

1 Water

2 Identify turning points in the history of marine biology.

- all coastal peoples dev a store of practical knowledge about sea
- cultural, practical, ecological
- < 2000 BC Pacific Islanders navigated w 3d maps made of sticks and shells
- 2000 BC Phoenicians

3 Ancient Marine History

- 400BC Aristotle 1st marine biol described many forms of marine life deduced gill
 - Function
- Math/Navigational skills, astronomy
- 325 BC Pytheas dev math detr of latitude N-S angular distribution in degrees
 - Equator
- 150 AD Ptolemy longitude and more latitude prime meridian

4 Age of Exploration

- 982-- 995 Viking explorers Erikson Vinland
- 1492-1522 Age of Discovery Renaissance Columbus Magellan 1519
- change in view of world MAPS
- 1768 James Cook circumnavigated globe all great seas
 - 1st to use chronometer determine position made accurate charts
- Instrumentation charting
- 1777 Ben Franklin estab 1st map of gulf stream from own observations currents
- 19th century common to take along naturalists Darwin HMS Beagle 1831 atoll formation, plankton, barnacles, → Biology/ecology

5 James Cook

6 Maury

- 1836 Matthew Fontaine Maury father of Oceanography/
Am Naval officer; immobilized due to accident studied ship logs compilation of data; Published physical geography of sea looked for path in the sea-charts and
 - Currents
 - physical

7 **Maury**

8

- 1839 James Ross Ross Sea Antarctica navigation
- Joseph Hooker naturalist on trip analysis of veg in Antarctica
- Algae//diatoms plankton-photosynthesis
- Sounded 2,400'
- bio and chem
- 1854 Edward Forbes 1st ecological principles apply to marine sci
- Dredged bathymetric zonation, 1st biogeographical provinces
- Ecology, physical

9 **James Ross**

10 **HMS Challenger**

- 1872 HMS Challenger Charles Thompson 1st major oceanographic expedition
- Sailed 3.5 years collected data that took 19 years to analyze 50 vol
- 76 authors included 1st chem composition of sea water, physical and chem char of sea floor deposits
- distribution of life at all depths of sea
- deeper soundings- determined topography of sea floor

11 **HMS Challenger Route**

12 **HMS Challenger: sailed 68K miles**

13

- Alexander Agassiz (son of Louis Agassiz) obs fauna in Caribbean more like Pacific than Atlantic hypoth Isthmus of Panama under water
- continental drift/ theories
-
- ridge separating Arctic from Atlantic water in N Atl ocean called Thompson Ridge head of Challenger expedition fauna different each side of ridge

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- dead specimens in jars
- wanted to know function and life style need live studies
- biol ecol BEHAVIOR
- 1st marine station in Naples Italy
- 1872 Stazione zoologica still operational
- 1879 Plymouth England Lab of Marine biological Assoc of UK pub jrnal Marine Biol
- 1888 Marine biological Laboratory at Woods Hole, MA
- communications

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- terminology beginning to surface Karl Mobius eurythermal or haline, stenothermal or haline, biocenosis living together, symbiosis interrelated
- Hopkins Marine station in Pacific Grove CA
- Scripps Institution of Oceanography in La Jolla
- Friday Harbor Marine Lab in Friday Harbor, WA
- 1900's Peterson Grab sampling device jaw sediment sample
- designated bottom communities

16 TECHNOLOGY

- 1968 Glomar Challenger inernation cooperative effort deep sea drilling > 7 miles
- WWII sound navigation ranging SONAR sub warfare
- scuba selfcontained underwater breathing appartus
- Emile Gagnan auromobiles to run on compressed natural gas
- Gagnan Jacques Cousteau modified to breathe compressed air uner water natural environment observations
- ALVIN deep submersible Woods Hole
- JASON thermal vents
- satellites

17 ALVIN & JASON

18 Couteau & Gagnon

19 define, currently, marine biology, and explain why marine biology is not a separate science but a compilation of many fields of science

- marbio: sci study of plants, animals, and other organisms that live in ocean or at the ocean's edge

20 Examine different methods of studying marine life

- methods: sampling techniques, physio, submersibles, scuba, sonar, satellite, Peterson's grab to current sediment sampling

21 Describe water molecules

22 Hydrogen bonding in water

23 4 no five!

