

MINORS

Minors

Undergraduate Study

In addition to academic majors available at ESF, many departments offer academic “minors” for undergraduate students to build an area of additional breadth outside their major program of study. Admission to undergraduate minors for ESF students is via petition, with additional application requirements as noted in the descriptions of the minors below, along with a minimum cumulative GPA of 2.7. Successful completion of a minor will be noted on the transcript of each student.

Applied Statistics Minor

Coordinator: Eddie Bevilacqua

This minor provides students with an opportunity to extend their understanding of and ability to apply statistical methods beyond the basic techniques presented in introductory courses. The minor is intended to provide students with a strong background in statistical design (both sampling design and experimental design) and analysis. The 12-credit minor consists of two required courses (6 credits), APM 391 (or APM 395) and FOR 323 and 6 credits of directed electives of advanced courses, independent study, or teaching experience related to applied statistics.

Courses:

This minor requires 12 credits and includes the required courses (6 credits) and directed electives (6 credits) listed below. Other applied statistics courses may be substituted by petition for any course in the directed elective list with the approval of the FNRM Undergraduate Education Committee.

Required Courses (6 credits):

Course		Credits
APM 391 OR APM 395	Introduction to Probability and Statistics Introduction to Statistics in Engineering	3 (cannot use both)
FOR 323	Forest Biometrics	3

Directed Electives (6 credits):

Course		Credits
APM 620	Experimental Design and Analysis of Variance	3
APM 625	Sampling Methods	3

FOR 495	Undergraduate Teaching Assistance (must be in association with APM 391 or FOR 323)	1
FOR 498	Independent Study (under guidance of instructor of APM applied statistics courses)	2-3

Eligibility requirements:

Students from all programs at ESF are eligible for this minor if they have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same standing).

Bioprocess Science Minor

Coordinator: Dr. Gary Scott

The bioprocess science minor gives students an understanding of the rapidly developing bioprocessing industry, which uses the chemical, physical and biological processes developed by living organisms or their cellular components in a type of advanced manufacturing of specialty commercial products. Bioprocess science will influence diverse fields as it becomes widely used, such as for producing energy from sustainable sources.

The bioprocess science minor is available to all ESF undergraduate students (**except students in the bioprocess engineering program**) who maintain a minimum cumulative grade point average of 2.70, and who desire to develop greater knowledge of bioprocess science and its related fields. Interested students must submit a petition and application form, with courses listed, to their academic advisor and the chair of their department, with final approval from the dean of Instruction and Graduate Studies. Students should declare the minor by the end of the sophomore year, but may petition to their home department for enrollment at any time after that. Successful completion of the minor will be noted on the student's transcript.

Eighteen credit hours (6 courses) are required to satisfy the minor. Specified courses: PSE 370 Principles of Mass and Energy Balance (3); BPE 310 Colloid and Interface Science (3); BPE 420 Bioseparations (3); and at least three directed elective courses available from both ESF and Syracuse University including biology, forestry, chemical engineering, chemistry, paper science and engineering, bioprocess engineering, and environmental and biological engineering. Students are required to complete at least one course from a list of biological and chemistry electives and at least one course from a list of engineering electives. The complete list of courses is available from faculty advisors.

Biotechnology Minor

Coordinator: Dr. Christopher Whipps

The minor in biotechnology is for students who wish to add knowledge of biotechnology theories and methodologies to the experiences and qualifications gained from their undergraduate program. Required courses develop a basis for understanding biotechnology, both at the theoretical and practical levels. Directed electives allow students to focus on an area of interest in the field. The minor is available to all ESF undergraduate students except those in the biotechnology major.

Twenty credit hours of coursework are required for completion of the minor. Seventeen credits of specified courses include EFB 307 Principles of Genetics (3); EFB 308 Principles of Genetics Lab (1); BTC 401 Molecular Biology Techniques (4); EFB 325 Cell Biology (3); FCH 530 Biochemistry I (3); and FCH 532 Biochemistry II (3). One directed elective course (for a minimum of three credits) must be selected from the following list. A maximum of eight credits can count toward both major and minor requirements; overlap in excess of this number must be offset by taking additional courses from the directed elective list.

- BTC 425 Plant Biotechnology (3)
- BTC 426 Plant Tissue Culture Methods (3)
- BTC 498 Research Problems in Biotechnology (3-6)
- BTC 420 Internship in Biotechnology (3)
- EFB 303 Introductory Environmental Microbiology (4)
- FCH 531 Biochemistry Lab (3)
- BIO 464 Applied Biotechnology (4) (SU)
- MEDT 439 Applied Techniques in Medical Biotechnology (2) (SUNY Upstate)

Chemistry Minor

Coordinator: Ted Dibble

The Minor in Chemistry is open to all undergraduates at SUNY ESF. Admission to the Chemistry minor requires sophomore, or higher, status, students to have completed one year of General Chemistry (I and II) with lab (8 credits) and one year of Organic Chemistry (I and II) with lab (8 credits).

To enroll in the Chemistry Minor, fill out the form [How to Declare a Minor in Chemistry](#) and the [ESF Minor Enrollment Form](#) and bring them to the Coordinator of the Chemistry Minor

Fifteen credit hours of upper division chemistry credits (300 level or above) are required from a list of suggested courses, including:

Required Courses

Course Number	Course	Codes *	Credits
FCH 325	Organic Chemistry III		4
FCH 360	Physical Chemistry I		3
FCH 361	Physical Chemistry II		3
FCH 380	Analytical Chemistry I		2
FCH 382	Analytical Chemistry I Lab		1
FCH 381	Analytical Chemistry II		3
FCH 410	Inorganic Chemistry		3
FCH 430 OR FCH 530	Biochemistry I Biochemistry I		3 3

FCH 431 OR FCH 531	Biochemistry Laboratory Biochemistry Laboratory		3 3
FCH 432 OR FCH 532	Biochemistry II Biochemistry II		3 3
FCH 510	Environmental Chemistry I		3
FCH 511	Atmospheric Chemistry		3
FCH 515	Meth/Envrn Chem Analysis		3
FCH 550	Polymer Sci:Synth&Mech		3
FCH 551	Polymer Techniques		3
FCH 552	Polymer Sci:Prop&Tech		3
FCH 584	Spectro ID/Organic Compounds		3

Computer and Information Technology Minor

Coordinator: Dr. Gary Scott

The computer and information technology minor is available to all ESF undergraduates who want to develop greater skill in computer science and information technology applications. By understanding the basic principles behind software development, students can more effectively use these tools in their chosen fields. To be eligible for this minor, a student must have a cumulative grade point average of 2.700 or better by the end of the sophomore year. Interested students must submit a minor enrollment form to their academic advisor and the minor coordinator for approval.

