Topic 5: Life in Oceans (50 hours)

Essential idea: Planktonic organisms are present and have a significant role in all marine ecosystems.

5.1 Plankton and productivity

Nature of science: Looking for patterns, trends and discrepancies has lead scientists to realize the central importance of plankton to marine ecosystems. [3.1]

Understandings:

- Plankton may be multi-cellular organisms, bacteria, or viruses
- there are autotrophic bacteria as well as phytoplankton
- There is a great abundance of viruses in marine waters.
- Plankton may be photosynthetic and play an essential role in food chains
- Light, temperature and nutrients affect primary production by phytoplankton
- some phytoplankton cause Harmful Algal Blooms that have effects on marine ecosystems and on human health
- phytoplankton play in important role in the global carbon cycle
- zooplankton and heterotrophic bacteria have important roles in marine ecosystems.

Applications and skills

- skill: Describing and evaluating two methods of sampling plankton.
- skill: microscopic examination and sketches of phytoplankton and zooplankton (practical 5)
- skill: calculating the primary productivity, gross primary production & net primary production for an ecosystem from data.
- skill: Describe and evaluate two methods of measuring primary productivity.
- Analysing marine food webs in terms of carbon cycling with indications of carbon and energy budgets

Guidance:

Essential terminology includes plankton, phytoplankton, zooplankton, bacteria, viruses.

Microscopic plankters can be obtained from commercial suppliers or even found on-line for purposes of Practical 5.

International-mindedness:

Theory of Knowledge:

Utilization:

Environmental Systems and Societies, Topic 2.5.4-2.5.7

Aims:

- **Aim 2** Acquire a body of knowledge, methods and techniques that characterize the science of marine biology.
- **Aim 6** Develop investigative scientific skill including the use or remote sensing.

Option A: Marine Ecosystems (15 hours)

Essential idea: A great variety of plankton with special adaptations for survival and unique lifestyles inhabit oceans.

A.1 Marine plankton as the link among all marine ecosystems

Nature of science: Use careful observations to explain natural phenomena. [2.2] The idea of adding iron sulfate to the open ocean to stimulate phytoplankton and reduce atmospheric carbon dioxide may be fanciful, but it has attracted the imagination of serious scientists as a possible way to slow global warming. [1.5]

Understandings:

- the morphology of planktonic diatoms, dinoflagellates and coccolithophores varies. → shape, structure
  test: compare the morphology. (similar + difference)
- asexual and sexual reproduction in diatoms provides an example of planktonic lifecycle.
- adaptations that phytoplankton and zooplankton possess to survive in marine ecosystems.
- Zooplankton include meroplankton and holoplankton
- relative primary productivity varies among marine ecosystems.
- the microbial loop describes a micro-food chain that can work within or alongside a classical food chain.
- the place of krill in marine food webs.
- lack of nutrients (especially iron) in the open ocean reduce the presence of phytoplankton

Applications and skills:

- application: discussion of the ways in which marine plankton are the link among all marine ecosystems
- skill: Comparing morphology of diatoms, dinoflagellates and coccolithophores
- skill: illustrating the life cycles of one phytoplankton species and one larval planktonic species
- application: comparing primary productivity of two marine ecosystems

Guidance:

- Krill are small crustaceans that feed on plankton; larval krill are zoo-plankton. The distinction is the ability of adult krill to swim against a current in the ocean.

International-mindedness:

How should the precautionary principle be applied to the idea of iron fertilization of the open ocean? What international agencies should be consulted? What scientific studies should be done?

Theory of Knowledge:

The precautionary principle is meant to guide decision- making in conditions where a lack of certainty exists. Is certainty ever possible in the natural sciences?

Utilization:

topic 5.1

Aims:

- **Aim 2** Acquire a body of knowledge, methods and techniques that characterize the science of marine biology.
- **Aim 6** Develop investigative scientific skill including the use or remote sensing.
- **Aim 7** Use of 21st century communications should be used to explore simulations and data available on this topic.
- **Aim 8** Become critically aware of the human impact upon oceans and the ethical implications of this information

5.1. PLANKTON.

Oct. 28. 2019.

I. Defn.

~~drift around at the mercy of water~~

1. Organisms. 2. passively ~~drifte~~ carried along w/ the flow of water

can be multicellular or unicellular.

microscopic or macroscopic.

algea, animal, bacteric, viruses.

II Describe & Evaluate Methods.

(1) Jar / Bucket.

Description:
lower a clean. empty jar / bucket into the water to be sampled, let water fill the jar / bucket; ~~take~~ out,

Evaluation:
☺: easy + cheap + able to catch larger plankton ~~like~~ like jellies.
☹: ~~can~~ used only when plankton is concentrated and can be seen using ~~eye~~ eyes + small amount of sample + easy to fall out + limited depth & range.

