# Devils Postpile National Monument National Park Service

US. Department of the Interior



# Exploring Climate Science: A Snow Study 5<sup>th</sup> Grade Curriculum

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#### Rationale:

Water is essential for life on Earth. Relative water availability is a major factor in designating habitats for different living organisms. In the United States, things like agriculture and water rights are hot topics. Current models predict that average global temperatures are going to continue to rise even if regional climate changes remain complex and varied. These changes will have an impact on all of Earth's systems.

Studies have shown that climate change is driven not only by natural effects but also by human activities. Knowledge of the factors that affect climate, coupled with responsible management of natural resources, is required for sustaining these systems on Earth. Long-term change can be anticipated using science-based predictive models, making science and engineering essential to understanding global climate change and its possible impacts.

National Parks can serve as benchmarks for climate science trends and effects over time because they are protected areas void of human influence. Understanding current climate trends will set students up to be successful in interpreting and engaging in discussions about climate change, which will lead to informed decision making.

#### Next Gen Science Standards:

#### The 2 week unit builds toward standard:

**5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

#### Additional standards relevant to specific days of the unit are listed below.

SCIENCE AND ENGINEERING	DISCIPLINARY CORE IDEAS	CROSS-CUTTING CONCEPTS
8. Obtaining, evaluating, and	ESS3.C: Human Impacts on Earth	4. Systems and system models
communication information	Systems	
		Connections to nature of science
		Science Addresses Questions About the Natural
		and Material World

Unit Plan Outline & Standards	
Throughout the unit students will develop an understandi	ng of climate change, how scientists study climate
change, and what can be done locally to address climate o	change issues.
<ul> <li>Day 1: Climate Change</li> <li><b>Objectives:</b> <ol> <li>Students will be able to list three causes of climate change.</li> <li>Students will be able to describe at least two impacts to the environment caused by climate change.</li> </ol> </li> </ul>	Standard 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Day 2: Weather vs. Climate	Standard 5-ESS2-1. Develop a model using an example
Objective:	to describe ways the geosphere, biosphere,
1. Students will be able to compare and contrast weather and climate, providing at least three	hydrosphere, and/or atmosphere interact.
differences between the two.	Standard 5-ESS3-1. Obtain and combine information
	about ways individual communities use science ideas to
	protect the Earth's resources and environment.
Day 3: Snowpack and Snow Water Equivalent	Standard 5-ESS2-2. Describe and graph the amounts
Objectives:	and percentages of water and fresh water in various
<ol> <li>Students will be able to define the snow water equivalent (SWE)</li> </ol>	reservoirs to provide evidence about the distribution of water on Earth.
2. Students will be able to predict two affects	
warming climates could have on snowpack	Standard 5-ESS3-1. Obtain and combine information
	about ways individual communities use science ideas to
Day 4: Snow Water Equivalent Measurements	protect the Earth's resources and environment. Standard 5-ESS3-1. Obtain and combine information
Objectives:	about ways individual communities use science ideas to
1. Students will be able to collect snow water	protect the Earth's resources and environment.
equivalent measurements	
2. Students will be able to describe two ways that	
snow levels are important to the local	
community.	
Day 5: Watersheds	Standard 5-ESS2-2. Describe and graph the amounts
<b>Objectives:</b>	and percentages of water and fresh water in various
<ol> <li>State the watershed(s) in the area and explain why it is important.</li> </ol>	reservoirs to provide evidence about the distribution of water on Earth.
1. Show how the watershed connects their town	
to others in the area/region.	Standard 5-ESS3-1. Obtain and combine information
	about ways individual communities use science ideas to
	protect the Earth's resources and environment.
Day 6: Measuring Stream Flows	Standard 5-ESS2-2. Describe and graph the amounts
Objectives:	and percentages of water and fresh water in various
1. Students will be able to create a double line	reservoirs to provide evidence about the distribution of
graph to show the changes in stream flow	water on Earth.
throughout the year 2. Students will be able to make two predictions	Standard 5-ESS3-1. Obtain and combine information
about how climate change may affect stream	about ways individual communities use science ideas to
flows	protect the Earth's resources and environment.
Day 7: NPS Connections	Standard 5-ESS3-1. Obtain and combine information
Objective:	about ways individual communities use science ideas to
1. Students will be able to identify ways in which	protect the Earth's resources and environment.
National Parks are studying climate change.	

Day 8: Research Projects <b>Objective</b> :	Standard 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to
<ol> <li>Students will be able to create a hypothetical research proposal that examines the potential impacts of climate change on the local community</li> </ol>	protect the Earth's resources and environment.





Students will be able to:

- 1. List three causes of climate change.
- 2. Describe at least two impacts to the environment caused by climate change.

#### **Prerequisite Concepts and Skills:**

#### <u>Vocabulary</u>

Pollution, climate change, global warming, greenhouse effect (these words to be taught in context during the lesson)

#### Materials and Resources

Model of earth and sun (NPS provided) White strips of paper, 1 per student, (teacher created) 5 yellow strips of paper (teacher created)

Reading materials: (NPS provided master copies) http://www.timeforkids.com/news/going-extremes/41921 http://www.timeforkids.com/news/polar-bears-peril/86701 http://www.timeforkids.com/news/president%E2%80%99s-climate-plan/97006 http://www.epa.gov/climatestudents/basics/today/index.html http://www.epa.gov/climatestudents/impacts/effects/index.html Sufficient copies of reading materials for student work groups

Worksheet 1.1 (NPS provided master copy)

#### Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction:	1. Listen, participate, and discuss.	5 min
1. Explain to students that they will be		
spending the next two weeks learning		
about climate change and what		
scientists are doing to address climate		
change. Brainstorm – have students		
share what they already know about		
climate change.		

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Grade(s):\_\_\_\_\_

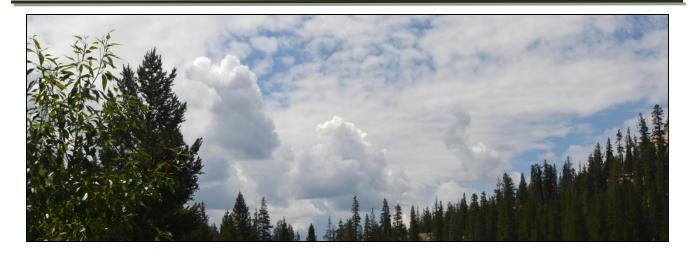
New Content:		
1. Pass out white strips of paper to	1. Students write one type of pollution on their strip	3 min
students. Ask students to write one	of paper. Use a student volunteer to collect the	
type of air pollution on their strip of	white strips and tape them together as students	
paper. Collect the strips and tape them	finish.	
together in a circle.	2. Three student volunteers, remaining students are	5 min
2. Have student volunteers hold up the	listening	
model of the earth and the sun. Use	3. Students read text with their partner, fill in	10 min
the yellow strips of paper to	worksheet 1.1, and plan what they will share with the	
demonstrate how the sun's rays reach	class.	
the earth and then bounce back away	4. Students present the most important facts from	10 min
from the earth. Have another	their articles to the class. Other students use the	
volunteer hold up the circle of	information presented to finish filling out worksheet	
"pollution" around earth. Again	1.1.	
demonstrate the yellow rays hitting the	5. Students share examples of when research or	2 min
earth, but then show how they are	learning has led students to take action in their	
trapped by the pollution, thus warming	personal life.	
the earth.		
3. Have students divide into pairs, read		
the text passages, and record their		
learning in worksheet 1.1.		
4. Have each pair summarize and share		
two to three facts they learned about		
climate change from their reading.		
5. Talk about how scientists respond to		
climate change by conducting scientific		
research (monitoring) and then taking		
action based on that research.		
Lessons will focus on this over the next		
two weeks.		
Wrap Up:	1. Discuss and share.	5 min
1. Ask students how they think climate	2. Quick write.	
change or global warming is impacting		
the local community.		
2. Exit ticket question: "How is climate		
change caused and what are some of		
its impacts?"		

# **Organizational and/or Behavioral Management Strategies:**

# Assessment and Evaluation:

### **Extensions:**

# Adaptations:



Students will be able to:

- 1. Compare and contrast weather and climate, providing at least three differences between the two.
- 2. Use an anemometer and thermometer to collect local weather data.

