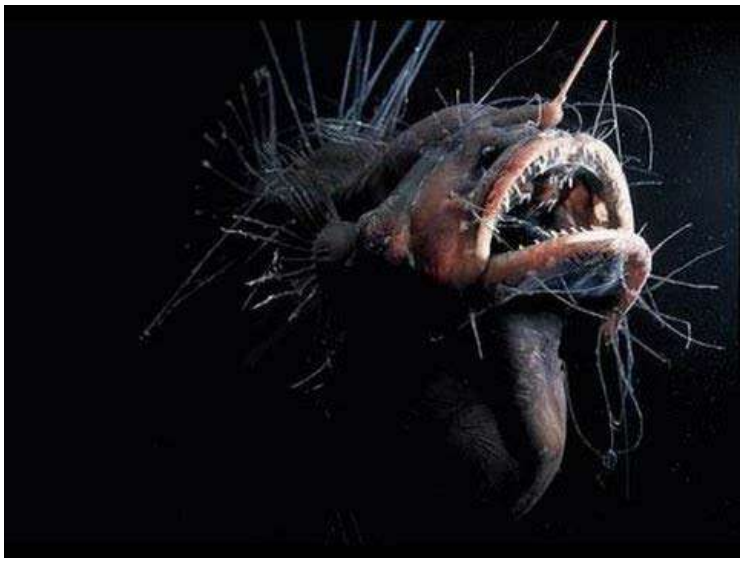
Introduction to Marine Biology



- What are words or things you associate with marine biology?

Ocean Literacy

The Earth has one big ocean with many features.

The ocean and life in the ocean shape the features of Earth.

The ocean makes the Earth habitable.

The ocean is a major influence on weather and climate.

The ocean supports a great diversity of life and ecosystems.

The ocean and humans are inextricably interconnected.

The ocean is largely unexplored.

What Is Marine Biology?

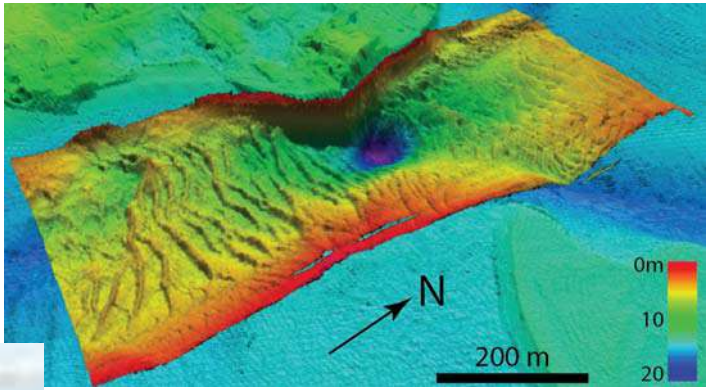
- It's the scientific study of organisms that live in the ocean

Why Study Marine Biology?

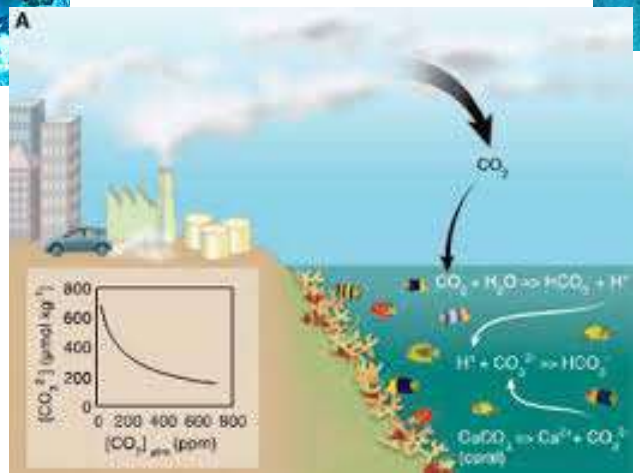
- Gives us insight to how the Earth originated
- Regulates our climate
- Medical advances : used to develop treatment for HIV, cancer, dengue fever, inflammation, etc…
- Large source of food for world population
- Source of recreation and tourism
- Produces about half of the oxygen we breathe

Marine Biology includes many sciences:

Oceanography



Marine Geology



Ocean Chemistry

- Mid-19th century voyages were organized to study the ocean
- Marine labs have grown over the years and now can house multiple scientists
- Sonar was developed in marine biology but now used by submarines (WWII)
- Many universities now have research vessels

Floating Instrument Platform (FLIP)

Marine Ecology

- Ecology is the interaction between organisms and their environment.
- These interactions affect the survival and distribution of these organisms.
- Organisms within a community interact with each other in very complex ways.

Terms to Know

Community: All populations of organisms living in a defined area.

Habitat: The physical place where an organism lives.

Niche: The resources (biotic & abiotic) an organism uses for survival, growth and reproduction.

Needs of a Species

- Populations demand specific resources to survive.
- These resources can affect population growth if they are in short supply.
- These resources that have the ability to affect the growth of a population are called limiting resources.
  - Examples: Nutrients, Light, Space (habitat), Oxygen or carbon dioxide, Inorganic compounds

Marine Ecology

Ways that Species can Interact:

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

Competition

- Competition occurs when organisms must “fight” with one another over a limiting resource they both require for survival.

- Types of competition
  - Intraspecific competition – Competing with members of their own species
  - Interspecific competition – Compete with members of other species

