

PST 263 Watershed Model

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Supplies

- Large plastic wash basin
- Chicken wire (approx 5 mm grid)
- Wire
- Variety of sponges (different absorbencies)
- Modeling clay (variety of colors)
- Additional supplies to make houses
- Dark green ScotchBrite scouring pads
- Duct tape
- Square plastic water bottles (250 and 500 mL)
- Plastic sheeting
- Cinnamon
- Food coloring
- Thin sponge cloths (for agriculture, grassland, buffers, etc)
- Sticks/twigs
- Clear plastic or glass cup
- Watering can
- Spray bottle

Tools

- Pliers
- Wire cutters
- Saw
- Nails
- Candle
- Scissors
- Sewing kit
- Knife

Design

Preparation:

1. Cut window in basin, remove approximately one-third of side. Leave a lip at bottom to catch water and channel it towards the center. At the center, far edge of the tray drill hole in basin to drain water.
2. Shape chicken wire. Fold the wire in a non-uniform manner that replicates the randomness of a watershed. Use pliers to bend and pull chicken wire into shape. This watershed should have six natural-looking divides that allows forest, agriculture, grassland, clear-cut forest and developed urban areas. We further subdivided developed urban land into sustainable development and poor development practices.
3. Hold nail with pliers, and heat nail at tip of candle flame for approx 30 seconds. Poke pairs of holes spaced 1 cm apart every 10 cm at the top of the basin to allow wires to be fed through to secure the chicken wire in place. Cut off excess chicken wire and fold it under the lip
4. Use duct tape to cover sharp ends of chicken wire along ridge of basin and at front of model.
5. Decide the location of the different land use areas in the model. This particular model demonstrates (from left to right): urban land developed poorly, sustainably developed urban land, agriculture, grassland, clear-cut forest and forest. Riverbeds were used as the boundaries for the landuse/landcover areas.
6. Cover impermeable areas and riverbeds with plastic sheeting and secure with wire. This particular model has impermeable areas in the poorly developed urban land, parts of the sustainably developed area, and the clear-cut land.
7. Cover the plastic sheeting with the modeling clay. In this model, green modeling clay was used for the urban land, brown for the clear-cut land and blue for the riverbed. Additionally, one can use different colors of modeling clay to create a higher level of detail, such as roads, gardens, basketball courts, et cetera.
8. For the urban areas the format is similar; however, in the urban land that was developed poorly make sure that there is no/very little permeability in this region. This is to illustrate the differences between an area with a high infiltration rate, such as a forest, and a low infiltration rate, i.e. urban areas. One can approach the

construction of these areas by spreading the modeling clay over all of the plastic sheeting.

9. The main difference in the design is to cut out areas in the plastic for the urban land developed sustainably. It is easier to cut out holes in the plastic after it is already affixed to the chicken wire but before the clay is applied. The best way to illustrate green development is not demonstrated in our model. Green development would be better represented by having houses surrounded by agriculture (light green sponge). Then, agriculture surrounded by grassland (yellow sponge) and/or forest (dark green scouring pad). Finally, riparian vegetation/buffer strips (yellow sponge that was not shown in the picture above) along the banks of the river. Due to time constraints, the 263 PST model did not incorporate these ideas.
10. Beneath the infiltration areas in the sustainably developed area, create a cup using water bottles and containing leftover sponges/scraps to catch infiltrated water. This will simulate water trapped in the soil profile. Between demonstrations, the container should be emptied so that water does not overflow. Note: the audience should not see this.
11. Cut the leftover yellow sponge cloth to fit along the banks of the river in the urban area developed sustainably. Then, sew these pieces together to form a long “string” of sponge that will soak up the water to illustrate the benefits of riparian vegetation. Do not affix the buffer strips to the model, because they will be squeezed out during the demonstration.
12. In the clear-cut area, deforestation is represented by attaching parts of twigs to resemble tree stumps. The twigs are simply held in place by just the modeling clay.
13. In the forested areas, stretch and work the ScotchBrite scouring pads to make them more pliable. Secure the pads to the forest area using wire. This design is to represent the canopy of a forest. If streambeds run through the forest, apply blue modeling clay on top of the scouring pads to create the stream.
14. For the grassland and agricultural areas use the thin sponge cloth. When purchasing these find the highest absorbency material the store sells because in the presentation the purpose is to show infiltration as well as runoff. Do not secure these sponges to the chicken wire in order to wring them out during the presentation.
15. After the clay is applied to the plastic sheeting for the clear-cut area, and the rest of the detail work is done, apply cinnamon to the deforested area of the model. Initially, the cinnamon will stick to the clay and will not properly illustrate the process of erosion. Note: before each demonstration sprinkle the cinnamon on the bottom-half only of the clear-cut area. This prevents the cinnamon from splattering on the adjacent grassland and forested areas.
16. Create soil profile. First, cut plastic bottles to size and shape to create bedrock to keep the subsequent "soil layers" off of the bottom of the model so they don't get wet from water from other sources than “infiltration.” The insides of the plastic bottles can be coated with modeling clay to create the desired appearance. Second, cut the sponges to fit underneath the model. Use a low-absorbency sponge for the layer above the bedrock (blue sponge) and a high-absorbency

sponge for the top soil layer (yellow sponge). Note: unfortunately, the yellow sponges are about five times the price of the blue sponges; despite this, they are very effective in demonstrating the concept of infiltration that the blue sponges alone could not have done.