#### **Prerequisite Concepts and Skills:**

Vocabulary

Weather, climate, adaptation, habitat (these words to be taught in context during the lesson)

Prerequisite Concept Venn Diagram

#### Materials and Resources:

Video *Earth: Climate and Weather* <u>http://video.nationalgeographic.com/video/science/earth-sci/climateweather-sci/</u>

Worksheet 2.1 (NPS provided master copy) Anemometers and thermometers (NPS provided) Worksheet 2.2 (NPS provided master copy) Worksheet 2.3 (NPS provided master copy)

#### Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction: 1. Display video <i>Earth: Climate and</i> <i>Weather</i> . Have students fill out	<ol> <li>Watch the video. List similarities and differences between weather and climate using the Venn Diagram (worksheet 2.1).</li> </ol>	5 min
worksheet 2.1 while watching the video.		
New Content: 1. Take students outside to an open	1. Use wind meters and thermometers to make observations about the current weather.	5 min
area and demonstrate how to use the	2. Provide data collected from gauges.	5 min
anemometers and thermometers. Split	3. Participate in discussion.	8 min
students into small groups to take a reading recording their data on worksheet 2.2	4. Complete worksheet 2.3.	12 min

Date:
Grade(s):

2. Bring the group back together for a		
discussion about local weather.		
Emphasize how the weather today		
could look very different from the		
weather tomorrow.		
3. Discuss how the data they collected		
today was for the local weather.		
Climate would be the readings taken		
over a much longer period of time		
(decades etc). Facilitate brainstorm		
about how climate change can		
influence climate.		
4. Explain how climate is connected to		
ecosystems—a hot climate is a desert		
while a cold snowy climate would be		
the arctic. Animals and plants have		
specific climates that they live in.		
Facilitate worksheet 2.3 having		
students describe the climate in		
different pictures and match the		
animals to the ecosystem.		
Wrap-up:	1. Quick write.	5 min
1. Exit ticket question: Write at least		
three sentences about the day's		
weather versus the local climate.		
		l

# **Organizational and/or Behavioral Management Strategies:**

#### **Assessment and Evaluation:**

#### **Extensions:**

Continue to have students collect local weather data each day. Use this data in a variety of ways: use data to practice graphing skills, compare weather data to past weather data to evaluate changes in the climate, compare weather data to past weather data to come to a consensus about the local climate, etc.

#### Adaptations:

Date:	
Grade(s):	



The students will be able to:

- 3. Define the snow water equivalent (SWE).
- 4. Make two predictions about the affects warming climates could have on snowpack.

#### **Prerequisite Concepts and Skills:**

#### <u>Vocabulary</u>

Snow water equivalent (SWE), snowpack (pre-teach vocabulary words)

#### Materials and Resources

Worksheet 3.1 (NPS provided master copy)

Video CA Dept of Water Resources Snow Surveying [Note: wmv format] http://www.water.ca.gov/newsroom/video/education.cfm

#### Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction:	1. Participate in discussion.	5 min
1. Review climate. Discuss the local		
climate. What happens in the winter		
versus the summer time? Is there snow		
in the winter?		
New Content:	1. Students fill in worksheet 3.1 to practice with	12 min
1. Pre-teach vocabulary: snow water	vocabulary words.	
equivalent and snowpack.	2. Participate in lecture.	5 min
2. Lecture: Snow is an extremely	3. Watch video CA Dept of Water Resources Snow	
valuable resource because it stores	Surveying and participate in discussion.	
water in a frozen state (snowpack)		
releasing it slowly in the spring time.		
The release of this water allows us to		
capture more of it to use for drinking		
and irrigation. For many states, the key		

Grade(s):\_\_\_\_\_

<ul> <li>water reservoir is snowpack. The important thing to study with snowpack is the water content.</li> <li>Sometimes snow that falls can have very little water (light fluffy snow) and other times it can have a high water content (heavy thick snow). It is important to scientists to measure the amount of water in snow (snow water equivalent) because that's how we know how much water will be released in the springtime. If the snow water equivalent and snowpack is low, cities may have to enforce stricter water conservation regulations for that year. How do scientists measure snow water equivalent?</li> <li>3. Display CA Dept of Water Resources Snow Survey video and discuss what students learned from the video.</li> <li>Wrap-up:</li> <li>1. How can climate change influence snowpack? If more precipitation falls as rain instead of snow, what will happen to animals like the weasel that go through a morphological change in the winter to have a white coat instead of brown? Show students example summer and winter pelts of weasel.</li> <li>2. Exit ticket question: What is snow water equivalent? How can climate change affect snowpack?</li> </ul>	1. Participate in discussion. 2. Quick write.	5 min 5 min
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# **Organizational and/or Behavioral Management Strategies:**

**Assessment and Evaluation:** 

**Extensions:** 

Adaptations:

### **Teacher Reflections:**



Students will be able to:

- 1. Explain the process of setting up a snow course and collecting the snow water equivalent (SWE).
- 2. State at least two ways in which snow impacts their community.

#### Prerequisite Concepts and Skills:

#### <u>Vocabulary</u>

Density, depth, volume, snow water equivalent, snow pack, adaptation, camouflage (these words to be taught in context during the lesson)

#### Materials and Resources

**Option 1**: Schedule a field trip with Devils Postpile National Monument or your local NPS site to bring students on a snow science snowshoeing program. Visit <u>www.nps.gov</u> to find sites in your area.

**Option 2**: Take students out into the school yard or other natural area for a teacher led lesson on snow science following procedure 4.1. Visit <u>www.nps.gov/DEPO</u> for information on having the equipment mailed to you. **Option 3:** Schedule a ranger from Devils Postpile National Monument to come into your classroom to demonstrate snow science.

**Option 4**: Set up a virtual lesson with Devils Postpile National Monument or another NPS site to bring a lesson on snow science into the classroom. Contact Devils Postpile National Monument for further information. **Option 5:** Pull up snow course data from the Natural Resources Conservation Service website

http://www.wcc.nrcs.usda.gov/snowcourse/sc-data.html and have students practice doing the math to find the snow water equivalent.

Snowshoes (NPS provided for local schools only) Procedure 4.1 (NPS provided) Worksheet 4.1 (NPS provided master copy)

Date:	
Grade(s):	

Materials and Resources:

Option 2: Lesson Activities: 40 min

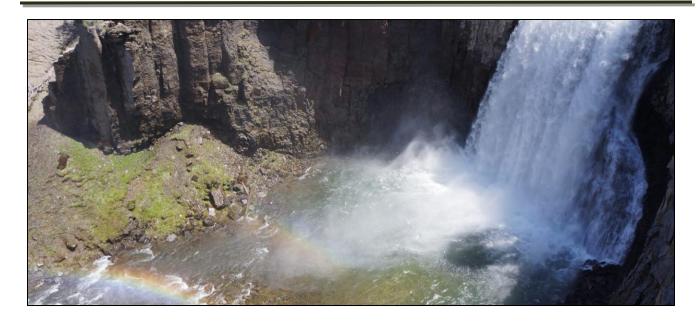
Teacher Activities	Student Activities	Time:
Introduction: 1. Review: In order for scientists and communities to make recommendations about how to help the environment, they must do the research and collect data. Today the students are going to be scientists helping to collect snow water equivalent data. The data that they collect will go to their local NPS site to provide additional information on the current state of the snowpack.	1. Listen.	3 min
New Content: 1. Using snowshoes or winter boots, take students out into an open area with a lot of snow. Use procedure 4.1.	<ol> <li>Observe and participate.</li> <li>Collect data.</li> </ol>	10 min 20 min *Allow additional time,
2. Set up a snow pit following procedure on 4.1 to collect the data and perform the calculations on	3. Participate & record ideas.	if available 2 min
worksheet 4.1. Assist students with collecting the data and doing the calculations.		
<ol><li>Brainstorm reasons why snow is so important to animals and humans.</li></ol>		
Wrap-Up: 1. Exit ticket question: Describe at least two reasons why snow is important to your town and two reasons why it's important to the region/state.	1. Quick write.	5 min

# **Organizational and/or Behavioral Management Strategies:**

# Assessment and Evaluation:

**Extensions:** 

# Adaptations:



Students will be able to:

- 2. State the watershed(s) in the area and explain why it is important.
- 3. Show how the watershed connects their town to others in the area/region.

