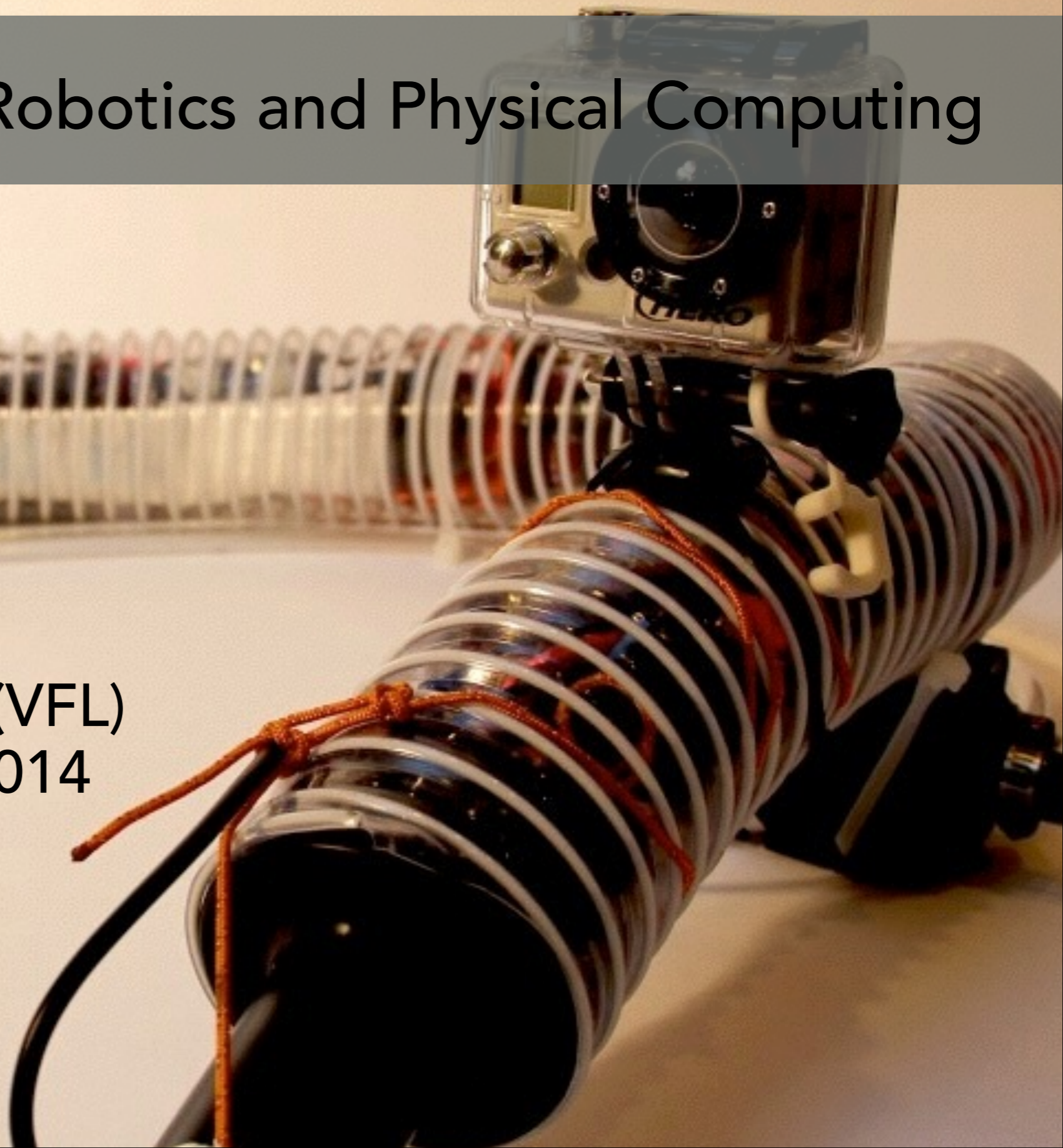


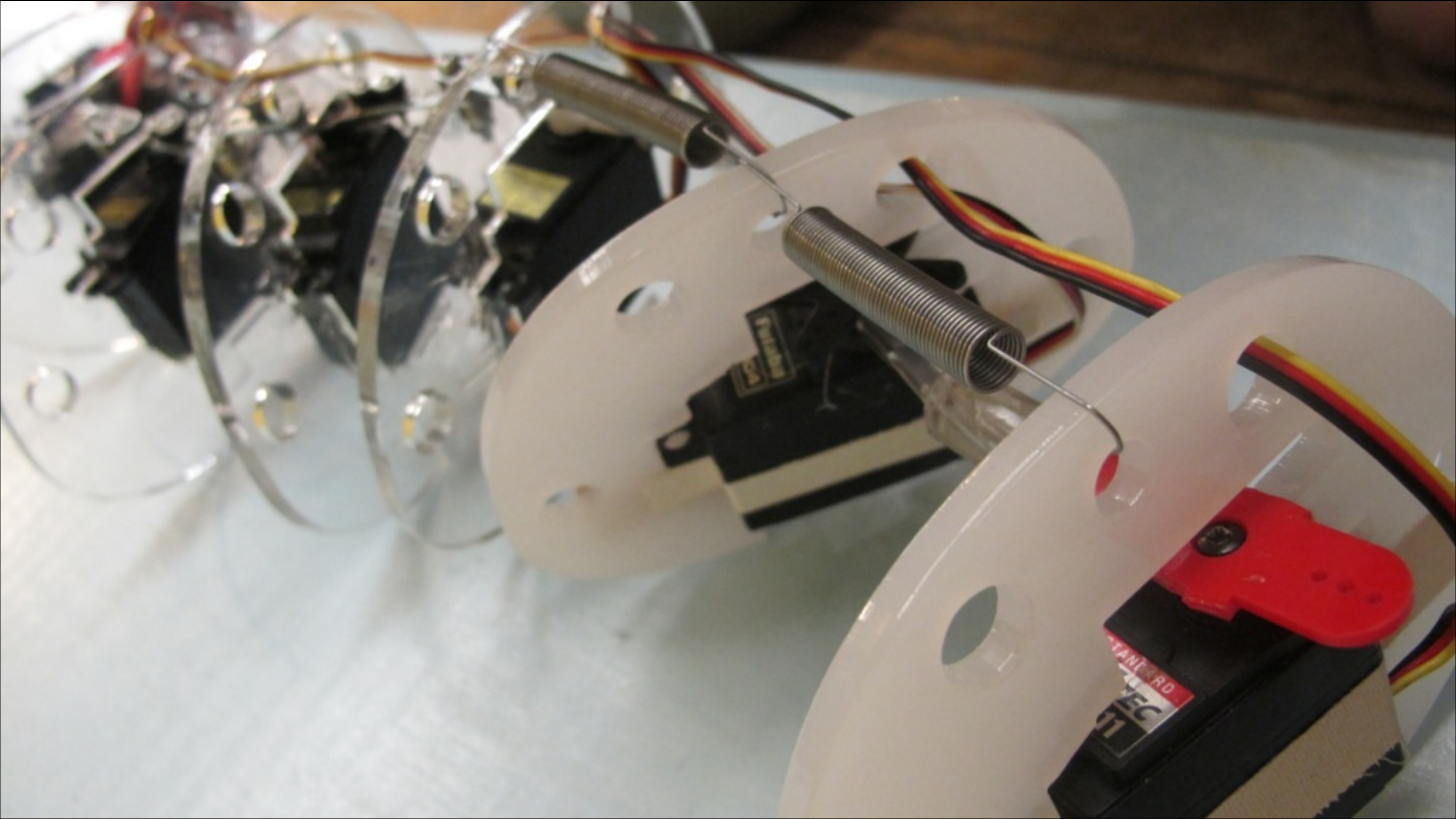
Basic Concepts of Robotics and Physical Computing

