

Watershed Model

Abstract: In this activity students will build a three-dimensional model of a watershed in their local area. Working from local area topographic maps, they first make a cardboard framework, then fill it in with modeling material made of Vermiculite. The model can be painted and used to demonstrate how surface water runs off the watershed. This activity should be done immediately after complete units on "Topographic Maps" and "Mapping Your Watershed."

Objectives: Be able to:

1. Interpret topographic maps and translate features to a three-dimensional model.
2. Explain how point source ground pollution can affect the water quality in the watershed.
3. Identify in the local watershed sources of potential pollution.

State Standards Addressed:

Science - A14A-C, A15, B1, D2-5

Geography - A1-6, B1, C1, E2, E3, E5, E6

Time Frame & Schedule:

Preparation: 90 min.

Class: *Gear-Up* 30 min.

Explore - Period One - 50 min.

Period Two - 50 min.

Period Three - 5 to 10 min. several times during the day

Period Four - 45 min.

Period Five - 30 min.

Generalize - 30 min.

Materials: K -Included in kit / O - Order / L - Obtain locally

- ✓ USGS Topographic map of local area (O) or use example in kit (K)
- ✓ Tracing paper, cardboard, marker, scissors (L)
- ✓ Elmer's glue (L)
- ✓ Vermiculite (L) (O) (K)
- ✓ Cornstarch (L)
- ✓ Measuring cups (L)
- ✓ 1 - 600 mL beaker (L)
- ✓ One gal. plastic bucket (L)
- ✓ Large piece of heavy cardboard or plywood (L)
- ✓ Varathane or other clear lacquer (L)
- ✓ Acrylic paint and small brushes (L)
- ✓ Spray bottle for application of "rain" (L)

Teacher's Preparation:

1. Order USGS Topographic map of local area.

2. Make photocopies of appropriate section of area topographic map. You may want to enlarge the section you are interested in to enlarge the scale of the model.
3. Make overhead transparency of the photocopied section.
4. Prepare Vermiculite modeling material (or let students do it).
5. Collect other necessary equipment and materials.
6. Make copies of Student Exercise Directions for this activity and for the unit "Topographic Mapping."

Description of Student Activities:

1. *Gear-Up:* (Have students work in groups of 2 - 3)
 - a. Hand out copies of the topographic map for your local area to each group. If none are available make copies of the example provided.
 - b. With the aid of an overhead transparency of the area topographic map, review the process of reading the topographic map and identify local features.
 - c. If you have photocopied only a section of the original map, display the original for students to view.
 - d. Let the students spend some time finding things on their maps.
 - e. Go around to each group and have them show you features on the map.

2. *Explore:*

First Period

- a. This activity uses the same techniques already done in the unit "Topographic Mapping" to create the framework for the model. Have students refer to that exercise.
- b. First, analyze the map to determine where the community watershed is or could potentially be and, with a marker, draw a line around the boundary of the watershed.
- c. Now, using the techniques you learned before, trace each contour line onto tracing paper, cut it out, and transfer the pattern to a piece of cardboard.
- d. Next, as before, glue the cardboard in a stack that reflects the three-dimensional shape of the watershed. Allow this to dry over night.

Second Period

- e. Prepare Vermiculite modeling material:
 - i) First prepare a cornstarch paste as follows:
 - a) Add 1/8 cup cornstarch to 1 cup cold tap water and mix the slurry.
 - b) After it is well mixed, heat to boiling. Boil until clear (about 1 min.).
 - ii) In a 1 gallon bucket mix cooled cornstarch paste with Vermiculite in the following proportions:
 - a) 1/8 cup starch paste to 1 cup Vermiculite.
 - b) The exact amount you need depends on the size and number of your models.
- f. Secure the cardboard framework made during the first period to a larger sheet of thick cardboard or plywood. Secure with thumbtacks, small nails, or glue.
- g. With moistened fingers apply the Vermiculite modeling material to the framework shaping it to create the hills, valleys, ridges, canyons, etc., created by the stacked cardboard and shown on the topographic map.
- h. Allow drying overnight.

Third Period

- i. Spray the surface of the dried Vermiculite modeling material with clear Varathane and let dry. This should be done outside or someplace with good ventilation. Repeat this step several times.

Fourth Period

- j. Paint the model with acrylic paints. Use the following scheme or one of your own design:
 - White for snow or ice
 - Blue for lakes, ponds, rivers, streams
 - Green for trees areas
 - Brown for muskeg or tundra
 - Gray for bare rocks or sand
 - Red for roads or trails
- k. Also locate buildings and other structures on the model.
- l. Allow drying overnight.

Fifth Period

- m. Spray water onto the model to represent rain and observe how the water flows down the slopes and into the rivers and lakes.
 - n. Place a very small drop of food coloring somewhere on the model to represent a pollution source. Then repeat the spraying "rain" and observe where the pollution goes.
3. *Generalize:*
- a. Have the students compare the topographic map with their model to enforce the ability to interpret the features on the topographic map.
 - b. Encourage students to look at each other's models and explain the features to each other.

Extension Activities:

1. Display the models at a public meeting or in a public place (village council or assembly meeting, utility board meeting, city offices, etc.).
2. Invite students from other grade levels to view the models and have students explain them.

Assessment:

1. Demonstrate knowledge of watershed by explaining the model to peers. Peers question and evaluate each other.
2. Evaluate each model as to accuracy and completeness.
3. Collect and evaluate questions on Student Exercise Directions.
4. Make entries in a journal or log book regarding sources of pollution in the watershed and how they could be identified and corrected.

