Michigan Technological University

ED 5601 The Ecology of the Great Lakes Aboard the R/V Lake Guardian

Monday-Saturday, July 5-10, 2004

COURSE SYLLABUS (CRN 51841)

Coordinating Instructor

Joan Schumaker Chadde
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Faculty

Lead Faculty: Dr. Marty Auer, Civil and Environmental Engineering, Michigan Tech University

Dr. Nancy Auer, Research Professor, Biological Sciences, Michigan Technological University
Mr. Mark Gleason, Director, Isle Royale Institute
Dr. Sarah Green, Chemistry, Michigan Technological University
Dr. Judith Perlinger, Civil and Environmental Engineering, Michigan Technological University
Dr. Noel Urban, Civil and Environmental Engineering, Michigan Technological University
Doug Jensen, Aquatic Invasive Species Center Coordinator, Minnesota Sea Grant

Target Audience 18 teachers (Gr. 4-12)

Course Credit

ED 5601 (3 Semester Credits) Summer 2004. Students have the ***option*** to receive up to **three semester hours** of graduate credit for the course, either through the MTU Department of Education or as an independent study through their own home institution. The cost of MTU tuition is included in the registration.

Text *Introduction to Limnology* by Stanley Dodson. 2005. McGraw-Hill. (will be provided)

Objectives

At the end of this institute, teachers should be able to:

1. Design a 5-day, teaching unit for a biology, environmental science, life science, general science, earth science, mathematics, or chemistry course that addresses both content knowledge and skills, and aligns with Michigan Content Standards for at least two subjects.
2. Conduct real world, inquiry-oriented classroom activities, labs and field investigations related to Great Lakes topics.
3. Articulate an understanding of the ecology, research methods, and critical issues facing the Great Lakes.
4. Identify curriculum support resources and tools.
5. Identify teaching resources and scientific expertise to use in the development and delivery of curriculum.

Course Requirements

- **Completion of Pre-Course Readings and Participation in Reading Groups** *(5%)*
- **Attendance, Class Participation, and Field Journal** - All participants are expected to attend all sessions and to enter into substantive discussion during sessions with peers. A ***field journal*** is required during the institute. A journal will be provided. (40%)
- **Best Teaching Idea** - All participants will present a session during the Institute on a pre-assigned topic. This must be a well-developed pre-planned presentation for their professional peers including substantive content, and where applicable, will also include activity description, teaching aids, handouts, and authentic assessment strategies. (15%)
- **5-Day Teaching Unit** – After the Institute, teachers must design a teaching unit that contains at least 5 days of activities appropriate for their teaching level on a topic of interest *related to their institute experience*, and that meets the guidelines of the Michigan Curriculum Frameworks or national content standards. ***The teaching unit must be submitted by August 31, 2004 to receive credit for the entire course.*** See attached teaching unit grading rubric. (40%)

Course Description

This 6-day course is designed to teach elementary, middle, and high school educators about the physics, chemistry, and biology of the Great Lakes ecosystem. Participants will have an opportunity to live aboard the U. S. Environmental Protection Agency's 180-foot research vessel, the Lake Guardian, and to work with research scientists in the ship's laboratories. Hands on experience in data collection and sample analysis will be emphasized and concepts from the mathematical, physical and social sciences will be woven into the curriculum.

The Guardian will depart Houghton on Monday morning, steaming along the south shore of the Keweenaw on its way to Isle Royale. Stops along the way include the wreck site of the USCG vessel *Mesquite*, a profundal site in mid-lake and Superior Shoal. Tuesday will be spent in the vicinity of Isle Royale featuring benthos sampling, an investigation of the *Kamloops* wreck and, possibly, a short visit to the Island. Wednesday will be spent at anchor off Grand Marais, Minnesota conducting atmospheric research and engaging in presentation on various topics in limnology. On Thursday, we will sail westward along the Minnesota shore to Duluth where we will have a presentation on exotic species and shore leave for visits to the Great Lakes Aquarium and the Maritime Museum. On Friday will steam through the Apostle Islands, collecting samples for chemical analysis and stopping briefly at Ashland, Wisconsin. Friday afternoon and Saturday will be devoted to explorations of fisheries resources and the sediments as the vessel makes its way to Ontonagon, the north shore of the Keweenaw Peninsula and back to port in Houghton.

