Introduction to the

Biology of Marine Life

Ninth Edition

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Chapter 2

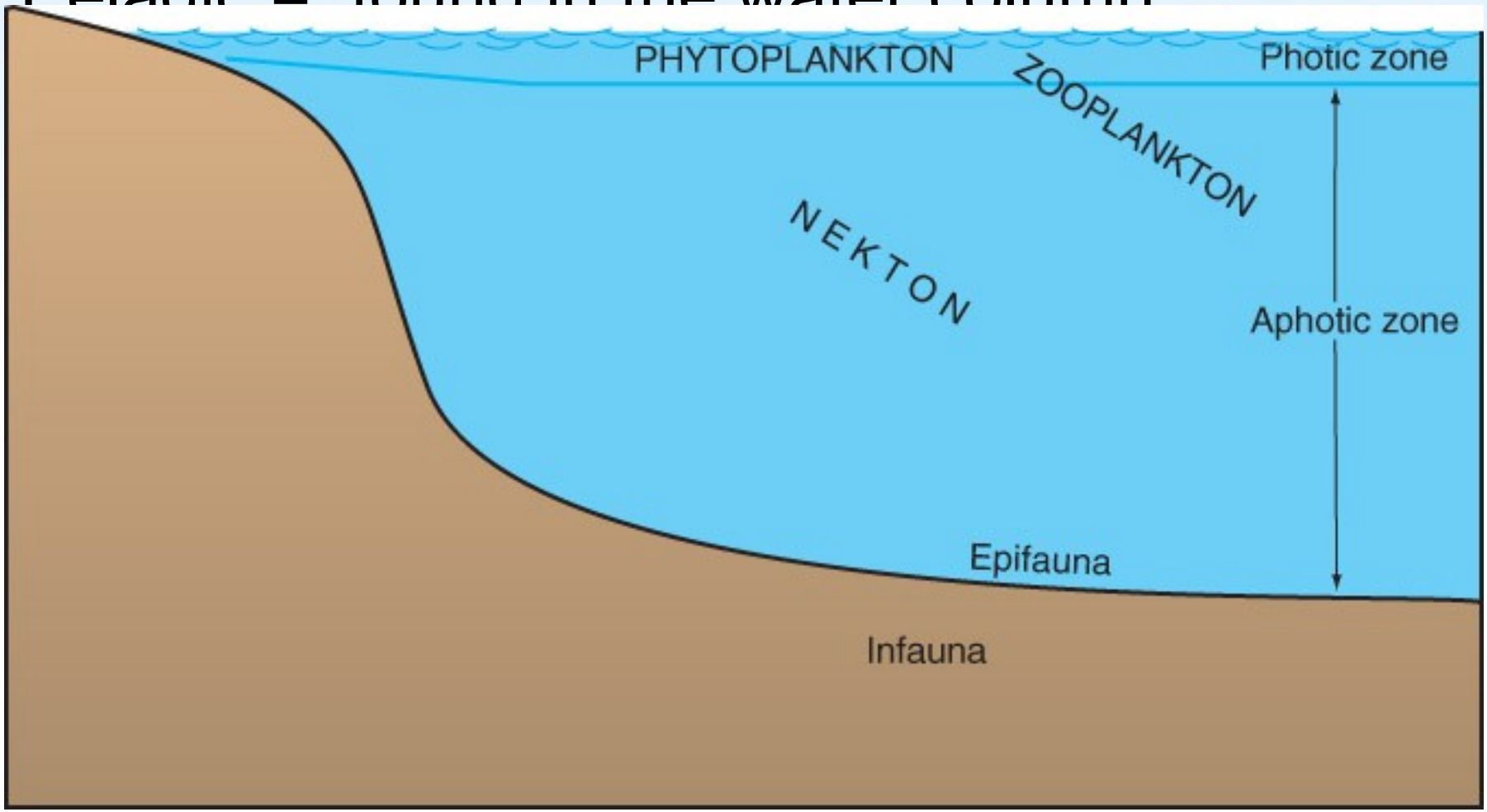
Patterns of Associations

This chapter presents three commonly used criteria for classifying marine organisms:

1. **geographic distribution**
2. **evolutionary interrelationships**
3. **trophic interactions**

1. Spatial Distribution – some terms!

Pelagic = found in the water column



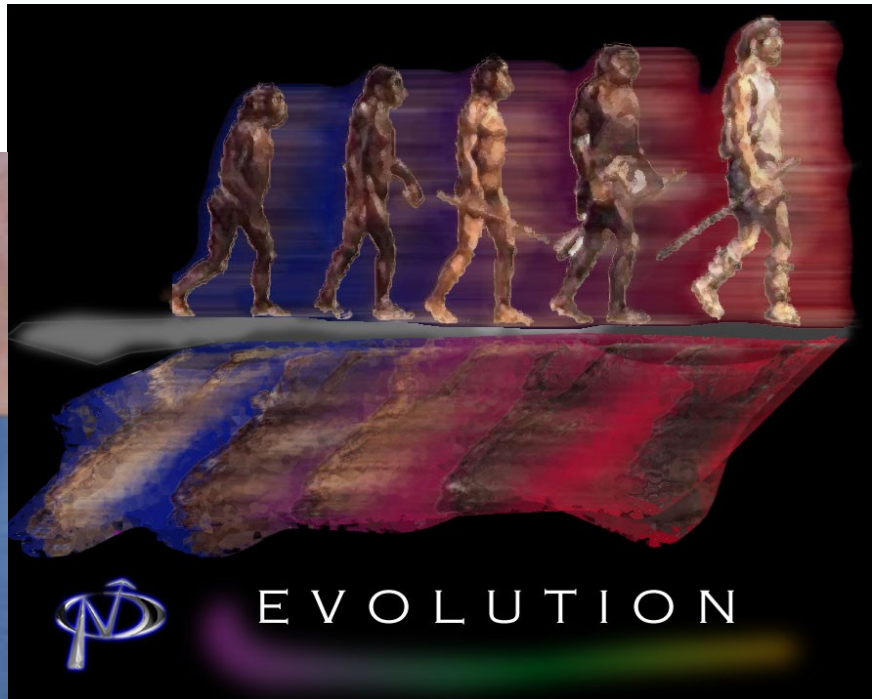
2. Evolutionary Relationships and Taxonomic Classification

Some more terms:

Evolution

Natural selection

Adaptive trait



Natural Selection/Evolution Example

Our society is getting taller. Why is this so? Read this article to get an idea!

http://www.timesonline.co.uk/tol/news/uk/article532535.ece

What's the adaptive trait? Or, in other words, what trait is being selected for in this "habitat"? Can this change???

Mutations


THE FACT THAT YOU WERE BORN IN A CHEMICAL DUMP DOESN'T MAKE YOU DIFFERENT.
MUELLER

Adaptive Trait

- Populations evolve, individuals don't!

2 os

a on

Cellular

Fission

Budding

s!!!

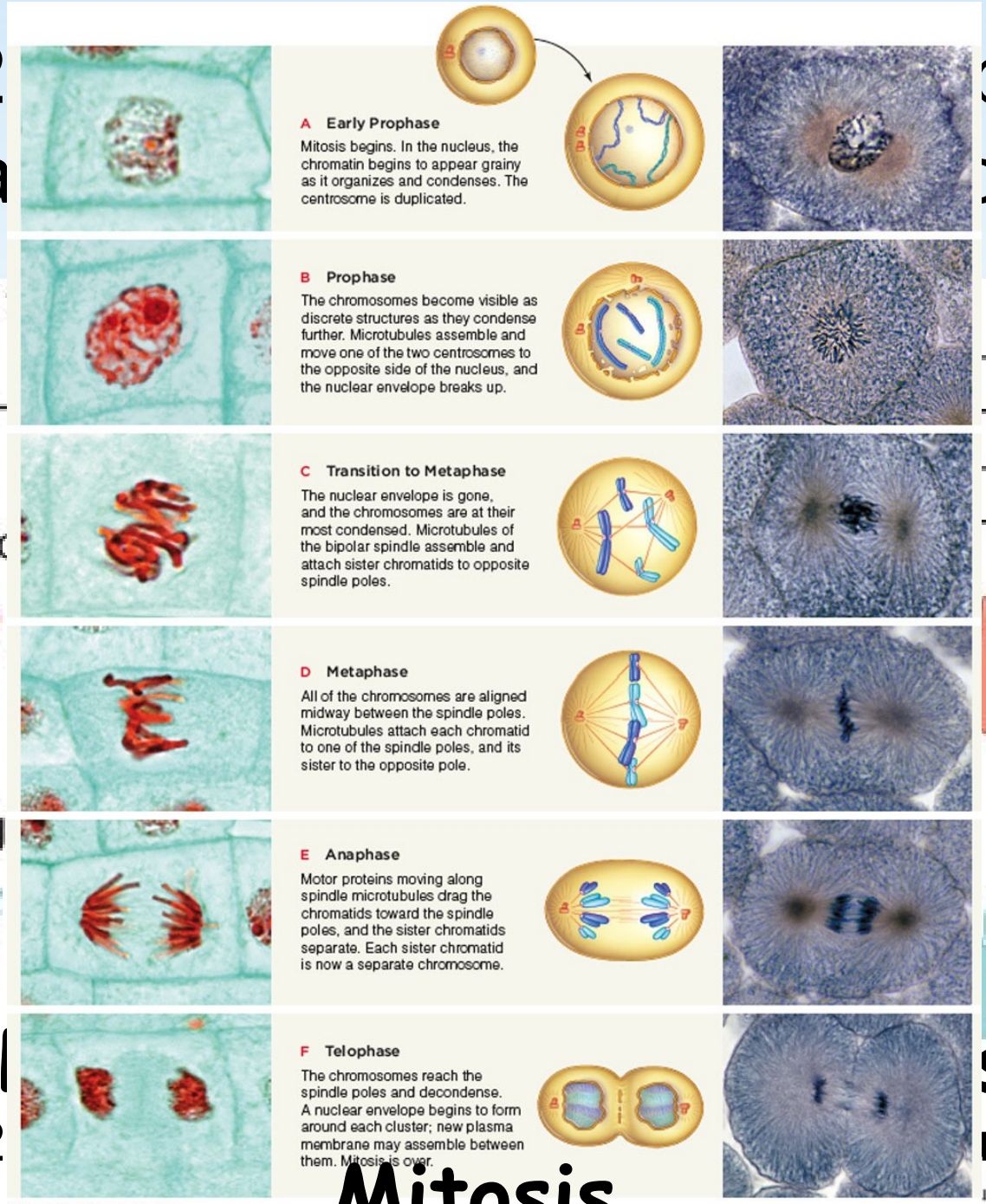


Fig. 2 uction.

Mitosis

Why Sex?

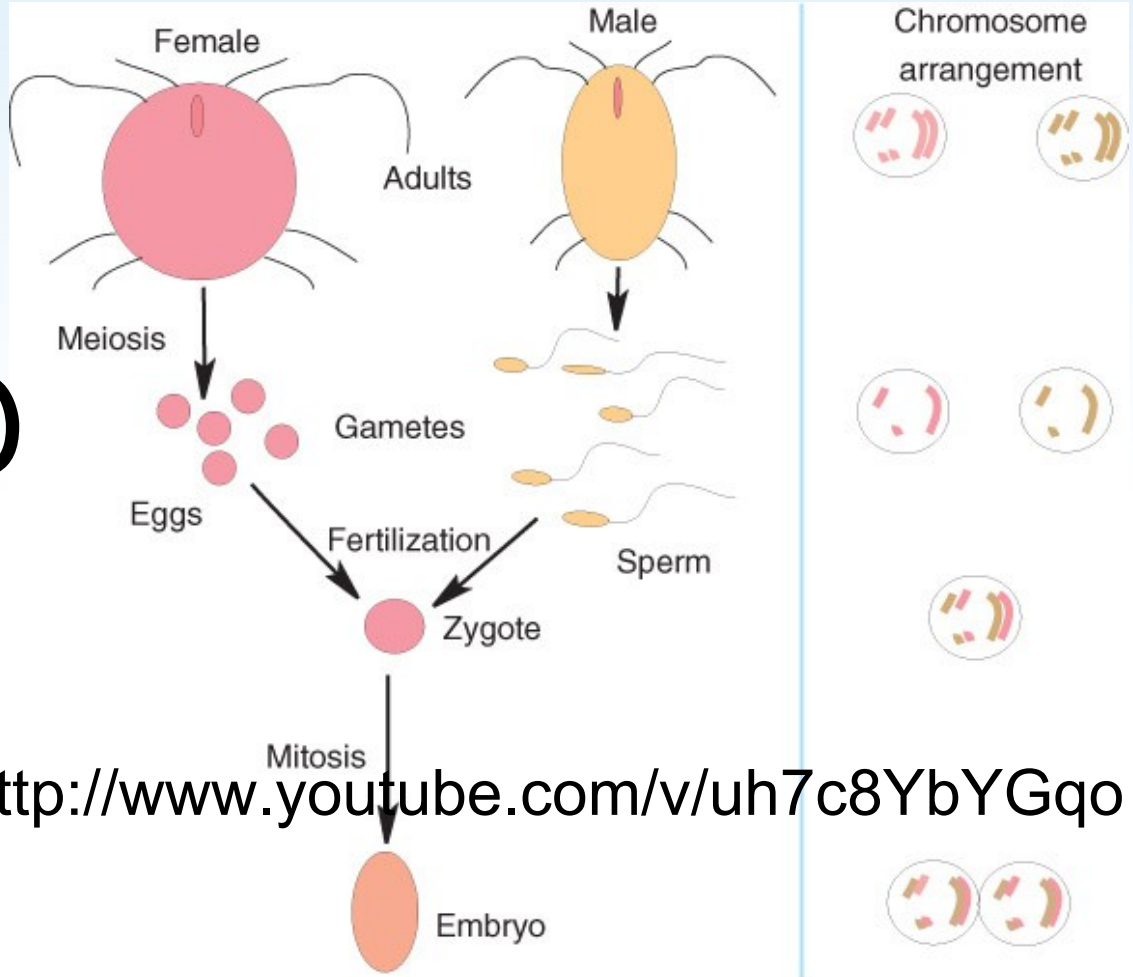
An adaptive trait tends to spread more quickly through a sexually reproducing population than through an asexually reproducing one

Evolutionary Relationships and Taxonomic Classification

Diploid to

Haploid (meiosis)

to
diploid



http://www.youtube.com/v/uh7c8YbYGqo

Parent ≠ child

Fig. 2.3 The basic components of sexual reproduction. The chromosome arrangement of each cell is shown to the right.

