



Climate Change Education Initiatives

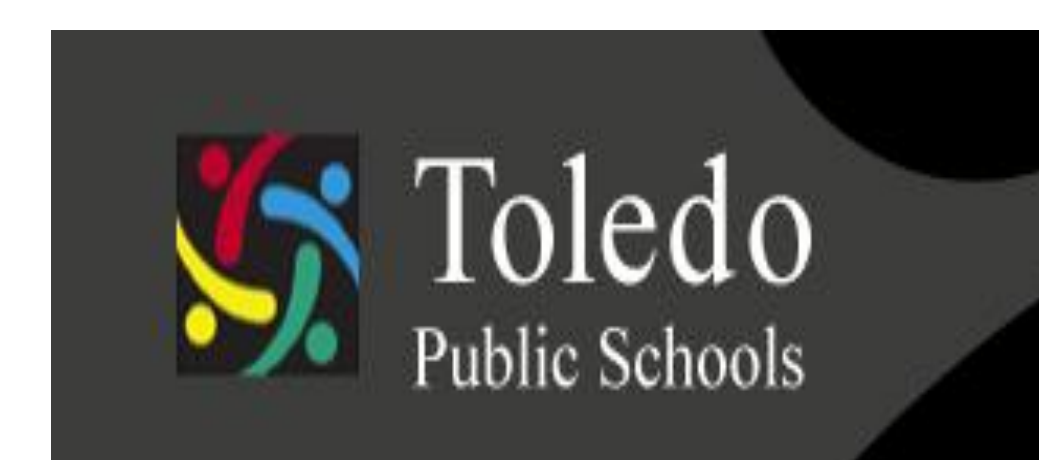
at the University of Toledo

Patrick Lawrence and Kevin Czajkowski
Department of Geography and Planning

University of Toledo, Ohio

(patrick.lawrence@utoledo.edu)

(kevin.czajkowski@utoledo.edu)



Overview

In recent years faculty, educators, and web designers at the University of Toledo have been engaged in education initiatives related to climate change. This presentation will summarize these efforts and provide specific examples of educational products and outcomes developed to date from this work. In 2009 two faculty developed and taught a Distance Learning online undergraduate course on climate change that has subsequently resulted in three course offerings to a total enrollment of 125 students. This course was designed to engage and interest students in a range of climate change topics covering both the natural science and policy aspects. In 2009 a project team from UT was successfully awarded a National Science Foundation grant in support of advancing science education in local schools in the area of renewable energy. One teacher training course developed for this program was in the topic area of climate change and allowed for increased educational and project based science pedagogy by teacher leaders for subsequent adaptation in K-12 classrooms. The NASA Global Climate Change Education program is currently funding a grant for a UT project team for the development of five climate change learning modules that will make use of available and emerging NASA science and data to address common misconceptions regarding climate change and provides such learning materials to local high school science programs.

New undergraduate course in Climate Change

In 2009 the Center for Teaching and Learning at the University of Toledo awarded a course development grant in support of new introductory course in climate change to be offered jointly between Geography and Environmental Science

