Climates of the World

Science **Grades: 6-8**

Standards Alignments:
McRel Level III: Geography Standards 7 and 8, Science Standard 1; National Standards: NS.5-8.6 Personal and Social Perspectives

Time:

- Motivate and Focus: one 45- minute class period
- Build Interest: three 45- minute class periods
- Independent Research: 1-3 weeks
- Wrap Up: two 45- minute class periods

Materials:

l-p
Computers with Internet access; projector or interactive whiteboard (optional)
xSpace leveled texts (online access or printouts)
Printouts of project ideas for independent research

Learning Objectives

Students will:

- Discuss focus questions
- Review key vocabulary
- Watch an anchor video about Climates of the World
- Build knowledge about Climates of the World by working together
- Complete either the first two projects individually or collaboratively or the third project independently:
  - create a polar map of the Arctic region, labeling continuous land and water masses, and describe the climate of the region as a whole
  - create a slideshow that describes dendrochronology and how it is used to date climate change. Describe the bristlecone pine, the oldest living organism on Earth
  - research types of alternate and renewable energy resources; choose one approach and describe its scientific basis, its advantages and disadvantages, and its future possibilities

Academic Vocabulary
eliminate (verb): to leave out, or to get rid of
indicate (verb): 1. to show or prove something; 2. to point something out clearly
occur (verb): to happen
similar (adjective): alike, or of the same type
vary (verb): to change, or to be different

Content Vocabulary
biosphere (noun): a clear dome designed to be a sealed, self- contained world. It contains a tiny desert, rain forest, and grassland.
carbon dioxide (noun): a gas that is a mixture of carbon and oxygen, with no color or odor. People and animals breathe this gas out, while plants absorb it during the day.
current (noun): the movement of water in a river or an ocean, or of electricity through a wire
dendrochronology (noun): the science of using tree rings to date structures and events or to reconstruct past environmental conditions
equator (noun): an imaginary line around the middle of Earth, halfway between the North and South Poles
equinox (noun): one of the two days in the year when day and night last exactly the same length of time all over the world
glacier (noun): a huge sheet of ice found in mountain valleys or polar regions. A glacier is formed when snow falls and does not melt because the temperature remains below freezing.
greenhouse (noun): an enclosed structure used for the growth and protection of tender plants. Temperature and light are controlled in a greenhouse so that all plants can grow out of season.
humid (adjective): damp and moist

Motivate and Focus

Introduce the topic.

l-p
Tell students that the focus of this lesson is on climates of the world. Explain that they will be learning about the difference between climate and weather, the distinct characteristics of climates in our world, the factors that determine each type of climate, and how and why climates changed in the distant past and are changing in today's world.

Write the three focus questions for this lesson on the board, on an overhead transparency, or on chart paper. Read each question aloud to the class, pausing after each one to give students time to think about the question. Then tell them that when they complete this lesson they are expected to be able to provide a set of answers for each question.

1. *What is climate and how does it vary worldwide?*
2. *How has climate changed over the centuries?*
3. *How do human activities affect climate?*

Activate prior knowledge.

Start the class by displaying a map of the world and asking students what they know about the climate in various places around the world. For example, point to a region in the United States where you all live and ask them about the climate there. Then, point to a country in Africa and ask about the climate that one might find there. Continue pointing to a few other areas on the map, each time eliciting responses about what students might know or believe about the climates of these areas.

Now refer to the three focus questions you have written on the board. Based on their discussion above, have students answer the first focus question. Write their answers on the board. Then, have them consider the second and third questions, adding these responses to those already written on the board. You may also wish to pose additional questions, such as the following:

What is the difference between climate and weather?
Why do we have seasons?
How does climate affect human life?
What does the presence of fossils show us about climate in prehistoric times?
About how much of Earth's fresh water is stored in glaciers?
What are some of the problems created by global warming?

Preview key vocabulary.

l-p Display the list of vocabulary terms on a whiteboard or other presentation means. Pronounce each word or phrase carefully and discuss its given definition.

