TITLE:	Introduction to Environmental Chemistry of the Arctic
NUMBER:	CHEM 194
CREDITS:	3
PREREQUISITES:	MATH 107X or higher
LOCATION:	TBD
MEETING TIME:	On Campus: 2hr Lecture, 3hr lab/wk Distance: Remotely attend 2 hr synchronous lecture via Google Hangouts or watch lectures asynchronously. Lab experiments and collaboration performed asynchronously.

Instructors:	Dr. Sarah Hayes	Dr. Jennifer Guerard	Dr. Chris Iceman
Office:	Reichardt 188	Reichardt 180	Reichardt 182
Phone:	907-474-7118	907-474-5231	907-474-6610
Email:	s.hayes @alaska.edu	jguerard@alaska.edu	criceman@alaska.edu

Office Hours: TBD, or by appointment.

COURSE DESCRIPTION

This course introduces students to environmental chemistry through investigating the air, water, and soil quality of the arctic environment as affected by natural and anthropogenic cycling of nutrients and contaminants. The lab component will focus on characterization of natural waters collected around the state. Pre-requisites: MATH 107X or higher

This 3 credit course cannot fulfill the core science requirement. Petitions to request that it counts as the core science requirement will be denied by the registrar.

EXPANDED COURSE DESCRIPTION

This course introduces students to environmental chemistry through investigating the air, water, and soil quality of the arctic environment as affected by natural and anthropogenic cycling of nutrients and contaminants. The lab component will focus on characterization of natural waters collected around the state through the use of collaborative research teams, made of a combination of distance and on-campus students. All students will have the same lab experiences, except for lab weeks 3 and 4 of the semester, when distance students will sample natural waters and do on-site analysis and on-campus students be exposed to advanced instrumentation that will be used to analyze collected samples. These experiences will be shared between research teams through the use of screencasts (due week 5).

Within each research team, the distance students will be the site experts, while the on-campus students will be instrumentation experts, thereby strengthening the team. Distance students will have the opportunity to share their field sites with their on-campus team through photos, videos, and screencasts, but maintain an inherently better understanding of their unique sampling sites. On-campus students will develop expertise on advanced instrumentation used by the TA to collect data on natural water samples and share that information with the rest of the class, particularly distance students, through screencasts. Although on-campus students will have a more interactive experience with advanced instrumentation because they will have a tour with the TA operating the instruments, distance students will be included asynchronously through virtual tours available to all students. In all cases, students will be provided with equivalent opportunities.

COURSE GOALS
Students will gain an appreciation of the influence of chemistry in the natural, arctic environment and the implications of human-caused perturbations of these systems and potential remediation strategies.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, students will:

- Understand the basic chemical concepts as they relate to the function of ecosystems and the existence/transformation of contaminants.
- Outline basic metrics for assessing air, water, and soil quality and explain their importance as indicators of environmental health.
- Identify examples of anthropogenic influences of natural cycles and explain how that impacts ecosystem health.
- Evaluate student-generated water quality data from across the state and interpret data to assess anthropogenic perturbation of ecosystems.

COURSE READINGS/MATERIALS
Required readings are available on Blackboard or on course website.
Distance students must purchase and receive lab kits by week 2.

TECHNICAL REQUIREMENTS FOR COURSE
Students must have regular access to a computer and the Internet to access online materials in Blackboard. Students will be expected to download course material as well as upload assignments. Students are also expected to regularly use their UAF Gmail accounts, Blackboard, Google Hangouts, and screencast-o-matic as methods of collaboration and sharing of their understanding.

INSTRUCTIONAL METHODS
Course material will be delivered through a combination of lectures incorporating active learning techniques, lab exercises (a combination of virtual, field, and kitchen-based labs), and weekly activities (ie case studies, interviews with experts, developing screencasts, etc). Research teams of on-campus and distance students (2 on-campus for every distance student at max enrollment) will generate lab-based replicate data sets of surface water quality data from communities across the state. Student groups will work closely and engage in peer mentoring (distance student is the expert on the field site while on-campus students will become instrumentation experts) and build a community of learners across the state of Alaska.

COURSE SCHEDULE
See attached.

COURSE POLICIES
Continued attendance to class indicates each student agrees to the policies set forth in this syllabus. Distance course attendance will be measured through effort on assignments, collaborative activities, and exams.

