# Analysis of Atmospheric Conditions for a High Mountain Retreat

**Adapted from: My NASA Data Lesson Plans**

http://mynasadata.larc.nasa.gov/preview_lesson.php?&passid=17

## Focus on Inquiry

The students will focus on inquiry by collecting data and constructing graphs of Tibetan weather data and then analyzing the data, drawing conclusions, and offering recommendations based on new data.

## Lesson Overview

Students use weather data from ground-based and satellite observation to plan a high mountain retreat in Tibet. Students examine the relationship between altitude, atmospheric pressure, temperature and humidity.

| Duration | Setting | Grouping | PTI Inquiry Subskills |
|---|---|---|---|
| 1-2 50 minute class periods | Classroom/computer lab | Small groups of 2-3 | 3.1, 3.8, 4.2, 5.2, 5.3, 5.7, 7.2, 7.3 |

| Lesson Components | Estimated Time | Inquiry Subskills Used | Technology Used | Level of Student Engagement | Brief Description |
|---|---|---|---|---|---|
| ***Engage*** | 10 minutes | | | 1 | Class discussion on altitude, pressure and temperature. Teacher reads letter to set up experiment. |
| ***Explore*** | 40 minutes | 3.1, 3.8, 4.2 | Computer with Internet Access | 3 | Students use the Internet to collect and analyze real satellite climate, temperature, and altitude data on the region of Tibet. |
| ***Explain*** | 20 minutes | 4.2, 5.2, 5.3, 7.2, 7.3 | | 3 | Students answer questions and draw conclusions regarding their observations and respond to the letter with recommendations. |
| ***Expand*** | 50 minutes | 3.1, 3.8, 4.2, 5.7, 7.2 | | 3 | Gather new climate information on Tibet and alter recommendations based on new data. |
| ***Evaluate*** | | | | | Students can be assessed using their graphs, questions, and recommendation letter content. |

**Level of Student Engagement**

| | | |
|---|---|---|
| 1 | Low | Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction |
| 2 | Moderate | Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance |
| 3 | High | Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered |

### National Science Education Standards – 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
Communicate scientific procedures and explanations

### National Science Education Standards – Earth Science

Global patterns of atmospheric movement influence local weather. Oceans have a major effect of climate, because water in the oceans holds a large amount of heat.

### Louisiana Grade Level Expectations – Inquiry

Gr. 8, Inquiry GLE#6. Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
Gr. 8, Inquiry GLE#9. Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3)
Gr. 8, Inquiry GLE#11. Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
Gr. 8, Inquiry GLE#12. Use data and information gathered to develop an explanation of experimental results (SI-M-A4)

| |
|---|
| Gr. 8, Inquiry GLE#16. Use evidence to make inferences and predict trends (SI-M-A5)<br>Gr. 8, Inquiry GLE#19. Communicate ideas in a variety of ways (e.g. symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations)<br>Gr. 8, Inquiry GLE#22. Use evidence and observations to explain and communicate the results of investigations (SI-M-A7) |
| **Louisiana Grade Level Expectations Earth Science**<br>Gr. 8, GLE#23. Explain the processes of evaporation, condensation, precipitation, infiltration, transpiration, and sublimation as they relate to the water cycle.<br>Gr. 8, GLE#24. Investigate and explain how given factors affect the rate of water movement in the water cycle (e.g., climate, type of rock, ground cover) (ESS-M-A10) |

## Materials List (per group)

- Computer with Internet access
- World Atlas or Map of Tibet
- Printer access (optional)
- Copies of the FSL Output Format description document: http://raob.fsl.noaa.gov/intl/fsl_format-new.cgi

## Advance Preparation

1. Gather materials necessary to complete lab (have students bring in the necessary supplies).
2. Before implementing the lesson with students, it is strongly recommended that you check to see that the browser being used is compatible with the Live Access Server, and that the pop-up blockers are turned off.
3. Also, before you begin, it may be helpful to review the website The Standard Atmosphere (http://dss.ucar.edu/docs/equations/std.atmos.html). This document will provide the general relationship between altitude, pressure and temperature.

## Other Information

### Learning Objectives

- Students will explore correlations between atmospheric parameters.
- Students will practice science and math in real world application.
- Students will write reports detailing their scientific conclusions.

### Prior Knowledge Needed by the Students

- Lesson introduction to meteorology (pressure, temperature, humidity)
- Accessing Internet

### Procedure

#### *Engage*

1. As a class, review the definitions of **altitude** (the vertical distance or height measured from sea level), **atmospheric pressure** (the weight of the column of the atmosphere above a surface), and **temperature** (a relative degree of heat, usually measured on a scale such as the Fahrenheit or Celsius scale).
2. Read or hand out the following letter to the students. It may be good for students to have a copy of this letter as a reference for the questions in the Blackline Master #1.

   Dear Students,

   It has come to our attention that you are extremely brilliant scientists.

   My company, BRAND Incorporated, wants to develop a High Mountain Tibetan Retreat (HMTR) for deep meditation. However, we want the retreat to be as comfortable as possible for those low-altitude sea shore dwellers. Could you please do an analysis of the air pressure, temperature and relative humidity at various altitudes in the region based upon weather data from the nearby capital city, Lhasa? My planning department would be grateful for any best-fit equations that could be developed and possible results between altitudes 12,000 feet and 28,000 feet.

   We look forward to your report.

