Lesson Three: Background Investigation of a Watershed

Activity One: Contour Lines

Grade Level
6-10

Time Frame
One Fifty-Minute Class Period

Materials
Contour Matching Worksheet

Overview

This activity teaches the student how to make observations of topographic maps and make educated predictions about the landforms they represent.

TEKS

Social Studies
Grade 6 6.6, 6.7, 6.21, 6.22
Grade 7 7.10, 7.21, 7.22
Grade 8 8.30, 8.31
Geography 4A, 4B

Objective

The student will be able to interpret contour lines as landforms.

Background

The interpretation of certain slope types on a topographic map is sometimes difficult for students with no prior map reading experience. This teaching tip suggests a method of demonstrating concave and convex slopes by using a simple bowl with contour lines drawn on the inside and outside. The four basic slope types depicted by contour lines on a topographic map include uniform gentle, uniform steep, concave, and convex.

Most instructors begin teaching slope characteristics on topographic maps by explaining that the wide spacing of contour lines indicates a gentle slope, while the close spacing of contour lines indicates a steep slope. Armed with this basic information, students can progress to an understanding of the four basic slope types.

The visualization of uniform gentle and uniform steep slopes on a topographic map usually poses no problems for students. A uniform gentle slope is illustrated by contours that are evenly spaced but far apart, while a uniform steep slope is illustrated by contour lines that are evenly spaced but close together. Concave and convex slopes, on the other hand, are more difficult for students to visualize and locate on a topographic map. Before asking students to examine a topographic map, these slopes can be

demonstrated by drawing contour lines on both the inside and outside of a bowl or pie plate.

Academic Questions

How can contour maps aid in understanding the physical topography of a place?

Procedure/Activities

- *Concave slope:* using the rule for slope steepness and the spacing of contour lines, the instructor or students can draw contour lines on the inside of the bowl to illustrate a concave slope (bowl is right side up). Progressing down the steep sides of the bowl from the rim, the contour lines will first be spaced close together, and then farther apart on the nearly flat bottom.
- *Convex slope:* upside down, beginning at the top center, the slope is first gentle, and then steepens as one descends the sides to the bottom. The contour lines would be drawn widely spaced near the top, and closely spaced on the sides of the inverted bowl.
- *Two topographic features* (a hill and a depression): Turning the bowl upside down and drawing contour lines in the form of closed loops inward from the rim toward the center can illustrate a hill. Similarly, a depression can be illustrated by drawing closed contours with hachures on the inside of the bowl turned right side up.

While these demonstrations are simple, they provide students with a vivid mental image of the spacing of contour lines on a familiar object. The technique also reinforces learning because students are reminded of topography while consuming breakfast cereal.

