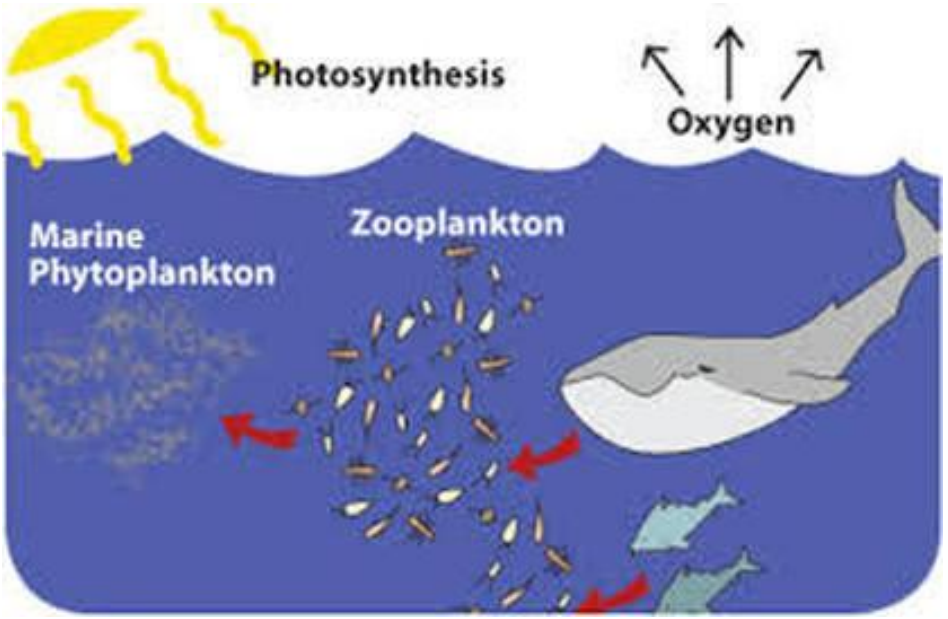
Chapter 10

Marine Ecology

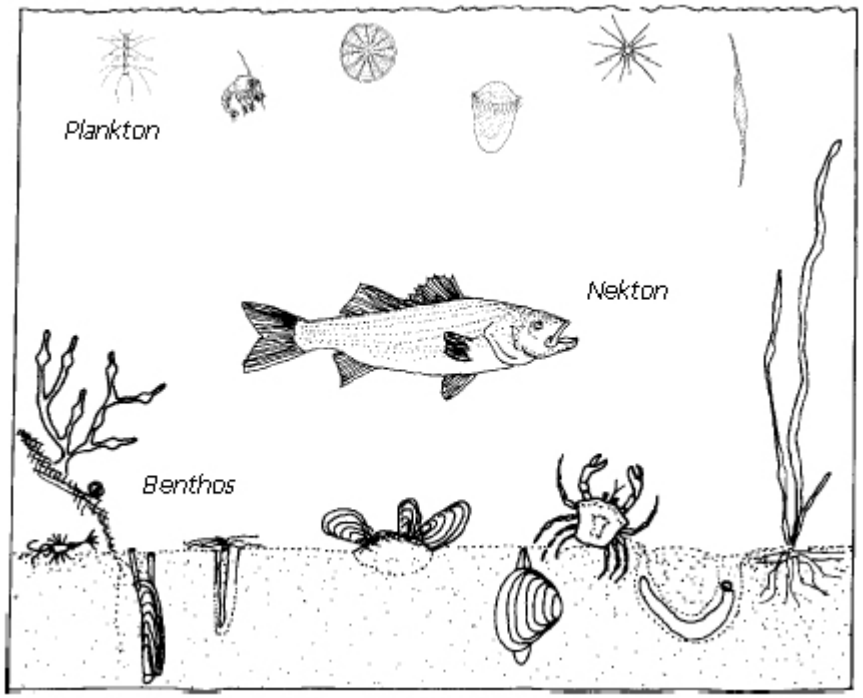
Marine Ecology

- *Ecology* is the <u>interaction between organisms and their environment</u>.
  - These interactions affect the survival and distribution of organisms.



Marine Ecology

- **Population** – All individuals of the same species living together.
- **Community** – All populations of organisms of different species living in a defined area.



