Term Information

Effective Term	Spring 2014

General Information

Course Bulletin Listing/Subject Area	Biology
Fiscal Unit/Academic Org	Introductory Biology - D0326
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1109
Course Title	The Nature of Sustainability
Transcript Abbreviation	Sustainability
Course Description	Students will gain a better understanding of sustainability by using insights from biology, physics, chemistry, and economics to develop proposed policy statements with an emphasis on the history and nature of science. The case study-policy theme emphasizes interplay between science, technology and society.
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week, 7 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture, Recitation
Grade Roster Component	Recitation
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites

Exclusions

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0101
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Quarters to Semesters

Quarters to Semesters	New course
Give a rationale statement explaining the purpose of the new course	Biology 1102 variant
Sought concurrence from the following Fiscal Units or College	

Requirement/Elective Designation

General Education course:

Biological Science

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- See attached.

Content Topic List

- Nature of Science
- Disease
- Biodiversity
- Evolution
- Stem Cells & Cloning
- Cancer
- Nutrition
- Genetic Modification
- Climate Change
- Public Policy

Attachments

- Biology 1109 GE Assessment plan.docx: GEC Assessment

  (GEC Course Assessment Plan. Owner: Eakins,Barbara Ann)
- BIO 1109 Syllabus REV 8_13.docx: 1109 Syllabus - Revised

  (Syllabus. Owner: Eakins,Barbara Ann)
- 1109 Rissing responses.docx: Rissing Responses

  (Other Supporting Documentation. Owner: Eakins,Barbara Ann)
- 1109 Fiksel et al 2012 Sustainability.pdf: Support for Responses

  (Other Supporting Documentation. Owner: Eakins,Barbara Ann)

Comments

- See 12-5-12 e-mail to B. Eakins. *(by Vankeerbergen,Bernadette Chantal on 12/05/2012 12:15 PM)*
- Course Title: The Nature of Sustainability

Transcript Abbreviation: Sustainability

Course description: Exploration of contemporary issues in biology; topics may include evolution, disease, genetics, stem cells & cloning, nutrition, biodiversity, climate change, and biotechnology.

Content topic list: REMOVE sex & gender and addiction, ADD nature of science, public policy, biodiversity, genetically modified organisms *(by Misicka,Matthew Alan on 11/21/2012 02:36 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Eakins,Barbara Ann	11/21/2012 02:05 PM	Submitted for Approval
Revision Requested	Misicka,Matthew Alan	11/21/2012 02:36 PM	Unit Approval
Submitted	Eakins,Barbara Ann	11/21/2012 02:50 PM	Submitted for Approval
Approved	Misicka,Matthew Alan	11/21/2012 02:53 PM	Unit Approval
Approved	Hadad,Christopher Martin	11/23/2012 01:31 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	12/05/2012 12:15 PM	ASCCAO Approval
Submitted	Misicka,Matthew Alan	09/11/2013 10:00 AM	Submitted for Approval
Approved	Misicka,Matthew Alan	09/11/2013 10:02 AM	Unit Approval
Approved	Hadad,Christopher Martin	09/11/2013 10:39 AM	College Approval
Pending Approval	Hanlin,Deborah Kay Hogle,Danielle Nicole Jenkins,Mary Ellen Bigler Nolen,Dawn Vankeerbergen,Bernadette Chantal	09/11/2013 10:39 AM	ASCCAO Approval

Biology 1109 – What is the Nature of Sustainability? – Spring 2013

Dr. Steve Rissing, Professor; rissing.2@osu.edu (best contact method); 688-4989

Lecture: M, W, F (3 x 55 min); Recitation 1 x 110 min
Text Required: *The New York Times* (subscription recommended)
Optional: Any recent college-level, introductory biology textbook (or web access)
Prerequisites: While no prerequisites exist, I recognize that all recent high school graduates have completed three years of science, usually including biology and have passed some form of state high school graduation examination. This course builds on that foundation (and that of BIO 1101 or its equivalent, if you have taken it) and does not repeat it.
Course Objectives: I have designed this course to meet the needs and interests of college students who have majors outside the biological sciences. The course presents the science of biology and related fields that bear on sustainability issues. I employ processes of discovery and inquiry to develop student-authored public policy positions on aspects of sustainability.

Consistent with this view of science as a process of discovery and application, BIO 1109 emphasizes student discovery of basic biological and related information, facilitated by lecture, and then applied in group and individual development of policy suggestions on each topic raised (see lecture schedule below.) I will use a "case study" approach, examining a few topics in sufficient detail to permit development of policy recommendations for each topic. This approach is also consistent with OSU's General Education (GE) Curriculum guidelines (see box); most students enroll in BIO 1109 to meet these guidelines. (From: http://gec.osu.edu/breadth.cfm)

General Education Curriculum Natural Science Goals & Objectives
We have developed this course and its approach to fulfill the following GE Natural Science goals and objectives (copied from the OSU GE course list):

Goals/Rationale: Courses in natural sciences foster an understanding of the principles, theories and methods of modern science, the relationship between science and technology, and the effects of science and technology on the environment.

Learning Objectives (*emphases* added):

1. Students understand the basic facts, principles, *theories and methods of modern science*.
2. Students learn key events in the *history of science*.
3. Students provide examples of the *inter-dependence of scientific and technological developments*.
4. Students *discuss the social and philosophical implications of scientific*

I hope my students will gain a better understanding of sustainability by using insights from biology, physics and chemistry, and economics to develop proposed policy

statements. I will emphasize the history and nature of science. The case study-policy theme emphasizes interplay between science, technology and society. This is the last science course many of you will take before joining the elite rank of college-educated citizens; the staff and I have designed this course with that opportunity and responsibility in mind.
Rather than concentrating briefly on a large number of topics, we will focus on five major areas of science that raise particularly perplexing public policy issues as follows:

COURSE THEMES

1. *Science & Public Policy I (introduction):* What biological insights does a scientifically literate American need to know?
2. *Breast Cancer:* Can we apply BIO101's "Genotype + Environment = Phenotype" insight to understand, predict and prevent breast cancer? How? Can production and release of environmental estrogens and correlated increase in breast and other cancers be long-term sustainable?
3. *Stem Cell Research:* Stem Cell research may save your life; why not do it? Can stem cell-based therapies provide a long-term sustainable route to global public health? Is this the best use of health care funds?
4. *Genetically Modified Organisms:* Can GM Foods feed the world sustainably? Are there risks?
5. *Biodiversity:* It's more than polar bears and koalas, and it's the link between GMOs and medicine. So, why are we throwing it all away? Can we sustain our agriculture and the environmental services provided by the natural environment with current and predicted rates of extinction?
6. *Global Climate Change:* How do we impact the environment? What are our responsibilities and opportunities? Are current rates of global fossil fuel use sustainable in light of climate change predictions and effects?
7. *Science & Public Policy II (coda):* What role does/should science play in setting public policy? Can we sustain sufficient public understand of an increasingly complex and technical world to form reasoned, public policy?

