

MENTOR INVITATIONAL 2009

ENVIRONMENTAL CHEMISTRY 'B' DIVISION

**ONE PIECE OF 8.5" x 11" PAPER WITH HANDWRITTEN
NOTES ON ONE OR BOTH SIDES IS PERMITTED**

PER STUDENT

Soil Horizons

O Horizon: litter layer; common in forests

A Horizon: topsoil; dark; nutrient rich

E Horizon: eluvial horizon

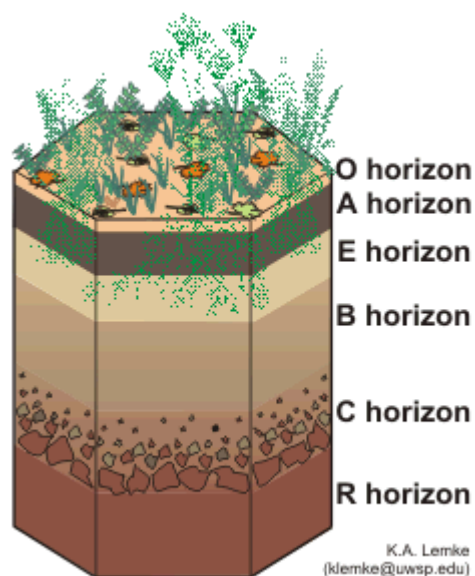
clay, iron & aluminum eluviated most often
sand & silt concentrated here
light colored

B Horizon: illuvial horizon

clay, iron & aluminum illuviated here

C Horizon: weathered parent material

R Horizon: consolidated bedrock



School _____ Team # _____

Names of participants

1. _____ 2. _____

Raw score _____ / 62 possible

Rank _____

MENTOR INVITATIONAL 2009 DIVISION B

ENVIRONMENTAL CHEMISTRY

Please answer all questions in the space provided: (one point unless stated)

1. What is the chemical symbol for potassium? _____
2. Give the chemical formula for potassium as traditionally expressed in fertilizer.
3. What is the potassium used for by plants? (answer more than “growth”)
4. What is the chemical symbol for nitrogen? _____
5. Give the chemical formula for nitrogen as found in fertilizer. _____
6. What is the nitrogen used for by plants? (answer more than “growth”)
7. What is characteristic of plants showing a nitrogen deficiency?
8. What is the chemical symbol for phosphorus? _____
9. Give the chemical formula for phosphorus as found in fertilizer. _____
10. What is the purpose of phosphorus in plants? (answer more than “growth”)
11. Soil is formed from rock through what process. _____
12. The natural pH of most water is about 6 and not the 7 that defines neutrality as you would expect pure water to be. Be specific and explain why natural waters have the pH of 6.

13. George Washington Carver was a big proponent of a specific method of farming. In this method, destructive pests and diseases are reduced and nutrients replenished. What is the term for this type of farming?

List three examples of organic fertilizers:

14. _____

15. _____

16. _____

17. How many **pounds** of potassium are in a **500-pound** bag of 16-8-4 fertilizer?

18-21. Circle from the list below the 4 major components of all soils 4pts. .

air	clay	roots	sand	fungi
minerals	quartz	silt	water	worms
bacteria	organic matter			

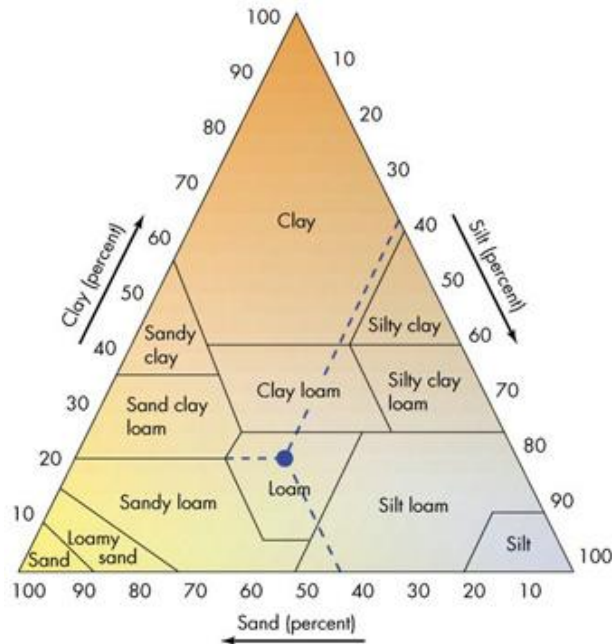
MULTIPLE CHOICE Place your answer on the line to the left of the question. Print clearly—if I cannot distinguish the letter it will be marked incorrect.

_____ 22. Which of the following is an indicator of a "healthy" soil?
a. worms b. organic matter c. soil moisture
d. all of the above e. "a" and "b"

_____ 23. What is the soil order most dominant in Northeast Ohio?
a. alfisols b. entisols c. gelisols d. oxisols e. spodosols

_____ 24. If you are an alien plant, such as the one in "Little Shop of Horrors," you might like fresh blood. Here on Earth, dried blood (not human) can be used as a fertilizer supplying which element to the soil?
a. N b. P c. K d. Co e. B

_____25. According to this figure below, which has the most clay by percent?
 a. sandy clay b. silty clay loam c. sand clay loam d.
 loamy sand



MATCHING – you may draw lines from the left to the correct answer on the right.

ELEMENT	PURPOSE
26. Calcium	A. vital to protein structure.
27. Iron	B. flowering and fruiting, pollen germination
28. Boron	C. required for photosynthesis
29. Magnesium	D. structural element in primary cell walls
30. Chlorine	E. present in the chlorophyll molecule
31. Sulfur	F. Helps catalyze a number of reactions in plants

GET OUT YOUR CALCULATORS: Your irrigated pasture has been tested and it is suggested that you fertilize at a rate of 140 pound of nitrogen per acre. You are using Ammonium Sulfate, a 16-20-0-15 fertilizer. A 100-pound bag of this fertilizer will contain 16 pounds of nitrogen.

1. How many pounds of this type of fertilizer should you apply, per acre? 2 pts.

2. What element is represented by the fourth number on the fertilizer label, 16-20-0-**15**?

PART I I---SOIL TEST SAMPLES (28 points total)

Please observe the three sets of soil samples that have already been treated with the necessary chemicals to develop the respective colors on the tests. Record your observations in the chart below: (1pt each) You may have to share depending upon the #stations available.

Sample set number	pH (nearest 0.5)	Nitrogen	Phosphorus	Potassium
1				
2				
3				

Now answer the questions below which relate to these samples.

SOIL SAMPLE #1 questions:

5 PTS. EXPLAIN how you would treat the #1 soil sample, if at all, to make it productive for growing corn based upon all the results of your soil tests.

2pts: What is the main disease of corn?

SOIL SAMPLE #2 questions

3pts. What material should Soil Sample #2 be treated with, if at all, to make it productive to grow tomatoes?

2 PT. What is the cause of “splitting” (like an open cut) on the tomatoes while still on the vine?

1pt. When is the best time to fertilizer soil?

1pt. Why?

SOIL SAMPLE #3 question

2 pts. What should Soil sample #3 be treated with, if at all, to make it productive to grow lettuce?

MENTOR INVITATIONAL 2009 DIVISION B

KEY

KEY

ENVIRONMENTAL CHEMISTRY

Please answer all questions in the space provided:

1. What is the chemical symbol for potassium? _____ **K**
2. Give the chemical formula for potassium as traditionally expressed in fertilizer.
K₂O
3. What is the potassium used for by plants? (give more than “growth”)
Strength and root systems, forms carbohydrates and promotes protein syntheseis, improves color and flavor of fruit, aids early growth, stem strength and cold hardiness; important in plant photosynthesis to help plants metabolize their food to get energy; controls water and chemicals inside plants that help them function well; absorption of water
4. What is the chemical symbol for nitrogen? _____ **N**
5. Give the chemical formula for nitrogen as found in fertilizer. _____
any of these acceptable: NH₃, NH₄⁺, NO₃⁻
6. What is the nitrogen used for by plants? (answer more than “growth”) **ANY ONE**
deep green leaves, lush leaf growth, helps plants use carbohydrates to gain energy, make proteins
7. What is characteristic of plants showing a nitrogen deficiency? **ANY ONE**
Yellow leaves, stunted growth, and thin,spindly stems
8. What is the chemical symbol for phosphorus? _____ **P**
9. Give the chemical formula for phosphorus as found in fertilizer. _____**P₂O₅**

10. What is the purpose of phosphorus in plants? (answer more than "growth")
ANY: **Produce fruits, seed development, plant genetics, help with photosynthesis; Helps plants respire, provides energy transfer and storage, use water Increases vitamin content and aids the plant's resistance to disease**

11. Soil is formed from rock through what process. **Weathering**

12. The natural pH of most water is about 6 and not the 7 that defines neutrality as you would expect pure water to be. Be specific and explain why natural waters have the pH of 6.
Dissolved CO₂ forms carbonic acid with water, lowering the pH. Carbonic acid is a weak acid.

13. George Washington Carver was a big proponent of a specific method of farming. In this method, destructive pests and diseases are reduced and nutrients replenished. What is the term for this type of farming?
Crop rotation (or crop alternation)

List three examples of organic fertilizers: **ANY 3 given credit**

- | | | | | |
|-----|------------------|----------------------|------------------------------------|-------------------|
| 14. | bone meal | humus | sawdust, | wood chips |
| 15 | compost | leaf mold | peat moss | straw |
| 16 | manure | fish emulsion | urea (an organic compound) | |

17. How many **pounds** of potassium is in a **500-pound** bag of 16-8-4 fertilizer?
4% = 4 pounds/100 pound bag x 500 pounds = 20 pounds

18-21. Circle from the list below the 4 major components of all soils 4pts. .
air clay roots sand fungi minerals
quartz silt water worms bacteria
organic matter
air water organic matter minerals

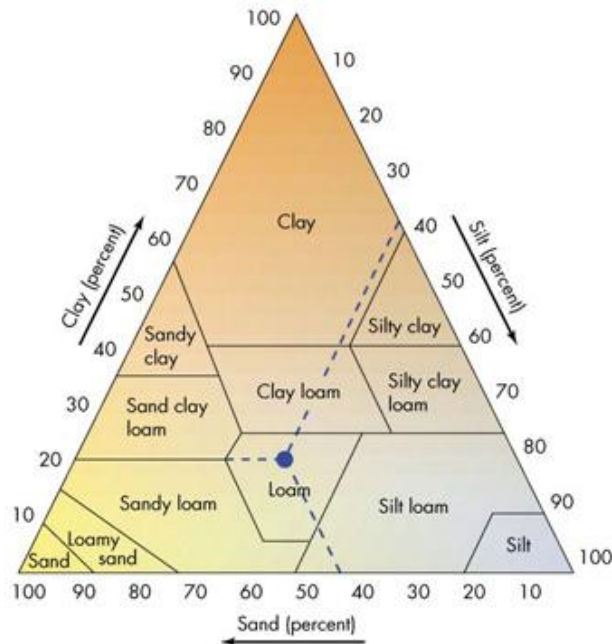
MULTIPLE CHOICE Place your answer on the line to the left of the question. Print clearly—if I cannot distinguish the letter it will be marked incorrect.