Marine Ecology

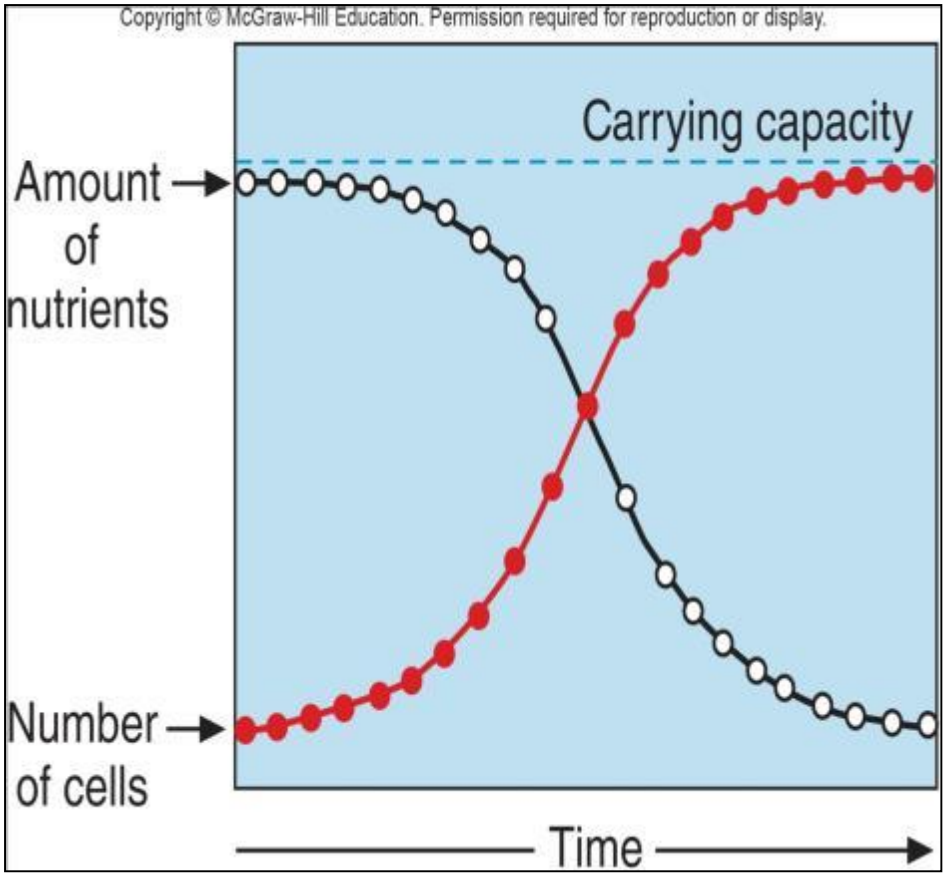
- **Ecosystem**: the interacting biotic and abiotic factors of an environment.
  - **Biotic factors**: living (ex. all living organisms in an ecosystem)
  - **Abiotic factors**: non-living (ex. water, temp, sunlight, dissolved gases)
- **Habitat** – The physical place where an organism lives.
- **Ecological niche** – All the resources (biotic & abiotic) an organism uses for survival, growth, and reproduction.

Marine Ecology - Populations

- Populations require specific resources to survive.
- These resources can affect population growth if they are in short supply.
- Resources that affect the growth of a population are called limiting resources.
- Limiting resources include:
  - Food and nutrients
  - Physical factors (light, salinity, substrate, etc.)
  - Space (habitat)
  - Oxygen or carbon dioxide

Marine Ecology - Populations

- There is a maximum number of individuals that any habitat can support: the carrying capacity.
  - As a population becomes more crowded, the growth rate of that population will decrease.
  - Resources become limited with the increased population.



Marine Ecology

Ways that species can interact:

1. Competition
2. Predator-Prey Interactions
3. Symbiosis

Competition

- *Competition* occurs when two different species use the same limiting resource they both require for survival.
  - ***Interspecific Competition***: between different species.
    - May result in one species excluding the other species.
    - May result in species coexisting.
  - ***Intraspecific Competition***: between members of the same species.

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Predator-Prey Interactions

- **Predation**: one species (predator) kills another (prey) for food.
  - Prey species often have adaptations that help them avoid being eaten such as warning coloration, camouflage, and mimicry.
  - Herbivory: when an organism (herbivore) eats seaweeds or plants.

Symbiosis

- When organisms of different species live in close association with one another.
  - Can be a beneficial or detrimental relationship.
  - Some relationships have no effect on one of the organisms.
  - Smaller partner = symbiont; larger partner = host

1. *Facultative symbiosis* - if partners can live free without one another
2. *Obligate symbiosis* - if a partner can't survive without the other partner

Symbiosis

Types of Symbiosis:

1. **Mutualism** - both species benefit (examples: cleaning associations, zooxanthellae and corals)
2. **Commensalism** - one species benefits with no apparent effect on the other (example: barnacles living on whales)
3. **Parasitism** - one species benefits & the other is harmed (example: tapeworms in the guts of whales)

Mutualism  

- <u>Both species involved benefit</u> from the relationship.

Commensalism

- One species involved <u>benefits</u>, while the other one is <u>not affected</u> by the relationship.

Parasitism

- One species <u>benefits</u> from the relationship, while the other species is <u>harmed</u>.