Seventeen credit hours (6 courses) in computer science courses, information technology courses, and other strongly computer-based and analysis courses are required to complete the minor.

Required Courses (11 credits)

- Choose One:
 - GNE 160 Computing Methods for Engineers and Physical Scientists (3)
 - ERE 335 Numerical and Computing Methods (3)
 - CIS 151 Fundamentals of Computing and Programming
 - CPS 196 Introduction to Computer Programming
- ESF 200 Information Literacy (1)
- CIS 252 Introduction to Computer Science (4)
- CIS 351 Data Structures (3)

Elective Courses (6 credits)

ERE 445 Hydrologic Modeling (3)
 ERE 530 Numerical and Computing Methods (3)
 ERE 551 GIS for Engineers (3)
 ERE 533 Ecological Modeling (3)
 ERE 622 Digital Image Analysis (3)
 ESF 300 Introduction to Geospatial Information Technologies (3)
 CIS 3xx/4xx/5xx Any CIS course offered at the 300, 400, and 500 level
 CPS 234 - Introduction to Computational Thinking
 CPS 333 - UNIX Operating System and Internet
 CPS 335 - JAVA programming for the Internet
 CPS 504 - Introduction to C++
 CPS 506 - Introduction to C
 CPS 551 - Computer Organization & Operating System Design
 CSE 261 - Digital Logic Design
 CSE 262 - Digital Logic Design Laboratory
 CSE 283 - Introduction to Object-Oriented Design
 CSE 381 - Computer Architecture
 CSE 382 - Algorithms & Data Structures
 CSE 384 - Systems and Network Programming
 CSE 389 - Web System Architecture and Programming
 CSE 398 - Embedded and Mobile Systems Laboratory
 CSE 418 - Deep Learning
 CSE 444 - Mobile Application Programming
 CSE 458 - Data Networks: Basic Principles
 CSE 464 - Introduction to VLSI Design
 CSE 483 - C# and Windows Programming
 CSE 484 - Introduction to Computer and Network Security
 CSE 486 - Design of Operating Systems
 CSE 487 - Access Control, Security and Trust
 CSE 488 - Introduction to Internet Security
 CSE 561 - Digital Machine Design
 CSE 581 - Introduction to Database Management Systems

Construction Management Minor

Coordinator: Dr. Paul Crovella

The construction management minor is available to all ESF undergraduates (except students in construction management) and prepares students for management careers in the construction industry. Admission to the minor requires sophomore status, with a cumulative grade point average of 2.70 or higher.

Eighteen credit hours (6 courses) are required to complete the minor. Four courses are specified, with an additional two courses selected from the list of six courses given below. A cumulative grade point average of 2.000 or higher is required for the construction management courses.

Specified Courses

Course Number	Course	Codes *	Credits
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CME 255	Plan Interpn&Quantity Takeoff		3
CME 434			
CME 453	Construct Plan/ Scheduling		3
CME 454	Construction Project Mgt		3

Two additional courses are chosen from the following

Course Number	Course	Codes *	Credits
CME 331	Construction Safety		3
CME 335	Cost Engineering		3
CME 444	Materials Marketing		3
CME 455	Construct Contracts/ Specs		3

Economics Minor

Coordinator: Dr. John Wagner

Economics analyzes how people with limited resources make choices and provides the fundamentals for good decision-making. The minor in economics provides students with common microeconomic models and tools that can be used to analyze optimal management and policy decisions in natural resources management.

The Economics minor totals 15 credits.

Required Courses

Course Number	Course	Codes *	Credits
FOR 207	Introduction To Economics		3
ECN 301	Intermediate Microeconomics		3
ECN 311	Intermediate Mathemat. Micro		3

In addition, students must choose from the following directed electives (a minimum of 9 credits)

Directed Electives

Course Number	Course	Codes *	Credits
FOR 333	Natural Resrc Managerial Econ		3
SRE 454	Sustainable Energy Fin&Analysis		3
FOR 495	Undergrad Teaching Assistance		1 - 3
FOR 670	Resource & Envrn Economics		3
ESC 422	Energy Markets and Regulation		3
ERE 430	Engr Decision Analysis		3

It is the responsibility of the student to meet any prerequisites associated with courses in the minor.

Admission to the minor requires students to have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with the same standing).

Environmental Biology Minor

Coordinator: Dr. Greg McGee

This minor provides students the opportunity to explore fundamentals of molecular, cellular and organismal biology and ecology, and to develop laboratory and field proficiencies in the discipline. The minor is open all ESF undergraduate students who maintain a GPA of at least 2.70 after completing at least one semester at ESF and who have completed EFB 101/102 & 103/104 General Biology (8 cr) or their equivalents, and one semester of introductory chemistry with laboratory (4 cr).

Eighteen credit hours of biology courses are required to satisfy the minor, including: EFB320 General Ecology (4 cr); EFB307/308 Principles of Genetics w/ laboratory (4 cr); EFB311 Principles of Evolution (3 cr); 7 cr of directed biology electives that may include: EFB202, either EFB 210 or 211, and any 300+ level EFB course except EFB 420, 495, 498.

A maximum 6 of 18 credits may count toward both major and minor degree requirements, including directed electives; overlap in excess of 6 credits must be offset by taking additional 300+ biology courses.

