

University of Guelph  
Department of Integrative Biology

**Marine Ecological Processes ZOO\*4570 – Winter 2017**  
**COURSE OUTLINE**

**Course description: ZOO\*4570 Marine Ecological Processes W (3-1) [0.50]**

This course provides an advanced analysis of the physical and biogeochemical processes in the world's oceans and the dependence of biological processes on physical and chemical processes from micro- to macro-scales. Topics to be discussed include production and energy transfer within pelagic food webs, export of energy to the benthos, and structure and dynamics of marine communities.

**Prerequisites:** BIOL\*2060, BIOL\*3450, PHYS\*1080

**Teaching team:**

Professor Elizabeth G. Boulding, [boulding@uoguelph.ca](mailto:boulding@uoguelph.ca), x54961; Rm 1464 SSC.

**Office Hours:** please arrange appointment with Dr. Boulding by email

Professor Josef D. Ackerman, [ackerman@uoguelph.ca](mailto:ackerman@uoguelph.ca), x58268, Rm 2468 SSC.

**Office Hours:** Friday 1:30-3:30; or via appointment by email

Melissa Holborn, [mholborn@uoguelph.ca](mailto:mholborn@uoguelph.ca), Rm 1466 SSC.

**Office Hours:** During tutorial period.

**Course schedule:**

**Lectures:** Monday, Wednesday, and Friday 10:30AM - 11:20AM in ROZH 105

**Laboratory:** Friday 12:30PM - 01:20PM in SSC 2314

<b>Course Assessment:</b>	Midterm exam	25%	01 Mar 17 (in class)
	Term paper	25%	06 Mar 17 (3% Peer Assessment)
			13 Mar 17 (2% Peer Assessment)
			27 Mar 17 (20% paper)
	Laboratory	15%	10 weekly assignments during laboratories
	Top Hat	2.5%	questions during class or as homework
	Final exam	<u>32.5%</u>	17 Apr 17 TBA (7-9 pm)
	Total	100%	

**Course Content and Readings\*:**

<b>Week</b>	<b>Lecture Topics</b>	<b>Lab Topics</b> (based on Pipkin et al. <i>Lab Exercises in Oceanography</i> )	<b>Readings in Marine Ecological Processes 2017 (Custom Text)</b>
<b>(A) Marine Geology (Professor Boulding)</b>			
(1)	Seaweeds; Plate tectonics	Marine Macroalgae (wet lab)	Ch1 - Plate Tectonics, Ch8 - Multicellular Primary Producers
(2)	Ocean basins/Ocean sediments	Seafloor spreading, plate tectonics	Ch2 - Ocean Floor
<b>(B) Marine Chemistry (Professor Boulding)</b>			
(3)	Ocean compartment properties; Seawater Composition; Ocean fertilization	Marine sediments/ ocean pH; CCD depth	Ch3 - Water and Ocean Structure
<b>(C) Marine Physics (Professor Ackerman)</b>			
(4)	- <u>Atmospheric Circulation</u> (Coriolis effect Circulation cells, up/downwelling, ENSO, NAO); - <u>Ocean Circulation</u> (Forces, Surface Currents – Ekman transport)	Temperature , salinity; Coriolis effect	Ch4 – Atmospheric Circulation Ch5 – Circulation of the Ocean
(5)	- <u>Ocean Circulation</u> ( <u>1</u> : Surface Currents – geostrophic gyres, convergence/divergence zones; <u>2</u> : Thermohaline Circulation – water masses, Ocean Conveyor belt) - <u>Tides</u> (equilibrium model, forces, structure)	Surface currents; deep water masses	Ch5 – Circulation of the Ocean Ch6 – Waves and Tides
(6)	- <u>Tides</u> (patterns, amphidromic system, currents) - <u>Waves</u> (structure, classification, deep vs. shallow, wind waves, interactions)	Satellite Oceanography - remote sensing	Ch6 – Waves and Tides