(2) ~~Nets~~ Nets.

Description:
put the net into seawater, drag it along (for a c. 1 min), pull it out

So trust the plankton accumulate at the cop end.

Evaluation:
☺: ~~a~~ large amount of water + easy + different sizes. + can go deep(?)
☹: expensive + ~~limited depth.~~ + damage jellies.

3. Tube / bottle.

Description.
lower the tube/bottle ~~to~~ to ideal depth. pull the line on land so that the tube/bottle closes.

Evaluation:
☺ discrete depth. + go deep ~~at~~ easy.
☹ small amount. expensive

4. Traps.

Description:
when pulled up, water goes through mesh.

Evaluation:
☺ ~~does~~ go deep. sample + particular depth + ~~attract certain zooplankton~~ selective.
☹ Can be expensive. time. small volume.

5. Pump.

Description:
machine is powered to pump water up through a mesh. plankton stay

Evaluation:
☺ large amount
☹ energy

III. Phytoplankton

1. Defn. producers. autotrophic. photo~~synthesize~~ synthesize.

Include: algae + ~~autroph~~ autotrophic bacteria.

2. General:
a. · All have ~~chlorophyll~~ chlorophyll. (+ some have red/brown pigments too).

• photosynthesis:

$$CO_2 + H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + O_2.$$

(glucose).

• Need light & nutrient,

3. Five categories of phytoplankton:

	diatom (20 to 2000 μm)	Dinoflagellets (20 – 2000 μm)	~~20~~ Coccolithophores (2 – 40 μm.)
cellular:	unicellular	unicellular	unicellular
flagella?	no; can't move	2. transverse + longitudinal	2. and the same end.
skeleton	~~fla~~ frustule. × 2 valves; epitheca, hypotheca.	cellulose. in ~~on~~ cell wall	~~calcium carbonate~~. Covered in calcium carbonate disks.
Adaptation	• oil droplets, buoyancy → ocean foam. • spines + chains. e.g. chae? × Chaetoceros.	• Ceratium grow ~~fingers~~ ~~hands~~ to ↑ Bouyancy. ↑ area. ↑ light. • ~~Noctiluca~~. Bioluminescence. ↓ Noctiluca.	Flagella for movement.

* Diatom Reproduction:

Asexual + Sexual.

Asexual ↓ Reduce size. → by ~~split~~ splitting cells. cell division.

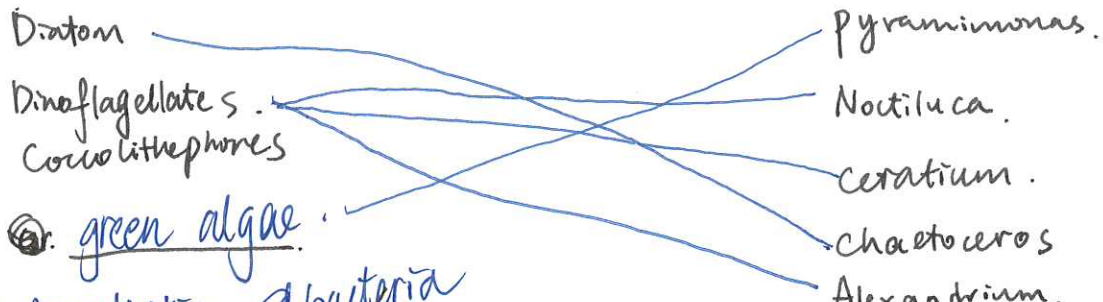
Sexual ↓ restore size.

⇒ Amount of ~~iron~~ silica. in seawater limits rate of reproduction.

* Diatom usages:

shoe deodorizer, facial exfoliant.
pesticide. Absorbent
scouring powder.

preserving food, health
Filtering.



or. green algae.

photosynthetic ~~bacteria~~

~~cyno bacteria~~ Cyanobacteria.

↳ size: 0.5 – 15 μm. prokaryotes.

4. Factors affecting phytoplankton.

light. ~~nutrition~~ nutrient. temperature.

defn (primary production)

turning inorganic matter into organic matter (CO_2, H_2O)

defn (bloom)

great ↑ in population/# of ~~phytoplankton~~ algae.

5. ~~Phytoplankton Bloom~~

- HABs.
- Affect marine ecosyst by:

(i) ~~exhaust~~ Oxygen depletion → dead zone.

(ii) Block light for ~~macroorganisms~~: macroalgae.

(iii) ~~clog~~ fish gills.