Environmental Health Minor

Coordinator: Dr. Lee Newman

The Environmental Health minor will introduce students to environmental health with a core context of epidemiology and toxicology; the minor requires 15-17 credit hours. There are 3

required courses (7 credit hours): EHS250 Foundations of Environmental Health(1), EFB360 Epidemiology(3), and EFB400 Toxic Health Hazards(3). Students will have the flexibility to explore a variety of components by selecting an additional three courses (8-10 credit hours) from among the following: EHS440 Occupational Health and Safety(3), EHS350 Environmental Health Management(3), EHS320 Disease Prevention(2), FST102 Food fights: Contemporary Food Issues(3), FCH399 Introduction to Atmospheric Science(3), ENS470 Environmental Risk Assessment(3), EST245 Foundations of Environmental Communication(3), EHS480 Hazardous Waste Management(3), EFB303 Introductory Environmental Microbiology(4).

The Environmental Health minor will be available to students in all majors (except Environmental Health) who want to increase their knowledge of the impact of the physical environment on human health.

Some of the courses have additional pre-requisites, and students should investigate this before selecting courses to fulfill the minor requirements.

Students must have a minimum GPA of 2.7 to apply. Interested students should submit the minor enrollment form accompanied by a list of courses to fulfill the minor requirements to their faculty advisor and the Environmental Health minor coordinator, with final approval from the Dean of Instruction and Graduate Studies.

Environmental Policy and Communication Minor

Coordinator: Dr. Andrea Feldpausch-Parker

The minor in Environmental Policy and Communication is designed to provide students with the knowledge and skills to navigate the environmental policy process, to effectively communicate with diverse stakeholders in public and private spheres, and to critically reflect on and elucidate the interactions between scientific knowledge, social processes, and environmental problem-solving.

The Environmental Policy and Communication Minor is available to all ESF undergraduates.

Twelve credit hours are required. All students must take a course on the Fundamentals of Environmental Policy (typically EST 321, Government and the Environment). Additionally, to complete the minor, students must take a course in Environmental Communication; an Upper Level Course in Environmental Policy, Leadership, or Decision Making; and a course in Critical Perspectives on Environment & Society. Admission to the minor requires sophomore status with a cumulative GPA of 2.70 or better.

Students in the Environmental Studies department pursuing the Options in either Environment, Communication and Society or Environmental Policy, Planning and Law should work with their advisor and the Environmental Policy and Communication Program Lead to ensure that the minor is complementary rather than redundant with their option. No more than 6 credits may be double-counted for both the Minor and an Option.

Required Courses (12 credits total):

- 1) A Course in the Fundamentals of Environmental Policy (3 Credits)
 - Government and the Environment (EST 321)
- 2) A Course in Environmental or Science Communication (3 Credits)

- Public Communication of Science & Technology (EST 395)
- Environmental Communication Workshop (EST 493)

3) An Upper Level Course in Environmental Policy or Decision Making (3 Credits)

- Community Planning & Sustainability (EST 426)
- Environmental & Energy Auditing (EST 427)
- Land Use Law (EST 460)
- Environmental Impact Analysis (EST 550)
- Comprehensive Land Planning (LSA 451)

4) A Course on Critical Perspectives on Environment & Society (3 Credits)

- Environmental Justice (EST 415)
- Attitudes, Values & The Environment (EST 366)
- Social Processes of the Environment (EST 390)
- Indigenous Issues and the Environment (EFB 305)

Additional relevant 300 and 400-level courses (from ESF or SU) may be acceptable

Environmental Writing and Rhetoric Minor

Contact: Jacob Gedetsis

The Writing Program at ESF is a space where artistic and humanistic insights can find creative ways to address our ecological crisis. The Environmental Writing minor creates a path to develop the expertise of environmentally-minded humanists and artists to make sense of, represent, and respond holistically to the natural world. Students in the minor engage in audience-centered approaches to writing, reading, and communicating across genres and contexts. They develop skills in environmental storytelling, digital literacies, and presentation to better prepare them to be active participants in academic, professional, and civic life. Why add this minor? Our students find that there are often multiple skill sets that careers demand of them and increasing one's exposure to, and practice of, writing can help with job placement and security. The minor also provides the ability to flex already existing interests in the creative world, all while exploring how writing functions in public spheres. Whether you love to read or write, the minor provides an opportunity to engage with wide-ranging composition skills, including criticism, creative writing, journalism, publishing, editing, and tutoring.

Prerequisites (6 Credits)

EWP 190: Writing and the Environment

EWP 290: Research Writing and Humanities (also offered in the summer; covers General Education Humanities)

Or equivalent courses from AP or transfer credit

Coursework (12 credits total):

Required Core Course (3 Credits)

- EWP 300: Survey of Environmental Writing

Choose Two Upper Division EWP Courses (6 credits)

- EWP 311: Urban Environmental Literature
- EWP 350: Eco-Cinema: Perspectives and Practices
- EWP 390: Literature of Nature
- EWP 394: Art of Storytelling
- EWP 407: Writing for Environmental & Science Professionals

- EWP 420: Advance Public Presentation Skills
- EWP 490: Contemporary Literature of Nature
- EWP 494: Creative Non-Fiction in the Sciences
- EWP 495: Environmental Journalism

Directed Electives (3 Credits)

- EWP 401 Capstone Experience (with permission of instructor) **or**

Another 3 credit, upper division EWP course (300, 400)

Additional relevant 300 and 400-level courses (from ESF or SU) may be acceptable.

Food Studies Minor

Coordinator: Dr. Lee Newman

The food studies minor will be available to students in all majors who want to increase their knowledge of the impact of food production systems, food security and food systems on human society and individual human health.

Some of the directed elective courses have additional pre-requisites, and students must investigate this before making up their proposed course plan.

Interested students (GPA 2.7 required in order to apply) must submit a petition, with a list of potential courses to fulfill the minor requirements to (a) their faculty advisor, (b) the undergraduate curriculum coordinator of their home department and (c) the food studies minor coordinator, with final approval from the Dean of Instruction and Graduate Studies.

Many of these courses are offered at Syracuse University. Students pursuing this minor may incur additional fees as required for exceeding their SU accessory instruction allocation.

