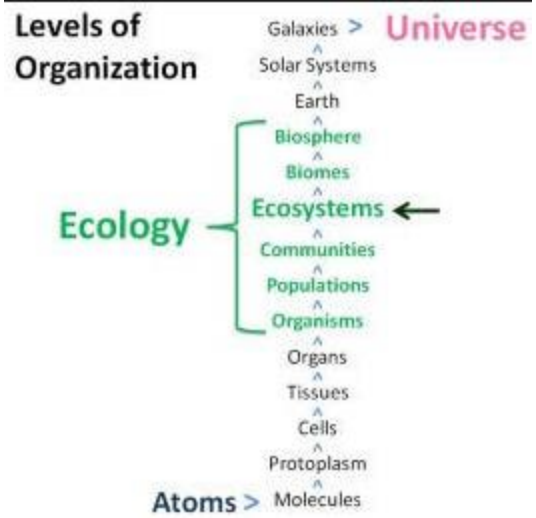
UNIT 9 - ECOLOGY

Topic 1 – Ecology Basics
Topic 2 – Population Ecology
Topic 3 – Community Ecology
Topic 4 – Energy Transfer and Nutrient Cycles

TOPIC 1: ECOLOGY BASICS



By the end of this topic, you should be able to…

- Identify and describe the different levels of ecological organization
- List key features of the main biomes (aquatic and terrestrial)
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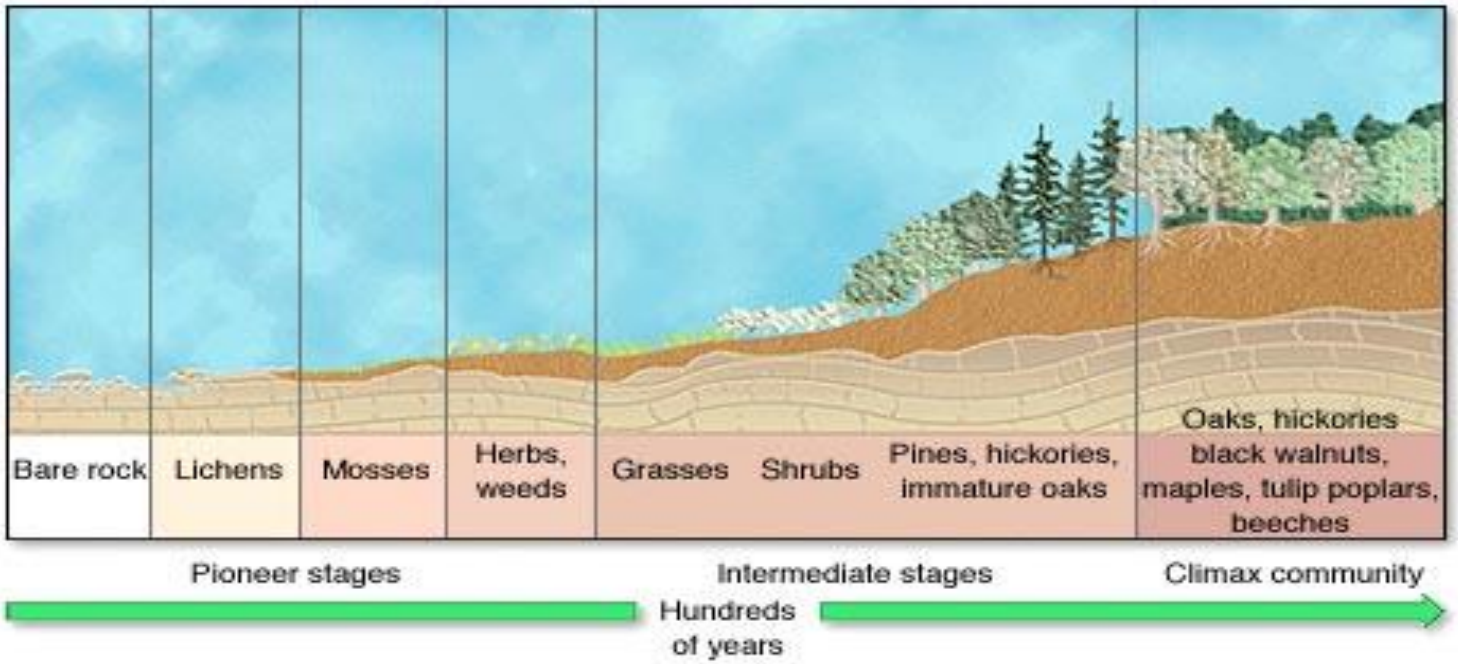


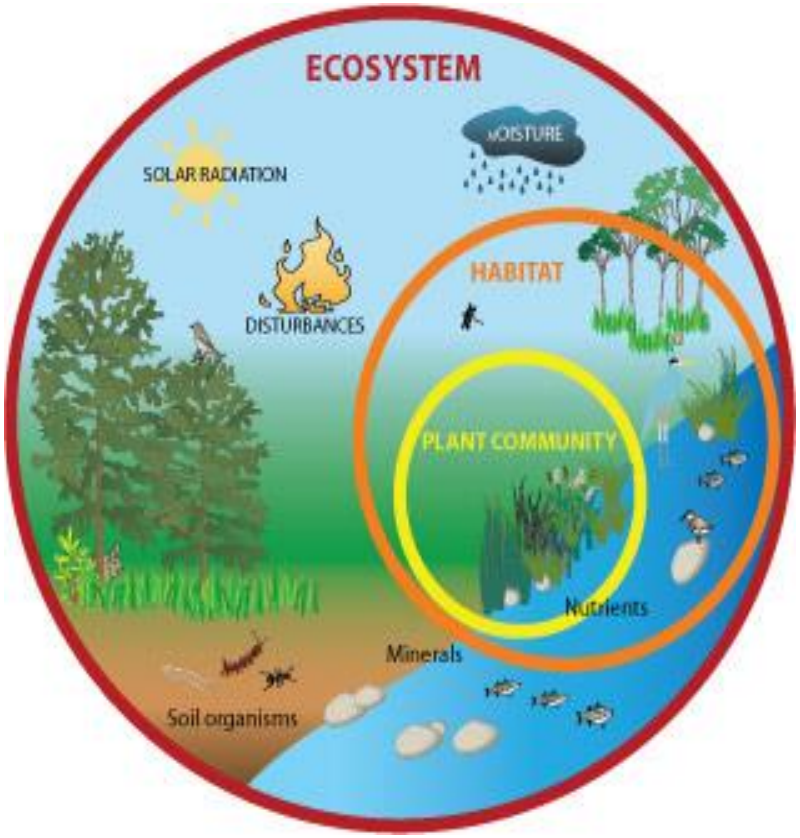
Ecology = the study of the interactions between organisms and the **living** and **nonliving** components of their environment

What is another word for living?

- *examples?*

What is another term for nonliving?

- *examples?*



LEVELS OF ORGANIZATION IN ECOLOGY

Biosphere = the thin volume of earth and its atmosphere that supports life

Biome = major habitat areas, either terrestrial (on land) or aquatic (in water)

Ex: savannah, tundra, ocean

Ecosystems = all the organisms and non-living things in a particular place

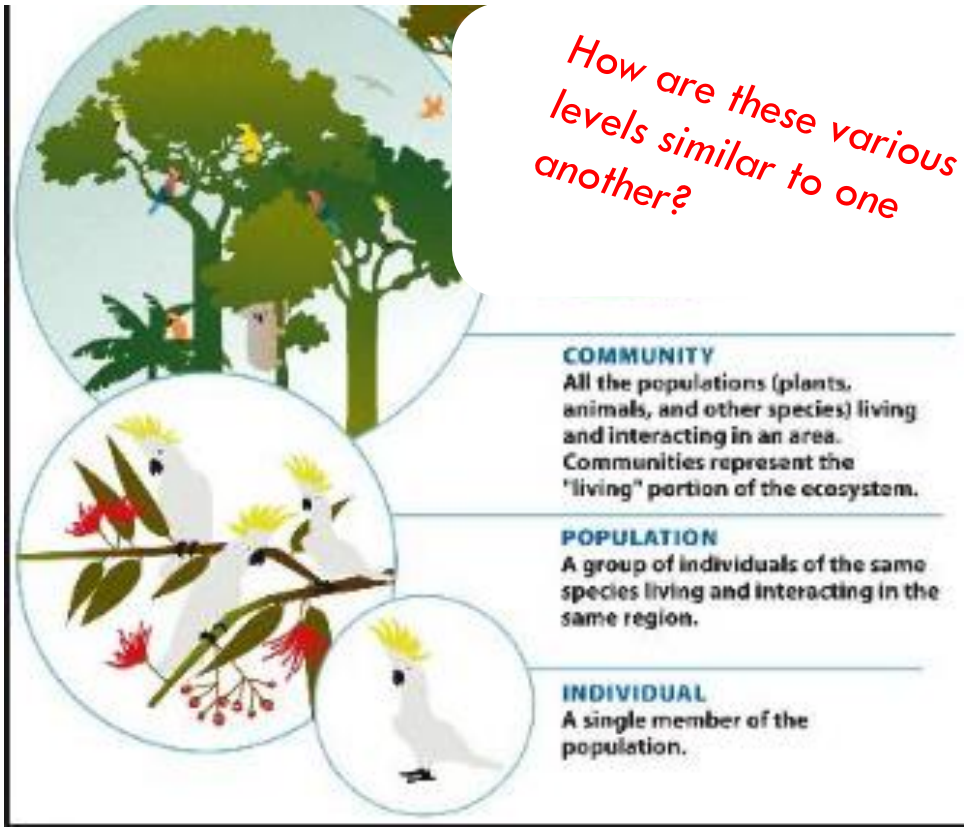
How are these various levels similar to one another?

LEVELS OF ORGANIZATION IN ECOLOGY (CTD.)

