

# Climate Quest

## *Teacher's Guide*



## **Overview**

EarthGames at the University of Washington created a fun instructional game, Climate Quest, that teaches individuals ages 8 and up about climate disasters. The game is designed to be played in a museum or classroom setting, or at home. It takes approximately 10 minutes to play through the game.

Climate disasters are occurring across the United States, but your 4 heroes have the skills to save countless lives and protect fragile ecosystems! Forecasts of climate disruptions appear all across the map, each based on real impacts selected from the US National Climate Assessment.

The player must choose which scientist-hero is best suited to prepare against the disaster: the urban planner, the ecologist, the agricultural scientist, or the climate scientist. Only the swiftest player will be able to prepare for all the events and earn the top score!

## **Objective**

Fix as many as natural disasters that occur as fast as possible before the time is up and it destroys the area.

## Learning Goals

The students will learn about the different kinds of natural disasters that occur in the United States as well as be able to identify what kind of scientists are required and able to fix the damages.

- a. Knowledge
- b. Skills
- c. Dispositions

## Next Generation Science Standards

Students who demonstrate an understanding can:

1. **ESS3-D: Global Climate Change:** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.
2. **MS-ESS3-2** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
3. **MS-ESS3-3** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
4. **MS-ESS3-5** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Science and Engineering Practices: Constructing Explanations and Designing Solution

Crosscutting Concepts: Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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

## The 5 Es of Teaching with ClimateQuest

*In this guide, we will provide you with sample lesson plans and activities. Here is an sample outline (information about the activities can be found in other sections of this guide):*

**Engage:** Post-It Game

**Explore:** Climate Quest

**Explain:** Policy Research

**Extend:** Movies and Videos

**Evaluate:** Jeopardy

## Key Concepts

*Students should be able to understand these concepts as well as their impacts on distinct ecosystems:*

|                 |                     |                       |             |
|-----------------|---------------------|-----------------------|-------------|
| Climate Science | Adaptation          | Overexploitation      | Disaster    |
| Climate Change  | Urban Planning      | Sustainability        | Hurricane   |
| Ecosystem       | Urbanization        | Drought               | Algae Bloom |
| Ecology         | Ocean Acidification | Agriculture Scientist | Flood       |
| Sea Level Rise  | Forest Fire         | Animal Migration      | Policy      |

*See pre-game activities for ideas on how to actively and effectively teach these concepts.*

# Engage

## Pre-Game Activities

### Worksheet

Attached at the end of this Teacher’s Guide is a worksheet that can be passed out before playing the game. Students would fill out their own definition for the different terms. Then as a class come up with the best definition (revised definition), as well as examples of how the key concepts affect the environment/ecosystems.

### Post-It Poster

Alternatively, in this activity students will walk around the classroom to different posters that each hold a key concept (from the list previously provided) and write their own knowledge and associations with the terms on a post it and post-it on the poster. After students have finished writing for all the concepts, the class can come as a whole to see what other students wrote as well as clarify the terms.

# Explore

## Downloading the Game

- The Mac version may require you to go to System Preferences, Security & Privacy, General, and “Open Climate Quest Anyway” to open an application downloaded from the internet.
- Alternatively, you can right-click (or control-click) the Climate Quest application and click “open.”

## Process

*The game is fairly self-explanatory, but here is a step-by-step guide on how to play the game:*

1. The game starts off by introducing you to some of the “heroes” of the game (Lydia the Climate Scientist and Cid the Urban Planner).
2. Disasters then start popping up across the United States.

- a. A “?” symbolizes a forecast for a disaster that needs to be prevented. Click on it to read the description.
  - b. Depending on the type of disaster, send the appropriate hero to go prevent the disaster from striking by clicking on him/her and then the forecast, which now appears as a “!”, as you have already read the description.
  - c. Make sure to send the hero as quickly as possible. The red bar (continuously decreases) indicates the amount of time you have left before the disaster strikes the area. The yellow bar shows the amount of work the hero has left to do to save the area.
3. As time goes by, more disasters will pop up and you will be introduced to more heroes that will be better suited to fix different issues.
  4. At the end, you will be given a report on how many disasters you successfully prevented.

## Explain

### Post-Game Activities

#### Group Research

For Students can pick an issue found in the game such as ocean acidification, floods, drought, sea-level rise, forest fires, algae blooms, hurricanes, water management, heat management and do research on it. After a given amount of time, students will come together and present what they found out regarding their topics.