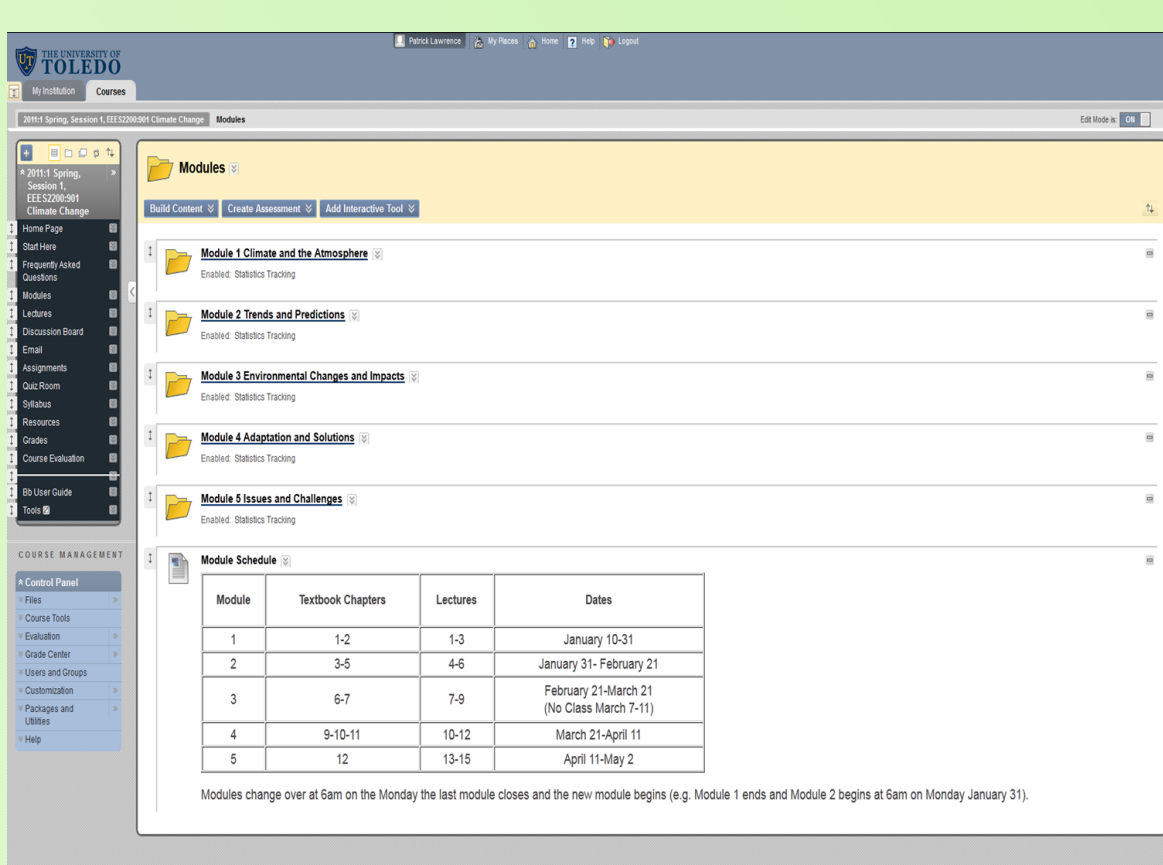
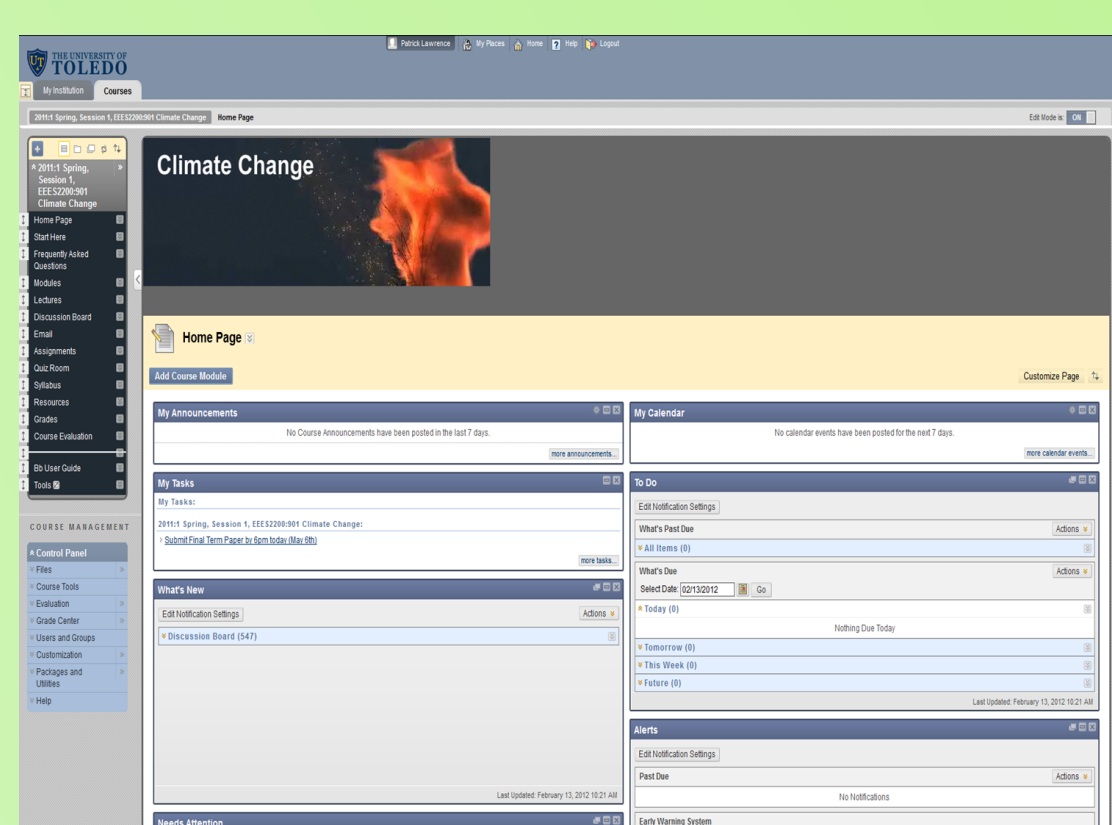
LEADERS: Climate Change course for teachers in MA Education program in renewable energy

This program is designed to provide graduate degrees in Education focusing on aspects of renewable energy, including the related aspects of climate change

High School Learning Modules to address common climate change misconceptions

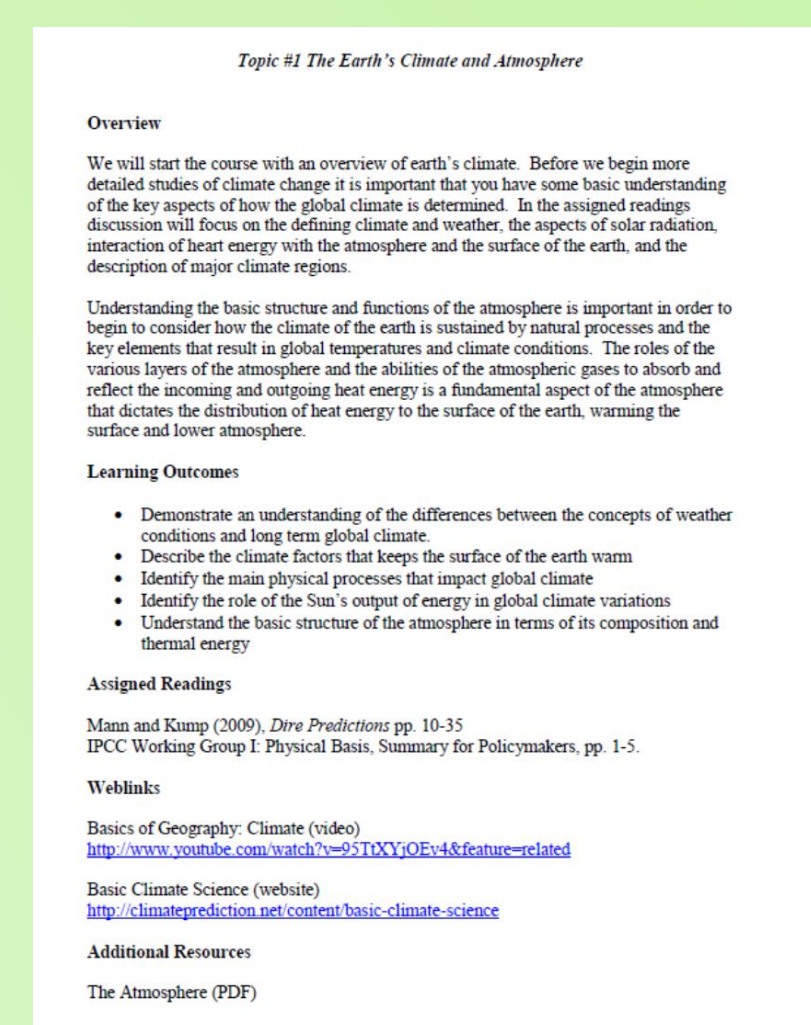
The aim of this project is to develop learning modules for high school students to examine common misconceptions regarding climate change