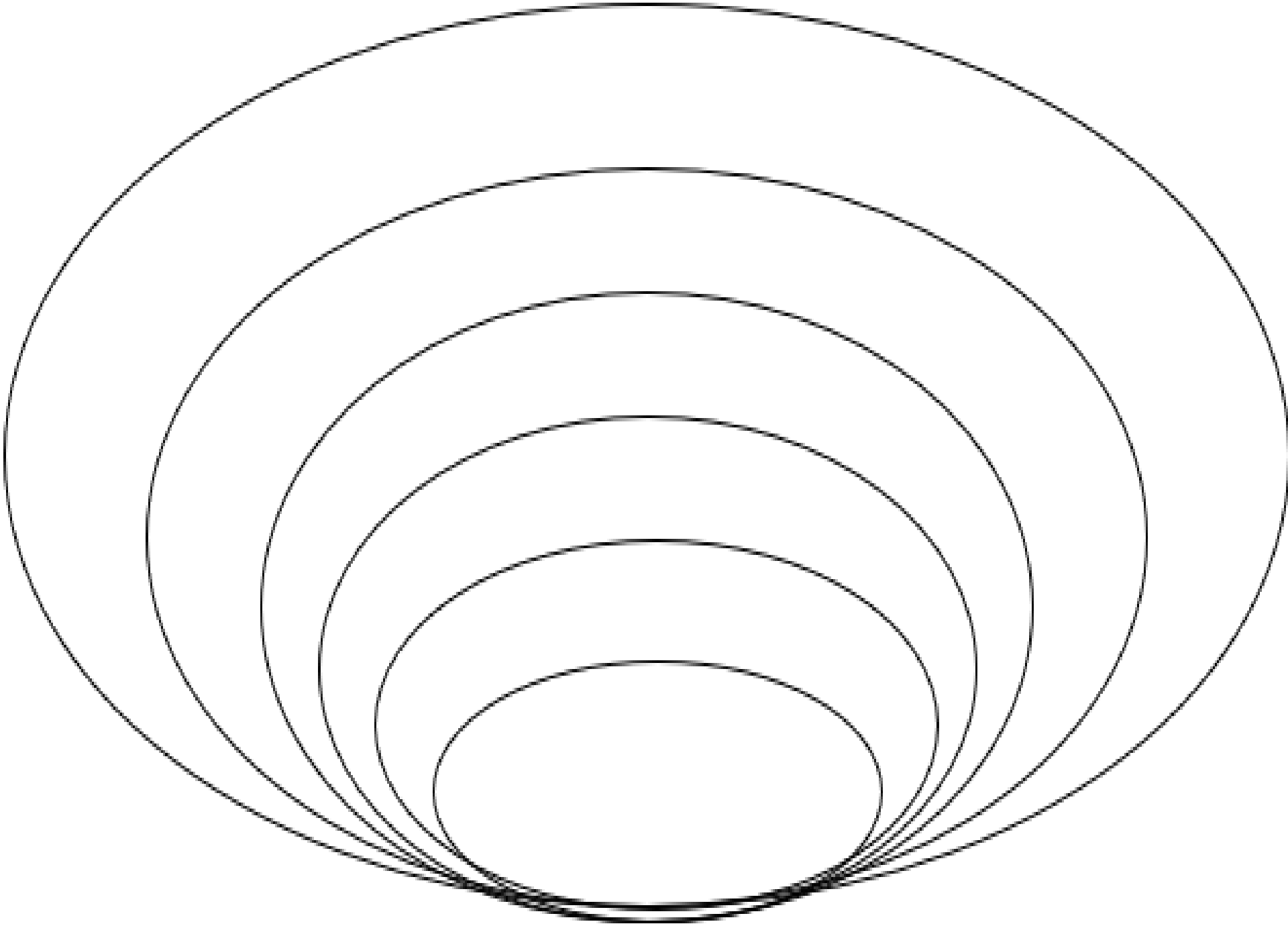
Communities = all the interacting populations in an area (only living things)

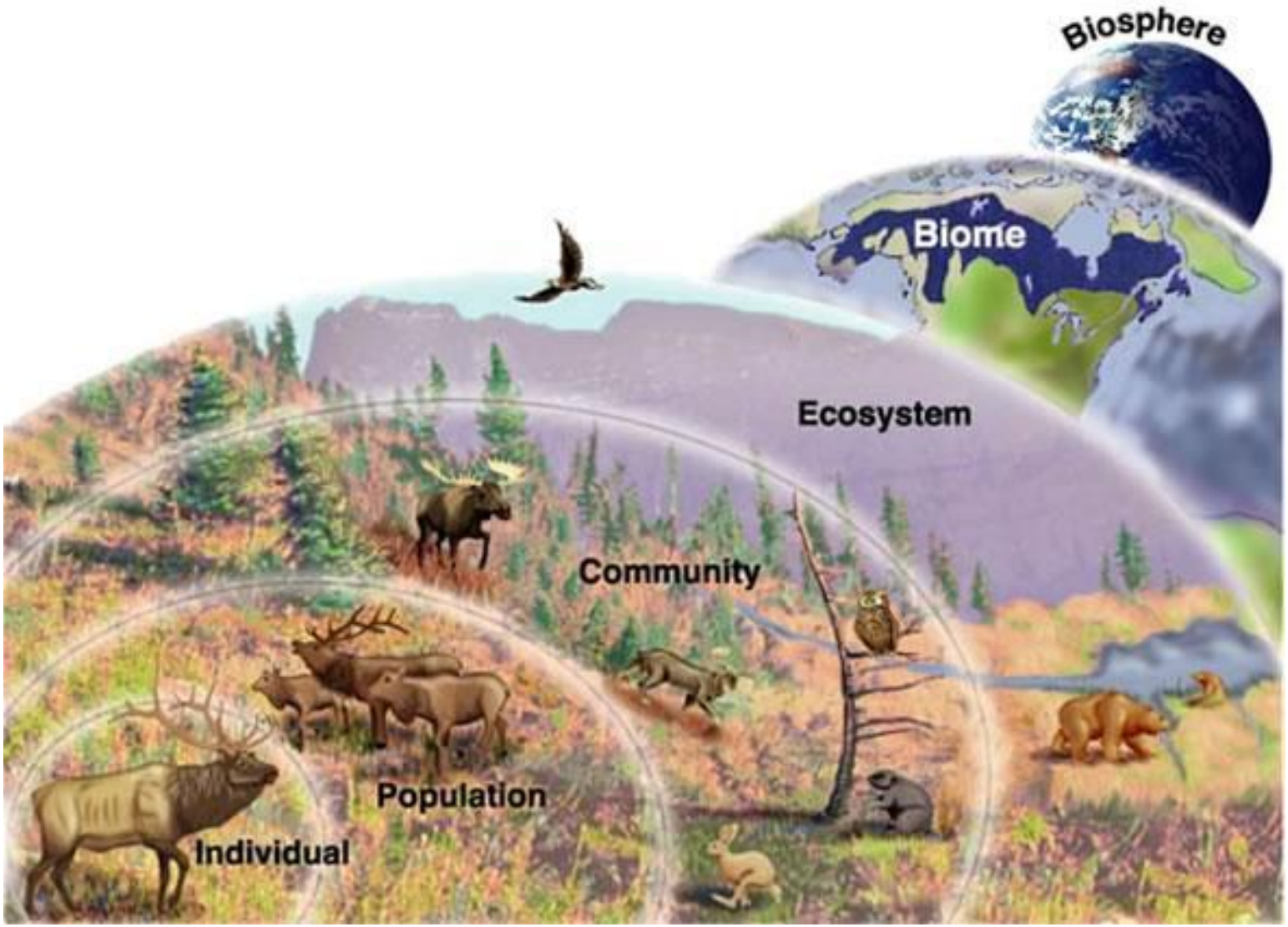
Populations = all the members of a single species that live in one place at one time (ex: all the salmon in a stream)

Organisms = An individual living thing



How are these various levels similar to one another?

