MS-ESS2-5

Monitor the weather

Students record the weather outside, using materials created in the classroom or provided by the STEM lab and compare them to reports of previous years. The data from the previous years will be researched from internet sources. The data from this year and the data from 20, 40, 60, 80, and 100 years ago will be placed on a table and will also require a creation of a graph indicating temperatures over the years. Students will explain how the climate has changed over the course of 100 years.

http://www.k12science.org/curriculum/weatherproj2/en/

Part 1: Data Tables
Make the following two tables in your *Weather Learning Log* to record your weather data:

A. **Current Conditions**

	Class Instruments	Internet	Barrow, AK
Latitude, Longitude:	NA		
Time Conditions last updated:			
Temperature:	C	C	C
Sky Conditions:			
Wind:			
Wind Direction:			
Wind Speed:			
Precipitation Type:			
Precipitation Amount:	mm	mm	mm
Air Pressure:	units	mb	mb

B. **Temperature for the last seven days**

	7 days ago	6 days ago	5 days ago	4 days ago	3 days ago	2 days ago	Yesterday
Your City	C	C	C	C	C	C	C
Barrow, AK	C	C	C	C	C	C	C

Part 2: Use the Internet to observe weather

1. **Class Instruments:** Record your measurements in the column marked "Class Instruments" using the weather instruments you made in the previous activity.

NOTE: If you are combining Activities 1 and 2, you should record your measurements as you build each of the instruments.

2. **Your City / Town**
    1. Go to the Weather Underground site.
    2. Enter the name of your city in the "Fast Forecast" box which is in the upper left hand corner and click the return button on your keyboard. If the exact location is not in the database then select the next closest city or town.
    3. Locate the latitude and longitude on the right-hand side of the screen in the navy blue bar and write it in the "Current Conditions" data table.
    4. Locate the current weather conditions in the center of the page and write the time the conditions were last updated, the current temperature, wind, air pressure, etc. in the "Current Conditions" data table.
    5. Scroll down to "Historical" below the current conditions and select the date for **yesterday** and then click on "GO".
    6. Write the "Mean Temperature" in the corresponding column for your city / town (i.e. yesterday) in the Temperature for the last seven days Data Table.
    7. Click the "Previous Day" link and write the mean temperature in the *2 days ago* column.
    8. Repeat until you complete for the seven days.
    9. After you've entered the data, click the back button to return to this page.

3. **Barrow, AK**
    1. Return to the Weather Underground site and enter Barrow, AK in the "Fast Forecast" window.
    2. Repeat the steps above and enter the corresponding information into both Data tables.
    3. After you've entered the data, click the back button to return to this page.

Part 3: Analyze the Data

1. **Class Instruments vs. the Internet**: Compare and contrast the weather you collected for your city with the data from the Internet for your city.
    1. Create a bar graph comparing the temperature you collected with the class instruments with the data from the Internet for your city / town (see example).
    2. Is your temperature the same as reported on the web site? If not, can you think of any reasons why they're not the same?
    3. Will the temperature be the same tonight? tomorrow? in one week? in one month? Why or why not?
    4. Why is it important to use standardized terminology for sky conditions? Are your sky conditions the same as reported on the web site? If not, can you think of any reasons why they're not the same?
    5. Does your wind data (direction and speed) match the data from the web? If not, can you think of any reasons why they're not the same?
    6. For air pressure, you used general units while the Internet posted the measurement in mb. How could you correlate the two?
    7. What are some of the other items listed on the weather web page? What do they measure?

2. **Your location vs. Barrow, AK:** Compare and contrast your city with the weather data from

Barrow, AK.

