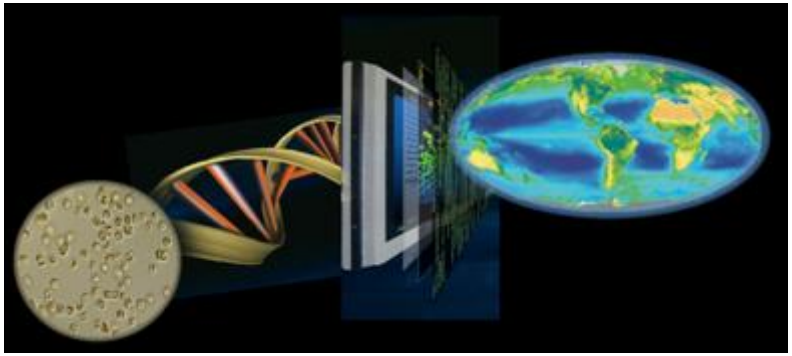


Microbes in the Sea

Dr. Sonya Dyhrman and Sheean Haley

Originally presented
8 March 2014

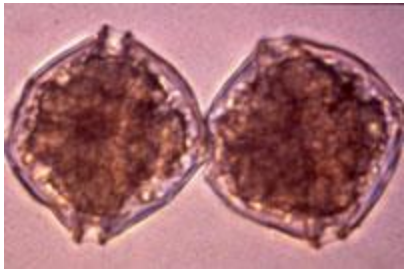
Microbial Oceanography Group

- Members of the Dyhrman group are interested in how phytoplankton interact with their geochemical environment
- Explore the interface of microbial physiology and the nitrogen and phosphorus biogeochemical cycles.
- Use a suite of approaches to investigate nutrient assimilation in model cultures and field populations

Microbial Oceanography Group

- Provides advanced training for graduate students
- Also used as framework for the development and implementation of inquiry-based educational activities for children

http://www.ldeo.columbia.edu/res/fac/micro_ocean/Home.html

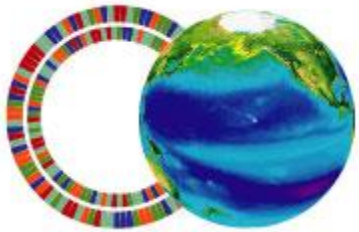


Microbes

- Dominate our planet—oceans, land, in and on you!
- Invisible to naked eye—usually < 100 µm
- Taxonomically diverse
  - autotrophic & heterotrophic
  - producers, consumers, decomposers
- Essential to understand their roles in structure and function of marine ecosystems

Strategies for Research

- Isolate individual cell types (pure cultures)
- Mixed microbial assemblages in labs
- Ecological-field approach in the open sea



