

Global Change 1: Physical Processes

Environ 110
Biol 110
Geosci 171
AOSS 171
ENSCEN 171

home lectures labs syllabus reference

Global Change 1 Physical Processes

GLOBAL CHANGE
Physical Processes

LectureTools
CTools
GC Home

Every day, millions of human and natural activities are altering the planet on which we live. Over the past century, through our ever-increasing population and mastery of technology, we have been changing the global environment at a pace unknown to natural history.

The University of Michigan's **Global Change Program** offers an interdisciplinary three semester introductory course sequence that investigates the causes and potential impacts of global change using a combination of traditional lecture-based and modern web-based teaching methodologies. The courses can be taken alone or in conjunction with companion courses toward completion of the **Global Change Minor**.

This semester course deals with issues relating to the physical, chemical and biological cycles contributing to Global Change. Students apply learned knowledge by using discussions and Stella systems modeling software to investigate the dynamics of natural systems.

www.globalchange.umich.edu/ **Meet the GCI Instructors**

Global Change 1: Introductions

Professors

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Interdisciplinary, Team-taught Natural and Social Science Curriculum

"To become better equipped to contribute to the important debates concerning global environmental change, resource management and societal adaptation strategies."

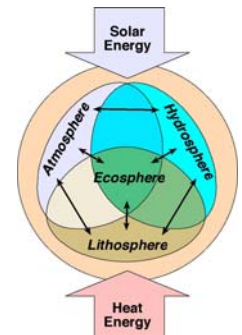
Science and understanding changes, we have to keep up!

3

GC1 - Course Objectives

Understand Earth as an "integrated system":

- **Change and evolution** (stars, solar systems, atmosphere, soils and life evolve from precursors)
- Underlying **physical and natural processes**, how they work and how they are integrated
- **Variability and uncertainty** (climate has always varied, prediction is difficult in complex systems)
- **Human alteration** of Earth's physical and biological systems (rates are key)



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Course Management: U-M's Ctools

Global Change 1: Physical Processes

Every day, millions of human and natural activities are altering the planet on which we live. Over the past century, through our ever-increasing population and mastery of technology, we have been changing the global environment at a pace unknown to natural history.

The University of Michigan's **Global Change Curriculum** offers an interdisciplinary introductory course structure that promotes the causes and potential impacts of global change using a combination of traditional lecture-based formats and modules with innovative teaching methodologies. The courses can be taken alone or in conjunction with complementary courses toward completion of the **Global Change Major**.

The fall semester course deals with issues relating to the physical, chemical and biologic systems contributing to Global Change. Students apply learned knowledge by using scenarios and systems dynamics modeling to investigate future systems.

There is no textbook for the course. Topical webpages, Powerpoint presentations and personal notes taking will be used.

NO LAB/DISCUSSION SECTIONS UNTIL WEEK OF 8/16, FIRST CLASS Wednesday, 8/13.

LectureTools: <http://www.lecturetools.org>

<https://ctools.umich.edu/>

Lectures

Week	Date	Day	Topic	Instructor
1	9-Sep	Wed	Introduction and Goals	All
	11-Sep	Fri	Readings: The Scientific Method; Lecture Tools setup	King
	9-11-Sep		NO LAB	
2	14-Sep	Mon	The Big Bang and Fundamental Laws	van der Pijpen
	16-Sep	Wed	Evolution of Substances and States	van der Pijpen
	18-Sep	Fri	Our Solar System and the Energy Balance of Planets	van der Pijpen
	14-18-Sep		"Challenges We Face" - Discussion and Intro to Terms Presentations	
3	21-Sep	Mon	Clocks in Rocks: Indicators and the Age of Earth	Luhmann
	23-Sep	Wed	Our Shifting Earth - Plate Tectonics	Luhmann
	25-Sep	Fri	The Cycle of Rocks and Formation of Soils	Luhmann
	21-25-Sep		Introduction to Soils - Dairy World	
4	29-Sep	Mon	Evolution of the Oceans and Atmosphere	Luhmann
	30-Sep	Wed	The Origin of Climate on Earth	Luhmann
	2-Oct	Fri	Greenhouse Gases and the Greenhouse Effect	Luhmann
	29-Sep-2-Oct		Earth's Energy Balance Model	
5	5-Oct	Mon	Composition and Evolution of the Atmosphere	Luhmann
	7-Oct	Wed	Weather and Climate	Luhmann
	9-Oct	Fri	Water and Ice - the Hydrophere and the Cryosphere	Luhmann
	5-9-Oct		Climate and Atmosphere Lab - Long-Term Climate Regulation	