Presentation:

1. Immediately prior to presenting the model, apply cinnamon to the deforested area and drops of food coloring to the poorly developed area. In the model shown, five drops of food coloring were put on the basketball court where a small indentation was created. Note: if food coloring is added too early it will dry up and not demonstrate the principle of non-point source pollution.
2. Moisten sponge cloths with the water bottle or a small amount of water so they will lie properly on top of model. Note: the less water used will make the presentation more effective because the audience will see a larger difference.
3. Use a cup to measure out the same amount of water for each trial. Pour water into watering can, and place cup beneath drainage hole in model. This is important so the audience can understand how to compare the land uses and see the differences.
4. This particular model is best presented in the following order: forest, clearcut, grassland and agriculture, poorly developed urban land, and finally sustainably developed land. This allows some residual soil (i.e. cinnamon) from the clear-cut trial to be washed out during the agriculture and grassland demonstration. Similarly, presenting the sustainably developed after the poorly developed area allows residual food coloring to be washed into the river.
5. Spray bottle can be used to clean up model after demonstration.
6. Allow watershed model to dry thoroughly after use. Removing detachable sponges to dry in sun works well, but be careful about drying the entire model in the sun because the clay can soften very quickly and melt.

Ideas for other improvements or modifications:

1. Rice terraces for the mountain provinces.
2. Revisit the urban land developed sustainably because the design is slightly flawed. It was deficient in two areas. First in concept of green development. Green development would be better represented by having houses surrounded by agriculture (light green sponge). Then, agriculture surrounded by grassland (yellow sponge) and/or forest (dark green scouring pad). Finally, riparian vegetation/buffer strips (yellow sponge that was not shown in the picture above) along the banks of the river. Secondly, the riparian vegetation/buffer zone design left room for improvement. The pieces sewed together to form the long “string” of sponge that soaked up the water to illustrate the benefits of riparian vegetation did not work very well. If we would have affixed the buffer strips to the model, it would have worked better but then we could not have squeezed out during the demonstration. This problem needs to be addressed before another watershed is constructed.
3. Mangroves at delta of river and along coastline to talk about importance of mangroves to prevent shoreline erosion, uptake of pollutants and habitat for fish spawning. An idea was proposed to illustrate uptake of pollutants by mangroves. One would need to add some kind of material to both of the urban areas—that could not be suspended very well in water flow, perhaps sand—before the demonstration. When the water washes the food coloring into the river some of the “sand” would be washed in there too and catch on a small lip at the river delta to symbolize how mangroves slow down the flow of water, as well as intake pollutants. Note: this would not affect the cinnamon because it floats on top of the water.
4. A book was used during the demonstration, however, adding two small legs a couple of centimeters tall on the back of the model would be good addition. It would help the water flow towards the front, out the hole in the bottom of the model and into the cup.

Attachments:

- A very basic version of the watershed presentation was translated to Tagalog for a LTI (language/technical integration) presentation during 263 PST. The English and Tagalog versions of this simplified presentation script are attached.

The 263 Watershed Model was built for under P1000. It is estimated that it could be built for around P700.

1. An area of land that is drained by the same stream or river is called a watershed. If a drop of rain falls anywhere within a watershed, it can only flow out to the same surface waterbody (i.e. lake, pond, river, estuary, etc.).
2. Topography (lay of the land) determines the boundaries of a watershed. The highest elevations in land divide one watershed from another. Many smaller watersheds are nested inside a larger watershed.
3. Healthy watersheds are vital for a healthy environment and economy. Our watersheds provide water for drinking, irrigation, and industry. Many people also enjoy lakes and streams for their beauty and for boating, fishing and swimming. Wildlife also need healthy watersheds for food and shelter.
4. Anything that happens upstream in a watershed effects the region downstream. Everyone relies on water and natural resources to exist. What you and others do on land impacts the quality and quantity of water and our other natural resources.
5. For example, in this section of natural, undisturbed forest, the trees hold the soil in place. You can see that when it rains, the water infiltrates into the soil and is filtered beneath the surface. This is the groundwater that is tapped by wells. Some water also runs across the surface and directly into the stream and river.
6. This is a section of deforested land. There is nothing to hold the soil in place or protect it from the impact of rain. Also, the sun has baked the soil so that it is hard and cannot absorb the rainwater. Look what a mess the river becomes when a heavy rain comes along.
7. On grassland and agricultural areas, the plants also help prevent runoff and soil erosion. See how much water infiltrates into the soil.
8. On this developed section of land, houses, cement, and lack of vegetation prevent the water from soaking into the ground. Therefore, pollution from cars, chemicals like fertilizers and pesticides, and sewage does not get filtered through the soil. Instead, there is a lot of runoff and the pollution is carried directly into the river. See how dirty the water is. See how dry the soil layers are.
9. So it would be a good idea to make sure to leave a buffer strip of grassland or other vegetation around rivers and streams. This riparian area helps to keep the river clean and prevent erosion. See how much cleaner the water is in this better developed section of land. See how much water the riparian area helps to absorb and filter.
10. Managing the water and other natural resources is an effective and efficient way to sustain the local economy and environmental health. The most important part of watershed management is to involve all of the stakeholders. That way landuse by one party will not spoil the possibilities for the other residents in the watershed.

Tungkol sa “watershed” ang presentation ko.

1. Watershed – Ang tawag sa lugar na pinagkukunan ng tubig ng sapa o ilog. Anuman pátak ng ulan ang mapunta sa loob ng “watershed” ito ay dadáloy pa rin sa támang lugar (halimbawa sa lawa at ilog).
2. Topography – Ang nagtatakda ng mga hangganan ng “watershed.” Ang pinakamataas na bahagi ang naghahati ng dalawang “watershed.” May napapaloob na maliliit na “watershed” sa malaking “watershed.”
3. Ang malusóg na watershed ay importante sa malusóg na kapáligiran at ekonomiya. Ang “watershed” ang nagbibigay ng tubig na inumín, irigasyon, at industriya. Maraming tao rin ang nasisiyahan sa mga láwa at sapa sa kanilang ganda at sa paglaláyag, pangingsida at paglalangoy. Ang mga ilang na may buhay ay kailangang din ng malusog na “watershed” para sa pagkain at kanlúngan.
4. Anuman ang magyari sa pinakamataas na bahagi ng “watershed” ay makakaapekto sa ibabang bahagi. Ang lahat ay umaasa sa tubig at likas na yaman para mabuhay. Anuman ang gawin mo at ng ibang tao sa lupa ay makakaapekto sa kalidad at dami ng tubig at ibang likas na yaman.
5. Halimbawa, itong bahagi ng kagubatan, ang mga puno ay tumutulong sa pagpígil ng lupa. Kayá makikita ninyo na kapag umulan, ang tubig ay tumátagos (soaks in – point) sa ilálim ng lupa at nasasála sa ibabaw. Ito ang tubig sa ilálim ng lupa na ginágawang balon. Ang ibang tubig ay dumadaloy sa ibabaw papunta sa sapa o ilog (point). (pour water, squeeze sponge)
6. Itong bahági ay walang tanim na mga puno. Wala ng mga puno na puwedeng pumígil o magprotekta sa matinding ulan. At dáhil sa matinding init, tumigas na ang lupa at hindi na makasipsip ng tubig ulan. Tingnan ninyo kung gáano karumí ang tubig sa ilog dáhil sa lakas ng ulan. (pour water, show mud) Mapútik!
7. Sa lupang may mga damô at pananim, ang mga tanim ay tumutulong din para mahadlangan ang dáloy at pagka-agnas ng lupa (pour water). Tingnan ninyo kung gaano karaming tubig ang nasasala sa lupa. (squeeze surface sponges)
8. Itong bahagi na umúnlad na ang lupa mga bahay, sementado ang maga kalsada, at kulang na ang pananim ay hinahádlangan ang tubig na mabábad sa lupa. Kaya ang polusyon galing sa mga sasakyan, kemikal tulad ng abono at pesticides at kanal ay hindi na nasasala sa lupa. Bagkos, maraming polusyon ang umaagos papunta sa ilog (pour water). Tingnan ninyo kung gaano karumi ang tubig (show water). At tingnan ninyo kung gaano katuyô ang lupa (squeeze dry sponge).

9. Kaya magandang idiya na mag-iwan ng isang bahagi ng mga damô, o ibang pananim sa paikot ng ilog at sapa (point to buffer). Itong lugar na ito ang tumutulong upang mapanatiling malinis ang tubig sa ilog at mahadlangan ang pagka-agnas ng lupa (pour water). Tingnan ninyo kung gaano kalinis ang tubig sa lugar na umúnlad (show water). Tingnan ninyo kung gaano karámi ang tubig na nasipsip at nasala sa lugar na may pananim (squeeze buffer).
10. Ang pag-aalága ng tubig at iba pang kalisan ang epektibong paraán upang mapanatili ang lokal na ekonomiya at kalusugan ng kapaligiran. Ang pinkaka-importanting bahagi ng pag-aalága ng “watershed” ay ang mapabilang ang komunidad at ang ibat iba pang ahensiya. Sa ganitong pamámaraan, sa paggamit ng lupa ng sínurang mapabilang ay hindi makakasira sa mga iba pang nakatira malapit sa “watershed.”

Tapos na! May tanong ba kayo?