Name _____ Date _____
APES Topic 10 – Geology and Mineral Resources Mr. Romano

Aim: How do soil resources form and how are they classified?

A. SOIL FORMATION

Soil: The weathered fragments of rocks & minerals (sediments),and decomposing organic material (humus).

Steps in Soil Formation:

1. parent material (solid rock)
2. weathering (physical and chemical processes)
3. lichens / mosses / fungi
4. organic matter produced from death and decay (humus)
5. higher plant life and soil organisms

1 inch of soil takes 150 years to form and it can take 500-1000's of years to develop a full soil profile

B. SOIL PROFILE INDICATING SOIL HORIZONS

O-horizon
organic
freshly fallen, partly decomposed - surface "leaf-litter"
animal waste, fungi

A-horizon
dark **topsoil** layer
humus (organic material) & mineral (inorganic nutrients)
roots present

E-horizon
zone of **leaching** → percolating water brings minerals downward

B-horizon
subsoil layer a.k.a. zone of accumulation
clay/nutrient/mineral-rich
little organic material

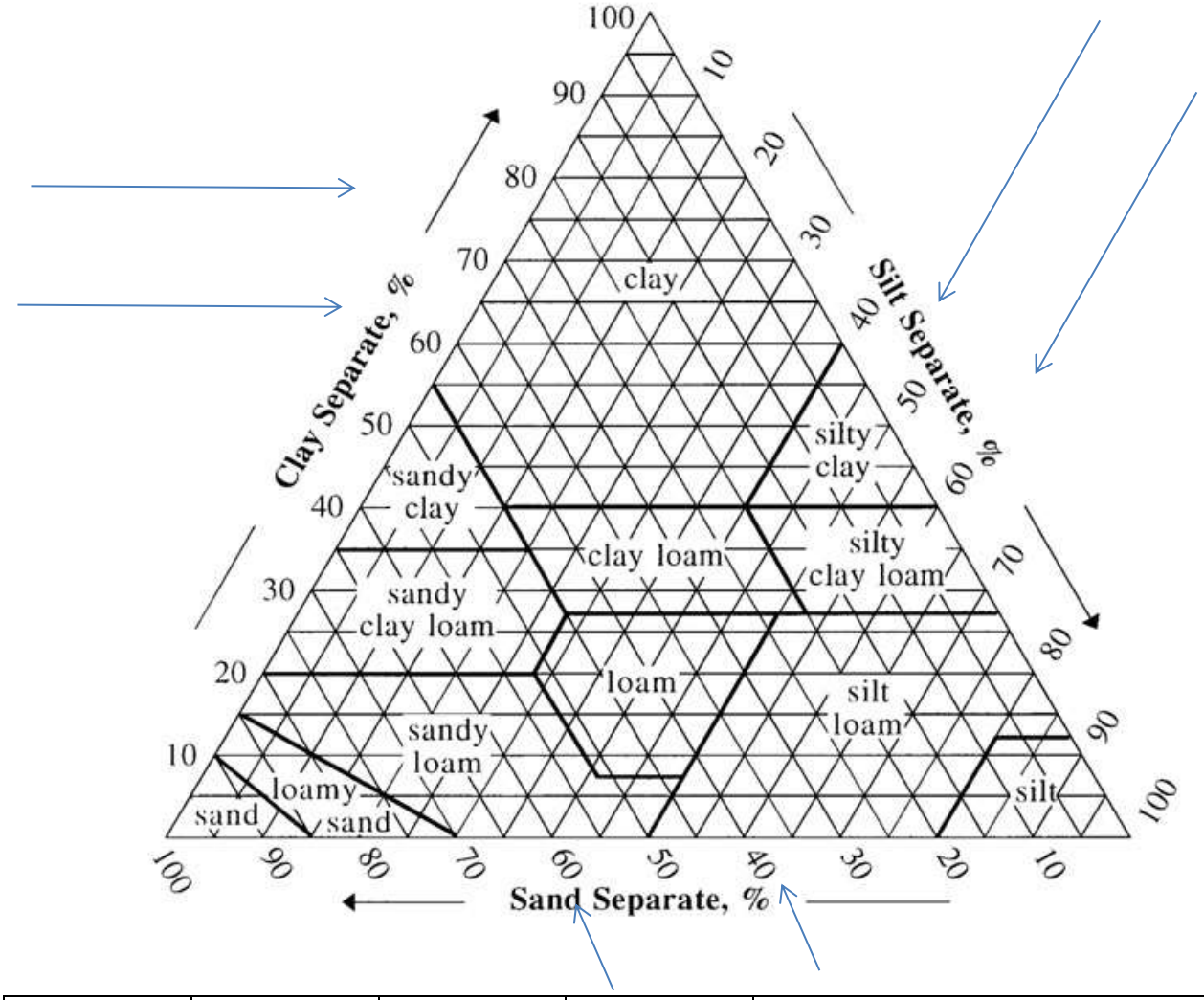
C-horizon
regolith - weathered parent material
no organic matter

Bedrock
parent material- solid rock
main determiner of chemical content of soil

C. SOIL TEXTURE

1. sand (fine to coarse) (.05 → 2mm)
2. silt (.002 → .05mm)
3. clay (less than .002mm)
4. loam (mixture of all) – ideal for agriculture

USDA SOIL TEXTURE TRIANGLE (indicates 12 soil texture classes)