Evolutionary Relationships and Taxonomic Classification

Changes in individuals (mutations) which become adaptive traits leads to changes in populations (evolution) over time through natural selection…phew!!!

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Fig. 2.4 Tail slap of a killer whale directed at its sea lion prey.

Evolutionary Relationships and Taxonomic Classification

Evolutionary Adaptations

Differences in populations can lead to different species!

Table 2.1

A Comparison of Foraging-Related Differences Between Transient and Resident Killer Whales of the Pacific Northwest

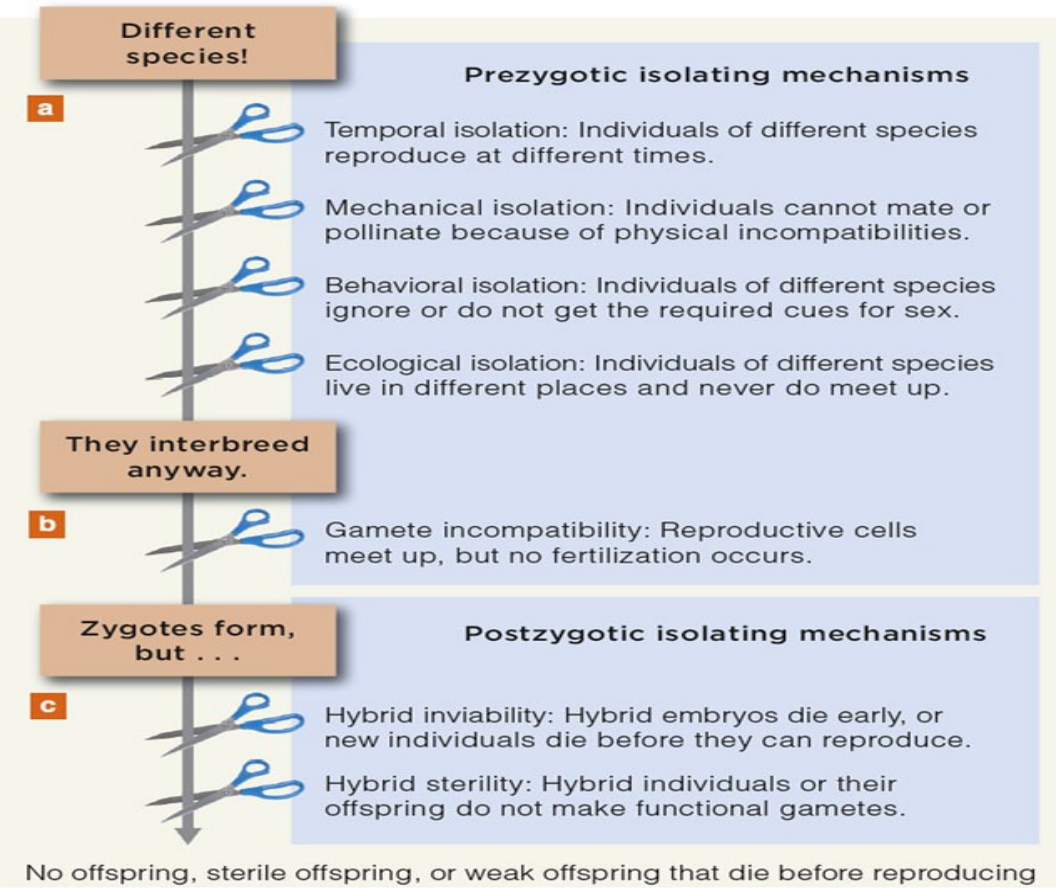
Character	Residents	Transients
Group size	Large (3–80)	Small (1–15)
Dive pattern	Short and consistent	Long and variable
Temporal occurrence	With salmon runs	Unpredictable
Foraging areas	Deep water	Shallow water
Vocalize when hunting?	Frequently	Less frequently
Prey type	Salmon and other fishes	Mammals
Relative prey size	Small	Large
Prey sharing	Usually no	Usually yes

Modified from Baird et al., 1992.

Reproductive Isolation

Reproductive isolating mechanisms evolve when gene flow between populations stops

Divergences may lead to new species



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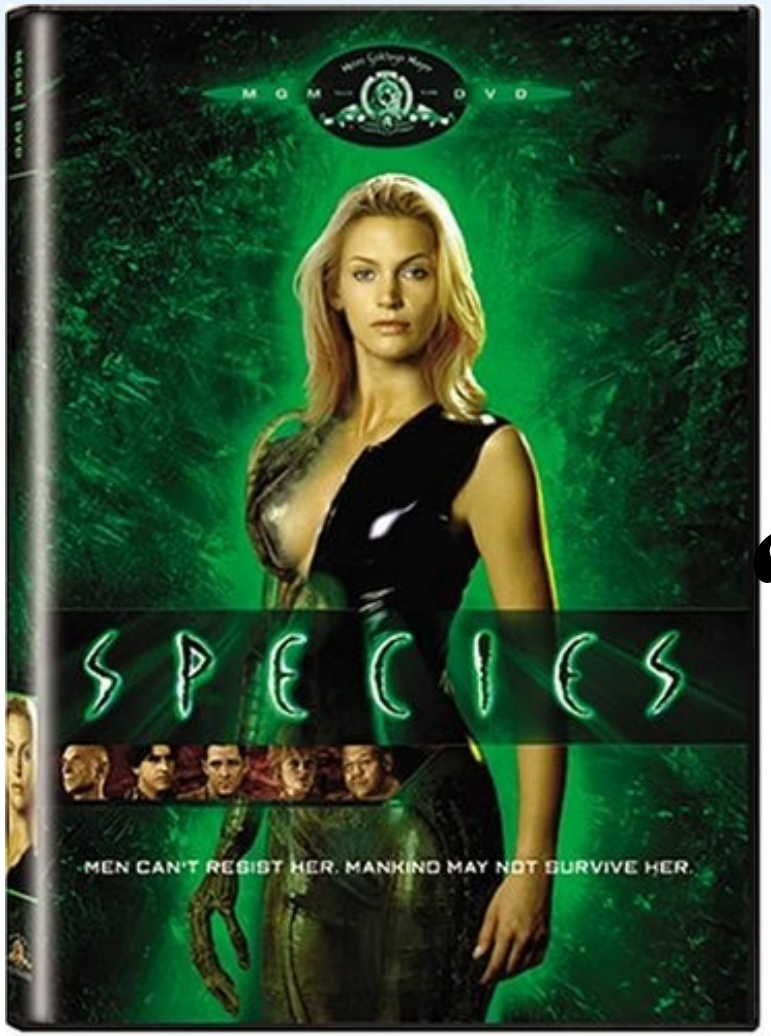

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Evolutionary Relationships and Taxonomic Classification

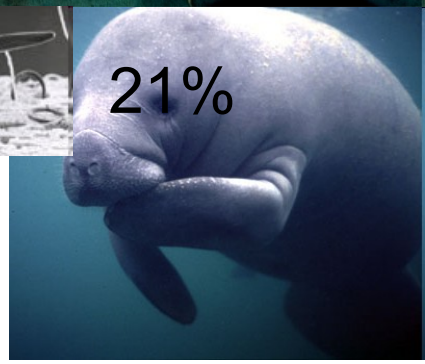
Taxonomy and Classification

Taxonomy

- The science of naming and classifying species

We group species based on what we know about their evolutionary relationships.

Evolutionary Relationships and Taxonomic Classification



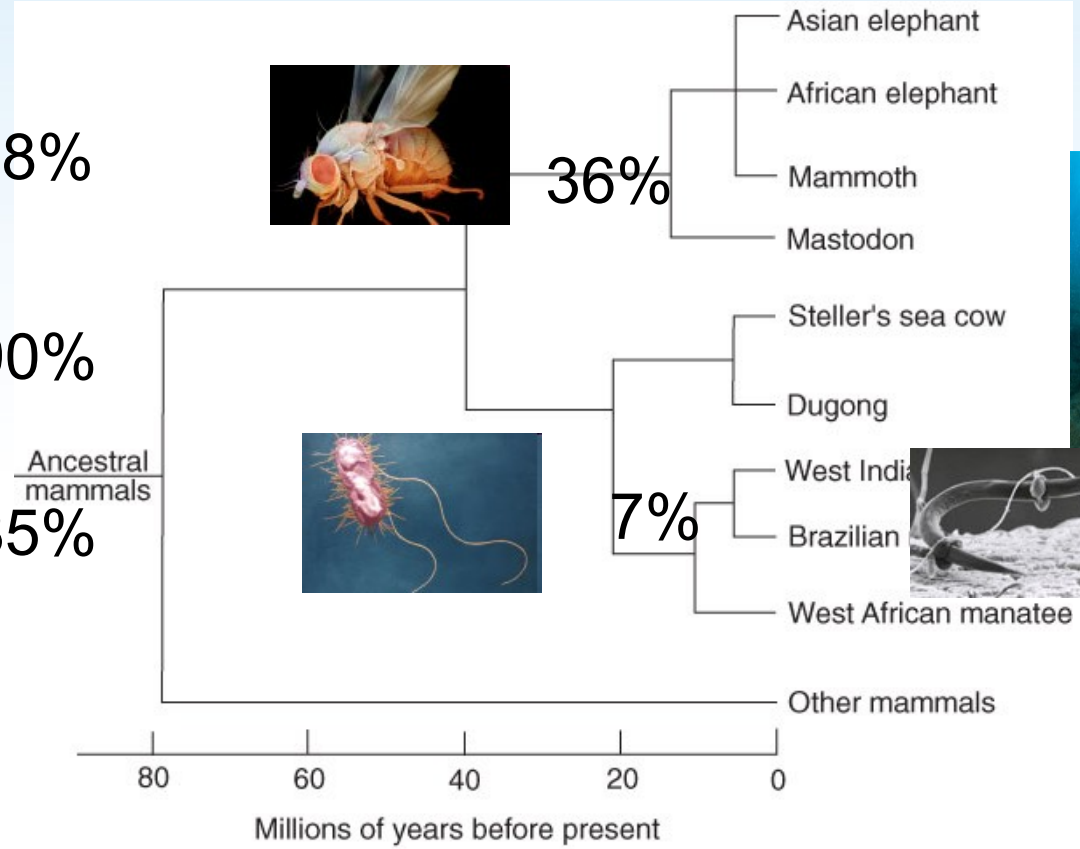


Fig. 2.5 A cladogram illustrating the relationships between Sirenians and elephants and their close relatives based on differences in mitochondrial DNA. Time scale for speciation events estimated from rates of DNA change.