*Note: This activity requires computers and/or access to a library.*

#### Create a Policy

Alternatively, in this activity students will come up with policies for their school, city, or country, and share their ideas to the class. The class will then assess each idea provided and together contribute their ideas to create one “mock” policy.

# Extend

## Pre-Game Videos

- Climate Change for Kids <<https://www.youtube.com/watch?v=ko6GNA58YOA>>
- Climate Change Animation <<https://www.youtube.com/watch?v=9JwhyiyN-aY>>
- Adaptation <<https://www.youtube.com/watch?v=kVaF-O0cVoo>>
- Urbanization <<https://www.youtube.com/watch?v=fKnAJCSGSdk>>

# Evaluate

## Jeopardy

*After the game has been played, students can engage as a class in a Jeopardy Game < \_\_\_\_\_ > to further strengthen the student's knowledge of the key concepts and ideas discussed.*

## Climate Quest's Awards

Climate Quest won first place in the Climate Game Jam, a national event sponsored by the White House, NOAA, and the Smithsonian!

## Additional Information:

- Climate Quest features original 8-bit graphics and a soundtrack in the style of classic Nintendo games. Although everything in the game is based on scientific facts and is vetted by climate scientists, it keeps a playful and optimistic tone.
- We'd love to hear from you if you download our game! Write us with comments, suggestions or to join our mailing list at [EarthGamesUW@gmail.com](mailto:EarthGamesUW@gmail.com).

## Further Reading:

Each event in Climate Quest is based on a climate disaster that has actually occurred, and is forecast to increase in frequency in the future. You can read more about these scientific facts and the specific events in the following set of resources.

None of this reading is necessary before presenting the game to your class. We include this section in case you'd like to know more about the science behind each event, and the specific inspiration for each disaster.

If you have any questions about the science of climate change, feel free to contact us at [EarthGamesUW@gmail.com](mailto:EarthGamesUW@gmail.com), or Professor Dargan Frierson at [dargan@uw.edu](mailto:dargan@uw.edu).

## ADAPTATION VERSUS MITIGATION

This game is about adaptation to climate change, meaning preparation for warming. Mitigation, on the other hand, addresses the root source of global warming, greenhouse gas emissions. The public discussion of solutions to global warming almost always focuses on mitigation, and rarely mentions adaptation.

However even if mitigation efforts succeed and we stop greenhouse gas emissions as quickly as possible, the global warming that we'll experience in coming decades will be roughly twice that experienced so far (2 degrees Celsius warming versus the 1 degree Celsius that has occurred already). Therefore adaptation is a necessary part of the response to climate change. The strategies taught in Climate Quest are tested ways to reduce the impact of global warming and its range of consequences.

<http://climate.nasa.gov/solutions/adaptation-mitigation/>

## SEA LEVEL RISE

Sea level rise is occurring (approximately 8 inches rise so far, including 3.5 inches of rise since 1993) and will continue (forecasts of 2100 sea levels compared with today range from 7 to 37 inches additional rise, with the possibility of significantly larger rise if ice sheets in Greenland or West Antarctica collapse).

<http://climate.nasa.gov/vital-signs/sea-level/>

[https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5\\_Chapter13\\_FINAL.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter13_FINAL.pdf)

- Event: CITY UP. The Native American village of Taholah, WA is moving up the hill in response to sea level rise

<https://toolkit.climate.gov/taking-action/quinault-indian-nation-plans-village-relocation>

- Event: OH HECK IT'S UP TO MY NECK. Southeastern Louisiana is sinking faster than most places around the world, due to the combined effects of sea level rise (from global warming) and land subsiding (from oil and gas drilling).

<http://projects.propublica.org/louisiana/>

There are large incentives in Louisiana for homeowners to put their houses on stilts (or penalties if they don't comply).

<http://www.bloomberg.com/news/articles/2013-08-22/femas-new-flood-maps-pressure-homeowners-to-raise-their-houses>

## DROUGHT

Drought is expected to intensify in the US in the future, especially in the Southwest, southern Great Plains, and Southeast. A warmer atmosphere can hold more water vapor, which sucks moisture from the soil, leading to more prolonged droughts. Also rain bands are expected to shift away from the southwestern US.