Lectures, cont.

Lecture Notes and PowerPoint files

1. Your own class notes are important. Be here, so you learn more and won't be surprised.
2. Supporting notes on-line (but they do not replace lectures).

3. PowerPoint slides through Ctools and LectureTools (updated prior to lectures)

Information Environment (LectureTools)

The screenshot shows the LectureTools interface with sections for 'SELECT LECTURE DATES', 'MY LECTURE DATES', 'LECTURE PREP', 'ACTIVITY PREP', and 'MANAGEMENT'. It includes a calendar view for September 2008 and a list of lecture dates with status indicators.

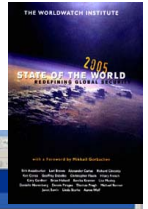
Bring your wireless-enabled laptop to class for lecture notes, web access, and real-time searches



Details on Friday ...

Labs: Discussions and Analysis

- Before lab, read articles
- In class, discuss questions and activities related to the articles to explore our role in global change.

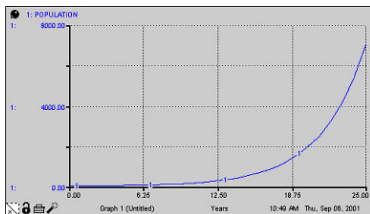
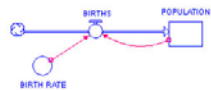


The screenshot shows the 'Global Change 1 Labs/Discussions Fall 08 Schedule' website. It features a table with columns for SECTION, TIME, GSI, DISCUSSION ROOM, and COMPUTER ROOM. Below the table, there are sections for 'LABORATORY ACTIVITIES' and 'MEET IN DISCUSSION ROOM FOR FIRST LAB (WEEK 2, LAB 1)'.

SECTION	TIME	GSI	DISCUSSION ROOM	COMPUTER ROOM
2	Wed 2-5	John Bertini	1048 DANA	3323 DANA
3	Th 2-5	Sarah Barbero	1048 DANA	3323 DANA
4	W 2-5	John Bertini	1048 DANA	3323 DANA
5	T 2-5	Sarah Barbero	3556 DANA	3323 DANA
6	T 2-5	Daniel Horton	1048 DANA	3323 DANA
7	W 2-5	Daniel Horton	1048 DANA	3323 DANA
8	W 2-5	Sarah Neville	1048 DANA	School of Public Health A
9	Th 2-5	Sarah Neville	1048 DANA	Chairman's A, Art

System Dynamics Modeling (Stella)

Population Example:
 $BIRTHS = (BIRTH\ RATE) * (POPULATION)$



- Stocks are variables of interest
- Flows change stocks. Flows go into or out of stocks
- Converters change relationships between stocks and flows
- Connectors allow information to be passed between variables

Next Week's Lab Reading

Before coming to lab, read:

The Challenges We Face – A History of our Future

2003 State of the World p. 3-13

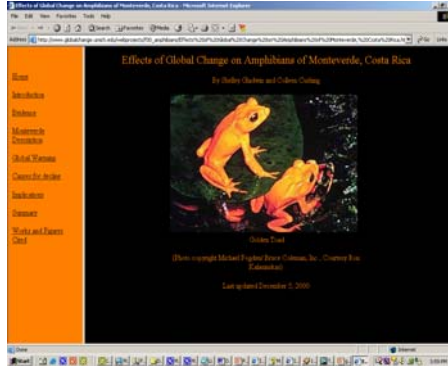
The screenshot shows the 'STATE OF THE PLANET' software interface. It features a globe and various tabs for 'POPULATION', 'WATER', 'UNIVERSITY', and 'TIME'. The main text reads: 'The good news: population growth is slowing. The scary news: population growth is expected to double. But our climate and our food supplies will be tight.' There are buttons for 'ENTER' and 'EXIT'.

"We have only one or perhaps two generations in which to reinvent ourselves."

Group Term Project

The term project is a group research activity that will be presented in a PowerPoint class presentation and posted as a website.

Students organize into teams of 3 to develop a plan and implement the project related to the course material.



Suggestions for project topics and sample projects are offered, but the choice will be left to each team with guidance from your lab instructor. 13

Syllabus - Grades et al.

The class uses a **point system** for determining final grades:

- Midterms (2): 100 points each
- Final: 150 points
- Lab/Discussion: 13 points each (hand-in by next lab)
- Lecture Homework: 5 points each (hand-in by next lab)
- Term Project: 100 points total
- Surveys/Assessments: 1 point each (excluding UM's E&E)



Optional, non-graded self-tests for lectures available as a link on the CTools site.

The total points are normalized on a scale from 0-100, using a **straight scale for letter grades**. The grades are:

- 0-59 = E
- 60-62, 63-65, 66-69 = D-, D, D+
- 70-72, 73-75, 76-79 = C-, C, C+
- 80-82, 83-85, 86-89 = B-, B, B+
- 90-92, 93-95, 96 and up = A-, A, A+

George Kling

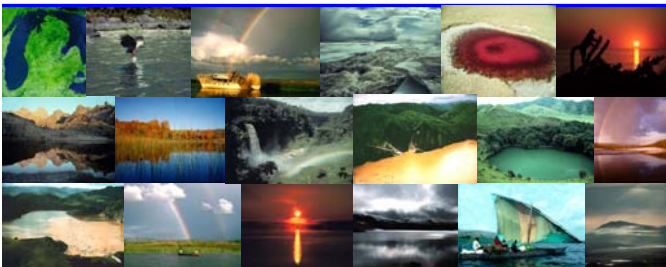
Department of Ecology & Evolutionary Biology
1041 Natural Sciences Bldg
gwk@umich.edu

Teaching:

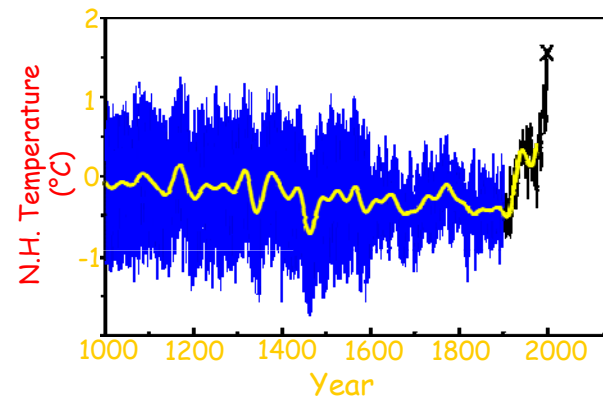
- *Global Change (Bio 110)*
- *Ecosystem Ecology (EEB 476)*
- *Limnology (study of lakes; EEB 483)*

Research:

- *Aquatic Ecosystems*
- *Impacts of Climate Change*
- *Biogeochemistry*
Arctic, Africa, Michigan



