

Biological Oceanography

OCN 621

Spring 2010

The who's

- **Matthew Church**

Assistant Professor, Department of Oceanography:
Pelagic ecology and biogeochemistry

- **Karen Selph**

Specialist, Department of Oceanography:
Pelagic ecology, fisheries oceanography

- **Rhian Waller**

Assistant Researcher, Department of Oceanography:
Benthic oceanography, Coral reef ecology

- **Guest lecturer: Grieg Steward**

Associate Professor, Department of Oceanography:
Aquatic microorganisms and viruses

The where's

- **MWF 9:30-10:20 AM**

Marine Science Building Room 315

3 lectures per week

The what's

- Graduate level course required by the Department of Oceanography.
- 3 credits
- Grading and requirements:
 - Come to class and participate- 10%
 - Exam 1 (Church)- 30%
 - Exam 2 (Selph)- 30%
 - Exam 3 (Waller)- 30%

General Course Outline

- **Weeks 1-6:** Pelagic ecology, microbial food webs, biomass, production, respiration, nutrient cycling
 - **EXAM 1: Friday Feb. 19**
- **Weeks 7-12:** Pelagic consumers, zooplankton ecology, fisheries oceanography, community ecology
 - **EXAM 2: Monday April 5**
- **Weeks 12-17:** Benthic ecology and oceanography, sediment biogeochemistry, benthic organisms, coral reefs
 - **EXAM 3: Monday May 10**

What is biological oceanography?

- Biological oceanography is the study of life in the sea, including the ecology, distributions, abundance, and production of oceanic, marine, coastal, and estuarine organisms.
- Studies of viruses, Bacteria and Archaea, phytoplankton, zooplankton, fish, benthic invertebrates, shellfish, and marine mammals.
- Highly interdisciplinary, includes elements of biochemistry, ecology, genetics, and physiology. In addition, biological oceanographers must be knowledgeable of ocean physics, chemistry, geology, and atmospheric processes.

What do biological oceanographers do?

- Make measurements of ocean biological processes and properties.
- Formulate and test hypotheses.
- Collect data in the field (ocean) and in the lab.
- Measure ocean properties from ships, moorings, gliders, satellites.
- Develop and utilize mathematical models for insight into biological dynamics in the sea.

What do biological oceanographers study?

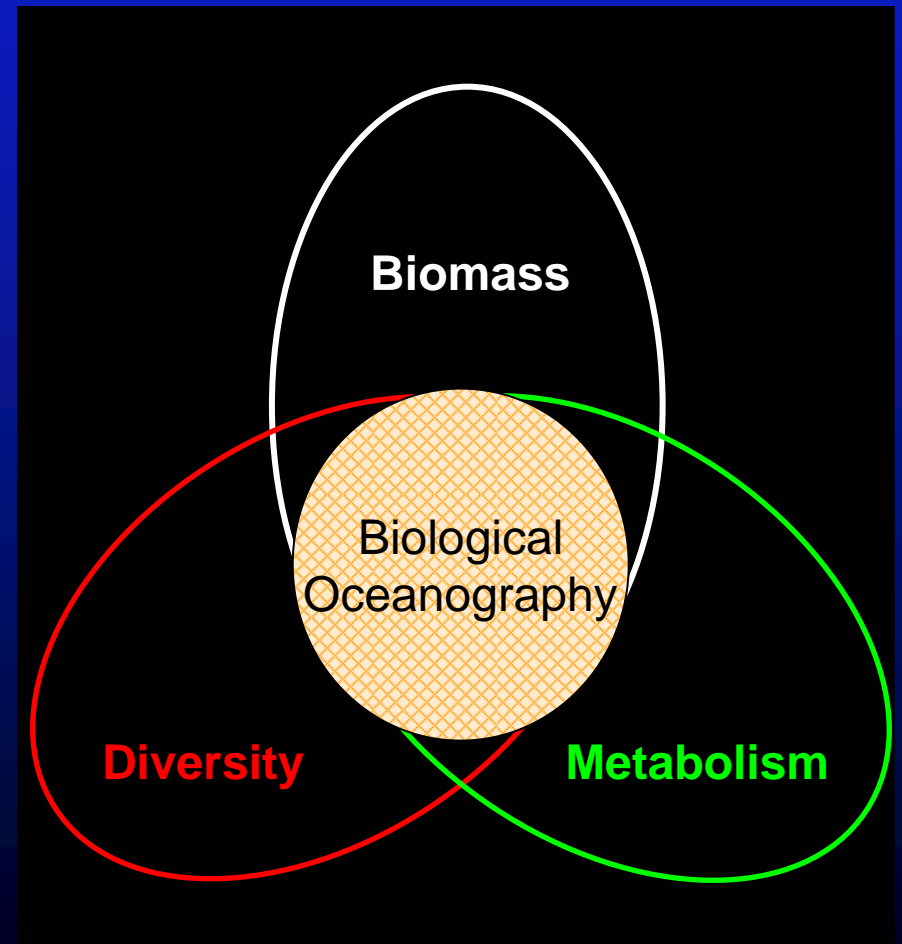
- Chemical and physical factors influencing distributions and activities of marine organisms
- Ecology & food web dynamics
- Nutrient cycling and energy harvesting
- Physiological, behavioral, and biochemical adaptations to environmental variables, including natural variations in food, temperature, pressure, light, and the chemical environment

