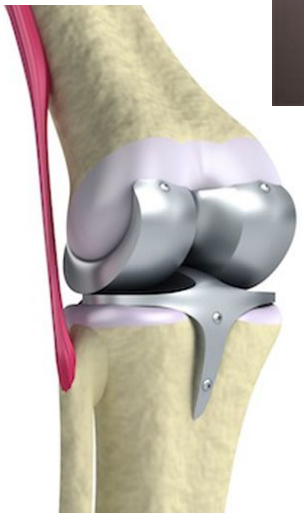
Science, Engineering, Technology & Math

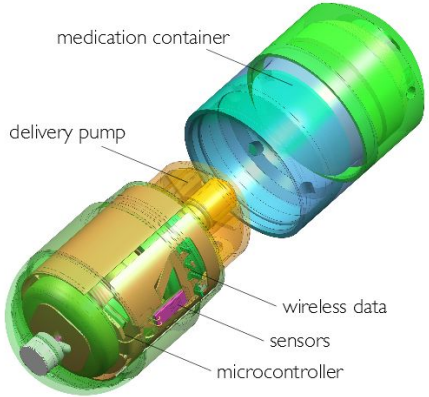
Engineer Your Body

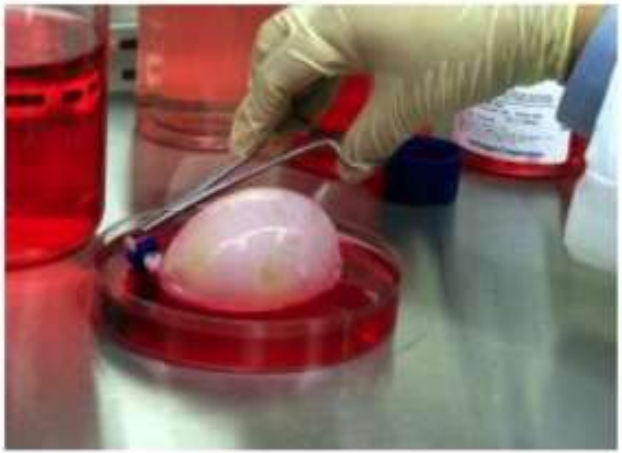
Welcome to
Engineer your Body

You will learn about
Biomedical Engineering



What do you see? Medical Device





A tissue engineered bladder (left) and trachea (right) seeded with stem cells.

What do you see? More Medical Devices

Medical Device are used to...

Save Lives

Improve quality of Living for the Sick

Prevent, diagnose, and Treat disease

and much more!

We will be making something like this:

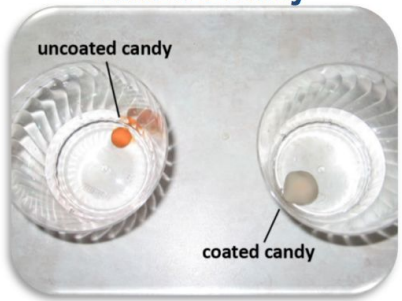
Wait for it...

Bioengineering Program

* Learn about Biomedical Engineering
* Making Models & Building Medical Device

Make a Cast

Dissolve Candy



What is Biomedical Engineering?

Using engineering concepts in Medicine

Why Biomedical Engineering?

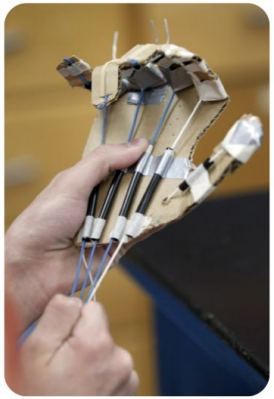
* Have Fun
* Save Many Lives
* Make a Difference
* Make a lot of Money

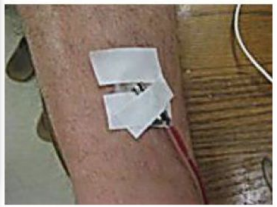
Build your own DNA model

Perform Virtual Lab Experiment

Build a model Lung with BALLOONS!

