UNIT EVALUATION

Your thoughts on these lessons/activities will be critical to the continued refinement of these specific topics, as well as to the development of future teaching units.

Teacher's Name	Miriam Sutton		
School	Newport Middle School		
Email	msutt@coastalnet.com	Phone	252.808.7485
Grade(s)	8	Class Size	14 – 22
Unit Taught	Iron Fertilization	Subject/topic	The Biological Pump

← Not at all — Adequate — Excellent →

Component	Rating	0	1	2	3	4
A. OVERALL TEACHING UNIT						
1.	Unit is clearly written	0	1	2	3	4
2.	Objectives are well-defined and relevant to topic	0	1	2	4	4
3.	Instructions are easy-to-follow	0	1	2	3	4
4.	Provides adequate background information for teachers	0	1	2	3	4
5.	Includes appropriate sequence of lessons/activities	0	1	2	3	4
6.	Easily integrated with national standards	0	1	2	3	4
7.	Grade appropriate and/or adaptable to grade level; comprehensible to students	0	1	2	3	4
8.	Interesting/motivating/compelling to students	0	1	2	3	4
B. ACTIVITIES						
1.	Consistent with unit objectives	0	1	2	3	4
2.	Include hands-on components	0	1	2	3	4
3.	Include inquiry-based/problem-solving components	0	1	2	3	4
4.	Engage students in the scientific process	0	1	2	3	4
5.	Incorporate real-time data in an authentic way	0	1	2	3	4
6.	Integrate technology appropriately	0	1	2	3	4
7.	Offer low-tech/alternative implementation options	0	1	2	3	4
8.	Appropriate for a variety of learning styles	0	1	2	3	4
9.	Include sufficient extension activity(ies)	0	1	2	3	4
10.	Teaches described concepts	0	1	2	3	4
C. CULMINATION/MASTERY						
1.	Includes information on product/process assessment	0	1	2	3	4
2.	Specifically measures the unit objectives	0	1	2	3	4
3.	Offers ways to assess students' thinking about the topic.	0	1	2	3	4
4.	Results in creative, authentic student work	0	1	2	3	4
5.	Provides opportunities for student reflection on learning	0	1	2	3	4

What are the strengths of this topic/lesson?

The lesson covers the key components of the biological pump and illustrates the biogeochemical cycle that occurs in the ocean. The lesson also incorporates the cycles' connection between aquatic and terrestrial food webs.

What are the weaknesses of this topic/lesson?

The lesson does not address one of the objectives (i.e., the environmental influences on the biogeochemical cycle).

What modifications are needed to improve this topic/lesson?

(See attached modifications to the Power Point presentation.) Modifications to the activity included points of clarification and adaptations needed for middle school students (grade 8).

Please include any additional comments that you think will be useful to you and others at next year's workshop.

Incorporate real-time or real scientific data into the activity and encourage more student inquiry using the scientific process. One possible example might be to begin the lesson with a short discussion of plankton poop. (It's fun to watch teenagers realize all the "stuff" that's in the ocean they play in all summer.) Encourage students to hypothesize about the life cycle of plankton and their waste products. This should lead into a terrestrial food web discussion based on their prior knowledge and provide a nice transition into the lesson.

Please let us know of any resources (websites, materials, etc) that you used or think would be useful to enrich/enhance the unit.

I instructed my students to answer as many of the follow-up questions as possible using information found in the slide show and to place an asterisk beside questions they were unable to answer. The questions most often receiving an asterisk were follow-up questions 3 (How might environmental changes influence the biogeochemical pump?) and 4 (How does the primary production of phytoplankton affect aquatic and terrestrial food webs?) I added a link to my C-MORE/OPEREX research cruise blog from the summer of 2008 and encouraged my students to use a few of my entries to locate more information about phytoplankton's contribution to our planet and other influences to plankton blooms. The OPEREX blog assisted them in locating the remaining answers.

Thank you very much for your time and assistance with this evaluation. If you are interested in the 2008 EARTH workshop please let me know. Using an activity and completing this rubric are requirements for participation. We will be discussing these evaluations and looking at the existing activities as well as creating some new ones.

Please return this form to me either in hardcopy or electronic format.

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The Biogeochemical Pump

- The biogeochemical pump is the process by which CO_2 used in photosynthesis is transferred into the ocean resulting in a temporary or permanent storage of carbon.
- This biogeochemical process involves phytoplankton, the animals that consume them, and the bacteria that decompose their waste.
- The biogeochemical pump plays a central role in the global carbon cycle.