3 Types of Symbiosis

Type of Symbiosis	Species 1	Species 2
Mutualism		
Commensalism		
Parasitism		

3 Types of Symbiosis

Symbiosis: _____

Type of Symbiosis	Species 1	Species 2
Mutualism		
Commensalism		
Parasitism		

Energy in Ecosystems

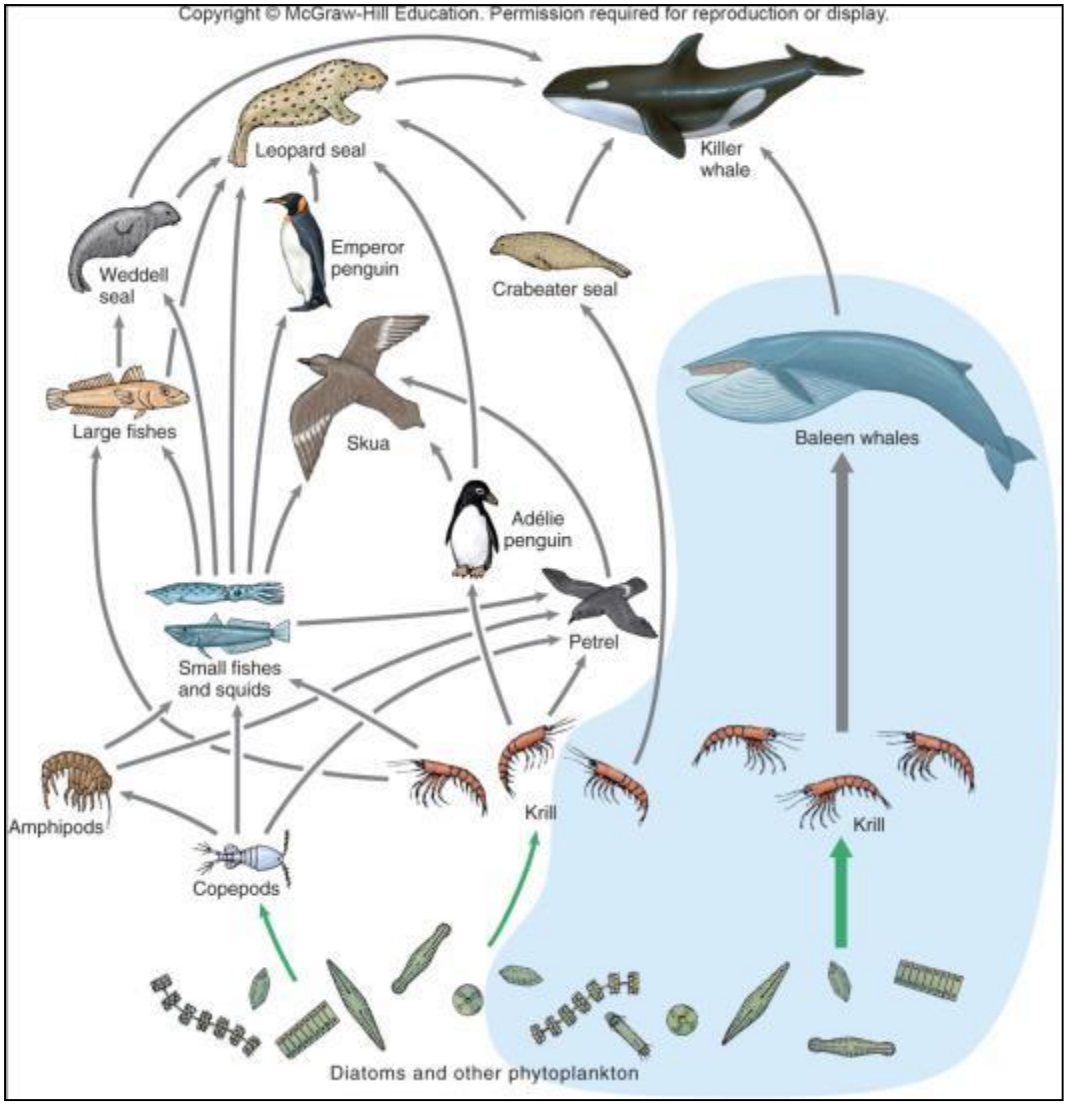
Ecosystem: all the biotic (living) and abiotic (nonliving) components in a particular area;

= *community* (biotic) + abiotic factors

- Ecosystems interact with each other.
- All ecosystems require a constant *input* of energy.
- Chemicals and nutrients are *cycled* within ecosystems.

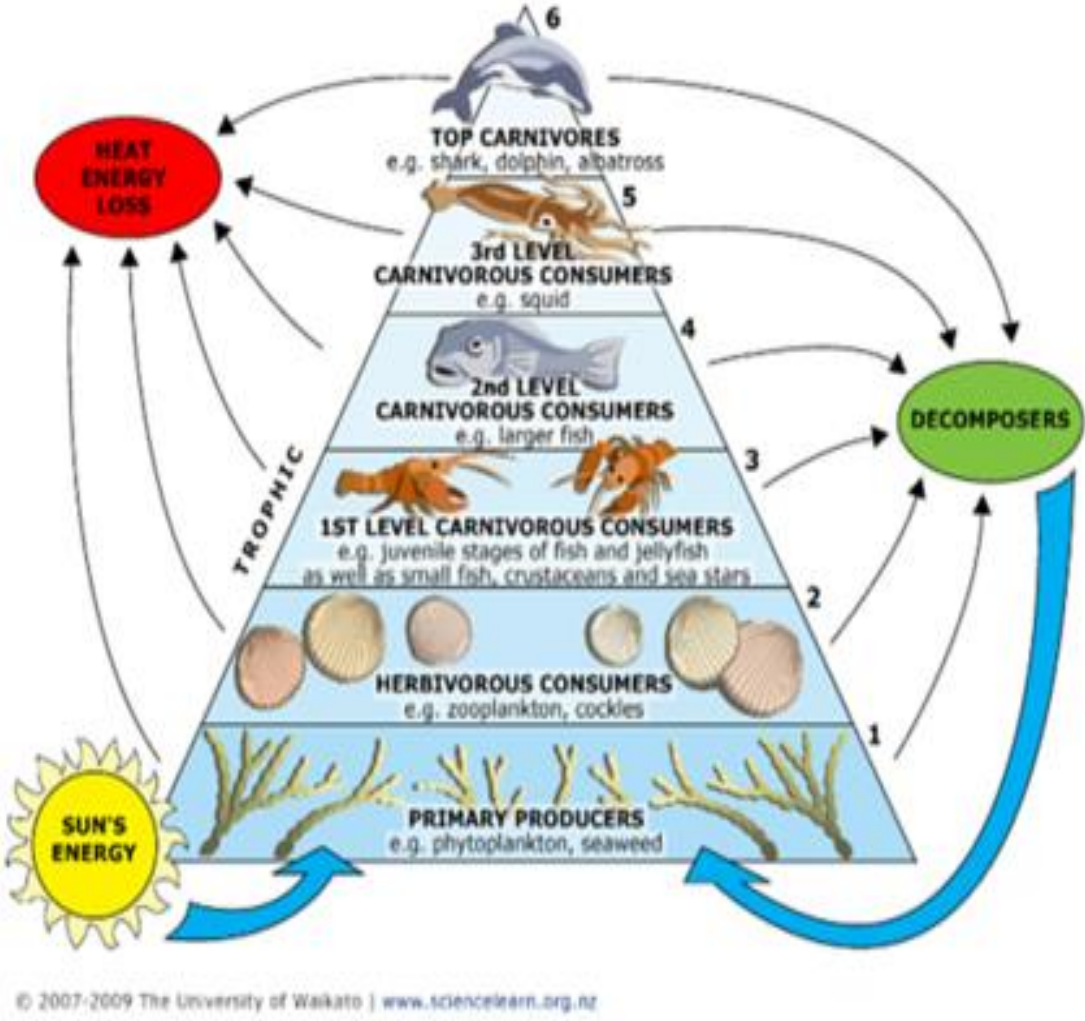
Energy in Ecosystems

- Energy flows through an ecosystem in ONE direction (*trophic structure*).
- ***Primary producers*** – *autotrophs* that make food are <u>at the BOTTOM</u>.
- ***Consumers*** – *heterotrophs* that feed on food made by primary producers and above the producers.



