

# FLORIDA ATLANTIC UNIVERSITY™

## Graduate Programs—NEW COURSE PROPOSAL<sup>1</sup>

UGPC APPROVAL \_\_\_\_\_  
 UFS APPROVAL \_\_\_\_\_  
 SCNS SUBMITTAL \_\_\_\_\_  
 CONFIRMED \_\_\_\_\_  
 BANNER POSTED \_\_\_\_\_  
 CATALOG \_\_\_\_\_

DEPARTMENT: BIOLOGICAL SCIENCES

COLLEGE: COLLEGE OF SCIENCE

**RECOMMENDED COURSE IDENTIFICATION:**

PREFIX      ZOO      COURSE NUMBER 6695 LAB CODE (L or C)     

(TO OBTAIN A COURSE NUMBER, CONTACT [MJENNING@FAU.EDU](mailto:MJENNING@FAU.EDU))

COMPLETE COURSE TITLE: **Bivalve Biology and Physiology**

**EFFECTIVE DATE**

(first term course will be offered)  
 FALL 2014

CREDITS<sup>2</sup>: 3

TEXTBOOK INFORMATION: R.H. Carmichael, A.C. Shriver and I. Valiela. 2012. Bivalve Response to Estuarine Eutrophication: The Balance between Enhanced Food Supply and Habitat Alterations. *J. Shellfish Res.*, 31:1-11  
 D.B. Lowry. 2012. Ecotypes and the controversy over stages in the formation of new species. *Biol. J. Linnean Soc.*, 106: 241-257.

GRADING (SELECT ONLY ONE GRADING OPTION): REGULAR      X      SATISFACTORY/UNSATISFACTORY     

COURSE DESCRIPTION, NO MORE THAN THREE LINES: Course examines bivalve mollusc biology, such as feeding, reproduction, stress response and population genetics, in relation to natural life history, invasion potential and culture.

PREREQUISITES \*: Undergraduate General Biology or Invertebrate Biology or Permission of the instructor

COREQUISITES\*:

REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL)\*:

\* PREREQUISITES, COREQUISITES AND REGISTRATION CONTROLS WILL BE ENFORCED FOR ALL COURSE SECTIONS.

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE: PH.D. IN THE RELEVANT FIELD

Faculty contact, email and complete phone number:  
 Dr. John Scarpa  
[jscarpa1@fau.edu](mailto:jscarpa1@fau.edu)  
 (772) 242-2404

Please consult and list departments that might be affected by the new course and attach comments.<sup>3</sup>

**Approved by:**

Department Chair: *David Bryjic*  
 College Curriculum Chair: *[Signature]*  
 College Dean: *Russell Oly*  
 UGPC Chair: *[Signature]*  
 Graduate College Dean: *[Signature]*  
 UFS President: \_\_\_\_\_  
 Provost: \_\_\_\_\_

**Date:**

1/30/14  
2/10/14  
2/16/14  
2/26/14  
2/26/14

1. Syllabus must be attached; see guidelines for requirements: [www.fau.edu/provost/files/course\\_syllabus.2011.pdf](http://www.fau.edu/provost/files/course_syllabus.2011.pdf)
2. Review Provost Memorandum: **Definition of a Credit Hour** [www.fau.edu/provost/files/Definition\\_Credit\\_Hour\\_Memo\\_2012.pdf](http://www.fau.edu/provost/files/Definition_Credit_Hour_Memo_2012.pdf)
3. Consent from affected departments (attach if necessary)

Email this form and syllabus to [UGPC@fau.edu](mailto:UGPC@fau.edu) one week before the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

## Course Syllabi for Bivalve Biology and Physiology

1. **Course title/number, number of credit hours**  
Bivalve Biology and Physiology - ZOO 6695, 3 credits
2. **Course prerequisites or corequisites**
  - a. Prereq: Undergraduate General Biology or Invertebrate Biology  
or
  - b. Permission of the instructor
3. **Course logistics**
  - a. Term – FALL 2014
  - b. Notation if online course – N/A
  - c. Class location and time (if classroom-based course) – HBOI, room TBD
4. **Instructor contact information**
  - a. Instructor's name – John Scarpa
  - b. Office address – HBOI-ACTED Bldg, Room 112
  - c. Office hours – TBD each semester and by appointment
  - d. Contact telephone number – Office (772) 242-2404, Fax (772) 466-6590
  - e. E-mail address – jscarpal@fau.edu
5. **TA contact information (if applicable):** not applicable
6. **Course description**

