

# Systems Thinking for Sustainability

EnvirSt 402/Agronomy 375, 3 Credits, Fall 2018

Tuesday & Thursday, 9:30 - 10:45 AM  
Science Hall, Rm. 110

L&S Course attributes – Breadth: S - Social Science  
Canvas website: <https://canvas.wisc.edu/courses/103572>

## Instructors:

Dr. Robert B. Beattie

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Office Hours: 12-2 Monday, other times as arranged.

Dr. Molly Jahn

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Office Hours: After class and other times as arranged.

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*When we try to pick out anything by itself, we find it hitched to everything else in the Universe. - John Muir*

Have you ever thought about fixing global warming? Do you want to understand the causes of poverty? Have you wondered how ideas of human rights develop and spread? Do you want to promote an environmentally sustainable campus or business? It turns out that complex systems are at the root of many of our most pressing problems and largest opportunities. This class will give you practical tools and strategies you can use to tackle the world's biggest challenges. Students will be given direct experience with the concepts and practices used to define and analyze systems, and learn to use systems thinking tools to describe, assess, understand, and manage complex systems from local to global scales. The course will consider a range of topics including systems science, complexity and behavior of complex adaptive systems, networks, and patterns of organization.

We don't promise that you will leave the class able to solve all the world's problems. But you will be able to better understand more precisely how and why any one issue is "hitched to everything else in the Universe. If you have the skills to help you understand, describe, and analyze complex systems, you will be better prepared to be an effective citizen in a democratic society that needs everyone's participation.

## Course Objectives/Learning Goals

After completing this course, students will be able to:

- Explain concepts of systems thinking
- Identify and provide examples of the basic characteristics of a system such as:
  - system boundaries

- elements
- feedback loops
- stocks and flows
- thresholds and tipping points
- hierarchies
- self-organization
- limiting factors
- Ask questions to determine what is there, and what isn't there in a system
- Explain sustainability in terms of design and systems
- Identify and describe “wicked problems” and explain why they are difficult, if not impossible, to solve.
- Recognize some of the limits of systems thinking as a tool for problem description and problem solving

**How the 3 credit hours are met:**

The course has three class hours (150 minutes) of direct instruction and approximately 6 hours of outside work (reading, media, homework, reflective journals, assignments, etc.) each week for the duration of the semester.

**Attendance (out of 200 points)**

Attendance is absolutely mandatory in order to succeed in this class. If you come to class every day, on time, you get these points for free. You have one unexcused absence; beyond this, each absence costs you 75 points. For an absence to be excused, such as for travel to a conference or for a contagious illness, contact both instructors by email at least 24 hours before the class period. Last minute family or health emergencies are exceptions to this rule. For cases such as these, contact your professors as soon as you are able. They will do their best to work something out with you, accommodating your needs.

*On time arrival to class*

Coming on time to class is absolutely mandatory in order to succeed in this class. After the first week of class, you are not allowed any late entries (9:31 AM is late). Each lateness costs you 25 points. If for some reason you cannot make class on time, please let your professors know at the start of the semester. They will work something out with you. If you drive to campus, plan so that you don't get caught in an accident on the Beltline. If you take a bus, consider taking an earlier one. OK, we know. You live in Wisconsin where it is known to snow, sleet, and get windy and foggy. Please be safe on the sidewalks, streets, and highways.

**Participation (out of 150 points)**

All students are expected to fully participate in class discussions. At the end of the semester, student's participation will be evaluated using the following outline:

<b>Outstanding Participant (-0 points)</b>	The student actively participated in every in-class discussion with substantive insights. The student's participation demonstrated exceptional preparation for in-class discussion. The quality of in-class discussions would have been notably diminished without this student.
<b>Good Participant (-20 points)</b>	The student actively participated in most in-class discussion with substantive insights. The student's participation demonstrated good preparation for in-

class discussion. The quality of in-class discussions would have been diminished without this student.

**Adequate Participant (-40 points)**

The student participated in some in-class discussions with somewhat substantive insight. The student's participation demonstrated occasional preparation for in-class discussions. The quality of in-class discussions would have been somewhat diminished without this student.

**Unsatisfactory Participant (-60 points)**

The student rarely participated in in-class discussions. When the student did participate, comments and ideas were never insightful or substantive. The student's lack of valuable participation demonstrated a lack of preparation for in-class discussions. The quality of in-class discussion would not have been affected without this student.

**Non-Participant (-100 points)**

Student contributed little to nothing to in class discussions.