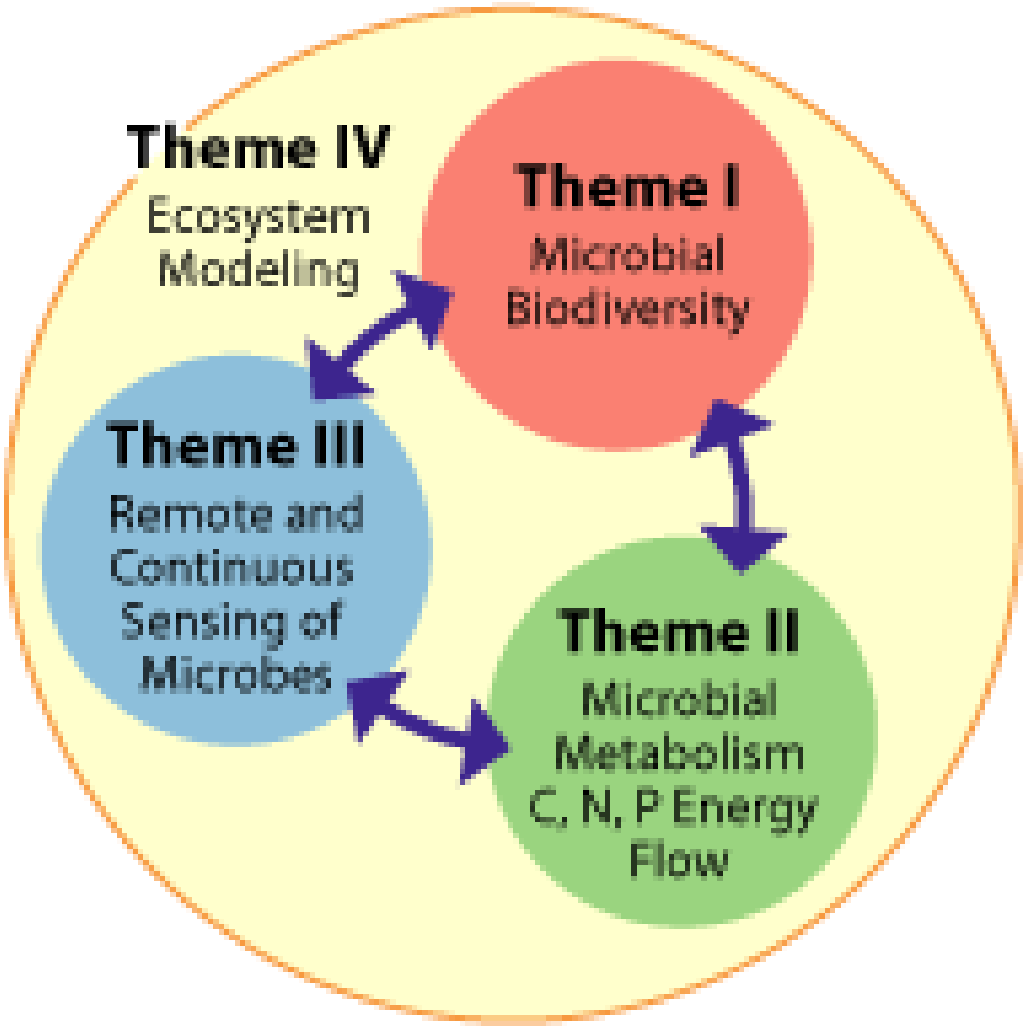
center for microbial oceanography: research and education

C·more *linking genomes to biomes*

- http://cmore.soest.hawaii.edu/index.htm
- Established in 2006
- Coordinated at the **University of Hawai'i at Manoa**
- Partners:

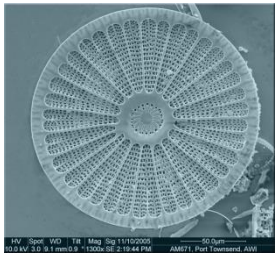
  LDEO, MIT, UC Santa Cruz, Oregon State, Woods Hole Oceanographic Institution, Monterrey Bay Aquarium

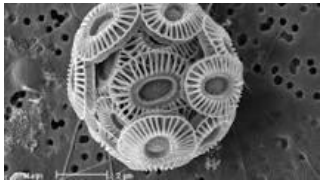
4 Themes


Theme IV
Ecosystem Modeling
Theme I
Microbial Biodiversity
Theme III
Remote and Continuous Sensing of Microbes
Theme II
Microbial Metabolism C, N, P Energy Flow

Phytoplankton

- Autotrophic
- Diatoms
- Cyanobacteria
- Coccolithophores





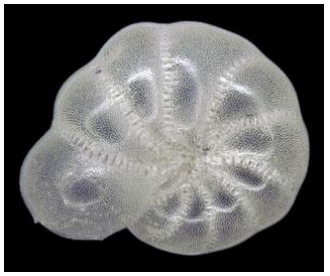
http://cmore.soest.hawaii.edu/microscopy/album/autotrophs/index.html

Nitrogen-fixers (diazotrophs)

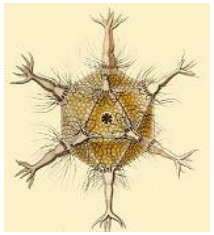
- N essential for life– proteins, nucleic acids, other bio-compounds
- Only a few organisms can tap into N_2 dissolved in seawater

http://cmore.soest.hawaii.edu/microscopy/album/diazotrophs/index.html

Zooplankton ("grazers")



- Feed directly on microbes
- Protozoans such as flagellates and ciliates
  Foraminifera
  Radiolaria