Collaboration and Classroom Behavior - Collaboration and working in small groups is a key component of classroom and lab time. Your group is there to support your learning, not do the work for you. Students are expected to conduct themselves in a professional manner at all times. Disrespect of the classroom learning environment, instructors, and fellow students will not be tolerated!

Late work- Assignments will be due at 11:59pm. Late work will be accepted at a 10% per day reduction of the points possible. This is in an effort to keep the entire class moving through the projects efficiently. Emergency situations will be dealt with as needed.

Instructor-Initiated Withdrawals- Any time up to and including the last day to drop with a "W", the professor has the right to withdraw a student that "...has not participated substantially in the course." In CHEM 194 nonparticipation includes:
(1) Either of the first two assignments are not turned in within 1 week of the due date,
(2) Exam I is missed without an excused absence,
(3) one or more lab reports are not turned in within 1 week of the date due, or
(4) completes less than 2/3 of homework assignments.

EVALUATION POLICIES

There are **1000 total points available** in this class. Grades are assigned as follows: 1000-900 A, 900-800 B, 800-700 C, etc. Grades are assigned on the typical scale 90-100 A, 80-90 B, 70-80 C, etc. The instructors reserve the right to adjust grading scheme to the student's benefit.

Hour exams	2 x 100 pts	200
Homework	15 pts x 15 weeks= 225 points possible	200
Activities & Quizzes	20pts x ~20 assignments= 200 points possible	180
Labs	14 x 30 pts	420
Total points		1000

Exams- Two hourly exams are scheduled, a midterm and final exam. For distance students, UAF eLearning will contact you regarding proctored exams. More information will be given to distance students after enrollment.
Homework- Reading assessment assignments will be due before class begins. Weekly online homework assignments will be due each Wednesday.
Activities and Quizzes- Class participation will be assessed weekly using in-class activities (case studies, worksheets, interviews with experts, etc) and a few quizzes. All students are expected to participate in blog discussion of case studies, and interviews.
Labs- Fourteen weeks of lab experiments will be performed during the semester, each worth 30 points. Collaborative and individual lab reports will be exchanged between students and the instructor using student Blackboard and UAF google drive.

Successful, timely completion of this course depends on committing yourself early and maintaining your effort. To this end, this course adheres to the following UAF eLearning Procedures:

INSTRUCTOR RESPONSE TIME

The instructors will attempt to respond promptly to student emails during normal business hours, but response times may be up to 24 hours. Assignments graded by instructors (e.g., lab reports, exams, blog posts) will generally be returned within 48 hours after assignment due date but no longer than a

week. Grades in Blackboard will be updated weekly.

HOW TO CHECK YOUR GRADE
To check your grades for assignments and find comments from your instructor, click on the My Grades link in the sidebar menu in Blackboard. All the assignments and their due dates are listed. If your instructor has left comments, there will be a Comments link. Click on this link to view comments.

If the score is for a test or quiz, click on the check mark or your score to see results and feedback.

If the score is for an assignment, the title of the assignment is a link and by clicking this link you'll be taken to your submission, grade and comments.

If you see a green explanation point, your assignment has not been graded yet.

EFFORT AND STUDENT INVOLVEMENT*
The categories below demonstrate how the 2 hours of lecture, 3 hours of lab and 4 hours of non-lecture in a face to face course translate into 9 hours of work in an online course, meeting the requirement of 9 hours of work per week for a 3 credit course. This calculation covers the entire course.

1. **INSTRUCTION:** lectures *22%*
2. **INDIVIDUAL RESEARCH:** *lab experiments 33%*
3. **ASSIGNMENTS:** readings, *case studies, quizzes, homework 22%*
4. **COLLABORATION:** *case studies, laboratory project 23%*

*This metric of student effort is used during development to ensure rigor and alignment with the federal guidelines and definitions for credit hour equivalents for online learning and other out-of-classroom work. This portion of the syllabus is for development purposes only and students will see only the sections required by Faculty Senate in their syllabus.

EXPECTATION OF STUDENT EFFORT
Students should expect to spend 9 hours per week on this class. Students are expected to complete the weekly assignments by their due dates.
If circumstances arise that cause you to need extra time on any assignment(s), e-mail your instructor for guidance. Extensions of due dates may be granted, but your instructor expects to be informed in advance if you are not able to submit your assignment on time. Students are expected to maintain a working backup plan to be implemented in the event of a computer malfunction or an interruption of their normal Internet service during the course.

