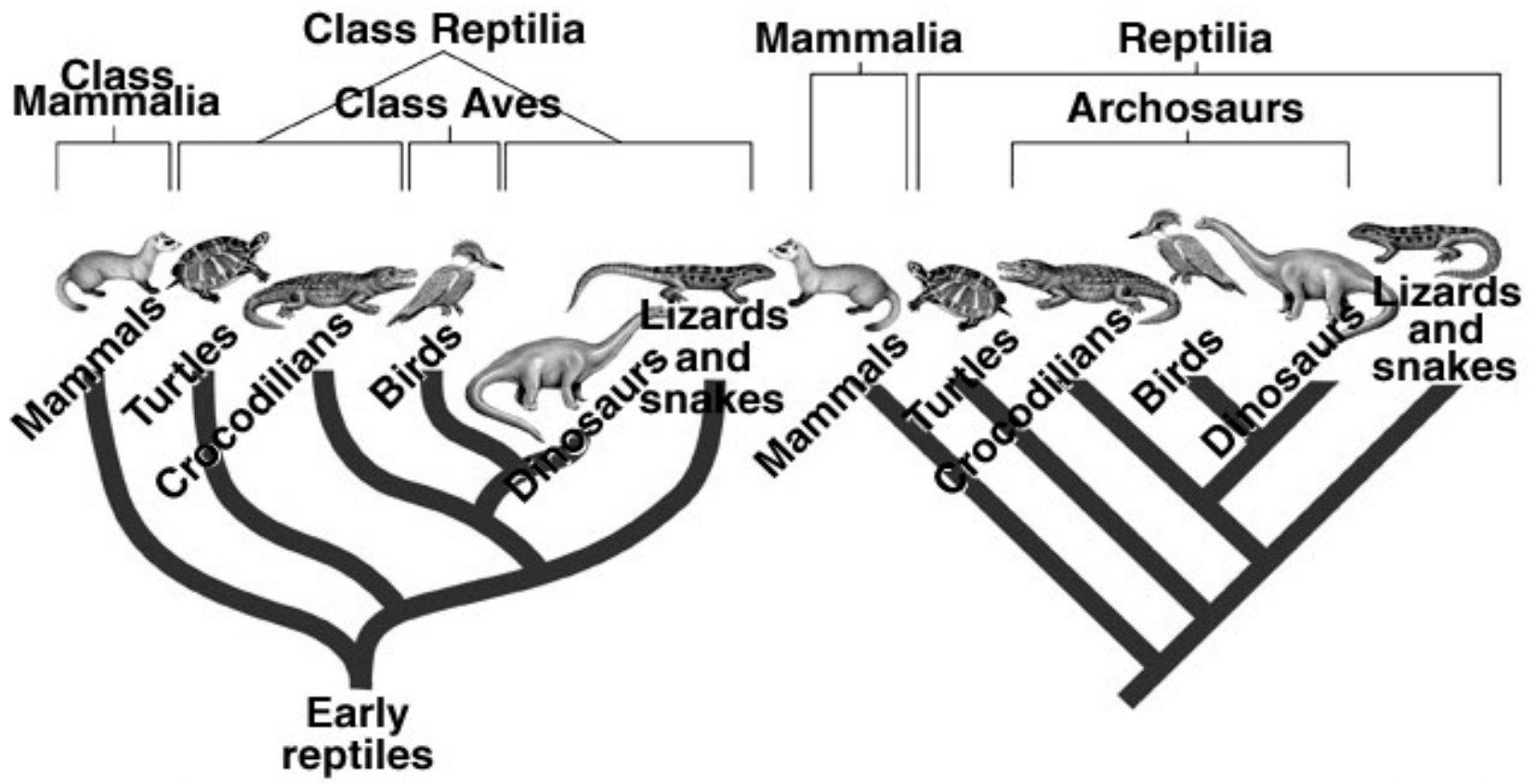
Three Groups of Phylogenies



The trend in modern classification is to create cladistic classification. Cladistic classifications include only monophyletic groups. Some rearrangements of long-established groups will result:

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Traditional Versus Cladistic Classification