• Affecting Human Health:

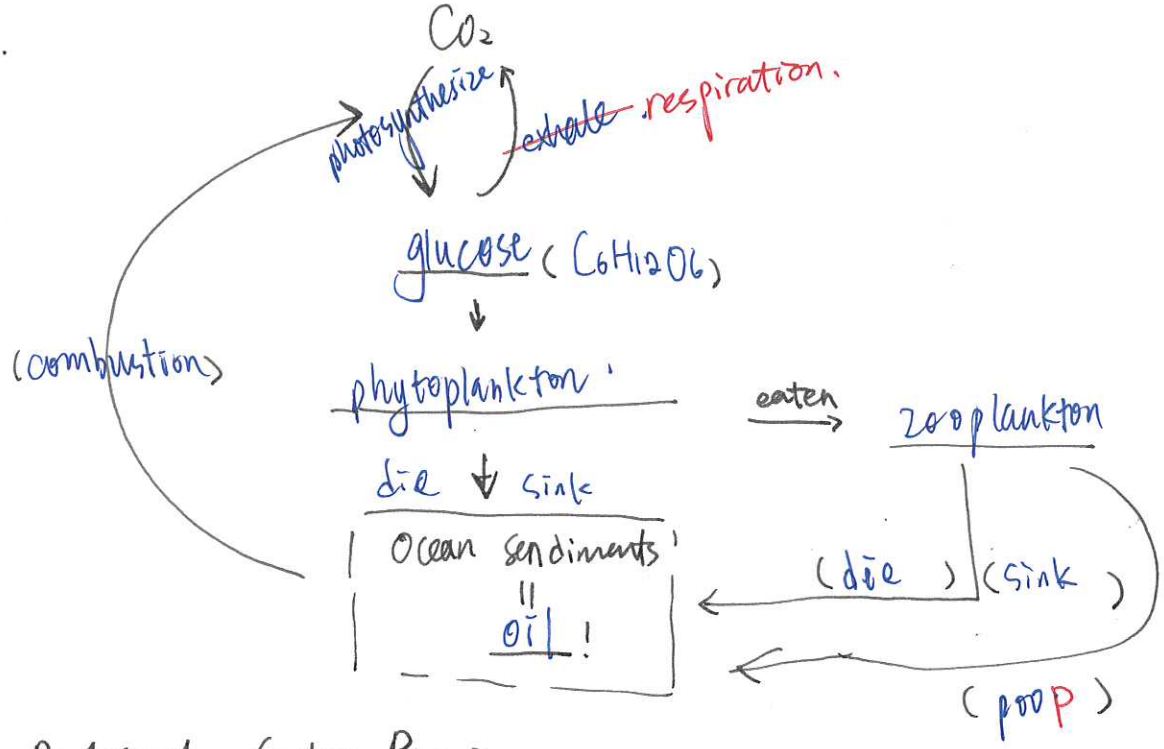
(i) Alexandrium. causes PSP (paralytic shellfish poisoning)

(ii) Psudo-nitzchia.sp. → domoic acid. → ASP (Amnesia ——→).

(iii) Dinophysis. → okadaic acid. → ~~Diarrheic~~ diarrheic

IV. Global Carbon Cycle. Psendo-nitzchia. sp.

1.



2. Biological Carbon Pump.

1. photosynthesis / primary production by phytoplankton.
2. Sinking / marine snow.
3. ~~ocean snow~~ Deep sequestration of carbon.

3. precautionary principle.

If no scientific ~~consensus~~ consensus, those who perform the experiment have the responsibility to prove the experiment is harmless.

4. Iron Fertilization.

(i) ~~pump~~ dump iron
(ii) ~~get absorbed by phytoplankton.~~ Algae bloom
(iii) ~~phytoplankton bloom.~~
(iv) ~~get eaten by krills.~~ absorb CO_2
(v) sentiment, bring CO_2 to ground

samples taken.

☺:

(i) bring down some CO_2.
(ii) more krill, more whale, ~~more salmon~~
(iii) restore phytoplankton levels.

☹:

(i) don't know consequence. of ↑ algae growth
(ii) toxic. ~~HABs.~~
(iii) temporary. Small portion every time.
(iv) dead zone.
(v) nitrous oxide.

V Zooplankton.

1. defn. consumers. ~~hetro~~ heterotrophic

before benthically or as nekton.

include: Animals + heterotrophic bacteria.

- meroplankton
  - defn: part of ~~life~~ life as plankton.
  - e.g. prolarvae crab larvae. ~~krill~~/barnacle. Sea star larvae.
- holoplankton
  - defn: whole life zooplankton
  - e.g. comb jellies, copepods.

2. Adaptations.

(physical)
- (i) transparent e.g. jelly Chaetognaths.
- (ii) red e.g. deep-sea jelly.
- (iii)
- (iv)
- (v)

(behavioral)
- (i) e.g.
- (ii) e.g.

3. planktivores.

- zooplankton.
- Some human.

Facts:

(i) ~~Krills~~. are the largest source of protein. in the ocean.

(ii)

The life cycle of a barnacle.

Nauplius → ( ) →