Activities, growth, biomass, diversity

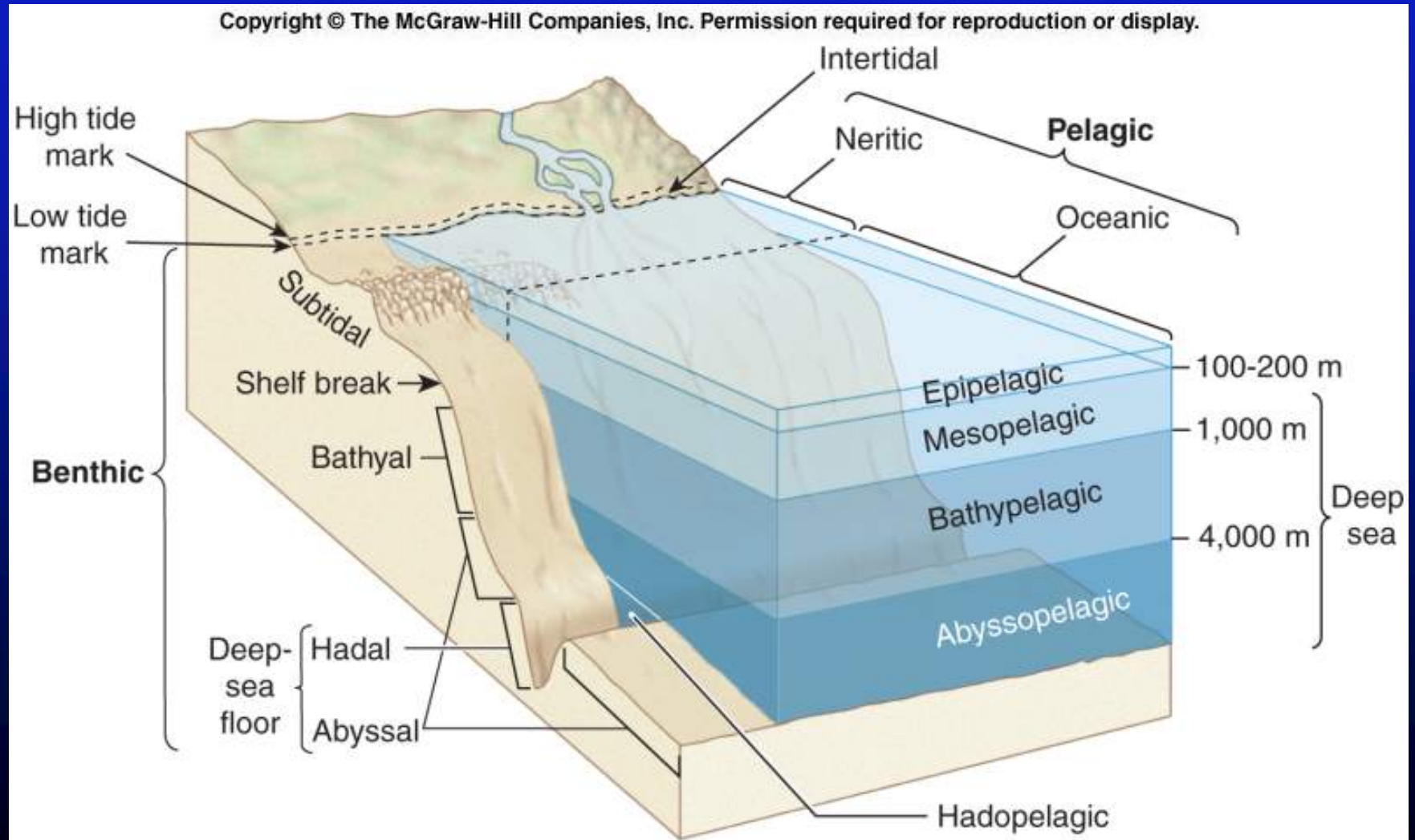
- How many and at what rate?
- Distributions and patterns
- Diversity
- Physiological controls

Food web dynamics

- Elemental fluxes and energy flow
- Transfer efficiency
- Food web control
(top down versus bottom up)



