

***Shoals Marine Laboratory***  
***BIOSM 4720 Genetics of Marine Diversity***  
***TENTATIVE 2009 Syllabus (subject to change)***

Faculty: Dr. Andrew M. Shedlock, Harvard University, OEB, MCB, MCZ (shedlock@oeb.harvard.edu)

All laboratory and lecture activities will be based in the Kiggins Wet Lab and Leighton Table Room

Fld = field; Lec = lecture/discussion; Lab = laboratory; LT = low tide

Meals: Mon-Sat Breakfast 7:30 am, Lunch 12:30 pm, Dinner 6:00 pm  
Sunday Brunch 10:00 am, Sunday Dinner 5:00 pm

**20 July Monday** (LT @ 0748, 1957)

*STUDENTS ARRIVE AFTERNOON*

Afternoon Lec: Fire & Water, General information (*appx 1500-1530*)  
*Settle into rooms 1530-1630*

Fld: Island tour and history w/Hal Weeks, SML (*1630-1730*)

Evening Lec: Welcome and introductions, course philosophy, organization and goals (*1900-2000*)  
*Break 15 min*

Lec: Initial considerations of student research projects (*2015-2130*)  
a) Structure of the class projects, proposal synthesis and student symposium  
b) Overview of available PCR and computational facilities  
c) Molecular, taxonomic and geographic sampling strategies  
d) Building a foundation for an SML genetic data archive

Assignment: Sleep well and dream about what species you would like to investigate

**21 July Tuesday** (LT @ 0825, 2041)

Morning Fld: Intertidal sampling of inverts across Appledore. *Carpe diem!* (*0815-1145*)  
Lab: Safety issues; Preparation of specimens for DNA extraction (*1200-1230*)

Afternoon Lec: Guest: Julie Ellis, Tufts U. - *Seabird research on Appledore* (*1315-1445*)  
*Break 15 min*

Lab: Bench set-ups and methods for DNA isolation (*1500-1800*)

Evening Lab: Completion of DNA extractions; Intro to running gels (*1900-2030*)  
Lec: Rock Talk: Ted Ames, Penobscot East Fisheries Center - *Gulf of Maine fisheries conservation* (*2030-2130*)

**22 July Wednesday** (LT @ 0905)

Morning & Afternoon Fld: Coastal NH intertidal collections, exposed and sheltered locations on mainland  
(*dep 0815, return 1515; box lunches*)

Lab: Isolate DNA from new coastal field samples (*1600-1800*)

Evening Lec: Intro to basic concepts I: Data generation (*1900-2030*)  
*Break 15 min*

Lec: Intro to basic concepts II: Data analysis (*2030-2130*)

**23 July Thursday** (LT @ 0948)

- Morning Lec: Guest: Jim Coyer, U. Groningen - *Rockweed molecular ecology (0815-1045)*  
*Break 15 min*  
Lec: Guest: Jim Coyer, U. Groningen - *Rockweed genetics cont'd (1100-1230)*
- Afternoon Fld: Specimen collecting, Smuttynose Is. (1315-1530)  
*Break 15 min*  
Lab: PCR set up and DNA amplifications (1600-1800)
- Evening Lec: Guest: JB Heiser, Cornell U. - *Reef fish zoogeography (1900-2015)*  
*Break 15 min*  
Lab: Lec: Guest: Hal Weeks, SML - *Marine fisheries in theory and practice (2030-2130)*

**24 July Friday** (LT @ 1036)

- Morning Lab: Intro to genotype and sequence reaction processing (0815-1045)  
*Break 15 min*  
Lab: Open period for bench experiments (1100-1230)
- Afternoon Lab: PCR marathon and reaction preps, cont'd (1315-1800)
- Evening Lec: Robin Hadlock Seeley, Cornell U. - *Tales of snails (and crabs) (1900-2015)*  
*Break 15 min*  
Lab: Open period for bench experiments (2030...)

