Washington State University
MAJOR CHANGE FORM – REQUIREMENTS

NOTE: If proposing a **new** program (degree) or **extending, moving, consolidating, eliminating or renaming** an existing program (degree), these proposals must first go through the Provost's Office review process. Please do not use this form. Please contact the Provost's Office for directions on processing program (degree) proposals.

SUBMITTING PROPOSAL – Follow the steps on form, then:

- **Submit one electronic copy of complete packet of signed form/rationale statement/supporting documentation and/or edits** to wsu.curriculum@wsu.edu.
- **Send the original stapled packet** PLUS **10 stapled copies of packet to the Registrar's Office,** campus mail code 1035.

Department Name Interdisciplinary Certificate across the WSU campus

1. Check proposed changes:

- ☐ New Plan (Major) *in* _____ CIP#___._____
- ☐ Change name of Plan (Major) *from* _____ *to* _____
- ☐ Revise certification requirements for the Plan (Major) *in* _____
- ☐ Revise Plan (Major) requirements *in* _____
- ☐ Drop Plan (Major) *in* _____

- ☐ New Sub-Plan (Option) *in* _____ CIP#___._____
- ☐ Change name of Sub-Plan (Option) from _____ *to* _____
- ☐ Revise requirements for the Sub-Plan (Option) *in* _____
- ☐ Drop Sub-Plan (Option) *in* _____

- ☐ New Minor *in* _____ CIP#___._____
- ☐ Change name of Minor from _____ *to* _____
- ☐ Revise Minor requirements *in* _____
- ☐ Drop Minor *in* _____

- ☑ New Certificate *in* C-NSPIRE: Carbon & Nitrogen Systems Policy-Oriented Integrated Research and Education CIP#___._____
- ☐ Change name of Certificate from _____ *to* _____
- ☐ Revise Certificate requirements *in* _____
- ☐ Drop Certificate *in* _____

- ☐ Other _____

2. Effective Date: Fall 2014 (Requirement changes are effective for following fall terms.) ***Submission deadline is Oct 1st.***
NOTE: Items received after deadlines may be put to the back of the line or forwarded to the following year. Please submit on time.

Contact: Kristen Johnson Phone number: 335-4131
Email: johnsoka@wsu.edu Campus mail code: 6351

3. PLEASE ATTACH A RATIONALE STATEMENT giving the reasons for each request marked above, and explaining how this impacts other units in Pullman and other campuses (if applicable).

4. PROVIDE SUPPORTING DOCUMENTATION AND/OR CURRENT CATALOG COPY with edit marks showing requested changes.

5. SIGN AND DATE APPROVALS.

Chair Signature/date	Dean Signature/date	CSC Date

Chair Signature/date	Dean Signature/date	AAC or GSC Date	Senate Date

WASHINGTON STATE UNIVERSITY
College of Agricultural, Human, and Natural Resource Sciences
Office of the Dean

October 13, 2014

To Whom It May Concern:

The College of Agriculture, Human and Natural Resource Sciences strongly supports the interdisciplinary graduate certificate entitled *"C-NSPIRE: Carbon & Nitrogen Systems Policy-Oriented Integrated Research and Education"*. This proposed certificate is an outgrowth of WSU's successful interdisciplinary IGERT grant, *NSPIRE*. The certificate builds on the *NSPIRE* experience and seeks to train new scientists in the skills needed to recognize and navigate interdisciplinary problems such as nitrogen or carbon science and to understand the role policy plays in science. Additionally, the certificate will allow students the opportunity to develop their science communication skills as they seek to discuss science with policy makers. A certificate of this type will enhance the experience of our graduate students and institutionalize the *NSPIRE* success.

We also support the shared administration of the certificate across the three colleges. The proposed faculty administrative structure will allow each college strong input into the certificate ensuring it continues to grow and develop into a world class experience for our graduate students. Interdisciplinary graduate training is a hallmark of graduate experiences in CAHNRS and we support mechanisms by which these opportunities for students can continue to grow and develop across campus.