Traditional phylogeny and taxonomic classification

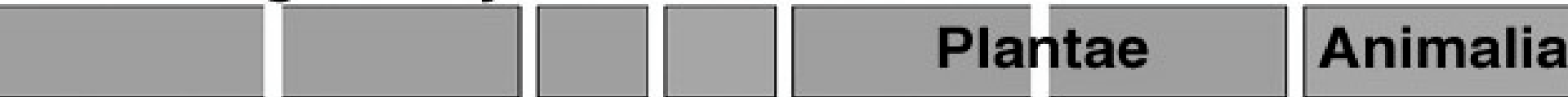
Cladogram and cladistic classification

Classifications through time:

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Approaches to Classifying Organisms

A two-kingdom system—Linnaeus



A five-kingdom system—Whittaker



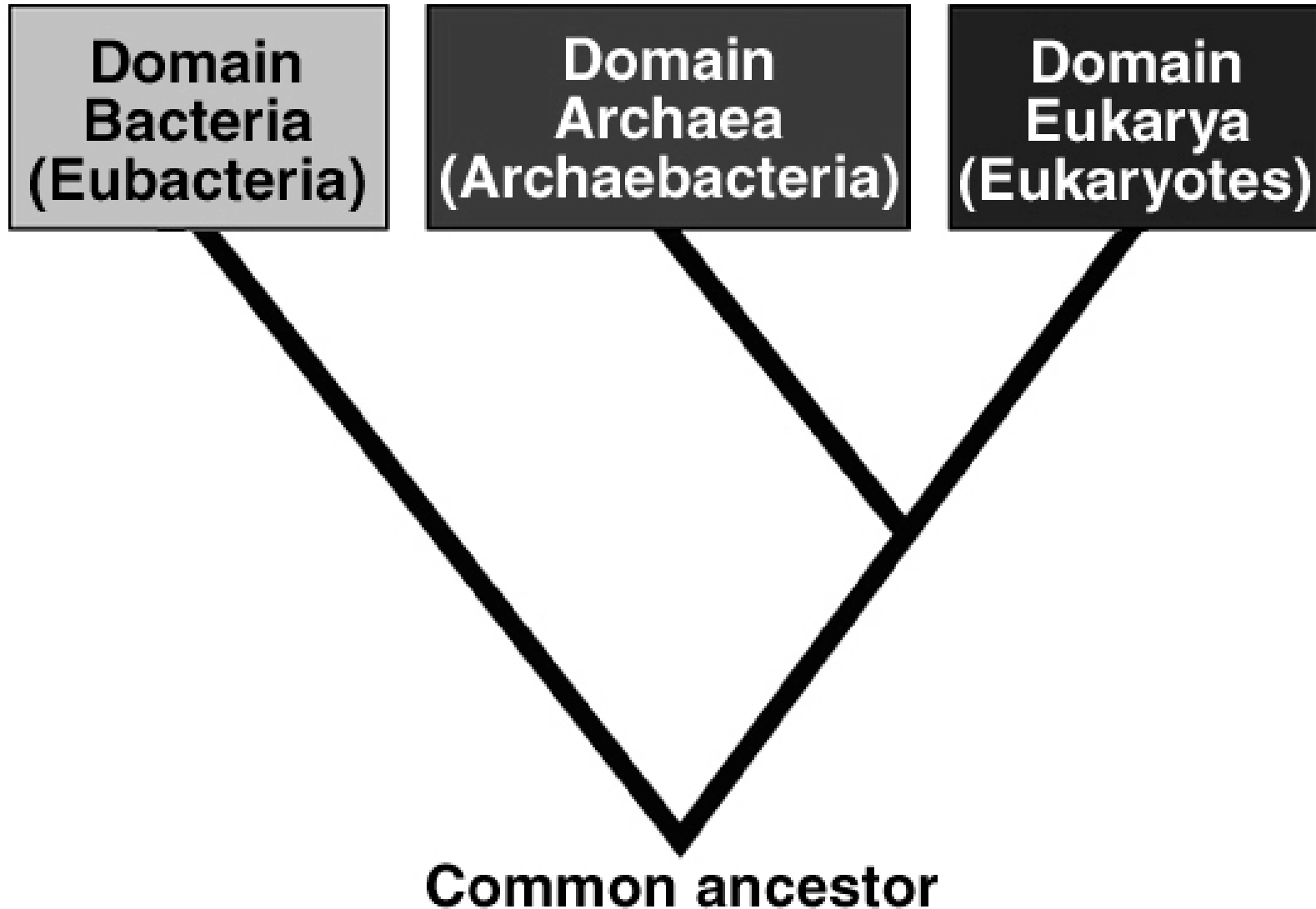
A six-kingdom system—Woese



A three-domain system—Woese



Evolutionary Relationships Among Domains



Bacteria and Archaeans are both prokaryotic:

