

EOSC 112 - The Fluid Earth: Atmosphere and Ocean

Spring 2018

In this course, we will explore environmental physics, chemistry, and biology to explain what we know about the complexity of the Earth system and climate change on our planet.

COURSE LEARNING GOALS

By the end of this course students will be able to...

1. DESCRIBE how Earth's atmosphere, hydrosphere, lithosphere, and biosphere comprise an integrated system driven by a continuous supply of energy
2. EXPLAIN the primary factors determining Earth's climate
3. EVALUATE evidence and hypotheses explaining why Earth's climate changes on different time scales
4. COMPARE today's climate to the climate of the past
5. Using scientific principles and evidence, EVALUATE information about climate change

INSTRUCTOR

Stephanie Waterman

ESB Room 3053

To contact, please send a message in CANVAS**.

TEACHING ASSISTANTS

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To contact, send a message in CANVAS**.

CLASS MEETINGS

Mon Wed Fri 11:00a-11:50a in [Earth Science Building \(ESB\)](#) Room 1013

CLASS RESOURCES

1. Course Website on CANVAS*

To access go to <http://canvas.ubc.ca> and log on using your campus-wide login (CWL). If you do not yet have a CWL, go to <http://www.it.ubc.ca/cwl> to request one. We will use this CANVAS website to post important information (the syllabus, course schedule, course announcements etc.), as well as Instructor's Notes, copies of Lecture Slides, and other course files like readings and worksheets. We will also use it to host the course's Discussion Board, post your grades, and as a means for you to contact the Instructor and Teaching Assistants. Finally, all quizzes for the course will also be

* Canvas is UBC's new online learning platform, which will be gradually replacing Connect (Blackboard Learn) throughout the 2017/18 academic year. At some point during this academic year, you may have Science courses in both systems (Canvas and Connect). To find out which of your classes will be in Canvas this January 2018, please check the Canvas course lists here: <http://students.canvas.ubc.ca/>.

** To contact the Instructor or TAs in Canvas use the "Inbox" feature. In "Inbox" click the "Leaf Button" (= Compose a new message), then select course "EOSC 112 – Spring 2018". In the directory accessed via the button on the right-hand side of the "To" input box select "Teachers" then "All in Teachers" or "Teaching Assistants" then "All in Teaching Assistants" or an individual name as appropriate.

administered via CANVAS. Please familiarize yourself with the course website and ask for help if you need it.

2. Instructor's Notes

Instructor's notes for each module will be posted on CANVAS in advance of the module lectures. These are based on the material that will be presented in the lectures, and include copies of (many of) the lecture slides, accompanying notes, and supplementary information. You'll do well to consult these before class. Note these "Notes" contain examinable information unless noted as "optional" regardless of whether it is covered in class.

3. Lecture Slides

Copies of the slides shown in each class (apart from Clicker question answers – you'll need to come to class for those!) will also be posted on CANVAS after each lecture. These are a useful reference to review exactly what was discussed in class in each day.

4. The CANVAS Discussion Board

Use this space to communicate with your fellow students, post and answer questions, and form study groups. TAs will monitor the discussion board and help where they can.

5. Module Practice Questions

A set of practice concept sketches and multiple-choice questions will be posted for each module. These questions are an excellent example of the types of questions you can expect to be asked on quizzes, midterms and the final exam. Note we DO NOT post the answers to these practice questions. The reasons for this are discussed under Study Advice For EOSC 112 in the "All About EOSC 112" module.

6. Recommended Texts

There is no required textbook for this course. The Instructor's Notes, as well as readings accessible via links from the notes, should serve as your course text. If you would like additional references, we recommend "The Earth System", 3rd edition, by L. R. Kump et al., 2010, and/or "Earth's Climate Past and Future" 3rd edition, by W. F. Ruddiman, 2014 (the 2nd edition is also fine).

THINGS YOU'LL NEED

1. A way to answer "Clicker Questions" in class

During every class, we will ask questions that the class will answer electronically, using the "clicker" or REEF polling system. You'll need to either:

- (i) Buy a **clicker** from the bookstore for this course. UBC is using the "clicker" system. You can sell it back to the bookstore after the term if you don't need it for future classes.
- (ii) Purchase a subscription for **REEF polling**, which will allow you to answer "clicker" questions in class using your own electronic device. For information about how to do this, go to: http://wiki.ubc.ca/Documentation:Clickers/REEF_Polling#Students

2. A Custom Course Pack

You'll also need to buy a **Custom Course Pack** for this class from the bookstore. This is a pack of 2-ply carbonless copy paper specifically used for EOSC 112.