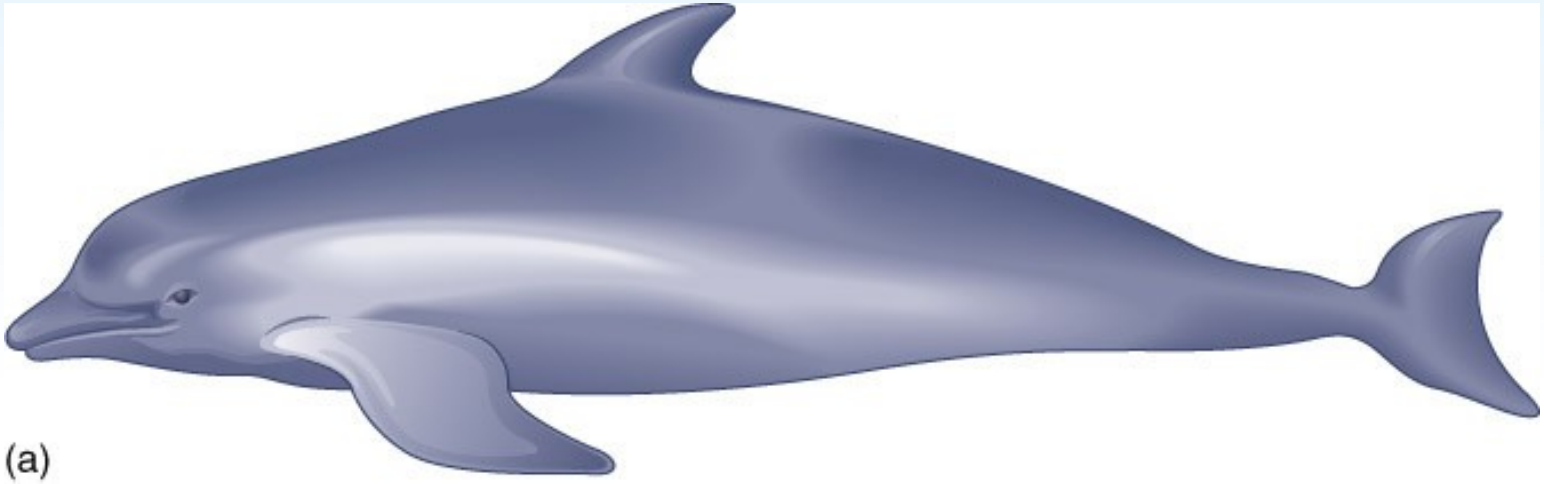
Linnaean Classification

Carolus Linneaus ranked organisms into ever more inclusive categories

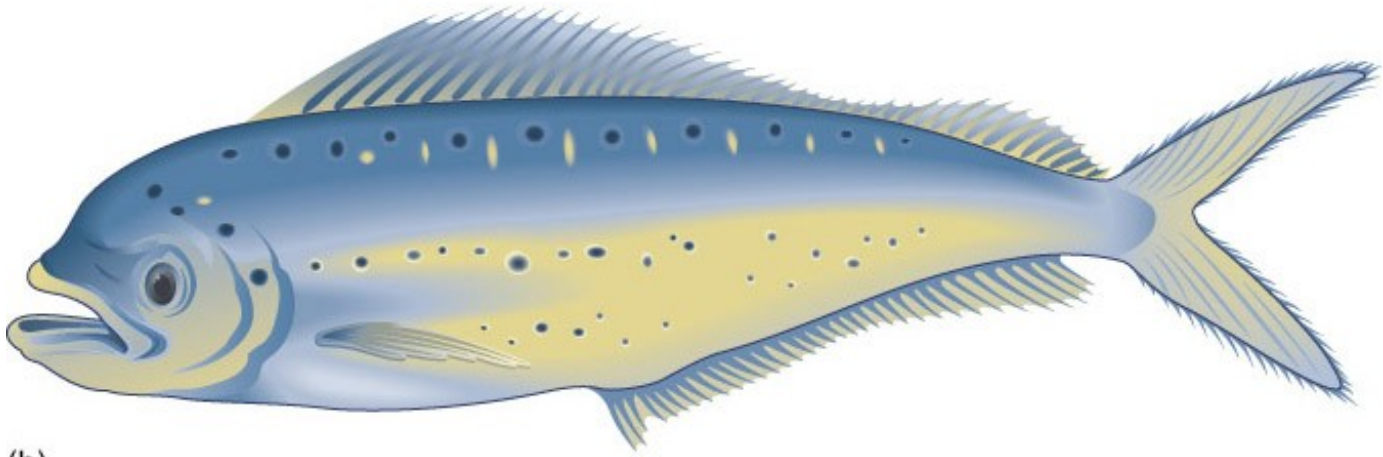
- Species
- Genus
- Family
- Order
- Class
- Phylum
- Kingdom
- Domain (Eukarya, Archaea, Bacteria) – we won't be using this here!!!

Why scientific naming???

Evolutionary Relationships and Taxonomic Classification



(a)



(b)

Fig. 2.6 (a) Common dolphin, *Delphinus*. (b) Dolphinfish, *Coryphaena*, also known as a dorado or mahi-mahi.

Evolutionary Relationships and Taxonomic Classification

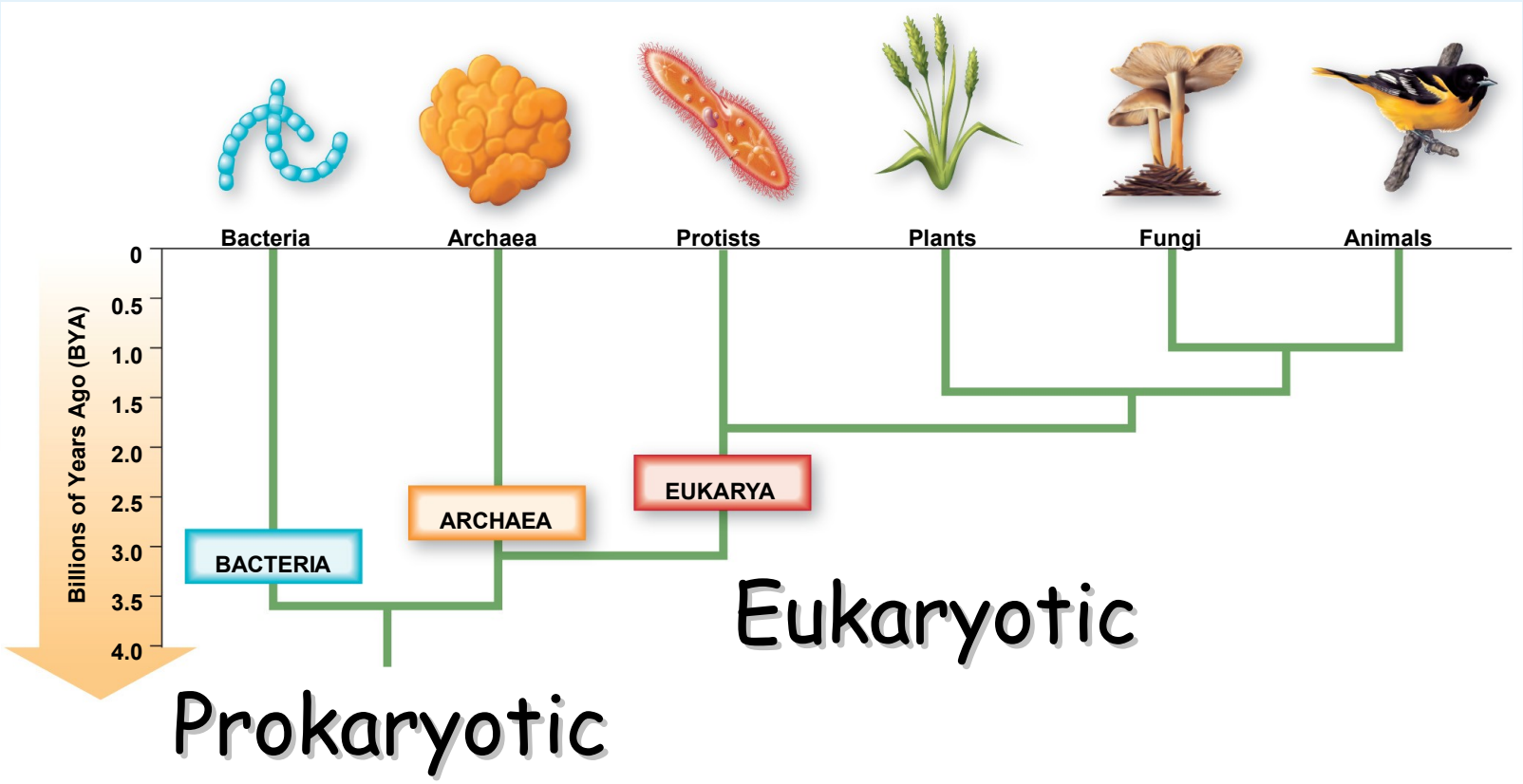
Table 2.2

Taxonomic Classification of Some Marine Organisms

	Taxonomic category						
Organism	**Kingdom**	**Phylum/Division**	**Class**	**Order**	**Family**	**Genus**	**Species**
Blue whale	Animalia	Chordata	Mammalia	Cetacea	Balaenopteridae	*Balaenoptera*	*musculus*
Dolphin	Animalia	Chordata	Mammalia	Cetacea	Delphinidae	*Delphinus*	*delphis*
Dolphinfish	Animalia	Chordata	Osteichthyes	Teleostei	Coryphaenidae	*Coryphaena*	*hippurus*
Copepod	Animalia	Arthropoda	Crustacea	Calanoida	Calanidae	*Calanus*	*finmarchicus*
Mangrove	Plantae	Anthophyta	Dicotyledones	Laminales	Avicenniaceae	*Avicennia*	*germinans*
Tintinnid	Protista	Ciliophora	Ciliata	Spirotricha	Tintinnidae	*Halteria*	*grandinella*

What's more closely related to what???

Evolutionary Relationships and Taxonomic Classification



I love your book, except…

Evolutionary Relationships and Taxonomic Classification

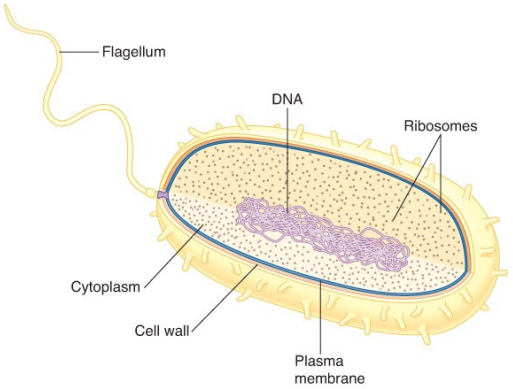
Eukaryotic cell

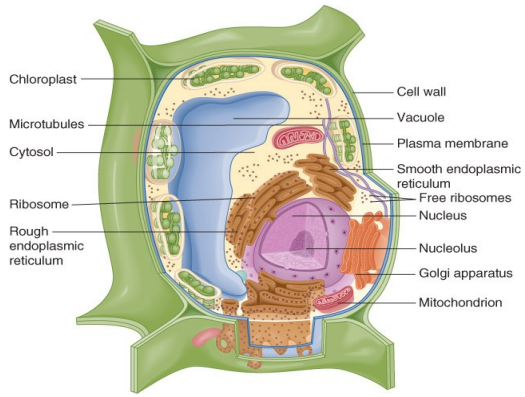
Cell interior is divided into functional compartments, including a nucleus

Prokaryotic cell

Small, simple cells without a nucleus

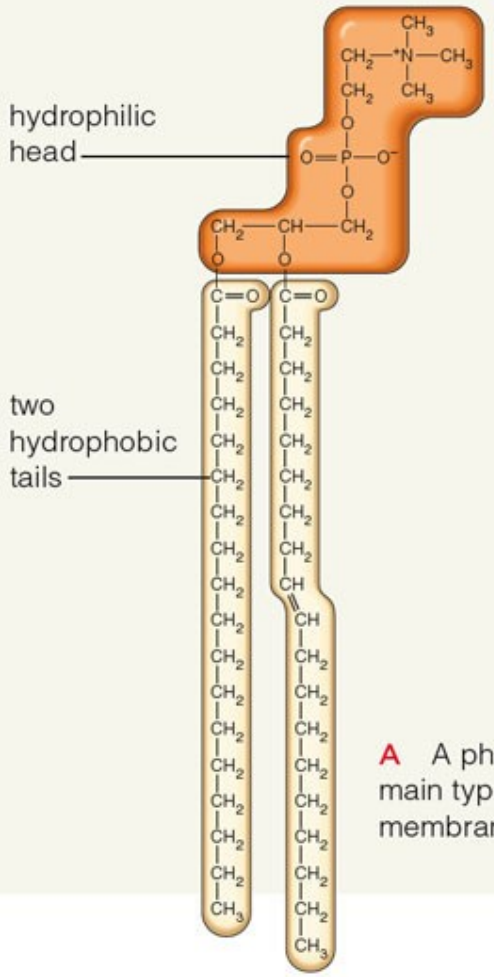
DNA in nucleoid region



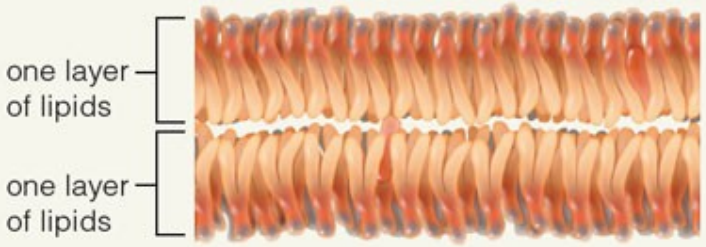


Basic Structure of Cell Membranes

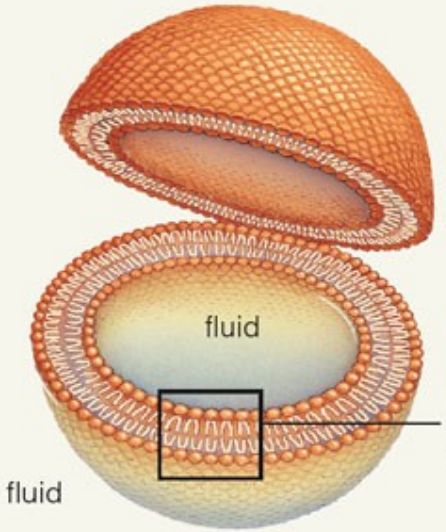
http://www.youtube.com/v/GW0lqf4Fqpg



A A phospholipid, the main type of lipid in cell membranes.



B A lipid bilayer has two layers of lipids, the tails of which are sandwiched between the heads. Proteins (not shown) typically intermingle among the lipids.



C The hydrophilic heads of the phospholipids bathe in the watery fluid on both sides of the bilayer.