ACADEMIC INTEGRITY
Honor code and Academic integrity- Students are expected to conduct themselves in accordance with the UAF Honor code. The Chemistry Department policy states: *Any student caught cheating will be assigned a course grade of F. The students' academic advisor will be notified of this failing grade and the student will not be allowed to drop the course.*

As described by UAF, scholastic dishonesty constitutes a violation of the university rules and regulations and is punishable according to the procedures outlined by UAF. Scholastic dishonesty includes, but is not limited to, cheating on an exam, plagiarism, and collusion. Cheating includes providing answers to or taking answers from another student. Plagiarism includes use of another author's words or arguments without attribution. Collusion includes unauthorized collaboration with

another person in preparing written work for fulfillment of any course requirement. Scholastic dishonesty is punishable by removal from the course and a grade of "F." For more information go to Student Code of Conduct. (http://uaf.edu/usa/student-resources/conduct)

SUPPORT SERVICES

UAF eLearning Student Services helps students with registration and course schedules, provides information about lessons and student records, assists with the examination process, and answers general questions. Our Academic Advisor can help students communicate with instructors, locate helpful resources, and maximize their distance learning experience. Contact the UAF eLearning Student Services staff at 907. 479.3444 or toll free 1.800.277.8060 or contact staff directly – for directory listing see: http://elearning.uaf.edu/contact

UAF Help Desk

Go to http://www.alaska.edu/oit/ to see about current network outages and news.
Reach the Help Desk at:

- e-mail at helpdesk@alaska.edu
- fax: 907.450.8312
- phone: 450.8300 (in the Fairbanks area) or 1.800.478.8226 (outside of Fairbanks)

DISABILITIES SERVICES - The **UAF Office of Disability Services** operates in conjunction with UAF eLearning. Disability Services, a part of UAF's Center for Health and Counseling, provides academic accommodations to enrolled students who are identified as being eligible for these services.

If you believe you are eligible, please visit their web site (http://www.uaf.edu/disability/) or contact a student affairs staff person at your local campus. You can also contact Disability Services on the Fairbanks campus by phone, 907.474.5655, or by e-mail (uaf-disabilityservices@alaska.edu).

VETERAN SUPPORT SERVICES - Walter Crary (wecrary@alaska.edu)is the Veterans Service Officer at the Veterans Resource Center (111 Eielson Building, 474-2475). Fairbanks Vet Center 456-4238. VA Community Based Outpatient Clinic at Ft. Wainwright is 361-6370.

UAF eLearning
2175 University Avenue, Suite 200
P.O. Box 756700 • Fairbanks, AK 99775
907.479.3444 • 800.277.8060 • fax: 907.479.3443
uaf-elearning@alaska.edu
elearning.uaf.edu

Tentative Lecture and Lab Schedule

Week 1 - Introduction

Environmental science connection between health of ecosystems, animals, and communities types of contaminants and how we will look for them in lab. History of environmental monitoring and activism (*Silent Spring*, silent snow, living downstream, etc).
Case study: Ch 1-2 excerpt from Silent Spring by Rachel Carson

Lab 1: Safety and Scientific Method

- Get kit and unpack it
- Escience Safety lab
- EscienceLabs scientific method exercise

Week 2 – Air Quality

Introduction to indoor and outdoor air quality. Description of air quality parameters and natural and anthropogenic factors that degrade air quality. Transportation of air masses and pollutants, especially to the arctic (Grasshopper Effect). Legislative history and discussion of where we go from here.
Case study: Bear Trouble

Lab 2: Air Quality Experiments

- Modeling pollution in student communities
- Modeling movement of volcanic plumes

Week 3: Introduction to Water Quality

Water cycle and distribution on earth, metrics of water quality, History of water quality legislation, legacy and emerging contaminants
Case study: Tricolsan in water treatment – from research to regulation in Minnesota

Lab 3: Drinking Water Analysis

- Escience Labs – Water Quality
- Distance students - Plan water sampling and test probes (Week 4)
  On-campus students – Prepare to receive samples from distance students (Week 5).