- generally small and simple,
- lacking membrane bound organelles,
- no nuclear membrane,
- if present, flagella consist of a single fiber,
- genetic recombination occurs through
 - transformation, conjugation, or transduction

Bacteria and Archeans differ

- First amino acid in protein synthesis
- presence of introns in genes
- membrane lipid structure
- number of RNA polymerases
- peptidoglycan in cell wall
- response to some antibiotics

Bacteria

f-Met

No

unbranched

one

yes

sensitive

Archaea

Met

some

branched

several

no

insensitive

Bacteria

- source of many diseases in plants, fungi, and animals
- some are photosynthetic - purple sulfur bacteria, cyanobacteria
- some are anaerobes
- important decomposers in every habitat on earth

Archaea

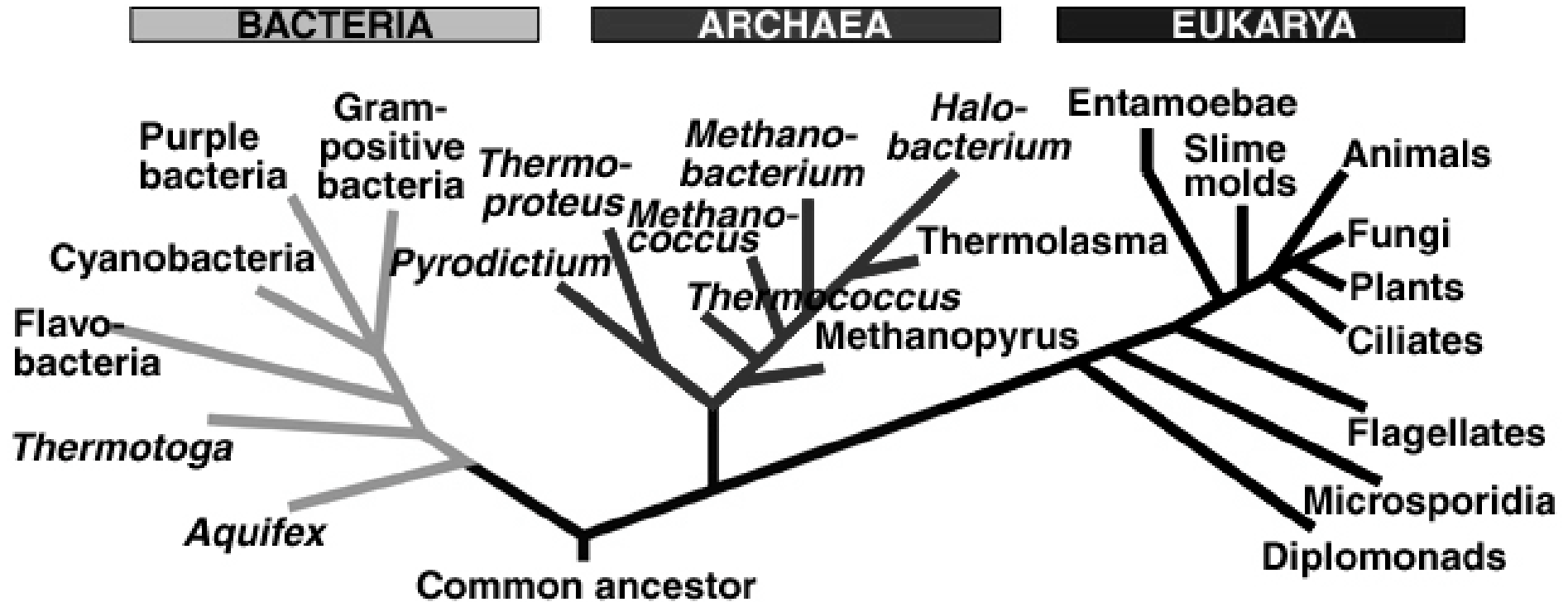
- many obligate anaerobes
- many live in extreme environments (extremophiles)
 - thermophiles
 - halophiles
 - methanogens

Archaeans share many characteristics with the Eukarya

- First amino acid is Met
- Genes with introns
- Several RNA polymerases
- Lack peptidoglycan in cell wall
- Insensitive to antibiotics

