PBS TeacherLine Course Syllabus

Title

NASA Resources for Teaching Global Climate Change in Middle School

Target Audience

This course is intended for pre-service and in-service teachers of grades 5-8 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 climate change using effective STEM instructional techniques, and facilitate the integration of NASA data models and other NASA resources into classroom instruction. The course will integrate readings, videos, resources, and content from PBS with current data collected by NASA and other affiliated organizations.

What are the causes and effects of global climate change and how can we use NASA data and resources to help our students discover mitigations or adaptations to the problems it causes? This essential question will guide learners as they collect resources to teach students about global climate change. Learners will focus on one aspect of climate change for their particular local environments, find activities that seamlessly integrate science, technology, engineering, and mathematics, and use an inquiry/problem-based approach. 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

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In this course, learners will gain knowledge about climate, weather, the evidence supporting global climate change, the controversies surrounding this issue, 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 climate change with their students.
- Integrate NASA resources into instruction.
- Connect global climate change education (GCCE) with existing standards and curriculum.

Outline of Content and Assignments

After previewing the documents in 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 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 five parts to the course project:

- Part 1: GCC Resources (Sessions 1-6)
- Part 2: GCC Topic of Interest (Sessions 2-3)
- Part 3: GCC Essential Question(s) (Session 4)
- Part 4: GCC-STEM Classroom Activity (Session 5)
- Part 5: Implementation Reflection (Session 6)

This course is designed to address the following standards:

- National Science Education Standards – *Science Content Standards*: Grades 5-8, 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*
  I (A, B); III (B); IV (A); V (A, C, D)
  http://cnets.iste.org/teachers/t_stands.html
- NCTM: National Mathematics Standards – *Overview: Standards for School Mathematics: Prekindergarten through Grade 12*
  http://www.nctm.org/standards/content.aspx?id=4294967312

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

Much attention has been recently given to the "fear" that America is not preparing our students to "keep up" or "get ahead" in the global economy. 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, the learner will be able to:

- Define professional goals and expectations for this course.
- Explain prior knowledge of teaching about global climate change and STEM instruction.
- Analyze skills that students bring to the classroom and the impact they have on teaching and learning.

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- Explain how PBL, STEM, and NASA meet the needs of 21st century education.
- Investigate and develop a social bookmarking site.

Read
- Framework for 21st Century Learning
- "Possibilities for 21st Century Education"
- "Promoting STEM Education - A Communications Tool"
- "Change the Equation - STEM Vital Signs"
- Problem-Based Learning
- STEM Exploration
- *The National Science Education Standards*
- "Pendulums"
- *National Educational Technology Standards for Students*
- "Listing of STL (Standards of Technology Literacy) Content Standards" Standards-Based Model
- "Leading Hands–On Engineering Activities with NASA and DESIGN SQUAD"
- "Design and Build a Road Sign Support"
- "Overview: Standards for School Mathematics: Prekindergarten through Grade 12"

Explore Web Sites
- Diigo
- Diigo: 21st Century Learning Bookmarks
- Delicious
- Delicious: Global climate change sample bookmarking account

View Videos
- "Diigo V3: Highlight & Share the Web! Social Bookmarking 2.0"
- NASA SCI Files – Engineering Design Process
- "What Is the Design Process?"

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

Write Journal Reflections
- Reflect on professional goals and expectations for the course.
- Reflect on prior knowledge teaching about global climate change and STEM instruction.
- Reflect on how NASA, STEM, and PBL fit the needs of 21st century education.

Participate in Online Discussions
- Get to know each other in the Virtual Café.
- Discuss the needs of the 21st century workplace and how these needs can be met.

Complete Activities and Assignments
- Course Project Part 1: GCC Resources (Sessions 1-6) – Learners will post the URL to their account on the appropriate discussion forum; full assessment occurs in Session 6

Session 2: Understanding Climate and Weather

This session will explore the differences between climate and weather and the factors that affect climate. Learners will develop an understanding of the evidence behind global climate change and begin thinking about how to teach these concepts to their students.

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

- Analyze the evidence of global climate change and its application to the classroom.
- Explore the economic activities in local communities that contribute to increased CO2 production and determine what steps could be followed to mitigate this increase.

Read

- "My Big Fat Planet"
- "Climate Change: How Do We Know?"
- Climate Kids
- Climate Literacy Network
- "What's the Difference Between Weather and Climate?"
- "What is Climate and Climate Change?"
- Complicating Factors

View Videos

- "Meteora: The Unchained Goddess"
- "Climate Change"
- "Earth as a System"
- "Real World: Monitoring Earth's Energy Budget with Ceres"
- "The Difference Between Weather and Climate"
- "Climate Change - Fact and Fiction"

Explore Interactive

- "Climate Time Machine"

Write Journal Reflections

- Reflect on the evidence that supports the idea of global climate change.

Participate in Online Discussions

- Explore the economic activities in local communities that contribute to increased CO2 production and determine what steps could be followed to mitigate this increase.

Additional readings and resources (not required)

- "What You Need to Know: Twenty Questions and Answers about Climate Change"
- "An Introduction to Earth's Dynamically Changing Climate"

Complete Activities and Assignments

- Student Assessment Activity
- Course Project Part 2: GCC Topic of Interest (Sessions 2-3)

Session 3: Causes and Effects of Global Climate Change

This session explores the causes and effects of global climate change, analyzing data and resources to further the understanding of the factors responsible for climate changes and the consequences of these changes.

