ENVIRONMENTAL INQUIRY

12TH Grade, 2009-10, 20 Periods per Week, 40 Weeks

Written by John Cunningham Approved Standardized Draft, Spring '09

OVERVIEW:

- The *theme* for the course is Forensics: Data gathered and evaluated by students will strive for the same quality as that presented by the D.E.P. in a lawsuit. The Hach & Lamotte Equipment (probes, analytical tools, software and legal handling) is professional grade. The foci are air, soil and water
- *Models* for design: All a-biotic protocols and lab format are based on the Case Western Environmental Engineering lab manual. The biotic lab methods use the peer-review and proposal design in the Cornell/Penn-State Environmental Inquiry system. The Molecular Ecology unit arose from DNALC Leadership Fellow work, in conjunction with the Jackson County MI 4H club. Paleo-ecology lessons are based on investigations of Miocene vegetal fossils under the tutelage of Dr. Bill Rember, U. Idaho.
- *General breakdown*: The first term is an introduction to equipment, field-collected evidence, data handling, lab report writing & presentation. The second term hones peer review skills with the introduction of biological tolerance assessment; students must complete the course with a comprehensive project, from proposal to execution.
- ALL Units involve home sampling, local or remote fieldwork, and some individual &/or small group work off site, especially the Gowanus Canal, in collaboration with Dr. E. Drucker and the NYC Storm-Surge Preparation offices.

FALL TERM (85 days):

UNIT	OBJECTIVES	SKILLS	ACTIVITIES	NYS L-STD's	NYC P-STD's
Introduction to lab & each other 1	Wet/dry lab familiarity	Safety, organization and neatness	Jennings Policies & Procedures Manual – Collab. Exercz	Tech 5.6	S5-f
Lab Field-trip	Outline production	Reading	In-lab exercises	S1-3.5	S3-e

report format 2		interpretation & application	Jennings p28 CWRU Manual		S5-f S8-b
Data analysis by Linear regression 2	Formula derivation & use	Application	Dry lab Jennings p21-23 CWRU Man	S1-3.1 S1-3.2	
Lab report graphics 2	Visual data handling	Graphing	Dry lab Jennings p24-25 CWRU Manual	S2-3.1	S5-c
Dilutions and Solutions 2	Liquid and reagent handling	Volumetric dilution and accurate solutions	Wet lab Jennings p29-33 CWRU Manual, Cornell/Penn-State Environmental Inquiry system, Bioassay Protocols p 1-2	S7-3.1pp S5-2.1, 2.2, 2.3, 2.4	S6-a, b, c, d & e
Pipetting & error 1	Proper technique	Measurement	Wet lab only Jennings p36-40 CWRU Manual	S1-M1.1 S5-2.1, 2.2, 2.3, 2.4	S6-a, b, c, d & e
Solids Determination 4	TDS evaluation	Evaporation, Filtration, Drying, Conductance	Field collection, Wet Lab Jennings p41-48 CWRU Manual	S5-2.1, 2.2, 2.3, 2.4	S6-a, b, c, d & e
Bacteriology basics 5	Colony growth & counting	Simple coliform handling and qualitative data production	Field collection, Wet lab Jennings p49-53 CWRU Manual, Drucker and the NYC Storm-Surge Preparation	LE4-5.2 S5-2.1, 2.2, 2.3, 2.4	S2-c, d & f S6-a, b, c, d & e S8-b

Precipitation, Coagulation and Flocculation 5	Judicious dosing	Jar Test	Field collection, Wet Lab Jennings p54-62 CWRU Manual	S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S8-b
PH, Acid-Base Titrations 5	Use of Molarity in assay	Titration, probe & meter	Field collection, Wet/Dry lab Jennings p63-71 CWRU Manual	S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
Chlorine Residual & Demand 2	Liberation of Iodine	PH probe	Field collection, Wet/Dry Lab Jennings p72-79 CWRU Manual	S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e
Dissolved Oxygen and the BOD4	Incubation for measurement	DO probe & Winkler Titration	Field collection, Wet/Dry Lab Jennings p81-89 CWRU Manual		S1-a, b & f S2-c, d & f S6-a, b, c, d & e S8-b
A-biotic testing and detection 3	Carbon Dioxide	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
A-biotic testing and detection 3	Ammonia	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
A-biotic testing and detection 3	Nitrates, Nitrites	Probe/Sensor use, data acquisition and	Field collection, Wet/Dry Lab Hach & Lamotte Equipment,	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2	S1-a, b & f S6-a, b, c, d & e S8-b