SAMPLE	% Sand	% Silt	% Clay	Soil Texture Class
1	20	30	50	**clay**
2	50	10	40	**sandy clay**
3	70	20	10	**sandy loam**
4	42	21	37	**clay loam**
5	27	52	21	**silt loam**
6	5	70	25	**silt loam**

D. OTHER SOIL DESCRIPTORS

1. **Porosity** – the amount of open space between soil particles where air and/or water is present
   – determines how much water can be stored in the sample

2. **Permeability** – how well water passes down through a soil sample (better in larger grains)

3. **Water Holding Capacity / Retention** – how much water is held in a soil sample rather than being leached or evaporated
   (small particles like clay and organic material increase retention)

4. **Aeration** – how well air flows through soil pore space (soil packing reduces aeration)

5. **Workability** – how easy soil can be cultivated (clay soils not very workable)

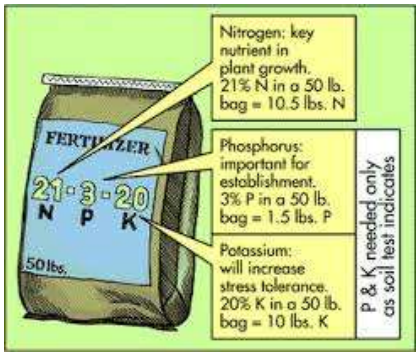
E. MAJOR SOIL ORDERS BASED ON BIOME

	BIOME	CLIMATE	DESCRIPTION
1. aridisols	**deserts**	**warm and dry**	poor horizon development due to lack of rainfall, little organic material
2. mollisols	**grasslands**	**semiarid**	deep, dark A-horizon rich in humus, very fertile for farming
3. spodosols	**coniferous forests (taiga, boreal forest)**	**cool and moist**	ample rainfall causes leaching, acidic O-horizon from pine needles, ashy-gray color
4. alfisols	**northern deciduous forests**	**cooler temperate and wet**	extensive profile development, humus/mineral rich A-horizon with clay subsoil
5. ultisols	**southern deciduous forests**	**warmer temperate and wet**	reddish, clay-rich subsurface, acidic soils that are naturally suitable for forestry, low fertility but can be made agriculturally productive
6. oxisols	**tropical rainforests**	**hot and wet**	rainfall causes highest level of weathering and leaching, rich in Fe-Al oxides, not suitable for agriculture

pedocals

pedalfers

F. SOIL CHEMISTRY AND FERTILIZER TREATMENT



NPK VALUES

Three important nutrients are considered when measuring soil conditions: nitrogen, phosphorus, and potassium – (N-P-K). In agriculture and horticulture, potassium is sometimes referred to as potash which is a potassium-rich salt that is mined and/or manufactured mainly for the use as fertilizer. "Potash" is derived from the collection of wood ash soaked in metal pots to make fertilizer many centuries ago before the industrial era.

Fertilizers are all labeled with an NPK value. It usually appears as a series of three numbers like 10-10-10, 20-20-20, 10-8-10. The higher the number, the more concentrated the nutrient is in the fertilizer. For example, numbers on fertilizer listed as 20-5-5 has four times more nitrogen in it than phosphorus and potassium. A 20-20-20 fertilizer has twice as much concentration of all three nutrients than 10-10-10. So now that you know what the numbers on fertilizer mean, you should also be aware of what these nutrients do for your plants:

Nitrogen (N) – nitrogen is largely responsible for the growth of leaves on the plant.
Phosphorus (P) – phosphorus is largely responsible for root growth and flower and fruit development.
Potassium (K) – potassium is a nutrient that helps the overall functions of the plant perform correctly.

Knowing the NPK values of a fertilizer can help you select one that is appropriate for the type of plant you are growing and the needs at a particular time of the growing season. For example, if you are growing leafy vegetables, you may want to apply a fertilizer that has a higher nitrogen number to encourage leafy growth. If you are growing flowers, you may want to apply a fertilizer that has a higher phosphorus number to encourage more blooms. If you are planting grass seeds, you would want to use a starter fertilizer for lawns with a high P number to establish the root system. Later in the season, you would switch to a higher nitrogen fertilizer to promote plant growth.

Before you apply fertilizer to your garden beds, you should do a soil test to determine the appropriate balance of fertilizer numbers that will be appropriate for your garden's soil needs and deficiencies.
The Fertilizer Recommendation Table shown below is used to interpret soil chemistry test results.

	Pounds of Nutrient to be Added per 2000 sq. ft.		
Test Result	***Nitrogen***	***Phosphorus***	***Potassium / Potash***
Very high	2	4	3
High	4	6	4
Medium high	5	7	5
Medium	6	8	6
Medium low	7	9	7
Low	8	10	8
Very low	10	12	10

SOIL pH

In addition to the NPK value, soil pH needs to be tested and possibly adjusted. If the soil has a lower pH than normal (acidic), **pelletized or pulverized lime ($CaCO_3$)** is **used to increase the pH**. If the soil has a higher pH than normal (alkaline), it is probably because the location already has a calcium-carbonate rich parent material that is weathering into soil in an arid or semiarid environment, or there is pine-litter acidifying the soil. **Using elemental sulfur** that will react with water to produce sulfuric acid (H_2SO_4), **adding a commercial soil acidifier**, or **adding peat moss (which also aids in water retention)**, **will help lower the pH** to bring it to the optimal gardening / landscaping range of 6.0-7.2