Gabriella Levine
Visible Futures Lab (VFL)
Artist in Resident, 2014
SVA





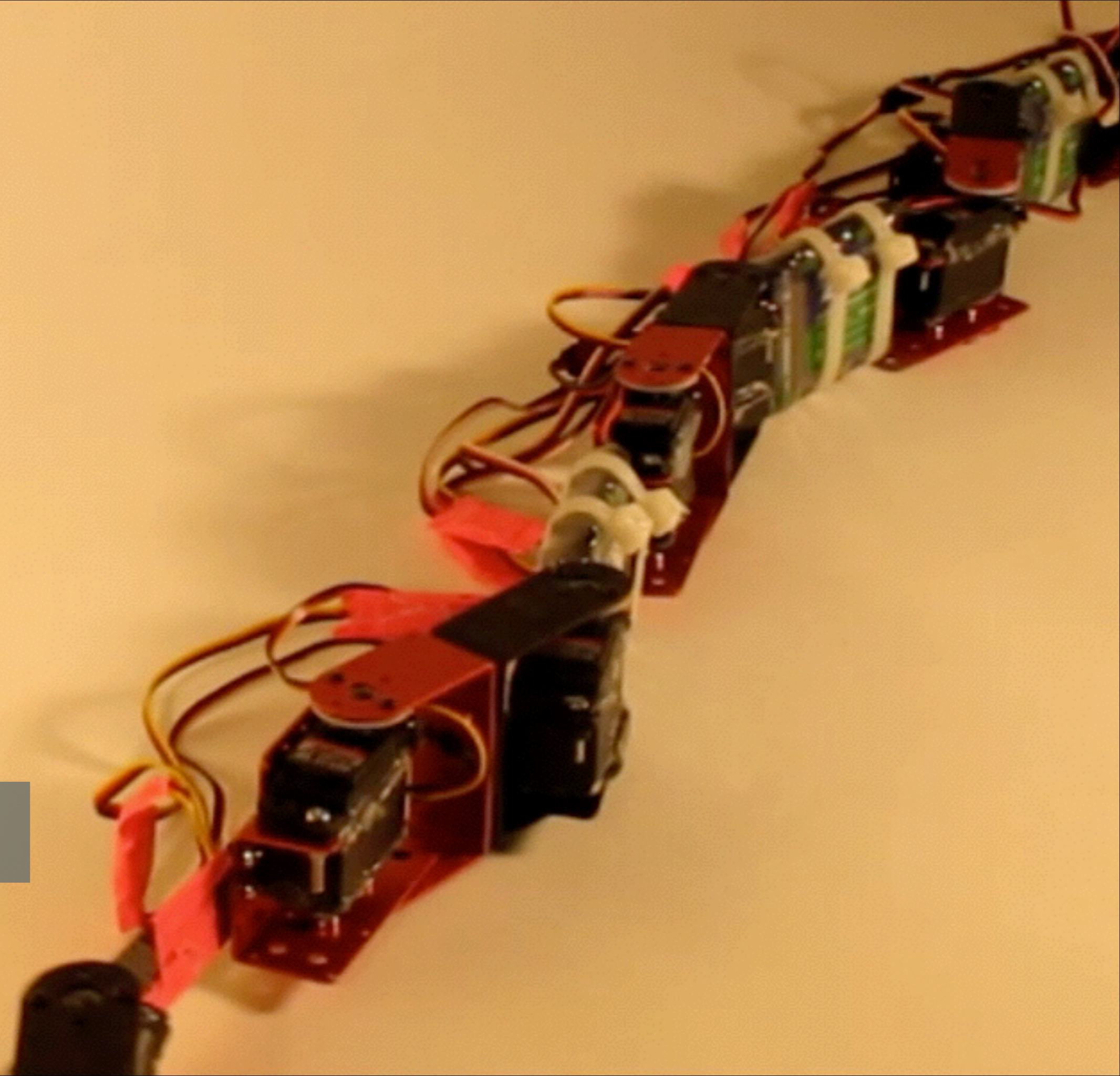
Sneel





Servo motors and brackets

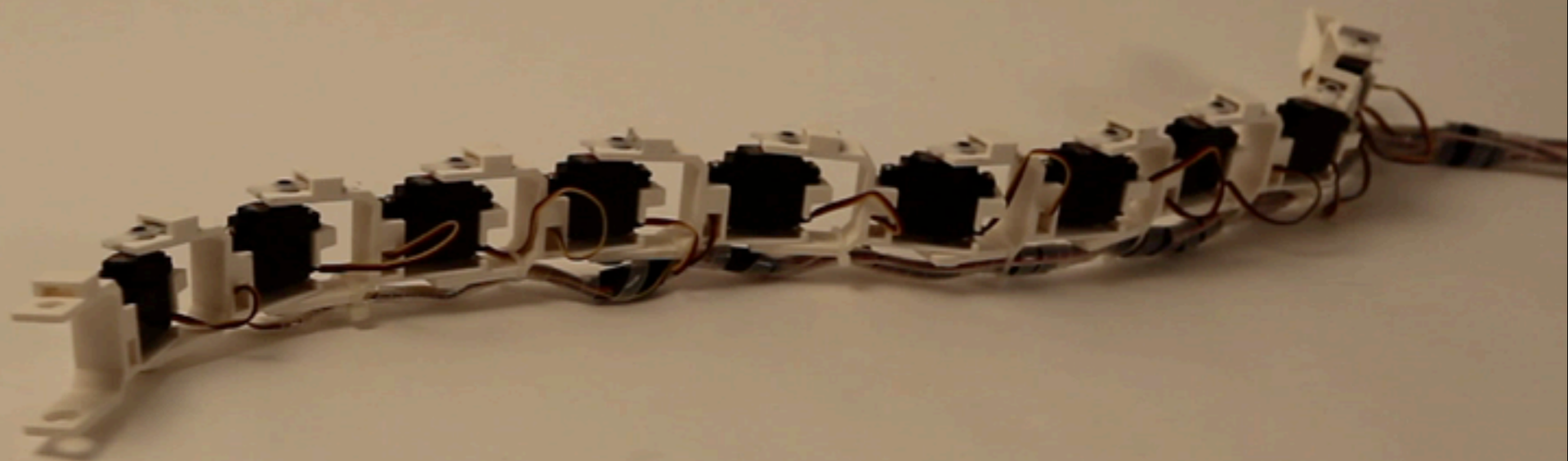
Sneel_003





Sneel_002

Sneel_004



PHYSICAL COMPUTING & ROBOTICS

1. *MECHANICAL MOTION*
2. *ACTUATION with hardware*
3. *SIMPLE MACHINES*
4. *SOFTWARE LIBRARIES*

I. MECHANICAL MOTION

1. *Types of Motion*

I. TYPES OF MOTION

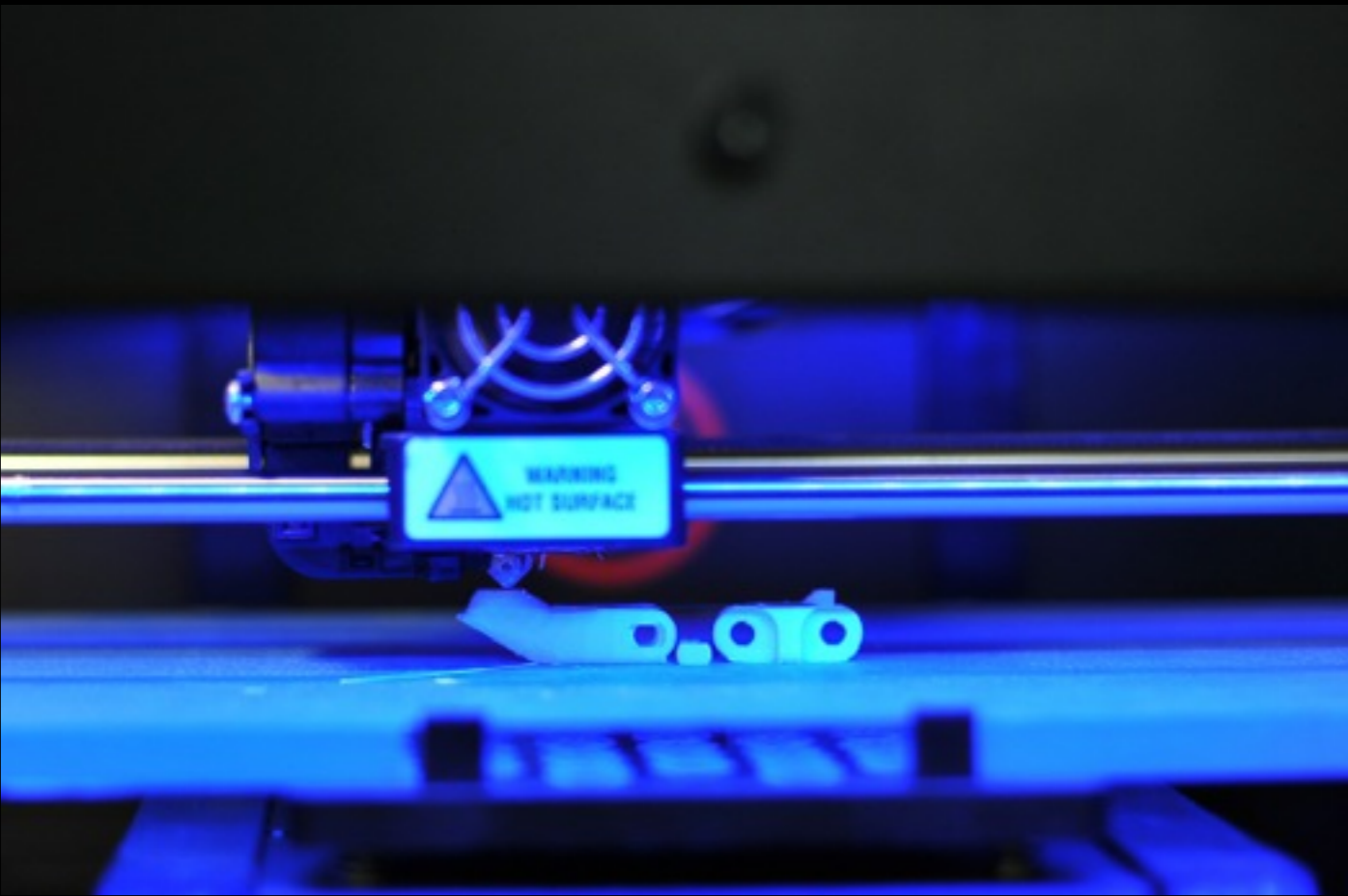
1. Linear
2. circular (around an axis)
3. oscillation or periodic motion
4. vibration [reciprocating]
5. random [Brownian]

LINEAR

One dimensional: Motion along a straight line

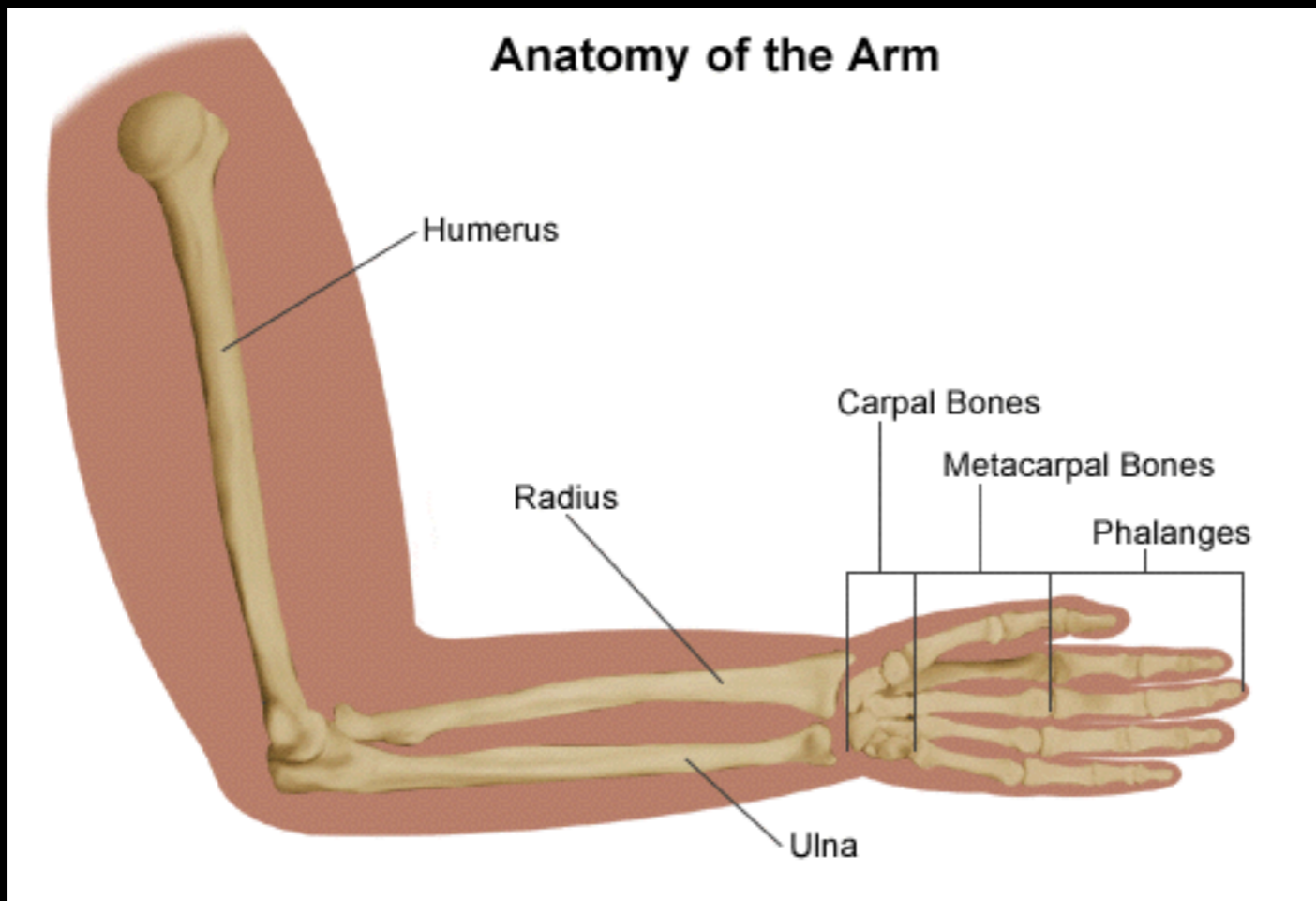
A. uniform (constant velocity, no acceleration)

B. variable velocity



LINEAR

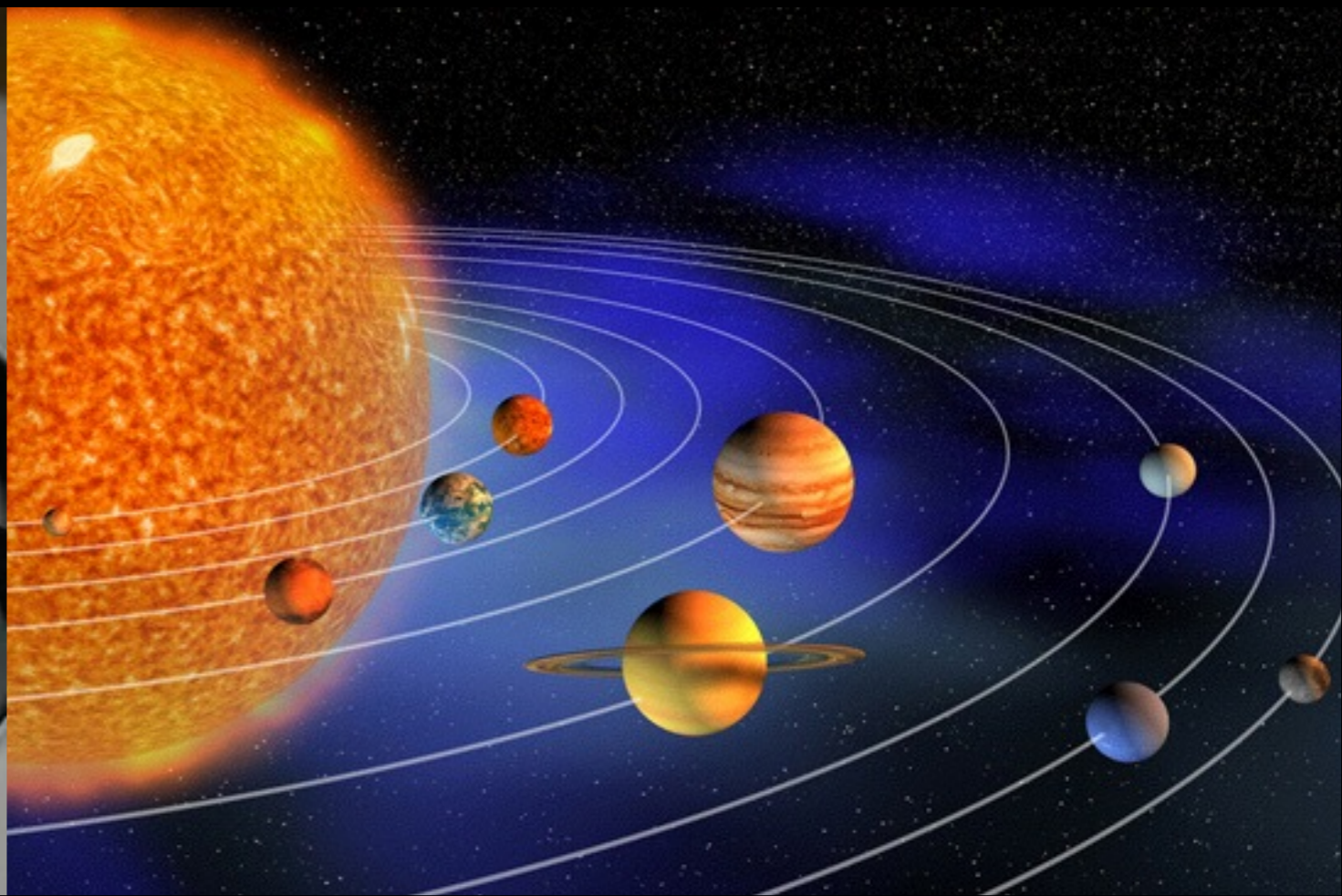
ELBOW
KNEE



CIRCULAR

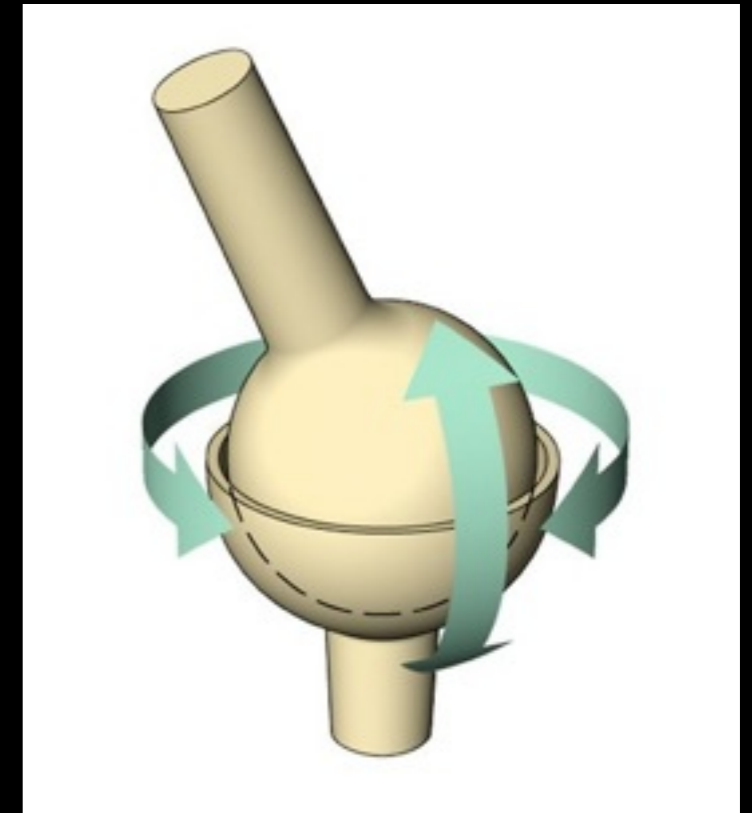
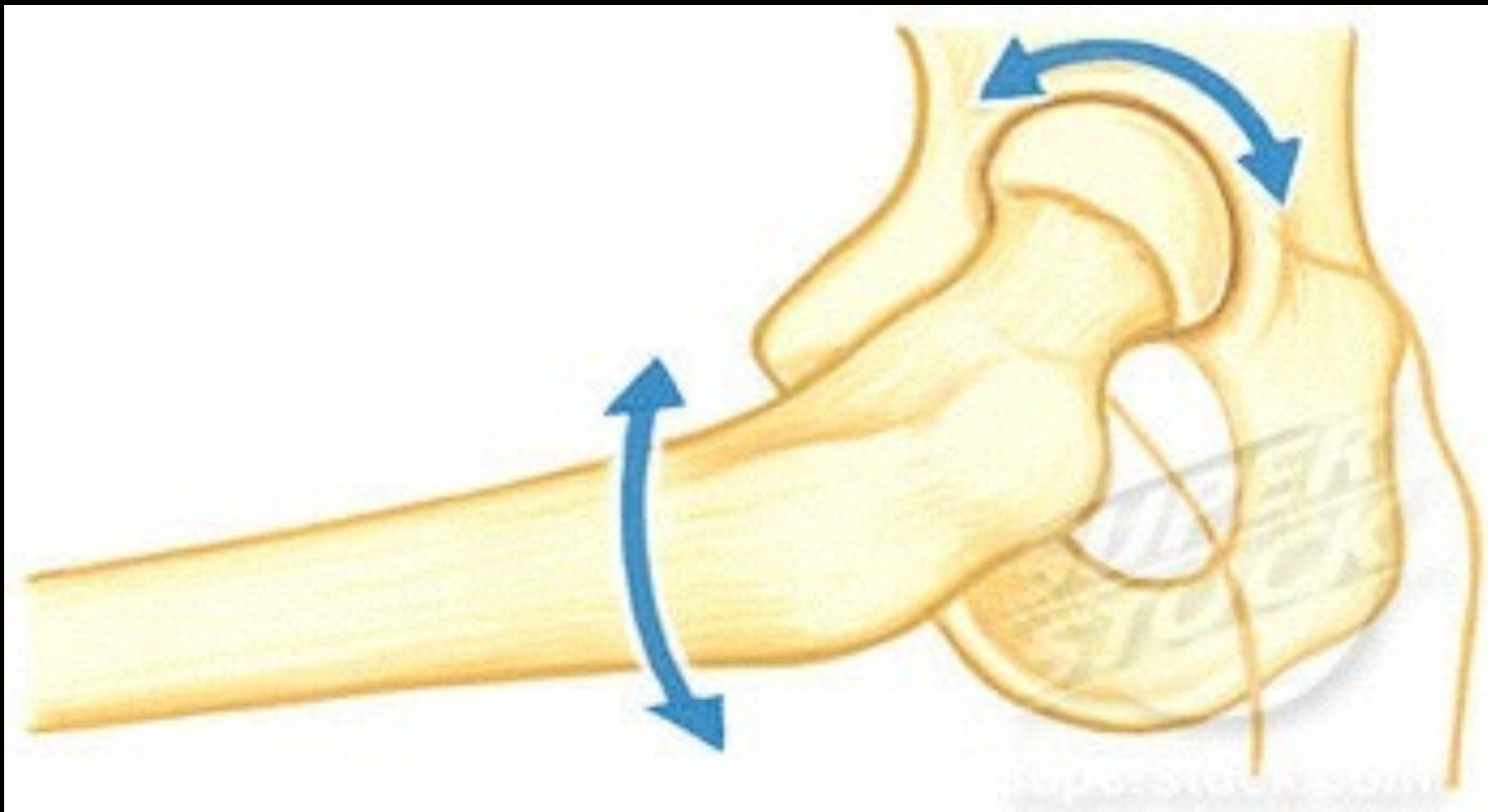
Around a fixed axis, or on a circular path