Sincerely,

Ron Mittelhammer
Dean, CAHNRS
Regents Professor
Washington State University

Kimberlee K. Kidwell
Executive Associate Dean, CAHNRS
Washington State University

421 Hulbert Hall, P.O. Box 646242, Pullman, WA 99164-6242
509-335-4561 • Fax: 509-335-1065

WASHINGTON STATE UNIVERSITY
College of Arts and Sciences

October 14, 2014

Colleagues,

I strongly support the proposal for the Graduate Certificate Program, C-NSPIRE. This interdisciplinary certificate program is an extension of a highly successful collaborative program titled, "Nitrogen Systems: Policy-oriented Integrated Research and Education (NSPIRE) at WSU. The continuation of this program has tangible benefits for our graduate students because it embodies the integration across engineering and agricultural, physical, life, and social sciences. This progressive and necessary mode of education will prepare scientists and engineers to better integrate their future endeavors in the context of a broad array of societal stakeholders.

I support this interdisciplinary graduate certificate being administratively through the Graduate School.

Sincerely,

Daryll B. DeWald

Daryll B. DeWald, Dean
College of Arts and Sciences

PO Box 642630, Pullman, WA 99164-2630
509-335-4581 • Fax: 509-335-8986 • cas@wsu.edu • cas.wsu.edu

WASHINGTON STATE UNIVERSITY
VOILAND COLLEGE OF ENGINEERING AND ARCHITECHTURE

Memorandum

To: Kristen Johnson, Animal Sciences
Brian Lamb, CEE
Stephanie Hampton, CEREO
Steven Stehr, Politics, Philosophy and Public Affairs
R. David Evans, Biological Sciences

From: David Field, Associate Dean Research and Grad. Education, VCEA

Date: October 15, 2014

Subject: C-NSPIRE Certificate Program Support Letter

It is with pleasure that I write this letter to support your efforts to create an interdisciplinary certificate based on the successful Nitrogen Systems: Policy-oriented Integrated Research and Education (NSPIRE) program previously funded as an NSF-IGERT program. I recognize that this program is aimed at graduate students in a variety of disciplines, including engineering, sciences, and agriculture, and perhaps others.

The objectives and approaches outlined in your proposal documents and rationale for the program will be of considerable benefit to graduate students in the Engineering disciplines. The desired outcomes described will help to broaden the student's understanding of the environmental impacts of the C and N cycles and the variety of approaches that are necessary to ensure that these complexities are addressed appropriately in policy decisions.

Please do not hesitate to contact me if I can be of any assistance in your endeavors regarding the C-NSPIRE program.

PO Box 642714, Pullman, WA 99164-2714
509-335-5593 | Fax: 509-335-9608 | www.cea.wsu.edu

Proposed Graduate Certificate Program (10/1/14)

Certificate Title: C-NSPIRE: Carbon & Nitrogen Systems Policy-Oriented Integrated Research and Education

Contact information:

Kristen Johnson
Professor, Animal Sciences
johnsoka@wsu.edu; 5-4131

Stephanie Hampton
Professor and Director CEREO
s.hampton@wsu.edu; 5-6750

R. David Evans
Professor, School of Biological Sciences
rdevans@wsu.edu; 5-7466

Steven Stehr
Professor, Politics, Philosophy and Public Affairs
stehr@wsu.edu; 5-8929

Brian Lamb
Regents Professor, Civil and Environmental Engineering
blamb@wsu.edu; 5-5702

Rationale for certificate program (Target audiences)

This certificate program builds on the foundation provided by the Nitrogen Systems: Policy-oriented Integrated Research and Education (NSPIRE) program. NSPIRE was funded through the National Science Foundation's Integrated Graduate Education Research Training Program (NSF-IGERT) and aimed to prepare highly qualified Ph.D. students who have rigorous multi-disciplinary training in nitrogen cycling and an integrated view of nitrogen science coupled with the ability to effectively communicate with public policy makers and other stakeholders. After successful conclusion of the grant, we wish to make a broadened version of the program a permanent opportunity at WSU.

