Soils and Land Use Learning Objectives for the NCF-Envirothon

You may not pay much attention to it, but there is a lot going on underneath your feet! Soil is the foundation for all terrestrial life. Soil shapes our landscape. It nourishes plants – growing crops, grasses, and forests to form the basis of our food webs. It serves as a natural purifier for water, filtering out toxins and pollutants. It helps to recycle nutrients and provides habitat for fungi, microbes, and fossorial animals. The health of the soil is essential to the health of terrestrial ecosystems and to our way of life.

Just like the ecosystems we study, human society and culture are incredibly diverse. In the same way that biodiversity makes ecosystems more resilient, these differences in human perspective and experience make us stronger as a global community. Every person's story and relationship with the environment is important, and we must work together to ensure that everyone's stories are heard, including the historically marginalized and economically disadvantaged. We invite you to seek out stories from your own communities – to discover the unsung conservation heroes, to learn the histories that aren't typically taught in classrooms, to highlight local environmental issues, and to explore what types of natural resource conservation are occurring in your local community, state/province, and nation.

Students should be able to:

- Provide an informed opinion about current issues in soil conservation.
- Think critically about solutions to current issues regarding soils and land use.
- Work collaboratively in a team to synthesize and apply knowledge.
- Make connections between the concepts in Soils and Land Use and the subjects of Forestry, Aquatic Ecology, Wildlife, and the Current Issue.

Students will be able to:

Geology

1. Explain the impact of geomorphology on landforms and landscapes, and how these processes relate to soil formation.
2. Identify unique geological features of the state/province, nation, and world.
3. Describe the role of tectonic plate movement to create landforms and geologic events (such as earthquakes and volcanic eruptions) and how it impacts soil formation.
4. Describe the characteristics of the three major types of rocks (igneous, sedimentary, and metamorphic) and give examples of each.
5. Identify and describe the layers of the Earth (crust, mantle, outer core, inner core) and how they were formed.
6. Describe how the rock type of a parent material determines what minerals are present in a soil.
7. Explain the importance of different types of weathering (mechanical and chemical) in soil formation.
8. Describe how geology influences topography, on both micro and macro scales.

Soil Structure and Function

9. Define the five soil-forming factors and describe their influence on a particular soil.
10. Identify different types of parent material and how they are formed (such as residual material, eolian deposits, alluvial and marine deposits, colluvial deposits, volcanic deposits, glacial deposits, and organic deposits).
11. Identify soil forming processes (additions, losses, translocations, and transformations) and describe their effects on soil.
12. Describe the characteristics of the major soil orders.
13. Describe how different soil components (mineral composition, organic matter, particle size, et cetera) affect the properties of a soil.
14. Connect a variety of soil processes to observed soil characteristics. (For example, the incorporation of organic matter resulting in darker topsoil and improved soil structure.)
15. Explain the importance of pore space, types of pores (macropores and micropores), and pore connectivity in relation to soil health and vegetation growth.
16. Describe the importance of organic matter in various forms (humus, litter, et cetera) to soil health, structure, and fertility.
17. Identify the different particle sizes in a soil (sand, silt, and clay) and describe how their proportions influence soil properties.
18. Describe what factors influence soil structure and explain the impact of soil structure on soil properties.
19. Identify different types of erosion and recommend management practices to prevent and mitigate erosion.
20. Describe how pH affects soil health, nutrient availability, and other soil properties.
21. Explain the causes of soil compaction and recommend management practices to prevent and mitigate compaction.
22. Describe what factors influence available water capacity in a soil, and how this affects vegetation growth.
23. Explain the requirements for a Prime Farmland designation and identify potential candidates.
24. Describe the following soil properties and their importance:
    a. Density
    b. Porosity
    c. Permeability
    d. Cation exchange capacity
    e. Salinity
    f. Shrink-well capacity
    g. Friability
    h. Plasticity
25. Identify characteristics and properties of hydric soils.

Soil Ecology

26. Describe the cycles of essential elements (such as nitrogen, phosphorus, and carbon) as they relate to soil, nutrient availability, and plant growth.
27. Explain how plants take in nutrients and water, and what soil conditions and characteristics influence this uptake.

28. Explain the interactions of soil with the water cycle, including infiltration, runoff, and reservoirs such as aquifers.
29. Describe the ecosystem services provided by soil, such as water filtration, carbon sequestration, nutrient cycling, et cetera.
30. Describe the roles and services of soil organisms (including microorganisms, fossorial animals, fungi, et cetera) in the overall health and functioning of the soil.
31. Describe how soil type and other soil properties can influence the plant communities found on a particular soil.
32. Explain how soils impact the biodiversity of an ecosystem, and how biodiversity in an ecosystem may impact the soil.

Soils, Land Use, and Society

Native and Indigenous peoples have cultures and traditions that include close relationships with the environment. Native and Indigenous communities are unique, and each group has its own history, culture, Indigenous systems of science, traditional ecological knowledge, and conservation practices. The NCF-Envirothon encourages each state, province, and partner nation to consult with your local Native and Indigenous communities to highlight their unique environmental perspective in your Envirothon learning objectives, study materials, and competitions.

The following Learning Objectives should be applied on a local, state/provincial, national and/or worldwide (international) scale as appropriate to each objective and the unique parameters under consideration.

33. Identify major legislation (local and national) and international agreements pertaining to soils and land use, and describe how they provide protection for natural resources.
34. Demonstrate a solid understanding of the land use issues facing marginalized communities (including Native and Indigenous peoples, people of color, and other minority communities), and identify rights associated with a clean and healthy environment.
35. Identify key stakeholders, agencies, and organizations that oversee soil resource protection and land use management, such as local conservation districts, state/provincial agencies, and national environmental and conservation agencies.
36. Explain the processes by which fossil fuels are formed, and their ecological, economic, and social impacts.
37. Describe how soils and their associated ecosystems can be impacted by pollution.
38. Describe common agricultural/urban practices and their effects on soil health.
39. Explain how human development on floodplains impacts the soil formation and ecology around streams and rivers.
40. Describe the impact of changes in climate on soil ecology.
41. Explain how certain types of soil are better suited than others for specific human uses (mining, farming, septic tanks, et cetera).
42. Describe the importance of historic events relevant to soil conservation (such as the 1930s Dust Bowl, et cetera).

43. Describe the roles of key leaders in the soil conservation movement, both historical and present (such as George Washington Carver, Hugh Hammond Bennett, Dr. Robert Bullard, et cetera).
44. Relate soil conservation concepts to agriculture, land development/construction, and everyday life.

Field Skills

45. Identify characteristics of a soil pit or soil sample, including horizons, color, structure, texture, and special features.
46. Measure slope using a clinometer or other field tool.
47. Apply knowledge of soil properties and characteristics to make recommendations for management.
48. Use a soil survey (online and paper copy) to assess soil properties and conditions, such as drainage class and limitations on selected uses.
49. Use a soil triangle to evaluate the texture of a soil.
50. Interpret designations of the Land Capability class system.
51. Read and interpret a topographic map.
52. Recommend Best Management Practices (BMPs) for soil health, and analyze which BMPs are best suited to specific soil and substrate types, climatic conditions, and land uses.
53. Interpret aerial photographs in the context of land use.
54. Utilize field tools to provide on-site soil analysis, including:
    a. Auger
    b. Munsell soil color chart
    c. Compass
    d. Particle sieve
    e. pH test kit
    f. GPS
55. Explain how GPS and GIS can help soil scientists with field analysis.
56. Determine the drainage class for a particular soil.
57. Evaluate a soil profile for soil properties and characteristics, land use history, water table level, and management recommendations.