ASSIGNMENTS

Assignments focus on development of public policy on topics related to the nature of sustainability. Specifically, I have employ exercises to permit students to translate insights into current policy issues based a level of scientific understanding of any college graduate today. In this information age, students can access specific, technical details of a policy issue easily. We ask how to use that access to form reasonable, effective policy alternatives within the larger processes of a modern democracy. I intend the course and its exercises for soon-to-be college graduates who recognize the opportunities and responsibilities in this process.
I employ the device of college students who spend an academic term working on the staff of a member of Congress who prepare reports on current issues and the policy options available. In real-life, interns use information available from data repositories (including The Library of Congress) and from expert testimony in hearings to prepare policy statements and positions. Course lectures and guest presentations serve this function in our class. Each policy statement for each issue addressed includes the following:

4	Problem Statement (1 page maximum; group)	40 points
4	Option Statement (2 page maximum; individual)	50
4	Preferred Policy & Contrary Statements (2 pages; group)	60
		150/policy

In addition to the above, a brief lecture exercise (done cooperatively, or in some cases, individually) will generate 5 points per class meeting. Weekly New York Times exercises generate 10 points each, and recitation exercises generate 20 points each. The final grade is based on the following distribution of points earned by participating students:

Five policy statements at 150 points each	750 points
Forty lectures activities at 5 points each	200
Fourteen New York Times assignments at 10 points each	140
Eight recitation activities at 20 points each	160
SALG & other surveys	25
	~1275

The final grade depends on the percentage of total points you earn divided by the number of points possible (~1275). The grade scale is the standard one for OSU ($92.9 < A \leq 100$; $90 \leq A- < 93$; $87 \leq B+ < 90$; etc.); while I do not round scores for individual assignments, I carefully evaluate all scores and grades based upon them at the end of the term. I will never curve components or grades down; I reserve the option to curve them up.

COURSE TOOLS

1. **Carmen** (http://carmen.osu.edu); Check Carmen regularly for relevant news items, course schedule changes, assignment guidelines, copies of images used in lecture, supplemental readings, etc.
2. **Collaborative Learning**: Working in heterogeneous teams provides a more effective learning experience; I will employ this approach.
3. **Center for the Study and Teaching of Writing** (http://cstw.osu.edu); The Writing Center at CSTW offers free help with writing at any stage of the writing process. It also maintains a resources page with writing handouts and web links.

EXPECTATIONS AND ASSURANCES

Students with Disabilities: I have tried to use insights of Universal Design for Learning in this course; the course staff and I routinely accommodate a number of students with varied disabilities. Should any student need any accommodation, please contact the Course Coordinator, Mr. Adam Andrews or Dr. Rissing.

Sustainability: We will consider "ecological footprints" during the study of global climate change and related issues. I am trying to reduce the footprint of BIO 1102 and encourage you to do the same. Lecture images and other course materials are provided digitally; I encourage you to store and use them in that form. Please share with course staff and me ideas on how we might further decrease the ecological impact of the course.

Absences: Many written assignments are completed in lecture/recitation as part of a discussion. You can only earn points if you are present. Having someone else place your name on an assignment when you not there violates the OSU Code of Student Conduct (see below.) If you must miss a class session (for a university sanctioned event) or miss because of illness, be prepared to provide documentation.

Academic Misconduct: OSU has a strict code of academic misconduct that requires us to report any and all cases of suspected misconduct (e.g. plagiarism in written assignments, etc.) to the OSU Committee on Academic Misconduct for adjudication. We have to adhere to this policy. You should understand the nature and consequences of plagiarism (and of anti-plagiarism sites like www.turnitin.com).

Section Changes: Make recitation section changes at the Center for Life Sciences Education office from 8:00-4:00 in Jennings 260. The staff there has up-to-the-minute information on space availability in the recitation section you may want to add.

Late Assignment Policy: 10% will be deducted from the graded assignment for each day past the due date that an assignment is late. After five (5) working days, no late assignments will be accepted. Exceptions may be made once with appropriate documentation (note from health care practitioner, employer, etc.).

A Word About Large Classes

This is a large class, but you are not a small part of it! To make our time together as valuable as possible, we all have to work hard at it. The following basic principles provide some guidelines:

Every student has the right to learn and the *responsibility* to not deprive others of that right
Every student is accountable for his or her own actions.

In order to get the most out of this class, please consider the following:

1. Attend all scheduled classes and arrive on time. Late arrivals and early departures disrupt class. If you must be late or leave lecture early, minimize the disturbance.
2. Do not read a newspaper or use your laptop during class; this distracts others around you.
3. Do not text-message during class; this also distracts people around you.
4. If you have trouble hearing in lecture because of distractions around you, quietly ask those responsible for the distraction to stop. If the distraction continues, please let us know.
5. Please remember to turn off your cell phone *before* it rings in class.

Lecture Schedule (Tentative)

NOTE: Dates are for 2013, when course was offered as BIO 1102

Week	Date	Lecture Questions	Recitation Activity
1	1/7	What to expect from this course; what is expected of me? What is scientific literacy?	Introductions; Writing sample; Grade norming exercise
	1/9	What is cancer and its frequency?	
2	1/14	Why is breast cancer frequency increasing?	Unintended effects of some compounds; Breast Cancer PS; NYT #1 & 2
	1/16	What does mitosis have to do with cancer?	
3	1/21	Martin Luther King Day (no class)	Breast Cancer OS Ethical Genetics; NYT # 3
	1/23	What environmental factors influence cancer?	
4	1/28	How do economists view cancer?	Breast Cancer PPS NYT# 4
	1/30	Why can't we find a 'cure for cancer'?	
5	2/4	What have we learned from 4000 yrs of GMOs?	GMO PS; Chapt Summ & disc #1; NYT # 5
	2/6	Who embraces new technologies first?	
6	2/11	How can we genetically manipulate organisms?	GMO OS NYT # 6
	2/13	Can we meet the worldwide demand for food?	
7	2/18	What is cloning?	GMO PPS Stem Cells PS; NYT # 7
	2/20	Why not just transplant organs?	
8	2/25	What are ethicists' concerns about cloning?	Stem Cells OS NYT # 8
	2/27	How would Darwin view cloning?	
9	3/4	Dr. Douglas Kniss, Guest lecture	Stem Cells PPS NYT # 9
	3/6	How many species are there?	
<= Spring Break =>			
10	3/18	Why/Why not preserve biodiversity?	Biodiversity OS; Chapt Summary #2; NYT # 10
	3/20	Which biodiversity should we preserve?	
11	3/25	Isn't extinction natural?	Biodiversity PPS; GCC PS NYT # 11
	3/27	Can we clone biodiversity?	
12	4/1	What/why is the carbon cycle?	GCC OS; Ecological Footprint; Sustainability Tour; NYT # 12
	4/3	Isn't CO_2 green?	
13	4/8	Are things really that different?	GCC PPS; NYT # 13 (Stnblty tour, rain date)
	4/10	How do economists view Global Climate Change?	
14	4/15	What is the role of science in a democracy?	Chapt Summary #3 NYT # 14
	4/17	What can other perspectives offer? (PANEL)	
15	4/22	What is the role of science in public policy?	No discussion sect
TBD		Final Exam (Project) due	

Biology 1109 GE rationale

Over the last decade, many have recognized the need for college graduates to become more "scientifically literate," and to have a better understanding of the area of "sustainability." At the same time, curriculum development perspectives emphasized development of formal reasoning, critical inquiry, and facility with basic scientific processes relevant to societal concerns. These goals fall within the realm of the OSU General Education Learning Goals, as evidenced by the OSU President's Council on Sustainability call in March 2009 for a GE course on sustainability ("support and encourage curriculum on sustainability and the development of a GEC class" [President's Council on Sustainability Annual Report to University Senate, 12 March 2009, target implementation date March 2010]). The course proposed here, the first, dedicated GE course option explicitly addressing sustainability as well as the pedagogical goals discussed above, comes in response to that call almost four years ago.