The certificate is aimed at graduate students in engineering, sciences, and agriculture, although students from other colleges may also find it valuable. The primary objective is to provide students an interdisciplinary perspective of the science related to the global nitrogen and carbon cycles and to introduce science and engineering students to public policy studies as they intersect with environmental science. The C and N (and other nutrient) cycles are closely coupled and together are associated with global sustainability issues related to climate change, air quality, water quality, and other environmental impacts. Given the complexities of the C and N cycles, policy solutions to mitigate the environmental impacts require an **integrated management approach**. Our goal is to develop among the students a critical scientific understanding of the nutrient cycles and, in particular, to understand how scientific research informs policy needed to address environmental and global change issues.

We anticipate the number of graduate students initially interested in the certificate will be approximately 5 to 10 because of the broad faculty participation and interest in the certificate. We anticipate that number will grow as more students who have interest begin their graduate programs at WSU. Additionally, as students take the core classes the instructors of those classes will mention the certificate program as an option for students to consider. CEREO will highlight the certificate program on its website as well.

1. Student Learning Objectives

The WSU Student Learning Objectives will be addressed in each course within the certificate program. *Critical and Creative Thinking, Quantitative Reasoning, Scientific Literacy*, and *Information Literacy* are core skills for graduate students and these skills will be developed across the certificate program. Each course builds on skills learned and expands the *Depth, Breadth and Integration of Learning* particularly with regard to biogeochemical cycling and the formation of policy associated with environmental issues. Additionally, *communication* skills, both oral and written, of many types will be developed. Students will work in teams, write proposals, present ideas orally, practice making science presentations accessible to policy makers and stakeholders in oral and written form, and learn to speak and write clearly and succinctly in their scientific writing as well as in communication to policy makers. (Assessment of the success of the student learning objectives and desired learning outcomes will occur as a part of the final defense of the student's disciplinary degree. See Section 5: Administration and Oversight below.)

Desired learning outcomes

Students earning this certificate will be able to:

- Demonstrate a ***conceptual understanding*** of the interactive biophysical processes governing global carbon, nitrogen and associated water cycles.
- Use physical ***principles and reasoning*** to describe microenvironments of living organisms and energy and mass transfer between organisms and their environment.
- Learn how environmental scientists measure and model mass and energy fluxes that drive interdependent biogeochemical processes.
- ***Critically explore and evaluate*** relevant literature and ideas in carbon and nitrogen cycling, and foster interdisciplinary thinking and development to address complex ecological issues.
- Work on complex scientific questions within ***teams, write*** interdisciplinary research proposals, provide an ***oral*** overview of the proposal to faculty and other students, and constructively and critically review the proposals of other students.
- Attend seminars and interact with speakers brought to campus through the Center for Environmental Research, Education and Outreach (CEREO) and other departmental seminars to create a network and to broaden their thinking about their own disciplinary research.
- Utilize relevant case studies and role-playing to explore the simulated tradeoffs between policy strategies and experience how the inclusion of stakeholder values in decision-making can give rise to the dynamic behavior of the system.
- Examine carefully and critically some of the theories, models and frameworks that have been developed to better understand how societies might address pressing issues as they relate to environmental problems.
- Explore the facets of public policy creation through an interactive visit with decision makers who work at the boundaries of environmental science and public policy (e.g. Olympia, Washington D.C.).
- Create an individualized **capstone** experience that allows each student to **integrate** their own disciplinary research with the foundational biogeochemical training from the

certificate and the policy training. Examples of a capstone experience might be a fellowship in government, an NGO or attendance at a national policy meeting.

2. General rules (Admission requirements)

Admitted Masters or Ph.D. students under the advisement of participating faculty are eligible to apply for the certificate program. Students who are eligible will notify their department's graduate committee and their guidance committee of their interest in the certificate. Once the guidance committee has agreed that it is in the student's best interest to pursue and complete the certificate, the student will apply to the *C-NSPIRE* Administrative Committee. The application will include a statement from the student's advisor and graduate committee supporting the application. In this way we hope to enhance the disciplinary degree. The student will also identify a desired capstone experience for the certificate. This capstone could be attendance at a policy meeting, a policy fellowship, or other activity that will allow the student to tie the science policy experience together. The administrative committee will make an admission decision after review of the student's application.