We will focus on methods to help students to think critically, to ask questions that help them learn about the real world, to formulate hypotheses and gather data, and to use evidence in order to make decisions. The knowledge and experience gained throughout the cruise will form the basis for an instructional unit that teachers develop and implement.

The content of the institute will draw on four primary resources:

- Expertise and research experiences of faculty scientists and expert educators.
- Teaching experience and insight of each participant who brings a wealth of knowledge and creativity to share with each others while developing a sense of community and peer-support which is essential for the success of this institute;
- Educational resources, websites, and reference materials.

- The lake.

Grading Criteria

The grading scale is based on oral and written performance during the week of the institute and the attached teaching unit rubric.

Suggested References

*Bennett, Thomas R. 1995. *Shoreline Processes of the Great Lakes*. Michigan Dept. of Environmental Quality – Land & Water Management Division – Shoreline Management Unit (Land & Water Management Technical Report 95-1)

*Dodson, Stanley. 2005. *Introduction to Limnology* McGraw-Hill. New York, NY.

*Graham, Loren. 1995. *A Face in the Rock*. University of California Press, Berkeley and Los Angelos, CA.

*Great Lakes Aquarium. 1998. *Lake Effects: Lake Superior Curriculum Guide for Grades K-8*. Duluth, MN.

LaBerge, Gene L. 1994. *Geology of the Lake Superior Region. Geoscience* Press, Inc. Tuscon, AZ.

*Monson, Bruce A. 2000. A Primer on Limnology 2nd Edition. (Public Report Series #6). University of Minnesota Extension Service, Room 173 McNeal Hall, 1985 Buford Ave., St. Paul, MN 55108

*Shaw, Byron, Christine Mechenich and Lowell Klessig. 2002. *Understanding Lake Data*. University of Wisconsin Extension

*U.S. EPA and Government of Canada. 1995. *The Great Lakes: An Environmental Atlas and Resource Book*

Wetzel, Robert G. *Limnology: Lake and River Ecosystems*. 2001. Academic Press.

Wetzel, Robert G. and Gene E. Likens. *Limnological Analyses* 3rd Edition. 2000. Springer-Verlag, N.Y., N.Y.

*These books will be provided to participants during the institute. *Lake Effects* for K-8 teachers only. *Additional readings will be suggested during the institute.*

Ecology of the Great Lakes Aboard the R/V Lake Guardian 2004

Description of Course Sessions

1. Exploring Shipwrecks ROV-Style

Mr. Mark Gleason, Director, Isle Royale Institute

The Institute's Remotely Operated Vehicle (ROV) will be deployed over two shipwrecks, the *Mesquite* and the *Kamloops* and in Ashland and Duluth Harbors providing participants with an opportunity to view the lake bottom and operate the instrument. The ROV will be available to participants as part of school visits during the 2004-05 academic year, where students will be able to examine and deploy this fascinating instrument.

2. Lake Effects—A Lake Superior Curriculum Guide

Joan Chadde, Education Program Coordinator, Western Upper Peninsula Center for Science, Mathematics and Environmental Education, Michigan Technological University

Participants will engage in fun, hands-on activities that will bring the cultural history, geography, and ecology of Lake Superior to life, for them and their students in the classroom. These activities are linked to national content standards for science and social studies. Participants will receive a copy of *Lake Effects: The Lake Superior Curriculum Guide* that contains more than 30 interdisciplinary activities.

3. PV = nRT or A Cup of Coffee in the Deep Hole

Dr. Marty Auer, Department of Civil & Environmental Engineering, Michigan Technological University

This brief exploration in physical limnology will examine the relationship between gas volume and pressure as we send a Styrofoam coffee cup to the bottom of a (very) deep hole in Lake Superior. Great fun, this!