1

The Biogeochemical Pump

- This slideshow will take you through the steps of the ocean 's biogeochemical pump.
- As you view the slideshow, record your thoughts while considering the following…

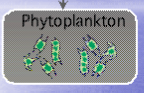
2

Things to Consider

- What 3 primary factors regulate the growth of phytoplankton?
- How do biologically -produced nutrients that sink to the deep ocean find their way back to the surface to "refuel" the biogeochemical pump?
- How might environmental changes (e.g. dust storms, hurricanes, El Nino) influence the biogeochemical pump?
- How does the primary production of phytoplankton affect aquatic and terrestrial food webs?

3

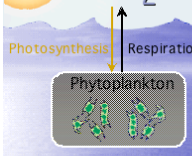
CO_2 Photosynthesis



- Carbon dioxide is removed from the atmosphere by producers (phytoplankton) that use CO_2, sunlight and nutrients to make food through the process of photosynthesis .

4

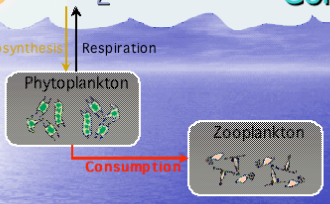
CO_2 Respiration



- Some CO_2 is then released back into the water through respiration as the phytoplankton break down their food to release energy.

5

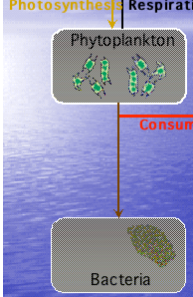
CO_2 Consumption



- Some of the carbon is passed on to primary consumers (like zooplankton and other filter feeders) that depend on phytoplankton for their energy.

6

CO_2 Decomposition



- Bacteria play a key role in the biological pump. They breakdown (decompose) waste products and dead organisms that sink to the deep sea. (Decomposition releases CO_2.) Bacteria are so good at decomposition that they can actually reduce the amount of waste and particulate matter that normally falls to the deep ocean from the surface.

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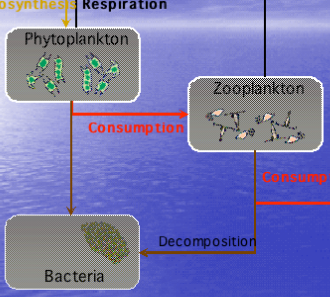
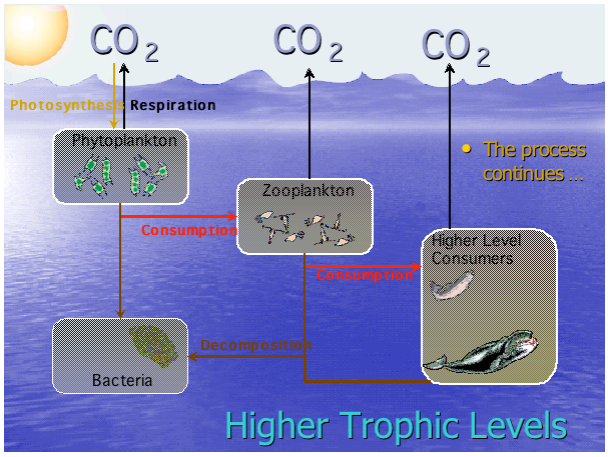
CO_2 CO_2



- Consumption continues to transport carbon through higher trophic levels .

Higher Trophic Levels

8


CO 2
CO 2
CO 2
Photosynthesis
Respiration
Phytoplankton
Zooplankton
Consumption
Consumption
Higher Level Consumers
The process continues …
Decomposition
Bacteria
Higher Trophic Levels

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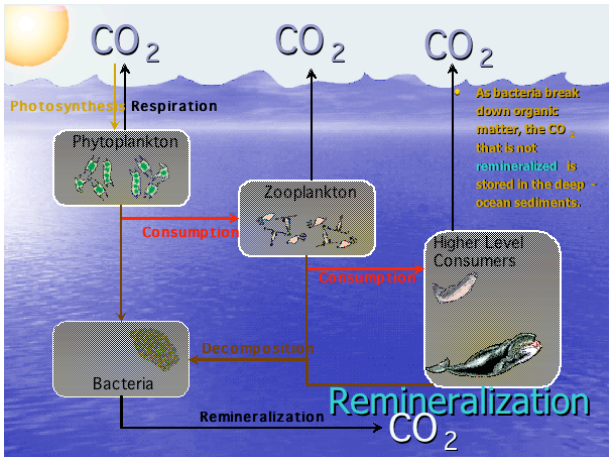
CO 2
CO 2
CO 2
Photosynthesis
Respiration
Phytoplankton
Zooplankton
Consumption
Consumption
Higher Level Consumers
As bacteria break down organic matter, the CO 2 that is not remineralized is stored in the deep ocean sediments.
Decomposition
Bacteria
Remineralization
Remineralization
CO 2

