

Objectives

The student will be able to do the following:

- Define streamflow
- Explain what influences streamflow (input and output)
- Navigate to and examine rainfall and streamflow data available on the web
- Use Microsoft Excel to graph and examine rainfall and streamflow data
- Identify causes of floods, including the specific cause of the Manoa Flood

Materials

Worksheet and directions, at least one per group or one per student if desired
Computers, one per group or one per student, with Microsoft Excel and Internet access

Background

This unit introduces students to the use of real data to examine natural a phenomenon. This unit relies on students' memories of the Manoa flood from 2004.

Advance Preparation

Students should be comfortable using the internet and Microsoft Excel.

Procedure

1. Begin by discussing streamflow. Students should be able to define streamflow.
2. Ask students to brainstorm ideas for what influences streamflow. What are the inputs and outputs for streamflow in Hawaii?
 - Inputs: Rainwater is the ultimate input. But before water gets to the stream it can go through many paths (seepage from soil, overground runoff, dripping from forests, etc.)
 - Outputs: Public water supplies, irrigation, storage in reservoirs, diversions for taro patches, etc.
3. Stress conservation of mass. For instance, when it rains, water does not disappear. It may evaporate, be stored, or flow into a stream.
4. Ask students to think about what causes a flood. What are some reasons that flooding occurs?
 - High amounts of rainfall
 - Dams that break
 - Poor land uses that funnel streamflow to one place quickly
 - Students should identify rainfall as an important cause of flooding in Manoa.
5. Tell students that they will get to examine rainfall and streamflow data for themselves, and that they will use this data to determine when floods have occurred in Manoa.
6. Have students break into groups. These groups may function better as smaller groups. Each group should have computer with Microsoft Excel and Internet access.

7. Begin by having students identify where rainfall and streamflow data can be found.
 - Explain that the US government has a responsibility to monitor rainfall and streamflow, and that because that data is taken by the government, it must be publicly available.
 - Have everyone go to: <http://hi.water.usgs.gov/>. This is the homepage for all of their Pacific water data.
 - Have them follow the link under Water Conditions – Quick Links, recent conditions, and click on State of Hawaii.
 - This link will take them to: <http://hi.water.usgs.gov/recent/index.html>
 - a. Ask students what the website says about recent rainfall in Oahu. You may want to go over the results – what is average, or some % above or below average. You might also need to discuss the median (the middle number)
 - b. Ask students what the website says about recent streamflow in Oahu.
 - c. On 12 February 2008, streamflow was above normal while rainfall was below normal. You may want to pause and examine what could have caused this. You can point out that streamflow is not an immediate response to rainfall. Streamflow is influenced by how much water the soil can hold, how much is used by plants, etc. It might be good to remember places where water is found. You might also discuss problems with data collection. Streamflow is collected relatively easily and accurately, especially when it is not a low-flow situation. Rainfall has a higher error (rain does not fall consistently in one spot, it blows around with the wind, it can be intercepted by trees).
 - d. Have students hit the back button to get back to the homepage (<http://hi.water.usgs.gov/>)
 - Have them follow the link under Real-Time Data for rainfall (there is no current data for Manoa streamflow)
 - a. They should find the Manoa rainfall gauge (second one down) and identify what the current rainfall is.
 - b. They should hit back to get back to the homepage
 - Have them go hit the link for rainfall under Historical Data
 - a. They will have to scroll down to find the Manoa rainfall data. They should be able to identify the name of the rainfall station (711.6 Manoa RG at Kanewai Fld, Honolulu, Oahu, HI)
 - b. Click on the link for the rainfall data for the station.
 - c. Have them click on daily data
 - d. This will show them a graph of rainfall from the last year.
 - e. Have students look at the data from 2004
 - i. Under begin date they should type 2004-01-01
 - ii. Under end date they should type 2004-12-31
 - iii. Click “Table”
 - iv. Click GO
 - v. They will see a table with values. Ask them what the numbers mean (total inches for the day). Go over the measurements –

rainfall is measured in inches or cm (height) of rain falling per day.