- Copepods (tiny crustaceans)
- Others

http://cmore.soest.hawaii.edu/microscopy/album/grazers/index.html

Higher Organisms

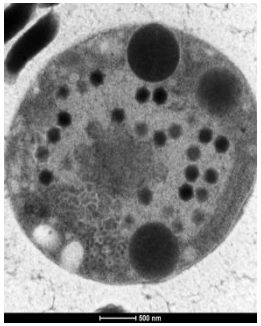
- Some permanently plankton
- Some temporarily planktonic when larval
- Juvenile squid, crabs, fish

http://cmore.soest.hawaii.edu/microscopy/album/higher_org/index.html

Viruses

- Most numerous group in aquatic ecosystems
- 3x – 10x higher than bacteria
- Infect bacteria and plankton

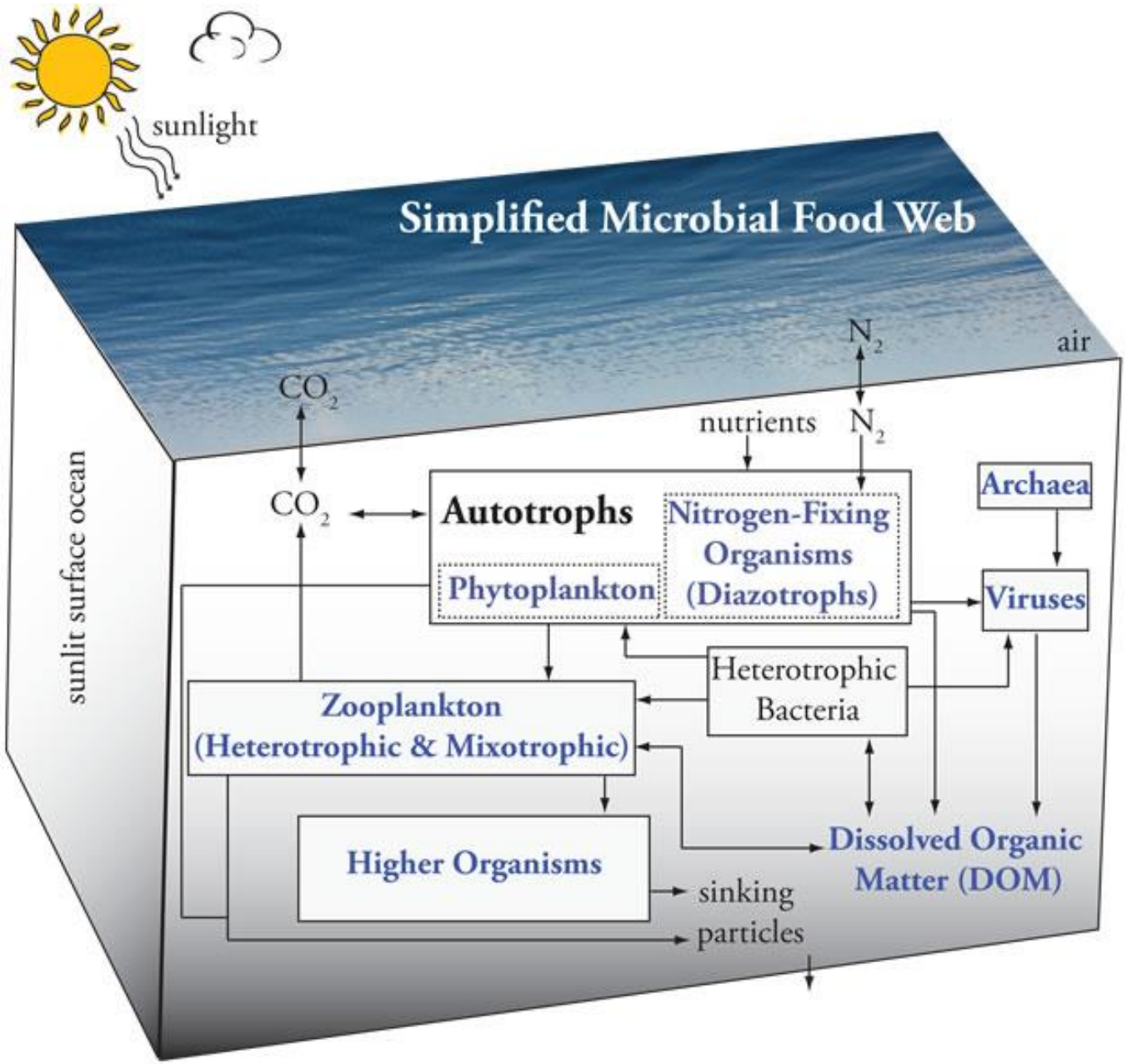
http://cmore.soest.hawaii.edu/microscopy/album/viruses/index.html



