

Objectives

The student will be able to do the following:

- List and describe land uses in the Manoa watershed
- Describe how land uses influence streamflow
- Identify possible sources of pollution to the Manoa stream

Materials

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

Background

The Internet is a rich source of data for many things. Publicly available packages such as maps.google.com and Google Earth provide current aerial photographs, topographic maps, and feature maps for most places on earth. Students can use this data to examine their own watershed and identify stream influences.

This unit builds on the second watershed unit, taking students from a 2-D to a 3-D platform and asking for more detailed understanding of the watershed.

Advance Preparation

Students should be comfortable using the internet. Teachers may want to pre-load Google Earth onto computers, in which case the class can skip to the examination section.

Each student or group (as desired) should have a copy of the worksheet.

Procedure

1. Discuss land uses. Students should understand the people change and impact the landscape, and these are land uses. Areas that are not changed are also land uses, but may be considered natural areas. Explain that in this activity, students will examine all ways that land is used AND not used (both developed and natural areas) in the Manoa watershed.
2. Discuss how land uses impact a watershed:
 - a. In terms of streamflow:
 - i. Industrial areas often use water from streams and convert some of the water to steam so that it leaves the stream.
 - ii. Municipal water supplies in many places outside of Hawaii divert water to public supplies, reducing the amount of water in the stream. This water is often diverted to treatment plants after use, rather than returned to the watershed. In Hawaii, most public water is groundwater.
 - iii. Agricultural areas divert water to fields, where it can evaporate, be stored in plants, or be diverted to other watersheds.

- iv. People build dams and reservoirs to store and regulate water in streams.
 - v. Natural forest areas are important for water, but tend to reduce the amount of flow in a stream as water is stored in the soil or taken up in plants and transpired.
 - vi. Removal of vegetation often leads to more water in a stream or river, but the regularity of flow many vary.
 - vii. In Manoa, there is no agriculture, industry, or municipal water source using water from the stream. Thus, streamflow is influenced by the amount of forested area and the amount of developed area.
- b. In terms of pollution:
- i. Natural areas tend to remove pollution from runoff before it reaches a stream.
 - ii. Developed areas tend to introduce pollution into runoff and streams.
 - iii. Cleared areas are sources of sediment. Cleared areas around streams increase the temperature of the stream.
 - iv. Industrial areas are sources of contaminants such as metals and oils, and are often point sources of pollution.
 - v. Agriculture is a source of sediment and excess nutrients, plus chemicals from pesticides. Animal farms can provide coliform.
 - vi. Residential areas are sources of excess nutrients and contaminants from soaps, fertilizers, and pesticides. Residential areas relying on septic tanks are sources of coliform bacteria.
 - vii. Roads and paved areas are sources of oils and heavy metals.
3. Discuss why we want to study land uses (to see what influences streamflow and pollution).
4. Ask for input on ways to identify and quantify land uses. Possible methods are to obtain aerial photos, conduct on-the-ground surveys, look at printed maps, talk to others, etc.

Activity

1. Explain that in today's activity, they are going to use aerial photos and satellite images to examine the watershed.
2. The worksheet will guide students through installation and use of Google Earth.
3. The worksheet will also ask them to identify influences on streamflow and sources of pollution.
4. Have students break into groups. These groups may function better as smaller groups. Each group should have computer with Internet access.
5. Each group should navigate to maps.google.com.
 - a. Type in Hokulani Elementary School, Honolulu, HI
 - b. Examine the maps (maps, satellite, terrain)
 - i. Find the address of the school (Letter A, 2940 Kamakini St, Honolulu, HI)

- ii. Examine each type of map (maps shows roads, buildings on an abstract background, satellite is aerial photographs, terrain is a relief map showing elevation).
 - iii. Find the tributaries to the stream (4 total)
- 6. Each group should navigate to earth.google.com
 - a. Download Google Earth
 - b. Install Google Earth
 - i. A question asks about the icon (a blue circle/globe with white lines)
 - c. Use Google Earth to examine the watershed, including in 3-D using the zoom and turn features.
 - i. Turning off the terrain leaves a flat map
 - d. Examine the Manoa Stream
 - i. A problem with Google Earth is that it does not show streams (other than as photographs) so it is hard to tell where they are located. Students can use the green riparian area to help find the stream in the developed areas. They can also use the terrain to infer where the locations of the tributaries are in the forested areas.
 - ii. Scientists often have to work with incomplete data sets, so they use multiple data sources to inform their work.
 - iii. There is a riparian buffer zone along much of the stream. Near the Manoa District park there is a missing patch and behind Hokulani. Below the highway there are missing patches.
- 7. Each group should answer questions on the worksheet, including influences on streamflow and possible sources of pollution throughout the watershed.
 - a. Land uses: residential, commercial/business, roads, paved areas (parking lots, driveways), natural areas (forests), and parks.
 - b. Prevalent – natural forest and residential
 - c. Natural areas are on the mountains, not in the valley
 - d. The land uses influence streamflow
 - e. Sources of pollution – vary, from land uses.

Directions and Worksheet Questions

Name _____

Follow these directions and answer each question.

1. Open the internet and Go to: <http://maps.google.com/>

2. Type in "Hokulani Elementary School, Honolulu, HI "

What is the address of the school? _____

3. Click on the Map, Satellite, and Terrain buttons

What does each type of map show?

Map _____

Satellite _____

Terrain _____

4. Pick a way to view the map (map, satellite, or terrain), zoom in, and follow the Manoa Stream.

How many tributaries feed into the Manoa Stream? _____

5. Go to: <http://earth.google.com/>

6. Click on the DOWNLOAD button

7. Agree to the conditions and hit download. Click run to install the software. The software should install on your computer. This may take a few minutes. After the software has installed, look for the icon to start the program on your computer.

What does the icon for Google Earth look like? _____

8. Open the program. Under "Fly to," type in "Manoa Stream"

9. Take a few minutes to explore the Manoa watershed.

- You can zoom in, and you can make the watershed vertical. Play with the compass, the zoom bar, and the horizontal plane bar. Use the mouse to move around the watershed.
- You can view different layers. In the box on the bottom left, turn on and off layers.

What happens when you turn off the terrain layer while you are in a horizontal view?

10. Find the Manoa Stream. Try to follow the Manoa stream back to its tributaries.

What is one problem with Google Earth? _____

Is there a map showing where the stream is? _____

What clues can you use to find the stream? _____

Is there Riparian Buffer Zone along the entire stream? _____

Where is the Riparian Buffer Zone missing? _____

11. Use both maps.google.com and Google Earth to examine the Manoa watershed.

12. Some land uses in Hawaii include: industry, agriculture, residential, commercial/business, roads and paved areas, natural areas, parks, and cleared/bare areas.

What are the land uses in the Manoa watershed? _____

What is the most prevalent land use? _____

Where are natural areas found? _____

What influences streamflow in the Manoa Watershed? _____

What are some sources of pollution in the Manoa Watershed? _____

Circle the land uses present in the Manoa Watershed:

Industry	Agriculture	Residential	Commercial/business
Roads	Paved areas	Natural areas	Cleared areas