Biomimetics and Bioinspiration  
Wednesdays, 1-4PM  
332 Bio-Life Sciences Building

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Summary: The emerging fields of biomimetics and bioinspiration use biology to inspire solutions to challenging problems, or speed biological progress by reaching outside of biology to other disciplines for inspiration. Common examples include the invention of Velcro, a product mimicking burrs when they stick to fur; or the development of game theory for ecological applications, originating from economic theory. In this course, we will explore how these ideas of biomimetics and bioinspiration permeate our daily lives, examining past and present examples, and creating some of our own.

Goals: The primary goal is to introduce the ideas of biomimetics and bioinspiration, simultaneously developing and honing your abilities to think across disciplines for active problem-solving. Over the course of the semester, you will be encouraged to identify problems and to think cross-disciplinarily for creative, effective solutions. By the end of the course, you should clearly understand what are biomimetics and bioinspiration, and provide examples of each. You should also be able to reach into other disciplines for addressing challenges. Finally, you will be able to evaluate your progress and what you have learned in the course through the completion of a public blog that you can continue building upon after the course is finished.

Objectives:

1. Develop an understanding of biomimetics and bioinspiration, and how these fields can aid human progress and sustainable living;
2. Develop and hone skills for thinking and communicating cross-disciplinarily for creative problem-solving;
3. Practice teamwork and collaboration skills, as well as become more comfortable with presenting in front of an audience;
4. Increase awareness of how disciplines outside of biology can enrich the field, and likewise, how biology can speed progress in other industries.

Organization: The seminar will consist of a mix of guest lectures, discussions, and student presentations, ending with a final course project. Topics will be adjusted to complement the student composition in the course.

Grading:

The final grade will be determined based on the following:

   Attendance/Participation (20%)
   Student-led Discussion (20%)
   Final Project/Presentation (60%)
Assigned Reading:

Reading will be assigned weekly from the primary research literature

Some books that may be of interest (not required reading for the course):


*Note: Do NOT purchase this book – access it as an e-book through Temple’s libraries.*


Expectations:

You are expected to arrive on time to class, having read all assigned readings and be prepared to contribute to the class discussion.

You will be expected to lead one to two discussions based on a relevant journal article from the primary literature to complement the week’s topic. You will be expected to email the class with your selected journal article by the Friday (11:59PM) preceding class.

You will also be expected to work as a group to complete a submission for the Biomimicry Institute Student Design Challenge.

The efficacy of this course is built upon active discussion and creativity, which requires that we will not be personally judged for our ideas. Therefore, all students are expected to be respectful and open-minded of other people’s ideas, views and beliefs.

Student-Led Discussion:

Each student in the course will lead one class discussion covering a topic in the field of biomimetics and bioinspiration. All associated reading must be emailed to the class by Friday night (11:59PM) preceding the class when it will be discussed.

Final Project: The final project will be a submission to the Biomimicry Institute Student Design Challenge. Details will be discussed in class, and can also be found online: https://www.biomimicrydesignchallenge.com/
## Course Schedule

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<tr>
<th>Week</th>
<th>Topic</th>
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<tr>
<td>1 – 1/22</td>
<td>CLASS CANCELED DUE TO SNOW</td>
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<tr>
<td>2 – 1/29</td>
<td>An Introduction to Biomimetics/Bioinspiration</td>
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| 3 – 2/5 | Design Principles and Brainstorming  
Bar-Cohen, 2006; Helms et al., 2009; Wilson et al., 2010 |
| 4 – 2/12 | Biomaterials: synthetic analogs – **Carlos and Brandon**  
Design Challenge: An Introduction to the Biomimicry Methodology  
Team Assignments |
| 5 – 2/19 | Sensors – **Gianluca**  
Design Challenge: Collaboration  
Idea brainstorming  
TENTATIVE: Wagner Museum visit |
| 6 – 2/26 | Robotics – **Subashini and Ramya**  
Design Challenge: Additional Resources  
Idea brainstorming |
| 7 – 3/5 | **NO CLASS – SPRING BREAK** |
| 8 – 3/12 | Smart materials  
*Guest lecture*: Sneha Patel and Rashida Ng (Architecture)  
Design Challenge: Design critique and feedback |
| 9 – 3/19 | Artificial intelligence – **Annie and Andrew**  
Design Challenge: Refine, revisit, re-design |
| 10 – 3/26 | Prosthetics – **Nina and Collin**  
Design Challenge: Refine, revisit, re-design |
| 11 – 4/2 | Sensors – Robot vision  
*Guest lecture*: Dr. Rolf Lakaemper (Computer and Information Sciences)  
Design Challenge: Design FREEZE (start work on submission) |
| 12 – 4/9 | Predictive modeling algorithms – **Alex and Subashini**  
Design Challenge: work on submission |
| 13 – 4/16 | Optogenetics  
*Guest lecture*: Dr. Andrew Spence (Bioengineering)  
Design Challenge: finishing touches on submission (DUE APRIL 20th) |
| 14 – 4/23 | Optimization and search algorithms – **Alicia and Star-Lena**  
Mathematical and biological origami  
**Film**: *Between the Folds* |
| 15 – 4/30 | **Final project presentations, TBD** |

* Student-led discussion dates will be adjusted to accommodate the availability of guest speakers.
### Important Dates:

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<th>Date</th>
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<td><strong>5-12 February</strong></td>
<td>Brainstorm “Life-Friendly Transportation Solutions”</td>
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| 19-26 February   | Identify problems of interest and reframe the problem in a functional manner  
|                  | *Some useful resources:*  
|                  | Helms et al. 2009 (Design Studies)  
|                  | Problem statements and design goals post Need Statement Development (note that this has a medical device bias, so should be read in-context for what we are doing) |
| 5 March          | **Spring Break** – Brainstorm biological solutions |
| 22 March         | Define biological solutions (within teams), extract principles for inspiration |
| 19 March - 2 April| Refine, revisit, re-design |
| 2 April          | **DESIGN “FREEZE”,** Prepare presentations |
| 20 April         | **SUBMISSIONS DUE** |
| 30 April         | Final presentations |