1. Was the weather similar or different? Describe the similarities and differences.
2. Create a bar graph comparing the current temperatures in Barrow, AK with your city.
3. Was the temperature similar or different in both cities?
4. What reason (s) do you think might account for the similarities or differences? (Hint: there are several)

3. **Temperature for the last seven days:** Analyze the changes in temperature for the last week and compare the two cities.
    1. Draw one graph containing two line graphs comparing the temperature from your city and Barrow, AK for the last seven days over Time (seeexample). Label the x-axis using each of the different dates starting with 7 days ago to the left and ending with today's date to the right and the y-axis in ◆C.
       NOTE: Don't forget to label each of the lines to distinguish between the two graphs.
    2. For your city, did the temperature go up, down, or stay the same over the past week?
    3. For Barrow, AK, did the temperature go up, down, or stay the same over the past week?
    4. How did the two cities compare?

Homework *(optional)*:
Do you think weather is the same all over the world? Choose a city in another country where a family member or friend lives and write a short narrative about what you think the weather is like there. In your paragraph, try to answer the following questions:

- Do you think the temperature in your relative's town will be warmer or colder then in your own? Why?
- How would this affect their lives? For example, their house, clothes, etc.
- What type of precipitation might you expect? Why?
- Will the wind speed be higher or lower? Why?

Part 1: Locate and Answer

1. Locate the following two cities on a world map.
    - New York, NY, USA (41° N 74° W)
    - Sao Paulo, Brazil (24° S, 47° W)
2. Based on its location on the map, what do you think the temperature will be like in New York? Why?
3. Based on its location on the map, what do you think the temperature will be like in Sao Paulo? Why?

Part 2: Prepare your Weather Learning Log
Format approximately 3 pages in your Weather Learning Log (one page per city) to record the following current weather conditions for the next 2 weeks. Each page should be numbered from 1- 14 (one line for each day).

	Date	**High Temp.*** (°C)	**Wind Speed** (km/h)	**Wind Direction** (N, S, etc.)	**Air Pressure** (mb)	**Precipitation** (mm)	**Sky Conditions** (clear, partly cloudy, etc.)
1.							
2.							
...							
14.							

* **Important**: Since these are real time weather readings, remember the time of day in the regions may be quite different. Therefore, compare the high temperature readings for today's forecast.

Part 3: Track Weather like a Meteorologist
Each day over a two-week-period (minimum), record the following weather measurements and add them to your *Weather Learning Log*. If you are using a wall chart, add them there as well.

A. **Weather at your school**
Use your class weather instruments and the weather web site below to record your measurements in the table marked "Data from My Town".
    - www.wunderground.com *(back-up)*

B. **Weather from New York, NY, USA and Sao Paulo, Brazil**
Record the current weather conditions from the cities below in your *Weather Learning Log* (click the Refresh / Reload button on your browser to update the following Real-Time data feeds):
    - New York, NY *(back-up)*
    - Sao Paulo, Brazil *(back-up)*

C. **Repeat for Two Weeks**
Record the current conditions for your city, New York City, and Sao Paulo every day for a two week period. If you are unable to record the data for one day or over the weekend, use the "Historical" data to complete the data tables.

***EXTENSION - Satellite Maps & Web cams*:**
Print a satellite map and live photo of the two regions you are studying every day and at the end of the two weeks, make a poster displaying all of the images in series.

- **Satellite Maps**: access and print a satellite map where your country/continent is located each day. After you record each day's measurements, try to predict the next day's sky conditions based on the maps.
    - Satellite Maps *(back-up)*
- **Web cam**: access one of the following web cams and print out the image (color printouts work best).
    - New York *(back-up)*
    - Sao Paulo *(back-up)*

Part 1: How does the weather change?
Discuss and answer the following questions:

- How would you describe the weather for the two-week period for each of the three cities?
- In general, how did the weather change during the week for each of the three cities?
- How was the weather the same or different in each of the three cities? For example, which

location seemed the warmest? coldest?

- Can you think of any reasons why the weather was similar or different?

Part 2: Weather Variables

For this exercise, you will graph several of the weather variables in depth to compare and contrast the weather data that was collected from the three locations.

A. **Temperature:** Line graphs show gradual changes in data and are good for summarizing the relationship between two pieces of information, such as temperature and time.
   - Draw three LINE graphs *(one for each city)* on three separate graphs comparing the Temperature each day over Time. Label the horizontal, or x-axis using dates from the first day you began to take weather measurements to the last day and the vertical, or y-axis in ◆C. Don't forget to label each of the graphs to distinguish between the three locations.

