

TITLE: Regions of Change
 PRIMARY SUBJECT: Science
 GRADE LEVEL: 6th - 12th
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CONCEPTS / TOPICS TO TEACH:

There is a fundamental difference between weather and climate. Climate change is weather patterns that occur over the long term, and is observable in many different forms including, ocean acidification, global increase in temperature, warming oceans, shrinking ice sheets, glacial retreat, decreased snow cover, extreme weather events, and sea level rise. Therefore, different regions experience the effects of climate change in different ways.

STANDARDS ADDRESSED:

COMMON CORE	NGS STANDARDS
<p>Grades 6-8: <u>CCSS.ELA-LITERACY.WHST.6-8.7</u> Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>Grades 6-8: <u>MS-ESS3-3.</u> Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</p>
<p>Grades 9-10: <u>CCSS.ELA-LITERACY.SL.9-10.4</u> Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.</p>	<p>Grades 9-12: <u>HS-ESS3-1.</u> Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity</p>
<p>Grades 11-12: <u>CCSS.ELA-LITERACY.RST.11-12.7</u> Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>	

General Goal(s):

Explore the various effects climate change has on different regions of the world. Introduce students to areas that are already experiencing effects. Explore why these areas are more heavily affected.

Specific Objectives:

Students will use investigative research skills to determine why certain regions are more heavily affected. This activity will allow students to work together to create a collaborative presentation that will allow them to utilize skills in oral presentations, scientific writing, critical thinking, and vocabulary development.

Required Materials:

- Access to computer or tablet
- Access to printer
- Climate Change Effects Worksheet
- Poster Board
- Markers

Websites for Students Research

- <https://climate.nasa.gov/effects/>
- <https://www.epa.gov/cre/climate-change-coastal-communities>

Anticipatory Set (Lead in):

Complete climate change effects worksheet to review the effects of climate change with students.

- Q: Ask students if they think weather is consistent where they live, for example what was the weather like in February this year (and every other year they can remember).
- A: Students answers will vary but may involve extreme weather, higher temps, etc
- Q: Ask students what impacts they think climate variation could have where they live, such as how it might impact plants, or animals.
- A: Some living things will do better, while some might be harmed or move off to different areas.
- Q: Ask students how a ski resort in the mountains would be affected by climate change (this question can incorporate the economic impact to the ski resort owner).
- A: Less snow, warmer temperatures, shorter seasons, less money
- RESOLVE: Several regions across the United States and beyond are already being affected by a variable climate, and it can be seen in different ways across different locations.

ACTIVITY

Students (in groups) will be assigned a region of the world that is affected by climate change and research the effects experienced by assigned region following these steps;

- 1) Students complete “Effects of Climate Change” knowledge review (below).
- 2) Students should locate their assigned area on a map and predict whether it is a place that will be highly affected by a changing climate, and come up with a list of reasons to support their thesis.
- 3) Students should conduct online research about their assigned country to find out what is any impacts of climate change have been reported, and compile a list of their findings.

- 4) Advanced opportunity: Have students pick five towns that are spread out across their assigned country and collect data on the average daily temperatures and rainfall over a one month time frame, and create a graph with the collected data to compare weather in the five towns.
- 5) Students should share the information they gathered to classmates in a formal or informal presentation.
- 6) Lead a discussion about why there are differences between the locations each team studied.

REGIONS TO BE ASSIGNED

- The Alps
- Haiti
- Mumbai
- Zimbabwe
- Honduras
- United States

WRAP UP

- Have groups present their region to the class
- After presentations, compare and contrast regions and discuss how the response can often vary in developed regions versus underdeveloped regions