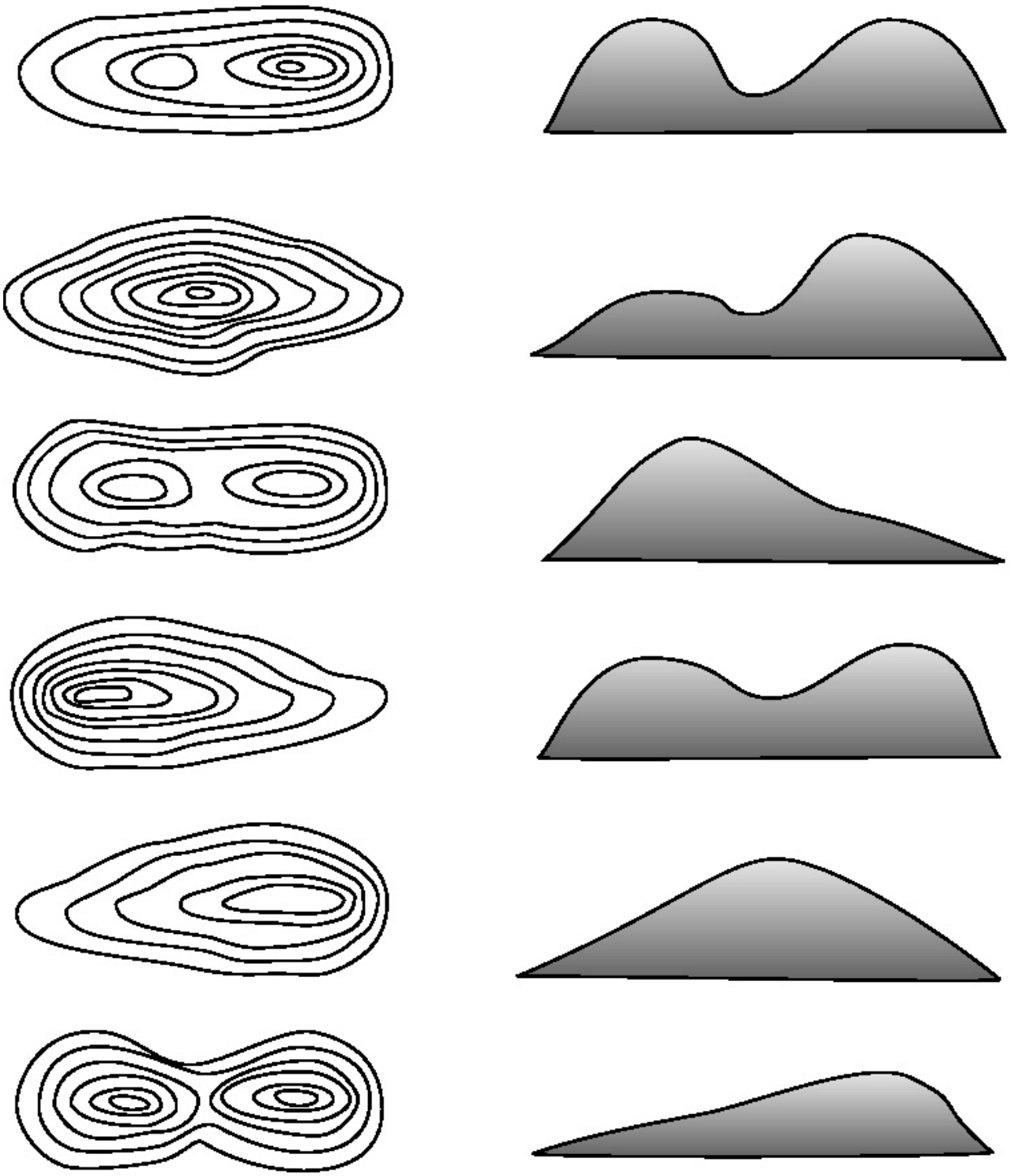
Product/Application

The teacher presents a small oval clay mountain model, which is steep on one end, and gradually sloping on the other end. Students individually draw a topographic map of Clay Mountain. Allow students to briefly explain to the class why they drew the contour lines as they did.

Assessment

Pass out the Contour Matching Worksheet and allow students to determine how each elevation would be represented using contour lines.

Contour Matching Worksheet



Lesson Three: Background Investigation of a Watershed

Activity Two: Hand Land

Grade Level:
3-6

Time Frame: Three Fifty-Minute Class Periods

Materials
Water
8.5" x 11" typing or writing paper
eye dropper
pencil
paper towel
color dot labels, 1/4". Each student needs a minimum of 6 dots. One package holds 450 dots.

Overview

Hand Land offers students an opportunity to learn through fun and simple observations complimented by inquiry based analysis. Students will learn the physical definition of a watershed: by observing the general watershed characteristics of high, middle and low topography that are visible on one's own hand. Four exercises are included in Hand Land.