For example, you might say *Dendrochronology, pronounced den- droh- krahn- AHL- uh- jee, is the science of using tree rings to date structures and events or to reconstruct past environmental conditions. The word comes from three Greek words, "dendron," "chromos," and "logos," that mean "tree," "time," and "the science of," respectively.*

Ask students to take turns reading aloud each of the vocabulary terms and restating their definitions or meanings. Remind students that they should refer to the list as they read each article to be sure that they understand the readings.

Play the anchor video.

l-p Tell students that they will next view a short video called Climates of the World. Encourage students to take notes as they watch the video and jot down any questions that they may have.

After students have watched the video, you may want to pose the following questions as a means of reviewing its content.

How can you determine the climate of the area where you live?
Where are the warmest climates on Earth? The coldest?
What are the factors that determine climate?
What have humans done to live more comfortably in hot and cold environments?
What are the negative consequences of human activity on Earth's climate?

Take a few minutes to discuss possible answers to the questions above. If students can't answer the questions easily, play the video a second time.

You may connect to your curriculum/ textbook here. Or Build Interest in the topic through small- group collaboration or Assign Projects for independent research.

Build Interest

In- Class Science Activity.

l-p Many activities are controlled by the weather. For example, a sports event might be cancelled if it rains, or schools might be closed if there's a bad storm. Controlling the weather is impossible, yet we all make decisions based on what we think the weather will be like on a certain day. For this information, we turn on the radio or TV or check the Internet (e.g., www.weather.com). So, to get your students to think about the weather where you all live, before class begins, log on to the following Web site: http:// countrystudies.us/ united- states/ weather/. Choose your state and then your city (or one closest to you) and print the statistical data found there. These data list the average monthly high and low temperatures for each month of the year, the mean monthly temperature, and the average precipitation for each month.

Divide the class into pairs of students and give each pair two (or more) blank sheets of graph paper and a copy of the data that you printed from the Web site given above. Explain to students what the data represent and tell them that they are to create two graphs: one graph will be a temperature versus time graph, and the second graph will be a precipitation versus time graph. Tell students that they can choose the type of graph that they want to draw for either or both types of data — either bar graphs or line graphs — and that they will have to create a scale for each set of numeric data. Here are specific considerations for each type of graph.

Temperature graph Since there are three sets of data related to temperature (average monthly highs, average monthly lows, and the calculated means for each month), suggest that students use different colored pens or pencils for each type of data and include a key that indicates the color that corresponds to each bar or line graph.

Precipitation graph For some regions of the country the monthly variation in the precipitation, expressed to the nearest tenth of an inch, might be very small. Therefore, remind students that it would be a good idea to create intervals along a scale that clearly separate data points. For example, if the precipitation data for two consecutive months are 3.4 inches and 3.5 inches, then an appropriate scale should be in tenths, from 0 to the greatest integer value in the range. That is, if the largest data value is 4.2 inches, then the greatest integer value would be 5, and the scale could range from 0 to 5, with intervals divided into tenths, such as 0.1, 0.2, 0.3, …, 0.9, 1.0, etc.

Once students have constructed their graphs, have them analyze the information that they convey. That is, are there any temperature extremes in your area? If so, when did these occur? If there were no extremes, then what does this suggest about the climate of the region where you live? What about the precipitation values — do these vary a lot or a little? In either case, what does this suggest about the climate? You might also want to ask students why graphs are a good way to convey the data presented in a table. Depending on where you live, students should recognize that graphs provide a snapshot of what the weather and yearly climate are like in your part of the world.

Introduce the xSpace.

l-p Now, display the home page of the Climates of the World xSpace and tell students that they will be researching the following three topics: Weather and Climate, Climates of the Past, and Climate Modification. Review the interactive features. Show students how to find the text that fits their reading level.

Remind students of the three focus questions again, adding additional questions such as those listed below. You may want to add others.

