Laboratory Analysis

Making Sense of the Particle-Size Distribution Measurements

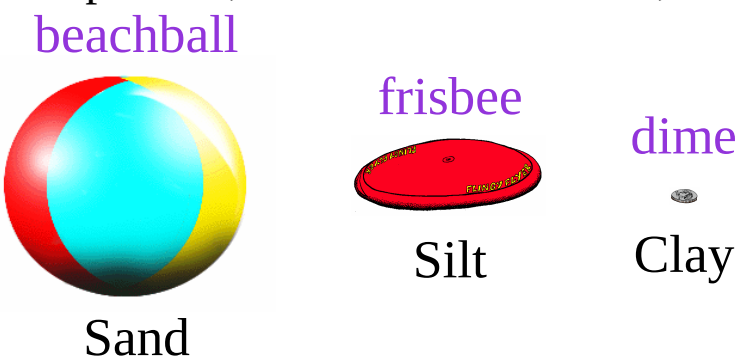
(**Note**: Refer to the Learning Activity in the 1997 Supplement to the GLOBE Teacher's Guide)

- The **amount of each size particle** (sand, silt, or clay) in the soil is called the **particle-size distribution**. Knowing the particle-size distribution of a soil sample helps to understand many soil properties such as how much water, heat, and nutrients the soil will hold, how fast water and heat will move through the soil, and what kind of structure, bulk density and consistence the soil will have.

- **Sand, silt,** and **clay** are the three particle sizes of mineral material found in soils. The amount of each of these is called the "**particle-size distribution**" and the way it feels is called the "**soil texture.**"

- **Sand** is the **largest** sized particle, **Silt** is **medium** sized, and **Clay** is the **smallest.**

Relative Size Comparison of Soil Particles



Laboratory Analysis

Making Sense of the Particle-Size Distribution Measurements (continued)

There is disagreement in the scientific community about the exact size ranges of sand and silt. For GLOBE, we will measure sand and silt based on two different size definitions.

1. US Department of Agriculture (**USDA**) which defines the size of:

sand = 2.0 mm - 0.05 mm **silt = 0.05 - 0.002 mm**

2. The International Soil Science Society (**ISSS**) which defines the size of:

sand = 2.0 mm - 0.02 mm **silt = 0.05 - 0.002 mm**

- **Clays** are the smallest particles and are defined (by both organizations) as being **smaller than 0.002 mm.**

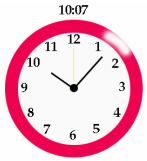
- Particles **greater than 2.0 mm (sand size)** are called **stones** or **gravels** and are not considered to be soil material.

Laboratory Analysis

Making Sense of the Particle-Size Distribution Measurements (continued)

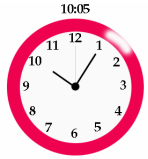
- Heavy, large particles settle first, so when a soil sample is stirred or shaken in a 500 mL cylinder, **sand** particles (according to the **USDA** definition) settle to the bottom of the cylinder after **2 minutes**, while the clay and silt size particles stay in suspension.

(Sample starting time)



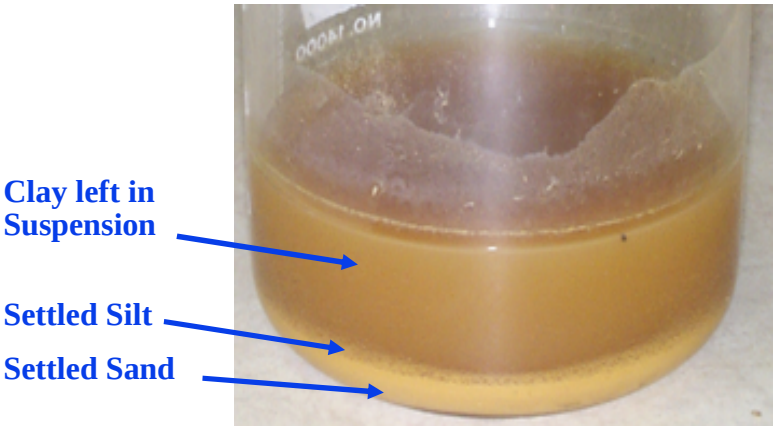
- After **12 minutes**, the **sand**, according to the **ISSS** definition, has settled, leaving the clay and silt size particles in suspension.

- After **24 hours**, the **silt** size particles have settled, and only the **clay stays in suspension** to be recorded by the hydrometer.