Week 4: Water Quality and Treatment

Basic modes of treatment/remediation techniques, challenges with water treatment for different water quality parameters, Overview of remediation strategies.
Case study: Interview with CH2M Hill professionals

Lab 4: Natural Water Sampling & Analysis:

- Distance students: Go to field site, record sampling observations, collect samples. Prepare and ship samples to UAF for additional analysis.
- On-campus students: Jigsaw of analytical techniques. Students will develop a screencast to teach classmates about advanced analytical techniques used to characterize water.

Week 5 – Water quality of groundwater

Contamination and treatment of groundwater.

Lab 5: Analysis of natural waters

- Escience Labs – Water quality parameters of natural water (sampled in week 4).
- Site descriptions (distance) and analytical jigsaw screencasts (on-campus) due.

Week 6: Marine water quality

Influence of CO_2 concentration in the atmosphere controls ocean acidification, effects of ocean water pH on corals, petroleum spill remediation techniques, salinity, plastics in the ocean
Case study: Effects of ocean acidification on corals

Lab 6 – Testing effect of ocean acidification

- Effects of CO_2 concentration on pH changes as a function of salinity
- Effects of acidity on shell-based organisms.

Week 7 – Contaminant transport and transformation

Contaminant transport and degradation processes. Introduction to abiotic and biotic transformations.
Case study: PCBs in salmon causing accumulation in spawning lake sediments

Lab 7: Modeling of contaminant partitioning

- Virtual lab modeling contaminant partitioning from water into organisms
- Escienclab- Partitioning of contaminants

Week 8 – Aquatic microbial biodiversity

Types of planktonic and self-mobilized microbes in freshwaters, from bacteria to algae and diatoms, up to rotifers and daphnia, bioindicators such as identification of insect species in differing levels of pollution
Case study: Coliforms in Antarctica

Lab 8: Investigating the microscopic world

- *Optional* Students may bring water samples to examine. Distance student are encouraged to return to field site, record observations and water quality parameters, and collect a lab sample
- Esciencelab- virtual magnification and microscopy

Week 9 – Soil Quality

Geology and soil development within Alaska, permafrost degradation, landscape formation (braided rivers, mass transport by wind and water).
Case study- How permanent is permafrost?

Lab 9: Weathering and soil formation

- Esciencelab- rock weathering
- Esciencelab- soil formation

Week 10 – Metals and Inorganic contaminants

Metals as nutrients and toxins- form and quantity, Environmental hazards (acid mine drainage, groundwater contamination, dust transport) and remediation strategies.

Case study – Pebble mine: Tension between mineral recovery, subsistence and commercial fishing, and community health

Lab 10: Soil properties and acid mine drainage

- Esciencelab- soil properties
- Esciencelab- acid mine drainage and natural metals

Week 11 – Environmental Microbiology in Soils

Microbes in geomedia and soils. Microbes that are harmful to health, microbial roles in ecosystems, microbes in biological degradation of contaminants, mechanisms of contaminant degradation.
Case study – Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in US History (Exxon Valdez, BP Gulfwater Horizon)

Lab 11: Bacterial diversity in soils

- Esciencelab- Bacterial isolation from soil samples
- Esciencelab- Characterizing bacteria isolated from soil

Week 12 – Food webs and Bioaccumulation

Survey of ecosystems in Alaska, food web interactions in the Arctic, biomagnification of contaminants
Case study: Tuna for lunch? Bioaccumulation of mercury

Lab 12: Ecology of organisms

- Esciencelab- Yeast response to pollution
- Esciencelab- Ecological interactions, biomagnification

Week 13 –Forest Fires & Ecological Succession

Phases of primary and secondary succession – coastal rainforests, boreal forests, tundra, progressive vs. regressive succession
Case study: Primary succession following deglaciation at Glacier Bay, Alaska

Lab 13: Sharing project data

- Peer research project presentations, peer evaluations

Week 14 - Climate Change in the Arctic

Climate records, principles of climate change, measurements of climate indicators, modeling future climate, feedback mechanisms, effects on the arctic environment.
Case study: What does the data tell us about climate change?

Lab 14:

- Esciencelab - solar energy budget calculations and greenhouse effect
- Working with peers to prepare for presentations

Week 15 – Peer Research Presentations, Story GIS Project

Sharing TA synthesis of whole dataset with students and discuss how this could be helpful to their communities