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

- Identify and analyze the causes of global climate change.
- Evaluate how economic activities in a local community contribute or support efforts to decrease planetary warming.
- Reflect on how knowledge and understanding of the causes of global climate change are related to 21st century teaching and learning.

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- Analyze the relationship between increased greenhouse gas emissions and the American life style.
- Determine the global climate change topic that students will investigate in the classroom.

Read
- "Global Climate Change: Causes"
- "Global Climate Change: Effects"
- "Climate-Sensitive Diseases"
- "Warming Climate is Changing Life on Global Scale"
- "Key Findings"
- "Regional Climate Change Impacts"

View Videos
- "Global Warming: The Physics of the Greenhouse Effect"
- "Ocean Tipping Point?"

Explore Interactives
- "Global Warming Effects Map"
- "Climate Hot Map"

Write Journal Reflections
- Reflect on the causes of global climate change and relate these topics to economic activities in communities and 21st century teaching and learning.

Participate in Online Discussions
- Discuss the relationships between increased amounts of greenhouse gases and global climate change and how the American lifestyle may affect this relationship.

Complete Activities and Assignments
- Course Project Part 1: GCC Resources (Sessions 1-6)
- Course Project Part 2: GCC Topic of Interest (Sessions 2-3)

Session 4: Problem Solving Global Climate Change

This session explores possible solutions, mitigations, and/or adaptations to global climate change. Activities and resources that use an interdisciplinary, integrated, project-based approach to further understanding of climate change will be explored.

By the end of this session, learners will be able to:
- Develop an essential question on global climate change that will guide the selection of a STEM activity.
- Analyze why the topic of climate change is presented as being controversial, causing difficulty in reaching consensus on appropriate mitigation and adaptation strategies.
- Identify problem based, STEM supported activities on global climate change.

Read
- "What is an Essential Question?"
- 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
- "Global Climate Change: Understanding the Greenhouse Effect"
- "Global Climate Change: The Effects of Global Warming"
- NASA's Global Climate Change Education Modules

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- "MY NASA DATA"
- "Coral Bleaching in the Caribbean"
- "The March of the Polar Bears: Global Change, Sea Ice, and Wildlife Migration"
- "Leading Hands-On Engineering Activities with NASA and Design Squad"
- "STEM Education Resource Center: Engineering Resources"
- "STEM Resources from PBS"
- Engineering Activity Example

View Videos
- "Climate Change Adaptation and Mitigation"
- "Dr. Gavin Schmidt"

Explore Interactive
- "Capturing Carbon: Where Do We Put It?"

Participate in Online Discussions
- Discuss why the topic of climate change is presented as being controversial, causing difficulty in reaching consensus on appropriate mitigation and adaptation strategies.
- Describe the GCC-STEM activity and the essential question(s).

Activities and Assignments
- Explore resources from NASA and PBS for global climate change activities.
- Course Project Part 1: GCC Resources (Sessions 1-6)
- Course Project Part 3: GCC Essential Question(s)

Session 5: Engaging Students in Learning about GCC

This session explores activities that fit with the STEM methodology, one of which learners will implement with students. Learners will analyze how Web 2.0 tools can be integrated into the classroom to engage students in the topic of global climate change.

By the end of the session, learners will be able to:
- Adapt an activity to meet the STEM definition.
- Analyze how Web 2.0 tools can be integrated in the classroom and engage students in learning about GCC.

Read
- "ReadWriteWeb E-Learning 2.0 – How Web Technologies are Shaping Education"

View Videos
- "The Machine is Us/ing Us"

Write Journal Reflections
- Reflect on how to engage students in actively learning and participating about global climate change using Web 2.0 tools.

Discussion Forum
- GCC-STEM Classroom Activity Template peer review

Activities and Assignments
- Course Project Part 1: GCC Resources (Sessions 1-6)
- GCC-STEM Classroom Activity Implementation
- Course Project Part 4: GCC-STEM Classroom Activity

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Session 6: Reflections on the Past and the Future
In this final session learners reflect on the implementation of their GCC-STEM classroom activity and discuss future plans for how they will continue to collaborate on teaching about global climate change. Learners will reflect on their acquired knowledge, professional goals, and expectations.
By the end of this session, learners will be able to:

- Reflect on the implementation of the GCC-STEM classroom activity.
- Discuss future plans for teaching about global climate change.
- Assess their learning in this course by comparing prior knowledge and acquired knowledge.
- Analyze the learning experience in this course by reflecting on professional goals and expectations.

Write Journal 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 future plans for teaching about global climate change.

Activities and Assignments

- Course Project Part 1: GCC Resources (Sessions 1-6)
- Course Project Part 5: Implementation Reflection
- NASA Long Term Experience - Educator End of Event Survey

Schedule

This course is scheduled to take approximately 45 hours to complete readings, activities, video, 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 learners will likely spend double the indicated number of hours completing all coursework depending on learning styles and work habits.

Requirements

Learners are expected to:

- Complete all assignments
- Complete assigned 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

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- 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.

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