The climate change course is designed for online Distance Learning format using the Blackboard platform. The course is organized around five learning modules each consisting of three topics – with a topic having a short multiple choice quiz – and each module also includes an assignment and a discussion board that requires posts and replies on a module related question. The course is open to all students with no prerequisites and is a requirement for the new undergraduate minor in renewable energy as well as meeting major requirements for the BA Geography and BA/BS Environmental Studies/Science degrees.



Each learning module is self contained and allows for self paced learning over a three week period. All course materials are housed and organized with the Blackboard course webpage including the syllabus, a welcome page and FAQ pages that provide an introduction and background to the course arrangements and schedule. A discussion board tool allows for posting of course updates and enquires from students. The course covers the range of climate change topics from the basic physical science through impacts, mitigation and adaptation.

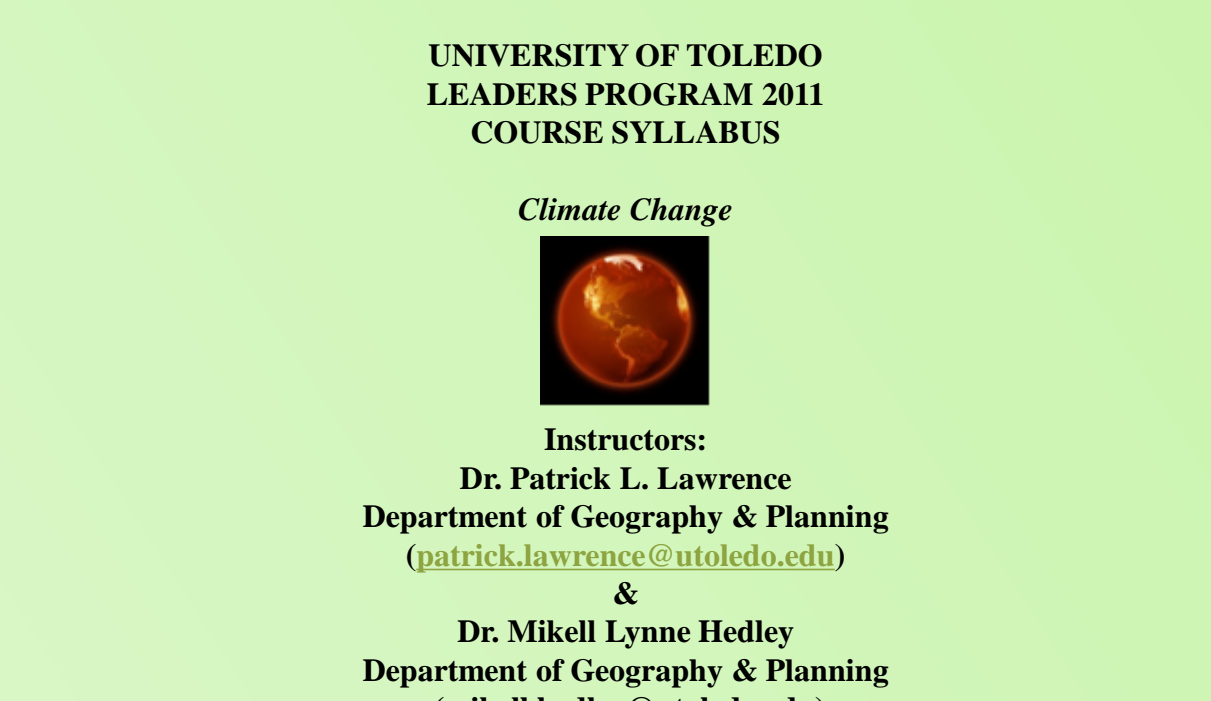
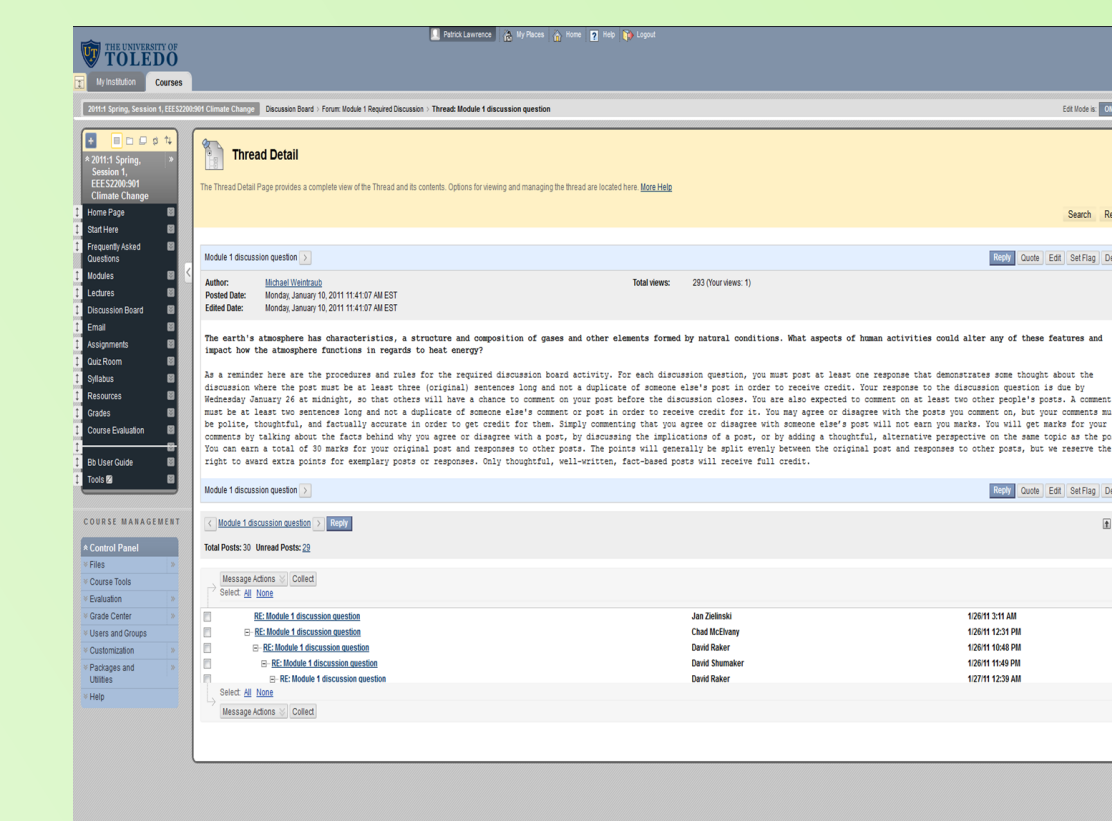
A typical topic page (see example on right) consists of an overview to introduce the topic to be covered. Learning outcomes are provided so the student is aware of the key concepts, ideas and facts they need to understand from this topic. The course has two required readings: a course textbook (Mann and Kemp, 2009) and the 2007 IPCC Reports (Summaries for Policymakers) with selected readings identified for the topic. Each topic consists of a series of web link and additional resources, both intended to supplement the readings.