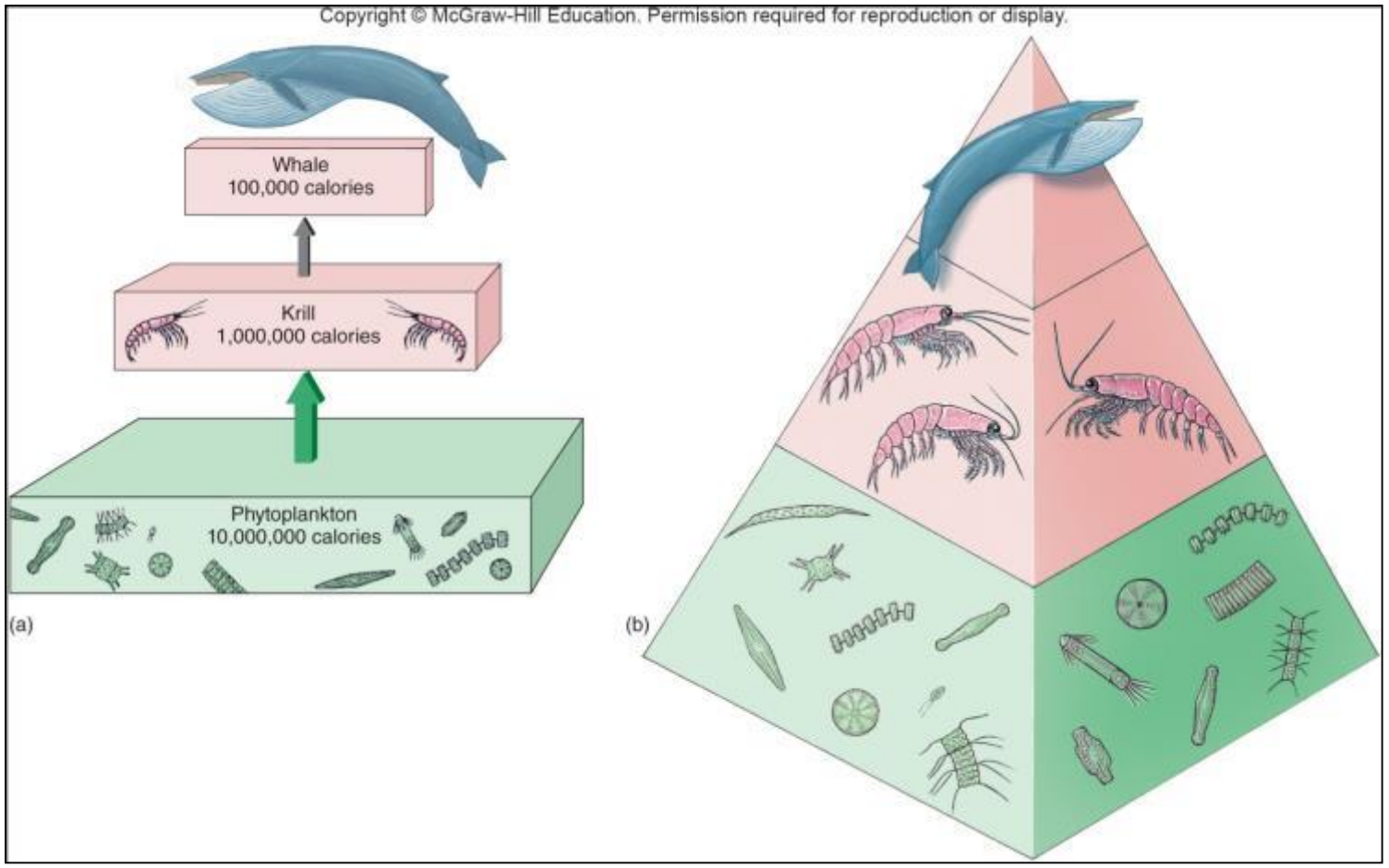
Energy in Ecosystems

- **Food Chain**: shows the flow of energy in an ecosystem.
- **Food Web**: interconnected food chains within an ecosystem.
- **Decomposers/scavengers**: eat dead or decaying organisms and can link organisms in a food web.