Requirements

For the Minor, all students must take 6 courses distributed as follows among 3 categories:

Two required lower division courses:

- FST 102 Food Fights: Contemporary Food Issues (3)
- FST 202 Agroecology (3)

Select one among the following courses:

- EFB 337 Field Ethnobotany (3)
- EFB 437 Plant Propagation (3)
- EST 361 History of the American Environmental Movement (3)

Select three among the following courses:

- FST 204: Food, identity and Power (3)
- FST 303 Food Movements (3)
- FST 304 Farm to Fork (4)
- FST 306 Food Cooperatives (3)
- FST 307 Feeding the World: Global Agri-food Governance (3)
- FST 309 Philosophy and Practice of Locavorism (3)
- FST 310 Will Work for Food: Labor Across the Food System (3)
- FST 312 Emergency Food Systems (3) ***Note: This course is not offered each year.
- FST 402 Feeding the City: Urban Food Systems (3)
- FST 403 The Human Right to Adequate Food and Nutrition (3)

- FST 421 Morality of a Meal: Food Ethics (3)
 - FST 423 Food in History (3)
 - NSD 555 Food, Culture and Environment (3)
- **NOTE**** This has prerequisites that will add to SU credits.

Forestry Minor

Coordinator: Dr. Rene Germain

The minor in forestry draws from the biological, physical, social, and managerial sciences. The curriculum aids in understanding the biological complexities of the forest and the interactions between the forest and social and economic demands. The minor is designed to provide students with an appreciation of forest resources management. Course themes include forest measurements, forest ecology, forest management and silviculture, and forest policy and economics.

Admission to the minor requires students to have a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same standing).

The minor in Forestry requires 17 credits. It is the responsibility of the student to meet any prerequisites associated with courses in the minor. **Required courses:**

- FOR 322 Natural Resources Measurements and Sampling (3) (prerequisites: FOR 304 or equivalent and APM391 or equivalent)
- FOR 332 Forest Ecology (4) (prerequisites: FOR 232 or EFB 320 or equivalent)
- FOR 334 Silviculture (4)
- FOR 370 Forest Management Decision Making and Planning (3) (prerequisites: FOR 322 and FOR 334) or FOR 373 Forest Operations (3) (prerequisites: FOR 322 or FOR 334 or permission of instructor)
- FOR 333 Natural Resource Managerial Economics (3) (prerequisite: FOR 207 or equivalent) or FOR 465 Natural Resources Policy (3)

Information Management and Technology Minor

Coordinator: Scott Shannon

In collaboration with the Syracuse University School of Information Studies (the i-School), ESF also offers an undergraduate minor in Information Management and Technology for ESF students. This minor is designed to give students knowledge of information technology and an understanding of information and communications problems. It complements many majors because all organizations need people who understand information resources and information technology. To be eligible for this minor, students must have a cumulative grade point average of 2.70 or better and apply for the minor after completing at least one semester at ESF, but as soon after that as possible to ensure all courses can be completed. It is preferable students begin the minor during their sophomore year.

The following 18 credits of courses are required: ITS 195 Information Technologies (3); 9 credits of ITS elective coursework; and one course from each of the following two general areas of study:

Technology:

- IST 233 Introduction to Computer Networking (3)
- IST 352 Applications of Information Systems (3)
- IST 459 Introduction to Database Management Systems (3)

Management:

- IST 335 Introduction to Information-based Organizations (3)
- IST 352 Information Analysis of Organizational Systems (3)
- IST 445 Managing Information Systems Projects (3)

For questions regarding the selection of elective coursework, please contact Elaine Morgan with the i-School at 443-1830 or emmorgan@syr.edu

Landscape Architecture Studies

The minor in Landscape Architecture Studies provides an understanding of the natural and human factors and the role of design in shaping our physical environment. This minor is available to SU and ESF students. To complete this minor, students must complete 15 credit hours (5 courses) with a cumulative grade point average of 2.5. One course is specified, with an additional four courses to be selected from the list of seven approved courses listed below.

Admission to the minor requires a cumulative grade point average of 2.7 or higher and permission (ESF petition) of the Landscape Architecture Undergraduate Curriculum Director (331 Marshall Hall).

Required Courses (3 Credits)

- LSA 220 - Introduction to Landscape Architecture

Approved Courses (3 Credits each)

- LSA 311 - Natural Processes in Planning and Design
- LSA 312 - Place/Culture/Design
- LSA 305 - History of Landscape Architecture I (meets Gen Ed)
- LSA 306 - History of Landscape Architecture II
- LSA 321 - Ecological Applications in Planning and Design
- LSA 451 - Comprehensive Land Planning
- LSA 497 - Contemporary Issues in Landscape Architecture

Total credits required: 15

Management Minor**Coordinator: Rene Germain**

The management minor is available to all ESF undergraduate students who want to develop greater skills and knowledge of business fundamentals. In addition to understanding basic financial and managerial accounting principles, students can further develop focus in their minor through coursework in entrepreneurship, finance, marketing, human resources, and other topics.

Admission to the minor requires sophomore status, a cumulative grade point average of 2.70 or better and permission (via the ESF Minor Enrollment Form) of the Coordinator of the minor. Normally, students are allowed to take only one management course at Syracuse University's Whitman School per semester, so careful planning is required.

The management minor requires fifteen (15) credits, six (6) credits from a required course and nine (9) credits of elective courses. It is the responsibility of the student to meet any prerequisites associated with any courses in the minor.

Required Courses (6 credits)

Course Number	Course	Codes *	Credits
FOR 360 AND FOR 205 OR CME 151	Principles of Mgmt/ Envrn Prof Principles of Accounting Intro to Financial Accounting		3 3 3

Elective Courses (9 credits)

Course Number	Course	Codes *	Credits
CME 252	Intro to Managerial Accounting		3
CME 444	Materials Marketing		3
EST 450	Sustainable Enterprise		3
FOR 485	Business and Managerial Law		3
SRE 422	Energy Markets and Regulation		3
SRE 454	Sustainable Energy Fin&Analysis		3
ERE 519	Green Entrepreneurship		3
PSE 456	Management in Industry		3

SU courses

Course Number	Course	Codes *	Credits
EEE 370	Intro To EEE		3
EEE 375	Entreprenrsl. Family Bus. Mgmt.		3
EEE 382	Entrepreneurial Marketing		3
EEE 442	Emerging Enterprise Law		3

EEE 443	Emerging Enterprise Consulting		3
FIN 301	Essentials of Finance		3
MAR 301	Essentials of Marketing		3
SHR 247	Introduction to Strategic Mgmt.		3

*Students in the Sustainable Energy Management major may not use ENS 422 and FOR 454 to satisfy the requirements in the Management minor.