**25 July Saturday** (LT @ 1129)

- Morning Lec: Research proposals: The good, the bad, and the ugly (0830-0945)  
*Break 15 min*  
  
Assignment: Peer Review of Research Grant Proposal  
  
Lab: Free time to develop proposal and review literature (1000-1230)
- Afternoon Lec: Guest: Chris Botka, Harvard U. - *Intro to the computational toolbox (1330-1445)*  
*Break 15 min*  
Lab: Discussions of data analysis and computer software applications (1500-1545)  
*Break 15 min*  
Lab: Time for bench work or proposal development (1600-1800)
- Evening Lab: Final period for preparing PCR products for genotyping/sequencing (1900...)

**26 July Sunday** (LT @ 1217)

Morning SUNDAY BRUNCH

Fld: Visit and tour of UNH Hubbard Center for Genome Studies (*depart 1100*)

Host: Jobriah Anderson, Head Technician, HCGS

Fld: Free time to explore downtown Portsmouth (*return to Appledore by 1700*)

ISLAND BANQUET (1900-2000)

Evening Lec: Phylogenomics of mobile repetitive DNA (*2015-2100*)

*Break 15 min*

Lec: Vertebrate S/LINEs, amniote genomics and cetacean macroevolution (*2115-2200*)

**27 July Monday**

Morning Lec: Guest: Chris Botka, Harvard U. - *Genome informatics I* (*0830-0945*)

*Break 15 min*

Lec: Guest: Chris Botka, Harvard U. - *Genome informatics II* (*1100-1230*)

Afternoon Lab: Student comp-bio exercises with practice sequences (*1330-1430*)

*Break 15 min*

Lab: Student comp-bio exercises with practice genotypes (*1445-1600*)

*Break 15 min*

Lab: Time for proposal development (*1615-1800*)

Evening Lec: Anglerfish mitogenomics part 1 (*1900-2000*)

*Break 15 min*

Lec: Anglerfish mitogenomics part 2 (*2015-2130*)

Assignment: Peer review of research journal manuscript

**28 July Tuesday**

Morning Lab: Begin editing student raw ABI output files (*0830-0945*)

*Break 15 min*

Lab: Continue editing raw ABI output files (*1100-1230*)

Afternoon Lab: Edited sequence alignment and assembly (Sequencher) (*1330-1430*)

*Break 15 min*

Lab: Scoring microsatellite alleles (GeneMapper) (*1445-1600*)

*Break 15 min*

Lab: Guidelines for constructing primary data sets (*1615-1800*)

Evening Lec: Rock Talk: Matt Hare, Cornell U. - *A window into larval dispersal provided by genetics* (*2030-2130*)

### **29 July Wednesday**

- Morning      Lab: Student sequence matrix analysis (1900-2000)  
                    *Break 15 min*  
                    Lab: Student allele frequency analysis (2015-2130)
- Afternoon    Lab: Statistical analysis of student data sets (1330-1800)
- Evening      Lec: Time to discuss literature and work on peer reviews (1900-2000)  
                    *Break 15 min*  
                    Lab: Open lab for data analysis and synthesis (2015-2130)
- Reading: Conservation genetics article

### **30 July Thursday**

- Morning      Lec: Guest: Akiko Okusu, Simmons Coll. - *Invertebrate DNA tree of life* (0830-0945)  
                    *Break 15 min*  
                    Lec: Guest: Akiko Okusu, Simmons Coll. - *Sand dollar population genetics* (1100-1230)
- Afternoon    Lab: Proposal data synthesis and writing (1330-1800)
- Evening      Lec: Discussion of conservation article (1900-2000)  
                    *Break 15 min*  
                    Lab: Open question and answer period (2015-2130)
- Reading: Comparative genomics research article

### **31 Aug Friday**

- Morning      Lec: Conservation genetics: population issues (0830-0945)  
                    *Break 15 min*  
                    Lec: Conservation genetics: phylogenetic issues (1100-1230)
- Afternoon    Lab: Proposal data synthesis and writing (1330-1800)
- Evening      Lec: Discussion of genomics reading (1900-2000)  
                    *Break 15 min*  
                    Lab: Guidelines for student symposium (2015-2100)

