Communicating Climate Data to Nonscientists

CLIMATE DATA JAM

Jam 100% DATA

DESCRIPTION

Students analyze and then showcase climate data by developing a creative project to communicate data trends to nonscientists.

GRADE LEVEL
6 – 12

OBJECTIVES

Students will:
- Analyze long-term, local precipitation and temperature data
- Evaluate local predicted precipitation and temperature conditions
- Identify and explain a data trend
- Develop a creative project to portray a data trend and communicate scientific data to nonscientist audiences

TIME
4 HOURS TOTAL OVER 4 DAYS

COMMON CORE STATE STANDARDS

English Language Arts Standards » Science & Technical Subjects » Grade 6-8

CCSS.ELA-LITERACY.RST.6-8.4. 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 grades 6-8 texts and topics.

CCSS.ELA-LITERACY.RST.6-8.7. 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).

English Language Arts Standards » Science & Technical Subjects » Grade 9-10

CCSS.ELA-LITERACY.RST.9-10.4. 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 grades 9-10 texts and topics.

CCSS.ELA-LITERACY.RST.9-10.7. 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.

English Language Arts Standards » Science & Technical Subjects » Grade 11-12

CCSS.ELA-LITERACY.RST.11-12.4. 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 grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.7. 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.

NEXT GENERATION SCIENCE STANDARDS

Middle School

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

High School

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

BACKGROUND

As the climate changes, changes in temperature and precipitation will impact humans and ecosystems. Temperatures are predicted to increase throughout the United States. Some areas will receive less precipitation than historic levels, and some will receive more. However, *how* and *when* these changes in precipitation affect people and ecosystems may be complex. For example, in some counties, total annual precipitation is predicted to increase, but seasonal predictions show that much of the precipitation may occur at different times of the year than it historically fell. Seasonal changes in precipitation may have important effects on local ecosystems and human residential, commercial, and agricultural water supplies.

Most areas in the United States are predicted to experience warmer temperatures in the future. As temperatures continue to increase, more water from lakes, streams, oceans, soil, and plants will likely evaporate or transpire, especially in arid areas. Evaporation and transpiration are often combined and termed **evapotranspiration**, which is the total of evaporation and transpiration from Earth's surfaces, bodies of water, and plants. Heat causes water to evaporate more quickly because water molecules move faster when they are warm. Since the molecules are moving faster, more of them can leave the surface at one time. For evapotranspiration to occur, however, the humidity of the atmosphere must be less than the surface, and therefore evapotranspiration rate increases will be most pronounced in dry regions. In dry regions, evapotranspiration rates may offset any gains experienced through increased precipitation rates.

Interactions between precipitation and temperature in our global climate are complex. Predicting how climate change will affect water supplies for humans and ecosystems is an important first step to developing adaptation and mitigation strategies. The effects may vary greatly in localized areas because of seasonal variability in climatic conditions, especially precipitation and temperature.

MATERIALS

- *Climate Data Jam* handout [1 per student]
- *Climate Data Jam Scoring Rubric* handout [1 per student and enough for project scoring]
- Precipitation map
- Maximum Temperature map
- PowerPoint presentation
- Computer and projector for the educator
- Computers or tablets with web browser and internet connection for students [1 per every 1-3 students]
  - If not available, plan to access data in advance and provide for students
- A large assortment of craft and recycled household supplies to be used for projects such as:
  - Large-format paper, butcher paper, and/or poster boards
  - Markers and/or crayons
  - Glue
  - Pipe cleaners
  - Plastic/paper cups
  - Plastic/paper plates
  - Paper bags
  - Fabric
  - Pom poms
  - Googly eyes
  - Streamers
  - Beads
  - Stickers
  - Cardboard
  - Empty, clean egg cartons

PREPARATION

1. Prepare the craft and recycled household supplies for student use. If you have space, it is helpful to lay the supplies out on a surface so that students can more quickly assess available supplies and develop project ideas.
2. Set up a computer and projector and display the PowerPoint presentation.
3. Set up student computers or tablets. If you would like to save time, you can open the precipitation and maximum temperature maps for students on a web browser. Precipitation: http://spatial-web.nmsu.edu/flexviewers/PrecipitationByCounty/ Maximum Temperature: http://spatial-web.nmsu.edu/flexviewers/MaxTempByCounty/
   a. If student computers or tablets with internet access are not available, access the maps in advance and fill out tables 1 and 2 on page 3 of the handout. Show the tables using a document camera or draw them on the board.

