

Eyes on Earth: Teaching Earth Science from Space

Atmosphere Assignment

By Brenda Williams

Title

Exploring Global Climate

Grade Level

Fifth Grade

Length of Lesson

Five 45-minute lessons

Materials

Elementary GLOBE book: What in the World Is Happening with Our Climate?
https://www.globe.gov/documents/348830/35487706/EGclimate_Final_27April2017.pdf/64cdfba2-ce9f-4660-a4b5-0644c3f0be74 • Global Annual Mean Temperature Data--
https://www.jpl.nasa.gov/edu/pdfs/global_annual_mean_temp_anomalies_land-ocean_1880-2016.txt • Quadrille-ruled graph paper (four squares per inch) • Tape • Scissors • Science journal/notebook • Photographs of roofs from houses around the world • Chromebooks • Books about desert, tropical, and Arctic biomes • Books with pictures of homes around the world • Assortment of materials for students to create model homes; use what you have available; suggestions: cardboard, poster board, foam core board, sticks, straws, Popsicle sticks, toothpicks, old cloth, foil, felt, straw, rocks, clay, wood, beans, Playdoh, string, duct tape, paper clips, mosaic tiles, etc. • Various roofing materials (use whatever is available, such as cardboard, clay for adobe houses, hay or long grass for grass huts, corkboard, saran wrap for roof for tropics houses, etc.) • Tape measures and rulers • Weather elements: water, strainer, ice cubes, hair dryer to produce wind, 10+ coins or washers, tissues, strainer, plastic tub • Circle Thinking Map—see page 10 • Homes Around the World article—see page 11 • Rubric -see page 9

Resources/Links & Citations

<https://www.nasa.gov/feature/goddard/2018/nasa-measures-heavy-us-rainfall-from-space>

<https://www.jpl.nasa.gov/edu/teach/activity/graphing-global-temperature-trends/>

https://www.jpl.nasa.gov/edu/pdfs/global_annual_mean_temp_anomalies_land-ocean_1880-2016.txt

https://www.globe.gov/documents/348830/35487706/EGclimate_Final_27April2017.pdf/64cdfba2-ce9f-4660-a4b5-0644c3f0be74

<https://youtu.be/nAuv1R34BHA?list=PL9TFrgFq7555f>

<http://cedar-wmu.edenpr.org/rrice/files/2012/03/Thinking-Map-Templates.pdf>

https://www.teachengineering.org/activities/view/roofs_for_different_climates

Core State Standards Initiative. (2018a). Retrieved from

<http://www.corestandards.org/ELA-Literacy/>

Core State Standards Initiative. (2018b). Retrieved from

<http://www.corestandards.org/Math/Content/5/NBT/>

NGSS Lead States. (2013). *Next Generation Science Standards: For States, by States*. Washington, DC: The National Academies Press.

Texas Education Agency. (2012). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§111.6. Math. <http://tea.texas.gov>

Texas Education Agency. (2017a). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§110.15.English Language Arts and Reading. <http://tea.texas.gov>

Texas Education Agency. (2017b). Texas Essential Knowledge and Skills for 4th and 5th Grade.

§112.15. Science. <http://tea.texas.gov>

Standards

Science Texas Essential Knowledge and Skills (TEKS)

5.3 Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to: (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student; (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

5.4 Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to: (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.

5.8 Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to: (A) differentiate between weather and climate; and (D) identify and compare the physical characteristics of the Sun, Earth, and Moon.

(9) Organisms and environments. The student knows that there are relationships, systems, and cycles within environments. The student is expected to: (A) observe the way organisms live and survive in their ecosystem by interacting with the living and non-living elements; and (C) predict the effects of changes in ecosystems caused by living organisms, including humans, such as the overpopulation of grazers or the building of highways; (Texas Education Agency, (2017b).

Next Generation Science Standards (NGSS)

3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

3-EES2-2 Obtain and combine information to describe climates in different regions of the world.

3-ESS3-3 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

3-PS2-4 Define a simple problem that can be solved through the development of a new or improved object or tool. (NGSS Lead States, 2013).

Math or ELA Connections

Math TEKS:

5.1 Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.

5.2 Number and operations. The student applies mathematical process standards to represent, compare, and order positive rational numbers and understand relationships as related to place value. The student is expected to: (A) represent the value of the digit in decimals through the thousandths using expanded notation and numerals; (C) round decimals to tenths or hundredths. (Texas Education Agency, 2012).