4. The Case of the Disappearing Amphipod

Dr. Marty Auer, Department of Civil & Environmental Engineering, Michigan Technological University

The amphipod *Diporeia* lives on, in and above the sediment of the Great Lakes and is a critical part of the food chain. *Diporeia* is disappearing from all the lakes except Superior and scientists don't know why. Michigan Tech researchers are presently studying healthy populations of *Diporeia* in Lake Superior, seeking clues to its vulnerability in the other lakes. Students will have an opportunity to collect and analyze benthos samples to describe the distribution of Diporeia at various sites on the lake.

5. Isle Royale National Park—An International Biosphere Reserve

Mr. Mark Gleason, Director, Isle Royale Institute

The history and resources of Isle Royale National Park, an archipelago of wilderness Islands off Lake Superior's north shore will be described. The role and significance of the Park as an International Biosphere Reserve will be discussed. Permission is being sought for a brief shore stop, weather permitting, at the west end of the island.

6. Physical Limnology: Temperature and Solar Radiation

Dr. Marty Auer, Department of Civil & Environmental Engineering, Michigan Tech University

Everyone knows that biology is best, but in Lake Superior, physics rules. Participants will use the ships CTD apparatus to collect temperature and light profiles, establishing the development of thermal stratification and the position of the compensation depth. The role of light and temperature in governing the distribution of microflora and fauna will be described. Physical phenomena such as vertical stratification, the thermal bar, upwellings,

seiches and local climatology will be discussed.

7. Air Toxicants in the Water and Water Toxicants in the Air

Dr. Judith Perlinger, Department of Civil & Environmental Engineering, Michigan Technological University

The atmosphere is the primary source for many of the pollutants entering the Lake Superior ecosystem. During this cruise, researchers will be measuring air-water exchange of toxic substances such as PCBs. Students will learn of the origin, transport, bioaccumulation and health impacts of these chemicals. A demonstration of the atmospheric pollutant monitoring system will be included.

8. Biological Limnology: Plankton Studies in Lake Superior

Dr. Marty Auer, Department of Civil & Environmental Engineering, Michigan Tech University

Participants will conduct net tows to collect plankton and then participate in a Plankton Scavenger Hunt. A sophisticated research microscope, with image capture capabilities will be available so that participants can take home pictures of their favorite plankton. We will discuss the Paradox of the Plankton and examine the role of bacterial, algae and microcrustaceans in transferring energy through the Lake Superior food web.

9. The Taconite Delta at Silver Bay

Dr. Marty Auer, Department of Civil & Environmental Engineering, Michigan Technological University

The dumping of taconite (iron ore) tailings in Lake Superior led to one of the most well know pollution battles in the history of the State of Minnesota. The history of the problem and its resolution will be discussed. We will seek to visit the taconite delta and collect tailings samples for comparison to 'natural' Lake Superior sediments.

10. Invasive Species in the Great Lakes

Mr. Doug Jensen, Aquatic Invasive Species Center Coordinator, Minnesota Sea Grant

Many non-native, aquatic nuisance species such as the ruffe, the round goby, the spiny water flea, the sea lamprey, and zebra mussels are now resident in the Great Lakes. Lake Superior is not immune to this problem and the Duluth-Superior area has been particularly impacted. An overview of the area and aquatic invaders will be provided and the ROV will be deployed to check out some zebra mussels up close and personal.

11. Biological and Chemical Limnology: Chlorophyll, Oxygen and Phosphorus

Dr. Sarah Green, Department of Chemistry, Michigan Technological University

Participants will utilize in situ probes and bench scale analytical techniques (fluorometry, spectrophotometry, and titrimetry) to analyze selected water quality constituents. Depth profiles of these analytes will be prepared and examined with respect to the biological and physicochemical processes which govern their form.

12. Biological Limnology: Macroinvertebrates and Fish

Dr. Nancy Auer, Department of Biological Sciences, Michigan Tech University

Benthic sleds, bongo nets, and otter trawls. Need we say any more? Participants will collect fish and their prey and examine fish stomachs for clues to what they're eating. The distribution of species in the water column and over various habitats will be discussed and considered within the context of lakewide fisheries management.

