

BIOMIMETIC DESIGN

Welcome!

ITP 2013 Fall
Biomimetic Design
Gabriella Levine | Gabiellalevine.com | gabriella.levine@gmail.com

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gabriellalevine [skype]

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SCHEDULE

Over the course of 7 weeks [15:30 - 18:00] :

3 Assignments:

[1 week]

[1 week]

[4 weeks : this is your core project]

SCHEDULE

Over the course of 7 weeks [15:30 - 18:00] :

3 Assignments:

[1 week : due class 2]

OUTPUT (design organic motion) - individual

[1 week : due class 3]

INPUT (design a sensing system) - groups of 3

[4 weeks : integrate] -

Integrated biomimetic system - groups of 3

FINAL PROJECT

Integrated biomimetic system - groups of 3

>>Presentation & Exhibition

*Integrating Physical, Digital and web
Design for a non-human user
Dealing with Communication
Feedback mechanism*

>>>robot

>>>system

>>>product

>>>device / tool

>>>replica

>>>application

September 2013

ITP : Biomimetic Design

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	-Intro- -Design Excercise- [Project1 : Organic motion]	4	5	6	7
8	9	-HW Demo- -Properties of Biomimicry- -Sensors & Feedback- [Project 2 : sensing]	11	12	13	14
15	16	-HW Demo- -AI / cybernetics- -Launch Final Project- [Outside research & systems diagrams]	18	19	20	21
22	23	-Present ideas- -POV statement- -wireframes- -Ideation excercise-	25	26	27	28
29	30					

October 2013

ITP : Biomimetic Design

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			2	3	4	5
6	7	-Demo Prototypes and Feedback- -Begin User Testing-	9	10	11	12
13	14	-User Testing- -Documentation-	16	17	18	19
20	21	-Final Presentations-	23	24	25	26
27	28		30	31		

TODAY

1. Intro

15:30 - 16:15

2. Lecture [*Properties of Biomimicry*]

16:15 - 17:50

2. Design & Biomimicry excersize

17:00 - 17:40

4. Debrief & Assignment

17:40 - 18:00

TOPICS

- **Control systems: feedback loops**
 - **OUTPUT: Organic motion & fabrication techniques**
 - **INPUT: sensing systems**
- **Biological properties & biomimicry in biology**
- **AI, cybernetics, cyborgs**
- **Biomimicry in interface design**
- **Agent - based systems & representing biological systems on-screen**
- **Bio-inspired design versus Living-design**
- **Energy regeneration**

CLASSTIME

- *Lecture & Discussion : biomimicry,*
- *Tech / Design demos*
- *Demo your work & presentations*
- *Group user testing*
- *Feedback / critique*
- *Debrief*

INTROS

1. *name*
2. *background / field of practice*
3. *hometown*
4. *example of bio-inspired work of yours?*
5. *what do you hope to get out of this course?*

TOOLS

- Software : Processing , OpenFrameworks...
- Hardware : Arduino , Raspberry Pi...
- Digital Fabrication - laser, cnc, 3d printer
- Physical Fabrication

TOOLS



CODE

github.com/gabriella/exploringBiomimicry

ATTENDANCE

don't miss class

don't be late

10 mins late = missed

gabriella.levine@gmail.com

GRADING

participation - attendance, input

assignments - content, design

WEBSITE

[http://www.levinegabriella.com/
exploringbiomimicry/itp](http://www.levinegabriella.com/exploringbiomimicry/itp)

All of the course info can be found here:

*lectures, assignments, schedule, syllabus,
links, and your work*

DOCUMENTATION

[http://www.levinegabriella.com/
exploringbiomimicry/itp](http://www.levinegabriella.com/exploringbiomimicry/itp)

- *blog your assignments*
- *add a link to your work & responses on the class website or embed your responses directly, for each assignment*
- *github for software*
- *fritzing for hardware*
- *CAD, inDesign, google sketchup, rhino etc. for systems diagrams*
- *photos, videos [youtube, vimeo, flickr]*

PARTS / TOOLS

- *Sensors*
- *Actuators / Motors*
- *Brackets / Joints*

ROBOTIC ARM

SENSORS

temperature

light

water / moisture

GPS

acceleration / position

magnetic

motion sensor

humidity

barometric pressure

flex

force

ACTUATORS

servo motors

linear actuators

stepper motors

dc motors (w/ encoders)

muscle wire

RESOURCES

Motion:

flying pig, kmoddl...

Sensors:

Sparkfun, Adafruit, digikey, jameco...

Hardware:

*McMaster, Robotshop, Small Parts,
lynxmotion...*

RESOURCES

<http://www.robives.com/mechs>

<http://school.mech.uwa.edu.au/~dwright/graphicsExamples/>

<http://www.levinegabriella.com/exploringbiomimicry/itp/links-references/>

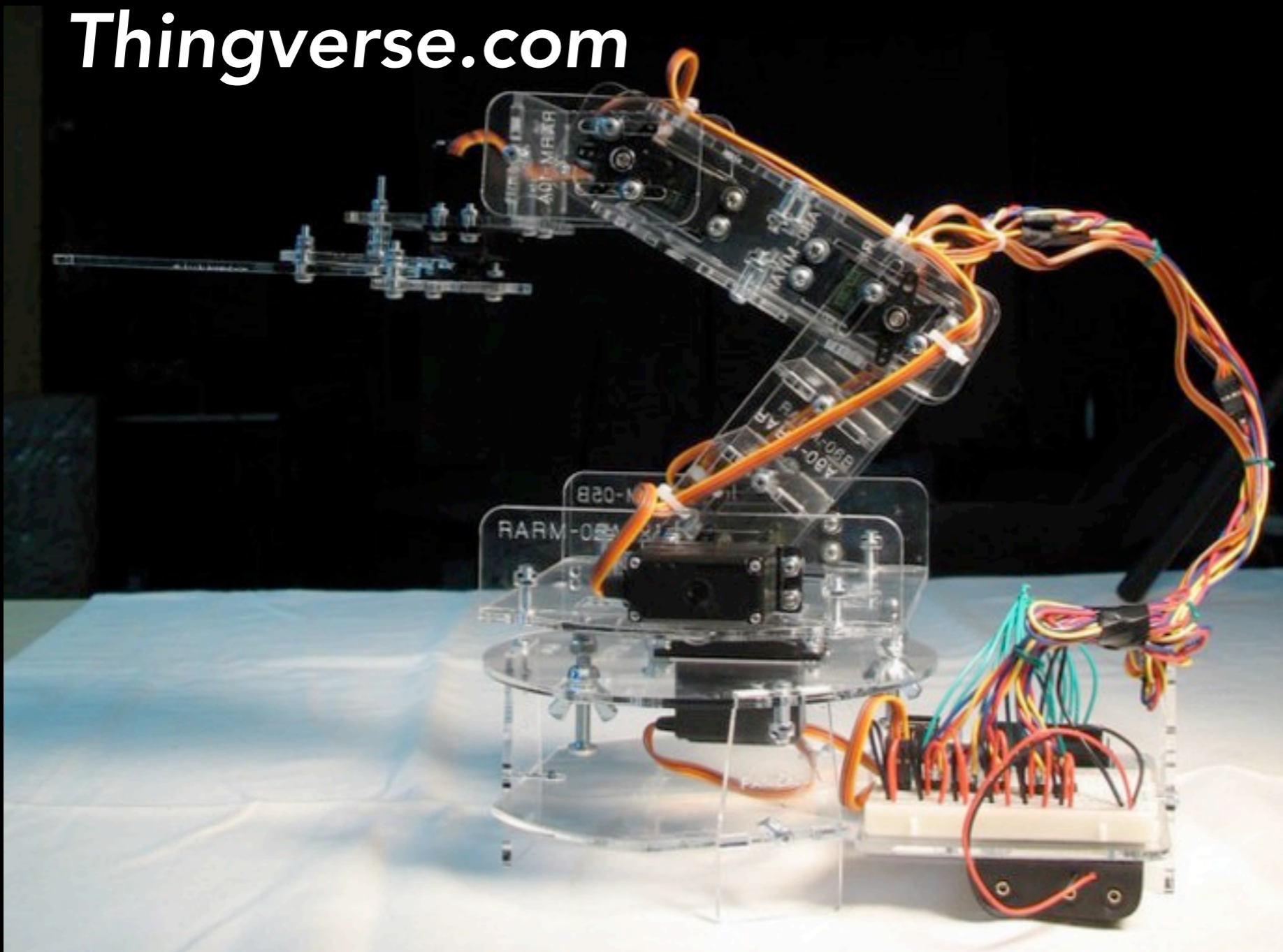
ACTUATORS

New! Adafruit's analog feedback servo motors



RESOURCES

Instructables.com
Thingiverse.com



OFFICE HOURS

Tuesday 18:00 - 20:00

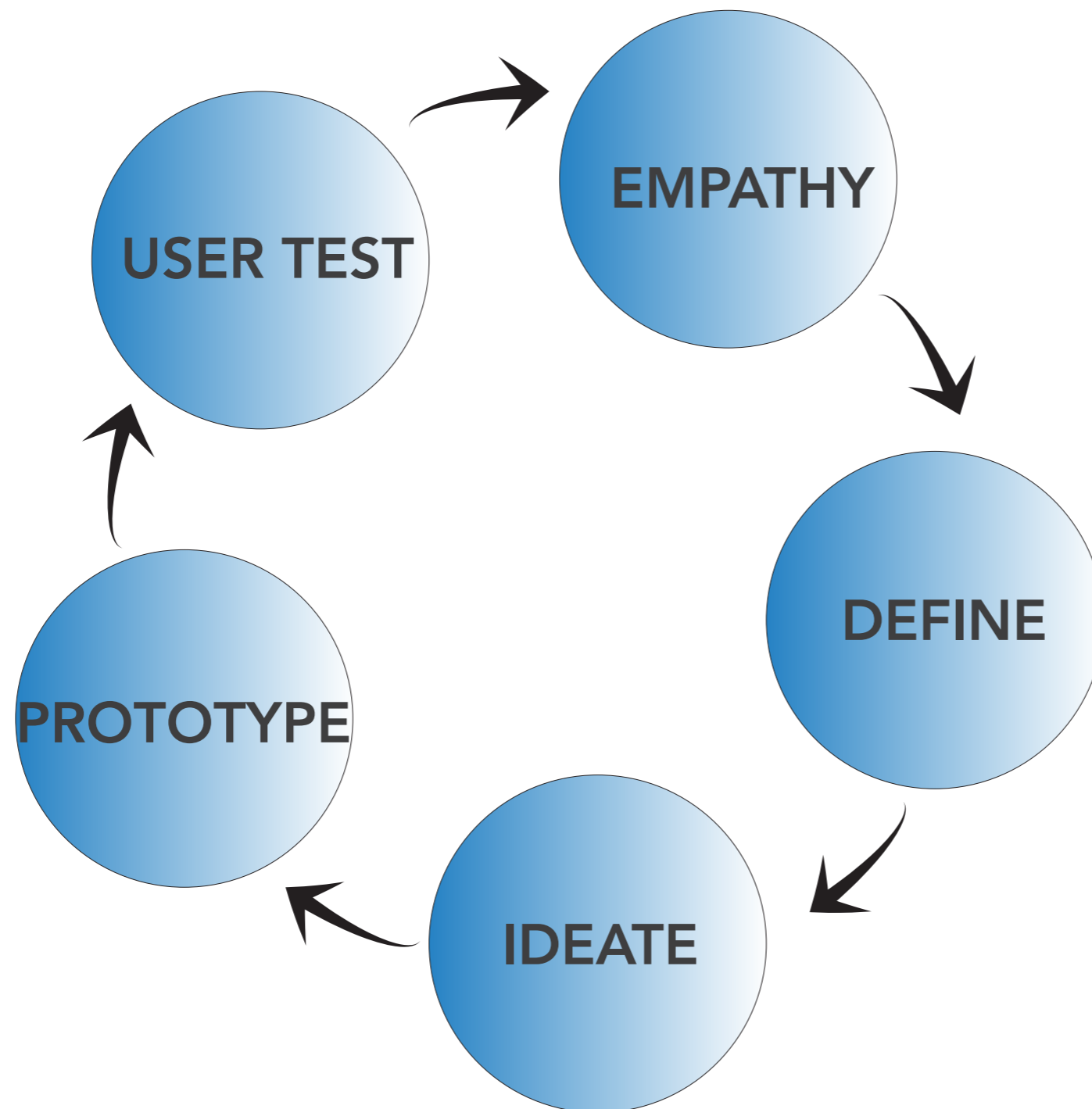
and / or

Friday 15:00 - 18:00

...(or by appointment)

