

**GEO 106 – GLOBAL CLIMATE CHANGE**  
***Scientific Literacy & Inquiry Sequence***

**COURSE DETAILS**

Session: Spring 2020  
Classroom: Knox 109 (before 3/23)  
Lecture Times: Tuesdays and Thursdays 12:30 – 1:50 pm

Instructor: Xin Tao ([xintao@buffalo.edu](mailto:xintao@buffalo.edu))  
Office: Wilkeson 131  
Office hours: Tuesday 2:00 – 3:00 pm (before 3/23) & by appointment

Teaching assistant: Dameng Yin ([damengyi@buffalo.edu](mailto:damengyi@buffalo.edu))  
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Office hours: By appointment

**COURSE DESCRIPTION**

This course explores how and why climate has changed over Earth's 4.6 billion year history—but especially over the last 100 years. It examines how greenhouse gasses cause warming, predictions of future climate, and how those predictions are developed. Lastly, we discuss the impacts of future climate change and how they can be mitigated.

**STUDENT LEARNING OUTCOMES**

Successful completion of this course will provide students with knowledge about: methods that scientists use to study and predict climate change and its environmental impacts; how the Earth's climate is ever-changing due to interactions between geology, the atmosphere, ocean, and biosphere; key examples of how and why the climate has changed at different times in Earth's history; and how the scientific method helps scientists improve their knowledge of climate. After this class, students will be able to recall the factors that contribute to climate change, describe how the climate changed through Earth's history, demonstrate the rough steps to build climate model, compare ancient climate with recent ones, identify the impacts of climate change on human societies, and propose solutions to fight against climate change.

**SUGGESTED MATERIALS**

**Textbook:** Kump, L, JF Kasting and RG Crane. 2010. *The Earth System*, 3<sup>rd</sup> Edition. Prentice-Hall. ISBN: 978-0321597793. Available for purchase or rent at the UB bookstore, Amazon.com, and Greeks and Sneaks (<http://www.gsbuffalo.com/>) a local, independent bookstore.

**Top Hat subscription:** We will be using Top Hat student response technology. You must register with Top Hat and obtain an active subscription. We will typically use Top Hat five times per lecture. See more information below regarding the use of Top Hat in course grading.

**LECTURE MATERIALS**

The lectures consist of a mix of materials from the textbook and supplementary information from other sources. The lecture notes will post on UBLearns. It is a very good idea, however, for you to annotate additional notes of your own and sketch some of the diagrams to keep your brain actively engaged. The lecture notes also identify figures and tables from your textbook. In the written lecture notes, square brackets may enclose the information and numbers like this: [0.06]. Such items are to help you understand key ideas, but they are optional points and will not be part of an exam question.

I encourage you to ask questions in the discussion board or making appointments for office hour.

### **TOP HAT RESPONSE TECHNOLOGY**

We will be using Top Hat student response technology ([www.tophat.com](http://www.tophat.com)) to develop active learning and to assess your understanding of the lecture. There will typically be five Top Hat questions per lecture. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or through text message.

Please visit the Top Hat overview page (<https://success.tophat.com/s/article/Student-Top-Hat-Overview-and-Getting-Started-Guide>) which outlines how to register for a Top Hat account and provides an overview of the system. You will receive an invitation through email, but if you do not receive this email, you can register by simply visiting our course website: <https://app.tophat.com/e/059015>. Use the Course Join Code: 059015

Top Hat will require a paid subscription, and a full breakdown of all available subscription options are available here: [www.tophat.com/pricing](http://www.tophat.com/pricing). Should you require assistance with Top Hat at any time, because they require specific user information to troubleshoot issues, please contact their Support Team directly by way of email ([support@tophat.com](mailto:support@tophat.com)), the in-app support button, or by calling 1-888-663-5491. Their user support has been very good.

