**Spectrophotometer Use for Soil Analysis Lab Key**

**Objectives:**

* To understand how to operate a spectrophotometer.
* To understand that a spectrophotometer can emit light from a controlled wavelength.

**Notes:**

* The spectrophotometer can either measure the transmittance of this light through a substance OR measure the absorption of this light by the substance.
* Transmittance and absorption levels are always opposite of each other.
* With a spectrophotometer, you can determine what wavelengths a substance will transmit, and what wavelengths it will absorb.
* The more dense (opaque) a substance, the more it will absorb, rather than transmit, wavelengths. The less dense (more transparent) a substance, the less it will absorb, but the more it will transmit, wavelengths.
* Water alone without the soil should have almost 100% transmittance of all wavelengths.
* The goal of this lab is not to be exact in your guess of particle size of the soil.
* Time will affect the amount of transmittance.

**Teacher Instructions: (please see further enclosed directions for using the Spec 20 Spectrometer)**

* 1. Gather 3 types of soil samples with different textures (some smaller grains like clay, medium grained like potting soil, larger grained like sand).
	2. Having a Spec 20 machine for each lab table is the preferred method.
	3. Care should be taken so that soil samples do not scratch the cuvettes (scratched cuvettes will interfere with light transmission).

**Student Instructions:**

1. Calibrate the Spec 20.
	* + Use the empty cuvette
		+ Set wavelength to 300 – 500
		+ Set the transmittance to 100%
		+ Match the white line of the cuvette with the plastic line on the sample holder
		+ Calibration must occur before each sample is measured
2. Put 2ml of soil into the cuvette.
	* + Use a 10ml graduated cylinder to measure the soil
		+ Observe and record the color and texture on the data table
3. Add 7ml of water into the cuvette.
	* + Shake for 20 – 30 seconds
		+ Observe and record the appearance with water while shaking
		+ Immediately put the cuvette into the Spec 20
		+ Start the timer and note percent transmittance quickly for start data
4. Note percent transmittance at 1-minute intervals for 10 minutes.

*Teacher Note*: Results will vary because of differences in the soil samples. Generally, the more transmittance there is, the largerthe particles. The less transmittance, the smaller the particles.

1. Use the table below to distinguish the particle size and soil type. Convert percent of transmittance to size of particles.

**Grain Size Scale Table :**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Size of Particle (in mm)** |  |  | **Number of Sieve Series** |  |  | **Texture Type/Name** |  |  |
|  |  |  |  |  |  |  |
| 3.35 |  | 6 |  |  | Very coarse/gravel |  |  |
| 2.00 |  | 10 |  |  | Very coarse/gravel |  |  |
| .850 |  | 20 |  |  | Coarse/sand |  |  |
| .425 |  | 40 |  |  | Medium/sand |  |  |
| .250 |  | 60 |  |  | Medium fine/sand |  |  |
| .150 |  | 100 |  |  | Fine/silt |  |  |
| .075 |  | 200 |  |  | Very fine/silt |  |  |
| .038 |  | 400 |  |  | Very, very fine/clay |  |  |
| .002 |  |  |  |  |  | Very, very, very fine/clay |  |  |

1. Repeat for each sample.
2. Graph the data with a line graph (time is the x-axis).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  | **Analysis** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **% of Transmittance Recorded Every Minute** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
|  |  | **Sample** |  |  |  | **Color** |  |  |  | **Texture** |  |  | **With** |  |  | **Start** |  |  |  | **1** |  |  | **2** |  |  |  | **3** |  |  | **4** |  | **5** |  |  |  | **6** |  |  | **7** |  |  |  | **8** |  |  |  | **9** |  | **10** |  |  |  | **Particle** |  |  | **Soil** |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  | **water** |  |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **min** |  | **Size** |  | **Type** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |

#1

#2

#3

Mix of 2

1. Which soil type had the highest percent transmittance after 10 minutes? **Coarser soil, like sand, should have the most** percent transmittance after 10 minutes? **Coarser soil, like sand, should have the most** **transmittance after 10 minutes. Finer soil, like clay, should have the least transmittance after 10 minutes**
2. What does percent transmittance mean? How does this relate to soil particle size? **Percent transmittance is related to what** **wavelengths get through the material. The higher the transmittance, the more waves come through, and the less solid areas there are in the cuvette. So probably, over time, transmittance will become higher as particles settle out.**
3. How could this test be used in a CSI lab? **A forensic scientist could extrapolate that similar soils would have similar** **transmittance and absorption ratings at similar time intervals. Good preliminary match of soil types.**