Title
Global Climate Change Education for High School

Target Audience
This course is intended for pre-service and in-service teachers of grades 9-12 who are interested in learning more about global climate change using STEM (Science, Technology, Engineering, and Mathematics) methodology in their classrooms.

Prerequisites
To successfully participate and complete the assignments in this course, the learner must:
• Have past experience using the classroom computer.
• Have past experience working with the Internet.
• Be familiar with taking an online course or have completed the PBS "Practice Learning Online with TeacherLine" course.
• Be familiar with middle or high school educational content.
• Have access to a classroom or group of students in order to complete an implementation.

Course Description
This course is designed to enhance teachers’ content knowledge of climate change, provide guidance about teaching global climate change using effective STEM instructional techniques, and facilitate the integration of NASA data models and other NASA resources into classroom instruction. The course integrates readings, videos, resources, and content from PBS with current data collected by NASA and other affiliated organizations. Throughout the course, teachers will use a blog to collect and evaluate resources that will help them to teach about global climate change. Their final project will be a collaborative presentation that demonstrates the STEM attributes of teaching about a future environmental scenario.

How can we use NASA resources, STEM methodology, and 21st century tools to teach high school students about global climate change? This essential question will guide learners as they collect resources to teach students about global climate change. Learners will investigate resources that seamlessly integrate science, technology, engineering, and mathematics, and use an inquiry/problem-based approach as they develop a collaborative story/presentation on emission scenarios. These scenarios will be used to analyze possible future storylines about global climate change. As learners work through each session and explore all the resources, they will complete activities and be exposed to various resources that they can use with students. By the end of the course, learners will have a collection of valuable resources that they can share with students and peers.

This course was developed with funding from NASA under the Global Climate Change Education initiative (grant number NNX09AL84G) and support from the NASA Global Climate Change Education Project.

Instructor/Facilitator
See instructor/facilitator sheet

Credits
To be determined by college or university
Goals

In this course, learners will gain knowledge about the evidence and issues behind global climate change and the controversy surrounding this topic while also learning how to use STEM, Web 2.0 tools and problem-based learning as a methodology for teaching students in the 21st century classroom.

By the end of the course, learners will:

• Collect resources to help teach students how to understand climate change.
• Use STEM teaching techniques to investigate global climate change with their students.
• Integrate NASA resources into instruction.
• Connect global climate change education (GCCE) with existing standards and curriculum.
• Use Web 2.0 tools and 21st century teaching strategies to engage students.

Outline of Content and Assignments

After previewing the Course Information area, learners will proceed to Course Content to complete the following six sessions, working through each session in order. Essential information pertaining to the topic is presented within each session. Learners are asked to articulate their ideas in various forms: they are encouraged to reflect on their ideas and experiences; the discussions in the discussion forum are designed to allow learners to glean information from other learners’ experiences. To finish and pass this course, learners will need to successfully complete the course project. This project enables learners to use what they have learned in each session and apply it to their own teaching situation. There are two parts to the course project:

• Part 1: Team Assignment – Brainstorm and Develop Your Story (Sessions 3-6)
• Part 2: Individual Assignment - Self Assessment (Session 6)

This course is designed to address the following standards:

• National Science Education Standards – Science Content Standards: Grades 9-12, Science as Inquiry, Earth and Space Science, Science in Personal and Social Perspectives
  http://www.nap.edu/openbook.php?record_id=4962
• International Technology Education Association – Listing of STL Content Standards
  Standards 1, 2, 3, 4, 5, 8, 9, 10, 11
  http://www.iteaconnect.org/TAA/PDFs/ListingofSTLContentStandards.pdf
• ISTE NETS*T – National Educational Technology Standards
  1 (a, b); 3 (a, d); 4 (a); 5 (a, b, c, d)
• NCTM: National Mathematics Standards – Overview: Standards for School Mathematics: Prekindergarten through Grade 12

Session 1: 21st Century Teaching and Learning with NASA, PBL, and STEM

Understanding the skills and needs of our students will prepare us to think about what methodology and resources will most effectively help us to teach our students in the 21st Century classroom. This session looks at some of the research about what we need to be teaching our students and how we should be teaching them. The critical attributes seen in all of the literature suggests that 21st century curriculum should be interdisciplinary, project-based, and research-driven. It should involve collaborating on a real
world, community problem that involves higher-thinking skills such as analysis and creative thinking.