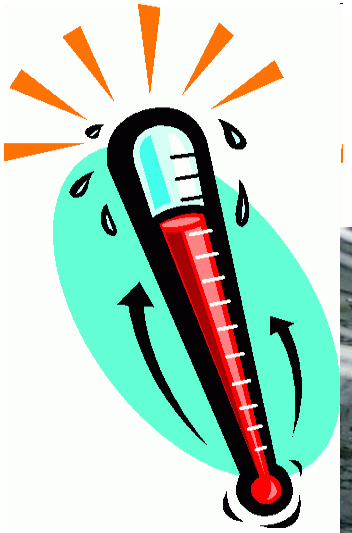



Biosphere
Biome
Ecosystem
Community
Population
Individual

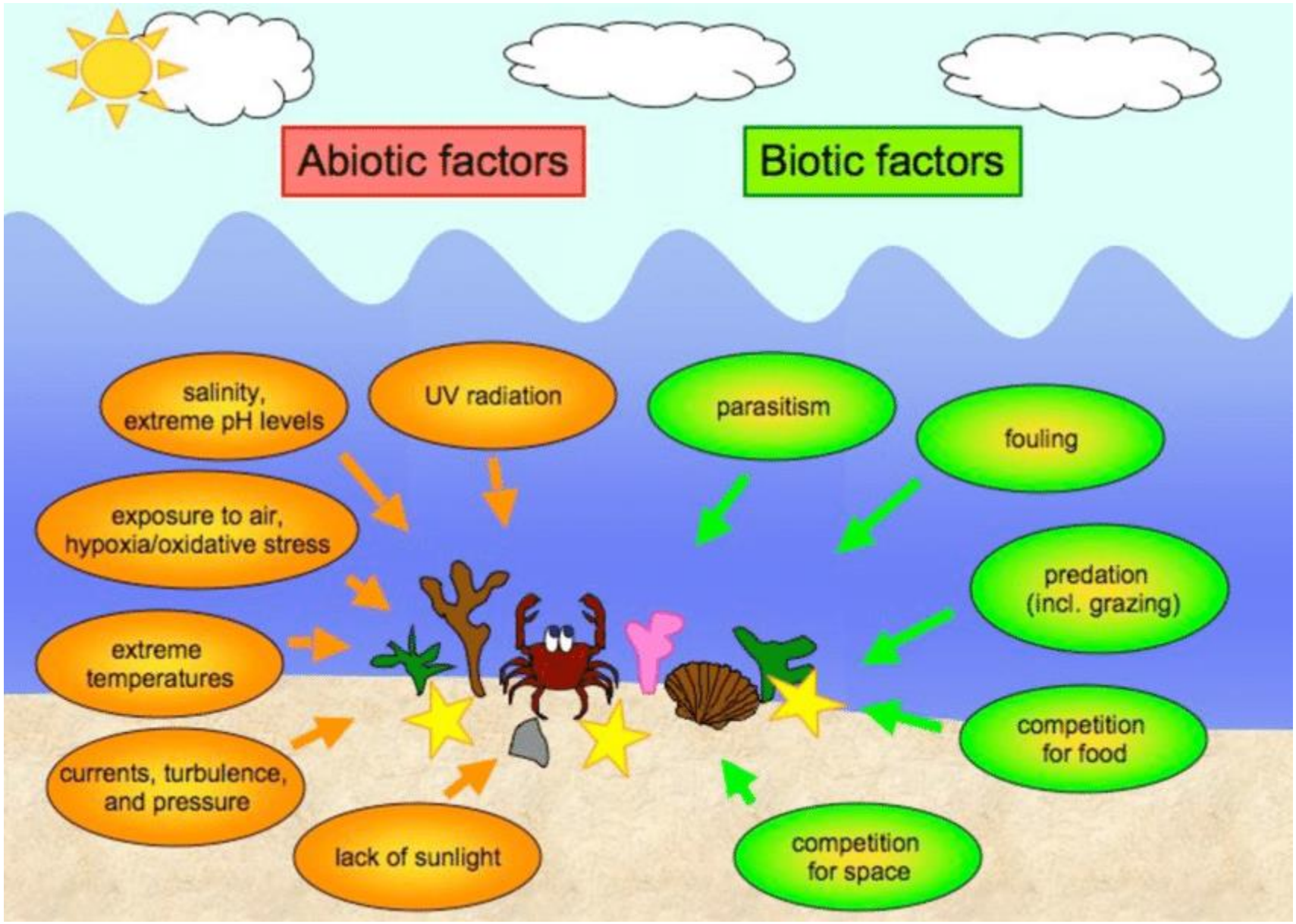
ENVIRONMENTAL FACTORS

Biotic factors are living and abiotic factors are non-living

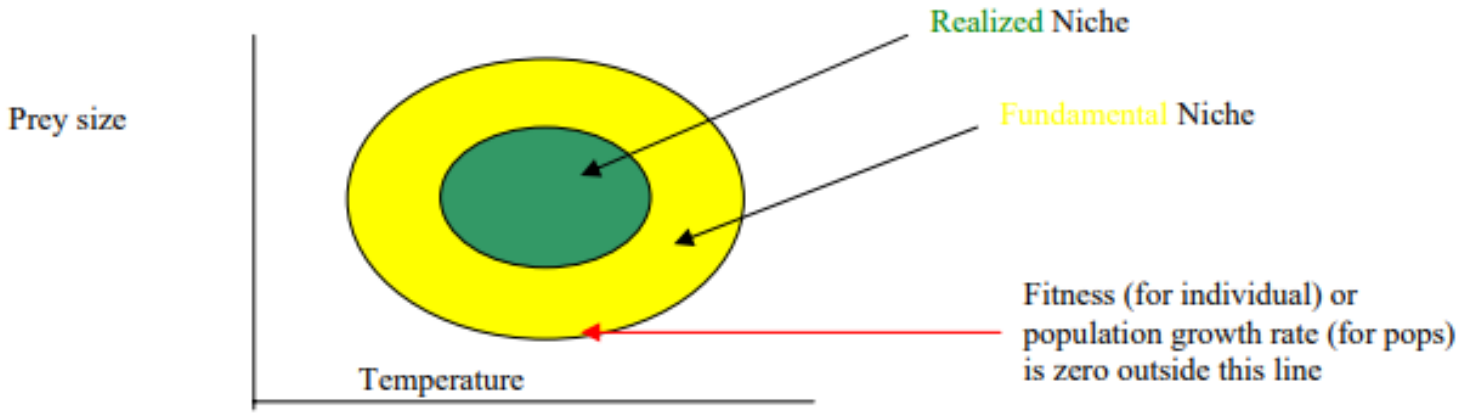
Biotic Examples: Predators, disease, parasites



Abiotic Examples: Temperature, humidity, precipitation


Abiotic factors
Biotic factors
salinity, extreme pH levels
UV radiation
parasitism
fouling
exposure to air, hypoxia/oxidative stress
predation (incl. grazing)
extreme temperatures
competition for food
currents, turbulence, and pressure
lack of sunlight
competition for space

NICHE



Niche = the role an organism plays in its environment (includes habitat, ways of obtaining nutrients, etc.)

1) Fundamental Niche = the range of conditions and resources a species COULD use/tolerate

2) Realized Niche = the range of conditions and resources a species actually DOES use/tolerate

IS A SPECIES' HABITAT THE SAME AS ITS NICHE? (PART OF FUND. V REAL. NICHE)

Tolerance = each organism has an upper and lower limit for survival

- Steelhead trout
- Ideal water temp range = 13 degrees c – 21 degrees c
- Can survive at slightly lower temps
  - Physiological stress = inability to grow & Reproduce

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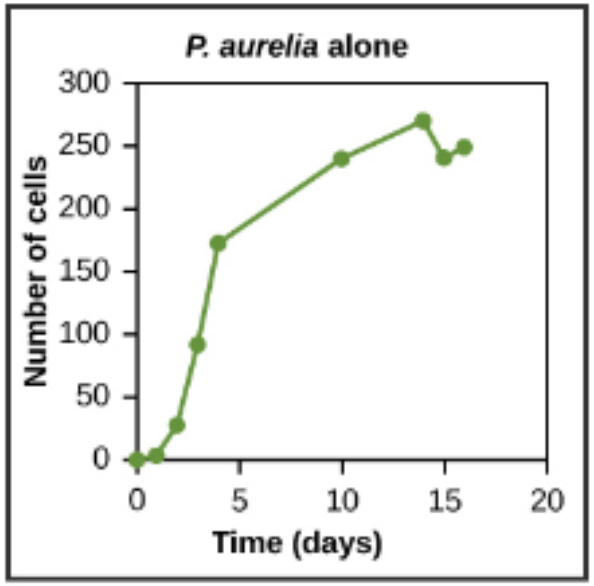
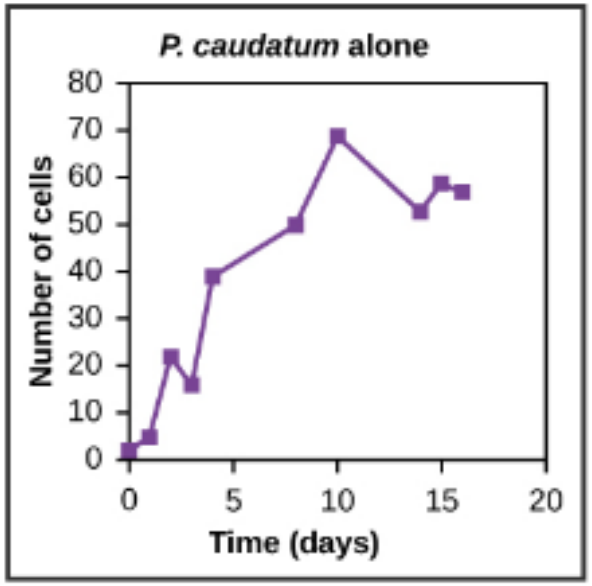
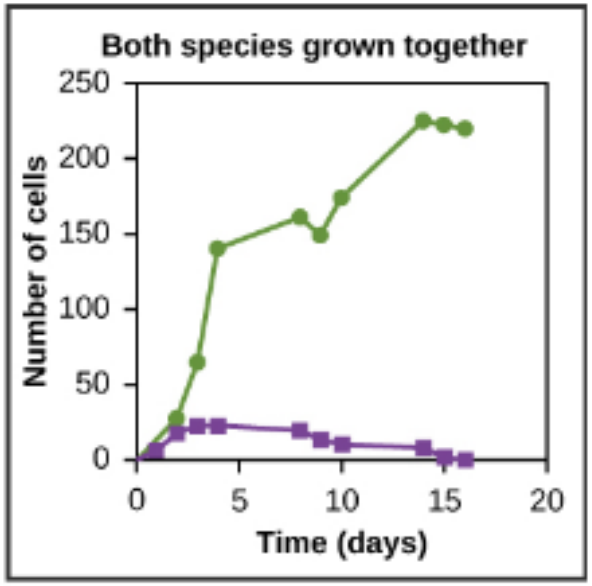




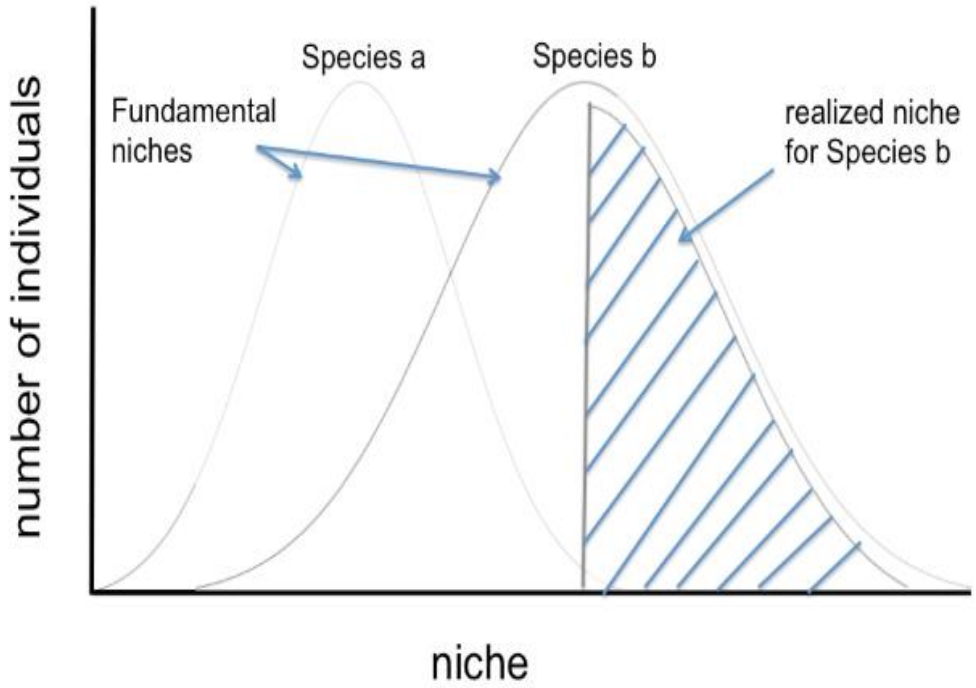


Competitive exclusion principle *- two species can't have exactly the same niche in a habitat and stably coexist*

- *Species with identical niches have identical needs, which means they would compete for precisely the same resources.*

Above: 2 single-celled microorganisms, Paramecium aurelia and Paramecium caudatum

- *Grown individually, both species thrive*
- *Grown in the same test tube (habitat) with a fixed amount of nutrients, both grow more poorly and P. aurelia eventually outcompetes P. caudatum for food, leading to P. caudatum's extinction.*



Based on this graph, is species a or species b the stronger competitor?

