Overview: The Earth has been transforming itself ever since it formed. People have been altering the Earth ever since our earliest ancestors appeared, but in the 20th century humanity became a significant driver of global change. Earth system science seeks to understand these anthropogenic transformations in the context of the interconnected history and dynamics of the fluid, solid, and living Earth.

Throughout the course, students will progress from descriptive to analytical systems thinking. Upon finishing the course, they will have a scientific understanding of how key interactions among hydrospheric, geologic, and biospheric processes shape the underlying structure of the Earth System, and of the unprecedented modification of that structure by anthropogenic processes.

A team of Earth system scientists from the departments of Atmospheric and Oceanic Sciences, Earth and Planetary Sciences, and Geography will teach the course. They will incorporate recent scientific discoveries, debates, and policy issues from the perspective of Earth System Science (ESS).

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Class structure: ESYS 200 will be taught in two distinct parts. The first part of the course (weeks 1-5) establishes the scientific vocabulary of ESS, enabling us to 'speak the same language' for the second part of the course. While we will touch on many important topics in lecture, the readings from your textbook will present the necessary information in more depth. Material from lectures and readings will be covered in the midterm examination. The second part of the course (weeks 6-14) consists of a sequence of
detailed case studies that focus on issues of climate, biodiversity, biogeochemical cycles, and resources from an ESS perspective. The Tuesday class of every week will present an overview of the case study. At the end of this lecture, we will hand out an accessible (and short) paper (or set of papers) from the contemporary scientific literature. These papers will review the case study in detail, and will form the basis of the discussion that will take place during the Thursday class of every week. This discussion will be facilitated in two ways. We will hand out a short set of questions, due at the beginning of Thursday's class, that will direct your reading of the papers. In addition, each of you will prepare a short presentation on the week's reading once during the semester.

Expected Learning Outcomes: At the end of this course, students will be able to:
- Distinguish the operating principles of ESS
- Describe the historical development of ESS
- Recognize modern observing and modeling techniques of ESS
- Define the various 'spheres' that make up the Earth System
- Identify and explain important processes taking place within the Earth System
- Evaluate how different processes directly link the spheres of the Earth System
- Appraise topics in climate, biodiversity, biogeochemical cycles, and resources from an Earth System perspective
- Reflect critically and knowledgeably on complex global Earth issues

Tentative lecture schedule: Note that this schedule may be rearranged due to unforeseen conflicts (for example, babies, scientific conferences, train derailments).

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Tu Lecture</th>
<th>Th Lecture</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 4</td>
<td>None</td>
<td>Intro, Syllabus BL, BT, BW</td>
</tr>
<tr>
<td>2</td>
<td>Jan 9/11</td>
<td>ESS (Why) BL</td>
<td>ESS (What) BW</td>
</tr>
<tr>
<td>3</td>
<td>Jan 16/18</td>
<td>ESS (How) BT</td>
<td>Geosphere BW</td>
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<tr>
<td>4</td>
<td>Jan 23/25</td>
<td>Hydrosphere I BT</td>
<td>Hydrosphere II BL</td>
</tr>
<tr>
<td>5</td>
<td>Jan 30/Feb 1</td>
<td>Biosphere BL</td>
<td>Midterm Exam</td>
</tr>
</tbody>
</table>

Readings from The Blue Planet for lectures/midterm exam: Geosphere (chs. 4, 8, 6, 7); Hydrosphere I [Oceans, Ice, and the Atmosphere] (chs. 10, 11, 12, 13); Hydrosphere II [Hydrology and the Atmosphere] (chs.9, 13); Biosphere (chs. 15, 17,16). Underlined chapters indicate mostly complete coverage.

6 Feb 6/8 Effects of climate change on global water resources BL
7 Feb 13/15 Modern issues in global land and food resources BL
6 Feb 20/22 Spring Break
8 Feb 27/Mar 1 Canadian cod fisheries and global climate change BT
9 Mar 6/8 Rapid decline of sea ice in the high Arctic BT
10 Mar 13/15 Carbon cycling: a paleo-perspective BT
11 Mar 20/22 A natural history of atmospheric oxygen BW
12 Mar 27/29 A global biodiversity crisis ~251 million years ago BW
13 Apr 3/5 Brave new world? : the finite nature of petroleum resources BW
14 Apr 10 Summary BL, BT, BW
Assessment: Grades will be awarded on the basis of 5 different aspects of your performance in the class. These are outlined below. Each aspect has been assigned a certain number of points out of a total of 100. The points from each aspect will be totaled and the final percentage will be converted into letter grades following Faculty of Science guidelines.

1. Midterm examination: 25% of total grade (25 points)
Mostly short questions/answers based on content of lectures and course material (see assigned chapters from *The Blue Planet*).

2. Short answers to questions about weekly paper: 20% of total grade (20 points)
These questions will primarily be there to guide your reading of the weekly paper. There will be 1 point awarded per question and 3 questions for each paper. Since there will be 8 papers, 24 points are available for this section but the assessment will be made on the basis of 20 points. A missed assignment will receive 0 points. Any extra points from this section will be taken into consideration during the evaluation of final grades.
Assignments will be due at beginning of Thursday classes.

3. Scheduled short presentation once during the term: 20% of total grade (20 points)
Evaluation will be based on the following four categories (5 points each):
   i. Understanding and answering the question
   ii. Format of presentation (within time/slide limits: maximum 5 min. presentation, 3 power point slides or equivalent)
   iii. Responses to Q&A
   iv. Peer evaluation (audience fills in a short questionnaire at end of class)

4. Short (one paragraph) in-class reflections: 10% of total grade (10 points)
Reflections will be written up and handed in during the last 10-15 minutes of Thursday classes in weeks 6-13. Up to 1.5 points will be given for each completed reflection. Since there will be 8 papers, 12 points are available for this section but the assessment will be made on the basis of 10 points. Any extra points from this section will be taken into consideration during the evaluation of final grades. A missed assignment will receive 0 points.

5. Final exam: 25% of total grade (25 points)
The final exam will be held during the official Winter Term exam period. It will consist primarily of essay answers to your choice of questions on 2 of the 8 case studies.
**Academic Integrity:**

Senate on January 29, 2003 approved the following resolution on academic integrity, which requires that a reminder to students be printed on every course outline:

Whereas, McGill University values academic integrity;
Whereas, every term, there are new students who register for the first time at McGill and who need to be informed about academic integrity; Whereas, it is beneficial to remind returning students about academic integrity;

Be it resolved that instructors include the following STATEMENT on all course outlines:

*McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see http://www.mcgill.ca/integrity/ for more information).*

Be it further resolved that failure by an instructor to include a statement about academic integrity on a course outline shall not constitute an excuse by a student for violating the Code of Student Conduct and Disciplinary Procedures.