ELAR TEKS:

5.7 Reading/Comprehension of Literary Text/Literary Nonfiction. Students understand, make inferences and draw conclusions about the varied structural patterns and features of literary nonfiction and provide evidence from text to support their understanding. Students are expected to identify similarities and differences between the events and characters' experiences in a fictional work and the actual events and experiences described in an author's biography or autobiography.

5.26 Research/Organizing and Presenting Ideas. Students organize and present their ideas and information according to the purpose of the research and their audience. Students are expected to synthesize the research into a written or an oral presentation that: (A) compiles important information from multiple sources; (B) develops a topic sentence, summarizes findings, and uses evidence to support conclusions; and (C) presents the findings in a consistent format.

5.27 Listening and Speaking/Listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity. Students are expected to: (A) listen to and interpret a speaker's messages (both verbal and nonverbal) and ask questions to clarify the speaker's purpose or perspective; and (C) determine both main and supporting ideas in the speaker's message.

5.29 Listening and Speaking/Teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in student-led discussions by eliciting and considering suggestions from other group members and by identifying points of agreement and disagreement (Texas Education Agency, 2017a).

ELA and Math Common Core Standards:

CCSS.ELA-Literacy.RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.RI.4.2/5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

CCSS.ELA-Literacy.RI.5.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and time/effect.

CCSS.ELA-Literacy.W.4.1.B Provide reasons that are supported by facts and details.

CCSS.ELA-Literacy.W.5.2.E Provide a concluding statement or section related to the information or explanation presented (Core State Standards Initiative, 2018a).

CCSS.Math.Content.4.MD.A.1 Solve problems involving measurement and conversion of measurements (Core State Standards Initiative, 2018b).

***Engage** (5 minutes)

1. Students will view the following image--

<https://www.nasa.gov/feature/goddard/2018/nasa-measures-heavy-us-rainfall-from-space>

2. Formative Assessment Discussion Questions:

*What is the difference between weather and climate

*How many days were used for data collection?

*Is this map an example of weather or climate? Why?

*Which states received more than 15 mms of rain each day? Fifteen mm of rain is equivalent to how many cm?

*What can we infer about the areas in yellow?

*What do you think can scientists learn about Earth by using this image?

***Explore** (40 minutes)

The following directions and questions are based on NASA's Jet Propulsion Laboratory lesson --

<https://www.jpl.nasa.gov/edu/teach/activity/graphing-global-temperature-trends/>

Introduce the activity. Explain to students that they will be analyzing average temperatures measured on Earth for the past 136 years, but each group will only be looking at a portion of that data. Distribute the global temperature data, either as a whole set or pre-divided for individuals or groups--

https://www.jpl.nasa.gov/edu/pdfs/global_monthly_temp_anomalies_1880-2016.txt.

Distribute graph paper.

1. The data file for this activity contains 137 years of average global annual temperature measurements. Depending on class size, the steps in “Procedures” can be done by individuals or groups of students.
2. Divide the data so that each group or individual has approximately the same number of data points.
3. Help students determine an appropriate vertical scale. Determine the range of data by subtracting the maximum and minimum temperature values (e.g., $14.87 - 13.54 = 1.33$). Placing the graph paper in portrait orientation allows for approximately 40 lined intervals. Determine scale by asking which place value (ones, tenths, hundredths, etc.) should be used. Demonstrate that counting by ones on each line will not allow for accurate resolution of data. Have students determine how many lines they will need if they count by tenths and if they count by hundredths.
4. Help students determine an appropriate horizontal scale. It is important to evenly space the years. When all graph axes are labeled and teacher-approved, have students proceed with plotting their data points.
5. Monitor students closely while they are plotting data points to be sure they are using a consistent scale. A consistent scale allows data to be combined seamlessly and accurately. Instruct students to make their data point dots large and dark so they will be visible when their graph is held up for the class. Students will use a ruler to connect their data points.
6. When individual graphs are complete, have students determine if they see an increase or decrease in mean global temperature for their group’s time frame. Discuss the risk of making climate assumptions and projections when looking at a small data set.
7. Have students tape their graphs to the whiteboard and line them up horizontally, by year, maintaining equal spacing between all the years. When combining individual graphs into the class graph, be sure to fold back or cut off extra paper so that the year spacing remains constant throughout the graph. Ask students to examine the data and determine which value, year or annual mean temperature, should go on the vertical axis. *Although it can be done either way, annual mean temperature should go on the vertical axis for ease of viewing.*
8. Have students stand back and assess the trend. Is there a trend of global temperature increase or decrease?
9. Ask students if this trend has always been the case over the past 136 years? If not, when did the trend shift?
10. Have students guess why the trend shifted, then have them research the years when the trend shifted.

