

2006 Canon Envirothon
Soils Station Test

Soils and Climate Change

There are many kinds of soil on the surface of the earth. The kind of soil that is present at a given location is determined by 5 soil forming factors: time, parent material, topography, organisms (including humans) and climate. Not only does climate affect how a soil forms in a given area, the soil also affects the climate.

The Mount Hermon area is in the coast redwood/Douglas-fir belt along the California coast. These forest environments have a unique relationship with the climate. The forest, and consequently the soil beneath the forest, are dependent on winter rains and summer fog. Hence, climate change can have a major effect on the soils of the area.

Your task is to examine the soil and see what role climate played in its formation, how the soil can be managed to affect climate change and how human activities and climate change can affect the soil.

In the questions below there are several references to Soil Organic Matter (SOM). Your readings talked a lot about soil organic carbon (SOC). SOC is directly proportional to SOM (in other words higher SOM means higher SOC and vice-versa).

Circle the letter or letters corresponding to the correct answer(s). There is only one correct answer for each unless otherwise noted.

DESCRIBE THE SOIL PROFILE

Since the surface and subsoils have multiple horizons, use the horizons with the nail in them for determining color and texture.

Answer the following questions by making observations in the soil pit. Use the area between the ribbons for measuring only—do not dig in that area.

1. What is the color of the surface layer? (3 points)
 - A. Very dark
 - B. Medium or bright
 - C. Very light
 - D. Drab or mottled

2. What is the texture of the surface layer? (3 points)
 - A. Coarse (Sand or loamy sand)
 - B. Medium (Loam, sandy loam, or silt loam)
 - C. Fine (Clay loam, sandy clay loam, or silty clay loam)
 - D. Very Fine (Clay, sandy clay, or silty clay)

3. What is the permeability of the surface layer? (3 points)
 - A. Rapid
 - B. Moderate
 - C. Slow

4. What is the thickness of the surface layer? (3 points)
 - A. 20 inches or more
 - B. 10 to 19 inches
 - C. 4 to 9 inches
 - D. Less than 4 inches

5. What is the color of the subsoil? (3 points)
 - A. Very dark
 - B. Medium or bright
 - C. Very light
 - D. Drab or mottled

6. What is the texture of the subsoil? (3 points)
 - A. Coarse (Sand or loamy sand)
 - B. Medium (Loam, sandy loam, or silt loam)
 - C. Fine (Clay loam, sandy clay loam, or silty clay loam)
 - D. Very Fine (Clay, sandy clay, or silty clay)

7. What is the permeability of the subsoil? (3 points)
 - A. Rapid
 - B. Moderate
 - C. Slow

8. What is the depth of the soil to the parent material? (3 points)
 - A. less than 10 inches
 - B. 10 to 14 inches
 - C. 15 to 19 inches
 - D. 20 to 24 inches
 - E. 25 to 29 inches
 - F. 30 to 34 inches
 - G. 35 to 40 inches
 - H. More than 40 inches

9. What is the parent material of the soil at the pit location? (3 points)
 - A. Hard Bedrock
 - B. Soft Bedrock
 - C. Loose or mixed materials
 - D. Organic materials
 - E. Cannot know for sure - Parent Material is not observable

10. What is the depth to a water table? (3 points)
- A. More than 60 inches or not present
 - B. 40 to 59 inches
 - C. 20 to 39 inches
 - D. Less than 20 inches

DESCRIBE THE SITE

In this section we want to compare the site of the disturbed landscape to the previous landscape.

11. What is the slope of the landscape? Measure the slope at the wooden stakes marked with the green flags. (3 points)
- A. 0 to 1 percent
 - B. 2 to 4 percent
 - C. 5 to 8 percent
 - D. 9 to 15 percent
 - E. 16 to 25 percent
 - F. 26 to 50 percent
 - G. More than 50 percent
12. Look in the area bounded by the stakes with pink flags. What kind of erosion, if any, is occurring? (There may be more than one correct answer) (3 points)
- A. None
 - B. Sheet & Rill erosion
 - C. Gully erosion
13. If there is any erosion, what evidence do you see? (There may be more than one correct answer) (3 points)
- A. There is no erosion
 - B. Rills are present
 - C. Gullies are present
 - D. Deposition
14. What is the severity of the erosion? (3 points)
- A. There is no erosion
 - B. Slight: Mineral soil is exposed but less than 1 inch lost
 - C. Moderate: More than 1 inch but less than 4 inches of mineral soil lost OR rills are present
 - D. Severe: More than 4 inches of mineral soil lost OR gullies are present

