

Using Online Data Sets to Teach K-12 Students and Teachers about Climate Change

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Outline

- Description of project
- Data-based Activities
- Inservice Teacher Use and Feedback
- Preservice Teacher Use and Feedback
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Description of Project

- NSF Nevada EPSCoR Climate Change Project Summer 2012 State and Community College Fellowship
 - My Fellowship research involved integrating climate data from the Nevada NSF EPSCoR data portal into curriculum materials on climate science and climate change.

Description of Project

- Nevada NSF EPSCoR data portal
 - Climate data collections sites
 - <http://sensor.nevada.edu/NCCP/Climate%20Monitoring/Locations.aspx>
 - Data Transects
 - <http://sensor.nevada.edu/NCCP/Climate%20Monitoring/Equipment.aspx>
 - Climate Data archive
 - <http://sensor.nevada.edu/Data%20Search/Silverlight%20Data%20Client.aspx>

Description of Project

- Three climate-science activities for middle school and high school students were created.
 - Work on the project involved collaboration with the EPSCoR Cyberinfrastructure component
 - Dr. Sergiu Dascalu, Associate Professor of Computer Science and Engineering, University of Nevada, Reno
 - Mike McMahon and Eric Fritzinger, software developers in the Cyberinfrastructure component.

Data-Based Activities

- A total of five activities were created on three different topics
 - Air temperature and relative humidity investigation
 - Discovering the relationship between air temperature and relative humidity at a single weather station.
 - Middle School and High School versions
 - Climograph Investigation
 - Reading and interpreting climographs based on Nevada transect data
 - Middle School and High School versions.

Data-Based Activities

– Transect Vegetation Zone Investigation

- the relationship between vegetation zones, temperature, and precipitation at seven Nevada Transect Stations.
- High School version
 - Most in-depth of all three investigations
 - 16 pages in length
 - Intended to be computer-based, with students viewing investigation instructions and other support information online.

Data-Based Activities

Dew Point and Relative Humidity Investigation



NEVADA CLIMATE CHANGE PORTAL

Air temperature and relative humidity investigation

Grade: 6th – 8th

Objective:

The purpose of this investigation is to understand the relationship between relative humidity and temperature for a Transect Data Site.

Materials:

Instructions (below)

Temperature and Relative Humidity graph for the Sheep Range Blackbrush Research Site
Access to the Nevada Climate Change Data Portal

Important Terms:

Relative Humidity

Temperature

Sheep Range

Blackbrush plant community zone

Driving Question:

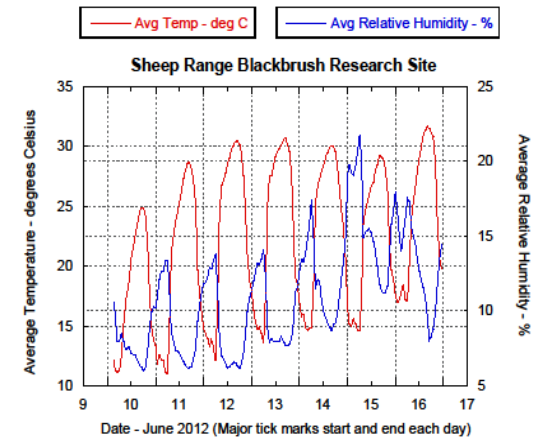
What is the relationship between relative humidity and temperature at a transect data site over a period of one week?

Investigation:

Use the graph of Relative Humidity and Temperature vs. Date for the Sheep Range Blackbrush Research Site to answer the following questions.

1. Which day had the highest temperature, what was that temperature and what time of day did that temperature occur?
2. Which day had the lowest relative humidity value, what was that value, and when did it occur?
3. What is the general relationship between temperature and relative humidity through this one-week period during June of 2012?
4. Why do you think that the relationship you described in your answer to question #5 exists?
5. How do you think that this graph would change for a wetter, higher-elevation location in the Sheep Range such as the Pinyon-Juniper, Montane, or Subalpine zones?

1. How do you think that a temperature-relative humidity vs. time graph would look for a dryer, lower-elevation location, such as desert shrub? Draw a simple sketch graph to go along with your description.



Data-Based Activities

Climograph Investigation



NEVADA CLIMATE CHANGE PORTAL

Climograph Investigation

Grade: 9th – 12th

Objective:

The purpose of this investigation is to be able to read and interpret a climograph.

Materials:

Climographs of each transect measurement station.

Important Terms:

Climograph

Diving question:

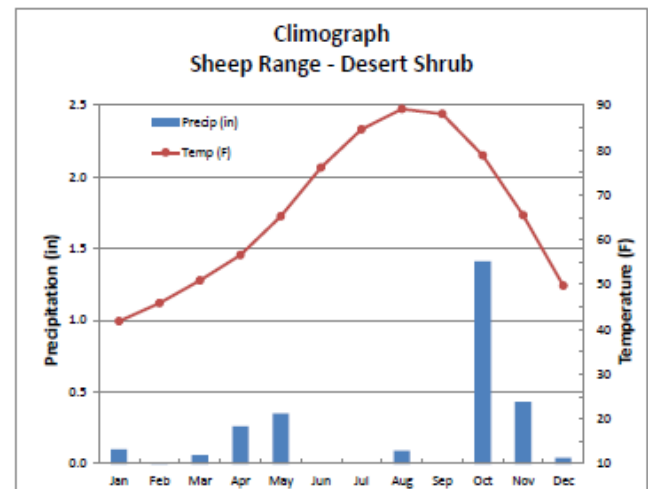
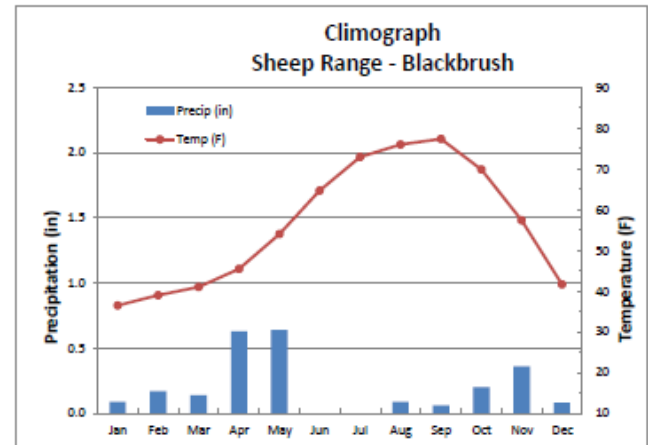
What essential information does a climograph display and how can this information be used to better understand climate?

Background Information

Data from the transect measurement stations has been collected since the spring of 2011. Climographs are usually made using data that has been collected over a long time period (usually 30 or more years). This discrepancy results in the climographs based on transect data exhibiting more variability than would be expected, especially in the precipitation curves. These graphs were made in 2012. As more years of data are gathered the extent to which these graphs represent climate will improve.

Investigation:

- 1) Examine the seven climographs. What information on the graph indicates that all of the stations are in the northern hemisphere? Explain.
- 2) Are there any trends to the temperature data? If so, describe the trends.
- 3) Are there any trends to the precipitation data? If so, describe the trends.
- 4) Examine a map of world climates. Use the maps' legend to give each of the transect measurement stations a three-letter climatic description.
- 5) Explain your choice of the three letters to describe the transect station's climate.



Data-Based Activities

Transect Vegetation Zone Investigation



NEVADA CLIMATE CHANGE PORTAL

Transect Vegetation Zone Investigation

Grade: 9th – 12th

Objective:

The purpose of this investigation is to closely examine seven vegetation zones on the Nevada data transects and successfully match images and graphs of temperature and precipitation to the transect sites.

Materials:

Table of the dominant plant species found at each of seven transect sites.

Images of each transect site

Temperature and precipitation vs. month graphs of each site.

Images of individual plants found at the transect sites.

Important Terms:

Dominant plant species

Sheep Range

Snake Range

Vegetation zone

Temperature and precipitation vs. month graphs

Diving question:

What plant species dominate many of the vegetation zones found at seven sites on two data transects in Nevada and what are the temperature and precipitation characteristics of each site?

Investigation:

Examine the images of seven transect data sites. Match the transect sites in the table below to the site images by number. Once you have matched the transect images to the sites listed in the table below, examine the temperature precipitation graphs match each graph to one of the sites on the table.

Use any resources available to you, including the internet, to find both more information and images for the dominant plant species for each zone. A set of labeled plant images is provided for reference. This information will help you match the images and graphs of each zone to the transect zones on the table below.

Transect Vegetation Zone Investigation

Table 1. Site descriptions of locations along the two NevCAN transects.

Transect	Zone	Dominant Plant Species	Altitude (m) (5120 ft.)	Site Image	Graph
Snake	Salt Desert	<i>Sarcobatus vermiculatus</i> , <i>Atriplex confertifolia</i>	1560 (5120 ft.)		
Snake	Sagebrush	<i>Artemisia tridentata tridentata</i> , <i>Sarcobatus vermiculatus</i>	1790 (5870 ft.)		
Snake	Pinyon- Juniper	<i>Pinus monophylla</i> , <i>Juniperus osteosperma</i>	2200 (7220 ft.)		
Snake	Subalpine	<i>Pinus longaeva</i> , <i>Pinus flexilis</i>	3355 (11,000 ft.)		
Sheep	Desert Shrub	<i>Larrea tridentata</i> , <i>Ambrosia dumosa</i>	900 (2950 ft.)		
Sheep	Blackbrush	<i>Yucca brevifolia</i> , <i>Atriplex canescens</i>	1670 (5480 ft.)		
Sheep	Montane	<i>Pinus ponderosa</i> , <i>Juniperus osteosperma</i>	2320 (7610 ft.)		



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Data-Based Activities

Transect Vegetation Zone Investigation

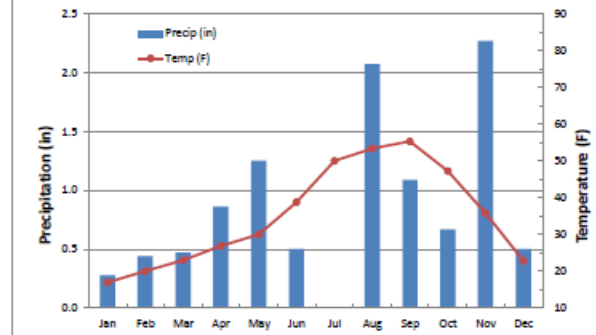
Site Image A



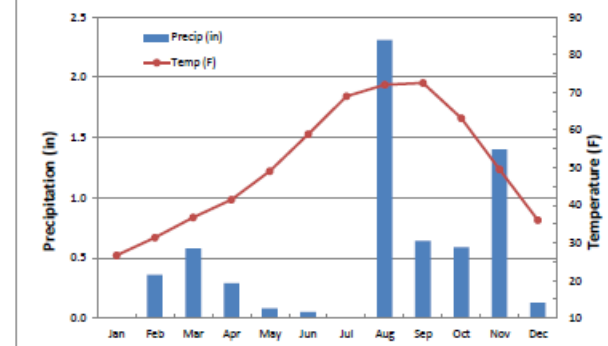
Site Image B



Climograph
Site 3



Climograph
Site 4



Data-Based Activities

Transect Vegetation Zone Investigation



White bursage (*Ambrosia dumosa*)



Four-wing saltbrush (*Atriplex canescens*)



Joshua Tree (*Yucca brevifolia*)



Ponderosa pine (*Pinus ponderosa*)

Inservice Teacher Feedback

Teachers in
the 2012
Summer
Institute
working
on the
Transect
Vegetation
Zone Activity



Inservice Teacher Feedback

1. Simplify wording so that the questions are more directly stated.
2. Add a vegetation identification key for the Transect Vegetation Zone Investigation.
3. Reduce the complexity of the graphs for students who lack graphing experience.