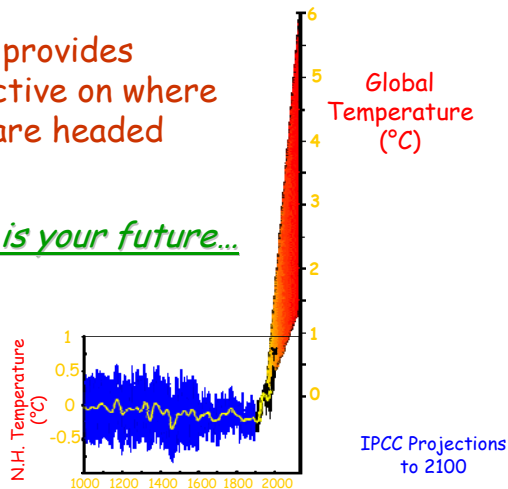
“Recent” climate change and variability...



Mann et al. (1999) GRL 26:759-762

...provides
perspective on where
we are headed

This is your future...

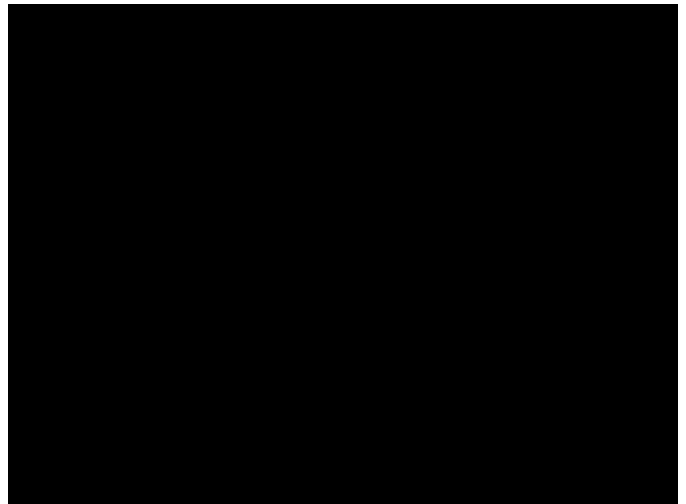


My Themes

- Global change on our planet can only be understood by combining "abiotic" and "biotic" components - *must look at the whole Ecosystem*
- A combination of facts and scientific concepts can help us understand even the most complicated problems
- Science is *NOT* hard, and everyone can and **MUST** learn enough to make rational decisions about our world's future

Possible Projects

- The "missing sink" - Where did all the CO₂ go?
- Microbes rule, Humans drool
- Does the rainforest really matter?
- The day the Earth turned brown and blue - The limits to food production
- Who's doing who? Climate skeptics and the use and misuse of Science facts
- Who needs more ice? Melting the Earth's glaciers (a.k.a. "Water World 2050", starring B. van der Pluijm as K. Costner...)
- WWF Climate 2009 "rage in the cage" - People vs. Nature
- Abrupt climate change - can El Nino's run wild?
- Whatcha gonna do when the rain don't come - Shifts in the Global water cycle