This course will expose students to the basic biology and physiology of bivalve molluscs, with an emphasis on the eastern oyster and northern hard clam, through lecture, readings assignments, discussion and demonstrations. Potential topics include taxonomy, anatomy, feeding, reproduction, larval development, shell formation, stress response, immune system, culture techniques for research, population genetics, and invasive species.
7. **Course objectives/student learning outcomes**

This course aims to introduce fundamental biology and physiology of bivalve molluscs. Upon completion of this course students will be able to: a) delineate taxonomic positions, b) identify major anatomical features, c) describe feeding mechanisms, d) describe gametogenesis, e) describe larval development and metamorphic cues, f) relate physiological response to stressors, g) describe cellular immune response, h) apply basic culture techniques, i) understand population genetics and gene flow, and j) relate environment to success of invasive species for bivalve molluscs.
8. **Course evaluation method**

There will be graded homework assignments accounting for 10% of the student's cumulative performance, a midterm exam accounting for 40% of the student's

cumulative performance, a final exam accounting for 40% of the student's cumulative performance, and a written research report accounting for 10% of the student's cumulative performance. The overall grade in the course is derived from the cumulative performance according to the following table.

#### 9. Course grading scale

Cumulative Performance	Grade
>92%	A
>88% - 92%	A-
>85% - 88%	B+
>82% - 85%	B
>78% - 82%	B-
>75% - 78%	C+
>72% - 75%	C
>68% - 72%	C-
>65% - 68%	D+
>62% - 65%	D
>58% - 62%	D-
<58%	F

#### 10. Policy on makeup tests, late work, and incompletes

Attendance for lectures and exams is required. No exam grade will be dropped. If an exam is missed with proper prior notification, the test may be taken as soon as possible after the exam date, but no later than the following class day. If the exam is not taken a grade of zero (0) will be entered. No extra credit assignments will be given. If a student cannot turn in a homework project on time due to circumstances beyond their control then the instructor may assign appropriate make-up work. Students will not be penalized for absences due to participation in University-approved activities, including athletic or scholastics teams, musical and theatrical performances, and debate activities. Students who are absent due to participation in University-approved activities are required to make up missed assignments and material. Reasonable accommodation will also be made for students participating in a religious observance. Grades of Incomplete ("I") are reserved for students who are passing a course but have not completed all the required work because of exceptional circumstances. A grade of "I" will only be given under certain conditions and in accordance with the academic policies and regulations put forward in FAU's University Catalog. The student must show exceptional circumstances why requirements cannot be met. A request for an incomplete grade has to be made in writing with supporting documentation, where appropriate. As per university policy, an incomplete grade will only be given to a student who fulfills all of the following criteria:

- a. misses multiple exams or the final examination due to a legitimately documented emergency as defined by the FAU Academic Policies and Regulations:

[http://www.fau.edu/academic/registrar/09-10\\_catalog/academics.html](http://www.fau.edu/academic/registrar/09-10_catalog/academics.html)

- b. has a grade of C or better
- c. submits evidence of the emergency and signs an incomplete agreement.

**11. Special course requirements (if applicable) – N/A**

**12. Classroom etiquette policy**

University policy on the use of electronic devices states: “In order to enhance and maintain a productive atmosphere for education, personal communication and electronic devices, such as cellular telephones and pagers, are to be disabled during class sessions.”

**13. Disability policy statement**

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodation due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) -- in Boca Raton, SU 133 (561-297-3880); in Davie, MOD 1 (954-236-1222); or in Jupiter, SR 117 (561-799-8585); – and follow all OSD procedures. [Please check on phone numbers.]

**14. Honor Code policy statement**

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty, including cheating and plagiarism, is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001 at [http://www.fau.edu/ctl/4.001\\_Code\\_of\\_Academic\\_Integrity.pdf](http://www.fau.edu/ctl/4.001_Code_of_Academic_Integrity.pdf)

**15. Required texts/readings**

There is no required textbook. Reading assignments related to the topics under discussion will be drawn from the current scientific literature and will form the basis of homework assignments. Examples follow:

1 - R.H. Carmichael, A.C. Shriver and I. Valiela. 2012. Bivalve Response to Estuarine Eutrophication: The Balance between Enhanced Food Supply and Habitat Alterations. *J. Shellfish Res.*, 31:1-11.