As part of the student learning evaluation (grading), each topic has one assignment that is related to the topic theme and intended to have the student explore one aspect in greater detail. An assignment typically provides an overview of an issue, often providing a case study or set of readings to which the student completes a set of tasks or questions examining key questions presented with the topic.

Another important aspect of the course is the discussion board posts assigned to each module. The instructors post a question to which each student must post one original reply and two content specific replies to other student posts. This encourages active debate among the students and enhances the interaction component of the learning experience.

With three course offerings since 2010, 125 students have completed the course with an average mean final grade of B+ and student evaluations generally positive.

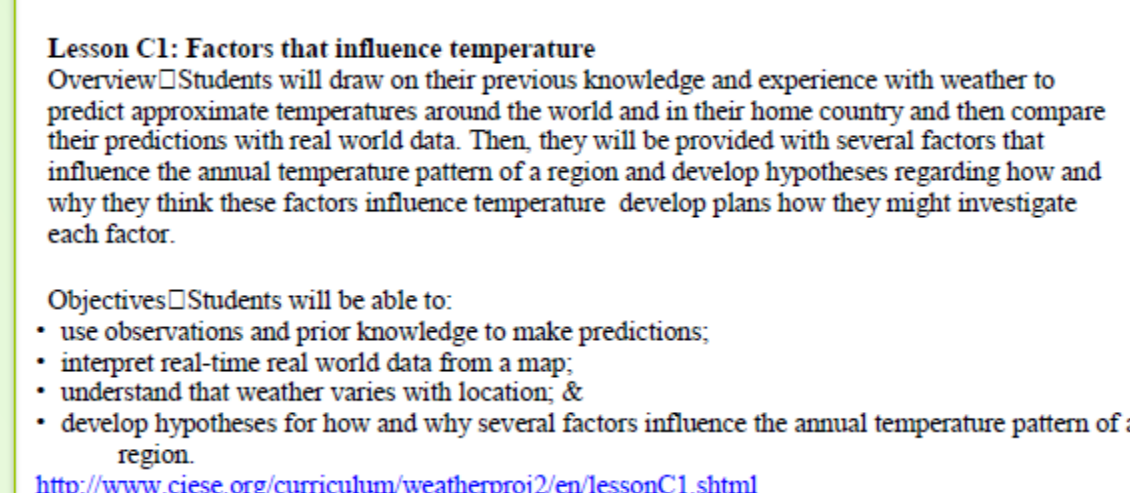
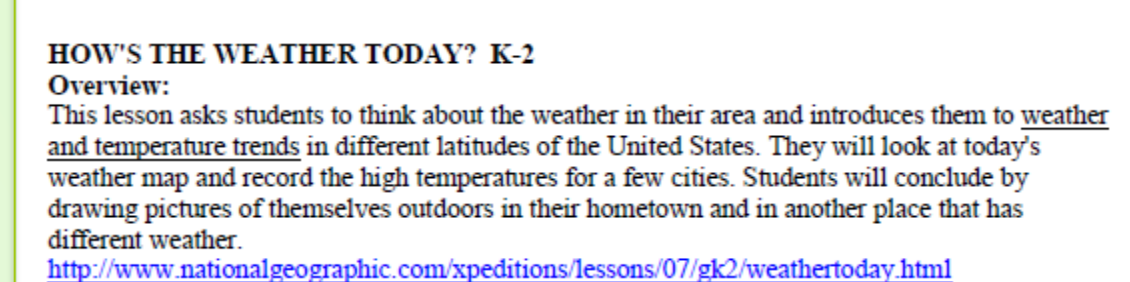
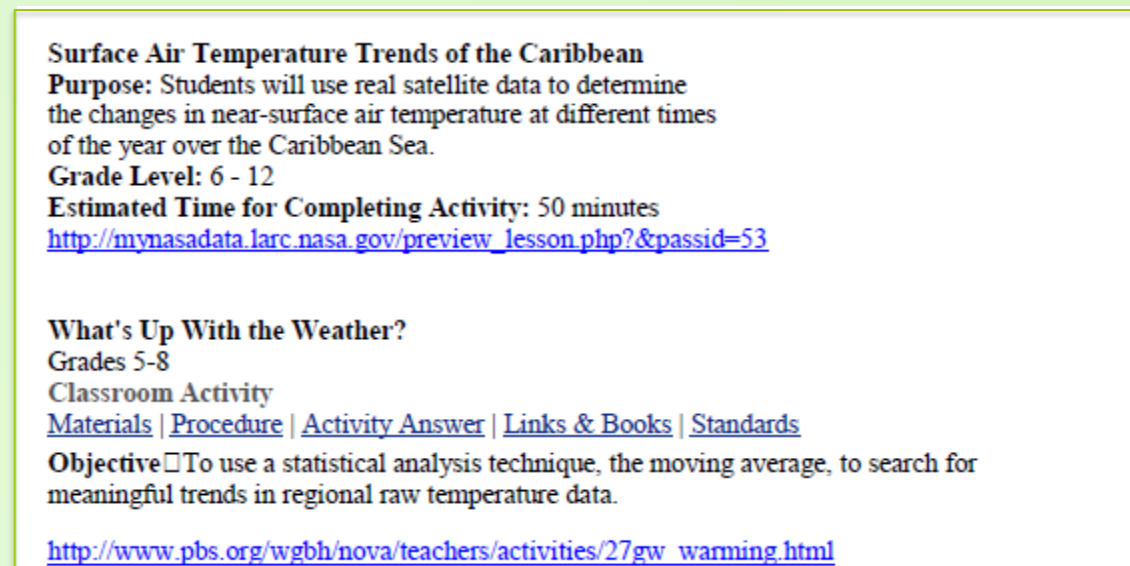