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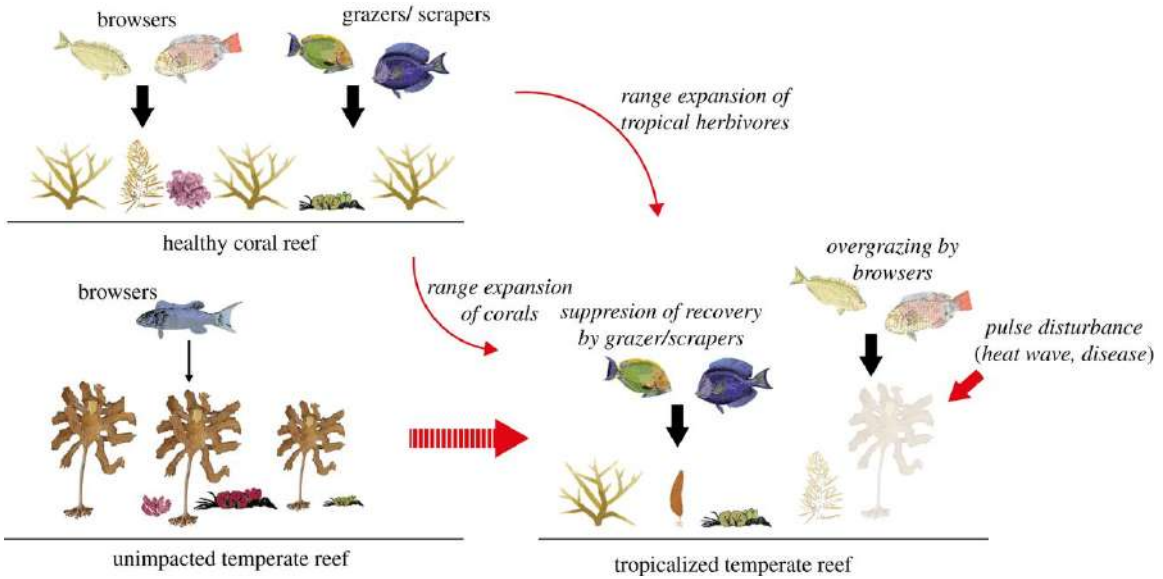
Competition

- An organism can use a resource at the expense of another organism.
- This may result in reduced ability of that individual to reproduce or even survive.
- Poorer competitors may die out due to this competition.

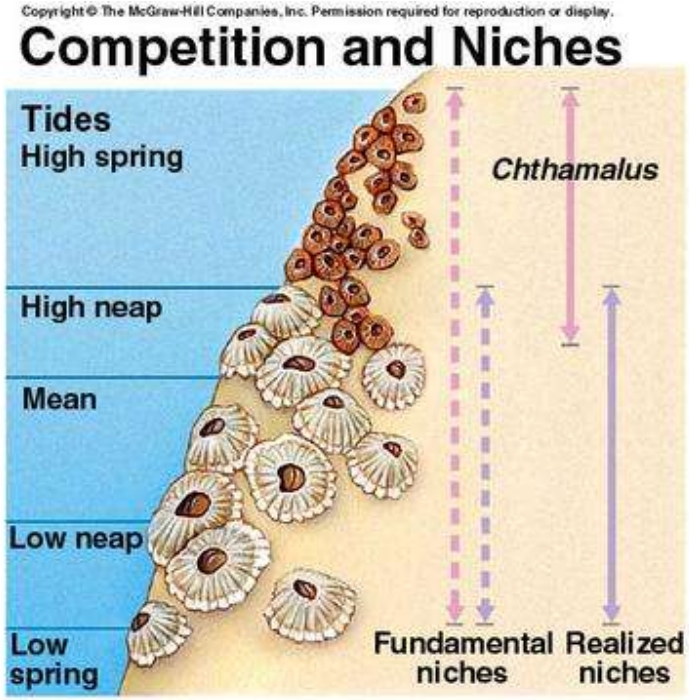
- Interspecific Competition- Individuals of different species compete for same resources (food, shelter, space).
- What are possible outcomes of interspecific competition?
  - one individual *excludes* the other (principle of competitive exclusion)
  - they *coexist* (resource partitioning)



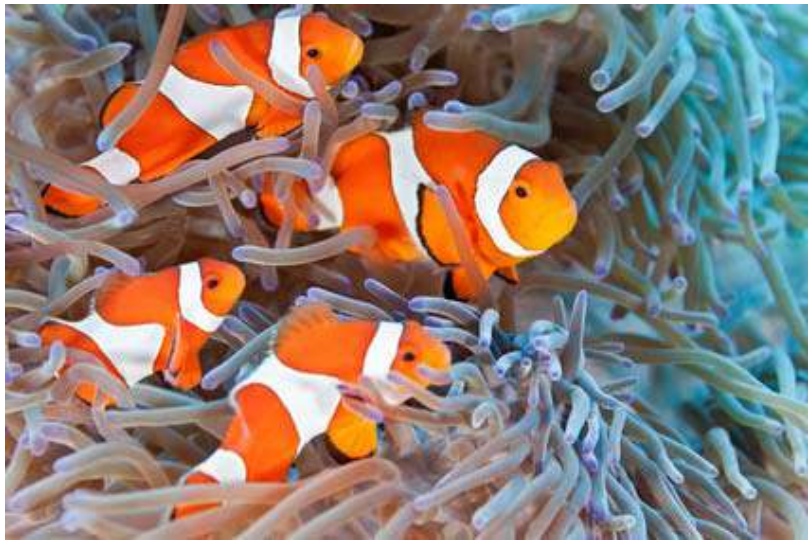
More on Niches

- Fundamental niche - all resources a species is *capable* of using.

- Realized niche - all resources a species actually uses in a community.
  - The realized niche may be different due to specific interactions with competitors.



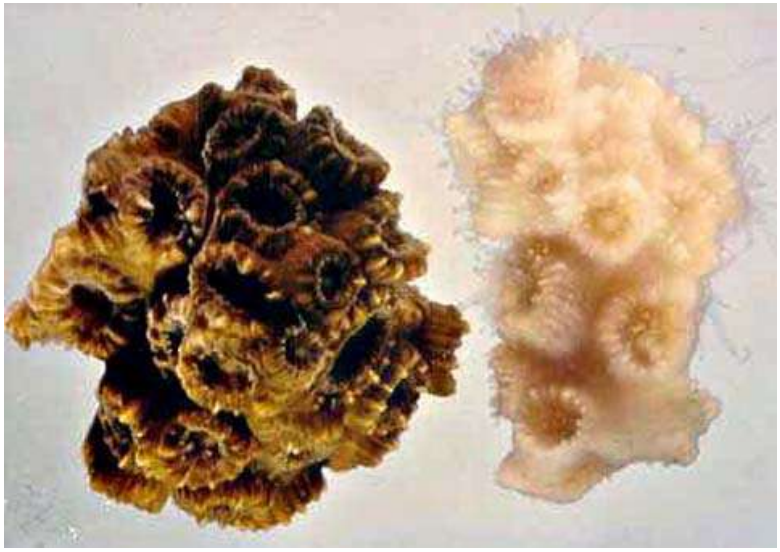
Symbiosis: interaction between two different organisms living in close physical association