IS A SPECIES' HABITAT THE SAME AS ITS NICHE?

A species' habitat (where it lives) is PART of its niche…the fact that a lizard lives in a desert is part of its niche

Other parts of its niche:

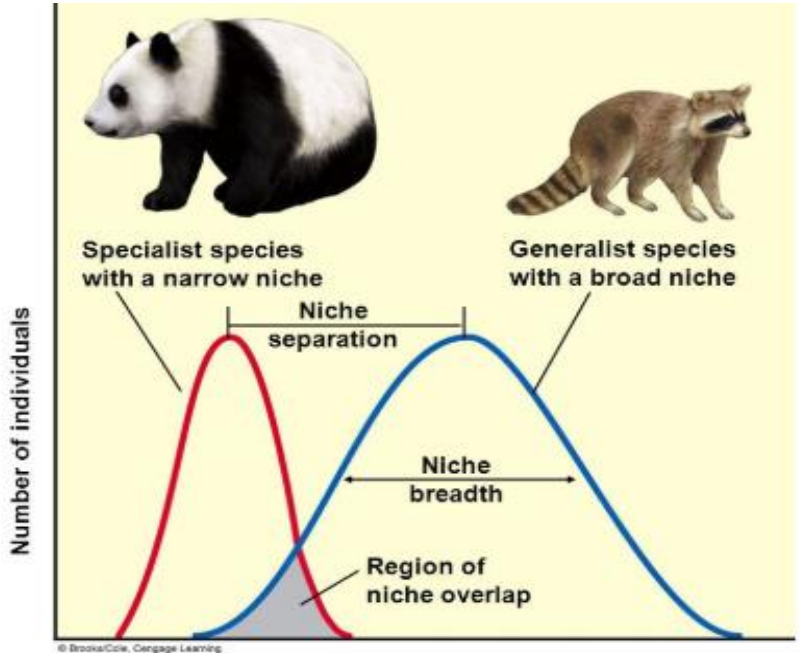
-sunning behavior to regulate body temperature

-methods of catching insects

NICHE

Generalists = species with broad niches (ex: possums and raccoons)

Specialists = species with narrow niches (ex: koala)



Koalas: Australia's Pickiest Eaters

Posted on August 3, 2012 23 Comments

Koalas, one of nature's pickiest eaters, choose to only dine on eucalyptus leaves. (Photo credit: Purestock/Getty Images)

Many people have favorite foods. But the koala takes favorite food to the extreme. These Australian marsupials have evolved to live almost exclusively on eucalyptus leaves. And if that isn't picky enough, recent research suggests that koalas are highly selective as to the species of eucalyptus they prefer and even the individual trees from which they choose to eat. How have these animals become so picky, and how can scientists use this information to aid in koala conservation efforts?

Filling a Niche

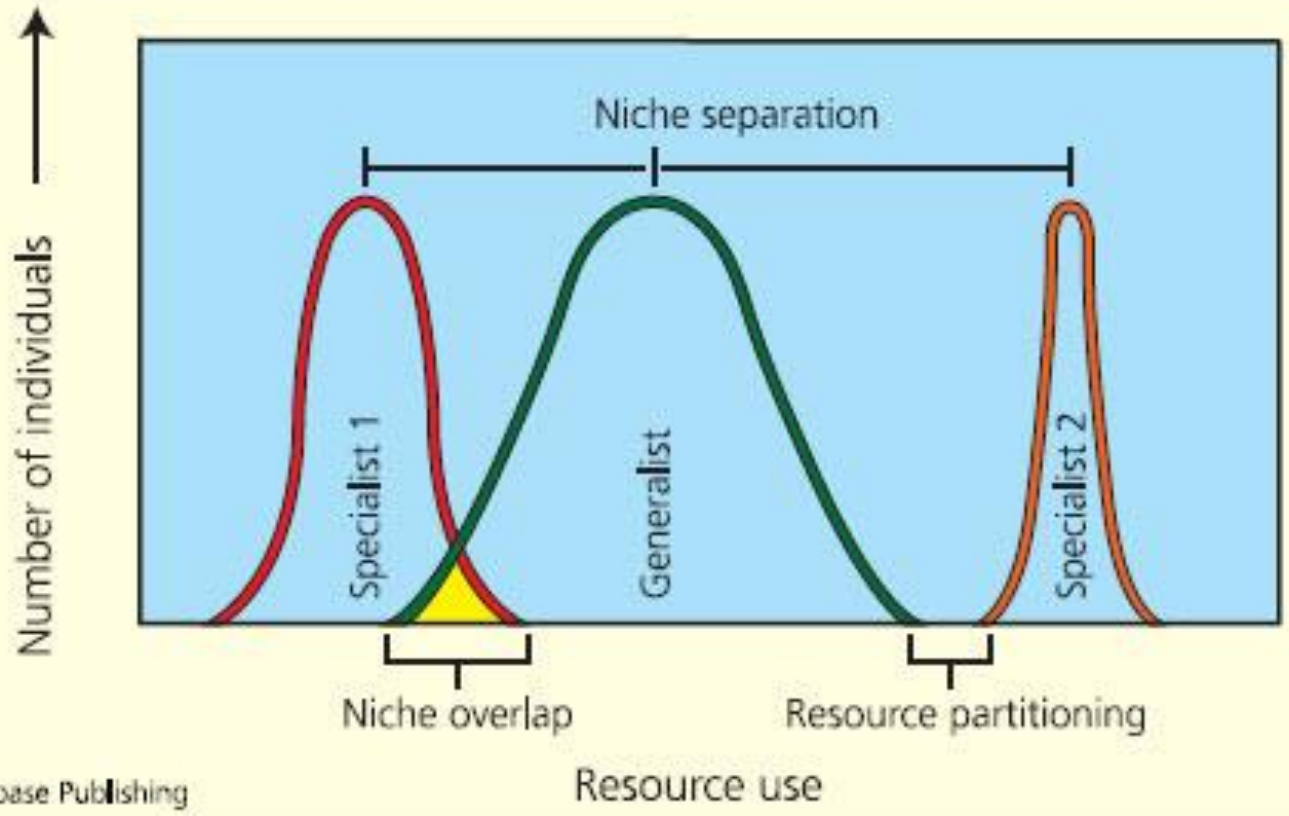
In ecological terms, the highly-selective diet of the koala makes them a specialist, that is, a consumer that primarily eats one specific organism or a very small number of organisms. Specialist species are generally sensitive to environmental changes, especially changes that affect the availability of their food source. However, the pickiness of koalas is likely an evolutionary adaptation.

Eucalyptus trees are the dominant trees of Australia. In fact, there are more than 700 species in the genus Eucalyptus, and most are native to Australia. However, the leaves of these trees are actually very low in protein, not easily digested, and contain compounds that are toxic to most species. Therefore, the ability for koalas to specialize in eating eucalyptus leaves has allowed them to fill an ecological niche. Koalas have virtually no competition for their preferred food source.

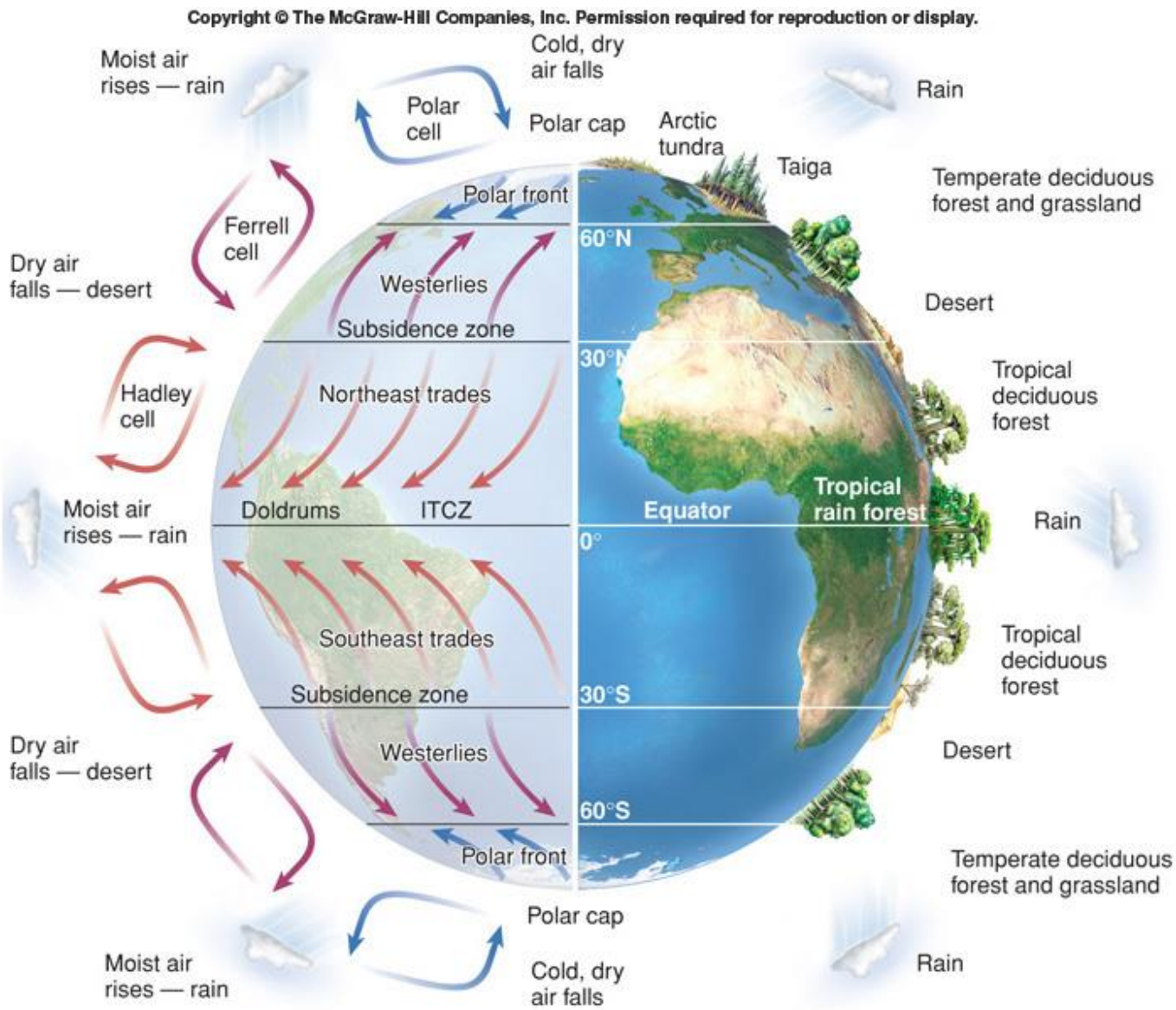
Koalas spend approximately 18-20 hours each day sleeping, and most of the remaining time is spent eating. They eat about 500 grams of eucalyptus leaves each day. A number of adaptations allow koalas to digest this food efficiently:

- Powerful jaws allow the koala to chew the leaves into a very fine paste.
- The koalas liver is able to deactivate the toxic compounds found in eucalyptus leaves.
- A portion of the koalas large intestine is greatly enlarged to maximize the amount of nutrients extracted.