### **COURSE EVALUATION**

**Top Hat Responses:** Top Hat will be used to promote active learning and for immediate assessment of learning during each lecture. Your Top Hat responses are worth up to 16% of your final course grade. You will be graded using two types of Top Hat questions—informational and quiz questions. For informational questions, you will receive credit for any response. For quiz questions, you will receive credit for a correct response. Each question will specify which type it is. If you do not use Top Hat, or miss a class, the points for those Top Hat questions will instead become part of your exam average.

#### **Exams:**

There are three non-cumulative exams. We will average the highest two exam scores as your exam score. Each chosen exam is worth at least 42% (and up to 50%) of your grade depending your use of TopHat or not. The fewer days you respond via Top Hat, the more your exam scores count towards your final grade.

Each exam will have 50 questions. The questions will be directly based on the material in the lectures preceding the exam. Roughly similar number of questions come from each of those lectures (and from throughout the lecture). You must show picture ID (e.g. UB Card) when you hand in your exam. You will only be tested on material in the lecture notes that are posted online.

While writing the exam you must finish it in a specific time. Exams 1 would be at the beginning of the class period (12:30 pm) and last 1 hour and 20 minutes (1:50 pm). If you arrive late, you must still complete your exam by 1:50 pm. If you are very late, you may choose to not begin the exam and instead take a make-up exam. Exam 2 will be open on Monday, April 13 and close at the end of day on Wednesday, April 15. Exam 3 will be open on Wednesday, May 13 and close at the end of day on Friday, May 15. You must finish it in one attempt. If the time does not work for you, we can schedule a different time that works for you.

### **Missed Exams:**

Multiple-choice make-up exams are available only if all three of the following criteria are met:

(i) the student contacts the instructor either before, or on the day of, the scheduled exam, unless the note that explains the absence indicates why the instructor could not be contacted;

(ii) the student provides a note from an appropriate authority, as outlined at:

<https://catalog.buffalo.edu/policies/attendance.html>

(iii) the student completes the make-up exam within two weeks of the missed exam. In the case of the second exam, they would have to complete it during the scheduled final exam period.

If a student cannot meet all three of the above criteria, their make-up exam(s) will consist of a combination of multiple choice and short answer questions. These make-up exams will be administered on Monday, May 18 from 9:30 am to 12:00 pm (Eastern Daylight Time). You must finish each make up exam in 1 hour and 20 minutes. If you missed both exams, you would need to schedule them separately. Failure to take a make-up exam on the prescribed date will result in a zero grade for the exam. No exceptions to this time and date will be given.

### **Final Course Grade:**

Your final course grade will be determined using a combination of your exams and Top Hat scores. There are no exceptions.

The highest two exams are worth at least 84% and the Top Hat questions are worth at most 16% of your final mark. Your Top Hat scores will only be used for the classes in which you submitted answers, and if your Top Hat average for the semester (not including days that you did not participate) was higher than your exam average. Thus, if you attended all classes and your Top Hat average was higher than your exam average, the exams would be worth 84% and the Top Hat scores would be worth 16%. If you did not use Top Hat in any of the classes, then the exams would be worth 100%. If you used Top Hat in half of the questions and the average of those scores was higher than your exam average, then your Top Hat score would be worth 8% and your exams would be worth 92%.

The percentages are converted to a letter grade using the following grading scheme:

$\geq 85.0\%$ = A	$\geq 76.6\%$ = B+	$\geq 66.6\%$ = C+	$\geq 55\%$ = D+
$\geq 80.0\%$ = A-	$\geq 73.3\%$ = B	$\geq 63.3\%$ = C	$\geq 50\%$ = D
	$\geq 70.0\%$ = B-	$\geq 60.0\%$ = C-	$< 50\%$ = F

