

## Soil Conservation Laboratory Exercises for Students

### #1 Soil Texture in a Jar

Timing: Long-term

Objective: Observe the different soil particle sizes and their settling behavior in water.  
Determine your soil texture.

Materials: 1 quart canning jar with lid

8% Calgon solution (mix 6 tablespoons of Calgon/quart of water)

Ruler with millimeter (mm) graduations

Tablespoon

Method: Place 1 cup of soil in a quart jar (plastic may be used for children). Add five tablespoons of the 8% Calgon and three cups of water. Cap and shake for five minutes. Place the jar on a desk and let stand for 1 month (an abridged version can be done over 24 hours). After one month, measure and record the depth of the settled soil with a ruler. This represents the total depth of the soil. Shake thoroughly for five minutes. Place the jar on a table and let stand for 40 seconds. Measure the depth of the settled soil with a ruler. This is the sand layer. At the end of 30 minutes, measure the depth of the settled soil and subtract this from the sand depth. This is the silt layer. The murky water is clay in suspension.

Results: To calculate percent sand, divide the mm sand by the



Figure 1a. Two settling soils.

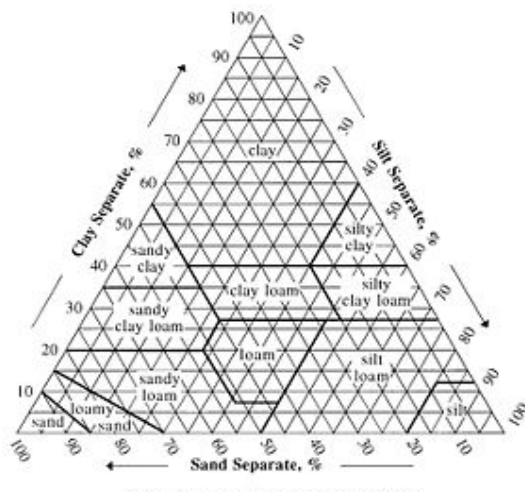


Figure 1b. Soil textural triangle.

total soil depth. Percent silt is found by dividing the mm of silt by the total soil depth. Subtracting silt and sand from 100% gives an approximate percent clay. Clay smaller than 0.002mm will stay in suspension almost indefinitely. This analysis will be less accurate with high clay soils. Once you have these numbers, start at the bottom left corner of the textural triangle and read up until you reach your percent clay. Then, start at the bottom right corner and read along the bottom, to the left, until you reach your percent sand. Follow that line up to the left until you intersect your percent clay. The area surrounded by the bold

black lines in which your intersection lies denotes your textural classification.

Lessons: Sand settles out of water quickly, while clay can stay in suspension nearly indefinitely. By looking at a floodplain, one can discern the general speed of water by looking at the soil particles left behind. A sandy beach had water moving fairly quickly. Fine silt and clay coated areas are typical of slow moving or still backwaters and ponds left from high water. Because it stays in suspension, clay and fine silt is hard to catch with filters, buffer strips, or settling ponds on construction sites or farms.

## #2 Make Your Own Hydroseed

Timing: Long-term

Objective: Attempt to combine the erosion control characteristics of soil cover, moisture holding capacity, temperature regulation, stability, fertility, and vegetation establishment in a homemade hydroseed mixture.

Materials: Grass and legume seed  
Shredded office paper  
Organic fertilizer  
Water and flour mixture  
Bucket  
Measuring cups

Method: Mix three cups of water with two cups of flour. Pour into a bucket and stir in shredded office paper until a gooey mass is formed. Add a tablespoon of organic fertilizer and a tablespoon of erosion control seed. Mix well. Apply hydroseed to a bare slope or any eroding area so it is a half inch thick.

Results: Observe the site on a regular basis to determine when seeds sprout. Upon sprouting, observe plant growth and spacing. Plants bunched up in one area will compete with each other, while plants spaced too far apart or not germinating won't protect the soil after the mulch decomposes.

Alternate: Use different seed mixes or different types or amounts of fertilizer.

Lessons: Mulch such as straw or wood chips washes off of slopes. Grass seed applied for erosion prevention often dies soon after germination due to nutritional deficiencies or drought. Hydroseed combines the necessary requirements for successful erosion control and re-vegetation into one package.



Figure 2. Hydroseed supplies.

## #3 Hillside Erosion Control

Timing: Long-term

Objective: Observe the difference in effectiveness between various erosion control techniques.

Materials: Grass and legume seed  
Erosion control materials such as straw, lawn clippings, sawdust, various erosion control mat, burlap, used fabric softener sheets, shredded office paper, conifer branches, wood chips, or hydroseed mix (see hydroseed laboratory).

