

# BIOMIMICRY: TOWARDS A SUSTAINABLE DESIGN

INSTRUCTOR: CATALINA FREIXAS

Janine Benyus articulates nine principles in her 1997 book *Biomimicry*:

“Nature runs on sunlight  
Nature uses only the energy it needs  
Nature fits form to function  
Nature recycles everything  
Nature rewards cooperation  
Nature banks on diversity  
Nature demands local expertise  
Nature curbs excesses from within  
Nature taps the power of limits”

Benyus, J. M. 1997. *Biomimicry: Innovation Inspired by Nature*,  
New York: Quill, William Morrow.

## COURSE DESCRIPTION

The seminar introduces undergraduate and graduate students of different backgrounds to the fundamental concepts of Biomimicry. This course seeks to expand the language of architecture through a practical investigation of natural processes biomechanics and performative qualities.

John Paxton, Anton Gaudi, and Buckminster Fuller, among others have used plants as a paradigm, for the mechanical properties of their architecture. The most advanced engineering achievements of humans pale in comparison to the very practical and sophisticated systems of even the most common plants and natural systems.

Focus is placed on understanding natural systems, the development of the built environment within natural systems, and the economic, social, ecological, ethical, philosophical, political, psychological, aesthetic and cultural issues in shaping design decisions.

The seminar will be a collaborative studio that welcomes students of disciplines such as Biology, Engineering and Architecture, among other Schools. Based on scientific principles, concepts, and methodologies required to understand the relationships of the natural world, the students will analyze alternative solutions for resolving and/or preventing specific environmental problems.

This course will research and study the structure and function of biological systems as models for the design and engineering of materials for buildings. It will involve the study of nature's design and processes as a tool to bring a solution to an architectural problem that will push technology forward while helping us minimize our environmental impact. The course will allow students to evaluate a range of methods that will help them identify and select sustainable

solutions to design problems; improve existing solutions; and develop critical thinking.

## **COURSE GOALS**

The teaching/learning process will be supported by a number of lectures given by professionals from various backgrounds, with broad experience in sustainable design and Biomimicry, focusing on their approach and contribution to creating Green Environments. Videos, web-based resources, and group investigations/discussions will also be an essential part of the curriculum.

The seminar will be a collaborative studio that welcomes students of disciplines such as Biology, Engineering and Architecture, among other Schools. The goal of this course is to create environmental awareness; understanding building ecosystems and increase the ability to design sustainable buildings from an interdisciplinary perspective.

The aim of this seminar is to prepare the students to participate in cross disciplinary design teams that can develop working methods to study complex architectural problems and challenges, and facilitate a technical as well as aesthetic successful, durable and sustainable design.

The students at the end of the course will have gained a better understanding of the importance of using nature as a model, mentor and measure.

## **LEARNING OBJECTIVES**

The workshop will be oriented towards exploring analytical and critical interpretations of Biomimicry in different disciplines. The intent is to generate speculations and propositions of environmental conditions implemented at various scales.

The ultimate goals of this seminar are: to create environmental awareness, understand building ecosystems and increase the ability to design sustainable buildings through theory and practice.

Due to a shortage of teaching materials for environmental education in architecture; our subsequent attempt is to produce work of a publishable quality that can help educate and inform a broader community.

## **COURSE REQUIREMENTS AND GRADING**

To successfully complete this course, the student will need to comply with the following issues:

#### Reading:

Students are expected to read the texts and articles as assigned in class.

#### Attendance:

Attendance is critical to a sufficient understanding and working knowledge of course material. A 75% attendance it is mandatory to successfully pass this seminar.

#### Class Participation:

Class participation in plenary and group discussions, presentations and exercises is essential. Twenty percent (20%) of the grade will be based on effective class participation.

#### Grade:

The final grade will be determined as follows: 20% class participation, 20% research on natural process, 20% modeling craft, 40% design project. An extra point will be give for substantial contribution to material database.

The course will be structured in the following phases.

1. Research on natural process to investigate its components, its connections and physical movements.
2. Building of hand model as simulations of the mechanical performance and form of the initial study.
3. Building of a second model after refining the initial study to include more complex detailing of components and connections for production with the CNC cutter and other technique (3D printing, rod-bending, forming).
4. Propagation of the initial study to create a tectonic, surface or spatial system.

The final project will be presented in an oral presentation to a panel of guest critics.

### **CLASS FORMAT**

The classes will consist of a combination of formal lectures and facilitated discussion periods (plenary and group work). The student will be exposed to various topics and will be asked to explore those topics with the help of the instructor. Biomimicry can be approached in many different ways. There are no definite answers to the issues that will be discussed in class. Guest speakers will provide additional expertise that will be beneficial to all.

Type of facility space: Due to the need of videos, web-based resources, and power point presentations as part of the curriculum, this seminar will require a room with DVD, VCR, and computer access.

Maximum enrollment allowed: Since the goal of this course is to transform the natural process research into a tectonic, surface or spatial system, a maximum of 15 students will be allowed to enroll at a time. Student will work in groups of 3 to 4 people.

Schedule: To be confirmed

Credits: 3 credits