24 Explain properties of water

- **Water is a solvent**
- **Water is cohesive and adhesive**

- 25 **Water is a solvent**
- Dipolar molecule-can dissolve other polar molecules or ionic substances by the interaction of its partial charges with the solutes electrical charges or partial charges
 - Nonpolar forms interface not dissolve reactions occur at the interface like carbon compounds
 - Enhances variety of chemical reactions
- 26 **Water is cohesive and adhesive**
- Surface tension capillarity adheres to sand grains
 - Plankton bouyancy
- 27 **Water has a high specific heat**
- Lot of heat to raise temp or lot of heat lost to lower temp 4.184 J raise 1g water 1C
 - Thermal conductivity-spreads throughout rapidly
 - Maintenance of salinity of oceans and temp heat lost in tropics falls as rain in temperate/polar gain temp
- 28 **Water has a high freezing point and a lower density as a solid than as a liquid**
- Max density 4C seawater max density 1.8 and freezes at 1.8
 - Density mixes ice float insulation
 - Helps maintain ocean temperature-heat lost to ice goes to atmosphere heat gained molecular energy of water
- 29 **Water has high viscosity as medium**
- Viscosity strength to break like bonds resistance to flow
 - Relatively low for a liquid-high compared to air
 - marine locomotion:
 - Sink rate
 - Drag
- 30 **Describe seawater**
- water w metals, organic material and gases dissolved
- 31 **Define salinity**
- total weight of solid material dissolved in a kilogram of seawater
 -

- 32 List and give parts per thousand of the major constituents of seawater.
- Cl⁻ 19 0/00
 - Na⁺ 10.6 0/00
 - SO₄⁻ 2.66 0/00
 - Mg⁺² 1.28 0/00
 - Ca⁺² 0.4 0/00
 - k⁺ 0.38 0/00
 - remember based on 1 kg 1000 of seawater
- 33 List the minor and some trace constituents of seawater.
- K, Br, C, Sr, B, Si, F
- 34 Describe methods of measuring salinity and identify the method used to determine salinity in class (record aquaria salinity).
- 1. Refractive index-refractometer based on bending light rays
 - 2. Conductivity - ionized dissociated electrolytes
 - 3. Chlorinity-Cl predominate ion in sea water - ppt AgNO₃
 - 4. Hydrometer- density - sp grav
- 35 Explain why it is possible to determine salinity based on the chloride ion alone
- always in same proportions so if calc Cl, get salinity
- 36 Identify the salinity of deep oceanic waters.
- 34.7 ppt
- 37 Compare O₂ concentrations of the atmosphere w water
- O₂ concentrations of air:water
 - 0C 35ppt seawater 8mL O₂/L
 - Atmosphere 21 mL/L
 - 20o 35 ppt seawater 5.4 mL/L
- 38 Identify the 3 factors which affect O₂ content of water.
- Temp
 - density ppt- pressure
 - surface or deep wave action aerates

39 Explain why the aquaria need to be large compared w freshwater aquaria

Ocean lg and can absorb and distribute materials, when small these materials accumulate and the water no longer has the same balance; some of the compounds that accumulate and the depletion of others contribute to fish kills

40 size and wt our aquaria

■ 55 gal water: 440 lbs; tank about 40 lbs, gravel 60 lbs, others-filters, powerhead, lids, lights, shell, fish roughly just under 600 lbs

41 Identify the source of water in our aquaria; compare advantages and disadvantages of our sources of water.

■ sources-inshore seawater
■ other possibilities deep sea or artificial

42 artificial

■ Balanced salts
■ No N fix bacteria
■ Convenient
■ Cl from tap
■ Readily available
■ Expensive

43 deep seawater

■ Contain salts animals use
■ Not easy access
■ Farther out pollutants dilute
■ No mix or measure

44 inshore

■ Salinity for critters we catch
■ pollutants
■ Accessible

45 List some benthic zones and describe their boundaries

■ supralittoral zone-spray zone: above high tide, only covered w water during storms or extremely high tides
■ Berm-storm tide, flat area extending to dunes at a beach
■ littoral or intertidal: between high and low tide marks
■ sublittoral or subtidal; below low tide to about 200m depth water
■ Where no plants are found growing-50m inner sublittoral

46 Field methods