Species Resource Use



TERRESTRIAL BIOMES



Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Tropical Rainforest	Tall broad-leaved trees, ferns, etc	Chimpanzees, bats, toucans,	Near equator	Consistently high temperature, rainfall and humidity

Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Desert	Cacti, Joshua trees,	Lizards, bobcats, desert toads	Every continent except Europe	Widely Varying temperatures, low rainfall

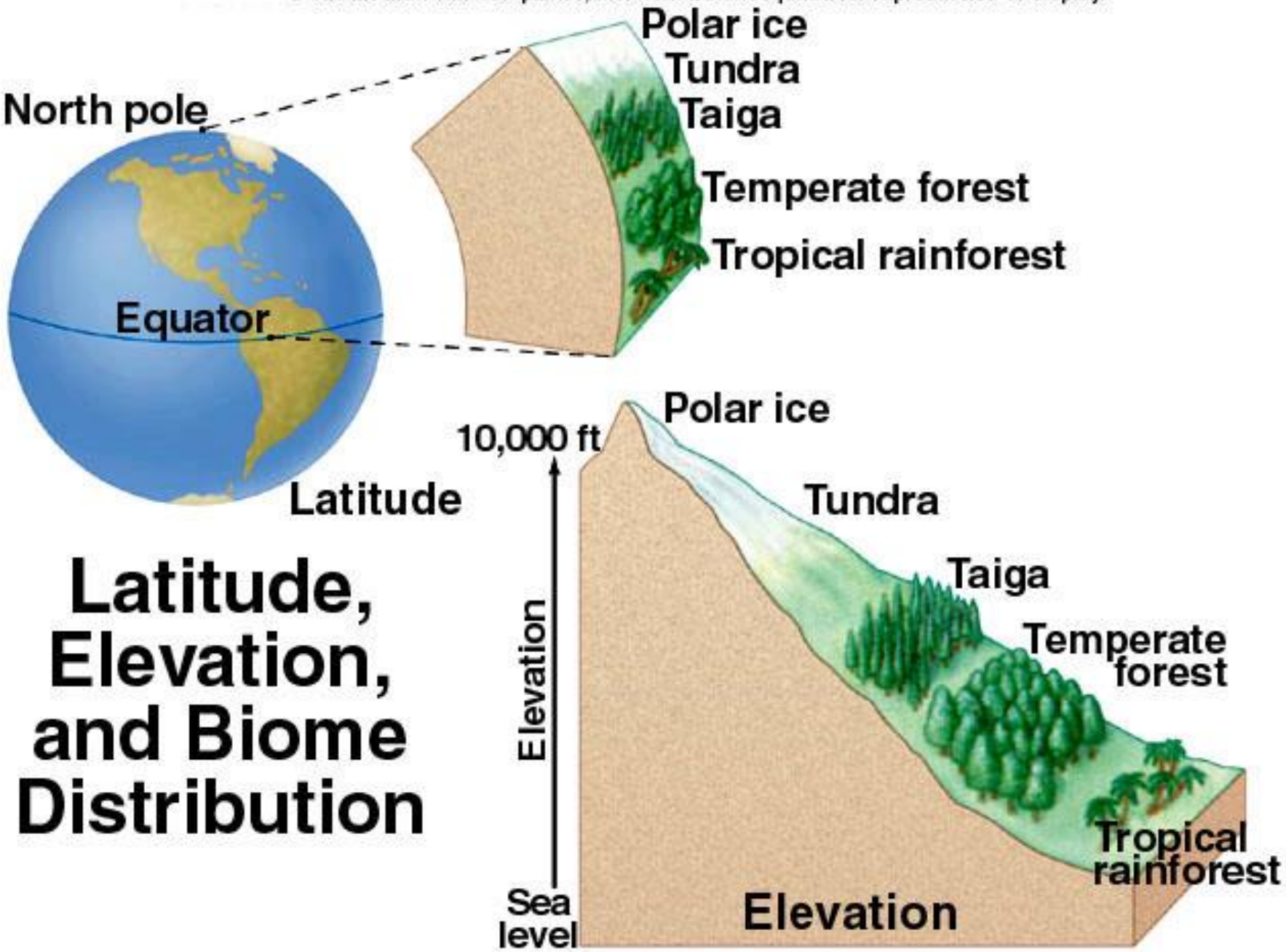
Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Boreal Forest (AKA Taiga)	Spruce and fir trees, small shrubs	moose, beavers, mountain lions	South of arctic circle	Summers = short and moist ; winters = long, cold, and dry ; contains mostly coniferous trees (don't lose leaves)

Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Temperate Forest	Oak, beech, and maple trees	Squirrels, deer, black bears	South of the boreal forests	Well-defined seasons (spring, summer, fall, winter) ; mostly deciduous trees (lose leaves in fall)

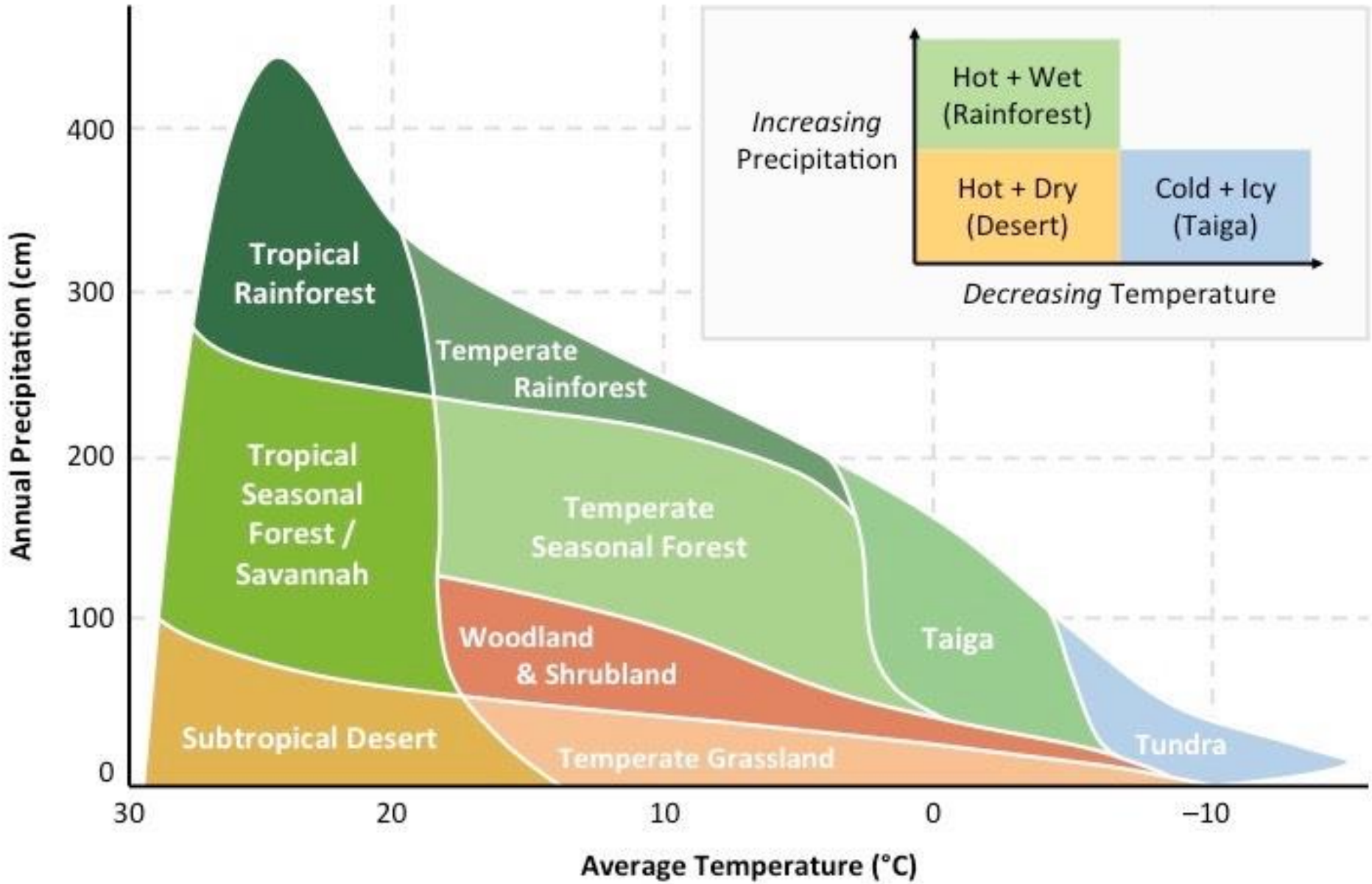
Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Savannah (Grassland Type 1)	Grasses and scattered trees	Lions, elephants,zebras	Africa, South America, and Australia	Summers = hot and rainy, winters = cool and dry