Marine Science Minor

Coordinator: Dr. Kim Schulz

The marine science minor is available to students in all majors who want to increase their knowledge of marine systems. Prior to admission students must have completed one year of General Biology (EFB 101/102 and EFB 103/104) and one year of General Chemistry (FCH 150/151), or equivalent, and have earned a cumulative GPA of 2.70. Some of the directed elective courses have additional pre-requisites, which will not count toward the minor.

Courses:

This minor requires at least 12 credits from the list below, with no more than 3 courses taken from any one department, and no more than 3 credit hours of lower division credits counted. Other marine science courses may be substituted by petition for any course in the directed elective list with approval of the marine science curriculum coordinator.

Although not required, all participants in the marine science minor are encouraged to incorporate a field or hands-on component in their choice of courses. Such courses may include the Sea Education Association courses, approved field courses from other marine stations or institutions, an approved internship (e.g., EFB 420) or approved independent research (e.g., EFB 498, ENS 498, FCH 498) opportunities related to marine topics (must be approved in advance by the marine science minor coordinator) or other marine field courses approved by the minor coordinator.

Directed Electives

Course Number	Course	Codes *	Credits
EFB 355	Invertebrate Zoology		4
EFB 423	Marine Ecology		4
EFB 486	Ichthyology		3
EFB 487	Fisheries Science & Mgt		3
FCH 520	Marine Biogeochemistry		3

FCH 525	Oceanography		3
BIO 100	Ocean Life		3
EAR 117	Oceanography		3
EAR 205	Water & Our Environment		3
EAR 210	Hist of Earth and Life		3
EAR 325	Introduction to Paleobiology		4
EAR 429	Topics in Paleobiology		3
EAR 432	Seafloor Spreading&Oceanographic Lithosphere		3
EAR 544	Quaternary Environment&Climate Change		3
GEO 327	Geography of Coastal Environments		3

In addition, the following Sea Education Association courses would count toward the minor without petition, and not subject to the lower division requirement described above (221 Oceanography, 224 Practical Oceanographic Research, 225 Practical Oceanography I, 226 Practical Oceanography II, 320 Ocean Science and Public Policy, 321 Oceans in the Global Carbon Cycle, 324 Advanced Oceanographic Field Methods, 325 Directed Oceanographic Research, 326 The Ocean and Global Change, 327 Toward a Sustainable Ocean: Conservation and Management, 450 Advanced Topics in Biological Oceanography: Biodiversity).

Mathematics Minor

Coordinator: Dr. Gary Scott

The mathematics minor is available to all ESF undergraduates who have an interest in developing greater knowledge in the field of mathematics. To be eligible for this minor, a student must have a cumulative grade point average of 2.700 or better by the end of the sophomore year. Interested students must submit a minor enrollment form to their academic advisor and the minor coordinator. Twenty one credit hours (6 courses) in mathematics courses are required to complete the minor. Admission to the mathematics minor requires students to have completed Calculus I and Calculus II.

Required Courses: (15 credits)

- APM 205: Calculus for Science and Engineering (4)
- APM 206: Calculus for Science and Engineering II (4)
- APM 307: Multivariable Calculus (4)

- Choice of:
 - APM 485: Differential Equations for Engineers and Scientists (3)
 - MAT 331: First Course in Linear Algebra (3)

Elective Courses: (6 credits)

ERE 465: Environmental Systems Engineering (3)
 ERE 533 Ecological Modeling (3)
 APM 391 Introduction to Probability and Statistics (3)
 APM 395 Probability and Statistics for Engineers (3)
 APM 485 Differential Equations for Engineers and Scientists (3)
 APM 510 Statistical Analysis (3)
 APM 585 Partial Differential Equations for Engineers and Scientists (3)
 APM 595 Probability and Statistics for Engineers (3)
 APM 620 Experimental Design and ANOVA (3)
 APM 625 Sampling Methods (3)
 APM 630 Regression Analysis (3)
 APM 635 Multivariate Statistical Methods (3)
 APM 645 Nonparametric Statistics and Categorical Data Analysis (3)
 APM 730 Adv Regression Modeling Methods (3)
 MAT 3xx/4xx/MAT 5xx Any MAT course numbered 300 or above (3)

Microscopy Minor

Coordinator:

The microscopy minor is available to all undergraduates at ESF and Syracuse University, who desire knowledge of methods and applications of light and electron microscopes for research and industry. The minor will prepare students to use a variety of microscopes for applications in biology, nanotechnology, environmental medicine, chemistry, materials science, engineering, pulp and paper and others.

Admission requires junior status and GPA 2.75. To enroll in the minor, students must submit a petition to their advisor, the undergraduate curriculum coordinator in their home department, and the minor coordinator in the NC Brown Center for Ultrastructure Studies in the SCME department with final approval by the Dean of Instruction.

The minor requires 12 credits of coursework:

Required courses

Course Number	Course	Codes *	Credits
MCR 480	Fundamentals of Microscopy		3
MCR 484	Scanning Electron Microscopy		3
MCR 485	Trans Electron Microscopy		3
MCR 585	Light Microscopy/ Rsrch Appl		3

Native Peoples and the Environment Minor

Coordinator: Dr. Madeline Nyblade

The Native Peoples and the Environment minor is available to all ESF undergraduates. The interdisciplinary suite of courses provides students with a cohesive introduction to Indigenous cultures, worldviews and knowledge systems and their application to environmental thought. The minor creates a conceptual framework for integrating traditional ecological knowledge with western scientific approaches in service to the science of sustainability. Through the breadth of courses and experiences, students will gain an appreciation for both the global nature and the local context of indigenous issues and the environment. The minor includes a required team taught seminar which enhances opportunities for interdisciplinary and cross-cultural integration.