- A. uniform (constant velocity, no acceleration)
- B. variable velocity

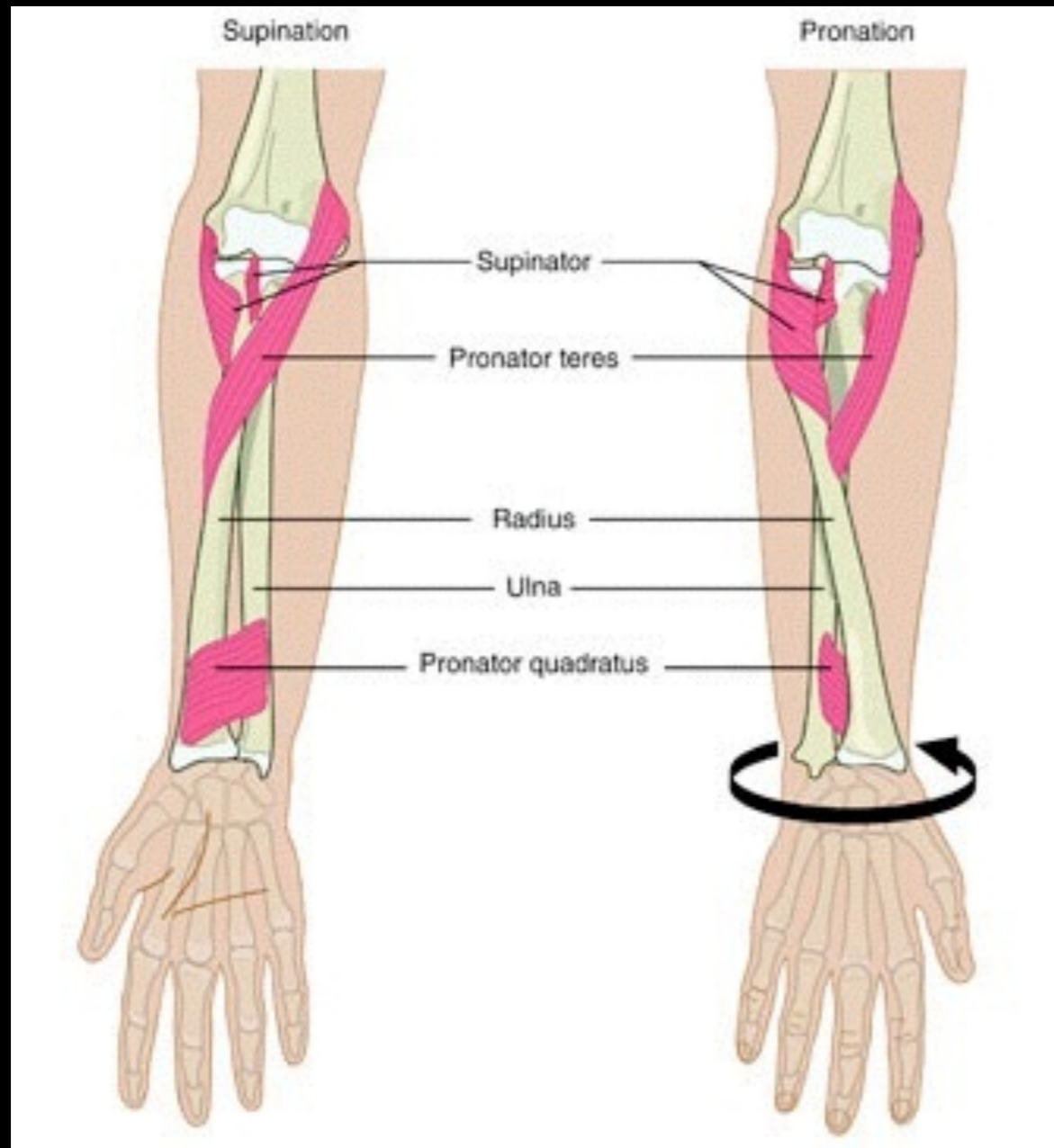


BALL IN SOCKET

SHOULDER
HIP

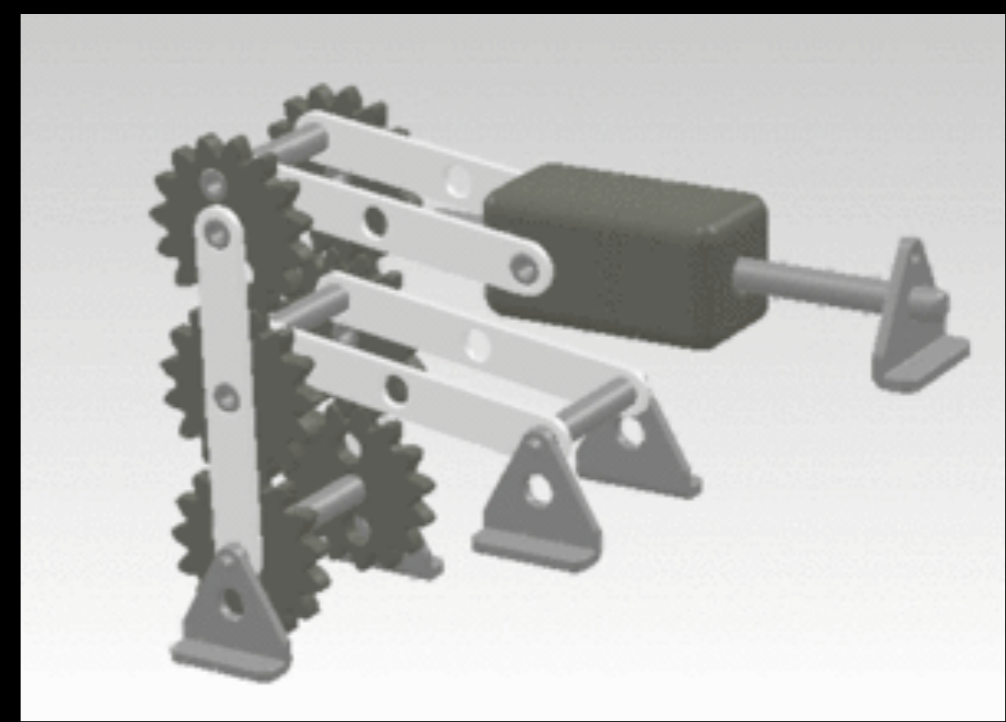
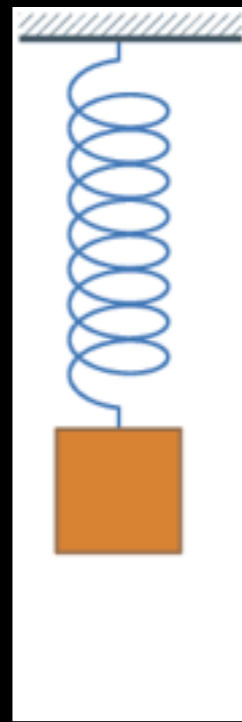


ROTATION



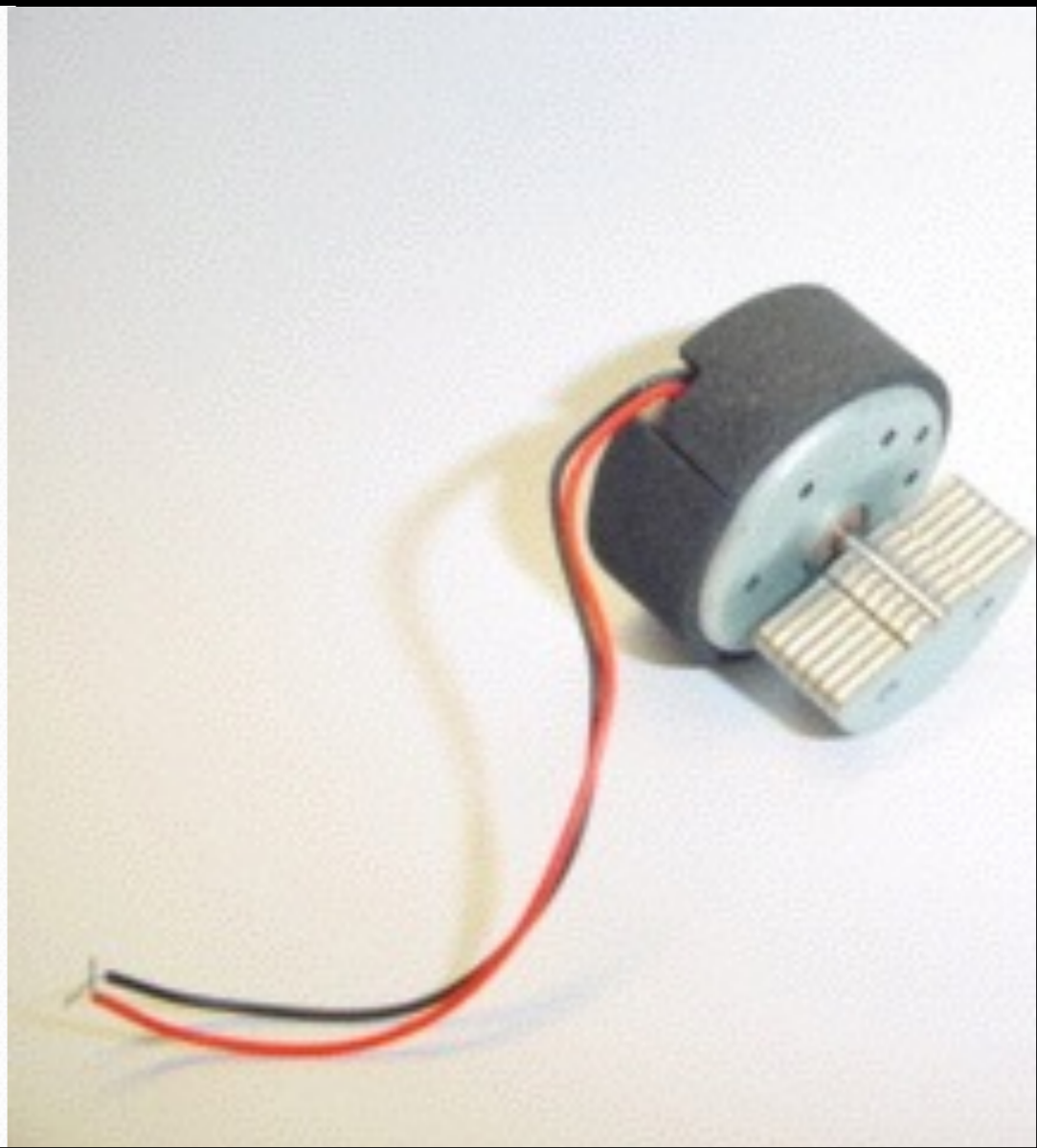
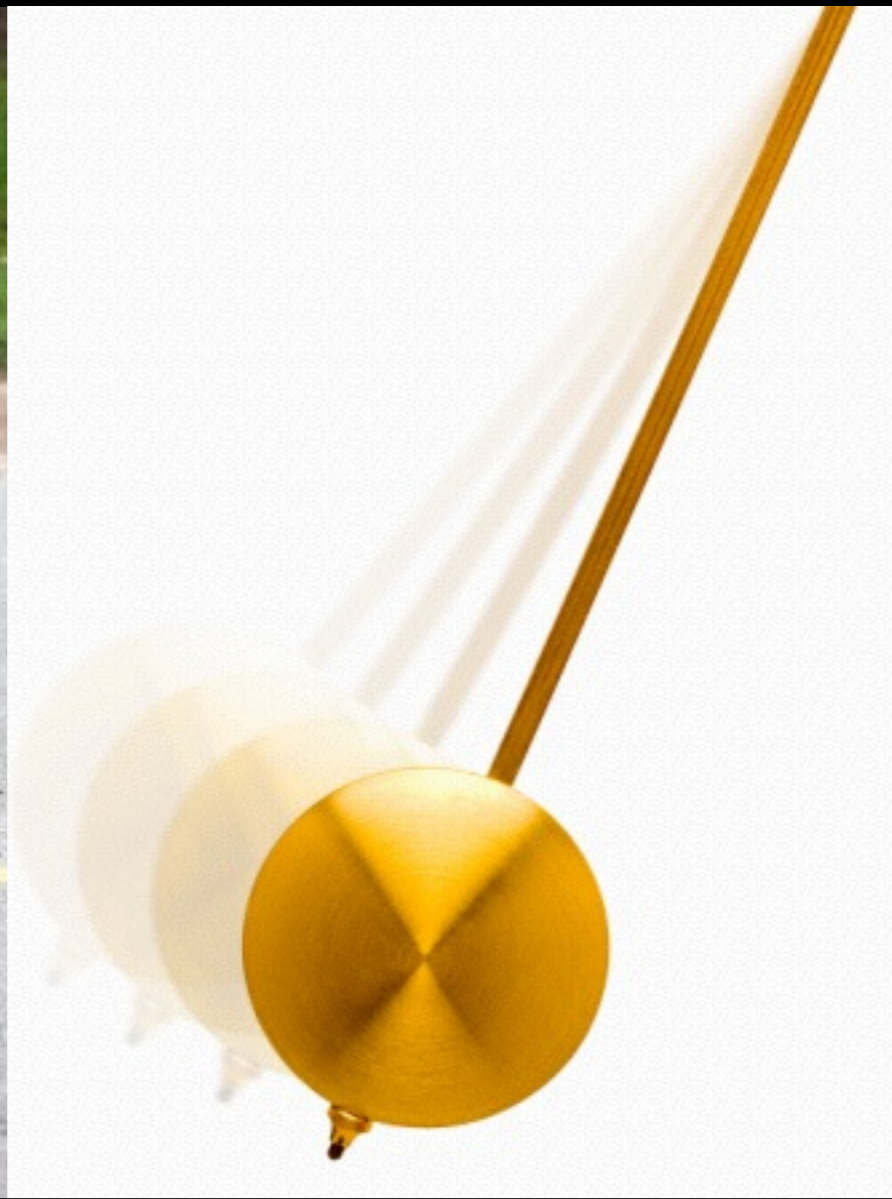
OSCILLATION

Periodic : back and forth at regular intervals
Reciprocation : repetitive back and forth