B. **Wind Direction:**
   - Label the Wind direction for each day at the same points for the temperature for each day in the line graphs you made above for each of the cities (you will analyze this later).

C. **Sky Conditions:** Circle graphs will help demonstrate how the whole week can be divided into its parts and will make it easier to compare the sky conditions for each of the three cities.
   - Make three CIRCLE graphs *(one for each city)*showing the number of sunny, cloudy and rainy days.

D. **Precipitation:** Bar graphs are good for comparing data and illustrating how something changes over time.
   - Draw one BAR graph for your city over Time. Label the x-axis from the first day you began to take weather measurements to last day. Label the y-axis in mm of precipitation.

E. **Air Pressure**
   - Draw three LINE graphs *(one for each city)* on three separate graphs comparing the Air Pressure each day over Time. Label the x-axis from the first day you began to take weather measurements to the last day and the y-axis in mb from the lowest to the highest recorded air pressure value. Don't forget to label each of the graphs to distinguish between the three locations.

Part 3: Analyze the Data

Use the graphs and charts above to answer the following questions.

A. **Temperature**
   1. How would you describe the temperature changes in each of the three cities? For example, does it seem to be going up, down, or staying the same?
   2. What was the highest temperature in each location and when did it occur?
   3. What was the lowest temperature in each location and when did it occur?
   4. What was the average temperature in each location?

B. **Sky Conditions and Temperature:**
   1. Which city had the most sunny days, cloudy days, and rainy days?
   2. Was there any relationship between the sky conditions and temperature in each of the three cities? For example, was it colder on cloudy days, etc.?

C. **Wind Direction and Temperature:**
   1. Did the wind generally come from one direction more than another in each of the three

cities?

2. Was there any relationship between the wind and the temperature the next day in each of the three cities? For example, was it colder on days that the wind was coming from the one direction and warmer when the wind was coming from a different direction?

D. **Precipitation**

1. Which day had the most precipitation? The least?
2. What was the total precipitation for the two weeks?

E. **Air Pressure and Sky Conditions**

1. How would you describe the air pressure changes in each of the three cities? For example, does it seem to be going up, down, or staying the same?
2. Was there any relationship between air pressure and the sky conditions the next day in each of the three cities? For example, did falling or decreasing air pressure lead to cloudy or fair weather?

Part 1: How do meteorologists predict the weather?
Discuss and answer the following questions:

- What tools do meteorologists use to predict weather?
- Are they always right? List several examples when they were right or wrong.

Part 2: Are weather forecasters always right?

1. Go to the CNN Weather Maps weather web site and access the satellite and radar images for your country/region. After you access each of the maps, view the animated version.
    - satellite image for your region / country;
    - animated satellite image for their region / country;
    - radar image for region / country; and
    - regional animated radar image for your region / country.
2. In the animated images, was the weather generally moving in one direction? If so, which?
3. How do you think this might assist you to predict, or forecast the weather?
4. In Part 3 of the previous activity, you analyzed the weather from the previous two weeks to look for trends. How do you think this might assist you to forecast the weather? *For example, was the air pressure falling or raising at the end of the two-weeks? Did the temperature hold steady?, etc.*
5. Make predictions for the weather for the next four (4) days based on the graphs and data analysis from the last activity in addition to the satellite and radar images. Explain your reasons for your forecast.
6. Once you have recorded your forecast, use a newspaper or go to the Weather Underground (*back-up*) and look at the forecast for the next four days. How do your predictions compare with the predictions on the site?
7. Do you agree with the forecast? Why or why not?
8. **THE NEXT DAY**: Check the accuracy of your forecast with he actual weather of the day? Was it correct? Was the weather web site's forecast correct?

