

Forestry Learning Objectives for the NCF-Envirothon

Plant communities shape our world. Forests comprise 30.8 percent of global land area (*Food and Agriculture Organization of the United Nations, 2020*)¹, while grasslands and rangelands make up approximately 50 percent of Earth's terrestrial surface (*National Institute of Food and Agriculture, USDA*)². Humans rely on the biodiversity of forests for many services, including timber for homes, wood pulp for paper, biochemical models for future medications, recreation, aesthetic beauty, and countless others. Grasslands and rangelands are home to unique species such as bison and prairie dogs, and they provide fertile land to grow our crops and to raise livestock that are critical to feeding the world's human population. A good understanding of plant biology, forest and grassland ecology, and human impacts to these ecosystems will help to inform good management practices to conserve these areas for future generations.

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 forestry and plant communities.
- Think critically about solutions to current issues regarding forestry and plant communities.
- Work collaboratively in a team to synthesize and apply knowledge.
- Make connections between concepts in Forestry and the subjects of Soils and Land Use, Aquatic Ecology, Wildlife, and the Current Issue.

Students will be able to:

Plant Biology

1. Explain the fundamentals of plant biology as they apply to trees and other common plants, including:
 - a. Anatomy
 - b. Life cycles
 - c. Reproduction
 - d. Growth habits
 - e. Adaptations

¹ "The State of the World's Forests" published by the Food and Agriculture Organization of the United Nations and the UN Environment Programme, 2020: <http://www.fao.org/3/ca8642en/ca8642en.pdf>

² "Grasslands and Rangelands Programs" by the United States Department of Agriculture, National Institute for Food and Agriculture, 2020: <https://nifa.usda.gov/program/rangelands-and-grasslands-programs>

2. Describe the evolution of different plant families, and how their unique adaptations help them to thrive in their environments.
3. Explain the formation and function of different types of tissues found in trees and other plants (including xylem, phloem, cambium, cuticle, stomata, vascular bundle, apical meristem, and lateral meristem).
4. Describe the different types of leaves and their evolutionary advantages.
5. Identify the differences between the following: angiosperm, gymnosperm, deciduous, coniferous, evergreen, hardwood, and softwood.
6. Explain the importance of nutrients, hormones, and enzymes in plant growth and function.
7. Identify the characteristics of monocots and dicots.
8. Explain the chemical processes that take place within plants (including their fundamental importance, basic chemical reaction equations, and impact on plant survival) such as:
 - a. Photosynthesis
 - b. Respiration
 - c. Transpiration
 - d. Nutrient use
9. Describe how tree rings form, and how they are used in dendrochronology.

Forest/Grassland Ecology

10. List the biotic and abiotic components of a forest ecosystem.
11. Describe the major types of forests found in your region and generally in other regions of the world.
12. Differentiate between hardwood, softwood, and mixed stands.
13. Explain the structure of a forest ecosystem and identify different crown classes.
14. Describe the typical structure of a forest soil and identify unique characteristics of forested soils.
15. Describe the typical structure of a grassland soil and identify unique characteristics of grassland soils.
16. Diagram the energy flow in a forest ecosystem and describe the relationships between trophic levels.
17. Explain how forested ecosystems benefit water quality.
18. Define an ecological niche and describe how different organisms in forest ecosystems fulfill these roles.
19. Describe the edge effect and how it is important to plant and wildlife species.
20. Explain the role of vertical stratification in forest ecosystems.
21. Identify and describe the roles of mycorrhizal fungi in forest ecosystems.
22. Define resilience and describe what it means for ecosystems and plant species.

Plant Communities

23. Explain what factors influence why certain plant communities develop in certain areas, including climate, soil type, aspect, topography, elevation, seed dispersal, available light, available nutrients, and competition.

24. Describe successional change in an ecosystem over time, including changes in species composition, shade tolerance, and interactions with disturbances.
25. Differentiate between primary and secondary succession.
26. Describe the role of fire in ecosystems (including fire-dependent and non-fire-dependent systems).
27. Identify the causes of erosion in plant-dominated ecosystems and recommend practices for prevention and mitigation.
28. Describe the role that plant communities play in nutrient cycling, including carbon, nitrogen, and phosphorus.
29. Describe the role that plant communities play in the water cycle, including major events such as flooding, droughts, and storms.
30. Explain how different plant communities provide different types of habitat and describe the importance of this habitat variety to wildlife.
31. List the benefits of snags and downed logs to wildlife species.
32. Explain the importance of biodiversity in plant communities.
33. Apply concepts of landscape ecology to plant communities, including:
 - a. Patterns and spatial differences in landscape, growing conditions, and vegetation type
 - b. Conditions affecting the distribution of plant species
 - c. Effects of disturbance on an ecosystem and its impact on plant species
 - d. Importance of habitat connectivity in the spread and adaptation of plant species
 - e. Genetic diversity in species across landscapes and the importance of this genetic diversity to healthy species populations

Forests 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.

34. Describe the ecosystem services provided by forests, grasslands, and other plant communities.
35. List the economic benefits provided by forests, grasslands, and other plant communities.
36. Describe how unsustainable uses of forest, grasslands, and other plant communities can affect overall ecological health.
37. Describe the impact of changes in climate on forests, grasslands, and other plant communities.
38. Explain the historical roles of forests, grasslands, and other plant communities.
39. Describe the development of forestry as a practice and field of study.

40. Identify major legislation (local and national) and international agreements pertaining to forests, grasslands, and other plant communities and describe how they provide protection for natural resources.
41. Describe how forests and other plant communities are used for recreation.
42. List human uses for forest and plant products and describe how these products are obtained from natural resources.
43. Describe common forestry practices, including thinning, harvesting, and regeneration methods.
44. Explain the concept of Best Management Practices (BMPs) in forestry and list examples.
45. Describe the different types of forest management.
46. Explain how management strategies differ between even and uneven aged stands.
47. Apply silvicultural practices to make recommendations based on management goals.
48. Define an urban forest and describe common urban forestry practices.
49. Explain the role of forests and other plant communities on watershed health.
50. Identify common grazing systems on rangelands and recommend best management practices based on ecological conditions.
51. Describe wildlife and livestock interactions on rangelands, or native grassland habitats such as prairies, including forage overlap and habitat requirements.
52. Describe the roles of key leaders in forestry and forest conservation, both historical and present (such as Gifford Pinchot, Carl Schenck, Robin Wall Kimmerer, Wangari Maathai, Rue Mapp, et cetera).

Field Skills

53. Identify common local trees and plants by leaves, bark, branching patterns, buds, fruit, and other characteristics without the use of a key.
54. Identify uncommon local trees and plants with the use of a key.
55. Use common forestry tools, such as:
 - a. Biltmore stick/Merritt hypsometer
 - b. D-tape
 - c. Wedge prism
 - d. Tree caliper
 - e. Clinometer
 - f. Increment borer
 - g. GPS
56. Describe how foresters and plant ecologists use GIS in their work.
57. Make management recommendations based on ecological conditions of the forest and management goals (such as wildlife habitat, timber production, recreation, et cetera).
58. Identify common plant pests and diseases without use of a key, describe how they are spread, and list methods of control.
59. Utilize and make common forestry measurements, such as diameter at breast height (DBH), chain, cord, total tree height, merchantable height, board feet, log, and basal area.
60. Interpret a site index graph.
61. Interpret current and historical aerial photographs in the context of land use, succession, and forest growth.