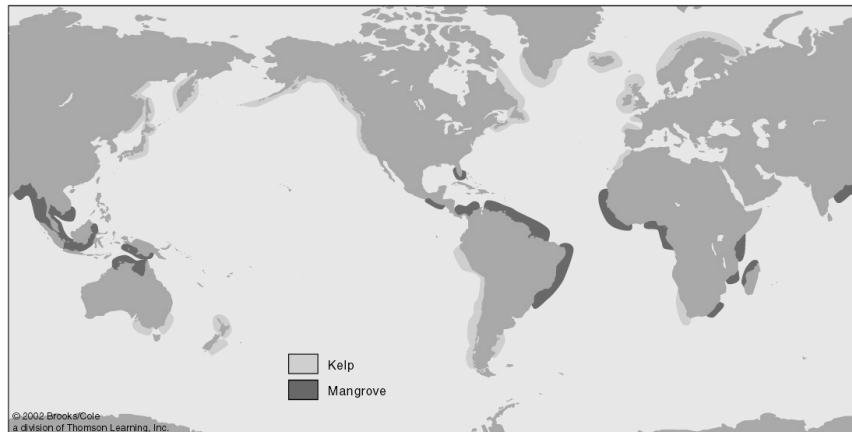


Primary Producers



Kelp forests are one of the ocean's most productive habitats.

1

Key Ideas

- Energy flows through living systems, but matter is recycled.
- Primary producers (autotrophs) synthesize glucose by photosynthesis or chemosynthesis.
- Heterotrophs cannot synthesize glucose; they must consume autotrophs or other heterotrophs for food.
- Feeding relationships resemble webs.
- Phytoplankton are some of the world's most important producers; zooplankton are the most abundant consumers in the ocean.

2

Capture and Flow of Energy

Most of the energy used by marine organisms to make food comes from the sun.

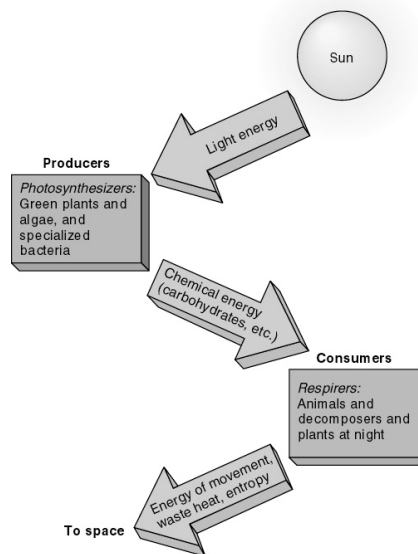
Photosynthesis is the process used by most producers to convert the sun's energy to food energy.

Chemosynthesis is the production of food in the absence of light using chemical energy.

3

Flow of Energy Through Living Systems

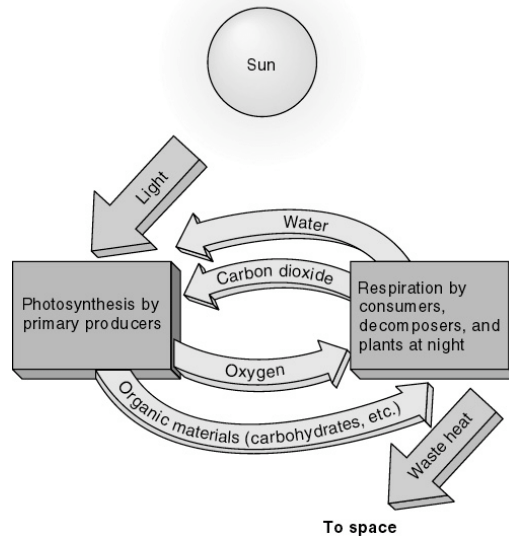
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Cycling of Matter Through Living Systems

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5

Feeding Relationships

Terms used to describe feeding relationships:

Autotrophs – organisms that make their own food, also called *producers*.