Part 3: FINAL CONCLUSIONS

Write a few paragraphs describing your final conclusions of this investigative study. You should include the following:

1. *Introduction* - basic information such as:
    - School name, location, grade and/or subject area, etc.
2. *Main Body*
    - Name, place, and description of where you measured the weather (temperature, precipitation, sky conditions, wind, etc.).
    - Description of your investigation (e.g. what you did, how long, etc.)
    - Description of each of the weather variables (temperature, etc.) and the tools used to measure them.
    - Summary of the observed weather in each of the three cities during the two week period (you can include graphs, charts, etc. for this)
3. *Conclusions*
    - What is weather?
    - How do meteorologists predict weather?

EXTENSION: this last section can be completed over the next several days.

1. Record the actual weather for the next four (4) days using the class instruments and the weather web site every day. At the end of the four days, answer the following:
2. Which forecast was more accurate? yours, the weather web site, both, or neither?
3. Were the four-day forecasts accurate every day or were they more accurate for the first couple of days or last couple of days? Why do you think so?

1. **Make a Weather Learning Log:** This log will be an important tool. You will use it to record weather information as time goes on.
    a. Write your name on the notebook (if you are working as a group, each member should put their name on it). As an optional activity, you can decorate the cover as well.

2. **Discuss and answer the following questions**. Record your answers in your Journal.
    a. What do you think of when you hear the word "weather"?
    b. How does weather affect our daily lives? (Ex. what kinds of clothes do you wear, outdoor activities that you do, etc.)
    c. What kinds of things would you look for if you wanted to describe the weather of a particular day to someone else?

d. What kinds of information are important to collect?

3. **Brainstorm** designs for instruments that you could use to measure each of the following AND answer the corresponding questions in your Journal:
   a. Temperature: What does temperature have to do with weather?
   b. Wind: How can you describe wind? Are there different types of wind? Can you measure how fast the wind is blowing and where its blowing to?
   c. Precipitation: Are there different types of precipitation?; How could rain be measured?
   d. Air pressure: What is air pressure? Why should we measure it? What does air pressure have to do with weather?
   e. Sky conditions: Write a list of standardized terms to describe sky conditions (e.g. clear, partly cloudy, overcast with openings, overcast, etc.)

4. **Present**: Each group should first design the class weather instruments.

   - Additionally, the class should develop a list of standardized sky condition terms to use for the rest of this project.

Part 2: Make a Class Weather Station

1. **Build** the following weather instruments in the order below. Directions are provided for each.
   A. Barometer (Air pressure)
   B. Rain Gauge (Precipitation)
   C. Thermometer (Temperature)
   D. Wind Vane (Wind Direction)
   E. Anemometer (Wind Speed)

2. **Practice with the Instruments**: repeatedly test the instruments for accuracy.

3. **Record your measurements:** Please follow the guidelines below.
   NOTE: If you are combining Activities 1 and 2, record your measurements in the column marked "Class Instruments" in the Current Conditions table.

   1. Temperature (Use a commercial outdoor thermometer and record in degrees Celsius):
   2. Sky conditions (Observe outside and use one of the standardized sky condition terms. For example, clear, partly cloudy, overcast with openings, overcast, etc.):
   3. Wind (calm, light, etc.):
   4. Wind Direction (N, NW, W, SW, etc.):
   5. Wind Speed (how many times the anemometer spun):
   6. Precipitation Type (at data collection time - rain, drizzle, snow, none, etc.):
   7. Precipitation Amount (in last 24 hours. Record your findings in mm):
   8. Air Pressure (record your finding in the units marked on your class barometer):

Homework *(optional)*

1. Do you think the weather instruments you made are as accurate as those used by professional meteorologists? Why or why not?
2. How could you make them more accurate?
3. If you have Internet access, select and print a satellite maps (back-up) where your country is located and answer the questions below:
4. Questions:
    - What do you see in the map?
    - Do the current weather conditions in your city match up to what you see on the satellite map?
    - How could you use a satellite map to predict weather?