The course aligns well with GE Natural Science learning objectives; specific examples follow:

1. Students understand the basic facts, principles, theories and methods of modern science.
    a. Demonstrate Laws of Thermodynamics with energy conversions, biological and physical.
    b. Experiments conducted in the 1970's to reveal presence of cell signaling molecules (as basis for breast cancer and environmental estrogens)
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
    a. van Helmont's discovery of how plants gain mass (CO_2)
    b. Lyell's (and others) discovery of geological time (and its significance with respect to fossil fuels)
    c. History of Agriculture and subsequent interactions with discoveries by Mendel and then Watson and Crick
3. Students describe the inter-dependence of scientific and technological developments
    a. Discovery of the "Ozone Hole" with satellite imagery
    b. Role of particle physics in discovery of DNA replication
    c. Development of climate models with use of super-computers
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.
    a. GMOs to feed the world; world population growth
    b. CO_2 accumulation through industrial burning of fossil fuels
    c. The Laws of Thermodynamics: "There's no such thing as a free lunch."

Biology 1109 Assessment plan

GEC Learning Objective	Indirect Methods	Direct Methods
1. Students understand the basic facts, principles, theories and methods of modern science.	SALG	Grading rubric for the policy statements will include a subscore addressing this learning outcome
2. Students learn key events in the history of science and recognize that science is an evolving body of knowledge.	SALG	Grading rubric for the policy statements will include a subscore addressing this learning outcome
3. Students provide examples of the inter-dependence of scientific and technological developments.	SALG	Grading rubric for the policy statements will include a subscore addressing this learning outcome
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.	SALG	Rubric used in grading policy statements and New York Times assignments will have separate subscores addressing this learning objective

We will use specific subscores on the rubrics used to grade policy statements to evaluate GE learning objectives 1-3. For example, students must use basic facts, principles, theories and methods of modern science (LO #1) in their Option Statement. Learning objective 4 will be assessed by evaluating each student's ability to discuss social and philosophical implications and uses of scientific discoveries in their policy statements as well as the New York Times assignments for this course.

In addition, we will use the Student Assessment of Learning Gains (SALG), an instrument that has been extensively used in other Biology courses at Ohio State (including Biology 1102) to evaluate students' perceptions of the course as well as their self-assessment of whether they have met the GE learning objectives for this course. The SALG is described at the following website: http://www.wcer.wisc.edu/salgains/ftp/SALGPaperPresentationAtACS.pdf

Examples of SALG questions asked in a previous Biology 102 class:

As a result of your work in this class, what GAINS DID YOU MAKE in your UNDERSTANDING of each of the following? (1 = no gains, 2 = a little gain, 3 = moderate gain, 4 = good gain, 5 = great gain)

- How ideas from this class relate to those encountered in other disciplines
- How this class helps people address real world issues
- Articles in the media that discuss scientific findings
- How to think about a research question
- Historical aspects of biology
- Understanding the main concepts (basic facts, principles, theories and methods of modern biology)
- Understanding the interdependence between scientific and technological developments
- Understanding the potential of science and technology to address problems of the contemporary world
- Current and future significance of biology on society
- Scientific ethics and practices

Please comment on how this class has CHANGED YOUR ATTITUDES toward this subject.

What will you CARRY WITH YOU into other classes or other aspects of your life?

The indirect and direct measures of the GEC learning outcomes will be compiled by the instructor and Center for Life Sciences Education staff and reviewed with the course instructor, the course coordinator, and other CLSE staff. The expected level of achievement is:

- at least 75% of the students will perform satisfactorily (C work or better) on the policy statement subscores reflecting learning objectives 1-3
- 75% of the students will perform satisfactorily (C work or better) on the policy statement subscores and the New York Times assignment subscores having to do with learning objective 4
- a class average of 3.0 or higher on the SALG questions in which students self-evaluate how their understanding of the GE objectives has increased during the course

These scores would indicate that most students perceived at least “moderately” increased understanding of the objectives of the GEC and could demonstrate their learning in writing. Other questions on the SALG address additional course learning outcomes, course mechanics, *etc.*, and will be considered in making modifications to the course, if necessary. If the course assessments indicate that students do not meet the expected level of achievement of GEC learning outcomes, the instructor will modify the course in ways that will more fully address these learning outcomes.

Biology 1109 (new course; requesting Natural Science--Biological Science GE):
The Panel *did not take a vote* on this course.

Rissing response: The proposed BIO 1109 is not new and has been offered as BIO 102, an existing General Education course since 2002; for example, I attach a copy of the course from over one decade ago. Following a policy I introduced as the Director of the predecessor to the Center for Life Sciences Education, several different pedagogical formats for BIO 102 began in early 2000. I developed and have presented the case studies approach focusing on relevant topics, all dealing with society's dependence on the environment, while others retained the more narrow Human Biology (The Kidney, The Heart, The Liver, etc.) I processed a request to list these formats with different decimal numbers indicating these different perspectives in 2003, but that effort appears to have also stalled somewhere above my administrative level. Considerable student confusion occurred between the different BIO 102 approaches, and the decision was made to clarify this by designating the Case Studies, human-environment course (which I developed) as BIO 1109 as part of the semester transition.

The Panel had a number of questions or concerns, which I here list:
Sustainability is not addressed in the proposal. It is not clear how the topics in the proposal are linked to the theme of "sustainability." There is no definition of how the proposal views "sustainability." What does the proposer mean by that word?

Rissing response: I am a charter member in OSU's UCAT Faculty Learning Community on Sustainability Across the Curriculum which began in 2010; completing the transition of my old BIO 102 course into the proposed BIO 1109 shell formed the focus of my project in this effort. That interdisciplinary program decided that "sustainability" represented a broad swath of academic disciplines all dealing with long-term persistence of society—all of it—interacting with the environment. As such, a precise definition of sustainability can be counter-productive. The University Presidents' Statement on Climate Change and the OSU President's and Provost's Panel on Sustainability, on whose advisory committees I have been active, have taken the same approach. The four topics addressed at length in past and planned iterations of the course all facilitate learning of OSU's Natural Sciences General Education Learning Goals, specifically the interdependency of science and society. So, for example, advancement of general public health through STEM cell therapy likely cannot provide a sustainable option for public policy as long as it remains so expensive and difficult for the general public to understand, much less shape as policy in our democratic form of government. I have written extensively on these issues and used them to meet OSU's general education science goals for some time in my BIO 102 course. UCAT has cited me as one its "Champions of Teaching" because of my efforts on this course and its focus on sustainability.

To some extent, I use the development of a sense of the nature of sustainability as a task for my students to address on their own as they discover and discuss the issues I have chosen for this course.

Panel recommendation:
- Either: If content of the course is maintained, rethink title and course description (e.g.. course as

currently developed does not seem to address much sustainability, physics, or economics)

Rissing response: I appreciate the committee's explicit mention of physics and economics, both of which appear when appropriate in the course. Basic physics pervades the discussion of energy, including an entire period devoted to discussing/describing the physics and energetics of combustion of marshmallows. A recitation exercise and homework exercise on cap-and-trade alternatives explicitly introduces the supply-demand curve of economics and cost-benefit analyses. I have added these and other instances of both into the syllabus and course description.

