PROJECT TIME!!

- **Marine Environments Project**
  Select a marine environment to focus on. Select a marine species that lives in the ecosystem.
  http://education.nationalgeographic.org/media/marine-community-illustrations-grades-9-12/

- **Environment:**
  Location
  Range
  Map
  Physical Characteristics
  Biological Characteristics
  Visuals
  Human Impacts
  Current Threats
  What Can We Do?
  What can we do?

Animal:
Scientific Name
Classification
Pictures
Range within environment
Predator?Prey?
Diet?
Sample food chain and web
Importance (role) in ecosystem
Physical Characteristics
Behavioral Characteristics
Why did you select this species?
Current threats? What can we do?

EXTRA CREDIT
Build a model of your environment
AND/OR
Build a model of your organism

Bellringer: 11/1/2017

1. What do you remember about the levels of organization from biology?? (ex: atoms…cells… ecosystems… biosphere…)
2. STOTD

Bellringer: 11/1/2017

- Mid

Bellringer: 11/3/15

Mid Year Class Evaluation

On a SEPARATE sheet of paper, I want you to take a couple of minutes to evaluate your Marine Science class so far. **It can be anonymous & be honest!** Some things to think about:

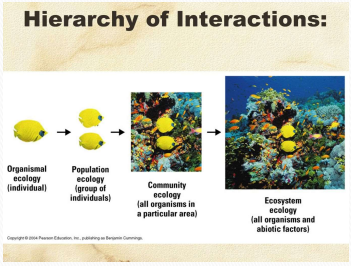
1. What do you like most about class?
2. What are some helpful suggestions to make class more engaging?
3. What can you do to be better prepared for class?
4. What can my teacher do to better prepare me for class?
5. What do you want to learn more about?
6. Overall summary of the class

Unit 5: Principles of Marine Biology

Ecological Hierarchy

- Ecology is studied at many interacting hierarchical levels

1. Individual
2. Population
3. Species
4. Community
5. Ecosystem
6. Biosphere



Levels defined: Individual

- An organism that is independent from other individuals
- **Example**: a single clownfish
- We study how these individuals manage to find shelter and mates, avoid predators, and locate food

Levels defined: Population

- A group of individuals of the *same species*
- **Example**: a group of crabs living and breeding in an estuary
- We study how large a population has to be in order for the species to produce enough young for the species to survive.

Levels defined: Species

- A single population, or group of populations, that will not reproduce with other species
- **Example**: Tuna vs Shark OR clown fish vs damsel fish… not the same species
- Important to study to see long term impacts on environments

Levels defined: Community

- A group of interacting populations, each belonging to different species and all living in the same place
- **Example**: all the barnacles, snails, seaweeds, starfish, and other species that live together & interact
- We study communities to see how species interact with one another (predator/prey, symbiotic relationships, etc....)

Levels defined: Ecosystem

- An entire habitat, including all abiotic (non-living) & biotic (living) features
- **Example**: an estuary and its inhabitants
- When studying ecosystems, we look at many different factors:
  - Water currents
  - Reproductive timing of species
  - & anything else that explains the structure of the habitat

Levels defined: Biosphere

- The entire set of living things on the earth and the environment with which they interact.
- **Example**: the burning of fossil fuels producing carbon dioxide, the amount of forests producing oxygen, the amount of photosynthesis, and the circulation in the ocean

Interactions in the Hierarchy

- Both abiotic and biotic interactions are important
- Ecological niche: special role of organism in the community
- **Interactions that occur between individuals can be ranked using a plus-minus-zero system.**
- **Plus (+): interaction is beneficial**
- **Minus (-): interaction is harmful**
- **Zero (0): there is no impact**

Interactions: Territoriality

- When a "home range" is maintained and protected by an individual.
- The individual may be protecting/maintaining:
  - A feeding area
  - A breeding site
  - A nest

