WATERSHEDS:
STREAM CHANNELS AND POST-FIRE STREAM FLOWS

AUTHORS:

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GRADE LEVELS: 5-8

OVERVIEW OF LESSON PLAN:
Students will draw cross sections of a stream channel from field data. In the field, they will determine the depth of a stream channel across its width and record what materials are in the channel bottom across the profile. In the classroom, they will use a spreadsheet to graph the stream channel. Students can compare the shape and nature of their profile to those taken in the same location in previous years.

SUGGESTED TIME ALLOWANCE:
One hour in the field, two hours in the classroom.

SKILLS:
- Collect, organize, and analyze data.
- Use various measuring tools to collect data.
- Examine the impacts of humans on the natural environment
- Observe, graph, record and predict geological changes on earth.

TEACHER BACKGROUND:

Streams adjust their dimensions to the amount of stream flow and erosional debris. The type of sediment and bedrock they flow through, the relief, or steepness of the watershed, the size of the watershed, and the impacts of humans on the watershed modify individual streams.

A watershed is a natural system. It is the land area that water, sediment and other materials drain to a common point, usually a river, lake or the ocean. Landforms such as mountain peaks, ridges and mesas form the divides. The divides determine the direction that the water flows. For instance, water falling as rain on the top of the Quemazon Trail could drain south, into Los Alamos Canyon, or could drain to the north into Pueblo Canyon.

FACTORS AFFECTING WATERSHEDS

Climate

Watersheds are linked directly to the climate of an area. The climate determines when water comes to the watershed. In some places, such as the Northwest Coast of the U.S., precipitation falls fairly regularly on the watershed. In our part of the world most of our precipitation comes from snow in the winter and high intensity short duration rainfall events during summer.

Most of the rain falling on the watershed runs immediately off and is what we see as stream flow during and after a storm. However, some of the precipitation infiltrates the soil and percolates through the bedrock into the aquifer, or ground water. Natural groundwater discharge is the main contributor to stream flow in streams like Frijoles Creek during the dry parts of the year.

Erosion

In most cases a watershed is composed of hill slopes and stream channels. Water falling as rain or snow falls on the hill slopes and eventually finds it way into the stream channels. The process of water running over the hill slopes causes erosion. The water picks up soil and rocks and transports them to the stream channel. Stream channels change their size and shape by erosion and deposition.

Physical features

The area of a watershed affects the amount of water produced. In general, a watershed covering a larger area receives more precipitation that a small watershed. Shape and slope of the watershed and its drainage pattern determine how fast water runs out of the watershed.

Vegetative cover

The amount of grasses, forbs, shrubs and trees also determine how fast water runs out of the watershed. Plants build up a layer plant litter, or duff, that helps to protect the soil from the impact of rainfall. Plants and the duff absorb the energy of the falling rain. This energy tends to dislodge soil particles and start the erosion process on un-protected soils. The duff also helps to absorb water and release it slowly to the soil. The roots of the plants and trees help to hold the soil together and help to open up the soil so water can infiltrate.

Human Influences

Watersheds and stream channels respond to our activities in watersheds. Activities such as timber harvest can increase erosion and reduce vegetative cover. Grazing can also remove vegetative cover and degrade riparian areas, which hold stream banks together.

Fire

Fire can be very destructive to watersheds and their plant cover. Under certain conditions, a fire can remove all the vegetation, the duff and cause the soil to become hydrophobic, or water repellant.

Without its protective layer of plants and duff, the runoff and erosion are greatly increased from a watershed. A rainfall event that would hardly produce any stream flow on a well-vegetated watershed can produce massive destructive flows in burnt watershed. Most of the precipitation falling on a burned watershed becomes rapid runoff. Streams in these watersheds carry massive loads of sediment and debris. Stream channels in burnt watersheds will respond by becoming wider and or deeper in profile.

Fire can be beneficial to a watershed when it is carefully managed. Fire can be used as a tool to reduce available fuel loads to prevent more destructive fires in the future. Fire thins plants that complete for the same light and space. In this area, ponderosa pine is the major forest type and frequent low intensity fires maintain its health.

PRE-FIELD TRIP ACTIVITY: WHAT IS A WATERSHED?

OBJECTIVE

Students will learn what a watershed is by using a map to define the boundaries of watersheds in the Los Alamos area.

TEACHER INSTRUCTIONS FOR MAPPING ACTIVITY

Use the map of Los Alamos Watersheds. Each student should have a copy of the map and 10 different colored pencils or markers. Tell students that the Los Alamos area has about 10 major watersheds, and seven of those are shown on the map, along with a few minor watersheds. Their task is to trace the streams in each watershed a different color and to draw a boundary around each of the watersheds.

