SEMESTER AT SEA COURSE SYLLABUS

Fall 2011
Discipline: Biology
CHEM 3559-502: Biomedical Applications of Genetic Engineering
Upper Division
Faculty Name: Marc Zimmer

Pre-requisites: An introductory biology and/or chemistry course

COURSE DESCRIPTION This course examines the use of molecular methods to study gene expression and its critical role in health and disease. Fluorescent proteins are commonly used in biomedical applications - their use and development will be used as a thread throughout the course. We will discuss how genetic engineering can be used in organ transplant, malaria, AIDS and dengue fever research. At the same time we will see how the countries we visit deal with these diseases and control their spread. The use of genetically modified animals (cattle, chickens, fish, goats, pigs and sheep) to produce blood products, protein-based drugs, vaccine components and replacement tissues will also be examined.

COURSE OBJECTIVES To present the fundamental principles involved in genetic bioengineering. Topics include DNA replication, transcription, translation, methods for studying genes and gene expression at the mRNA and protein levels, methods for mutating genes and introducing genes into cells, methods for creating genetically-engineered animals and methods for accomplishing gene therapy by direct in vivo gene transfer. To examine how the different countries we visit regulate genetic bioengineering and how the diseases examined affect them.

REQUIRED TEXTBOOKS

None

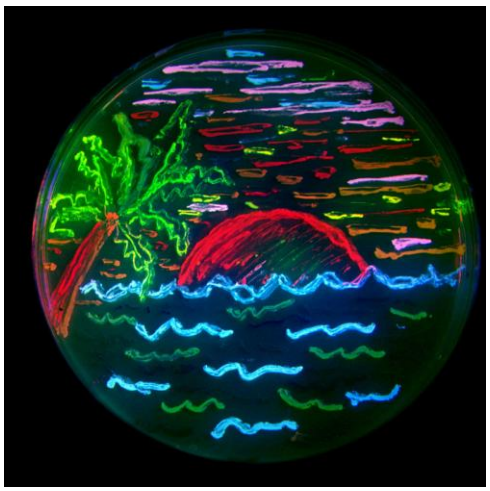
TOPICAL OUTLINE OF COURSE

Day, **Topic** (*Potential Field trips*) Readings

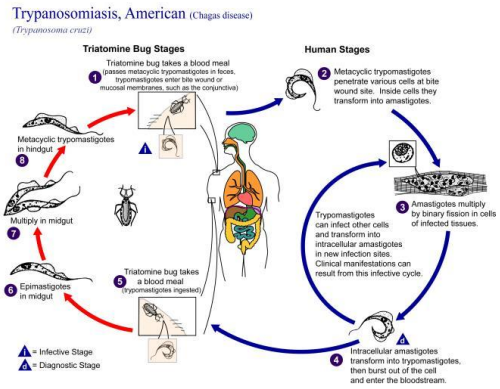
Day #1 **Intro to Bioengineering and Archaebacteria** (*Hot Springs*) Genetic Engineering Fact Sheet

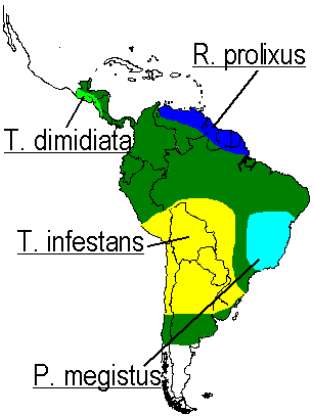
Day #2 **DNA, Genes, Genetic manipulation** (*Research labs*) Animations

Day #3 **Fluorescent Proteins** (*Corals*)

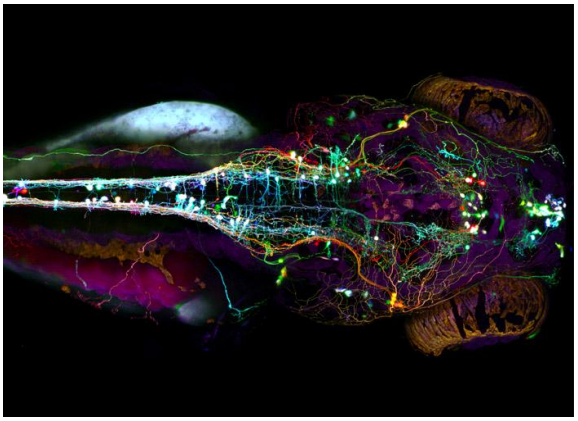


Day #4 **Brazilian Botflies, Chagas Disease** (*Medical Facilities, Research Labs*)