(the next day)

Soil Mineral Particles Dispersed in Beaker

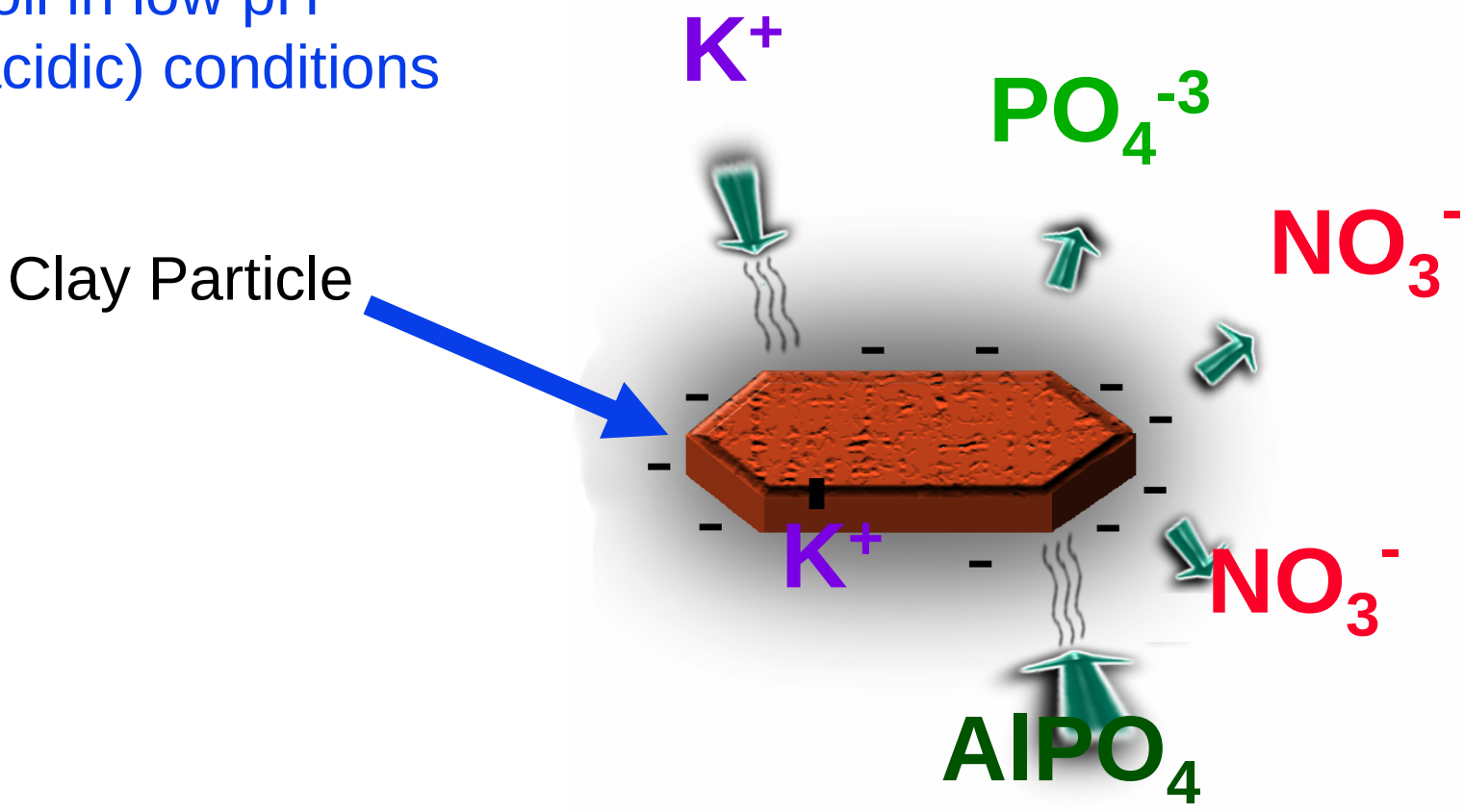


Laboratory Analysis

Soil Fertility

Soils that have clay particles and organic matter usually have a negative charge.

