Classification of Marine Life & Habitats
Autotrophs can make the organic building blocks of life starting from carbon dioxide. Heterotrophs have to eat organics.

carbon dioxide → sugars → amino acids

nucleotides → lipids
Classifying Marine Organisms by Nutrition

- **Autotrophs** - use CO$_2$ to make organics
  - Who: All plants, some protista and bacteria
  - Can use sunlight (photo-) or chemical (chemo-) energy
- **Heterotrophs** - Need to consume organic compounds
  - Who: everything that is not autotrophic
- **Mixotrophs** - They can do both!
Cells are more than sugar. Other compounds are built from simple sugars plus nutrients (Nitrogen, Phosphorous) & trace metals.

Autotrophy

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

Energy

Autotrophnic Cell

Sugar
Respiration

Reversing the reaction yields energy the cell can use

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]
Heterotrophs consume organics. Much is resired to get energy and some is used as building blocks to grow.
Mixotrophy

Very common among marine plankton
Many Protists in the ocean are both phytoplankton AND predators!
Mixotrophs can do this

But when nutrients are scarce

So they EAT other cells to get their nutrients especially nitrogen (N) and phosphorus (P)

They can’t make all the necessary building blocks
- **Photosynthesis (Cyanobacteria)**
- **Bacteria and Archaea**
- **Eukaryotes (Protists)**
- **Multicellular Life**
- **ANIMALS**
- **FUNGI**
- **PLANTS**

- **Photoautotrophs**
- **Heterotrophs**
- **Mixotrophs**

Timeline:
- > 3.5 billion
- 2 billion
- 700 million
- 500 million
EXCEPTIONS

“Mixotrophic” Animals

Sea Slug
Eastern Emerald Elysia

Truly Mixotrophic Plants

Venus Fly Trap

Upside-down Jelly
Cassiopea

Pitcher Plant
Classifying Marine Organisms by Habitat

- Benthic (*benthos* = bottom)
- Pelagic (*pelagius* = of the sea)

Ocean Habitats

Intertidal (littoral) zone
Classifying Marine Organisms by Lifestyle

- **Benthic** (*benthos* = bottom)
  - Infauna
  - Epifauna
- **Pelagic** (*pelagius* = of the sea)
  - Plankton (Drifters, weak swimmers)
  - Nekton (Swimmers)
Pelagic Organisms

Nekton (all are animals)

Plankton

phytoplankton
zooplankton
bacterioplankton
Physical Divisions of the Marine Environment

NERITIC

NERITIC

Supralittoral (splash zone)

Littoral (intertidal)

Sublittoral

Epipelagic

Mesopelagic

Bathypelagic

Bathyal

Abyssal

Abyssopelagic

Hadal

Hadalpelagic

200 m

1000 m

4000 m

6000 m
Physical & Chemical Factors Affecting Life

• Temperature & Light DECREASE with Depth & Latitude
• Pressure INCREASES with Depth
• Salinity more variable near shore
• Air exposure in the littoral zone
Pressure Increases with Depth

Photo courtesy Kate Achilles
Deep-diving marine mammals have collapsible lungs
Temperature Variations

Temperature Decreases with Depth

Temperature Decreases with Latitude

- POLAR
- TEMPERATE
- TROPICAL
Light Variations

Light intensity decreases with latitude and with depth.

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[Diagram showing light intensity variations with latitude and depth.]
TOTAL light and COLOR Spectrum Vary with depth

Euphotic zone = where photosynthesis is possible!

Disphotic zone = there is light but not enough for photosynthesis!

Aphotic

No light from the sun penetrates
Photosynthesis Feeds The Ocean
The Pelagic Divisions
(By Light)

EUPHOTIC ZONE
“Good” Light
Photosynthesis can only happen up here!
20 to 100 m

DISPHOTIC ZONE
Twilight

APHOTIC ZONE
No Light
about 600 m