- **Example**: a species of seabird maintaining a territory for nesting
- **Plus-minus-zero rating: +- or --**

Interactions: Predation

- Predators search for prey using a variety of methods
  - Chemicals
  - Mechanical
  - Visual stimulus
- Predators can be mobile or stationary
  - Mobile examples: fishes, starfishes, birds
  - Stationary example: anemones, coral polyps
- **Plus-minus-zero rating: +-**

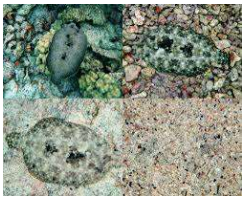
Interactions: Predation
Predator Avoidance

- Resistance to predators comes in many forms

1. Crypsis
2. Escape Responses
3. Mimicry
4. Mechanical Defense
5. Chemical Defense

Predator Avoidance: Cypsis

- Blending in with the background
- **Examples**: many fishes, crustaceans, and cephalopods (like octopus) have chromatophores, which are cells that rapidly change colors



Predator Avoidance: Escape Response

- Specialized responses to escaping predators
- For **example**:
  - Being active at night when predators are active during the day
  - Being able to move quickly to avoid predators
  - Using jet propulsion to deter predators

Predator Avoidance: Mimicry

- Allows organisms to resemble another species
- Examples: snake eels that are harmless have the coloration of extremely poisonous sea snakes

Predator Avoidance: Mechanical Defense

- Most common defense
- Features of an organism used for self-defense

Examples:

- Shells
- Spines
- Stinging cells

Predator Avoidance: Chemical Defense

- Organisms use chemical toxins for protection
- Can also be used during mechanical defense
- Commonly associated with creatures that have unique coloration as a warning

Examples:

- Toxic sea cucumbers & sponges
- Lionfish
- Toxic seaweed

Interactions: Commensalism

- The interaction benefits on species only.
- Usually relates to food or living space
- Example: barnacles may settle and live on a variety of species (like mussels, seaweeds, whales)
- **Plus-minus-zero rating: +0**

Interactions: Mutualism

- Two individuals benefiting from the relationship
- Usually for protection
  - Predators
  - Disease
- Or provides food

Examples:

- Crabs carrying anemones on their claws
- Cleaner crabs & cleaner fish
- **Plus-minus-zero rating: ++**

Interactions: Parasitism

- When members of one species lives off another (parasite) and one species potentially dies (host)
- Ectoparasite: live attached to the outside of the host
- Endoparasite: lives with in the host

Bellringer: 11/6/2017

1. Which marine environment have you decided to focus on for you Interactions between Individuals assignment?
2. What are some interesting interactions you have learned about?
3. STOTD

What is classification?

- Classification is the grouping of living organisms according to similar structures and functions.

Early classification systems

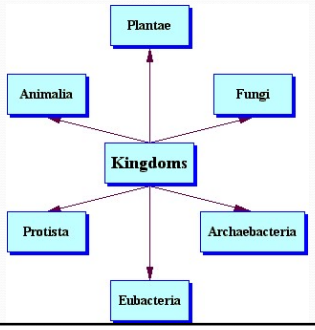
- Aristotle grouped animals according to the way they moved



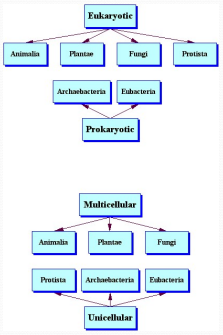
The modern classification system

- **Developed by Carolus Linnaeus**
- **Consists of 7 levels**:
  1. Kingdom
  2. Phylum
  3. Class
  4. Order
  5. Family
  6. Genus
  7. Species