3. Course Requirements

To earn the certificate in *C-NSPIRE* a student must complete a minimum of 13 credits including ten required credits and three elective credits. This progression of courses is intended to facilitate an interdisciplinary understanding of nitrogen and carbon cycle science, the modeling of dynamic, complex systems as they relate to pressing environmental issues, and the important role of the policymaking process as society attempts to address these issues. Particular attention will be paid to developing student communication skills so that they are more able to bridge the gap between biophysical science and policy creation and implementation.

Required Courses

BIOLOGY 569 Ecosystem Ecology and Global Change (3cr) This course provides certificate students with a common background in nitrogen and carbon science and global change. The objectives of this course are to develop conceptual understanding of biophysical, interactive processes governing global carbon, nitrogen and water cycles, critically explore and evaluate collective, relevant literature and ideas, and to foster interdisciplinary thinking and development to solve complex ecological issues. The course will be led by Dr. R. David Evans and other faculty who participate in the certificate program, who will lecture, lead discussions, and coordinate appearances of other participating faculty. The course will provide fundamental understanding of past and current climate, and projections for future climate change. Lecture material will also review the evidence for and the drivers of global change. Readings from current literature will be emphasized through written reviews of journal articles, and synthesis skills will be developed through a review paper of a current topic in global change.

BIOLOGY 593 Seminar I. Literature and Problems (1 cr; taken with Biology 569) The goals of this course are for students to form teams and write interdisciplinary research proposals, provide oral overview of the proposal to faculty and other students, and to review the proposals of other students in the course. Biology 569 will provide a foundation in carbon and nitrogen cycle science while this course provides the necessary next steps of stressing interdisciplinary team work through collaboration, and synthesizing expertise and information from diverse fields to address a common question in carbon and nitrogen cycle science. Emphasis is also placed on

communication skills in an interdisciplinary setting through team presentations of the proposals. Finally, evaluative skills in an interdisciplinary setting are emphasized by students reviewing proposals of their colleagues. The interdisciplinary approach will be reinforced throughout the course by targeting the NSF program "Emerging Topics in Biogeochemical Cycles." A key sentence in the program announcement is "Proposals must bridge the biological and geosciences disciplines and be relevant to at least one program in the BIO Directorate and at least one Program in the GEO Directorate." Each of these directorates includes divisions that have specific descriptions of their programs. For example, some teams may target a combination of Atmosphere and Geospace Sciences in the GEO directorate and the Ecosystem Studies program in the BIO directorate.

ENVR SCI 550 Modeling the Environment (3cr) This is an established course on system dynamics modeling that emphasizes the benefit of developing interdisciplinary models that simulate the interactions between and within environmental and human systems. System dynamics can provide a framework to integrate physical and social sciences, policy and decision-making. Simulation models are designed with icon-based, stock-and-flow software. The clarity of the models encourages wide participation in their development and thus system dynamics models are commonly used in real world decision processes, especially those that include multiple stakeholder perspectives. The models are especially adept at capturing nonlinearities, short and long-term time frames and lags in response, and feedbacks between multiple types of information. The models are mathematically equivalent to a coupled set of first-order differential equations, with simulation results typically appearing in seconds. The speed of the simulations encourages interactive simulation, promotes active discussion and iterative model development. Case studies relevant to the management of nitrogen, carbon and associated water cycles especially those that have gained active stakeholder involvement in the modeling process will be selected for exploration.

This course will reinforce policy, systemic and ideational levels of analysis. The natural focus of systems modeling is the policy level, where problems are identified and solutions are simulated. The students will also be introduced to the systemic level, simulating the extent to which the institutional structures and processes can shape environmental outcomes. The ideational level, often avoided in engineering and scientific analysis, will be incorporated via the inclusion of stakeholder relevant social values into models. Collaborative system dynamics modeling has been utilized and shown to be effective for the inclusion of stakeholder values into natural resource decision and policy development and support. Utilizing relevant case studies and role-playing, students will explore the simulated tradeoffs between the policy strategies and experience how the inclusion of stakeholder values in decision-making can give rise to the dynamic behavior of the system.

Students will take one of Pol_S 430, Pol_S 514, Pol_S 590 & Pol_S 591

POLITICAL SCIENCE 430 Natural Resource and Environmental Policy (3cr). The central aim of this course is to examine carefully and critically some of the theories, models and frameworks that have been developed to better understand how societies might address pressing issues as they relate to environmental problems.

