

Learning Objectives and Outcomes for B.S. in Forestry

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The goal of the Forestry program is to produce professional foresters with outstanding scientific knowledge, practical field and technical skills, strong communication abilities, and a strong stewardship ethic needed to sustainably manage private and public forestlands for wood products, recreational opportunities, biological diversity, water, and other ecosystem services. Graduates of the program will be sought by private and public forestland management organizations to monitor and manage diverse forestland. This professional degree is proposed for re-accreditation by the Society of American Foresters (SAF).

Learning Objectives

Students graduating from the Forestry program will be effective and ethical stewards of forests for all resources, including trees, biological diversity, water, and recreation by being able to:

1. Think, write, and speak effectively about the complexities and tradeoffs associated with responsible stewardship of forest resources.
2. Utilize quantitative and qualitative methods for resource analysis and problem solving.
3. Integrate knowledge of basic biology, physical sciences, forest and wildlife ecology, and social sciences into the stewardship of forest resources.
4. Apply knowledge of and techniques from forest measurement, geomatics, silviculture, forest economics, forest operations, forest bioproducts, and forest policy to develop and evaluate alternatives for managing forest resources.
5. Choose and employ appropriate concepts, models, and effective techniques to produce and analyze forest resource plans, from woodlots to landscapes, which consider multiple competing objectives.

Curriculum

General Education:

The University of Maine's goal is to ensure that all of its graduates, regardless of the academic major they pursued, are broadly educated persons who can appreciate the achievements of civilization, understand the tensions within it, and contribute to resolving them. This component of every program is called general education. The design of general education at the University

of Maine is meant to be flexible within the broad goals it seeks to achieve. It affords each student many ways of meeting its requirements.

The General Education curriculum is divided into three broad categories as shown in required Documents A-1 and A-2: Oral and written communications, science and mathematics, and social science and humanities.

Oral and Written Communications (non-SFR courses).

Effective written communication is a critical skill for professional foresters and as such many core SFR courses require students to apply concepts learned in ENG 101 (English Composition) such as developing a structure of reasoning and providing substantial support for their positions through the use of experimental data or from existing sources. Students are required to provide necessary references for external work as well. These skills are further developed in ENG 317 (Technical Writing) to prepare SFR students to produce a quality management plan or other technical document as part of their senior capstone project in the final semester.

With respect to required learning outcomes for **oral and written communications** in the SFR, forestry graduates will be able to:

1. Prepare and deliver effective oral presentations.
2. Comprehend and critically evaluate information presented in a variety of writing styles and compose essays, papers, and reports that effectively communicate ideas.

With respect to non-restrictive General Education learning outcomes for Demonstrated Writing Competency at the University of Maine, graduates will be able to:

3. Critique and revise their writing.
4. Achieve the intended purpose in the writing task, with awareness of audience.
5. Identify and fully develop ideas to a specific thesis.
6. Organize ideas effectively.
7. Adhere to proper mechanics and style.
8. Achieve clarity of expression in language, argument, rhetorical form, and idea.

Science and Mathematics:

Introductory courses in both chemistry (CHE 121/123) and physics (PHY 111) are required courses for SFR students in the first two years of the program. Fundamental concepts of reaction rates, acid and base interactions, equilibriums, energy, heat, and material properties are

reinforced through examination of physical, chemical and mechanical properties of wood and wood products (SFR 215 – Introduction to Bioproducts and Bioenergy) and examination of soil chemical properties important for plant growth (PSE 140 – Soil Science).

With respect to required learning outcomes for **science** in the SFR, most are listed under the Professional Curriculum. The introductory learning outcome for non-biology science includes:

9. Understand physical and chemical properties, measurements, and states of matter.

With respect to General Education learning outcomes for **science** at the University of Maine, graduates will be able to:

10. Explain what makes knowledge scientific, i.e., "...things and events in the universe occur in consistent patterns that are comprehensible through careful, systematic study." (AAAS)
11. Demonstrate the appreciation that scientific knowledge is subject to change as new observations and interpretations challenge current understanding.
12. Recognize that valid scientific information is durable, i.e., it is continually affirmed as new observations are made.
13. Perform scientific inquiry including aspects of the scientific method, such as observation, hypothesis, experiment, and evaluation. Note: Covered in laboratory science courses but not necessarily in applied science courses.