**The ocean covers ~70% of the surface of Earth.
Ocean dynamics are intimately linked to the
atmosphere and land.**

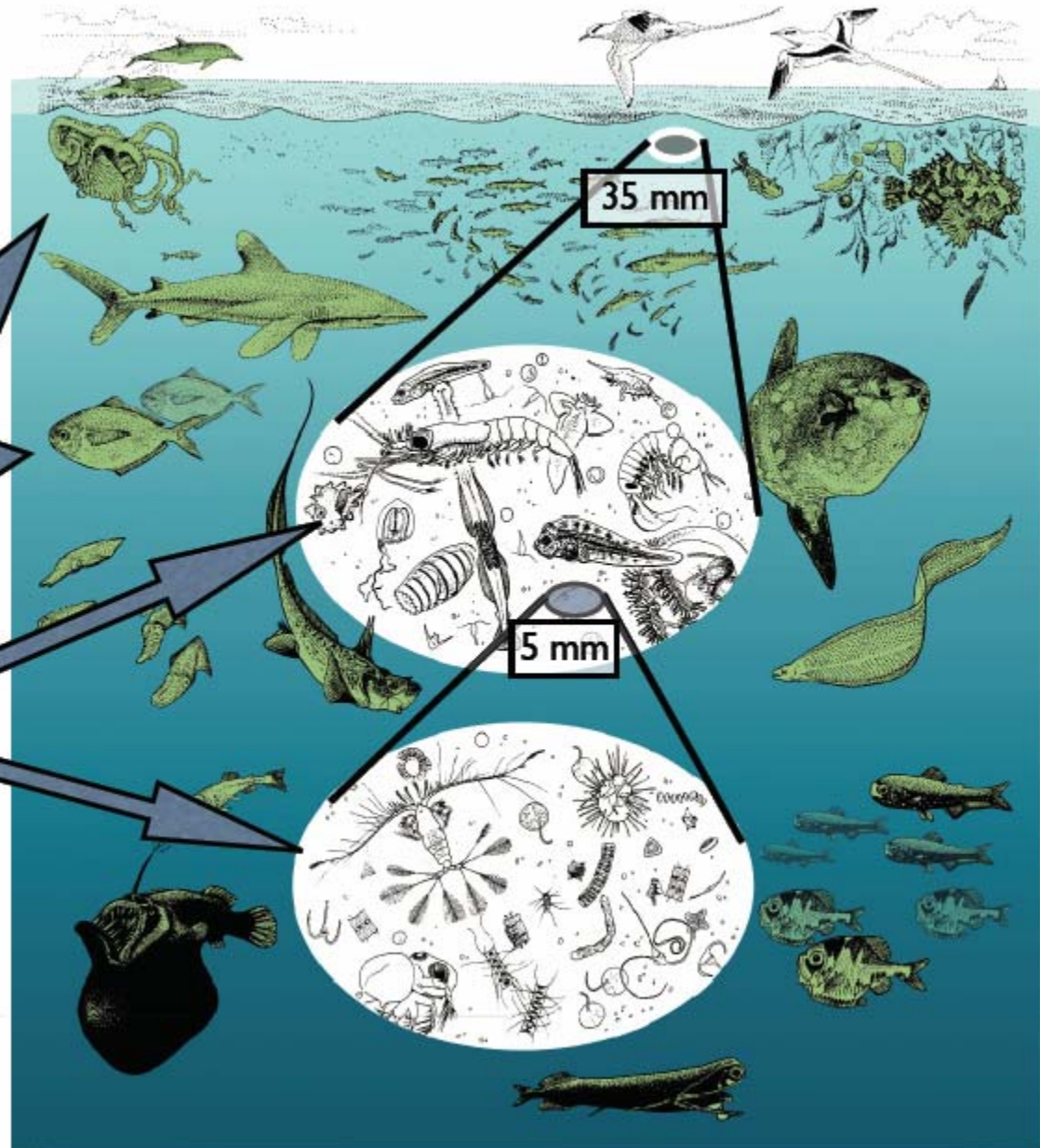


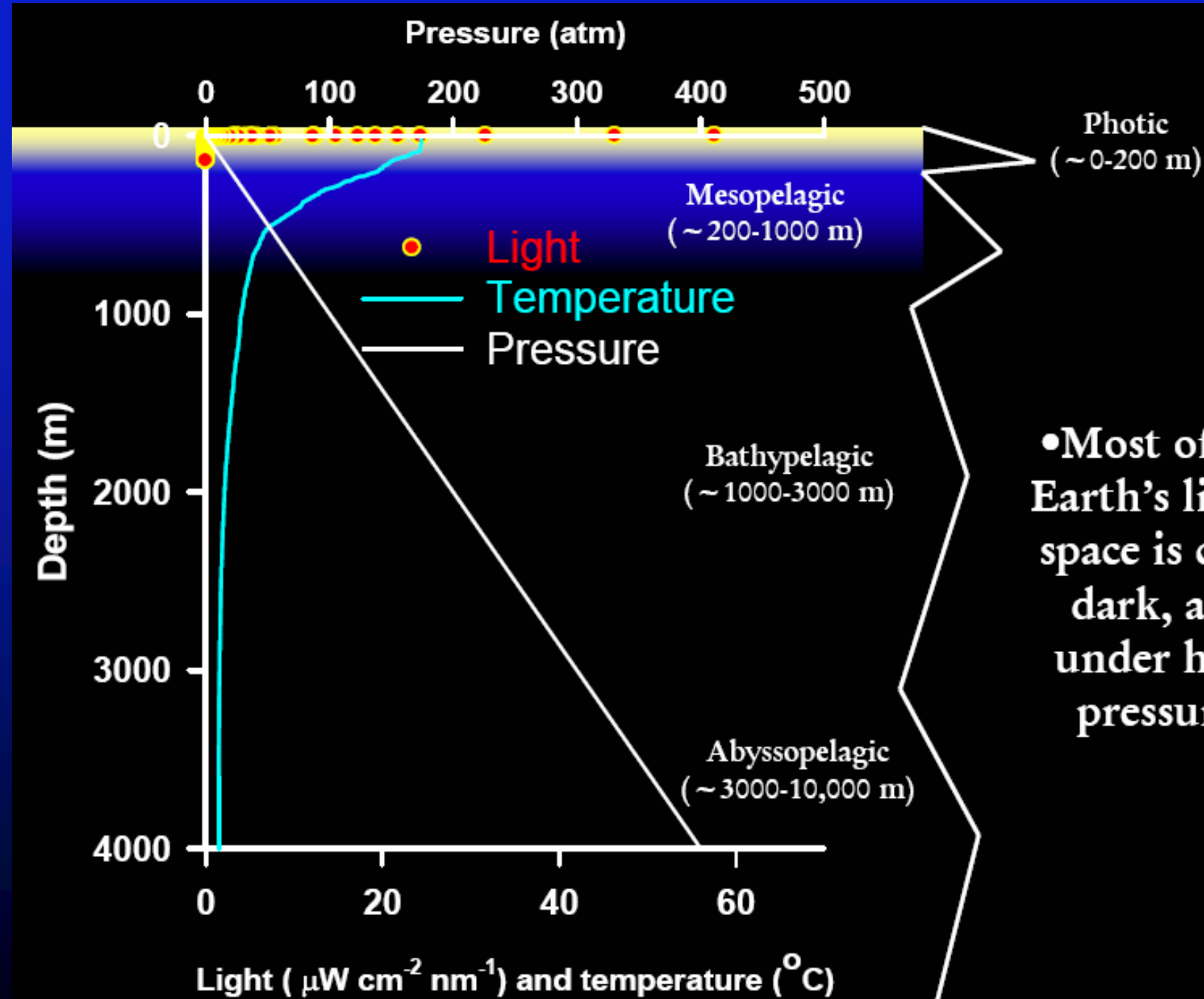
- **Classification of organisms based on habitat:**
 - Pelagic (pelagius = of the sea)
 - Benthic (benthos = bottom)
- **Classification of organisms based on habitat:**
 - Pelagic
 - Plankton (drifters and weak swimmers)
 - Nekton (swimmers)
 - Benthic
 - Infauna
 - Epifauna