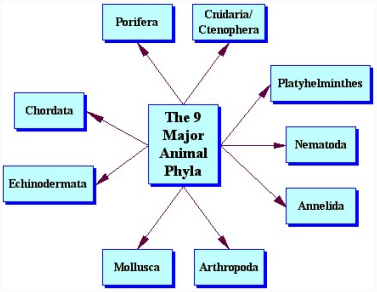
Animal Kingdoms



2 Ways to classify animal kingdom



9 major Animal Phyla

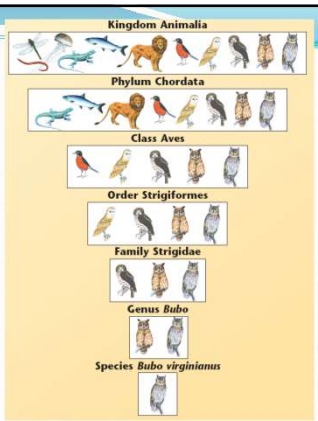


Bellringer: 11/7/2017

- Find examples of organisms in the following Phylums:

1. Cnidaria
2. Porifera
3. Chordata
4. Enchinodermata
5. Mollusca
6. Arthropoda
7. STOTD

**You may use a computer



Classification Level				
Common Name	Human (?)	Canada goose	Lake darner	Mosquito
Kingdom	Animalia	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Arthropoda	Arthropoda
Class	Mammalia	Aves	Insecta	Insecta
Order	Primate	Anseriformes	Odonata	Diptera
Family	Hominidae	Anatidae	Aeshnidae	Culicidae
Genus	*Homo*	*Branta*	*Aeshna*	*Aedes*
Species	*sapiens*	*canadensis*	*eremita*	*fitchii*

Binomial Nomenclature

- Developed by Carolus Linnaeus
- Two-name system:
  1. First name is the organism's genus
  2. Second name is the organism's species

What rules are used to write scientific names?

1. The first letter of the genus is ALWAYS capitalized
2. The first letter of the species is NEVER capitalized
3. Scientific names of organisms are always *italicized* or <u>underlined</u>

Using the Classification System

Field guides help identify organisms.

-they **highlight differences** between similar organisms (like trees)

Taxonomic Key (**Dichotomous Key**)

-**paired statements that describe the physical characteristics** of different organisms

How to use a Dichotomous Key:
http://youtu.be/YDGv_n_uqs

Bellringer: 4/4/2017 (Tuesday)

1. How do organisms keep their species from going extinct?
2. List the 7 levels of classification in order from smallest to largest.

- After you complete the bellringer assignment
  - Complete notes in Cornell Note format (pencil/paper) until you see the next Bellringer Assignment.
  - Work on your Marine Environments Project.
    - I will be checking on your progress each day
    - Email me with any questions you may have.

Bellringer: 11/13/2017

- STOTD in your Bellringer Notebook
- Then, add the following words to your packet:
  - Asexual reproduction
  - Fission
  - Budding
  - Vegetative reproduction
  - Sexual reproduction
  - Meiosis
  - Zygote
  - Spawning
  - ***FIELD TRIP $$ AND FORMS!

Perpetuating Life

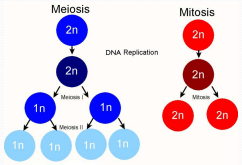
- Reproduction:
  - All organisms need to reproduce to keep their species from going extinct.

2 Types:

1. Asexual Reproduction
2. Sexual Reproduction

Perpetuating Life : Asexual Reproduction

- Asexual Reproduction:
  - **1 organism** will **divide** into **two identical organisms**.
  - **Cell fission**: Cells divide to produce daughter cells.
  - This process is also known as **mitosis**.
  - Primary way single-celled organisms reproduce.