Feature	Domain		
	Archaea	Bacteria	Eukarya
Amino acid that initiates protein synthesis	Methionine	Formyl-methionine	Methionine
Introns	Present in some genes	Absent	Present
Membrane-bounded organelles	Absent	Absent	Present
Membrane lipid structure	Branched	Unbranched	Unbranched
Nuclear envelope	Absent	Absent	Present
Number of different RNA polymerases	Several	One	Several
Peptidoglycan in cell wall	Absent	Present	Absent
Response to the antibiotics streptomycin and chloram-	Growth not inhibited	Growth inhibited	Growth not inhibited

Tree of Life



Domain Eukarya - consists of four kingdoms

Kingdom Protista - diverse single celled organisms -
some colonial or with primitive multicellularity

nutritionally diverse -

autotrophic - photosynthetic

heterotrophic - both saprobes and ingesters

Kingdom Fungi - mushrooms, rusts, molds, etc. -

multicellular

saprobes - use extracellular digestion

cell walls made of chitin

immobile

Kingdom Plantae - plants

multicellular, cell walls made of cellulose

photosynthetic using chlorophyll a & b

immobile

Kingdom Animalia - animals

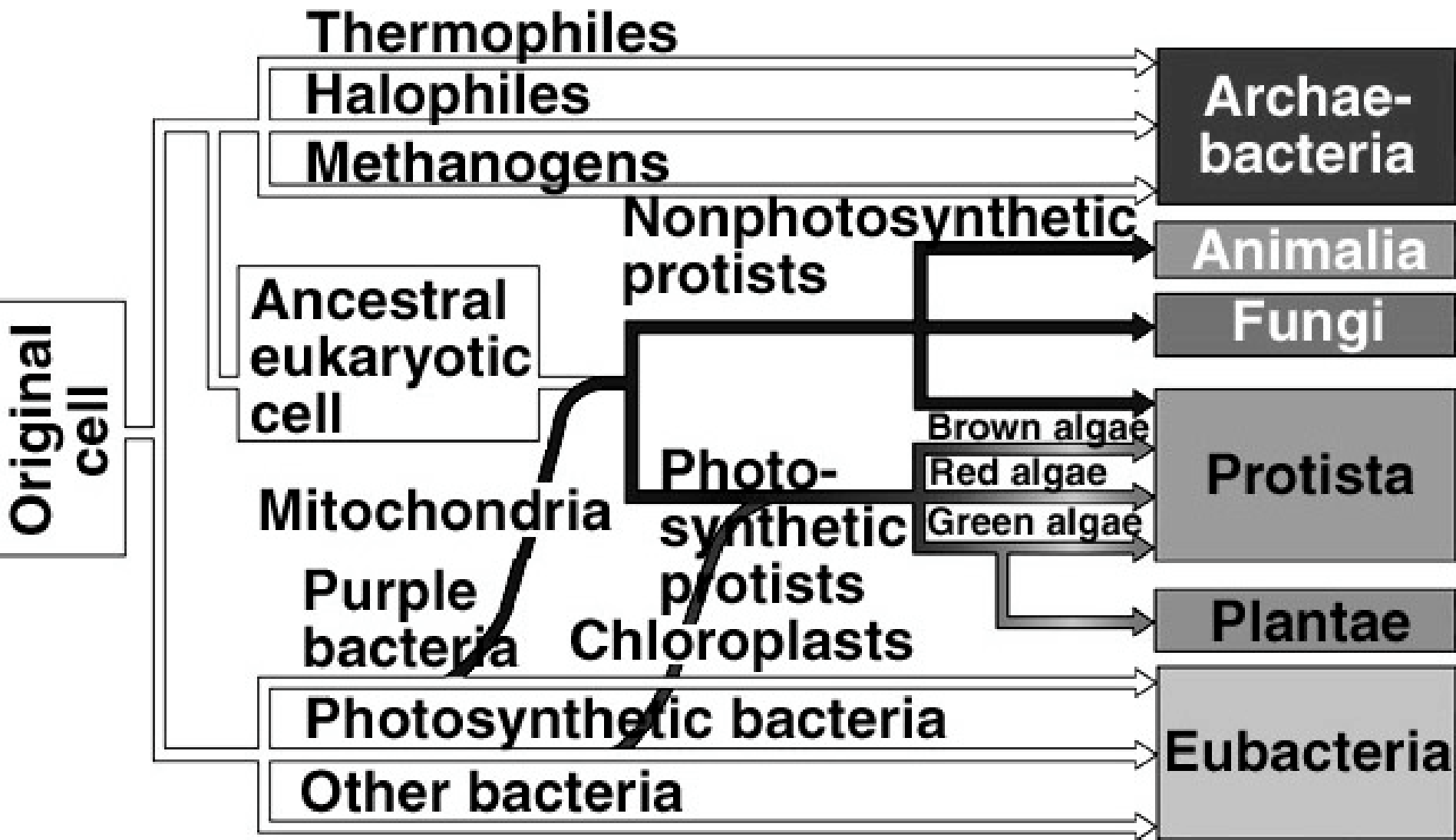
multicellular

lack cell walls

usually mobile

heterotrophic ingesters

Evolutionary Relationships Among Kingdoms

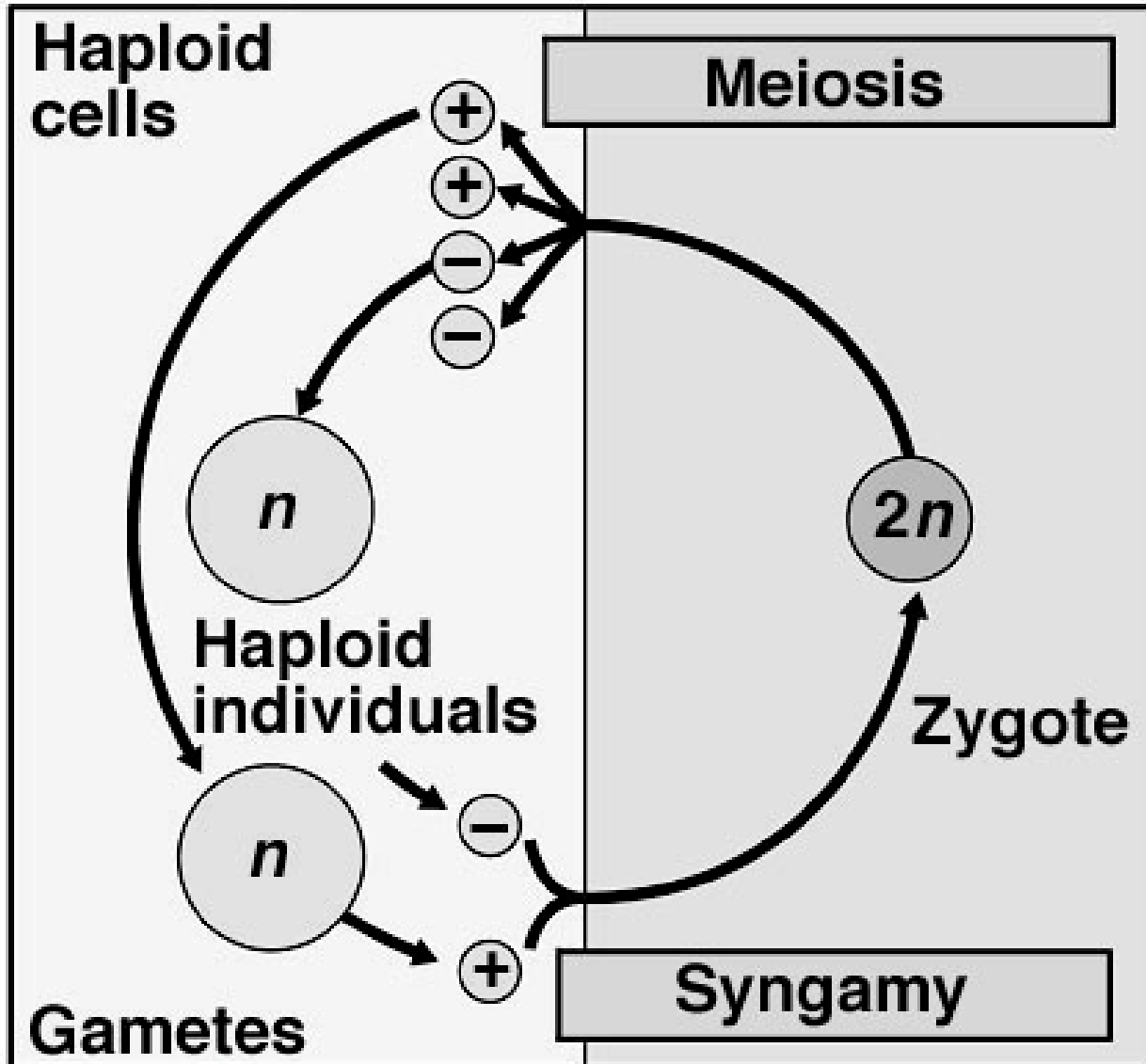


Sex is the hallmark of the Eukarya

- the combination of genetic information from two different sources - through syngamy
- life cycle consists of both a diploid stage and a haploid stage
- either stage may be multicellular or single celled

