## Life in the Oceans

#### Life on earth depends on

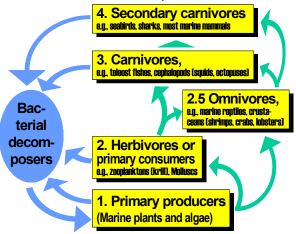
- the flow of high-quality energy from Sun through earth's life-support systems that then returns to the space as low-quality heat;
- gravity because it governs/modulates earth's surface processes; and
- the recycling of vital chemicals by a combination of biological, geological and chemical processes.

### 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:

#### 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).

Photosynthesis  $\Rightarrow$  6CO<sub>2</sub> + 12H<sub>2</sub>O + Sunlight + Nutrients  $\Rightarrow$  C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6H<sub>2</sub>O + O<sub>2</sub> $\uparrow$ 

Cellular respiration  $\Rightarrow$   $C_6H_{12}O_6 + 6O_2 \rightarrow Energy + 6H_2O + 6CO_2 \uparrow$ 

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

#### **Carnivorous Animals** Cart-rut Shell, Mulberry Whelk, Octopus, Sea Anemones, Fishes. Hunt down and eat other animals, often hunter-prey specific. Filter Feeders and **Browsers** Omnivores and/or Detritus Feeders Barnacles, Tube Worms, Galeolaria, Oysters, Mussels. Eat plankton sifted from water by Scavengers Shore Crabs, Reef Crabs, Flatworms, Sand Hoppers, Marine Slater, Chitons, Limpets, Sea Hare, Top Shells. Feed on microscopic gills or by mucus, or feed on detritus which is finely divided particles of plants and animals that bacteria is layer of micro-algae, Sea Gulls. Eat debris; cast up torn-off algae, bodies of dead animals, and shore refuse. spores, and young macro-algae that coat the moist rocks. breaking down Producers Green, Brown and Red Algae, algae mats, microscopic algae which coat the rock and sand surface. Take nutrients from the surrounding water and absorb energy from the sun to photosynthesize.

	<u>Oceans</u>	Amount*	<u>Land</u>
<u>ا</u> ح اہ	Open ocean	~50	Deserts, grasslands
ry bio-	Coastal seas	25-150	Forests, common crops and pastures
Cal Juci	Upwellings, deep	150-500	Rain forests, moist
Primar logical produc	estuaries Shallow estuaries	500-1250	crops Intensive farming
띠그	Measured in grams of carbon per m <sup>2</sup> per year		

# 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.