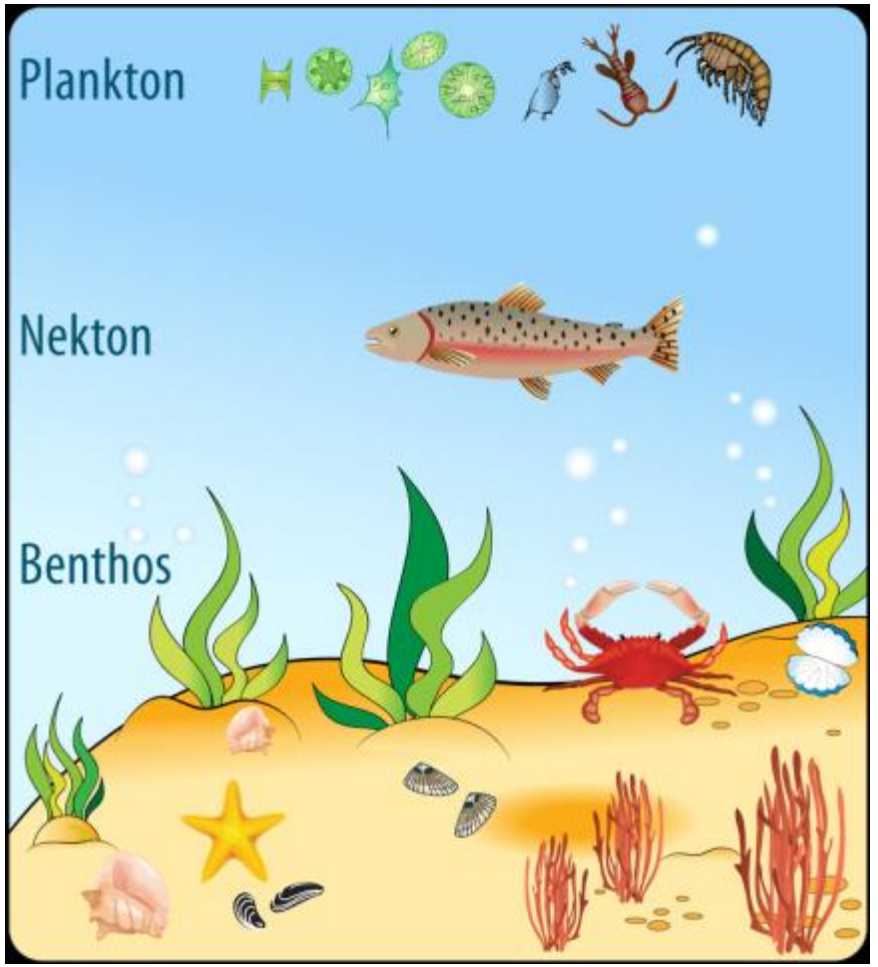
Energy in Ecosystems

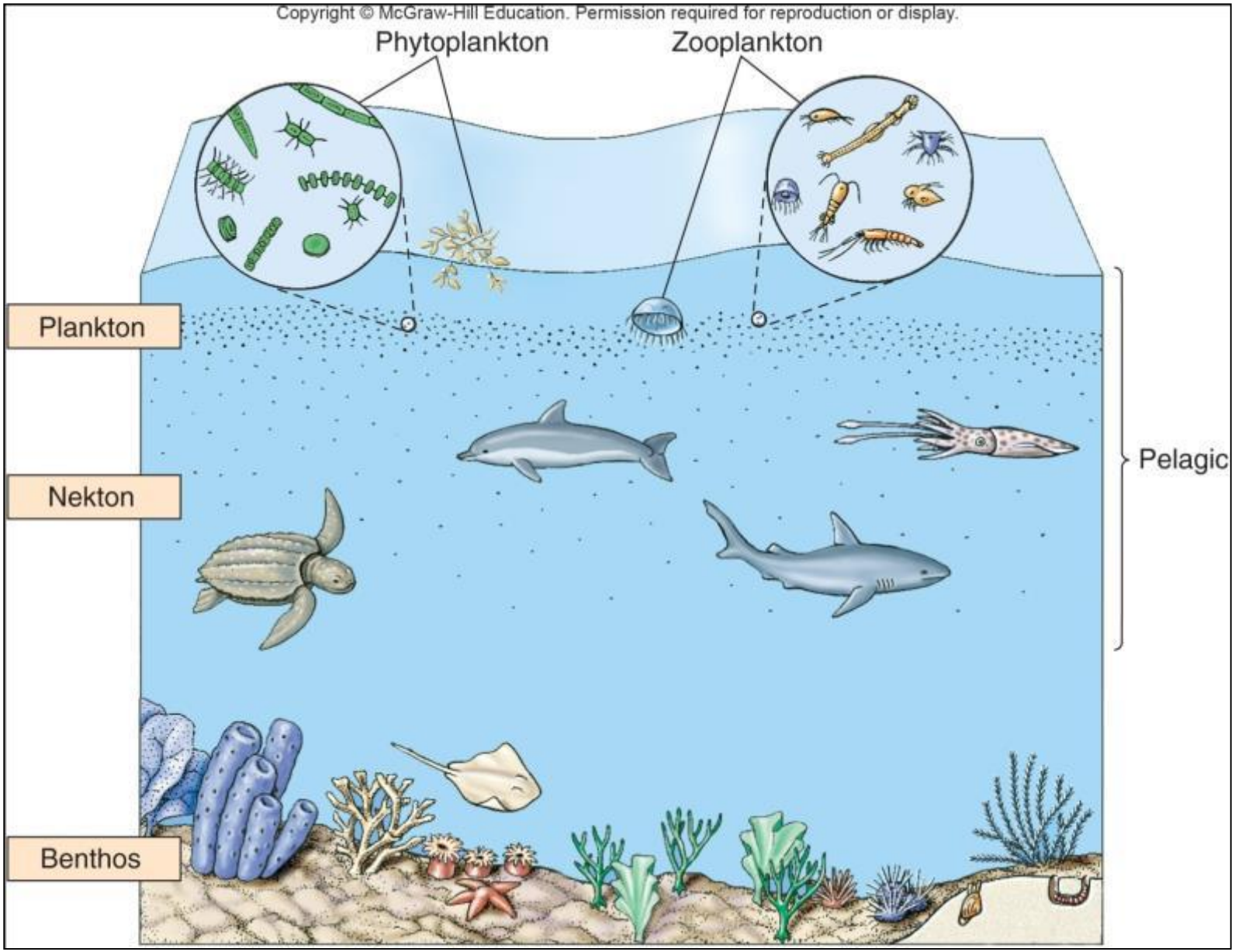
- On average, only <u>about 10%</u> (5-20%) is transferred to the next level of the food chain: *pyramid of energy.*



