

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

**COURSE DETAILS**

Session: Fall 2017  
Classroom: Fillmore 170  
Lecture Times: Tuesdays 6:30 – 9:10 pm

Instructor: Xin Tao (xintao@buffalo.edu)  
Office: Wilkeson 131  
Office hours: Tuesday 9:20 – 10:20 pm & by appointment

Teaching assistant: Misa Yasumiishi (misayasu@buffalo.edu)  
Office: Wilkeson 126A  
Office hours: Tuesdays 4:30 – 5:30 pm & 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; how complex systems can be modeled; 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. Please see the Student Learning Outcomes chart on the last page to see how these ideas relate to Scientific Literacy and Inquiry requirements.

**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.

**LECTURES**

The lectures consist of a mix of materials from the textbook and supplementary information from other sources. The lecture notes will be posted on UBlearns prior to the lecture and will remain there until the exam has been given. It is a very good idea, however, for you to annotate additional notes of your own and sketch some of the diagrams during the lecture to keep your brain actively engaged. Indeed, not all figures, photos and tables will generally not be posted, so drawing them is useful. Figures and tables from your textbook will be identified, so if you have the textbook then you will not have to draw them. In the written lecture notes, some information and numbers will be enclosed by square brackets like this: [0.06]. Such items are provided to help you understand key ideas, but they will ***not*** be part of an exam question.

I encourage you to ask questions in class. However, out of respect for your classmates, it is required that you be quiet during class except when asking questions. If you arrive late or leave early, please use the doors at the rear of the classroom and sit on the edge of a row. If arriving early, please sit at the center of a row so that latecomers won't have to walk in front of you.

### **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 at least 5 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. An invitation will be sent to you by email, but if you don't receive this email, you can register by simply visiting our course website: <https://app.tophat.com/e/030063>. Use the Course Join Code: 030063

Top Hat will require a paid subscription, and a full breakdown of all available subscription options can be found here: [www.tophat.com/pricing](http://www.tophat.com/pricing). Should you require assistance with Top Hat at any time, due to the fact that 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**

**Labs:** There are no labs for this course.

**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 only 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 4 non-cumulative exams. We will average the highest 3 of the 4 exam scores as your exam score. Each chosen exam is worth at least 28% (and up to 33.4%) of your grade. The fewer days you respond via Top Hat, the more your exam scores count towards your final grade.

Each exam will have 40 questions. The questions will be directly based on the material in the 8 lectures preceding the exam. Roughly 5 questions per exam will come from each of those 8 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. However, if material that was not in the notes was added in the lecture, and you were explicitly told to add it to your notes, then you will also be expected to know it for the exam. If

material in the online notes was not presented in the lecture due to time constraints, it will still be required for the exam. No other material from the text will be on the exams.

While writing the exam you must keep both hands on top of the desk, to ensure that you are not looking at notes or electronic media in your lap. If you are seen handling any electronic device during the exam then you will automatically be given a mark of zero for that exam. You are ***not*** allowed to leave an exam to visit the restroom, so as to ensure academic integrity.

Exams will be given at the beginning of the class period (6:30 pm) and must be completed within 50 minutes (7:20 pm). If you arrive late, you must still complete your exam by 7:20 pm. If you are very late, you may choose to not begin the exam and instead take the essay make-up exam (see below). When all exams are handed in, we will have a short break and then begin new lecture material for the remainder of the class period.

There will ***not*** be a final exam in this course. (But see below regarding make-up exams.)

### 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:  
<http://undergrad-catalog.buffalo.edu/policies/course/attendance.html>;  
(iii) the student completes the make-up exam within two weeks of the missed exam. In the case of the fourth exam, they would have to complete it during the scheduled final exam period.

If a student cannot meet all three of the above criteria, then their make-up exam(s) will consist of two mandatory essay questions. These make-up exams will all be administered on Tuesday, December 5th in Cooke 121 from 6:30 pm to 9:10 pm. You ***must*** begin your exam at 6:30 pm; late arrivals will be given a zero. If you missed multiple exams, they must all be written during this three-hour period. 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. But, to pass this course, you ***must*** obtain a minimum average of 50.0% (D) on at least three exams. There are no exceptions.

