



ENVIRONMENTAL SCIENCES GRADUATE PROGRAM AREA OF CONCENTRATION IN BIOGEOCHEMISTRY

PURPOSE

The Area of Concentration in Biogeochemistry is designed for students who have a strong natural science background and want to develop understanding of biogeochemistry. Biogeochemistry is the study of processes that account for the movement of energy and chemicals between components of the earth, including the hydrosphere, lithosphere, and the atmosphere. Examples of biogeochemistry are processes that account for nutrient and water cycling in ecosystems, that control the composition of the earth's atmosphere, and that account for climate change. The biological component of biogeochemistry includes both human and other organisms on earth. Within the Biogeochemistry track, students may choose to focus on integrated aspects of terrestrial, aquatic, atmospheric, and marine systems.

PROGRAM OF STUDY

The Biogeochemistry track includes courses in 6 categories: the ES Core courses, Methods and Numerical Skills courses, Basic Earth System courses, Science Focal Area courses, Elective courses, and Thesis. Total credits required are a minimum of 45 Cr for the M.S. and M.A. degrees and 108 Cr for the Ph. D. degree. Typical Programs of Study will include minimum credits as follow:

<u>Subject Area</u>	<u>M.S. & M.A. Degrees</u>	<u>Ph. D. Degree</u>
ES Core Courses	9 Cr	10 Cr
Methods and Numerical Skills	6 Cr	9 Cr
Basic Earth Systems Courses	12 Cr	15 Cr
Science Focal Area Courses	9 Cr	24 Cr
Electives	0 Cr	0-14 Cr
Thesis	9 Cr	36-50 Cr
Total	45 Cr	108 Cr

CORE COURSES

9-12 Cr. for the M.S and M.A. degree (required are ENSC 515, 520, 508 and one class from the approved list of core courses- below) and 10-12 Cr. for the Ph. D. degree. (required are ENSC 515, 520, 508 and classes from the approved list of core courses- below). These courses include Environmental Perspectives, Environmental Analysis, Environmental Profiles, and the Joint-Campus Workshop in Environmental Science, Studies, and Policy.

Approved Core Course List:

ANTH 581	Natural Resources and Community Values
ANTH 582	World Food and the Cultural Implications of International Development
BI/BOT 589	Analysis of Environmental Issues
BI 570	Community Structure and Analysis
BI 670	Community Structure and Analysis
Comm 540	Theories of Conflict and Conflict Management
EC 539	Public Policy Analysis
FOR 561	Forest Policy Analysis
FS520	Posing Researchable Questions
FS521	Natural Resource Research Plan
FS565	Forest Ecosystem Management
FS646	Ecosystem Analysis and Evaluation
FW 515	Model Selection and Inference
GEO 520	Geography of Resource Use
H524	Health Data Analysis
H525	Intro Epidemiology
H526	Epidemiological Methods

H549	Health Risk Communication
H575	Evaluation
H576	Proposal Writing
HIST 569	History of the Pacific Northwest
LA 607	Experimental Seminar in Biocomplexity and Alternative Futures
MRM515	Coastal Resources Management
PS 574	Bureaucratic Politics and Policy
PS 575	Politics of Environmental Problems
PS 576	Science and Politics
RNG 650	GIS Watersheds Analysis
SED 580	Research and Evaluation
SOC 581	Society and Natural Resources
Z582	Molecular Methods in Ecology and Evolution

METHODS AND NUMERICAL SKILL COURSES

6 Cr for the M.S. and M.A. degree and 9 Cr for the Ph. D. degree. These courses are to ensure students have sufficient skills in research methods including mathematics, statistics, and computer science. Courses are to be selected by the student, advisor, and advising committee from the list below and from other offerings.

CS 540 Database Management Systems
 CS 515 Algorithms and Data Structures
 GEO 565 Geographic Information Systems
 MTH 581, 582, 583 Mathematical Methods for Engineers and Scientists
 MTH 587, 588, 589 Numerical Methods for Engineers and Scientists
 OC 675 Numerical Modeling in Ocean Circulation
 OC 682 Oceanographic and Atmospheric Data Analysis I
 OC 683 Oceanographic and Atmospheric Data Analysis II
 STAT 511, 512, 513 Methods of Data Analysis
 STAT 515 Design and Analysis of Planned Experiments
 STAT 522 Introduction to Mathematical Statistics
 STAT 531 Sampling Methods

BASIC EARTH SYSTEM COURSES

12 Cr for the M.S. and M.A. degree and 15 Cr for the Ph. D. degree. Basic Earth System courses are intended to develop basic knowledge in Oceanography, Atmospheric Science, and Geo/soil Science. The courses below are not a complete list of courses satisfying the Basic Earth System category of courses. Basic Earth System courses are to be selected by consensus of the graduate advisor, advising committee, and student.

ATS 511 Atmospheric Physics
 ATS 513 Atmospheric Chemistry
 CSS 535 Soil Ecosystem Properties and Processes
 CSS 546X Geochemistry of Soil Ecosystems
 CSS 555 Biology of Soil Ecosystems
 CSS 565 Soil Morphology and Survey
 FE 530 Watershed Processes
 FW 556 Limnology
 FW 580 Stream Ecology
 GEO 530 Geochemistry
 GEO 587 Hydrogeology
 OC 530 Physical Oceanography
 OC 540 Chemical Oceanography
 OC 550 Biological Oceanography

SCIENCE FOCAL AREA COURSES

9 Cr for the M.S. and M.A. degree and 24 Cr for the Ph. D. degree. Focal area Courses are intended to develop depth of student understanding in biogeochemistry. The courses below are a suggested partial listing and are to be selected by consensus of the graduate advisor, advising committee, and student.

ATS 515 Atmospheric Dynamics
ATS 546 Atmospheric Boundary Layers & Turbulence
ATS 590 Air-Sea Interactions Turbulence
ATS 613 Cloud and Aerosol Physics
ATS 630 Climate
BRE 525 Stochastic Hydrology
BRE 549 Regional Hydrologic Modeling
BRE 672 Biosystems Modeling Application
CSS 525 Sustaining Soil Productivity
CSS 555 Modeling Soil Ecosystems
CSS 585 Environmental Applications of Soil Science
CSS 615 Plant Nutrient Availability
CSS 635 Chemical Processes in Soil Systems
CSS 645 Soil Biology and Biochemistry
CSS 655 Plant-Water Relations
CSS 665 Soil Genesis and Classification
FE 532 Forest Hydrology

FE 535 Water Quality and Forest Land Use
FE 536 Integrated Forest Engineering & Hydrology
FS 531 Ecosystem Approach to Forest Manipulation
FS 546 Ecosystem Analysis and Application
FW 570 Aquatic Toxicology & Pollution Biology
GEO 518 Geographic Photo Interpretation
GEO 544 Remote Sensing
GEO 565 Geographic Information Systems
GEO 566 Digital Image Processing
GEO 569 Topics in Geographic Techniques
OC 657 Ecological Biogeochemistry
OC 644 Phytoplankton Ecology
OC 647 Microbial Ecology
OC 673 Descriptive Physical Oceanography
OC 674 Turbulence
RNG 536 Wildland Fire Science
RNG 555 Riparian Ecology and Management
RNG 662 Rangeland Ecology
RNG 667 Fire Ecology

ELECTIVE COURSES

0 Cr for the M.S. and M.A. degree and 0-14 Cr for the Ph. D. degree. Students will work with their graduate advisor and committee to select elective courses to develop necessary background to add breadth and depth to the student's Program of Study.

THESIS:

9 Cr for the M.S. and M.A. degree and 36-50 Cr for the Ph. D. degree.