Major Marine Environments

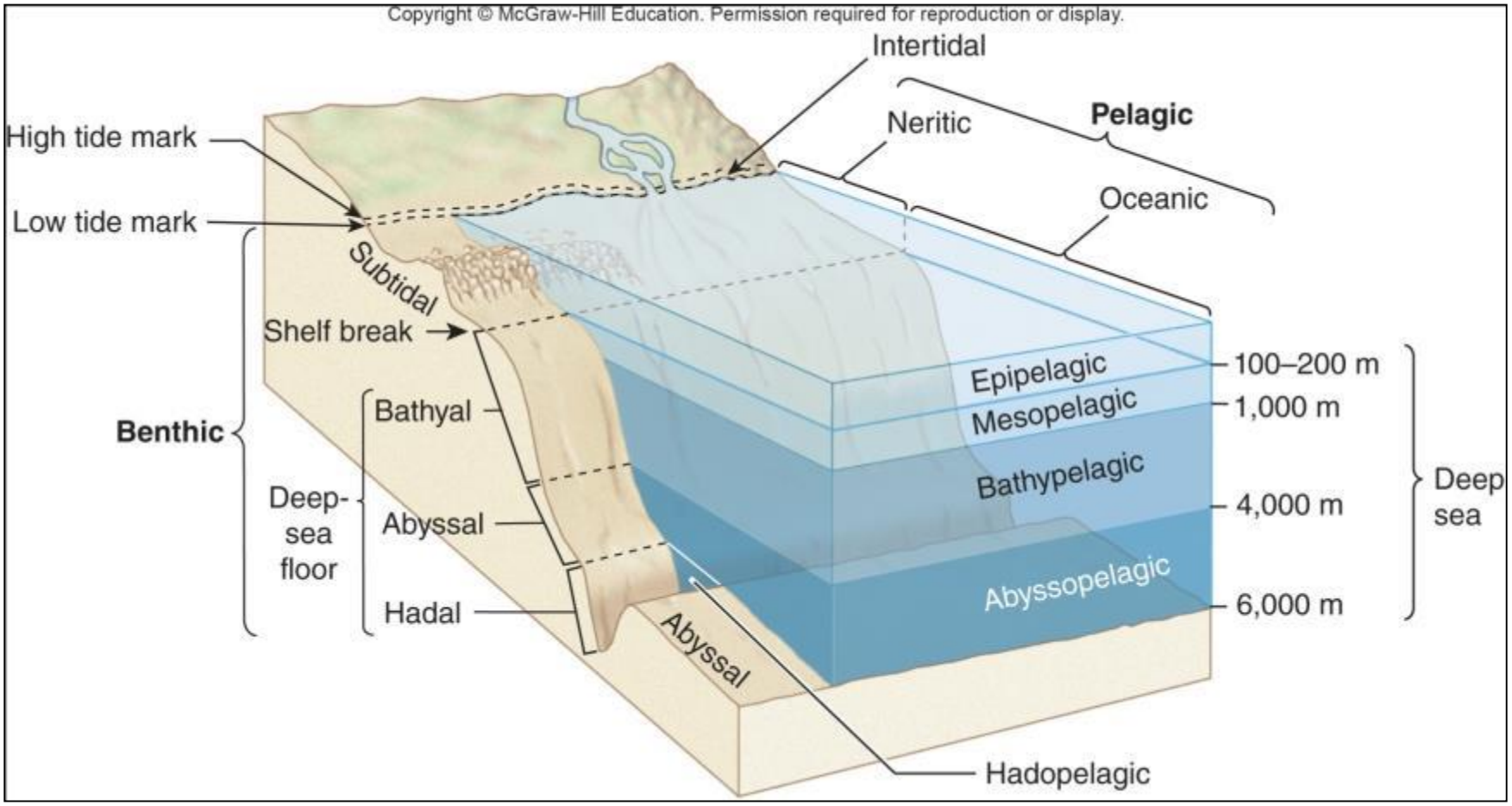
- Benthos – live in or on the bottom
  - *sessile* (attached) or move about on the bottom.
- Pelagic organisms – live in the water column
  - Plankton – drift with currents
    - Phytoplankton – plant-like, *autotrophic* (photosynthesis)
    - Zooplankton– animal-like, *heterotrophic*
  - Nekton – swim to oppose currents





Major Subdivisions of the Marine Environment

- Benthos:
  - **Intertidal** zone – between high and low tide, exposed at least once a day
  - **Subtidal** zone – below the low tide level to edge of continental shelf (*shelf break*), always submerged
  - **Deep sea** – bathyal, abyssal, and hadal zones beyond shelf break