POLITICAL SCIENCE 514 Seminar in Public Policy (3cr). The study of public policy focuses on describing, analyzing, and evaluating the policy choices, the programmatic outputs, and the societal outcomes associated with governmental action. Our central aim in this course is to examine carefully and critically some of the theories, models, and frameworks that have been postulated as ways of explaining, understanding, and controlling the activities that occur in the formation, implementation, and evaluation of public policy. Among the questions we will consider in this seminar are: Why does government intervene in society to produce and distribute goods and services? What are some alternative methods of delivering public services? What are some of the policy instruments that are utilized to change private behavior in the name of the public good? How are public problems defined? Why do some problems get on the public agenda while others are ignored? How are governmental institutions organized to make public policy choices? How are public policies designed? What techniques are utilized to evaluate the consequences of public programs? Under what conditions can scientific knowledge improve policy formation and delivery?

POLITICAL SCIENCE 590 and 591 Public Policy Studio (4 cr) These courses were designed for the NSPIRE-IGERT program. POLS 590 is an intensive introduction to the general area of public policy studies with a focus on reviewing the major theories, models and frameworks that have been developed to understand policy formation and implementation. POLS 591 focuses on problems and issues related to environmental policy with special attention directed at the problem of integrating science and engineering knowledge into the policymaking process.

Only students in *C-NSPIRE* are eligible to enroll in these courses; exceptions will be considered on a case-by-case basis. These modules of the Policy Studios suite of courses are designed to allow close interaction between the students, the student mentors, the core policy faculty, and other members of the core faculty. The primary activities are: (1) the development of a pre-proposal detailing how the student's science or engineering research will incorporate a public policy component; (2) training in research ethics featuring structured "role playing" exercises; and, (3) a week-long trip to Washington, D.C. to identify potential Fellowship / Internship placements.

Electives

SOIL SCIENCE 514 Environmental Biophysics (2cr) Physical environment of living organisms (temperature, humidity, radiation, wind); heat and mass exchange and balance in plant and animal systems. Students will use physical principles and reasoning to describe microenvironments of living organisms and energy and mass transfer between organisms and their environment. Within this objective, more specific course goals include: increased understanding of basic physical parameters that describe organisms and their environment; increased understanding of microclimates and their effect on organisms; learning to understand and work with mathematical expressions to make estimations where measured values are lacking; and learning to use microclimatic variables and transfer laws and associated mathematical expressions to estimate transfer of energy, water, and gases between organisms and the environment.

SOIL SCIENCE 515 Environmental Biophysics Laboratory (1cr) (Course Prerequisite: Soil Sci 514 or concurrent enrollment). Students will learn techniques and principles used to: measure

variables of the physical microenvironment and analyze energy and mass exchange between organisms and their environment based on such measurements. Emphasis will also be given to explaining the principles of operation of the instruments, how to work with the data collected, and sources of error in the measurements. Students will complete an individual research project requiring environmental data collection and analysis. Typically this project will be the data collection part of the Soils 514 project, and will involve selection and calibration of appropriate sensors, data logger programming, field or laboratory data collection, and data analysis. Students will meet with the instructor in groups and individually to select a project, learn to use data loggers and sensors, and evaluate data.

CIVIL ENGINEERING 555 Natural Treatment Systems (3cr) Comprehensive introduction to the emerging field of natural treatment systems, focusing on nutrient removal in free water surface treatment wetlands. Course topics include: wetland hydrology, water balance, and hydraulics; wetland ecological structure and function including discussions of wetland vegetation, energy balance, water temperature, oxygen dynamics, and oxidation-reduction processes; reactor kinetics and modeling treatment performance and stochastic processes in treatment wetlands; biogeochemistry of nitrogen and phosphorus cycling and removal in treatment wetlands. Course includes field trip to local treatment wetland.

SOIL SCIENCE 441 Soil Fertility (3cr) Course Prerequisite: SOIL SCI 201. Nutrient management impacts on crop productivity, soil and water quality; mineral requirements; soil testing; plant analysis; inorganic and organic fertilizers.