		manipulation for presentation	Drucker and the NYC Storm-Surge Preparation	S5-2.1, 2.2, 2.3, 2.4	
A-biotic testing and detection 3	Phosphates	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
A-biotic testing and detection3	Fluorides	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
A-biotic testing and detection 2	Ozone	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
Metals7	Mercury, Manganese, Lead, Nickel, Chromium, Iron, Aluminum, and Copper	Probe/Sensor use, data acquisition and manipulation for presentation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3, 2.4	S1-a, b & f S6-a, b, c, d & e S8-b
pH, conductivity and temperature 5	Use in Soil, air and water assays	Probe/Sensor use, data acquisition and manipulation	Field collection, Wet/Dry Lab Hach & Lamotte Equipment, Drucker and the NYC	S2-1.1, 1.2, 1.3 1.4, 1.5 S4-3.1, 3.2 S5-2.1, 2.2, 2.3,	S6-a, b, c, d & e S8-b

		for presentation	Storm-Surge Preparation	2.4	
Water screening and sampling6	Turbidity, salinity refractometer deployment, hydrometer use and gathering with the plankton net	Never getting feet wet	Field technique Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1, 1.2, 1.3 1.4, 1.5 S5-2.1, 2.2, 2.3, 2.4	S2-c, d & f S3-e S5-a, b, c, d & e S6-a, b, c, d & e S8-b
Air7	Sampling and pollutant detection	Slow and fast pass technique	Local Field work, Wet and Dry lab Hach & Lamotte Equipment	S2-1.1, 1.2, 1.3 1.4, 1.5 S5-2.1, 2.2, 2.3, 2.4	S5-a, b, c, d & e S6-a, b, c, d & e
Trees 3	Use of clinometer and dendrometer	Geometric eco-inference	Fieldwork Hach & Lamotte Equipment	S2-1.1, 1.2, 1.3 1.4, 1.5	S2-c, d & f S6-a, b, c, d & e S8-b
E.I. Mapping 5	Generation of geographic data for substance moiety location and movement over time	Use of Compass and GPS devices, familiarity with basic Arc-View techniques	Field measurement and Dry Lab only Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation	S2-1.1 S2-2.1, 2.2, 2.3 S5-2.1, 2.2, 2.3, 2.4 S6-ST all, M all	S2-c, d & f S6-a, b, c, d & e

SPRING TERM (85 days):

UNIT	OBJECTIVE	SKILLS	ACTIVITIES		
Intro to E.I.'s 2 Levels of Inquiry 2	Use of Protocols and Interactive	First application of peer review	Collaborative exercise	S5-H&IT6.3 S5-MT7.1-7.6	S5-a, b, c, d & e S7-a, b, c, d & e

	research		Cornell/Penn-State Environmental Inquiry system , Cor-Pen 2 Levels	ST6-PoC all and Opt all	
Protocols and tolerance 10	Simple dose/response applications and the concept of the tolerance profile in a system	Dose/response frame of reference for research	Wet lab Cornell/Penn-State Environmental Inquiry system Protocols + Tolerance	S5-2.1, 2.2, 2.3, 2.4	S2-c, d & f S3-e
The Bioassay 9	Experiences in toxicity testing, on representative invertebrates & plants	Developing bioassay procedures	Field collection, Wet/Dry Lab Cornell/Penn-State Environmental Inquiry system	S2-1.1, 1.2, 1.3, 1.4, 1.5, 1.6 S5-2.1, 2.2, 2.3, 2.4	S2-c, d & f S5-a, b, c, d & e S6-a, b, c, d & e S7-a, b, c, d & e S8-b
Interactive research preparation 5	Presenting results and peer review	Presentation software and critique	Use of demo equipment and local network Cornell/Penn-State Environmental Inquiry system	LE4-7.2 S4-1.1, 2.1 S2-1.1, 1.2, 1.3, 1.4, 1.5, 1.6 S2-3.1, 3.2, 3.3	S3-e S4-c, d & e S5-f S5-a, b, c, d & e S7-a, b, c, d & e S8-a
Digital and Polarizing Microscopy 2	Use of DM & PM for research and presentation	Micro-photography, movie making, birefringence and measurement	Field collection, Wet/Dry Lab	S5-2.1, 2.2, 2.3, 2.4	S6-a, b, c, d & e S8-b
Pathogens, microbes and Human Tolerance 5	Pathogen recognition and safety	Total aerobic and coliform count; asays for acid	Slide collection survey, Field sampling, Wet lab	LE4-1.1, 5.2 LE4-7.1	S2-c, d & f S4-c, d & e S6-a, b, c, d & e