2 - D.B. Lowry. 2012. Ecotypes and the controversy over stages in the formation of new species. *Biol. J. Linnean Soc.*, 106: 241-257.

- 3** - J.E. Ward, L.P. Sanford, R.I.E. Newell, and B.A. MacDonald. 1998. A New Explanation of Particle Capture in Suspension-Feeding Bivalve Molluscs. *Limnology and Oceanography*, 43: 741-752.
- 4** - J.E. Ward and S.E. Shumway. 2004. Separating the grain from the chaff: particle selection in suspension- and deposit-feeding bivalves. *J. Exp. Mar. Biol. Ecol.*, 300: 83-130.
- 5** - E. Pales Espinosa, M. Perrigault, J.E. Ward, S.E. Shumway and B. Allam. 2010. Microalgal Cell Surface Carbohydrates as Recognition Sites for Particle Sorting in Suspension-Feeding Bivalves. *Biol. Bull.*, 218: 75-86.
- 6** - J.P. Evans, F. Garcia-Gonzalez, M. Almbro, O. Robinson and J.L. Fitzpatrick. 2012. Assessing the potential for egg chemoattractants to mediate sexual selection in a broadcast spawning marine invertebrate. *Proceedings of the Royal Society B*, doi: 10.1098/rspb.2012.0181
- 7** - B. Morton. 2012. The functional morphology of the abyssal *Limopsis cristata* (Arcoida: Limopsidae) with a discussion on the evolution of The more advanced bivalve foot. *Acta Zoologica*, doi: 10.1111/j.1463-6395.2012.00561.x
- 8** - D.E. Jacob, A.L. Soldati, R. Wirth, J. Huth, U. Wehrmeister, W. Hofmeister. 2008. Nanostructure, composition and mechanisms of bivalve shell growth. *Geochemica et Cosmochimica Acta*, 72:5401-5415.
- 9** - S. Hahn, R. Rodolfo-Metalpa, E. Griesshaber, W.W. Schmahl, D. Buhl, J.M. Hall-Spencer, C. Baggini, K.T. Fehr, and A. Immenhauser. Marine bivalve geochemistry and shell ultrastructure from modern low pH environments. *Biogeosciences Discuss.*, 8: 10351-10388.
- 10** - G.H. Leonard, M.D. Bertness and P.O. Yund. 1999. Crab predation, waterborne cues, and inducible defenses in the blue mussel, *Mytilus edulis*. *Ecology*, 80: 1-4.
- 11** - M. Nakaoka. 2000. Nonlethal effects of predators on prey populations: predator-mediated changes in bivalve growth. *Ecology*, 81: 1031-1045.
- 12** - G. Santinia, C. Bruschinia, L. Pazzagli, G. Pieraccini, G. Monetic, and G. Chelazzia. 2001. Metabolic responses of the limpet *Patella caerulea* (L.) to anoxia and dehydration. *Comp. Biochem. Physiol. A*, 130: 1-8.
- 13** - C.E. Braby and G.N. Somero. 2006. Following the heart: temperature and salinity effects on heart rate in native and invasive species of blue mussels (genus *Mytilus*). *J. Exp. Biol.*, 209: 2554-2566.