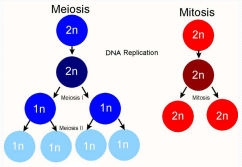


Perpetuating Life : Asexual Reproduction

- **Fission: Splitting**
  - Ex) Sea anemones
- **Budding**: new **organism buds off parent** organism.
  - Ex) sponges
- **Vegetative reproduction**: **Plant** sends out a "runner" that will **grow roots and separate from parent** plant.
  - Ex) seagrass

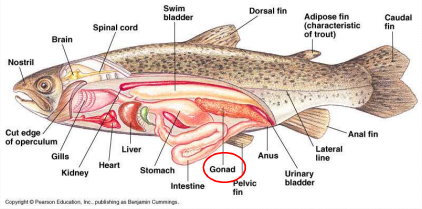
Perpetuating Life: Sexual Reproduction

- Sexual Reproduction:
  - **Two parents** come together with gametes (sperm and egg) to form **an offspring genetically different** from both parents.
  - **Meiosis**: process of forming gametes, all gametes are genetically different from each other.



Perpetuating Life: Sexual Reproduction

- **Gonads**: tissues that form gametes.
  - females: ovaries
  - males: testes



Perpetuating Life

- **Zygote:**
  - a sperm and egg combine for the first time
  - the first cell of the new organism
- This will later form into an **embryo**, then a **fetus**.
- Some organisms will form into a **larval stage** which will look completely different than the adult organism.
- **Spawning**: eggs and sperm are released directly into the water column.

Bellringer: 11/14/2017

1. What is photosynthesis?
2. What organisms photosynthesize?
3. STOTD

**Field trip $$ and Forms!

Bellringer: 11/15/2017

1. Which of your organisms are primary producers?
2. Which of your organisms photosynthesize?
3. STOTD

Field Trip $$ and Forms

Open Note Test and Project Due on Friday

Life in the Sea

Biodiversity

- Earth contains over 100 million different species. All species are made up of the same major elements.

49

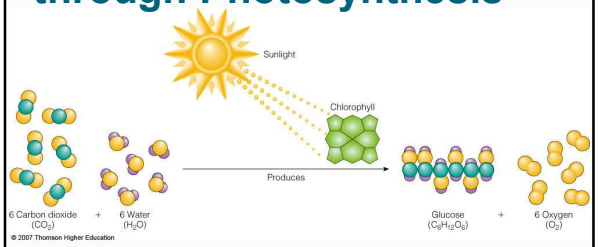
Elements

- All of Earth's organisms are composed of about 23 of the 107 known chemical elements. Four elements-carbon, hydrogen, oxygen, and nitrogen-make up 99% of the mass of all living things.

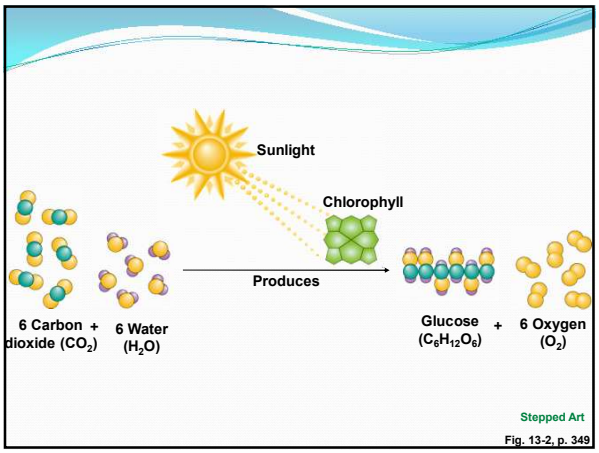
50

50

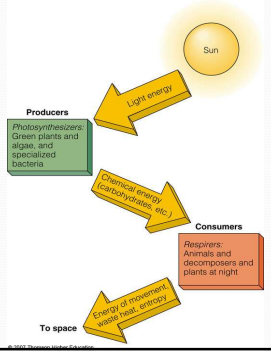
Energy Can Be Stored through Photosynthesis



In Photosynthesis, **energy from sunlight** is used to bond six separate carbon atoms (derived from carbon dioxide) into a single energy-rich, six-carbon molecule (the sugar glucose). The pigment **chlorophyll** absorbs and briefly stores the light energy needed to drive the reactions. Water is broken down in the process, and oxygen is released.