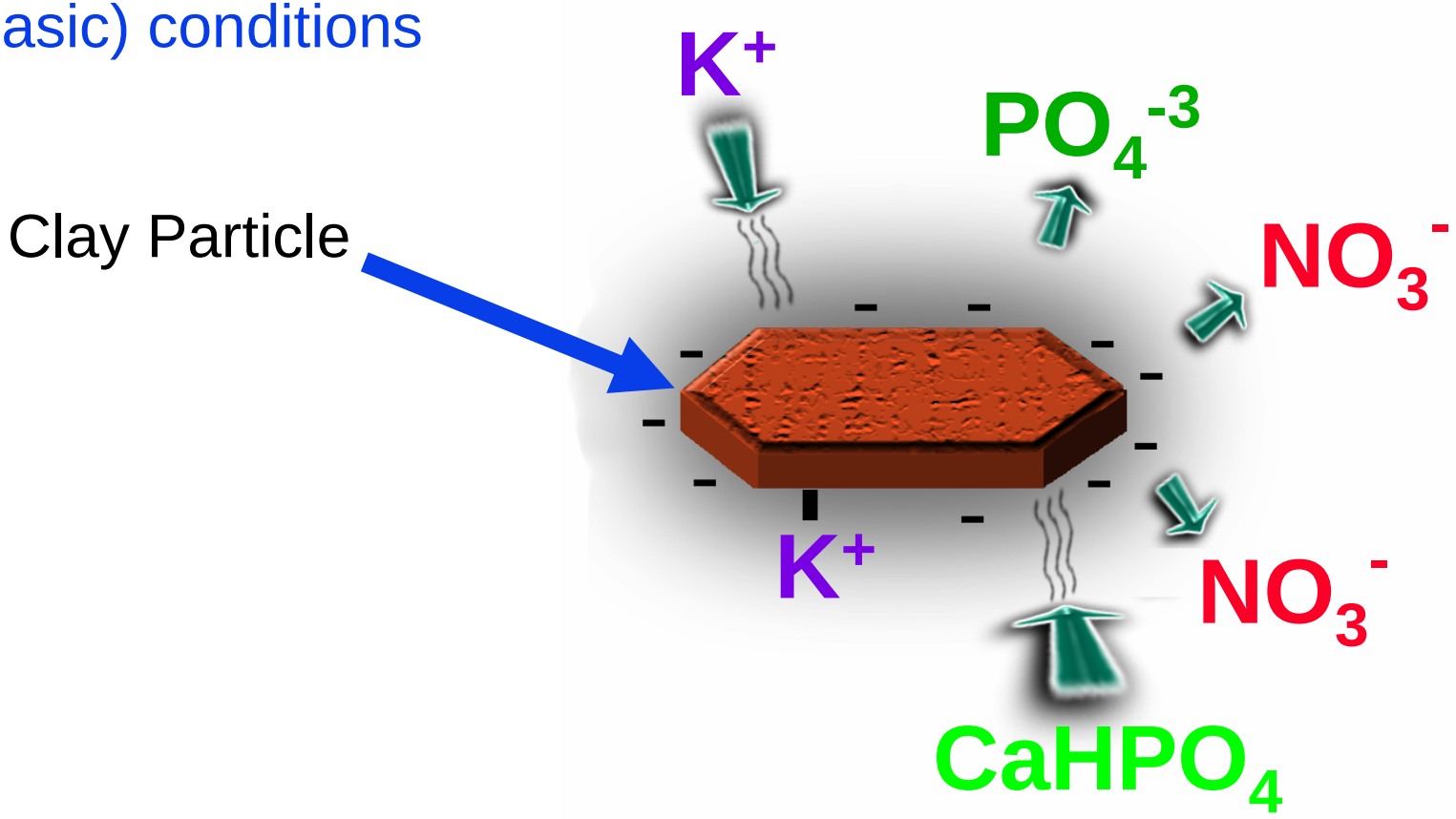
Soil in low pH
(acidic) conditions



Soil Fertility (continued)

Soils that have clay particles and organic matter usually have a negative charge.

Soil in high pH (basic) conditions



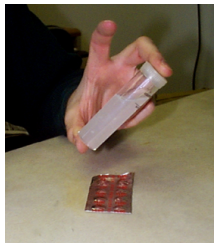
Laboratory Analysis

Soil Fertility (continued)

Part 1: Preparation and Extraction

1. Fill the extraction tube from your Soil Test Kit to the 30 mL line with distilled water.

2. Add 2 Floc-Ex tablets. Cap the tube and mix well until both tablets have disintegrated.



3. Remove the cap and add one heaping spoonful of dry, sieved soil.

4. Cap the tube and shake for one minute.

5. Let the tube stand until the soil settles out (usually about 5 minutes). The clear solution above the soil will be used for the nitrate (N), phosphorus (P), and potassium (K) tests.

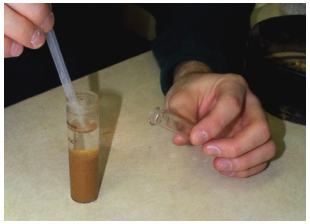
Note: For some soils, especially those with a high clay content, there may not be enough clear solution extracted. If more clear solution is needed, repeat steps 1-5.