- Or: If proposer wishes to maintain "sustainability" in title, provide justification for name and consider which changes in content would make this course more compatible with the topic of sustainability. In this case, the proposer will need to seek concurrences from the appropriate units around campus.

Rissing response: I believe the committee is employing a narrow definition of "sustainability" that, for example, does not reflect the excellent educational efforts on sustainability in Literature, the Humanities Institute, and Religious Studies. This narrow definition is not consistent with the OSU/UCAT Sustainability Across the Curriculum efforts or the draft OSU Sustainability Plan (which I have helped formulate as a member of several of its topical working groups). I am one of four faculty authors of a white paper on Sustainability posted on the President's Sustainability page and published recently (see attached); all of these discussions and applications of sustainability as they pertain to OSU embrace a broader definition and understanding of sustainability. As BIO 102 the course has focused on the natural aspects of sustainability (for example, the role of environmental estrogens on increasing the incidence of breast cancer—a non-sustainable trend—in the United States) for over a decade in order to meet the spirit and the letter of its designation as meeting the General Education requirement in the natural sciences.

Based on its preliminary analysis of the course as currently conceived, the NMS Panel believes this course would be a GE Natural Science—Biological Science course for BA-students only.

Rissing response: As Director of what is now known as the Center for Life Sciences Education, I have attended class sessions of most courses on this campus (and some of the regional campuses) that qualify as meeting the Natural Sciences General Education requirements. This class has—and has had for over a decade—all of the pedagogical rigor of virtually all of the courses I have ever reviewed. The course has—and will continue to have—explicit linkages to all of the General Education learning objectives, especially those above and beyond the one to know basic science content. Limiting it to BA students only misrepresents its rigor and ignores the recent advice of the new AgEcon major for its students to take this course when meeting their GenEd requirements.

Course form in curriculum.osu.edu: Intended rank: would this course really be intended for seniors?

Rissing response: This course is at least as appropriate for seniors (BA and BS) as any other BIO GenEd science course.

Editorial issues:

- Syllabus:
  - p. 1: Under "Course Objectives": "I have designed this course to meet the needs and

interests of college students who have majors outside biology" should be changed to "majors outside the biological sciences."

Done

- P. 2: Second paragraph: "... we will focus on four major areas of science." This statement is actually followed by 7 course themes. Clarify.

Rissing response: Reference to the schedule of lectures/class meetings indicates that five topics (breast cancer, GMOs, Stem cells, biodiversity loss, and Climate Change) receive heavy emphasis, while the other two (repeated for pedagogical effect) is limited. I was trying to be truthful in my description of the class for my students.

- P. 3:

Total points is presented as ~1275. However, sentence right underneath that refers to ~ 1250.

Corrected (point totals are tentative depending upon factors beyond instructor's control such as projector failure obviating in-class activity points).

Please clarify whether SALG and other surveys are included in the total.

It has been the policy of CLSE (to which I have objected) that the SALG is administered and generates a small number of points for response by students. This is the case for all BIO classes, not just mine.

Grading scale contains mistakes: e.g., A goes through 92.9 but 93 is the beginning of A-. 90 is both A- and B+. Better leave info in parentheses out (since sentence refers to standard grading scale).

This is not correct; I used an underlined "<" for "less than or equal to" and a non-underlined "<" for less than. This is common usage. A 90 can only be (and should only be a "B").

Disability statement should be replaced with approved language: see ASC syllabus template p. 13 https://asccas.osu.edu/sites/asccas.osu.edu/files/ASC_CurrAssess_Operations_Manual_2012-13.pdf

Rissing response: On campus and nationally, I have been quite active in meeting the needs of students with disabilities; I was co-PI on a successful NSF request ($1.25 M) on meeting the needs of students with disabilities, and I was the faculty representative to the ODS review committee two years ago. I find my disability statement and the comments I share with my students when I discuss this much more student-friendly than the template wording. However, I shall comply with this directive as soon as I find it; the link provided is dead.

Remove/replace reference to Biology 102 in next-to-last paragraph

Done

- GE rationale: Experiments conducted in the 1970s is listed as a point to justify expected learning outcome number 1 (pertaining to modern science). The issue is whether experiments conducted in the 1970s can be considered to be a part of "modern science."

The experiments referred to in my justification and apparently objected to by the committee deal with the discovery of cell-signaling molecules and their role in causing cancer. I include them explicitly in my course—and have done so for at least ten years—because of the extraordinary manner in which they display the reasoning power of scientific investigation and the manner in which science provides insights—here, the environmental triggers of cancer—to larger social issues. The extent to which such science may be modern or not is not relevant here. Indeed, this is an extraordinary example of the history of scientific thought and public policy.

I do not believe that the modernity of a powerful set of experiments performed in the 1970s constitutes a valid basis for rejecting my course number and title change. Besides, the example (taken from the most popular majors, introductory biology text on the market today) speaks to "*theories and methods*" of science. Like all good experiments, these are timeless. The topic is no more or less modern than the Laws of Thermodynamics which I mention just prior to these experiments in my justification.

- GE Assessment plan: The references to GEC should to be replaced with GE.

Done.

I will return Biology 1109 via curriculum.osu.edu in a minute to enable the proposer to address the points above.
Should you have any question about this feedback, do not hesitate to contact Harald Vaessin, Chair of the ASCC NMA Panel (cc'd on this e-mail), or me.

Sustainability at The Ohio State University: beyond the physical campus

Joseph Fiksel, Rick Livingston, Jay Martin & Steven W. Rissing

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Sustainability at The Ohio State University: beyond the physical campus

Joseph Fiksel · Rick Livingston · Jay Martin · Steven W. Rissing

Sustainability is not a problem, not something to be solved, but rather a vision of the future that provides us with a road map (Barlett and Chase 2004).

Introduction

The Ohio State University's main campus in Columbus, OH, USA is one of the largest in the nation, with over 50,000 students. Like many US universities, Ohio State University (OSU) has committed (www.presidentsclimatecommitment.org/) to work toward climate neutrality and to build sustainability considerations into the university's plans for campus growth. In 2009, OSU adopted a detailed Framework Plan (http://oneframework.osu.edu/) including measurable goals, design standards, and action plans to assure sustainable management of energy, materials, buildings, transportation, and infrastructure, consistent with current best practices. However, such efforts at managing physical campus operations will yield only incremental contributions to global sustainability; true leadership in sustainability requires more than operational improvements.

The authors were invited to participate in a faculty–staff advisory committee to help steer OSU's sustainability planning efforts. They concluded that OSU should take on the challenge of sustainability in the spirit of the university's historic educational mission, fully integrating environmental and social responsibility into the intellectual and social life of the campus. Beyond the physical operations, sustainability should be a vital thread interwoven into the fabric of the university, binding the institution to the multiple communities—local, regional, and global—that it serves.

The global challenges of sustainability include climate change, biodiversity loss, degradation and depletion of water supplies, population growth, lack of sanitation, and widespread poverty. These interrelated threats place intensifying pressure on natural and social resources; moreover, the complexity of these systems means that every solution has hidden consequences. It has become apparent that "business as usual" will not lead to global sustainability (Fiksel 2009). Leading scientists believe that we have already exceeded the "safe operating space" for humanity in three critical indicators—greenhouse gas emissions, nitrogen flows, and biodiversity losses. And the rate of change is accelerating—new materials, products, and processes are emerging faster than scientists can study their impacts. Incremental efforts by corporations and governments to reduce emissions and waste are inadequate, unable to offset the costs of economic growth in the developing world, let alone deliver a sustainable future[1]. Progress is further impeded by the lack of

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[1] As Oberlin's David Orr writes, in a report by the WorldWatch Institute, "the addition of only four new medium-sized coal plants anywhere in the world would eliminate the gains even if all U.S. institutions of higher education were to eliminate their carbon dioxide emissions entirely." "What is Higher Education For?" in Erik Assadourian, ed. *State of the World 2010* (Norton 2010).

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public understanding of complex sustainability issues and the persistence of denial even in the face of mounting evidence of global environmental change. Radical breakthroughs are necessary: not only accelerated technological innovation, but also expanded research in the field of sustainability science, improved data management and analysis tools, broad educational initiatives that create sustainability literacy, intensive public outreach and communication, and strong collaboration among governmental agencies at all levels, businesses, and civil society.

The Ohio State University is in an excellent position to help catalyze such breakthroughs. Cutting-edge research programs, a global reputation, extensive contacts throughout the world, a diversified undergraduate and graduate student population, ready access to instructional resources, a campus with economic and ecological footprints palpable at local and regional scales, and commensurate cultural and intellectual influence: by all measures, institutions like OSU have the capacity to exercise significant leadership. A strong and deliberate effort is needed to translate this potential into visible and effective action. Reducing energy consumption is a valid goal, but OSU's greatest impact on sustainability will be to inspire a new generation of global citizens through formal and informal educational efforts. Thus, sustainability planning at OSU should aim not just to reduce the university's environmental resource footprint and the associated costs, but also to increase society's capacity for understanding and responding to the above challenges, so that we can act as stewards of our collective destiny.

Figure 1 offers a systems view of possible pathways for OSU to exert a positive influence upon sustainability progress on its campus and beyond. Ongoing efforts at energy and operations management will yield immediate benefits for the regional environment. In addition, linking these efforts to sustainability education and research will result in a variety of broader benefits. Students participating in sustainability courses and associated projects will develop new skills that enhance their professional contributions. Likewise, OSU's innovations in the design of sustainable technologies and policy assessment tools will influence business and government practices throughout the nation and the world. Moreover, OSU's collaboration with external organizations in sustainability research and innovation will benefit the State of Ohio as well as the fast-growing economies where OSU maintains a growing international presence. These influences on global sustainability progress will far outweigh marginal gains achieved through improvements in campus operations.

To capitalize on these opportunities, the authors recommended the formation of a task force to develop a strategic plan for sustainability and appointment of a Chief Sustainability Officer, accountable to the President, and charged with coordinating sustainability activities across research, teaching, and university operations. The following sections describe in detail the original recommendations made in 2010, and the last section describes the progress that OSU has made since then.

Fig. 1 Systems view of "One Ohio State" Sustainability Framework. Increased sustainability of OSU facility operations not only will benefit the regional environment, but also will strengthen OSU's missions of education, research and outreach, exerting a broad influence on regional, national, and international sustainability practices in business, government, and academia

Education

OSU can leverage its campus sustainability efforts by integrating them with its educational mission. Students enter OSU with a basic sense of "personal virtue" about sustainability. For example, they may remember[2] to recycle aluminum cans once they are told. Higher education should build on such concrete[3] views to develop the reasoning skills that are expected of college graduates and responsible citizens. The sense of personal responsibility will expand to a broader scope of organizational and social responsibility, accompanied by the capabilities to take meaningful action.

Sustainability issues present OSU with compelling, interdisciplinary teachable opportunities. For example, OSU classes and laboratory exercises should link to campus sustainability initiatives, such as carbon footprint assessment and reduction. Indeed, sustainability education should reach every student if the university is to contribute to an informed and effective citizenry. As such, sustainability can provide a unifying theme for the university's general education curriculum, and can demonstrate the value of broad, interdisciplinary education, as opposed to a traditional "silo" model (Gee 2009).

[2] As in Bloom's Taxonomy of Educational Objectives.
[3] As used by Piaget.

Benchmarking with peer institutions has revealed many creative avenues for integrating sustainability education into the undergraduate curriculum. A diverse set of initiatives, driven by interested faculty and passionate students, has emerged at OSU. The following is only a partial list.

- Several collaborating colleges introduced a new, interdisciplinary undergraduate major in the autumn of 2012 called "Environment, Economy, Development and Sustainability".
- Many existing majors offer concentrations (e.g., "Environment and Society" in the Department of Geography offered by the Environmental History group).
- Minors offered include "Environmental Citizenship", "Environmental Engineering", "Ecological Engineering" and "Environmental Economics".
- The College of Engineering's Center for Energy, Sustainability, and Environment has proposed several graduate specialization options (e.g., Sustainable Systems Engineering).
- The Department of Agricultural, Environmental, and Development Economics offers a Ph.D. program in environmental economics and supports an Environmental Policy Initiative.
- The Center for Automotive Research sponsors seminars and student projects addressing sustainable mobility themes and has close ties with the automotive industry.
- The Fisher College of Business has established sustainability electives and a certificate option for both undergraduates and MBA students.
- The Environmental Graduate Studies Program offers Ph.D. students from many departments an opportunity to customize an interdisciplinary degree in sustainability.
- The Health Science Colleges have a robust array of curriculum initiatives rooted in impacting behavior (e.g., Center for Personalized Health, Institute for Behavioral Medicine Research).

Recommendations

Without necessarily prescribing a core curriculum, the university should initiate a concerted effort to weave a thread of environmental and social awareness throughout OSU campus life, making visible the systemic connections between the many dimensions of sustainability. We recommend that the task force create a *sustainability education committee*, in coordination with the Office of Academic Affairs, to (a) develop clear sustainability learning objectives and measurable assessments and (b) work with OSU administrators to explore the full spectrum of educational initiatives, as follows.

- Commission a comprehensive *inventory* of sustainability-related educational programs, graduate and undergraduate, offered or planned by OSU colleges and departments.
- Develop an overview of the goals, content, and potential linkages among these programs, and identify potential synergies with ongoing research and outreach activities (see below).
- Perform a baseline survey of sustainability literacy and educational needs for incoming students (see also Welcome Week recommendation under "Outreach" section below).
- Expand the sustainability-related content in the general education curriculum (GEC) by convening a working group of GEC faculty members and representatives of professional colleges. Provide this group with sufficient administrative resources, and charge it to:
  - Develop GEC-appropriate sustainability learning objectives (for examples, see Fig. 2) and assessments, and pilot test these in one or more classes.
  - Improve student recognition of the interdisciplinary nature of sustainability issues through various mechanisms such as:
    - Learning modules (e.g., cost/benefit analysis of personal and/or campus-related energy investment decisions)
    - Engagement in campus facilities management (e.g., "adopt a building" and analyze its resource consumption patterns such as energy use)
  - Determine trade-offs between the design of a new GEC required course vs. update of current GEC courses.
  - Introduce a sustainability pedagogy workshop series sponsored by OSU's University Center for the Advancement of Teaching.
- As a service to graduate students, develop a coordinating framework for the multiplicity of graduate education options in different colleges that include different types of "sustainability" content. Use this as a basis for proposing an integrative scheme for graduate education, such as an interdisciplinary graduate specialization, and evaluate its potential for a proposal to National Science Foundation (NSF)'s program in Integrative Graduate Education and Research Traineeship.
- Investigate cocurricular options for strengthening formal educational programs. Examples include:
  - Course projects highlighting efforts to improve sustainability of physical operations and their quantitative justification
  - Inclusion of an environment/sustainability theme as part of the First Year experience
  - Proposed campus sustainability themes for senior capstone projects, individual or team
- Investigate student life options to reinforce sustainability awareness. Examples include:
  - Improved coordination of student organizations (e.g., Net Impact (http://www.osunetimpact.org/), Save the Planet)

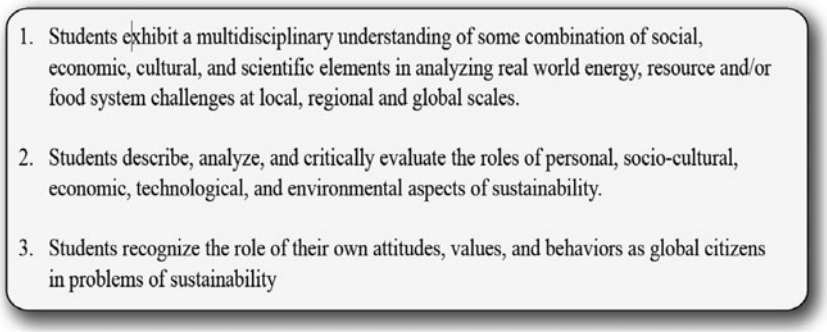

Fig. 2 Examples of undergraduate sustainability learning objectives (University Center for Advancement of Teaching (UCAT) 2011)

- Creation of an "eco-village" in the form of a sustainable micro-society on campus
- Planned events such as Earth Day activities and Sustainability Week

Additional opportunities are discussed further in the "Outreach" section below.

- Investigate expansion of service–learning options, including opportunities for students to participate in campus and community sustainability programs in collaboration with partners such as the Mid-Ohio Regional Planning Commission, the Ohio EPA, the City of Columbus, American Electric Power, and local school districts.
- Post building energy metering data on the web to facilitate analysis projects in courses
- Assign student teams to work on sustainability projects with OSU partner organizations
- Establish international exchange programs to foster global sustainability awareness

Research

As one of the leading research universities in the USA, OSU contributes multidisciplinary knowledge about sustainability science, technology, and human behavior. To achieve eminence, OSU should strive to apply this knowledge in two ways, discussed below. First, faculty research expertise should be channeled into enhancement of campus operations, since a "sustainable" campus should visibly investigate the conditions of its own sustainability. Second, OSU expertise should be applied to broader sustainability challenges at a local, regional, national, and international scale.

OSU Campus Sustainability Research The sustainability planning effort commissioned by OSU has already begun to collect data about a broad range of campus activities and impacts. Implementation of the plan will generate additional insights about physical and behavioral changes associated with sustainability initiatives. In particular, incorporation of sustainable design principles into campus construction standards and practices should result in measurable energy savings. Researchers in many colleges at OSU will be keenly interested in participating in these efforts, and could use the resulting data streams to develop and refine novel hypotheses about systemic sustainability. A variety of grassroots initiatives have already appeared that connect OSU research programs to ongoing campus enhancements, including the following:

- Research on improved management of food waste, including life cycle assessment, sponsored by the Energy Services and Sustainability Group
- Efforts to develop sustainable infrastructure, including completion of three rain gardens and the planned construction of a green roof and rainwater harvesting systems (http://sustainability.cfaes.ohio-state.edu/on-campus/green-horizons-at-ohio-state/)
- Studies of the energy use and efficiency of buildings on campus by student groups that have resulted in grants and physical improvements to reduce energy use
- Environmental restoration and renewable energy production initiatives taking place at OSU's agricultural research facilities
- Ongoing construction of a geothermal heating and cooling system for student dormitories (http://urds.osu.edu/whatsgrowingon/geothermal-well-systems)
- Plans to utilize the restoration of the adjacent Olentangy River as a learning laboratory with embedded research opportunities for multiple colleges

Recommendations

In both planning and implementation, every effort should be made to coordinate campus sustainability initiatives with ongoing and emergent research programs at OSU, and to multiply opportunities for developing new knowledge, refining methodologies, and experimenting with technological innovations. Examples of research opportunities include:

- Broadening of the collaboration between the Energy Services and Sustainability Group and faculty research initiatives with dedicated funding for campus research internships

- Integration of faculty knowledge and expertise into campus sustainability improvement initiatives (e.g., water reuse, treatment, and capture; green building technology; alternative energy systems; industrial ecology and by-product synergy; and bioproducts innovation)
- Application of integrative sustainability metrics (e.g., ecological footprint) to track the overall progress of OSU's sustainability initiatives over time, as opposed to merely tracking individual metrics (e.g., water, energy, and waste)
- Incorporation of campus incubators into applications for research grants (e.g., NSF sustainability programs, STEM education initiatives, engineering research centers)
- Collaboration across universities (e.g., Committee on Institutional Cooperation) to track, compare, and disseminate sustainability results under different campus conditions
- Introduction of a sustainability category into competitive Undergraduate and Graduate Research Forums where students deliver oral and poster presentations
- Collaboration with student organizations to communicate sustainability research activities and encourage involvement of students in campus-related sustainability projects
- Educational research on effective strategies for teaching sustainability to build appreciation of multidisciplinary aspects; dissemination of results in mainstream publications

Broader sustainability research OSU faculty members in many colleges already engage in a broad range of sustainability research, from technological innovation to social responsibility. The university's Office of Energy and Environment provides a mechanism for coordinating some of these research efforts. However, many OSU research activities related to sustainability remain fragmented in diverse departments and centers, mirroring the fragmentation of educational approaches to sustainability. Many of OSU's beneficial applications of sustainability research are not widely known even within the institution. Further effort can improve coordination of research across public health, humanities, business, and many other disciplines. The following is a partial list of OSU's areas of research excellence relevant to sustainability:

- College of Arts and Sciences—assessment of climate change and associated changes in the aquasphere, geosphere, and biosphere
- College of Engineering—sustainable technologies for energy, mobility, manufacturing, and waste recovery; life cycle assessment of ecological impacts
- College of Food Agriculture, and Environmental Sciences—carbon cycling, ecosystem adaptation, natural resource economics, biobased products, renewable energy
- College of Public Health—impacts of changes in climate, lifestyle, technology, and environmental conditions on human health and well-being
- College of Medicine—connections between healthy outcomes and behavioral change
- College of Business—sustainability in supply chain management, product development, entrepreneurship, enterprise strategy, and social responsibility

Recommendations

A unified view of OSU's sustainability research areas of excellence should be developed and articulated by the University President. This will help OSU to establish a clear identity as a sustainability leader among collaborating universities and research sponsors. It will also help to increase OSU's competitiveness in attracting major funding for sustainability research facilities and programs. Accordingly we recommend formation of a task force to support the following actions:

- Assign a faculty/student research committee to compile a comprehensive inventory of OSU research initiatives, programs, and resources relevant to sustainability.
- The President should issue an overarching document characterizing OSU's sustainability vision, research strengths, and future aspirations. This can be used for purposes of building internal awareness, student and faculty recruiting, and sponsor communications.
- The Office of Research should provide resources to assist faculty who include a sustainability component in their grant proposals for research funding.
- Faculty researchers should be encouraged to connect their research programs with communities of practice in Ohio and beyond (e.g., "transition towns").
- Publish a periodic sustainability newsletter that highlights OSU's sustainability research accomplishments and lists new funding opportunities.
- Develop speaking opportunities at professional conferences to expand international awareness of OSU sustainability research accomplishments.