GLOSSARY OF LESSON TERMS

- **Climate Change**: Climate change refers to any significant change in the measures of climate lasting for an extended period of time.
- **Carbon Dioxide**: A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal human caused greenhouse gas that affects the Earth's radiative balance.
- **Emissions**: The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.
- **Glacier**: A multi-year surplus accumulation of snowfall in excess of snowmelt on land and resulting in a mass of ice that shows some evidence of movement in response to gravity. A glacier may be on land or in water. Glacier ice is the largest reservoir of freshwater on Earth.
- **Global Warming**: The recent and ongoing global average increase in temperature near the Earth's surface.
- **Greenhouse Effect**: The trapping and build-up of heat in the atmosphere near the Earth's surface caused by greenhouse gases.
- **Greenhouse Gas**: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.
- **Ocean Acidification**: Increased concentrations of carbon dioxide in seawater causing a measurable increase in acidity (i.e., a reduction in ocean pH). This may

lead to reduced calcification rates of calcifying organisms such as corals, mollusks, algae and crustaceans.

Plan for Independent Practice:

- Further explore how different regions of the United States specifically are affected by climate change.
- Discuss how different governments are responding to climate change.

Suggested Reading:

National Oceanic and Atmospheric Administration information page;
<http://www.noaa.gov/resource-collections/climate-change-impacts>

Time Magazine; Climate Change Could Wreck the Global Economy
<http://time.com/4082328/climate-change-economic-impact/>

New York Times: What the Climate Report Says About the Impact of Global Warming
<https://www.nytimes.com/2017/11/03/climate/climate-change-impacts.html>

NASA's Climate change pages for kids:
<https://climatekids.nasa.gov/menu/weather-and-climate/>

Potential Connections to Other Subjects:

Language: vocabulary development, scientific writing, literacy

Environmental Science: relationships with natural world

Ecology: Basic biology, connections to other organisms

Worksheet Key

1. Ocean Acidification
2. Decreased Snow Cover
3. Warming Oceans
4. Extreme Weather
5. Global Temperature Rise
6. Glacial Retreat
7. Sea Level Rise
8. Shrinking Ice Sheets

PRESENTATION OUTLINE

Assigned Region: Briefly describe the assigned regions: economy, climate, resources, and food sources.

Effects: Describe the specific effects of climate change the region is experiencing

Why: Why is this region is more vulnerable to climate change than other regions?

Response: How is the region adapting or responding to the effects, do they receive aid from other countries?

Potential Solutions: Give a few suggestions for viable solutions for the region

*Make sure to include a picture for each section

Name: _____

Date: _____

EFFECTS OF CLIMATE CHANGE

Instructions: Using the word bank below, write in the correct term for each definition

Global Temperature Rise Warming Oceans Glacial Retreat Shrinking Ice Sheets

Decreased Snow Cover Sea Level Rise Extreme Weather Ocean Acidification

1. Significant changes of chemistry in the ocean. The result of humans emitting more carbon dioxide into the atmosphere and being absorbed into the oceans.

2. The amount of snow in Northern Hemisphere is decreasing and snow is melting earlier

3. Oceans are absorbing extra heat in the top 700 meters.

4. Heat waves, drought, floods, hurricanes and winter storms.

5. The planet's average surface temperature is increasing, largely influenced by the greenhouse effect.

6. The result of higher temperatures and less snowfall. When ice melts more quickly than snowfall can accumulate and form new glacial ice.

7. Caused by warming of ocean and increased melting of land-based ice. Puts coastal regions at risk of experiencing flooding, shoreline erosion, and closer destructive storm surges.

8. Occurs in polar regions and happening at fast-rate. Contributes to sea level rise.

TITLE: Climate Change Solutions

PRIMARY SUBJECT: Science

GRADE LEVEL: 6th - 12th

AUTHOR: Carlee Belt

CONCEPTS / TOPICS TO TEACH:

The burning of fossil fuels such as oil and coal, deforestation, industrialized agriculture and other human activities has increased atmospheric concentration of carbon dioxide by more than a third in the last century. The increased emission of greenhouse gases into the atmosphere traps more heat and affects Earth's climate. It's important for students to understand the greenhouse effect and how human activities are causing increased emissions of greenhouse gasses. It's also necessary for students to grasp that there are ways to approach solutions, varying from a larger scale approach to small habit changes in individuals.