**Method:** Find a bare slope or any eroding area. Sprinkle erosion control seed on the site. If the slope causes seed to roll off, seed must be injected into the bank. A pencil can be used to poke a hole into the soil. A seed can then be inserted into the hole and pressed shut with a finger. Apply various mulches and erosion control materials in equal sized patches. Small patches, such as four square foot plots, are easily managed. Burlap, erosion control mat, and fabric softener sheets should be staked down with small wooden stakes such as shish kebab skewers. Avoid skewers sticking far out of the ground where they might pose a safety hazard.



**Results:** Observe the site on a regular schedule, such as twice per week during the rainy season. Record any erosion, seed sprouting, or material failure. Material failure includes mulch washing away, mat preventing seed germination, or animal disturbance. Observe nutrient deficiencies of erosion control plants, such as stunted or yellow seedlings. After the seed has grown into established plants on at least one plot, rate the various plots from most effective erosion prevention to least effective. Vegetation establishment can also be rated.

**Alternate:** Use different seed mixes with one type of erosion control material. An example could be using two different feed store erosion control mixes, a couple of single species plots, and a couple of native erosion control mixes.

**Lessons:** Erosion reduces the ecological function of the land. Soil acts as a pollutant in our waterways. Many erosion control failures can be seen on the roadside. By applying several different erosion control techniques, reasons for failure can be observed. An example is where mulch is applied to a slope without netting to hold it down. Mulch quickly washes off of a slope. Another example is where erosion dense erosion control mat prevents erosion control seed from sprouting. Real erosion control must be monitored to fix any failed aspects, such as mulch re-application after it washes away, or fertility problems preventing plants from growing.

#### **#4 Infiltration**

**Timing:** Short-term

**Objective:** Observe the difference in infiltration rates between a compacted soil and a healthy soil.

**Materials:** Two cylindrical containers (both the same size).

Cheese cloth

Wire screen

Stopwatch

Measured volume of water

**Method:** Obtain or make two cylindrical containers with no top or bottom, preferably

clear (clear not required). Cover the bottoms with cheese cloth-covered wire screen. Carefully slide a core of compacted soil into one container and a core of vegetated, un-compacted soil (with the vegetation sheared off) into the other container. Be sure any gaps are crammed with soil to prevent water bypassing the soil column. Pour a measured volume of water on the un-compacted soil, starting the stopwatch as soon as the water contacts the soil. Record the time it takes the water to drain through the soil column. Repeat with the other soil. Alternatively, have two different people pour water on both soils at the same time, with someone else starting the stopwatch. If it is difficult to load the cylinders, loose soil can be poured into the cylinders and the soil in one cylinder can be compressed to form a compacted soil. Do the normal soil first. After waiting a few minutes longer than the normal soil cylinder took to drain, the compacted soil can be abandoned, since students will get the point that compaction inhibits infiltration (it may take all day to drain).



Figure 4. Infiltration tubes in compacted pathway (left), and porous, vegetated soil (right).

of vegetated, un-compacted soil (with the vegetation sheared off) into the other container. Be sure any gaps are crammed with soil to prevent water bypassing the soil column. Pour a measured volume of water on the un-compacted soil, starting the stopwatch as soon as the water contacts the soil. Record the time it takes the water to drain through the soil column. Repeat with the other soil.

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cylinders and the soil in one cylinder can be compressed to form a compacted soil. Do the normal soil first. After waiting a few minutes longer than the normal soil cylinder took to drain, the compacted soil can be abandoned, since students will get the point that compaction inhibits infiltration (it may take all day to drain).

**Results:** Record the time when the water stops dripping out, and record the volume of water that drips through. The water should take much longer to filter through the compacted soil.

**Alternate:** Use additional soils such as other soil series or forest vs. grassland, etc. Another way to do this experiment is to use durable cylinders like six inch diameter PVC pipe with one end of each piece sharpened. Pound the sharp end of the pipes into the ground on a compacted trail and a normal soil area.

**Lessons:** Compaction caused by vehicles, pedestrians, animals, or construction reduces the natural function of the soil. Water, air, roots, and soil animals cannot move properly through compacted soil, which adversely affects other aspects of soil health such as soil structure, organic matter cycling, plant growth, and erodibility.

## #5 Infiltration Buffer Strip

**Timing:** Long-term

**Objective:** Create an area where water can infiltrate the soil after leaving buildings, pavement, or a muddy area.

**Materials:** Grass and legume seed  
Shovels or rototiller  
Organic fertilizer  
Dolomite lime (found at local feed stores and nurseries)

**Method:** Find an area where water runs off of pavement or a muddy area. The downhill side of parking areas, gravel roads,



Figure 5. Densely growing double-infiltration buffer.

animal pens, or eroding hillsides are good choices. Ideal minimum width of the strip is 15 feet. Some sites may not have 15 feet, so any strip is better than none. Till the area toward the end of March and incorporate about 80 pounds of lime per 1000 square feet. Heavily mulch the downhill side to catch any soil that erodes during rain events. After one month, till in the organic fertilizer according to label directions. Sow a predominantly grass seed mixture on the site and water the seed. Monitor site to ensure adequate moisture.

**Results:** Observe the site on a regular basis to determine if areas need additional seed. Grass in a filter strip should be fairly dense. Observe the established buffer strip during rain events and note how much more effectively runoff infiltrates the strip compared to the previous site condition.

**Alternate:** Use a native seed mix that doesn't require heavy soil amendment applications.

**Lessons:** Buffer strips are very effective for removing oil and grease, heavy metals, and sediment from runoff water. Grass buffers slow water velocity, which allows sediment to settle out and reduces erosion potential. Since buffer strips are like a crop, they must be managed to be effective. Synthetic fertilizers have high solubility so organic fertilizers are the best choice for buffer strips. Organic fertilizer will act as a slow release nutrient source for your buffer strip, while minimizing pollution to ground or surface water.

## #6 Stream Table

**Timing:** Short-term

**Objective:** Determine the effects of water on landforms resulting from the processes of erosion and deposition. Investigate the variables that affect landforms, including land slope and floods.

**Materials:** Aluminum turkey roasting pan  
Sediment such as fine sand and silt, or Diatomaceous earth, or Granulated plastic mixed in a 15:2:3 ratio of 16/20 grit, 12/16 grit, & 20/30 grit, respectively

**Method:** Fill a large roasting pan to approximately an inch from the top with a pre-moistened sediment mixture. Fine sand with diatomaceous earth or a granulated plastic mix will work best, due to low water velocity on a stream model. Form a drain in one end of the pan by cutting a "V" notch in the top or punching holes in the end. Place plastic animals, buildings, and pieces of vegetation in the sediment to simulate a real scene. Place the pan on a board and tilt the model so water will flow from one end of the pan to the other (the drain end). Trace a large "S" from the upper end of the pan to the drain to guide the initial stream flow. Using a small hose or small bucket of water,



Figure 6. Stream table showing erosion.

apply a steady stream of water to the upper end of the pan. Observe changes along the waterway over time. After seeing erosion and deposition take place, add small barricades in the channel to deflect water from erosional sites. Place barricades pointing downstream, perpendicular to flow, and pointing upstream to observe which angles prevent or exacerbate erosion. Refill the pan with sediment and smooth the surface. Try increasing or decreasing the water volume and note any changes in erosion or deposition dynamics. Slope angle can also be changed.

**Results:** Describe changes that occurred in the upland and lowland after the simulated storm event. Record where the most erosion occurred, as well as the most deposition.

**Alternate:** Add a quarter cup of colored aquarium gravel to the sediment mix and note how it travels differently than the sediment.

**Lessons:** Hydrology produces different outcomes when acting on various landforms. The outside of a river bend will receive the most erosion, while the inside curve will receive more deposition. The downhill region of the pan will form an alluvial fan, while the uphill region is carved into a channel. Placing barricades in erosional areas can cause worse erosion if barricades are improperly installed. When water velocity is decreased, less sediment is detached, and detached sediment settles out much quicker.

## #7 Stormwater Fieldtrip

**Objective:** Observe different areas that will act as sources of pollution and areas that receive pollution, as well as other stormwater and erosion-related features.

**Materials:** Pencil and notepad for notes, binoculars

**Method:** Have an adult drive you around and look for areas where the soil is un-protected or where erosion is already occurring. Look for construction sites



Figure 7a. Eroding bank on 11<sup>th</sup> St. in Arcata.

and examine them for bare soil or gravel areas adjacent to roadways. Look for soiled tire tracks on the pavement. Find drain pipes coming out of roadsides or into creeks. Look for trash, oil sheens, or muddy water. Examine parking areas for oil spots. Observe gravel road junctions with paved roads during the rainy season. Sediment can be seen flowing off of the gravel roads entering Sutter Road in McKinleyville. Road cuts are usually good areas to see active erosion. Examples of current Humboldt County

erosion or pollution hazards are: the bank on 11<sup>th</sup> Street at its conjunction with F Street in Arcata; hillsides along Highway 299 between Bluelake and Lord Ellis Summit; the road cut on the east side of Highway 101 along Big Lagoon at 41° 11'34.47'N latitude, 124° 06'37.15' W longitude; the cliffs east of Highway 101 along Clam Beach; the cliff east of Broadway along the Bayshore Mall in Eureka; creosote coated pilings on old piers in Humboldt Bay typically have oily sheens around them when the tide surrounds them.

**Results:** Record the types of pollution you see: silt appears muddy in water or dirty on pavement; trash is easy to spot; an oily sheen indicates petroleum in the water.

**Lessons:** We have a lot of erosion and pollution right here in Humboldt County. A lot of improvements can be made.



Figure 7b. Hwy. 299 erosion.