MS-ESS3-5

Lesson Plan: Climate Systems - Which Location Is Best For Me?

https://oceanservice.noaa.gov/education/lessons/which_location.html

This lesson plan was developed by NSTA master teacher Caroline Goode through NSTA's partnership with NOAA.

Grade Level: 5-8

Subject Areas

Earth Science, Mathematics, Geography

Standards Alignment - National Science Education Standards

Earth and Space Science

- Structure of the Earth system
  - Global patterns of atmospheric movement influence local weather.

Abilities Necessary to Do Scientific Inquiry

- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.

Time Required

Three 45-minute classes

Internet Resources

- Weather Eye: http://weathereye.kgan.com/cadet/climate/climate_vs.html
- EPA Climate Change Kids Site: http://www.epa.gov/globalwarming/kids/climatesys.html
- NOAA JetStream - Climate: http://www.srh.noaa.gov/jetstream/global/climate.htm
- Image: United States Annual Mean Daily Average Temperature: http://www.ncdc.noaa.gov/img/about/cdrom/climatls1/info/temp.gif
- Image: United States Annual Mean Total

Precipitation: http://www.ncdc.noaa.gov/img/about/cdrom/climatls1/info/prec.gif

Lesson Goal

Students will learn the difference between weather and climate, gather climatic data for different locations around the world, and use their data to complete a climate challenge scenario.

Learning Objectives

- Students will use the Internet to research and identify the five parts of Earth's climate system.
- Students will illustrate each of the five parts of the climate system.
- Students will use the Internet to gather climatic data for specific regions.
- Students will analyze their climatic data to prepare a climate report.
- Students will use critical thinking and decision-making skills to determine which climatic region they would relocate to.
- Optional: Students will share their relocation decisions in a class presentation.

Prerequisite Knowledge

- Computer/Internet experience
- Vocabulary terms: precipitation, temperature, annual, mean
- Making graphs
- Writing an informative report

Misconceptions/Preconceptions

- Weather and climate are the same
- Daily weather is regional
- Oceans, landforms, and humans have no effect on our climate and weather

Classroom Resources

- One computer with Internet capabilities for each group of three to four students
- One U. S. map with cities and states identified or an atlas/social studies book with a U.S. political map for each group of three to four students
- Colored pencils/markers

- Science notebooks
- Copies of Student Worksheet #1 and #2, one per student

Click here for printable versions of student worksheets

Procedures/Instructional Strategy (based on the 5E model):

Day One - Engagement Activity:

This activity will help students to understand the difference between weather and climate.

Materials:

- One computer with Internet access for each group of three to four students or one computer and large screen monitor for whole class viewing Optional: Download and print reference materials for each group
- Student notebooks
- Markers/colored pencils

1. Organize students in groups of three to four. Conduct a class discussion by asking students to make a two-column chart on a piece of notebook paper. The first column will be labeled "Weather" and the second column will be labeled "Climate."
2. Allow students to discuss and record their ideas of what environmental and natural factors comprise weather and climate. Give them about five minutes to brainstorm.
3. Ask each group to share their ideas with the class. Record responses on a piece of chart paper or board as a class chart.
4. Ask the class to come up with a definition for each term: weather and climate. This may be difficult but accept any reasonable answers. Summarize and record the class answers on the class chart.
5. Explain that this will begin our search to determine the difference between weather and climate and the factors that affect them.
6. If possible, assign each group of students to a computer with Internet capabilities. Optional: one computer connected to a large monitor for whole class viewing.
7. Go to the Weather Eye Web site (http://weathereye.kgan.com/cadet/climate/climate_vs.html) to read an explanation about weather vs. climate. Ask students to read the information and come up with a one-sentence answer that explains the difference between weather and climate. Record the sentence on the class chart. For example: Weather is what is happening outside your window every day and climate is the long-term weather conditions over a period of 30 years.
8. Next, ask students to think about the factors that affect climate and weather, record responses on the class chart. Go to "EPA Climate Change Kids Site" website to read another description of weather and climate. Discuss the five climate system factors listed and ask students to either print the page or copy the chart into their notebooks (this should be done individually, not as a group). Instruct students to make a third column on their climate system chart to illustrate each of the five climate system factors.
9. If needed, illustrations can be completed for homework. Completed climate system charts may/may not be

graded and could be displayed on a classroom wall.