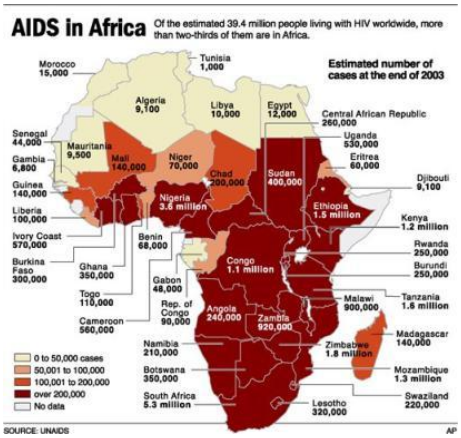


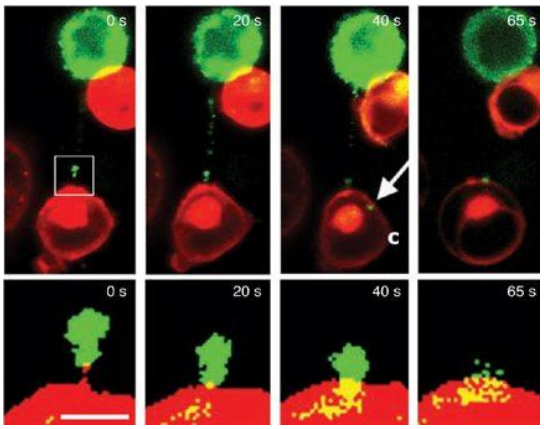
Day #5 **Fluorescent Proteins, Genetic Imaging** (*Corals*)



Day #6 **Malaria** (*Medical Facilities, Research Labs*) Ghana Malaria Fact Sheet, Economic Burden of Malaria in Ghana, *Nature Biotechnology* 2005, **23**, 1371–1372.

Day #7 **HIV, AIDS** (*International Center for Genetic Engineering and Biotechnology*), *Nature Cell Biology* 2008, **10**, 211 – 219. HIV & AIDS in South Africa



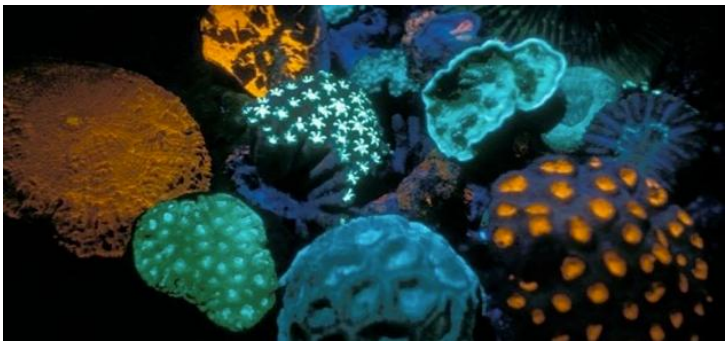


Day #8 **Organ Transplants**, Cylcosporin (*Groote Schuur, Cape Town*)

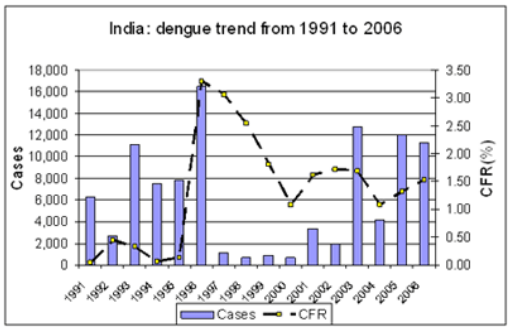
HEART OF CAPE TOWN museum

Day #9 **Xenotransplants** (*Groote Schuur, Cape Town*) Biomedical Applications of Genetically Engineered and Cloned Animals, *Biotechnology & Genetic Engineering Reviews* 2008, **25**, 245-266.

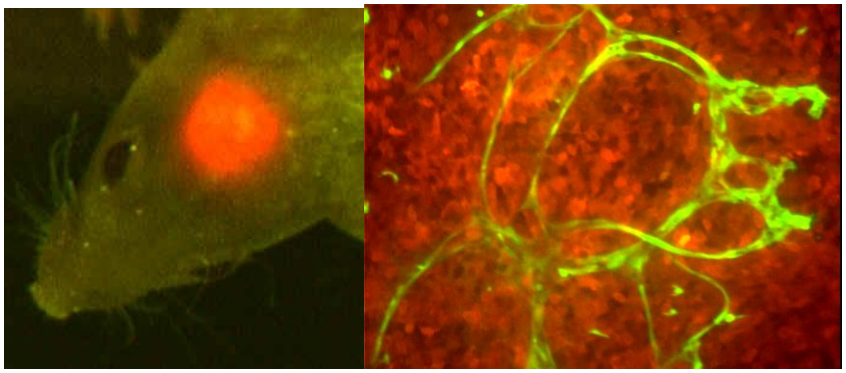
Day #10 **Genetic treasure hunts in coral reefs** (*Marine Reserves in Mauritius and elsewhere*)



Day #11 **Dengue Fever** (*Medical Facilities, Research Labs*) The Oxitec www site and *Science* 2010, **330**, pg 1030.

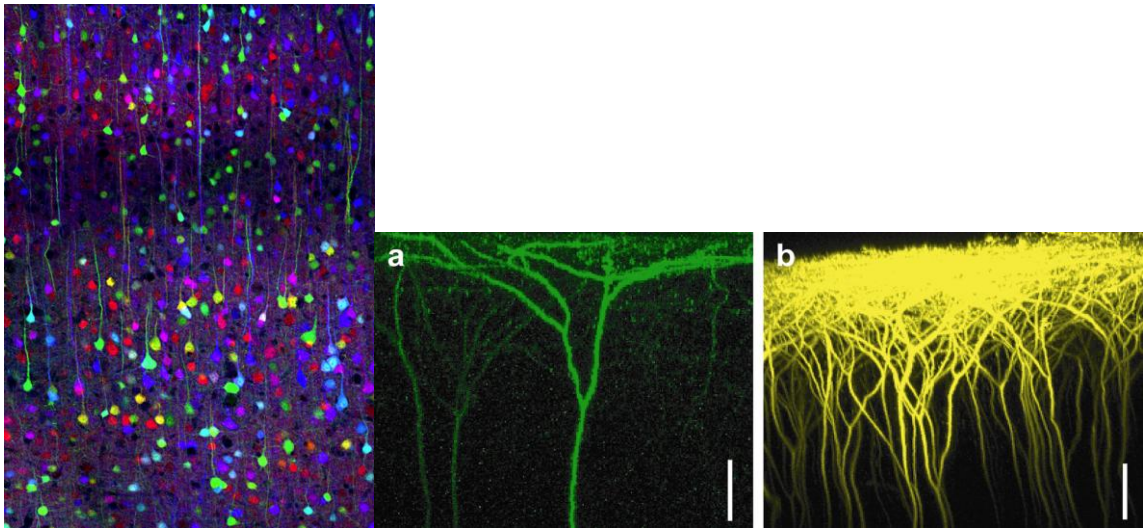


Day #12 -14 **Cancer** (*Medical Facilities, Research Labs*) The Anticancer www site



Day #15 **Bird Flu** (*Medical Facilities, Research Labs, Agriculture*) *Science* 2011, **331**, 132-133.

Day #16 **Neurons** (*Medical Facilities, Research Labs)* Janelia Farms



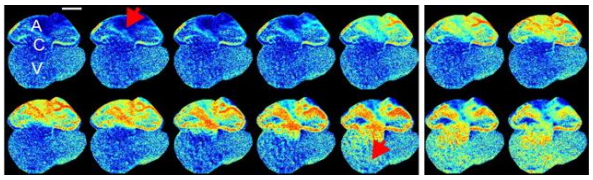
Day #17 **Transgenic Animal Bioreactors** (*Medical Facilities, Research Labs) Transgenic Research* 2000, **9**, 305.

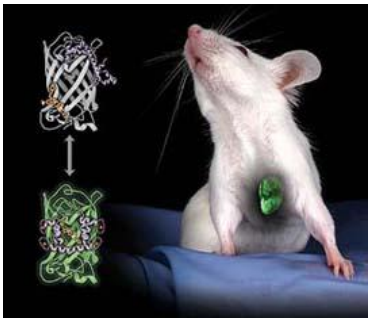
Day #18 **Blood products** (*Medical Facilities, Research Labs)* Origen, Hematech.

Day #19 **Mad Cow Disease – BSE knock out cow** (*Kobe beef*), *Nature Biotechnology* 2007, **25**, 132-138.