#### **Prerequisite Concepts and Skills:**

**Vocabulary** 

Watershed, precipitation, stream flow (these words to be taught in context during the lesson)

#### Materials and Resources

Sandbox, pitcher of water, 1-2 large ice cubes (teacher provided) Procedure 5.1 (NPS provided)

Interactive online watershed map

http://www.arcgis.com/apps/OnePane/basicviewer/index.html?appid=387531ac0c094da5b6139b890958fca6

Worksheet 5.1 – Watershed map handout (NPS provided master copy) Colored pencils, crayons, or thin-tip markers for tracking watershed (teacher provided) Procedure 5.2 (NPS provided)

Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction:	1. Observe the demonstration and write at least	10 min
1. Demonstrate the power of water	three sentences to explain observations.	
using a sandbox, water, and ice cubes.		
See procedure 5.1.		
New Content:	1. Follow along.	10 min
1. The snow that accumulates up in the	2. Copy watershed map to individual worksheet.	10 min
mountains eventually melts and flows		
into the local watershed. Trace several		

Day 5: Watershed Earth Science		Date: Grade(s):	
local watersheds on interactive online map to show students where water ends up (see materials and resources section for the link). What would happen if the precipitation that normally falls as snow was rain instead? Snow is a natural water reservoir. As long as temperatures remain cold, the snow will stay and release slowly over time. The slow release does more for the steam flow and than a large runoff event happening all at once. 2. Trace watershed from Thousand Island Lake and Owens River using worksheet 5.1. Have students follow along marking on their own maps. See procedure 5.2 for a model of how students should mark the maps.			
Wrap-up: 1. Exit ticket question: Describe the ways in which snow can impact the	1. Quick write.		5 min

# **Organizational and/or Behavioral Management Strategies:**

# Assessment and Evaluation:

**Extensions:** 

watershed.

Adaptations:



The students will be able to:

- 1. Create a double line graph to show the changes in stream flow throughout the year.
- 2. Make two predictions about how climate change may affect stream flows.

#### **Prerequisite Concepts and Skills:**

<u>Vocabulary</u>

Stream flow, peak flow, water level (pre-teach vocabulary)

<u>Prerequisite Concepts</u> Line graph, double line graph, bar graph

#### Materials and Resources

Stream flow data from Pohono Bridge in Yosemite Valley from 1960-2013 (NPS provided) Worksheet 6.1 (NPS provided master copy) Hydrology podcast from CD (NPS provided) Procedure 6.1 (NPS provided)

Graphing paper (teacher provided) Markers (teacher provided)

#### Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction:	1. Complete worksheet 6.1 to practice using	5 min
1. Explain that scientists measure water flow to track climate changes	vocabulary words.	
just like they measure snow water		
equivalent. Pre-teach vocabulary:		
stream flow, peak flow, water level.		
Additionally review <b>double line graph</b>		
and <b>bar graph</b> if necessary.		
New content:	1. Write down two predictions of things that may	2 min
1. Have students make predictions	impact stream flows (more/less snow in the winter,	

Grade(s):\_\_\_\_\_

about what impacts stream flow.	more/less rain in the summer, the speed of snowmelt,	
2. Show hydrology podcast from CD so	etc.)	
students can observe how scientists	2. Students review vocabulary with worksheet 6.1.	3 min
measure stream flow.	3. Students create a double line graph along with	8 min
3. Explain to students that they will be	teacher on a blank piece of paper or in notes.	0 11111
graphing the stream flow from Pohono	Students circle and label the peak flow for both 2009	
Bridge in Yosemite Valley. Model	& 2010. Participate in a discussion about other	
creating a double line graph using data	questions or do a quick write about one of the	
from 2009 & 2010 (see procedure 6.1).	questions of do a quick write about one of the	
Then, facilitate a discussion of the	4. Students work independently or in pairs to	12 min
graph. When is peak flow? How are	complete their own double line graph. Record two	12 11111
water levels different for 2009 & 2010?	observations about the graph when finished.	
Why is the most water released in May	5. Listen.	2 min
and June?	6. Record predictions about how stream flow has	2 min
4. Have students create a double line	changed over time. Share thoughts.	2 11111
graph using data from 2011 & 2012,	7. Record and share observations about bar graph.	8 min
then record two things they notice		0 11111
about their graphs in relation to stream		
flow (on sticky notes or on the graph		
itself). Share observations.		
5. Talk about how stream flow can give		
us information about climate change.		
Measuring stream flow can give		
scientists a good idea of how much the		
snowpack is melting on a specific day		
or month. Due to climate change the		
peak stream flow could begin to occur		
sooner in the year. This could have the		
potential to throw many natural		
systems off and could negatively		
impact the water availability for human		
use.		
6. Tell students that scientists began		
measuring stream flows from this		
stream in 1960. Ask: how do you think		
stream flow has changed over time? If		
necessary direct student thinkingpeak		
stream flow might occur earlier		
because snow melts earlier due to		
warmer temperatures, etc.		
7. Show students the graph of decade		
averages from 1960 – 2010 (procedure		
6.1). Talk about what the graph shows.		
Emphasize the importance of		
continuing to record information so		
scientists can see changes over time.		
Wrap-up:	1. Quick write.	3 min
1. Exit ticket question: Why is		
monitoring stream flow important?		
Think about what stream flow might		
tell us about peak flows, water levels,		
climate change, etc.		

Date:\_\_\_\_\_ Grade(s):\_\_\_\_\_

# **Organizational and/or Behavioral Management Strategies:**

Assessment and Evaluation:

**Extensions**:

Adaptations:



Prerequisite Concepts and Skills: Vocabulary

Dependent on NPS topics discussed

<u>Prerequisite Concepts</u> National Park Service background information

#### Materials and Resources

Procedure 7.1 on setting up Skype/Facetime/Google+ Hangout with a webcam (NPS provided) Pencil and notebook paper for taking notes (teacher provided)

#### Lesson Activities: 40 min

Teacher Activities	Student Activities	Time:
Introduction:	1. Listen.	5 min
1. Provide students with some		
background information on National		
Parks (what they are, where they are,		
their mission)		
New Content:	1. Participate in discussion.	5 min
1. Review the process that NPS sites go	2. Watch presentation and ask questions of NPS staff.	25 min
through to take action on climate		
change: they must monitor and collect		
data to see what's happening and then		
decide on proactive steps that they can		
take to help reverse it.		
2. Virtual visit (see procedure 7.1 about		
setting up a visit; if a visit isn't possible		
see extension activities section).		
Wrap-up:	1. Quick write.	5 min

Date:	
Grade(s):	

1. Exit ticket question: Write at least	
three sentences about how National	
Parks are studying climate change.	

### **Organizational and/or Behavioral Management Strategies:**

### **Assessment and Evaluation:**

#### **Extensions:**

If you aren't able to schedule a virtual field trip, play students an NPS podcast or video on climate change instead.

#### Watch a presentation from a National Park to show students how NPS sites are studying climate change:

Podcast- Devil's Postpile National Monument: Cold Air Pooling http://www.nps.gov/depo/photosmultimedia/videos.htm Video- Rocky Mountain National Park: Pika research http://news.nationalgeographic.com/news/2009/09/090904-pika-in-peril-missions-video-wc.html Video – Great Smokey Mountains National Park: Phenology and Citizen Science http://nature.nps.gov/multimedia/CCRP\_Phenology1/index.cfm

#### Adaptations:



Students will be able to:

1. Create a hypothetical research proposal that examines the potential impacts of climate change on the local community.

#### **Prerequisite Concepts and Skills:**

Apply knowledge learned throughout the two-week unit plan.

#### Materials and Resources

Fake money (NPS provided template)

Worksheet 8.1 - Copy of rubric for each student (NPS provided master copy)

Worksheet 8.2 – Copy of the model grant proposal (NPS provided master copy)

Worksheet 8.3 – Copy of the grant proposal worksheet or lined paper if preferred (NPS provided master copy)

Procedure 8.1 – Website list to share with students who need to complete additional research (NPS provided)

Lesson Activities: 45 min \*Depending on how deeply you would like to explore the activities of the lesson, this lesson could take anywhere between one and three 40 minute lessons. For example on day one, you could explain the project and students could begin work. On day two, students could continue preparing their work and then begin working on their presentations, and on day three students could finish their presentations and share with the class. Conversely, you could do a quick introduction, give students 30 minutes to prepare their grant proposals and then have a quick whip around, share-out, thereby concluding the lesson in a day. The times below are based on one 45 minute lesson.

Teacher Activities	Student Activities	Time:
Introduction:	1. Listen.	2 minutes
1. Explain to students that they will be		
thinking like a climate scientist today		
and using what they have learned the		
past two weeks to create their own		
climate monitoring project. Explain		
that in the real world it costs money to		
conduct research. To get money,		
scientists apply for grants. Grants are		

Date:	
Grade(s):	

free money that organizations give to scientists to study and protect the planet. Place fake money on table. There is only enough grant money for two groups to do their project. The two best grant proposals will be awarded the funding and will be able to make a difference in the world. New Content: 1. Pass out worksheets 8.1, 8.2, and 8.3. Read through the papers explaining sections if necessary. Be sure to discuss rubric. Explain that grant proposals will be scored using the rubric. Have students score worksheet 8.2 (the model) and discuss the scores given. 2. Ask: what could you research? Brainstorm research ideas as a class. 3. Student work time (Students can work in groups, pairs, or individually according to teacher preference). It may be helpful to have computer time available in case students need more background knowledge about a topic.	<ol> <li>Read through the worksheets. Discuss and listen. Use rubric to score worksheet 8.2.</li> <li>Participate in brainstorm of research ideas.</li> <li>Students work on grant proposals (worksheet 6.3) and conduct research. Time permitting, they should self-score their final project before turning it in.</li> </ol>	5 min 3 min 30 min
See procedure 6.1 for website ideas. Wrap Up: 1. Have students share their ideas.	1. Students not presenting should listen. You could have students vote on the grant proposal that they	5 min
Depending on time, some options include: -Doing a quick discussion -Putting proposals on tables and doing a gallery walk of proposals	think should receive the grant funding.	
-Student presentations to the class -Creating a poster for a mini science fair, etc.		

# **Organizational and/or Behavioral Management Strategies:**

# Assessment and Evaluation:

# **Extensions:**

# Adaptations:

Date:	
Grade(s):	

# TEACHER RESOURCES

1

# **PRE/POST SITE EVALUATION**

- 1. Climate change is
  - a. an increase in the average global temperature.
  - b. a myth.
  - c. caused by a decrease in the concentration of greenhouse gasses.
  - d. irreversible.
- 2. Causes of climate change include
  - a. Air pollution.
  - b. A shift in the rotation of the sun.
  - c. Burning of fossil fuels.
  - d. Both a and c
- 3. Weather is \_\_\_\_\_\_
- 4. Climate is \_\_\_\_\_\_

5. How can climate change influence climate?

- 6. Animals and plants have unique \_\_\_\_\_ to live in their environment.
  - a. Features
  - b. Personalities
  - c. Adaptations
  - d. Strategies
- 7. In California, most fresh water available during the summer months comes from
  - a. monsoonal rain storms.
  - b. snowmelt in the Sierra Nevada mountain range.
  - c. the Colorado River.
  - d. Groundwater.
- 8. The amount of water stored in snow is called
  - a. snowpack.
  - b. the summer water reserve.
  - c. Sierra cement.
  - d. snow-water equivalent.
- 9. The snow water equivalent (SWE) is
  - a. Mass/volume
  - b. Depth x Density/density of water
  - c. Depth/Density
  - d. Density of water

- 10. Stream flow measures
  - a. the volume of water that passes a given point in one second.
  - b. how many species of fish can be found in a given area of a stream.
  - c. the amount of trash that flows into the watershed.
  - d. how fast water is moving at a given point in a stream.
- 11. What is peak flow and how is it measured?
- 12. Snow that falls at Thousand Island Lake will flow into the
  - a. Owens Watershed.
  - b. Merced Watershed.
  - c. San Joaquin Watershed.
  - d. LA aqueduct.
- 13. One possible effect of climate change on animals is
  - a. Loss of habitat
  - b. An increase in food
  - c. Extended lifespan
  - d. Easier migration.

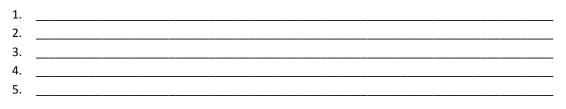
14. National Parks belong to

- a. Everyone
- b. Park rangers
- c. The government
- d. No one
- 15. Why is it important for scientists who study climate change to collect data?

#### **Climate Change Note-Taking Guide**

As you read your article record any important facts in the appropriate section. You will share the most important facts that you have learned with the class and record additional notes from your classmates presentations.

List some causes of global warming. Be specific!



What are some effects or consequences of global warming?

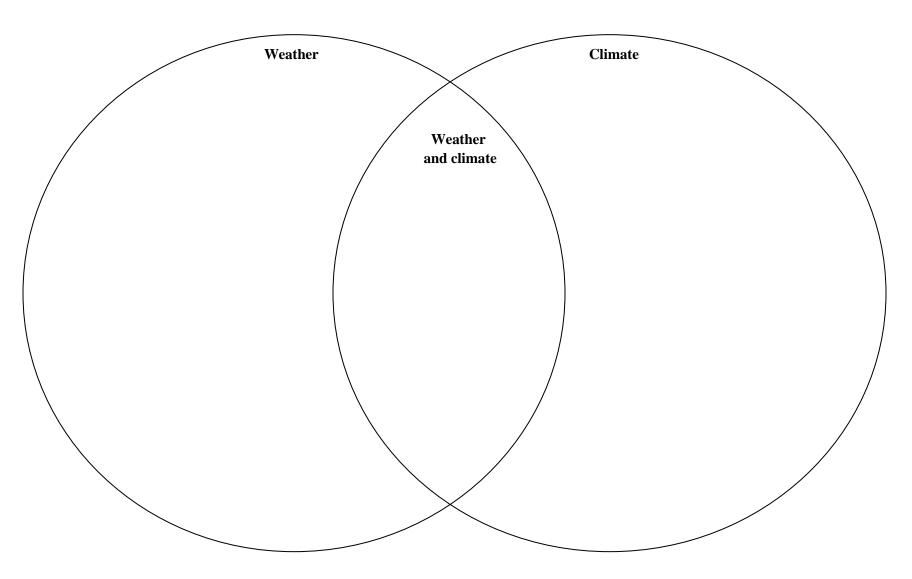
1.	
2.	
3.	
4.	
5.	
-	

What are some actions that have been proposed to address global warming?

1.	
2.	
3.	
4.	
5.	

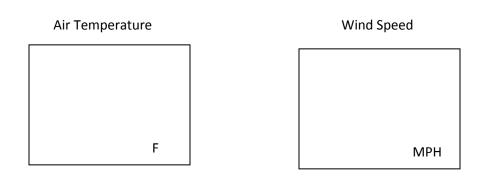
What specifically do you plan to share with the class?

Name\_\_\_\_\_ Date\_\_\_\_\_



Earth Science Worksheet 2.2–Weather and Climate Name\_\_\_\_\_ Date\_\_\_\_\_

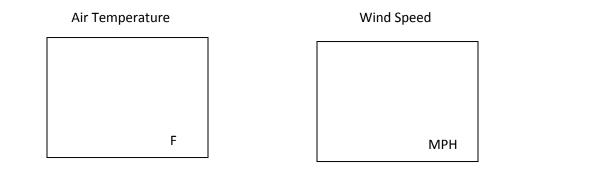
Date:\_\_\_\_\_



Earth Science Worksheet 2.1 – Weather and Climate



Date:\_\_\_\_\_



Earth Science Worksheet 2.1 – Weather and Climate Name\_\_\_\_\_ Date\_\_\_\_\_

Date:\_\_\_\_\_

Air Temperature Wind Speed F MPH

Name\_\_\_\_\_ Date\_\_\_\_\_



This climate is	
This climate is	

This climate is

This climate is









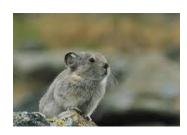
Thi	s clin	nate	is	













Earth Science Worksheet 3.1—Vocabulary Name: \_\_\_\_\_Date: \_\_\_\_\_

-

Date:

Word	Definition	Sentence	Picture
	Define the word	Use the word in a sentence	Draw a picture to help you remember the word
Snow water equivalent (SWE)			
Snowpack			

This lesson was created in partnership with the Teacher-Ranger-Teacher program through the National Park Service.

Name:

. . . . . . . . . .