Course Description:
An overview of the understanding of climate change and role of human activities, including atmospheric processes, greenhouse effect, carbon cycling, physical evidence, impacts, and consequences. The course will begin with an introduction and orientation during the week of July 18th when teachers will meet with the course instructors each morning for overviews of the course materials and to evaluate potential classroom teaching activities associated with climate change topics.

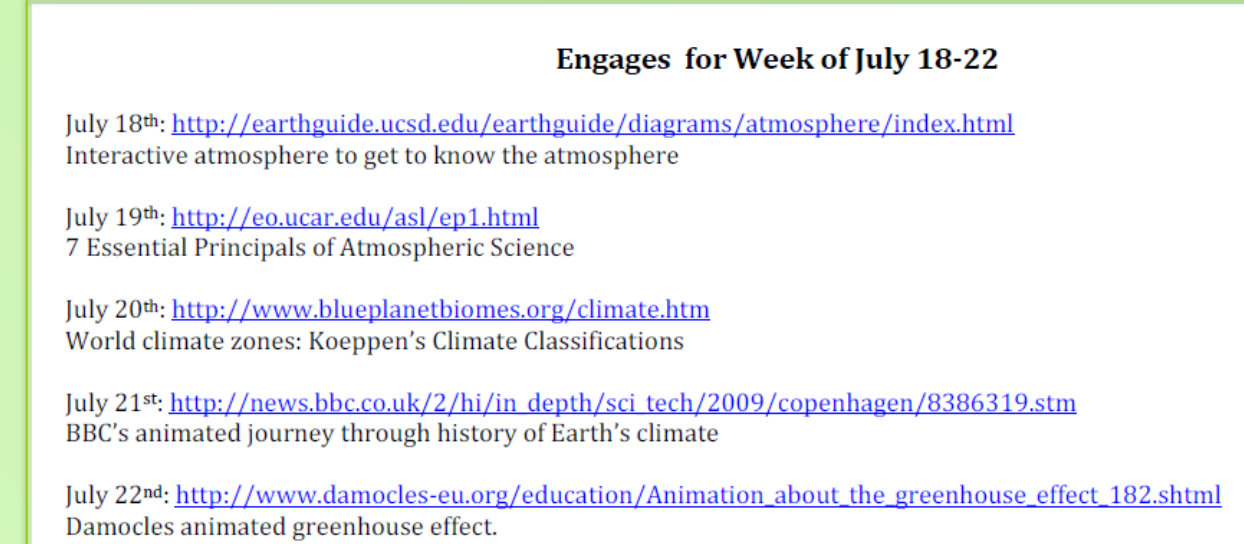
The main course content will be delivered by the use of online lectures via the LEADERS ScienceCafe website from July to November 2011. Four in-person meetings (on Thursdays from 4 to 6 pm) will be held in conjunction with the online materials: September 15th, October 12th, and November 2nd to provide for review and additional learning and teaching activities. Teachers will be required to review the online lecture materials and complete quizzes and assignments before attending the subsequent class meeting. On Thursday November 17th (Open to 9pm) the class will conclude with poster project presentations by each teacher on a topic related to climate change.

