

GLACIERS AND GLOBAL CHANGE

Earth and Space Sciences 203 Winter Quarter 2010

Course Syllabus

Class Website: <https://courses.washington.edu/ess203/>

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Glaciers, arctic sea ice, and permafrost – they are all melting as Planet Earth warms up. Glaciers and polar ice sheets can alter climate, landscape and sea level, both locally and globally, and they can also teach us about past climate and environmental changes, both natural and human-caused. Glaciers slowly advance and retreat in response to past and present climate changes, and their weight can push down the earth's crust; as a result, changes in Earth's glacial environment today can tell us about climate in the past. Layers of buried glacier ice from earlier climate periods also contain a rich and detailed history of the atmosphere and the climate in the past, unlike the records found anywhere else. We examine theories of the Ice Ages, and look at evidence for glaciers that covered Puget Sound. Finally, we consider how ice in our planet is changing today, and how it might change in the future, with accompanying impacts on our society.

Although you may not want to be a scientist, knowing what science is and how scientists do their work can be helpful in any career, because science has shaped so much in our society. As we look at ice in the environment, we will also investigate how scientists get answers to the questions they ask, how they communicate results, and what is meant by a scientific consensus. You will have an opportunity to take an anthropological/sociological viewpoint – investigating this exotic tribe called *Scientists*. You will also have opportunities to play the role of *the Curious Scientist*, by asking questions and formulating answers.

LEARNING OBJECTIVES:

I hope that you will get from this class:

- You will understand how the ice on Planet Earth is changing today.
- You will appreciate how glaciers and polar ice sheets alter climate, landscape and sea level in ways that affect our society.
- Insight into the ways earth scientists can extract a wealth of information about past environments from measurements on ordinary materials like ice, stone, mud, or wood.
- You will be able to read scientific research papers, to get the story from the original source.
- You will understand the power and usefulness of simple arithmetic to help you find approximate answers to fundamental environmental questions.
- You will appreciate how you can apply these methods to other questions beyond this course.

TENTATIVE TIMETABLE:

Week 1: What is a glacier? Where are they and why?

- Week 2: Glacier motion - deformation and sliding
- Week 3: Types of glaciers around the planet
- Week 4: Changing climate, changing glaciers
- Week 5: Ice cores reveal climate changes
- Week 6: Ice Age cycles
- Week 7: Lake Vostok - ancient life under the ice, a stepping stone to the planets?
- Week 8: Glacier outburst floods
- Week 9: Melting glaciers, sea level rise
- Week 10: Other changes in the cryosphere now and in the future

COURSE READING MATERIALS: Textbook:

Frozen Earth: the once and future story of ice ages. D. Macdougall. University of California Press. 2004.

We will not follow this book in all details, but it is a "good read" on the topic of ice and a changing world. We will use extensive sections from the book for some topics and Labs.

Optional additional text:

Glaciers and environmental change. Atle Nesje and Svein Olaf Dahl. London Arnold; New York: co-published in the U.S. by Oxford University Press, 2000.

This is a textbook aimed at science majors.

Scientific articles:

- Publications from scientific articles written for general audiences with some scientific background (such as this class), e.g. journals *Nature* and *Science*.

The articles that we will discuss during the Quarter will be available on the class web page

<http://courses.washington.edu/ess203/>

Look under **READING**. To access the reading materials, you need to login with your **UW Net ID** login and password. The reading materials will be in pdf format.

Additional reading:

Ice ages: solving the mystery. John Imbrie and Katherine Palmer Imbrie. Cambridge MA: Harvard University Press, 1979.

This is a classic book describing the development of the scientific theories of the ice ages.

The Ice Finders: how a poet, a professor, and a politician discovered the Ice Age. Edmund Blair Bolles. Washington DC. Counterpoint Press, 1999.

This is another good story about the discovery of the ice ages.

SCHEDULE

We will meet 3 times weekly for classes.

Check Time Schedule for time and place.

Choose 1 of the 2 lab sections, on Tuesday or Thursday

Check Time Schedule for time and place.

COURSE STRUCTURE

Classes:

Classes will be a mix of instruction and group discussions. I will expect you to attend classes and contribute to discussions. Your preparation will entail some reading and library and/or web research of topics for class discussions.

There will be regular short writing assignments on topics discussed in class. These assignments will be due at the start of the next class. To help me to assess your understanding of the course material, I will read your written work and give you feedback on content and writing style on each assignment. Completion of

these assignments will contribute significantly to your Class Participation grade (below). I will not give you a numerical grade for these assignments. They will be C/NC; however, if I think that you have missed the major points in the assignment, I may ask you to revise your answers before you get credit.

