

Indiana State University
Unbounded Possibilities (UP)
Concept Paper Routing Form

This routing form should be submitted with concept paper and seed funding supplement to the Office of Sponsored Programs. Materials (including a pdf scanned version of this form) can be submitted electronically as an email attachment to ISU-UP@mail.indstate.edu (after 3/29; email account still being set up) or via hand delivery anytime before deadline to Erickson Hall room 511. Deadline for submissions is 4:30pm on March 31.

Project Title:

Center for Environmental, Mathematical & Evolutionary Epidemiology CEEME

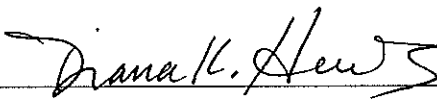
Requested category for funding:

Academic Discipline/Department
(participants in a proposal limited to a singular discipline/department)

Cross-Disciplinary Collaboration
(participants in a proposal that crosses traditional disciplinary or institutional boundaries)

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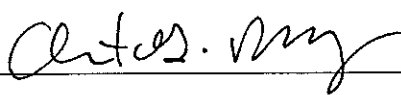
This application is complete and accurate to the best of my knowledge.

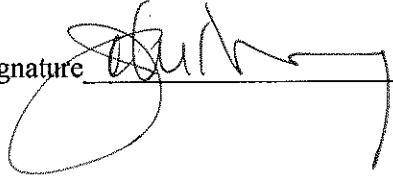
Signature:  Date 30 March 2011

Co-Director (1) Signature  Date 3/30/2011

Co-Director (2) Signature _____ Date _____

Chair and Dean Signatures: I am aware of this proposal as conceptually envisioned.

Department Chair Signature  Date 3/30/11

Dean Signature  Date 3/31/11

Concept Paper # 11-21 (assigned by OSP)

**TITLE: Center for Environmental, Mathematical & Evolutionary Epidemiology (CEEME)
DRAFTING GROUP PARTICIPATING FACULTY**

Diana Hews, Associate Professor of Biology, *College of A&S*

Qihao Weng, Professor of Geography, *College of A&S*

Kathleen Dannelly, Associate Professor of Biology, *College of A&S*

Jennifer Latimer, Assistant Professor of Geology, *College of A&S*

Steve Wolf, Associate Professor of Chemistry, *College of A&S*

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SUMMARY. The Center for Environmental, Mathematical & Evolutionary Epidemiology (CEMEE, pronounced “see-me”) has, at its core, an emphasis on the *environment* - most broadly defined- and to *mathematics* and *evolution* and their relationships to *epidemiology*. One definition of epidemiology is the *study of patterns and causes of disease and other health events in the community*. At its core is an analytic computational approach to assessing spatial and temporal patterns of disease and all aspects (societal, biological, etc.) that affect transmission, risk, and outcomes. Many human health challenges stem from anthropogenic changes to our environment - industrial pollution, agricultural practices, unwitting use of toxins in homes - are all examples [10, 11, 13]. Success in facing the challenges of emerging infectious diseases (HIV, MRSA) and diseases associated with contamination will require a deeper appreciation of evolution, especially as it relates to evolution of virulence, evolution of antibiotic resistance, and evolution of homeostatic mechanisms related to development and to immune system function and health. Success also require more successfully integrating teaching and research in these disciplines [6, 7, 8], and gaining a better understanding of how changing environments impact living organisms and generate ecosystem-mediated human health impacts [10, 13,14].

Center Activities - Under the guidance of two Co-Directors, faculty associates, and with help from graduate assistants, the CEMEE will facilitate experiential learning and community engagement by coordinating research around several multi-year Foci. It will coordinate inclusion of this research in courses and experiential learning projects. Multiple teams will examine a particular CEMEE Focus, each from their discipline-specific perspectives. Teams will integrate their activities in multi-team external grant proposal submission and workshops. The CEMEE will sponsor two Visiting Scientist Lecturers each semester, to speak both to the University, the medical communities on their research related to a CEMEE Focus, and to the general public.