- Lecture Modules:**
Climate and the Atmosphere – Online Content opens Monday June 22nd
The Earth's Climate Atmospheric Processes
The Greenhouse Effect
Trends and Predictions – Online content opens Monday August 22nd
Carbon Cycling
Historical Global Climates and Temperature Trends
Climate Modeling
Environmental Changes and Impacts – Online Content opens Monday September 19th
Evidence for Climate Change
Human Activities and Climate Change
Impacts and Consequences

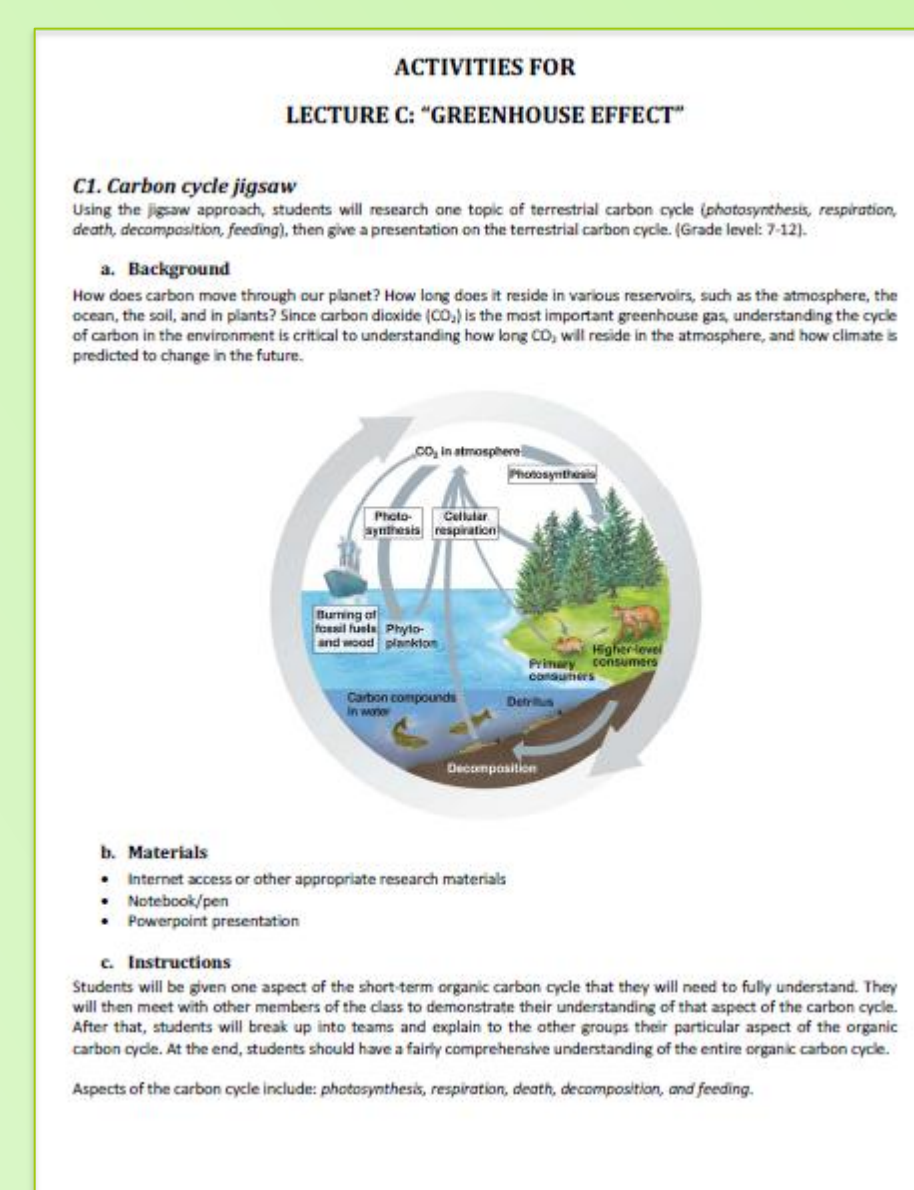
Throughout the course the LEADER teachers were exposed to a variety of Project Based Science (PBS) classroom activities that they were encouraged to sample and evaluate for potential application in their classrooms – see below.



The climate change course for the LEADERS MA Education program consisted of a hybrid classroom/online course using ScienceCafe as the primary website for content delivery. The course was designed to cover the scientific basis for climate change, well providing opportunities to develop 7-12 grade classroom content and student learning through Project Based Science (PBS). The course syllabus from the summer/fall 2011 offering is shown at left. A total of 12 senior elementary and high school science teachers (from private and public school systems) were in the LEADERS program in 2011.



During each class day with the LEADER teachers "on hand" learning activities were introduced to engage the leaders on the topic in order to enhance their learning and to consider means by which to bring this topic into the classroom through online activities or tasks. The list above provides a set of online engagement activities for the first week of the course where the focus was on basic understanding of the climate and atmosphere.



For each course module two or three learning activities were introduced and the LEADER teachers, divided into smaller working groups, completed the tasks for the activity and discussed the learning gained from the activity with consideration of its utility by students in their classrooms (sample above). LEADER teachers also developed their own projects resulting in presentations to fellow teachers to assist in their classroom instruction on climate change topics linked to state science standards.



The module will clearly demonstrate that uncertainty can be incorporated into the benefit-cost analysis (BCA) and highlight that the only remaining debate amongst environmental economists is how much reduction how soon? For every "dirty job" that is lost, there is a "clean job" created somewhere else in a low greenhouse gas emitting sector of the economy. In Figure 1, a simple Production Possibility Frontier (PPF) Model illustrates the transfer as, e.g., we move from pt. A on the PPF to pt. B.

"Individuals cannot make a difference" is a misconception often held by students. This misconception can largely impede our society's ability to reduce emissions. If individuals assume there is nothing they can do, they might not think about any solutions or ways they can help reduce greenhouse gas emissions. To be able to answer this question, students and teachers will have to first investigate how their actions and lifestyles may or may not contribute to global climate change through a personal carbon calculator.