		producing bacteria, blue-green algae, fluorescing pseudomonads, heterotropic aerobes, nitrifying bacteria, pool and spa bacteria, slime forming bacteria and sulphate reducing bacteria	technique, Tolerance curve generation from Medical data Hach & Lamotte Equipment, Drucker and the NYC Storm-Surge Preparation		S7-a, b, c, d & e
Molecular Ecology 10	Recognition of GE applications in EI, using bacteria, insects, plants & soil nematodes, especially with mtDNA and plDNA	Use of GE tools (electrophoresis, PCR, blots, transformations and limited polyacrylamide gel sequencing	Field collection, Wet/Dry labs in bioinformatics, DNALC Leadership and Rember	LE4-1.1, 2.2, 6.2	S2-b & e S2-c, d & f S6-a, b, c, d & e S7-a, b, c, d & e S8-b
Separation Technology in EI 4	Use of Paper chromatography, TLC and GC	Chromatogram evaluation and use in presentation	Field collection, Wet/Dry Lab	S5-2.1, 2.2, 2.3, 2.4	S4-c, d & e S5-a, b, c, d & e S6-a, b, c, d & e S8-b
Wildlife ID and Eco-Forensics 9	Taxon recognition (trees, flowers, birds, reptiles, insects, mammals, and molloscs	Population sampling and intolerance recognition	Fieldwork, Dry lab Hach & Lamotte Equipment	S4-3.1, 3.2	S2-c, d & f S3-e S4-c, d & e S5-a, b, c, d & e S6-a, b, c, d & e S8-b

Risk assessment and Cost/Benefit analysis 2	Numerical approaches to RA and C/B analysis	Graphing and presentation of RA & CB	Collaborative exercises, Drucker and the NYC Storm-Surge Preparation	LE4-7.1 S5-CT4.1, 4.2 S5-H&IT6.3 S5-MT7.1-7.6	S4-c, d & e
Paleo-Ecology 9	Reconstruction of ancient environments	Use of fossil plants, animals, pollen & micro-organisms to profile a dated sediment	Lab exercises in aDNA, matrix extraction and fossil ID DNALC Leadership and Rember	S4-2.1 S4-6.1 LE4-1.1, 3.1, 3.2	S2-b & e S2-c, d & f S4-c, d & e S5-a, b, c, d & e S6-a, b, c, d & e S7-a, b, c, d & e
Soil Extraction and profiling 3	Techniques	Recording and presentation	Field collection, and wet lab Hach & Lamotte Equipment	LE4-7.1 S5-2.1, 2.2, 2.3, 2.4	S5-a, b, c, d & e S6-a, b, c, d & e S8-a, b
***The culminating Project 15**	Design, proposal, and presentation	Peer review and predictive revision	Field collection, Wet and dry lab Cornell/Penn-State Environmental Inquiry system, Cor-Pen LTER. Drucker Storm Surge, Idaho, Saga	LE4-7.2 S4-1.1, 2.1 S2-1.1, 1.2, 1.3, 1.4, 1.5, 1.6 S2-3.1, 3.2, 3.3 S5-H&IT6.3 S5-MT7.1-7.6	S3-e S5-f S5-a, b, c, d & e S7-a, b, c, d & e S8-a

*The “Culminating Project”, a senior exit presentation, is begun during the first (abiotic) term, in the “Interactive Research Preparation” unit. Students will be required to **either** make a choice to pursue a line of research within these areas:

NYC Storm Surge Preparedness for Public Health, in the Gowanus area
The Molecular Ecology of the niche expansion of *Saga pedo*, a beneficial “invasive” insect
The Paleo-botany and palynology of Miocene plants in the St. Marie River basin
Forensic Environmentalism and NYC brownfields

…**or** to develop a research project based on the students’ own interests, by the and of the first teaching unit of the Spring term.

Standards Column headings:

NYS L-STD’s = *Learning Standards for Mathematics, Science & Technology, revised Edition March 1996, University of the State of New York*

NYC P-STD’s = *New York City Performance Standards, First Edition, 1999, Board of Education of the City of New York*