1. ADVANCING INSTITUTIONAL DISTINCTION & SOCIETAL NEEDS. A number of “emerging diseases” challenge society. Often such emergences are associated with degradation of the environment. Some diseases are infectious (West-Nile virus, Lyme disease, malaria, community-associated methicillin-resistant bacterial infections). Others are associated with alterations in developmental programming, due to adverse environmental exposure (environmental endocrine disruptors [8, 15] and cancers due to agricultural pesticide and herbicide use [13]; ground water contamination; lead poisoning). Education about these challenges and research into the pattern and causes of the health disorders is needed [10,13,14]. Hence, ISU would capitalize on its programmatic developments for training health professionals, and in its graduate programs in the sciences, by having a Center devoted to research and education in understanding the patterns and causes of health challenges facing populations in Indiana.

2. CONTRIBUTIONS TO THE ISU VISION AND MISSION. The CEMEE would better prepare pre-medicine and pre-health professionals, basic biologists and environmental scientists in understanding the importance of an integrative approach to health, which includes applying

knowledge from environmental and evolutionary perspectives to help solve such human health challenges [13,14]. For example, CEMEE and associated faculty will enhance courses, experiential learning, and community engagement opportunities that will provide future health practitioners with a more grounded understanding of how evolutionary processes affect health (e.g. evolution of pathogens and pathogen virulence; evolution of the HIV virus; evolution of antibiotic resistance, see [12]), and a richer understanding of how local environmental challenges are impacting people living in west-central Indiana. Basic scientists would be better informed about the connections between environmental and wildlife health and human health [10, 11, 12]. By participating in CEMEE-connected courses and experiential learning projects, students will become members of a community of learners that is committed to understanding the environmental health challenges faced by west-central Indiana. Some tangible links to the Wabash valley community are the facts that children have lead poisoning, that citizens cannot eat fish from the Wabash because of toxic metals, that soils a few blocks from ISU are contaminated with toxic metals requiring remediation, that IDNR state fishing areas have toxic sediments, and that agricultural and industrial compounds [15] can dramatically affect developing fetuses.

The interdisciplinary nature of the CEMEE is a major strength. A report by the National Academies of Science [7] predicted the need for those working in biology -- in tandem with those in physical, computational, and earth sciences as well as mathematics and engineering -- to tackle four pressing issues: sustainable food production, the ecosystem, biofuels production, and human health. Many of these themes intersect with the core CEMEE mission. The CEMEE mission would align with an *ISU Core Value, Stewardship*. Students would be exposed to and learn about real-world examples of how individual behavior and societal practices are connected to some environmental and human health consequences. Connections to social responsibility and Environmental Justice can also be strengthened via interaction of courses in Economics with some CEMEE-based projects. *Hence, the CEMEE would align closely with the ISU VISION and MISSION of combining strong undergraduate and graduate education with a focus on community and public service. Further, by its interdisciplinary nature, the CEMEE would provide concrete foci around which to integrate teaching, research, and creative activities that would engage and challenge students in their preparation to become productive citizens..*

3. ALIGNMENTS WITH ISU STRATEGIC PLAN

ISU GOAL 1: Increase the number of students taking advantage of the educational opportunities at Indiana State University, and assist all those attending to realize their educational goals. The CEMEE would aid enhancing ISU’s growing distinction in the training of health and environmental professionals, because of the real-world focus on current challenges. CEMEE would have great potential to increase student enrollment in CEMEE-related programs.

ISU GOAL 2: Advance experiential learning to where all ISU students have a significant experiential learning experience within their major. The integration of real-world projects into course content, and the coordination of research around the CEMEE foci would significantly contribute to the experiential learning opportunities of undergraduate and graduate students in CEMEE-associated courses and research.