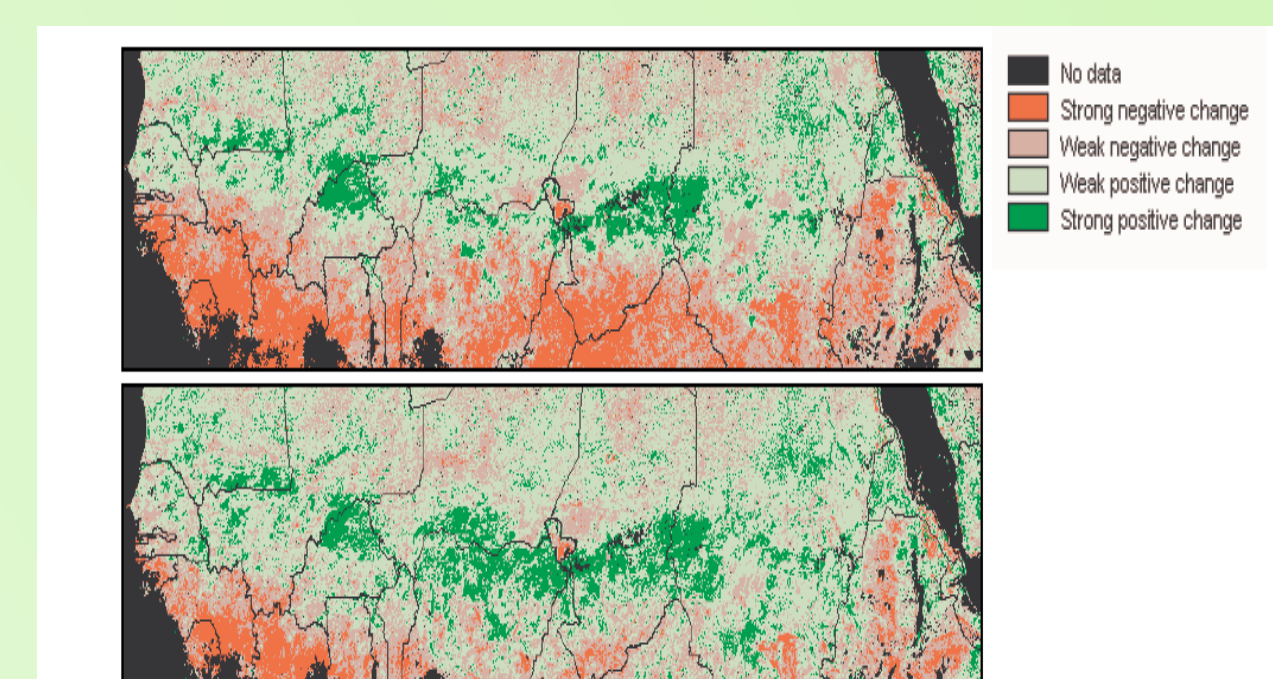
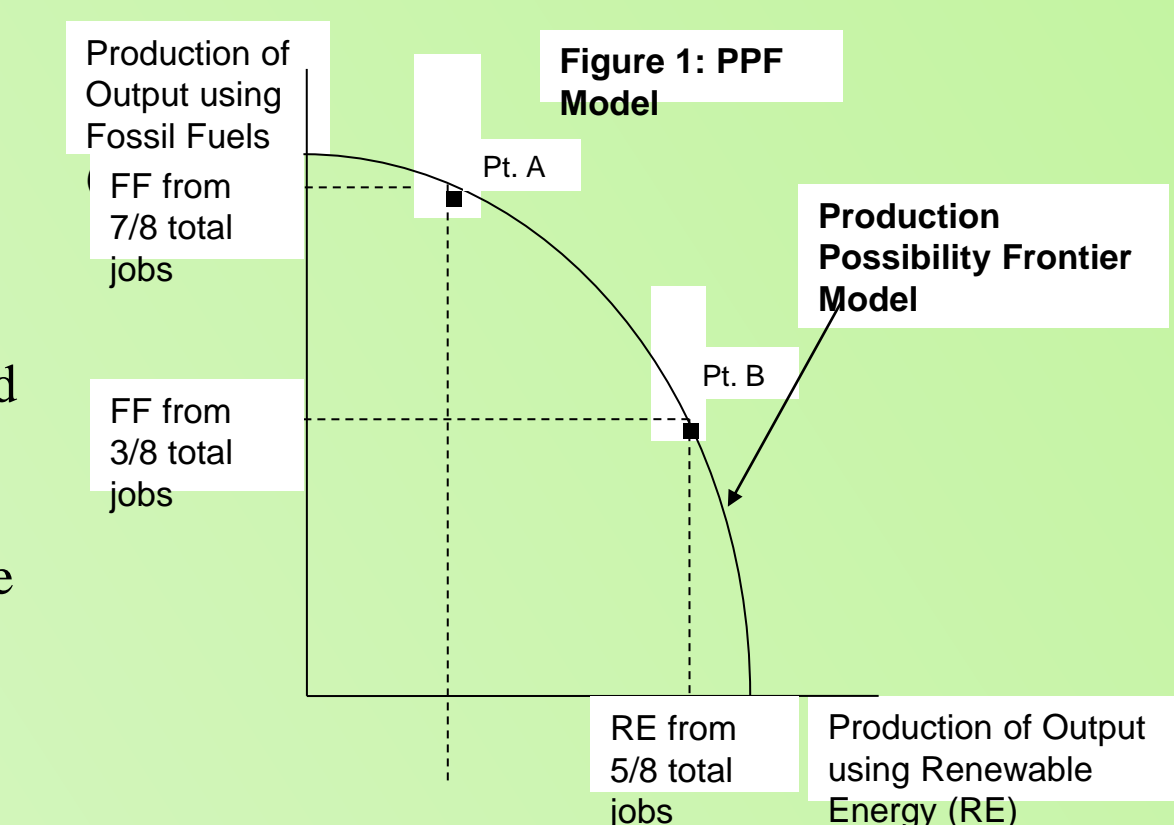
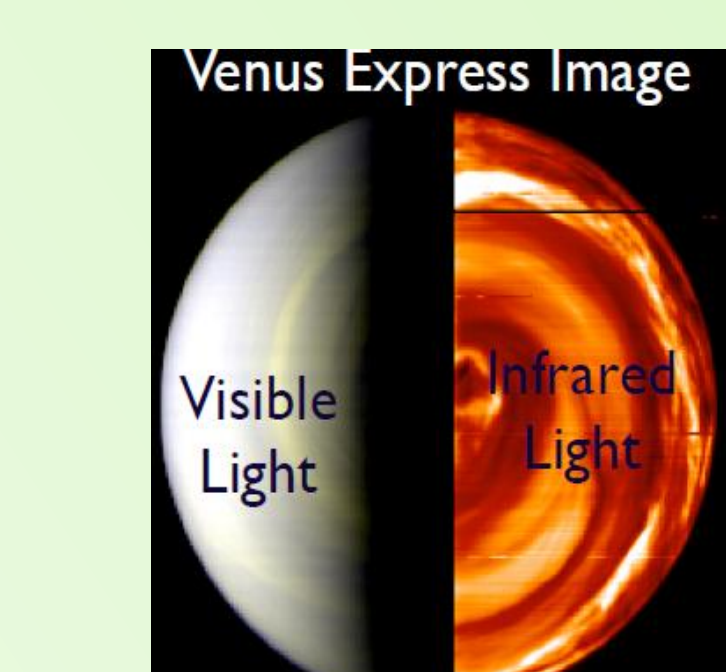
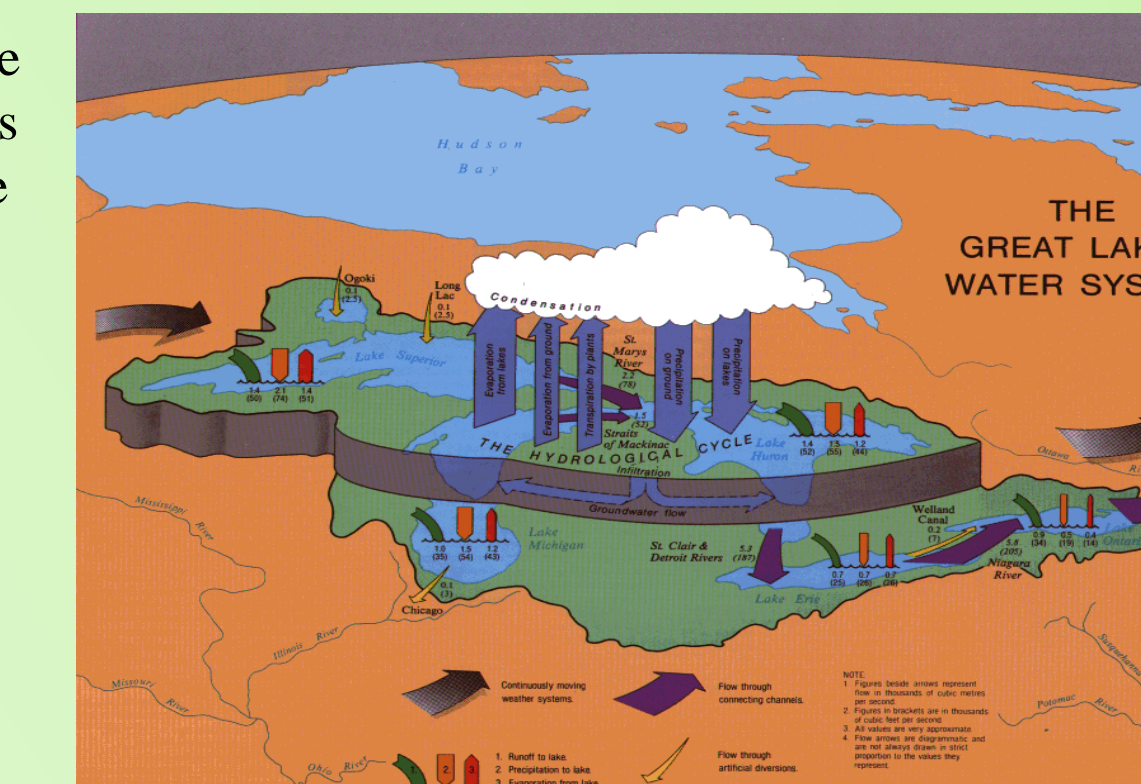