Zygotic Meiosis

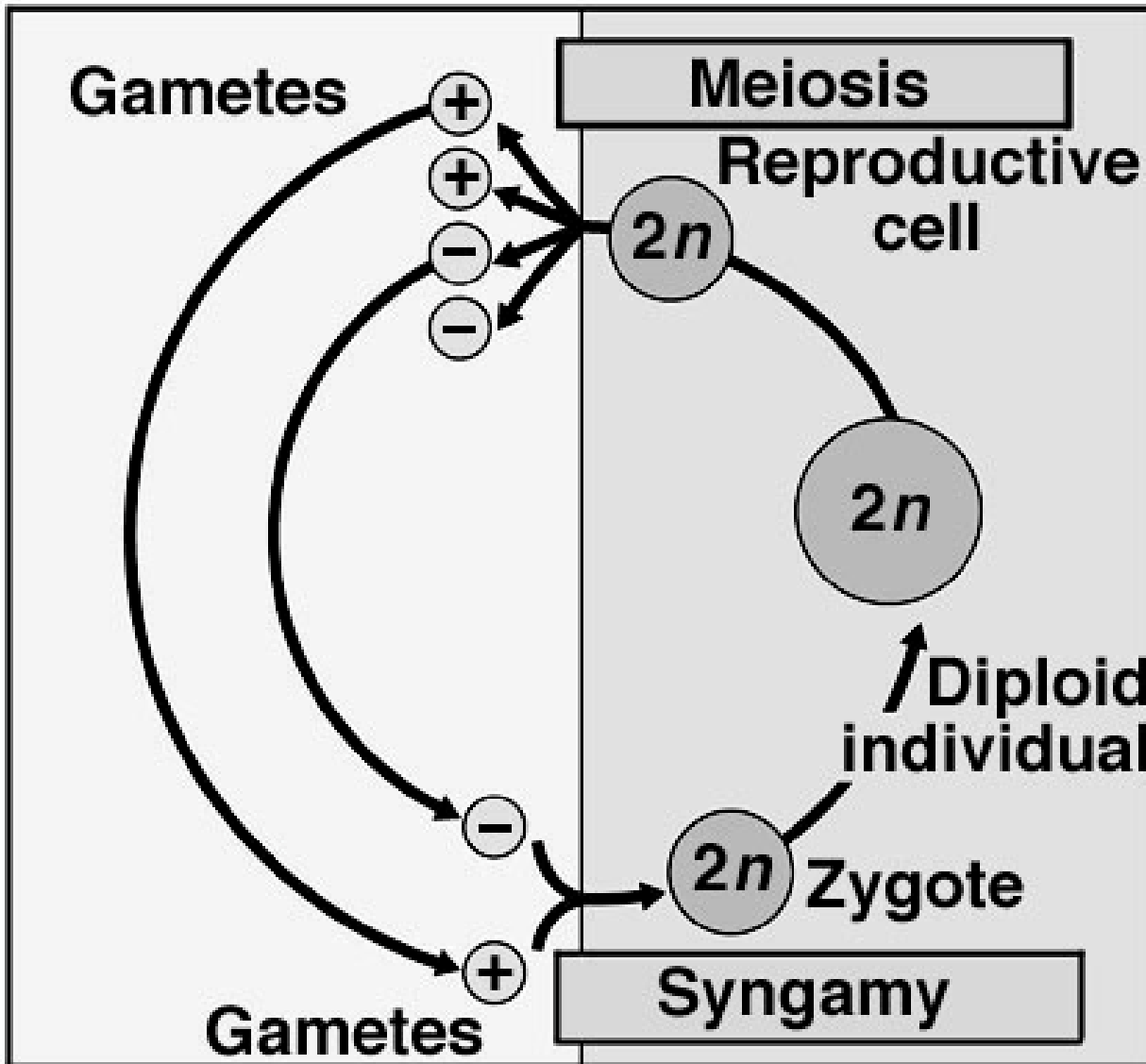
Key: Haploid Diploid



Seen in
Fungi and
algae

Gametic Meiosis