Day #20 **Genetically Engineered Animals and Public Health** (*Medical Facilities, Research Labs)* Genetically Engineered Animals and Public Health

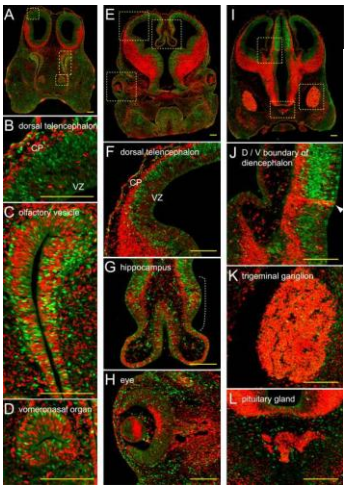
Day #21 **Heart disease, *in vivo* calcium monitors** (*Medical Facilities, Research Labs)*

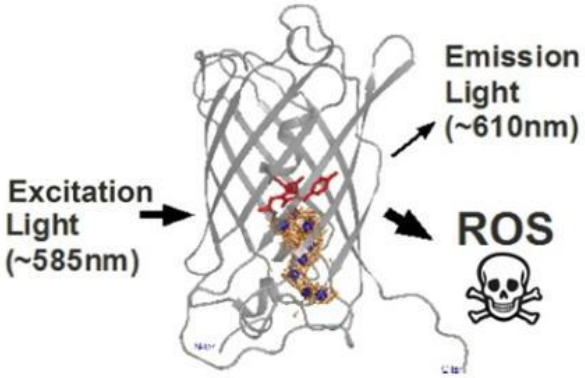




Day #22 **Optogenetics**, (*Medical Facilities, Research Labs)* Nature 2010**, 465**, 26-28

Day #23 **KillerRed, Fucci, Kaede** (*Medical Facilities, Research Labs)*





FIELD ASSIGNMENTS (*At least twenty percent of the contact hours for each course.*)

Once all the field trips for this voyage have been finalized this syllabus will be modified to include a list of field trips relevant to this course. The topical outline of the course, given above, should provide a good overview of the types of field trips considered and their relevance to the course.

The list of appropriate field trips will be long and you will be required to attend at least 5 of the trips, one of them has to be to one of the research labs. You will be required to write five short reactions/reflection papers. The papers should be 3-4 pages in length. The goals of these reflection papers are to encourage you to reflect upon experiences that you had during your field trips and most importantly to integrate the material studied in class with the on-shore experiences in the countries visited.

Think about how the countries we are visiting are affected by the diseases we are studying (AIDS, Malaria, Dengue Fever, Chagas (kissing disease))? What are the attitudes/laws to genetic engineering and biotechnology?

The reports should also answer the following three questions; a) What did you learn on the trip? (A summary of knowledge and insight acquired); b) How did you learn it? (A detailed description of what was accomplished); c) Why is this important? (An informed discussion about how this experience fits into the context of the course and any other courses you are taking this semester).

The reports will be evaluated s follows

40% of the report grade will be based on the science in the report (is it correct and is there sufficient science in the report),
40% content/integration
10% grammar, spelling etc.
10% style and readability

Preliminary List of Field Trips

Location	Trip	Description
Dominica	Zimmer	Hot Springs & Snorkeling in

		Champagne Reef
South Africa	Zimmer	Heart transplant museum Institute of Infectious Disease and Molecular Medicine International Centre for Genetic Engineering and Biotechnolgy
Mauritius	MAU05	Volcanic Island
	MAU13	Marine Science Research & Marine Park
India		Bhopal: Twenty seven years later
Hong Kong	HKG06	Sustainable living: Is high-density the new green?
Japan	Zimmer	Riken – Center for Developmental biology (Kobe) Riken – Yokohama Institute
Hawaii	HIL05	Captain Zodiac Snorkeling Excursion
	HIL08	Volcanoes National Park

ELECTRONIC COURSE MATERIALS

PDF files of all articles associated with this course will be available on the ship's intranet.

METHODS OF EVALUATION

Two class tests	40%
Six integrated field trip reports	20%
Class participation, Homeworks	10%
Final exam	30%

POLICIES AND EXPECTATIONS

Attendance: The success of your learning experience depends on the active contributions of all the students enrolled in the class. Therefore, your attendance is important and required. If you miss class or are absent due to an illness, you are responsible for the information covered

during the missed class meeting. You can have no more than two unexcused absences.

Make-ups: No make-up exams or presentations will be given unless you have a verifiable excused absence. Without a verifiable excused absence, you will receive a score of zero for the test or assignment.

Extra Credit: No extra credit will be given in this course.

Academic Honesty: Academic dishonesty encompasses both cheating and plagiarism. You will be tested on all materials covered in the assigned readings, class lectures, and field trips. Exams will be cumulative.

Due Dates: The reaction papers should be turned in on time on the specified day and time. If papers are turned in late, 10 percent will be deducted for each day the submission is late.