DESIGN Prosthetics





Make your own ECG pads

*ECG records heart activities

Class Structure

Week #1:

Day 1 (Engineering)

- Explore Engineering & Biomedical Engineering

Day 2 (Bioinformatics)

- DNA Candy Model

Week #2:

Day 3 (Bioinformatics)

- Finish DNA Candy Model
- PCR Virtual Lab

Day 4 (Bioinformatics)

- DNA Extraction Lab

Week #3:

Day 5 (Biomechanics)

- Balloon Stent

Day 6 (Biomechanics)

- Lung Model

Week #4:

Day 7 (Biomechanics)

- Prosthetics

Day 8 (Biomechanics)

- Robot Hand Model

Continue Next Slide…...

Class Structure

Week #5:

Day 9 (Bioelectrical)

- ECG Pad

Day 10 (Biochemical)

- Drug Coating & Drug Delivery

Week #6:

Day 11 (Other types of Biomedical Engineering)

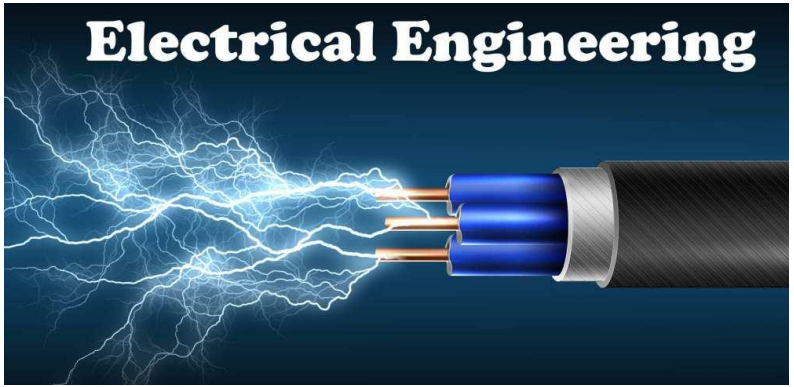
- Tissue Engineering
- Biomimicry

Summary:

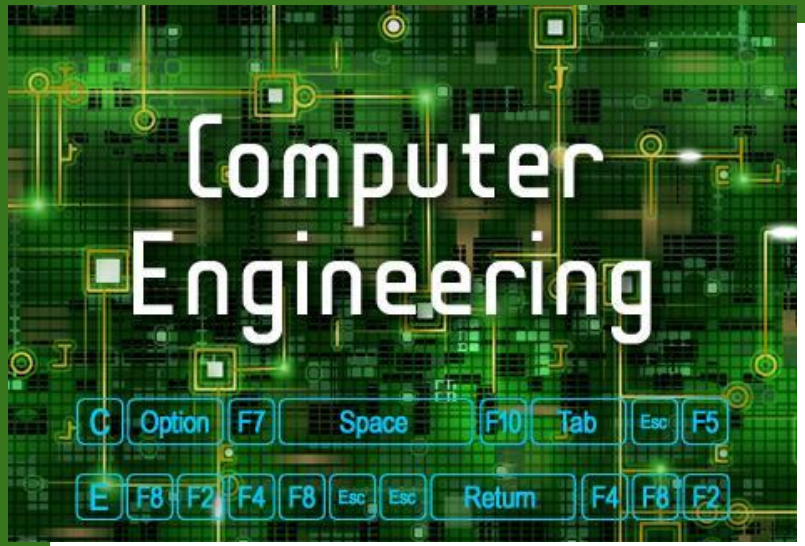
- Types of Engineers
- Biomedical Engineering
  - Bioinformatics
  - Biomechanics
  - Bioelectrical
  - Biochemical
  - Tissue Engineering & Biomimicry

Day #1: What is Engineering?

Applications of combining science, math, and technology to design, build, and develop material goods, machinery, etc.