**Grading:**

On Time Attendance	200 points
Class Participation	150 points
Weekly Reflective Journal	275 points (11 journals, 25 points each)
Midterm Group Presentation	175 points
Final Project	200 points
<b>Total Points</b>	<b>1000 points</b>

Point Range	Letter Grade
1000-910	A
909-890	AB
889-810	B
809-790	BC
789-700	C
699-600	D
599-0	F

**Assignments:**

Reflection Journal. See Assignment for details - you will receive a new prompt each week

Midterm Project (Group project of 4 or 5 peers to develop and deliver a professional 4 slide, 5-minute presentation about a system) See Assignment for details.

Final Project (Individual project to develop and deliver a 4-slide, 5 minute presentation about a system, and write a brief (5-8 page) description and analysis of the system that discusses its structure and functions and how it might respond if you intervened in the system. See Assignment for details.

**Books you should consider buying for the class:**

Capra, and Pier Luigi Luisi, *The Systems View of Life*. (2014) Cambridge University Press, Cambridge UK (available at: <https://www-cambridge-org.ezproxy.library.wisc.edu/core/books/systems-view-of-life/35186BA5B12161E469C4224B6076ADFE>)

Gunderson, Lance H. and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*. (2002) Island Press, Washington, DC.

Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT (available as a pdf here: <http://wtf.tw/ref/meadows.pdf>)

Smil, Vaclav, *Energy - 2<sup>nd</sup> Edition*. (2017) Oneworld Publications, London.

Recommended website: Resilience Alliance website - <https://www.resalliance.org>

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## Course Schedule

(Note: The readings listed for each class should be completed BEFORE class)

### Week 1

Thursday, Sept. 6 - Introduction to systems through an introduction to each other

Readings/Media: Watch “Systems Thinking - A Little Film about a Big Idea”

(<https://www.youtube.com/watch?v=-sfiReUu3o0>)

### Week 2

Tuesday, Sept. 11 – Thinking in Systems

Readings: Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT. Introduction & Chapter 1

Thursday, Sept. 13 - History of thought - Paradigms

Readings: Capra, Fritjof and Pier Luigi Luisi, *The Systems View of Life*. (2014). Cambridge University Press (Introduction, Ch. 1, 2)

Assignment: Reflective Journal (due Monday Sept. 17 @ noon)

### Week 3

Tuesday, Sept. 18 – System Basics (definitions, concepts)

Readings: Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT. Chapter 2

Thursday, Sept. 20 - System Basics II (Connections in systems)

Readings: Capra, Fritjof and Pier Luigi Luisi, *The Systems View of Life*. (2014). Cambridge University Press (Ch. 4, 5),

An Ecology of Mind (film about Gregory Bateson - available on the Canvas website)

Assignment: Reflective Journal (due Monday Sept. 24 @ noon)

### Week 4

Tuesday, Sept. 25 – Systems Behavior I

Readings: Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT. Chapter 3 & 4

Thursday, Sept. 27 - System Behavior II (Thresholds, Tipping Points)

Readings: Capra, Fritjof and Pier Luigi Luisi, *The Systems View of Life*. (2014). Cambridge University Press (Ch. 6)

In-class activity with debrief: The Fish Game (<https://cloudinstitute.org/fish-game/>)

Assignment: Reflective Journal (due Monday Oct. 1 @ noon)

## Week 5

Tuesday Oct. 2 - System Management (Possible Guest Lecture)

Readings: Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT. Chapter 5

Thursday, Oct. 4 - System Management II (learning from mistakes/Guest debrief)

Readings: Meadows, Donella H. *Thinking in Systems*. (2008) Chelsea Green Publishing, White River Junction, VT. Chapter 6

Assignment: Reflective Journal (due Monday Oct. 8 @ noon)

## Week 6

Tuesday, Oct. 9 - Systems and adaptation (Scale)

Readings: Gunderson, Lance H., and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*. (2002) Island Press, Washington, DC. Ch. 1 - "In Quest of a Theory of Adaptive Change"

Thursday, Oct. 11 – Resilience and Adaptive Cycles

Readings: Gunderson, Lance H., and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*. (2002) Island Press, Washington, DC. Ch. 2 - "Resilience and Adaptive Cycles"

Assignment: Reflective Journal (due Monday Oct. 15 @ noon)

## Week 7

Tuesday, Oct. 16 - Institutions and Systems

Readings: Gunderson, Lance H., and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*. (2002) Island Press, Washington, DC. Ch. 4 - "Why systems of people and nature are not just social and ecological systems"

Listen: Podcast on persistent surveillance systems - Systems and social limits.

<https://www.wnycstudios.org/story/eye-sky/>

Thursday, Oct. 18 – Institutions and Systems II

Before-class activity: Explore *The Madness and Wisdom of Crowd* at: <https://ncase.me/crowds/>

In-class activity - What questions can we ask to reveal the qualities of social systems and institutions?