CLASS SCHEDULE

	Date	Topic	Contact TA
W	3 Jan	Introduction	
F	5 Jan	Radiation Balance 1	Sam
M	8 Jan	Radiation Balance 2	Sam
W	10 Jan	Radiation Balance 3	Sam
F	12 Jan	Atmosphere 1	Sam
M	15 Jan	Atmosphere 2	Sam
W	17 Jan	Atmosphere 3	Sam
F	19 Jan	Atmosphere 4	Sam
M	22 Jan	Hydrosphere 1	Sam
W	24 Jan	Hydrosphere 2	Sam
F	26 Jan	Hydrosphere 3	Sam
M	29 Jan	Hydrosphere 4	Sam
W	31 Jan	MIDTERM 1	Sam
F	2 Feb	Lithosphere 1	Yulia
M	5 Feb	Lithosphere 2	Yulia
W	7 Feb	Biosphere 1	Yulia
F	9 Feb	Biosphere 2	Yulia
M	12 Feb	<i>Family Day – no class</i>	
W	14 Feb	Carbon Cycle 1	Yulia
F	16 Feb	Carbon Cycle 2	Yulia
M-F	19-23 Feb	<i>Reading Week – no classes</i>	
M	26 Feb	Greenhouse Effect 1	Camilo
W	28 Feb	MIDTERM 2	Yulia
F	2 Mar	Greenhouse Effect 2	Camilo
M	5 Mar	Greenhouse Effect 3	Camilo
W	7 Mar	Natural Drivers of Climate Variability 1: Changes in Solar Radiation	Camilo
F	9 Mar	Natural Drivers of Climate Variability 2: Changes in Albedo	Camilo
M	12 Mar	Long-term Climate Evolution 1	Camilo
W	14 Mar	Long-term Climate Evolution 2	Camilo
F	16 Mar	Pleistocene Ice Ages 1	Camilo
M	19 Mar	Pleistocene Ice Ages 2	Camilo
W	21 Mar	MIDTERM 3	Camilo
F	23 Mar	Pleistocene Ice Ages 3	Camilo
M	26 Mar	Modern Climate 1	Camilo
W	28 Mar	Modern Climate 2	Camilo
F	30 Mar	<i>Good Friday – no class</i>	
M	2 Apr	<i>Easter Monday – no class</i>	
W	4 Apr	Modern Climate 3	Camilo
F	6 Apr	Review	

ASSESSMENT

Research on how people learn shows that humans must engage with material on a regular, ongoing basis in order to incorporate new knowledge. Evidence from past EOAS courses shows that students who participate continuously during the term statistically perform far better on high-stakes exams. The structure of assessment in this course is thus designed to provide several different ways for you to engage with the course material throughout the term. Information on the various assessment activities, the assessment schedule, and their contribution to your final grade are detailed below.

Assessment Activities

1. Clicker Questions (in class; 3% of final grade; 20% “grace space”)

During every class, we will ask questions that the class will answer electronically, using the iClicker or REEF polling system. The purpose of these questions is for you to focus on a particular aspect of the material, right then and there, in class, and for you to make a decision about what you think. This is low-stakes practice with the material, and it’s OK to get the answers wrong. Some of the most useful learning comes from getting something wrong. Often, we will encourage you to discuss the clicker questions with students near you before answering. Sometimes, we’ll ask you to answer individually. The expectations for particular clicker questions will be clear during class.

Evaluation of clicker question participation and how to do well:

- You may earn between 0 and 3% total for participating in clicker questions throughout the term (with your iClicker or the REEF system).
- You are allowed 20% “grace space”, which means you are free to forget your clicker, run out of batteries, or have other issues, up to 20% of the time, with no penalty. If you respond to 80% of the clicker questions during the term, you’ll earn the full 3%. For participation less than 80%, we’ll scale your score between 0 and 3%. You do not need to tell us about the times you’ve missed or the reasons – that’s what the “grace space” is for.
- Often it will be helpful to skim the module’s Instructor’s Notes ahead of time for the upcoming class to be prepared for the clicker questions.
- There may also be clicker questions that include information from past classes to help you gauge your retention of the material.
- To maximize the benefit of the clicker questions, the best thing you can do is focus your attention when they arise and participate.
- ***There are plenty of ways to cheat with clickers. All of them are academically dishonest. The most obvious way to cheat is to send your clicker to class with someone else when you are not present, or to bring someone else’s clicker to class for them. All of these, and anything else you can think of, violate UBC’s standards for academic honesty. Cheating with clickers is identical in spirit to writing an exam for someone else, or asking someone to write an exam for you. It is your responsibility to inform yourself about UBC’s policies on academic honesty.***

2. Concept sketches & worksheets (in class; 2% of final grade; 20% “grace space”)

During some classes, we will ask you to create and turn in concept sketches or complete other paper-based activities like worksheets. How to create a concept sketch will be explained in class and instructions are posted on CANVAS. Concept sketches are a useful study tool and ***you will be asked to create them on exams.***

Evaluation of concept sketches & worksheets and how to do well:

- You may earn between 0 and 2% total for participating in concept sketches & worksheets throughout the term.
- You are allowed 20% “grace space”, which means that if you complete 80% of the concept sketches & worksheets during the course, you’ll earn the full 2%. For participation less than 80%, we’ll scale your score between 0 and 2%. You do not need to tell us about the times you’ve missed or the reasons – that’s what the “grace space” is for.
- Concept sketches and worksheets will be marked for participation only. The important concepts they cover will be discussed in class.
- Often it will be helpful to skim the module’s Instructor’s Notes ahead of time to be prepared for the concept sketches and worksheets. There may also be activities that include information from past classes to help you gauge your retention and synthesis of the material.
- To maximize the benefit of the concept sketches and worksheets, the best thing you can do is focus your attention when they arise and participate.
- ***There are plenty of ways to cheat on in-class assignments like concept sketches and worksheets. All of them are academically dishonest. The most obvious ways to cheat are to turn in a concept sketch for someone who is not present, or to include the name of someone not present on a group worksheet. All of these, and anything else you can think of, violate UBC’s standards for academic honesty. Cheating on concept sketches or worksheets is identical in spirit to writing an exam for someone else, or asking someone to write an exam for you. It is your responsibility to inform yourself about UBC’s policies on academic honesty.***

3. Quiz 0 (online in CANVAS; 1%)

To prepare for this quiz you will need to review all the material posted in the “All about EOSC 112” Module on CANVAS. Then, go to the Quizzes area on CANVAS and take Quiz 0. You can take this quiz as many times as you like and we will take your highest mark. See the schedule below for when Quiz 0 closes.

4. Pre-Class Quiz for Carbon Cycle Module (online in CANVAS; 2%)

For the Carbon Cycle Module, we’re going to be doing something a little different. First, you’ll read some material on the topic that we’ll make available on CANVAS, and then you’ll take a quiz on this material *before* you come to the classes (see the schedule below for the dates when the quiz will be available). This way, you’ll already have some experience with this topic before you come to the relevant classes.

5. Regular Quizzes (online in CANVAS; 15% of total grade; we’ll count the best 4 of 5)

There will be five online quizzes throughout the term administered in CANVAS. The purpose of these quizzes is to encourage you to keep up with the coursework throughout the term, and to give you practice with the types of questions that will be on the higher-stakes exams. Quizzes will contain several multiple-choice questions, and you’ll have 2-3 minutes per question to complete them (which is more time per question than you’ll have on the exams). The material covered for each, as well as their respective opening and closing times are listed in the Assessment Schedule below. ***You need to complete the quizzes within the time window designated. There are no extensions. Also note that Quizzes are intended to be INDIVIDUAL work.***

Evaluation of quizzes and how to do well:

- We will average your top 4 quiz scores to assign your final quiz mark. This means we're throwing out your bottom quiz score.
- Because of this, you have one opportunity to have internet problems, skip a quiz because of scheduling problems, or whatever, with no penalty. You do not need to tell us when or why you've skipped a quiz, just be aware you have 1 freebie (not more). **There are no make-up quizzes.**
- To do well on the quizzes, prepare beforehand. Study the notes, "do" the learning goals, read and clarify your understanding by using the discussion board, practice with the review questions. Ask yourself, "What kinds of questions would I ask, if I were creating these questions?"
- Learn from your mistakes. You can review your answers to the quizzes after the quiz period has closed. Use this opportunity to practice for the higher-stakes exams.

6. Midterm Exams (in class; best 2 of 3; 15% each; 30% total)

You'll have the opportunity to write 3 midterm exams in this course. Exams will have two types of questions: (1) multiple choice, with questions similar in style and format to the questions you'll encounter on the quizzes, and (2) concept sketches, similar to the work you will have practiced in class and in your own studying. Typically, the concept sketch is worth 15% of your individual exam score.

Evaluation of midterm exams and how to do well:

- Exams will occur in two stages. In the first stage, you will answer the exam questions individually. In the second stage, you will re-take the exam as part of a small group. The purpose of this structure is so that you get very timely feedback on your own thinking about the exam questions. Your individual mark will count for 85% of your total exam score; your group exam mark will count for 15% (assuming it is higher than your individual mark (which it usually is). Note that if your individual mark happens to be higher than your group mark, you will receive your individual mark i.e. your group mark can never lower your total exam score from your individual exam mark. You will have practice working in small groups during class before exam time. Use this time to figure out how to best work in a small team.
- To do well, follow the "How to Study" document posted in CANVAS in the "All About EOSC 112" module.
- Of the 3 midterms, we will average your best 2 scores, i.e. we'll toss out your lowest exam score.
- Since we are tossing one of your exam scores, there are no makeup exams. If you miss an exam, that's the one we'll toss.
- We strongly encourage you NOT to miss the first midterm!
- Our own data show that students who participate in in-class and out-of-class activities score on average about 10% higher on high-stakes exams than students who don't. So, it is to your advantage to participate in the clicker questions, concept sketches, class activities, and quizzes to maximize both your learning and your exam scores.

7. Final Exam (during the Exam Period; date and time TBA; 47%)

The final exam will cover all material in the course. It will contain multiple choice questions and concept sketches similar in format to those on the quizzes and midterm exams. It will have two stages, like the midterms. If you miss the final exam for whatever reason, it is your responsibility to visit your Advising office and apply for deferred standing.

8. Extra-credit surveys (in class and online in Canvas; bonus 1%)

Your feedback helps improve the course this year and in future offerings. Further the Department of Earth, Ocean and Atmospheric Sciences is conducting research to improve science teaching and learning. You can earn 1% extra credit by filling out various surveys (2-4 surveys through the term both online and in class). Your answers will help make EOSC 112 and UBC Science better. Thanks! See Announcements on CANVAS throughout the term for details about online surveys available.

Your final grade will be amassed from these assessment activities with this break-down:

Clicker Questions	3%
Concept Sketches & Worksheets	2%
Quiz 0	1%
Pre-Class Quiz for Carbon Cycle	2%
Regular Quizzes	15%
Midterm Exams	30%
Final Exam	47%
TOTAL	100%
Extra-Credit Surveys	+1%

The *assessment schedule* is as follows:

What	Opens	Closes	Notes	Contact TA
Quiz 0	W Jan 3 12p	F Jan 12 11:59p	on "All about EOSC 112"; can take multiple times for the best grade	
Quiz 1	T Jan 16 3 p	Th Jan 18 11:59p	on Radiation Balance	Sam
Quiz 2	T Jan 23 3p	Th Jan 25 11:59p	on Atmosphere	Sam
Midterm 1	W Jan 31 in class		covers all material through Hydrosphere	Sam
Quiz 3	T Feb 13 3p	Th Feb 15 11:59 p	on Lithosphere & Biosphere	Yulia
Carbon Cycle Pre- Class Quiz	W Feb 7 3p	W Feb 14 11:59p		Yulia
Midterm 2	W Feb 28 in class		on Lithosphere, Biosphere & Carbon Cycle plus up to 20% of questions on earlier material	Yulia
Quiz 4	T Mar 13 3p	Th Mar 15 11:59p	on Greenhouse Effect & Natural Drivers of Climate Variability	Camilo
Midterm 3	W Mar 21 in class		on Greenhouse Effect, Natural Drivers of Climate Variability & Long-term Climate Evolution plus up to 30% of questions on earlier material	Camilo
Quiz 5	T Mar 27 3p	Th Mar 29 11:59p	on Pleistocene Ice Ages & Modern Climate 1	Camilo
Final Exam	TBD			

OFFICE HOURS

Throughout the term, the TAs will hold office hours to provide dedicated time for giving individual help with the course material. The schedule outlined below will be structured around the quiz and exam schedule, as typically students' demands for help peak in advance of these assessments. TAs will also hold office hours after midterms to allow you to view your graded exam and discuss any outstanding questions you have about the relevant material. The exact hours and location will be posted by the TAs in CANVAS one week in advance. At the beginning of the term, please complete the survey about the best days and times for you here <https://www.surveymonkey.com/r/GKD37X2>. The TAs will use the results of this poll to set office hours that work best for the majority of students.

For What?	When?	Days of week	# of office hours	Who?
Quiz 1 preparation	During week of Jan 15	M, T	3	Sam
Quiz 2 preparation	During week of Jan 22	M, T	3	Sam
Midterm 1 preparation	During week of Jan 29	M, T	6	Sam
Midterm 1 viewing	During week of Feb 5	W, Th, F	2	Sam
Quiz 3 preparation	During week of Feb 12	M, T	3	Yulia
Midterm 2 preparation	During week of Feb 26	M, T	6	Yulia
Midterm 2 viewing	During week of Mar 5	W, Th, F	2	Yulia
Quiz 4 preparation	During week of Mar 12	M, T	3	Camilo
Midterm 3 preparation	During week of Mar 19	M, T	6	Camilo
Quiz 5 preparation	During week of Mar 26	M, T	3	Camilo
Midterm 3 viewing	During week of Mar 26	W, Th	2	Camilo
Final exam preparation	TBD	TBD	16	ALL

STUDY ADVICE FOR EOSC 112:

Students who take EOSC 112 come from a wide variety of backgrounds and have a wide variety of motivations for taking this course. Everyone CAN do well in this course. Three tips to help you succeed are as follows:

1. Focus your studying around the LEARNING GOALS.

This course is structured around aiming to meet a number of very specific learning goals for each topic we cover. These learning goals are published on Canvas and each class we'll list exactly which learning goals we will aim to cover in that day's lecture. Quizzes and exams will be written to directly assess these goals. Thus, your primary study guide should be the learning goals, and you should use them to focus your studying.

What to do:

Check out each learning goal. Try to "do", in your own words, what that learning goal asks. For example, the first goal in Radiation Balance is: "*COMPARE infrared, ultraviolet, and visible electromagnetic radiation in terms of energy per photon, frequency, and wavelength*". To "do" this *comparison* requires you to be fluent in some of the characteristics of electromagnetic radiation and how those characteristics change along the spectrum. We will thus discuss these characteristics and their variation across the electromagnetic spectrum in the lecture. We will also do a few clicker

questions in class that target this goal. Some review questions will also directly test your ability to “do” this goal. When you study, see if you can match up the clicker questions to the goal. See if you can match up any review questions to this goal. See if you can match up any quiz questions to this goal. What are these questions asking you to do? Then, imagine **ALTERNATIVE** questions, variations that could be asked, or different questions that target the same goal. What are the answers to your own alternative questions? You'll likely need to consult the notes in order to answer some of these questions. This **TARGETED consultation of the notes** is far more productive than simply re-reading the notes from start to finish.

2. Make the most of all practice multiple choice questions.

For every practice multiple choice question (either a clicker question, a review question, or a question on a quiz), try to explain not only why the correct answer is correct, but also why all the other answers are incorrect. If you do this, you'll be prepared to answer many more alternative questions than just the one available for practice.

3. Study actively not passively.

Students who re-write their own notes in their own words and practice explaining concepts to others learn more and do better on exams. Students who re-read and merely highlight passages, or, only re-read their own highlighted passages, do not do as well. There's important brain activity that comes with attempting to produce or create one's own explanations, in the context of what's already in your brain. If you find you are bored, or your mind is wandering, or that studying seems too easy, what you're doing is probably a waste of your time!

IF ISSUES ARISE

University students often encounter setbacks from time to time that can impact academic performance. Discuss your situation with your Instructors or an academic advisor. Learn about how you can plan for success at www.students.ubc.ca. For help addressing mental or physical health concerns, including seeing a UBC counselor or doctor, visit: <https://students.ubc.ca/health-wellness>

ACADEMIC CONDUCT

Neither we, nor the University, are sympathetic to academic dishonesty. For more information, here is the University's webpage about academic conduct and misconduct:

<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,958> The rules governing formal examinations are here: <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,0,0>

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