8. Have students close the internet browser. They have explored where data can be found. Now they will play with real data.
9. Using Excel. Go over Excel if necessary.
10. Each student should have the “Manoa Water” file on their computer. They should open the file.
11. Students should graph the streamflow data for the year.
 - a. Select Column D (Discharge, cubic feet per second)
 - b. Hit the Chart button
 - c. Select either the bar
 - d. Grab the graph and move it to the side so that it is not on top of the data
12. Have students examine the data.
 - a. Is there a clear peak? About what day of the year was the flood (somewhere between day 300 and 323)
 - b. Have students then go to the data itself and identify the exact day of the flood (Day 305, October 30). They can also click on the bar on the graph and it will tell them the number of the day and the value (490 ft³/s)
13. Have student graph the rainfall data for the year, following the same procedure as for streamflow.
14. Have students examine the graph.
 - a. What does the rainfall show? Was there one single day of rain that led to the flood? (No, it was a combination of rainfall over a number of days, including high rainfall from the 24th and 25th). On the day of the flood it was very high (3.36 inches)
 - b. Was the rainfall before the flood the largest rainfall of the year? (No, there were other events that had more rain before)
 - c. What happened before it started raining (it was pretty dry)
 - d. Was the rainfall before the flood above, below, or at average? (You can have students figure out the average using the Average Key (Average E3:E368) or just tell them the average (0.15 inches). The rainfall in the days before the flood was way above average (it was above average on some of the days before the flood).
15. Have students discuss what caused the flood. It was more than just a single high event, otherwise there would have been flooding in February, which had the highest rainfall for the year (3.81 inches). It was a combination of many days of rain and a very high rainfall event on the day of the flood.

Directions and Worksheet Questions

Name _____

Follow these directions and answer each question.

1. Open the internet and Go to: <http://hi.water.usgs.gov/>
2. Click on "State of Hawaii" under Water Conditions - Quick Links/ Recent conditions
You should be at <http://hi.water.usgs.gov/recent/index.html>

What is recent rainfall in Oahu like? _____

What is recent streamflow in Oahu like? _____

Why are they different? _____

3. Hit the back button (<http://hi.water.usgs.gov/>)
4. Click on the link for Real-Time Data for Rainfall

What is the current rainfall in Manoa? _____

5. Hit the back button
6. Click on the link for Historical Data
7. Scroll down and find the Manoa rainfall data

What is the name of the Manoa rainfall station? _____

8. Click on the link for the station (the blue link with the numbers)
9. Click on daily data. Examine the graph of rainfall from last year.
10. Get the data from 2004.
 - Under begin date, type "2004-01-01"
 - Under end date, type "2004-12-31"
 - Click "Table"
 - Click GO

What are the units for rainfall data? _____

11. Close the internet. Open the Microsoft Excel file called "Manoa Water"

12. Go to the worksheet called Manoa Streamflow. Graph the streamflow for the year:

- Select Column D (Discharge, cubic feet per second)
- Hit the Chart button
- Select the bar option and ok
- Grab the graph and move it to the side so that it is not on top of the data
- Use the graph and the data to figure out what day the flood happened.

What day was the flood? _____

What was the value of the streamflow on the day that it flooded? _____

13. Go to the worksheet called "Manoa Rainfall." Graph the rainfall data for the year, the same way you graphed streamflow.

What was the rainfall on the day of the flood? _____

Was this the highest rainfall of the year? Yes No

What day was the highest rainfall of the year? _____

Was the flood caused by rainfall on only one day? Yes No

Was there heavy rainfall on other days before the flood? Yes No

What days? _____

What were the conditions like before it started raining heavily? _____

Was rainfall on the day of the flood average, above average, or below average? _____

In your opinion, what caused the flood? _____