Heterotrophs - organisms that must consume other organisms for energy

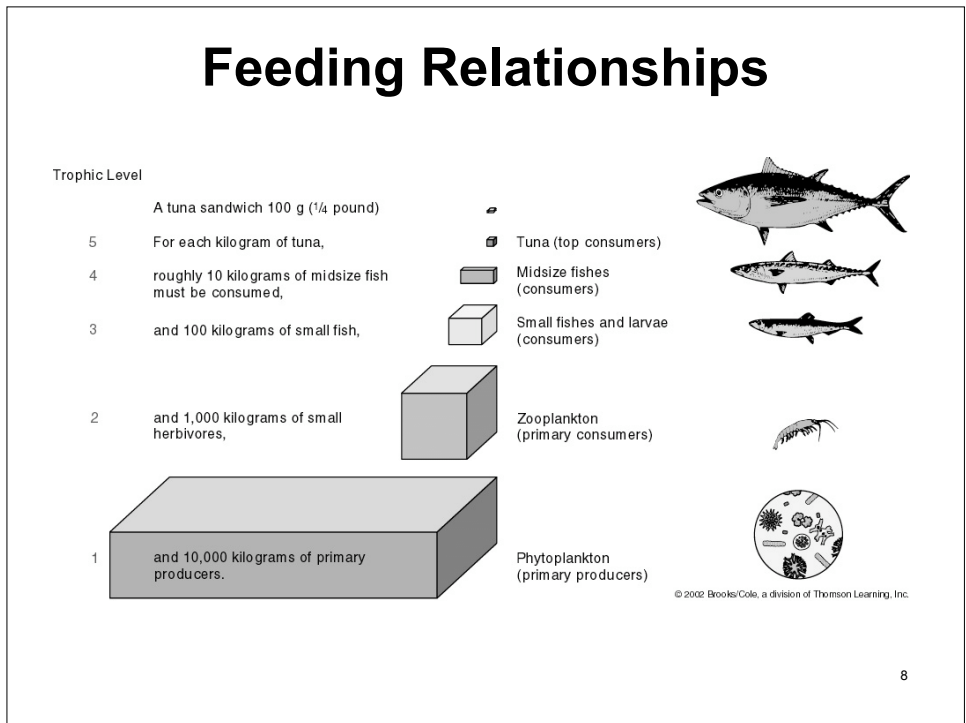
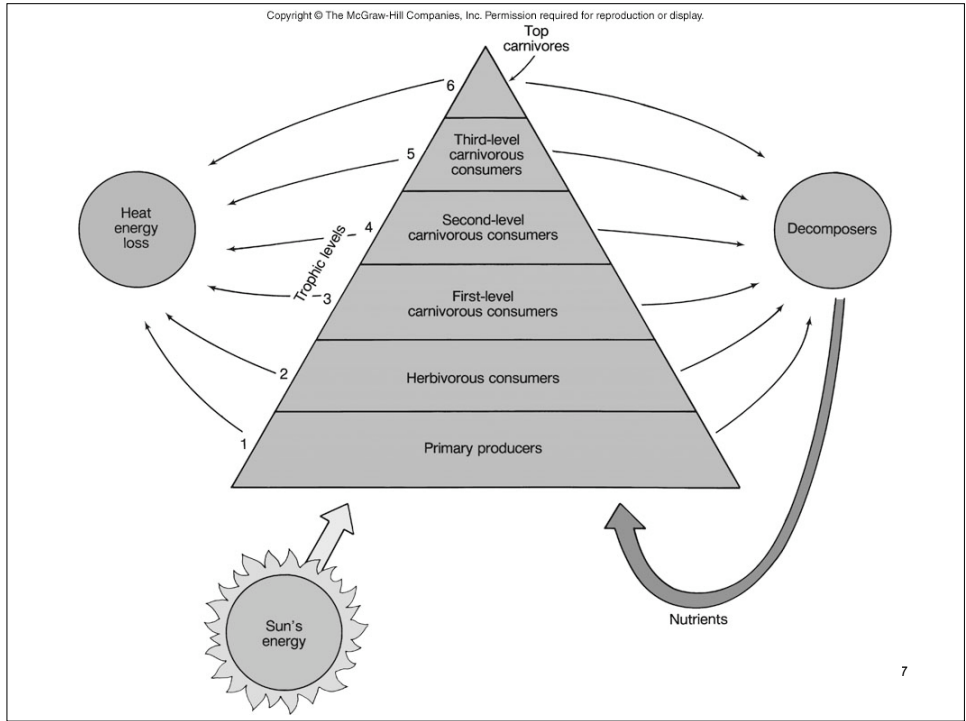
Trophic pyramid - a model that describes who eats whom