Pelagic Organisms

Nekton
(all are animals)

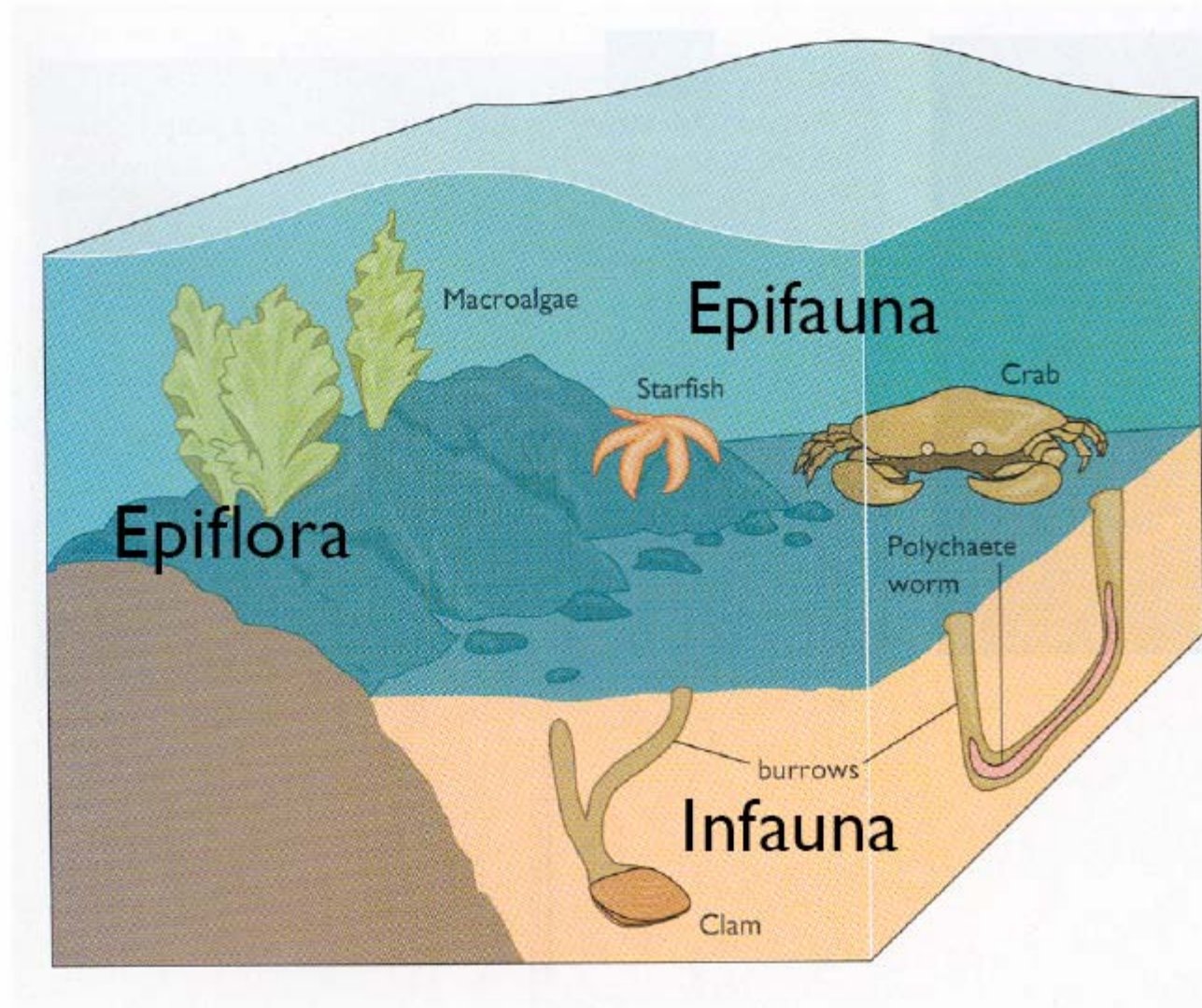
Plankton
phytoplankton
zooplankton

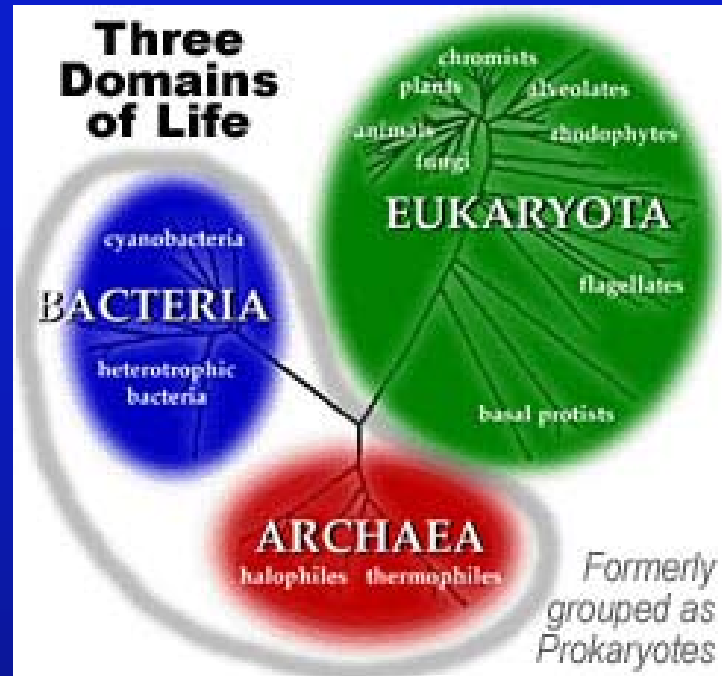




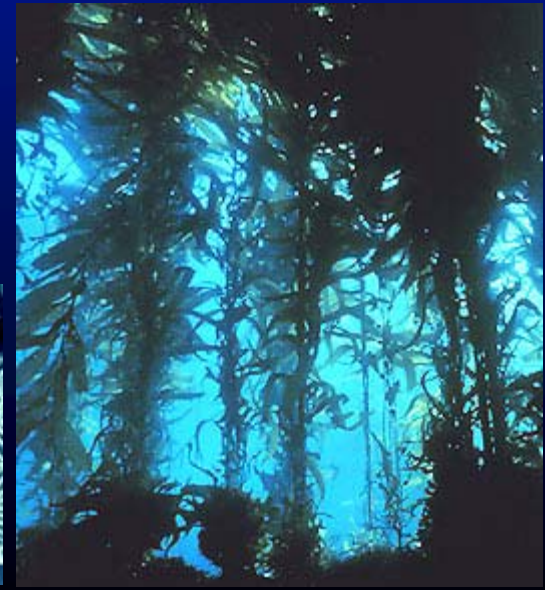
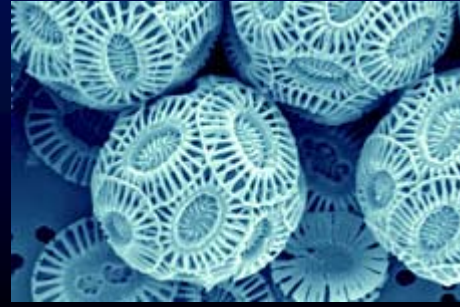
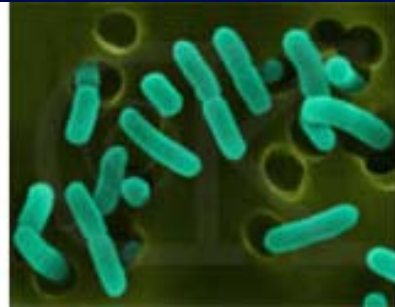
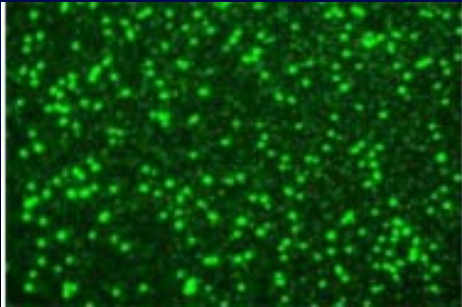
Benthic Organisms