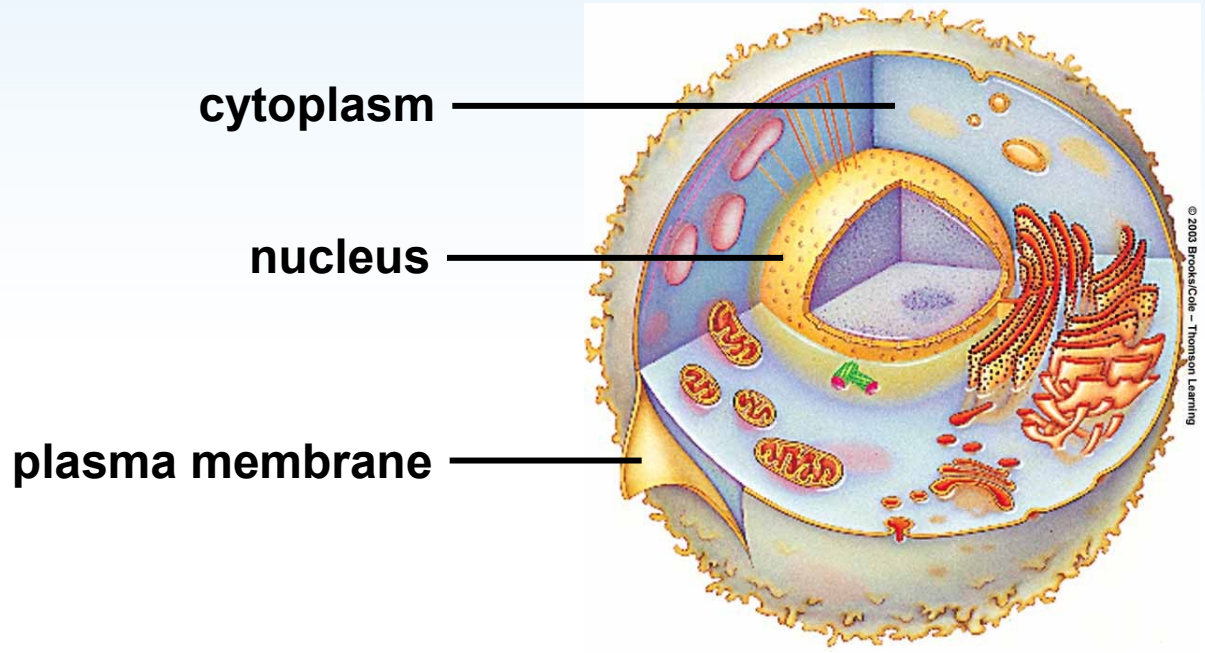
Organelles of Eukaryotic Cells

4 categories of organelles:

1. Nucleus and ribosomes
2. Endomembrane system
3. Energy-related
4. Cytoskeleton

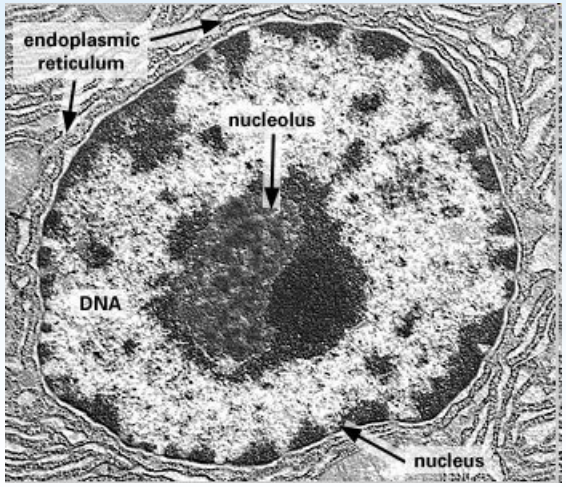
1. Nucleus & Ribosomes

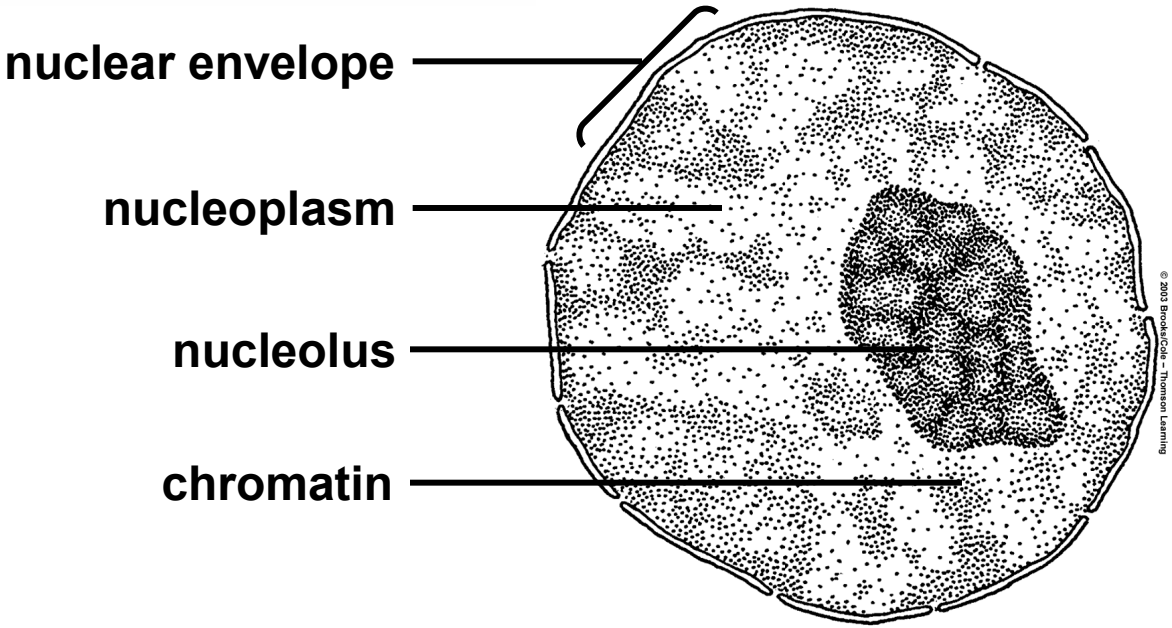
What's the function of the nucleus?



keeps eukaryotic DNA away from potentially damaging reactions in the cytoplasm

1. Nucleus & Ribosomes



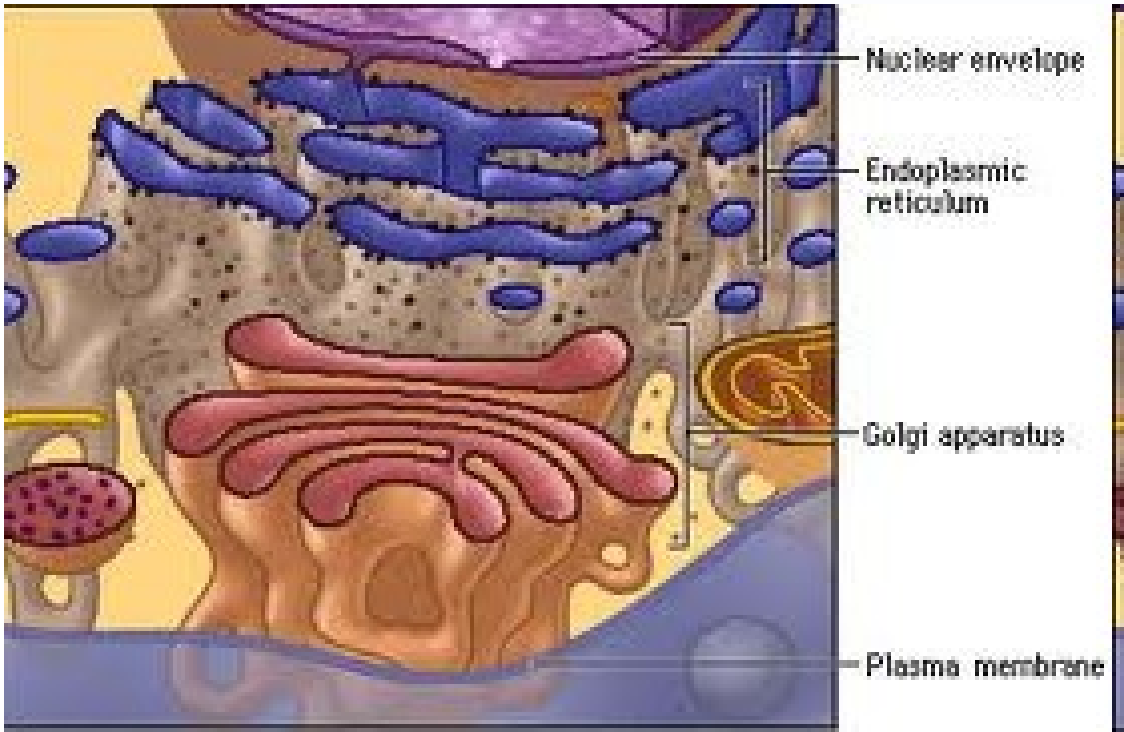


Bartlett Publishers, LLC (www.jbpub.com)

2. The Endomembrane System

A series of interacting organelles between the nucleus and the plasma membrane

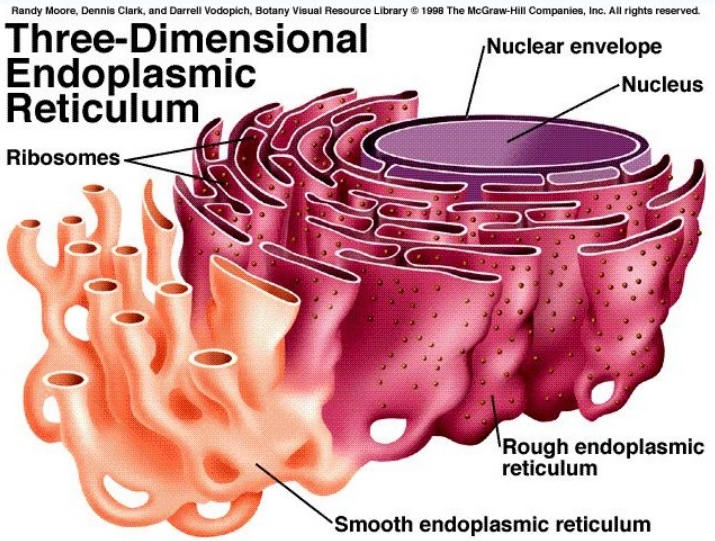
- Nuclear envelope – already talked about!
- Endoplasmic reticulum (ER)
- Golgi apparatus
- Vesicles



The Endoplasmic Reticulum

Endoplasmic reticulum (ER)

- Two kinds of endoplasmic reticulum
  - Rough ER (with ribosomes) that modifies proteins
  - Smooth ER (no ribosomes) makes lipids, breaks down carbohydrates and lipids, detoxifies poisons



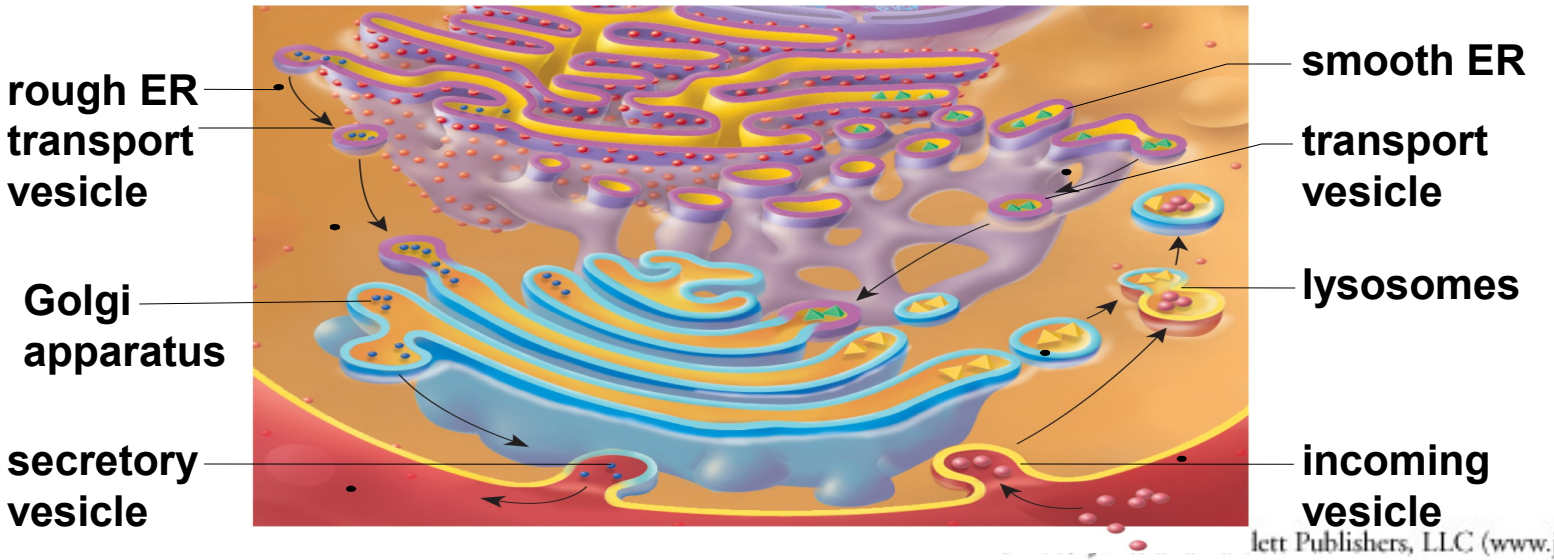
Golgi Apparatus

- finish polypeptides and lipids delivered by the ER in vesicles
- Packages finished products in vesicles

Vesicles

- Small, membrane-enclosed saclike organelles that store or transport substances

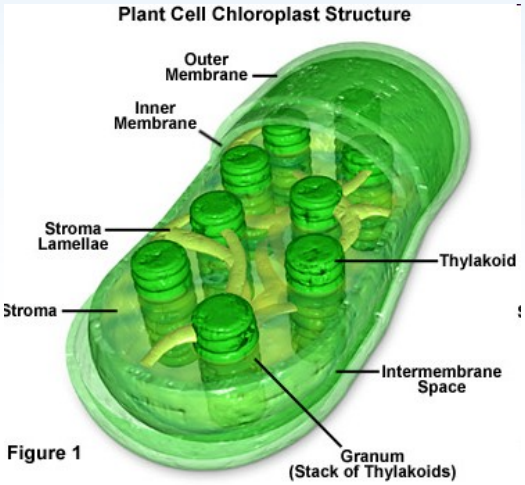
http://www.youtube.com/v/cnK7RT1q0bA

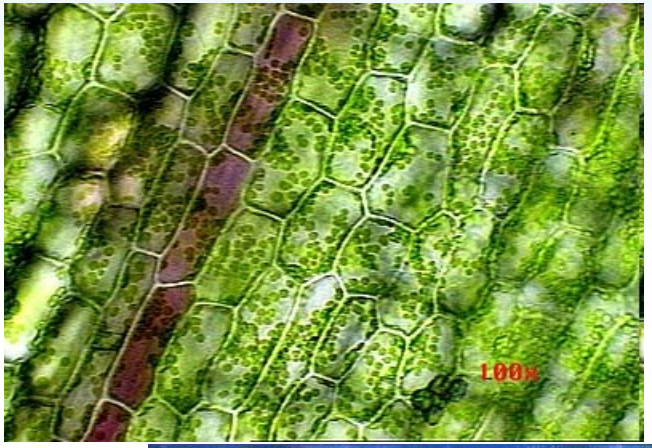


3. Energy-related organelles

Chloroplasts function in photosynthesis in plants and some types of algae

- Use solar energy to synthesize carbohydrates

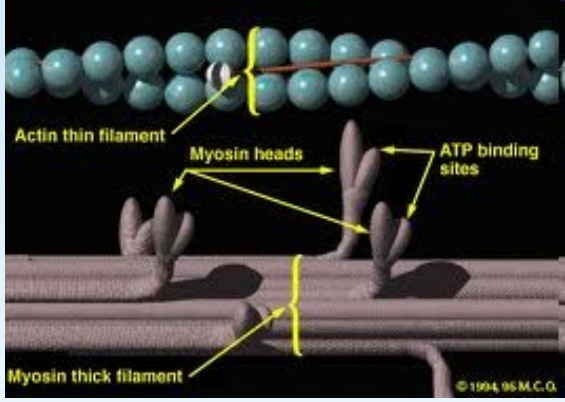




Eukaryotic cells make most of their ATP in **mitochondria.**

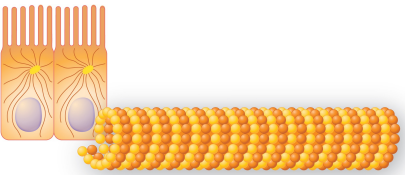
Do plants have mitochondria?