Week	Lecture Topics	Lab Topics (based on Pipkin et al. <i>Lab Exercises in Oceanography</i> )	Readings in <i>Marine Ecological Processes 2017 (Custom Text)</i>
<b>(D) Marine Biology (Professor Boulding)</b>			
(7)	Primary production; Phytoplankton diversity	Primary productivity, critical depth	Ch7 – Marine Microbes
(8)	Zooplankton diversity	Plankton (wet lab)	Ch7 – Marine Microbes Ch9 – Marine Communities
(9)	Open Ocean Upwelling effects on food chain length; Ocean fertilization	Ocean Networks Canada observatories	Ch9 – Marine Communities
<b>(E) Marine Ecosystems and Processes (Professor Ackerman)</b>			
(10)	<ul style="list-style-type: none"> <li>- <u>Coasts</u> (Leading edge, Trailing edge (Neo-, Afro-, &amp; Amero- ), Island coasts)</li> <li>- <u>Rocky Intertidal</u> (zonation, abiotic, biotic factors, keystone predators, disturbance)</li> <li>- <u>Hydrothermal Vents &amp; Seeps</u> (formation, geochemistry, distribution, ecology)</li> </ul>	Tides	Ch8 - Multicellular Primary Producers Ch9 – Marine Communities
(11)	<ul style="list-style-type: none"> <li>- <u>Estuaries and Soft Sediment Ecology</u> (flows, saltmarsh/mangrove; sand/mud flat; sediment processes, suspension /deposit feeding)</li> <li>- <u>Suspension Feeding</u> (diversity, particle capture, biotic vs. abiotic)</li> <li>- <u>Seagrass Ecology &amp; Reproduction</u> (diversity, morphology, productivity, reproduction)</li> </ul>	No lab scheduled	Ch8 – Multicellular Primary Producers Ch9 – Marine Communities
(12)	<ul style="list-style-type: none"> <li>- <u>Coral Reefs</u> (biology, diversity, reef types, environmental impacts, microbialites)</li> <li>- <u>Broadcast Spawning</u> (reproductive strategies, mass spawning/triggers, gamete contact, sperm limitation)</li> <li>- <u>Larval Dispersal and Settlement</u> (diversity, movement, settlement, flux, local vs. far field)</li> </ul>	No lab scheduled	Ch8 – Multicellular Primary Producers Ch9 – Marine Communities

\*Topics subject to change

**Course Assessment, Due Dates, and Links to Learning Outcomes:**

Assessment		Due Date	Course Content /Activity	Learning Outcome Addressed
Form	Weight			
First Lecture*	--	09 January 2017 (Monday)	--	--
Top Hat**	2.5%	in-class / beginning of next class	Questions/discussions	1-20
First Lab	--	13 January 2017 (Friday)	--	--
Laboratory*	15%	Weekly assignment due at end of each laboratory	Laboratory and computer oceanography activities	1 to 20
Reading week	--	20-24 February 2017	No Classes /Labs scheduled this week	
Midterm***	25%	1 Mar 2017 (Wednesday) in lecture	Lecture, Assigned Readings	
Peer assessment of Complete draft of Term paper	3%	06 March 2017 (Monday), (posted on PEAR before 23:59)	Term Paper	1-20
40th Class day	--	10 March 2017 (Friday)	Last day to drop course without penalty.	
Quality of Peer review of another student's	2%	13 March 2017 (Monday) (posted on PEAR before 23:59)	Term Paper	1-20
Final version of term paper	20%	27 March 2017 (posted on (1) PEAR and (2) D2L before 23:59).	Term Paper	1-20
Final exam***	32.5%	17 April 2017 (TBA; 7-9 pm)	Lecture Reading	1-20
TOTAL	100%			

\*Regular attendance and successful completion of Laboratory assignments is required to obtain credit for course. Not all lecture slides will be posted on D2L and some important points are made orally by the instructors therefore it is important to take notes during class and tutorial lectures.

\*\* Top Hat is provided to students free for use in pilot study; Questions will be graded after 23 Jan 2017.

\*\*\*Multiple choice and written short answers – the final exam will cover all lectures and assigned readings, including the ones before the midterm but the emphasis will be on topics from after the midterm.

### Learning goals and rationale

The course goal is to integrate introductory Marine Geology, Marine Chemistry, Marine Physics, Marine Biology and Marine Ecosystem Processes with the existing Zoology background of Marine and Freshwater Biology majors.

Topic	Expectations (input), students entering this class should be able to describe:	Learning Outcomes (output), students successfully finishing this class should be able to:
Ocean geology	Factors affecting species distribution and abundance	1) Describe how plate tectonics affects the distribution of vent fauna
Ocean geography	The major oceans and continents	2) Explain spatial and depth variation in composition of ocean sediments.
Water movements	Major ocean currents	3) Understand factors affecting ocean basin circulation
Tides and Wave	Tides and waves	4) understand how tides and waves affect abiotic and biotic processes
Ocean stratification	Seasonal thermal stratification in lakes and perhaps oceans	5) Explain seasonal nutrient availability in euphotic zone
Convergence/Divergence	Seasonal nutrient regeneration in lakes and perhaps oceans	6) Predict where major upwelling/downwelling regions are located
Seawater Composition	Freezing point depression, boiling point elevation with increasing salinity.	7) Understand constancy of composition of seawater and how halocline density gradients form
Nutrient limitation	Nitrogen and phosphorous cycles.	8) Use Redfield ratio to predict which nutrient is limiting.
Primary production	Understand reactions involved in photosynthesis	9) Predict factors which limit primary production in a particular environment.
Phytoplankton diversity	Secondary pigments and metabolites in plants	10) Understand how the absorption spectrum of a water mass affects critical depth & how armour and chemical warfare affect herbivory.
Zooplankton diversity	Life at low Reynolds numbers	11) Understand feeding mechanisms of small copepods
Predator-prey	Functional responses to prey density	12) Describe feeding efficiency changes with relative predator-prey size
Pelagic ecosystems	Food chains and food webs	13) Understand how food chain length affects fish production.
Oceanographic Processes	Population and Community Ecology	14) Describe the effects of ocean circulation on community structure.
Coastal Processes	Plate tectonics	15) Understand the relationship between tectonics and coasts/estuaries
Benthic ecosystems	Larval forms of marine invertebrates and fishes	16) Predict when benthic-pelagic coupling is important
Marine communities	Disturbance, species diversity and succession	17) Describe factors affecting zonation and succession
Ecosystem engineers	Global distribution of Coral reefs, seagrass beds, mangroves, and kelp forests	18) Predict changes in species richness when ecosystem engineers are added to or removed from a section of coastline.
Reproductive Systems	Algal and plant reproduction, Larvae of marine invertebrates	19) Understand reproductive strategies and tradeoffs in benthic ecosystems
Feeding Ecology	Invertebrate diversity and function	20) Understand the role of abiotic and biotic factors in suspension feeders

## Course Resources

**CourseLink:** Please check the course D2L site under:

(1) **“Content”**: postings of pdfs of selected (the more detailed) lecture slides, details of wet and computer laboratory assignments, Practice midterm and final exam questions.

(2) **“Discussions”**: student-lead postings about current topics in marine ecology

(3) **Required textbooks:**

*“Readings in marine Ecological Processes 2017 (ZOO\*4570)*. ISBN-13: 978-0-17-6774257 (Nelson).

(4) **Lecture Material Sources** (most available on 2 hour reserve in McLaughlin Library):

1. *Biological Oceanography: an Introduction. 2nd Edition.* C.M. Lalli and T.R. Parsons. 1997., Open University Set Book, 314 pages, ~ \$73, Butterworth-Heinemann /Elsevier, ISBN: 0-7506-3384-0
2. *Ocean circulation. 2nd edition.* Open University 2001, Butterworth-Heinemann of Elsevier. 286 pages, ~\$50, ISBN: 0-7506-5278-0
3. *Marine Biogeochemistry.* July 2005 (formerly Ocean chemistry and deep sea sediments), Open University, Butterworth-Heinemann of Elsevier. ~\$68 ISBN:0-7506-6793-1
4. *Dynamics of marine ecosystems: Biological-Physical Interactions in the Oceans.* 3rd edition, Mann and Lazier, Blackwell. Summer 2005. ~ \$87.
5. *Seawater: its composition properties and behaviour. 2nd ed.,* Open University 1995, Butterworth-Heinemann of Elsevier. 166 pages. ~ \$55, ISBN: 0-7506-3715-3
6. *Waves, Tides and Shallow water processes. 2nd ed.* Open University 2000, Butterworth-Heinemann of Elsevier 227 pages. ~ \$47, ISBN: 0750642815.
7. *Marine Ecological Processes.* 2nd ed., Valiela 1995, Springer-Verlag, 686 pages. ~ \$72, ISBN: 0-387-94321-8
8. *Biological Oceanography.* Miller 2004. Blackwell, 402 pages. ~ \$85, ISBN: 0-632-05536-7
9. *Essentials of Oceanography.* 8th ed. Trujillo and Thurman. 2005. Pearson, Prentice Hall. 532 pages, ISBN: 0-13-144773-4
10. *Introductory Oceanography.* 10th ed. Thurman and Trujillo. 2004. Pearson, Prentice Hall. 608 pages, ~ \$120, ISBN: 0-13-143888-3
11. *Oceanography: an Introduction to the Planet Oceanus.* Pinet 1992. West. 572 pp., ISBN: 0-314-77008-9
12. *Marine Biology: Function, Biodiversity, Ecology with CD-ROM Second Edition* Jeffrey S. Levinton 2007 Oxford Press ISBN13: 9780195141726
13. *Laboratory Exercises in Oceanography 4th edition* by Bernard W Pipkin et al. Paperback: 272 pages, Publisher: Worth Publishers; 4th edition (2011) ISBN-10: 0716794926, ISBN-13: 978-0716794929.

## Term Paper

### Term Paper Instructions

1. Must be double-spaced in font size of 12 with one inch margins all around.
2. Maximum length is 6 pages excluding Title page, List of References, Figures, and Tables. Minimum length is 5 pages. Penalties for too long or too short.

3. Figures and Tables should be placed after List of References.
4. Citation of references in text and List of References in style of the journal *Marine Biology*.
5. Possible topics include:
  - (1) Effect of a Physical Oceanographic (or a Biogeochemical) Process on Populations of a Marine Species,
  - (2) Effect of a Physical Oceanographic (or a Biogeochemical) Process on a Marine Community
  - (3) Effect of a Physical Oceanographic or (a Biogeochemical) Process on a Marine Ecosystem,
  - (4) How changes in Physical Oceanographic (or Biogeochemical) Processes caused by human activities are Impacting Marine Ecosystems.

Please check with professor before doing other topics.
6. Minimum 10 references from the primary literature in peer-reviewed scientific journals with at least five being from the past three years. Can also include websites and recent review articles.
7. Draft term paper must be peer-reviewed electronically by your term paper partner assigned by PEAR before we will grade your revised final copy.
8. Submit final version twice: post one final electronic pdf copy on PEAR for your instructors to read and one pdf copy on D2L for your classmates to read.

### **Evaluation Of Term Paper**

Final draft of Term paper is graded out of 100% but is worth 25% of final course grade (5% of which is from electronic peer reviewing exercise). The same grading rubric will be used by the peer reviewer to grade your first version and by your instructors to grade your final version.

Scientific Content	50%
Creativity and Synthesis of ideas	20%
Logical Organization and Writing Style	20%
English/grammar, Punctuation	<u>10%</u>
Total: 100%	

## **Course and University Policies**

### **Recording of Materials**

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

### **Absence and Illness**

If you are absent from classes and/or labs during the semester, you will be expected to make up missed lecture and laboratory material on your own.

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact, and be prepared to provide supporting documentation. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

When, for legitimate reasons, any assignments are missed, ensure that you have both given the instructor supporting documentation and obtained a written statement (e.g., email) of your revised grade evaluation from the instructor.

If you miss an assessed item for medical or other authorized reasons, you will not be given a new assignment, but will have your final mark based on a proportionate adjustment of completed term work.

#### **Copies of out-of-class assignments**

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

#### **Late Policy**

Penalty is 10% per day of draft or of final copy of Term Paper unless valid compassionate or medical exemptions apply (Please see "When You Cannot Meet a Course Requirement" section below).

#### **Exam Policy**

For more information about exam scheduling and conflicts, please consult the undergraduate calendar <http://www.uoguelph.ca/registrar/undergraduate/index.cfm?exams>

#### **When You Cannot Meet a Course Requirement**

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or teaching assistant) in writing in an email, with your name, id#, and e-mail contact, and be prepared to provide supporting documentation. See the undergraduate calendar for information on regulations and procedures for Academic

Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Where possible laboratories missed because of illness or compassionate reasons will be completed in subsequent laboratory periods.

#### **Accessibility**

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS) as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <https://www.uoguelph.ca/csd/current-students>

#### **Academic Misconduct**

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.



Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

### **E-mail Communication**

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

### **Drop Date**

The last date to drop one-semester courses, without academic penalty, is the 40<sup>th</sup> class day. To confirm the actual date please see the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

### **Campus Resources**

The Academic Calendar is the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>

If you are concerned about any aspect of your academic program:

- make an appointment with a program counsellor in your degree program.  
<http://www.bsc.uoguelph.ca/index.shtml> or <https://www.uoguelph.ca/uaic/programcounsellors>

If you are struggling to succeed academically:

- There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. <http://www.learningcommons.uoguelph.ca/>

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.  
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention.  
<https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.uoguelph.ca/~ksomers/>

If you have a documented disability or think you may have a disability:

Student Accessibility Services (SAS) can provide services and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability. For more information, including how to register with the centre please see:

<https://www.uoguelph.ca/csd/current-students>