

## Unit One: Physical and Chemical Oceanography

### The Oceans

- The world ocean is separated into five major divisions: Pacific, Atlantic, Indian, Arctic and newly designated<sup>(\*2021)</sup> Southern. \_\_\_\_% of the southern hemisphere is covered in ocean while \_\_\_\_% of the northern hemisphere is covered in ocean.

### Latitude and Longitude

- \_\_\_\_\_ are circles running east-west around the world, parallel to the equator, to describe position.
  - The angular distance north or south is latitude, running from 0° (equator) to 90° (poles)
- \_\_\_\_\_ are semicircles running pole to pole.
  - Longitude is the angular distance, running from 0° (prime meridian) to 180°

### The Poles

- Because of the tilt of the earth, the geographic poles are different from the geomagnetic poles.
- The angle between the direction of the geographic poles and the direction the compass needle points (geomagnetic poles) is called the \_\_\_\_\_.

### Nautical Charts

- While maps primarily represent land, charts depict water-related information. A nautical chart is primarily concerned with \_\_\_\_\_ water areas and includes coastlines, harbors, obstructions, currents, and depth.

### Properties of Water

- Water has several properties that make life as we know it possible.
  - High surface tension
  - High conduction of \_\_\_\_\_
  - Low \_\_\_\_\_
  - Universal solvent

### Seawater

- Seawater is 96.5% pure water. The other 3.5% comes from the dissolved solids that rivers carry to oceans.
- The total amount of dissolved material in water is its \_\_\_\_\_. The global average is 34.7 ppt.
- The major dissolved solids in seawater:
  - 55.04% - Chloride (Cl<sup>-</sup>)
  - 30.61% - \_\_\_\_\_ (Na<sup>+</sup>)
  - 7.68% - Sulfate (SO<sub>4</sub><sup>2-</sup>)
  - 3.69% - Magnesium (Mg<sup>2+</sup>)

### CTD

- An important tool for oceanographers is a CTD, which measures \_\_\_\_\_, temperature, and depth. Other instruments can be attached, such as a \_\_\_\_\_ bottle (collects water at different depths) and an oxygen sensor.

### Bathymetry

- Bathymetry is the measurement of ocean depths and the charting of the shape or topography of the ocean floor
- \_\_\_\_\_ (Sound Navigation and Ranging) consists of a transmitter and a receiver
  - Sound waves travel at \_\_\_\_\_ m/sec in seawater

### Ocean Geomorphology

- The underwater extension of a continent is the continental \_\_\_\_\_
- At the outer edge of the shelf, there is an abrupt steepening of the bottom to become the continental slope.
- The deep, flat, sediment covered bottom of the ocean is the \_\_\_\_\_ plain. In some areas, the abyssal plain is broken by deep troughs called trenches or isolated underwater mountains called seamounts.

### **Plate Tectonics**

- The earth's crust is divided into large plates that float and ride on the surface. The movement of these plates over time is called \_\_\_\_\_.
- The plates move because oceanic ridges are centers of volcanic activity, creating new crustal material that moves the plates outward in a process called seafloor spreading.

### **Ocean Zones**

- There are two major zones of the ocean basin:
  - the \_\_\_\_\_ zone is the warm, nutrient rich water extending to the edge of the continental shelf, containing 90% of all marine species
  - the oceanic zone includes all waters beyond the continental shelf.
- The water column is also divided into zones based on depth:
  - \_\_\_\_\_: 0 - 200 m in depth, this the photic zone (lighted)
  - mesopelagic: 200 - 1,000 m, lower boundary in the tropics is the 10°C isotherm
  - bathypelagic: 1,000 - 2,000 to 4,000 m, 10°C to 4°C (benthic zone = bathyal zone)
  - abyssalpelagic: to a depth of 6,000 m, overlying the plains of ocean basins (benthic zone = abyssal zone)
  - \_\_\_\_\_: 6,000 - 10,000 m, includes the open water of the deep trenches (benthic zone = hadal zone)

### **Ocean Currents**

- Waters of the ocean move in giant streams called Currents
  - \_\_\_\_\_ currents are driven by wind, while deep currents are driven by density differences (temperature and salinity)
  - The \_\_\_\_\_ Effect is the deflection of the earth's winds and currents by the earth's rotation, causing huge circles of moving water called gyres
  - A turbidity current is caused by underwater landslides

### **Great Ocean Conveyor Belt**

#### **Ocean Waves**

- Waves are periodic up and down movements of water that transfer energy
  - \_\_\_\_\_ is the length crest-to-crest or trough-to-trough
  - Period is the time for one complete wave to pass a point
  - wave speed = wavelength / period
  - Three things determine wave size: wind speed, length of time wind blows, and \_\_\_\_\_ (distance wind blows)
  - Waves that topple over themselves are breakers

#### **Tides**

- The periodic predictable rise and fall of the level of the sea over a given time interval is called a tide. Tides occur due to the interaction of the gravitational attraction of the \_\_\_\_\_ and the \_\_\_\_\_ on the earth and the centripetal force generated by the rotating earth-moon system.

#### **Tidal Frequency**

- Locations having a single low tide and high tide per day are said to experience \_\_\_\_\_ tides. Those with two highs and two lows per day experience semidiurnal tides. Those having a mixture of diurnal and semidiurnal tides experience \_\_\_\_\_ tides.

#### **Tidal Range**

- The difference between levels of high tide and levels of low tide is the tidal \_\_\_\_\_
- Spring tides occur when there is a new moon or full moon and are large, due to sun-moon alignment
- \_\_\_\_\_ tides occur during first and third quarter moon phases and are smaller than normal