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**Final PolarTREC Classroom Implementation Strategy**

**April 18, 2014**

**A. Teaching/Learning Goals**

1. Overall Goals

* Convey specific content knowledge of polar ecosystems, carbon cycling and climate change
* Improve engagement and understanding on the process of science and pursuit of knowledge
* Obtain photographs, videos, and case studies to improve student engagement
* Obtain data to use for simulations and analysis by my students
* Improve laboratory exercises and field methods
* Identify opportunities to promote collaboration with other teachers
* Inspire students to pursue science in college and careers

2. Specific Concepts

* Impact of warming climate on polar ecosystems
* Carbon flux between the atmosphere - lithosphere - cryosphere - hydrosphere
* How to design a research experiment
* Effect of sunlight on organic matter
* Microbial respiration of organic matter

3. Applicable Curriculum

AP Environmental Science Curriculum

* I.A. Earth Science Concepts. seasons; solar intensity and latitude
* I.B. The Atmosphere. composition; structure; weather and climate
* I.D. Soil and Soil Dynamics. physical and chemical properties; erosion
* II. A. Ecosystem Structure. Biological populations and communities; biomes
* II.B. Energy Flow. Photosynthesis and cellular respiration
* II.D. Natural Ecosystem Change. Climate shifts; succession
* II.E. Natural Biogeochemical Cycles
* VII.B. Global Warming

IB Environmental Systems & Societies

* Topic 2: The Ecosystem. structure & function, measuring abiotic & biotic components, ecosystem change, measuring changes in the system, biomes
* Topic 3.4. The soil system
* Topic 6. Global warming

IB Theory of Knowledge - Aims of the Course:

* develop a fascination with the richness of knowledge as a human endeavor, and an understanding of the empowerment that follows from reflecting upon it
* develop an awareness of how knowledge is constructed, critically examined, evaluated and renewed, by communities and individuals
* encourage students to reflect on their experiences as learners
* encourage consideration of the responsibilities originating from the relationship between knowledge, the community and the individual as citizen of the world.

**B. Classroom Activities**

Effect of Sunlight on the Decomposition of Organic Matter

* Approach 1. Control experiment in which organic solutions are exposed to sunlight and decomposition is measured and analyzed by means of a colorimeter or spectrophotometer. Purpose is to model the breakdown of organic matter in permafrost upon exposure to sunlight.
* Approach 2. Compare respiration rates of microbial communities fed photo-exposed organic matter compared to dark-control organic matter

**REFLECTION: This experiment was conducted during December 2013. Students were tasked with designing the experiment, which ultimate failed due to weather and equipment problems. However, it was a great “teachable moment” as students had to analyze the experiment, identify reasons for failure, and propose improvements.**

Soil respiration

* Use Vernier CO2 sensors to measure soil respiration.
* Have students design experiments to measure variables that affect soil respiration rates (e.g. temperature, light, substrate, etc.)

**REFLECTION: This experiment worked very well as a short, group experiment. Results were clear and effectively conveyed principles of soil respiration. It also was a good lesson for data analysis.**

Surface water respiration

* Use Vernier CO2 sensors to measure respiration of the Passaic River compared to “the mud hole,” a pond near the MHS campus.
* Have students design experiments to measure variables that affect surface water respiration rates (e.g. temperature, light, time of year, etc.)
* Compare soil respiration rates to surface water respiration rates.

**REFLECTION: Still designing the equipment to do this, so have not conducted the experiment yet.**

Passaic River DOC

* Sample river water in the nearby Passaic River in varying seasons, location, weather
* Have samples analyzed for DOC and/or other analytes at Rose & George's labs at U Michigan
* Consider relationship between DOC and respiration.
* Have students analyze data and Skype/email with George & Rose to interpret

**REFLECTION: Still designing the equipment to do this, so have not conducted the experiment yet.**

Arctic Food Webs

* Use information/photographs/case studies of other research expeditions at Toolik to create activities on Arctic food webs

**REFLECTION: Effective experiment to teach about food webs and the tundra ecosystem. Students were fascinated by wolf spiders.**

Follow an Antarctic Expedition in the Field

* Follow Justin's expedition on soil microbes in the Dry Valleys and Jill's expedition on carbon transfer at Katkovik, which address similar issues to my expedition
* My students will ask questions in Follow the Team and relate the PT work to our curriculum

**REFLECTION: We ended up following Glenn’s expedition in Antarctica and participating in his webinar.**

Miscellaneous science activities

* My Arctic experience will be infused into a wide variety of activities and subjects in my class: biomes, ecosystem structure & function, biodiversity, air pollution, water resources, environmental economics, history of science, etc.

**REFLECTION: Incredibly effective.**

Activities for Theory of Knowledge Class

* One aspect of TOK class is to explore how knowledge is acquired in different “areas of knowledge,” including science. I will use my experience at Toolik as a detailed, first-person example of how “we know what we know.”
* Another activity in TOK class is student debates. I will use my PolarTREC experience to generate topics for debate such as climate change, opening the North Slope or Arctic Ocean to oil exploration.

**REFLECTION: PolarTREC expedition was a case study for how knowledge is acquired in scientific endeavors. I also used my Alaska experience to discuss indigenous belief systems.**

**C. Assessment**

Lab Reports

* My students will write formal lab reports on selected activities, which will be graded according to the standard IB lab rubric

Tests

* My students will sit for the AP and IB end-of-year tests. I will be able to compare 2014 scores with those from past years, although I expect the sample size will be too small to identify significant change (approximately 25 IB and 15 AP)

Writing Assignments

* My students will write short essays aligned with the Common Core State Standards for writing in science & technical subjects.

Independent Project

* My students will create a presentation involving some aspect of Arctic ecology, including interaction with a polar scientist

Student Surveys

* I will survey my students to measure the impact of lessons involving my PolarTREC experience

Class Discussion

* I will assess student understanding through conversation with my students