15. Rate soil profile 2 using the USDA Land Capability Classification System. Use your answers from questions 2 through 14 and the information provided below to help you make the determination. Use the following table to assign a Land Capability Class to the soil. Choose the Land Capability Class for the most limiting item or items. Limitations increase as you move from the top to the bottom of the table. Circle the correct answer below (7 points)

- A. Class I
- B. Class II
- C. Class III
- D. Class IV
- E. Class VI
- F. Class VII
- G. Class VIII

Effective soil depth: see question 8
Surface layer texture: see question 2
Permeability: see question 7
Depth to water table: see question 10
Available water capacity: 5.5 inches
Slope: see question 11
Amount of erosion: see question 14

Guide for Placing Soils in Land Capability Classes in California Modified from the FFA Land Judging Manual							
Capability Class	Effective Soil Depth (inches) 1/	Surface Layer Dryland 2/	Permeability	Drainage Class 3/	Available Water Capacity 4/	Slope	Amount of Erosion
I	> 40	Sandy Loam→ Clay Loam 0-15%	Moderate	Well or Mod. Well =60"	> 7.5 inch	<2%	None or Slight
II	> 40	Sandy Loams→ Clay 0-15%	Rapid→ Slow	Somewhat Poorly→ Somewhat Excessively =36"	> 5.0 inch	<5%	None→ Moderate
III	> 20	Sandy Loams→ Clay 0-35%	Rapid→ Slow	Poorly→ Excessively =20"	> 3.5 inch	<15%	None→ Severe
IV	> 10	Loamy Sand→ Clay 0-60%	Any	Poorly→ Excessively =20"	> 2.5 inch	<25%	Any
V	> 20	Any	Any	Any	> 2.5 inch	<2%	None or Slight
VI	> 10	Any	Any	Any	> 2.5 inch	<50%	Any
VII	Any	Any	Any	Any	> 1.0 inch	<75%	Any
VIII	Any	Any	Any	Any	Any	Any	Any

1/ Clay pans with slow permeabilities will be treated as limiting the effective depth
 2/ Percentage of gravel and rock fragments on the surface within the 10,000 ft² area
 3/ Depth to water table during growing season
 4/ Available moisture between field capacity and wilting point

INTERPRETING THE OBSERVATIONS.

16. The color of the surface layer of the mineral soil (under the leaf and tree litter) being what it is indicates that the soil has: (3 points)
- A. A relatively high albedo
 - B. A relatively low albedo
 - C. No albedo
17. The color of the surface layer of the soil indicates that: (3 points)
- A. It has high organic matter content
 - B. It is saturated for extended periods
 - C. It has low organic matter content
 - D. It has a high salt content
18. The color of the subsoil indicates that it: (3 points)
- A. Has more organic matter than the surface soil
 - B. Is wetter than the surface soil
 - C. Has less organic matter than the surface soil
 - D. Comes from a different parent material than the surface soil
19. At the intersection of Mound and Lake (northwest of the pit) is a trail that goes down the hill. What is the most likely effect of this trail on climate?(3 points)
- A. Most of the organic matter lost through erosion is eventually lost to the atmosphere as methane or carbon dioxide that contributes to global warming
 - B. Most of the organic matter lost through erosion is buried and therefore climate is not affected.
 - C. Organic matter is lost to surface waters contributing to a drop in global temperatures
20. The cutting of trees to put in roads and buildings has caused there to be openings in the tree canopy that allow more sunlight to reach the soil, while at the same time removing a source of litter that used to fall on the ground. Over time, this would cause the soil to become: (3 points)
- A. Darker due to less organic matter
 - B. Lighter due to less organic matter
 - C. Darker due to more organic matter
 - D. Lighter due to more organic matter