A solid foundation in mathematics is necessary for proper management of forest resources so SFR students are expected to be competent in algebra and trigonometry as well as have an understanding of polynomial, logarithmic and exponential functions. MAT 122 (Pre-calculus) prepares students for subsequent courses related to forest measurements (SFR 205 & 402), geomatics (SFR 208), forest operations (SFR 211) and forest economics (SFR 444).

With respect to required learning outcomes for **mathematics** in the SFR, most are listed under the Professional Curriculum. With respect to General Education learning outcomes for **mathematics** at the University of Maine, graduates will be able to understand the role that mathematics and quantitative thinking plays in solving and communicating information about real world problems and relationships. The learning outcomes for introductory mathematics includes:

14. Translate problems from everyday spoken and written language to appropriate quantitative questions.

15. Interpret quantitative information from formulas, graphs, tables, schematics, simulations, and visualizations, and draw inferences from that information.
16. Solve problems using arithmetical, algebraic, geometrical, statistical, or computational methods.
17. Analyze answers to quantitative problems in order to determine reasonableness. Suggest alternative approaches if necessary.
18. Represent quantitative information symbolically, visually, and numerically.
19. Present quantitative results in context using everyday spoken and written language as well as using formulas, graphs, tables, schematics, simulations, and visualizations.

Social Sciences and Humanities:

Courses providing a background on human interactions with forest resources are found within the professional curricula (SFR 220, 444, 446). As a prerequisite to SFR 444, students do take ECO 100 – Basic Economics. In addition, students need to take at least 6 more credits in courses that meet the University general education requirements for this category.

At the University of Maine, **social sciences and humanities** and in five broad categories: Western cultural tradition, social context and institutions, cultural diversity and international perspectives, artistic and creative expression, and population and the environment. In this broad topic group, an introductory economics course is the only course required outside of the Professional Curriculum. Students also need to complete at least two more courses outside of the Professional Curriculum that covers western cultural tradition, cultural diversity and international perspectives, and artistic and creative expression.

The Learning Outcomes in **social sciences and humanities** for the General Education requirements at the University of Maine include the following:

Students completing the General education area of the Western Cultural Tradition will be able to:

20. Examine the sources, transmission, development and outcomes among ideas, institutions, artifacts, and values within the traditions of the West.
21. Recognize and explore the complexity and variety among ideas, traditions, institutions, archaeological and historical texts and artifacts and values that inform the cultural traditions of the West.
22. Analyze and think critically about how societies are or have been defined by such cultural traditions.

Students completing the general education area of Social Context and Institutions will be able to:

23. Identify, describe and analyze social contexts and human institutions

24. Recognize and critically evaluate the interaction between social contexts and human institutions

Students completing the Cultural Diversity or International Perspectives general education area of will be able to do at least one of the following:

25. Recognize the experiences, perspectives, and cultural values of one or more groups who live within a culture different than their own.
26. Describe the diversity of American culture and reflect on their personal roles within that diversity.
27. Identify and assess how different cultures have related to each other either in the past or the present.
28. Achieve intermediate or advanced mastery of a language other than English.

Students completing the general education area of Population and Environment will be able to do at least one of the following:

29. Recognize and understand the role of both local and global environmental change on the quality of human life,
30. Describe the influence of diverse factors, such as philosophical, cultural, religious, economic, educational, and political, on population growth and environmental quality,
31. Understand the concepts and principles necessary to evaluate contemporary issues of population growth, natural resource conservation, and environmental protection,
32. Interpret diverse types of information about environmental issues, to develop their own perspectives on these issues, and to communicate these perspectives effectively,
33. Understand and describe technical and/or scientific approaches for addressing problems that arise in the relationship between human population and the environment.