Earth Science Worksheet 3.1 Vocabulary

 
 Word
 Definition Define the word
 Sentence Use the word in a sentence
 Picture Draw a picture to help you remember the word

 Snow water equivalent (SWE)
 Since
 Draw a picture to help you

 Snowpack
 Image: Since
 Image: Since

# **SNOW PIT PROCEDURE**

- 1. Pick an area that is on the uphill slope and away from any obstructions.
- 2. Record air temperature and wind speed.
- 3. Stick avalanche probe in the snow until you hit the ground and record the depth in cm.
- 4. Draw a line in the snow at least 2 people wide. Starting at the line, dig all the way down to the ground (or a good amount to have a section of snow exposed), and continue digging back for at least 2-3 feet.
- 5. When the snow pit is complete, use a shovel and then paint brushes to get the wall of the snow pit as smooth and straight as possible.
- 6. Determine the weight of a sample of snow. Take the collection cup and fill it with snow. Do not pack down the snow in the cup, just fill it up, shake it until the snow is level with the cup and then transfer it to the plastic baggie. Attach the bag to the field scale to weigh it. *Be sure to subtract the weight of the bag before you use the weight of the snow to calculate the snow water equivalent (SWE).*

### **Calculating (SWE)**

Use the field scale to measure the weight of the baggie used to weight the snow sample, 2.5 grams, for example. Take the weight of the snow and the baggie and subtract the weight of the baggie. So if the total for both was 21 grams.

21 g – 2.5 g = 18.5 grams

We need to find the density:

$$Density = \frac{Mass(g)}{Volume(cm^3)}$$

The volume is the same for each sample and is the volume in cubic centimeters of the sampling container (2 oz). That amount is 59 mL (remember 1 milliliter = 1 cubic centimeter). The volume amount under the mass is going to be 59 cm<sup>3</sup> for each density equation.

Earth Science Procedure 4.1—Snow Pit

$$r = \frac{18.5 \text{ g}}{59 \text{ cm}^3} = 0.31 \text{ g/cm}^3$$

Then use the following equation to find the SWE

SWE = 
$$\frac{\text{depth}(\text{cm}) \times \text{density}(\text{g/cm}^3)}{\text{density of water} = 1 \text{ g/cm}^3}$$

The density of water is 1, but it is important in the equation because we want to get the amount of water in each sample in a measure of centimeters.

Example:

$$SWE = \frac{5 \text{cm} \times 0.31 \text{ g/cm}^3}{1 \text{ g/cm}^3} =$$

$$\frac{5\text{cm}}{1} \times \frac{0.31\text{g}}{\text{cm}^3} = 1.55 \text{ g/cm}^2 \div 1 \text{ g/cm}^3 =$$

 $\frac{1.55 \text{ g/cm}^2}{1 \text{ g/cm}^3} = 1.55 \text{ cm of water}$ 

#### Snow Pit Site Description:

Air Temperature °F:	Wind Speed MPH:	Snow Depth (cm):
(A)Weight of baggie (grams):	(B) Weight of snow and baggie (grams):	Weight of snow (grams) (B)-(A)=

SWE Calculations:

 $Density = \frac{Mass(g)}{Volume(cm^3)}$ 

SWE =  $\frac{\text{depth}(\text{cm}) \times \text{density}(\text{g/cm}^3)}{\text{density of water} = 1 \text{ g/cm}^3}$ 

# THE POWER OF WATER PROCEDURE

# **Materials**

- □ Large shallow tray or plastic bin
- □ Sand
- Narrow neck bottle
- Wide neck bottle

# Procedure

Build a mountain (mound of sand) or have a student volunteer come up and create it.

Have another volunteer come up and use the narrow neck bottle to slowly pour water onto the mound. *This is what the stream is like during the lake summer and fall when most of the snow has melted up in the mountains.* 

Another volunteer can come up a rebuild the mound of sand. An additional student should then come up and use the wide neck bottle to slowly pour water onto the mound. *This is an example of what it looks like in the spring and early summer when all of the snow is melting.* 

This is what hydrologists (people who study water) call the stream flow. How slow or quickly snow up in the mountains melts affects how much water will flow.

# WATERSHED ACTIVITY PROCEDURE

## **Background Information**

The areas in and around Mammoth Lakes have a unique hydrologic story. Due to the topography of the Eastern Sierra Mountains, water either ends up traveling west towards the San Francisco Bay or east to Los Angeles. The hydrologic divide, which can be seen at the Minaret Vista, is the imaginary line that separates the two flows. Water that falls in the town of Mammoth Lakes goes east while water that falls in Devils Postpile National Monument heads west.

The middle fork of the San Joaquin River (SJR) starts at Thousand Island Lake and continues south where it passes through Devils Postpile National Monument. Later the middle fork converges with the north and south forks continuing roughly northwest to the Central Valley. Most of the surface water in the upper (SJR) is stored and diverted at Millerton Lakes' Friant Dam, near Fresno. From Friant Dam, water is pumped north through the Madera Canal and south through the Friant-Kern canal to irrigation districts and other water retailers, which then delivers the water to end users in the southern portion of the watershed. Water flowing in the (SJR) rarely ends up all the way to the San Francisco Bay because there is such a need in the Central Valley, specifically for crop irrigation. The 400-mile-long Central Valley supplies fully one-quarter of the food that America eats.

Water that falls into the Owens River draining into Crowley Lake flows through Owens Valley, the arid basin between the eastern slope of the Sierra Nevada and the Inyo and White Mountains. The Owens Valley watershed consists of several sub-watersheds (Mono Basin, Upper Owens, Owens Gorge, Middle Owens, Lower Owens, and Owens Lake). The river, until recently, terminated at Owens Lake due to the diversion of the LA aqueduct to Los Angeles to help provide essential drinking water to southern California residences. The first LA aqueduct was completed in 1913 and the second in 1970. In winter 2006, the Los Angeles Department of Water and Power restored 5% of the pre-aqueduct flow to the river, by court order, allowing the Owens River Gorge, the river bed in the valley, and Owens Lake to contain a small amount of water.

Both watersheds are essential not only to the residences of Mammoth Lakes or to California as a whole, but to the entire United States because of its agricultural purpose. Both watersheds are also examples of things that can go wrong when all or most of the water is depleted. Devastation especially to fish and amphibian populations are two of the many side effects that can be observed from water diversion. Wetlands provide many natural services from a rest spot for migratory birds to acting as a sponge, cleaning river water as it flows by. Humans should strive to find a balance between meeting the needs of the people and of the habitat so that neither one suffers. Earth Science Procedure 5.2—Watershed Activity

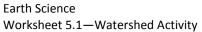
### Procedure

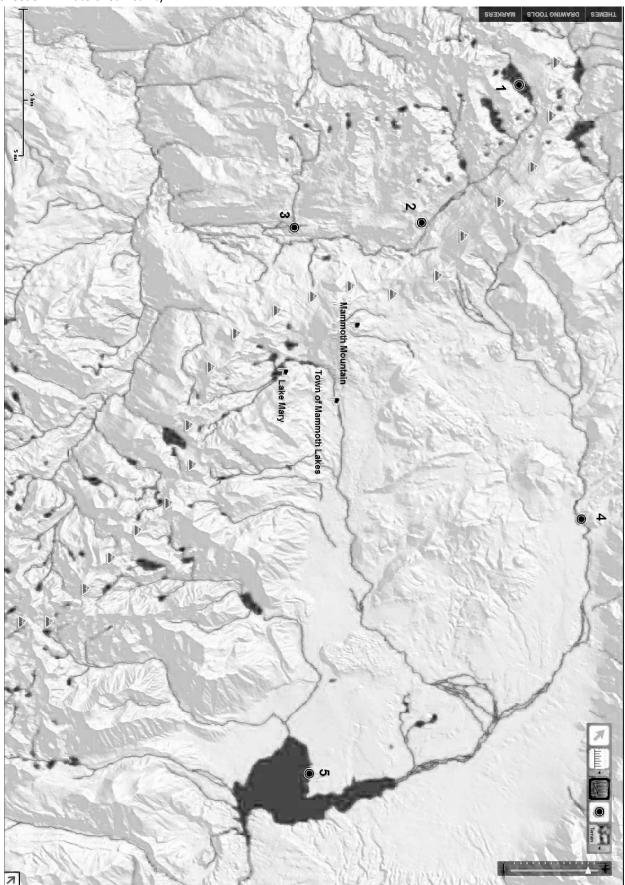
Have students follow along with you as you label all of the points. Spend some time on each one giving them some background information. By connecting the pictures of mountains together, they create the hydrologic divide. Have them highlight this line using a marker or highlighter.

Point Labels:

- 1. Thousand Island Lake
- 2. Devils Postpile National Monument
- 3. Middle Fork of the San Joaquin River
- 4. Owens River
- 5. Crowley Lake

After labeling all points and tracing the hydrologic divide, students will be able to see the two watersheds in this area and understand where each one flows to.