TEKS

Social Studies

Grade 3 3.16
Grade 4 4.22
Grade 5 5.8, 5.25, 5.27
Grade 6 6.6, 6.7, 6.21, 6.22

Art

Grade 3 3.1A, 3.2A, 3.2B
Grade 4 4.1A, 4.2A, 4.2B
Grade 5 5.1A, 5.2A, 5.2B
Grade 6 6.1A, 6.1B, 6.2A

Objectives

- Experience the movement of rainwater over land.
- Speculate on the flow characteristics of rainfall.
- Explain the concept of flow over a land.
- Explain topographical representation.
- Explain the boundary of watershed

Background

In a watershed, water flows from the high point to the low point terminating in a collective source: a river, lake or ocean. In our Hand Land watershed, water flows from the wrist downward, the bones in the back of one's outstretched hand act as the divides, or high points, delineating the watershed boundaries, causing water to flow in either direction. One can typically observe water moving in small streams down the hand towards the lowest elevation on the edge of the hand or into one of the other watersheds, which lie, between each finger. The back of the students' outstretched hands will act as the model for this experiment. Students

create a concentric drawing of their hand to record their prediction and experiment with water movement on this hand-model.

Academic Questions

- How do you make a topographic model?
- Where will the water go when it rains?
- Where are the boundaries for watersheds?

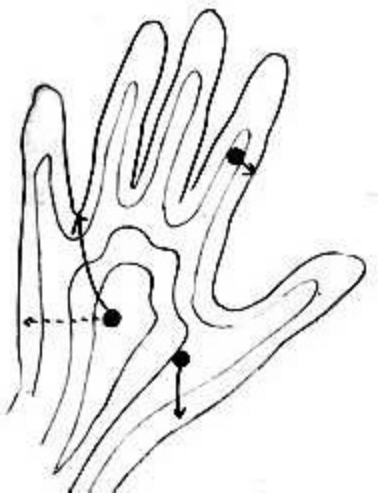
Preparation

Students work in pairs, sharing the eyedroppers and water.
Students get their own pencil, paper, paper towel and adhesive dots.
Review if necessary the concept of a watershed, the water cycle, and topographic maps including contour lines.

Activities/Procedures (total of 4 exercises)

Exercise 1: Create a topographical map of your Hand-Land.

- Review the watershed concept.
- Remind them of the topographical map of a watershed.
- Discuss boundary lines, high and low elevations.
- For our topographical map, students will mark a series of concentric lines 1/4" in from the outline of their hand.
- Materials are passed out and students begin to create topographical maps.



Exercise 2: Where will the water go when it rains?

- Have the students look carefully at their hands.
- Water flows down hill. How will water move when it falls on the surface of their hands?
- Each student should place three dots on their hand. Match these same points with a pen on their drawing.
- Draw a line with an arrow to show which way the water will move when it "rains" on their Hand-Land.

Exercise 3: Discovering the movement of water in a watershed

- Teacher's introduction: Observe the topography of your Hand.
- Notice its high points, the bone structure, and the low points.
- Take a water dropper and have the students put water drop by drop on their dots. Have them carefully observe which way the water moves.
- Track the movement of the water on their hand on their topographical map. Once they know which way the water moves in the area of the three dots, let them experiment with other areas of their hand.
- Each experiment and its related water movement must be recorded on their drawing.

Exercise 4: Finding a watershed boundary

- Teacher's introduction: Notice that the high points and ridgelines of the bone structure become the dividing lines that separate watershed boundaries.
- Ask students to carefully identify a single watershed with a specific color crayon.
- Then have them discover the total number of watersheds on their hand

Product/Application

Ask students to count the watersheds and identify the boundaries on their Hand-Lands.

Explain the concept of a sub-watershed and its relationship to a larger watershed.

Is the Hand-Land a single watershed or a group of sub-watersheds?

Share their discovery.

Assessment

Ask students to draw what actually happened versus what they thought would happen.

Ask students to write a brief description (3-4 sentences) of their observations.

Show map of Texas. Find the major watersheds in the state.

Extension Exercises

Watercolors offer a unique and creative approach to understanding topography.

In these exercises students paint the hand-land.