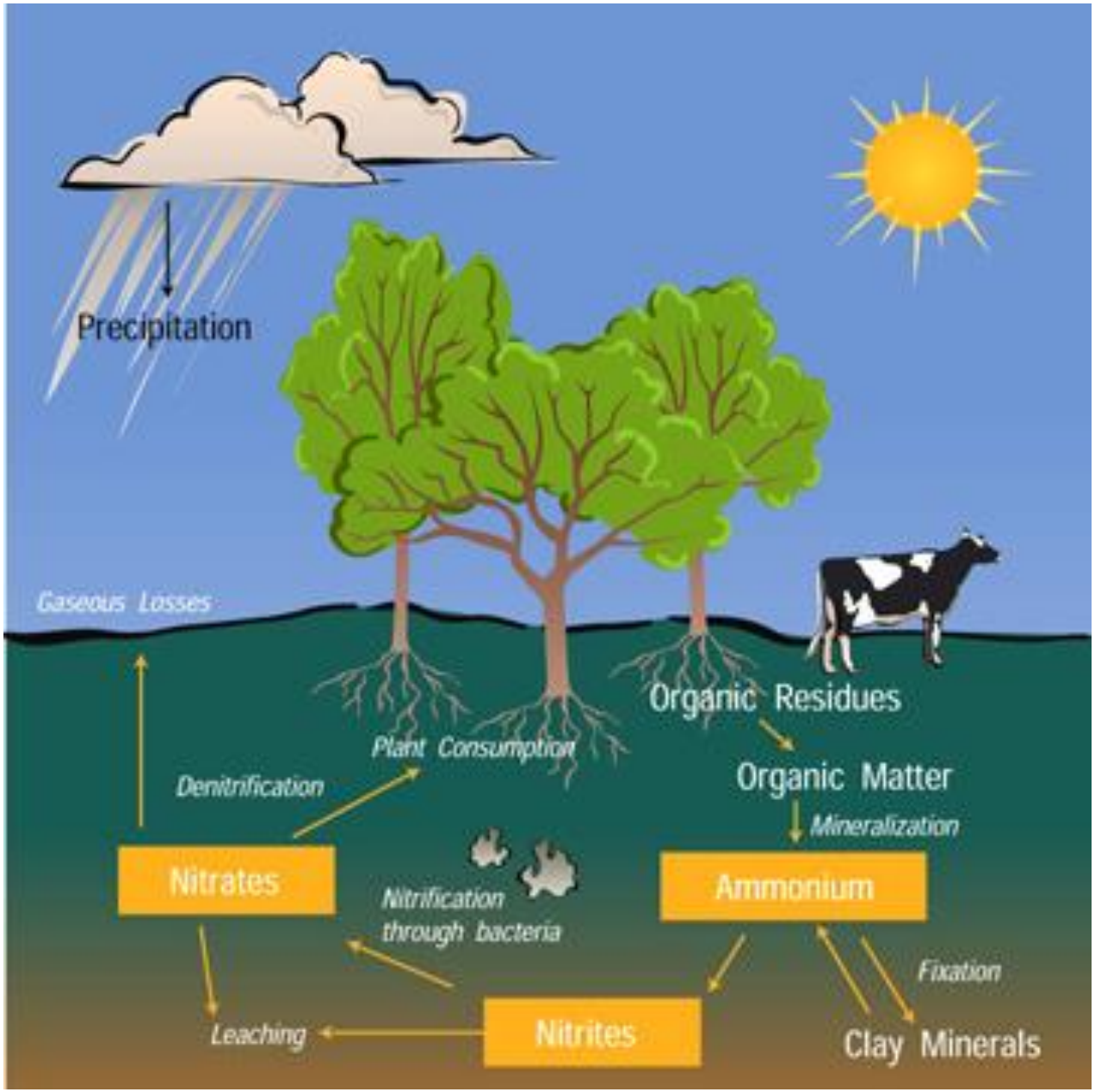
Symbiosis

- Mutually beneficial arrangements
- Best example: corals and zooxanthellae
- Many protists and cyanobacteria
- Relationships not well understood