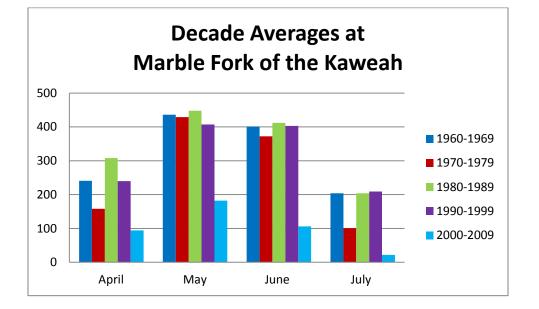




Earth Science Procedure 6.1—Sequoia-Kings Canyon Stream Flow Data

Decade averages of stream from 1960-2009 from April-July at Marble Fork of the Kaweah

	1960- 1969	1970- 1979	1980- 1989	1990- 1999	2000- 2009
April	241	158	308	240	94
May	436	429	448	407	182
June	401	372	412	403	106
July	204	101	204	209	22



	2002	2003	
January	53	45	
February	45	47	600
March	90	133	500
April	267	195	400
May	342	539	300
June	243	414	
July	32	60	200
August	18	20	
September	15	12	
October	14	12	January ebruary March April May June June June June Cember cember cember
November	236	12	January February March April April June June September October November December
December	22	12	De No Sep

Earth Science Procedure 6.1—Sequoia-Kings Canyon Stream Flow Data

# Average monthly stream flow from 1960-2012 for the Marble Fork of the Kaweah River

for the Marble Fork of the Kawean Kiver									
	-		961	1962	1963	1964	1965	1966	1967
January		2	0.4	3	135	1	157	27	139
February		27	1	117	383	1	81	25	140
March		61	13	49	90	24	76	81	227
April		183	88	422	212	130	205	220	250
May		236	120	368	528	270	359	265	774
June		116	64	447	517	196	456	102	885
July		2	1	109	232	14	218	24	740
August		1	5	2	22	3	50	20	203
September		2	4	2	2	9	10	12	61
October		1	1	3	2	11	10	11	10
November		2	1	1	29	19	51	46	17
December		2	1	3	2	184	29	732	18
1968	1969	1970	)	1971	1972	1973	1974	1975	1976
25	462	168	3	40	18	20	98	18	15
48	274	63	3	33	19	59	42	30	17
69	294	103	3	72	83	94	181	71	33
156	546	152	L	131	92	245	257	80	64
259	1178	450	)	243	157	858	567	545	171
141	1087	269	)	302	77	715	516	550	27
25	672	48	3	66	16	161	101	96	18
21	183	17	7	18	11	23	23	17	17
12	22	12	2	12	15	13	14	11	45
27	21	11	L	13	18	12	14	30	13
15	14	30	)	15	12	31	18	12	12
23	27	25	5	20	18	25	15	16	10
1977	1978	1979	Ð	1980	1981	1982	1983	1984	1985
14	80	4(	)	528	17	74	202	107	30
17	158	53	3	430	33	131	316	98	41
22	272	32	L	292	53	169	413	151	69
68	283	212	L	465	209	630	284	209	323
79	665	555	5	513	297	675	811	537	395
98	869	299	)	765	176	558	1271	226	232
17	426	56	5	501	17	336	786	99	24
17	94	17	7	101	16	79	354	22	14
9	123	12	2	7	11	157	73	10	9
12	12	29	)	13	12	125	19	15	11
11	11	12	2	12	38	145	137	51	25
72	12	17	7	16	32	215	192	20	88

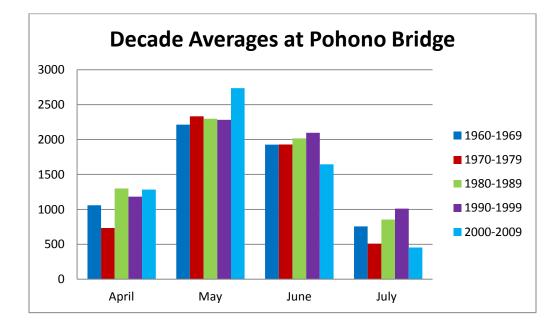
Earth Science Procedure 6.1—Sequoia-Kings Canyon Stream Flow Data

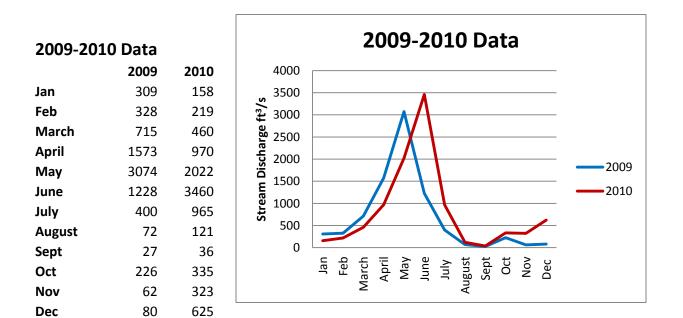
1986	1987	1988	1989	1990	1991	1992	1993	1994
81	16	39	18	17	17	17	87	17
489	31	24	24	19	17	27	59	25
504	42	62	110	55	180	34	189	67
391	195	115	255	123	198	170	278	147
645	210	193	206	140	341	160	581	267
610	84	93	107	76	402	36	504	160
228	16	17	16	17	106	19	198	18
42	16	22	17	14	26	17	40	15
13	13	13	26	9	15	10	12	11
18	12	10	16	10	18	27	11	13
13	13	15	13	11	16	15	11	14
13	22	15	12	12	13	12	11	47
1995	1996	1997	1998	1999	2000	2001	2002	2003
99	44	743	58	21	27	16	53	45
93	268	267	167	64	73	21	45	47
301	211	267	199	94	149	112	90	133
291	367	327	334	164	269	212	267	195
545	625	580	477	354	499	439	342	539
883	449	357	978	181	256	93	243	414
676	113	132	783	30	29	23	32	60
157	21	36	154	13	17	16	18	20
23	12	15	52	11	20	12	15	12
11	12	13	12	13	31	12	14	12
11	107	17	16	13	12	40	236	12
30	187	26	17	12	12	55	22	12
	207							
2004	2005	2006	2007	2008	2009	2010	2011	2012
25	27	0	16	0	19	19	0	24
18	0	0	17	0	0	24	0	17
0	0	0	27	0	0	0	0	28
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
31	0	0	23	0	0	0	0	26
16	0	0	17	23	24	0	0	19
14	17	17	14	19	19	18	0	22
12	12	23	13	14	14	22	0	13
12	13	12	15	17	15	0	37	no data
12	12	12	14	13	17	0	0	no data
12	15	13	22	14	16	0	34	no data
	-	-			-	-	-	

Note: Data ends after september 2012

rusen	inte.				
	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009
April	1058.1	734.1	1299.2	1183	1283.1
May	2212.7	2332.3	2298.5	2281.6	2736.2
June	1926.3	1928.2	2015.3	2096.1	1644.6
July	756.7	508.2	854.4	1010.4	453.4







Earth Science Procedure 6.2—Yosemite Stream Flow Data

# Average monthly stream flow from 1960-2013

at Pohono Bridge in Yosemite								
	1960	1961	1962	1963	1964	1965	1966	1967
Jan	26	42	67	127	98	556	150	231
Feb	107	114	249	1001	114	427	144	232
March	359	183	229	345	174	474	462	631
April	1137	786	1826	575	679	1030	1568	488
May	1449	1003	2015	2519	1442	2410	1888	2807
June	788	631	2355	2478	984	2553	564	4239
July	147	115	661	898	218	1140	153	2533
August	40	67	125	185	63	409	80	518
Sept	19	26	39	68	23	91	22	156
Oct	19	20	53	47	17	41	17	58
Nov	43	25	32	238	114	211	95	44
Dec	69	62	36	157	1348	166	493	76
1968	1969	1970	1971	1972	1973	1974	1975	1976
96	493	580	257	140	189	411	106	57
268	338	380	309	161	203	267	152	79
325	409	528	379	715	240	535	290	196
868	1624	805	860	744	1001	966	361	385
1289	5305	2224	1771	1762	3711	3229	2799	911
619	4052	1501	2035	1209	2256	2330	3389	240
115	1587	395	570	196	398	535	712	93
44	316	80	117	49	187	195	127	55
18	83	29	40	158	34	42	67	86
25	127	18	25	69	44	31	211	40
214	122	103	87	104	508	42	184	21
135	212	212	127	193	304	69	94	15
1977	1978	1979	1980	1981	1982	1983	1984	1985
17	222	303	967	53	327	358	522	136
28	244	215	666	175	934	411	412	168
52	603	457	527	212	647	625	697	260
343	928	948	1411	1009	2136	595	1207	1394
379	3196	3341	2644	1668	3858	3223	2939	1747
537	4039	1746	3012	841	3031	6308	1518	687
69	1724	390	1549	148	1476	3460	595	161
15	396	94	288	39	427	1045	170	59
7	426	36	79	21	358	322	83	57
6	64	78	43	52	436	204	82	114
16	52	107	42	327	418	573	182	97
132	85	117	57	304	379	672	152	211