Materials

Kozo or Sumi-e paper

Primary colors of watercolor paints (yellow, cyan, magenta)

Brush

Water

Preparation

Show some watercolor paintings, and explain how watercolor paint is used. Explain how we use and combine primary colors. Provide a specific demonstration of gradation painting. (Illustrate how to use paint to create a gradation of light to dark tones, by varying the amount of pigment in relationship to water.)

Procedure/Activities

Extension 1: Understanding the Process

Wet Kozo or Sumi-e paper with a large watercolor brush and water.

Select one color and touch a drop of the watercolor to the wet area.

Observe the flow of the watercolor into the wet area of the paper.

Saturate your brush with one color paint. Pull the saturated brush across parallel lines of the wet paper, as the brush runs out of color dip it into

water, and continue the process. Notice how the color becomes lighter as it loses pigment. Learn to regulate the amount of water and pigment needed to control gradation by working with a single watercolor painting darkest to lightest.
Share the students' process when they are painting.

Extension Two: Investigation and discovery with watercolor
Observe the original Hand Land drawing you made with concentric patterns of its outline.
Locate the highest areas within your drawing and the lowest areas of the topography.
Wet the drawing of the hand on Kozo or Sumi-e paper with a large watercolor brush and water.
Select one or at the most two color(s) and touch a drop of the watercolor to the wet area.
Control the watercolor by painting each concentric shape with a specific graduated tone of color until the entire drawing represents several "watersheds" with varying topographies.
Repeat this process until you have mastered the effect.
Paint a Hand-Land.

Product/Application
Were they surprised in the way the color moved?
Does the way water moves on a paper have anything to do with the way rain moves over land?
Which of the two art-works is more interesting?
Which of the two tell us more about watersheds?
Which of the two is the most beautiful?

Assessment
Ask each student to write three or four sentences about how the hand-land and painted hand-land represent watersheds.

Lesson Three: Background Investigation of a Watershed
Activity Three: Biography of a River

Time Frame:
2 Fifty Minute Class periods with research as homework

Grade Level:
6-10

Materials:
library

Overview
The students will research the development, history, and importance of several rivers in the state of Texas.

TEKS
Social Studies:
Grade 6 6.6, 6.7, 6.21, 6.22
Grade 7 7.8, 7.9, 7.10, 7.11 7.21, 7.22
Grade 8 8.30, 8.31
Environmental Studies 4C, 5B, 5C,5E, 8A
US History (Geo)8, Geo11, 24, 25
World Geography 8, SS22A,

English
Grade 6 6.13, 6.15, 6.20
Grade 7 7.13, 7.15, 7.20
Grade 8 8.13D, 8.13E, 8.15, 8.20
English I 2 A, 3D, 4D, 4F
English I I 3A, 3D, 4D

Objectives
Compare and contrast facts about the development, history, and importance of several rivers in Texas. Thoroughly research the history and development of one particular river.

Background
Rivers' vital role in the development of civilizations is reflected in the many references to rivers in literature and history. Today rivers need protection, and one way to fuel an interest in preserving a river is to have students become familiar with their local rivers so that they feel an ownership to them. Writing a biography of a river is one way for students to combine research, interview skills, creative writing, history, and science into a single project. Keep this project fun and allow for creativity; however, set limits on what material is acceptable.

Academic Question
How have rivers played an important role in local communities past and present, and predict their role in the future?

Preparation

Begin a general discussion of familiar rivers, asking:
What are the rivers in our state?
Who has ever seen/visited any of the rivers?
What did you do there?
Have any of your grandparents or parents told family stories about experiences on the rivers of this state?
Who has knowledge of other rivers in the U. S.?
How did rivers help in the development of this country?
In what ways are rivers important? Explain that important people have biographies written about them. That is what students are going to do for the rivers of the state.

Procedure/Activities

Assign each student (or pair, small group) a major river/waterway located within then state. For example, page 12 of *Conducting a Watershed Survey* includes a biography of Blunn Creek in Austin Texas.
The river biography should include the following:

- **Birth information**: This includes how the river was formed geologically, approximate time period, original course. How and why was the river named?