***SOIL SCIENCE 541 Soil-Plant Microbial* Interactions (*3cr*)** Soil-plant-microbial relationships to plant nutrition, plant health, and environmental cleanup; rhizosphere chemistry and microbial ecology. Required preparation must include two upper-division courses in biology, microbiology or soils.

GEOLOGY 562 Watershed Biogeochemistry (3cr). Sources, transformations, fates and impacts of biogeochemically important compounds as they move downstream through watersheds to the coastal zone.

4. Participating Faculty and Resources

Faculty and departments participating in this program include:

College of Agriculture Human and Natural Resources (CAHNRS)

Animal Sciences

- Kristen Johnson
- Joseph Harrison

Crop and Soil Sciences

- David Brown
- Lynne Carpenter-Boggs
- William Pan

College of Engineering and Architecture (CEA)

Civil and Environmental Engineering

- Jennifer Adam, CEE

- Marc Beutel, CEE
- Serena Chung, LAR
- Thomas Jobson, LAR
- Brian Lamb, LAR
- Shelley Pressley, LAR
- Timothy VanRekin, LAR

College of Arts and Sciences (CAS)

School of Politics, Philosophy and Public Affairs

- Nicholas Lovich
- Steven Stehr

School of Biological Sciences

- John Bishop
- Asaph Cousins
- R. David Evans
- Mechthild Tegeder

School of the Environment (CAS, CAHNRS)

- Allyson Beall King
- Stephanie Hampton
- John Harrison
- C. Kent Keller
- Alex Fremier

5. Administration and oversight

There will be a five person faculty Administration Committee, one from each participating college, the Director of CEREO, and a member of the Political Sciences faculty with an elected committee chair. The Director of CEREO and the Political Sciences faculty will be permanent members. The other three members on the Administration Committee will be for 3 years with a new member added each year. The first committee will be composed of R. David Evans (CAS), Kristen Johnson (CAHNRS), and Brian Lamb (CEA), Stephanie Hampton (CEREO) and Steven Stehr (Political Science). The role of the committee will be to guide the administration of the certificate, evaluate new course offerings and the relevance of the currently proposed courses, liaison with the instructors of the approved courses, work to coordinate the course offerings so they are available on time and without overlap, and to assess the effectiveness of the program. Finally the committee will review any requested exceptions or substitutions to the proposed coursework in cases in which significant student issues have arisen (it is expected that very few substitutions will be approved). The contact person for the certificate program will be the committee chair.

The NSF NSPIRE grant provided resources for a trip to Washington DC for each cohort. This trip was exceptionally effective in enhancing student skills in communication and providing more depth to their understanding of the role of science in policy making. It also created a significant network of people that the NSPIRE students and faculty had to find appropriate fellowships for students. The participating faculty and CEREO are working with the WSU Foundation and applying for competitive grants to obtain funding to maintain this important learning experience.

Requirements

- Admission to the certificate program requires the approval of the student's graduate committee and that a student be in good standing
- Students must earn a minimum of a B grade in all courses to earn the C-NSPIRE certificate.
- The capstone experience is the final part of the certificate and students will not be allowed to complete that requirement out of sequence.
- C-NSPIRE students will be expected to take advantage of relevant seminars across campus and interactions with seminar speakers to assist in building personal networks. Students will also be encouraged to attend and present information at brown-bag discussions regarding research and policy activities on campus.

6. **Advertisement**

The C-NSPIRE certificate will be advertised through the participating faculty, through the current NSPIRE website, with the Graduate School and through CEREO.

7. Assessment

We will create an assessment plan in consultation with the participating colleges and the graduate school that reflects current assessment protocols at WSU. Because the certificate is proposed to exist across colleges, and because we have the support of all of the colleges, we wish to create an assessment plan that is acceptable to all. As a part of the assessment plan discussions with the student and their advisor will occur. Of particular importance is the preparation for the capstone experience. In some cases, particularly those associated with a policy internship, the person who supervised the intern will be contacted and a general discussion of the student's performance will occur. In the event a student presented a paper at a meeting, the depth of understanding demonstrated through the presentation of the paper will also be used.

8. Appendix documents

Supporting letters from:

Dr. R. Mittelhammer and Dr. K. Kidwell, CAHNRS
Dr. D. Dewald, CAS
Dr. D. Field, CEA