Types of Engineers



BME

BIOMEDICAL ENGINEERING

Types of Engineers

What do you think about

What is Civil Engineering?

professional **engineering** discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings

Civil Engineering

Civil Engineering

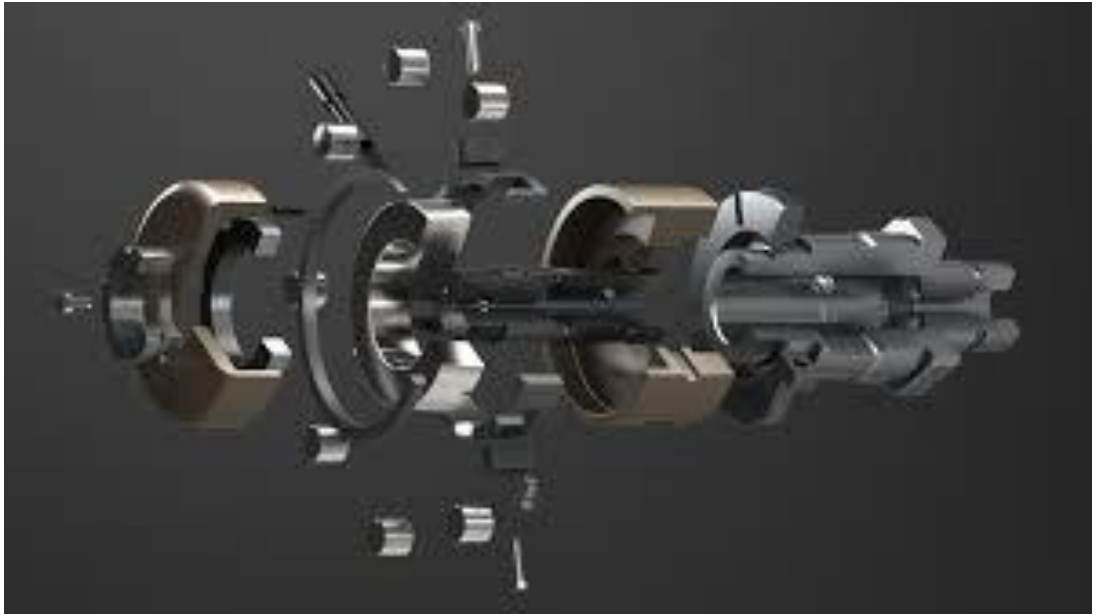
An Example of their work would be: The Hoover Dam

Civil Engineering

What do you think about

What is Mechanical Engineering?

discipline that applies the principles of **engineering**, physics, and materials science for the design, analysis, manufacturing, and maintenance of **mechanical** systems. It involves the design, production, and operation of machinery.



Mechanical Engineering

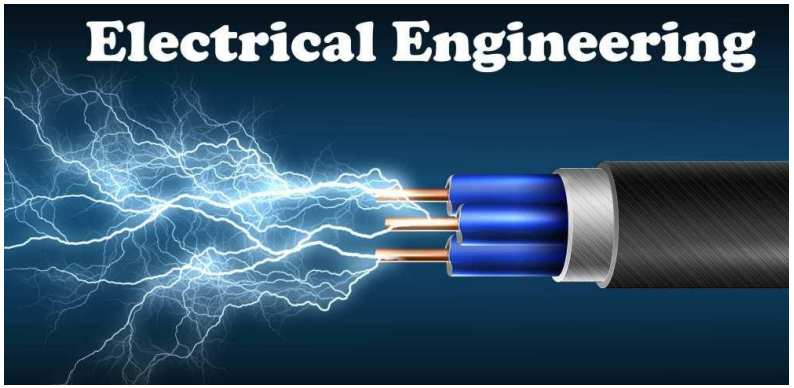
Mechanical Engineering

Everything is Possible!

