Ocean 11

Water Characteristics

The unusual characteristics of water itself determine most of the basic properties of seawater. The asymmetrical shape of a water molecule creates an electrical charge separation that initiates hydrogen-bonding interactions with adjacent water molecules.

Hydrogen bonding, in turn, affects water's basic properties, including viscosity, surface tension, heat capacity, solvent capability, density-temperature relationships, and its stability as a liquid.

The water molecule is an unusual molecule:

- Water is the only substance that exists as a solid, liquid, or gas at the earth's surface.
- The solid phase is less dense than the liquid phase, so ice floats.
- Water has a high heat capacity.

Heat Capacity

The heat capacity for water is 1 calorie/gram.

This means that water can absorb more heat than other substances.

The amount of heat added to increase the temperature is higher than for most substances. This is because more heat is required to break the chemical bonds between the oxygen and hydrogen atoms.

Effect on climate: This increased heat capacity allows the oceans to absorb and hold heat from the sun. This explains why coastal climates are less variable that inland climates.

The oceans absorb more sun's heat during the summer, keeping the atmosphere relatively cool. In winter, this latent heat is released, warming the areas along the shore.

Effect on day/night temperature:

Over most of the ocean, temperatures vary from day to night by less than 1 degree Celsius.

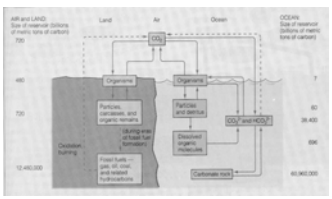
In contrast, the land surface varies greatly, as much as 15-30 degrees Celsius, due to the lower heat capacity of land.

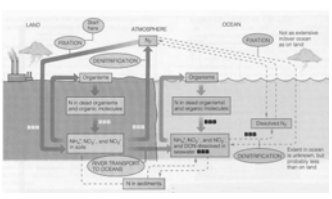
Seawater contains a variety of dissolved salts, gases, and other substances. These dissolved substances affect the density of seawater, its osmotic properties, buffering capacity, and other biologically significant features.

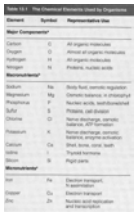
This water is constantly in motion, mixed and moved by winds, waves, tides, currents, sinking water masses, and upwelling.

Sizes of the Reservoirs
(billions of metric tons of nitrogen)

	Land and Air	Ocean
Atmosphere (N_2)	3,800,000	—
Dissolved N_2	—	20,000
Organisms	12	1
Dead organisms and organic molecules	760	900
NH_4^+, NO_3^-, and NO_2^-	140	100
Sediments	—	4,000,000







The total average mineral content is called salinity.

Salinity forms approximately 3.4 parts per thousand of the components of seawater. This varies somewhat, being higher in the subtropical areas of the world and lower in the polar regions.

Common salt - NaCl (sodium chloride) - comprises the greatest percent of mineral matter of ocean waters.

Other salts found are:

- Magnesium chloride (poisonous)
- Sodium chloride
- Sodium sulphate
- Calcium chloride

Evaporation of Salt

The ocean is actually made up of several "layers" of water, each with its own density, temperature and salinity characteristics.

Sounds produced by whales may get "trapped" in one of these layers and travel for thousands of miles.

Temperatures of open marine waters capable of supporting life. Some isolated areas in the ocean, notably within and beneath hydrothermal vents, may support specialized living organisms at temperatures of 113 degrees Celsius (238 degrees Fahrenheit).

•Thousands of feet beneath the surface, the sea temperature is always 40 degrees Celsius (39 degrees Fahrenheit), even in the tropics.

•The ocean is actually made up of several "layers" of water, each with its own density, temperature and salinity characteristics. Sounds produced by whales may get "trapped" in one of these layers and travel for thousands of miles.

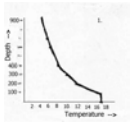
Graphing of temperatures, depth, density and salinity:

Oceans 11 - Lab Exercise -Water Graphing temperature, salinity, and depth in the ocean. The following data represents actual measurement taken at a particular location in the Pacific Ocean.

Procedure: Using the data included here, and suitable graph paper, plot the following six graphs:

Temperature (x) vs Depth (y)
2. Salinity (X) vs Depth (y)
3. Density (x) vs Depth (y)
4. Temperature (x) vs Salinity (y)
5. Temperature (x) vs Density (y)
6. Salinity (x) vs Density (y)

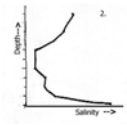
Depth (m)	Temp (degrees C)	Salinity (o/oo)	Density (g/cm3)
0 (Surface)			
100			
200			
300			
400			
600			
700			
800			
1000			



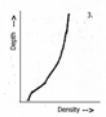
Graph #1: Temperature decreases as depth increases, because sunlight penetrates and warms water near the surface.

The line is not straight because water movement effects the heating process.

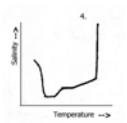
Thousands of feet beneath the surface, the sea temperature is always 4 degrees Celsius (39 degrees Fahrenheit)… even in the tropics.



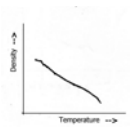
Graph #2: Salinity concentration is higher closer to the surface, because the sun evaporates water.



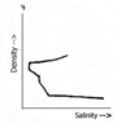
Graph #3: As depth increases, the pressure and the density of the salt water also increases.



Graph #4: As the temperature increases, so does the salt content.



Graph #5: The water becomes more dense as the temperature decreases.



Graph #6: With a decrease in salinity, the water becomes less dense.

Below 100 metres the salinity remains relatively constant, until about 600 metres, when the increased density of the salt water results in increased salinity.

Questions:

1. For *each* of the six graphs, state the relationship between the two variables. For example, in the *first graph*:
2. Does temperature increase or decrease as depth increases?
3. Why do you think salinity and temperature are highest at the ocean's surface?
4. Which has the greatest effect on density, salinity or temperature? Why do you think that?
5. Do you think this experimental data was collected near the equator or far from it?
6. Why do you think that?
7. Do you think this experimental data was collected close to the coast or far from it? Why do you think that?

Relationships for lab exercise based on graphing:

Graph #1: Temperature decreases as depth increases, because sunlight penetrates and warms water near the surface. Also, currents carry different temperatures to certain areas.

Graph #2: Salinity concentration is higher closer to the surface, because the sun evaporates water.
Below 100 metres the salinity remains relatively constant, until about 600 metres, when the increased density of the salt water results in increased salinity.

Graph #3: As depth increases, so does the pressure and the density of the salt water increases.

Graph #4: As the salt content increases, so does the temperature.

Graph #5: The temperature decreases as the water becomes more dense.

Graph #6: With a decrease in salinity, the water becomes dense.