Inservice Teacher Feedback

4. Label the x-axis (date) more clearly on the Relative Humidity vs. Temperature graph.
5. Define the important terms.
6. Print one climograph on a page so that the graphs are easier to compare.
7. Include the appropriate Nevada State Science Teaching Standards for each investigation.

Inservice Teacher Feedback

- Inservice teacher comments centered on making the investigations more student-friendly.
- Inservice teachers saw the main classroom application for the investigations as tools for teaching about graphing.
 - Learning about climate science seen as a secondary benefit of using these materials.

Preservice Teacher Feedback

- Preservice elementary teachers enrolled in three science teaching methods classes at Nevada State College completed the Dew Point and Relative Humidity Investigation.
- Students provided feedback on use of the activity in teaching elementary school science.

Preservice Teacher Feedback

- 1. Change the wording of the questions to a more appropriate level for elementary students.
- 2. Use these investigations during a unit on weather
- 3. Use separate graphs of temperature, precipitation, and humidity.
- 4. Add additional resources for students to use while they work on the activity, especially web resources.



Preservice Teacher Feedback

- 5. Reduce the number of questions and amount of data on the graphs.
- 6. Use this lesson at the end of a unit on reading graphs.
- 7. Label the time axis with numbers to show the time of day.
- 8. The driving question should be changed to something more elementary-friendly like:
 - “How are relative temperature and relative humidity linked over a week’s time at one place?”

Preservice Teacher Feedback

- Preservice teacher comments were centered on making the investigations more student-friendly.
 - Repeating the most common type of comment from inservice teachers.
- Many preservice teachers suggested ways to simplify the middle-school focused activity.
 - Concern that students not be overwhelmed?

Future Work

- Additional modification of existing investigations.
 - Create multi-level investigations for elementary students.

Future Work

- Increase the time range of the Nevada data sets by integrating other existing data sets.
 - Western Regional Climate Center (WRCC)
 - <http://www.wrcc.dri.edu/>
 - NASA Global Change Master Directory
 - <http://gcmd.nasa.gov>
 - Climate Data Guide
 - <http://climatedataguide.ucar.edu>

Summary

- Investigations using online, local (Nevada) weather data were created.
 - Three topics covered at the high school and middle school levels.
- Online data source used to:
 - Increase relevance to students
 - Allow for flexibility in data access
 - Possible yearly revisions in data sets

Summary

- Feedback was obtained from both inservice secondary teachers and preservice elementary teachers.
 - The majority of comments from both groups made suggestions as to how to make the investigations more student-friendly.
 - Use of the investigations to teach graphing was emphasized by the secondary-level teachers.
 - None of the inservice teachers contacted during the school year had used the investigations to teach about climate science.
 - Preservice teacher comments were also oriented to making the investigations more flexible so that they would be accessible by students at many different stages of learning about graphing.

Summary

- To build on the information received so far about the investigations, elementary-level versions will be created
 - With the goal of having the investigations used in the classroom by elementary students.
- More robust versions of the climographs used in the investigations will be created by incorporating additional data.
 - The goal is to extend the climate data back at least 30 years.

Conclusions

- More data is needed to assess the effectiveness of the existing investigations in teaching about graphing and climate science.
 - Data from student use will be especially important
- Flexibility is especially important for classroom use
 - Multiple versions of the same material could meet this need.
- More complete data sets need to be used for representative climographs to be made.
 - Minimum of 30 years of data needed.

Acknowledgements

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Acknowledgements

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- I would also like to thank the staff of the Southern Nevada EPSCoR Summer Institutes who agreed to incorporate the climate change investigations into the already full summer institute schedules.

Discussion

- What are appropriate ways to integrate online sources of data into teaching science?
- What methods would be effective to promote the use of local data in teaching science?
- What are the essential elements of climate science and climate change science that should be taught K-12?