

*Unless someone like you cares a whole awful lot, nothing is going to get better. It's Not.*  
- Dr. Seuss, The Lorax

# **UNIT I**

## **THE BIG CLIMATE CHANGE EXPERIMENT**

### **Lesson 4: Weather Versus Climate**

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#### **Unit I Guiding Question**

***Does the world's rising temperature affect me?***

## **A NOTE FROM THE HOT AUTHORS**

The Hot: One World, One Climate curriculum and simulation is a collaborative effort among secondary teachers, educational experts and journalists with faculty and staff from the NASA Goddard Institute for Space Studies (GISS) and the Columbia University Earth Institute. This interdisciplinary team – known as The GISS Climate Education Advisory Group – has been able to draw on many perspectives and areas of expertise to advance a real world, problem-based approach for student learning around many climate change topics.

The curriculum is designed to reinforce academic knowledge and skills outlined in national education standards with an eye toward student inquiry and research-like experiences. While exploring the science and stories of climate change, our goal is for students to use scientific research to build science and climate literacy, evaluate climate change solutions and develop 21<sup>st</sup> Century skills for informed civic engagement.

Our development process has been an iterative. The Climate Change in the Classroom (CCIC) Teacher Workshop at NASA GISS/Columbia University is a continuation of this process as we broaden the Hot collaboration to include the review, critique and recommendations more scientists and educators from 5 U.S. states.

It is important to note that we are in the active stage of review and development of the Hot curriculum and simulation. Hence, the materials being field-tested in the CCIC are not in their final form and require additional educational and scientific review. This is one of the major goals of the CCIC Teacher Workshop.

We hope that the Hot curriculum and simulation will prove to be a meaningful way for you and your students to engage in learning about Earth, and the intersections of science and society in the context of an important global issue – climate change. We also hope Hot is personally relevant students, and motivates a lifetime of interest and critical thinking about our planet and the special role humans have in the Earth system.

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## **UNIT I AT-A-GLANCE**

Students engage in lessons where they develop some basic background knowledge about climate change drawing on research from scientists around the world. They will begin to develop key ideas that climate change is happening, we can observe it and it is a global problem. Students also begin to understand some of the lines of climate change evidence. More fundamentally, Unit I explores the relationship between climate and life, and helps students explain the difference between weather and climate.

### **Summative Assessment**

Write a short news story using initial understandings developed in Unit I to describe the roles of humans and carbon in Earth's climate change story. The essay should accurately relate and explain at least one key climate science concept (e.g., difference between weather and climate) as well as 3 or more lines of climate change evidence. It should also express the influence of these roles in terms of time and spatial scale relevant to the climate change story.

### **National Education Standards Addressed**

Learning objectives for each lesson relate to national education standards found in the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS). Each lesson identifies the specific standards addressed.

### **Unit I Learning Progression**

Following input received from the 2013 Climate Change in the Classroom Teacher workshop, we will prepare a learning progression for the Unit. In its final form it will provide a short introduction and a lesson grid with brief summaries of student activities, learning objectives, standards addressed and performance assessments.

**MODEL AND EXPLAIN**

# I.4 Weather Versus Climate

**TIME:** 90 minutes or 2 class periods + homework



*“If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events.”*

- Climate Change: Picturing the Science

## overview

Students explore the difference between weather and climate, using analogies and considering the implications for understanding climate change.

## objectives

The student will be able to...

- explain weather and climate and the importance in our lives
- create an analogy to help the public differentiate between weather and climate
- identify ways people confuse climate and weather and the consequences

## prerequisite

None

## key vocabulary

**Statistics:** Mathematical practices of analyzing and interpreting large amounts of numerical data that help us describe relationships, find significance, and make predictions.

**Frequency:** The rate at which something occurs or number of times it is repeated over a period.

**Range:** The difference between the least and greatest values of a variable.

**Consequence:** Something produced by a cause or a set of conditions.

**Risk:** The chance or probability of a loss, injury or negative impact

**Topography:** The natural or man-made configuration of the land surface.

**Air Pressure:** The force per unit area exerted on a surface by the air above.

**Timescale:** A span of time during which events occur.

**Extremes:** The lowest or highest degree of something, e.g., weather events at the extremes of the historical distribution (unusual, severe).

**Analogy:** A comparison between similar features of two different things, e.g., heart and a pump.

## differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed....

## subjects

English Language Arts, Earth and Environmental Science, Social Studies / Geography

## standards

### NGES ESS2.D Climate and Weather

Climate describes patterns of typical weather over long timescales

### CCSS ELA Literacy:

Critically read informational text and use diverse media (RI.1-3, 7)

Engage in collaborative discussions and claims and findings (SL.1-3, 4)

### CCSS Math Literacy:

Model situation with linear and exponential functions (F.LE.1)

Represent data on 2 quantities (ID.1)

## resources / materials

Blackboard/chalk or butcher block paper/markers

Poster paper

LCD Projector that streams video

Graffiti Boards teaching strategy at <http://goo.gl/xeUBi>

Computers with Internet access

Climate vs. Weather Video (2:00 minutes) <http://on.fb.me/10BFf0>

“Climate in a Nutshell: What is Climate?” video (2:31 minutes) <http://goo.gl/eeHm2>

“Science Made Simple: Take the Dog for a Walk” video: (1:05 minutes) <http://goo.gl/EjU7S>

“Scientists Must End the Climate Confusion” BBC article at <http://bbc.in/16lfhBq>

## background

Weather is one of the most common human-interest stories and topics of daily discussion. American author, Mark Twain, said “climate is what we expect, weather is what we get.” These expectations describe a geographic area’s seasonal ranges in temperature, precipitation, winds, air pressure and humidity. Weather is how conditions are day-to-day or on short timescales. Climate is the average of conditions, usually over a 30-year period or longer. These long-term conditions are the result of multiple interactions between the atmosphere, living organisms, bodies of water and the land (topography) that produce regional and global climate.

Distinguishing between weather and climate is a matter of statistics. Scientists studying climate change analyze long data records to answer many questions. Among these questions: Are extreme weather events happening often enough that they are becoming the new normal for climate in a particular region?

Recently, the public is taking notice of extreme weather happening around the world – heat waves, droughts, wildfires, floods and storms – and the devastating impacts. For example, in 2003 summer heat waves in Europe led to over 50,000 deaths. In 2012, hurricane Sandy devastated coastal communities in New York and New Jersey. While one extreme weather event is not evidence that Earth’s climate is changing, scientists are finding trends in the frequency of extreme weather events around the world. These patterns are observed over many decades, giving scientists increasing confidence about connections to global warming.

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## suggested procedure

### graffiti board activity

1. Introduce the lesson by asking students to share their understanding about the difference between weather and climate. Students take turns contributing to a graffiti board (see resources for a description of this teaching tool). If you do not have access to an online graffiti board the students can create simple “T” charts with “weather” on one side and “climate” on the other side of the T.
2. Students discuss and summarize their collective contributions about the difference between weather and climate.
3. Watch the video, “Climate in a Nutshell: What is Climate?” Using the information from the graffiti board and the video, students identify criteria to decide if a weather event might be connected to climate change. For example, they might identify such criteria as time/duration, frequency, trends, patterns, and changes from normal conditions.
4. Conclude this portion of the lesson with students completing the student pages: CLIMATE VS. WEATHER INTRODUCTORY AND CONCLUDING QUESTIONS and/or the “CONNECT THE MINDS” LEARNING EXPERIENCE ORGANIZER (LEO).

### climate and weather analogies

5. Explain that communicating science to the public is one aspect of a scientist’s job and some scientists create analogies to help people understand science. Climate scientists sometimes use examples from everyday life to help illuminate climate concepts to the public, like the difference between weather and climate. Have a group of students or the entire class watch the video *Science Made Simple: Take the Dog for a Walk*, as an example of a climate analogy.
6. (optional) Ask the students to graph the dog and the owner in two other situations. Situation 1: The owner is walking on a steady course at the same level for 15 blocks while the dog wanders all over. Situation 2: The owner is walking on a gradual uphill street for 10 blocks and then for the last 5 blocks on steep hill to climb. The dog continues to walk all over. Discuss the value of graphs to help model situations, describe linear relationships and exponential functions.
7. In small groups have students brainstorm ideas for an analogy to explain the difference between climate and weather, weaving in the importance of climate change. Groups prepare a 1-minute presentation on the analogy they develop. Poster paper can be used for students to visualize ideas.
8. Pass out copies of the rubric for this activity for students to refer to as they develop their analogies.

9. They may complete the activity by answering the concluding discussion questions on the student page: CLIMATE VS. WEATHER INTRODUCTORY AND CONCLUDING QUESTIONS and/or the use another box on the “CONNECT THE MINDS” LEARNING EXPERIENCE ORGANIZER (LEO).

**wrap-up and discussion**

10. Once groups have completed their analogies, each group presents to the class.
11. Peer-to-peer feedback on the analogies each group developed using the rubric provided in the Assessment.

Discuss each group’s response to the concluding question: Reflect on the quote at the beginning of Lesson 1.2:

*“If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events.”*

12. Discuss why understanding the difference between climate and weather and its relationship to risk is important.

EXTENSION: For teachers who wanted to continue looking into the social and environmental implications of confusing weather and climate, the BBC article “Scientists Must End the Confusion” provides an interesting reading to for further discussion.

**assessment**

**Weather and Climate Analogy Rubric**

4	Concisely and accurately states the analogy relationship between 2 or more characteristics that distinguishes weather and climate. The explanation shows an understanding of the most important differences expressed in the analogy.
3	Concisely and accurately states the analogy relationship for at least one characteristic that distinguishes weather and climate. The explanation shows an understanding of important differences expressed in the analogy.
2	Generally expresses the difference better weather and climate in the analogy, with minor misconceptions.
1	Identifies differences between weather and climate that are not very important or has some key misconceptions about the relationship.

**feedback**

The authors of Hot value your thoughts and feedback on this curriculum. Please feel free to send us any suggestions or share anything your students found particularly interesting or engaging.

Comments can be sent to [cah40@columbia.edu](mailto:cah40@columbia.edu)

Name: \_\_\_\_\_

**INTRO & CONCLUSION QUESTIONS**

Date: \_\_\_\_\_

**Introductory Questions**

1. What is the difference between weather and climate?
2. Which is weather and which is climate? Babe Ruth hits the ball and gets a homerun in a game. Over the course his 22-year career, he came to bat 8399 times and got 2873 hits. His career batting average was .342.
3. How might people confuse weather and climate? Provide examples.

**Concluding Questions**

4. Why does understanding the difference between climate and weather matter?

5. Reflect on the following statement.

“If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events.” *Climate Change: Picturing the Science*




Name: \_\_\_\_\_




**CONNECT THE MINDS LEO**

Date: \_\_\_\_\_

Use this Learning Experience Organizer (LEO) to make connections between things you've read, heard, seen or experienced inside and outside of class.

Make sure you are specific about the ideas you are going to connect. For example, if the idea you are using comes from a book or film you want to copy the EXACT passage from the book in one of the upper boxes. Use the bottom rectangle of each box to explain WHY you made a unique connection between two ideas. This will prepare you for metaphorical thinking!

1. 	
<p>Reason for</p>  <p>Connection</p>	

2. 	
<p>Rationale for</p>  <p>Connection</p>	