13. Physical and Chemical Limnology: Sediments, Pollutants and Nutrient Cycling

Dr. Noel Urban, Department of Civil & Environmental Engineering, Michigan Tech University

Lake sediment record the history of geological and cultural impacts. Sediment cores will be collected and

examined for clues to the factors which influence their transport and deposition. The role of sediments in mediating the distribution of biota and pollutants and the cycling of nutrients in the lake will be discussed.

Web Sites for Great Lakes Information

Great Lakes Information Network http://www.great-lakes.net/

Great Lakes Environmental Atlas and Resource Book www.cciw.ca/glimr/data/great-lakes-atlas/intro.html

EPA Great Lakes National Program Office www.epa.gov/glnpo

Great Lakes Science Center www.glsc.nbs.gov

Michigan Sea Grant http://www.miseagrant.org/

T.E.A.C.H. Great Lakes http://www.great-lakes.net/teach/links/

Lake Superior Fish http://www.duluth.com/fishcam/

Bell LIVE UMD Education http://www1.umn.edu/bellmuse/mnideals/greatlakes/whatbelllive.html

Center for Great Lakes Environmental Education http://www.greatlakesed.org/directory.html

Michigan DEQ Environmental Education http://www.greatlakesed.org/directory.html

Understanding Lake Data http://www1.uwex.edu/ces/pubs/pdf/G3582.PDF

Water on the Web (University of Minnesota) http://wow.nrri.umn.edu/wow/overview.html
Contains pdf version of *Primer on Limnology* and access to real-time data on Minnesota lakes using robotics

Upwellings publications http://www.miseagrant.umich.edu/pubs/up/index.html

Great Lakes Education http://www.miseagrant.umich.edu/pubs/up/dec03/editorial.html

LAKE SUPERIOR WATERSHED

www.glaquarium.org
Great Lakes Aquarium at the Lake Superior Center in Duluth, MN

http://chmac2.chem.mtu.edu/KITES/kites.html
Keweenaw Interdisciplinary Transport Experiment in Superior (KITES)
Project Coordinator: Sarah Green, Assistant Professor, Chemistry Department,
Michigan Technological University

http://chmac2.chem.mtu.edu/KITES/images.html
Historical and current maps of Lake Superior are under "other images"

http://www.geo.mtu.edu/~jrbudd/kites/lst93_98/index.html
1993-98 comparison of Lake Superior surface temperatures

http://www.geo.mtu.edu/great_lakes/lakersi/lars/avhrr_archive/avhrr_archive.html
Index of satellite images for Lake Superior and other Great Lakes

Name: **Email:** **Due:** August 31, 2004

ED 5601 (CRN 51841) Ecology of the Great Lakes Teacher Institute July 5-10, 2004
~ Teaching Unit Rubric ~

Total Points Received:

Grading Scale (45 points maximum per unit)

A = 41-45 points	BC = 30-33 points	D = 25 points
AB = 37-40 points	C = 28-29 points	F = less than 25 points
B = 34-36 points	CD = 26-27 points	

CREDIT ASSIGNMENT: Develop a five-day teaching unit that you can implement in your classroom during Fall 2004. Teaching units should include the components listed below. When grading, a check will be placed by the score for each component and the total points shown above.

Target Grade/Subject: Identify appropriate grade & subject in which unit could be taught (2 points)

___ 0 – No target grade(s) or subject listed.
___ 1 – Only target grade(s) or only target subject listed.
___ 2 – Both target grade(s) and target subject listed.

Unit Overview – Provide a brief description of the overall goal of the unit and the topics to be addressed. Describe how the unit connects to units that you already teach, or how this new teaching unit will meet your curriculum needs. Be sure the unit relates to topics presented at the workshop. (2 points)

___ 0 – Description is too brief and unclear, or not listed.
___ 1 - Description does not clearly state the teaching/learning goals, or does not describe how the unit relates to other units that you teach, or does not relate to workshop topics.
___ 2 – Description clearly states the teaching/learning goals of the unit, how the unit relates to other units that you teach, and clearly relates to workshop topics.

Books/Sources Consulted – Provide title, author, pages, publisher & date in standard format. (3 points)

___ 0 – No references listed
___ 1 – One reference listed with or without proper citation
___ 2 - Two or more references are listed, but without proper citation.
___ 3 - Three or more references are listed with proper citation.

Objectives - Identify the knowledge and skills that students will gain after completing this unit. List measurable outcomes for your students. *"At the end of this unit, students will be able to:…. "* (4 points)

___ 0 – No objectives listed.
___ 1 – Objectives are listed, but are not measurable.
___ 2 - Two objectives listed but not measurable, or only one objective clearly stated and measurable.
___ 3 - Two to three objectives are clearly stated and are measurable.
___ 4 – Four or more objectives are clearly stated and are measurable.

Michigan Content Standards: List content standards that will be addressed for the subject area being taught, plus content standards that could be met for at least one other subject area. (4 points)

___ 0 – No content standards listed.
___ 1 – Incomplete list of content standards that are not cited properly
___ 2 - Two or fewer content standards listed properly
___ 3 - Three content standards listed properly.

___ 4 – Four content standards listed properly, with content standards from two or more subject areas.

Describe five days of classroom or field activities – For each day, describe the topics to be discussed and the activities or labs that will be done to accomplish the learning objectives of the unit. List sources of activities. Attach copies of all activities used in your unit, unless they are contained in resources provided to you at the institute. Be sure to *describe all activities clearly so that another teacher could implement them* in their classroom. (20 points)

___ 0 – No activities listed.
___ 4 - An incomplete unit with less than three days of activities, or activities not clearly described, or activities do not relate to goals and objectives of the unit.
___ 8 – An incomplete unit with less than five days of activities that are not clearly stated, and not related to the goals and objectives of the unit.
___ 12 - A complete unit with five days of activities clearly stated and related to the goals and objectives of the unit, but no description of the activities (i.e. copies or references for the activities) are provided.
___ 16 – A complete unit with five or more activities that are effective in accomplishing the goals and objectives of the unit. Copies of all activities are provided and referenced properly.
___ 20 – An outstanding, creative unit with five or more activities that are effective in accomplishing the goals and objectives of the unit, provide interdisciplinary connections, and emphasize inquiry. Copies of all activities are provided and/or referenced properly.

Overall Unit Assessment – Explain *how* you will assess students' accomplishments of the objectives listed. This explanation should include a copy of the assessment tools to be used, such as journal reflections, tests, quizzes, lab reports, project assignments, etc. The assessment should be described clearly enough that another teacher could implement it in their classroom. (5 points)

___ 0 – No assessment listed.
___ 1- Assessment plan is very minimal, unclear and not related to the goals and objectives of the unit.
___ 2 – Assessment plan is satisfactory, but is unclear or not related to the goals and objectives of the unit
___ 3 – Assessment plan is clear and related to the goals and objectives of the unit, but does not use a variety of tools.
___ 4 – Assessment plan is clearly stated, includes a variety of tools that are embedded throughout the unit and related to the goals and objectives of the unit.
___ 5 - Assessment plan is clearly stated and includes a variety of tools that are embedded throughout the unit and related to the goals and objectives of the unit. Assessments used are creative and require students to effectively synthesize what they have learned.

Overall Neatness and Clarity (5 points)

___ 0 - Teaching unit is not typed, lacks organization, incomplete, and contains many grammatical and spelling errors.
___ 2 - Teaching unit is typed, not complete, lacks organization, contains many grammatical and spelling errors.
___ 3 - Teaching unit is typed, but lacks organization or contains many grammatical and spelling errors.
___ 4 - Teaching unit is typed, organized and complete, but contains some grammatical and spelling errors.
___ 5 - Teaching unit is typed, organized, complete, and contains no grammatical and spelling errors.

Submit teaching unit and supporting materials (email only) **by Tuesday, August 31, 2004 to:**

Joan Schumaker Chadde Email: jchadde@mtu.edu Tel: 906-487-3341

Only published supporting materials not in electronic form should be mailed to the address below.

Joan Schumaker Chadde
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