PROCEDURES

DAY 1 – INTRODUCTION

1. Pass out a *Climate Data Jam* handout and a *Climate Data Jam Scoring Rubric* to each student.
2. Give an introduction to the Climate Data Jam using the PowerPoint presentation.
   a. **Slide 2**: scientists around the world are collecting vast amounts of data every day. However, the general public often learns very little, if anything, about the information that scientists have amassed. There is a gap in the communication of scientific information to nonscientists.
   b. **Slide 3**: students will be creating a Climate Data Jam project over the next few days. The goal is to design a creative project and presentation that explains local precipitation and temperature data to an audience not familiar with this information.
   c. **Slide 4**: here is an example of an effective way to communicate data. This infographic is interesting and easy to understand because it puts data into a context to which most people in the continental United States can relate. Simply stating that Major League Baseball players

ran a total of 1,245 miles in 2006 may be considered by some to be a dry statistic. However, scaling a baseball diamond to represent 1,245 miles and overlaying it on a map of the continental United States may help people understand how large the distance is and inspire them to take an interest in the statistic.

d. **Slide 5**: this is an example of using music to communicate data. A University of Minnesota student, Daniel Crawford, created a song to represent the increase in average global temperatures since 1880. He was looking for a method to communicate scientific data in a way that would be more appealing to nonscientists and "people who would get more out of [a song] than maps, graphs, and numbers." His video may inspire students to be creative with their projects: https://vimeo.com/69122809
e. **Slide 6**: here is an example of a student using painting to communicate data. The different colored paint splatters were scaled to reflect the amounts of solar radiation, soil temperature, air temperature, and precipitation over several 4-year periods in Las Cruces, New Mexico.
f. **Slide 7**: this is an example of a student using dance to communicate data. The height of the student's foot was scaled to represent the amount of precipitation received every two year in Las Cruces, New Mexico. The ribbon tied to her foot helps visualize the differences each year.
g. **Slide 8**: students may work individually or in teams of up to three students. Larger groups are not recommended for this project because of the difficulties of ensuring that all group members are equally involved. Students should develop a very creative project to represent the data and appeal to nonscientists. The project should not be a graph or table. Instruct students to use their imaginations to design a project that will be attention grabbing and appealing. Example products could include songs, demonstrations, poems, children's stories, newscasts, physical models, infographics, and skits. Representations of the data trend or trends must be scaled accurately.
    i. Emphasize that students should represent a trend or trends in the data in a creative way rather than using the data directly in their projects. For example, the amount of annual precipitation could be represented in a physical model with cardboard cutout raindrops that represent 100 mm of water instead of simply stating that the county received 278.8 mm.
    ii. Ensure that students understand the word **trend** by asking for a volunteer to define it [answer: the general direction in which something is changing. For example, in the future, our county is predicted to receive less annual total precipitation than we did historically.]

    Students may go beyond the data and begin to examine the implications; however, their projects must also include representations of the data trends. For example, a student could write a rap song that includes a hypothesis about how increased temperatures in their county may lead to increased evapotranspiration, but they must incorporate a clear, accurately scaled description of the trend in the data as well.
h. **Slide 9**: direct students to look at the top of page 1 of their handout. A good Data Jam project is clear in that it accurately represents the data in a way that is understandable to nonscientists. The data must be scaled correctly, and a legend explaining how the data are represented must be included. The project should also be creative. Think of an imaginative way to get the attention of nonscientists. Finally, the project should be concise. Focus on one or two important trends, and explain them well.
i. **Slide 10**: today, students will be introduced to the project and start examining local precipitation and temperature data. Over the next two days, students will create a project and develop a 5-minute (maximum) presentation to explain their project to the rest of the group. On day 4, students will present their projects to the group.
j. **Slide 11**: direct students to look at the project directions on page 1 of their handout.
    i. Students should decide if they would like to work alone or with one or two other students to complete their Climate Data Jam project.
    ii. Use the online USDA Southwest Regional Climate Hub Precipitation and Maximum Temperature maps to acquire the needed data from your county. Fill in the data tables on page 3 of the handout.
    iii. Examine the data and find one or two trends of interest.
    iv. Read the Scoring Rubric so you know how the presentation and project will be evaluated.
    v. Brainstorm and fill out the brainstorming notes section.
    vi. Create the Climate Data Jam project (infographic, skit, etc.).
    vii. Fill out the Climate Data Jam Summary.
    viii. Practice the presentation.
k. **Slide 12**: direct students to look at the *Climate Data Jam Scoring Rubric*.