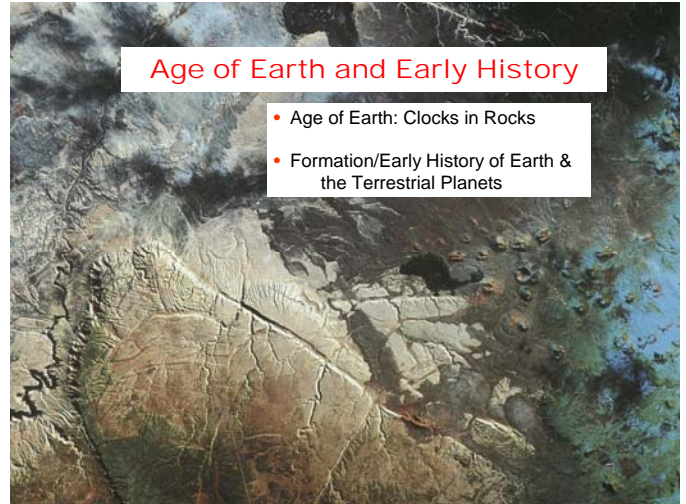


Kyger C “Kacey” Lohmann

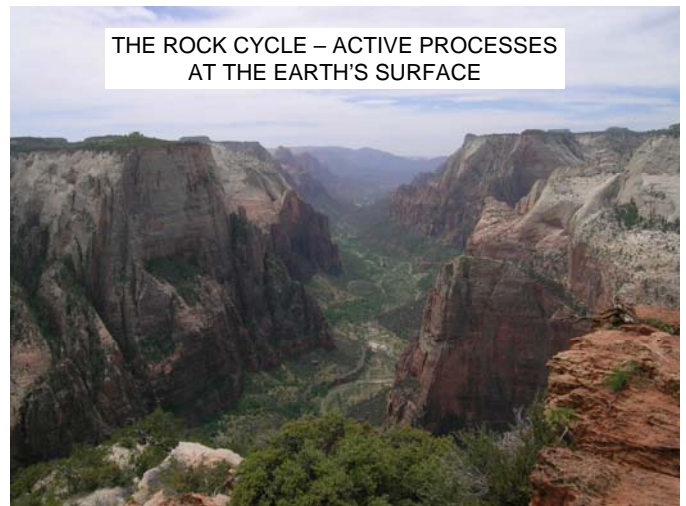
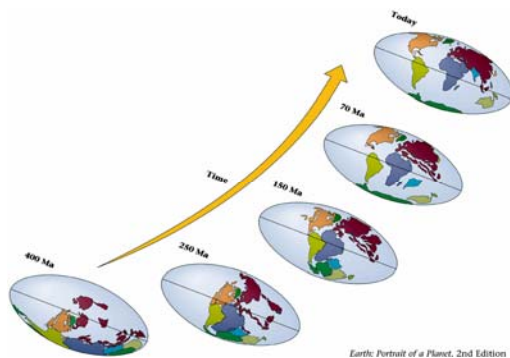
Professor
Department of Geological Sciences



- Sedimentary Geochemistry
- Changes in Ocean Chemistry over the last billion years of Earth's history
- Reconstruction of Earth's climate on geological time scales
- Fluid-Mineral-Rock reaction dynamics
- GS100 – Coral Reefs
- GS119 – Introductory Geology
- GS305 – Sedimentary Geology
- GS430 – Advanced Depositional Systems
- GS 580 – Isotope Geochemistry



Our Shifting Earth □ Plate Tectonics



Evolution of a Habitable Earth

- Why is Earth the only habitable planet in our solar system?
- What were the steps in making a habitable Earth?



Evolution of the Atmosphere & Ocean



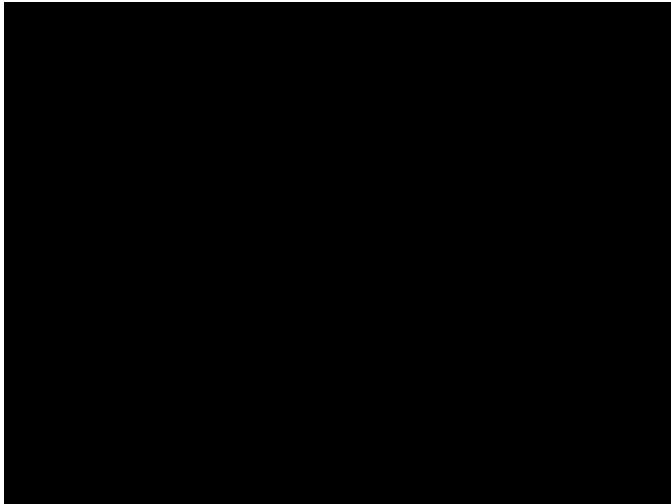
CLIMATE AND WEATHER

- What controls Earth's climate?
- Why do the winds blow?
- What is Global warming?