1986	1987	1988	1989	1990	1991	1992	1993	1994
316	28	171	89	74	18	73	240	37
1035	72	239	150	105	21	172	232	61
1459	163	474	691	409	225	290	723	274
1724	1012	881	1623	1103	626	1185	1405	787
3129	1127	1115	1535	901	1690	1165	3713	1188
2743	430	640	943	558	1674	386	2932	554
682	94	189	190	239	370	316	1109	97
185	36	63	56	44	52	51	220	26
65	23	33	69	20	27	30	66	12
53	49	14	103	18	26	19	33	87
30	171	31	86	19	98	66	27	197
26	116	59	83	17	58	70	35	179
1995	1996	1997	1998	1999	2000	2001	2002	2003
379	225	2461	175	174	90	45	228	264
445	775	557	284	310	217	85	237	277
1017	760	936	615	378	420	526	380	508
1439	1706	1637	1023	919	1497	1033	1639	866
3067	3126	2922	2096	2948	2997	2348	2091	2724
4822	1897	1511	4699	1928	1874	431	1243	2209
3398	636	426	3110	403	325	130	205	361
783	156	137	531	95	31	36	40	121
203	49	54	234	46	44	20	22	46
57	32	29	76	25	29	14	16	20
35	356	32	99	31	45	90	246	27
152	514	65	156	26	43	185	112	137
2004	2005	2006	2007	2008	2009	2010	2011	2012
175	315	557	75	73	309	158	515	81
195	364	506	145	147	328	219	461	109
1035	636	578	529	444	715	460	658	275
1549	1163	1456	891	1164	1573	970	1702	1332
1621	4411	4771	1103	2222	3074	2022	2983	1396
785	3467	3682	300	1227	1228	3460	4433	344
186	1463	1113	81	270	400	965	2231	94
45	232	180	29	40	72	121	473	64
19	59	62	24	15	27	36	153	22
76	39	40	17	15	226	335	184	16
168	48	44	17	198	62	323	69	43
142	408	56	22	77	80	625	41	300

# VIRTUAL FIELD TRIP PROCEDURE

- □ Contact park at least 2 month prior to your program.
- Discuss topic and desired content with park staff.
- □ Make sure that either Google Plus or Skype are set up on your computer.
- Double check contact information for park's account and that both parties have added each other prior to the session.

### **Google Plus**

**Open Google email:** make sure that you have sent an email back and forth with the teacher. Go to the "search people" box right above your contacts and search for the name of the teacher. Once found, move your mouse over the name and select the option to "show in chat list." You will then have to click on "invite to chat" in the same window. The teacher on the other end has to accept your chat invitation before you can video call them. They will get an announcement right above their contact list saying "\_\_\_\_\_ wants to be able to chat with you. Okay? Yes/no."

**Place call to audience:** click on the name of the user in your contact list and a small chat window will pop up at the bottom of your screen. In this window, you'll have an option to click on the video camera to send a video chat request.

#### Skype

**Open Skype:** Double-click on the Skype icon. Enter your user id and password at the applicable prompts.

**Make sure you are online:** You will see a green circle with a checkmark as well as the word "online" in the lower left corner of the Skype window.

**Place Call to Audience:** To connect with a Skype user, either double-click on the user name or highlight the user name and click the green telephone icon on the bottom of the window.

**Start Video:** When the person answers the Skype call, "Start my Video" so that the user can see your video.

**Using Chat:** Place your cursor in the text box at the bottom of the chat window and start typing your message; then click "Enter" on your keyboard. You will then see your chat message display under a gray heading. The person on the other end will reply and their text will display under a blue heading. The chat feature is very useful if you are having microphone issues as you can communicate with the user via text.

**Test video:** Once you are sure that your audio is working properly, make sure that your video is working.

**Select Tools -> Options -> Video Settings** and you should see your video on the right side of the window.

**Test your audio:** Once you are online, ensure that your headset/microphone is working properly. Double click on the "Skype Test Call" and follow the automated operator's instructions. You can then adjust volume and re-test (if necessary).

If your audio is not working, open the Tools->Options->Audio Settings in the Skype window. Ensure that the microphone is the "Windows Default Device"; then, click "Save". If your audio is still not working, reboot your computer. Upon rebooting, you may see a screen that requires you to select "microphone" and then click on "Okay." You can now re-test your audio.

# WEB RESOURCES

Use these sites to help students find additional information about climate change while working on their research project or use to supplement lessons and activities.

EPA kid friendly website all about the basics of climate change

http://www.epa.gov/climatestudents/basics/index.html

#### Website of games, activities, and other resources all about global warming

http://globalwarmingkids.net/

#### Provides information on animals impacted by climate change from around the globe

http://www.wwf.org.uk/what\_we\_do/tackling\_climate\_change/impacts\_of\_climate\_change/climate\_change\_and \_animals.cfm

#### Details impacts of climate change on various sea animals

http://www.neaq.org/conservation and research/climate change/effects on ocean animals.php

#### Website all about how kids can reduce energy consumption

http://www.energystar.gov/kids

Helpful slideshow on climate change, weather, and climate

http://www.slideshare.net/allsaintsscience/5th-grade-ch-8-lesson-5-what-is-climate

# GRANT PROPOSAL RUBRIC

	1 – Does not	2 – Fails to	3 – Meets	4 – Meets all
	meet	meet some	most	expectations
	expectations	expectations	expectations	
Format	-Most sections are incomplete -Most section length guidelines are not met -Proper paragraph formatting not used	-Some sections are complete -Some section length guidelines met -Proper paragraph formatting sometimes used	-Most sections are complete -Most section length guidelines met -Proper paragraph formatting, mostly, but not always, used	-All sections are complete -Section length guidelines met -Proper paragraph formatting used
Project Description and Timeline Sections	-Research question not relevant to climate change -Research project description is incomplete and/or difficult to understand -Tools and timeline do not relate to the project	-Research question relevant to climate change -Research project description is difficult to understand -Tools and timeline do not directly tie to the project	-Research question is practical, answerable, and relevant to climate change -A description of research project is provided -Tools and timeline are related to the project	-Research question is practical, answerable, and relevant to local climate change -A detailed description of research project is provided -Tools and timeline are relevant to the project
Background Section	-Inaccurate or no description of climate change -No causes of climate change -Does not use scientific evidence to support explanation	-Incomplete description of climate change -Missing or inaccurate causes of climate change -May use scientific evidence, but does not include learning from unit	-Describes climate change -Includes less relevant causes of climate change -Uses scientific evidence from unit to support explanation (1 example)	-Accurately describes climate change -Includes causes of climate change -Uses scientific evidence from unit to support explanation (at least 2 examples)
Outcome Proposals Section	-Actions described do not protect environment -Actions are not logical, and not related to the hypothesis	-Describes general actions that can be taken to protect the environment -Actions are logical, but not related to the hypothesis -Actions difficult to understand, or illogical, and difficult to implement in the real world	-Describes only one specific action that can be taken to protect the local environment -Actions are logical but not <i>directly</i> related to the hypothesis -Actions well thought out, but difficult to implement in the real world	-Describes specific actions that can be taken to protect the local environment (at least 2) -Actions are logical and directly related to the hypothesis -Actions could be implemented in the real world

Name: EXAMPLE

# **CLIMATE SCIENCE PROJECTS**

Today you are a climate scientist designing a project to protect our resources and environment. In order to conduct your research you must apply for a grant from the National Park Foundation. Only the best projects will receive funding. Your job is to create a well thought out, effective grant proposal so that you can project Mammoth Lake's environment.

**Project Design and Hypothesis** 

1.) **Design a scientific question about climate change**. Think about something you are curious about. It could have to do with animals, plants, snowpack, or water flows. Your question should be something that can be answered through scientific research.

How do warmer climates affect black bear hibernation in the area around Mammoth Lakes?