STANDARDS ADDRESSED:

COMMON CORE	NGS STANDARDS
<p>Grades 6-8: <u>CCSS.ELA-LITERACY.WHST.6-8.1.B</u> Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.</p>	<p>Grades 6-8: <u>MS-ESS3-3.</u> Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</p>
<p>Grades 9-10: <u>CCSS.ELA-LITERACY.WHST.9-10.7</u> Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the</p>	<p><u>MS-ESS3-5.</u> Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>

<p>inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>	
<p>Grades 11-12: <u>CCSS.ELA-LITERACY.WHST.11-12.2.E</u> Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).</p>	<p>Grades 9-12: <u>HS-ESS3-4.</u> Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p>

General Goal(s):

Introduce students to the human factors that drive climate change. Acquaint students with the causes of rising emissions and how it's connected to human activity. Establish understanding of effective strategies and conservation techniques that reduce our contribution to climate change.

Specific Objectives:

Students will review the scientific method and create a hypothesis around effective solutions for climate change, then use art to explain their hypothesis. This activity will allow students to utilize skills in critical thinking, research, solution oriented learning, literacy and vocabulary development and art.

Required Materials:

- Access to computer or tablet
- Climate Change Reflection Handout
- Activity Instruction Handout

Websites for Student Research:

- <https://climate.nasa.gov/causes/>
- <https://climate.nasa.gov/solutions/>

Anticipatory Set (Lead in):

- Q: Ask students how scientists test an idea?
- A: The scientific method
- Q: Ask students to review the steps in the scientific method
- A: Make an observation, form a hypothesis, experiment, record data, make a conclusion.

- Q: Ask students if the following statement is a good scientific hypothesis: “Captivity makes killer whales go crazy.”
- A: No because “crazy” is a subjective standard. How could this statement be tested using controls and variables?
- Q: Ask students to offer examples of a sound scientific hypothesis (remember it must be an idea that can be tested).
- A: whatever ideas students offer, ask them to describe how they would test that idea, and discuss what it actually means when something is “testable”.
- Q: Ask students to make an observation about climate change
- A: Human activities are impacting the climate, more carbon dioxide is being released into the atmosphere, the greenhouse effect traps more heat, ect (answers will vary)
- RESOLVE: Scientists can and do use the scientific method to test possible solutions for climate change.

ACTIVITY

After reviewing the causes of our changing climate and discussing effective strategies and solutions for combating climate change, students will develop a hypothesis (remind students that a hypothesis is a testable idea) then creatively represent it using an art medium of their choice, (drawing, model, song, magazine article, video, ect.).

Using the websites listed above, students can research current approaches that have been already taken to inspire their own hypotheses. If there are similar hypotheses presented in class (at teacher’s discretion) students can combine and work together in teams to create their solution.

GLOSSARY OF LESSON TERMS

- Greenhouse effect- When radiated heat from the sun is absorbed by greenhouse gases (water vapor, carbon dioxide, methane, chlorofluorocarbons, and nitrous oxide) which traps outgoing heat.
- Carbon dioxide (CO₂)- A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation and burning fossil fuels. Humans have increased atmospheric CO₂ concentration by more than a third since the Industrial Revolution began.
- Methane- A gas produced both through natural and human activities, including the decomposition of wastes in landfills, agriculture, and digestion and manure management associated with domestic livestock. Methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.

- Nitrous oxide- A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
- Water vapor-The most abundant greenhouse gas, but importantly, it acts as a feedback to the climate. Water vapor increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.
- Chlorofluorocarbons (CFCs)- Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases.
- Unsustainable resource: a resource that is not able to be maintained at the current rate or level
- Sustainable resource- a resource this is able to be maintained at a certain rate or level

Plan for Independent Practice:

- Encourage students to record their behaviors that contribute to climate change over a weeks time and discuss how to make habit changes as individuals and as a class to positively affect the environment.
- Challenge students to come up with a campaign advising other students about how to reduce the carbon footprint of their school.
- Ask students to research the “6th major extinction” and discuss how animals are affected by climate change.
- Challenge students to write a short persuasive paper on why they believe their hypothesis would be effective in combating climate change.