Types of Symbiosis

1. Mutualism - both species benefit

   example: cleaning associations (stingrays and bluehead wrasse) or feeding/protection (coral and zooxanthelae)

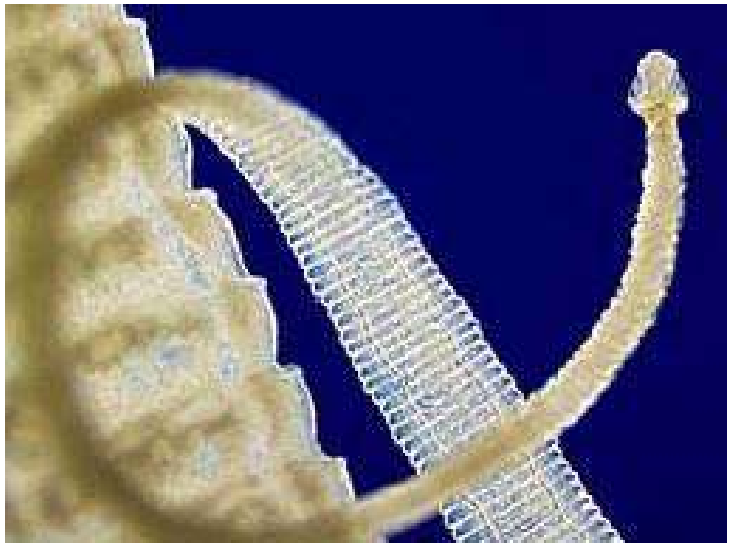


Types of Symbiosis

2. Commensalism - one species benefits with no apparent effect on the other (example: barnacles living on whales, fish feeding off algae on turtle).

Types of Symbiosis

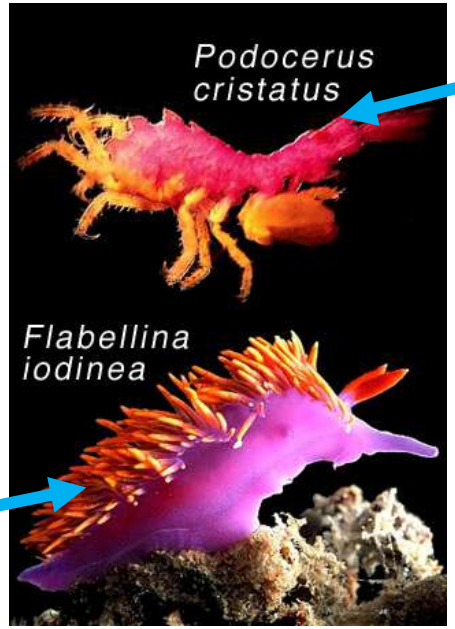
3. Parasitism - one species benefits & the other is harmed (examples: tapeworms in the guts of whales, magnificent frigate bird as a kleptoparasite).



Predation: <u>One species (predator) kills another (prey) for food</u>.

Prey species often have adaptations that help them avoid being eaten such as:

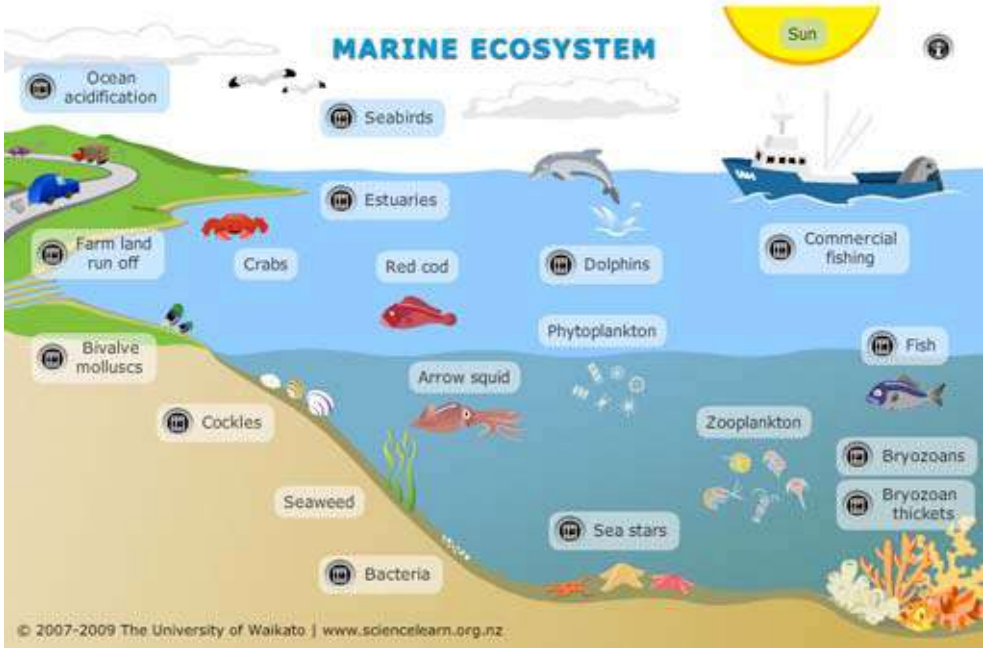
- Warning coloration
- Camouflage
- Mimicry