Extra Help: Resident - Crys Moore
crysmoore@nyu.edu

DESIGN METHODOLOGY



DESIGN METHODOLOGY

DERIVED FROM "DESIGN THINKING"

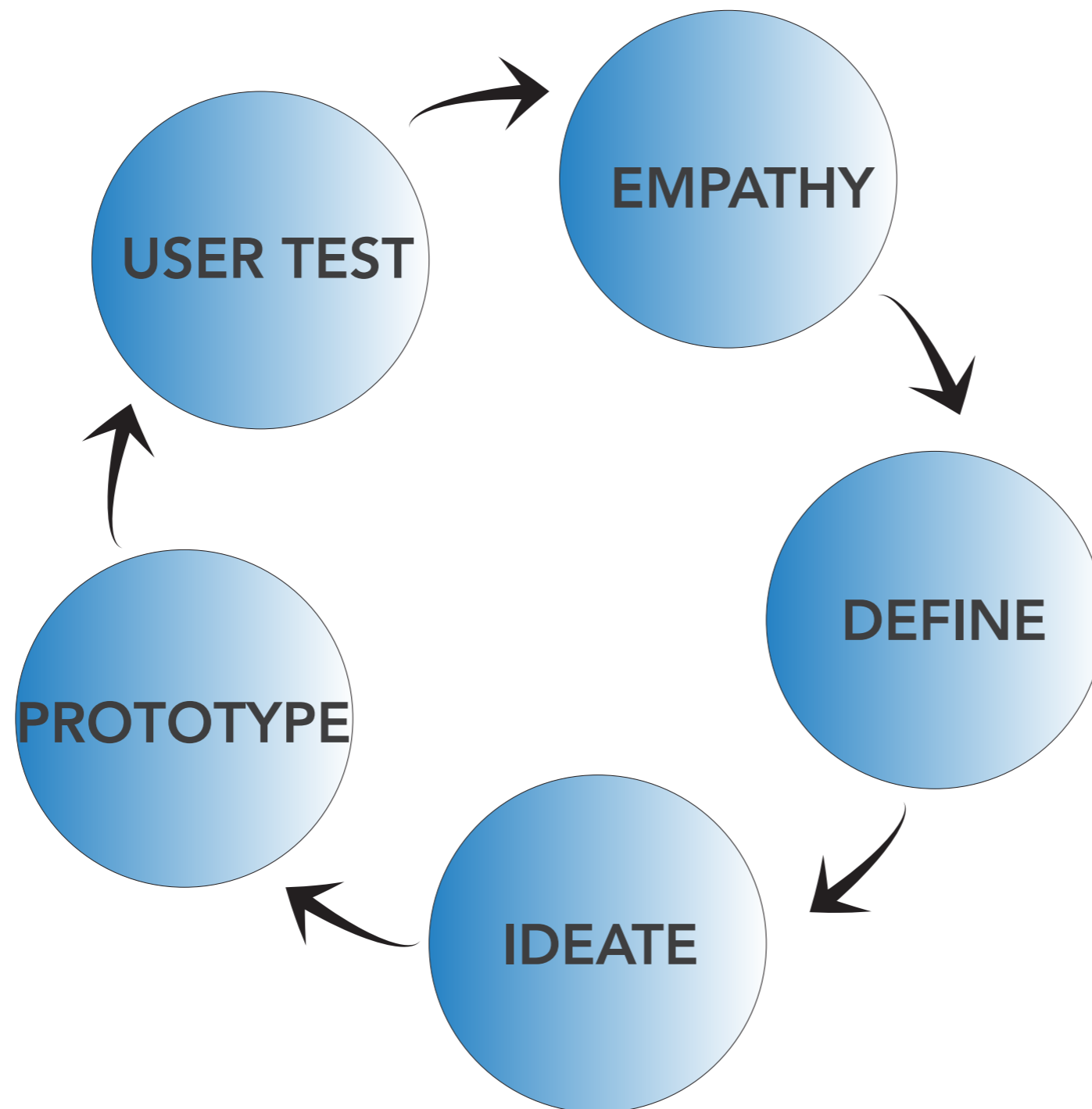
--Human based

--IDEO, Stanford d. School

--Five steps

- 1. Empathy**
- 2. Define**
- 3. Ideate**
- 4. Prototype**
- 5. User Test**

DESIGN METHODOLOGY



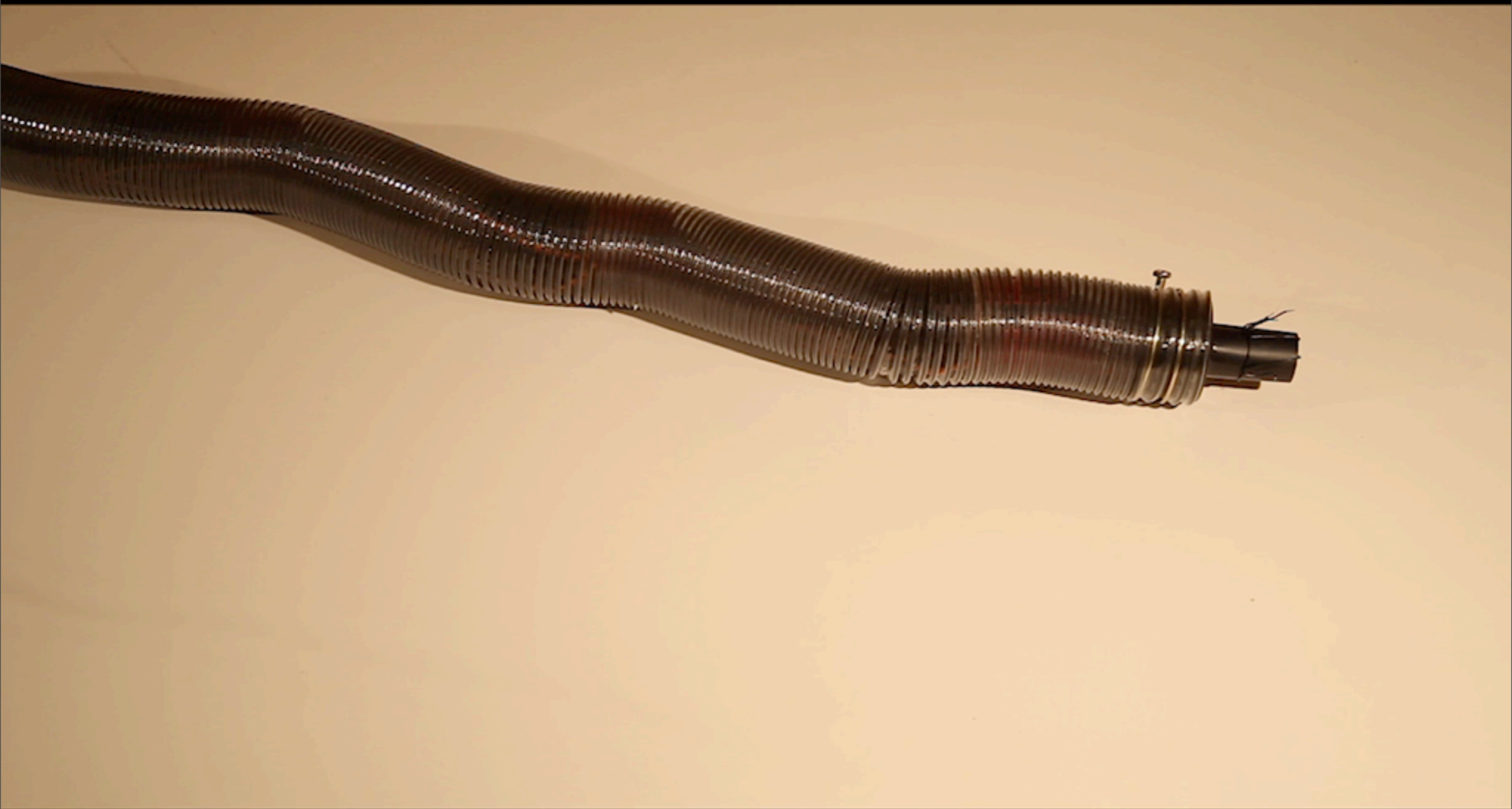
EXAMPLES



SNEEL



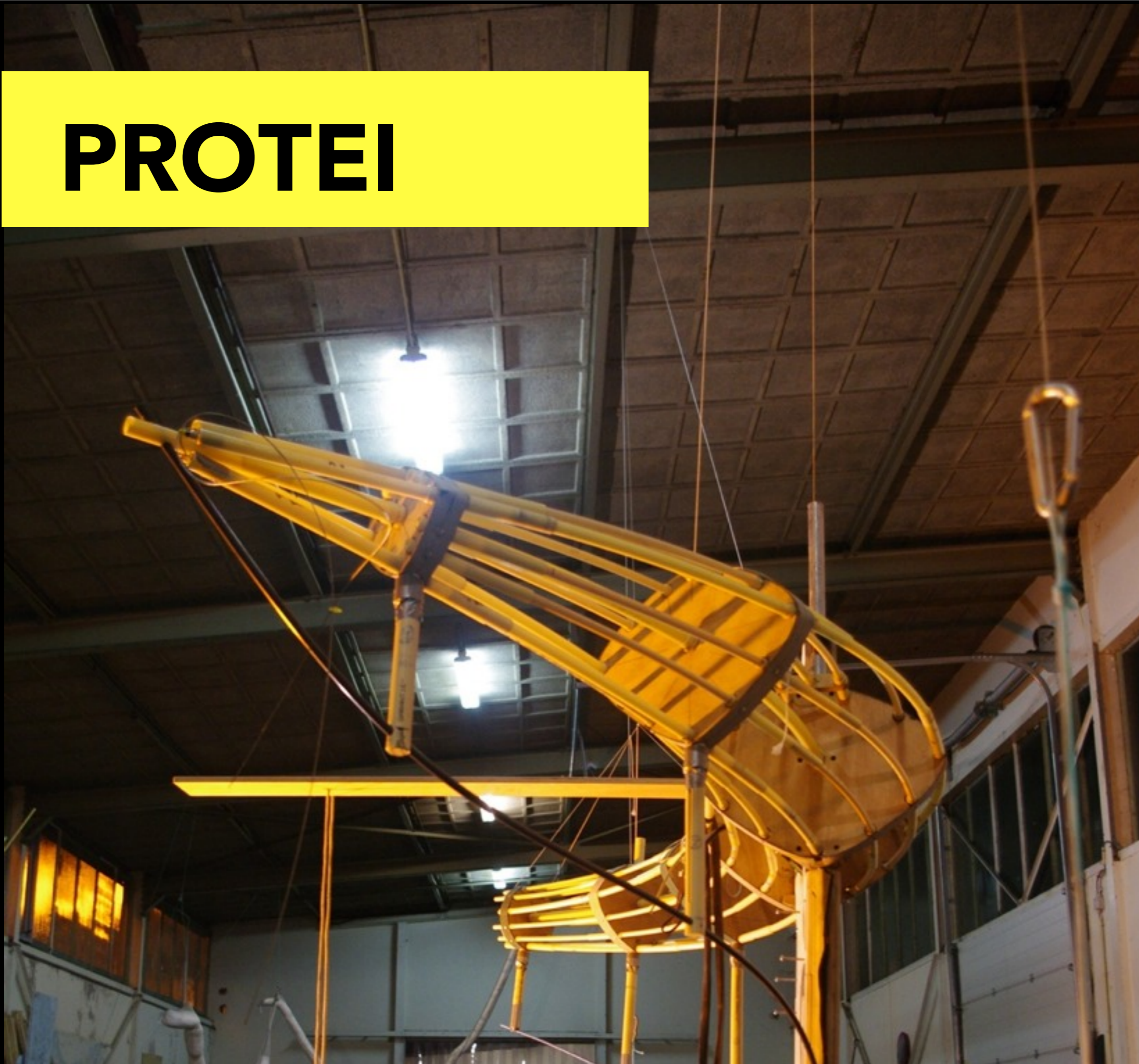
SNEEL



SNEEL



PROTEI



PROTEI



PROTEI



NATURAL FUSE



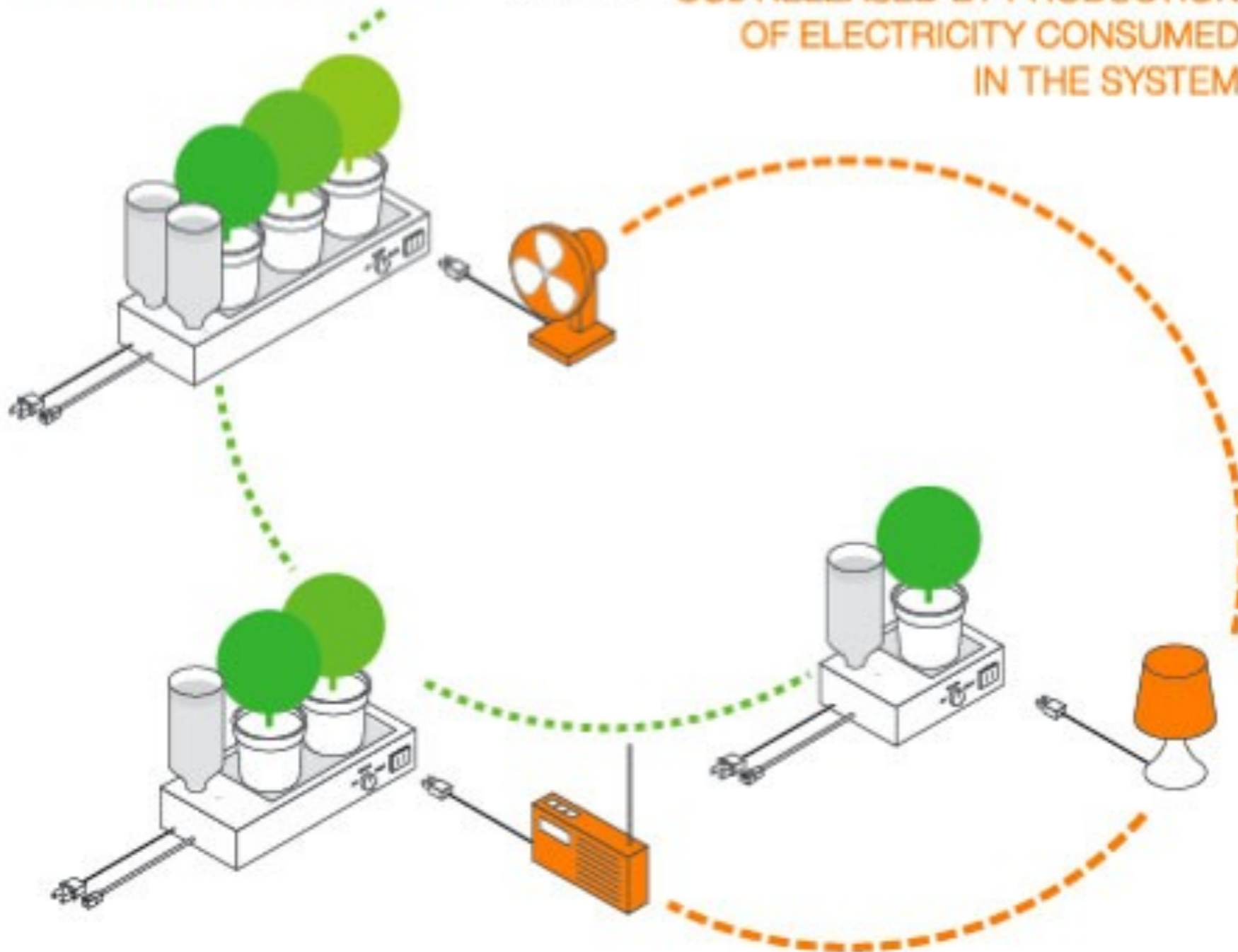
CO₂ overload protection framework for a networked plant system that powers light

NATURAL FUSE

CO₂ SEQUESTERED BY
PLANTS IN THE SYSTEM

OFFSETS

CO₂ RELEASED BY PRODUCTION
OF ELECTRICITY CONSUMED
IN THE SYSTEM



PROPERTIES of BIOMIMICRY

FORM & MOTION (robotic snakes)

MATERIALITY (waterproofing)

METHODS OF MANUFACTURE (spiderwebs)

MECHANISMS (velcro, sonar)

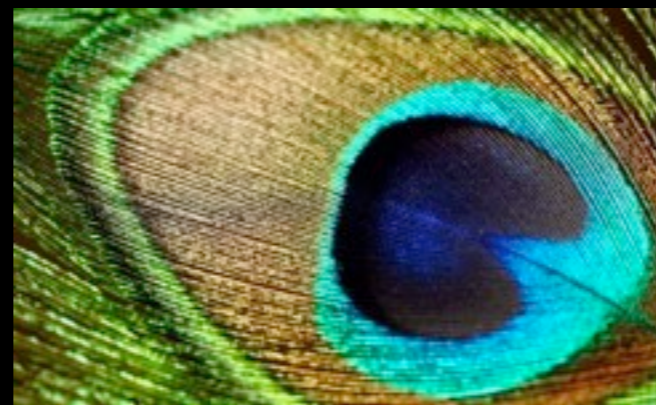
***ORGANIZATIONAL PRINCIPLES (bird
flocking, swarm intelligence of fish)***

BIOMIMETICS

- *flight*
- *adhesion*
- *adaptation & reconfiguration*
- *process complex three-dimensional (3D)*
- *recycle power*
- *self-replicate, self-grow*
- *generate and store energy*
- *optimization of search algorithms*
- *artificial intelligence*