Primary consumers - organisms that eat producers

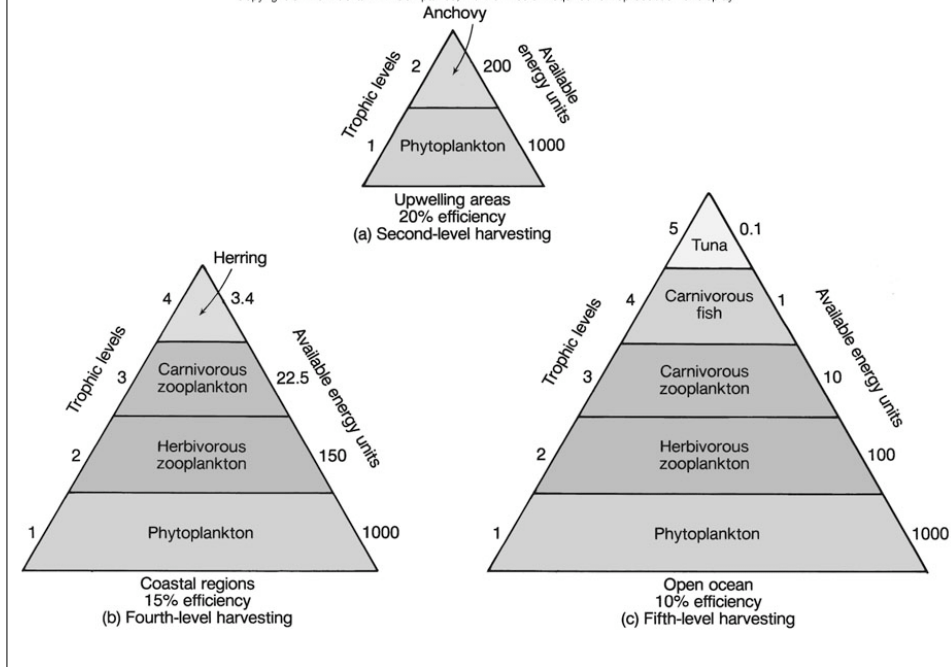
Secondary Consumers - organisms that eat primary consumers

Top consumers - the top of the trophic pyramid

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Primary Productivity

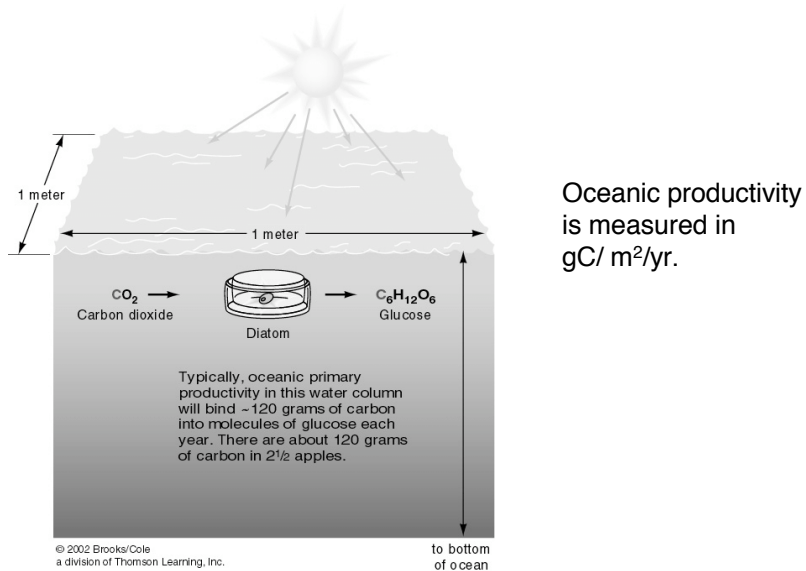
Synthesis of organic material from inorganic substances is **primary productivity**.