Students completing the general education area of Artistic and Creative Expression will be able to:

34. Participate in, identify or evaluate artistic and creative forms of expression.
35. Develop skills and/or intellectual tools central to the artistic and creative process or its critique.

Professional Education: Content

The SFR developed outcomes and metrics for the learning objectives, and courses were developed to meet these expectations. Appendix 1 lists the outcomes and metrics. Under each

metric is a list of courses that cover the metric in the approximate order they are taken in the curriculum.

The required professional courses are listed in required Document B-1; restricted elective are listed in Document B-2. What follows is a summary of the curricula based on the Areas of Study in Document B-1: Ecology and Biology, Measurement of Forest Resources, Management of Forest Resources, and Policy, Economics, Administration, & Law.

Ecology and Biology

Forestry students are immediately introduced to tree identification and basic forest ecology during the one-week field camp in SFR 101 – Introduction to Forest Resources. The first semester continues building tree identification and knowledge with SFR 107 – Forest Vegetation. A basic background in general biologic principles (cell biology, photosynthesis and respiration, plant biology – structure – function) is provided in the second semester in SFR 100 – Introduction to Forest Biology and SFR 102 – Biology of Woody Plants Laboratory. Additional information on cell wall composition and importance to wood products is provided in the fourth semester in SFR 215 – Introduction to Bioproducts & Bioenergy. PSE 140 – Soil Science in the fourth semester utilizes chemical principles and factors affecting plant growth from earlier courses to help emphasize the importance of soils to forest ecosystems. Important principles from the first two years are then used to assess students' abilities to apply the knowledge in SFR 300 – Field Practice in Forest Resources. In the sixth semester, the importance and complexity of ecological and biological principles are emphasized in SFR 407 – Forest Ecology, SFR 408 – Principles of Silviculture, SFR 409 – Silviculture and Ecology Field Lab, SFR 457 & 458 – Tree Pests and Disease. Not only do these courses draw upon the courses from earlier in the curriculum, but they also cross-reference each other so that students become competent in utilizing knowledge from one field to help problem-solve in another. By the end of the sixth semester, students will have learned wildlife conservation principles in WLE 230 – Introduction to Wildlife Biology or WLE 323 – Introduction to Conservation Biology. Also, basic dynamics of water flow in the landscape are covered in ERS 350 – Fresh Water Flow. During the final 3 semesters, students continue to apply ecological and biological principles in more measurement and management oriented courses: SFR – 402 Advanced Forest Measurements and Models, SFR 406 – Remote Sensing Image Interpretation and Forest Mapping,

With respect to learning outcomes for **ecology and biology**, Forestry graduates will be able to:

36. Identify forest and other tree species, their distribution, and associated vegetation and wildlife.
37. Understand how concepts of Conservation Biology influence forest management and biodiversity

38. Explain ecological concepts and principles including the structure and function of ecosystems, plant and animal communities, competition, diversity, population dynamics, succession, disturbance, and nutrient cycling.
39. Interpret and explain the components, patterns, and processes of biological and ecological systems across spatial and temporal scales.
40. Explain basic concepts of molecular biology, cells, organisms, populations, species, communities, and ecosystems.
41. Understand soil properties and processes, hydrology, water quality, and watershed functions.
42. Master concepts in tree biology.
43. Master concepts in tree pests and diseases, and use them to evaluating tree and forest health/productivity.
44. Make stand, forest, and ecosystem assessments.