Well… Almost

Mechanical Engineering

What do you think about



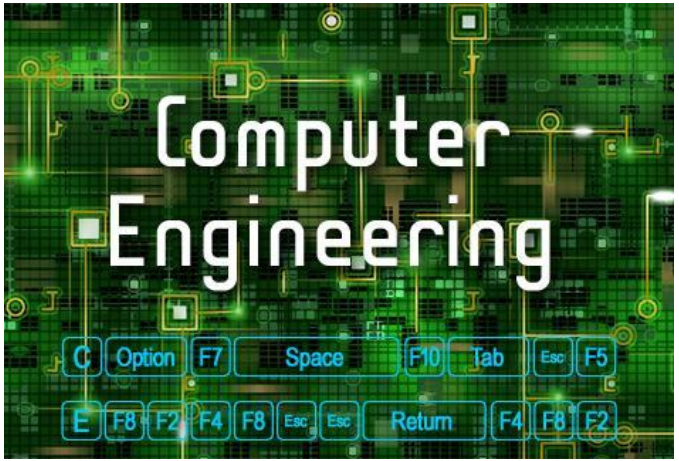
What is Electrical Engineering?

field of **engineering** that generally deals with the study and application of electricity, electronics, and electromagnetism

Electrical Engineering

Electrical Engineering

What do you think about

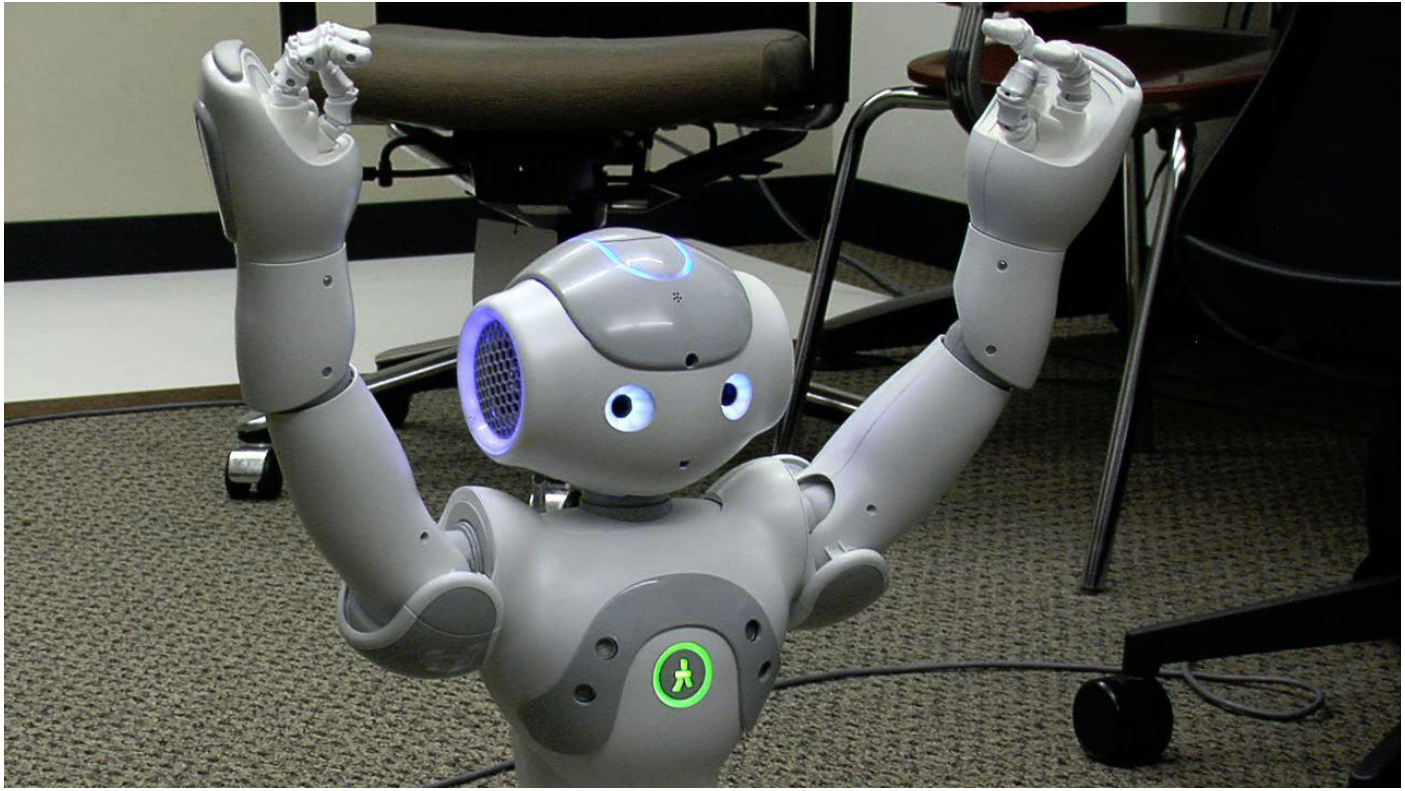


What is Computer Engineering?

discipline that integrates several fields of electrical **engineering** and **computer** science required to develop **computer** hardware and software.

Computer Engineering

Computer Engineering



Computer Engineering

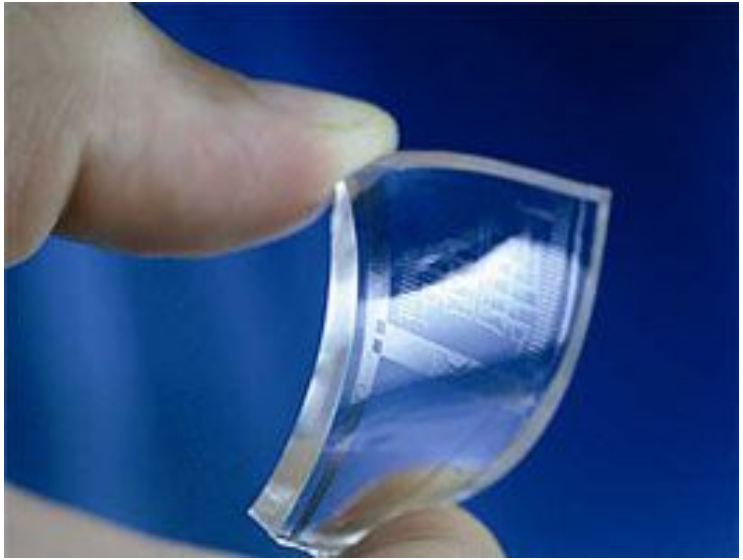
What do you think about

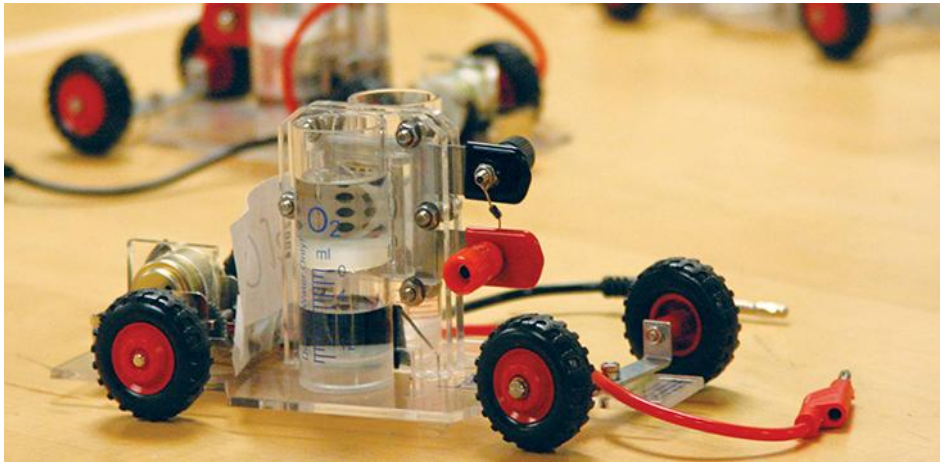
What is Material Engineering?

discipline focus on materials such as metals, ceramics, and plastics to create new **materials**. **Materials engineers** develop, process, & test **materials** used to create a range of products, from computer chips and aircraft wings to golf clubs and snow skis.

Material Engineering

Material Engineering





Material Engineering

What do you think about

What is Chemical Engineering?

branch of **engineering** that applies physical sciences (physics & chemistry) and life sciences (microbiology & biochemistry) together with applied mathematics and economics to produce, transform, transport, and properly use chemicals, materials and energy.

Chemical Engineering

Chemical Engineering

Chemical Engineering

What do you think about

What is Biomedical Engineering?

application of **engineering** principles and design concepts to medicine and biology for healthcare purposes (e.g. diagnostic or therapeutic).

Biomedical Engineering

Biomedical Engineering

Click to Watch Video

https://www.youtube.com/watch?v=kIY5PKAft-o

Biomedical Engineering

Creative Challenge:

COURTESY: GENEVIEVE ROSS

Why do we have Biomedical Engineering?

Think about what they do and why they do it

Why are you here?

Materials & Supplies

- Students to participate and ask questions
- Projector to display powerpoint
- A good attitude

Pro Tips by Shirley Luo

- Review Engineering 101 (types of engineering) and Learn it before teaching class !!
- Take video and photos of the kiddos throughout the class and add it to the presentation.
- Have the kids think :)

Resources:

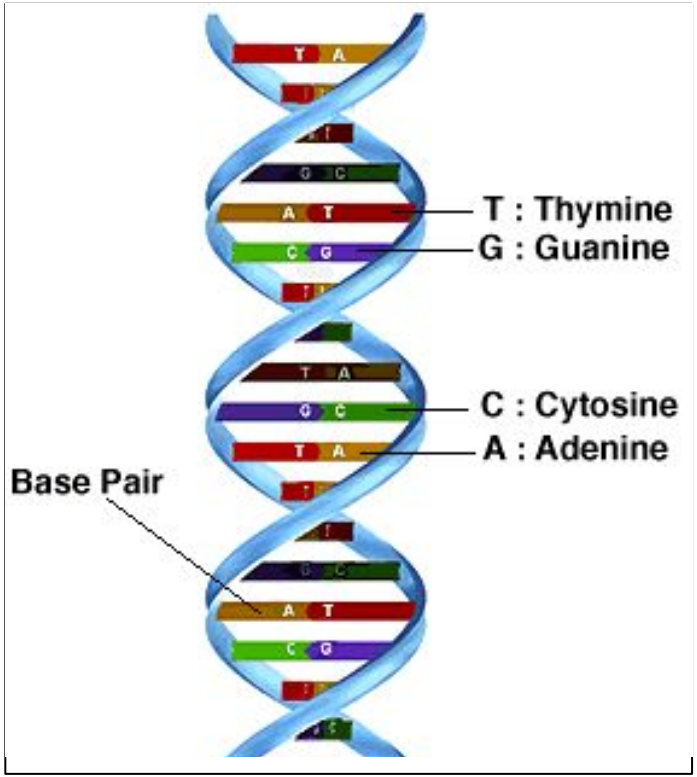
- https://www.youtube.com/watch?v=kIY5PKAft-o
- Wikipedia - for definitions
- Google Images - for images
- Engineering 101 - Types of Engineering Paper (by: Shirley Luo)

Day #2: Bioinformatics (DNA Candy Model)

https://www.youtube.com/watch?v=8kK2zwjRV0M

What is DNA?