NEW MATERIALS

MATERIAL PROPERTIES









Wednesday, September 4, 13

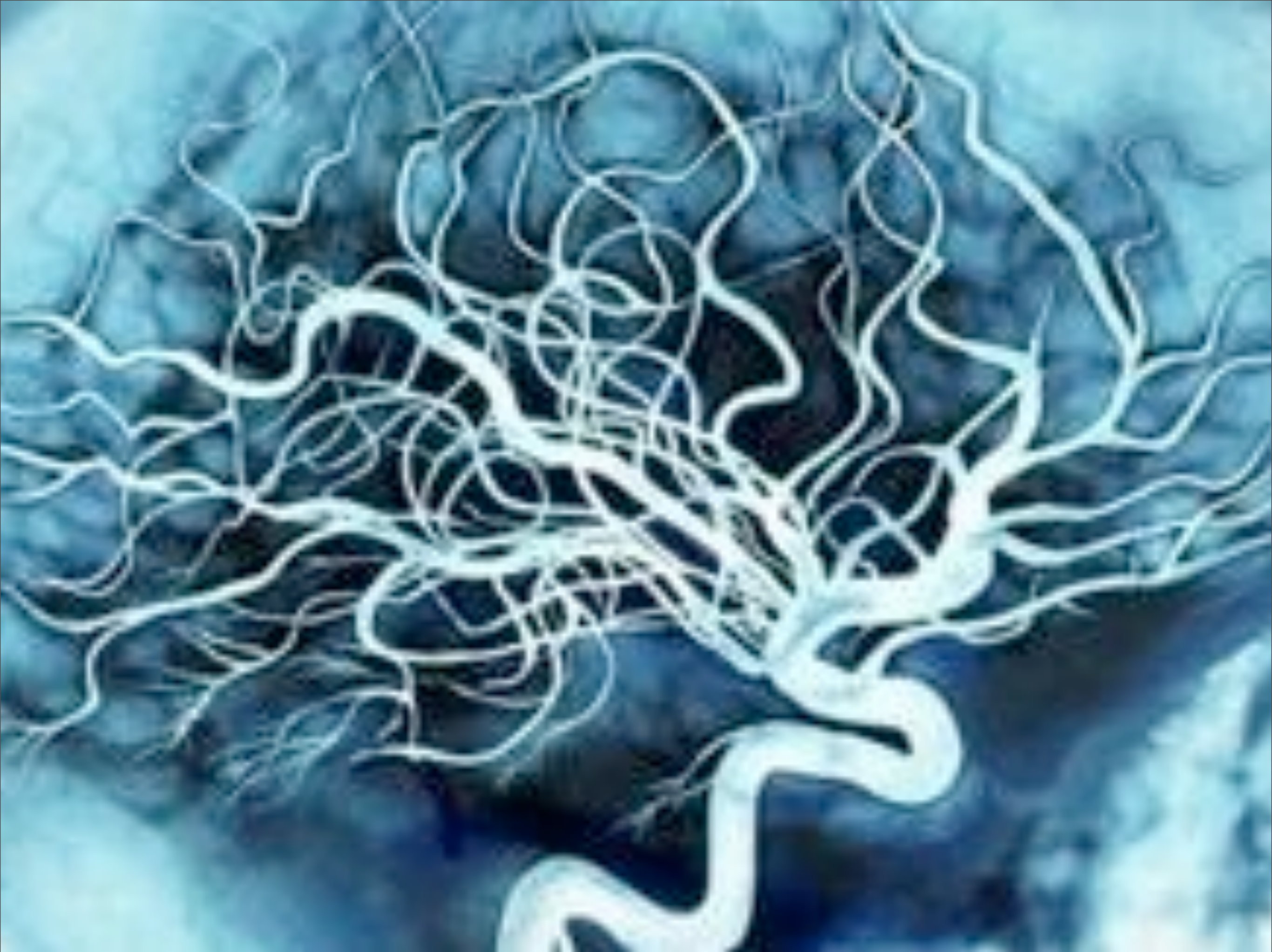






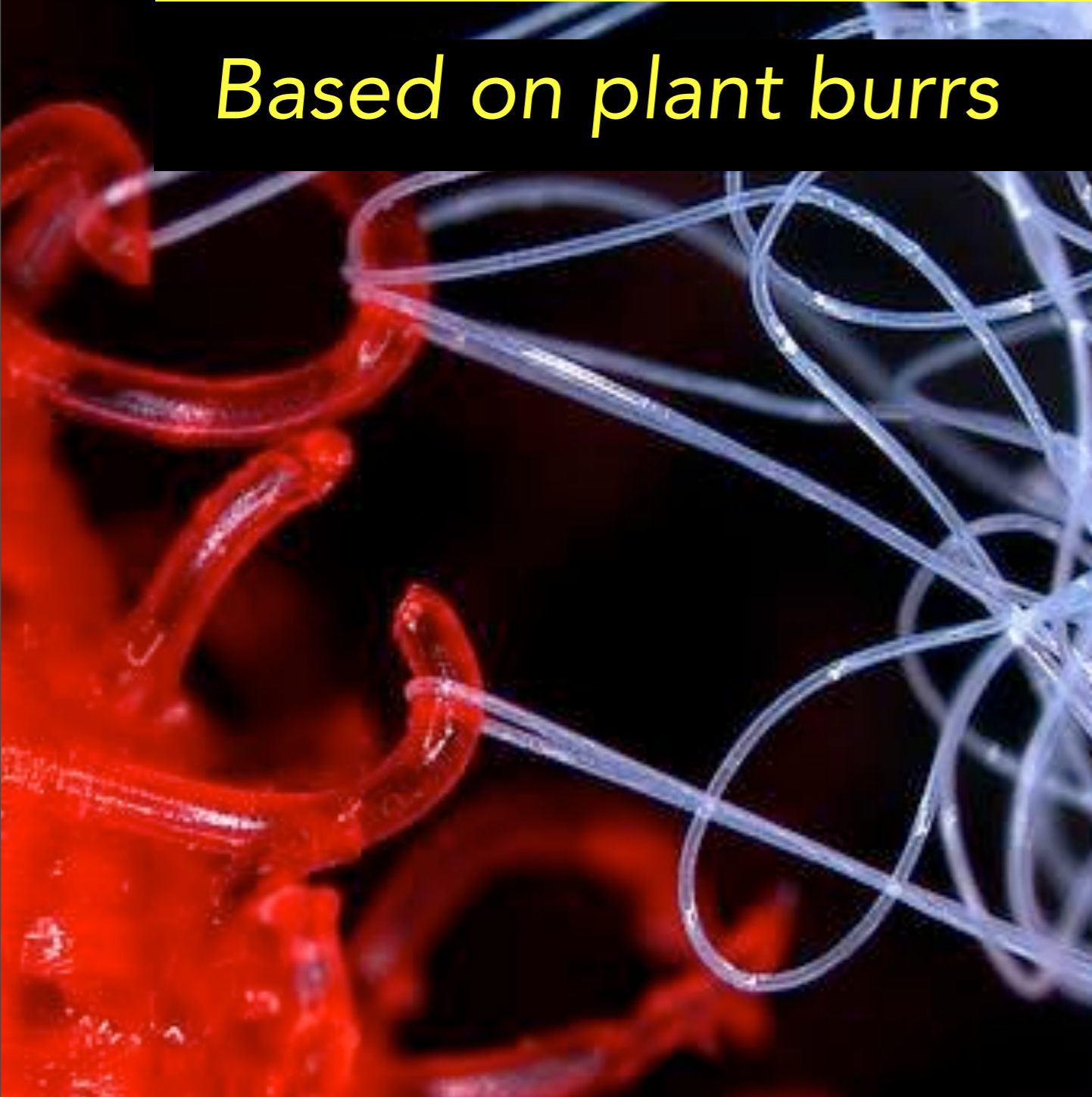






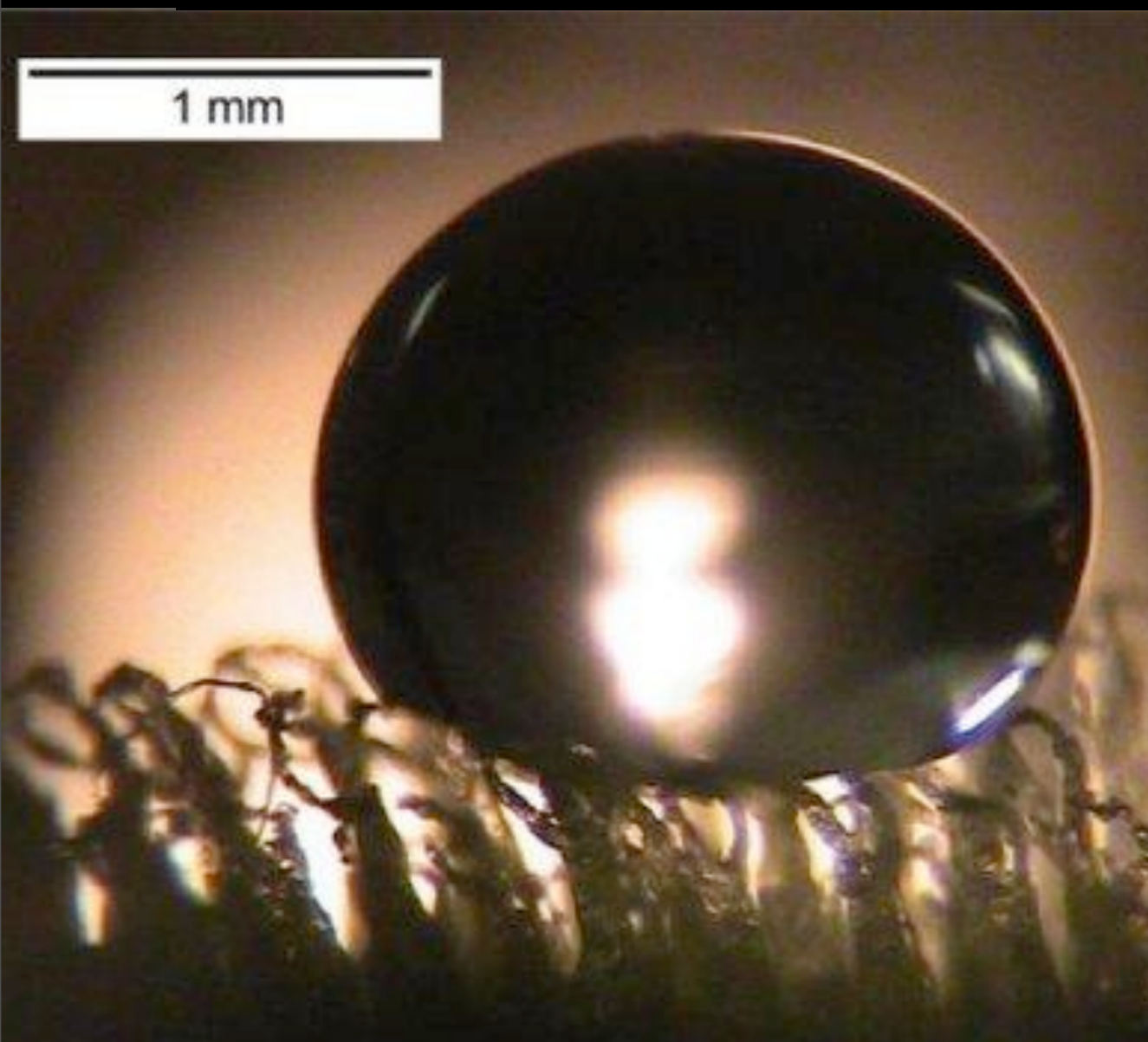
VELCRO

Based on plant burrs



WATERPROOFING

New material coating for boats from pesky aquatic plant



ULTRA SLIPPERY MATERIAL

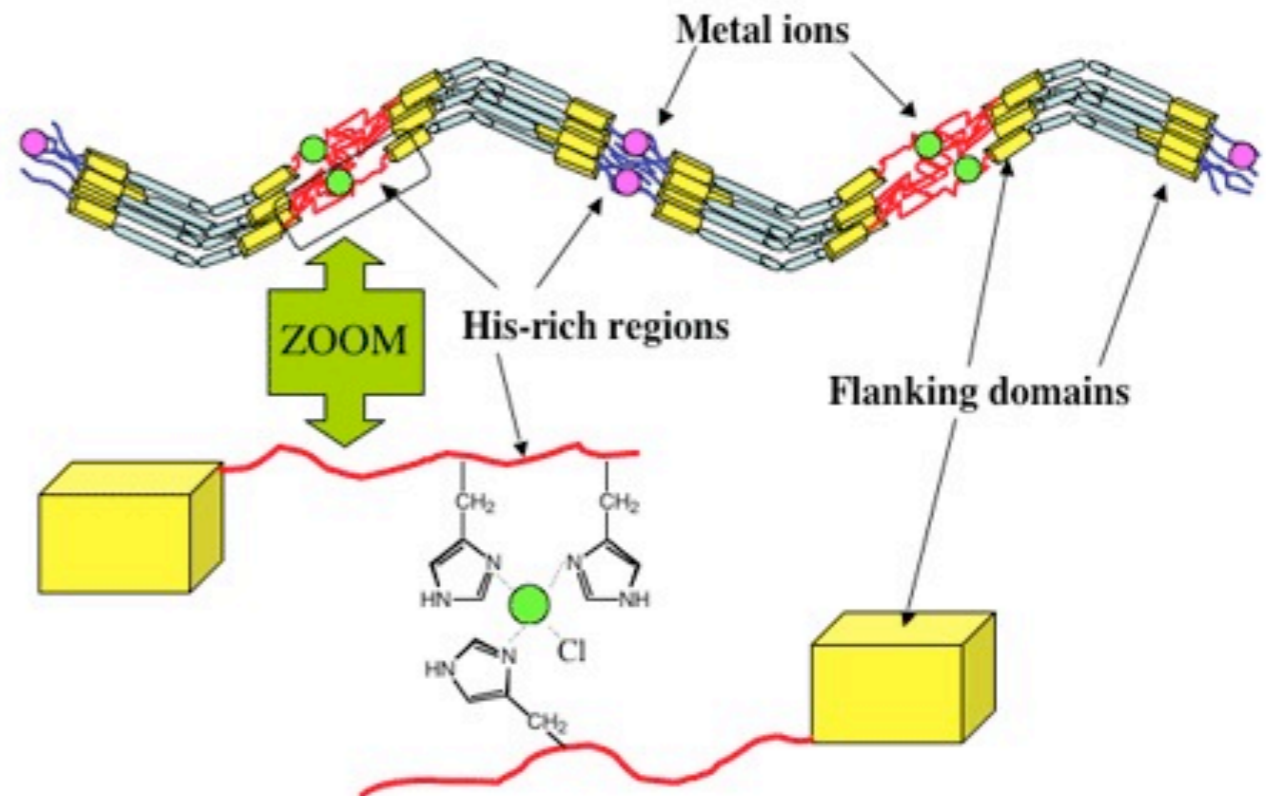
Inspired by carnivorous Pitcher plant



ULTRA STICKY MATERIAL

Inspired by blue mussels in intertidal zone

Metal ion mediated cross-links in preCOL units