i. Students will use this rubric to score each other's projects.
ii. Forty percent of students' total score will be based on their presentation.
    1. At the start of their presentation, students must state their names, the title of the project, and the data trends that they portrayed.
    2. Speak clearly.
    3. Hold the attention of the audience.
    4. Include an explanation of the factors leading to increased temperatures.
    5. Include a brief reflection of the presentation explaining what they liked best and what was most challenging about this project.
iii. Sixty percent of students' total score will be based on creativity in communicating data trends.
    1. The project idea must be creative.
    2. The data presentation must be easily understandable and appealing to nonscientist audiences.
    3. Resources and/or materials must be used effectively in a creative way.
    4. The project must accurately portray the trend or trends of the data, and a legend must be included.

l. **Slide 13**: students will first acquire the precipitation data from their county by using the USDA Southwest Regional Climate Hub Precipitation map. Direct students to look at the data directions on page 2 of the handout and open the URL below. It may be helpful to display the map and provide a tutorial. http://spatial-web.nmsu.edu/flexviewers/PrecipitationByCounty/

m. **Slide 14**: direct students to locate and record precipitation data for their county in table 1 on page 3 of the handout.
    i. Use the zoom and pan buttons on the left to zoom in to your state.
    ii. Locate your county and click on it.
    iii. A data box with a scroll bar will appear. Verify that you have clicked on the correct county by reading the county name in the data box.
    iv. In table 1 on page 3 of the handout, record the following historic (1971-2000) mean precipitation data in mm: Annual Total, Winter Total, Spring Total, Summer Total, and Fall Total. These seasonal mean precipitation data were derived from PRISM data, up-scaled (or generalized) to the county level, and represent the average mean seasonal precipitation for the county.
    v. In addition to historic values, this map provides predicted average annual and seasonal precipitation amounts for the future, 2040-2069. These values were derived from the Multivariate Adaptive Constructed Analogs (MACA, http://maca.northwestknowledge.net/) statistically downscaled data. They are based upon the mean of the 20 Coupled Model Intercomparison Project (CMIP) 5 general circulation models. In addition to averaging over models, means were derived over seasons to obtain an estimated change in precipitation up-scaled to the county level for the 2040-2069 time frame. Data are intended to provide a general estimate of broad seasonal changes in average precipitation at the county scale.
    vi. Scroll down to the predicted data for your county. Also in table 1, record the following mean predicted future (2040-2069) precipitation data in mm: Annual Total, Winter Total, Spring Total, Summer Total, and Fall Total.
    vii. Students may notice that a delta value is also available in the data box. Delta (Δ) is a Greek letter used to denote a change in quantity in science and mathematics. In this case, the delta value is future precipitation minus historic precipitation, or the change in mean future precipitation and annual precipitation (mm).

n. **Slide 15**: students will then acquire the maximum temperature data from their county by using the USDA Southwest Regional Climate Hub Maximum Temperature map. Direct students to look at the data directions on page 2 of the handout and open the URL below. It may be helpful to display the map and provide a tutorial. http://spatial-web.nmsu.edu/flexviewers/MaxTempByCounty/

o. **Slide 16**: direct students to locate and record temperature data for their county in table 2 on page 3 of the handout.
    i. Use the zoom and pan buttons on the left to zoom in to your state.
    ii. Locate your county and click on it.
    iii. A data box with a scroll bar will appear. Verify that you have clicked on the correct county by reading the county name in the data box.
    iv. In table 2 on page 3 of the handout, record the following historic (1971-2000) mean maximum temperature data in °C: Annual Max, Winter Max, Spring Max, Summer Max, and Fall Max. These seasonal mean maximum temperature data were derived from PRISM data,

up-scaled (or generalized) to the county level, and represent the average mean seasonal maximum temperature for the county.

v. In addition to historic values, this map provides predicted average annual and seasonal temperatures for the future, 2040-2069. These values were derived from the Multivariate Adaptive Constructed Analogs (MACA, http://maca.northwestknowledge.net/) statistically downscaled data. They are based upon the mean of the 20 Coupled Model Intercomparison Project (CMIP) 5 general circulation models. In addition to averaging over models, means were derived over seasons to obtain an estimated change in temperature up-scaled to the county level for the 2040-2069 time frame. Data are intended to provide a general estimate of broad seasonal changes in average maximum temperature at the county scale.

vi. Scroll down to the predicted data for your county. Also in table 2, record the following mean predicted future (2040-2069) data in °C: Annual Max, Winter Max, Spring Max, Summer Max, and Fall Max.

vii. Because many students may be unaccustomed to thinking about temperature in Celsius, you may want to instruct students to convert temperatures to Fahrenheit for their own use. Students can convert temperatures manually or by using an online calculator such as: http://www.onlineconversion.com/temperature.htm

viii. Students may notice that a delta value is also available in the data box. Delta (Δ) is a Greek letter used to denote a change in quantity in science and mathematics. In this case, the delta value is future temperature minus historic temperature, or the change in mean future temperature and annual temperature (°C).