WATER AND ICE





Catherine Badgley



Research

- Fossil record of mammals
- How mammals respond to climate over deep time
- Impact of agriculture on biodiversity
- Sustainable agriculture

Teaching

- Global Change I (Environ/Bio 110)
- Darwin play (RCIDIV 351)
- Food, land, and society (RCIDIV/Environ/EEB 318)



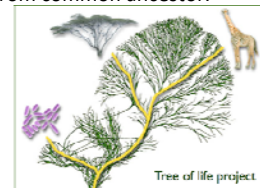
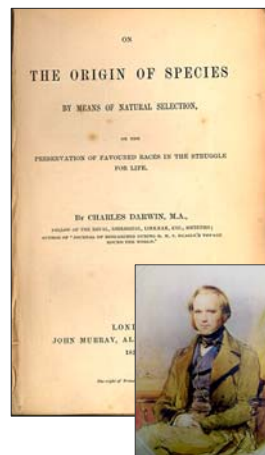
My themes

- What processes are responsible for the diversity of life?
Evolution, natural selection, species formation
- In what ways does the physical world influence living systems?
Earth history and diversification, extinction, climate and life
- What are the major ways that organisms interact within ecological communities?
Competition, predation, mutualism
- How have human activities affected all of this and what is at stake?
Habitat transformation, endangered species and communities

Evolution

3 ideas

1. Variation + differential survival and reproduction → change in traits over time.
2. Change in traits + geographic separation → formation of new species.
3. All species are related by descent from common ancestor.



Ecology

- Biological diversity depends on physical world for energy and habitats.
- All species participate in local and global cycles of nutrients.
- Species interactions are the basis for collaboration and competition for life's essential resources.



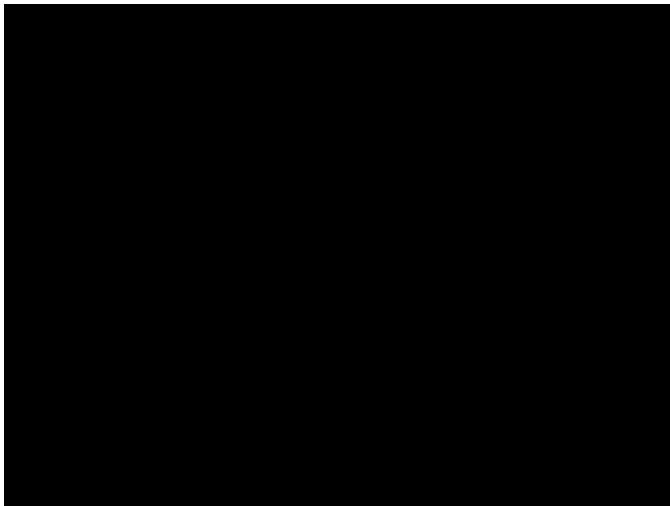
Relationship and Interdependence



<http://tolweb.org/tree/phylogeny.html>



Menzel and D'Alusio, Hungry Planet



Ben van der Pluijm

Bruce R. Clark Professor of Geology
 Professor of the Environment
 Director Global Change Program
www.globalchange.umich.edu/Ben
vdpluijm@umich.edu or globalchange@umich.edu

Research: Structural Geology

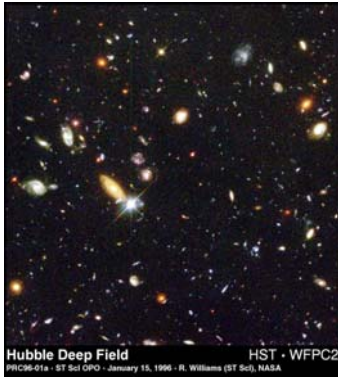
field areas: the northern Appalachians, the USA continental interior, North and South America's Grenville, northern Spain's Cantabria, East African Rift, US-Canadian Rockies, San Andreas (CA) and Alpine (NZ) faults.

topical areas: brittle and ductile faults, deep-crustal architecture, fault gouge and pseudotachylite, intraplate stresses, oroclinal, clay microstructures and textures, magnetic anisotropy, X-ray goniometry, paleomagnetism, geochronology, physical oceanography

Teaching

Interdisciplinary undergraduate teaching ([Global Change](#)), Environmental Geology, concentrator and graduate level specialty classes, IT-supported classroom education ([GeoPocket](#)), IT-supported field-based education ([GeoPad](#)).