Ecosystem

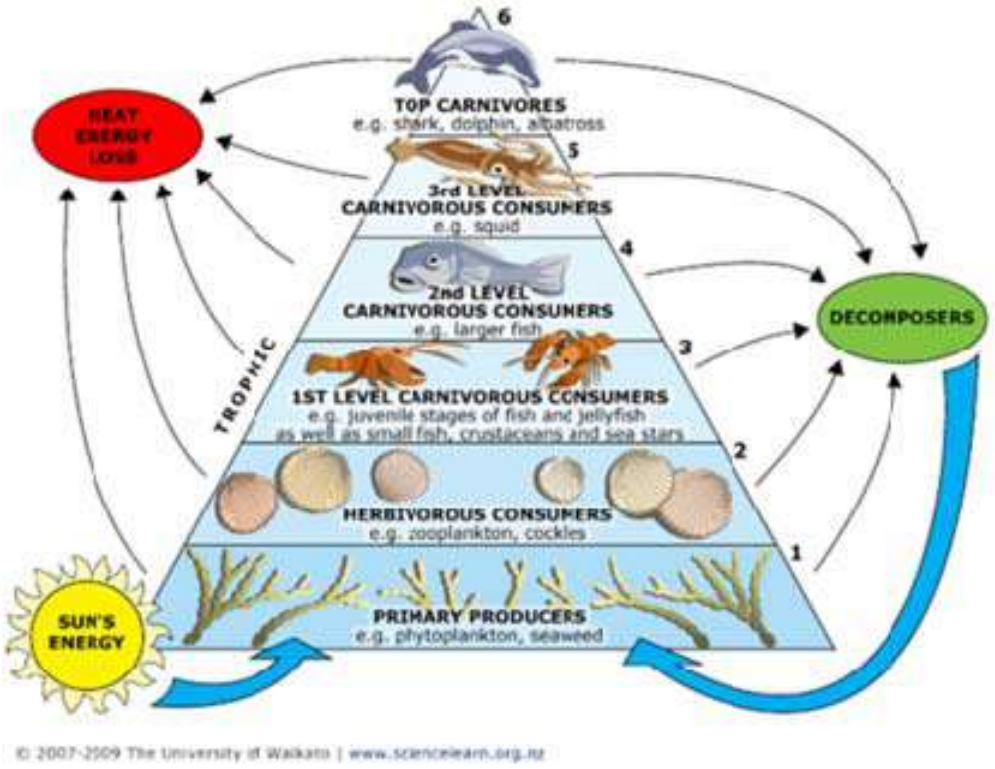
All the biotic (living) and abiotic (nonliving) components in a defined area.

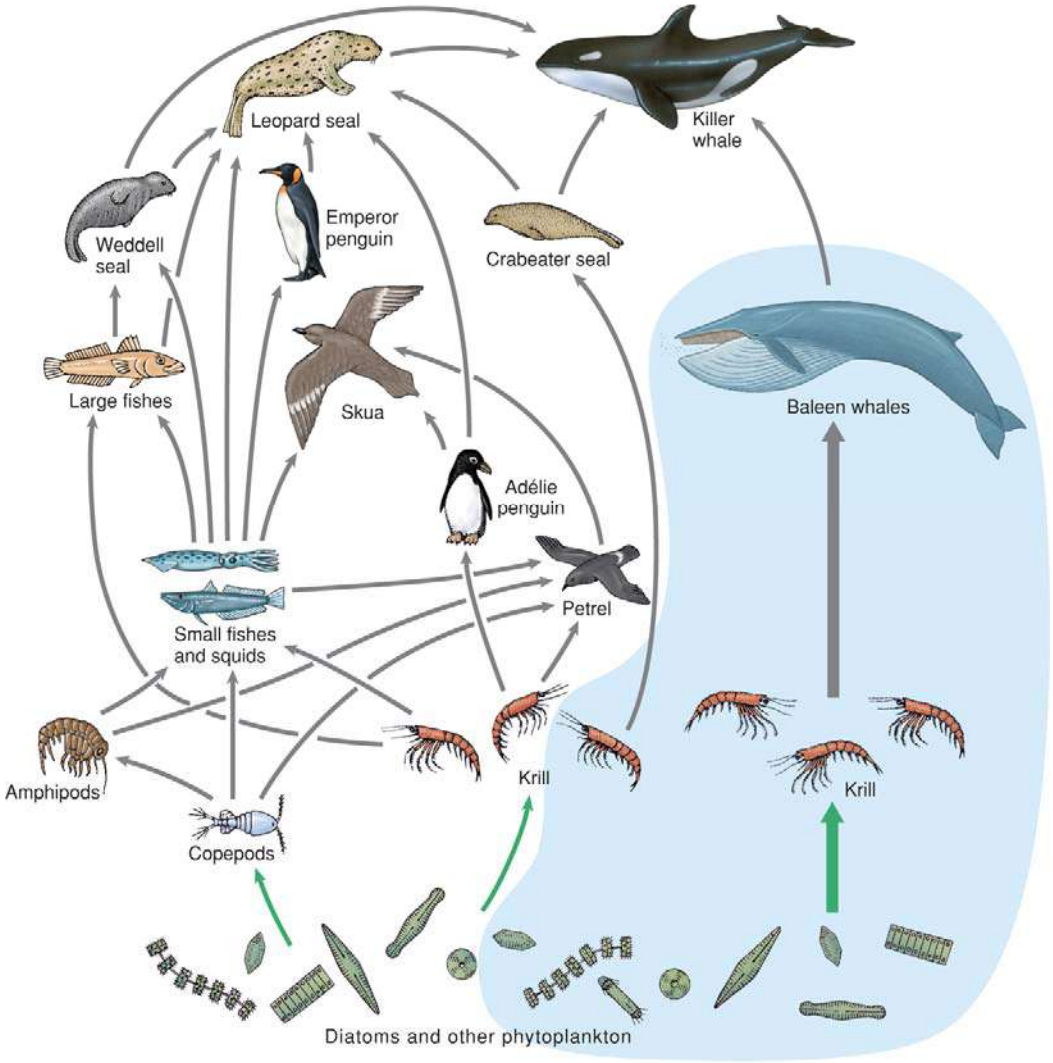
- Ecosystems interact.
- All ecosystems require a constant *input* of energy.
- Chemicals and nutrients are *cycled* within ecosystems.



Energy Flow

- Energy flows through an ecosystem
- Route of energy flow is determined by an ecosystem's *trophic structure*.



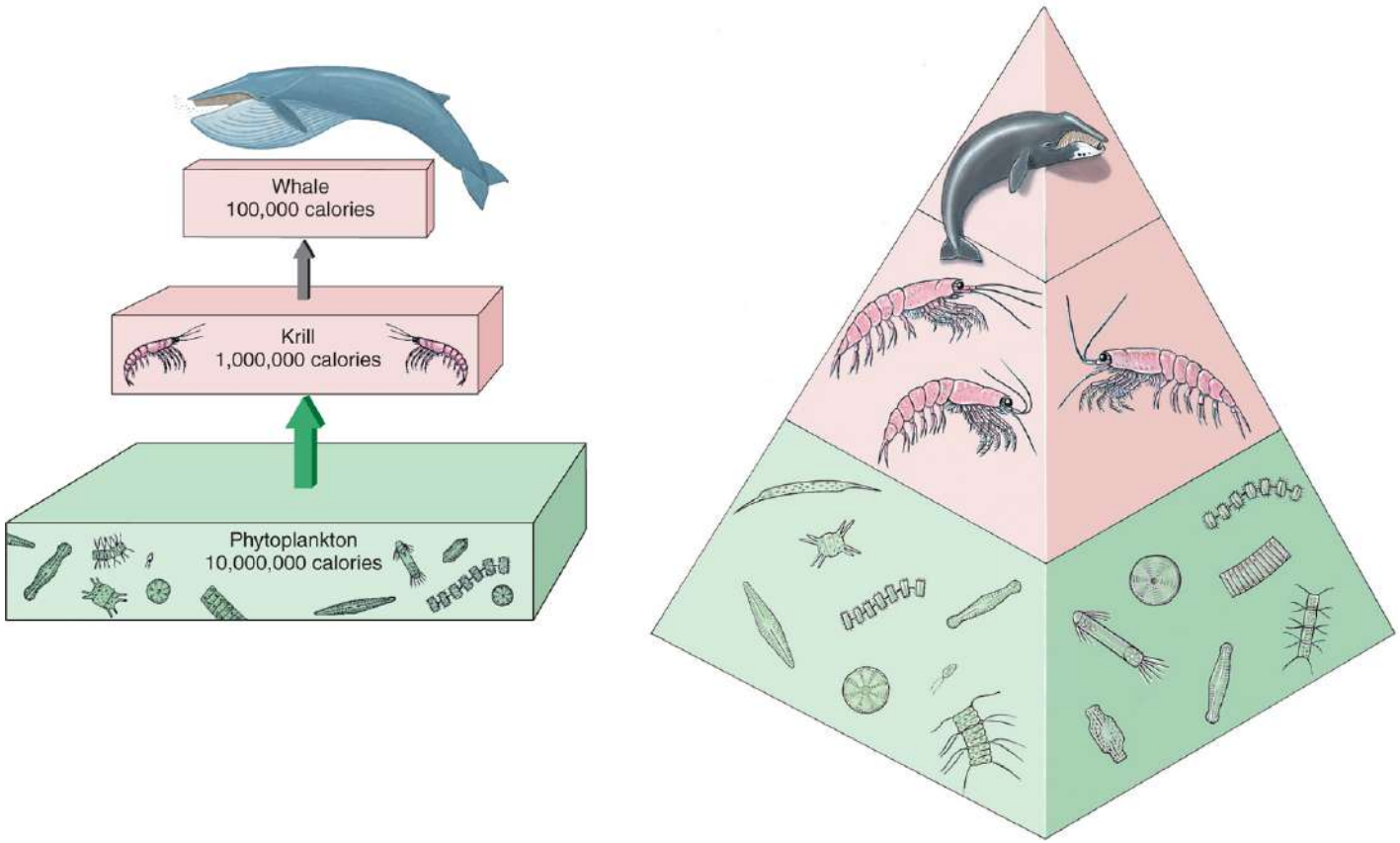


Where Does all the Energy Go?

- Is all of the energy stored by individuals at one trophic level available to the next?

  No - energy needs of individual take up most of the energy created or consumed.

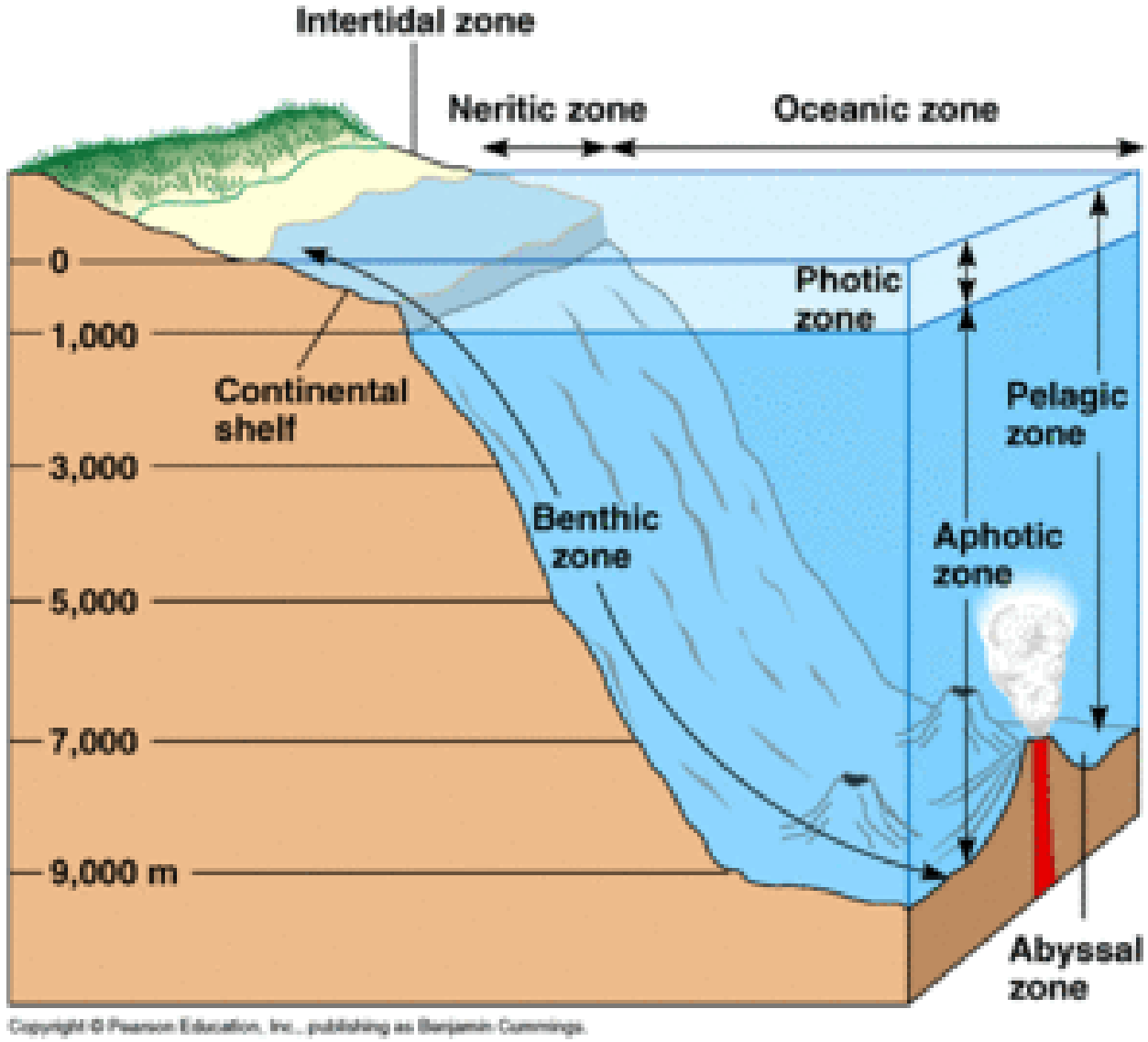
- On average, ~10% (5-20%) is transferred to the next level of the food chain.



Food chains rarely extend beyond four trophic levels except in the ocean community. Why??????

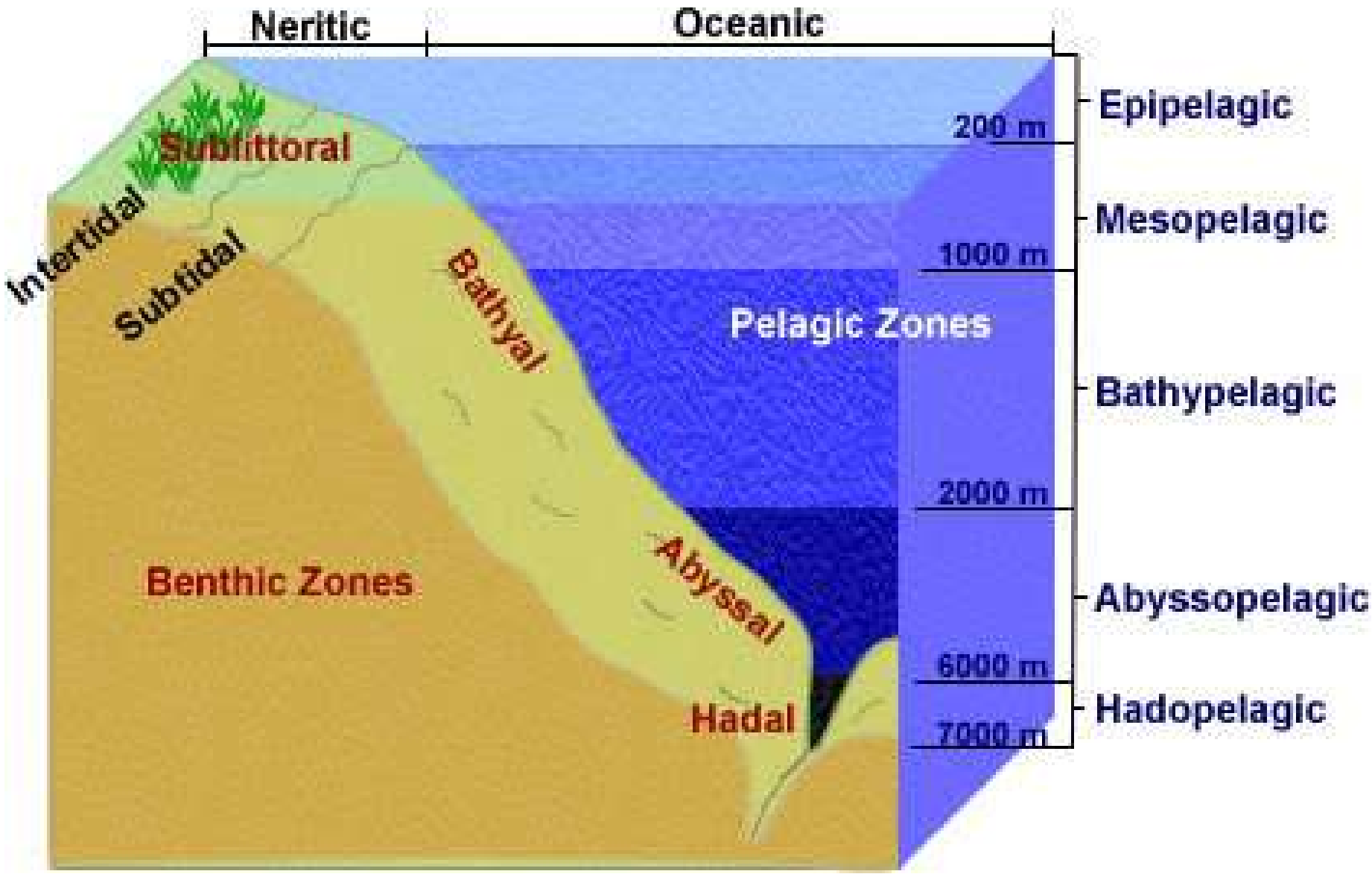
- There is more biomass created at the bottom of the trophic level – at the primary producer level. Think of all the primary producers present in the marine community and the VAST stretches of ocean that support primary production.
- Therefore, the system can support additional secondary consumers.

Marine Zones



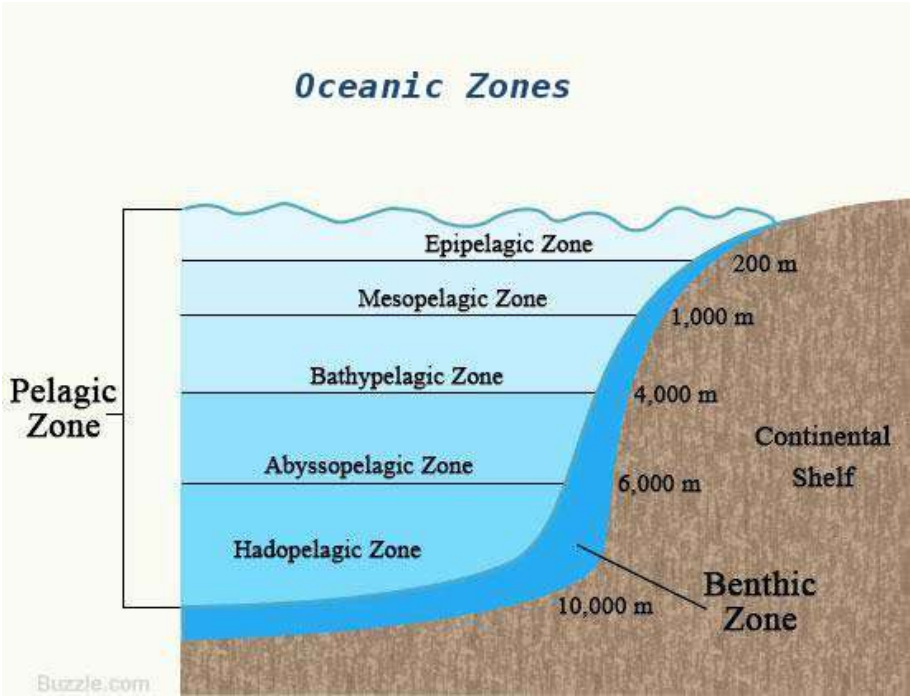
Major Marine Environments

- **Benthic organisms** – live in/near bottom features
- This can be subdivided by the depth of the benthic zone. Examples:
  - Intertidal zone – benthic zone located between high and low tide (therefore, this is exposed at least once a day)
  - Subtidal zone – always submerged; below the low tide level.


Neritic
Oceanic
Epipelagic
200 m
Mesopelagic
1000 m
Pelagic Zones
Bathypelagic
2000 m
Abyssopelagic
6000 m
Hadopelagic
7000 m
Intertidal
Supralittoral
Subtidal
Bathyal
Abyssal
Hadal
Benthic Zones

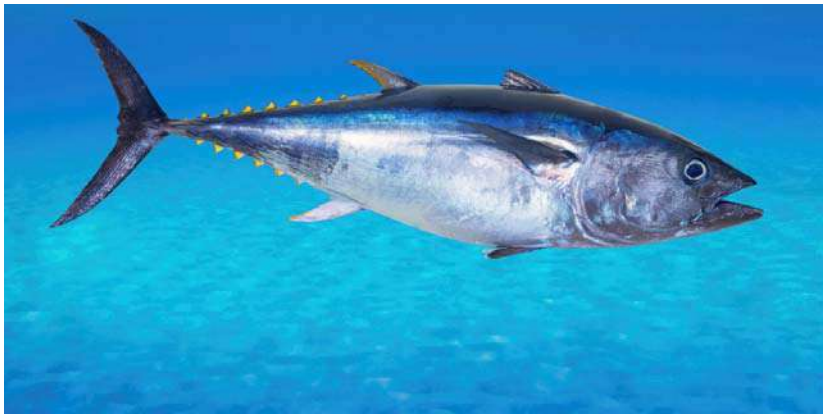
Major Marine Environments

- **Pelagic organisms** – live in the water column
- This zone, too, can be subdivided into different areas:
  - Epipelagic zone
  - Mesopelagic zone
  - Bathypelagic
  - Abyssopelagic
  - Hadopelagic



Pelagic Zones

- Epipelagic zone- extends from the water's surface to 100-200 m; plenty of sunlight available to support primary production
  - Species found in zone: jellyfish, tuna, orcas, sea turtles



Pelagic Zones

- Mesopelagic zone – extends from lower limit of epipelagic to about 1000 m;
  - although sunlight is not plentiful, new research has shown that some photosynthesis does occur in this zone, although it is very reduced compared to the epipelagic zone.
  - Species found in zone – squid, swordfish, cuttlefish, wolf eels

Wolf Eel

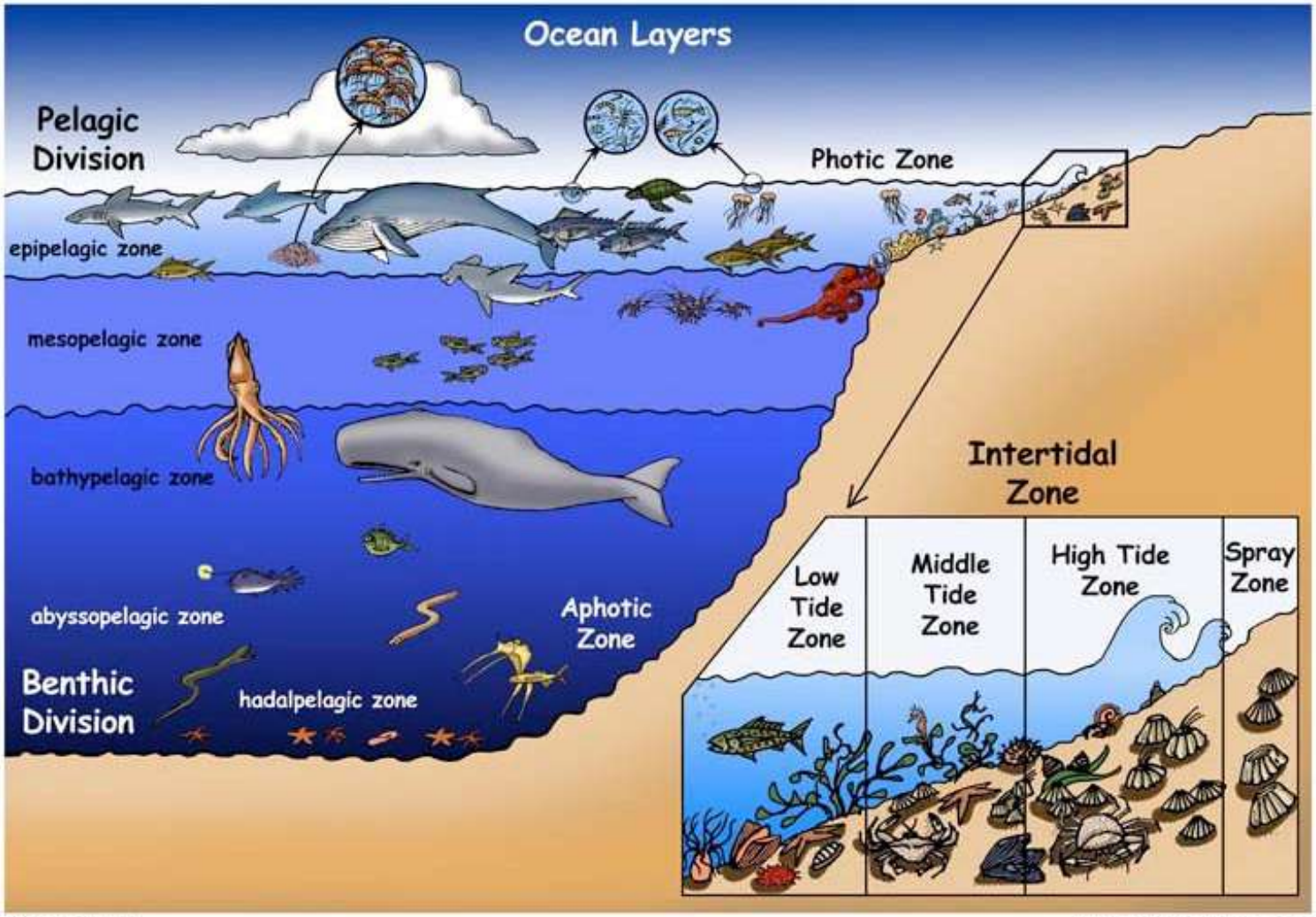
Cuttlefish

Pelagic Zones

- The bathypelagic, abyssopelagic and hadopelagic zones are deep sea zones where light does not penetrate. These will be covered in the chapter on deep sea organisms.
  - Types of species – mollusks, crustaceans (bathypelgaic zone)
    -- cookiecutter shark, dumbo octopus (abyssopelagic)
    -- sea cucumbers, tubeworms, viperfish (hadopelagic)

Cookiecutter shark

Viperfish


Ocean Layers
Pelagic Division
Photic Zone
epipelagic zone
mesopelagic zone
bathypelagic zone
abyssopelagic zone
Aphotic Zone
Benthic Division
hadalpelagic zone
Intertidal Zone
Low Tide Zone
Middle Tide Zone
High Tide Zone
Spray Zone
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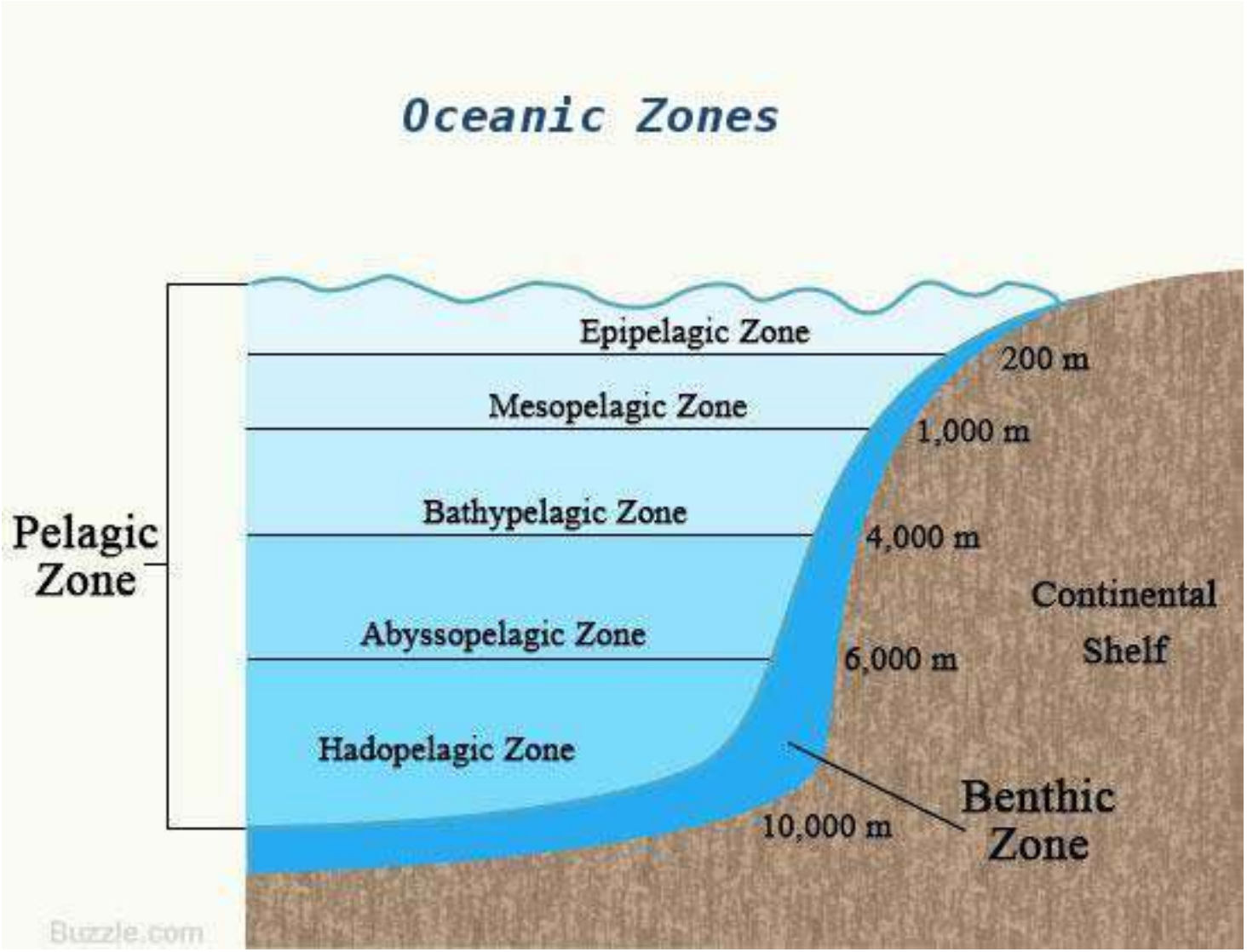
Oceanic Zones
Epipelagic Zone
Mesopelagic Zone
Bathypelagic Zone
Abyssopelagic Zone
Hadopelagic Zone
Pelagic Zone
200 m
1,000 m
4,000 m
6,000 m
10,000 m
Continental Shelf
Benthic Zone
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