

## **Introduction to the Marine Environment (with a brief review of Earth Science & Biology Basics)**

### **Brief History of Ocean Exploration (early history)**

- The earliest interactions with oceans was to obtain food, with primitive fishhooks and spears dating to 5000 B.C. The earliest recorded sea voyages were in 3200 B.C. by the \_\_\_\_\_
- Significant explorations were performed by the Phoenicians, Polynesians, and Greeks. The Greeks designed the latitude/longitude system, which was critical for exploring the oceans
- The Middle Ages (800-1400 A.D.) saw extensive exploration by Europeans, Vikings, and Chinese.
- The first expedition around the world was led by \_\_\_\_\_ in 1519-1522.

### **Brief History of Ocean Exploration (birth of marine science)**

- The voyages of James \_\_\_\_\_ in the mid-1770's were the first expeditions devoted to scientific oceanography. Key to this was the invention of the chronometer; a clock not affected by motion of the sea
- From 1822-1831, the Scottish ship H.M.S. \_\_\_\_\_ gathered enormous amounts of physical, chemical, geological and biological data. It is considered the most important expedition of its time.

### **Brief History of Ocean Exploration (the twentieth century)**

- The first submersibles were developed in the 1930's. Famous subs include
  - \_\_\_\_\_ – first sub to have reached the bottom of the Challenger Deep (10,838 m)
  - Alvin – first to find deep sea hydrothermal vents (Galapagos Islands)
- Self-contained diving dates back to bells used in 375 A.D. The first practical SCUBA (Self-Contained Underwater Breathing Apparatus) was introduced by Jacques \_\_\_\_\_ in 1943.
- Remotely Operated Vehicles (ROV's) do much of the underwater work in modern times.

### **Measurement on Earth: 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°

### **Measurement on Earth: 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.

### **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 continental drift.
- The plates move because oceanic ridges are centers of \_\_\_\_\_ activity, creating new crustal material that moves the plates outward in a process called \_\_\_\_\_ spreading.

### **Earthquakes**

- Earthquakes are vibrations in the earth's crust caused by sudden shifts along a \_\_\_\_\_
- Earthquakes cause seismic waves, vibrations that travel through the earth.
  - P waves (primary waves), travel through liquids, solids and gases
  - S waves (secondary waves), travel only through solids and are slower than P waves
  - L & R waves (\_\_\_\_\_ waves) are the slowest and occur when P and S waves meet the surface
- Aftershocks are tremors caused as seismic waves travel outward from an earthquake

## Tsunami

- A major earthquake with an epicenter on the ocean floor sometimes causes a giant ocean wave called a tsunami
  - The sudden drop or rise in the ocean floor results in violent water movement setting into motion a series of long and low waves
- An earthquake may also trigger underwater \_\_\_\_\_
- The seismic sea wave warning system (SSWWS) is a series of seismograph stations in the \_\_\_\_\_ Ocean used to predict and monitor seismic activity

## Volcanoes & Hot Spots

- Volcanism is any activity that includes the movement of \_\_\_\_\_ towards or onto the earth's surface
- Major volcanic zones include subduction zones, mid-ocean ridges, hot spots and the ring of fire
- Volcanoes erupt because magma under pressure at high temperatures causes the magma above to be pushed towards the surface and out the vent (opening of the volcano)
  - Once the magma hits the surface it becomes \_\_\_\_\_ and begins to harden

## Ecological Terminology

- An organism is any form of life
- A \_\_\_\_\_ is a group of organisms that can breed with one another to produce live, fertile offspring
- A population is a group of interacting individuals of the same species that occupy the same area at the same time
- A habitat is a place where a population lives
- Populations of all the different species occupying a particular place make up a \_\_\_\_\_
- An ecosystem is a community and its nonliving environment
- A \_\_\_\_\_ is the role an organism plays in its environment; its interactions with the ecosystem.

## Biotic Components of Ecosystems

- Autotrophs, or producers, make their own food. Usually, this is through \_\_\_\_\_; however, chemosynthesis occurs at hydrothermal vents in the deep ocean.
- Heterotrophs, or consumers, feed on other organisms.
  - Primary consumers (herbivores) feed directly on autotrophs
  - Secondary consumers (carnivores) feed on primary consumers
  - Tertiary consumers (carnivores) feed on secondary consumers
  - \_\_\_\_\_ are consumers that eat both plants and animals
  - Scavengers feed on dead organisms killed by other organisms
  - Detritivores, include detritus feeders and \_\_\_\_\_

## Energy Flow in Ecosystems

- The transfer of energy from a producer through a given series of consumers is called a food \_\_\_\_\_.
- The organisms in most ecosystems form a complex network of interconnected food chains called a food \_\_\_\_\_.
  - Each organism is assigned a trophic level (producers in the 1<sup>st</sup>, primary consumers in the 2<sup>nd</sup>, etc.)
- Energy stored in biomass is transferred from one trophic level to another, with some usable energy degraded or lost to the environment as low-quality heat in each transfer. (ecological \_\_\_\_\_)

## Taxonomy

- Example: Spotted Eagle Ray, *Aetobatus narinari*
- Kingdom – Animalia (animals)
- \_\_\_\_\_ – Chordata (vertebrates)
- Class – Chondrichthyes (cartilaginous fishes)
  - Subclass – Elasmobranchii (sharks, rays & skates)
- Order – Myliobatiformes (rays)
- \_\_\_\_\_ – Myliobatidea (eagle rays)
- Genus – *Aetobatus* (eagle rays)
- Species – *narinari* (spotted eagle ray)