1. *What is climate and how does it vary worldwide?*
    a. *How did Wladimir Köppen classify climates and when?*
    b. *Why do climates differ?*
    c. *What is "insolation"?*
    d. *What are the five factors that determine weather?*
    e. *Why does weather change?*
    f. *What causes the seasons?*
2. *How has climate changed over the centuries?*
    a. *What are the three periods of glaciation?*
    b. *When were the first weather instruments created? By whom?*
    c. *What are the various ways that glaciers behave?*
    d. *Where in the world are glaciers found?*
    e. *What was significant about the climate during the Pleistocene Epoch?*
3. *How do human activities affect climate?*
    a. *What are the negative effects of heat islands? Positive effects?*
    b. *What are ways for humans to control the negative effects of heat islands?*
    c. *What are the five major pollutant gases in our atmosphere?*
    d. *What are five negative effects of global warming on our planet?*
    e. *How can the design of buildings lessen the negative effects of artificial climates?*
    f. *What is renewable energy?*

Direct students to their previous responses to the focus questions and add any additional responses to the list. Tell students that they will work together in small groups to brainstorm answers to all of the above questions.

Divide the class into groups.

l-p Have students work in groups of three or four on this lesson, grouping students of different reading abilities together. This will help ensure that as much information as possible will be available to everyone in the group.

To ensure that every student in a group is an active participant, assign roles on the first day, such as timer and moderator, note- taker, and reporter. Then, have students rotate these roles during each day's work.

Tell students that they are all responsible for reading the survey article, the articles in each topic, and viewing the slideshow and the diagram provided in Topics 1 and 2 respectively. Emphasize that students in each group are to work together to answer each of the focus questions and any other questions that may have been added during the class discussion. Remind them also to check the vocabulary list as they go through the references and to include the new vocabulary terms in their notes and responses.

- Day 1: All students should start by reading the survey article, Climates of the World. With this as background, they can proceed in sequence through the three resources in this topic: two articles, Weather and Seasons, and the slideshow about Climate Zones.
- Day 2: Topic 2 deals with Climates of the Past. Students should read the two articles in sequence, Paleoclimatology and Glaciation. The third resource is a brief overview called Dendrochronology: Climate and Tree Rings. The first two resources provide historic views of climate change, and the third briefly describes tree dating.
- Day 3: Topic 3, titled Climate Modification, focuses on ways in which humans have positively and negatively altered climates around the world. There are three articles to be read: Heat-Island Effect, Global Climate Change, and Artificial Climates.

Circulate around the room as students work on the lesson, making sure that everyone stays on task. Students should be taking notes on the readings and accessing additional references for further information as necessary. Be prepared to answer any questions that students may have or to suggest alternate references that may help them answer their own questions.

Regroup as a class.

During the last 10 minutes of each day's class ask the reporter from each group to report its major findings for the day and its answers to the questions posed at the outset. Record student responses to all of the questions you've displayed on the board and correct any misstatements that may have been recorded earlier.

You may connect to your curriculum/ textbook here. Or Assign Projects for independent research.

Assign Projects

Distribute the project ideas to each student and give students a few minutes to look over each one. Then, either let students choose the project they wish to work on or assign specific projects to specific students. Have students work in pairs to complete Project 1 and Project 2. Students should either choose the partners with whom they wish to work or you may want to set up the pairs yourself based on individual student abilities and personalities. Students should work individually on Project 3. Carefully review the timeline for each project so that everyone knows when his or her project is due. Inform students that during the final wrap- up sessions, they will be asked to report their research projects to the whole class.

Project 1.

On Top of the World (Research Brief)

Using a compass and straight edge, create a polar map of the Arctic region. Indicate the locations of the North Pole and the North Magnetic Pole, the lines of latitude that define the Arctic region and the Arctic Circle, and the corresponding lines of longitude. Also, include labels of the countries, major cities, islands, and bodies of water that are found within the region. Be sure to include a scale on your map.

Explain to students that they are expected to:

- use two or three xSpace references to locate descriptions of the Arctic region and its geography
- create a polar map of the region with the North Pole at its center, bounded by lines of latitude from about 60°N to 90°N, including the major land and sea areas within it
- complete the brief within three class periods

Project 2.