<http://nca2014.globalchange.gov/highlights/report-findings/water-supply>

The recent California drought and Texas drought (Event: WHERE'S THE WATER) have been particularly devastating. See, e.g.,

<http://www.theatlantic.com/business/archive/2015/03/the-economics-of-californias-drought/388375/>

[http://www.nytimes.com/2013/04/07/sunday-review/getting-serious-about-a-texas-size-drought.html?\\_r=0](http://www.nytimes.com/2013/04/07/sunday-review/getting-serious-about-a-texas-size-drought.html?_r=0)

Many mountainous areas rely on melting snowpack for their water resources. In a warming climate, more precipitation will fall as rain instead of snow; this can lead to summer water stress even in a year with average precipitation (Event: ROCKY MOUNTAIN DRY)

<http://cses.washington.edu/db/pdf/snovertalsok2013sec6.pdf>

- Event: THIRST FIRST. Recent droughts have inspired creative solutions: California has used floating plastic balls to prevent evaporation from their reservoirs.

<http://www.accuweather.com/en/weather-news/shade-balls-los-angeles-water/51834017>

## OCEAN ACIDIFICATION

Ocean acidification is an unavoidable consequence of higher atmospheric carbon dioxide levels.

[https://www.youtube.com/watch?v=ntBgzK\\_OIA4](https://www.youtube.com/watch?v=ntBgzK_OIA4)

Ocean acidity has increased by 30% since pre-industrial times due to human-induced carbon emissions. Acidification harms marine organisms, particularly those that build shells out of calcium carbonate. This includes shellfish, coral reefs, and organisms closer to the base of the food chain such as phytoplankton.

<http://nca2014.globalchange.gov/highlights/report-findings/oceans#narrative-page-21099>

- Event: THE SEA'S SOUR STOMACH. The shellfish industry has been particularly hard hit by ocean acidification.  
<http://apps.seattletimes.com/reports/sea-change/2013/sep/11/oysters-hit-hard/>

Another ocean chemistry issue is dead zones, also known as hypoxia or low oxygen events (Event: THE DEADLIEST ZONE).

[https://en.wikipedia.org/wiki/Dead\\_zone\\_\(ecology\)](https://en.wikipedia.org/wiki/Dead_zone_(ecology))

Particular events are often caused by overuse of fertilizer, but this problem is expected to increase in severity with global warming because warmer water has hold less dissolved oxygen.

<http://www2.ucar.edu/atmosnews/news/20721/widespread-loss-of-ocean-oxygen-become-noticeable-in-2030s>

#### EXTREME RAINFALL EVENTS

A warmer atmosphere can hold more water vapor, meaning it can release it rapidly in large downpour events. Extreme rainfall events are increasing across the US (even in places where the total rainfall has decreased). With heavy rainfall, there is an increased chance of flash flooding, especially in areas that have very dry soil (Event: GONE IN A FLASH (FLOOD)).

<http://nca2014.globalchange.gov/highlights/report-findings/extreme-weather#narrative-page-20985>

#### HURRICANES

There has been a large increase in the intensity and frequency of hurricanes in the Atlantic since the 1980s. And since sea levels are rising, this makes the potential of flooding from hurricanes even more of a possibility.

<http://nca2014.globalchange.gov/highlights/report-findings/extreme-weather#narrative-page-20991>

Event: THE IMPERFECT STORM

There is also preliminary evidence that hurricanes are moving farther from the equator, into areas that haven't experienced as many historically. The impacts of a climate disaster are often worst when unfamiliar events happen.

<http://whyfiles.org/2014/hurricanes-typhoons-moving-away-from-equator/>

#### HEAT WAVES

Heat waves are not surprisingly expected to increase in a warmer climate; these are among the deadliest of natural disasters. In the 1995 Chicago heat wave, 739 people lost their life:

[https://en.wikipedia.org/wiki/1995\\_Chicago\\_heat\\_wave](https://en.wikipedia.org/wiki/1995_Chicago_heat_wave)

In the 2003 European heat wave, over 70,000 people died:

[https://en.wikipedia.org/wiki/2003\\_European\\_heat\\_wave](https://en.wikipedia.org/wiki/2003_European_heat_wave)

There are simple ways to prepare for heat waves that can prevent significant loss of life. Setting up cooling centers for those without air conditioning is a simple example (Event: MY SOLES ARE MELTING). The effectiveness of these programs can be seen in the significantly smaller mortality response to the 2012 Chicago heat wave, despite similar meteorological conditions:

<https://www.wunderground.com/blog/weatherhistorian/why-was-the-chicago-heat-wave-of-2012-so-much-less-deadly-than-that-of>

Event: HAZY DAYS

Air quality is often a concern in heat waves, and this can have large effects on human health.