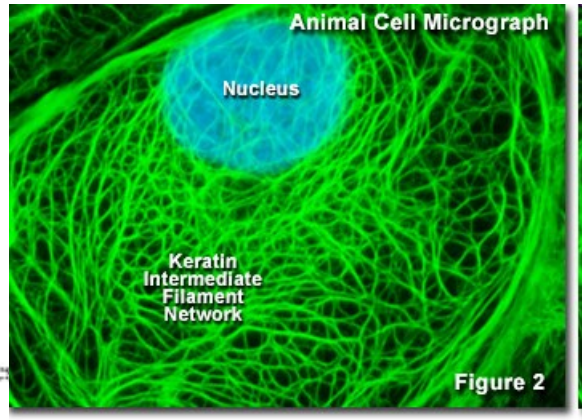
4. Cytoskeleton

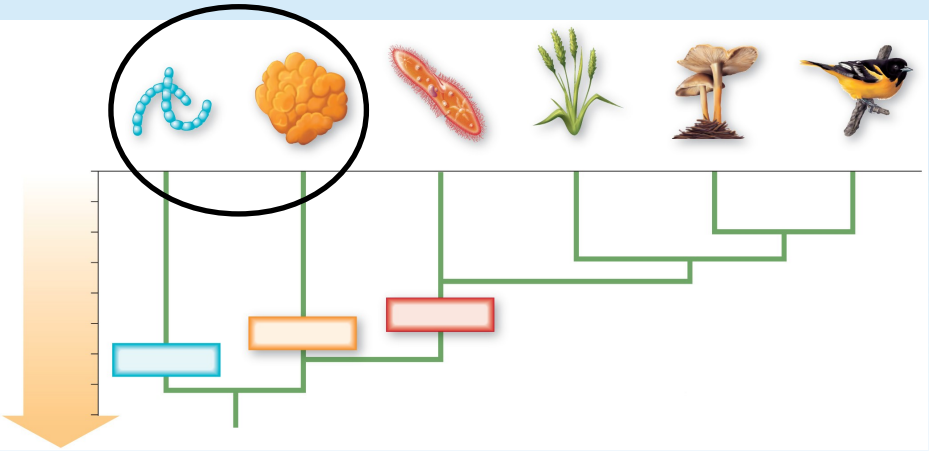


Eukaryotic cells have a network of interconnected protein filaments and tubules

- Maintains cell shape
- Allows cell and organelles to move (with motor proteins







Prokaryotes

Kingdom Bacteria

Kingdom Archaea

Single-celled

No nucleus or organelles – MOST IMPORTANT DISTINCTION!!!

Include producers, consumers, decomposers

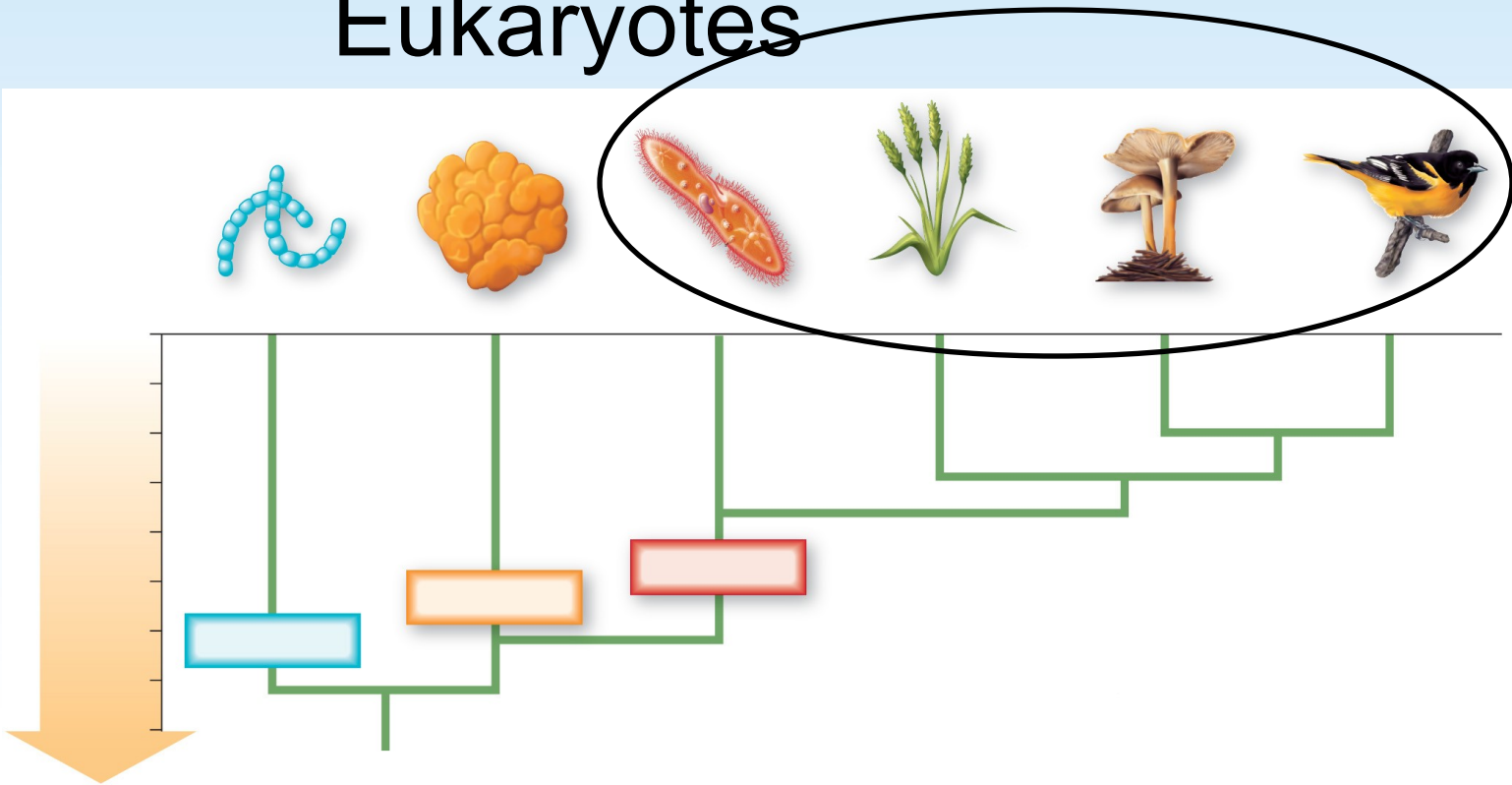
Eukaryotes

Kingdom Plantae

Kingdom Fungi

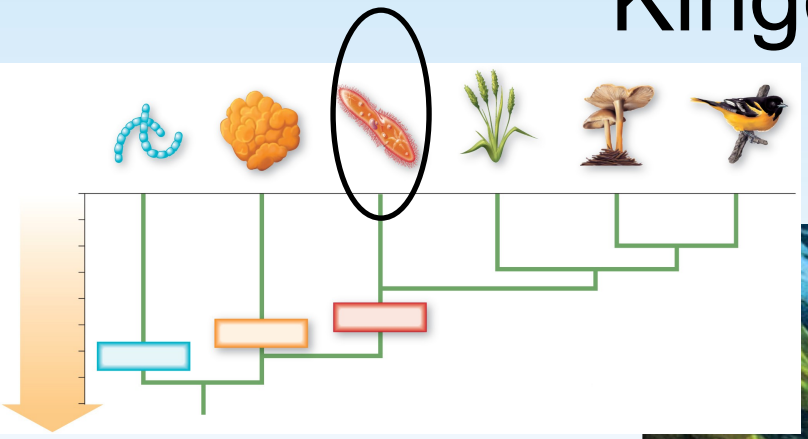
Kingdom Protista

Kingdom Animalia



DNA is inside a nucleus

Kingdom Protista



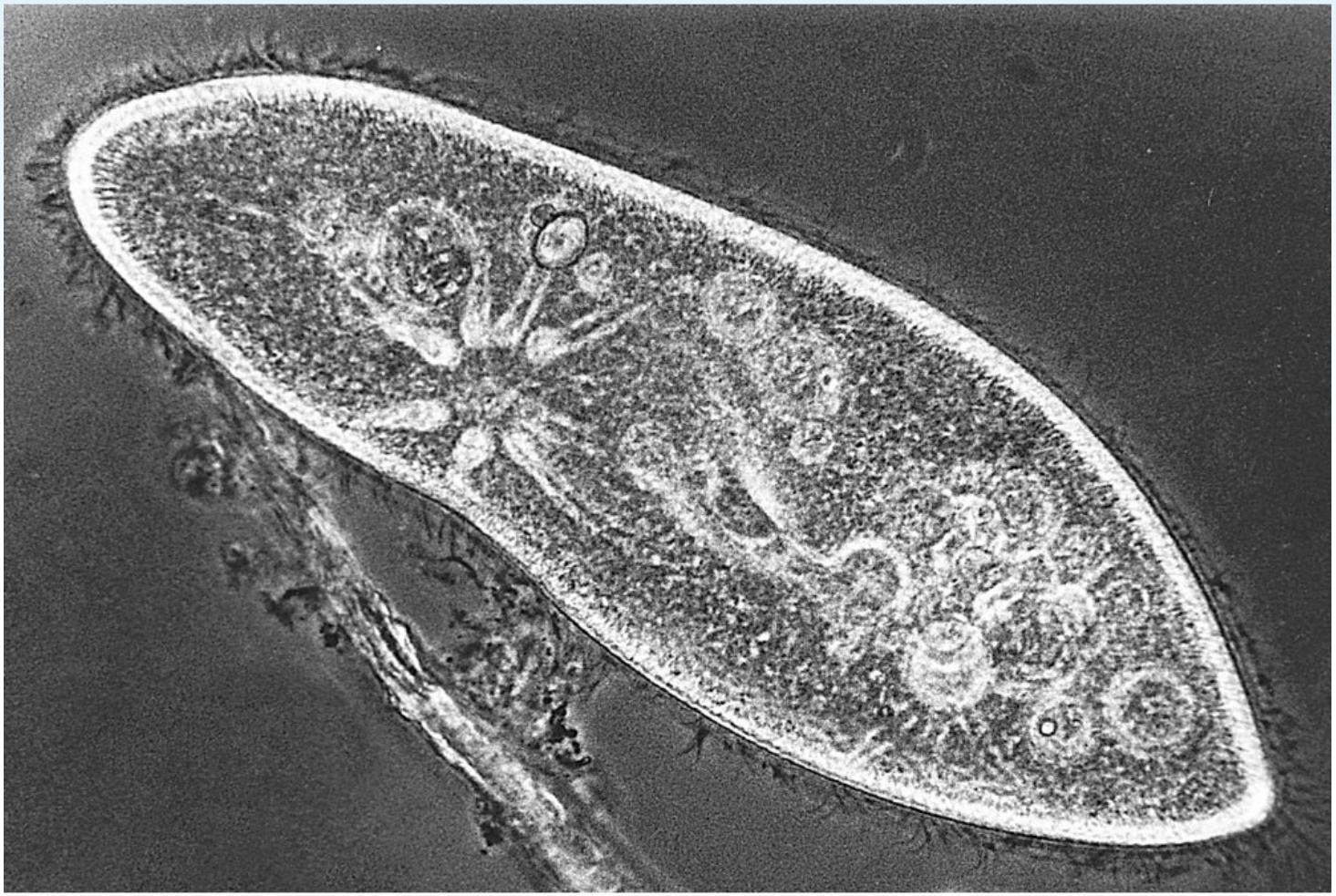
Plantlike, animallike, fungilike

The protists are the simplest eukaryotes!

The "catch-all" category!

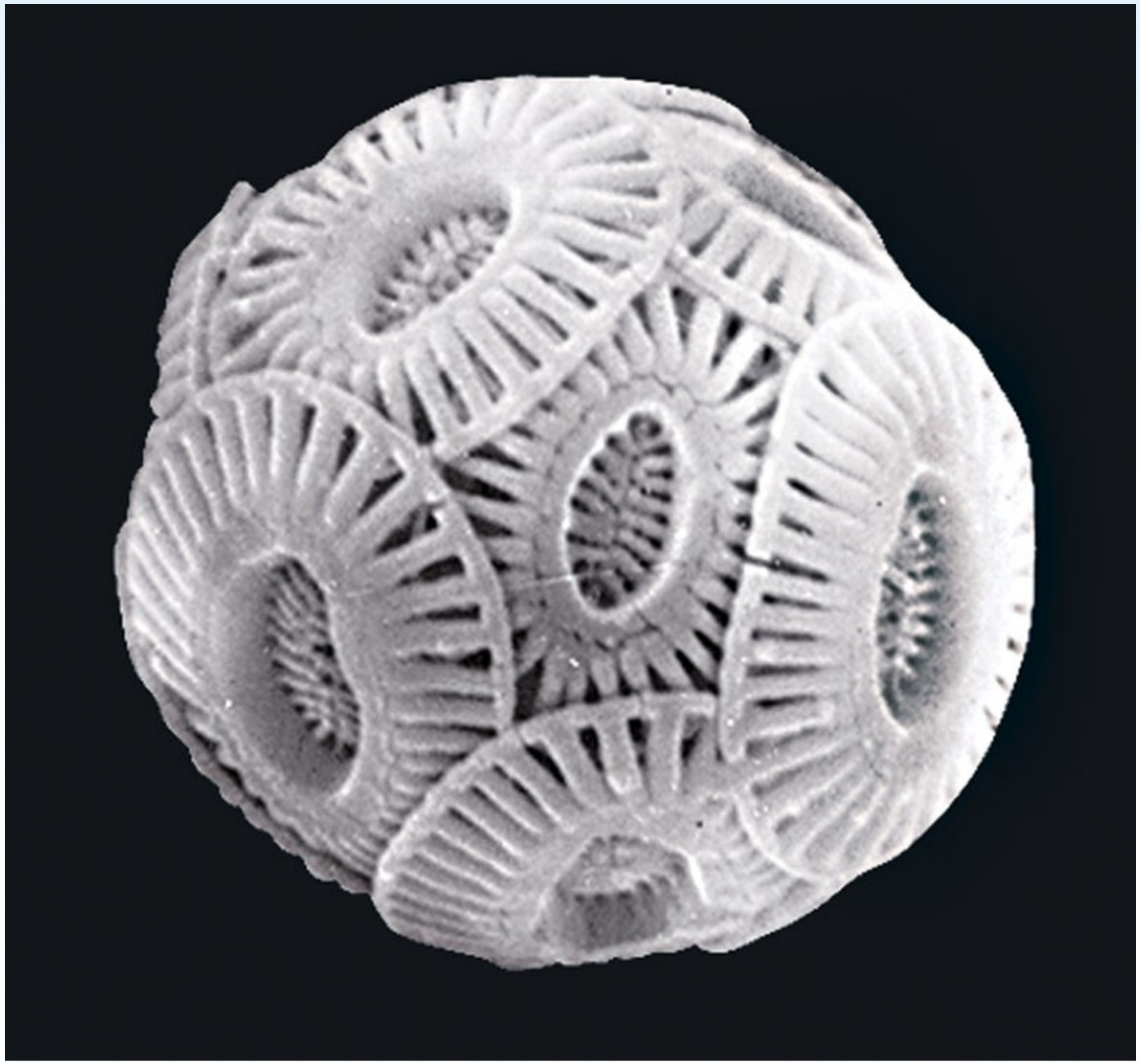
Kingdom Protista

Protists

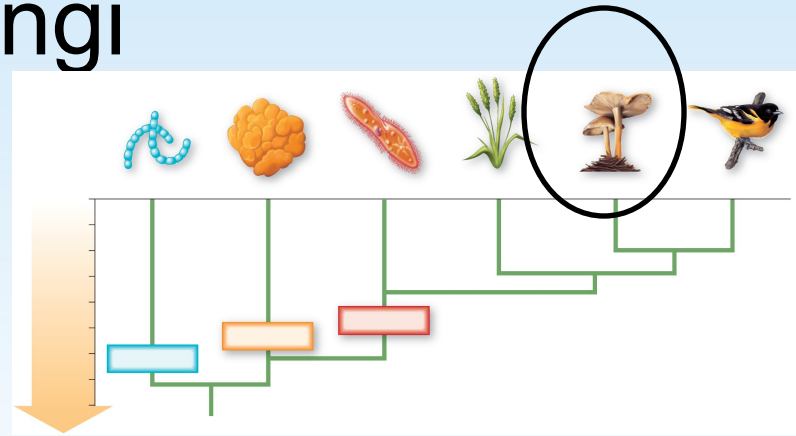


Kingdom Protista

Protists



Kingdom Fungi



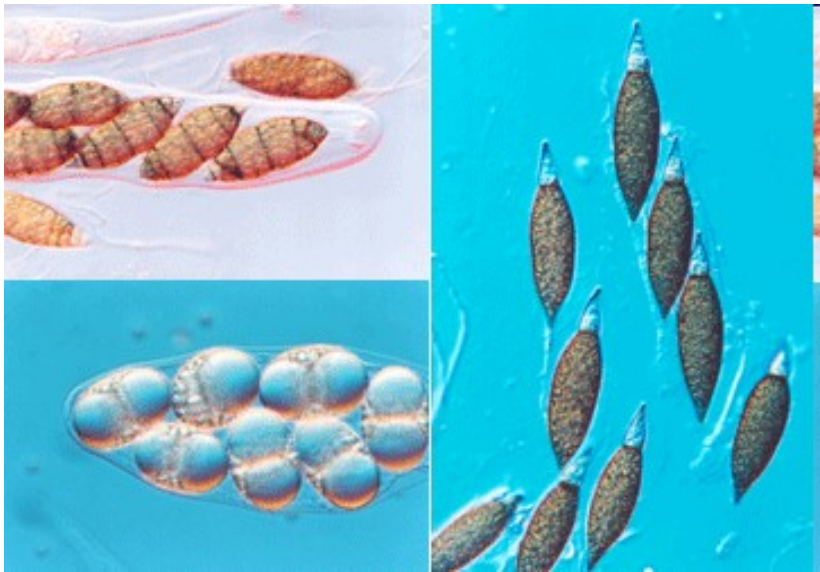
Most are multicelled

Consumers and decomposers

Extracellular digestion and absorption

Cell walls made of chitin

Why did everyone want to invite the mushroom to the party?