Waite et al. (1998) *Matrix Biol.*

SELF HEALING POLYMERS

Inspired by cell regrowth and tissue repair

15 micrometers

SYSTEMS & SCALE

COMMUNICATION

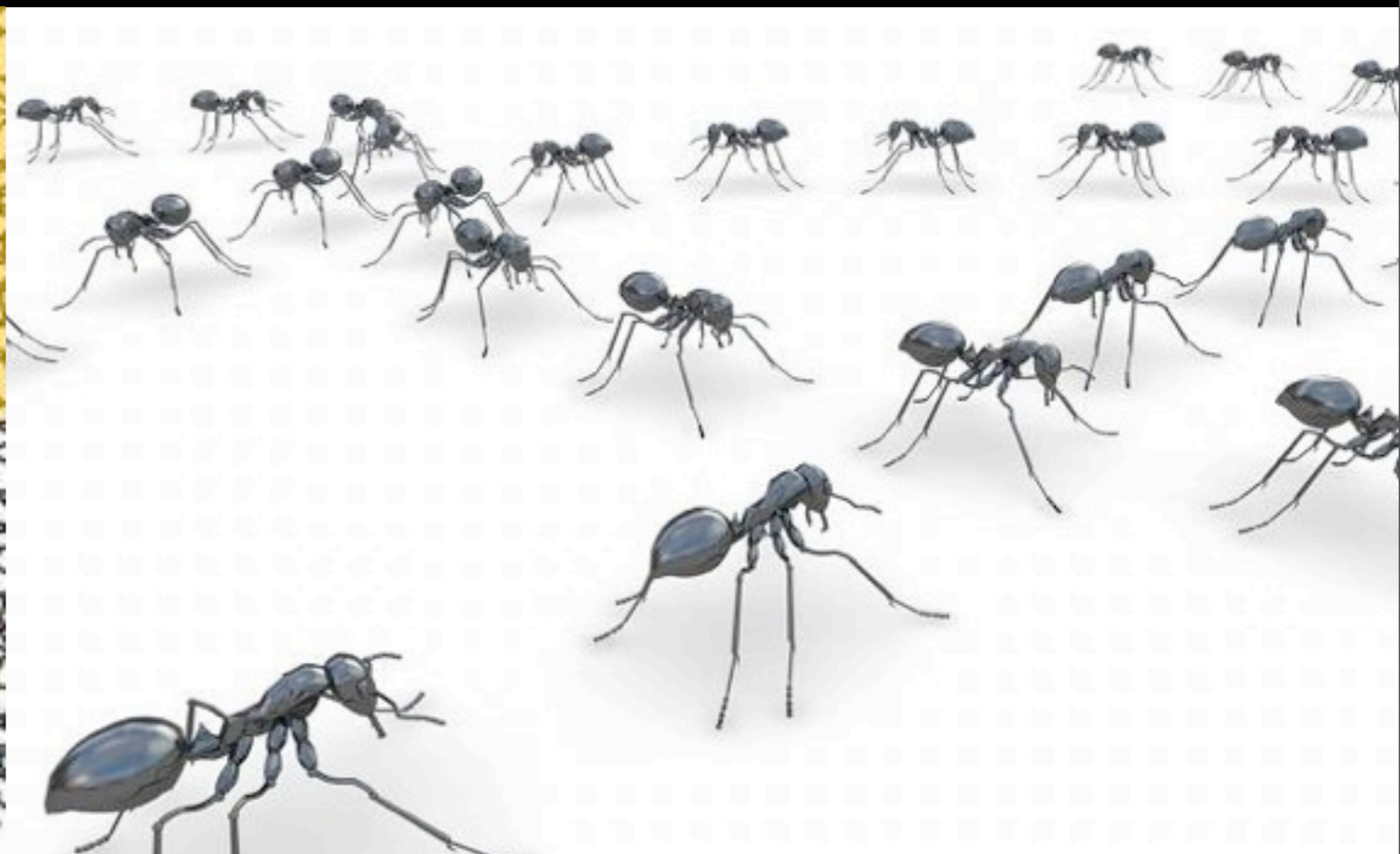


URBAN PLANNING



SOCIAL NETWORKS

*Better connectivity using ants as models:
SoSACO algorithm*



SURGICAL TOOLS

Surgical endoscope modeled on a snake



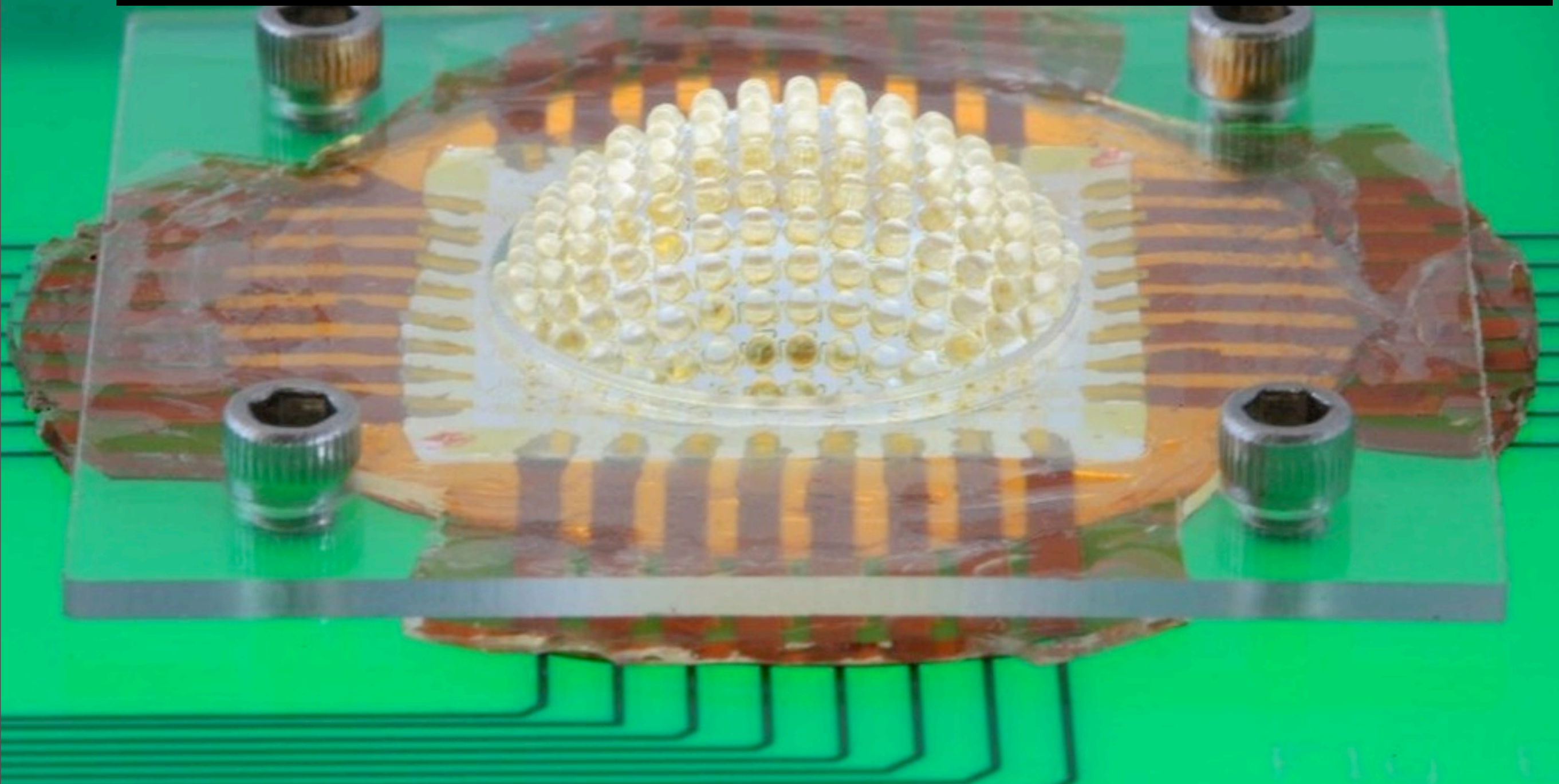
INTERACTIVE ART

*Networked sensor communication
of synthetic forms*



SENSORS

