Date _____

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

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

A. SOIL FORMATION

1. parent material (solid rock) is exposed at surface
2. weathering (Earth's physical and chemical processes)
3. lichens / mosses / fungi
   (biological weathering breaks down solid rock)
4. organic matter produced from death
   and decomposition (humus)
5. higher plant life and soil organisms
   become established

1 cm of soil takes 100-200 years years to form and it can take 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

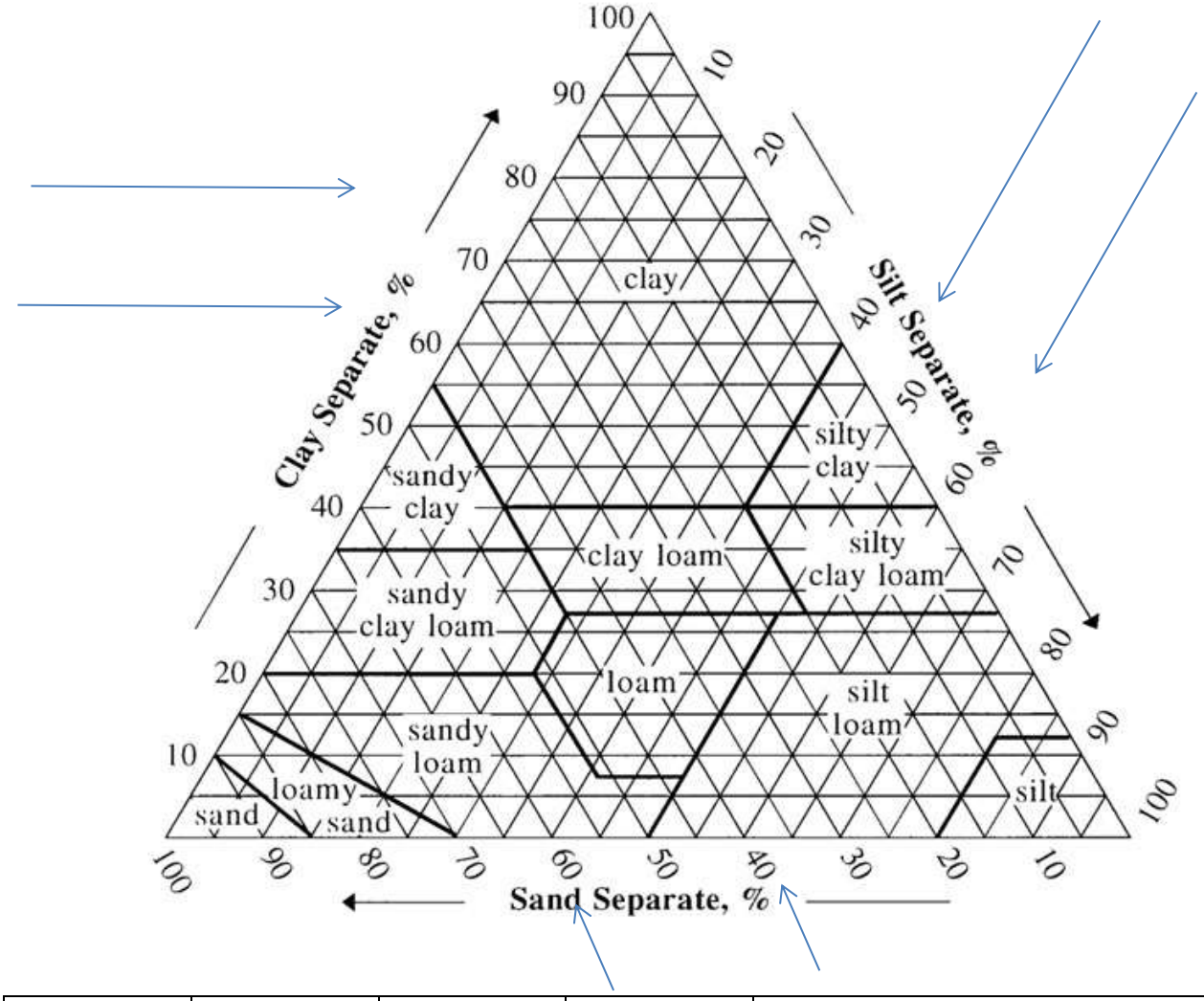
C-horizon
regolith - weathered parent material
no organic matter