References:

1. "Map Use: Reading, Analysis, Interpretation," Muehrcke, Phillip C., J.P.

Publications, Madison, WI, 1978.

Resources:

1. USGS maps for Alaska cost \$4.00 each (plus \$3.50 handling per order) and are available from the address below. Contact them for an index to identify your specific quadrangle map.

U.S. Geological Survey
Earth Science Information Center
4230 University Dr., Rm. 101
Anchorage, AK 99508-4664
1-800-USA-MAPS

2. Vermiculite 12 qt. bag
Eagle Hardware & Garden Inc.
333 E. Tudor Rd.
Anchorage, AK 99503
907-563-0391

STUDENT EXERCISE DIRECTIONS

Watershed Model

Purpose: To create a model of your watershed using a topographic map as a guide to the shape and vertical relief.

(Work in groups of 2 - 3 people)

1. First Period

- a. This activity uses the same techniques already done in unit "Topographic Mapping" to create the framework for the model. You should have the Student Exercise Directions for that Unit before you start this activity.
- b. First, analyze the map to determine where the community watershed is or could potentially be and, with a marker, draw a line around the boundary of the watershed.
- c. Now, using the techniques you learned before, trace each contour line onto tracing paper, cut it out, and transfer the pattern to a piece of cardboard.
- d. Next, as before, glue the cardboard in a stack that reflects the three-dimensional shape of the watershed. Allow this to dry over night.

2. Second Period

- e. Prepare Vermiculite modeling material:
 - i) First prepare a cornstarch slurry as follows:
 - a) Add 1/2 cup cornstarch to 1 cup tap water and mix
 - b) After it is well mixed dilute by adding 3 cups of tap water.
 - ii) In a 1 gallon bucket mix cornstarch slurry with Vermiculite in the following proportions:
 - a) 1/8 cup starch slurry to 1 cup Vermiculite.
 - b) The exact amount you need depends on the size of your model.
- f. Secure the cardboard framework made during the first period to a larger sheet of thick cardboard or plywood. Secure with thumbtacks, small nails, or glue.
- g. With moistened fingers apply the Vermiculite modeling material to the framework shaping it to create the hills, valleys, ridges, canyons, etc., created by the stacked cardboard and shown on the topographic map.
- h. Allow drying overnight.

3. Third Period

- i. Spray the surface of the dried Vermiculite modeling material with clear Varathane and let dry. This should be done outside or someplace with good ventilation. Repeat this step several times.

4. Fourth Period

- j. Paint the model with acrylic paints. Use the following scheme or one of your own design:
 - White for snow or ice
 - Blue for lakes, ponds, rivers, streams
 - Green for trees areas
 - Brown for muskeg or tundra
 - Gray for bare rocks or sand

General Safety Considerations

Only particularly unique safety issues are addressed in the individual units. However, teachers should instruct students in general laboratory safety practices and expect them to be followed at all times. Following are general safety considerations.

- Safety Equipment: Locate and know how to use all of the safety equipment in the lab. This includes fire extinguishers, fire blanket, safety shower, eyewash, Material Safety Data Sheets (MSDS), and first aid kit.
- Personal Protection: Wear goggles to protect your eyes whenever you are using chemicals or potentially pathogenic samples. Wear lab aprons to protect your clothes from chemicals. Wear rubber gloves when handling strong acids and bases and latex gloves when handling potentially pathogenic samples.
- In Case of Fire or Accident: In case of fire or accident, call your teacher at once. Report even minor incidents (such as small cuts, chemical spills, broken glassware, etc.).
- No food or drink in the lab: To avoid ingestion of harmful chemicals and potentially pathogenic samples do not bring food or drink into the laboratory area. Gummed labels should never be moistened with your tongue. Use tap water instead. Don't put your pencil or pen in your mouth.

Wash your hands thoroughly when you leave the lab and before you eat. This applies to short trip to the restroom as well as at the end of the period.

- Be cautious of hot plates and gas burners: To avoid burns, beware of hot plates and gas burners. Use protective gloves or long handled tongs when using autoclave, hot plate, furnace or oven. Never leave a burner unattended. Turn it off if you leave your lab table. Don't ignite it unless it is actually needed. If it is not working properly or does not light easily, ask your instructor for help. Long, loose sleeves and long hair are a fire hazard. Be careful. Pin hair back with a barrette or rubber band.
- Discard broken glassware appropriately: Discard or repair cracked or broken glassware immediately. Discard broken glassware in appropriate container, not the trash can.
- Pipeting: **NEVER** use your mouth to fill pipettes. Use a suction bulb every time.
- Consider all Chemicals as Dangerous: Always label chemicals properly. Never use chemicals or solutions from an unlabeled container. Never allow a chemical or solution to touch your skin. If you do, wash the area thoroughly with soap and water.
- Strong Acids and Bases: Be cautious of strong acids and bases. Always use

protective eyeglasses, gloves and apron when handling acids and bases. Always dilute strong acids and bases by adding the acid or base to the water, not *visa versa*.

- Samples: Most of the samples you work with will be harmless, but some are not. Wastewater samples and some freshwater samples may contain pathogens. To be safe, assume all of them to be potentially dangerous and handle them accordingly.
- Used Cultures: Place old cultures or any contaminated material in the biohazard bag provided by your teacher. Label all current culture tubes and dishes that you wish to keep with your initials, date and lab period (class).
- Spilled Cultures: Whenever bacterial cultures are accidentally spilled, notify your teacher so that proper disinfection procedures can be assured.