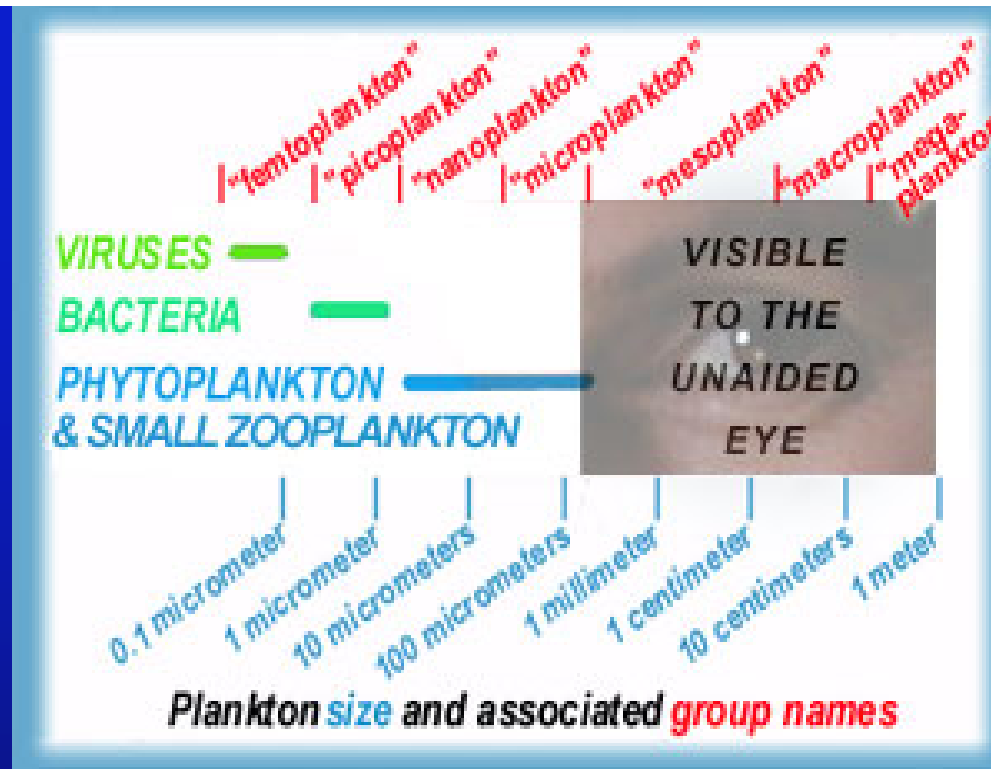
Infauna or
epifauna/flora





The oceans contain all three domains of life





Characteristic lengths of plankton

< 0.2 μm Femtoplankton (viruses)

0.2–2 μm Picoplankton (Eubacteria, Archaea, very small eukaryotes)

2–20 μm Nanoplankton (diatoms, dinoflagellates, protozoa)

20–200 μm Microplankton (diatoms, dinoflagellates, protozoa, copepod nauplii, etc.)

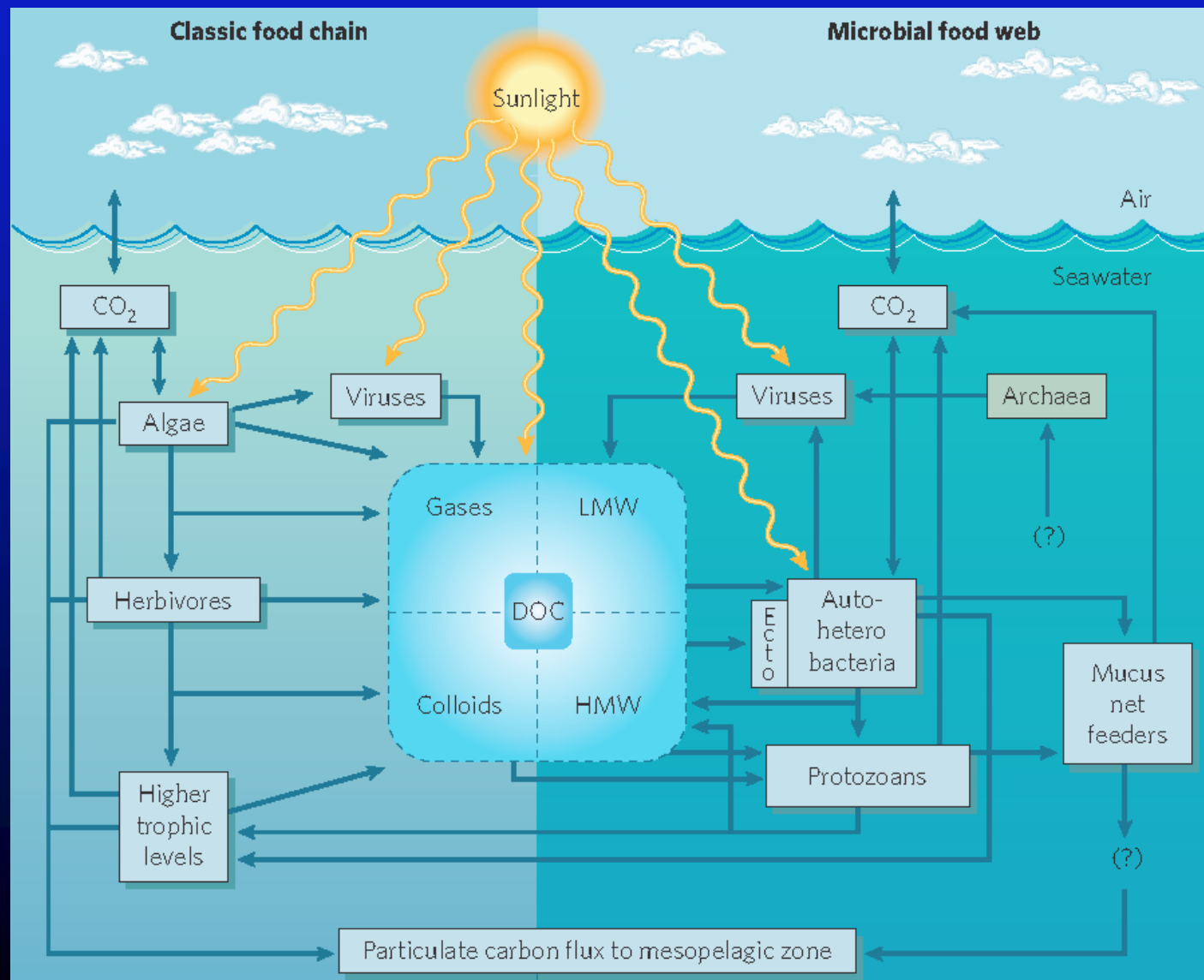
0.2–20 mm Mesoplankton (mostly zooplankton)