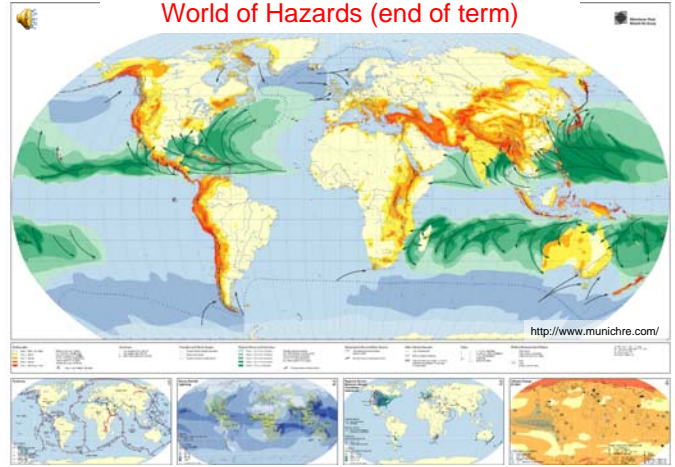
The Universe and Stuff (start of term)



We discuss

- Evidence and age of the Big Bang
- About electromagnetic radiation ("light")
- Fundamentals of energy
- Matter (elements)
- Solar system and Early History of Earth

World of Hazards (end of term)



Global Change Curriculum and Minor

Introduction to Global Change

biobiosphere
population growth
global warming
Global
emerged diseases
climate weather
Change
land quality
Program
energy resources
sustainability
urbanization

The University of Michigan's Global Change Curriculum, part of the Program in the Environment, offers an innovative approach in undergraduate science and social science education. In interdisciplinary, team-taught courses the topic of Global Change from physical and human perspectives are examined, and case studies are used to explore scenarios for sustainability. Complementary small-group sessions are used to promote students' critical thinking and analysis.

The courses are mostly aimed at first and second year students who want to understand the historical and modern aspects of Global Change. These two 4-credit courses include hands-on sections and carry NS and SS distribution credit. A Minor in Global Change can be completed in the first few years of study, with the two Global Change Courses at its core. Students learn further through the completion of one 200-level class and two electives from campus-wide courses in bio-, geo- or sociosphere.

Contact us: globalchange@umich.edu

Read the 2006 GC program article in *Journal of Resurgence Education*.
Read the [UM Global Change Program Information](#).
"A Technology-Enhanced, Interdisciplinary Learning Environment." View the [NSSE Case Study report on Global Change II: Global Change Sequence: A different type of course?](#). Read the [University Record feature article](#) by R. Oyle.

GC1	Global Change 1 - Physical Processes (Fall term)
GC2	Global Change 2 - Human Impacts (Winter term)
GC minor	Global Change Minor

<http://www.globalchange.umich.edu/>

THE GLOBAL CHANGE MINOR

"To become better equipped to contribute to the important debates concerning global environmental change, resource management and societal adaptation strategies."

GC Home Email Ben van der Pluijm, Director (vdpluijm@umich.edu) Click here to send and/or request course information (e-form)

Preamble

The three-semester, interdisciplinary course sequence "Introduction to Global Change" (<http://www.globalchange.umich.edu/>) is an inquiry-based undergraduate curriculum that forms the core of the University of Michigan's Global Change minor. Development of the program has benefited from the support of the Provost, various Deans, the Vice President for Research, the Whitaker Fund and CRLT, and from external funding from the National Science Foundation and the W.M. Hewlett Foundation. Recently it became part of the new Program in the Environment.