Sincerely,
Mr. Al G. Brand

3. Get students in groups of 2-3 (per computer).

### *Explore*

1. Make sure all computers are set to the Live Access Server (Armstrong) page: http://mynasadata.larc.nasa.gov/las/servlets/dataset. Make sure all pop-up blockers are turned off on the computer's browser.
2. Provide students with a World Map or Atlas so they can find the latitude and longitude of the region of Tibet. You could have them navigate here: http://europe.mapquest.com/atlas/main.adp?region=china or print out a similar map from the Internet.
3. Have students complete Part 1 of the **Blackline Master #1**.
4. Students should explore different months throughout the year to understand seasonal variations in the data. For example, have 1 group select Jan 2000, 1 group select April 2000, 1 group select August 2000, and so on. Discuss results as a class.
5. Have students complete Part 2 of the **Blackline Master #2**.
6. Hand out copies of the FSL Output Format description document: http://raob.fsl.noaa.gov/intl/fsl_format-new.cgi.

### *Explain*

1. Have students complete answer the questions on the Blackline Master #1. Students can share their letters with other groups or with the rest of the class. See if students note how surface pressure is low in the mountainous region. Explain that this is due to higher elevation. Also, note that surface temperature is lower in the mountainous region as expected due to elevation.

### *Expand*

1. Read the introduction of the journal article ('Weather and Death on Mount Everest: An Analysis of the 'Into Thin Air' Storm', Bulletin of the American Meteorological Society, 2006) http://ams.allenpress.com/archive/1520-0477/87/4/pdf/i1520-0477-87-4-465.pdf. The first 3-5 pages are sufficient. Ask the students to consider this real world event and relate it to their HMTR recommendation.
2. For Question 3 on the Blackline Master #1, have the students choose one of the 'other characteristics' that they suggested, then use the Live Access Server (Armstrong) to produce a plot of this parameter for Tibet for the time period used in Procedure Part I. Ask the students: Would the results affect your recommendation letter? Explain using examples of data.

### *Evaluate*

1. Students can be assessed using their graphs, answers to questions, and the content of recommendation letter.

## Blackline Masters

1. High Mountain Retreat

## Supplementary Resources

## Credits

*Laurissa Werhun, Toronto, Ontario, Canada*

PATHWAYS to INQUIRY



Name: _____ Date: _____

*High Mountain Retreat*

**Procedure**

**Part I:** Explore the Live Access Server to understand the historical weather conditions (climate) in Tibet.

2. Your computer should be connected to the Live Access Server (Armstrong). http://mynasadata.larc.nasa.gov/las/servlets/dataset
3. From this home screen, select Atmosphere, then Atmospheric Pressure, then check the box next to Monthly Surface Pressure (ISCCP). Click the Next link.
4. For Select view, select Longitude-Latitude map (xy).
5. For Select output, select Color plot.
6. For Select region, select Full Region.
7. You should have been provided a World Map or Atlas. Find the latitude and longitude of the region of Tibet (in China) and record them here. Note: Since Tibet is a region, you should enter a range of values, not just a specific location. For example, the Latitude may be 20 N – 30 N and the Longitude may be 50 E – 60 E.

   Tibet Latitude Range: _____ Tibet Longitude Range: _____

8. Using the latitude and longitude boxes to the right of the map, enter the range of values found in Step 6. Click the "Go" button underneath these boxes.
9. For Select time, use the drop-down menu to select the month and year you have chosen to investigate (For example, Jan 2000). Click the red Next link.
10. A color plot should appear in a separate pop-up screen. Save this data by printing it or clicking File → Save As. Enter "Tibet climate" as your file name and save it to your desktop or another specified location. Close this pop-up window only.
11. Back on the main screen, click on the Datasets link found on the left side of the screen.
12. Select Atmosphere, then Atmospheric temperature, and then check the box next to Monthly Near-Surface Air Temperature (ISCCP). Click the red Next link.
13. For Select view, output, region and time, select the same values as you used previously. Make sure the latitude and longitude range is the same and also the value in Select time. Click the Next link.
14. A color plot should appear in a separate pop-up screen. Save this data by printing it or clicking File → Save As. Enter "Tibet temperature" as your file name and save it to your desktop or another specified location. Close this pop-up window only.

**Part II:** Explore recent radiosonde data from Lhasa, Tibet to understand the change in weather conditions with altitude in the region.

1. Go to the NOAA Radiosonde Database. You can find this website here: http://raob.fsl.noaa.gov/
2. Under Input Dates, enter yesterday's date as the From date and today's data as the To date to get the most recent data. Click Continue Data Request.
3. In the text box under Option 2, enter the WMO station identifier number 55591 for Lhasa, Tibet. (WMO stands for World Meteorological Organization). With FSL format (ASCII text) selected, click Continue Data Access.
4. The output should appear in the screen. Save this data by printing it or clicking File → Save As. Enter "Tibet current conditions" as your file name and save it to your desktop or another specified location.
5. You should have a copy of the FSL Output Format description document. Review this document. Note: When looking at the output, remember the surface elevation is high, so the lower level data will always be missing (99999). Also note that dew point temperature may be compared to the temperature to examine relative humidity.
6. Answer questions 1-4 on page 2.

**Questions**

1. Referring back to the letter from Mr. Brand, what weather conditions do you think would make a good or poor retreat site?

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2. Does the weather data that you examined in Tibet support these qualities? Use the two graphs from Part 1 to help you explain your answer.

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_____

3. What other characteristics, such as precipitation, cloud cover, etc., would you examine?

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_____

4. What recommendation do you have? Complete a letter and report reply to Mr. Al G. Brand. Be sure to include an analysis of the relationship between altitude, pressure, temperature and humidity for your site.