ISU GOAL 5: Expand and diversify revenue sources to enhance the University's ability to fulfill its teaching, research and service mission. Several aspects of the CEMEE focus could be leveraged to increase the likelihood of success in seeking external funding. The doctoral graduate programs in key departments related to CEMEE will allow for leveraging this expertise for greater external funding. Nationally, there is a dialogue about “stemming the tide” of declining abilities in STEM disciplines in the U.S. [9]. Both the National Science Foundation and the

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National Institutes of Health have designated funding efforts to improve STEM education [2]. Two recently articulated investment priorities of the National Science Foundation [2] are to: 1) “prepare a diverse, globally engaged STEM workforce”, and 2) “Integrate research with education”. NSF also has a funding mechanism to improve training in the intersections of biology and mathematics [2]. The NASA has funding programs in Applied Sciences [4], one of which focuses on Public Health and Environmental Health. The NOAA has a several funding programs [5] on water resources and quality, aquaculture and aquatic invasive species, agricultural pollution and lake health. The USDA has two strategic goals -and parallel funding opportunities [3]- related to the CEMEE focus: Strategic Goal 5 -Improve the Nation’s Nutrition and Health, and Strategic Goal 6 - Protect and Enhance the Nation’s Natural Resource Base and Environment. Relevant goals in the EPA’s Strategic Plan [1] include: Goal 2, Protecting America’s Waters; Goal 3, Cleaning Up Communities and Advancing Sustainable Development; Goal 4, Ensuring the Safety of Chemicals and Preventing Pollution. The EPA Plan also introduces “cross-cutting strategies that set expectations for changing the way EPA works in achieving its results”, and three strategies relevant to the CEMEE mission are: 1) Expanding the conversation on environmentalism; 2) Working for environmental justice and children’s health; 3) Advancing science, research, and technological innovation.

ISU GOAL 6: *Take measures to enhance the University's ability to recruit and retain great faculty and staff in order to realize its goals and fulfill its mission.* The existence of the CEMEE would increase the likelihood of attracting and retaining scientists and health professionals in the CEMEE disciplines. Further, the doctoral programs in Biology, EES, and Psychology facilitate attracting quality faculty, as would the programmatic developments in the College of NHHS.

4. NATURE OF THE COLLABORATION. Four faculty hires (examples listed below) will strengthen the substantial faculty expertise in CEMEE-related disciplines.

*a. Dept of Applied Health Sciences (NHHS). NEW HIRE: **Mathematical Evolutionary Epidemiologist w focus of emerging diseases or cancers** current expertise: environmental epidemiology (air pollution) E Bermudez; S Ferng-Kuo.*

*b. Dept of Biology (CAS) NEW HIRE: **Host-parasite interactions (e.g., genetics of MRSA or HIV study; host-gene interactions rabies)** Current expertise: Biological Modeling (W Mitchell); Biostatistics (G Bakken); Cancer cell biology (A Albig); Immunology, DNA vaccines (S Ghosh); Bacteriology/MRSA (K Dannelly); Genomic analyses (G Stuart); environmental endocrine disruptors, Stress physiology (D Hews, G Bakken); Wildlife population health assessment (R Gonser, S Lima, J O’Keefe P Scott, E Tuttle).*

*c. Dept of Earth & Environm. Systems (CAS) NEW HIRE: **Water resource management; e.g agricultural pollutants; human-environment interactions.** Current expertise: GIS of Disease (Q Weng); bioarchaeology, health & disease (S Phillips); Environmental geochemistry (S Brake); Riverscape, remote Sensing (S Berta); Medical geology, environmental geochemistry (J Latimer); environmental science; GIS (S Aldrich); Soil, biogeography (J Speer).*

*d. Dept of Chemistry & Physics (CAS). NEW HIRE: **Environmental toxicologist (e.g. pesticides/herbicides; environmental endocrine disrupting compounds)** Current expertise: environmental chemistry (S Wolf), natural products analysis (R Fitch), structural bioinformatics (J Inlow), organometallic chemistry (L Rosenheim).*

*e. Other Departments: **Psychology** (Statistics; Counseling; Cognitive disorder research); **Math & Computer Science** (Modeling; Math education); **Nursing** (patient care).*

f. Other Organizations: IU-School of Medicine-Terre Haute; Rural Health Initiative Collaborative; RiverScape; Rose-Human Institute of Technology; Wabashiki FWA (IDNR).

5. PLAN FOR USE OF FUNDS AND OUTCOMES

Budget Estimate: \$1,000,000 for 5 years

a. New Faculty for core CEMEE disciplines

- \$75,000 Applied Health Sciences new hire (salary + benefits: \$60,000) and a \$15,000 budget for start-up, annually. (Years 1-3. NHHS responsible for remaining years' budget)
- \$75,000 Biology new hire (salary + benefits: \$60,000) and a \$15,000 budget for start-up, annually. (Years 1-3. CAS responsible for the remaining years' budget)
- \$75,000 EES new hire (salary + benefits: \$60,000) and a \$15,000 budget for start-up annually. (Years 4-5. CAS responsible for the remaining years' budget).
- \$75,000 Chemistry new hire (salary + benefits: \$60,000) and a \$15,000 budget for start-up, annually (Years 4-5. CAS responsible for the remaining years' budget)

b. Co-Director support

- \$20,000 Course reductions and summer stipends for CEMEE co-directors, annually. Two individuals receive \$10,000 each.
- Hews and Weng, for example, will assume this role for the first 2-3 years. The new faculty hires in the Applied Health Sciences and Chemistry Departments would take over those course reductions / summer stipends for the remaining 2-3 years.

c. Experiential learning & community engagement support

- \$11,400 Stipends for SURE (Summer Undergraduate Research Experiences), 3 students per annum each at \$3,800 (Stipend and summer benefits), annually.
- \$14,600 Stipends for Graduate Assistants. \$10/hour, total 1460 hours, annually, to assist the Co-Directors in coordinating CEMEE efforts (e.g. web site design, maintenance, and Center operations).
- \$4,000 annually for Visiting Scientist Lecture Series, 4 speakers per year.

Annual \$	Years	5-yr total	Purpose
\$75,000	3	\$225,000	Applied Health Sciences hire
\$75,000	3	\$225,000	Biology hire
\$75,000	2	\$150,000	EES hire
\$75,000	2	\$150,000	Chemistry hire
\$20,000	5	\$100,000	stipends for two CEMEE Co-Directors
		<u>\$850,000</u>	<u>Subtotal - Salary, Benefits, startup</u>
\$11,400	5	\$57,000	Undergraduate SURE Stipends
\$14,600	5	\$73,000	Graduate assistantship
\$4,000	5	\$20,000	Visiting Scientist Lecture series
	other	<u>\$150,000</u>	<u>Subtotal - Experiential Learning Support</u>
		<u>\$1,000,000</u>	<u>TOTAL</u>

Anticipated CEMEE Benchmarks are described in **Table 1**.

TABLE 1 Measureable Outcomes and Benchmarks

- Hire the first 2 CEMEE-associated faculty members (Year 1) & graduate students (Yrs 1,2)
- Establish CEMEE Foci, establish multi-disciplinary teams, coordinate research projects and learning plans (Yrs 1-5)
- Hire the remaining 2 CEMEE-associated faculty (Yr 3)
- Increased external grants submission (Yrs 1-5) and awards (Yrs 3-5) to CEMEE faculty
- Increased recruitment to ISU via outreach (web site, community involvement, etc) (Yr 3)
- Increased student retention in science, science education & health sciences (assess in Y 5)

Citations & Agency Abbreviations

Federal Agencies

EPA	Environmental Protection Agency
NASA	National Aeronautics and Space Administration
NIEHS	National Institute of Environmental Health Sciences (NIH)
NIH	National Institutes of Health
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
USDA	US Department of Agriculture

State Agencies

IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IDPH	Indiana Department of Public Health

Citations

1. <http://www.epa.gov/planandbudget/strategicplan.html>
2. <https://www.uvm.edu/~tri/pdf/NSF-InvestmentPrioritySummary.pdf> and <https://www.uvm.edu/~tri/pdf/NSF-StrategicPlan2006-11.pdf> and <http://commonfund.nih.gov/arra/stem.aspx>
3. <http://www.ocfo.usda.gov/usdasp/usdasp.htm>
4. <http://appliedsciences.nasa.gov/ApplicationAreas-PublicHealth.php>
5. http://www.climate.noaa.gov/cpo_pa/sarp/
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7. Committee on a New Biology for the 21st Century, NRC. 2009. *A New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution*. National Research Council of the National Academies. The National Academies Press. Washington, D.C.
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9. D'Orio, W. 2010. *Reversing STEM's Slide*. Public Purpose. Summer 2010 Issue.
10. Merchant, J.A. 2011. Advancing industrial livestock production: health effects, research and sustainability. *Epidemiology* 22(2):216-218.
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12. Stearns, S.C. and Koella, J.C. 2008. *Evolution in Health and Disease*. Oxford University Press.
13. <http://www.who.int/globalchange/en/> and http://www.who.int/globalchange/environment/ecosystem_assessment_large.jpg
14. <http://www.aghealth.nci.nih.gov/>
15. <http://www.niehs.nih.gov/health/topics/agents/endocrine/index.cfm>

CEMEE - SEED MONEY USE for Developing a Full Proposal - Summer 2011

We plan to have a workshop (one day) to bring together experienced consultants, potential collaborators, and faculty associates. We would focus on topics that include: 1) effective structural organizations for the CEMEE, 2) funding strategies, 3) effective outreach mechanisms, and 4) educational missions.

Possible Consultants

Prof. Emolio Moran, IU-Bloomington. Over the decades, he secures tens of millions of dollars from NSF and NIH, focusing on the studies of environmental issues from the perspective of ecological anthropology, and also has a great appreciation of various spatial analytical methods. Notably, he secured five-year funding to establish the Center for the Study of Institutions, Population & Environmental Change. <http://www.indiana.edu/~anthro/people/faculty/moran.html>

Potential Out-of-State Collaborators

1. NASA Marshall Space Flight Center: Among all NASA facilities, it has secured most funding in public and environmental health. Dr. Q. Weng visited in 2009 its Global Hydrology and Climate Center as a senior fellow, and thus has established a link.

2. Department of Epidemiology, University of Alabama at Birmingham. This Department has a national reputation in the field of epidemiology. Dr. Weng has contacts with a doctoral candidate (and his advisor), who has secured NSF funding to study health effect of air pollution in Beijing, and has a collaborative relationship with the Marshall Space Center.

3. Louis J. Guillette, Jr., Professor of Biology, University of Florida, and Professor of Obstetrics and Gynecology, Medical University of South Carolina. specialist on environmental endocrine disrupting compounds; wildlife and human health effects of alteration in gene expression and gonad development. Has worked with Dr. D. Hews.

4. Frederick vom Saal, Endocrine Disruptors Working Group, University of Missouri-Columbia, Division of Biological Sciences. A founding member of the ED Working Group at UM-C and is a national leader in EDC research. member of a NIH and EPA working groups on EDC policy and funding priorities.

5. Sigrid Economou, Center for Disease Control, who has been a collaborator of Dr. Weng, is the Project Lead of CDC WONDER, is a system for disseminating Public Health data and information, and who also has assisted with the development of other systems for secure surveillance and analysis at CDC.

Other Possible Collaborators

- *Daniel Doerge, Research Chemist, Division of Biochemical Toxicology, National Center for Toxicological Research, US-FDA.* Biochemical mechanisms for thyroid toxicity. Biological effects of soy isoflavones. analysis of environmental toxicants. Trace level determinations of oxidative and carcinogen-derived DNA adducts.
- *Deodutta Roy, Professor Dept of Environmental Health Sciences, University of Alabama-Birmingham.* Assessment of role of environmental chemicals with estrogen-like activity in the etiology of human cancers and reproductive health problems.
- *Erik Hofemeister, (PhD Immunology & Infections Diseases; and DVM), Veterinary Medical Officer, National Wildlife Health Center, USGS.* Zoonotic diseases including tick borne diseases such as Lyme Disease; Human granulocytic ehrlichiosis and Babesiosis; Mosquito vectored diseases such as West Nile virus.
- *Hon Ip, Ph.D Microbiologist, Virology Laboratory National Wildlife Health Center, USGS.* Microbiology, Molecular biology, Wildlife Disease, Emerging Disease, Avian influenza, Parasitology.