Assignment: Reflective Journal (due Monday Oct. 22 @ noon)

## Week 8

Tuesday, Oct. 23 - Identity and Systems

Readings: Powell, John A., Connie Cagampang Heller, Fayza Bundalli, *Systems Thinking and Race: Workshop Summary*. (2011) The California Endowment.

Thursday, Oct. 25 – Sustainable Systems

Videos: Watch the seven "Sustainability Planning" videos at:

<https://www.youtube.com/playlist?list=PLEXqjIYY5zi5DfC62qaxD7EafyFJVKq2J>

(1-Sustainability explained with simple natural science; 2-Sustainability plan: How might Einstein solve our problems? (backcasting); 3-4 principles to win the sustainability game (conditions of success); 4-Sustainability Gap: Creative tension engenders motion (ABCD); 5-Triple bottom line and

sustainability: the science of good business; 6-Social sustainability: Satisfying human needs; 7-Sustainability is like football: 5-step game plan to help you win)  
Assignment: Reflective Journal (due Monday Oct. 29 @ noon)

### **Week 9**

Tuesday, Oct. 30 - Sustainable Systems II

Readings: Explore *Yahara 2070*, scenarios depicting the future of the Yahara watershed under different courses of action. <https://wsc.limnology.wisc.edu/yahara2070>

Thursday, Nov. 1 – Welcome to the Anthropocene

Readings: TBA

Assignment: Reflective Journal (due Monday Nov. 5 @ noon)

### **Week 10**

Tuesday Nov. 6 - Wicked Problems I - Energy and sustainability

Readings: Voosen, Paul, “Meet Vaclav Smil, the man who has quietly shaped how the world thinks about energy.” *Science*. March 21, 2018 (<http://www.sciencemag.org/news/2018/03/meet-vaclav-smil-man-who-has-quietly-shaped-how-world-thinks-about-energy>)

Smil, Vaclav, *Energy - 2<sup>nd</sup> Edition*. (2017) Oneworld Publications, London. (Ch. 1, 4)

Thursday Nov. 8 – Wicked Problems II - Energy and sustainability

Readings: Smil, Vaclav, *Energy - 2<sup>nd</sup> Edition*. (2017) Oneworld Publications, London. (Ch. 5, 6)

Assignment: Reflective Journal (due Monday Nov. 12 @ noon)

### **Week 11**

Tuesday, Nov. 13 – Systems Thinking in Ecology (Potential Guest Lecture)

Readings: Capra, Fritjof and Pier Luigi Luisi, *The Systems View of Life*. (2014). Cambridge University Press (Ch. 16)

Thursday, Nov. 15 – Systems Thinking in Ecology II (Guest Lecture debrief)

Readings: Gunderson, Lance H., and C. S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems*. (2002) Island Press, Washington, DC. Ch. 5 - “Back to the Future: Ecosystem Dynamics and Local Knowledge”

Assignment: Reflective Journal (due Monday Nov. 19 @ noon)

### **Week 12**

Tuesday, Nov 20 – In-class activity (Midterm Group Presentations)

Readings: None

Thursday, Nov. 22 (No Lecture – Thanksgiving)

NOTE: No Reflective Journal this week

### **Week 13**

Tuesday, Nov. 27 – Possible Guest Lecture

Readings: TBA

Thursday, Nov. 29 – Guest Lecture debrief

Readings: TBA

Assignment: Reflective Journal (due Monday Dec. 3 @ noon)

### **Week 14**

Tuesday, Dec. 4 – Student Presentations

Thursday, Dec. 6 – Student Presentations

### **Week 15**

Tuesday, Dec. 11 – Last Class/wrap-up

Readings: TBA

Assignment: Final Assignment/Paper (Due 5 PM Friday, Dec. 14)

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#### Academic Integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, collaboration on individual assignments unless authorized by your instructor(s), and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to [studentconduct.wiscweb.wisc.edu/academic-integrity/](http://studentconduct.wiscweb.wisc.edu/academic-integrity/).

#### Accommodation for Students with Disabilities

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility.

*Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. <http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>*



### A Safe and Welcoming Classroom

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. Safe and welcoming classrooms “encourage that continual and fearless sifting and winnowing by which alone the truth can be found” by fostering an environment of free speech consistent with US law and safe from threats or violence.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

### Mental Health Resources

School is a context where mental health struggles can be exacerbated. If you ever find yourself struggling, please do not hesitate to ask for help. The University and larger Madison community offer mental health resources to support a range of psychological issues in a confidential and safe environment:

#### Confidential Counseling Services:

University Health Service (UHS) - For 24/7 confidential consultation: 608-265-5600 (option 9)