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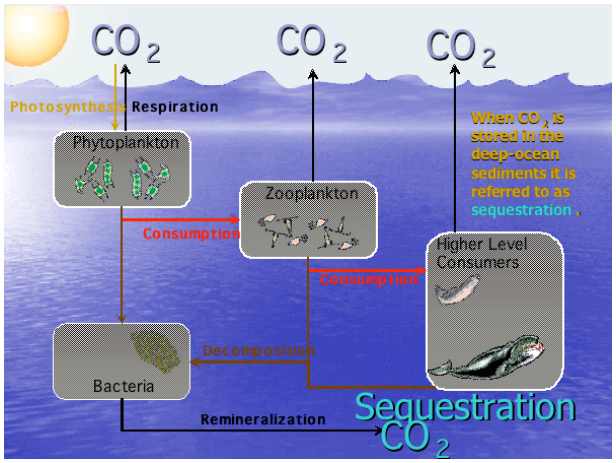
CO 2
CO 2
CO 2
Photosynthesis
Respiration
Phytoplankton
Zooplankton
Consumption
Consumption
Higher Level Consumers
When CO 2 is stored in the deep-ocean sediments it is referred to as sequestration .
Decomposition
Bacteria
Remineralization
Sequestration
CO 2

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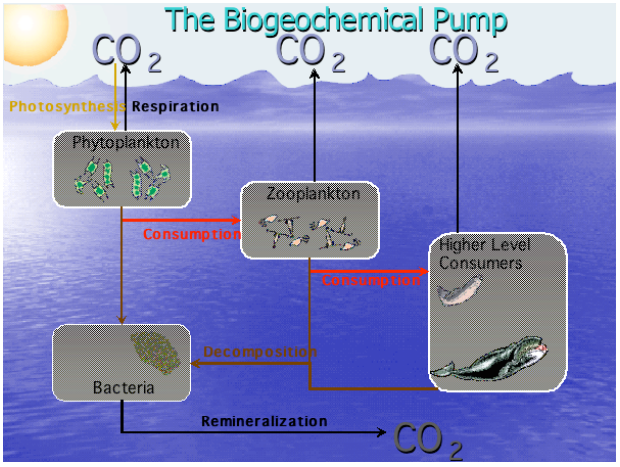
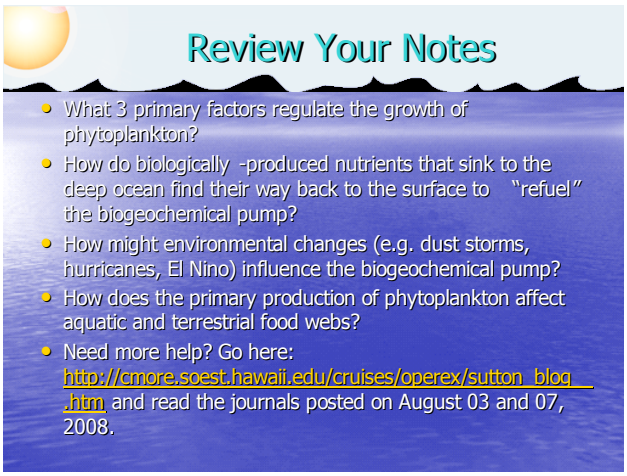

The Biogeochemical Pump
CO 2
CO 2
CO 2
Photosynthesis
Respiration
Phytoplankton
Zooplankton
Consumption
Consumption
Higher Level Consumers
Decomposition
Bacteria
Remineralization
CO 2

12


Review Your Notes
What 3 primary factors regulate the growth of phytoplankton?
How do biologically -produced nutrients that sink to the deep ocean find their way back to the surface to "refuel" the biogeochemical pump?
How might environmental changes (e.g. dust storms, hurricanes, El Nino) influence the biogeochemical pump?
How does the primary production of phytoplankton affect aquatic and terrestrial food webs?
Need more help? Go here: http://cmore.soest.hawaii.edu/cruises/operex/sutton_blog_.htm and read the journals posted on August 03 and 07, 2008.

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