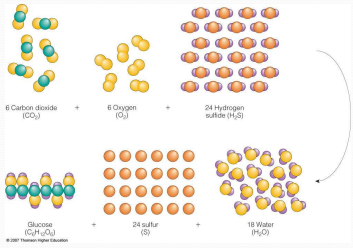


Energy Can Be Stored through Photosynthesis



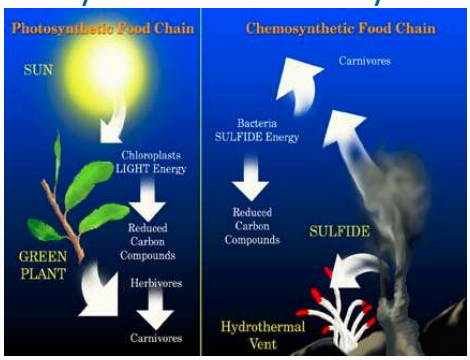
The flow of energy through living systems. At each step, energy is degraded (that is, transformed into a less useful form).

Energy Can Also Be Stored through Chemosynthesis

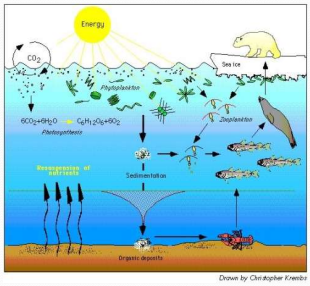


Chemosynthesis: converting carbon and nutrients into energy sources from other chemicals (like methane) vs using light energy (photosynthesis)

Photosynthesis vs Chemosynthesis



Primary Production



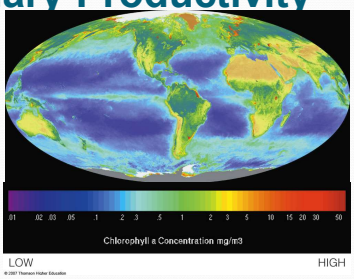
Drawn by Christopher Knembi

The production of new plant material by photosynthesis is **primary production.**

The source of primary production are small, single-celled organisms called **phytoplankton.**

Phytoplankton use **chlorophyll** to convert light energy into energy needed for survival.

Primary Productivity



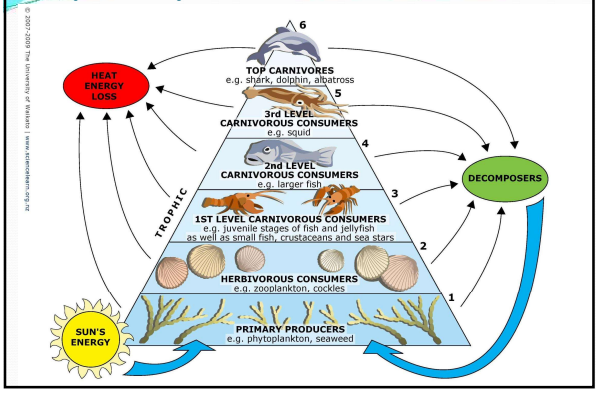
Oceanic productivity can be observed from space. NASA's *SeaWiFS* satellite, launched in 1997, can detect the amount of chlorophyll in ocean surface water. Chlorophyll content allows an estimate of productivity. Red, yellow, and green areas indicate high primary productivity; blue areas indicate low. This image was derived from measurements made from September 1997 through August 1998.

Food Webs Disperse Energy through Communities

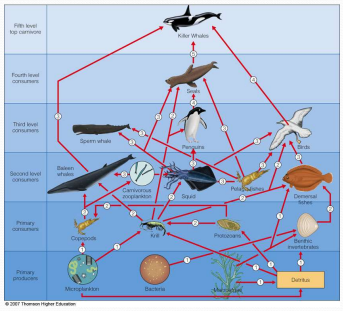
What terms are used to describe feeding relationships?