Balloon-Shaped camera mimics an insect's eye



WALL CLIMBING ROBOT

Inspired by gecko feet



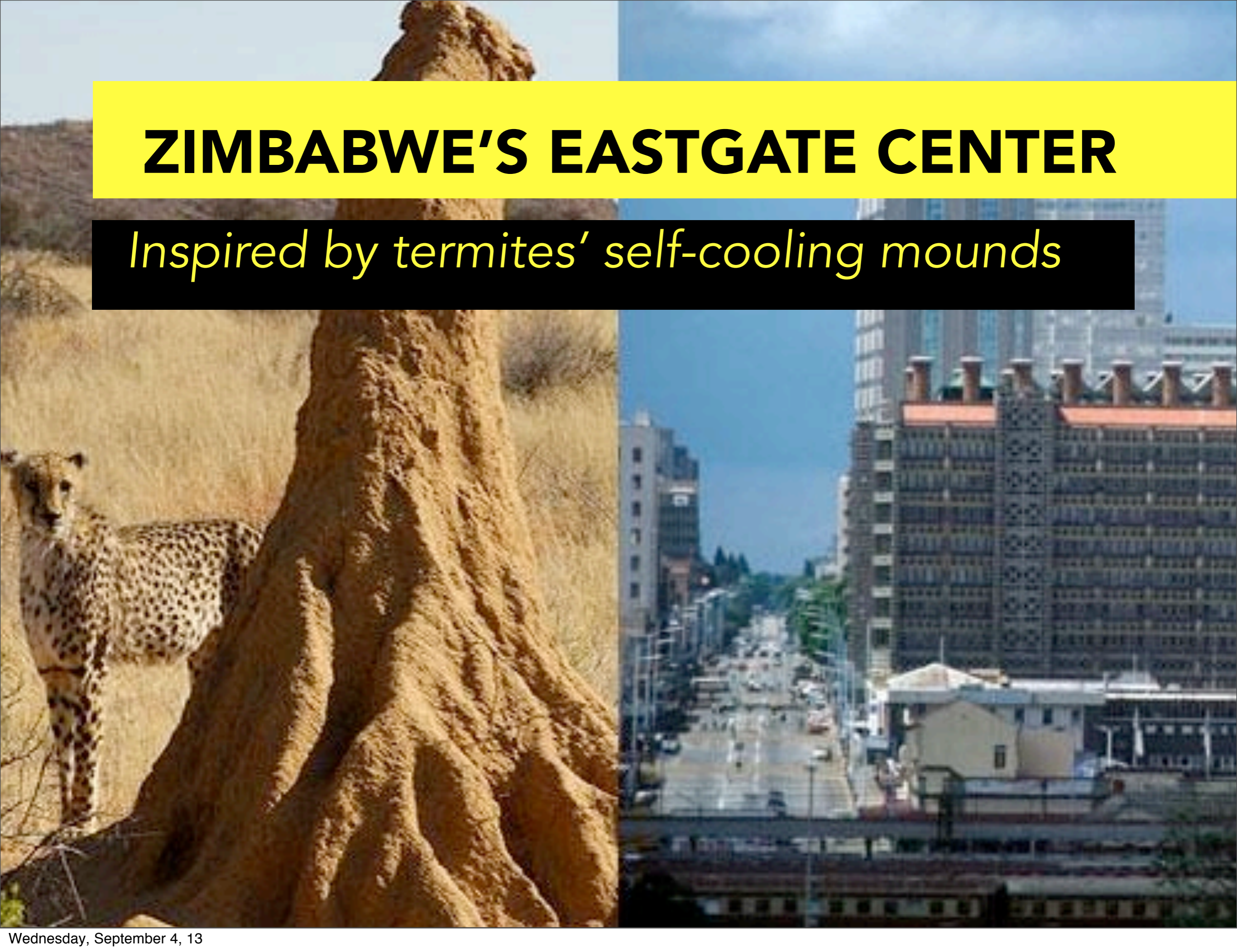
TRANSPORTATION

Shinkansen bullet train Inspired by kingfisher splashless water entry to minimize noise



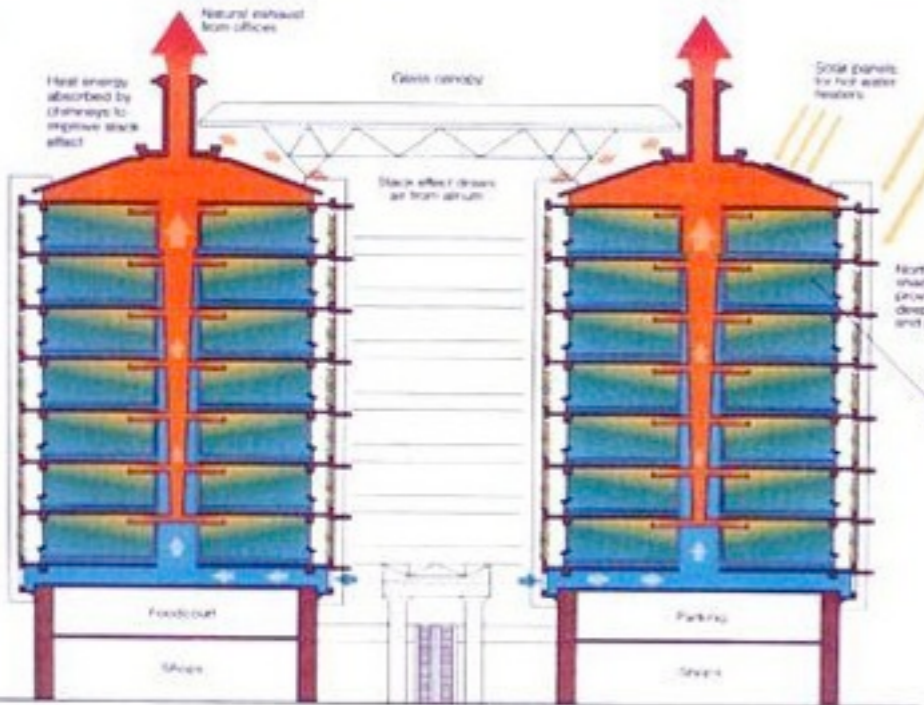
ZIMBABWE'S EASTGATE CENTER

Inspired by termites' self-cooling mounds

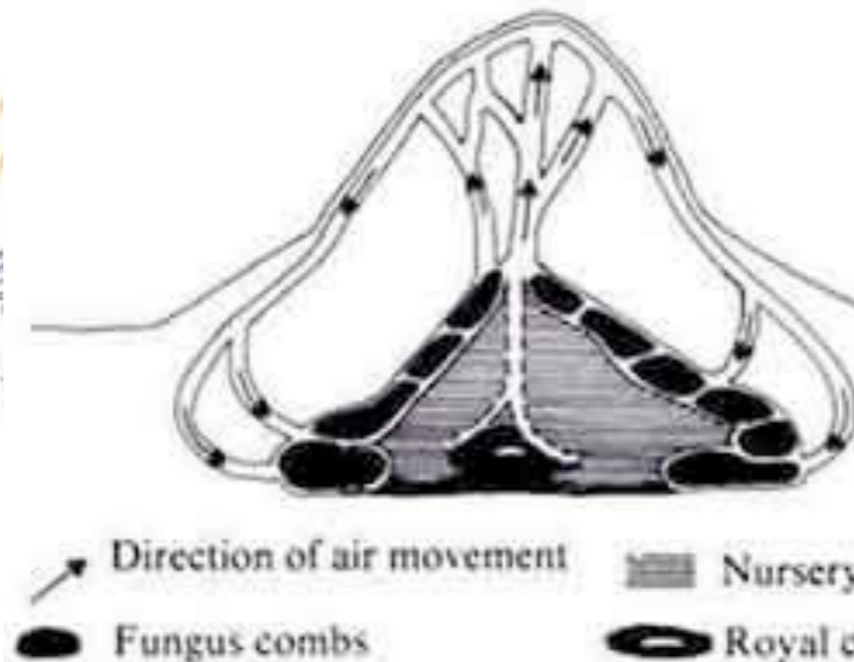


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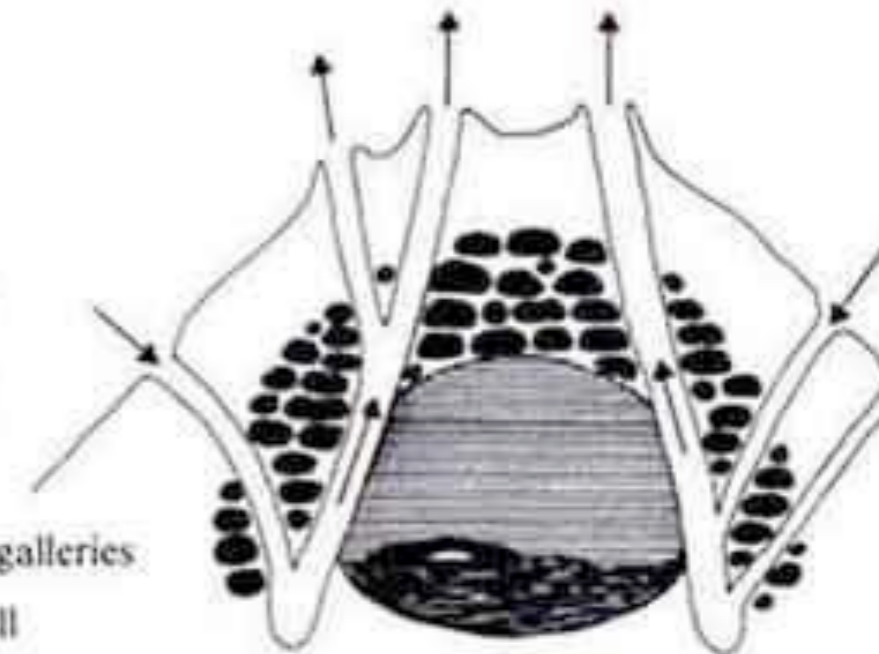
Inspired by termites' self-cooling mounds