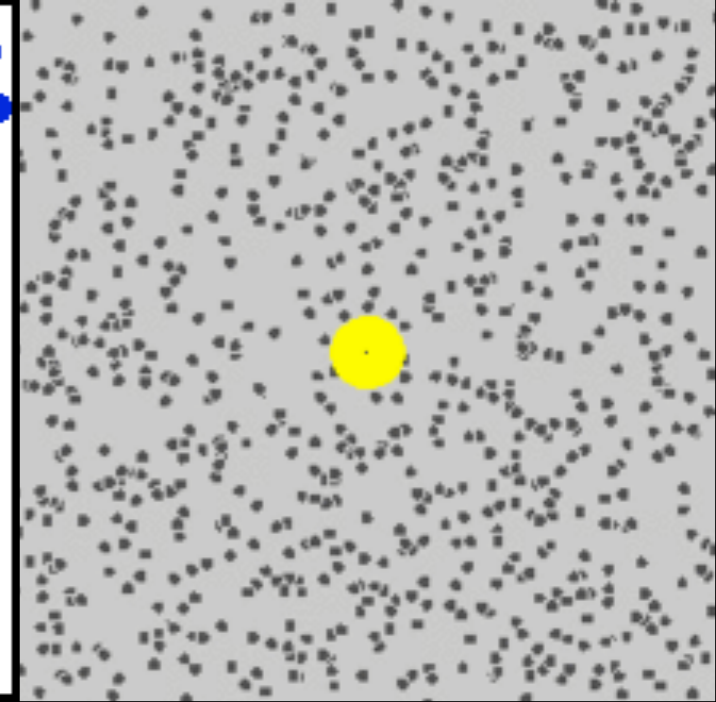
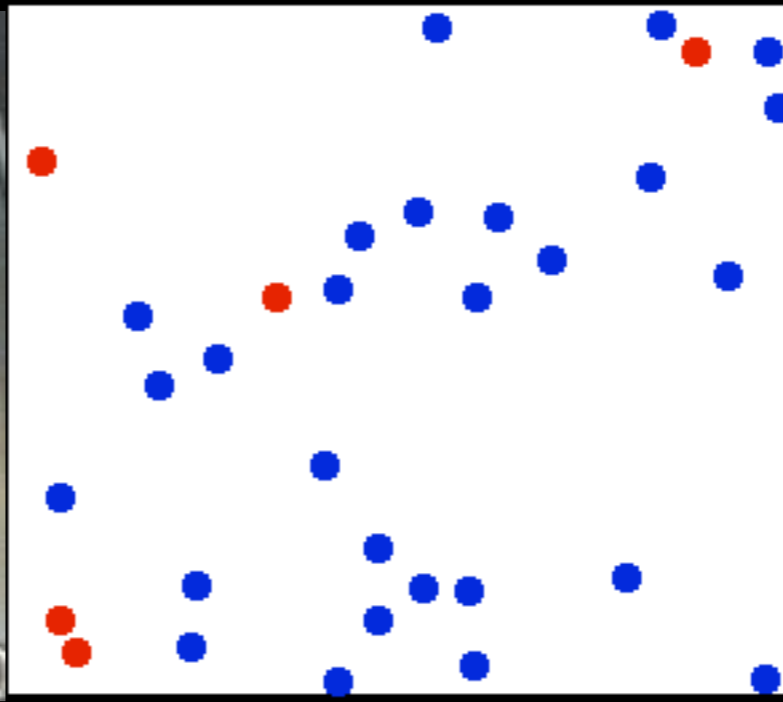
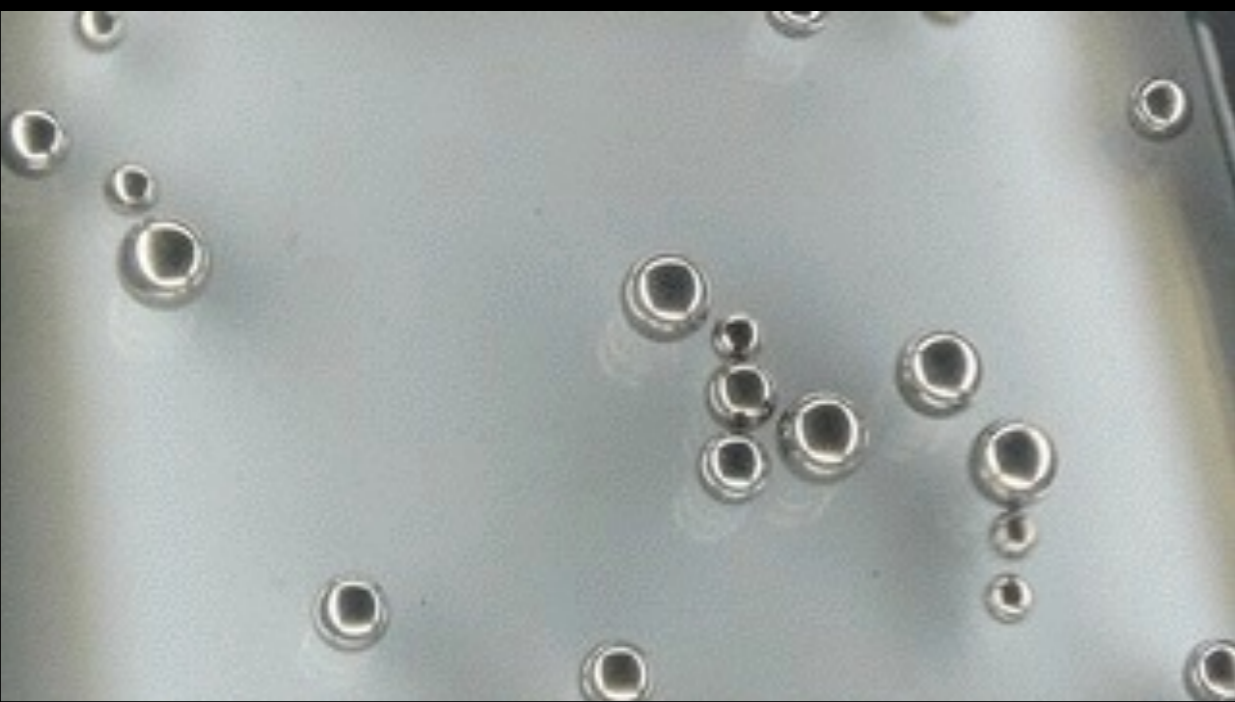
VIBRATION

movement around one equilibrium point



RANDOM

Random moving of particles suspended in a fluid



2. HARDWARE ACTUATION

A. Actuators to create motion

-with motors:

- servos, steppers, DC

-without motors

- air, muscle wire

B. Converting Motion

- cranks, cams, linkages

2. ACTUATORS

servo motors (continuous or ~180)

linear actuators

stepper motors

dc motors (w/ encoders)

motorless (muscle wire, air)



MOTORLESS MOTION

Fluid Pressure
Hydraulics
Pneumatics

“Artificial Muscle”
Memory Alloy
Nitinol wire
Polymers

LOW POWER ROBOT

NITINOL

You are here: [Home](#) >> [Wire & Cable](#) >> [Bulk Wire](#) >> [Flexible](#)

NITINOL WIRE 500 UM 1 METER

Jameco Part no. 357798

Manufacturer [MONDOTRONICS](#)

Manufacturer no. 3-401

[Catalog 131 , page 164](#)

[Data Sheet \(current\) \[613 KB\]](#)



[View Larger Image](#)
Image is representative only

MONDO•TRONICS

Pricing & Availability

\$16.95

# of Unit	Price
1+	\$16.95
5+	\$15.49

Availability: Ship today

+ [Add to my favorites](#)

Quantity

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Overview

Specifications

Related Products

Nitinol Shape Memory Alloy Wire

Untrained, as-drawn Ni-Ti wire in various sizes, cross sections and temperatures. Form and anneal to your own shapes for springs, thermal actuators, "memory wire" magic tricks, etc. Use with Actuator Design Manual.

- 500µm

RELATED PRODUCTS

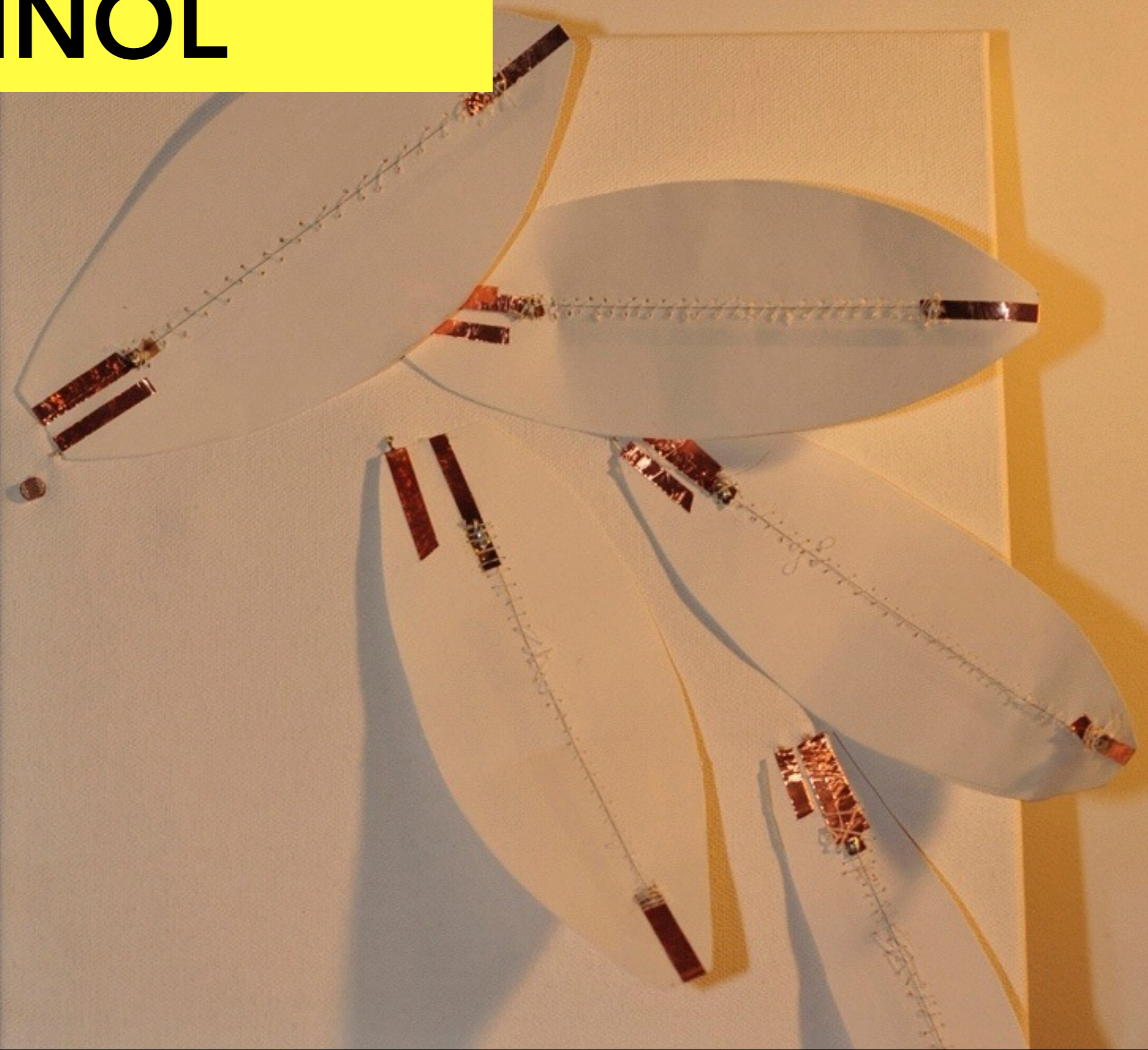
[MW PROJECT BOOK & SAMPLE KIT, MUSCLE WIRE](#)