http://cmore.soest.hawaii.edu/microscopy/album/symbionts/index.html

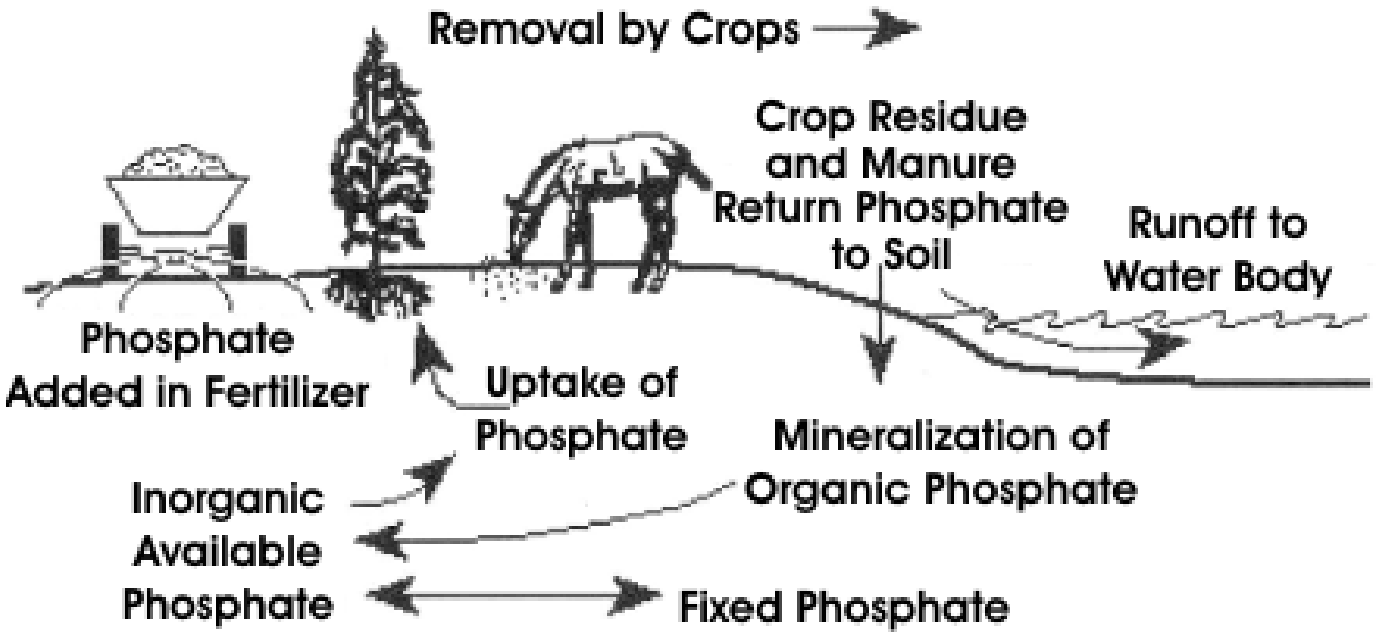


http://cmore.soest.hawaii.edu/microscopy/cmore_microscopy.html



http://eo.ucar.edu/kids/green/images/nitrogencycle.jpg

The Phosphorus Cycle



Source: Busman et al., 1997.

http://www.epa.gov/oecaagct/ag101/impactphosphorus.html

Animation

Crash Course—Nitrogen & Phosphorus Cycles

http://www.youtube.com/watch?v=leHy-Y_8nRs

Finally, some key terms

- “Genome” – genetic material of an organism
- “Phenotype” – all observable traits of an organism
- “Proteomics” – large-scale study of proteins
- “Biogeochemistry” – biological/geological/ chemical/physical processes and reactions
- “Cycles” among the “spheres”/”reservoirs

‘SYSTEM SCIENCE’