Suggested Reading:

Have students learn how to calculate their carbon footprint:

<https://www.carbonfootprint.com/calculator.aspx>

Informative article on how the shipping industry will reduce its carbon footprint:

<http://www.climatechangenews.com/2018/04/13/shipping-halve-carbon-footprint-2050-first-sector-wide-climate-strategy/>

New York Times: How to Reduce Your Carbon Footprint:

<https://www.nytimes.com/guides/year-of-living-better/how-to-reduce-your-carbon-footprint?campaignId=74XU8>

Georgetown University’s hints to reduce the carbon footprint:

<https://sustainability.georgetown.edu/getinvolved/thingsyoucando>

Interesting video short on the matter of ocean acidification:

<https://www.youtube.com/watch?v=5cqCvcX7buo>

Potential Connections to Other Subjects:

Art: drawing, design, graphics

Language: vocabulary development, scientific writing, literacy

Ecology: basic biology, ecosystem connections

NAME: _____

DATE: _____

CLIMATE CHANGE REFLECTION

1. What is an unsustainable resource? Give 2 examples.
2. What is a sustainable resource?
3. List two strategies the United States is using to combat climate change:
4. Do you personally contribute to climate change? How?

5. List 5 small things you can do to help fight climate change:

6. Now list 3 big ideas(project, law, model, ect) that could help fight climate change:

Name:

ACTIVITY INSTRUCTIONS

Choose one idea and form a hypothesis (a testable idea) on how the idea is an effective strategy in combating climate change:

Hypothesis:

After forming a hypothesis that is based in science and logic, think about how you will creatively represent your idea. Make a video, write a song/rap, paint or draw and model, write a magazine article or use any other form of art to bring your hypothesis to life.

Must include (either directly in presentation or written separately)

- An in depth description of hypothesis (Introduction)

- Why you thought of it, what influenced or inspired you?
- How it addresses climate change, be specific!
- Using the scientific method how could be tested or experimented? What would it require and who would be involved?
- Conclusion

TITLE: Weather Where You Live
PRIMARY SUBJECT: Science
GRADE LEVEL: 6th - 12th
AUTHOR: Carlee Belt

CONCEPTS / TOPICS TO TEACH:

Studying weather data is important as it helps us establish future climate expectations. It's also important to note that weather and climate differ. Weather is what you see outside on any particular day and is recorded over short periods of time. Climate is the average of such weather recorded over relatively long periods of time. Collecting weather data helps us understand our changing climate

STANDARDS ADDRESSED:

COMMON CORE	NGS STANDARDS
<p>Grades 6-8: <u>CCSS.ELA-LITERACY.RST.6-8.7</u> Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>	<p>Grades 6-8: <u>MS-ESS2-5.</u> Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.</p>

<p>Grades 9-10: <u>CCSS.ELA-LITERACY.RST.9-10.7</u> Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.</p>	<p>Grades 9-12: <u>HS-ESS2-4.</u> Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.</p>
<p>Grades 11-12: <u>CCSS.ELA-LITERACY.RST.11-12.4</u> Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p>	

General Goal(s):

Have students differentiate between weather and climate and acquaint them with ways to accurately record weather patterns over a week’s time.

Specific Objectives:

This activity will familiarize students with data collecting and graphing techniques. Students will engage in group work, utilize investigative research skills, and present data to the class to be compared.

Required Materials:

- Access to computer or tablet
- Daily weather data chart (provided)
- Weather.com

Anticipatory Set (Lead in):

- Q: Ask students to tell you about today’s weather.
- A: Answers will vary
- Q: Ask students to tell you what they think about when describing the daily weather.

- A: Answers should involve things like daily temperatures, clouds (cloud cover), rain/snow (precipitation), wind, ect.
- Q: Ask students to consider how the climate is studied.
- A: Answers should include things like studying the weather and recording data.
- RESOLVE: Weather and climate are different. Weather is short term, recorded daily, and what you see outside on any given day. Climate is the average of daily weather recorded and studied over long periods of time.