3. Direct students to divide into groups of 1 – 3 students.
4. Instruct students to examine the data to find one or two trends that interest them. You may want to provide an overview of the data, explaining trends and highlighting changes in the historic and predicted values. For example, in San Diego County, California, the historic mean annual precipitation total was 403.66 mm, and the predicted mean annual precipitation total is 400.11 mm. There is a predicted decrease in mean annual total precipitation of 3.55 mm, which is a relatively small amount. It is interesting to note the predicted seasonal changes, however. The historic mean spring precipitation total was 114.32 mm, and the predicted mean spring precipitation is 100.25 mm. There is a predicted decrease in mean spring precipitation of 14.07 mm. In this case, it would be useful to prompt students to think about the implications of a reduction in spring precipitation for humans and the ecosystem.
5. Tell students to complete the brainstorming notes section on page 2 of the handout. In this section, they will list the trend or trends that they might like to represent with their project and provide some possible ideas for a creative product.
   a. At this time, students may want to examine the available craft and recycled household supplies to help generate project ideas.
6. If you have the ability to purchase additional supplies for student projects, you may want to solicit the needs of students and create a list of supplies to obtain for them by tomorrow. You can also instruct students to bring in materials for their projects.

DAY 2 – PROJECT PREPARATION

1. Provide guidance while students are creating their projects. This may take several forms, and the level of support needed will vary by group. Students may need help with data interpretation, scaling data, project ideas, technical issues, and obtaining materials.
2. When approximately 30 minutes are remaining, ask students to fill out the Climate Data Jam Summary on page 4 of the handout. Explain that students will use this page to plan and prepare their presentation.

DAY 3 – PROJECT PREPARATION

1. Continue to provide guidance and support while students are creating their projects.
2. Remind students to review their Climate Data Jam Summary on page 4 of the handout and practice their presentations.

DAY 4 – PROJECT PRESENTATION

Additional preparation for today: make the necessary number of copies of the *Climate Data Jam Scoring Rubric*. For each group, you will need enough copies for each of the students who will not be presenting with that group. You may wish to make an additional copy for each group if you would like to participate in scoring.

1. Explain that students will be given five minutes to present their projects.
2. Tell students that they may use the Climate Data Jam Summary on page 4 of the handout to prompt them to include all of the necessary components.
3. Explain that students who are not presenting will be scoring the presentation.
4. Pass out the appropriate number of rubrics to each student. Review the rubric, explaining each section and how students can earn a high score.
5. Determine the order of group presentations by asking for

volunteers, drawing numbers from a hat, or assigning an order that is preferable to you.
6. Begin the first presentation. Set a timer or plan to watch the clock for five minutes.
7. Give the students who were scoring a moment to finish if needed.
8. Repeat with the remaining groups until all have presented.
9. Lead a discussion about the Climate Data Jam projects and what students learned. Solicit feedback for ideas about how this project could be extended further.

EXTENSIONS

1. Challenge students to showcase their Climate Data Jam project in a public setting.
2. Find additional climate data for your county, state, or region, and have students create another Data Jam project with the new data.

ADDITIONAL RESOURCES

1. Website that provides precipitation and temperature data over time by areas within states; could be useful for comparisons or extension activities:
   National Oceanic and Atmospheric Administration (NOAA), Climate at a Glance. Time Series. Accessed 16 Jul 2015. <http://www.ncdc.noaa.gov/cag/>.
2. Website with student-friendly information about evapotranspiration:
   North Carolina State University, Climate Education for K-12. Evapotranspiration. Modified 9 Aug 2013. Web. Accessed 11 Jun 2015. <https://www.nc-climate.ncsu.edu/edu/k12/.evapo>.
3. Report that summarizes research findings about evapotranspiration:
   Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013: Physical Science Basics. Section 2.5 Changes in Hydrologic Cycle, Subsection 2.5.3 Evapotranspiration Including Pan Evaporation, p. 205. Accessed Online. 10 Jun 2015. <http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter02_FINAL.pdf>.