Day 2 - Exploration Activity:

During this class, students learn that the world can be separated into six climate systems. As they record each system's latitude, temperature, and precipitation, they are able to see the major factors that define each system.

Materials:

- One computer with Internet access for each group of three to four students Optional: Download and print reference materials for each group.
- "What's the Climate?" Student Worksheet #1, one per student.

1. In this activity, students will work in groups of three to four to research the climate of four different cities of the United States.
2. Read the directions for "What's the Climate" to the class and discuss any questions students may have before beginning this activity.
3. Although students work as a team to research and gather the data, each student is responsible for completing his/her own worksheet.
4. In Part 1, students learn that scientists classify world climates into six categories, and use the web link identified to record each category, its latitude, and a climate feature.
5. In Part 2, students use the Web links identified to find the Annual Mean Total Precipitation and Annual Mean Daily Temperature for their own location plus four others.
6. Instruct students that the data on this worksheet will be required for the next part of this lesson.
7. Grade worksheet #1 using this rubric:

   = 30 pts (5 pts each category)
   = 20 pts (5 pts each)
   = 50 pts (10 pts each city)

   - Climate System Chart completed
   - State/Climate Category completed
   - Temperature/Precipitation Chart completed
8. If students are not finished with Part 2, it can be finished in the next lesson.

Day Three - Elaboration Activity:

Using what they've learned about climates, students will work together to determine the best location for them. As the groups discuss the challenge, they are required to come to a consensus on which cities are best for them. If students cannot come to a group consensus, each student can work on the challenge alone.

Materials:

- Political map of the United States (one large classroom map or one Social Studies book per group of three to four students)

- "The Climate Challenge!" Student Worksheet #2, one per student
- Completed "What's The Climate" Student Worksheet #1 from previous lesson

1. Inform students that this challenge will begin when "What's The Climate?" Student Worksheet #1 is completed.
2. Before students begin, go over the scenario together.
3. Read the "Challenge" scenario to the class and discuss how to set up the graph. You may choose to assign a specific graph such as bar or line, or you may allow students to choose their own type of graph.
4. Although students work as a team to research and gather the data, each student is responsible for completing his or her own worksheet.
5. Allow students 15 minutes to complete their graphs (if some students haven't finished, allow them to finish for homework).
6. Read Part 2 instructions, allow students to work until the end of class on making their group decisions. Each student will complete the report for homework.
7. Grade worksheet 2 using this rubric:

- 10 pts = Climate Data Graph is correct
- Report:
  20 pts = Report ranks cities in order of preference (#1-4)
  60 pts = Each choice of city includes detailed reasons to support its rank
  10 pts = Report is written in paragraph form in a clear, coherent way

Outcome/Assessment

- Exploration and Elaboration Activities are evaluated and scored according to the scoring rubric above.
- Optional Elaboration evaluation: Group presentation of their final choices for relocation:
  20 pts = Cities are ranked in order of first, second, third, fourth choice
  40 pts = Group is able to provide solid reasons for each choice
  40 pts = Group worked as a team and reached consensus in a cooperative way

Extensions

- Use the climate systems chart to research one of the six systems for a report/poster
- Create a world map that identifies the climate system regions
- Research other cities in the world, choose one, and write a "If I Could Live Anywhere" story

Climate Systems - Which Location Is Best For Me?