The Methuselah Tree (Research Exploration)

Using techniques of dendrochronology, scientists have identified what may be Earth's oldest living tree, the bristlecone pine, also called the Methuselah tree. Prepare a slideshow that describes the science of dendrochronology and how scientists use it to estimate the age of trees and to date climatic change. Then, describe the bristlecone pine tree, where it is found, its characteristics, and most importantly, its age. Also, explain why this tree is called the Methuselah tree.

Explain to students that they are expected to:

- use 3 to 10 xSpace articles to research dendrochronology and how it is used to date objects
- describe the characteristics and habitat of the bristlecone pine tree and why it was named after Methuselah
- complete the brief within two weeks

Project 3.

The Energy Crisis (Research Report)

Imagine that you are an advisor to the President of the United States, who has asked you to research the topic of alternate and renewable energy resources and what might be done to relieve the current energy crisis. Discuss the energy crisis and define what is meant by alternate and renewable energy resources. Then list at least five alternate energy resources and choose one to describe, including the science behind it, what would be required to harness this technology, and the advantages and disadvantages of this resource.

Explain to students that they are expected to:

use the conventions of the formal research paper, including appropriate maps, diagrams, and text
use resources beyond xSpace
complete the paper within three weeks

Assess

When assignments are submitted, you may use the questions below to assess student understanding.

Assessment Options

Use the following questions to assess student understanding.

Project 1: Research Brief (map)

2. Is the map drawn a polar map? Does it extend from at least 60°N and include the Arctic Circle and a mileage scale?
3. Are the countries and bodies of water that lie within the Arctic region clearly labeled?
4. Is the map correctly drawn and without spelling errors?

Project 2: Research Exploration (slideshow)

2. Does the presentation include a description of dendrochronology and how it is used in tree dating?
3. Is the information about the bristlecone pine complete and does it include its location and age?
4. Is the information well organized, grammatically correct, and without spelling errors?

Project 3: Research Report

2. Does the paper reflect an understanding of the current energy crisis in the world?
3. Does the paper include a list of possible renewable energy resources, and an elaboration of one source, the science behind it, its advantages and disadvantages, and how it might help solve the energy crisis?
4. Does the paper contain a sufficient number of details that address the topic?
5. Is the information, including any maps and diagrams, accurate?
6. Is the writing well organized, grammatically correct, and without spelling errors?

Wrap Up

Share research.

l-p Devote the first of the two wrap- up days to students who completed Projects 1 and 2. Collect the polar maps that were completed and display them on a poster board. Give students in the class a few minutes to walk around the room and examine the maps. Then ask students who drew the maps to briefly describe the climate in the Arctic region. Be sure that students understand that most of this region consists of ice and snow. Remind them that unlike Antarctica, which is a continent, the Arctic is an ocean mass, not a land mass. Also, point out the latitude measure of the Arctic circle itself. You may also have to explain the numbering system used to define latitudes, starting at the equator at 0° and proceeding north to 90°. If you have a standard world map in your room, point out this same line of latitude to the class. Mention the distortions that exist in the two map views.

Next, have students who completed Project 2 take turns projecting and narrating their slideshows to the class. Ask each pair of students to answer any questions that their fellow students may have and to compare their data about dendrochronology and the Methuselah tree.

On the second wrap- up day, ask students who completed Project 3 to report their findings to the class. Invite these students to the front of the class to form a panel of "energy experts," and ask each student to report his or her findings to the rest of the class. You may want to make a list of the different energy sources that students have researched. At the end of the presentations, spend a few minutes summarizing the advantages, disadvantages, and status of each one. Encourage any discussion about the issues raised and be prepared to answer any questions that students may have.

Recap the focus questions.

- *What is climate and how does it vary worldwide?*
- *How has climate changed over the centuries?*
- *How do human activities affect climate?*

Review the answers that students gave earlier to these questions and revise them based on their further study.

Extend learning.

l-p Have students discuss the following question as it applies to this lesson:

Humans in most of the highly developed nations of the world have created artificial climates. What are the advantages and disadvantages of artificial climates, and what would our life be like if they were no longer possible?