Primary productivity is measured in grams of carbon bound into organic material per square meter of ocean surface per year, or, more simply:

$$\text{gC/m}^2/\text{yr}$$

Recent studies suggest that total ocean productivity is between
75 gC/ m²/yr and 150 gC/ m²/yr.

Primary Productivity

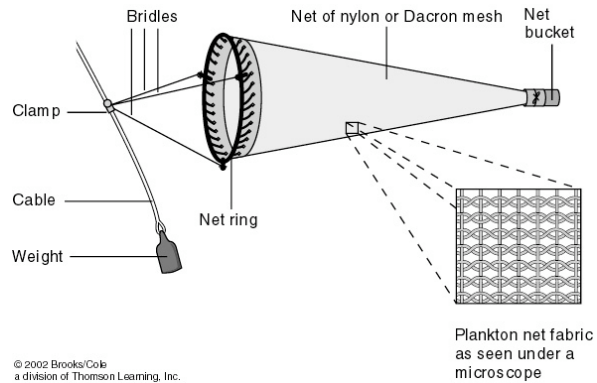


Factors That Limit Productivity

- Water
- Carbon dioxide
- Inorganic nutrients
- Sunlight

Since water and carbon dioxide are in good supply in the ocean, the factors that usually limit marine primary productivity are inorganic nutrients and sunlight.

Phytoplankton



Phytoplankton are drifting autotrophs of many species. They are collected and studied using plankton nets.

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Types of Phytoplankton

Diatoms - the dominant and most productive of the plankton; tests of silica

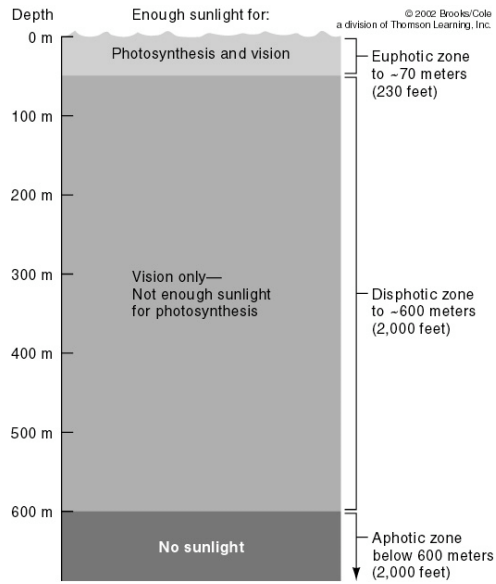
Dinoflagellates and silicoflagellates- use flagella to move

Coccolithophores - tests of calcium carbonate

Nanoplankton and picoplankton - encompasses most other types of plankton; very small.

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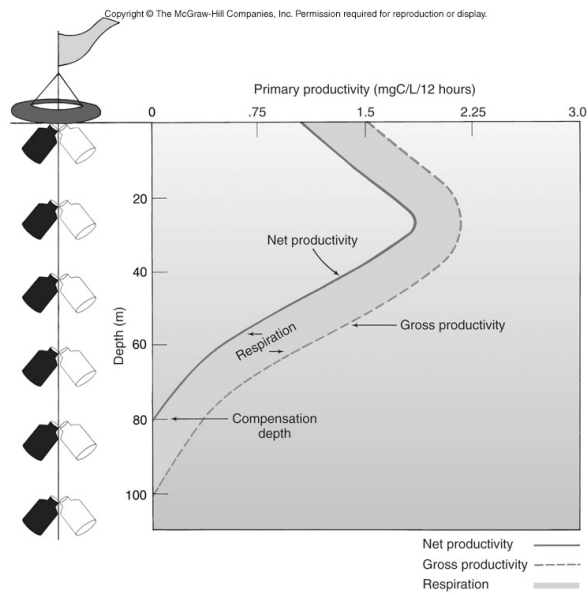
The Euphotic Zone



The euphotic zone is the site of photosynthetic production.