A. *Macrotermes michaelseni*



B. *Macrotermes subhyalinus*



FESTO'S AIR PENGUIN



FESTO'S BIONIC HAND

Inspired by an elephant trunk



EXERSIZE

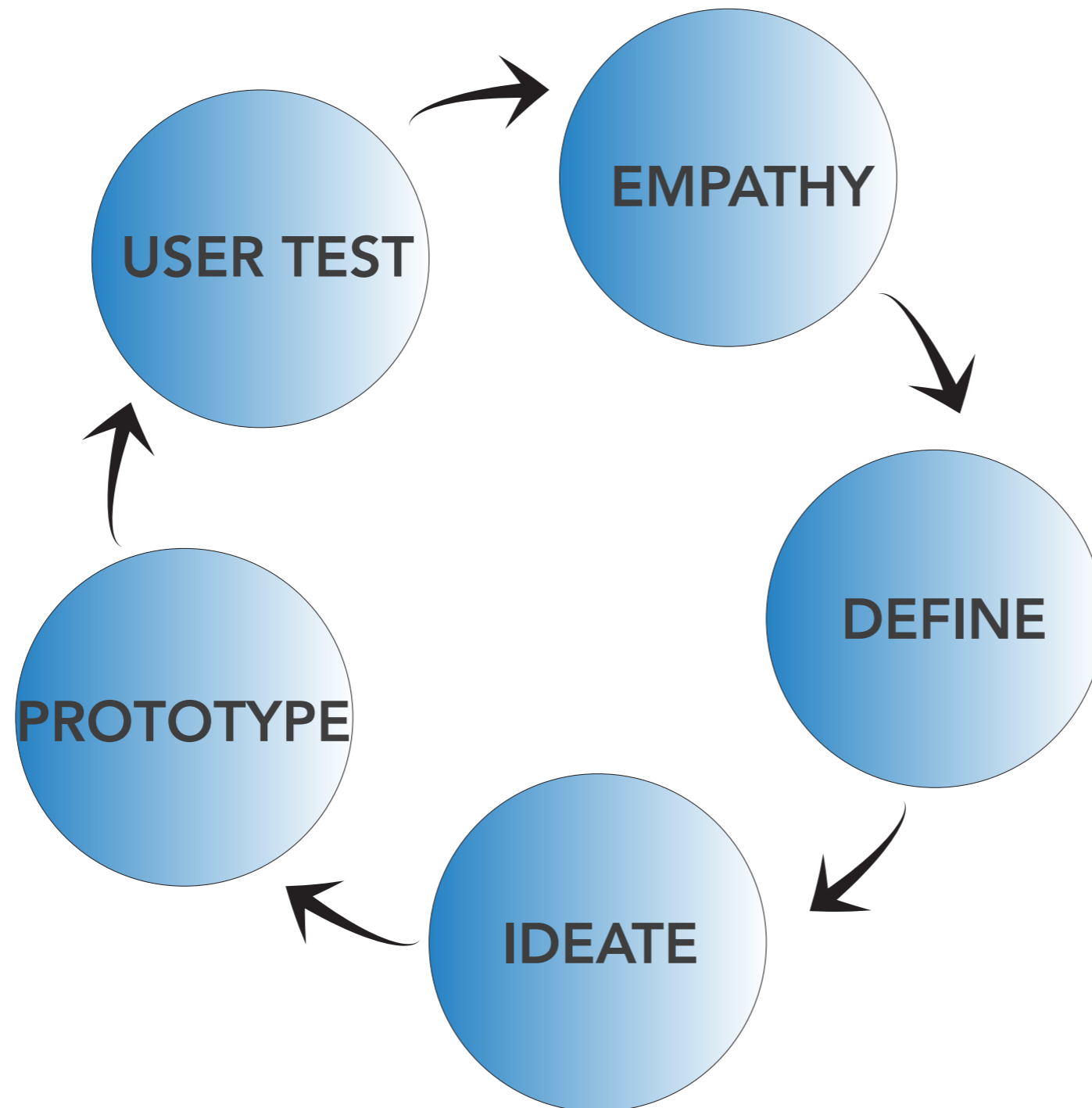
Redesign an ideal movable joint for your partner

http://levinegabriella.com/exploringbiomimicry/briefs/REDESIGN_JOINT_.pdf

[under handout page on the class website]

1/2 hour

DESIGN THINKING



EXCERSIZE

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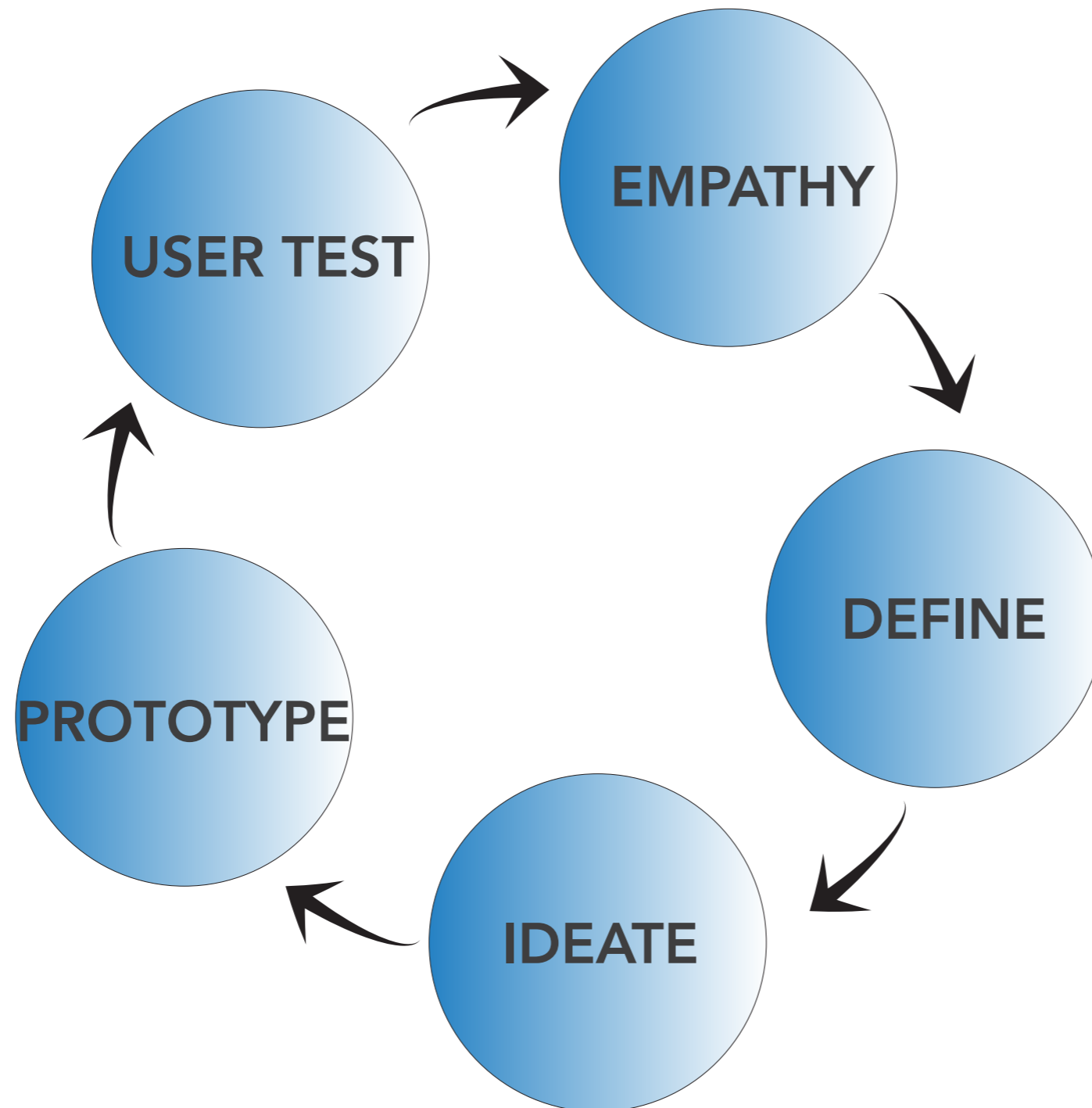
DEFINE

P.O.V. statement

User [_who_] needs a way to [_need_]

because [_____insight_____]

DESIGN THINKING



EXCERSIZE

Redesign an ideal movable joint for your partner

TODAY

1. *Intro*
2. *Lecture [Properties of Biomimicry]*
2. *Design Thinking & Biomimicry excersize*
4. *Debrief & Assignment*

NEXT WEEK

1. Discussion + Lecture:

- Biological systems
- Sensing & Feedback systems
- Organic Motion / Kinetics
- Biomimicry in Interface Design