Kingdom Fungi

Kingdom Fungi

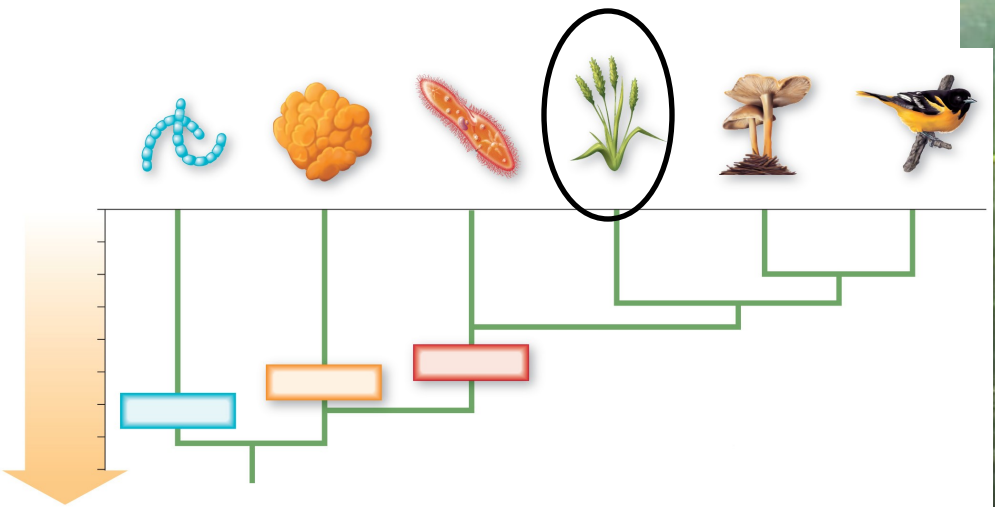
Kingdom Plantae

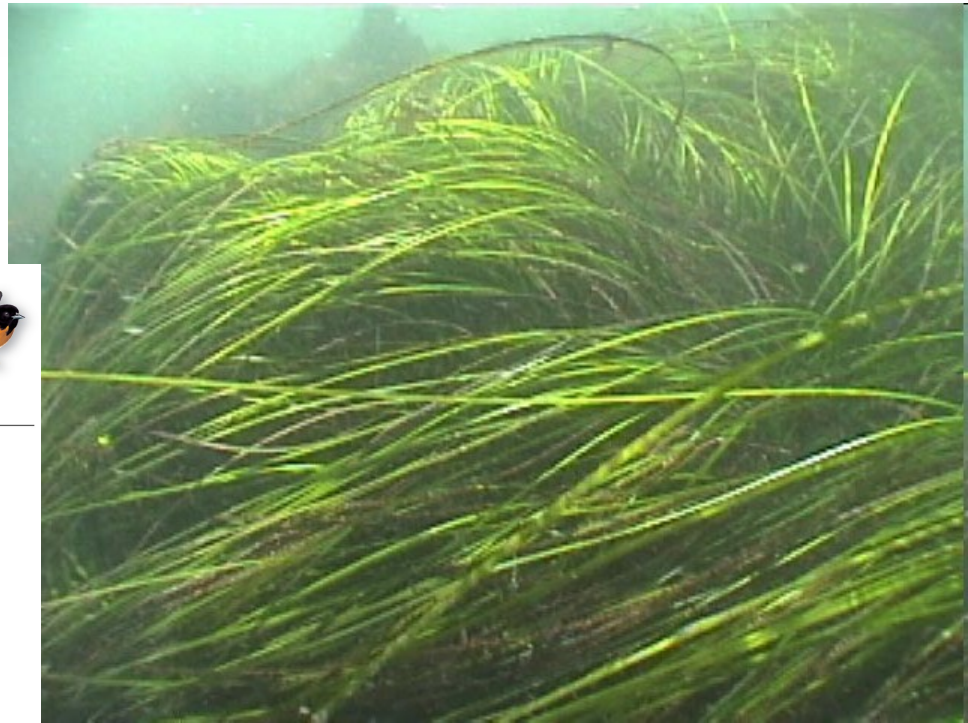
All are multicelled

Most are photosynthetic producers

Are the food base for terrestrial communities

Cellulose cell walls





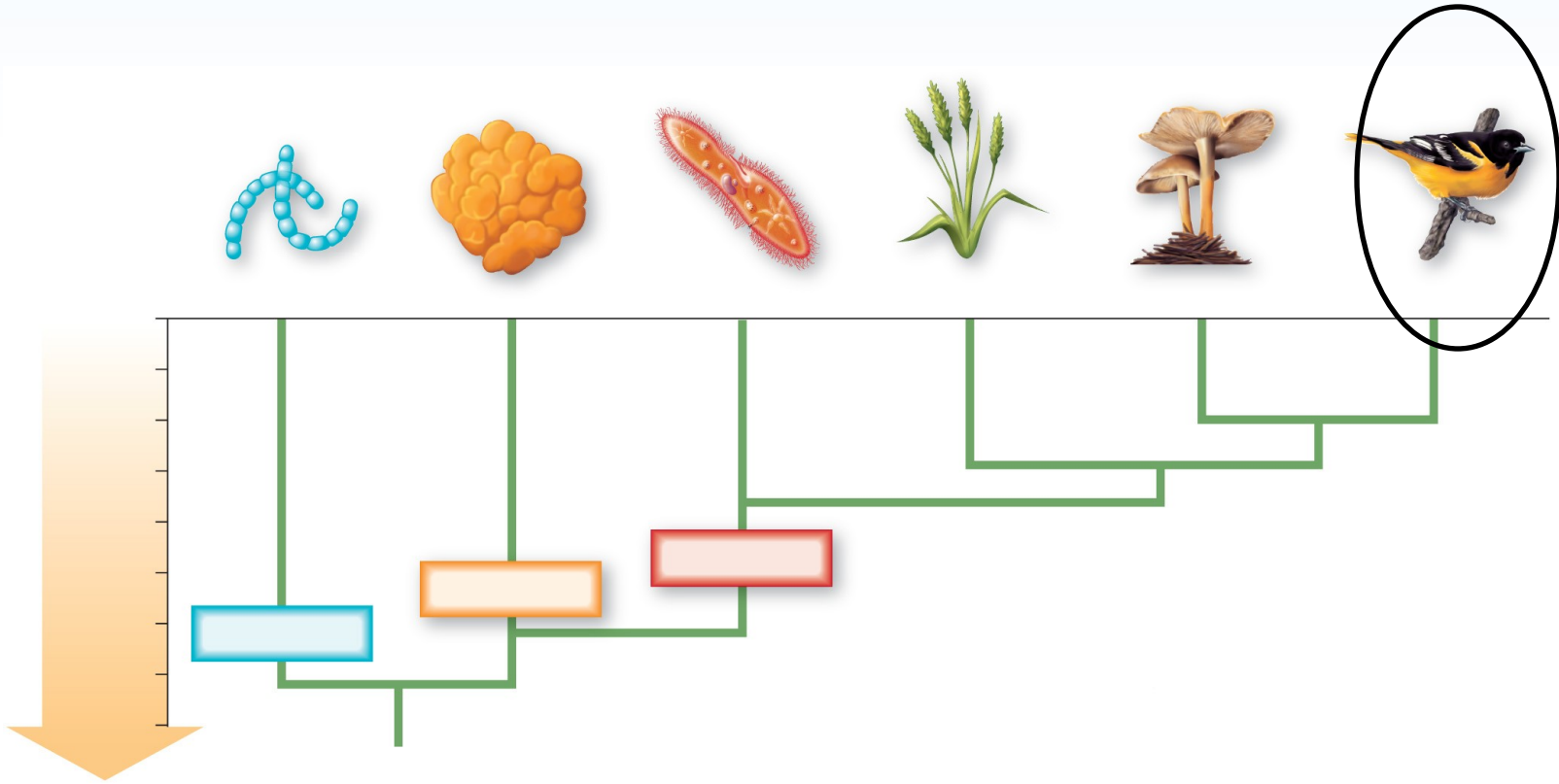
Kingdom Plantae

Kingdom Plantae

Kingdom Animalia

Multicelled consumers

Move about during at least some stage of their life

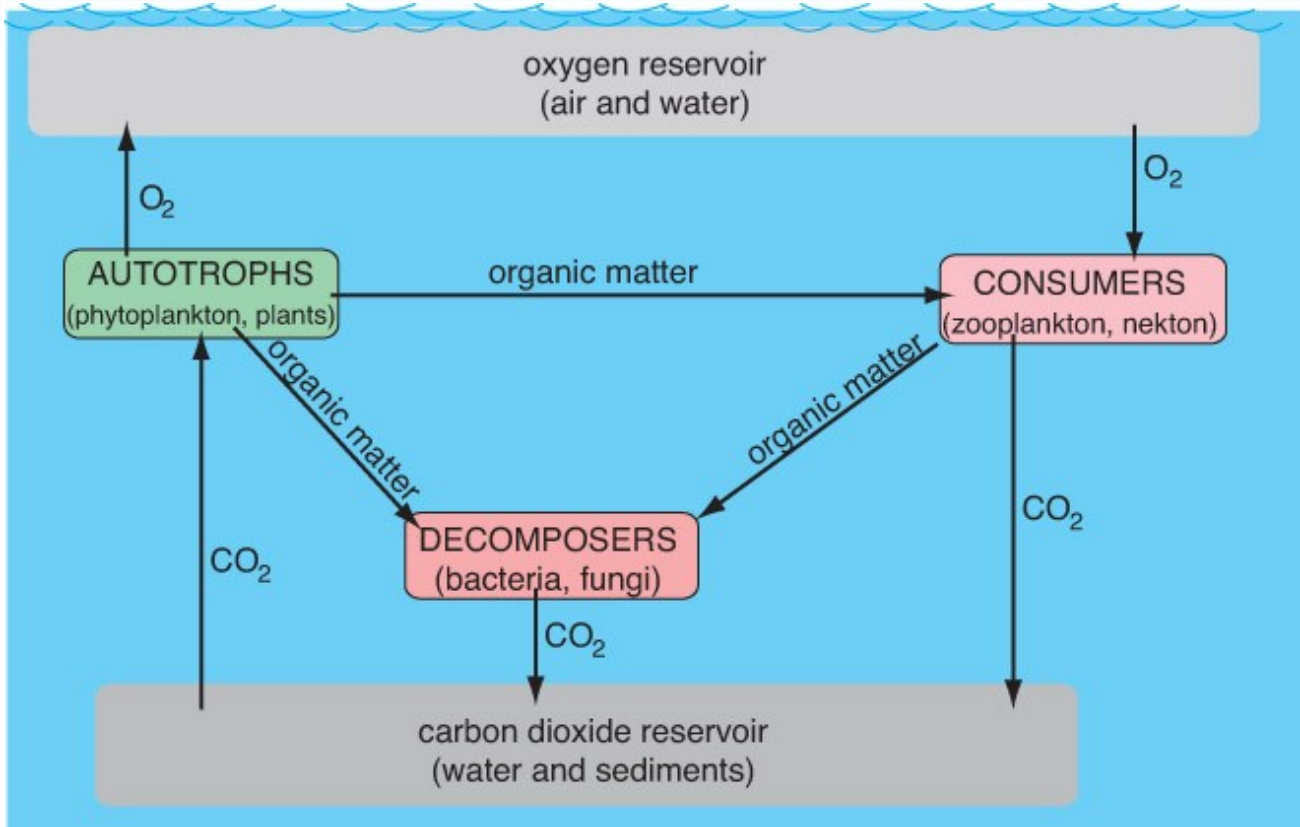


Kingdom Animalia

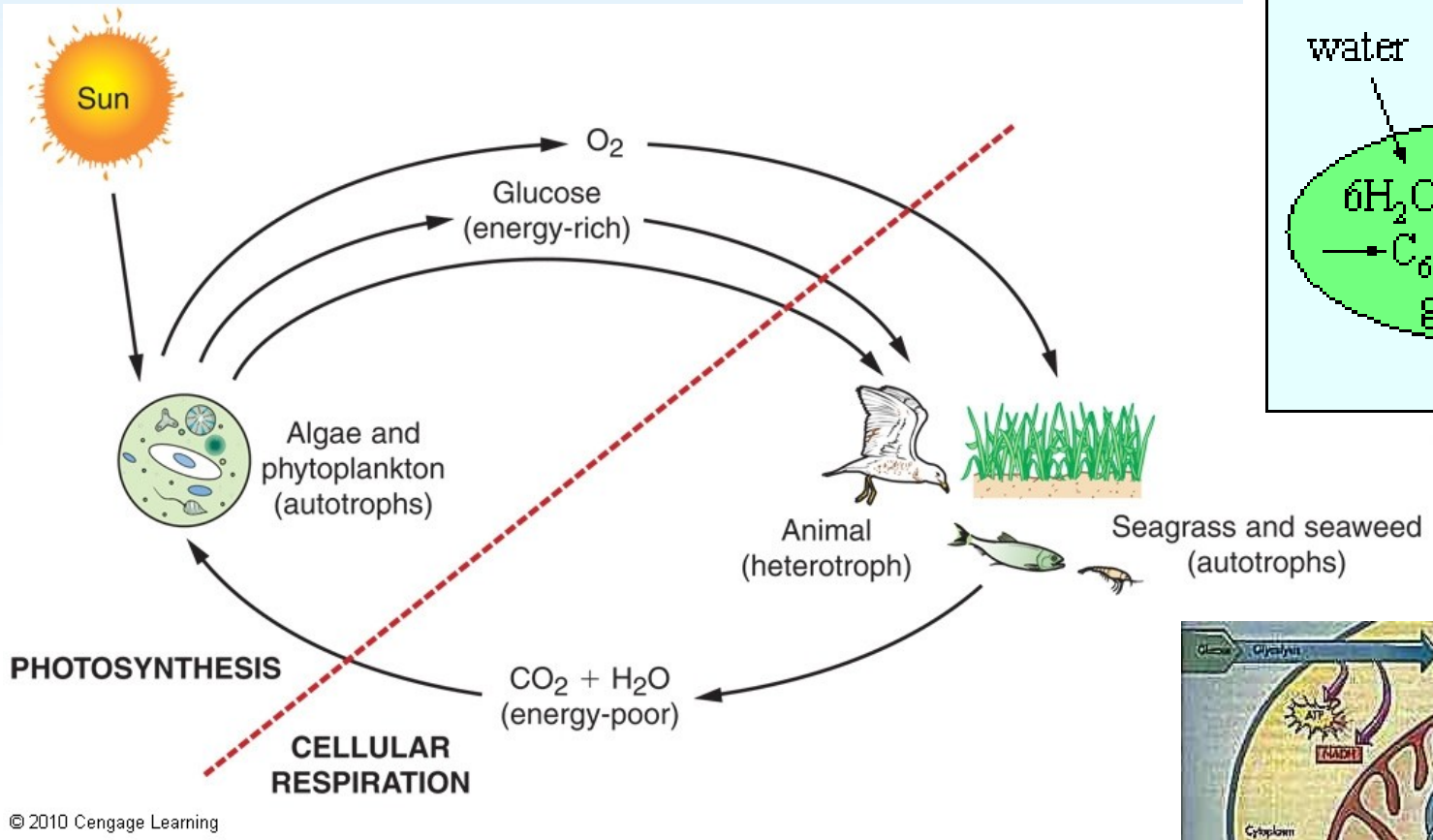
Multicelled consumers!!!

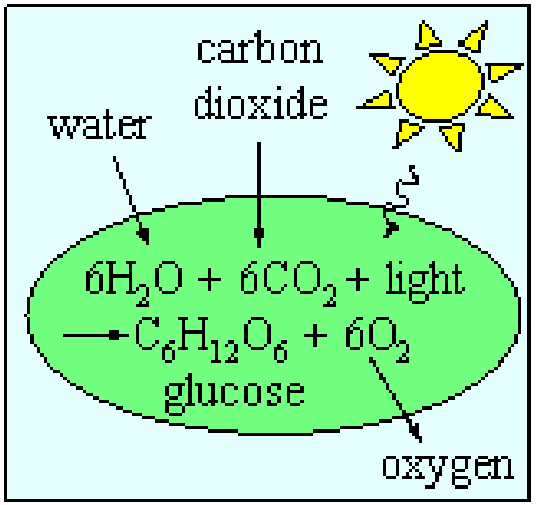
3. Trophic (what eats what) Relationships Harvesting Energy

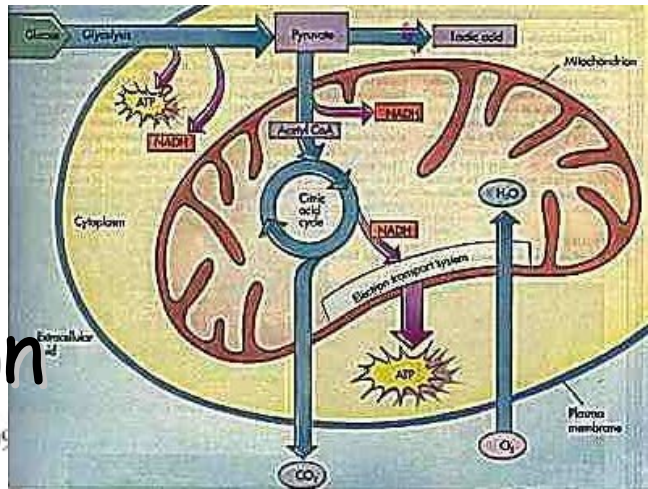
- Autotrophs (photosynthesizers & chemosynthesizers – producers)
- Heterotrophs (consumers & decomposers)



Energy Transfer in Cells







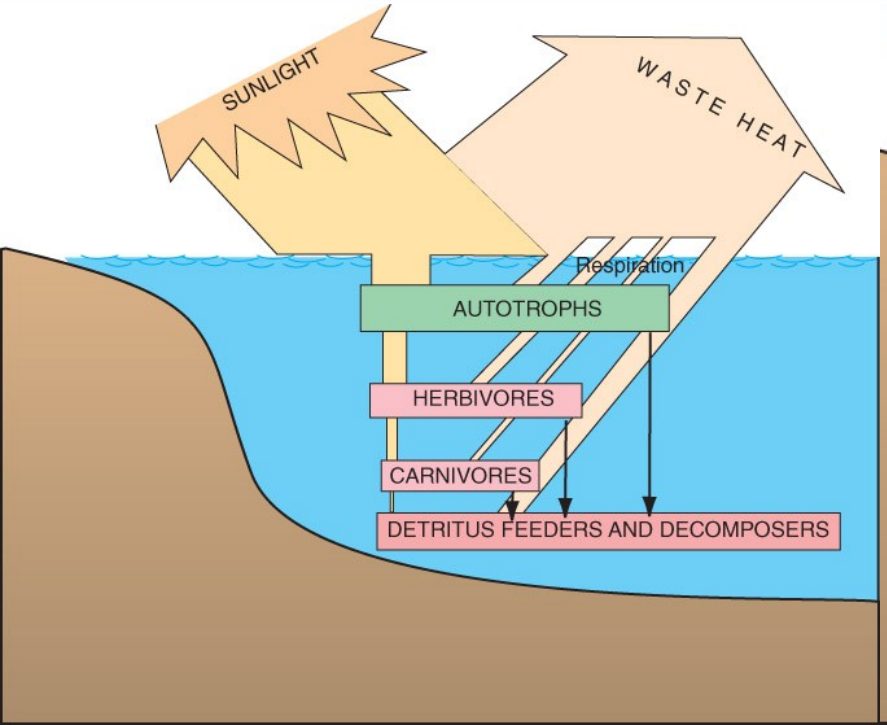
Anaerobic vs. aerobic respiration

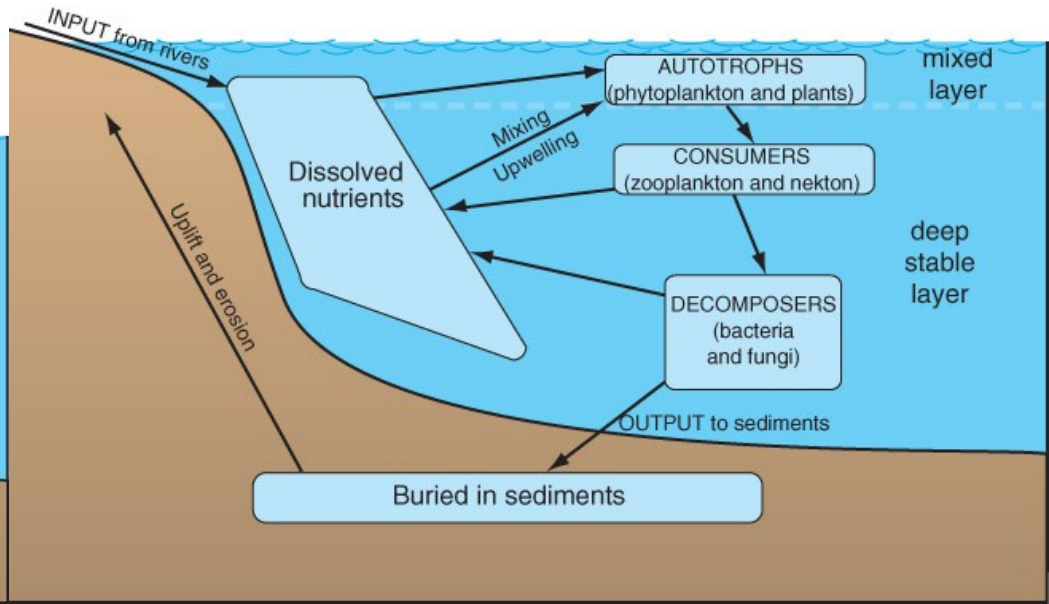
Trophic Relationships

Food Chains and Food Webs

- Both energy (one-way direction) and matter (biogeochemical cycle) flow through ecosystems.