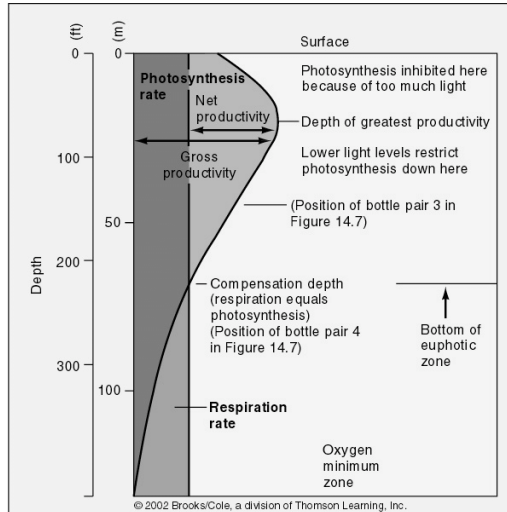
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Productivity Versus Respiration



16

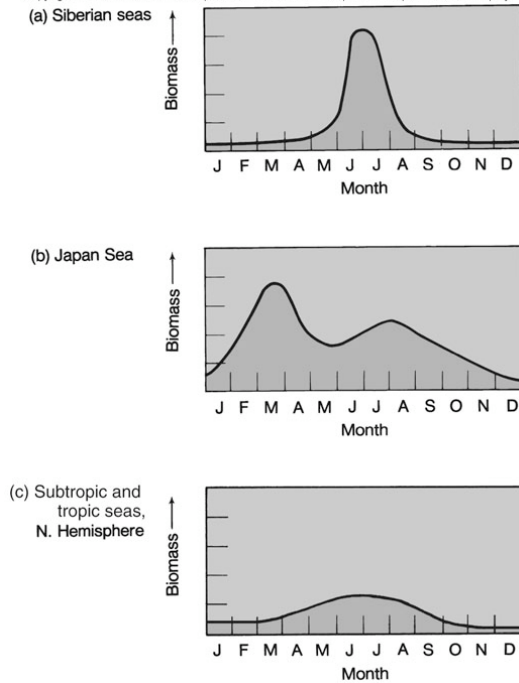
Compensation Depth



The balance between respiration and photosynthesis at different depths. The compensation depth is the “break even” depth.

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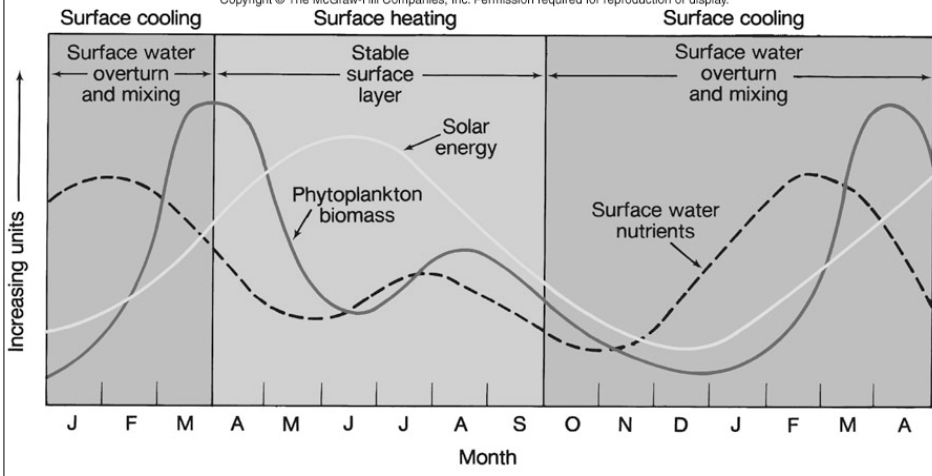


Productivity in different regions during the year.

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Mid-Latitude Productivity

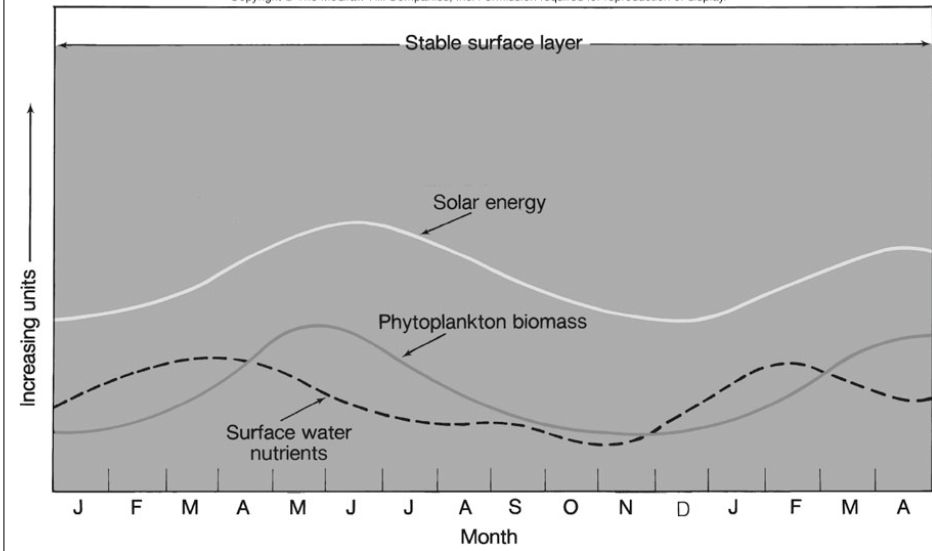
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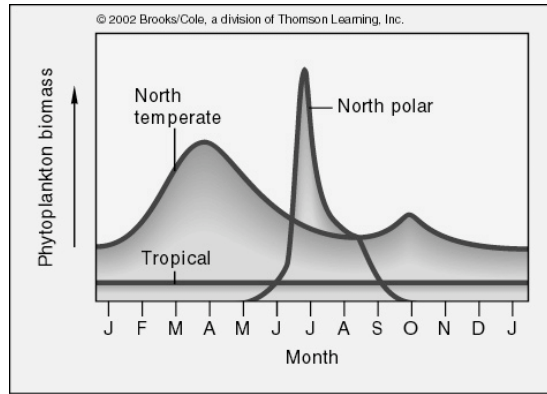
Tropical Productivity

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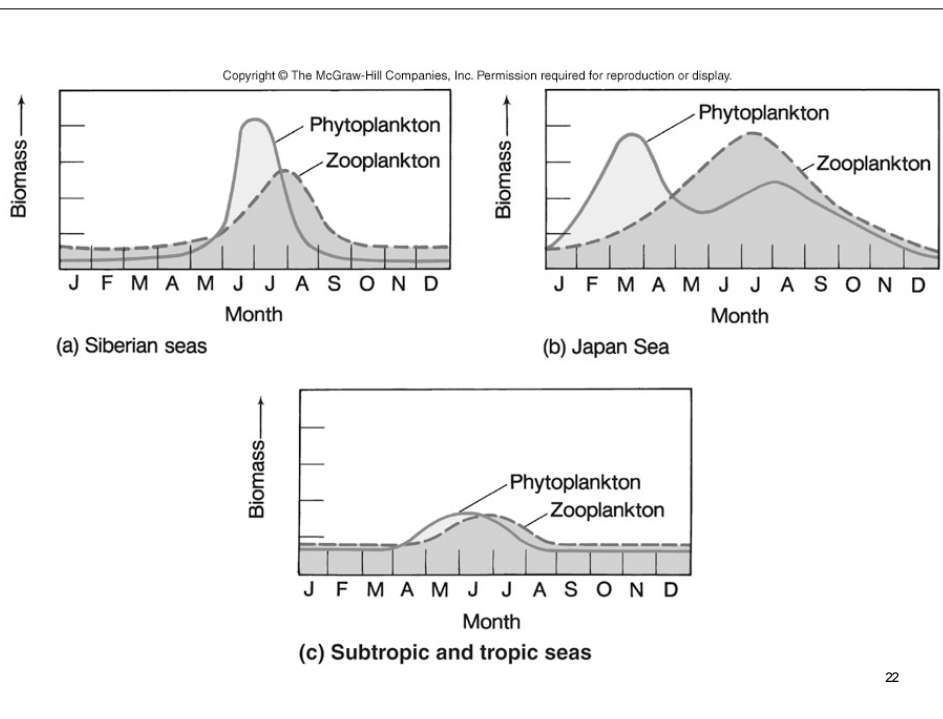
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Global Distribution of Plankton Productivity



The distribution of phytoplankton corresponds to the distribution of macronutrients. The productivity of plankton varies between the seasons.