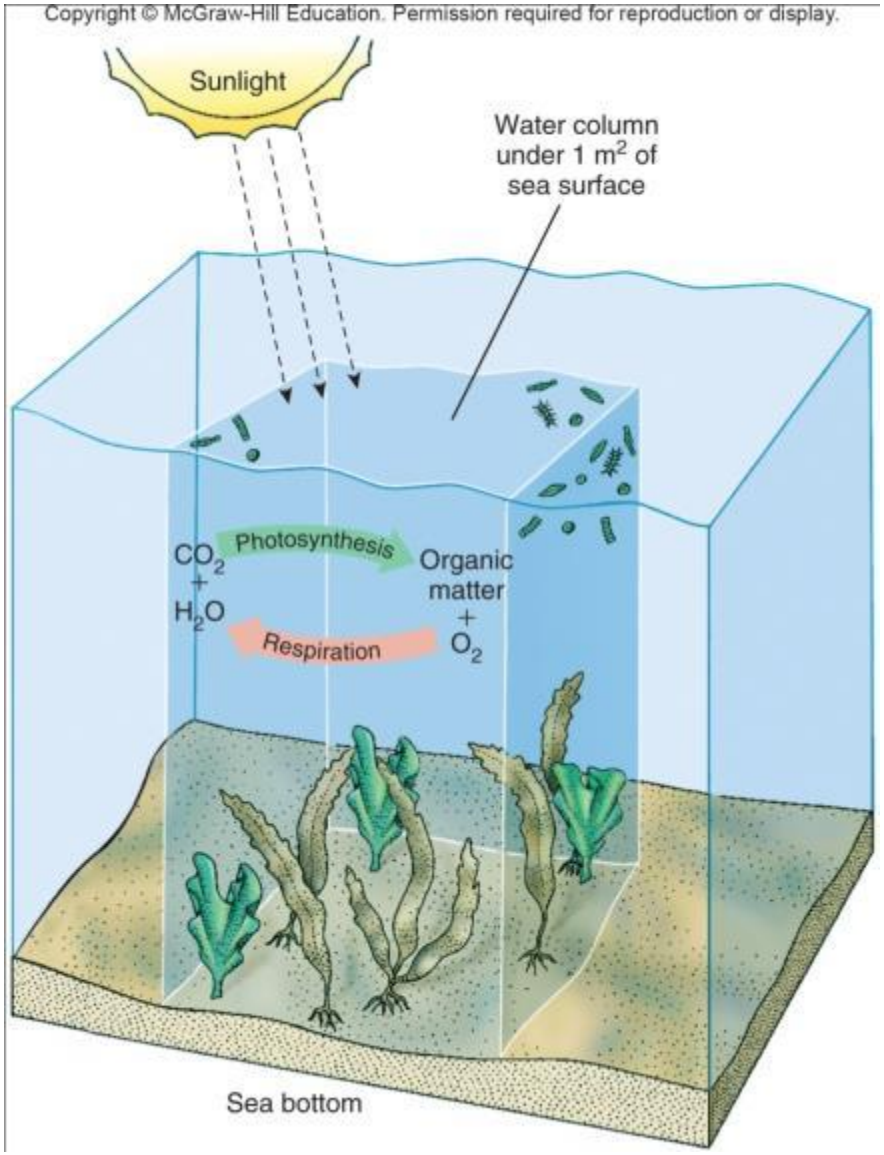
Major Marine Environments

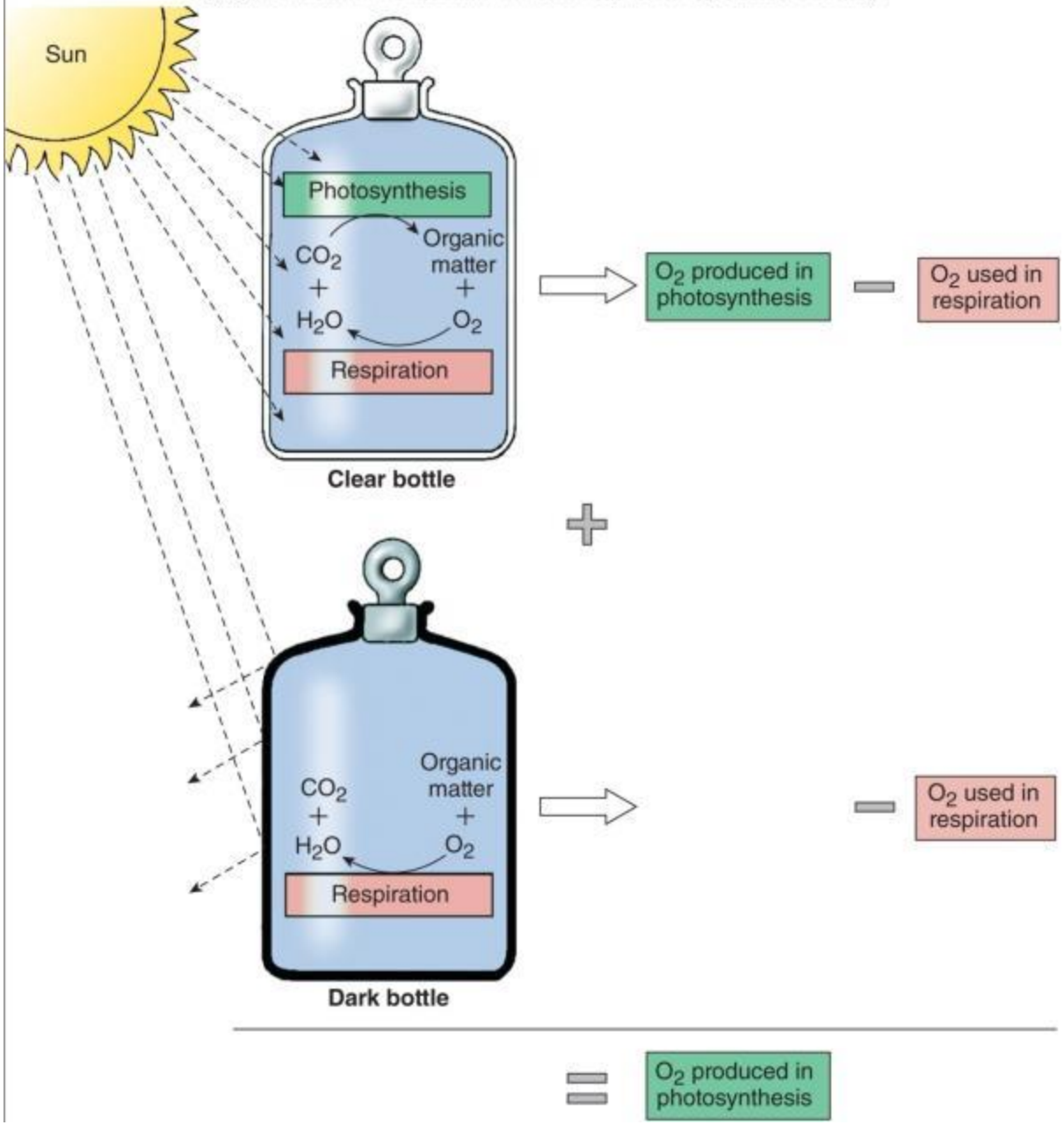
- Pelagic organisms:
  - **Epipelagic** zone is from the surface to 100-200 m; plenty of sunlight available to support primary production.
  - **Mesopelagic** zone extends from lower limit of epipelagic to about 1000 m; reduced light.
  - The **bathypelagic, abyssopelagic,** and **hadopelagic** zones are deep-sea zones where light does not penetrate.