ACTIVITY

Students, in small teams, will choose three towns from different areas of their home state and collect daily weather data over the course of one week (Monday-Sunday). Students will record daily high and low temperatures, precipitation (or % chance precipitation), cloud cover, wind speed/direction, and pressure. The activity instructions and chart handout provided can be printed so students are able to easily record daily observations (each group will need 3). After students have collected all data they will graph each category recorded over the week. A bar or line graph is suggested but teachers may use discretion to decide the type of graph would be best for their students. Each team will create a graph for temperature, precipitation, wind, cloud cover, and pressure. Each graph should include Monday-Friday and all three towns, this will help acquaint students with multiple levels of data represented on one graph.

Note: Weather.com is the recommended site students can use to collect data but if using other sources, instruct students to remain consistent with where they collect their data.

WRAP UP

- Compare the weather data recorded across the state and discuss how each group chose to record their daily data
- Discuss possible discrepancies that could have affected the data (ex: inconsistencies of where data was collected, if data was recorded at the beginning of the day versus the end of the day, ect.)
- Recap the difference between weather and climate

GLOSSARY OF LESSON TERMS

- Weather- the state of the atmosphere with respect to wind, temperature, cloudiness, moisture, pressure, etc.
- Climate- the composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.
- Precipitation- the amount of rain, snow, hail, etc., that has fallen at a given place within a given period, usually expressed in inches or centimeters of water.

- Atmospheric pressure- the force with which our atmosphere pushes down on a specific location on Earth.
- Barometer- the instrument that measures atmospheric pressure

Plan for Independent Practice:

- Ask students to research statewide averages from 20 years ago and write about how it compares to the collected class data
- Encourage students to think about why they experience the average weather they do in terms of their state’s geographic location
- Ask students to do additional reading from suggested reading section and write a reflection about what they read

Suggested Reading:

Weather for kids:

<http://weatherforkids.org/>

National Weather Service:

<https://www.weather.gov/cae/justforkids.html>

Potential Connections to Other Subjects:

Geography: physical features, earth’s atmosphere, human activity

Language: vocabulary development, scientific writing, literacy

Meteorology: atmospheric effects on weather

ASSIGNMENT OUTLINE

WEATHER DESCRIPTION: Here is where you will write general notes about today’s weather including the date and the description of the weather (foggy, snowy, sunny, showers, storms, ect)

HIGH/LOW TEMPS: Write today’s high and low recorded temperatures

PRECIPITATION: Precipitation moves moisture from the upper levels of the atmosphere to the lower levels and the surface, usually as rain or snow. If the average amounts of precipitation that fall changes the 30 year average either wetter or drier, that is a part of climate change. On the chart: record how many inches in rain or snow, if no rain or snow on this day record % chance of precipitation.

WIND: Without wind, weather would not exist. Wind allows water vapor and temperature variations to be moved from one area of the globe to another, creating

weather variations within specific climate zones. On the chart: You will be recording wind speed and direction. Ex: “NW 22 mph” or “S 5mph”

CLOUD COVER: If skies are clear, more heat reaches the earth's surface, if it is cloudy some of the sun's rays are reflected off the cloud droplets back into space allowing less of the sun's energy to reach the earth's surface, which causes the earth to heat up more slowly. This leads to cooler temperatures. On the chart: write if it is cloudy, partly cloudy, or sunny

PRESSURE: A high pressure system is a dense air mass that is usually cooler and drier than the surrounding air. A low pressure system is a less dense air mass that is usually wetter and warmer than the surrounding air. On the chart: write daily pressure which will be represented as a number and an up or down arrow Ex: 30.2 in ↓ represents "Barometric pressure is 30.2 inches and falling," (Falling air pressure indicates that bad weather is coming, while rising air pressure indicates good weather.)

Name:

Town observing:

Daily Weather Observation Data

	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>	<u>Saturday</u>	<u>Sunday</u>
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Date and weather description:							
High/ Low Temp:							
Precipitation % (rain/snow) :							
Wind Speed/direction:							
Cloud Cover:							
Pressure:							