### **ACADEMIC INTEGRITY POLICY**

Academic integrity simply involves you doing your work. Examples of academic dishonesty include: submitting work from another course, plagiarism, cheating, falsification, misrepresentation, usage of confidential documents, and buying or selling of assignments. If a student is suspected of academic dishonesty, then a three-step consultative resolution will be employed. First, the instructor will notify the student of the incident and arrange a meeting. Second, the instructor will orally inform the student of the sanction, which could include: warning, revision, reduction in grade, failure of course. Third, the instructor will provide the student with a written copy of the decision. The student can appeal the decision at the Departmental Level using a three-step process. If the student is not satisfied with the Departmental decision, they can enter a three-step appeal at the Decanal level. Detailed information on examples of academic dishonesty, consultative resolution, and the appeal processes, can be found at: <https://catalog.buffalo.edu/policies/integrity.html>

### **GENERAL POLICIES**

**University Incomplete Policy:**

At my discretion, a grade of "Incomplete" can be given for the course if (1) the student has a passing average on the work that they have completed, and (2) there are extremely well documented extenuating circumstances for not being able to complete the course. If a grade of "Incomplete" is given, the student will be expected to attend and complete the course the next academic year. Additional information is found at:  
<https://catalog.buffalo.edu/policies/explanation.html>

**Accessibility Resources:**

If you have a disability that limits your ability or opportunity to complete the course requirements, you must visit UB "Accessibility Resources" and provide them with official documentation of your disability. They will assess the documentation and then advocate for you with me so that you are given equal opportunity. For more information, see:  
<http://www.buffalo.edu/access.html>

**Class Attendance Policy:**

UB has a strong set of policies about student actions that disrupt the classroom and about the consequences for this: <https://catalog.buffalo.edu/policies/obstruction.html>. Distracting behavior not only lowers future exam scores of the distractor by typically 5%, but also actually lowers the exam scores of their neighbors by upwards of 10%.

Because distracting behavior has negative effects, this class has the following behavioral requirements: (a) no use of cell phones, laptops, or other electronic devices (except for taking notes and answering Top Hat questions) (please silence cell phones!); (b) no talking to your neighbor or pointing out funny memes on the Internet during class (except during think-pair-share activities); (c) please try and avoid walking between the instructor and the class during lecture.

There is a three-step set of consequences for ignoring these behavioral expectations:  
(1) You will be warned that you are being disruptive, and your name and/or picture will be taken.  
(2) If you are disruptive again in any of the remaining lectures you will be required to leave the lecture.  
(3) If you are repeatedly disruptive then, subject to Student Conduct Regulations and due process hearings, you will be dismissed from the course for the remainder of the semester.

**Email:**

All correspondence will be via UBLearns and via UB e-mail. Students are responsible for checking UBLearns and their UB e-mail. The professor may not always reply to emails after 6pm or on weekends. Normally, an email would be replied within 24 hours. Emails sent over weekend may not be replied until next workday. E-mails should be respectful and professional.

## LECTURE SCHEDULE

This schedule is subject to change due to unforeseen circumstances. You will be informed of any changes via your UBLearns email address. It is your responsibility to monitor those emails.

**\*\*Note:** If a class must be cancelled due to unforeseen circumstances, (e.g. a power break), everything will be pushed back and the new schedule will be announced on UBLearns.

<b>Week</b>	<b>Topic</b>	<b>Chapters</b>
1	Global change and science An introduction to systems	Syllabus & Ch. 1 Ch. 2
2	Global energy balance The Greenhouse Effect	Ch. 3 Ch. 3
3	Atmospheric and oceanic circulation Deep ocean circulation	Ch. 4 Ch. 5
4	No class (out of town) No class (out of town)	
5	Modeling the ocean-atmosphere system using GCMs Global Carbon Cycle: overview and short-term cycles	See UBLearns Ch. 8
6	Review <b>Exam 1</b>	
7	Global Carbon Cycle: short-term and long-term cycles Origin of Earth and life	Ch. 8 Ch. 10
8	No class (spring break) No class (spring break)	
9	The rise of atmospheric oxygen and ozone The Eukarya domain of life	Ch. 10 Ch. 11
10	Long-term climate regulation: faint young Sun paradox Long-term climate regulation: snowball Earth	Ch. 12 Ch. 12
11	Climate during the Phanerozoic and Paleocene–Eocene Thermal Maximum (PETM) Pleistocene glaciations and glacial cycles	Ch. 12 Ch. 12
12	<b>Exam 2</b> Role of oceans in glacial cycles; the Holocene	Ch. 14
13	Climate of the past millennium and its impacts Recent warming	Ch. 15 Ch. 15
14	Future climate predictions Impacts on the marine and terrestrial environments	Ch. 15 Ch. 16
15	Agricultural impacts; Energy solutions Institutional responses	Ch. 16 Ch. 16
16	<b>Exam 3</b>	