Student Worksheet #1: Climate

Click here for worksheet #1

Student Worksheet #2: Climate

Click here for worksheet #2

Click here for printable versions of student worksheets

Water Cycle in a Jar Demo Name: _____

https://www.youtube.com/watch?v=XVUA4pw5yzM
https://www.youtube.com/watch?v=2rwFK5_Viqo&t=43s

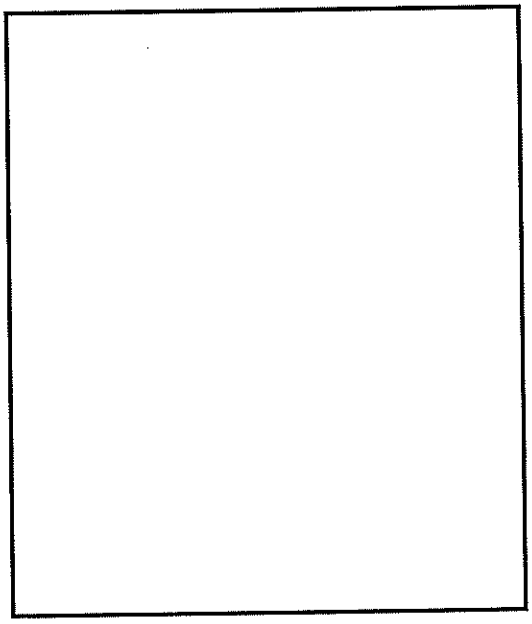
Precipitation is an important aspect of weather. Precipitation is a step in the water cycle. In this demonstration, you will observe the water cycle in action.

The water cycle includes:

- **evaporation** – water heats up and changes from a liquid to a gas, rising into the air
- **condensation** – water cools down and changes from a gas to a liquid in the atmosphere
- **precipitation** – liquid water becomes heavy and falls to the ground

As your teacher completes the demo, watch for each of these steps. Draw a picture and describe each below.

Evaporation



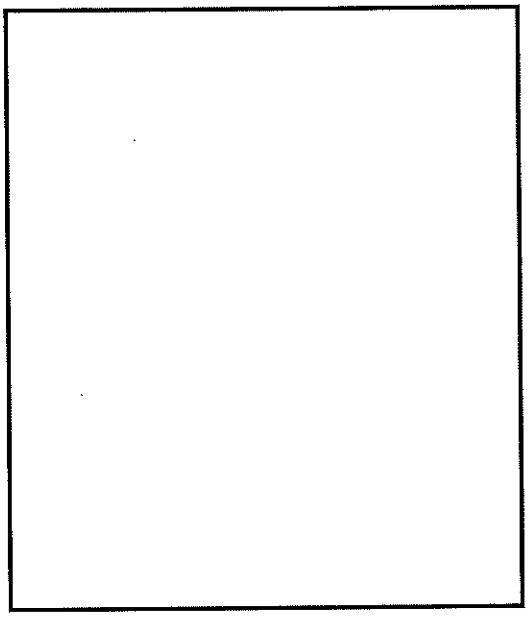
When did it happen?

_____
_____
_____
_____

What did it look like?

_____
_____
_____
_____

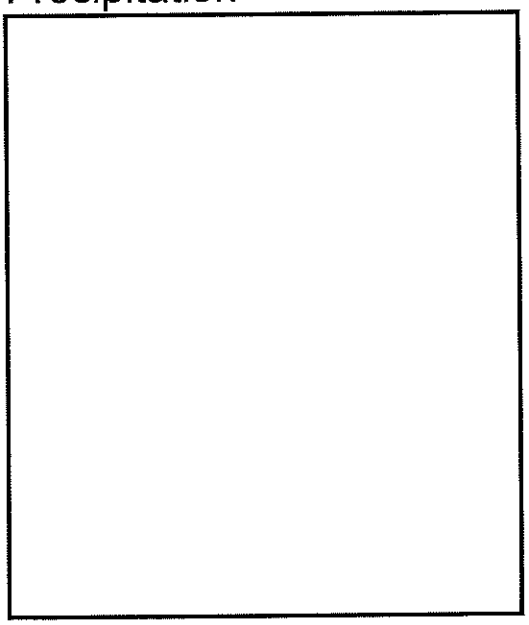
Condensation



When did it happen?

What did it look like?

Precipitation



When did it happen?

What did it look like?

The water cycle needs a source of energy (heat). What was the source of heat in the demo? What do you think drives the water cycle on Earth?