11. Have students predict global temperature means for the subsequent year. Research this data on the Internet to compare.

***Explain** (45 minutes)

1. Students will read “What in the World is Happening to Our Climate?”
https://www.globe.gov/documents/348830/35487706/EGclimate_Final_27April2017.pdf/64cdfba2-ce9f-4660-a4b5-0644c3f0be74

2. Students will watch the following video--<https://youtu.be/nAuv1R34BHA?list=PL9TFrgFq7555f>

3. Formative Assessment Discussion Questions:

*How many degrees has Earth’s temperature risen in the last century?

*How do green house gases in the atmosphere contribute to higher temperatures on Earth?

*How does melting ice contribute to higher temperatures on Earth?

*What do you predict will happen to Earth’s average temperature in 100 years?

4. Using a science journal/notebook, students will create a Circle Thinking Map. Students will place the words “Earth’s Climate” in the center of the circle then brainstorm ideas showing knowledge about that topic. Students may share and discuss responses with a partner or in small groups.

***Elaborate** (45 minutes)

The following directions and questions are based on the TeachEngineering.org activity--

https://www.teachengineering.org/activities/view/roofs_for_different_climates

1. Introduce the TeachEngineering.org activity—Students will choose materials and tools to create model houses for certain climates.

- Students will build a house with the following dimensions: 10 x 10 x 10 cm.
- Students will describe how houses in different environments are built differently (material choices, house design, construction methods).
- Students will explain how different climates result in different design strategies and techniques to best create human shelters.

2. Discussion--What does the roof of your house look like? Do you know what your roof is made of? Do you think people who live in tropical areas or desert areas have the same type of roof as you do? Do you think the materials that are used are the same in different climates? In this activity, you will choose the type of climate you

would like to live in: desert, tropics or arctic. You will build a model house with a roof designed to withstand the climate.

4. Have students read the article—Homes Around the World.

- a. Show students a wide range of photographs of houses around the world. Follow with a brief class discussion.
- b. Discuss climate and weather conditions of various world regions, how the homes for the region are constructed, and the materials used. Identify the regions discussed on a globe or world map.
- c. Discuss the appropriate materials necessary to survive under the given climate and environmental conditions of a particular region.
- d. Divide the class into pairs or small groups. Hand out the worksheet--https://www.teachengineering.org/content/wpi_/activities/wpi_roofs_for_different_climates/wpi_roofs_activity_worksheet_v2_tedl_dwc.pdf.
- e. Students will identify the problem—to choose materials and tools to create a model house with specific features for a certain climate.
- f. Review the engineering design process with students. In this activity, we are acting as engineers as we design, build, test and improve our model houses. Who can tell me the steps of the design process? Let's get started.

5. Have teams of two-four students choose one of the following regions for which they will construct model homes: desert, tropics or Arctic. Explain (and post in the classroom) the goals for their house. Example goals and tests for building the houses and roofs are as follows:

- Desert climate - Should be able to keep an ice cube from melting. Place an ice cube in the center of the model house and expose the house to wind and heat from a blow dryer for a specified amount of time (1-2 minutes). If the ice cube does not melt, then the building can withstand the elements of heat and wind.
- Arctic climate - Should be able to support snow. Gradually add coins or washers to the roof at varying weights to determine if the structure can withstand a large amount of weight from snow. The house should be able to support a specified number (+/-10) of washers or coins to pass a "snow load" test.
- Tropics - Should be waterproof. Place the house on a platform in an empty pan and pour water through a strainer to simulate rain. Place dry tissue or other absorbent material in the house first to determine if the house leaks in the "rain." To pass the test, the house must not collapse or leak. Use a standard amount of water (1-2 liters).

6. Have students do some research, looking through books and online for ideas about environmental conditions in different climates, and suitable designs, construction methods and materials to use.

***Engineer** (Two 45-minute lessons)

Teams will work through the engineering design process to complete their house. Remind students their house must be a 10 x 10 x 10 cm structure.

Each group will present their house to the class. Students are expected to produce an oral presentation that: (A) compiles important information from multiple sources; (B) develops a topic sentence, summarizes findings, and uses evidence to support conclusions; and (C) presents the findings in a consistent format (Texas Education Agency, 2017a).

9. The class may ask questions regarding each group's house. After all the model houses are completed, the teacher will vary the measurement of each house (10 x 10 x 10 cm) and test each house.
10. As a class, discuss the results and encourage students to offer suggestions on how each house could be improved. Remember to consider both materials and structural design (for example, roof angles) for the respective regions.
11. After the initial assessment of the houses, ask student teams to list three positive and three negative aspects of their houses. Mention that this is a typical part of the engineering design process (analyze test results and improve the design). They should collaboratively decide (and list) how they would improve their houses if they were given the opportunity and how they would construct another (better) model for that region.
12. Then have each group trade their house with another group who will list the other adjustments that they think should be made in the design or construction of the house.
13. Then they share what they think should be fixed and why they would make the changes. The two groups should compare their lists and discuss the differences and similarities.
14. Give teams time to redesign their homes and construct revised models. Test the second models, using the same criteria as the first.

***Evaluate**

Circle Thinking Map: Assess student comprehension as they brainstorm and relate ideas with the topic.

Worksheet: Assess student comprehension by observing and assisting students as they process through the worksheet to research, brainstorm, design, build and improve their model home designs.

The following rubric will be used to assess the students during the engineering design project (see next page). The students may use this rubric for self-assessment, and the teacher may use it for grading purposes.