Fourteen credit hours (5 courses) taken in residence are required to complete the minor. Two courses are specified, with an additional two or three courses selected from the list below. An internship may be used to fulfill a course requirement, if focused on Native peoples and the environment

Admission to the minor requires sophomore status with a cumulative GPA of 2.70 or better. Fourteen credit hours of courses are required.

Required Courses (6 credits)

Course Number	Course	Codes *	Credits
EST 140	Int/Native People,Land,Cult		3
EFB 305	Indigenous Issues&the Envrnmnt		3

Two or three courses (8 credits) selected from the following list

Courses

Course Number	Course	Codes *	Credits
EFB 306	Wildlife Field Techniques		3
EFB 337	Field Ethnobotany		3
EST 390	Social Processes & Envrn		3
EST 497	Onondaga Land Rights&our common Future		3
SOC 444	Contemporary Native American Movements		3

NAT 142	Native American Religion		3
NAT 400	Selected Topics		3
EFB 420	Prof Internship/Envrn Biology		1 - 5
EFB 496	Topics/Envrn&Forest Bio		1 - 3
EFB 496	Topics/Envrn&Forest Bio		1 - 3
EFB 496	Topics/Envrn&Forest Bio		1 - 3

Relevant 496 and 497 courses may be acceptable for inclusion in the minor, by petition to the minor coordinator.

Paper Science Minor

Coordinator: Dr. Gary Scott

The paper and related industries (including pulp, mineral, chemical and machinery suppliers) continually seek knowledgeable and skilled employees. Each year, companies hire numerous graduates of chemical, mechanical and environmental engineering programs as well as chemists and other environmental professionals in addition to paper science and engineering graduates. Salaries for new hires are among the highest for all fields of study at the bachelor's degree level. This minor gives students a basic understanding of the paper industry that will allow them to apply their major field of study to this growth industry. The paper science minor is available to all ESF undergraduate students (except students in paper engineering programs) who maintain a minimum cumulative grade point average of 2.70. Waivers to prerequisites of courses will be favorably considered in increase access to the minor across campus. Fifteen credit hours in paper science courses are required.

Required courses (4 credits)

- PSE 200 Introduction to Papermaking (3)
- PSE 202 Pulp and Paper Laboratory Skills (1)

Directed Electives Courses (11 Credits)

ECH 202 Principles of Mass and Energy Balance (3)
PSE 201 The Art and Early History of Papermaking (3)
PSE 223 Introduction to Lignocellulosics (4)
PSE 304 Professional Internship (1)
PSE 305 Professional Co-op (1)
PSE 306 Professional Synthesis (1)
PSE 350 Fiber Processing (3)
PSE 436 Pulp and Paper Unit Operations (3)
PSE 437 Equipment Troubleshooting and Maintenance (3)
PSE 438 Biorenewable fibrous and nonfibrous products (3)

PSE 450 Pulping and Bleaching Processes 3
PSE 456 Management in Industry (3)
PSE 462 Papermaking Processes I (3)
PSE 465 Fiber and Paper Properties (4)
PSE 466 Paper Pigment and Barrier Coating (3)
PSE 467 Papermaking Wet End Chemistry (3)
PSE 469 Functional and Nano Additives (3)
PSE 478 Papermaking Processes II (2)
PSE 481 Engineering Design (3)
PSE 552 Fiber Materials Recycling and Processing (3)
RMS 200 Renewable Materials and Composites from Lignocellulosics (3)
RMS 335 Transport Properties of Materials (3)
RMS 388 Wood and Fiber Identification Laboratory (2)
RMS 465 Renewable Materials and Surfaces: Testing (3)

Physics Minor

Coordinator: Dr. Gary Scott

The physics minor is available to all ESF undergraduates who have an interest in developing greater knowledge in the field of physics. To be eligible for this minor, a student must have a cumulative grade point average of 2.7000 or better by the end of the sophomore year. Interested students must submit a minor enrollment form to their academic advisor and the minor coordinator for approval.

Twenty hours (8 courses) in physics courses are required to complete the minor. Admission to the physics minor requires students to have completed General Physics I (with lab).

Required Courses: (8 credits)

PHY 211 General Physics I (3) or PHY 215 General Physics I for Scientists (3)
PHY 212 General Physics II (3) or PHY 216: General Physics II for Scientists (3)
PHY 221 General Physics I Laboratory (1)
PHY 222 General Physics Laboratory II (1)

Elective Courses: (12 credits)

Any PHY courses numbered 300 or above

Public Health Minor

Coordinator: Dr. Lee Newman

The Public Health minor will be available to students in all majors who want to increase their knowledge of the impact of public health issues and administration on human and human population health. Some of the directed elective courses have additional pre-requisites, and students must investigate this before making up their proposed course plan.

Interested students (GPA 2.7 required in order to apply) must submit a petition, with a list of potential courses to fulfill the minor requirements to (a) their faculty advisor, (b) the undergraduate curriculum coordinator of their home department and (c) the public health minor coordinator, with final approval from the Dean of Instruction and Graduate Studies. Many of these courses are offered at Syracuse University.

Three Required Courses

Course Number	Course	Codes *	Credits
EFB 360	Epidemiology		3
PHP 221	Community Health Promotion		3
PHP 309	Health Disparities		3

Select three among the following courses

Course Number	Course	Codes *	Credits
EHS 350	Environmental Health Managemnt		3
FST 403	Right to Food and Nutrition		3
PHP 302	Influencing Healthy Behavior		3
PHP 305	Community Mental Health		3
PHP 313	Issues Challenges Healthcare		3
PHP 306	Understanding Health Systems		3
PHP 414	Ethics & Law Hlthcare Adm		3
PHP 415	Public Health Ethics		3
PHP 436	Ethics in Addiction Services		3
PHP 437	LGBTQ Health and Well Being		3
PHP 438	Native American Health Promotion		3
PHP 462	Culture&Reprod Health&Med		3
PHP 463	Global Health		3

Recreation Resource and Protected Area Management Minor

Coordinator: Danielle Kloster

This minor provides students with the opportunity to combine visitor management with protected area management. Understanding the need to balance the opportunity for visitor experiences with protecting and stewarding protected areas provides professional insight into planning and managing those areas for limited visitor access. Understanding the motivations, preferences, and behavior of recreational users is necessary to integrate the human dimensions into protected area management with consideration of the social and environmental factors related to such management. Protected area managers need to be able to manage both the resource itself as well as a wide variety of users, such as campers, hikers, bird watchers, boaters, nature photographers and others who enjoy nature-based experiences in extensive protected area environments owned by public agencies, private landowners, or NGOs.

Students from all programs at ESF are eligible for this minor if they have completed a general ecology course and have a cumulative grade point average of 2.70 or better in their major program of study after one semester at ESF (or as a transfer student with same standing). Overlap between the minor and both one required course and one directed elective for a student's major is permitted; other courses taken for the minor can not overlap with the major.

This interdisciplinary minor requires 15 credits and includes the following courses taught at ESF in the Departments of Forest and Natural Resources Management and Environmental and Forest Biology:

Required Courses (9 credits)

Course Number	Course	Codes *	Credits
EST 370	Intro/Pers Env Interp Methods		3
FOR 372	Fund/Outdoor Recreation		3
FOR 475	Recreation Behavior & Managemnt		3

Required independent study or internship (3 credits)

Course Number	Course	Codes *	Credits
FOR 498 SECTION 20 OR FOR 499 SECTION 20			3 3

One of the following management/protected area courses (3 credits)

Management/Protected Area Courses (3 credits)

Course Number	Course	Codes *	Credits
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EFB 413	Intro To Conservation Bio		3
FOR 404	Ecotourism Abroad		3
FOR 476	Ecotourism and Nature Tourism		3
FOR 478	Wilderness & Wildlands Mgt		3
FOR 523	Tropical Ecology		3

Renewable Energy Minor

Coordinator: Dr. Tim Volk

The development of sustainable sources of energy has become a critical national and global issue due to concerns about the quality and quantity of the different potential resources, energy security, and potential impacts of each on the environment and human health. It is essential that our society and energy professionals understand the production and conversion of different forms of energy, their current and future supplies, the markets and policy mechanisms that regulate their supply, and the associated impacts on the environment for each fuel. In the past both traditional and renewable energy sources have been studied one resource at a time and usually from the perspective of a single discipline. This minor provides students an opportunity to examine different sources of traditional and renewable energy simultaneously in the context of our total energy use using a systems perspective. Students are exposed to views from a variety of disciplines which allows them to consider a wide array of issues related to current and future energy supply and use.

The Renewable Energy minor is available to all ESF and Syracuse University undergraduate students (except students who are in the Sustainable Energy Management Major and Environmental Science's Renewable Energy option) who have a GPA of 2.70 or better by the end of their sophomore year. The minor requires a minimum of 15 credits, 12 of which are required courses. The remaining 3 credits can be selected from a list of suggested courses.

Required Courses

Course Number	Course	Codes *	Credits
SRE 325	Energy Systems		3
SRE 337	Energy Resources Assessment		3
SRE 479	Life Cycle Assessment		3
CME 305 OR SRE 441	Sustainable Energy Sys/Bldgs Biomass Energy		3 3

Suggested Courses

(other courses may be used to meet this requirement with approval of minor coordinator)

Course Number	Course	Codes *	Credits
CME 305 OR SRE 441	Sustainable Energy Sys/Bldgs Biomass Energy		3 3
ECH 202	Principles of Mass and Energy Balance		3
ECH 212	Engineering Thermodynamics		3
ERE 380	Energy Systems Engineering		3
EST 427	Environmental and Energy Auditing		3
FCH 360	Physical Chemistry I		3
SRE 416	Sustainable Energy Policy		3
SRE 422	Energy Markets and Regulation		3
SRE 454	Sustainable Energy Fin&Analysis		3
SRE 481	Advanced Life Cycle Assessment		3

Sustainable Construction Minor

Coordinators: Dr. Paul Crovella

The sustainable construction minor is available to all ESF undergraduates (except students in construction management) and prepares students for careers related to sustainable construction. The objective of the minor is to provide a fundamental understanding of the concepts and methods used to take a design into the field and build a quality sustainable structure in the most efficient and effective manner with minimal environmental impact. Admission to the minor requires sophomore status and a cumulative grade point average of 2.70 or higher.

A cumulative grade point average of 2.000 or higher is required for the sustainable construction management courses in order to obtain the minor.

Fifteen credit hours are required to complete satisfy the minor. Choose 5 courses (15 credits) from the following:

Course Number	Course	Codes *	Credits
CME 215	Sustainable Construction		3
CME 305	Sustainable Energy Sys/Bldgs		3
CME 306	Engr Materials/ Sustainable Cons		3
CME 304	Envrn Perform Measures/Bldgs		3
CME 343	Construction Estimating		3
CME 405	Bldg Info Modelng/ Cons Mgt		3
CME 565	Sustainable Innovatns/Res Cons		3
CME 444	Materials Marketing		3
CME 453	Construct Plan/ Scheduling		3
CME 454	Construction Project Mgt		3
EST 426	Community Plng&Sustainability		3
EST 427	Environmental &Energy Auditing		3
EST 460	Land Use Law		3
EST 550	Envrn Impact Analysis		3
RMS 387	Renewable Mat/ Sustainable Cons		3
RMS 422	Composite Mat/ Sustainable Cons		3

Urban Environmental Science Minor

Coordinator: Dr. Margaret Bryant

Twelve credit hours (4 courses) of urban concentration courses are required to satisfy the minor: 6 credits of required courses and 6 credits of electives outside the student's major. Entry into the minor requires a minimum cumulative GPA of 2.70 in residence at ESF.

Core Course Requirements

To satisfy the Minor in Urban Environmental Science, the student must take the following core courses:

Core courses

Course Number	Course	Expected time of completion (Semester/Year)	Credits
EST 220 OR EFB 220	Urban Ecology Urban Ecology	offered Autum	3 3

and three credits of a "Capstone" project accomplished from among the following:

Capstone

Course Number	Course	Codes *	Credits
XXX 496	Approved 'experimental' course		3
XXX 498	Approved Independent Research Project		3
XXX 499	Approved Internship		3
ESTABLISHED COURSE	Approved Course		3

A student enrolled in the minor, will present to the advisory committee in the sixth week of the semester prior to engagement in the learning endeavor, a plan for a "capstone" experience, which will be undertaken working in conjunction with a faculty member(s) who will oversee an off-campus internship (courses numbered 499), independent-study project (courses numbered 498), or completion of a final project undertaken in a special topic (courses numbered 496) or established 3-credit course. All students will present their completed projects to the advisory committee and their peers in the last week of classes, depending on the semester of completion (fall or spring). All students currently enrolled in the minor are expected to attend capstone presentations.

Elective Course Requirements

Outside the student's Major, 6 additional credits selected from the list of approved courses, which are offered in a faculty other than that of the student's major, and which are above and beyond those courses being used to satisfy a student's major, general education or professional requirements.

Urban Forestry Minor

Coordinator: Dr. Eddie Bevilacqua

The Urban Forestry minor will provide students with the opportunity to better understand complex human-dominated ecosystems where trees and people coexist in close proximity. Understanding and attempting to manage this complexity requires a basic knowledge of plant physiology, nutrition, and tending at the individual tree level (arboriculture). In addition, the urban forester also must understand the changing dynamic of groups of trees and the effects of those trees on numerous ecosystem services and human health and well-being in a city (urban forestry). Because human activity is so dominant in the urban ecosystem, it is essential that the urban forester have some understanding of ecological interactions and human motivations for sustaining and maintaining existing trees (urban ecology). The courses listed below will provide the professional knowledge required for careers in these and related fields.

Fifteen credit hours are required:

Courses

Course Number	Course	Codes *	Credits
ESF 300	Intro/Geospatial Info Tech		3
EST 220	Urban Ecology		3
FOR 480	Urban Forestry		3
FOR 481	Introduction to Arboriculture		3
LSA 480	Seminar:Urban Design		3

The interdisciplinary minor includes courses taught in the Departments of Forest and Natural Resources Management, Environmental Studies, and Landscape Architecture. Admission to this minor requires students to have (1) completed a general ecology course (e.g. EFB 320 General Ecology), (2) a cumulative grade point average of 2.70 or greater after one semester at ESF (or as a transfer student with the same GPA).

Water Resources Minor

Coordinators: Dr. Kim Schulz (EB) and Dr. Chuck Kroll (ERE)

Water resources is a multi-disciplinary field that integrates the physical, geochemical and biological processes of the water cycle and their application to management of water resources, water policy, and human dimensions of water quality and quantity. The interdisciplinary minor in water resources is designed as a flexible program for undergraduate students to study and integrate principles of physical hydrology, geochemistry, aquatic and terrestrial ecology, natural resources management, and environmental policy. The minor can include courses in the Departments of Forest and Natural Resources Management, Environmental Resources Engineering, Environmental and Forest Biology, Chemistry, and Environmental Studies, as well as relevant courses at Syracuse University. The minor comprises 15 credit hours total that must be distributed across three departments at minimum (i.e., course numbers with three separate prefixes), with the intent of covering a breadth of disciplines. These courses must include at least one foundation course, either FOR 442 Watershed Ecology and Management, or EFB 424 Limnology: Study of Inland Waters. Courses taken for the minor can also count toward students'

majors or other academic requirements, subject to those other program guidelines. Students are responsible for meeting the prerequisite requirements for individual courses, as applicable.

Admission to this minor requires that a student from any ESF program has a cumulative grade point average of 2.70 or better after one semester at ESF (or as a transfer student with same GPA).

Required foundation course; students must take at least one of these:

Required Courses

Course Number	Course	Codes *	Credits
FOR 442	Watershed Ecology & Management		3
EFB 424	Limnology:Study Inland Waters		3

Approved elective courses that count toward the minor include the following, subject to availability and pre-requisite requirements. Other relevant courses may be petitioned. Note that some ERE elective courses may require prerequisites, such as calculus, chemistry, and programming; students who are interested in these courses should consider taking the engineering sections of their calculus sequence.

Fall Courses

Course Number	Course	Codes *	Credits
EFB 487	Fisheries Science & Mgt		3
EFB 488	Fisheries Science Practicum		1
EFB 496	Topics/Envrn&Forest Bio		1 - 3
EFB 500	Forest Biology Field Trip		1 - 3
EFB 525	Limnology Practicum		2
EFB 681	Aquatc Ecosys Restore/Enhance		2
ENS 601	Water Resources Mgt		3
ENS 607	Wetland Practicum		2 - 3
ERE 412	River Form and Process		3

ERE 475	Ecological Engr/Water Quality		3
ERE 527	Stormwater Management		3
EST 625	Wetland Management Policy		3
FCH 515	Meth/Envrn Chem Analysis		3
FOR 338	Meteorology		3

Spring Courses

Course Number	Course	Codes *	Credits
EFB 423	Marine Ecology		4
EFB 486	Ichthyology		3
EFB 492	Sr Synthesis/ Aquatic&Fish Sci		1
EFB 542	Freshwater Wetland Ecosys		3
EFB 692	Ecol And Mgt Of Waterfowl		3
ERE 340	Engr Hydrology&Hydraulics		4
ERE 440	Water and Wastewater Treatment		3
ERE 445	Hydrologic Modeling		3
ERE 508	Water-An Incredible Journey		3
ERE 570	Hydrology in a Chng Climate		3
FCH 510	Environmental Chemistry I		3
FCH 525	Oceanography		3
FOR 340	Watershed Hydrology		3

Approved Syracuse University courses

Course Number	Course	Codes *	Credits
CIE 352	Water Resources Engineering		3
CIE 457	Biogeochemistry		3
EAR 400	Selected Topics		3
EAR 400	Selected Topics		3
EAR 401 OR EAR 601	Hydrogeology Hydrogeology		3 3
EAR 612	Water-Energy Seminar		3
GEO 316	River Environments		3
GEO 422	Water: Env, Soc & Po		3