2.) What scientific research will you do to discover the answer to your question? Think about the scientific research we have learned about so far this unit: scientists are monitoring the stream flows in Yosemite National Park, and scientists are monitoring the water in snowpack.

In the summertime we will put research collars on black bears in the Mammoth Lakes area. We will have biologists catch and tag the bears. Then in the winter we will monitor bear activity. We will look at the month that the bears start hibernating and the month the bears come out of hibernation. Then we will compare our data about the bear's activities to the snowpack levels and winter temperatures.

#### When and how often will you do your research?

We will start our research this year and continue to monitor bear hibernation over the next ten years. We will continue to put research collars on new bears in the area in the summer. We will record data in the late fall (when the bears begin hibernating) and in the early spring (when the bears come out of hibernation).

#### What tools/information/people will you need?

We will need tracking equipment so we can monitor the movement of the bears. We need biologists who can put the tracking equipment on the bears. We also need a computer that uploads data about the bear's movements throughout the fall and spring. Finally, we need information on snowpack levels and temperatures.

#### 3.) What do you hypothesis you will discover from your research?

We hypothesize that bears will spend less and less amount of time hibernating as temperatures get warmer and the snowpack decreases.

#### **National Park Foundation Grant Application**

#### I. Proposal Summary

The proposal summary should be 1-3 sentences and give the reader a very general idea about your research project.

The changing climate has a huge impact on many things from plants, to weather, to water, to animals. Our project will look at how climate change impacts bears in the area around Mammoth Lakes. This information is really important to reduce problems between bears and humans, and to help bears survive in this area of the United States.

#### II. Background

The background section should be at least 5 sentences. It should explain the problem that results in the need for your research project; i.e. climate change. Be sure to use what you have learned over the past two weeks to provide **evidence** of climate change.

#### III. Project Description

In this section you need to provide a detailed description of your project. This can be as many sentences as you need, but remember the more details you include, explanations you provide, and better thought-out your project, the more likely you are to get funded, or money to do your project. Use what you wrote to answer question 2 to help you!

Climate change means that there is less snow and warmer days in Mammoth Lakes. This affects many animals. We would like to see how this impacts bears. How does climate change impact bears' hibernation habits in the area around Mammoth Lakes? In order to research this question, we would like to put research collars on bears to record their movements. Biologists will put the research collars on the bears in the summertime, and then in the fall we will record when the bears start hibernating. We will also record when the bears stop hibernating in the spring. We will compare this information with the snow pack for each year as well as the temperatures in the wintertime. To complete our project we will need to buy tracking and computer equipment, pay biologists, and collect information on snow pack and temperatures. We would like to study bear hibernation habits over ten years, so we can see if anything is changing.

#### IV. Project Timeline

Make a timeline of when you plan to do activities in order to accomplish your research project and get the data you need.

Spring 2014 -Purchase equipment -Hire biologists

Summer 2014 -Put tracking collars on as many bears as possible

Fall 2014 -Record start of hibernation of bears

Earth Science Worksheet 8.2—Climate Science Projects

> Winter 2014 -Record daily temperature -Monitor snowpack

Spring 2015 -Record end of hibernation of bears -Hire biologists -Buy new tracking equipment (if needed)

Summer 2015 -Put tracking collars on new bears

Fall 2015 – Fall 2024 Continue bear monitoring and doing the steps recorded above

### V. Outcome Proposals

This section needs to be at least 5 sentences. Assuming your hypothesis is correct, what do you plan to do with the data you collect? How will you use the data to make your community a better place?

We believe that we will discover bears are beginning hibernation later and ending hibernation early. This information is really important to reduce problems between bears and humans, and to help bears survive in this area of the United States. If our hypothesis is correct, we would like to use the information to teach people about keeping their food away from bears and respecting bear habitat in the late fall and early spring. We will also use our data to help people who care about bears to reduce their air pollution to help end climate change.

# CLIMATE SCIENCE PROJECTS

Today you are a climate scientist designing a project to protect our resources and environment. In order to conduct your research you must apply for a grant from the National Park Foundation. Only the best projects will receive funding. Your job is to create a well thought out, effective grant proposal so that you can project Mammoth Lake's environment.

Project Design and Hypothesis

4.) **Design a scientific question about climate change**. Think about something you are curious about. It could have to do with animals, plants, snowpack, or water flows. Your question should be something that can be answered through scientific research.

5.) What scientific research will you do to discover the answer to your question? Think about the scientific research we have learned about so far this unit: scientists are monitoring the stream flows in Yosemite National Park, and scientists are monitoring the water in snowpack.

When and how often will you do your research? \_\_\_\_\_\_

What tools will you need? \_\_\_\_\_

6.) What do you hypothesize you will discover from your research?

### **National Park Foundation Grant Application**

/1.	Proposal Summary
/11.	Background
111.	Project Description
۲.	Project Timeline

#### Х. **Outcome Proposals**

\_\_\_\_\_



Earth Science Fake money



### Day 1

Climate change – any significant change in the climate lasting for decades or longer.

Global warming— the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation.

Greenhouse effect – a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions.

Pollution— the introduction of contaminants into the natural environment that cause adverse change.

### Day 2

Adaptation – the ability of a species to survive in a particular ecological niche, especially because of alterations of form or behavior brought about through natural selection.

Habitat—an ecological area that is inhabited by a particular species.

Climate – the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation.

Weather – the state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

#### Day 3

Snowpack – forms from layers of snow that accumulate in geographic regions and high altitudes where the climate includes cold weather for extended periods of time throughout the year.

Snow-water equivalent – the amount of water contained within the snowpack.

### Day 4

Camouflage— the ability of an animal to blend in to its environment.

Density—the mass per unit volume of an object.

Depth— the perpendicular measurement downward from a surface.

Volume— the quantity of three-dimensional space enclosed by some closed boundary.

#### Day 5

Precipitation—any product of condensation of atmospheric water vapor that falls under gravity.

Earth Science Vocabulary

Stream flow-the flow of water in streams and rivers often from snowpack runoff.

Watershed – an area of land where all of the water that is under it or drains off of it goes into the same place.

### Day 6

Hydrology— the branch of science concerned with the properties of the earth's water, esp. its movement in relation to land.

Peak flow—the maximum flow of water in a river or steam in a given year.

Earth Science Student Evaluation

Student Name

Teacher Name

I learned new information about climate change. The unit was relevant to my life. My teacher explained necessary vocabulary so I could understand the content. There were enough hands-on activities in this unit. The hands-on activities in this unit were directly related to the content we studied. I have a deeper understanding of climate change and why it's important The National Park Service is an important agency that is helping to protect wild places and study climate change I can explain to friends and family how National Parks are "science labs" for climate change. This unit has increased my interest in National Parks. I would recommend this unit to be taught to other classes similar to mine. 

Earth Science **Teacher Evaluation** 

Teacher Name:\_\_\_\_\_

Grade:\_\_\_\_\_ School:\_\_\_\_\_

Mark one per row.

	Highly (4) Effective	Effective (3)	Developing (2)	Ineffective (1)
Lesson Plan	Creative, relevant, builds knowledge base, includes all essential elements	Useful activities, objectives, etc	Missing one element	Missing essential elements
Standards Correlation	Standards-born lesson incorporating common core standards for science	Connects to skills in science common core standards	Missing parts of the common core standards	Does not correlate to standards
Materials	Above and beyond needed materials	Sufficient materials	Most required materials available	Some materials needed
Reaching toward unit objectives	Lessons directly promote skills and understanding linking to unit	Lessons promote some unit skills	Lessons promote learning but not necessarily in relation to unit objectives	Does not tie into unit goals

### 1-strongly disagree 4-Strongly agree

This unit was grade-level appropriate.

1 2 3 4

The unit aligns with the science common core standards.

1 2 3 4

Within the lesson plans, the objectives were clear.

2 1 3 4

Within the lesson plans, the procedure was clear and easy to follow.

2 3 1 4

Students were receptive and enjoyed the unit.

Earth Science Teacher Evaluation

1 2 3 4

I would be interested in having Devils Postpile National Monument mail me the needed materials, even if I had to pay my own postage to send it back.

1 2 3 4

Which parts of the unit were the most useful?

Which parts of the unit did you use?

What did you like least from the unit?

What other resources could help make this unit work?

What was the most effective part of this lesson?

What would you change or improve upon if you taught this again?

How did you receive feedback from students? (Used student evaluations, took a class poll, etc)

Comments: