I Want to Hold Your Hand

The Science and Biomechanical Engineering of Replacement Body Parts

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Science, Math & Engineering

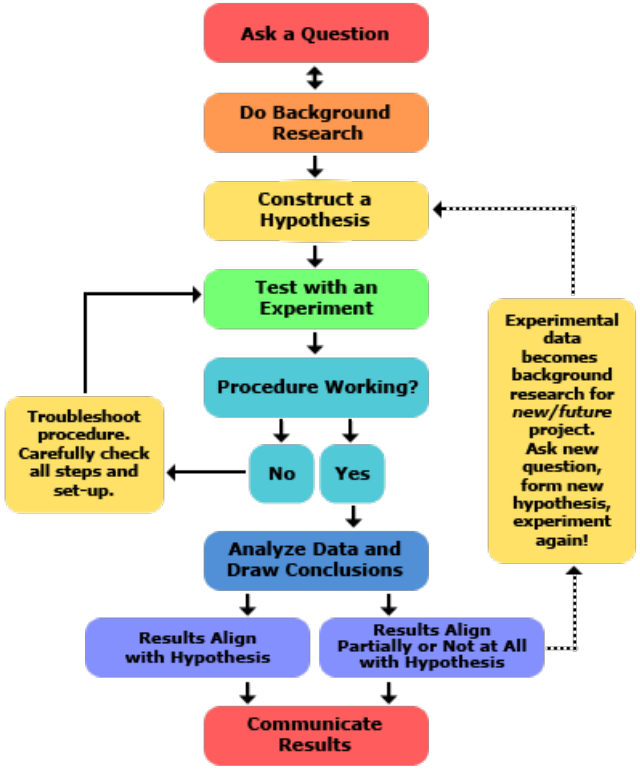
- Science – study of the physical and natural world (what we can see and also what we can't see)
- Math – study of logic, number, shape and arrangement
- Engineering – application of Math, Science and Technology to solve real-world problems

How do Scientists Solve Problems?

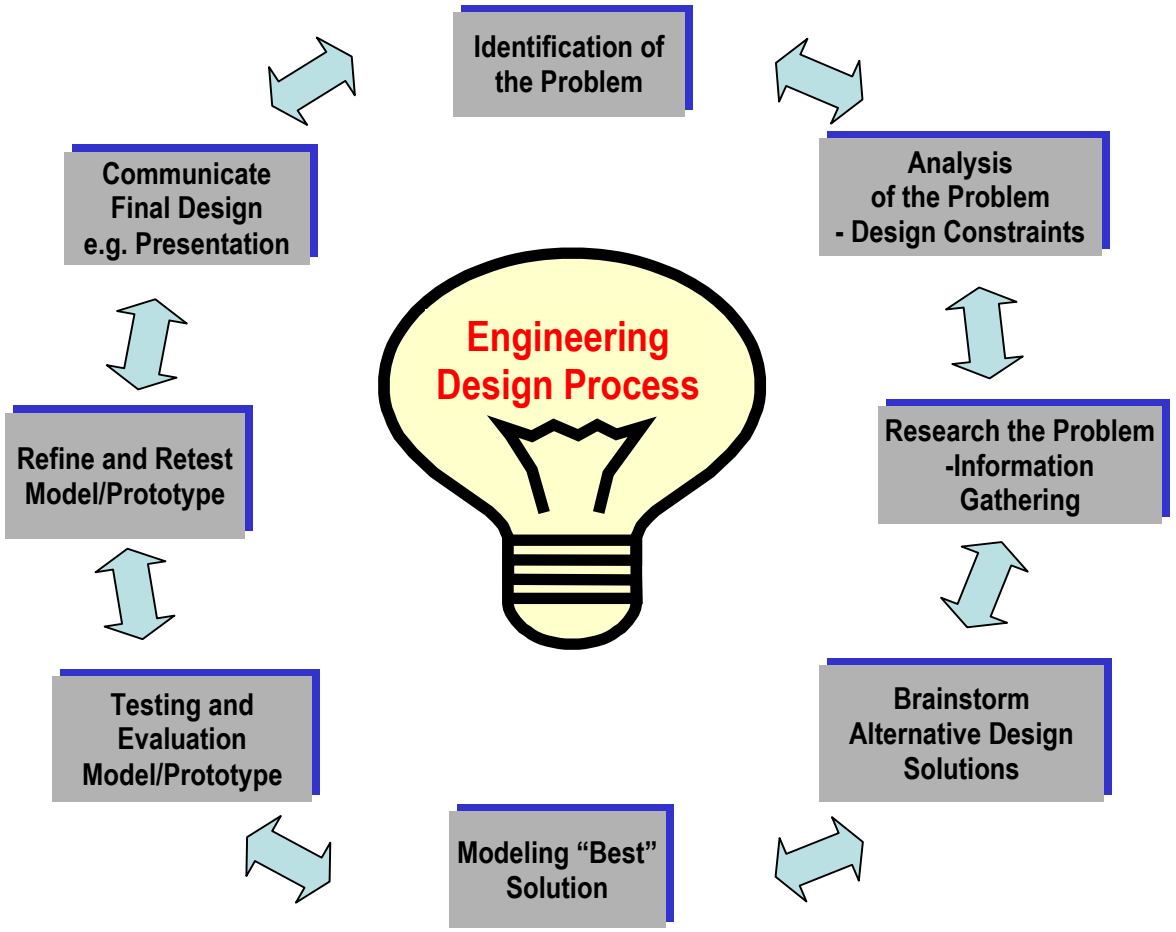
Scientific Method

Classic

Modern



How do engineers solve problems?

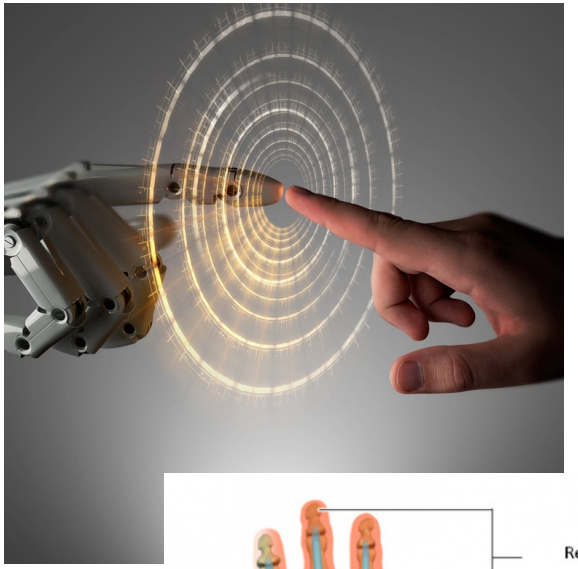


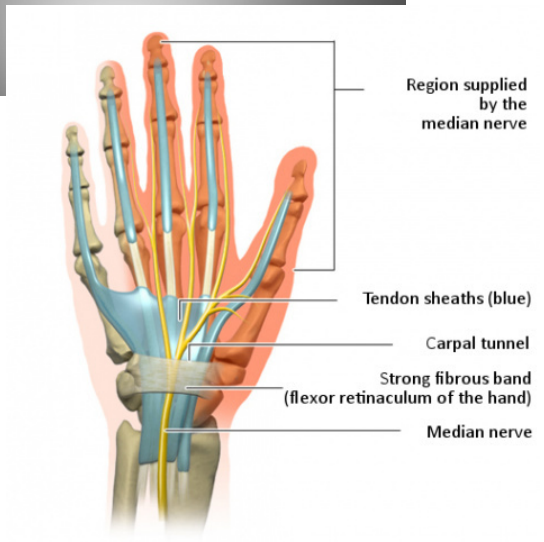
Today's Problem: Build a hand that works

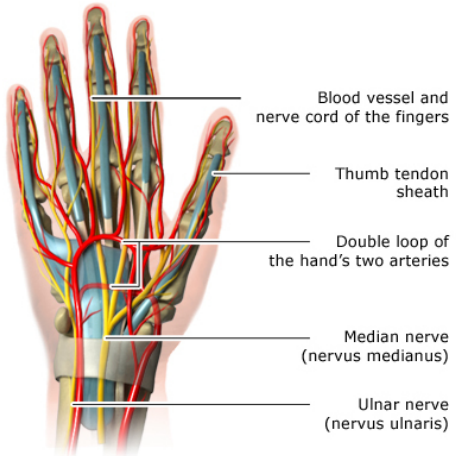
- How does a human hand work?
  - Try it yourself
  - Research
    - Watch a video
- What do we know from science that can help us?
  - Physics
    - Mechanics
  - Biology
    - Anatomy
  - Chemistry

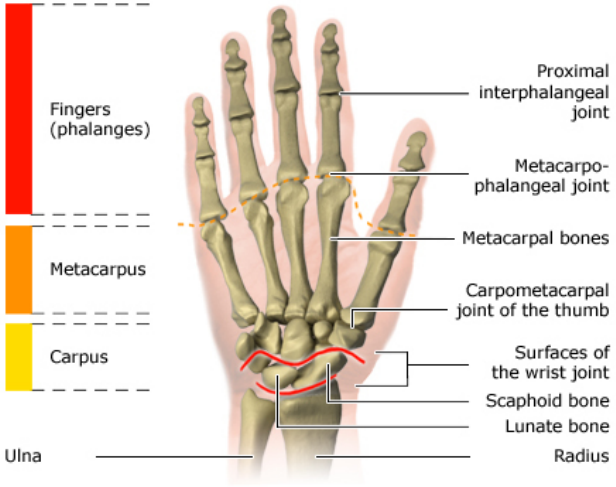
Physiology

We are complex!!







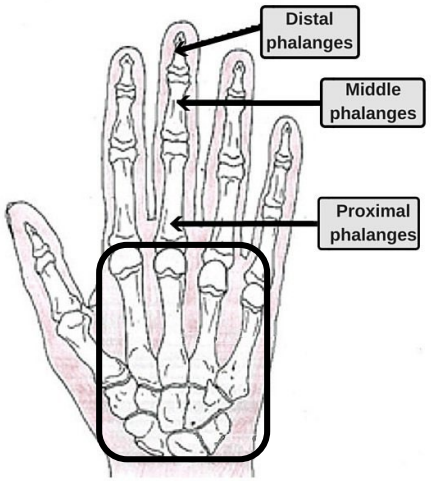


https://youtu.be/dMUMxm3O0Cc

Design Constraints

- Build a model to *learn*
- Start with something simpler: What do we really want to learn?

How does one finger move?



- Bones
- Joints (connections)
- Muscles
- Ligaments
- Nerves / Brain (controller)

Build a Model Finger

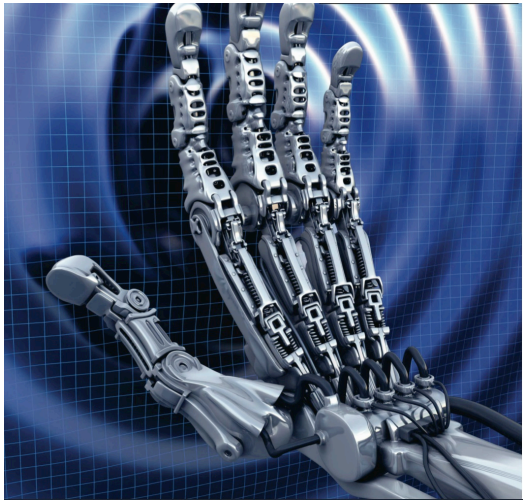
- Research: How does your finger move?
- Design a model using the materials provided. Make a sketch first.
- Build
- Test
- Share with another group – what researchers learn from each other How did the materials limit your design?

The Goal for Your Model Hand

Pick up an object and drop it in the basket

Build a model hand

- Palm
- Each child builds one finger
  - Fourth “finger” is the thumb
  - How to attach?



Materials	
9 Narrow Rubber Bands	Scissors
3 Coffee Stirrers	35 cm Nylon Cord
Cardboard	Centimeter Ruler
Tape and Scissors	Pen

Steps in Building Fingers

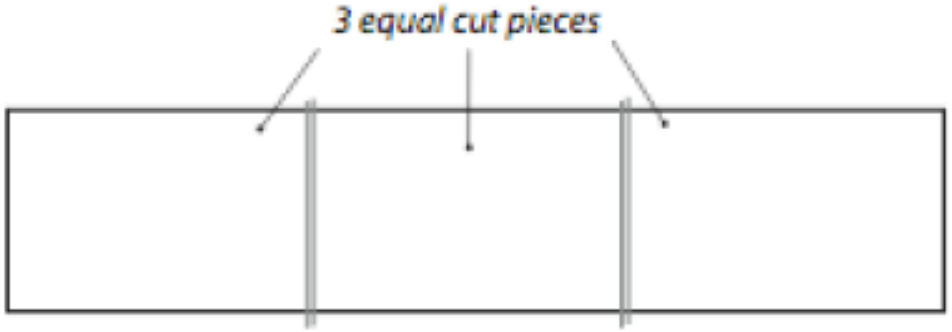


Diagram 1

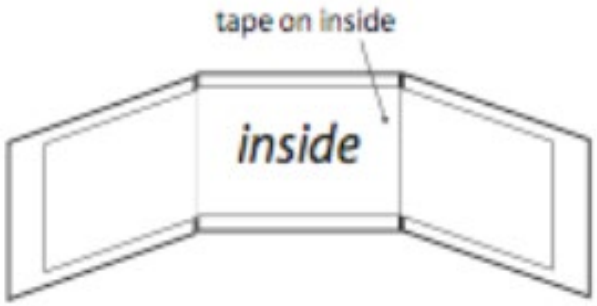


Diagram 2

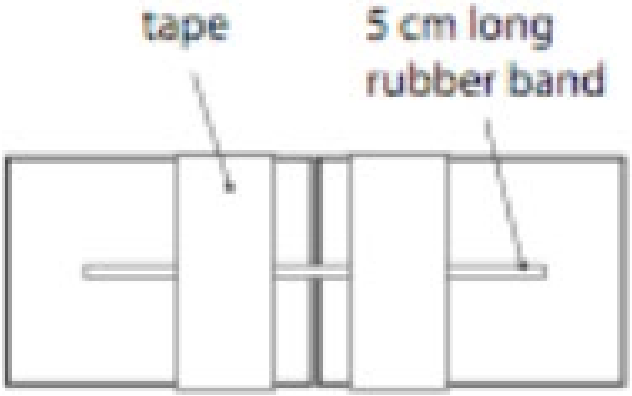


Diagram 3

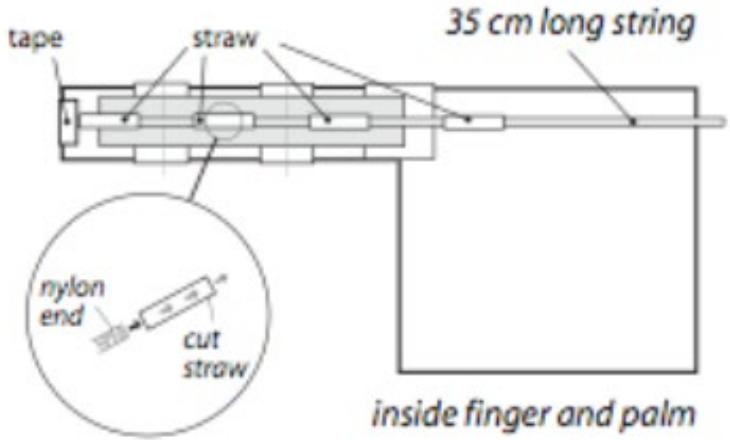


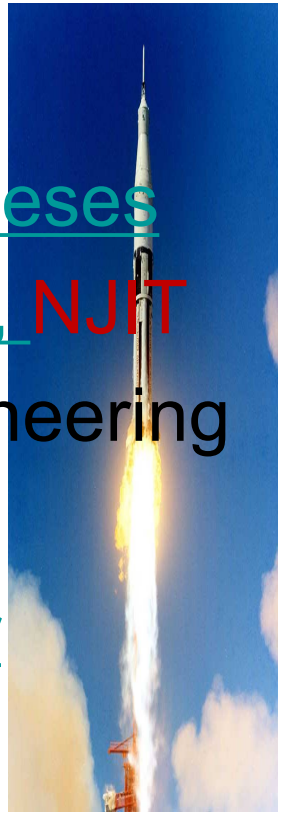
Diagram 6

Analyzing and Reporting Results

- What would you change for your next model?
- What factors might you have to consider if you were really building a working hand?
  - Anatomy / Physiology
  - Electronics Nanotechnology Innovation Center @ NJIT
  - Materials – weight / safe for human body / cost
  - Durability
  - Cost
  - Ease of maintenance / Cleaning
  - Aesthetics – manufactured skin Dr. Treena Arinzeh lab @ NJIT
  - Other …

Where is research taking us next?

- Dexter and inflatable hands
- Video games to learn how to use prostheses
- Tissue engineering: Dr. Treena Arinzeh, NJIT
- NJIT research areas in biomedical engineering
- NJIT biomedical research centers
- NJIT Microfabrication Innovation Center



Thank you for being part of our workshop. For further information on CPCP:

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Campus Tours

Google Earth view

https://earth.google.com/web/@40.74282357,-74.1769588,45.22207285a,761.33333367d,35y,-103.71896964h,44.99989893t,0r/data=CmUaYxJdCiUweDg5YzI1MzdkOThjMzk2Zjk6MHhiOTdjMjg3YTJlZjk1ZjQzGa69qg4UX0RAIRCglWpVi1LAKiJOZXcgSmVyc2V5IEluc3RpdHV0ZSBvZiBUZWNobm9sb2d5GAIgAQ

Big Bear Solar Observatory San Bernardino CA

https://en.wikipedia.org/wiki/Big_Bear_Solar_Observatory

http://www.bbso.njit.edu/new_virtual_tour.html

http://www.bbso.njit.edu/new_tour/h_alpha.html

Inside the dorms http://virtualhousing.njit.edu/