In addition, the sustainability task force should identify potential synergies of research programs with the educational initiatives described above; for example, by making empirical data on building energy use available to support course and research projects.

Outreach

A commitment to sustainability calls for expanding how OSU thinks about outreach. The university campus plays a major role in shaping the physical, economic, and social

environment in Central Ohio, from the daily commute of students and staff to campus to the formal and informal curricula that typify life at a major research university. On a broader scale, OSU Extension services reach every county in the state, while OSU researchers and alumni are active throughout the world. To see all of these impacts as dimensions of outreach, broadly conceived, is to glimpse a rich array of resources and points of leverage. Learning how to maximize the potential benefits from these resources will require broad collaboration, patient experimentation, creativity, and wise leadership.

For strategic purposes, we can distinguish among three types of outreach—partnerships, capacity-building, and social learning—based on their degree of formality. Instances of all three already exist at the university, but here we emphasize their systematic relationship.

- *Partnerships* involve institutional collaboration with entities already engaged in deliberate planning for sustainability. These include governmental agencies at city, county, State, and Federal levels; quasigovernmental entities such as solid waste authorities, transit authorities, soil and water conservation districts, regional planning commissions; and large-scale private sector organizations and corporations (e.g., Nationwide, Coca Cola, American Electric Power, the Columbus Partnership). These partnerships can involve educational programs, sponsored research and consulting, as well as collaboration on regional development initiatives.

An example of such collaboration is the Ohio By-Product Synergy network (www.OhioBPS.org) organized by OSU's Center for Resilience, in collaboration with the US Business Council for Sustainable Development, the Mid-Ohio Regional Planning Commission, and the Ohio Department of Natural Resources. The network helps businesses to convert waste materials into valuable by-products, thereby protecting the environment while stimulating the local economy. OSU has incubated similar networks in other areas (e.g., the Ohio Watershed Network housed in Extension).

Formal partnerships can also create undergraduate and graduate learning opportunities as a bridge between academics and civic or business engagement. Existing OSU programs such as the Environment and Natural Resources Scholars, the Mount Leadership Society, the Net Impact Society, and the Engineers for a Sustainable World can be strengthened as part of OSU's sustainability planning, by placing a strategic focus on leadership through outreach. Student enthusiasm about sustainability runs high, and every effort should be made to nurture such interests.

- *Capacity building* involves engagement with grassroots efforts that are addressing emergent areas of concern, such as recycling, local food systems, and alternative transportation. At a community level, it means enhancing opportunities for civic understanding, deliberation, and decision making; for the university, it means developing skills in citizenship and leadership. Integrating isolated service learning classes around a commitment to capacity building for sustainability would deepen the dialog between the campus and surrounding community, allowing for better-defined goals and more systematic reflection and evaluation among all participants. Conversion to semesters will likely enhance opportunities for in-depth service-learning due to the longer time frame available.

An outstanding example of capacity building is the School of Architecture's "Planning for Sustainable Development" class (Conroy 2004), in which students collaborate with neighborhood groups to draft sustainability plans for a range of urban communities. OSU Extension conducts many environmental programs, including Sustainable Agriculture, Woodland Stewardship and Watershed Management. Other faculty members and students provide technical advice to government agencies (e.g., the US Environmental Protection Agency), as well as to environmental groups, private citizens, and cultural organizations (e.g., museums).

Additionally, the arts and humanities have a critical role to play in promoting a regional culture of sustainability. For example, the Wexner Center for the Arts' "From Field to Screen" film focused on local food systems and sustainable agriculture, while a grant from OSU supported a "Ways of Knowing Water" exhibit that highlighted the efforts of local watershed protection groups. The Ecological Engineering Club is partnering with the Wexner Center to create a sustainable heirloom garden with funding from Coca-Cola; this is an example of integrating arts and technical disciplines.

- *Social learning* refers to the tacit or informal curriculum conveyed by campus life, the habits and expectations absorbed by belonging to the OSU community. While difficult to measure directly, social learning is a function of how the university is seen to approach sustainability, and how prominently the issue figures in OSU's public profile. Is our commitment to sustainability visible or invisible? Is it taken for granted as a background condition or placed in the foreground as an ongoing challenge? To what extent does the institution promulgate environmental and social awareness throughout the community? How can faculty and staff become ambassadors for sustainability, exercising civic leadership? These questions should be addressed in the sustainability plan.

Recommendations

The university should develop a unified approach to sustainability outreach interwoven with the education and

research activities suggested above. We recommend that the task force appoint an outreach committee to plan, initiate, and help coordinate the following activities.

- Develop and strengthen sustainability partnerships with governmental agencies, global corporations, and universities in Ohio and abroad. Include opportunities for research and service-learning while collaborating to develop and achieve sustainability goals.
- Improve regional capacity building through enhanced cooperation with public, private and non-profit sector organizations. Engage and empower OSU faculty, staff and students to participate in local and regional activities; develop and publicize innovative tools and data for local and regional planning purposes; and work with local and regional school systems to develop pragmatic initiatives for sustainability education.
- Promote social learning by actively associating the OSU name with sustainability initiatives via participation in public events (e.g., Earth Day, Riverfest), visible presence at OSU-sponsored events, and multi-channel communications (website, signage, employee, and student incentives).
- Engage undergraduate students through deliberate outreach efforts, including:

– Freshman class survey for basic awareness of sustainability issues, with follow-up surveys to gauge changes in understanding and behavior over 4–5 years.
– Welcome Week interventions (e.g., information packet; tour of campus sites; discussion with environmental groups; film screening) to engage core constituencies around different dimensions of sustainability (e.g., food, climate, design and engineering, biodiversity).
– Periodic follow-up activities (e.g., regional tours, alternative spring break, and service projects) to sustain student involvement.
– Strengthen the program for "sustainability coordinators" in residence halls to include training, support and additional incentives (e.g., a freshman seminar or service-learning credit) to connect individual goals to larger campus initiatives.

- Empower advisors and directors to develop cultures of sustainability in residence halls by:

– Providing regular updates on the university's strategic plans, goals, and policies in various aspects of sustainability (e.g., energy conservation, transportation, food, water usage).
– Supporting efforts to promote "greening" of residence halls, while maintaining an on-line archive of existing and proposed innovations (to minimize reinventing the wheel).
– Using art and design to encourage ecological awareness and a deeper sense of place.

- Promote communication and transparency about sustainability internally and externally:

– Establish campuswide communication networks and mechanisms for dialog.
– Publish a periodic sustainability report including measures of progress toward goals.

- Make the funding of sustainability initiatives a university development goal, focusing on "signature" sustainability projects that demonstrate innovative practices (e.g., the Eco-Village concept).

Progress at Ohio State and barriers encountered

The original paper developed by the authors was published as an internal report (http://president.osu.edu/assets/files/sustainability/Sustainability%20Planning%20at%20OSU.pdf), and was not officially endorsed by the University. However, many of the recommendations that were offered are consistent with OSU's subsequent strategic course and specific decisions.

In 2010, the authors recommended the following actions.