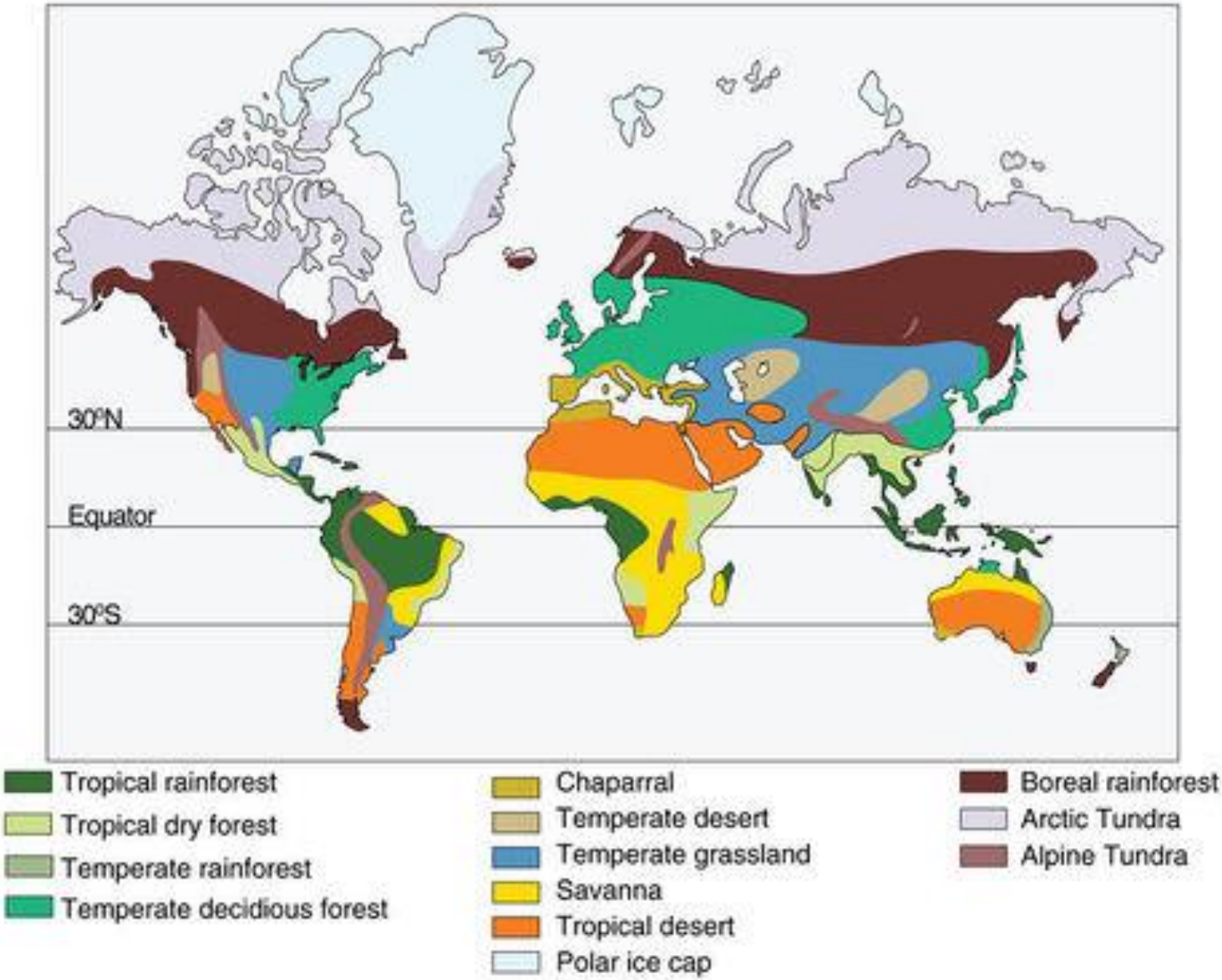
Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Temperate Grassland (Grassland Type 2)	Grasses and herbs	bison, horses, mice	All continents except Europe	moderate rainfall and temperature, fires possible

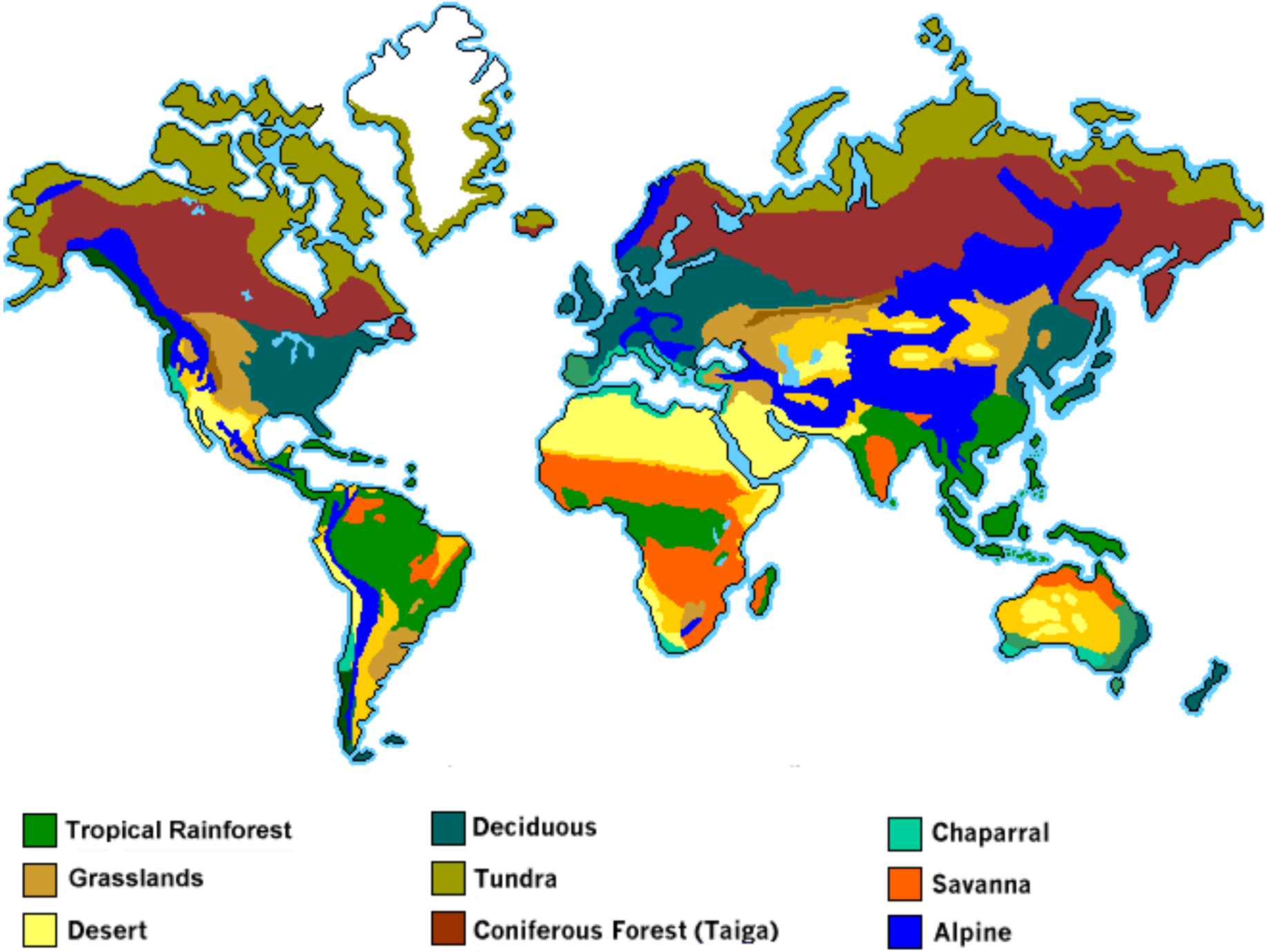
Terrestrial Biomes				
Biome	**Plant Species**	**Animal Species**	**Geographic Location**	**Basics to Remember**
Tundra	Short grasses, shrubs	Caribou, polar bears, salmon,	Arctic Circle	Constant layer of frost (permafrost), cold and dark much of the year