2–20 cm Macroplankton

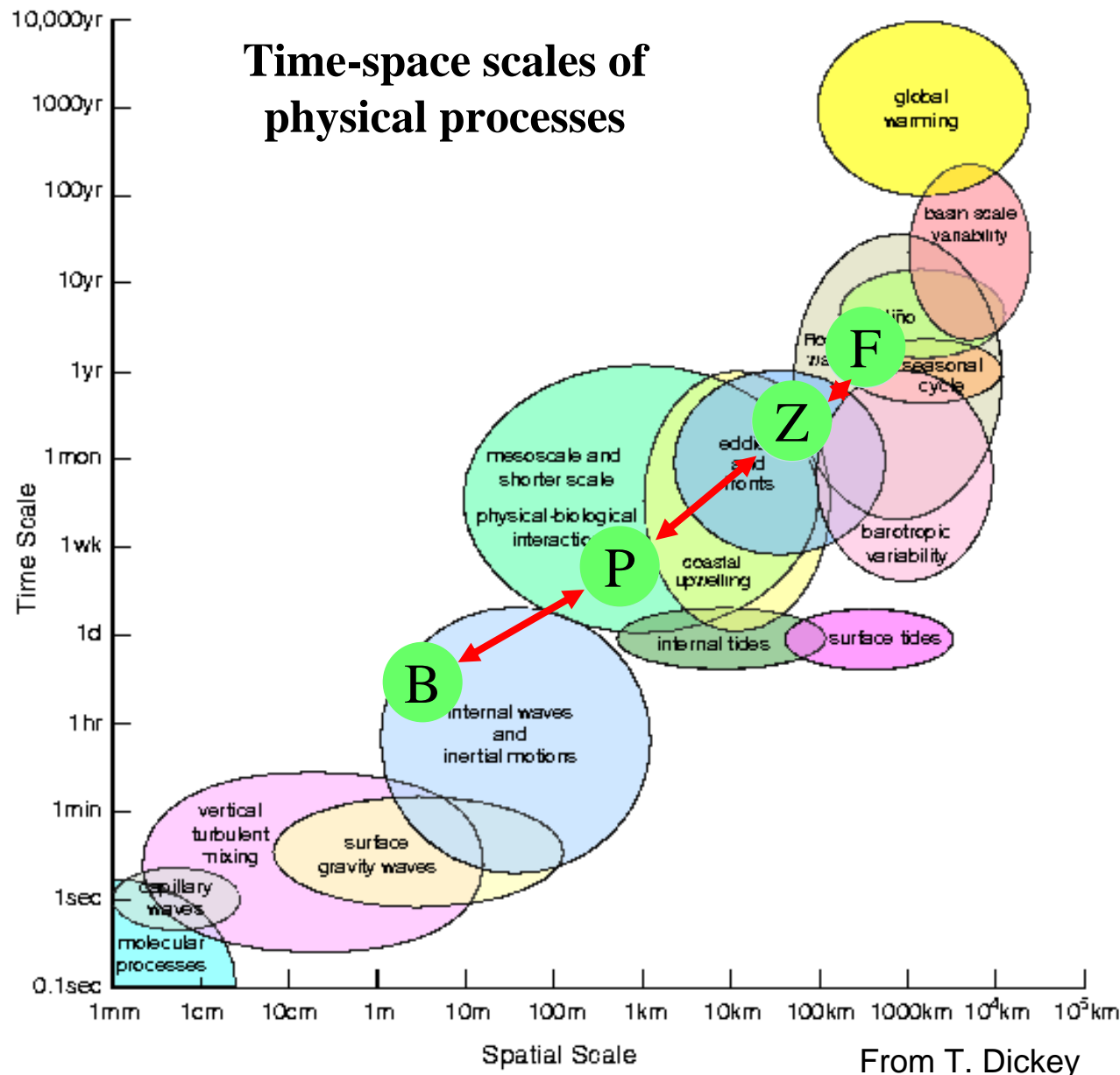
Ocean life and biogeochemistry

- **Biogeochemistry** is the study of how living systems control the composition of the Earth's crust, atmosphere, and oceans.
- In the sea, **plankton** control bioelemental cycling; as a result, the study of biological processes is inherently linked to the study of biogeochemistry.
- By understanding the **ecology of plankton**, we gain understanding of **biogeochemical** dynamics in the sea.