- **Location and description**: Include a drawn or copied map of the river noting the major cities and describe the land uses along its route, its aquatic life, and other characteristics including vegetation and wildlife.

- **Century report**: Beginning with 1700 through the present, write a report to include historical events related to or occurring near the river. Include important people related to the river or locations near the river, contributions/uses of the river (industry, transportation, recreation, security, agriculture), and changes to the river and surrounding area.

- **Personal interviews**: If possible, interview two people who have had personal experiences with the river. Write about their thoughts,

remembrances, experiences, and other information about the river and its importance or role in their lives.

- **Death announcement**: Research what could cause the "death" (no longer exists or no longer supports life) of the **river**. Write a fictional account of the events leading up to the death and the consequences of this death for the state.

Place all the information in a folder or report and illustrate the cover. You also may want oral reports on their findings.

Product/Application

Ask each student or small group to give a five-minute presentation about his/her river sharing the most significant facts and pointing out its location on a state map.

Assessment

Have students be responsible for reading the biographies of at least two other rivers and write a comparison paper comparing their river with these two.

Extension

Read descriptions of rivers in literature such as in Huckleberry Finn, the writings of J. Wesley Powell, the River Styx, and Cleopatra and the Nile. Compare these rivers

Have the students research any songs written about their rivers or compose one themselves.

Lesson Three: Background Investigation of a Watershed
Activity Four: Delineating A Watershed

Overview

This activity teaches the students to read, use, and interpret information on topographic maps. The student will understand the impact of land use on the watershed.

Grade Level:
6-12

Time Frame:
3 Fifty-Minute Class Periods

Materials
Sheet of plastic (mylar or acetate) – obtainable from art or office supply stores
Cardboard
Tape or thumb tacks
Dry erase markers
Rulers
Calculators
7 ½ Minute Topographic Map of your school or community

TEKS

Please refer to last page of this activity

Objectives

Understand processes involved in mapping a watershed.
Identify important features on topographic maps.
Determine primary land uses in watershed.
Identify potential hazards to water quality at monitoring site location.

Background Topographic Maps

Topographic maps provide one method of analyzing factors that influence water quality parameters and of mapping a watershed. Topographic maps, a type of contour map, project a flat, 2-D representation of the shape of earth's surface. These maps also identify other important physical and cultural features, such as vegetation, streams, lakes, caves, towns, buildings, roads, pipelines, and bridges.

Topographic maps serve many purposes for a diversity of professionals. These people include city planners, urban developers, hydrologists, flood plain managers, hazards researchers, and physical geographers, to name a few. In their jobs these people use topographic maps to identify areas for potential growth, assess future problems from growth, determine threats to the environment, locate boundaries of flood plains, find areas prone to damage from disasters, and study the physical landscape.

Background Latitude and Longitude

Latitude and longitude is one of the coordinate systems represented on topographic maps. Latitude lines measure north and south and run east and west. Longitude lines measure east and west and run north and south. When writing and reading latitude and longitude, latitude always comes first. Each corner of the topographic map displays the latitude and longitude of that corner. These are the boundaries of the topographic map. Latitude and longitude readings in between these corners, or boundaries, are shown on the side of the map. Latitude readings can be found on the vertical axes of the map, while longitude readings are on the horizontal axes of the map.

On topographic maps, latitude and longitude are given in degrees, minutes, and seconds. These units measure distance. One degree consists of 60 minutes and one minute consists of 60 seconds. The symbol for minutes is one apostrophe and seconds is two apostrophes. For example, a location at 29° 52' 30" N, 97° 45' 0" W is at 29 degrees, 52 minutes, and 30 seconds north latitude and 97 degrees, 45 minutes, and zero seconds west longitude.