Buy Now \$29.95

NITINOL

NITINOL



CONVERTING MOTION

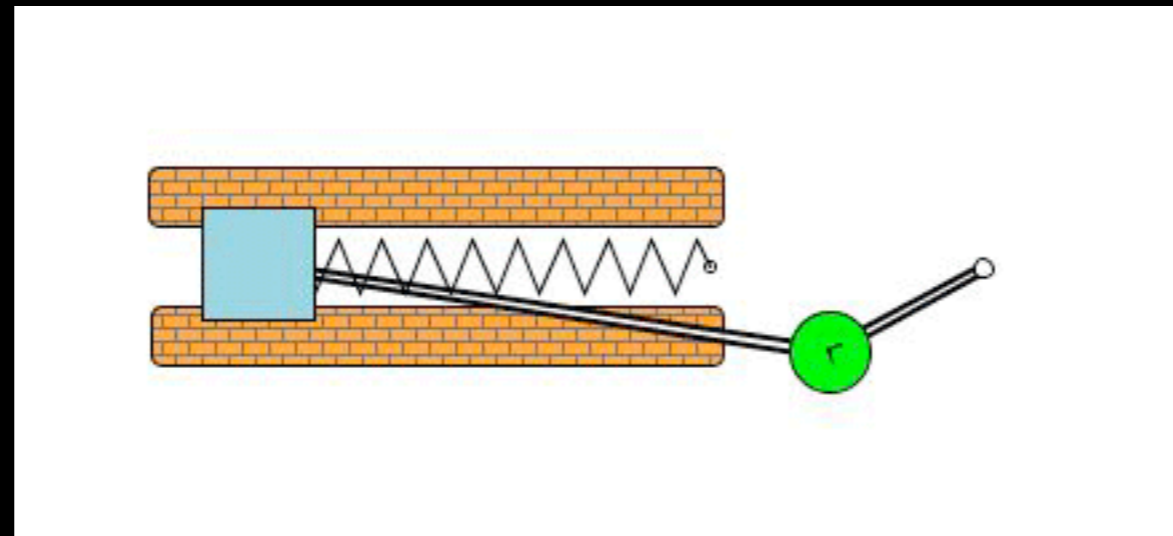
Cranks

Cams

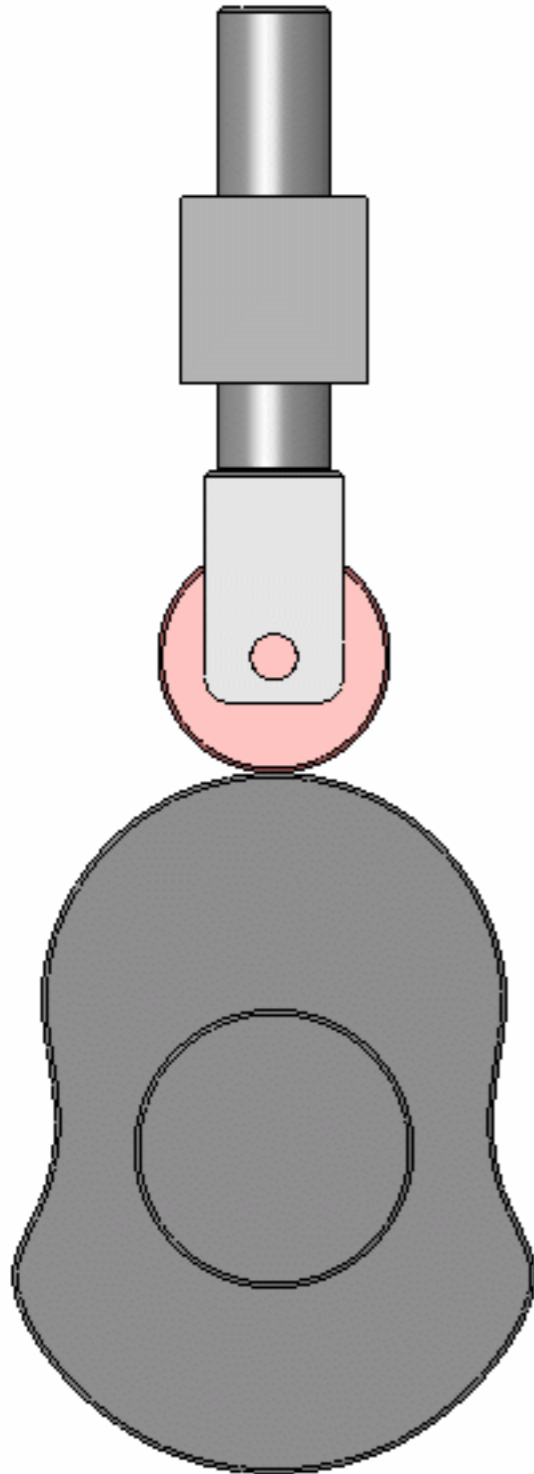
Linkages

CRANKS

Rotary to oscillating motion



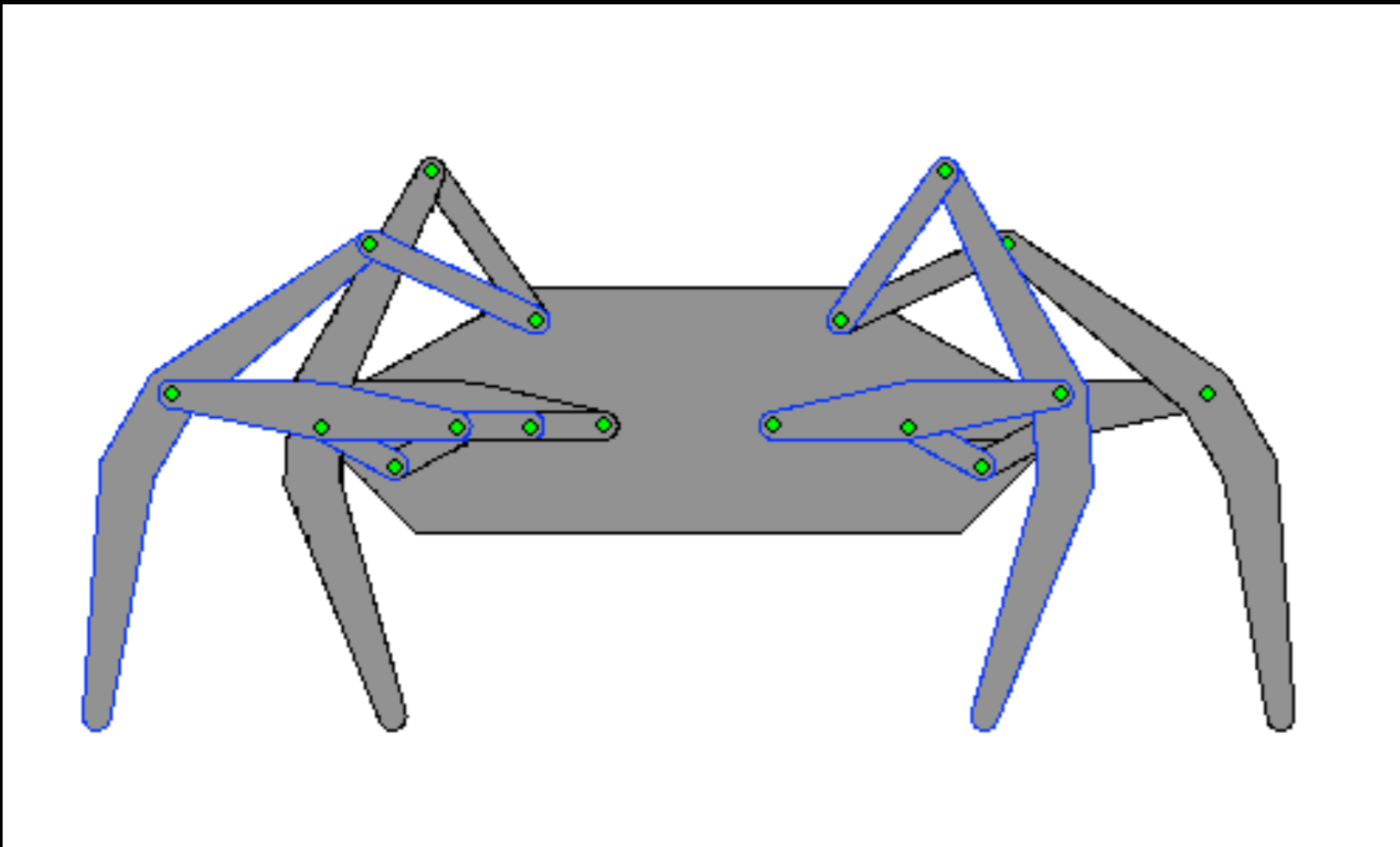
CAMS



The cam turns and the cam follower moves up and down

LINKAGES

Connection between units, at a joint



6 SIMPLE MACHINES

1. *Gears*
2. *Pulleys*
3. *Levers*
4. *Wheels*
5. *Screws*
6. *Inclined Planes*

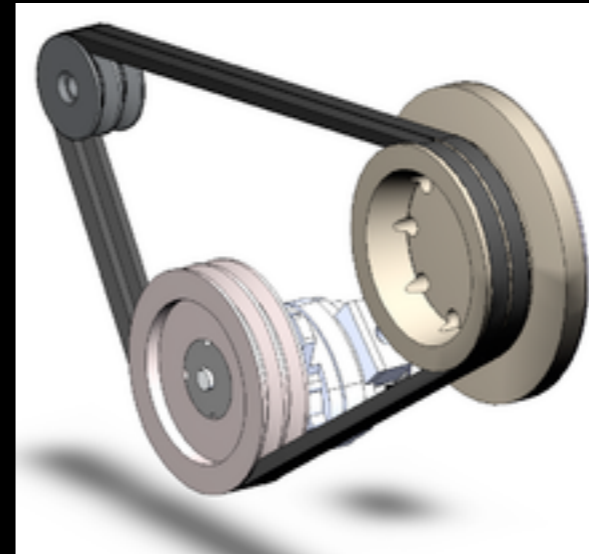
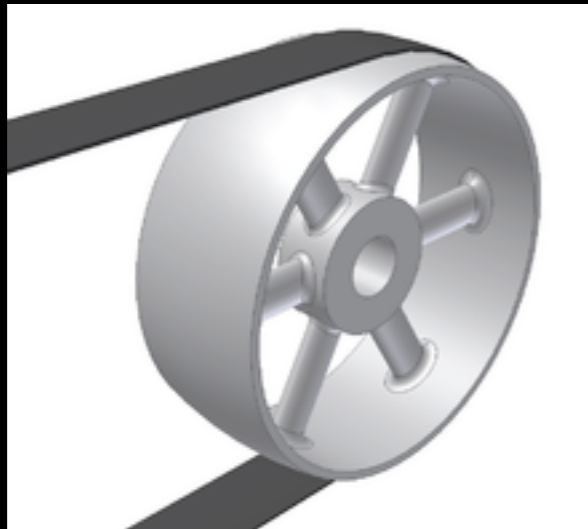
GEARS

Spur Gears
Worm Gears
Rack and Pinion



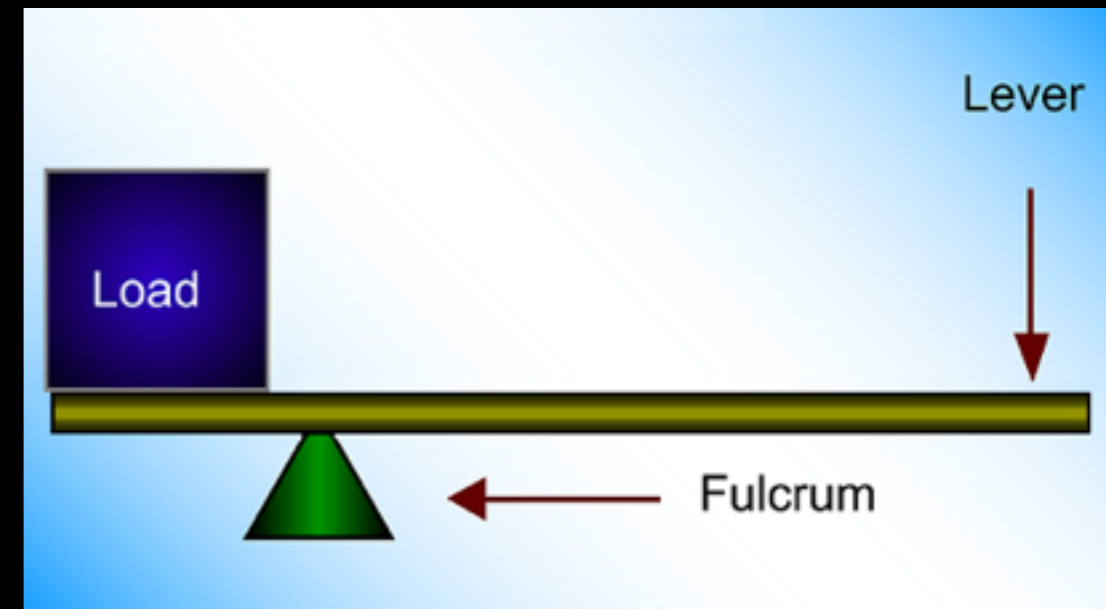
PULLEYS

Wheel on an axel supports movement of a cable

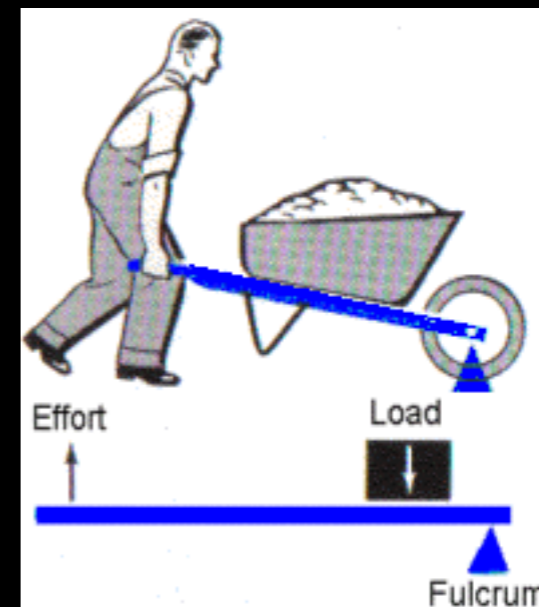


LEVERS

1st class lever:

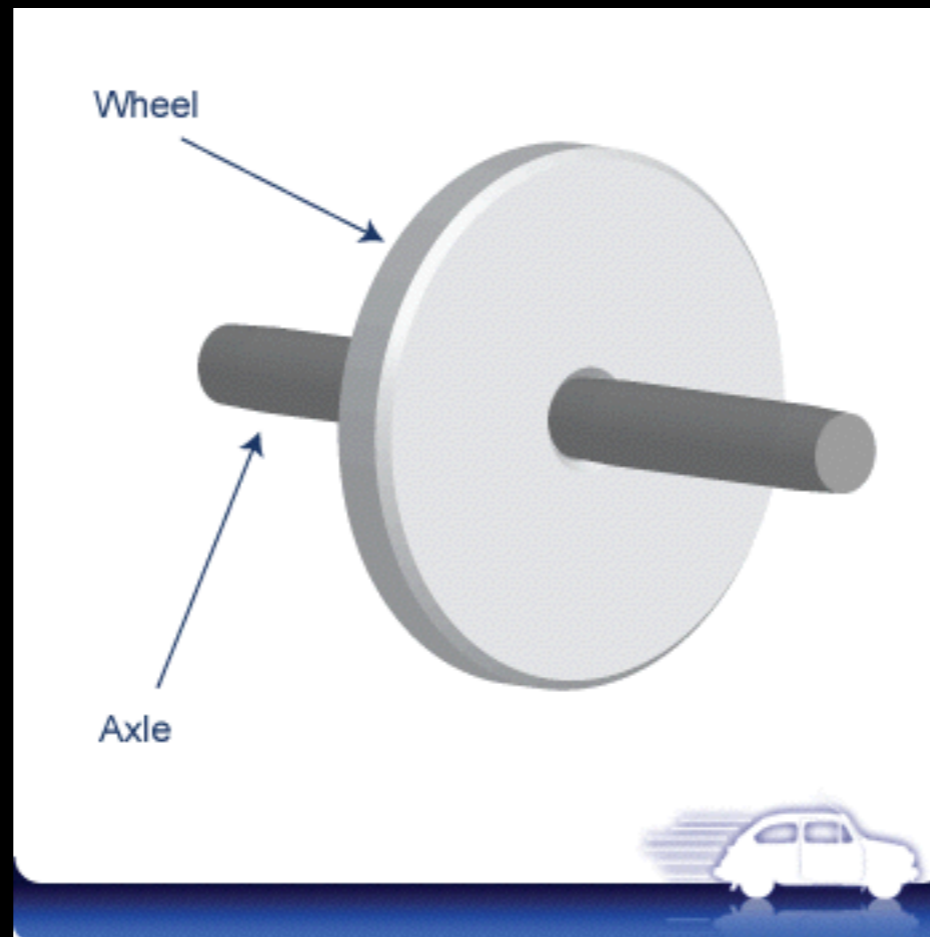


2nd class lever:



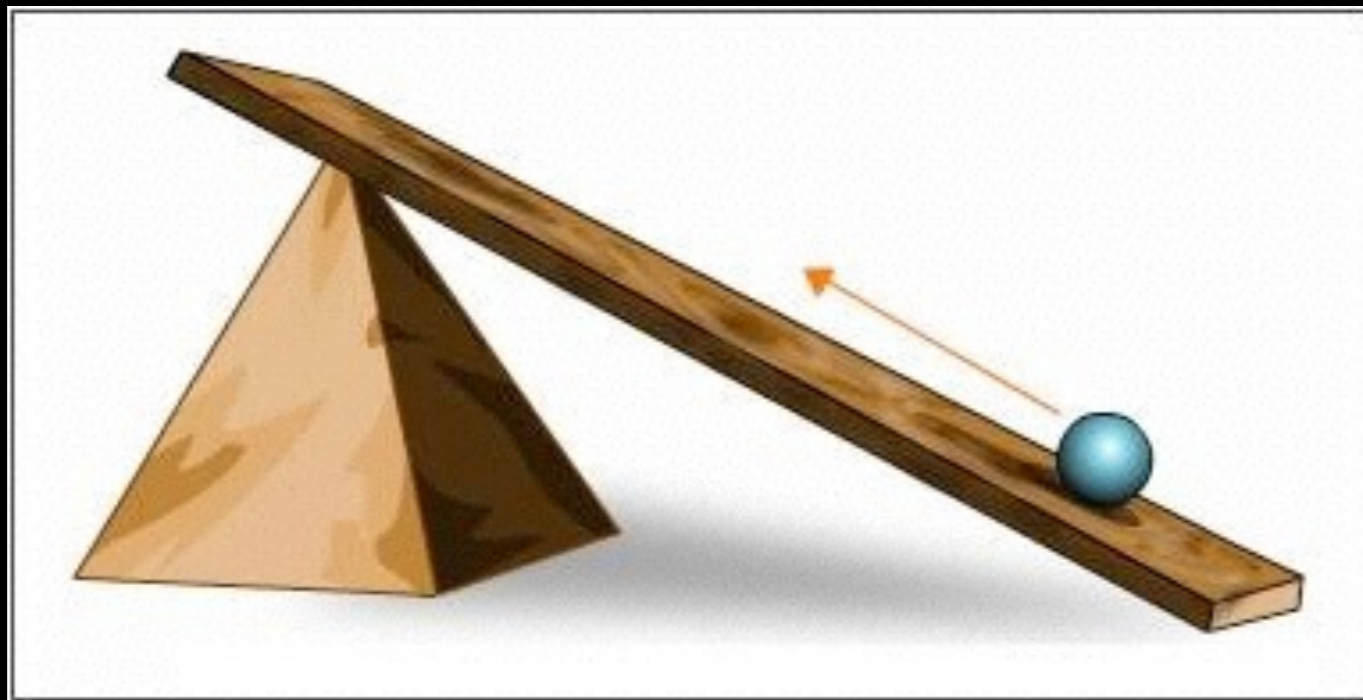
WHEELS

Rotation around the axel



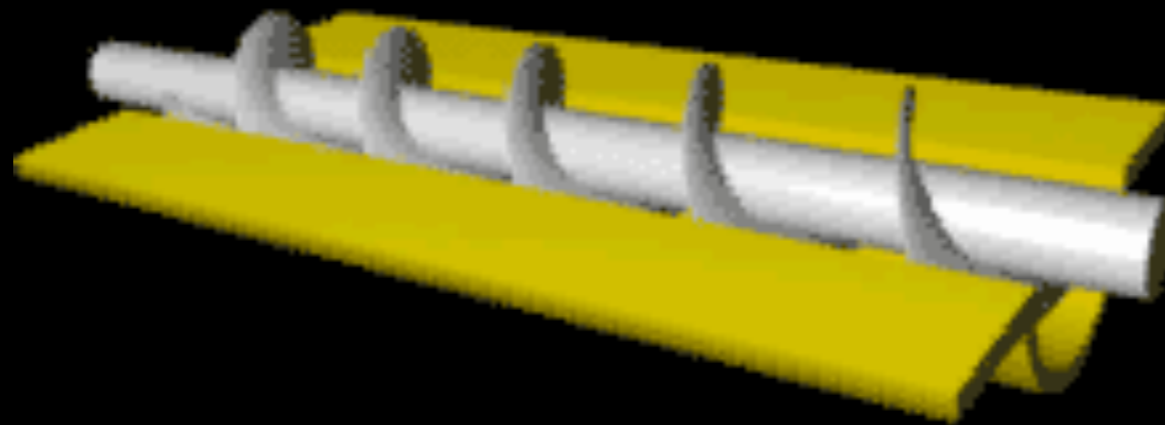
INCLINED PLANES

Mechanical advantage = length/height



SCREWS

Special type of inclined plane around interior shaft



3. SOFTWARE

Types of Algorithms for motion:

-Oscillation

-sine waves

-frequency, period, amplitude, wavelength

-Inverse Kinematics

CODE

github.com/gabriella/exploringBiomimicry

MOTIONS IN CODE

Sine wave

Inverse Kinematics

SINE WAVE

$$y = A * \sin(b)$$

A = amplitude of the wave

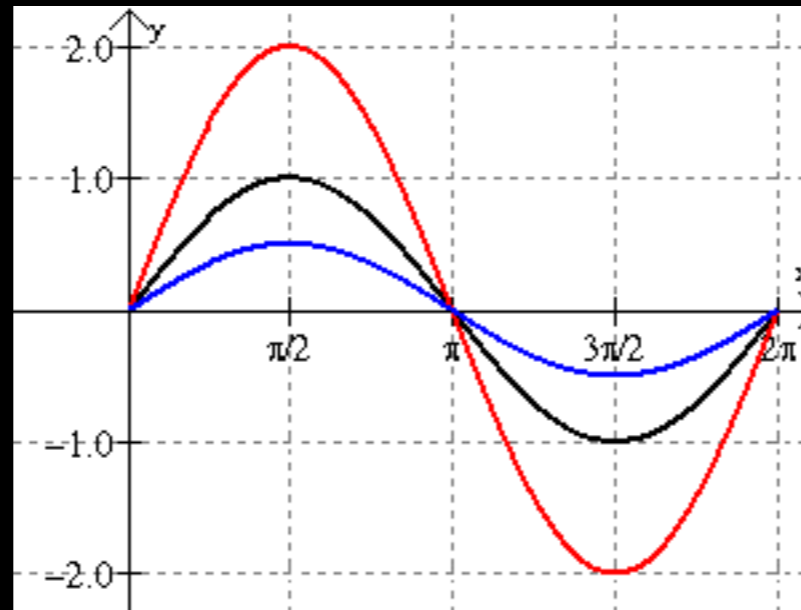
b = period (cycles between 0 and 360 degrees
(2PI))

SINE WAVE

$$A = 1$$

$$A = 2$$

$$A = 1/2$$



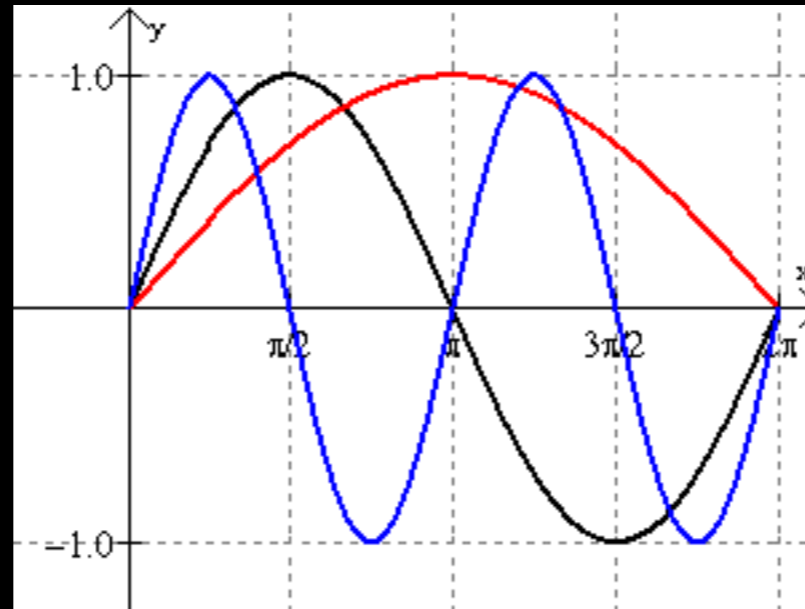
$$y = A * \sin(b)$$

SINE WAVE

$$y = \sin(x)$$

$$y = \sin(1/2x)$$

$$y = \sin(2x)$$



$$y = A * \sin(b)$$

SINE WAVE

$$y = A * \sin(b)$$

Change Chart Type: Line, Pie, Bar, Area, Scatter, Other

Insert Sparklines: Line, Column, Win/Loss

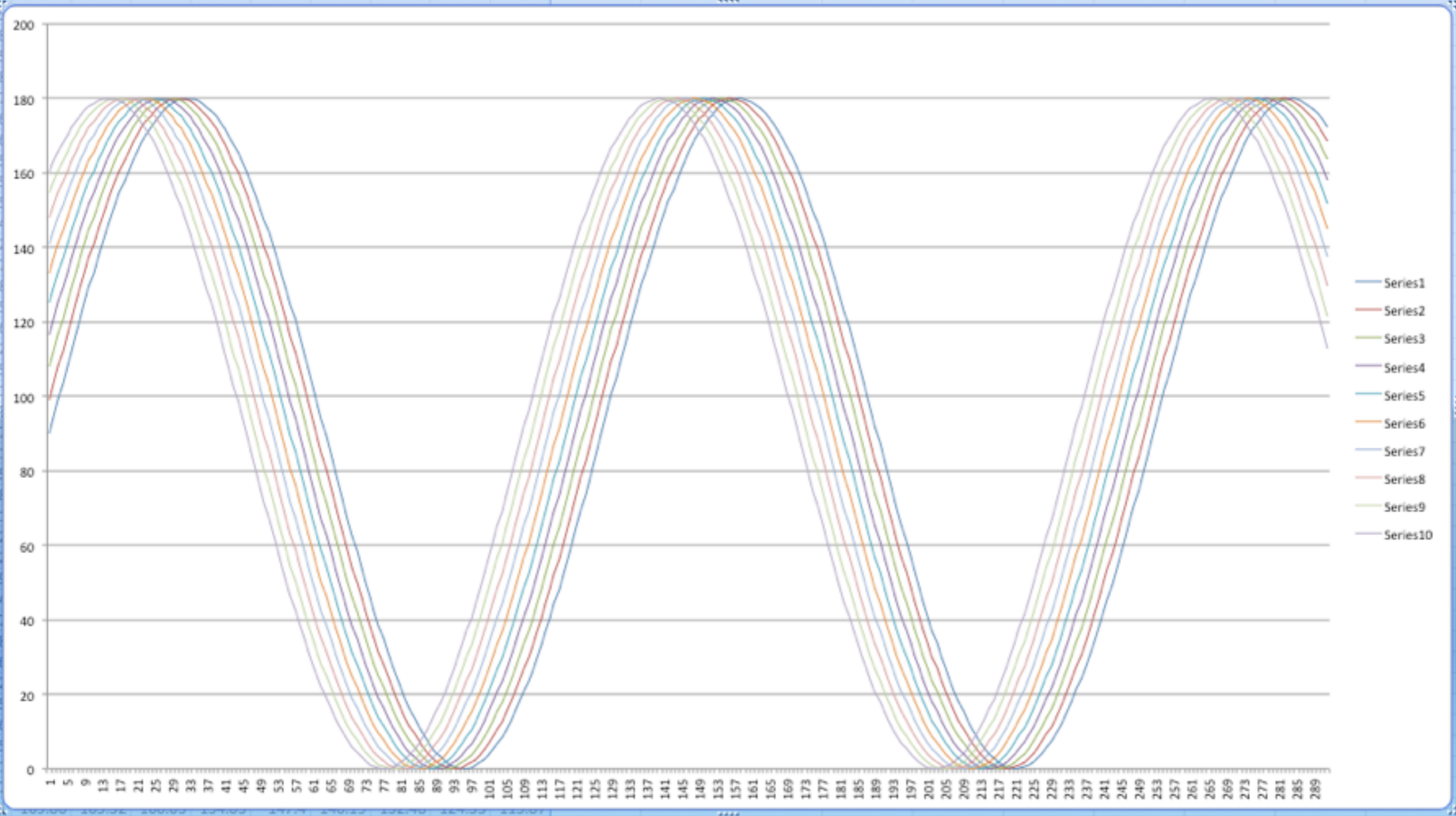
Data: Select, Switch Plot

Chart Quick Layouts: [Icons]

Chart Styles: [Icons]

Chart 1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
90	98.98	107.88	116.6	125.05	133.15	140.82	147.98	154.56	160.5												



- Series1
- Series2
- Series3
- Series4
- Series5
- Series6
- Series7
- Series8
- Series9
- Series10

171.84	167.69	162.76	157.11	150.79	143.86	136.4	128.46	120.15	111.53												
169.86	165.32	160.03	154.03	147.4	140.19	132.48	124.35	115.87	107.14												
167.69	162.76	157.11	150.79	143.86	136.4	128.46	120.15	111.53	102.7												
165.32	160.03	154.03	147.4	140.19	132.48	124.35	115.87	107.14	98.23												

Change Chart Type: Column, Line, Pie, Bar, Area, Scatter, Other

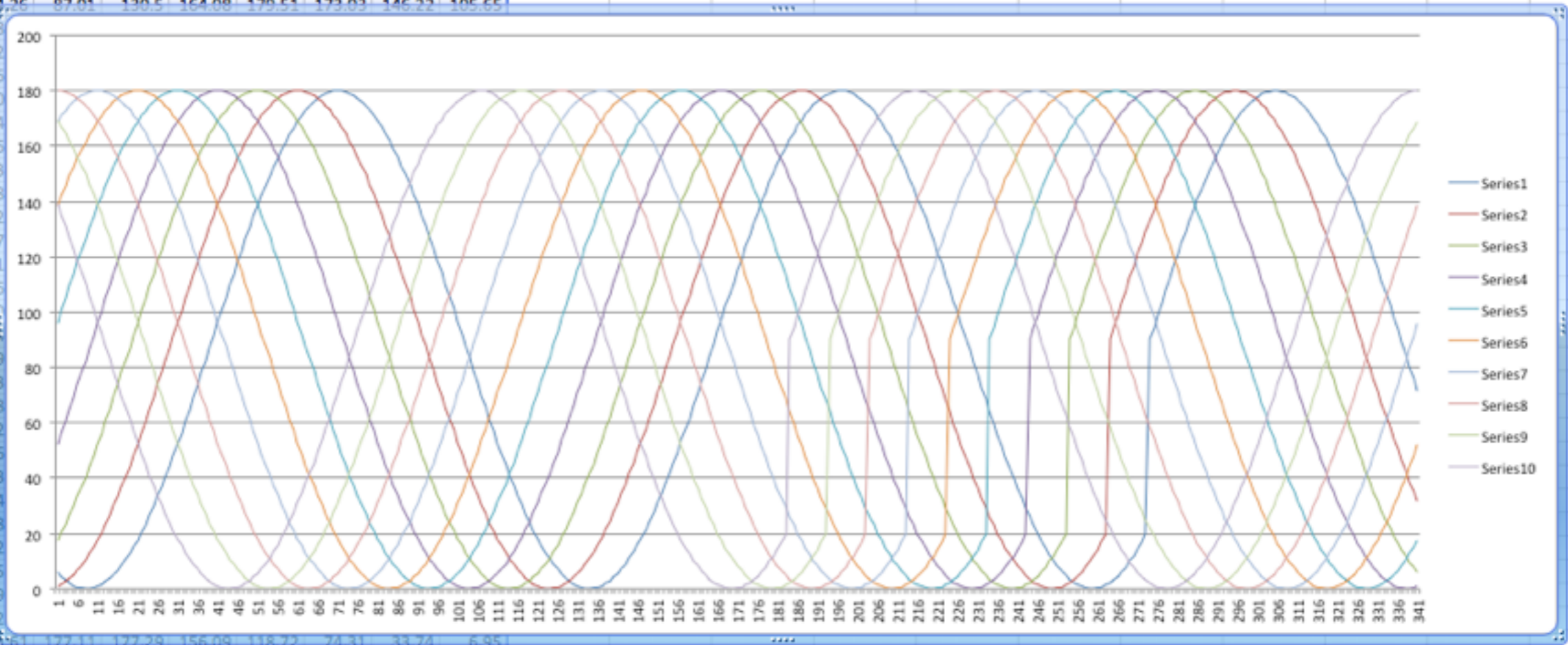
Insert Sparklines: Line, Column, Win/Loss

Data: Select, Switch Plot

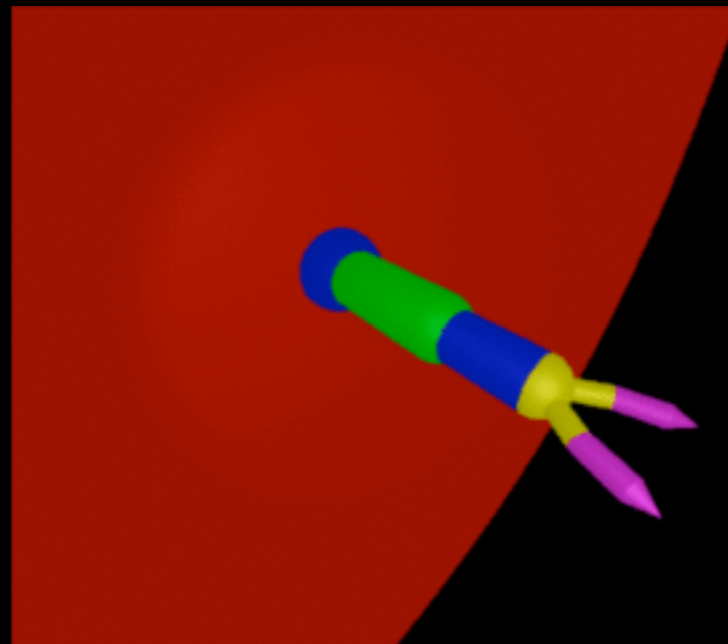
Chart Quick Layouts: [Icons]