By the end of this session, learners will:

- Define professional goals and expectations for this course.
- Explain prior knowledge of teaching about global climate change and STEM instruction.
- Discuss skills that students bring to the classroom and the impact these have on teaching and learning for the 21st century.
- Explore how Web 2.0 tools can be used to engage students in higher level thinking and learning.
- Explain how NASA, STEM, and PBL meet the needs of 21st century education.

Read
- Framework for 21st Century Learning
- "What is 21st Century Learning?"
- Bloom's Taxonomy Chart
- Bloom’s Rose
- "A New Bloom"
- "Building Better Instruction: How Technology Supports Nine Research-Proven Instructional Strategies"
- "ReadWriteWeb: E-Learning 2.0 – How Web Technologies are Shaping Education"
- "Writing with Weblogs: Reinventing Student Journals"
- "Ten Tips for Writing a Blog Post"
- Memorandum of Understanding
- Frequently Asked Questions About STEM
- STEMEd Caucus Steering Committee
- Problem-Based Learning
- STEM Standards

Explore Websites
- "What’s a blog?"
- Blogger
- Live Journal
- WordPress

View Videos
- "Did You Know; Shift Happens - Globalization; Information Age"
- "The Machine is Us/ing Us"
- "How to create a blog with Blogger"

Explore Interactives
- "50 Years of NASA"
- "NASA @ Home and City"

Write Reflections
- Reflect on professional goals and expectations for the course.
- Reflect on prior knowledge teaching about global climate change and STEM instruction.
Session 2: Global Climate Change

The integration of math and science through the use of technology and the engineering design process defines STEM education, with the emphasis on the investigation of real-world problems. Global climate change is one of the most critical real-world problems students face today. This session will delve into what global climate change is, the misconceptions that surround it and the evidence and controversy behind it. Learners will investigate what forces climate change and how specific feedbacks affect these changes.

By the end of this session, learners will:

- Discuss what has challenged your thinking and knowledge about global climate change and how you can apply this new thinking to your classroom instruction.
- Identify and evaluate local climate forcings and feedbacks and the resources available to help students understand forcings and feedbacks.
- Assess students' understanding of global climate change topics and determine common misconceptions and how they will impact your instruction.

Read

- "Climate Change: How Do We Know?"
- "Systems Theory and the Earth Systems Approach in Science Education"
- "Watching the Planet Breathe"
- "Earth’s Energy Budget"
- "Climate and Earth’s Energy Budget"
- Global Climate Change – Key Indicators
- What you Need to Know: Twenty Questions and Answers about Climate Change
- "Climate Change Uncertainties"
- "Inquiry strategies to use in your classroom"
- NASA Global Climate Change Education Modules
- "The Science Of Why We Don't Believe In Science"
- Skeptical Scientist website
- "Translating Scientific Data into Concrete Experience" from The Psychology of Climate Change Communication

View Videos

- "A Warming World"
- "Keeping Up With Carbon"
- "Climate Change"
Session 3: Sources and Scenarios of Global Climate Change

This session investigates more closely the uncertainties, causes, and effects of global climate change and looks closely at emission scenarios developed by the Intergovernmental Panel on Climate Change to help look at what the future might hold in terms of climate change.

By the end of this session, learners will be able to:

- Analyze the relationships among increased amounts of greenhouse gases, climate uncertainties, forcings, and feedbacks as these relate to specific emission scenarios.
- Analyze a specific emission scenario and the evidence that would support or refute its actual occurrence. (Course Project)

Read

- "Causes"
- "Carbon Cycle Diagram"
- "Climate Change Primer – The Greenhouse Effect"
- "Effects"
- "Climate-Sensitive Diseases"
- "Warming Climate is Changing Life on Global Scale"
- "Is the Planet’s Carbon Sink Getting Too Full?"
- "Environment: Climate Change Debate Rises with Pakistan Floods"
- "Get your Audience’s Attention" from The Psychology of Climate Change Communication
- The Intergovernmental Panel on Climate Change
- "Aerosols: Tiny Particles, Big Impact"
- "A new view on sea level rise"
- "The Importance of Sea Ice"
- "What Lies Beneath: An Interview with Permafrost Expert Larry Hinzman"
- "NASA: Climate Change May Bring Big Ecosystem Changes"
- "Regional Climate Change Impacts"
Session 4: Framing Solutions to Global Climate Change

To be successful in today's world and to help our country be competitive, our students must improve their performance in mathematics and science. How do we do that? In this session learners will look at various activities and resources focusing on global climate change, many of which use an interdisciplinary, integrated, project-based approach while helping students understand possible solutions to global climate change or adaptations to the results. Mitigating and adapting to the effects of global climate change is an opportunity for teachers and students to engage in project- and inquiry-based learning activities about current and future opportunities.