Figure 1. Trend in temperature (NO2 (top) and integrated NDVI (bottom)) in the Sahel (between 6 and 20 degrees latitude north) over the period 1982-2002.

This learning module will provide an opportunity to examine the issue of short term versus long term trends of the impacts on climate on water resources in the Great Lakes basin. The fluctuations in water supply to the basin and resulting water levels in the Great Lakes are well documented and understood natural processes leading to long term regional water balance. Short term weather conditions have been shown to drive the system through input (precipitation) and output (evaporation, discharge, outflows), whereas longer term climate conditions are superimposed on these factors resulting in cycles or periods of changes to stream flow conditions and water levels.



Studies have shown that students and the general public have significant misconceptions about the role and nature of greenhouse gases (e.g., Kempton 1997), the nature of the Earth's atmosphere, and the connection with the "ozone hole" (e.g., Jeffries et al 2001). We propose to address these misconceptions through a comparative study of the terrestrial planets, using NASA datasets. This module is designed to adapt an astronomy/planetary science approach to help students understand how and why carbon dioxide plays a major role in determining the surface temperatures of not just the Earth, but all the terrestrial planets with atmospheres. We will address how variations in incident sunlight, greenhouse gas concentrations, and albedo can affect surface temperatures, and what this comparison can tell us about possible future climate change on Earth.