10%!!!

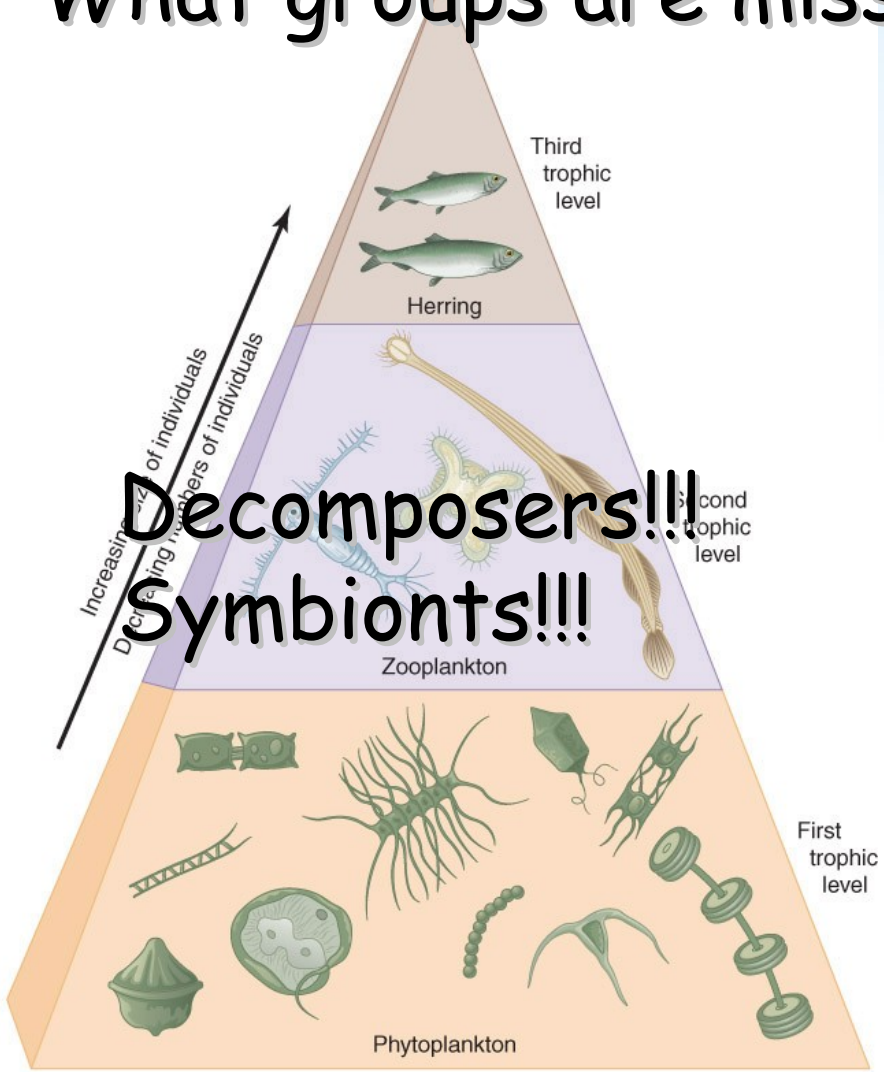




Trophic Relationships

FOOD CHAINS and Food Webs

Which are heterotrophs?
What groups are missing???



Secondary consumers
CARNIVORES

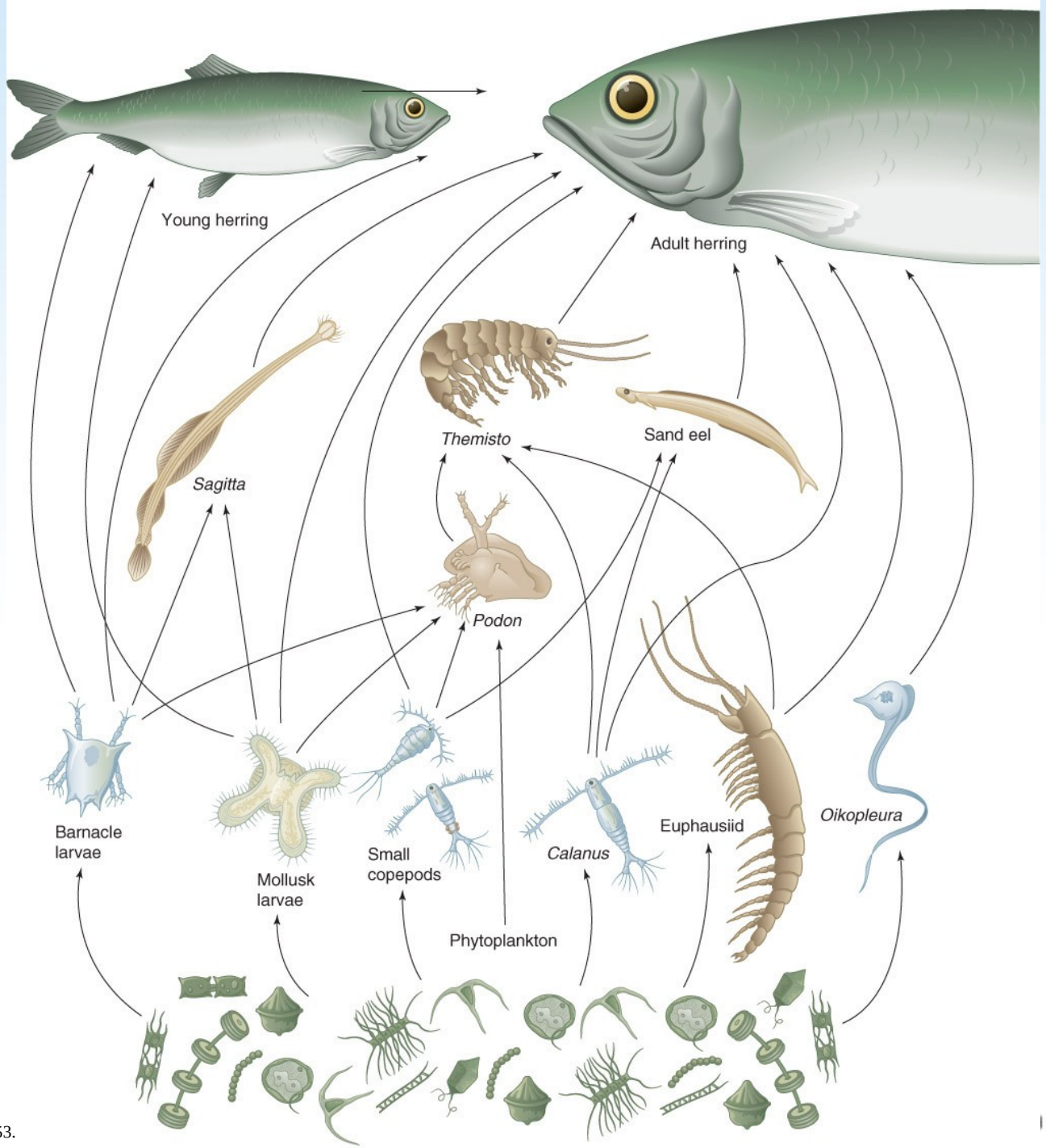
Decomposers!!!
Symbionts!!!

Primary consumers
HERBIVORES – what's the land equivalent???

Primary producers

Food Chains and **FOOD WEBS**

Trophic Relationships



Adapted from A. C. Hardy, Fisheries Investigations 7 (1924): 1-53.

The General Nature of Marine Life

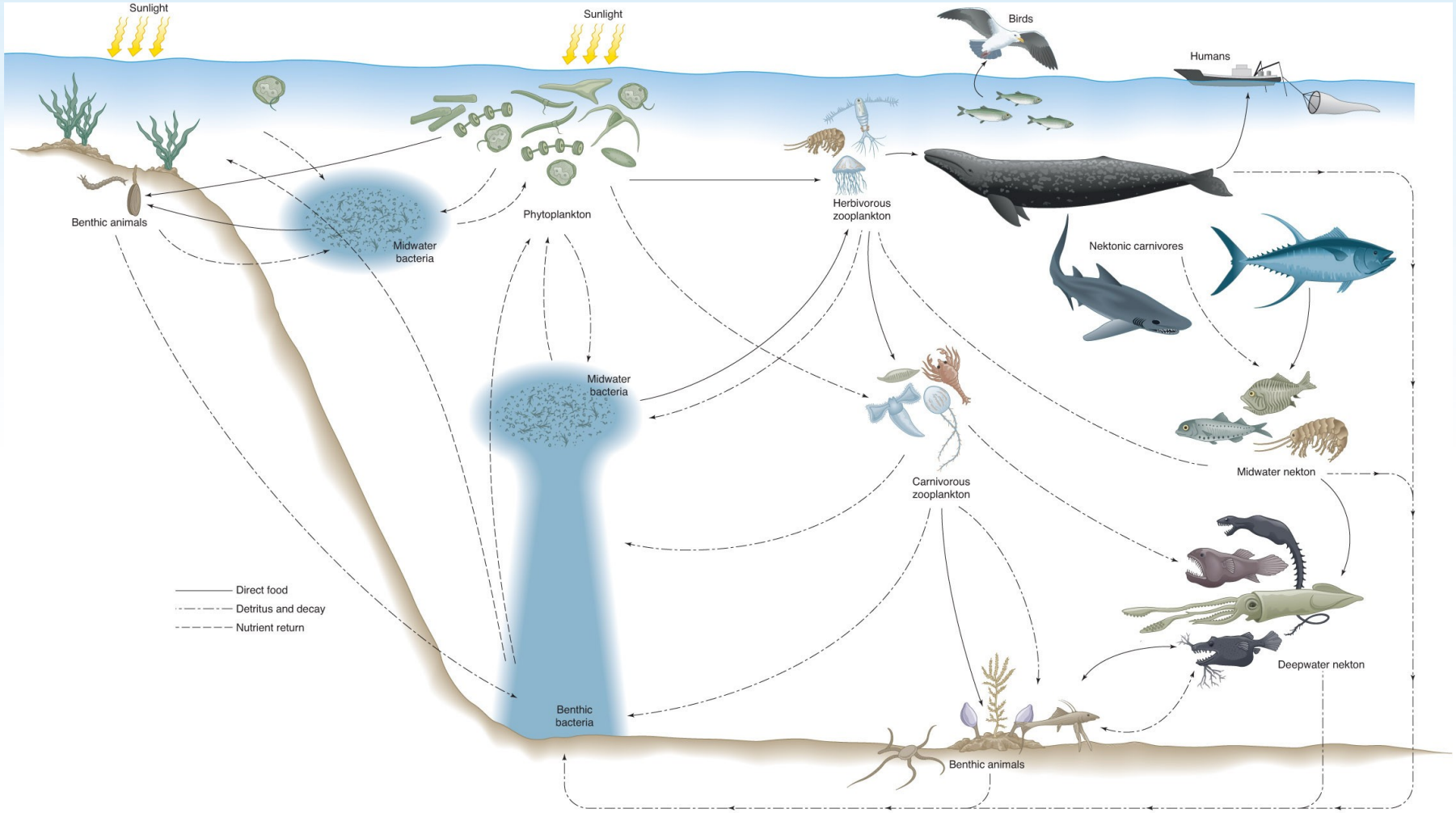
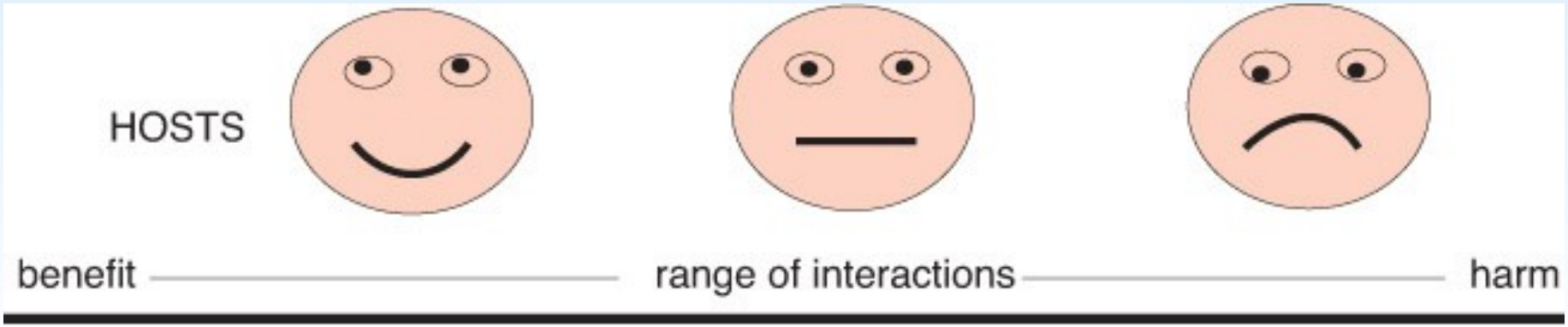


Fig. 2.15 Major biotic components of a marine ecosystem with their interconnecting paths of energy and nutrient exchange.

Adapted from W. D. Russell-Hunter. Aquatic Productivity. Macmillan, 1970

Trophic Relationships – Symbiosis



SYMBIONTS

Mutualism

Commensalism

Parasitism