Cheat sheet for biological oceanography midterm assignment

Planktons: groups of tiny floating organisms that cannot swim against the current. Taxonomy: size, function, autotrophs-producers, heterotrophs-consumers/decomposers, mixotrophs, complex, symbiotic/parasitic *Small to big: femtoplankton (viruses), pico (bacteria), nano (diatoms, dinoflagellates), micro(sameasnano+protozoa), meso(mostly zooplankton), macroplankton *Grazing food chain: Phyto-> zooplk-> fish*Sinking flux: dead fall to deeper ocean POM: Particulate organic materialDOM: dissolved organic material *Microbial Loop: see picture 1 Collection methods of plankton: Epi-fluorescence microscope, flow cytometer, scuba, submarine, bioacoustics methods Phytoplankton: red tide= dinoflagellate bloom ONLY Trichodesmium can fix N_2 Radiolaria-amoeboid protozoans (omnivores) Ciliates- use cilia for locomotion heteropods-mollusca more examples Meroplankton: Holo= planktonic whole lives Mero= Juvinile is planktonic Larvae: veliger-larvae of benthic snails and clams; veler: ciliated membrane Nauplius from barnacles: six stages planktonic forms; then succeed to Sypris stage which settle down and metamorphose; then adult stage Ichthyoplankton- collective term for fish eggs and larvae Spawning and hatching usually are tied to temperature and food (phytoplankton) cycles Biological Pump: CO_2 sinks to bottom of the ocean to get pereserved there Major species of algal bloom: diatoms, dinoflagellates, coccolithophores, etc. blooms are unsteady phenomenon Bloom definition: cell #’s ; 10^6mL^-1chlorophyll a concentration ? 3-fold of the annual average. Geosphere, Lithosphere, Atmosphere, Hydrosphere, Biosphere Gaia Hypothesis ??? (James Lovelock) The chemical constituents within the Earth System are out of equilibrium in a thermodynamic sense. Such “ dis-equilibrium” is maintained by the living biosphere. (In other words: The earth is a living system, it can adjust itself.) Microbial loop is:

DOM-; bacteria-; virus-; DOM 4 ways material is transferred? dissolved organic material; Grazing food chain; Microbial Loop (Also have DOC (bacteria) and POC)

When we talk about biological pump, we mean CO2 pump: -All CO2 is used up by phytoplankton-unused dissolved organic material sinks to the bottom and there is a decrease in CO2 in the ocean water so due to partial pressure needing to reach equilibrium, the air will supply the water with more CO2. Phosphate cycle: particulate organic (POP)-; Dissolved inorganic (DIP)-; Dissolved organic (DOP) -; POP Primary Production or Primary Productivity (not too important, they have same meaning) Production is short term production. Productivity is long term like a seasonal change, annual change or inter-annual change. Noon time has most photosynthesis because sun is at its highest.

Afternoon is the highest concentration of Oxygen in air because it takes time to produce and accumulate the oxygen. Redfield Ratio (in molar): O_2: C: N: P: Si = 138: 106: 16: 1: 1 Regeneration Ratio: O_2: C: N: P: Si = 170: 117: 16: 11 If you decompose completely, you will produce N+P+Si+Co_2+H_2*O ?? **During photosynthesis, oxygen comes from water, not from the CO_2 Photosynthesize completely: C_6H_12O_6 ??? N ??? P ??? Si + *O_2 Light reaction: H_2O -; Photo systems I; II O_2 +NADP^+ + ATPDark Reaction: CO_2 + NADP^+ + ATP Calvin Cycle -; (CH_2O)_6 Photosynthetic Pigments: Chlorophyll a, b ; c; 400 ; 720nmAccessory Pigments: Carotene; other wavelength Protection Pigments: Xanthophylls

Different species have diff accessory pigments. They can absorb wavelengths other than 400 and 720. Then that can go towards photosystems I; II. Xanthophylls: on the surface of the water column in the noon time in the summer, the light is so strong it will damage the phytoplankton so they need these protection pigments to avoid light damage. Like an umbrella used to block the sun on a sunny day. To measure primary production, don’t measure the disappearing rate, measure the appearing rate. Do NOT measure H2O, but you can measure CO2 if vacuum sealed Measurements of primary production: O2 evolution; CO2 consumption; P^H change; ?? C uptake; ??

O labeling; Depletion of N, P Limiting factors for photosynthesis: PP= f(L, N, T, G) -Light intensity -Nutrients: N, P, Si,&Fe -Temperature -Grazing (zooplankton) Iz= I0xe^-kZ Beers-Lamert Law k: extinction coefficient The higher the value, the shallower the euphotic zone depthEuphotic zone depth = 1% of I0Light intensity decreases with depth PLOT PBI curve: Normalized production rate vs Light intensity Photo-inhibition begins at P^B max (production max) Photo-inhibition curve has slope of ? eta When the light intensity is at its max production must decrease due to light intensity damageNormalized production is production/worker Photo-inhibition is different for different species. Plot chlorophyll (mgC/m^3) vs Depth (m) Peak at depth: nitrocline and euphotic zone depth Goes back down at Subsurface Chlorophyll Maximum Chlorophyll (mgC/m^3) Sources of inorganic new nutrients: 1. Diffusion from the bottom water 2. Atmospheric deposition 3. Resuspension processes (shallow system) 4. River input 5. Upwelling 6. N_2 ??? fixation (N_2 ?

NH_4^+)by cyanobacteria *Iron hypothesis: “ Give me half a ton of iron, and I’ll bring the earth back to the ice age” James lovelock *In the geological time scale there ice age and warm ages etc. The CO_2 period changes periodically, which is one of the most important greenhouse gasses, causing heating of the earth. Reduce the CO_2 and the earth becomes colder. So adding iron should stimulate phytoplankton to photosynthesize and fix Nitrogen into the water and store it there and cause decrease in temperature outside the ocean. *High Nutrient Low Chlorophyll (HNLC) ? Due to upwelling (Over Antarctic, on the left of south America and top right side of Greenland and Iceland (Limited by iron)