- **Autotrophs –** organisms that make their own food, also called *producers***.**
- **Heterotrophs –** organisms that must consume other organisms for energy
- **Trophic pyramid –** a model that describes who eats whom
- **Primary consumers –** these organisms eat producers
- **Secondary Consumers –** these organisms eat primary consumers
- **Top consumers –** the top of the tropic pyramid

Trophic Pyramid



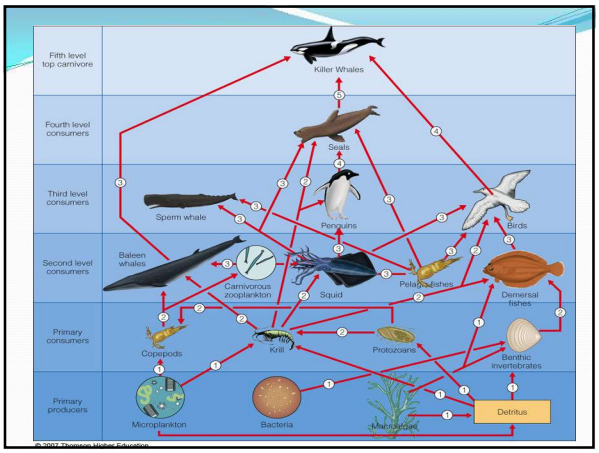
Food Webs Disperse Energy through Communities



Diatoms, and other primary producers, **convert the energy from the sun into food used by the rest of the oceanic community.**

(left) A simplified food web, illustrating the major trophic relationships leading to an adult killer whale.

The arrows show the direction of energy flow; the numbers on each area represent the trophic level at which the organism is feeding.



Bellringer: 4/6/2017 (Thursday)

1. Create a trophic pyramid for your organism that you are currently researching for your project

- After you complete the bellringer assignment
  - Complete notes in Cornell Note format (pencil/paper) until you see the next Bellringer Assignment.
  - Work on your Marine Environments Project.
    - I will be checking on your progress each day
    - Email me with any questions you may have.

Elements Cycle between Living Organisms and Their Surroundings

What are some atoms and molecules that cycle in biogeochemical cycles?

- **Carbon** - present in all organic molecules
- **Nitrogen** - found in proteins and nucleic acids (DNA)
- **Phosphorus** and **silicon** – found in rigid parts of organisms (Phosphate=Backbone of DNA)
- **Iron** and **trace metals** - used for electron transport
- **Carbon Dioxide** - dissolved in seawater is the source of the carbon atoms assembled into food (initially glucose) by photo synthesizers and most chemosynthetic organisms.

Physical and Biological Factors Affect the Functions of an Organism

A **limiting factor** is a factor found in the environment that can be harmful if present in quantities that are too large or too small.

- Any factor required for life can become a limiting factor.

Any aspect of the physical environment that affects living organisms is a **physical factor.**

What are the most important physical factors for marine organisms?

1. **Light** and **color**
2. **Temperature**
3. **salinity**
4. **Pressure**
5. **Environmental Zones**

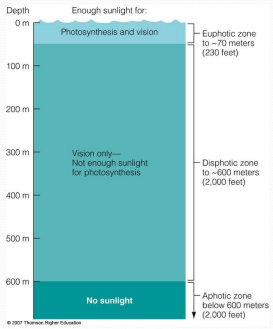
Physical and Biological Factors Affect the Functions of an Organism

Biological factors also affect living organisms in the ocean.

