Plankton Production and Food Webs (Chapter 12)
• What is Plankton?
• Phytoplankton and Zooplankton
• Food Web: All the feeding relationships of a community including production, consumption, decomposition and the flow of energy.
• Trophic Levels and Trophic Pyramids

The Ocean Food Web
Plant, animal and bacterial populations are dependent on the recycling of nutrients through the food web. The initial energy source is the sun, which fuels the primary production in the surface layers.

Herbivores graze the phytoplankton and are in turn consumed by the carnivores. Animals at deeper levels depend on organic matter from above.

Upwelling recycles nutrients to the surface where they are used in photosynthesis.

Trophic Level = A link in a web of consumption. Trends in Population, size and biomass?
Measure dry weight in grams

Study the amount of O₂ produced or the amount of CO₂ consumed

Count fixed ratios of elements by weight: O₂ : C : N : P, look how they change

Add isotope Carbon – 14, later measure how much incorporated into organic matter

Determine the concentration of chlorophyll using a fluorometer / SeaWIFS (SeaWIFS = Sea-viewing Wide Field-of-view Sensors)

The White & Dark Bottle Experiment:

The carbon:oxygen ratio for photosynthesis, the volume of water in the bottles and the duration of the experiment are used to convert the calculated changes in dissolved oxygen to changes in gC/volume/time.

Light nutrients and the stability of the water combine to provide conditions for the highest PP at a depth of approximately 30 meters.

Light Bottle = measure oxygen produced by photosynthesis and used in respiration (net photosynthesis or PP)

Dark Bottle = measure oxygen used by community respiration

LB - DB = total oxygen produced / gross photosynthesis or PP
Picoplankton: less than 0.0012mm, typically bacteria and extremely small phytoplankton

Nannoplankton: 0.002 – 0.02mm, larger phytoplankton

Microplankton or Net Plankton: 0.02 – 0.2mm include phytoplankton and zooplankton often collected in tow nets.

Macroplankton: 0.2 – 2mm or larger, typically zooplankton and other animals

### Sampling Plankton

The 3 Domains: Emphasizes separation of prokaryotes into 2 groups.

A new system based on genetic and biochemical research organizes life into 3 categories above the kingdom level. The Eukarya domain includes many single celled organisms with nuclei and animals, plants and fungi.

#### PHYTOPLANKTON:

1. **DOMAIN BACTERIA & ARCHEA**: Single celled organisms without membrane-bounded nucleus, some in groups or chains
   - Cyanobacteria: “Blue-green algae”, all autotrophic

2. **DOMAIN EUKARYA**: includes KINGDOM PROTISTA. All Holoplankton, microscopic, mostly single celled organisms (Autotrophs / algae)
   - Phylum Chrysophyta: Golden Brown and Yellow Algae, all autotrophic
     - Diatoms - important siliceous sediment contributors, produce up to 60% of O2 on the planet
     - Coccolithophorids (Coccoliths) - important Calcareous sediment producers
   - Phylum Dinophyta: fire algae, often bioluminescent, single cells with flagella
     - Dinoflagellates - not important sediment contributors ~50% are autotrophic, and ~50% heterotrophic, some are both, usually considered phytoplankton

### GENERALIZED PLANKTON CLASSIFICATION

Some common examples
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Nontoxic red tide of dinoflagellate *Noctiluca* in Puget Sound, 1996. The red tide extended ~10km and lasted ~1 week
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ZOOPLANKTON:
II. DOMAIN EUKARYA / includes KINGDOM PROTISTA: All Holoplankton, microscopic, mostly single celled organisms (heterotrophs / protozoa)
A. Phylum Sarcodina - single cell organisms
1. Foraminifera (Forams) - important calcareous sediment producers
2. Radiolaria (Rads) - important siliceous sediment producers

III. DOMAIN EUKARYA / KINGDOM ANIMALIA:
A. Phylum Arthropoda - paired, jointed appendages
1. Class Crustacea (Crustaceans) Holoplankton Members:
   a. Copepods
   b. Euphausiids, aka "Krill". Both (Krill & Copepods) are mostly herbivorous (can be omnivorous), not important sediment producers

MEROPLANKTON - Temporary Plankton from most other Phylums (i.e. fish, clams, snails, crabs, barnacles, worms, lobsters, starfish, sea urchins)
There are ~86 species of Euphausiids, which are one of the more important zooplankton biomass because of their relatively large size and great abundance. They can occupy 1,000’s of square kilometers and weigh over 6 billion metric tons. Important food for whales, seals, fishes and birds.

**Copepod Fun Facts:**
- Copepod means “oared foot”
- Most numerous group of animals on earth; can be anywhere from 500,000 to 1 million/square meter of seawater
- Fastest animals on earth; can swim 500 body lengths per second which would be comparable to a cheetah running 2,000mph! A typical military fighter jet flies ~15 body lengths per second
- Huge capacity to graze phytoplankton; satellites can see missing “patches” of phytoplankton, similar to cows grazing on grasses but much faster.

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