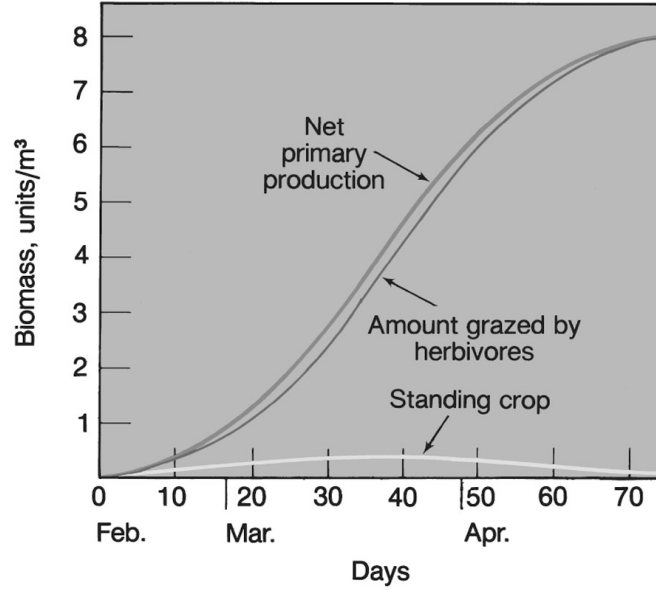
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Productivity Versus Standing Crop

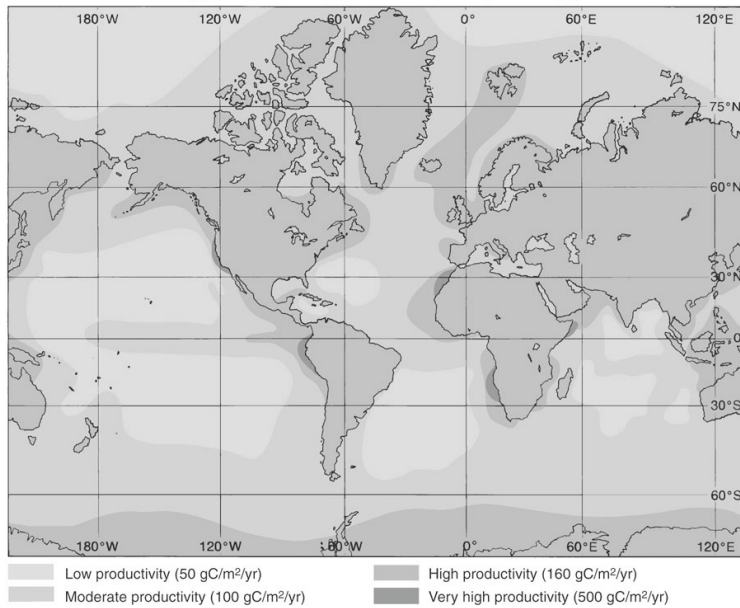
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Productivity of Oceanic Environments

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Larger Marine Producers

Some oceanic autotrophs are attached (plankton are drifters). Attached autotrophs are forms of protists commonly called algae or seaweed. Seaweeds can be classified based on the type of pigments they have.

Chlorophytes are green due to the presence of chlorophyll and the lack of accessory pigments.

Phaeophytes are brown; they contain chlorophyll and a secondary pigment.

Rhodophytes get their red color from accessory pigments.

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Marine Angiosperms

Angiosperms are advanced vascular plants that reproduce with flowers and seed. Most angiosperms are found on land but a few species are found in ocean environments.

Sea grasses are found on the coasts and are very productive compared to phytoplankton.

Mangroves are found in tropical lagoons, bays and estuaries.

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