Forest fires can be particularly harmful for air quality.

<http://nca2014.globalchange.gov/highlights/report-findings/human-health#narrative-page-21013>

## ECOLOGY

Many ecosystems can't adapt or prepare for climate change nearly as quickly as changes are happening. For a survey of expected impacts on ecosystems in the US, see this reference:

<http://nca2014.globalchange.gov/highlights/report-findings/ecosystems-and-biodiversity>

Often species respond to climate change with different timing. When events that used to happen at the same time (e.g., caterpillars hatching when baby birds are born) respond different to climate change (e.g., caterpillars hatching earlier than usual), there can be great harm to the natural balance. This is known as "disrupted synchrony" (Event: THE EARLY BIRD MISSES THE WORM).

<http://rspb.royalsocietypublishing.org/content/268/1464/289>

A charismatic species that is affected by climate change is the pika.

<http://twitter.com/PikaPics>

Pikas can get heat stroke and die when temperatures exceed 78 degrees. They live on the top of mountains where temperatures are colder. When temperatures rise, they have less time to forage for food. The pika are threatened by climate change since there is not always room for them to move upslope as temperatures rise (Event: PIKA MOVE!).

<https://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Effects-on-Wildlife-and-Habitat/Pika.aspx>

An innovative strategy to help animals to adapt to both climate change and fragmentation of ecosystems is to construct wildlife crossings. These can be placed across major highways, so animals can move to different habitats more easily (Event: THE ROUTE IS ON FIRE).

#### AGRICULTURE

Crop yields tend to decline significantly in warmer years. We expect significant stress on food production in the future, just from global warming (Event: THE POPCORN BELT). Drought can exacerbate this significantly.

<http://nca2014.globalchange.gov/highlights/report-findings/agriculture>

# Worksheet 1

## *Pre-Game*

| <b>Key Concept</b>    | <b>Your Definition</b> | <b>Revised Definition</b> | <b>Impact on the Environment</b> |
|-----------------------|------------------------|---------------------------|----------------------------------|
| Climate Science       |                        |                           |                                  |
| Climate Change        |                        |                           |                                  |
| Ecosystem             |                        |                           |                                  |
| Ecology               |                        |                           |                                  |
| Sea Level Rise        |                        |                           |                                  |
| Adaptation            |                        |                           |                                  |
| Urban Planning        |                        |                           |                                  |
| Urbanization          |                        |                           |                                  |
| Ocean Acidification   |                        |                           |                                  |
| Forest Fire           |                        |                           |                                  |
| Overexploitation      |                        |                           |                                  |
| Sustainability        |                        |                           |                                  |
| Drought               |                        |                           |                                  |
| Agriculture Scientist |                        |                           |                                  |
| Animal Migration      |                        |                           |                                  |
| Disaster              |                        |                           |                                  |
| Hurricane             |                        |                           |                                  |
| Algae Bloom           |                        |                           |                                  |
| Flood                 |                        |                           |                                  |
| Policy                |                        |                           |                                  |

# Worksheet 2

## *Post-Game Research Questions*

**Discussion Directions:** In a group of 2-4 students, pick one of the following impacts from Climate Quest to further investigate: ocean acidification, floods, drought, sea-level rise, forest fires, algae blooms, hurricanes, water management, heat management. Use the graphic organizer as a guide for your research and discussion.

**Presentation Directions:** Develop an engaging 5 minute presentation about your research and discussion on an impact associated with climate change. During your presentation provide an introduction, explain the impact, and elaborate on adaptation strategies for this impact.

### **Introduction**

Impact:

Define this impact in three sentences:

### **Impact**

What will be the future effects of this impact?

### **Adaptation**

What actions can be taken in order to adapt to this impact?

|  |
|--|
|  |
|--|

Are local, state, or federal policy makers adapting for this impact in your area? If so, how? (Hint: Research the your local government's website, the Department of Ecology, and the Environmental Protection Agency as a starting point.)

Local:

State:

Federal:

**Extension**

Research a two different countries that are or will be affected by this impact associated with climate change. Compare and contrast the resources available for each country to adapt to climate change.

# Worksheet 3

## *Post-Game Create a Policy*

**Directions:** As a group of 2-4 students you will create a policy for your school, city, or country and present the policy to your class. Use the graphic organizer to start your group discussion.

1. We will investigate the following impact of climate change \_\_\_\_\_

2. List the problems associated with this impact:

3. Pick one of the problems you listed above and fill out the “Policy Graphic Organizer.”



