

Life in the Oceans

Life on earth depends on

- the flow of high-quality energy from Sun through earth's life-support systems that then returns to the space as low-quality heat;
- gravity because it governs/modulates earth's surface processes; and
- the recycling of vital chemicals by a combination of biological, geological and chemical processes.

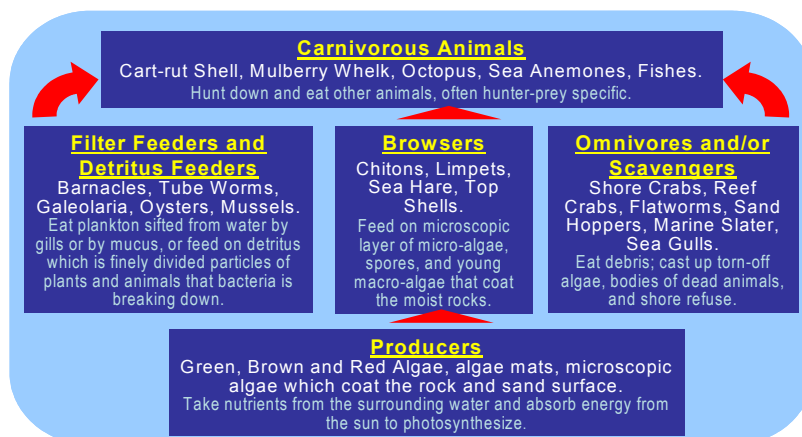
Two reversible equations (of life)

- Trophic levels: Food web passes from plants to herbivores, omnivores and carnivores to bacterial decomposers and nutrients.
- Photosynthesis - the synthesis of carbohydrates from carbon, water and energy - is the dominant primary food production process and characterizes plant kingdom [Chemosynthesis, another primary process of food production, occurs at volcanic centers and in groundwater in volcanic terrains. Also SLIME.]
- Respiration (or oxidation) - the secondary food production process - extracts energy from carbohydrates and characterizes the animal kingdom.
- We can thus write the two reversible chemical reactions (i.e., the products of one process are the exact reactants for the opposite process) as:

Photosynthesis $\Rightarrow 6\text{CO}_2 + 12\text{H}_2\text{O} + \text{Sunlight} + \text{Nutrients} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + \text{O}_2\uparrow$

Cellular respiration $\Rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow \text{Energy} + 6\text{H}_2\text{O} + 6\text{CO}_2\uparrow$

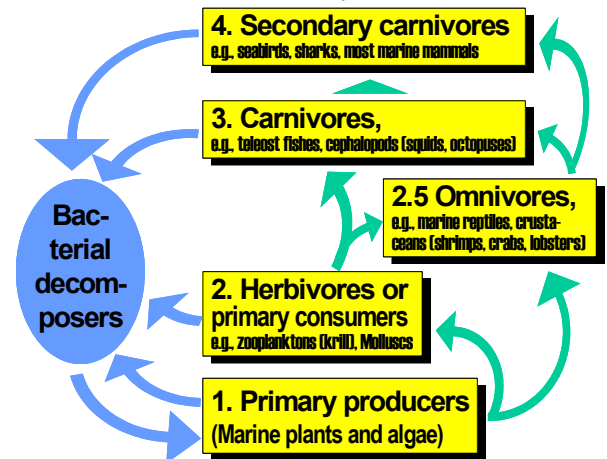
Trophic level is the position that an organism occupies in a food chain — what it eats and what eats it, as the following feeding relationships on a rocky shore in temperate Australia show. Source: http://www.mesa.edu.au/friends/seashores/trophic_levels.html



	Oceans	Amount*	Land
Primary biological productivity	Open ocean	~50	Deserts, grasslands
	Coastal seas	25-150	Forests, common crops and pastures
	Upwellings, deep estuaries	150-500	Rain forests, moist crops
	Shallow estuaries	500-1250	Intensive farming
	Measured in grams of carbon per m ² per year		

The Cell

- is the building block of life, be it unicellular or multicellular;
- functions through physicochemical processes involving molecules, its nucleus regulating its activities and membrane separating it from its environment; and, with a diffusive transport of material through the fluid medium - water, and
- has a small volume and a large surface area in the interest of efficiency.



Bacterial life can be autotrophic (chemosynthesizers) as well as heterotrophic (bacterial decomposers).

The Oceanic biological productivity

- is ~20 billion tons/yr carbon assimilation, compared to ~25 billion tons/yr on land, because photic zones often lack nutrients and the oceanic environment generally lacks challenges;
- is largely limited to continental shelves and equatorial and Antarctic divergences;
- depends mostly on photosynthesis which occurs in the photic zone [productivity maximizes ~20% of the way down through this zone]; and
- is restricted by poor mixing of surface and deep waters in the tropics and by poor photosynthesis at the polar latitudes whereas biological productivity in temperate latitudes fluctuates seasonally.