Latitude, Elevation, and Biome Distribution

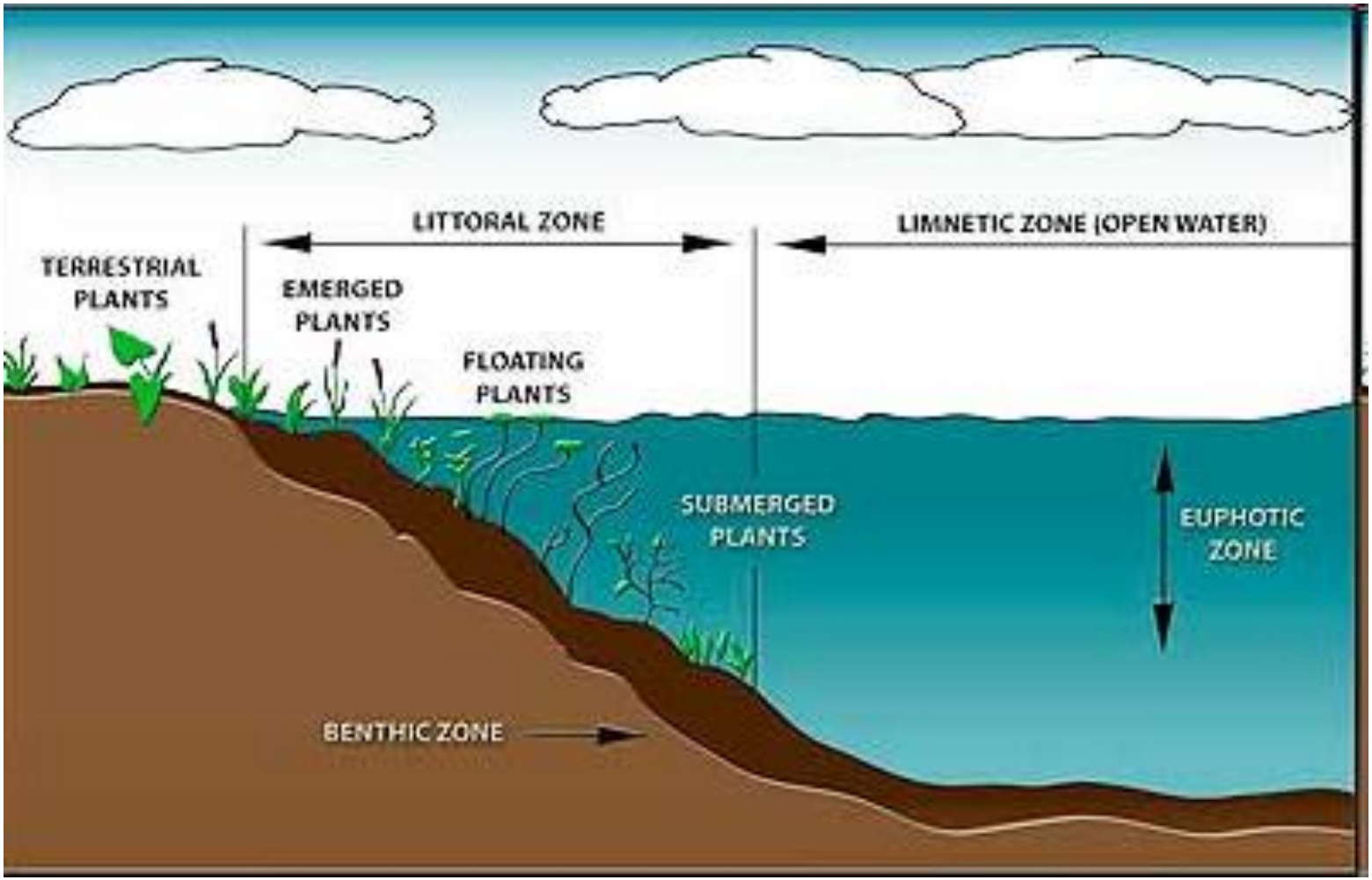

Annual Precipitation (cm)
400
300
200
100
0
30
20
10
0
−10
Average Temperature (°C)
Tropical Rainforest
Temperate Rainforest
Tropical Seasonal Forest / Savannah
Temperate Seasonal Forest
Woodland & Shrubland
Taiga
Subtropical Desert
Temperate Grassland
Tundra
Increasing Precipitation
Hot + Wet (Rainforest)
Hot + Dry (Desert)
Cold + Icy (Taiga)
Decreasing Temperature


30°N
Equator
30°S
Tropical rainforest
Tropical dry forest
Temperate rainforest
Temperate decidious forest
Chaparral
Temperate desert
Temperate grassland
Savanna
Tropical desert
Polar ice cap
Boreal rainforest
Arctic Tundra
Alpine Tundra


Tropical Rainforest
Grasslands
Desert
Deciduous
Tundra
Coniferous Forest (Taiga)
Chaparral
Savanna
Alpine

AQUATIC BIOMES

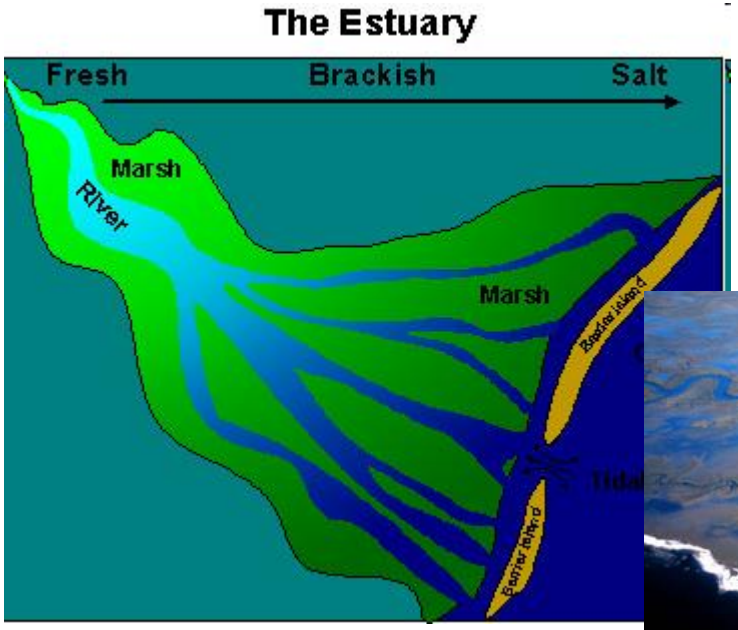
Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Lakes/Ponds		X	Algae, frogs, fish,	Body of standing water Zones based on water depth (littoral, limnetic, and profundal)


LITTORAL ZONE
LIMNETIC ZONE (OPEN WATER)
TERRESTRIAL PLANTS
EMERGED PLANTS
FLOATING PLANTS
SUBMERGED PLANTS
EUPHOTIC ZONE
BENTHIC ZONE

Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Rivers/streams		X	Strong reeds/plants, insect larvae, fish	Moving water, flows from source to mouth

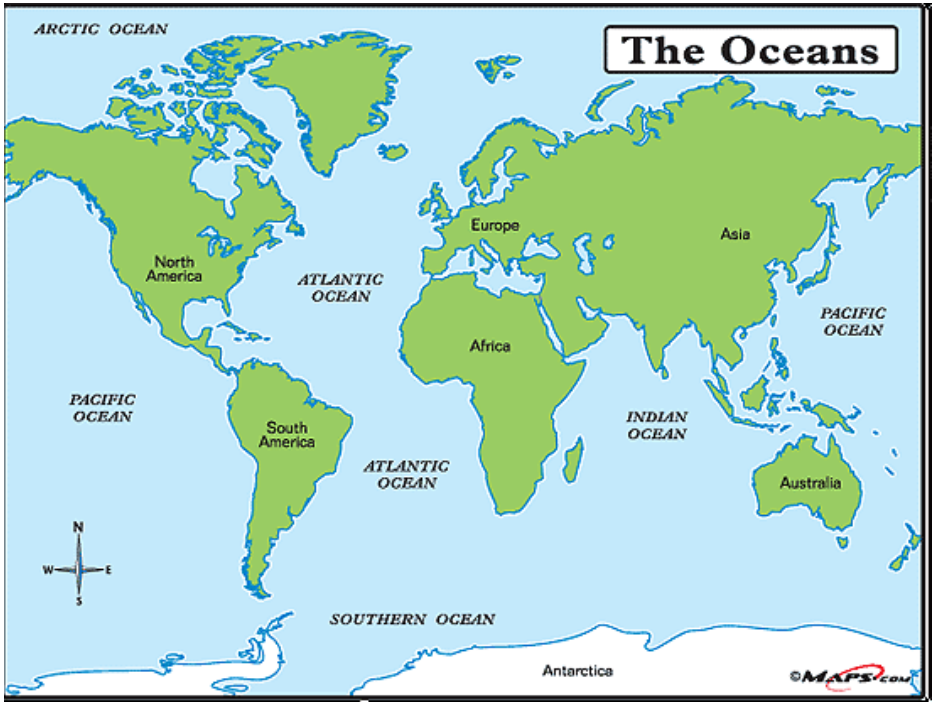
Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Wetland	Mixture of salt and freshwater		pond lilies, cattails, mangroves, willows, amphibians, ducks, raccoons, shrimp, shellfish	Types: marshes, swamps, bogs Moist and humid

Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Estuary	Mixture of salt and freshwater		Algae, seaweeds, marsh grasses, worms, crabs, geese	One of the most diverse ecosystems Forms where fresh water from a stream or river merges with salt water from the ocean



Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Coral Reefs	X		Coral, algae, sea slugs, octopi, sea stars, fishes	Very diverse Found in warm, shallow marine waters

Aquatic Biomes				
Biome	**Marine**	**Freshwater**	**Key Organisms**	**Basics to Remember**
Oceans	X		Depth depends on sunlight requirements Seaweeds, plankton, fish, jellyfish, whales	Zones based on water depth = photic, aphotic, benthic



