Soil Sampling

1. Describe the environment from which you took your soil sample. Include all of the information from your notes.

   Answers will vary, but each group was responsible for collecting the soil from one of the following locations:

   - *Bare soil from out in the "wild" area, not underneath a plant*
   - *Underneath a mesquite tree (legume… more nitrogen)*
   - *Underneath plants that are NOT a legume (perhaps a Desert Broom or some other little herbaceous stuff on the ground… maybe rabbit influence)*
   - *A flowerbed (the nice black, fluffy soil, not the rocky landscaped stuff)*
   - *Under grass from the lawn*

   They were told to write down the vegetation around, record soil moisture (it's a crappy meter on a scale of 1-10 with no meaningful units), mention disturbance and/or land use, etc.

2. How do these conditions relate to the soil characteristics measured during the lab exercise (texture, nutrients, pH, and biota)?

   The plants will influence moisture and nutrients (i.e. legume = more nitrogen, shade from plants = perhaps more moisture).

   Obvious differences between the "wild" and the "manicured". We add a LOT of water and fertilizer to the lawn and flowerbeds. (Note, actual results will vary depending on when the grass and flowerbed were last fertilized, and whether the irrigation was recently dripping)

Soil Texture

3. Looking at the soil texture triangle, which soil type has the greatest:
   a. water retention ability?
   b. water percolation rate?

   Clay has the best water tension because it has a higher surface:volume ratio, and therefore higher water tension, allowing soil particles to hold hold onto the water. Sand is made of larger particles, and therefore have bigger pore spaces, and water just runs through, so sand has a higher percolation rate. So, of the soil types found in class, the ones with greater sand content have more percolation (flower bed and "wild"), the ones with more clay have greater retention (grass).

4. What is the soil texture of your sample?

   The data are in the Excel file on Blackboard.

5. How will this influence plant growth in your soil compared to the other soils sampled?

   For a nice healthy environment for plants, a mix of small and large particles is best. If there's a lot of clay, there can be too much retention, causing the soils to be waterlogged and not have enough oxygen. If sand dominates, there can be too much percolation and therefore not enough water. The grass is on very fine soil, which has a problem with not getting enough air, which is why maintenance has to drive over it with the thing that pokes holes in the ground to allow air to infiltrate. The fowerbed and under the mesquite have a much nicer mix, which means it holds onto both water and air.

NOTE: The soil out in the "wild" tends to be a sandy clay loam. The mesquite frequently shows up as different because of the organic matter from the mesquite leaves decomposing. It throws off the results a bit.

6. One influence humans have on soil is with our feet. What will happen when an area of soil is heavily trodden by humans?
   By trampling the soil, the soil becomes compressed and soil particles are smooshed together, removing the pore spaces that contain air and hold water. Roots will be less able to penetrate (and biota might lose their habitat, if they live in those pore spaces.)

Soil pH

7. Why is pH such an important aspect of soil fertility?
   pH tells us how many protons are kickin' around in the soil interacting chemically with essential nutrients. If the pH is too low, H+ ions are bumping nutrients (Mg, Ca, K) off of their "storage bank" on the surface of soil particles. Therefore nutrients will not be held in the soil, and will be washed away by rain or irrigation water.

8. What is the pH of your soil sample? How will this influence organisms living in the soil (plant, animal, and microbial).
   Data are in the Excel file. They're all pretty much the same. A nice healthy neutral-to-slightly-basic, which is normal for desert soils. We can assume that the nutrients are able to stick around and that the biology will be happy (at least in regards to how they're affected by pH).

9. Nitrogen pollution in the atmosphere causes excess N deposition to soils, usually in the form of HNO_3 formed in the atmosphere. What do you think will happen when HNO_3 falls on the soil?
   When HNO_3 (nitric acid) falls on soil, it releases the acidic H^+ ions, which can cause the loss of important nutrients (Mg, Ca, K) being stored attached to soil particles. (NOTE: Some students answer this question by focusing on the nitrogen pollution. That's not nearly as important as the change in pH.

Soil Nutrients

10. Given the nutrient status of your soil sample, how much and what kind of plant and animal life would you expect to find living here?
    Results are in the Excel file. The test kit is not great for measuring N. It uses an indicator that turns darker pink with higher nitrogen. What we end up having to do is line up the samples from lightest pink to darkest pink. That's what the data mean. Bare soil was the lightest pink (lowest N), up to the flowerbed which was the darkest pink (highest N). The soil from under the mesquite usually ends up being just behind the flowerbed. Not sure why your lab's fell in the middle… I didn't watch where they grabbed their sample from…
    The more N, you'd expect more fertile soil with more plant growth and more abundant soil biota. Those lower in N would be less fertile.

11. Evaluate the fertility of the soil used in this lab activity based upon your results.

Soils are more fertile where we add them as fertilizer (flower bed) or where there are legumes (mesquite). Those are generally the only two "fertile" soils we investigate. The rest are relatively unfertile, with lower N.

12. Throughout lab, we've discussed many leguminous plants, which are able to create symbiotic associations with N-fixing bacteria. How will soils beneath these plants differ from the surrounding soil, and why?
    The soil surrounding leguminous plants should have a higher level of nitrogen, because there will be more N in their leaves that gets released when they're decomposed. Hopefully your students discuss why it is that their mesquite may have fallen out in the middle (potentially due to where the soil was collected or mistakes in the extraction in lab).

Soil Biology

13. Compare the mesofauna community of the different types of soil. How do they differ in abundance and diversity? What can we guess about the nutrient status of the soils, based on the biota living in them?
    The soil under the mesquite tree had the most abundant microarthropods, probably due to the yummy nutritious nitrogen-rich litter they're decomposing. That's why there are so many more beasts compared to the bare soil and under the desert broom, which were not very far away. The flowerbed also had a lot of N, but not nearly as many biota. This is because it's too heavily disturbed. We add fertilizer, but not the biota, and therefore we have to keep adding fertilizer to maintain that high level of N.

14. Compare litter to soil. Which has a more abundant/diverse community? Why?
    Mesquite litter also had a high abundance of biota (about the same as the soil, really), but higher diversity. The litter is a much more diverse type of resource because it's fresher and less processed, and can host different groups of microarthropods.

15. One way of increasing soil fertility is to add commercial fertilizers. What are some other, longer-lasting ways that you could suggest to increase soil fertility?
    Get some biota!! They can help breakdown organic matter and make the soil more fertile. Instead of adding fertilizers repeatedly, one could maintain soil conditions that are hospitable for biota (e.g., not too compacted, a healthy pH and moisture, balanced soil texture) and provide them with delicious organic matter to break down.