Curriculum

- Highly interdisciplinary, seamlessly crossing NS and SS disciplinary boundaries.
- Provide a broad understanding of the complex issues involving global change and global sustainability (Earth as a dynamic system). Enable students to use quantitative tools in approaching global change issues, including Stella (dynamic modeling), ArcView (spatial analysis), spreadsheets and interactive modules.
- Offer "credit load" minor to engage motivated students in their first year of study
 - Introduction to Global Change I (Environ10): Physical Processes (4cr) (NS)
 - Introduction to Global Change II (Environ11): Human Impacts (4cr) (SS)
 - One 200-level elective from Bio-, Geo- or Sociosphere (3-4 cr)
 - Two 300 or 400-level electives from Bio-, Geo-, Sociosphere (6-8 cr)

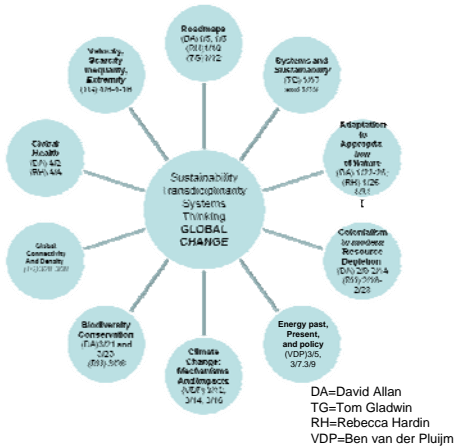
Eligibility

The GC minor requires 17 credits (typically 5 classes, of which one may count toward both the GC minor and the major). The Global Change minor has been approved in the following schools and colleges: the College of Literature, Science and the Arts (effective Winter 2000), the College of Engineering (effective Winter 2001), the Division of Kinesiology (effective Fall 2001), the School of Natural Resources and Environment (effective Fall 2000). Contact academic advisors for degrees in the Business School, the School of Music, and the School of Art and Design.

The GC2 Wheel of Lectures (Winter Semester)

How to read this slide:
Clockwise from the
"midnight" position:

- 1) First three basic Conceptual & Chronological Units preparing us to think about broad issues of past, present and future
- 2) The heart of the course is four theme-driven modules on relatively recent past and present issues: colonialism, energy, climate, and conservation
- 3) We conclude with a future-oriented series of lectures on global trends, including health



Interdisciplinary, Natural and Social Science Curriculum examining Dimensions of Global Change

"To become better equipped to contribute to the important debates concerning global environmental change, resource management and societal adaptation strategies."



Wrapping up

- Global Change encompasses all the ways that our planet has been changing since its formation ~4.5 billion years ago to today, and looking toward the future.
- Humans are affecting Earth and its life support systems at an unprecedented rate, which poses new challenges to humankind and our planet.
- Decisions and good policy require good science.

... that is why you are in Global Change !

GSI Introductions

Section #open	TIME	GSI	DISCUSSION ROOM	COMPUTER ROOM
2 - 1	W 3-5	John Berini	1046 DANA	3325 DANA
3 - 15	Th 5-7	Sarah Barbrow	1064 DANA	Classroom A AH
4 - 6	M 3-5	John Berini	1064 DANA	3325 DANA
5 - 0	T 9-11	Sarah Barbrow	3556 DANA	3325 DANA
6 - 0	T 11-1	Daniel Horton	1046 DANA	3325 DANA
7 - 8	M 5-7	Daniel Horton	1064 DANA	3325 DANA
8 - 6	W 5-7	Sarah Neville	1064 DANA	School of Public Health A
9 - 0	Th 3-5	Sarah Neville	1046 DANA	Classroom A AH

MEET IN DISCUSSION ROOM FOR FIRST LAB (Week 2; Lab 1)