Engineering Design Process Rubric

***Individual Progress Report**

Name _____

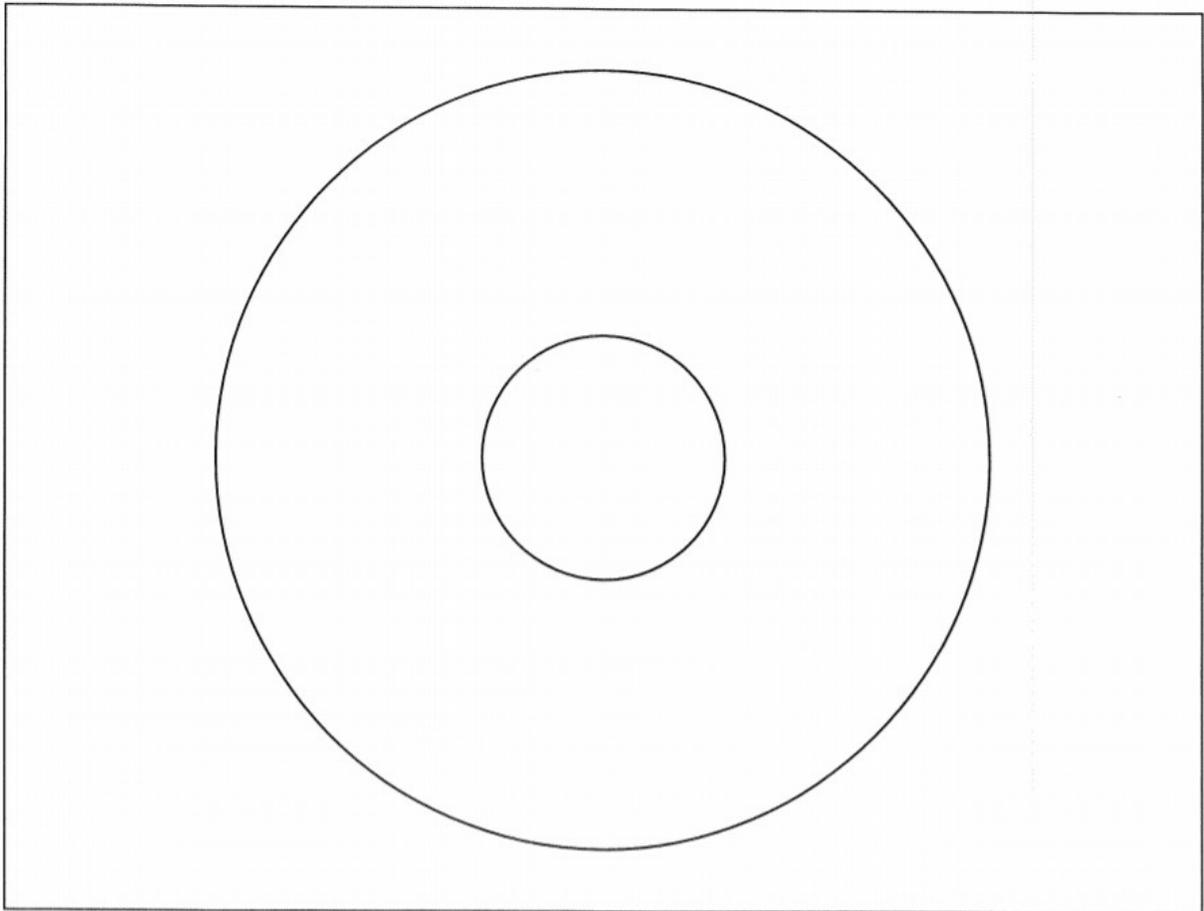
Date _____

Project _____

Grade _____

Criteria	4-5 Points	2-3 Points	0-1 Points	Points
Identifying the problem and brainstorming solutions	<p>Showed a clear understanding of the problem(s) to solve. Independently brainstormed solutions.</p>	<p>Needed some teacher direction to define the problem(s) and brainstorm possible solutions.</p>	<p>Needed lots of teacher direction to define the problem(s). Little if any independent brainstorming.</p>	
Working as a team member	<p>Worked well with team members. Participated and stayed on task.</p>	<p>Was occasionally off task.</p>	<p>Was often off task and not cooperating or participating fully</p>	
Using the engineering design process	<p>Assisted team in brainstorming many design ideas. Actively participated in testing and improving the design.</p>	<p>Was occasionally off task instead of assisting team in brainstorming ideas, testing, and improving design.</p>	<p>Brainstormed few design ideas and did little testing or redesigning.</p>	
Processing the science and engineering during group presentation	<p>Assisted team in strong presentation of its solution to the challenge. Showed clear understanding of the science concepts and design process.</p>	<p>Was occasionally off task during presentation. Showed less than adequate understanding of the science concepts and design process.</p>	<p>Did not participate in presentation. Showed little understanding of the science concepts and design process.</p>	
				Total Points

Circle Thinking Map



Circle Map for Defining in Context • Frame for Frame of Reference

Retrieved from
<http://cedar-wmu.edenpr.org/rrice/files/2012/03/Thinking-Map-Templates.pdf>

Homes Around the World

People in different parts of the world use different materials to build their homes and other structures. When building homes, they must think about how to use these materials to build houses that work well for where and how they live.

In the southwestern part of the U.S. where the land contains a lot of clay and few trees, people build houses from adobe, a mixture of clay, straw and water. Adobe houses have thick walls that keep the inside cool in the hot dry desert weather. Adobe houses would not be good in places where it rains a lot because too much water makes adobe crumble.

The weather in certain tropical islands in the Pacific Ocean is hot, but wet. People who live there make their homes from materials that are easy to find such as palm leaves, woven grasses and bamboo. Sometimes they build the houses on stilts to keep them off the wet ground and to let the breezes move under the house, helping to keep it cool.

Most Eskimos in Alaska and Canada build their houses out of sod or snow. These dome-shaped houses are called igloos. The dome shape of the igloo makes it very strong and able to withstand powerful winter storms. The thickness of the igloo also makes it a good insulator.

In the past, American Indians built dome-shaped houses made of poles, leaves and tree bark., called wigwams. Some Indian tribes that moved frequently built cone-shaped tepees out of buffalo skins or bark. Tepees could be easily built and taken apart quickly. Some Indians lived in more permanent structures called lodges made from logs and sod.

When early American settlers came to New England, they found the ground covered with large stones. They used these stones to build houses, barns and fences that you still see in the region today. The northwest part of the U.S. and Canada has plenty of forests, so most houses are made of wood.

In parts of China where there are few forests, it is rare to see wooden houses. More often, they use tile, concrete and stone to build beautiful, multi-storied pagodas and other buildings. The land mass of China is so large and varied that almost every climate can be found. (See the associated lesson for more background information as pertains to climates and China).

In parts of Africa, where tall grasses grow, people weave the stems of dried grasses together to make thatch huts.

In Tibet, some people even make their houses out of wool! They shear the wool from ox-like animals called yaks. The wool walls keep the houses warm through the cold winter months.

Most houses in the U.S. today are built of a combination of wood, brick, stone, concrete, steel, aluminum, and glass.

Retrieved from

https://www.teachengineering.org/activities/view/roofs_for_different_climates