21. What is the primary source of the organic matter in the soil at this site: (3 points)
- A. Food scraps added to the soil
 - B. Many years accumulation of deer manure
 - C. Cones, branches, leaves and needles from the trees
 - D. Manure from nearby dairies
22. South of the soil pit is a parking spot for the Founder's (red) cabin. This area is currently paved with gravel. If we would like to minimize loss of carbon from the soil and maybe even increase carbon in the soil, it would be better to pave the area with: (3 points)
- A. asphalt
 - B. wood chips
 - C. concrete
23. The texture and permeability of the subsoil indicate that: (3 points)
- A. It is difficult for roots to penetrate the subsoil
 - B. It is easy for roots to penetrate the subsoil
24. Southeast of the soil pit the ground is covered with *periwinkle* (vine with bluish flowers). Does this kind of cover reduce or increase the contribution of the soil toward global warming? (circle all that apply) (3 points)
- A. It helps reduce the contribution by helping prevent erosion
 - B. It helps increase the contribution by adding leaf litter to the soil

SOILS AND CLIMATE CHANGE

25. What is soil carbon sequestration? (3 points)
- A. Saving soil carbon for a rainy day
 - B. Putting atmospheric carbon into the soil
 - C. Extracting soil carbon and placing it in airtight containers
26. Which of the following is true? (3 points)
- A. A carbon sink absorbs more carbon than it gives off
 - B. A carbon sink emits more carbon than it absorbs
 - C. A carbon sink absorbs the same amount as it emits
27. Which of the following is true? (3 points)
- A. Soil may be a carbon source but not a carbon sink
 - B. Soil may be a carbon sink but not a carbon source
 - C. Soil may be either a carbon source or a carbon sink
 - D. Soil is neither a carbon source nor a carbon sink

28. Which of the following is true? (3 points)
- A. The soil carbon pool is larger than the atmospheric carbon pool
 - B. The soil carbon pool is smaller than the atmospheric carbon pool
 - C. The soil carbon pool is the same size as the atmospheric carbon pool
29. If you were to harvest trees from this area, how could you minimize loss of carbon from the soil? (circle all that apply) (3 points)
- A. Leave the stumps in place
 - B. Pile and burn the slash
 - C. Plow the soil before replanting
 - D. Replant as soon as possible
 - E. Use selective cutting instead of clearcutting
30. Given that this area is managed as a camp, what are some best management practices that can be done to minimize loss of carbon from the soil? (circle all that apply) (3 points)
- A. When removing dead or hazardous trees, chip and burn them
 - B. Mulch disturbed areas with wood chips or bark mulch
 - C. Pave steep roads to minimize erosion
 - D. Remove as much organic debris as possible from the soil
 - E. Park and drive on pavement whenever possible
31. The sun primarily heats the air indirectly. Radiant energy heats the surface of the earth which then heats the air by conduction and convection. Because of this, soils that absorb more heat tend to heat the air more. Therefore, which of the following is true? (3 points)
- A. Soils with high albedo tend to heat the air more
 - B. Soils with low albedo tend to heat the air more.
32. Which farming practice below can help reduce the amount of greenhouse gases in the atmosphere produced by the burning of fossil fuels? (3 points)
- A. Chiseling
 - B. No-till
 - C. Plowing
 - D. Subsoiling

REFERENCES (listed on <http://www.caenvirothon.com/soils.html>)

Questions 1-18, 23 *California Land Judging Manual*

Question 16, 31 *National Soil Survey Manual*; Albedo:
<http://soils.usda.gov/technical/handbook/contents/part618.html#04>

Questions 19, 20, 22, 26, 27, 29, 30 *The Role of Soils in the Terrestrial Carbon Balance* (Page 1 and 2): <http://www.esf.org/publication/185/RSTCB.pdf> and *Forests and Sinks*:
http://www.davidsuzuki.org/Climate_Change/Science/Forests_And_Sinks.asp and
Global climate change and agricultural production:
<http://www.fao.org/docrep/W5183E/W5183E00.htm>

Question 21 Observation

Questions 22, 28 *Soil Carbon Sequestration Impacts on Global Climate Change and Food Security* <http://www.sciencemag.org/cgi/reprint/304/5677/1623.pdf>

Question 25, 32 *Soil Carbon Sequestration—Fundamentals*: <http://ohioline.osu.edu/aex-fact/0510.html>

Question 32 *Beneficial effects of no-till farming depend upon future climate change*:
http://www.eurekalert.org/pub_releases/2005-10/uoia-beo101205.php

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