Measuring Primary Productivity

- Primary Production: the organic matter left over after the primary producers meet their own needs: base of the *trophic pyramid*

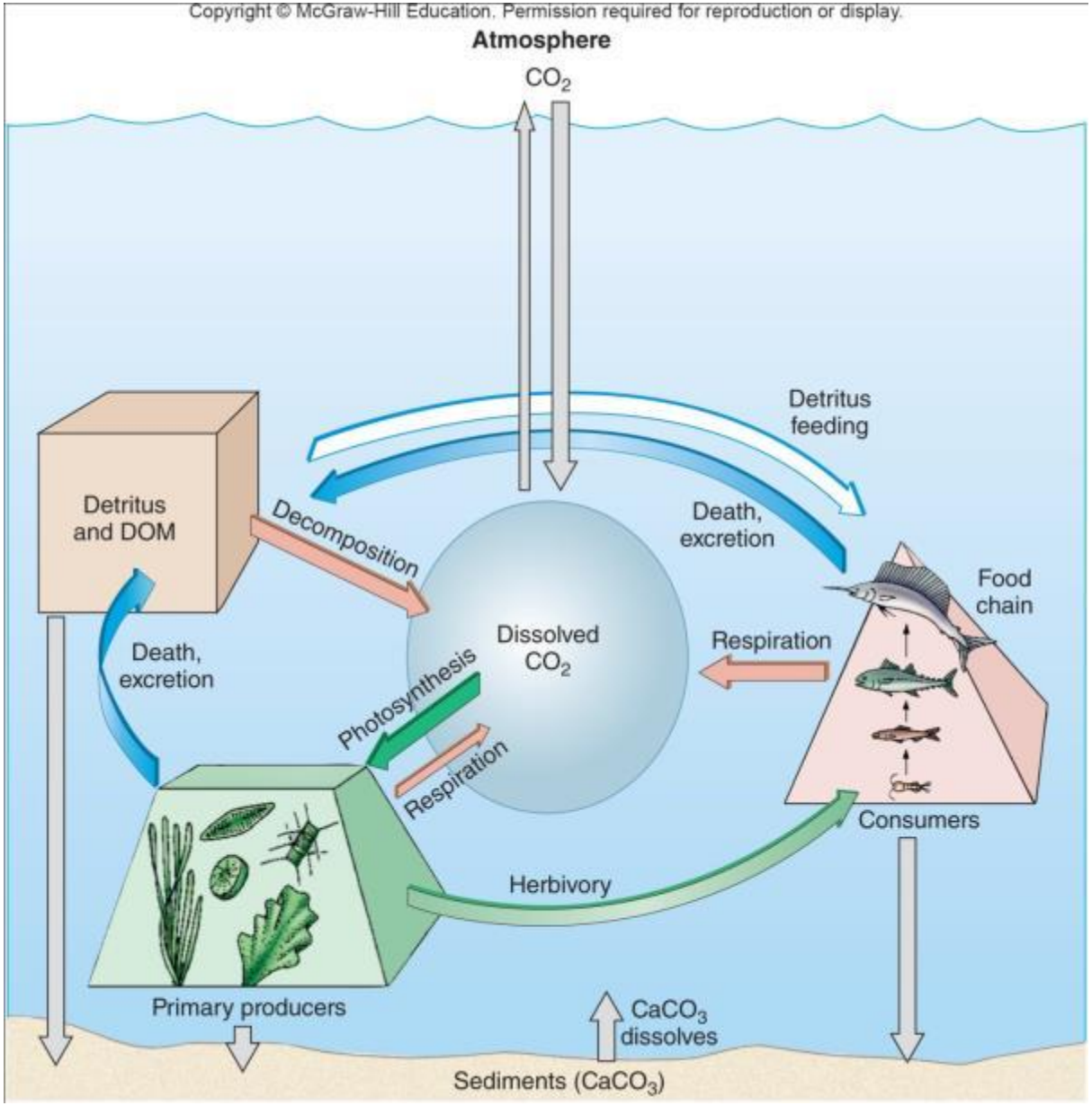
- Standing stock: the total amount of phytoplankton, the main primary producers in the water.





The Carbon Cycle

- Carbon is used by primary producers to manufacture organic molecules (photosynthesis).
- Complex carbon compounds are manufactured by both primary producers and consumers.
- Carbon dioxide (CO_2) is eventually released from all organisms through respiration and decomposition.



Nitrogen and Phosphorus

- Nitrogen and phosphorous are also required for primary production and must be cycled through the ecosystem.
- Both are important limiting factors for primary production in many marine ecosystems.