Labs:

Each Lab session will have activities to be discussed and/or carried out in groups. Attending Labs and participating in the activities is essential for understanding the learning objectives of the class. Lab activities will include:

- exploring topics from class in greater depth
- finding and using simple numbers to understand the world around us
- taking field trips to see results of glacier action around Seattle

There will be writing assignments associated with each lab. These exercises can be completed in the lab or finished up as homework. You are encouraged to work through the exercises as a group. However, each person should turn in his or her own answers the start of the following Lab period. These Lab assignments will be graded by the TA.

Group Research Reports

For research projects in this class, you will form groups with 2 or 3 people in each group. Each group will start by reading a paper or papers about an issue involving ice and changing environments, and write a collaborative report of about 3000-4000 words equivalent (6-8 pages) about the issues involved. This is the way most scientific papers are written. Each group is also encouraged to explore or follow up ideas in directions of your choosing.

- For example, your basic goal could be to identify the key elements in the paper that are used to argue to a conclusion, summarize that argument, and then discuss implications for the environment and society.
- Or, you might take the approach of writing a job description for an environmental consultant, and then writing a report by that person for a politician's office, about a current topic involving glaciers and sea level, or water resources, etc.
- Your group might write a report about how to make this course communicate more effectively to larger numbers of students about environmental concerns involving glaciers and ice.

During the last several weeks of the quarter, you will have opportunities in class or lab for your groups to discuss ideas and to report your progress. During the last week of the quarter, each group will present its findings to other class members in your Lab sections. I expect that you will question the other groups, to satisfy your curiosity about their topics and to ensure that they explain their research to you adequately. This is also your responsibility as a scientific audience. ☺

Ideally, each group member will contribute substantially to your group paper. In addition to the group paper, I will also ask each of you to turn in a short (1 page or less) paper describing *your* activities and contributions to the group paper.

Group-paper timetable:

- After the first 3 weeks, you will have formed tentative groups and identified topics to explore.
- Each Group will make appointments to *meet as a group with the instructor* in week 4 or 5, and again in week 9 to discuss progress, ideas and issues. It will be the responsibility of each Group to arrange these and additional meetings as desired, for mutually convenient times.
- During Week 6, each Group will present a 1 page outline of their paper.
- During the final lab sessions of the quarter (March 9 and 11), each group will present its findings to the rest of the class.
- The co-authored written papers are due on March 15 (first day of exam week).

Here are some sample topics:

- Global warming and the stability of the West Antarctic Ice Sheet
- The great climate flip-flop: can global warming trigger an ice age?
- Ice caps on Mars - is there a climate record there?
- Snowball Earth – did the Earth freeze over in late Precambrian time?
- Why are glaciers retreating in Greenland today?
- What’s happening to our permafrost?
- Why are ice shelves disintegrating in the Antarctic Peninsula?
- Will the Ross Ice Shelf break up in the near future?
- When will Washington State be glacier-free?
- Glaciers and water supplies in Asia and/or Africa
- The future of tropical glaciers

TESTS:

There will be 2 tests during the quarter:

- in the normal class period and room.
- after 4 weeks (Wednesday February 03) and after 8 weeks (Wednesday March 03).
- prose answers to 3 questions related to concepts discussed in class. I will post study questions.

There will be *no final exam*.

COURSE GRADES:

25% - class tests (2)

40% - lab projects

15% - group research project and report

20% - class participation

ACTION ITEMS:

1. Writing assignment due on Wednesday:

- (a) Write down 2 things that you learned today about glaciers. (If you did not learn something new, you can find 2 things by looking up "glaciers" on the web or in an encyclopedia).
- (b) What is 1 thing that you want to know about glaciers but don't (yet)?

To keep it easy, please do not exceed 1 paragraph or 1/2 page. Thanks!

I hope that we will be able to use the compiled answers as a framework for some future class discussions.

2. Class Questionnaire:

I have given you a Questionnaire so I can learn more about your backgrounds and interests. If you didn't get a copy in class, you can download it from the class page.

- Please return Questionnaires on Wednesday. Thanks.

3. Readings:

During the next week or so, we will be asking “*What is a Glacier?*”

- Please read the paper called *Sharp - Glaciers* from the class web page.
(Look under RESOURCES/Reading Assignments.)