HITTING HOME: CLIMATE CHANGE IN COLORADO

How would we know if Colorado’s climate is changing and how will it affect us?

Created in the Making Global Local workshops
University of Colorado at Boulder
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http://learnmoreaboutclimate.colorado.edu

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Driving Question
How would we know if Colorado’s climate is changing and how will it affect us?

Grade Level
6th Grade Science (adaptations for 3rd to 8th grade are easily made)

Lesson Time Requirement
4 hours

Climate Literacy Principles Addressed
Standard 4: Earth’s weather and climate systems are the result of complex interactions
Standard 6: Evidence indicates human activities are impacting the climate system

Colorado State Standards Addressed
High School: PS5, PS6, LS2, ES4, ES6
8th Grade: PS2, PS3, LS1, ES1, ES2
7th Grade: LS1
6th grade: LS1, LS2, ES2

Learning Objectives
• Students will be able to describe how scientists use a variety of data to make conclusions
• Students will be able to explain why the steps of the scientific method are used in real world situations
- Students will be able to provide evidence for or against the argument that climate change is occurring in Colorado and the world.
- Students will be able to describe some impacts that would occur in Colorado if climate change is occurring.

**Prior Knowledge Required**
- Students will be able to compare and contrast climate and weather
- Students will be able to diagram and explain the concept of the Greenhouse Effect

**Common Student Misconceptions & Prior Understandings**
- Students might think that global climate change is not occurring or that it is not occurring in Colorado

**Materials**
1. Evidence Cards: Slides that should be made into laminated cards. Two sets of cards are a minimum.
2. Student handouts (see “handouts” below)

**Introduction to Lesson**
Is climate change happening in Colorado? It’s important to approach such questions from a rational and scientific viewpoint, by examining actual data. In this lesson, students are given a set of observational data and asked to determine whether it supports or does not support the hypothesis that climate is changing over time in Colorado.

**Lesson Sequence**

**Engagement**
News stories in the local papers talk about climate change occurring in CO. What are your thoughts on this subject? What evidence would you use to support your hypothesis?
*(Do a think pair share and have kids report out)*

Show two climate videos from [http://learnmoreaboutclimate.colorado.edu](http://learnmoreaboutclimate.colorado.edu):
  i. Clip #1: Colorado and a Warming Planet (8:51)
  ii. Clip #2: Hotter, Drier Colorado (7:59)
Analyzing Data

1. Model how to fill out the Part A: Individual and Group Observation sheet with the class
2. Divide each class into 8 groups and assign them one of the following topics, giving the relevant Evidence Cards for that topic:
   1. Snow Pack
   2. Yearly Precipitation
   3. Average Yearly Temperature
   4. Frequency of Forest Fires
   5. Peak River Flow Days
   6. Glaciers
   7. Changes in Latitudinal Location of Bird Species
3. In groups have students fill in the topic and their hypothesis on the Part A: Individual and Group Observation sheet
   1. Formative questioning
4. Then have students analyze the data and fill in the rest of the Part A: Group Data Analysis sheet
5. Assign a recorder, a presenter, facilitator, time keeper within the group
6. Give students time to prepare their presentations
7. Hand out the Part B: Summary of Group Data sheet
8. Have each group present; at the conclusion of each presentation have students fill in the appropriate part of the Part B worksheet
9. Summarize all of the findings with the class Share out – 3 minutes max
   1. Questions for how all this evidence shows climate change.
      1. What data did you look at?
      2. What were your results?
      3. Were you able to answer your question? If not why do you think your results were inconclusive?
      4. Maybe you weren’t able to conclusively answer your question or if you didn’t obtain group consensus...what were the areas of conflict? What other information would you need to answer your question?
   2. Pulling it Together
      1. What trends did you notice in the overall data?
      2. What was it like to support your claims using the evidence provided?
      3. How this is important to our lives?
10. Show a Colorado Climate Video from http://learnmoreaboutclimate.colorado.edu
   1. Listening to Colorado’s Ecology
   2. Colorado and a Warming Planet (8:51)
   3. Hotter, Drier Colorado (7:59)
11. Hand out Part C: Conclusion worksheet and have students write a newspaper article summarizing the class findings
Student Handouts
All available at LearnMoreAboutClimate.Colorado.edu under “For Educators.”
3. Part C: “Hitting Home: Climate Change in Colorado?” Conclusion, Newspaper article writeup instruction.

Assessment
Students will complete a newspaper article about Climate Change. See materials section Part C for prompt and guidelines.

Lesson Development Prompts
This lesson was developed for middle school physical science courses by a collaboration of scientists, teachers, and educational researchers in the Making the Global Local workshops at the University of Colorado at Boulder.

Background Reading for Students and/or Teachers
See “references” and “extensions” for additional readings.

References
Snowpack Data
ftp://ftp.wcc.nrcs.usda.gov/data/snow/snow_course/table/history/colorado/05j42s.txt
Precipitation and Temperature Data--Colorado Climate Report 2008
Peak River Flow Colorado Basin River Forecast Center
Glacier Photos
Photographer: Andy Leach; leachfam.com
Photographer: W.T. Lee; NSIDC
Photo J.R. Brackett
Photo H. Waldrop
Photo W.T. Pfeffer
Bird Data National Audubon Society
Extensions

**Why Should We Care?**

- How will climate change affect Colorado's native species? Will invasive species increase?
- Will climate change affect our water usage? Will we have enough water?
- How will economic industries like agriculture be affected by climate change? Will we lose jobs?
- What kinds of new jobs may be formed in response to the need for reducing our carbon footprint?

Carbon footprint calculator: [http://www.nature.org/initiatives/climatechange/calculator/](http://www.nature.org/initiatives/climatechange/calculator/)

Links to on-line curriculum:

- [http://www.colorado.edu/news/r/4d5d013eaca14ee2eab3a4f355bd4565.html](http://www.colorado.edu/news/r/4d5d013eaca14ee2eab3a4f355bd4565.html)
- [http://ccc.atmos.colostate.edu/](http://ccc.atmos.colostate.edu/)
- [http://www.mathaware.org/index.html](http://www.mathaware.org/index.html)
- [http://www.climatechangeeducation.org/k-12/index.html](http://www.climatechangeeducation.org/k-12/index.html)
- [http://eo.ucar.edu/educators/ClimateDiscovery/](http://eo.ucar.edu/educators/ClimateDiscovery/)
- [http://www.nationalgeographic.com/xpeditions/lessons/08/g68/climatecontrols.html](http://www.nationalgeographic.com/xpeditions/lessons/08/g68/climatecontrols.html)
- [http://serc.carleton.edu/NAGTWorkshops/climatechange/index.html](http://serc.carleton.edu/NAGTWorkshops/climatechange/index.html)
- [http://education.arm.gov/teacherslounge/lessons.stm](http://education.arm.gov/teacherslounge/lessons.stm)

**Climate Literacy Essential Principles Addressed**

- **Standard 4:** Earth's weather and climate systems are the result of complex interactions
  - Interaction between various climate components can produce emergent phenomena unique to the system. Humans are an integral part of Earth’s climate system. Human activities such as fossil fuel burning or deforestation can affect climate and alter the equilibrium of the climate system.
- **Standard 6:** Evidence indicates human activities are impacting the climate system
Colorado State Science Standards (New)

High School

PS5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined

PS6. When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases

LS2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem

ES4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere

ES6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes

8th Grade

PS2. There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved

PS3. Distinguish between physical and chemical changes, noting that mass is conserved during any change

LS1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency

ES1. Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models

ES2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location

7th Grade

LS1. Individual organisms with certain traits are more likely than others to survive and have offspring in a specific environment

6th Grade

LS1. Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species

LS2. Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem
ES2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere