GLOBAL WARMING: Facts and Our Future Overview for Teachers

This webquest makes use of the Koshland Science Museum’s exhibit Earth Lab: Degrees of Change. It will allow students to learn firsthand how society and environment might be impacted by global warming and how to help people make better decisions regarding all the complicated issues surrounding climate change, energy use, and available policy options.

Overview

Global warming has been a topic of concern and much controversy for many years. Whatever the disagreements have been in the past, most scientists and policy makers now recognize that if the Earth’s surface temperatures continue to rise as much as they have in the past decade or so, then many parts of the world could face dire consequences, including food and water shortages, coastal flooding, and health consequences.

In this webquest students will work together in a group as a climate action team. Each student will take on one of five roles (climate scientist, policy analyst, economist, energy expert, or urban planner) researching issues from that particular perspective. Groups will make some of the same discoveries and decisions that are made in the “real world” every day.

Students

- Introduction and instructions
- Climate Scientist materials
- Policy Analyst materials
- Economist materials
- Energy Expert materials
- Urban Planner materials
- Group project worksheet and instructions

Teachers

- Teacher introduction
- Background
- Evaluation Rubric - for evaluating student achievement
- Academic Standards – Relevant Next Generation Science Standards and Common Core State Standards
- Additional Websites and Resources
Introduction and Instructions for Use in a Classroom

Global warming has become one of the most pressing issues facing the United States and the world. This webquest makes use of the Koshland Science Museum’s exhibit *Earth Lab: Degrees of Change* and is designed to introduce high school and middle school students to the complicated issues surrounding global warming and climate change. Through participating in a fictitious scenario, students will take an active role in determining how and why the climate is changing and how humans may have contributed to these changes. Students become climate scientists, policy analysts, economists, energy experts, and urban planners as they learn about climate science, environmental impacts, policy initiatives, and renewable energy choices. Upon completion of their individual tasks, student teams present their findings and make recommendations that address the situation.

This webquest activity can be used in many different ways. To encourage cooperative learning, students should be divided up into groups of five and each student in the group should assume the role of one of the climate action team members. Working in a group allows students to experience the way a real-world investigative team operates. Alternatively, students can complete the webquest individually and investigate all five roles by themselves. Either way, students should be required to share their findings with the class by creating a presentation using multimedia whenever possible.

This webquest is designed to take approximately one week. To shorten the activity, students could complete only the group work section, which should take one class period.
## Evaluation Rubric

<table>
<thead>
<tr>
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<th>Beginning</th>
<th>Developing</th>
<th>Accomplished</th>
<th>Exemplary</th>
<th>Total Possible Score</th>
<th>Score</th>
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<tbody>
<tr>
<td><strong>Initial Group Worksheet</strong></td>
<td>Short answers are incomplete or incorrect.</td>
<td>Short answers are mostly complete and mostly correct.</td>
<td>Short answers are correct and mostly complete.</td>
<td>Short answers are thorough and thoughtful.</td>
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<td>1 Point</td>
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<td>4 Points</td>
<td>5 Points</td>
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<td><strong>Individual Worksheet</strong></td>
<td>Worksheet is incomplete. Answers show minimal understanding of material.</td>
<td>Worksheet is complete. Answers show moderate understanding of material.</td>
<td>Worksheet is complete. Answers show mastery of material.</td>
<td>Worksheet is complete. Answers show the highest level of understanding.</td>
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<td>5 Points</td>
<td>5 Points</td>
<td>12 Points</td>
<td>15 Points</td>
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<tr>
<td><strong>Group Report and/or Presentation</strong></td>
<td>Grammar, organization, formatting, logical arguments, and adequacy of elements considered are minimally acceptable.</td>
<td>Grammar, organization, formatting, logical arguments, and adequacy of elements considered are acceptable.</td>
<td>Grammar, organization, formatting, logical arguments, and adequacy of elements considered show mastery of subject.</td>
<td>Grammar, organization, formatting, logical arguments, and adequacy of elements considered are at the highest level of performance</td>
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<td>9 Points</td>
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This activity addresses the following Next Generation Science Standards and Common Core State Standards for middle school and high school.