Laboratory Analysis

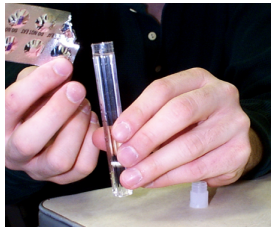
Soil Fertility (continued)

Part 2: Nitrate Nitrogen (N)

1. Use the pipette to transfer the clear solution above the soil to one of the test tubes in the Soil Test Kit until the tube is filled to the shoulder. (If more solution is needed, repeat Part 1).



2. Add one Nitrate WR CTA Tablet. Be sure that all the pieces of the tablet are added to the test tube and try not to touch the tablet as you place it into the tube. Cap and mix until the tablet disintegrates.



3. Rest the test tube in a cup or beaker. Wait 5 minutes for color to develop. (Do not wait longer than 10 minutes).

4. Compare the pink color of the solution to the Nitrogen Color Chart in the Soil Test Kit. Record your results (High, Medium, Low, or None) on the Soil Fertility Data Work Sheet.

5. Discard the solution and wash the tube and the pipette with distilled water.

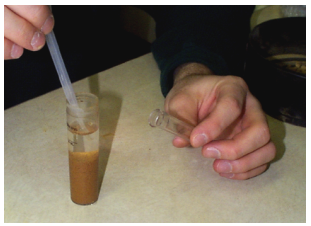
6. Repeat this procedure with the liquid from each of the soil samples. Be sure to rinse the pipette and tube with distilled water after they are used.

Laboratory Analysis

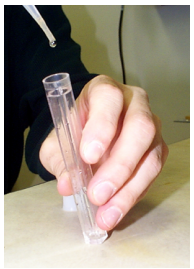
Soil Fertility (continued)

Part 3: Phosphorus (P)

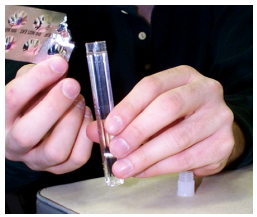
1. Use the clean pipette to transfer 25 drops of the clear solution above the soil to a clean test tube. (If more solution is needed, repeat Part 1).



2. Fill the tube to the shoulder with distilled water.



3. Add one Phosphorus Tablet to the tube and cap it. Be sure that all the pieces of the tablet are added to the test tube. Mix until the tablet disintegrates.



4. Rest the test tube in a cup or beaker. Wait 5 minutes (but no more than 10 minutes) for color to develop.

5. Compare the blue color of the solution to Phosphorus on the color chart in the Soil Test Kit. Record your results (High, Medium, Low, or None) on the Soil Fertility Data Worksheet

6. Discard the solution and wash the tube and the pipette with distilled water.

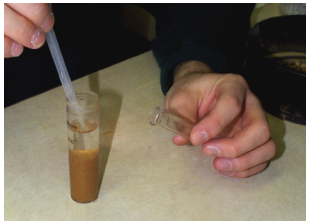
7. Repeat this procedure with the liquid from each of the soil samples. Be sure to rinse the pipette and tube with distilled water after they are used.

Laboratory Analysis

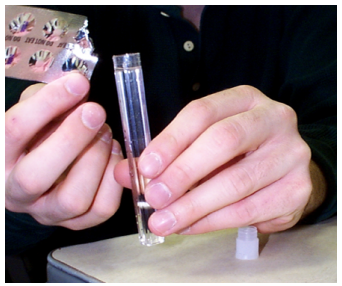
Soil Fertility (continued)

Part 4: Potassium (K)

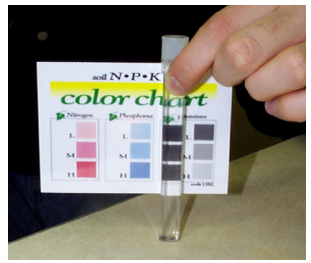
1. Use the clean pipette to transfer the clear solution above the soil to a clean test tube until it is filled to the shoulder. (If more solution is needed, repeat Part 1).



2. Add one Potassium Soil Tablet to the tube. Be sure that all the pieces of the tablet are added to the test tube. Cap and mix until the tablet disintegrates.



3. Hold the tube over the black boxes in the left column of the K portion of the color chart. Look through the "cloudiness" of the solution in the test tube and compare it to the shaded boxes in the right column. Record your results (High, Medium, Low, or None) on the Soil Fertility Data Work Sheet.



4. Discard the solution and wash the tube and the pipette with distilled water.

5. Repeat this procedure with the liquid from each of the soil samples. Be sure to rinse the pipette and tube with distilled water after they are used.