- 14 - L. Tomanek and G.N. Somero. 2000. Time Course and Magnitude of Synthesis of Heat-Shock Proteins in Congeneric Marine Snails (Genus *Tegula*) from Different Tidal Heights. *Physiol. Biochem. Zool.*, 73: 249-256.
- 15 - Galindo-Sanchez, CE, PM Gaffney, CI Perez-Rostro, J de la Rosa-Velez, J Candela, P Cruz. 2008. Assessment of genetic diversity of the eastern oyster *Crassostrea virginica* in Veracruz, Mexico using microsatellite markers. *J. Shellfish Res.*, 27: 721-727.
- 16 - Hare, MP, JC Avise. 1998. Population structure in the American oyster as inferred by nuclear gene genealogies. *Molecular Biology and Evolution* 15:119-128.
- 17 - Hedgecock, D. and A.I. Pudvokin. 2011. Sweepstakes reproductive success in highly fecund marine fish and shellfish: a review and commentary. *Bulletin of Marine Science* 87: 971-1002.
- 18 - Murray, M.C. and M.P. Hare. 2006. A genomic scan for divergent selection in a secondary contact zone between Atlantic and Gulf of Mexico oysters, *Crassostrea virginica*. *Molecular Ecology* 15: 4229-4242.
- 19 - Reeb, C.A. and J.C. Avise. 1990. A genetic discontinuity in a continuously distributed species: mitochondrial DNA and in the American oyster, *Crassostrea virginica*. *Genetics* 124: 397-406.
- 20 - Varney, R.L., C.E. Galindo-Sánchez, P. Cruz and P.M. Gaffney. 2009. Population genetics of the Eastern oyster *Crassostrea virginica* (Gmelin, 1791) in the Gulf of Mexico. *Journal of Shellfish Research* 28:855-864.
- 21 - S. Liu, T. Walshe, G. Long, and D. Cook. 2012. Evaluation of Potential Responses to Invasive Non-Native Species with Structured Decision Making. *Conservation Biology*, 1-8.
- 22 - J.G. Ehrenfeld. 2010. Ecosystem Consequences of Biological Invasions. *Annu. Rev. Ecol. Evol. Syst.*, 41: 59-80.
- 23 - J. Carlsson, R.B. Carnegie, J.F. Cordes, M.P. Hare, A. Thomas Leggett, and K.S. Reece. 2008. Evaluating Recruitment Contribution of a Selectively Bred Aquaculture Line of the Oyster, *Crassostrea virginica* used in Restoration Efforts. *J. Shellfish Res.*, 27: 1117-1124.
- 24 - M.H. Doall, D.K. Padilla, C.P. Lobue, C. Clapp, A.R. Webb and J. Hornstein. 2008. Evaluating Northern Quahog (= Hard Clam, *Mercenaria mercenaria* L.) Restoration: Are Transplanted Clams Spawning and Reconditioning. *J. Shellfish Res.*, 27: 1069-1080.

25 - C.W. McKindsey, T. Landry, F.X. O'beirn and I.M. Davies. 2007. Bivalve aquaculture and exotic species: a review of ecological considerations and management issues. *J. Shellfish Res.*, 26:281-294.

26 - **Biology of the Hard Clam**, 2001, edited by J.N. Kraeuter and M. Castagna, Elsevier, New York, NY, 751 pp.

27 - **The Eastern Oyster *Crassostrea virginica***, 1996, edited by V.S. Kennedy, R.I.E. Newell and A.F. Eble, Maryland Sea Grant Book, College Park, MD, 734 pp.

**16. Supplementary/recommended readings (optional)**

28 - Galtsoff, P.S. 1964. **The American Oyster *Crassostrea virginica***. *Fishery Bulletin of the Fish and Wildlife Service*, 64: 1-480.

29 - **Scallops: Biology, Ecology and Aquaculture**, 2006, edited by S. Shumway and J. Parsons. Elsevier, NY, 1500 pp.

30 - **The Mollusca**, 12-volume set, 1980s, Karl M. Wilbur (Editor-in-Chief), Academic Press, NY

**17. Course topical outline**

Week	Topic	H.W*. or Reading (# above)
1	Class Introduction	Read # 2, 26, 27 assign chapt
2	Bivalve Taxonomy	Read # 7, 26, 27 assign chapt
3	Bivalve Anatomy	Read # 3 to 5
4	Gill Structure/Feeding/Particle Handling	Read # 6
5	Gametogenesis/Larvae Development	Read # 8, 9
6	Metamorphosis/Shell Development	Read # 10 to 14
7	Physiological Response to Stresses	Study for Exam, Res. Rpt. Topic
8	Midterm Exam/Res. Rpt. Topic due	Read # 26, 27 assign chapt
9	Immune System (Hemocytes)	Read # 26, 27 assign chapt
10	Parasitic Diseases	Read # 1, 26, 27 assign chapt
11	Culture Systems for Research	Read # 26, 27 assign chapt
12	Culture Techniques for Research	Read # 15 to 20
13	Population Genetics/Connectivity	Read # 21, 22, 25
14	Invasive Molluscan Species	Read # 23, 24, 25
15	Natural Resource Management	Study for Exam, Res. Rpt.
16	Research Report due/Final Exam	

\*Other homework will be assignment of students who will lead discussion of reading material for each topic each week.