<table>
<thead>
<tr>
<th>Middle School</th>
<th>High School</th>
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<tbody>
<tr>
<td><strong>Next Generation Science Standards Standards</strong></td>
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<tr>
<td>• <strong>MS-PS1 Matter and its Interactions</strong>: MS-PS1-3</td>
<td>• <strong>HS-PS1 Matter and its Interactions</strong>: HS-PS1-4, HS-PS1-8</td>
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<tr>
<td>• <strong>MS-LS2 Ecosystems: Interactions, Energy, and Dynamics</strong>: MS-LS2-4, MS-LS2-5</td>
<td>• <strong>HS-PS2 Motion and Stability: Forces and Interactions</strong>: HS-PS2-6</td>
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<tr>
<td>• <strong>MS-ESS3 Earth and Human Activity</strong>: MS-ESS3-3, MS-ESS3-4, MS-ESS3-5</td>
<td>• <strong>HS-PS3 Energy</strong>: HS-PS3-2</td>
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<td>• <strong>MS-ETS1 Engineering Design</strong>: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3</td>
<td>• <strong>HS-PS4 Waves and their Applications in Technologies for Information Transfer</strong>: HS-PS4-5</td>
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<tr>
<td><strong>Science and Engineering Practices</strong></td>
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<tr>
<td>• Asking questions (for science) and defining problems (for engineering)</td>
<td>• Asking questions (for science) and defining problems (for engineering)</td>
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<td>• Analyzing and interpreting data</td>
<td>• Developing and using models</td>
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<td>• Constructing explanations (for science) and designing solutions (for engineering)</td>
<td>• Analyzing and interpreting data</td>
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<td>• Engaging in argument from evidence</td>
<td>• Using mathematics and computational thinking</td>
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<td>• Obtaining, evaluating, and communicating information</td>
<td>• Constructing explanations (for science) and designing solutions (for engineering)</td>
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<td><strong>Crosscutting Concepts</strong></td>
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<td>• Cause and effect: Mechanism and explanation</td>
<td>• Cause and effect: Mechanism and explanation</td>
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<td>• Structure and function</td>
<td>• Scale, proportion, and quantity</td>
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<td>• Stability and change</td>
<td>• Systems and system models</td>
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<td></td>
<td>• Energy and matter: Flows, cycles, and conservation</td>
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<td>• Structure and function</td>
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<td>• Stability and change</td>
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<td>Common Core State Standards</td>
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<td><strong>ELA/Literacy</strong></td>
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<tr>
<td>• <strong>Literacy in Science and Technical Subjects</strong>: RST.6-8.1, RST.6-8.7, RST.6-8.8, RST.6-8.9</td>
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<tr>
<td>• <strong>Writing (History/Social Studies, Science, and Technical Subjects)</strong>: WHST.6-8.1, WHST.6-8.7, WHST.6-8.8, WHST.6-8.9</td>
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<tr>
<td>• <strong>Reading: Informational Text</strong>: RI.8.8</td>
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<td><strong>Mathematics</strong></td>
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<tr>
<td>• <strong>Standards for Mathematical Practice</strong>: MP.2, MP.4</td>
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<tr>
<td>• <strong>Expressions and Equations</strong>: 7.EE.3, 7.EE.B.4</td>
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<td>• <strong>Ratios and Proportional Relationships</strong>: 6.RP.A.1, 6.RP.A.3, 7.RP.A.2</td>
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<tr>
<td>• <strong>Speaking and Listening (Grades 11 and 12)</strong>: SL.11-12.5,</td>
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<td>• <strong>Literacy in Science and Technical Subjects (Grades 11 and 12)</strong>: RST.11-12.1, RST.11-12.2, RST.11-12.7, RST.11-12.8, RST.11-12.9</td>
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<td>• <strong>Writing (History/Social Studies, Science, and Technical Subjects)</strong>: WHST.9-12.2, WHST.9-12.7</td>
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<td>• <strong>Literacy in Science and Technical Subjects (Grades 9 and 10)</strong>: RST.9-10.8</td>
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<td>• <strong>Standards for Mathematical Practice</strong>: MP.2, MP.4</td>
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<td>• <strong>Number and Quantity – Quantities</strong>: HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3</td>
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Additional Websites and Resources

National Academy of Sciences (NAS):
National Academy of Sciences - Climate Change
Sustainability at the National Academy of Sciences

State Government:
Energy Quest (State of California)
Climate Change Portal (State of California)

Federal Government:
US Global Change Research Program
Goddard Institute for Space Studies
US EPA Climate Change
National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center
NOAA Climate Program Office
NOAA Research - Weather and Climate Sites
NOAA Paleoclimatology
NASA’s Earth Observatory
Energy Information Administration Energy Kids Links

International:
Intergovernmental Panel on Climate Change (IPCC)
Implications of Climate Change (IPCC)
United Nations Framework Convention on Climate Change - Feeling the Heat
UNEP-GRID-Arendal Climate Change

Academic:
Princeton University Carbon Mitigation Initiative
NSF Dissertation Initiative for the Advancement of Climate Change Research
Climate Discovery Teacher's Guide
Carleton College - Teaching Climate Change
The Discovery of Global Warming On-line Textbook
Teachers’ Guide to High Quality Educational Materials on Climate Change and Global Warming (Carnegie Mellon)

Non-Governmental Organizations (NGOs):
American Association for the Advancement of Science (AAAS) Newsroom (search "Climate Change")
A Beginner's Guide to Global Warming (Woods Hole Research Center)
The Keystone Center - Climate Status Investigations
The Nature Conservancy Climate Change Initiative
California Global Climate Change & Energy
National Energy Education Development Project
Earth Day Network
Sloan Career Cornerstone Center (Careers in Science)
25 x '25
Institute for Global Environmental Strategies
Exploratorium - Science From the Poles/Climate Change
Exploratorium - Climate Change

Games, Interactives, and Other Resources for Kids:
Center for Climate and Energy Solutions
Union of Concerned Scientists (UCS) - The Great Green Web Game
UCS - Just the Facts
UCS - Climate Choices
Energy Hog
NRDC's Green Squad
The Stabilization Triangle: A Concept & Game (Princeton University CMI)
US EPA Climate Change Kids Site
AAAS Power Up! On-Line Energy Game

Media:
New York Times Science - Global Warming
Time Magazine Special Report - Global Warming
New Scientist – Climate Change Special Report
PBS - NOW: Global Warming
PBS - NOVA Frontline: Global Warming
PBS - NOVA Frontline: Warnings From the Ice
PBS - Scientific American Frontiers: Hot Times in Alaska
PBS - NOVA Online Adventures: Tracking El Nino
PBS - NOVA: Sinking City of Venice
NPR - Science Friday
NPR - Tech Nation
National Geographic - Global Warming
Seed Magazine - Climate Change Cribsheet
Real Climate Blog
Radio Ecoshock Audio on Demand - Climate Change

Video:
The Great Warming
An Inconvenient Truth
National Geographic's Strange Days on Planet Earth
Discovery Channel - Global Warming: What You Need to Know with Tom Brokaw
Kilowatt Ours
Books:

The Atlas of Climate Change: Mapping the World's Greatest Challenge
Kirstin Dow and Thomas Downing

The Weather Makers: How Man Is Changing the Climate and What It Means for Life on Earth
Tim Flannery

Field Notes from a Catastrophe
Elizabeth Kolbert

Climate Change: Turning Up the Heat
A. Barrie Pittock

The Winds of Change: Climate, Weather, and the Destruction of Civilizations
Eugene Linden

An Inconvenient Truth
Al Gore

The Two-Mile Time Machine: Ice Cores, Abrupt Climate Change, and Our Future
Richard B. Alley

Thin Ice: Unlocking the Secrets of Climate in the World's Highest Mountains
Mark Bowen

The North Pole Was Here - Puzzles and Perils at the Top of the World
Andrew C. Revkin

Climate Change and Biodiversity
Edited by Thomas E. Lovejoy and Lee Hannah

Science Magazine's State of the Planet 2006-2007
The Editors of Science

Big Coal: The Dirty Secret Behind America's Energy Future
Jeff Goodell