- President Gordon Gee, with the help of the President's Council on Sustainability, should appoint a task force to develop a strategic plan for sustainability, expanding beyond the current focus on campus operations. This plan should build upon the recommendations provided in this document and propose a multiphased approach for integrating sustainability into OSU's core missions—education, research, and outreach—as described above.
- President Gee should appoint a Chief Sustainability Officer (CSO), charged with guidance and coordination of sustainability activities across research, education, outreach, and university operations. The CSO would be responsible for implementing the above strategic plan and engaging all relevant stakeholder groups, including students, faculty, staff, alumni, and the surrounding community. The CSO should be equipped with sufficient financial and professional resources to enable effective accomplishment of his/her mission as well as coordination with various administrative offices. To expedite this process, the existing Energy Services and Sustainability (ESS) Group could be transplanted from Facilities Operations and Development to report to the CSO, thus providing a starting nucleus of knowledgeable professional resources.

OSU has taken a number of steps consistent with these recommendations, including appointment of a newly constituted President's and Provost's Council on Sustainability in 2010. Most importantly, the university has established an Office of Energy and Environment (OEE), with the mission

to advance OSU's prominence in solving global energy issues while promoting environmental sustainability by expanding and coordinating its assets and outreach. OSU recruited a distinguished individual to head the OEE, namely Dr. Ronald Sega, Vice President and Enterprise Executive for Energy and the Environment. The ESS Group now has dual reporting to this office as well as facilities administration.

OEE has adopted a comprehensive systems approach to engage students, faculty, and communities throughout Ohio, embracing academics, research, campus operations, and outreach consistent with public policy and Ohio State's land-grant mission. Initiatives are under way to establish Ohio State as a leader among sustainable campuses, including installation of geothermal energy sources, pursuit of a Climate Action Plan, and adoption of a green build policy to guide all new construction and renovation projects. In 2012 OSU announced the purchase of a wind farm in northwest Ohio to supply 25 % of its future energy requirements (http://www.thelantern.com/campus/ohio-state-plans-to-buy-25-of-energy-from-wind-farm-1.2921944#.UJ0-QYV7nmY). Another major milestone was achievement of near-zero solid waste at the football stadium. In addition, new sustainability courses are being developed and students are actively engaged in service learning projects and sustainability awareness-building activities. In 2012, OSU established an "Environmental Sciences Network" to encourage collaboration among faculty in different colleges who are working on sustainability. Meanwhile, OSU continues to expand its influence nationally and globally, opening "gateway" offices in China, India, and other countries to help form partnerships around sustainability and other critical issues[4].

In the research arena, OSU is pursuing the "Campus as a Living Laboratory" concept, integrating faculty and student research activities with facilities operations (http://footprint.osu.edu/campus-as-a-living-laboratory.html). Students can gain hands-on experience by working on research projects related to energy, water, materials management, logistics, healthy environments, food and food security, social and psychological issues, and marketing and communications. For example, to advance the critical issue of food security OSU is developing the "21st Century Farm" concept, which addresses food production and safety for the public, as well as development of rural communities' energy supply and demand opportunities in wind, solar, biomass, and subsurface energy resources. Another new project is investigating how to design "ecological synergies"; namely, beneficial interactions between human technologies and natural systems. Simple examples include collection of rainwater for purposes of irrigation, reduction in stormwater runoff through natural filtration in wetland ecosystems, and managing land use to sequester the emitted carbon dioxide. Understanding and harnessing the services provided by nature leads to a reduction in the demand for energy, water, and other resources and will thus decrease the overall carbon footprint of the campus, while enhancing its resilience and esthetic appeal.

The above progress is encouraging, but OSU remains far from achieving the full potential suggested in this paper. Many barriers have been encountered by faculty, administrators, and students who would like to see more rapid movement toward greater support and integration of sustainability activities. These barriers include:

- *Budgetary conflicts*—academic progress can be hindered by budgetary conflicts between departments; for example, introducing a multidisciplinary GEC course on sustainability could reduce the budgets allocated to departments that offer traditional single-discipline GEC courses.
- *Institutional inertia*—as in any large institution, it is difficult and time consuming to introduce substantial changes into existing administrative policies and procedures, especially when there is no sense of urgency. Even cost-saving initiatives with clear payback, such as energy efficiency improvement, are often slow to be adopted.
- *Organizational independence*—when major schools and colleges are largely independent, each with its own distinctive culture, resources, and perspectives, it is challenging to reach convergence on cross-cutting issues such as sustainability. This problem may be aggravated by the practice of using adjunct faculty who are not involved in sustainability initiatives.
- *Faculty disinterest and distraction*—academic tradition assigns a great deal of independence to individual researchers and educators, and sustainability advocates remain in the minority in most departments. Moreover, sustainability research requires interdisciplinary collaboration, which is often devalued by academic purists. At OSU, a recent switch from quarters to semesters was a major distraction that made it challenging to introduce innovative curriculum.
- *Communication challenge*—the concept of sustainability is esoteric, multi-dimensional, and subject to many different interpretations. Consequently, it is a great challenge to design effective communication materials for multiple audiences inside and outside the university.
- *Cultural context*—particularly in the USA, the pursuit of sustainability has become controversial, and is often the victim of perverse behaviors such as obfuscation and denial. Many opponents believe that sustainability is an economic burden, and fail to understand the connection between resource productivity and competitiveness.

[4] For more information about OSU's activities in energy, environment, and sustainability see: http://sustainability.osu.edu/

Despite these barriers, there are many sustainability advocates at OSU that maintain an earnest intent to gradually weave sustainability awareness into the fabric of university life. OSU will continue to develop sustainability-based policies appropriate for its role as a modern, diverse, public university, and will learn from similar efforts at other institutions.

Conclusion: sustainability and social responsibility

In recent years, the term "sustainability" has become something of a platitude, and its meaning has become ambiguous. Many organizations have used the term gratuitously as a marketing or branding tactic, without fundamentally changing the nature of their operations. The complexities of sustainability are so daunting that it is tempting to oversimplify, to focus on manageable targets and easily harvested "low hanging fruit" rather than on long-range planning and structural adjustments. Furthermore, the intergenerational time frame of sustainability makes it tempting to avoid the challenge, postpone difficult and controversial decisions, and discount or even ignore future costs, effectively taking the path of least resistance. Public universities need to provide the intellectual leadership to acknowledge the magnitude of sustainability challenges and to encourage relevant scholarly investigation and transformative solutions.

Rather than protecting the *status quo*, sustainability involves a commitment to objectivity, positive change, and value creation. The potential for "sustainable development" offers the promise of continued vitality for the Ohio economy as well as the public university system it supports. OSU can fulfill its commitments and help to realize this potential with educational initiatives, research programs, and outreach efforts associated with all aspects of sustainability. Graduate and professional concentrations and degree programs can integrate a well-designed and coordinated sustainability plan into the educational and research missions of the university. This in turn will lead to a qualified and motivated workforce that is prepared to meet the sustainability challenges confronting business and government.

A commitment to authentic sustainability is arguably a necessary part of the social compact of any university, and implicit in its covenant with communities. Given the increasing likelihood of significant global climate change, the strains on ecological resources such as water systems, the incalculable effects of diminishing biodiversity, not to mention the social and cultural pressures of an urbanized and interdependent world, sustainability is among today's most urgent issues for citizenship and advocacy—local, national and global. Therefore, it would be a disservice to students and society at large to treat sustainability as a tactical issue, or as the province of narrow disciplines and specialized expertise. Sustainability awareness, in its many forms and incarnations, should be woven into the academic and social life of a university, from physical operations to curriculum to innovative research to public policy. Every graduate should be fully prepared to grasp the dimensions of sustainability and apply those insights, thus making sustainability leadership a distinguishing factor in the university's regional and global presence.

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