Measurement in Forest Resources

Measurement of forest resources is addressed initially in the first semester in SFR 101 and SFR 106 – Forest Land Navigation and Outdoor Preparedness, courses that focus on field skills that are also applied in SFR 211 – Forest Operations Planning in the third semester. Also in the third semester, students take SFR 208 – Geomatics, Coordinate Geometry and GPS, a course that applies previously learned field and quantitative skills as well as providing a solid background in dealing with land measurements, surveying, and associated technology. During the fourth semester, the field skills and quantitative skills from earlier courses are tied together with measurement and statistical principles in SFR 205 – Forest Measurements and Statistics. Students also take in the fourth semester SFR 400 – Applied GIS where they can apply knowledge from SFR 208 and learn basic GIS skills. After the fourth semester, SFR 300 will assess student abilities in forest measurements. The basic skills are used again in upper level courses including SFR 408, 409, and 406. SFR 402 – Advanced Forest Measurements increases quantitative knowledge and skills so that students are prepared for the senior courses in SFR 477 – Forest Landscape Management & Planning, a course that introduces students to concepts and software need for forest management planning. The above courses are further integrated as students prepare forest management plans as part of the senior capstone course (SFR 492).

With respect to **measurement in forest resources**, Forestry graduates will be able to:

45. Use computers and other technologies for communication, measurement, analysis, and problem solving.
46. Identify and measure land areas and conduct spatial analysis.

47. Design and implement comprehensive and appropriate forest resource inventories.
48. Apply basic approaches and applications of mathematics, linear programming, and statistics for analysis and problem solving.

Management in Forest Resources

Forest management concepts are introduced in the first semester in SFR 101 and SFR 103 – Introduction to Forest Resource Professions. In the second semester, history of conservation in forest resources is covered in SFR 220, and basic forest operations (SFR 211) and recreation management (SFR 228) are covered in the third semester. SFR 208 and 400 then apply geomatic and GIS skills to relevant aspects of forest management during the third and fourth semesters. As with earlier subject areas, topics from the first 2 years are applied and assessed in SFR 300. Ecology (SFR 407), silviculture (SFR 408, 409), and tree pests and disease (SFR 457, 458) continue to integrate ecological components into dealing with forest management issues in the fifth semester. Three upper division courses address topics associated with forest economics (SFR 444), forest resource policy (SFR 446), and administration (SFR 446 and 464). SFR 477 introduces students to basic concepts and software needed for forest management planning. The above courses are integrated when students prepare forest management plans as part of the senior capstone course (SFR 492).

With respect to **Management in Forest Resources**, Forestry graduates will be able to:

49. Recognize various harvesting, transportation, and processing systems used in the management of forest resources and production of forest products.
50. Develop and evaluate management plans with multiple objectives and constraints.
51. Develop and apply silvicultural prescriptions appropriate to management objectives.
52. Analyze forest inventory information and project future forest, stand, and tree conditions.
53. Understand how mathematical programming techniques and regional impact analyses can be used in forestry decision making.

Forest Resource Policy, Economics, and Administration

Aspects of forest resource policy are introduced in SFR 103, SFR 220, and SFR 222 – Environmental Communication Skills during the first year. Policies related to harvesting (SFR 211) and recreation (SFR 228) are covered in the second year. Forest Resource Policy (SFR 446) in the senior year does a general survey of policies that impact natural resources. Economic concepts are introduced in ECO 100 in the fifth semester, and some get applied in silviculture (SFR 408/409). In the sixth semester, Forest Resource Economics (SFR 444) provides the needed background for senior level courses dealing with forest management (SFR 477, 492) and

SFR 464 – Forest Resources Business, Marketing, & Entrepreneurs. The latter classes integrate material and prepare students to work in the private sector of the economy.

With respect to **Forest Resource Policy, Economics, and Administration**, Forestry graduates will be able to:

54. Understand how resource conditions and social demands interact under various market and non-market structures to influence the valuation and availability of forest-related goods and services.
55. Understand how the existence of market externalities, ecosystem services, and non-market goods and services affect forestry decisions and resource conditions.
56. Evaluate moral and ethical questions by using critical reasoning skills.
57. Understand social and economic structures, processes, and institutions across a broad range of human experience and culture.
58. Recognize how federal, state, and local laws and regulations govern the practice of forestry and forest operations.
59. Understand the administration, ownership, organization, human resource, and legal aspects of forest management enterprises.
60. Understand forest policy, historical context of and processes by which it is developed.
61. Know the SAF Code and recognize the responsibility to adhere to ethical standards in forestry decision making on behalf of clients and the public.