Food web structure plays an important role in controlling elemental cycling and energy flow



Scales of variability are important

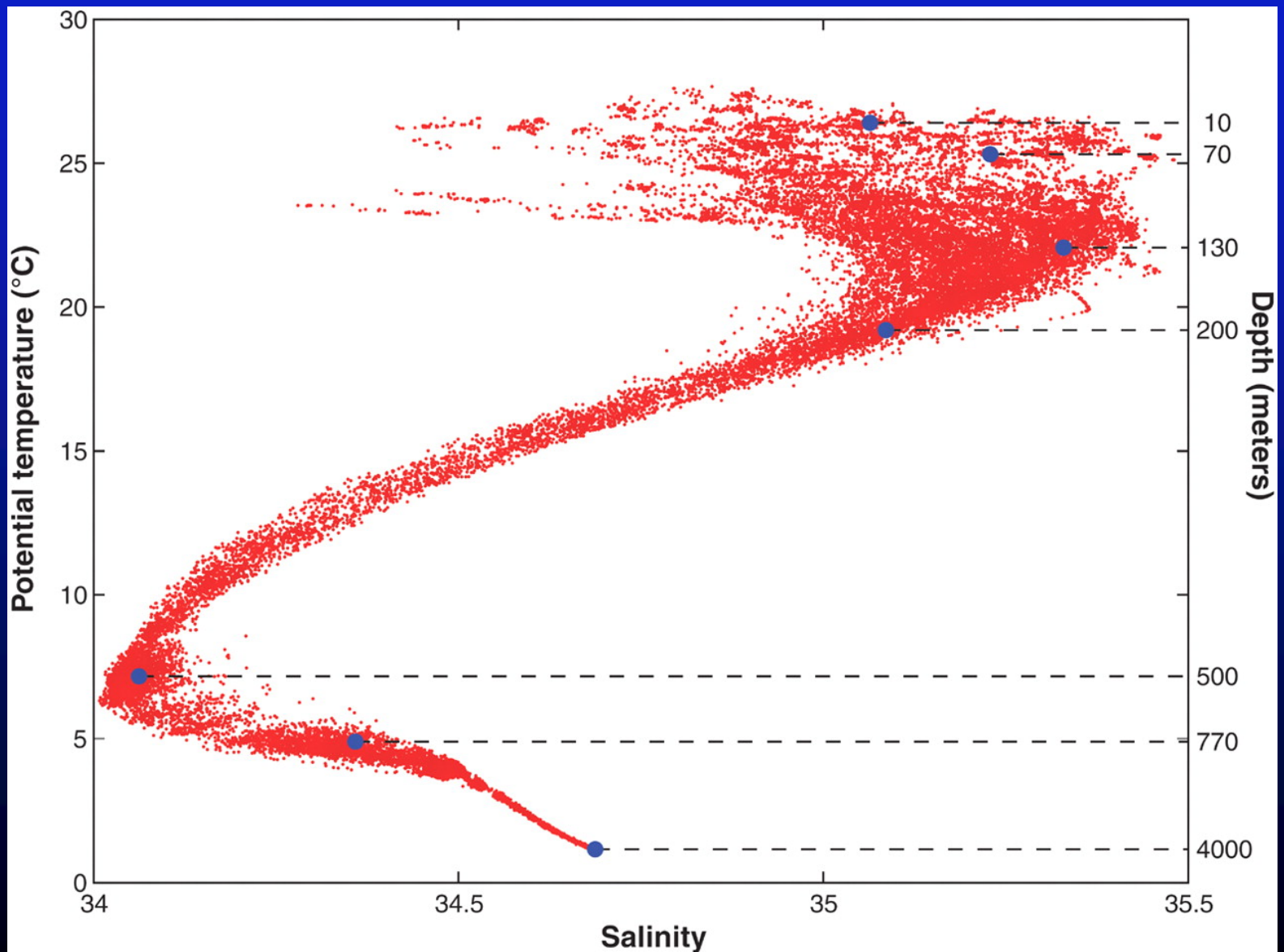


Note that increasing time scales generally correspond to increasing space scales

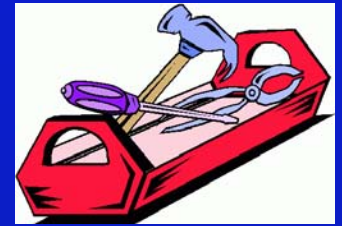
- Generation time of a tree: **years**

- Generation time of ocean phytoplankton: **days**

Temperature-salinity plot from Station ALOHA showing temporal variability in seawater temperature and salinity.



Tools of the trade



Sampling



Concentrating

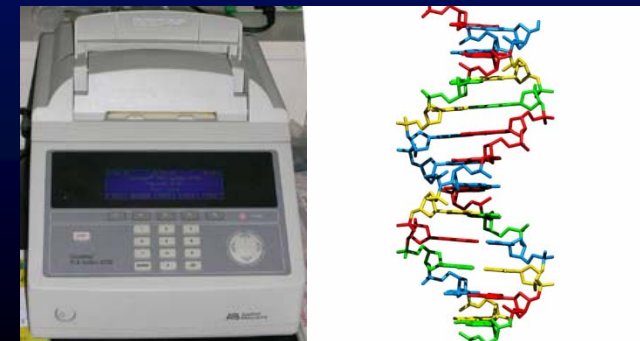


Measuring
density or
biomass



Cellular
metabolism

Diversity



Things you should learn in this course

- 1) Be able to define the major forms of life in the sea, describe characteristics that distinguish these forms, and describe how these life forms interact.
- 2) Explain how marine organisms influence specific bioelemental cycles.
- 3) Define major types and characteristics of marine habitats.
- 4) Describe processes controlling biomass, growth, productivity and distributions of marine organisms.
- 5) Describe methodological approaches appropriate for evaluating biomass, growth, and mortality of plankton, nekton and sessile organisms in the sea.