### **1 Aug Saturday**

- Morning      Lec: Guest: Abigail Fusaro, MIT/WHOI - *Popgen of deep sea thermal vents* (0830-0945)  
                    *Break 15 min*  
                    Lec: Guest: Abigail Fusaro, MIT/WHOI - *Thermal vent genetics cont'd* (1100-1230)
- Afternoon    Lab: Preparation of student symposium presentations (1330-1800)
- Evening      Lec: Genomics-enabled biology and next-generation DNA technologies (1900-2000)  
                    *Break 15 min*  
                    Lab: Time for proposal and/or symposium preparation (2015...)

## **2 Aug Sunday**

Morning            SUNDAY BRUNCH

Afternoon        Lec: *STUDENT RESEARCH PRESENTATIONS (1330-1530)*  
Lab: Lab all-hands clean up (*1530-1700*)

Evening           *WRITTEN RESEARCH PROPOSALS, PEER REVIEWS, NOTEBOOKS DUE BY 1900*  
  
*CLASS FAREWELL RECEPTION ON SUNSET PAVILION (1900...)*

## **3 Aug Monday**

Morning           Dorm clean-up and packing (*0830-1000*)  
  
Departure to mainland (*1000*)

## **Course Approach**

BIOSM 4720 is primarily a field and laboratory course and the majority of our time and effort will be focused on laboratory experiments based on specimens collected, sampled and archived from the local environment. As such, most of the grade is based on the completion of both field and laboratory components as reflected by summary of research activities in writing and orally. There are no formal exams. Guest lectures provide an opportunity to meet and interact personally with a diversity of leading investigators in the field and illustrate case examples of integrative research programs in marine molecular ecology, evolution and genomics.

## **Written Grant Proposal (40% of final grade)**

The primary assignment of BIOSM 4720 is a written research proposal of testable questions and how to address them with molecular genetic tools. The focus of this assignment is not on presenting comprehensive or conclusive data but rather on thinking critically about the integration of DNA analysis in ecology and evolution as a means of creative problem solving.

Proposal structure (6 page limit):

- 1) Literature and background
- 2) Summary of testable questions of target taxa; includes rationale and justification of proposed activities
- 3) Methods (field, lab, computational)
- 4) Preliminary data (pilot study, proof of concept)
- 5) Budget guidelines for practical design and sampling constrains (reality check); proposal priorities need to be constructed within this range of limited time and resources
- 6) Bibliography

## **Oral Presentation of Research (20% of final grade)**

On the final day of the course students will present a 20-minute research talk, open to the entire island community, using Powerpoint slides in the format of a professional research symposium. Questions and discussion will follow each presentation.

## **Peer Review Assignments (10% each review or 20% of final grade)**

Anonymous peer review is an essential process within the professional research community. Students will serve as referees for drafts of two forms of research communication: 1) A full-scope grant proposal in the format of a federal granting agency's guidelines; and 2) a manuscript in the format of that submitted to a specialty journal in molecular ecology, systematics and evolution.

### **Notebooks (10% of final grade)**

Keeping a detailed lab notebook is essential for completing a molecular study, recording protocols and sample information (including field collections), designing experiments and displaying raw data and interpreting/summarizing primary results. Be proud of your notebook: it is your scientific diary, and is generally considered a legal document in the professional research community. As such it provides critical continuity for you and others to evaluate, repeat and expand upon your work in the near and distant future. Notebooks will be reviewed for their clarity, organization, completeness and overall quality as a detailed, comprehensive record of your research activities during the course.

### **Participation (10% of final grade)**

Active participation is expected in all aspects of the course, including asking questions, participating in discussions, attending lectures and field trips and functioning cooperatively in the laboratory, including keeping a clean bench space and helping maintain common equipment, supplies and work areas.

### **Readings**

No texts are required but a large series of standard references in the field is available to students, loaned to the course from the instructor's personal library. Literature will be surveyed as a practical, targeted need to complete research activities and prepare research proposals. We will also select studies from the visible primary literature as a topical focus for in-class discussion.