NJIT BIOLOGY

Course Syllabus

SPRING 2016

BIOLOGY 337-002: COLLECTIVE INTELLIGENCE

INSTRUCTOR:	Dr. Simon Garnier	**WEB:**	www.theswarmlab.com
OFFICE HOURS:	R: 2-3pm, or by appointment	**EMAIL:**	garnier@njit.edu
COURSE SCHEDULE:	M, W: 1 – 2:25pm; CKB 320	**COURSE WEBSITE:**	http://moodle.njit.edu/

DESCRIPTION AND GOALS:

Understanding collective intelligence is one of the main challenges of contemporary science. Social dynamics are essential for the organization of gregarious and social organisms, and they are an important part of many human activities including the selection of social and industrial norms, the growing use of crowd-sourcing and viral marketing in social networks, and the influence of media and entourage on the outcome of democratic processes. For instance, did you know that...

- ...in spite of their tiny brains, ants regulate the traffic on their trails almost optimally while human beings, with their sophisticated technologies, still get stuck in traffic jams on a daily basis?
- ...Facebook, Twitter and Google can tell us in advance when and where there will be a flu outbreak?
- ...virtual ant colonies and bee swarms can help optimize the transfer of your phone calls and your emails?
- ...being too smart individually can make us stupid as a group, and vice versa?

And did you know that you can explain all of the above and even more with only a handful of simple mechanisms?

Through lectures, tutorials and documentaries, this course will provide an overview of the fundamental principles underlying the organization of animal societies. It will include detailed consideration of the behavioral, social and physical processes that are responsible for the coordination of activities in large animal and human groups.

This course will emphasize an integrative view of collective animal behaviors, with elements of ethology, behavioral ecology, sociology, socio-physics, and mathematical and computer modeling. It will also address topics in the evolution of sociality, the development of social and cultural conventions, and the applications of swarm intelligence.

COURSE OBJECTIVES:

Upon completion of this course, students will be able to:

1.) Demonstrate knowledge of the essential concepts that underlie social behaviors in animals and humans: mechanisms of social interactions, social networks, positive and negative social feedbacks, self-organization, information polling, and collective intelligence.

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COURSE OBJECTIVES (CONT.):

2.) Integrate and relate knowledge about the behaviors of individual animals (or humans) in a social context to their consequences on the higher-order group dynamics. In particular, students will demonstrate their knowledge of how simple, individual-based behaviors and interactions can lead to the emergence of aggregation, segregation, morphogenesis, collective movement and traffic organization, leadership, collective decision-making and democratic consensus.

3.) Relate basic concepts of statistical physics and applied mathematics to the analysis and modeling of collective intelligence phenomena.

4.) Students will be able to critically evaluate discussions on course topics and communicate effectively their understanding by participating in instructor-led discussions of the material.

PREREQUISITES: General Biology (R120:101, 102), Foundations of Biology (BIOL 205, 206).

REQUIRED TEXT: None.

RECOMMENDED TEXTS:

1.) "Self-organization in biological systems", by Scott Camazine, Jean-Louis Deneubourg, Nigel Franks, James Sneyd, Guy Theraulaz and Eric Bonabeau (Princeton University Press, 2001).

2.) "Critical mass: how one things leads to another", by Philip Ball (Farrar, Straus and Giroux, 2004).

3.) "Collective animal behavior", by David Sumpter (Princeton University Press, 2010).

4.) "The perfect swarm: the science of complexity in everyday life", by Len Fisher (Basic Books, 2009).

5.) "The Smart Swarm: How Understanding Flocks, Schools, and Colonies Can Make Us Better at Communicating, Decision Making, and Getting Things Done", by Peter Miller (Avery, 2010).

6.) "Honeybee democracy" by Thomas Seeley (Princeton University Press, 2010).

7.) And to relax during the weekend: "Prey", by Michael Crichton (Harper Collins, 2002).

CLASS WEBSITE: Via Moodle (http://moodle.njit.edu).

GRADING POLICY:

- There will be one mid-term and one final in class exam, each counting for 30% of the final grade (60% in total for in class exams). Each in class exam will have multiple choice questions (~1/3 of the exam grade), short answer questions (~1/3 of the exam grade) and one long answer question (~1/3 of the exam grade). Each in class exam will be on all the material seen since the beginning of the semester.
- Quizzes in the form of multiple choice questions and/or short answer questions will count for 20% of the final grade.
- Assignments will count for the remaining 20% of the final grade. They will correspond to readings or simple tasks aimed at complementing tutorials. They are points easy to earn.

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GRADING SCALE:	
A	88 – 100
B+	81 – 87
B	74 – 80
C+	67 – 73
C	60 – 66
F	0 – 59

IMPORTANT RULES AND POLICIES:

- **Academic Integrity:** The University Code on Academic Integrity is STRICTLY ENFORCED! Cheating and plagiarism will be taken into account when grading written assignments.
- **Electronic Devices:** The use of cell phones and other electronic devices during class or exam times is prohibited. The use of personal laptops during class will be authorized during some of the classes.
- **Make-Ups:** Grade of quizzes, assignments or exams missed because of a valid excuse will be determined on a case-by-case basis.

COURSE OUTLINE:

WEEK	DATES	DATES	TOPICS AND ASSIGNMENTS
1		W – 1/20	
2	M – 1/25	W – 1/27	
3	M – 2/01	W – 2/03	
4	M – 2/08	W – 2/10	
5	M – 2/15	W – 2/17	
6	M – 2/22	W – 2/24	
7	M – 2/29	W – 3/02	
8	M – 3/07	W – 3/09	
9	**MARCH 13-20: SPRING BREAK — NO CLASSES**		
10	M – 3/21	W – 3/23	
11	M – 3/28	W – 3/30	
12	M – 4/04	W – 4/06	
13	M – 4/11	W – 4/13	
14	M – 4/18	W – 4/20	
15	M – 4/25	W – 4/27	
16	M – 5/02		
FINALS	**FINAL EXAM WEEK: MAY 6-12, 2016**		