**Upon completion of this Scientific Literacy and Inquiry course, students will:**

<b>SLI Student Learning Outcome</b>	<b>Examples of how SLO is met</b>	<b>Delivery</b>
Demonstrate detailed knowledge of the natural sciences at three scales: micro, regional, and global.	Student will be able to explain how climate change results from various processes that influence energy transfer: (1) greenhouse gasses absorb and emit specific wavelengths of energy, (2) anthropogenic land cover conversion that influences surface albedo, and (3) global winds and ocean currents that redistribute heat.	Lecture, Tophat questions, and exams
Understand and employ the scientific method.	Demonstrate how the predictions made by climate models have been improved through the inclusion of climate forcing variables such as variations in solar intensity and volcanic eruptions.	Lecture, Tophat questions, and exams
Analyze how the understanding of scientific phenomena has changed through time, demonstrate that science is a continuous process, and identify different factors that may contribute to scientific discoveries.	Describe how the influence of greenhouse gasses (such as carbon dioxide) were first shown by Tyndale in ~1850, refuted by others, but that the ideas could not be tested until Keeling developed equipment to measure the atmospheric content of carbon dioxide in 1952, thus allowing us to measure how human activity has been increasing the amount of atmospheric carbon dioxide.	Lecture, Tophat questions, and exams
Examine the role science plays in everyday life.	Provide examples of how past climate changes lead to Viking settlements to be abandoned in Greenland after lasting three hundred years, and how the ability to predict future climate change may allow us to mitigate future impacts on human settlements.	Lecture, Tophat questions, and exams
Identify key ethical issues in scientific research.	Explore the challenge for climate scientists who advocate for humans to minimize future climate change, as this makes them seem nonobjective scientists to some citizens.	Lecture, Tophat questions, and exams
Distinguish scientific information from pseudo-scientific information, evaluate the role of pseudo-science on public opinion, and assess the effect of society (or historical pressures) on discovery.	Discuss and evaluate pseudoscientific explanations that have been given for ongoing climate change.	Lecture, Tophat questions, and exams
Question specific interpretations of data and debate current scientific controversies.	Discuss and evaluate the sources of uncertainty in our understanding of climate change and its past and future impacts.	Lecture, Tophat questions, and exams
Utilize the eportfolio to compile work that demonstrates this learning.	This SLO is addressed in the co-requisite lab course GEO105	Co-requisite lab course GEO105

**Note:** The eight SLI Learning Outcomes in the above table meet various UB General Education (UBGE); SUNY categories required by the SUNY General Education Program ([http://system.suny.edu/media/suny/content-assets/documents/academic-affairs/general-education/GenedCourseGuidelines\\_20120530.pdf](http://system.suny.edu/media/suny/content-assets/documents/academic-affairs/general-education/GenedCourseGuidelines_20120530.pdf)), and also meet Middle States Commission on Higher Education (MSCHE) categories of general education required by the (MSCHE). UBGE, SUNY UBGE, SUNY Natural Sciences, MSCHE Scientific & Quantitative Reasoning requirements are each met by all of the SLI Learning Outcomes. The MSCHE Ethics requirement is met by the fifth SLI Learning Outcome.