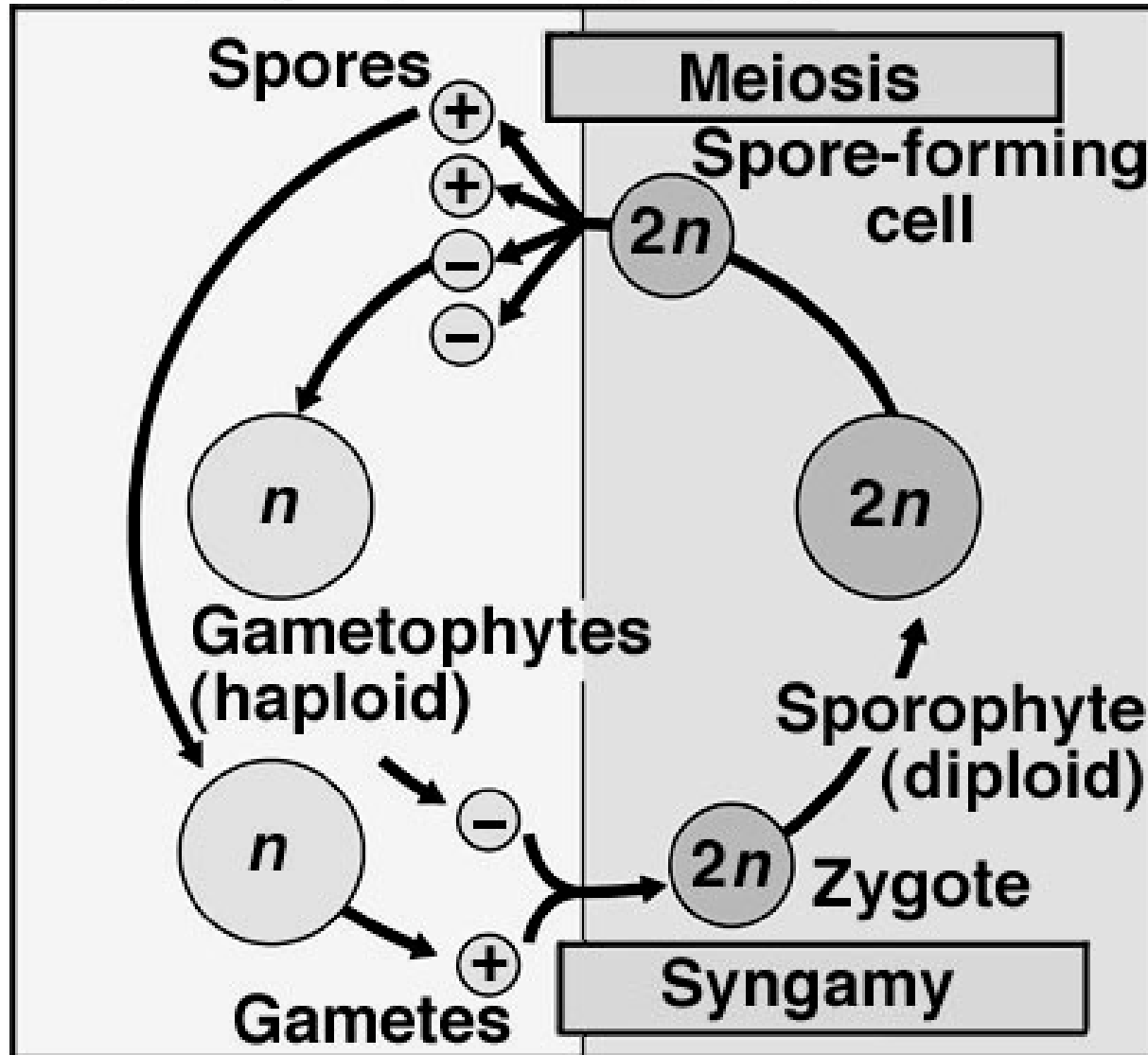
Key: Haploid Diploid



Seen in
Animals

Sporic Meiosis

Key: Haploid Diploid



Seen in plants and some fungi