___**D** 22. Which of the following is an indicator of a "healthy" soil? **D**
a. worms b. organic matter c. soil moisture
d. all of the above e. "a" and "b"

A 23. What is the soil order most dominant in Northeast Ohio?
 a. alfisols b. entisols c. gelisols d. oxisols e. spodosols

B 24. If you are an alien plant, such as the one in “Little Shop of Horrors” you might like fresh blood. Here on Earth, dried blood (not human) can be used as a fertilizer supplying which element to the soil?
 a. N b. P c. K d. Co e. B

A 25. According to this figure below, which has the most clay by percent? a. sandy clay b. silty clay loam c. sand clay loam d. loamy sand



MATCHING – you may draw lines from the left to the correct answer on the right.

- ELEMENT**
- D26. Calcium
 - F27. Iron
 - B28. Boron
 - E29. Magnesium
 - C30. Chlorine
 - A31. Sulfur

- PURPOSE**
- A. vital to protein structure.
 - B. flowering and fruiting, pollen germination
 - C. required for photosynthesis
 - D. structural element in primary cell walls
 - E. present in the chlorophyll molecule
 - F. Helps catalyze a number of reactions in plants

GET OUT YOUR CALCULATORS: Your irrigated pasture has been tested and it is suggested that you fertilize at a rate of 140 pound of nitrogen per acre. You are using Ammonium Sulfate, a 16-20-0-15 fertilizer. A 100-pound bag of this fertilizer will contain 16 pounds of nitrogen.

1. How many pounds of this type of fertilizer should you apply, per acre? **3 pts.**
 140 pounds divided by 16% = 875 pounds or you may solve it this way:
140 pounds divided by 16= 8.75 bags. Each bag is 100 pounds, so the grand total is 875 pounds of 16-20-0-15 fertilizer per acre to actually apply 140 pounds of nitrogen per acre.

2. What element is represented by the fourth number on the fertilizer label, 16-20-0-**15**?

S or sulfur

KEY PART I I---SOIL TEST SAMPLES (28 points total) KEY

Please observe the three sets of soil samples that have already been treated with the necessary chemicals to develop the respective colors on the tests. Record your observations in the chart below: (1pt each). You may have to share samples depending upon the # stations.

Sample set number	pH (nearest 0.5)	Nitrogen	Phosphorus	Potassium
1	5.0	surplus	depleted	Adequate
2	6.5	depleted	sufficient	surplus
3	7.0	sufficient	surplus	sufficient

Now answer the questions below which relate to these samples.

SOIL SAMPLE #1 questions:

5 PTS. EXPLAIN how you would treat the #1 soil sample, if at all, to make it productive for growing corn based upon all the results of your soil tests.

- a. **treat with lime (limestone)(2pts) to raise the pH of the soil 6.0-6.5 which is optimum for corn(1pt)**
- b. **add a phosphorus fertilizer (1pt)**
- c. **water the soil well and do not add nitrogen fertilizer for several months. (1pt)**

2pts: What is the main disease of corn? **Smut or Stewart's disease (bacterial wilt)**

SOIL SAMPLE #2 questions

3pts. What fertilizer should/should not Soil Sample #2 be treated with, if at all, to make it productive to grow tomatoes?

Need to add nitrogen fertilizer but not P or K. Use dried blood, Nitrate of soda. This balances the soil to help use us the excess potassium.

2 PT. What is the cause of “splitting” (like an open cut) on the tomatoes while still on the vine? **Overwatering**

1pt. When is the best time to fertilizer soil? **Late fall or early spring**

1pt. Why? **This gives you time to make adjustments before you plant your garden, since soil corrections may take a few months to become effective. Allows you to correct Nitrogen deficiency due to leaching, run off depending upon soil type.**

SOIL SAMPLE #3 question

2 pts. What should Soil sample #3 be treated with, if at all, to make it productive to grow lettuce? **Do not use phosphate fertilizers for a year or two and grow lots of plants to use up the excess.**Note: best pH is for lettuce--**pH 6.0-7.0**