Some biologic factors that affect ocean organisms:

1. feeding relationships
2. crowding
3. metabolic wastes
4. defense of territory

1. Light and Color: Photosynthesis Depends on Light



3 Ocean Light Zones

1. **Euphotic zone**: Most of the biological productivity of the ocean occurs in an area near the surface. Most photosynthesis and life found here.
2. **Disphotic zone**: vision only, not enough sunlight for photosynthesis
3. **Aphotic zone**: no sunlight at all. No photosynthesis ***occurs.***

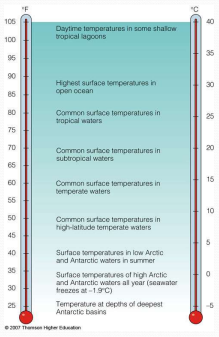
1. Light and Color: Bioluminescence

- Another source of light in present in the oceans, the organisms themselves!
- The light is **bioluminescence** produced by the interaction of chemicals in the body.
  - Agitating water disturbs microorganisms causing them to flash and glow in waves near the shore
  - Jellyfish glow if they come in contact with crushed tissue
  - Squid, shrimp, and some fish
- Middepth fish have light-producing organs called: **photophores**
  - act as lures to capture prey
  - Used to distract predators
  - Used for communication

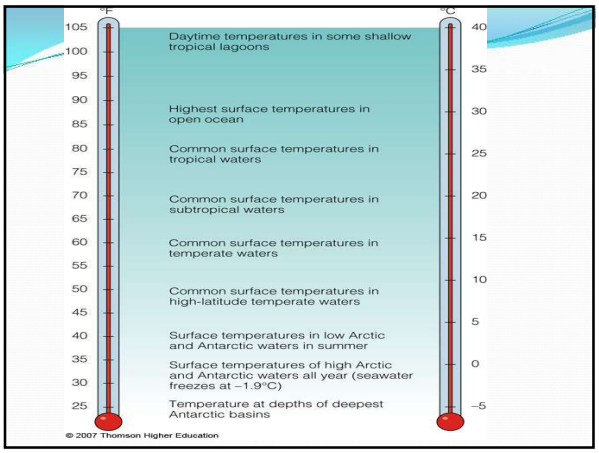
2. Temperature

- Impact:
  - Density of ocean water
  - Metabolic rate of organisms
- Deep Ocean & Polar latitudes: uniformly low temperatures
- Surface waters & coastal waters: varying temps according to seasonal changes and geographic location

Temperature Influences Metabolic Rate

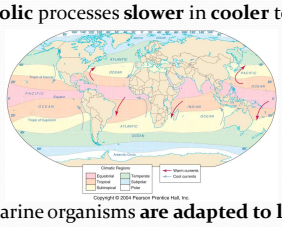


Some isolated areas of the ocean, notable within and beneath hydrothermal vents, may support specialized living organisms at temperatures of up to 400°C (750°F)!



2. Temperature

- Temperature:
  - Organisms are **greatly affected** by temperature.
  - **Metabolic** processes **faster** in **warmer** temp
  - **Metabolic** processes **slower** in **cooler** temp.



  - Most marine organisms **are adapted to live in specific temperature ranges**.

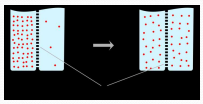
2. Temperature

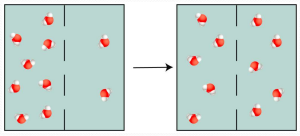
Classifications:

1. Ectotherms:
   - "cold-blooded" : as water temp changes so does body temp
   - AKA: Piokilotherms
   - Plants and marine animals other than birds and mammals
2. Endotherms:
   - Active fish
   - Metabolic heat raises body temp
3. Homeotherms:
   - "Warm-blooded": can produce heat when needed
   - Mammals and birds

3. Salinity

- **Salinity affects all marine organisms** living in ocean water.
- 2 ways animals can control salinity in their body:
  1. **Diffusion**: molecules or **ions** in water **will move from** an area of **high concentration** to **low concentration across semi-permeable membranes**
  2. **Osmosis**: **water** molecules will **diffuse** into or out of cells **to try to regulate/ control** concentrations of molecules or **ions**.