Chart Styles: [Icons]

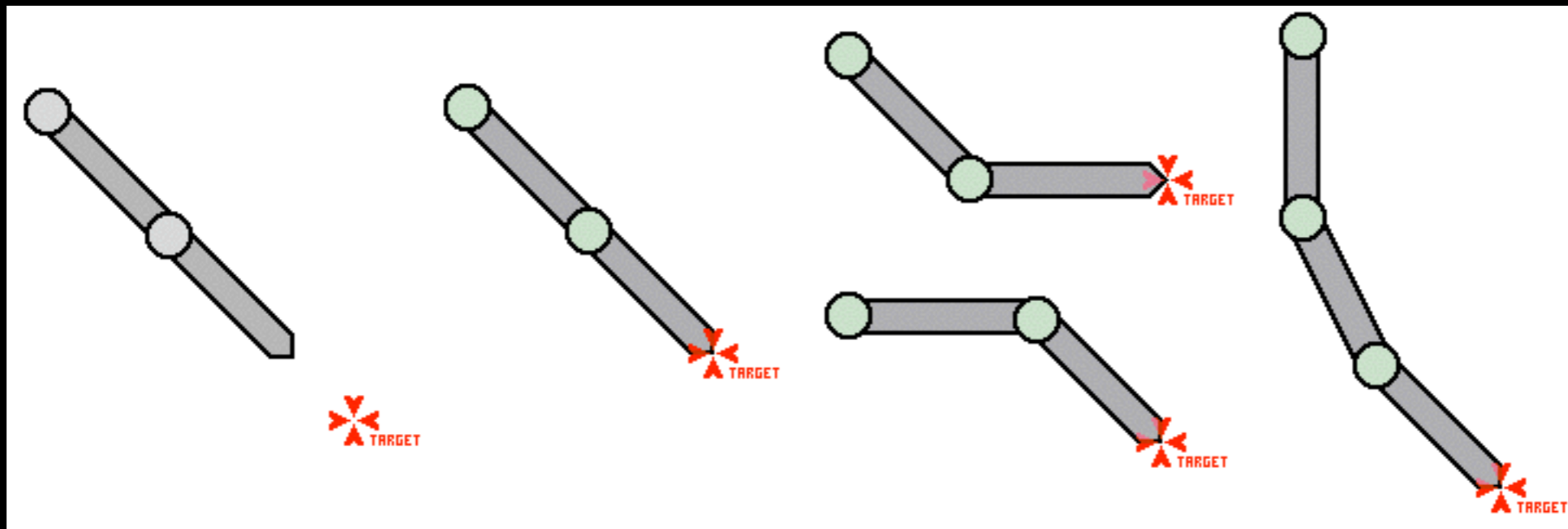
	A	B	C	D	E	F	G	H	I	J
1	5.85	0.85	17.68	52.22	96.01	138.33	168.81	180	169.15	138.93
2	4.36	1.58	20.45	56.35	100.49	142.06	170.88	179.9	166.91	135.09
3	3.08	2.53	23.39	60.57	104.94	145.66	172.76	179.59	164.48	131.14
4	2.02	3.7	26.5	64.85	109.36	149.13	174.42	179.04	161.86	127.09
5	1.18	5.08	29.77	69.2	113.73	152.45	175.87	178.28	159.07	122.94
6	0.57	6.68	33.19	73.61	118.04	155.61	177.11	177.29	156.09	118.72
7	0.18	8.48	36.75	78.05	122.28	158.6	178.13	176.09	152.96	114.42
8	0.01	10.49	40.44	82.52	126.44	161.43	178.94	174.67	149.67	110.06
9	0.06	12.7	44.26	87.01	130.5	164.08	179.51	173.03	146.22	105.65
10	0.35	15.1	48.19	91.51	134.47	166.54	179.87	171.19	142.64	101.2
11	0.85	17.68	52.22	96.01	138.33	168.81	180	169.15	138.93	96.72
12	1.58	20.45	56.35	100.49	142.06	170.88	179.9	166.91	135.09	92.28
13	2.53	23.39	60.57	104.94	145.66	172.76	179.59	164.48	131.14	87.84
14	3.7	26.5	64.85	109.36	149.13	174.42	179.04	161.86	127.09	83.4
15	5.08	29.77	69.2	113.73	152.45	175.87	178.28	159.07	122.94	78.96
16	6.68	33.19	73.61	118.04	155.61	177.11	177.29	156.09	118.72	74.52
17	8.48	36.75	78.05	122.28	158.6	178.13	176.09	152.96	114.42	70.08
18	10.49	40.44	82.52	126.44	161.43	178.94	174.67	149.67	110.06	65.64
19	12.7	44.26	87.01	130.5	164.08	179.51	173.03	146.22	105.65	61.2
20	15.1	48.19	91.51	134.47	166.54	179.87	171.19	142.64	101.2	56.76
21	17.68	52.22	96.01	138.33	168.81	180	169.15	138.93	96.72	52.32
22	20.45	56.35	100.49	142.06	170.88	179.9	166.91	135.09	92.28	47.88
23	23.39	60.57	104.94	145.66	172.76	179.59	164.48	131.14	87.84	43.44
24	26.5	64.85	109.36	149.13	174.42	179.04	161.86	127.09	83.4	39.0
25	29.77	69.2	113.73	152.45	175.87	178.28	159.07	122.94	78.96	34.56
26	33.19	73.61	118.04	155.61	177.11	177.29	156.09	118.72	74.52	30.12
27	36.75	78.05	122.28	158.6	178.13	176.09	152.96	114.42	70.08	25.68
28	40.44	82.52	126.44	161.43	178.94	174.67	149.67	110.06	65.64	21.24
29	44.26	87.01	130.5	164.08	179.51	173.03	146.22	105.65	61.2	16.8
30	48.19	91.51	134.47	166.54	179.87	171.19	142.64	101.2	56.76	12.36
31	52.22	96.01	138.33	168.81	180	169.15	138.93	96.72	52.32	7.92
32	56.35	100.49	142.06	170.88	179.9	166.91	135.09	92.28	47.88	3.48
33	60.57	104.94	145.66	172.76	179.59	164.48	131.14	87.84	43.44	-1.08
34	64.85	109.36	149.13	174.42	179.04	161.86	127.09	83.4	39.0	-5.64
35	69.2	113.73	152.45	175.87	178.28	159.07	122.94	78.96	34.56	-10.2
36	73.61	118.04	155.61	177.11	177.29	156.09	118.72	74.52	30.12	-14.76
37	78.05	122.28	158.6	178.13	176.09	152.96	114.42	70.08	25.68	-19.32
38	82.52	126.44	161.43	178.94	174.67	149.67	110.06	65.64	21.24	-23.88
39	87.01	130.5	164.08	179.51	173.03	146.22	105.65	61.2	16.8	-28.44
40	91.51	134.47	166.54	179.87	171.19	142.64	101.2	56.76	12.36	-33.0
41	96.01	138.33	168.81	180	169.15	138.93	96.72	52.87	18.11	-37.56



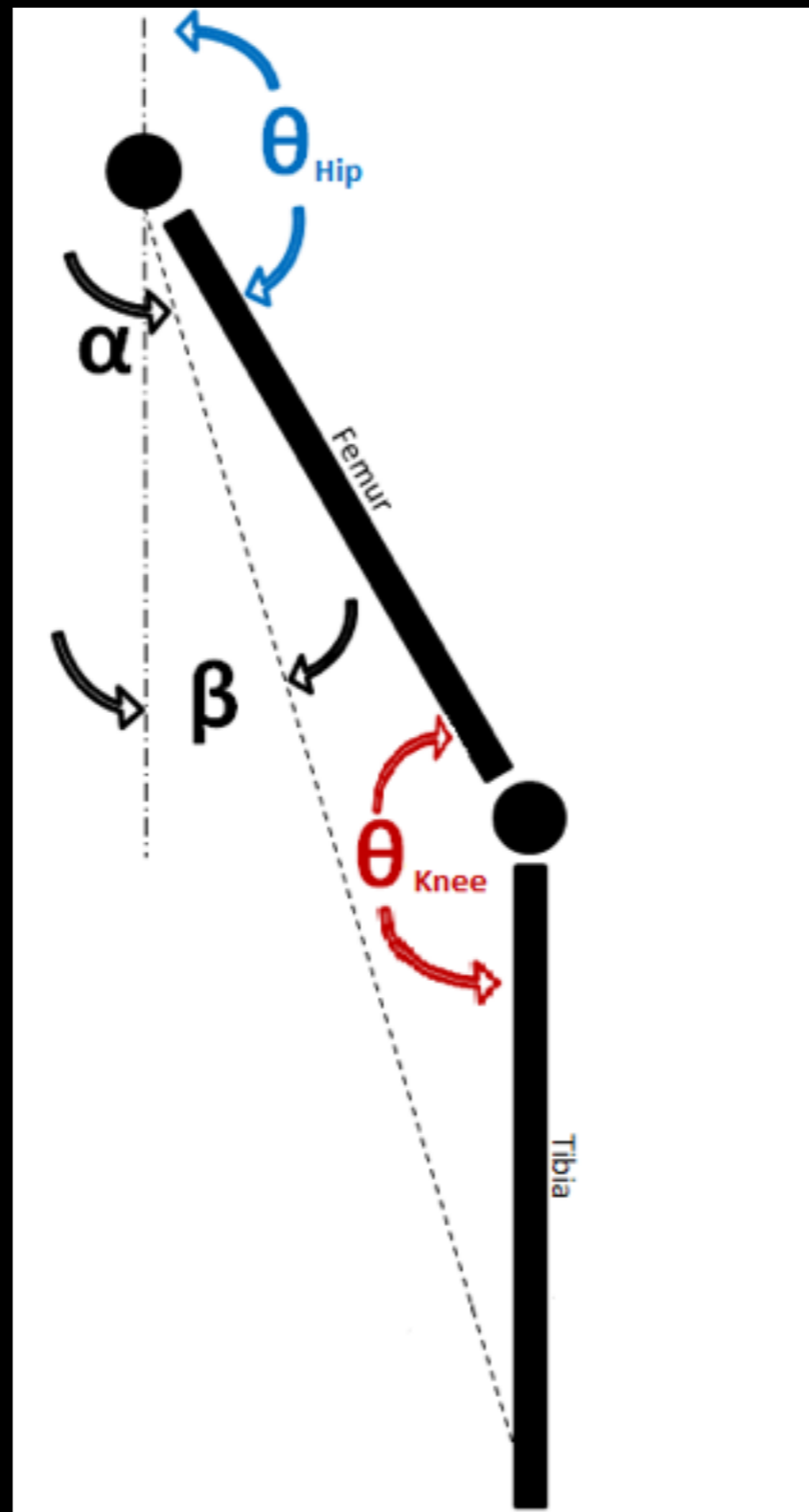
INVERSE KINEMATICS



INVERSE KINEMATICS



INVERSE KINEMATICS



INVERSE KINEMATICS

some code

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Stores

Tutorials

Repositories

TUTORIALS

learn.sparkfun.com/tutorials

learn.adafruit.com

[instructables.com](https://www.instructables.com)

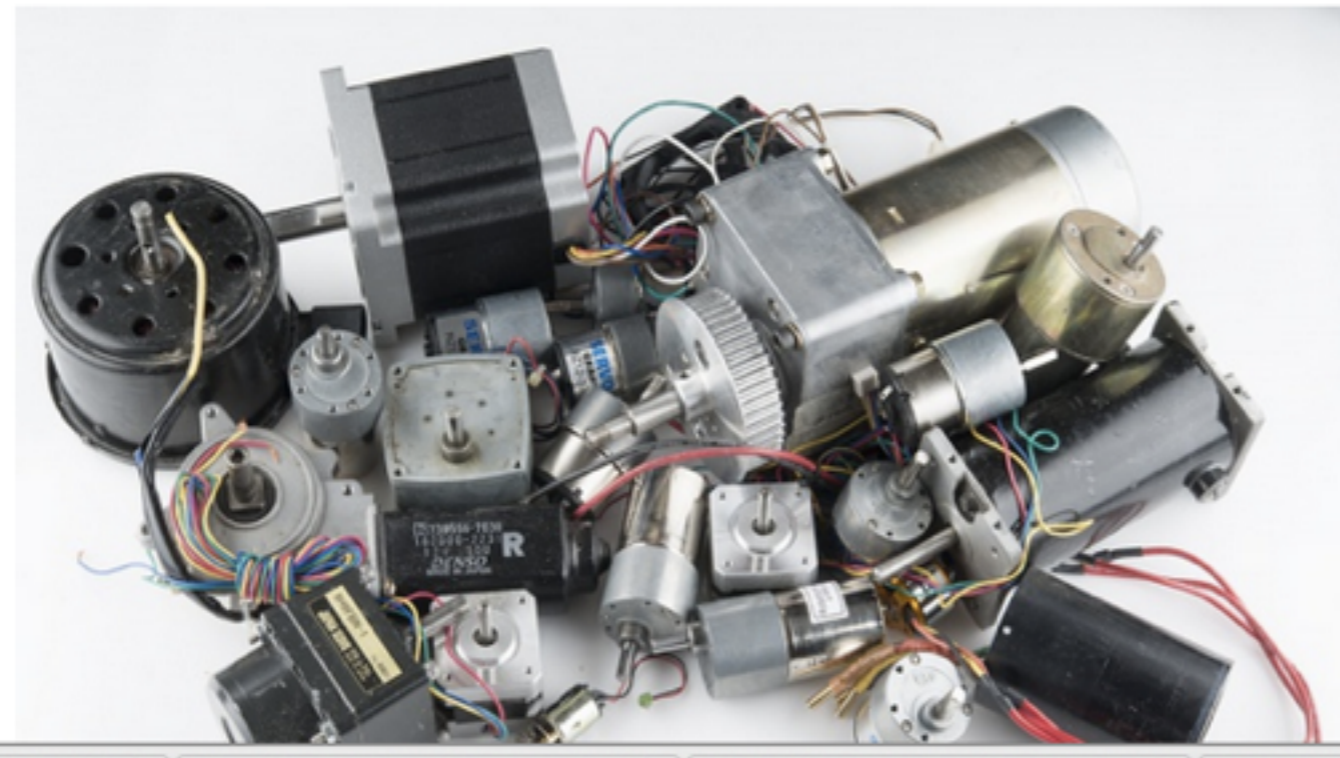
Making Things Move, by Dustyn Roberts
makingthingsmove.com

Home / Tutorials / Motors and Selecting the Right One

Motors and Selecting the Right One

Introduction

At any given moment, you are near at least one or two types of motors. From the **vibration motor in your cell phone**, to the fans and CD drive in your favorite **gaming system**, motors are all around us. Motors provide a way for our devices to interact with us and the environment. With a myriad of applications for motors, the design and operation of them can vary.



PAGES

- Introduction**
- What Makes A Motor Move?
- DC Brush Motors - The Classic
- Brushless Motors - MORE POWER!
- Stepper Motors - Simply Precise
- Linear Motors - The Future!!!
- Resources and Going Further

Discussion (1)

Feedback

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Single Page

Print

This incredibly small stereo amplifier is surprisingly powerful. It is able to deliver 2 x 2.8W channels into 4 ohm impedance speakers (@ 10% THD) and it has a i2c control interface as well as an AGC (automatic gain control) system to keep your audio from clipping or distorting.

Low Power WiFi Datalogger

Log sensor data with an Arduino and CC3000 for days on batteries!



Learn how to measure and reduce the power consumption of an Arduino and CC3000 datalogger project.

Trellis Python Library

Use the Adafruit Trellis with a Beaglebone Black or Raspberry Pi!