Choosing the Type of Topographic Map

One way of classifying topographic maps is by the scale of the map. The scale is a ratio between distance on the map and distance on the earth's surface. For example, one of the most common types of topographic maps is the 7 ½ minute quadrangle. This map depicts an area of 7 ½ minutes latitude and 7 ½ minutes longitude, thus making it the "7 ½ Minute Series." For this map, the scale is usually 1:24,000. This means that one inch on the map equals 24,000 inches on the earth's surface, and one foot on the map represents 24,000 feet of the earth's surface. Topographic maps also come in scales of 1:100,000 and 1:250,000. This lesson requires the 1:24,000, "7 ½ Minute Series" topographic maps.

Obtaining Topographic Maps and Legends

You may obtain topographic maps from several different sources.

1. The Texas Natural Resources Information System in Austin, Texas offers topographic maps for education. The only cost is shipping, which is $5 per tube of 25 maps. To order, visit them on the web at http://www.tnris.org or call at 512-463-8337.

2. The United States Geological Survey, USGS, provides information for ordering maps and for finding other map suppliers. Their web site is http://www.usgs.gov
3. The local public library may have topographic maps on file.
4. Private mapping companies also have topographic maps. The USGS website gives a list of these companies.

Academic Questions:

- What is a topographic map?
- What are the procedures for mapping a watershed?
- What are the primary uses of land in the selected watershed?
- What factors pose potential hazards for the water quality in the watershed?

Procedure/Activities

Each student will need the topographic map, sheet of plastic the size of their map, cardboards the size of their map, tape or thumb tacks, and dry erase markers. To set up:

1. Place the topographic map on the cardboard.
2. Place sheet of plastic on top of topographic map.
3. Tape plastic and map to cardboard. (May also use thumb tacks to fasten plastic and map to cardboard).

Pages 14-16 of *Conducting a Watershed Survey* provide additional background on mapping a watershed boundary. Pass out Rules of Contour Lines, Stream Order Worksheet, and Student Mapping Procedure Worksheet and have students delineate their watershed.

Product/Application

Once students delineate their watershed ask students to identify areas they recognize. Ask students to discuss popular land uses in the area. Are there any of those popular land uses (shopping centers, malls, parks, etc.) on the topographic map of the area? Pass out the *Land Use in Your Watershed* and have students identify different land uses according to the map legend.

Assessment

Divide students into groups and assign each group a land use identified in the topographic map activity for your area. Have students research the impacts

of each of these land uses on the community. Each group should present to the entire class their findings.

Extension

Aerial photographs offer a way for students to observe land use change overtime. Texas Natural Resource and Information System can supply teachers with aerial photographs and many are downloadable from the agencies web site. Have students estimate the difference in land use in two aerial photographs at least twenty years apart. Once students have identified land use difference overtime ask students to write a paragraph about likely changes in the future.

TEKS

Science

Grade 6: 6.1, 6.2, 6.3, 6.4
Grade 7: 7.1, 7.2, 7.3, 7.4, 7.8, 7.12
Grade 8: 8.1, 8.2, 8.3, 8.4
Biology: (b)1, 12.D
Aquatic Science: (b)1, 4.B, 7B,C, 8.C,D
Environmental Science: (b)1, 5.A, B, C, E, F
Geology, Meteorology, and Oceanography: 10.C

Mathematics

Grade 6: 6.1, 6.8, 6.11, 6.12, 6.13
Grade 7: 7.3, 7.4, 7.9, 7.13, 7.14, 7.15
Grade 8: 8.5, 8.14, 8.15
Geometry: 6

Social Studies

Grade 6 6.6, 6.7
Grade 7 7.10
Grade 8 8.32
Geography 8A, 8B, 9A

English

Grade 6: 6.1, 6.2, 6.5, 6.13, 6.17, 6.20, 6.22, 6/24
Grade 7: 7.1, 7.2, 7.5, 7.13, 7.17, 7.20, 7.22, 7.24
Grade 8: 8.1, 8.2, 8.5, 8.7, 8.10, 8.13, 8.17, 8.18, 8.20, 8.22, 8.24
English I: 1, 4, 6, 8, 13, 15, 16, 21
English II: 1, 4, 6, 7, 8, 13, 15, 16, 21