3. Salinity

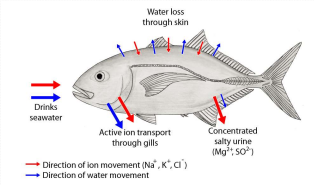
- Marine organisms have adapted to balance water and salts
- 2 Ways:
  1. Osmoconformers
  2. Osmoregulators

3. Salinity

1. Osmoconformers
   - Internal concentrations change as the salinity changes
   - Animals stay where salinity matches their fluids
   - If placed in fresh water they swell and burst!

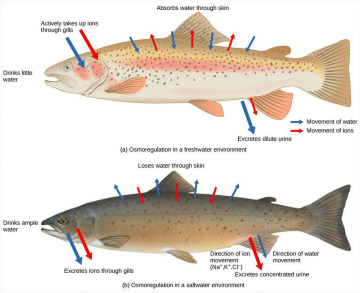
3. Salinity

2. Osmoregulators
   - Control their salinity levels
   - Change the amount of chemicals in their body to match salinity
   - Ex) Sharks & rays: change the amount of urea, by urinating.
   - Ex) Most fish can excrete extra salts.



3. Salinity

- **Freshwater fish**: Their **blood has** a **higher concentration of salt** than their surroundings.



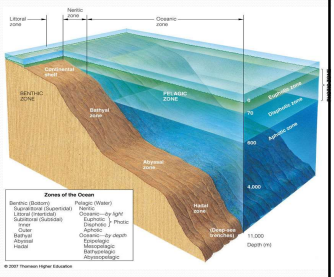
4. Pressure

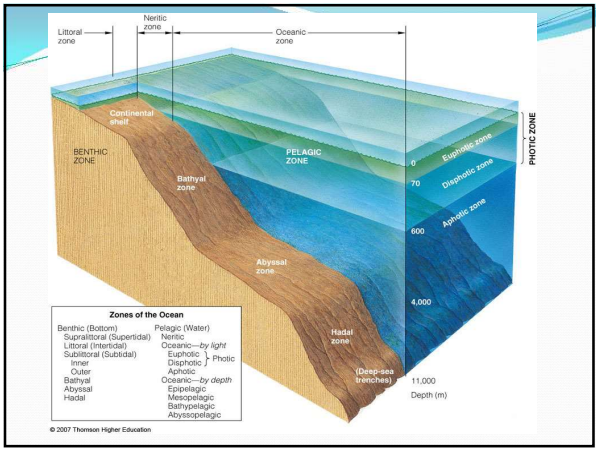
- **Deep-living organisms are unaffected by pressure** because they do not have gas filled lungs or bladders
  - **Worms**, **crustaceans**, **sea cucumbers**…
- **Air-breathing marine mammals make dives with out difficulty** because of their ability to adjust their physiology that allows their blood to absorb more oxygen
- Rising too quickly can cause a diver to experience extreme **pain**, paralysis, and sometimes death!
  - **Gas bubbles form** in the body tissues and blood vessels

5. Environmental Zones

Scientists divide the marine environment into **zones**, areas with homogeneous physical features.

Zones are classified by location and the behavior of the organisms found there.



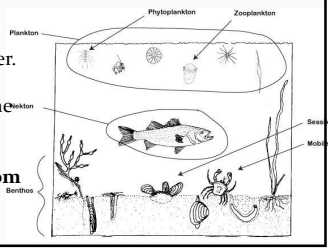


5. Environmental Zones

- All of these zones are inhabited by a variety or organisms that float, drift, swim, or are attached to the seafloor
- **Habitat**: **the natural environment where an organism lives**

EXAMPLES:

1. **Planktonic organisms**: **float** at the top of the water.
2. **Nekton**: **Swim** through the water.
3. **Benthic**: live on the **bottom** of the ocean



Bellringer: 4/7/2107 (Friday)

1. We can classify marine animals according to how they control their body temperature. What are the 3 classifications we talked about last week and how are they different?
2. STOTD

****PROJECTS DUE NEXT WEEK!**