R-horizon
solid bedrock also referred to as (**parent material)**
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 and not evaporated or leached out
   (small particles like clay and organic material increase retention)

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

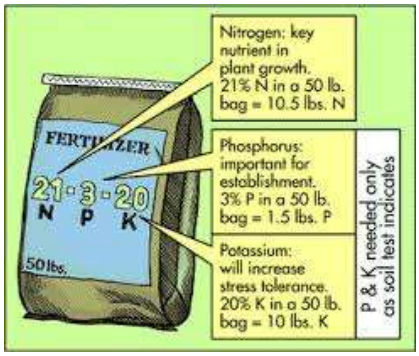
5. **Workability -** how easy soil can be cultivated (clay soils not very workable)

E. MAJOR SOIL ORDERS BASED ON BIOME

a large community of plants and animals that occupies a distinct region - typically defined by their climate and dominant vegetation

	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

nutrients are in stored in plants, the rest washed away from soil



F. SOIL CHEMISTRY (and fertilizer treatment)

N-P-K 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) – responsible for the growth of leaves on the plant.
Phosphorus (P) – responsible for root growth and flower and fruit development.
Potassium (K) – assists overall function and health (helps fight disease)

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, possibly due to the presence of pine-litter or another acidic substance, **pelletized or pulverized limestone ($CaCO_3$),** commonly referred to as **"lime"**, 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. **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

F. SOIL CHEMISTRY (and fertilizer treatment)… (continued)

Organic Fertilizers	Inorganic / Chemical Fertilizers (Scotts / Vigoro / Miracle-Gro)
1. **animal manure** - adds nutrients - beneficial bacteria	**Pros:** - easy storage - easy use - adds nutrients - increases crop yield
2. **green fertilizers** - plants tilled back into soil (ex . grass clipping and corn husk) - adds humus - increases water retention	**Cons:** - temporary fix - no beneficial bacteria - doesn't improve water retention
3. **compost** - leftover food scraps - decomposing organic matter	

SOIL CHEMISTRY Questions

Using the Fertilizer Recommendation Table, answer the following questions:

1. It is that time of the year when you are preparing your backyard for your spring plantings. You do a soil quality test and it indicates that the nitrogen levels are high, the phosphorus is low, and there is a medium potassium level. What NPK blend is best to apply to your soil to get it ready for plants?

   4-10-6 NPK blend

2. It's also that time of year that you need to get your front yard in order. In fact you decide to do this first to avoid the "bad neighbor effect" of lowering property values due to unsightly front-yard landscaping. The front yard, which has less of a tree canopy, yields different soil quality results than the backyard did. The front yard planting beds are low in nitrogen, medium-low in phosphorus, and register medium-high levels of potassium. What NPK blend is best to apply to your soil to get it ready for plants in this part of your yard?

   8-9-5 NPK blend

3. You want to start a tomato garden in your side yard because you have no room in your backyard or front yard. The optimal pH range for tomato growth is 6.0-6.8, but your soil indicates a pH reading of 7.8. What action can you take to adjust the pH of the soil that you are going to transfer your starter plants into to maximize the productivity of your tomato plants?

   add a soil acidifier: sulfur or peat moss to lower the pH

4. You have one last patch of yard that has just enough room for one more planting. You remembered that way back in the day you did an experiment with radish seeds. You remember so vividly because you really wanted to do the experiment with white icicle radishes, but your APES teacher stuck you with the French breakfast and cherry belle varieties. You have never recovered from the disappointment … Icicle radishes grow real well in soil with a pH of 6.0-7.0. This area of your yard happens to have some spruce trees nearby that have dropped their needles for years. The soil pH in this area registers at 5.5. What action can you take to adjust the pH of the soil before you plant your radish seeds?

   add lime ($CaCO_3$) to raise the pH