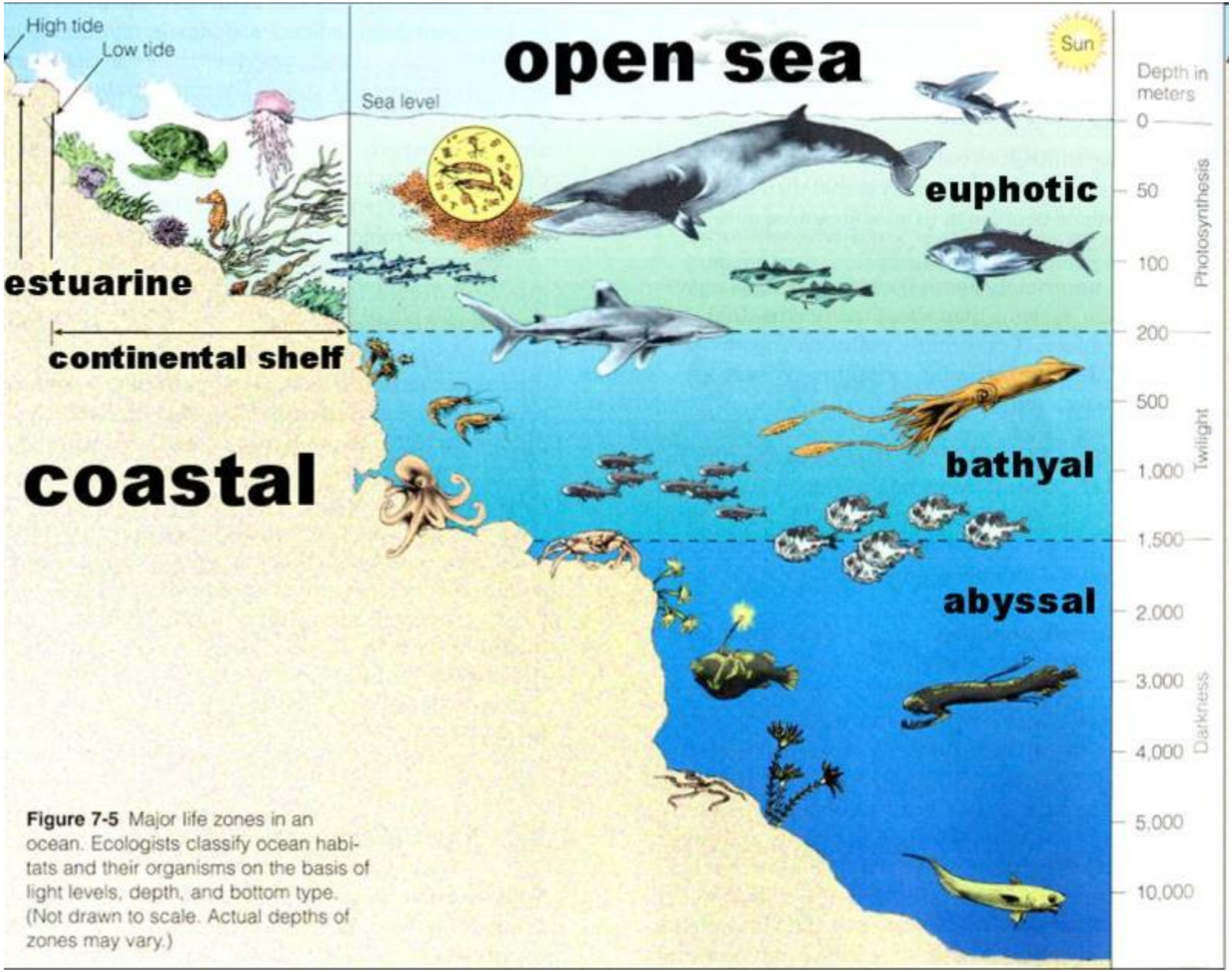
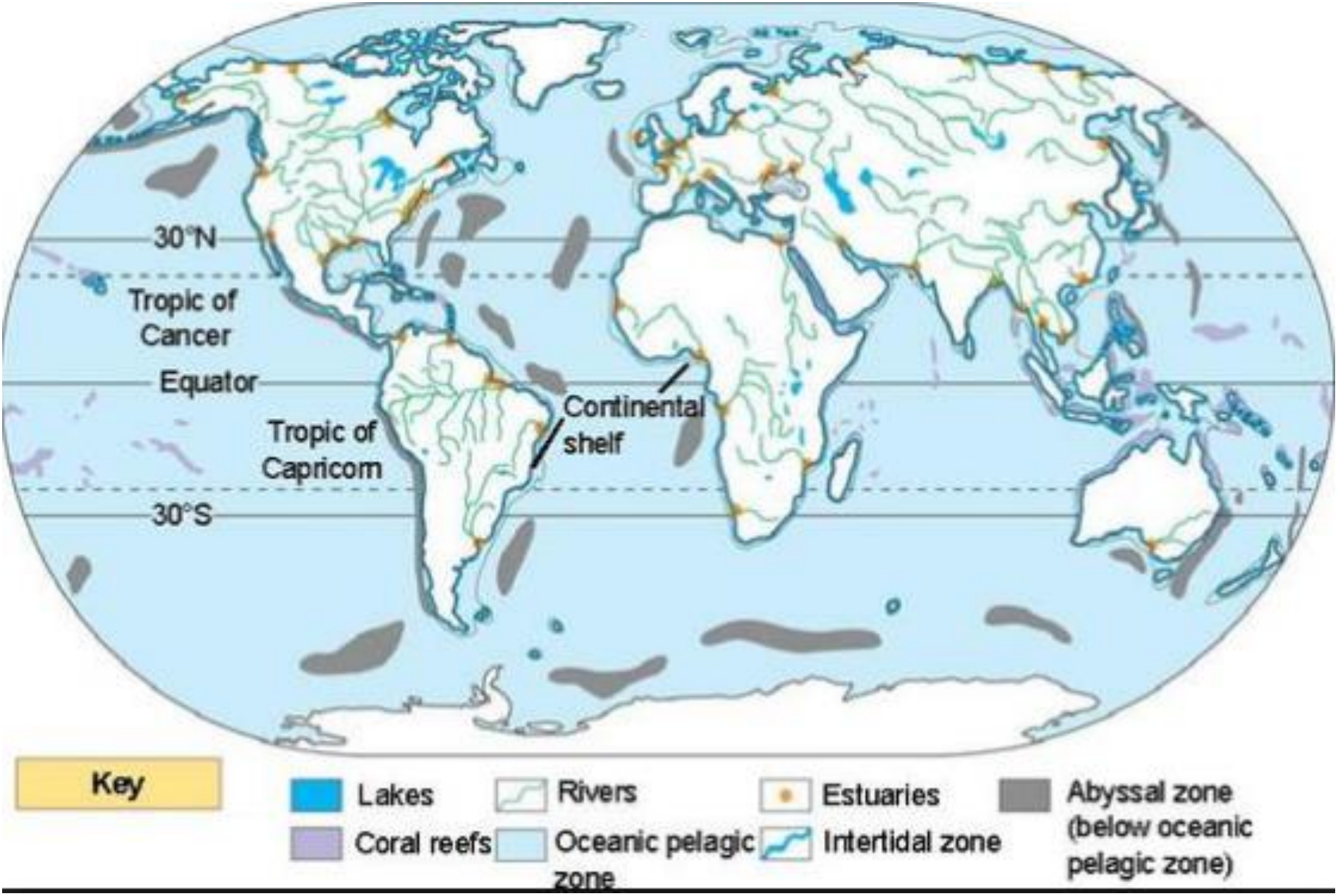
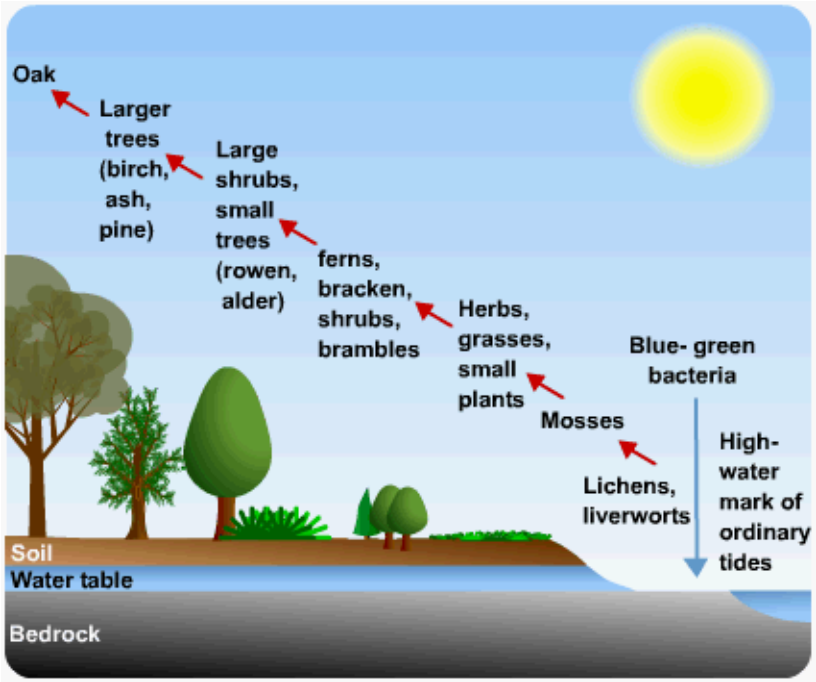


Figure 7-5 Major life zones in an ocean. Ecologists classify ocean habitats and their organisms on the basis of light levels, depth, and bottom type. (Not drawn to scale. Actual depths of zones may vary.)


30°N
Tropic of Cancer
Equator
Tropic of Capricorn
30°S
Continental shelf
Key
Lakes
Rivers
Estuaries
Abyssal zone (below oceanic pelagic zone)
Coral reefs
Oceanic pelagic zone
Intertidal zone

Ecological Succession = a series of changes in an ecosystem in which new populations of organisms gradually replace existing ones

Succession that begins in an area where there is no existing community is called primary succession

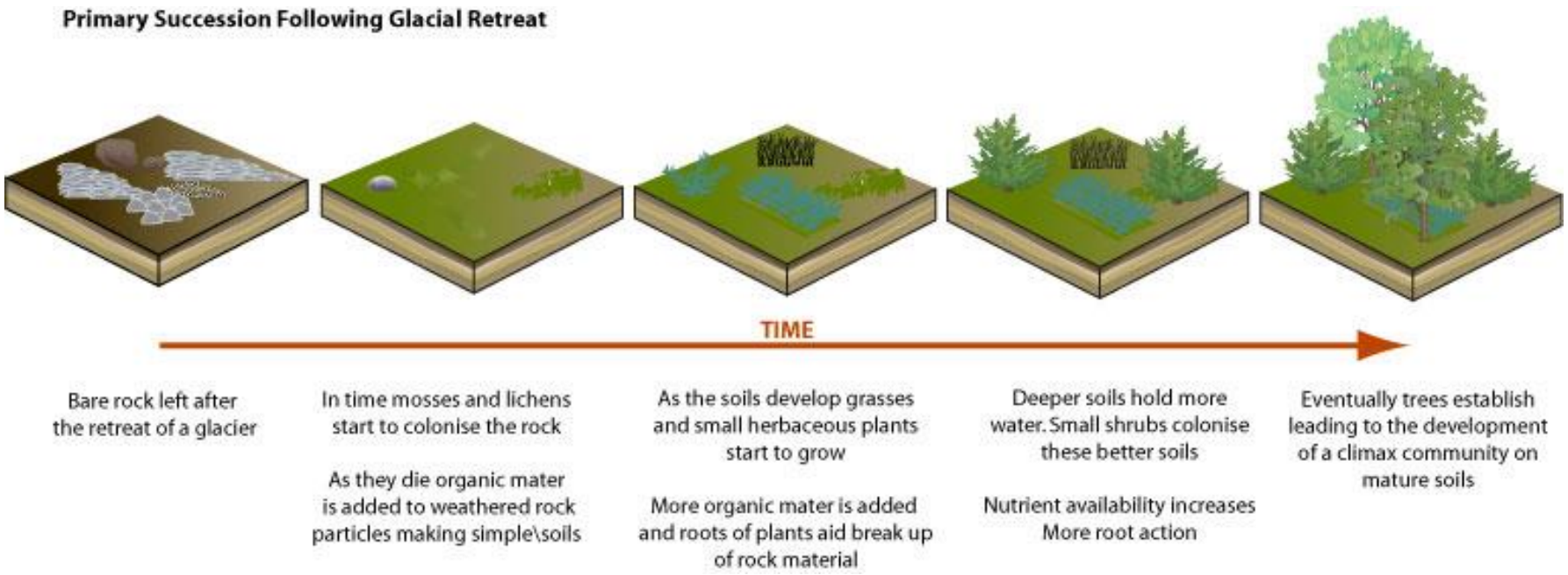


Examples of primary succession = bare rock, sand dune, or island formed by volcanic eruption

PRIMARY SUCCESSION

The first organisms to occupy an area going through primary succession are a pioneer species

Characteristics of a pioneer species= small, fast growing, and reproduce quickly



Over time, physical and chemical changes impact areas, leading to a difference in species that live here too (the species no longer fit for the changing environment die out)

SECONDARY SUCCESSION

Succession that has occurred in an area where an existing community has been partially destroyed is called secondary succession

Example of secondary succession: new plant growth after a forest fire

Eventually succession slows down and a stable community is established. This is called a climax community