By the end of this session, learners will:

- Discuss why mitigations and adaptations to global climate change may be considered a controversial subject.
- Evaluate resources that would address students' specific misconceptions about global climate change instruction and determine how the resources may be used with STEM methodology.
- Determine key uncertainties that exist for a specific emission scenario and this scenario's feasibility of occurrence within the next 100 years. (Course Project)

Read

- "Climate Economics"
- Table 4.1 Selected Examples of Planned Adaptations by Sector
- Table 4.2 Selected Examples of Key Sectoral Mitigation Technologies, Policies and Measures, Constraints and Opportunities
Session 5: Engaging Students in Learning about GCC

In this session, learners continue to explore Web 2.0 tools, with an emphasis on presentation tools and collaboration techniques that can be used to engage students. Learners will develop a presentation on a specific emission scenario, bringing together all the various aspects of global climate change and STEM methodology from what has been learned so far in the course.

By the end of the session, learners will be able to:

- Discuss how to engage students in actively participating and learning about global climate change using the engineering design process.
- Develop a story or presentation about teaching and learning about future, economic, social, technological, and environmental aspects of global climate change. (Course Project)

Read

- "Engineering Design Process"
- "New Skills for a New Century: Students Thrive on Cooperation and Problem Solving"
- "Collaborative Classrooms"
- "Collaborating Online: How to Get the Most From Group Work"
Session 6: Reflections on the Past and the Future
In this session learners look at assessment techniques, share their GCC story or presentation for their course project and discuss future plans for how to continue to collaborate on teaching about global climate change. They also have an opportunity to reflect on acquired knowledge, professional goals, and expectations.

By the end of this session, learners will:

- Share a story or presentation about teaching about global climate change. (Course Project)
- Discuss future plans for sharing and using resources on global climate change.
- Assess their learning in this course by comparing their prior knowledge and acquired knowledge.
- Analyze their learning experience in this course by reflecting on their professional goals and expectations.

Read
- "Reinventing Assessment for the 21st Century"
- "How Did We Work? Assessing Collaborative Projects in the Class or Workplace"
- "Assessing group work"
- "Student Project Assessments"

View Video
- "Comprehensive Assessment: An Overview"

Explore
- Collaborative resources

Write Reflections
- Acquired Knowledge: Reflect on what has been learned from this course and the skills or strategies gained which will be implemented into future instruction.
- Professional Goals and Expectations: Think about how this learning experience compares
with personal goals and expectations, which ones may not be able to be achieved and why,
and how these areas of professional development will be addressed in the future.

Participate in Online Discussions
• Discuss how to continue to share and use the resources discovered or created in this course
  and how to involve your students in a community of learning.

Activities and Assignments
• Course Project Part 1: Team Assignment - Solution: Share Your Story
• Course Project Part 2: Individual Assignment – Reflection
• Long Term Experience - Educator End of Event Survey from NASA
• Post-course evaluation survey from PBS TeacherLine

Schedule
This course is scheduled to take approximately 45 hours to complete readings, activities, videos,
assignments, reflections, and a course project. The number of hours identified for each course reflects
time spent online, but does not reflect the total time spent completing offline coursework and
assignments. All learners are different and may likely spend double the indicated number of hours
completing all coursework depending on their learning styles and work habits.

Requirements
Learners are expected to:
• Complete all assignments
• Complete assigned blog reflections
• Participate and actively engage in discussions with fellow learners while contributing to the social
  construction of knowledge
• Be self-directed and self-motivated
• Ask for assistance when they need it

Materials (hardware, software, plug-ins)

Technical Requirements
• Word processor
• Internet service provider
• E-mail
• PBS TeacherLine required plug-ins

Academic Dishonesty Policy
To be inserted by university institution only

Evaluation
This course is evaluated on a letter grade basis, and may be available for graduate credit. See graduate
credit details pertaining to specific graduate credit institutions.