Teacher Notes

Growing plants – Does the soil make a difference?

Background

Why can some gardens grow prize-winning azaleas while others produce hearty broccoli and asparagus? Aside from a person's ability to garden, it mostly depends on the soil. Soil properties, such as pH and soil composition, have a large impact on the type of plants it can sustain. Soil pH typically ranges from 5–8. Low pH soils dissolve certain minerals and nutrients for the plants to absorb while higher pH soils will dissolve others. To adjust soil's pH, gardeners lime the soil to raise the pH or add sulfur compounds to help acidify the soil. The soil composition affects the texture or "feel" of the soil. The texture is determined by the percent composition of the three main kinds of particles found in soil: clay (<0.002 mm), silt (0.002–0.05 mm), and sand (0.05–2.00 mm). The composition also relates to the water-holding capacity of the soil. If soil is sandy with many "large" particles it drains well and is rather dry, whereas smaller particles like clay and silt do not drain well and will retain water longer *(1).*

A sedimentation test can be used to measure the percent composition of a soil sample. This test is not part of the student activities, and can be performed as follows on a moist sample of soil:

- Fill a clear, colorless, straight-sided jar 1/3 full of damp soil after removing any rocks or large pieces of organic matter. Slowly add enough water to just cover the soil.
- Place the jar on a flat surface and measure the total height of the soil. Fill the jar nearly full of water.
- Add to the mixture a spoonful of calcium sulphate ($CaSO_4$) or barium sulphate ($BaSO_4$). (This will be provided in the lab.) (Alternatively, 1 tablespoon of Calgon powder can be used.)

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- Put the lid on the jar and shake for 3 min. Place the jar on a flat surface and leave it undisturbed. After ~1 min, measure and record the height of the layer that settles at the bottom of the jar; this is the sand component.
- After 1 hour, measure and record the height of the darker layer that has settled on top of the sand; this is the silt component. During this time some of the clay may have settled out; it is lighter in color than the silt, but do not include in your silt measurement.

The total clay component can be determined by the original total height of the soil less the sand + silt height.

The “Texture Triangle” (see Figure 1) (McCauley, Jones, & Jacobsen) is used to determine the specific composition of the soil. While there is no single perfect soil, since some plants thrive in sandy well-drained soil while others grow in heavy clay, most gardeners would agree that an ideal soil contains 40% silt, 40% sand and 20% clay, a soil that is part of the “loam” class (Arizona Master Gardener Manual).

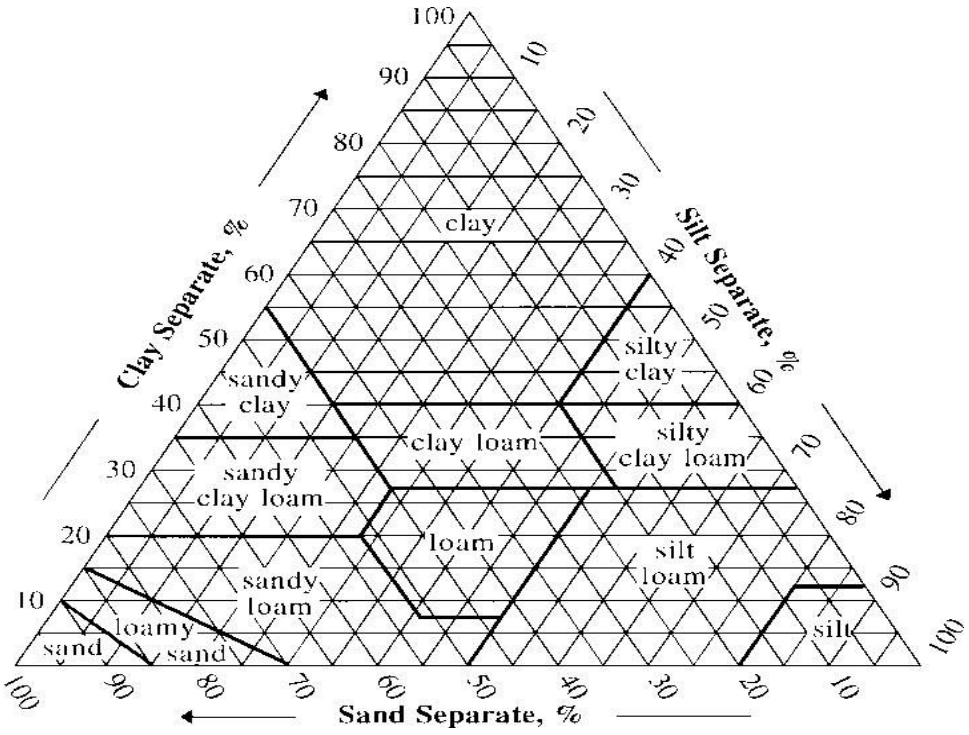

Figure 1. The soil texture composition triangle.

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References

Arizona Master Gardener Manual: Soils. *http://cals.arizona.edu/pubs/garden/mg/soils/soils.html*

Fanis, L. N. & Jacobsen, E.K. (2006). Soil testing: Dig In! (Classroom Activity #78). Journal of Chemical Education, 83, 240A-240B. [Supplemental Material is available in the electronic part of the same issue (February 2006 / No. 2) of Journal of Chemical Education *(JCE Online*).]

Ho, M. (1988). *Chemistry potpourri.* Singapore Science Centre.

McCauley, A, Jones, C., & Jacobsen, J. *Basic soil properties*.

http://www.agronomy.org/cca/exam_pdf/ss01930.pdf

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