For each watershed, have the students start tracing with a different color and to begin at the Rio Grande. Whenever the trace comes to where two streams meet, students should trace the longest stream first. The longest line is called the main branch of the watershed. After the main stream is traced, students should go back and trace all the streams that meet the main branch.

Repeat the tracing process for every stream that meets the Rio Grande. There will be 7 watersheds that have more than one branch and two small watersheds that only have one branch.

Next, with a different color pencil, students should draw a boundary around each of the watersheds. No boundary line should cross any of the streams. All precipitation falling within the boundary will flow to the Rio Grande.

<u>Extension</u>: Use photocopies of topographic maps to trace the boundaries of some of the watersheds in the Los Alamos area. Do this by tracing the stream channels in blue ink, then drawing the dividing lines between the watersheds in red ink.

Discuss:

1. Which are the largest watersheds in the Los Alamos area? Which watersheds would you expect to add the most water to the Rio Grande?

2. A watershed collects all the rain that falls within its boundaries. One inch of rain delivers about a half gallon of water on every square foot of land surface. The upper Pueblo Canyon watershed is about 2 square miles. If all the rain that falls on the watershed ran down hill and into the streams, how many gallons of water would flow under Diamond Drive?

3. In an unburned watershed, what features reduce the amount of water that flows down the streams?

Key terms:

Runoff: water from rain or snow that flows down hills and into streams

Watershed: a natural system made of the land area that water, sediment and other materials drain to a common point, usually a river, lake or the ocean.

Erosion: the removal of rocks and soil from the land by flowing water (or wind)

Sediment: small particles of rock and soil that are easily moved in water and deposited along streams

Non-point source pollution: particles or materials the flow in water that are the result of runoff and land use

STREAM PROFILE FIELD RESEARCH INSTRUCTIONS

Materials: long surveyor tape measure, short tape measure, line level, GPS, data sheet, C-clamps

Procedure:

1. Find your assigned profile location and record the letter and number written on the flagging material tied to the metal stake.

2. Use a GPS to find the coordinates for the profile end point (the metal stake) and record the point's location.

3. Cross the stream channel and locate the other end of the profile line, which is marked by another metal stake. Record the end point's location with the GPS.

4. Hook one end of the long tape measure on a metal stake at the red mark. Stretch the tape measure across the stream channel from metal stake to metal stake. Record the total length of your cross section (from metal stake to metal stake).

5. Put a C clamp on the second metal stake. Pull the tape tight, but not too tight and wrap the tape around the clamp to hold it in place. Use the line level to get the tape level across the stream.

6. Go back to the starting point and start collecting data. Take the short tape measure drop it straight down to the ground. Measure and record the height of the surveyor tape. Record what you see at the point where the short tape measure touches the ground: dirt, sand, pebbles, small rocks, a boulder, a log, etc.

7. Repeat the measurement of the height of the surveyor tape every two feet across the stream channel (measure every five feet for a large stream).

8. Back in the classroom, enter your data into a spreadsheet and graph the profile of the stream.

CLASSROOM ANALYSIS: CREATING FIELD REPORTS

Each group of students will generate a field report with stream channel data and analysis that can be used to compare with future field reports from the same profile site.

<u>Mapping the Endpoints of the Profiles</u>

Using mapping software, enter the coordinates of the endpoints of your cross section that you read from the GPS. Print the map as part of the field report.

<u>Creating a Profile of Your Cross Section with a Spreadsheet</u>

Create an electronic form of your data on a spreadsheet. Include all the information: Your names, the watershed name, the coordinates of the endpoints, the distance along the profile, the height of the survey line, and the description of the channel. ONE EXCEPTION: WHEN YOU ENTER THE NUMBER FOR THE HEIGHT OF THE SURVEY, MAKE IT A NEGATIVE NUMBER (4 BECOMES –4) SO THE GRAPH WILL SHOW A DEPRESSION.

Follow the instructions of the software to create a graph of your data. The graph will show the shape of the stream channel.

On your graph, label every 5 feet with a description of the material in the bottom of the stream channel from your data table.

<u>Assemble a field report</u>

Create a field report that has your data table and stream channel profile. Carefully label all your information so that other students can use it.

Discuss:

1. What part of the stream channel shows the most change: the sides, the middle, or somewhere else?

2. Sediment moving in a stream channel decreases the water quality of the stream. What changes in water quality would you expect from a point downstream of your cross section?

3. What are some of the ways to prevent flooding and erosion after a wildfire?

4. With data from other classes and school, compare the stream channel changes in different watersheds. Which watersheds have seen the most changes in the stream channels? Does the size of the watershed affect the amount of change in the stream channel? Does the burn severity in the upper watershed affect the amount of change in the stream channel?

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