The chosen 3 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, then 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:

|              |              |              |            |
|--------------|--------------|--------------|------------|
| ≥ 85.0% = A  | ≥ 76.6% = B+ | ≥ 66.6% = C+ | ≥ 55% = D+ |
| ≥ 80.0% = A- | ≥ 73.3% = B  | ≥ 63.3% = C  | ≥ 50% = D  |
|              | ≥ 70.0% = B- | ≥ 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: <http://undergrad-catalog.buffalo.edu/policies/course/integrity.html>

## **GENERAL POLICIES**

### **Extra Work**

There is **no** extra work. You have 4 exams and 32 Top Hat-days to show your abilities.

### **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:

<http://undergrad-catalog.buffalo.edu/policies/grading/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/accessibility/request.php>

### **Classroom Disruption Policy**

UB has a strong set of policies about student actions that disrupt the classroom and about the consequences for this: <http://undergrad-catalog.buffalo.edu/policies/course/obstruction.html>.

Distracting behavior has been found to not only lower future exam scores of the distractor by typically 5%, but 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.

## 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 snowstorm), everything will be pushed back a week. This means that Exam 4 could take place during Final Exam Week, on December 5th.

| <b>Date</b> | <b>Topic</b>  | <b>Chapters</b>              |
|-------------|---|------------------------------|
| 8/29        | Global Change, Science, and an Introduction to Systems                        | Syllabus,<br>Ch. 1 & 2       |
| 9/5         | Global Energy Balance: the Greenhouse Effect                                  | Ch. 3                        |
| 9/12        | Atmospheric and Oceanic Circulation   | Ch. 4 & 5                    |
|             | <b>EXAM 1</b>   |                              |
| 9/19        | Modeling the Ocean-Atmosphere System (GCMs);<br>Global Carbon Cycle: Overview | See <i>UBlearns</i><br>Ch. 8 |
| 9/26        | Global Carbon Cycle: short- and long-term cycles;<br>Origin of Earth          | Ch. 8<br>Ch. 10              |
| 10/3        | Origin of Life<br>Effects of Life on the Atmosphere                           | Ch. 10<br>Ch. 11             |
|             | <b>EXAM 2</b>   |                              |
| 10/10       | Long-Term Climate Regulation: Faint young Sun,<br>Snowball Earth              | Ch. 12                       |
| 10/17       | Long-Term Climate Regulation: Phanerozoic, PETM                               | Ch. 12                       |
| 10/24       | Pleistocene Glacial Cycles<br>Climate of the Past Millennium                  | Ch. 14<br>Ch. 15             |
|             | <b>EXAM 3</b>   |                              |
| 10/31       | Climate Impacts over the Past Millennium<br>Recent Warming                    | Ch. 15                       |
| 11/7        | Future Climate<br>Impacts to the Marine & Terrestrial Environments            | Ch. 16                       |
| 11/14       | Impacts on Agricultural<br>Energy Solutions?<br>Institutional Responses       | Ch. 16                       |
| 11/21       | No class (out of town)  |                              |
| 11/28       | <b>EXAM 4</b><br><b>Make-Up Exams</b>   |                              |
| 12/5        | <b>**Exam 4 &amp; Make-Up Exams only if another class is cancelled**</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>   | <b>Assessment</b>                   |
|--|---|---|-------------------------------------|
| 1. Demonstrate detailed knowledge of the natural sciences at each of the following three scales: (a) micro, (b) human, and (c) global.   | Lectures will explain how climate change results from various processes that influence energy transfer: (a) greenhouse gasses absorb and emit specific wavelengths of energy, (b) anthropogenic land cover conversion that influences surface albedo, and (c) global winds and ocean currents that redistribute heat.   | Lecture, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 2. Understand and employ the scientific method   | Demonstrate how the predictions made by climate models have been improved through the inclusion of climate forcing variables like variations in solar intensity and volcanic eruptions have been validated by comparing predicted with historical records of climate.   | Lecture, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 3. 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 while recognizing a path of a scientific discovery (or a set of discoveries) through history. | 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, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 4. 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 there hundreds of years, and how the ability to predict future climate change may allow us to mitigate future impacts on human settlements.  | Lecture, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 5. 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 to not be objective scientists to some citizens.  | Lecture, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 6. 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, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 7. 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, think-pair-share discussions, in-class polling | Top Hat quizzes<br>Exams            |
| 8. Utilize the eportfolio to compile work that demonstrates this learning.   | This SLO will be addressed in the co-requisite lab course GEO 105   | Done in co-requisite lab course GEO 105                 | Done in co-requisite course GEO 105 |

**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 1 to 8. The MSCHE Ethics requirement is met by SLI Learning Outcome 5.