Whether you mount it on your wall, stand it on your desk, or wear it around your neck, this NeoPixel ring clock will keep your time fresher than the crisper drawer.

3D Printed Google Glass Adapter

A 3d printed plastic adapter turns any frame into prescription google glasses.



Upgrade your google glass with your own frames using a 3d printed adapter.

Adafruit Qualia High Res Displayport Desktop Monitor

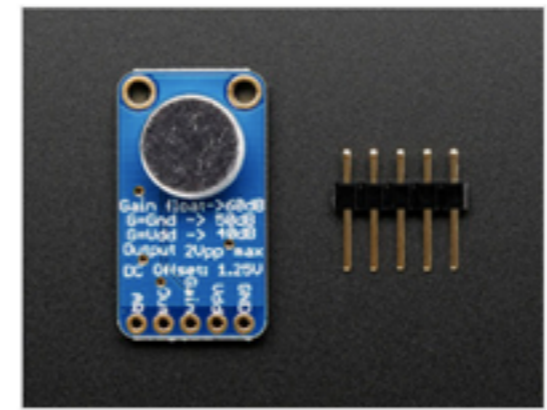
2048x1536 Retina-Blasting Pixels in a 9.7" Display



Have you ever forgotten to close your garage door and remembered to shut it after it was too late? In this tutorial I will show you how to open and close your garage door over the internet using a Raspberry Pi, relay, and Web IO Pi.

Adafruit AGC Electret Microphone Amplifier - MAX9814

Add a super-hearing microphone amplifier - our automatic gain is your gain!



This fancy microphone amplifier module is a step above the rest, with built in automatic gain control. The AGC in the amplifier means that nearby 'loud' sounds will be quieted so they don't overwhelm & 'clip' the amplifier, and even quiet, far-away sounds will be amplified. This amplifier is great for when you want to record or detect audio in a setting where levels change and you don't want to have to tweak the amplifier gain all the time.

Bluefruit "BlueFoot"



Transform a pair of desktop speakers, two servos, and a handful of 3D printed parts into a fully functional animatronic robot head.

Secret Knock Activated Drawer Lock

Unlock a drawer by knocking a secret pattern.





instructables

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Let's Make

robotic snake sneel

Everything



Make a swimming Robo-Snake
by gabriellalevine in Robots

★ 171 63K



Robot Snake
by IzzyLink in Robots

★ 7 4.3K



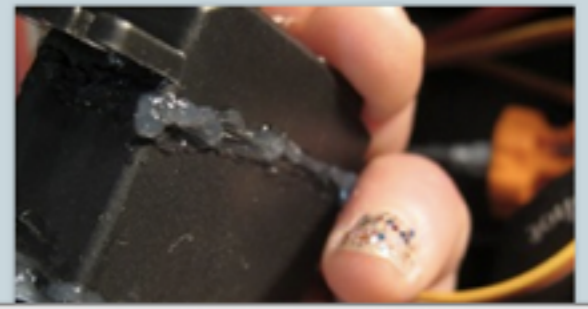
Robot Costume With LEDs
by joshf in Robots

★ 9 18K



Robot Night Light with two faces
by poza in Lamps

★ 8 821

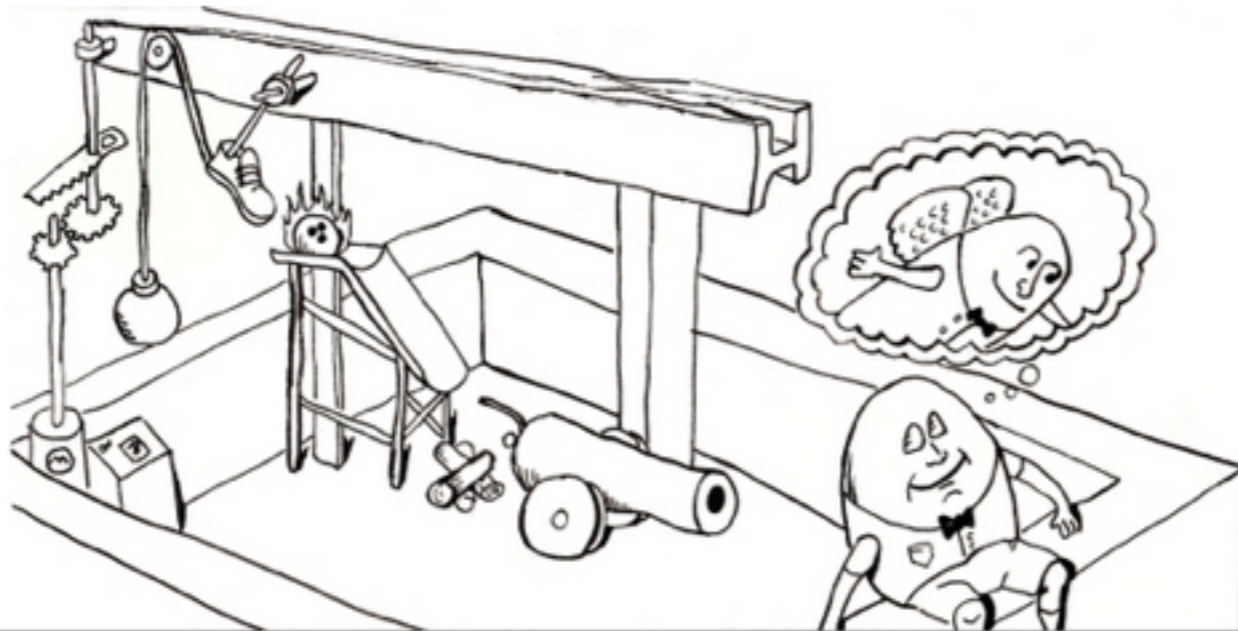


Making Things Move

by Dustyn Roberts — A blog about my book and all things related

About the Author About the Book **Resources** Translations Contact

Use the drop down menu under Resources to find all the links and files that support this book, organized by chapter. You'll find CAD files for laser cutting and 3D printing, pictures, and video clips of each of the projects. In general, if you search for dustynrobots just about anywhere ([flickr](#), [thingiverse](#), [Ponoko](#), etc.) you'll find me and links to these files.



Order the book!



GEARS AND LINKAGES

507 Mechanical Movements

(<http://507movements.com/index03.html>)

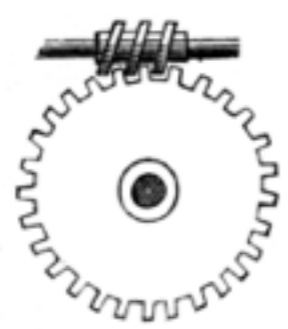
KMODDL (<http://kmoddl.library.cornell.edu/bib.php>)

FLYING PIG / ROBIVES (robives.com/mechs)

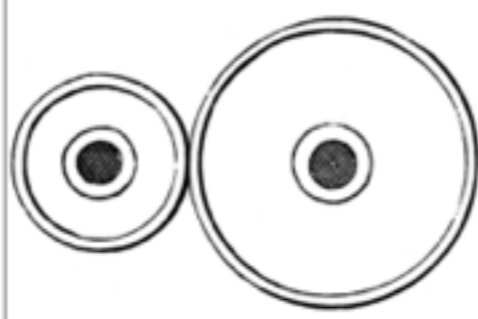
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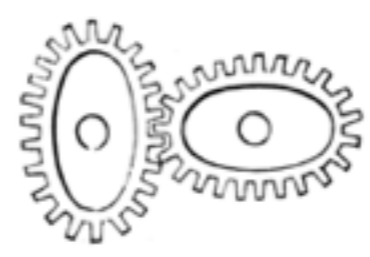
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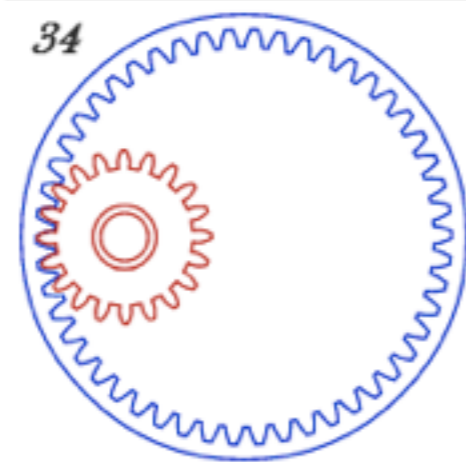
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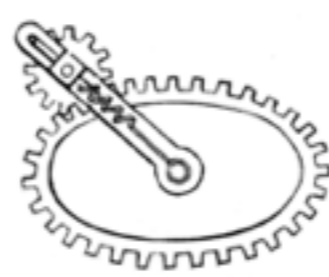
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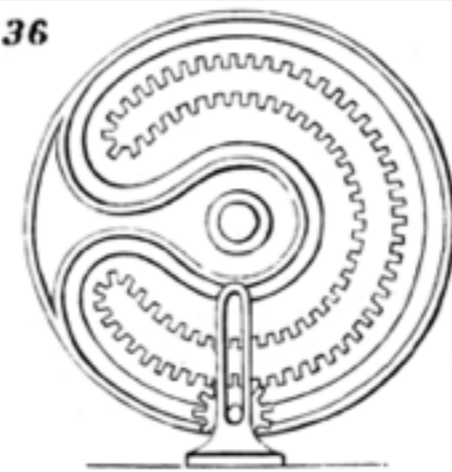
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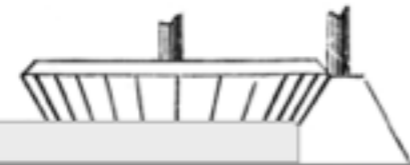
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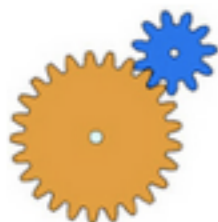


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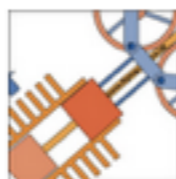


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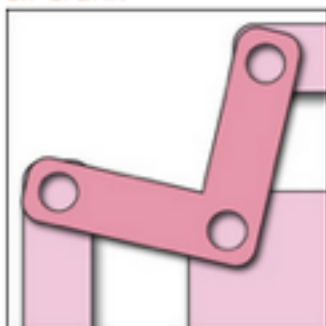
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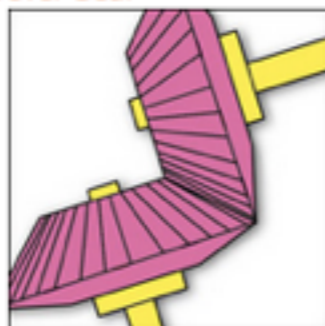
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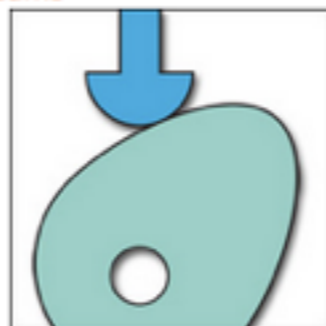
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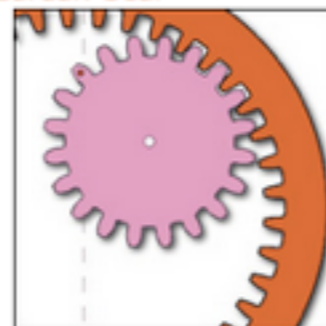
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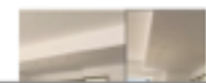
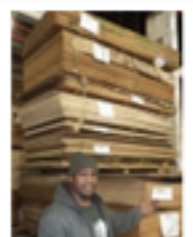
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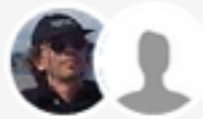
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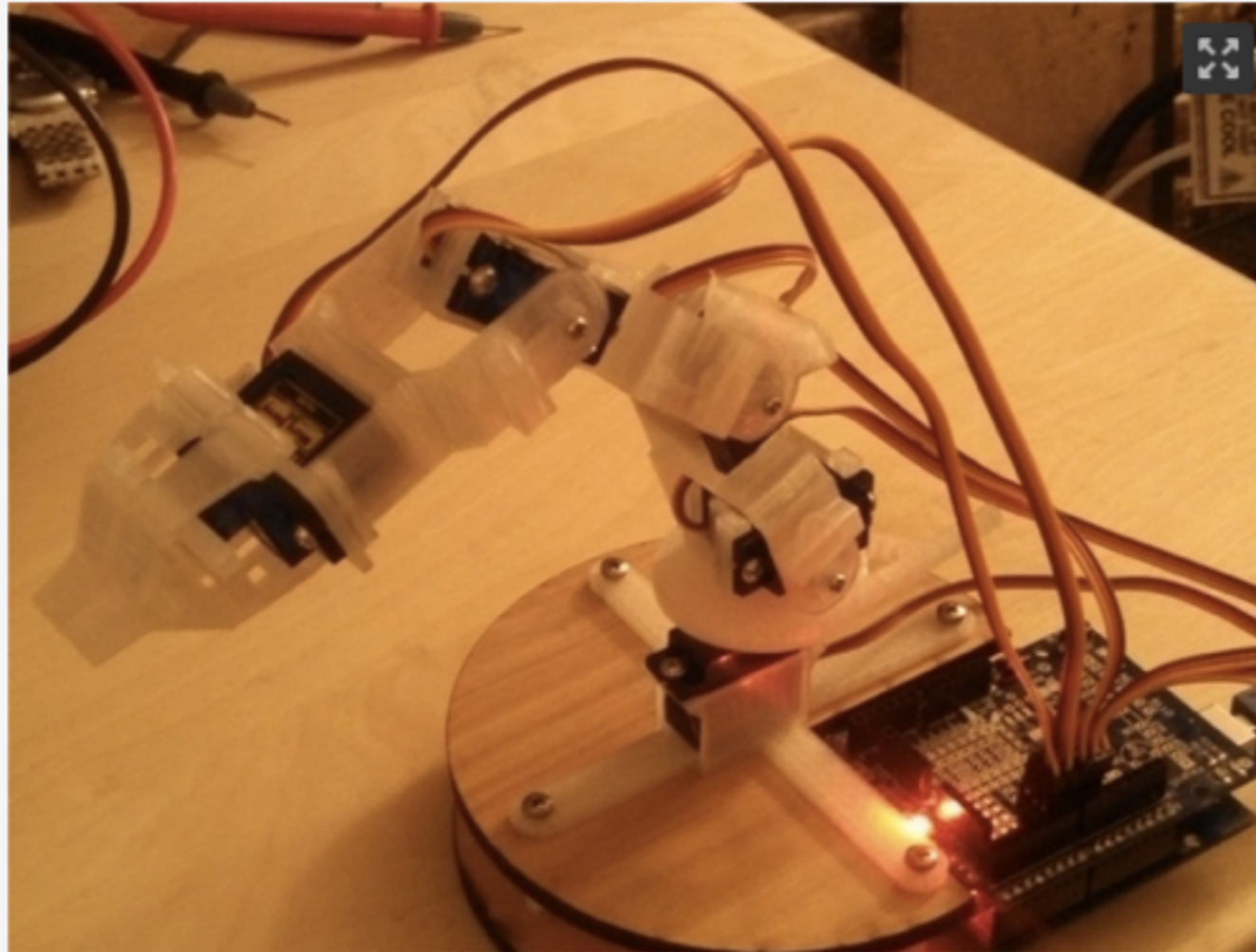
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OpenScad Micro Servo Robot Arm

Made by intijk, uploaded Jan 26, 2014



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by holgero
Mar 23, 2013

79 92 9

Description

This is the whole page, added some modification to it to fit accurate size of Makerbot

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