2. Design methodology

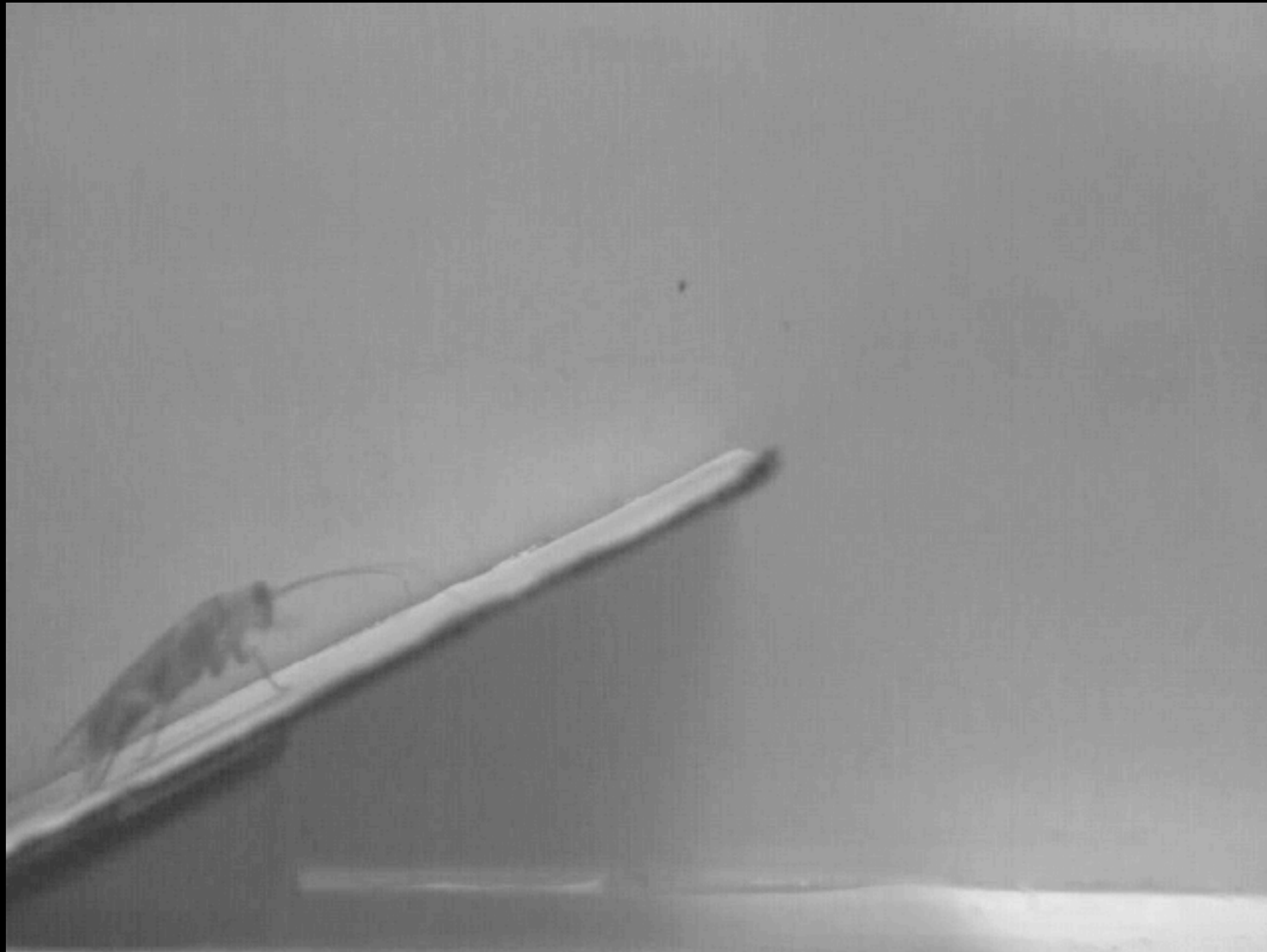
2. HW presentations

3. Assignment 2

INSPIRATION : GECKO



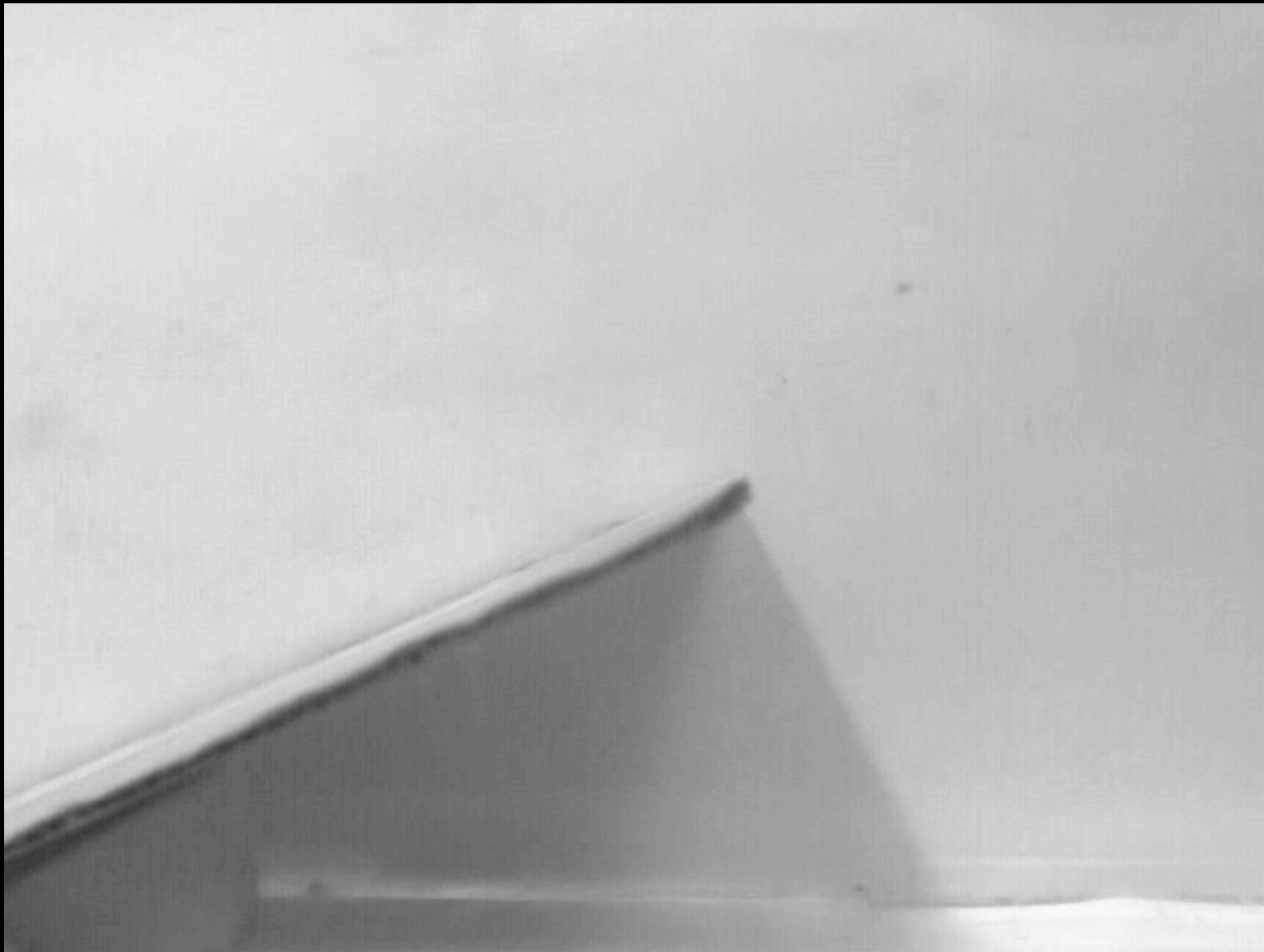
COCKROACH



ROBOT



FALLING



ARDUINO TAIL

[http://www.youtube.com/watch?
v=d1k9p1P4s8l](http://www.youtube.com/watch?v=d1k9p1P4s8l)

ASSIGNMENT

1. Biomimetic designs:

1. Example of an inspiring biomimetic project you love
2. Example of a biomimetic project you hate

Document with photos and writing :
what is the project, who created it, why do you / dont you like it?

2. Readings [links & more info on the class website]

1. <http://biomimicry.net/about/biomimicry/>
2. Bar-Cohen on Biomimicry
3. Designing features for Fido (Animal - Computer Interaction)

Write a 1 paragraph response to each

3. Build & Prototype: Design

Design a physical system & program organic motion
(a joint, rotation / linear, something that moves somehow...)

4. Join the Google Group

RECAP / DEBRIEF

How was today?

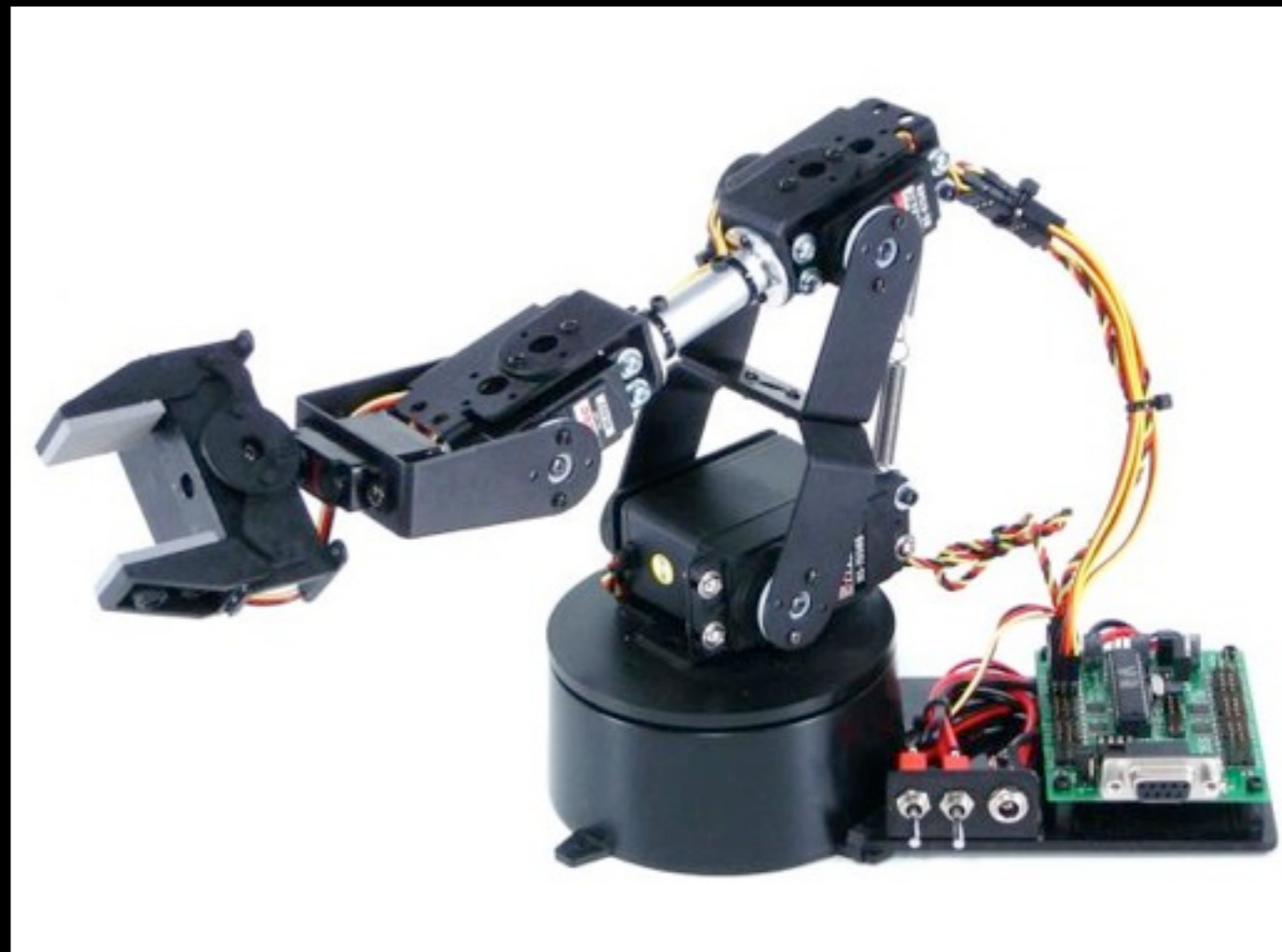
Questions?

Wishes for the class?

Things you liked?

ASSIGNMENT

- robives
 - animated gifs
 - instructables
 - thingiverse
-
- somewhat low res
 - integrate physical and digital
 - should move on its own
 - could be based on some input
 - What system does it mimic?
- be explicit and document the concept and tech online.



