

# Environmental Chemistry



Name(s): \_\_\_\_\_

School: \_\_\_\_\_

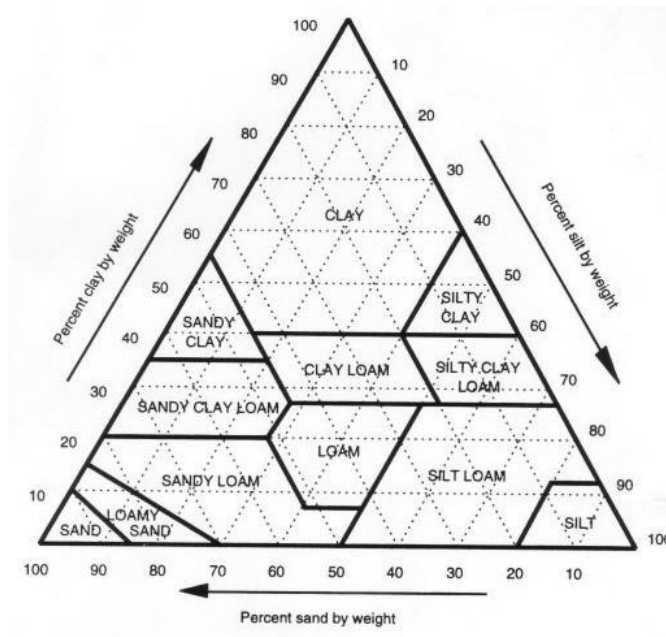
Team Number: \_\_\_\_\_

## PART 1: SOIL

1. Match the soil separates with their size:

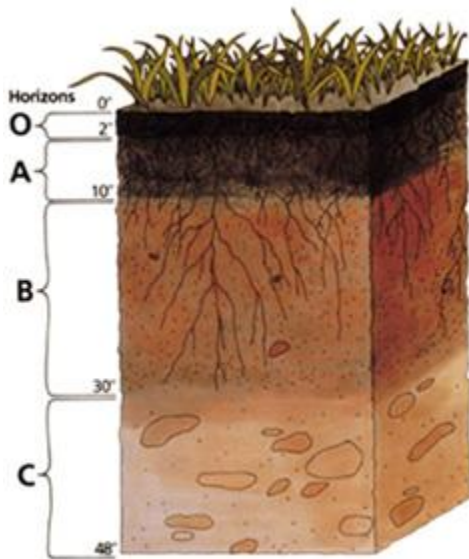
- |            |                        |
|------------|------------------------|
| _____ silt | A. 2.0 mm to 0.02 mm   |
| _____ sand | B. 0.02 mm to 0.002 mm |
| _____ clay | C. finer than 0.002 mm |

2. Using the soil texture triangle, answer the questions below.



- Which type of soil is 40% sand, 40% silt, and 20% clay?
- Which type of soil is 10% clay, 30% silt, and 60% sand?
- Which type of soil is 30% clay, 60% silt, and 10% sand?
- Of a., b., or c., which is the best soil for growing plants?
- Of a., b., or c., which soil has the poorest water infiltration?
- Of a., b., or c., which soil has the poorest nutrient holding capacity?

3. Match the descriptions below to their position on the soil profile shown. Use the Horizon letters O, A, B, and C to fill in the blanks.



\_\_\_\_ topsoil

\_\_\_\_ parent mineral material originally occupying the site of the soil

\_\_\_\_ high in Fe, Al, Ca, and other minerals

\_\_\_\_ litter layer

4. What are the 3 main things plant roots must obtain from soil?
5. List 3 attributes a soil must have to support crops.
6. Erosion is a major problem with soil.
- What are the 3 major practices that expose soil to erosion and lead to soil degradation?
  - What are 2 ways farmers can stop erosion?

7. Crop rotation is an important practice in farming. Give 2 reasons for crop rotation.
8. Acid rain can be formed from sulfur dioxide and sulfur trioxide released into the air by factories.
- Write balanced equations for the reactions between these compounds and moisture in the air.
  - What 2 critical nutrients in the soil are depleted by acid rain?
  - These 2 critical nutrients are usually found in the form of carbonates. Show the balanced equation for the reaction between nitric acid in acid rain and one of these carbonates.
  - What is pH?
  - A soil has a  $[H^+] = 3.5 \times 10^{-5}$  M. What is the pH of the soil? Is it acidic or alkaline? What would you add to the soil to remedy this problem?
  - A soil has a  $[H^+] = 6.7 \times 10^{-9}$  M. What is the pH of the soil? Is it acidic or alkaline? What would you add to the soil to remedy this problem?

## PART 2: FERTILIZERS

9. Label each of the following as macronutrients or micronutrients by writing “macro” or “micro” next to each one.

- |                |             |
|----------------|-------------|
| a. Iron        | e. Copper   |
| b. Phosphorous | f. Zinc     |
| c. Sulfur      | g. Nitrogen |
| d. Manganese   | h. Calcium  |

10. Use the fertilizer label to answer the following questions.



- a. Explain what “20-5-10” means specifically.
- b. If you had 500 kg of this fertilizer....
- How many kg would be potassium?
- How many kg would be nitrogen?
- How many kg would be phosphorous?

Match the nutrient with its plant function

\_\_\_\_\_ potassium

A. promotes green and growth

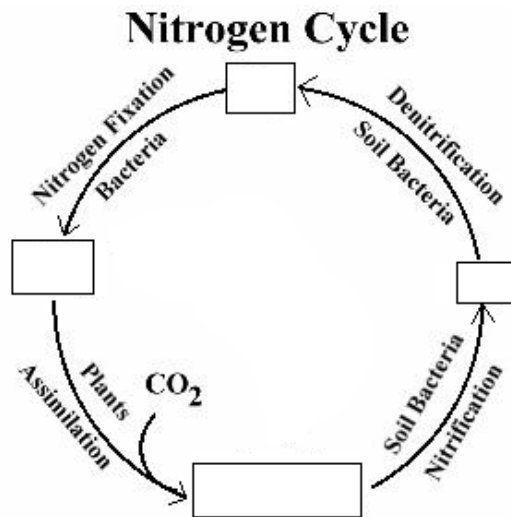
\_\_\_\_\_ nitrogen

B. promotes flavor and color of fruits and vegetables

\_\_\_\_\_ phosphorus

C. promotes fruit, flower, and roots

11. Nitrogen is a very important element in biological organisms. 79% of the earth's atmosphere is nitrogen, but most organisms cannot use nitrogen in that form. The nitrogen cycle shows how  $N_2$  is taken from the air and changed to a useable form. Fill in the boxes in the nitrogen cycle.



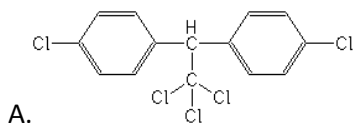
12. Which types of crops help return nitrogen to the soil?
13. In fertilizer, the nitrogen usually comes from ammonia or an ammonium compound.
- Write the balanced equation used to synthesize ammonia.
  - What is this industrial process called?
14. What is the common name for the compound that is the source of potassium in fertilizer? What chemical formula for this compound?
15. What compound is the source of phosphorous in fertilizer? Give its chemical name and formula.

### PART 3: PESTICIDES

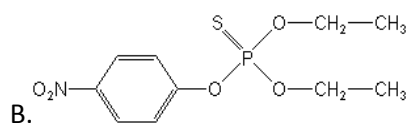
16. List 2 elements that are considered first generation pesticides. Why did their use stop in the mid-1900s?

17. Plant extracts have been used as pesticides since ancient times. Name one botanical pesticide.

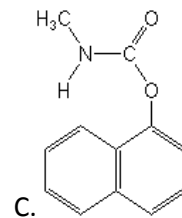
18. Organophosphates, organochlorines, and carbamates are classes of insecticides. Match the structural formula to the class of insecticide.



DDT



PARATHION



SEVIN

\_\_\_\_\_organophosphate

\_\_\_\_\_organochlorine

\_\_\_\_\_carbamate

19. Explain bioaccumulation and biomagnification of pesticides as it relates to DDT and the decline in the bald eagle population in the 1960s.

20. List 3 problems stemming from pesticide use.

Multiple Choice – circle the correct answer.

21. Breeding plants to be pest resistant is an example of:
- A. Chemical barriers
  - B. Genetic controls
  - C. Pheromones
  - D. Cultural controls
  - E. A form of pest control that is a long way from being used
22. Ladybugs are sold at garden supply stores
- A. As pollinators for plants
  - B. To breed, repopulate, and control weeds
  - C. As an organic method of controlling soil erosion
  - D. As a natural control for certain insects
  - E. To increase fertility
23. Pesticides have been linked to all of the following human health concerns **EXCEPT**:
- A. Breast cancer
  - B. Birth defects
  - C. Infertility
  - D. Defective sperm counts
  - E. Tuberculosis
24. Pesticides are beneficial for all of the following reasons **EXCEPT**:
- A. Pesticides eliminate pests that spread disease
  - B. Pesticides add important nutrients to the soil
  - C. Pesticides keep fruits and vegetables aesthetically appealing to consumers
  - D. Pesticides kill pests that harm crops
  - E. Pesticides allow people to live more comfortably

BONUS: Give the full name of DDT. Name the biologist who wrote *Silent Spring* about the effects of DDT.



## PART 4: SOIL TESTING

**This part of the event requires you to use the soil testing kit to test the soil samples at your table.**

### *Directions for testing pH:*

Find the vial labeled “soil for pH test”. Take out the green capsule, open it, and empty the contents on the soil in the vial. Add water to fill the vial about 1/3 full. Shake and then let sit. Compare the color to the comparison chart in the front of the room.

### *Directions for testing N,P, and K:*

Find the jar labeled “soil mixture for N,P,K tests”. This is a mixture of soil and water. You will test the liquid above the soil. Take each capsule out of the other three vials and add the liquid from above the soil to each vial – about 1/3 full. Open one capsule and add the contents to one vial. Repeat with the other capsules and other 2 vials. Shake the vials and allow the color to develop for 10 minutes. Compare the colors to the comparison chart in the front of the room. The purple capsule tests for N, blue for P, and orange for K.

1. From your tests and comparisons fill in the chart:

pH	
Nitrogen	
Phosphorus	
Potassium	

2. Is the soil acidic, alkaline, or neutral? Which of the following crops would grow best in this soil based on pH: apples, cherries, blueberries, potatoes, tomatoes, cabbage, and/or broccoli (list all that apply)?
  
3. Is the soil deficient or surplus in nitrogen, phosphorus, or potassium? If so, list the deficient/surplus mineral and give a recommendation for improving the soil.

4. The concentration of iron in the soil is to be determined. Spectrophotometry or colorimetry is often used to determine the concentration of a mineral in soil.

- a. The experimenter took standard samples of iron and determined their absorbance. The experimenter then took the iron sample from the soil and determined its absorbance.

Concentration of iron	Absorbance
0.00 M	0.00
0.0030 M	0.10
0.0060 M	0.21
0.010 M	0.35
Soil - ?	0.005

**From the data, calculate the concentration of iron in the soil in molarity and in ppm. Show all work.**

- b. What law states that absorbance is directly proportional to the concentration of a solution?
- c. Which of the following nutrients could NOT be tested using spectrophotometry? Circle them.

Ca    Co    Cu    Mg    Mn    Ni    Zn

Why can't they be tested using spectrophotometry?