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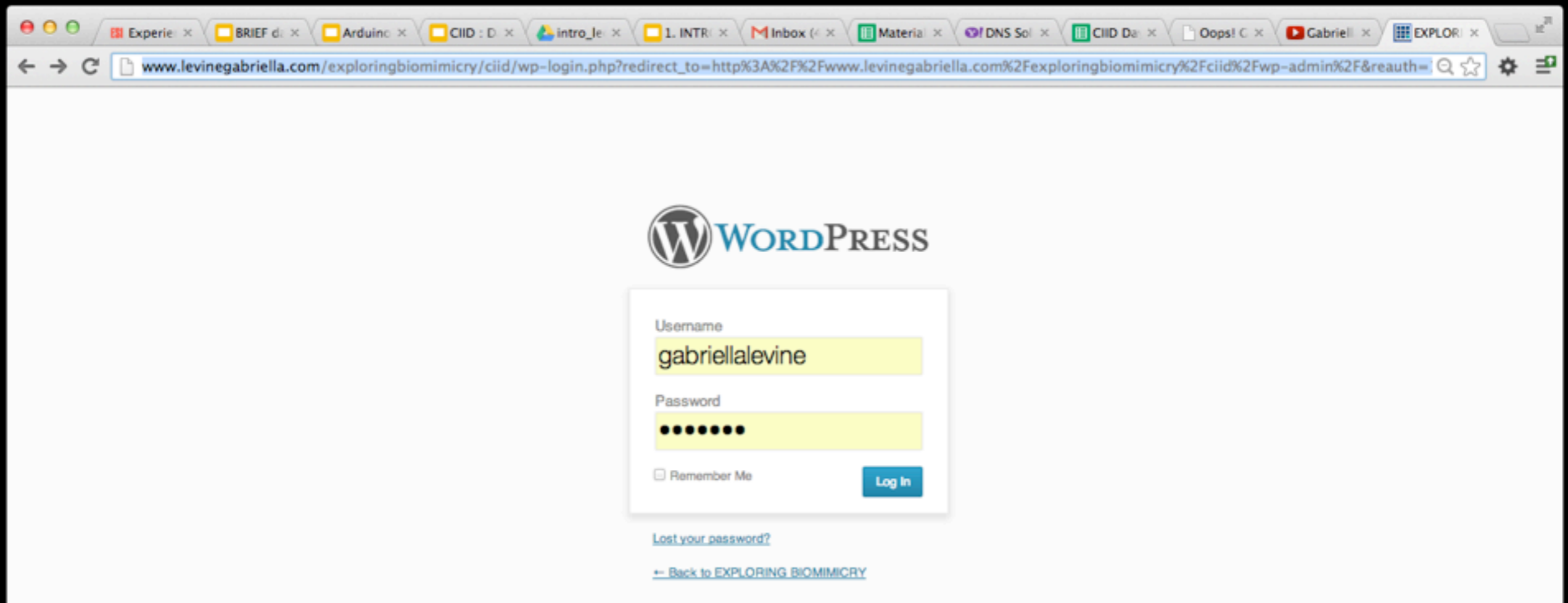
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BLOG INSTRUCTIONS

www.levinegabriella.com/exploringbiomimicry/itp/wp-admin

1. log in

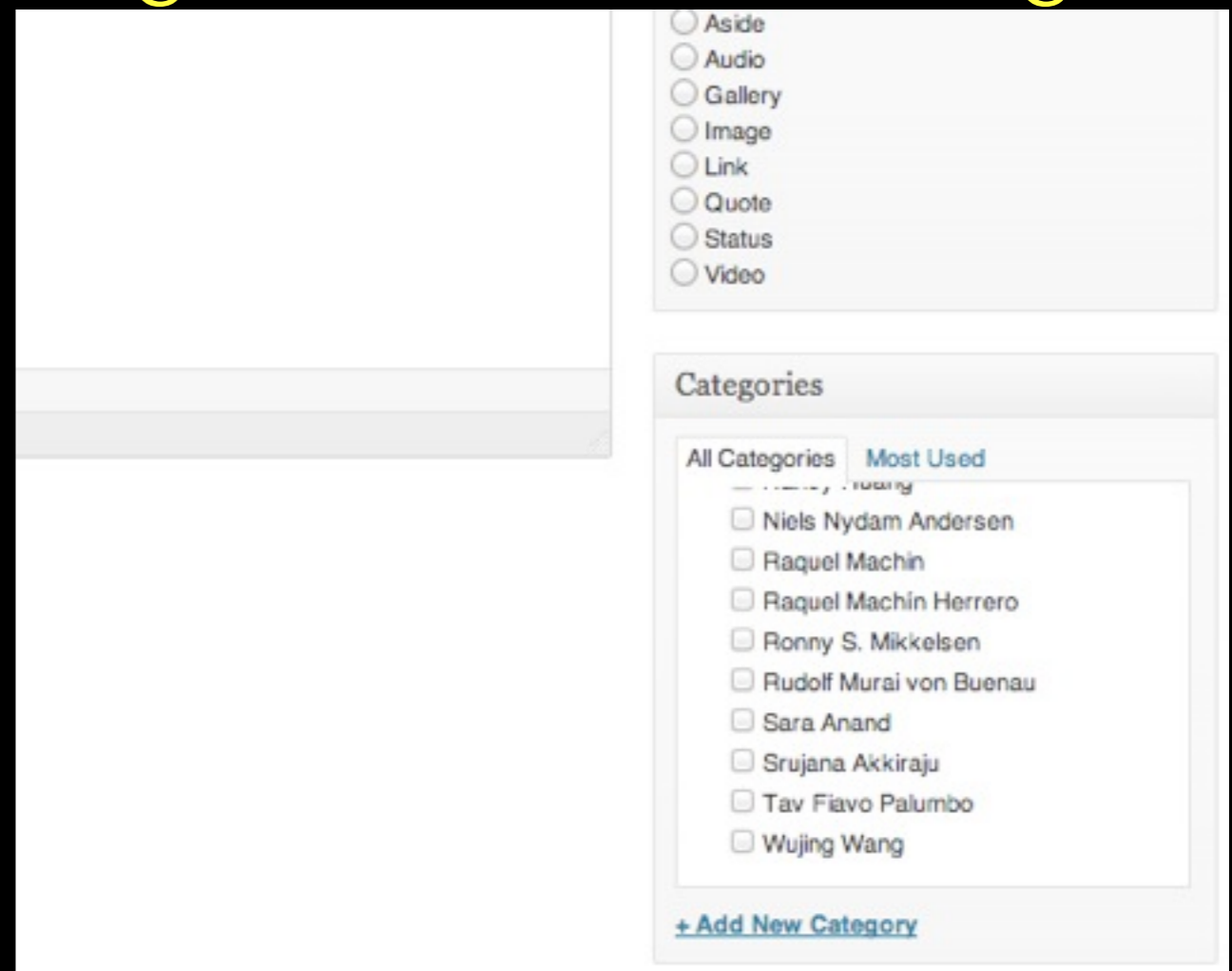
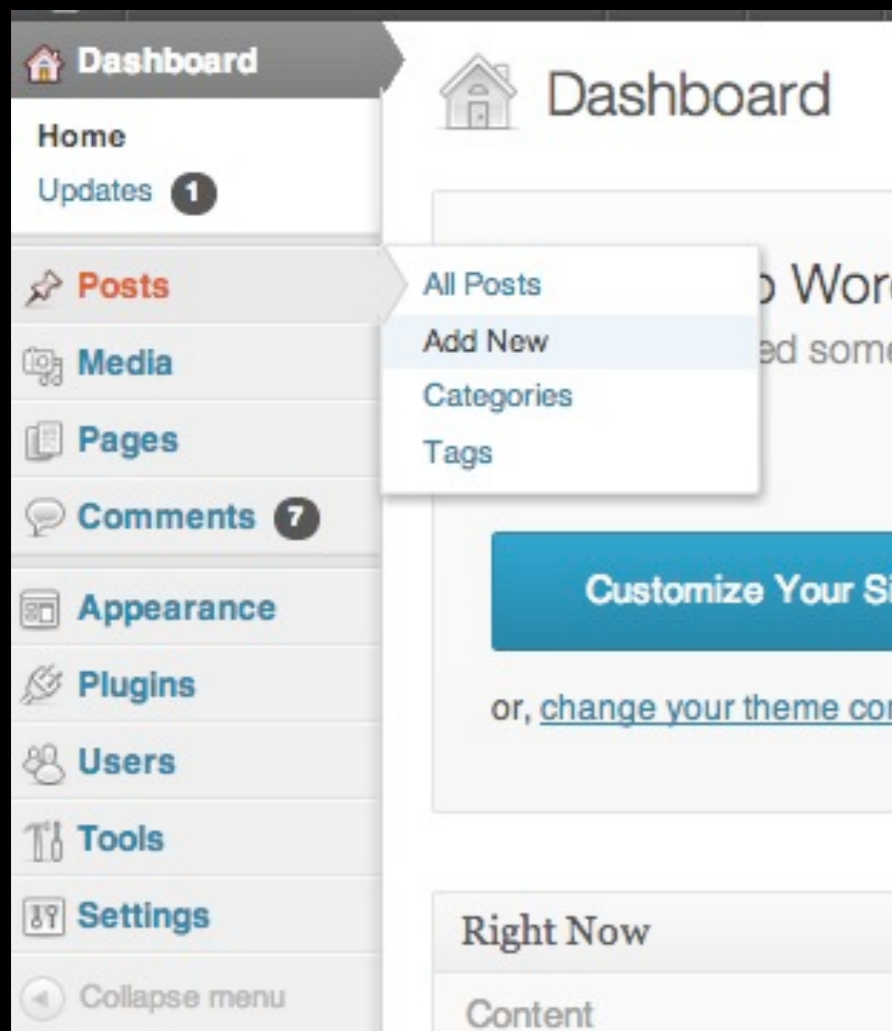


BLOG INSTRUCTIONS

www.levinegabriella.com/exploringbiomimicry/itp/wp-admin

1. add new post

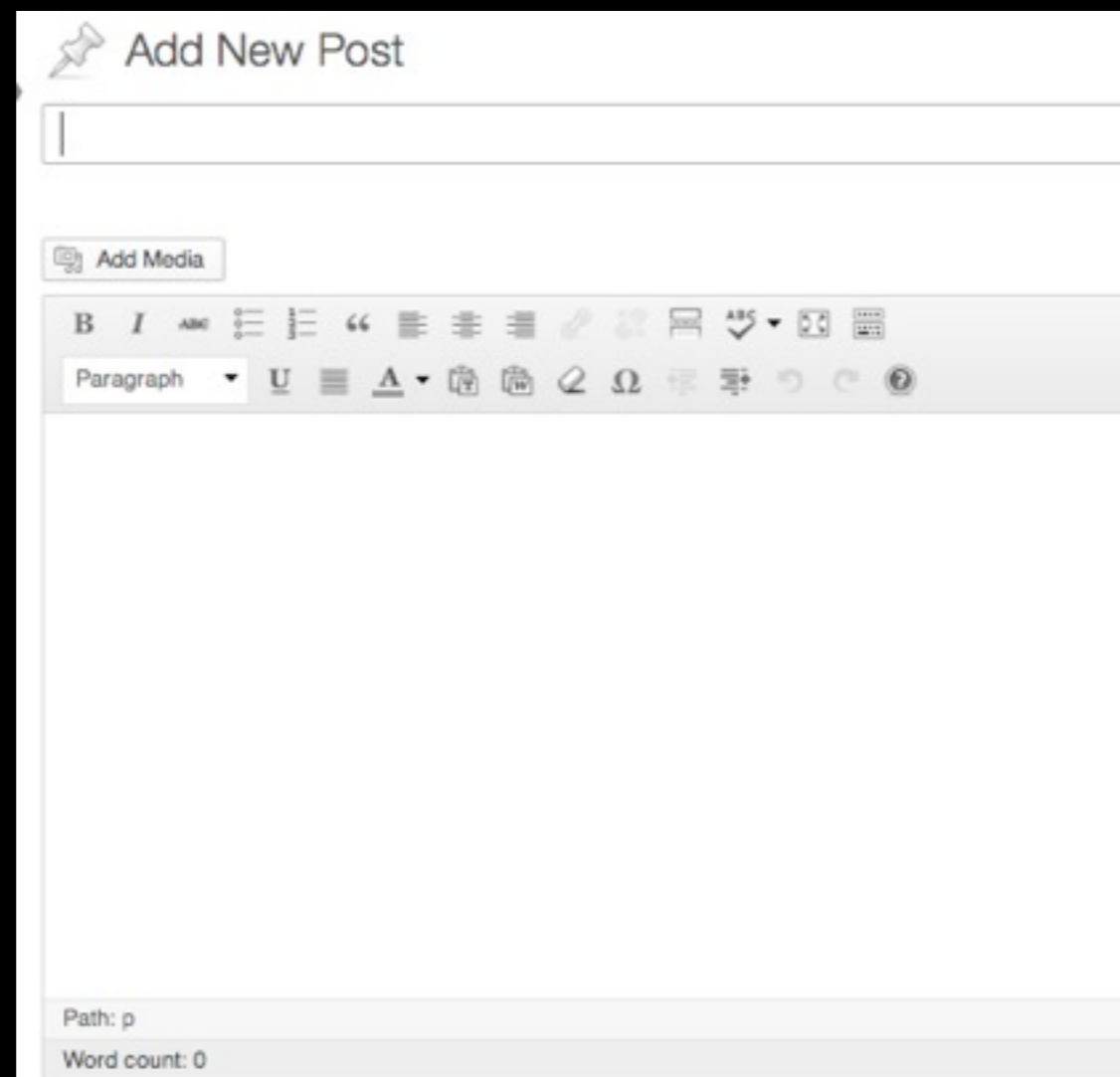
2. click **YOUR NAME** and **THE ASSIGNMENT** under categories, in the bottom right.



BLOG INSTRUCTIONS

Add 2 new posts with some media and writing!

- 1. Biomimicry documentation. Entitle this "biomimetic examples"*
- 2. Reading Responses. Entitle this "Reading Responses"*
- 3. Organic Motion design prototype. Entitle this "Motion Excercise"*



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