- Deoxyribonucleic acid
- Genetic materials for all living things
- It is the recipe that makes you (and all living things)
- 99.9% of our DNA is exactly the same as every other person's
  - § only 0.01% of difference determine the difference of how someone looks



- Certain DNA sequences code for specific characteristic (each sequences is unique)

What is DNA made of? *DNA factory sheet (**Appendix A**)

- DNA is made of nucleotides (A, T, C, G)
- A always pair up with T, C always pair up with G
- 3 nucleotide codes for 1 amino acid
- Amino acids make protein
- We need protein to function

DNA structure

- DNA is really long; only a portion of it codes for the essential
- Double stranded
  - Why? So it can copy (or replicate)
  - Why? To protect the DNA from mutating (copying the bases wrong)

	W	w
w	Ww	ww
w	Ww	ww

Terminology

- Phenotype: expression of physical characteristics by genotype
  - § Eg. Brown hair, blue eyes
- Geneotype: specific sequence of DNA in a gene
  - § Eg. CGA, AGC
- Gene: section of DNA that carries information to determine characteristics or traits
  - § Eg. ATGCGAACGTAGGAGTCATCGA

Mutation

- Occurs as we age, which is why we don't live forever
- Technology can detect heredity disease by sequencing your DNA (look for patterns of certain disease in DNA)
  - § Hereditary disease: Color blindness, down syndrome, diabetes

Biomedical engineers

- Improve health care and quality of life
- Use and build technology to
  - § Study DNA, understand genetic disorders, diagnose, treat, and/or prevent

Check if you have

- DNA to Protein Diagram (Appendix A)
- DNA Identity Worksheet (Appendix B)

3-base genotype that code for certain phenotype

Each group is only decoding one person (the name on the worksheet) on the DNA
Identity Worksheet

Keep your person’s identity a secret from other groups

Process

HOW TO DECODE:

For instance Mark has

green eyes ---> AGT
brown hair ---> CGA
round nose ---> GCA
medium ears ---> TCG
left handed ---> GTT

Mark's DNA sequence is: AGT**CGA**GCA**TCG**GTT
Mark's complementary sequence is: TCA**GCT**CGT**AGC**CAA

Process

Build model from gumdrops, lickerish, and toothpicks from code

Partner 1: Build DNA primary strand
Partner 2: Build complementary strand

When done raise hand (CHECK)
After check, wait quietly and patiently

Process

I switch your DNA model with another group

GUESS the person

Process

Creative Challenge:

- What is DNA?
- Where does an individual's DNA come from?
- What makes a person unique?
- What is phenotype? Genotype?
- Was the activity challenging?
- What were some of the parts you struggled with?
- What do you like overall?

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per groups of 2)
Toothpicks	15-20
Gumdrops	30-45
Marshmallow (optional)	15-20 (optional)
Lickerish	4-6
Plastic/paper plate	1
DNA to Protein Diagram (Appendix A)	1
DNA Identity Worksheet (Appendix B)	1
DNA Code Key (Appendix C)	1

Pro Tips by Shirley Luo

- Review Bioinformatics - DNA Model Construction before teaching class
- Print out Handouts (3)
- Review video (https://www.youtube.com/watch?v=8kK2zwjRV0M) and Learn it before teaching class !!
- Take video and photos of the kiddos throughout the class and add it to the presentation.
- Have the kids think :)

Resources:

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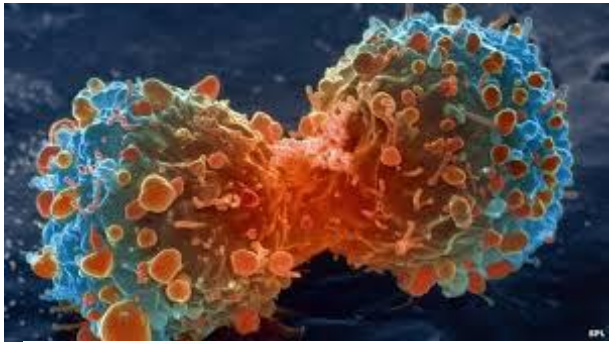
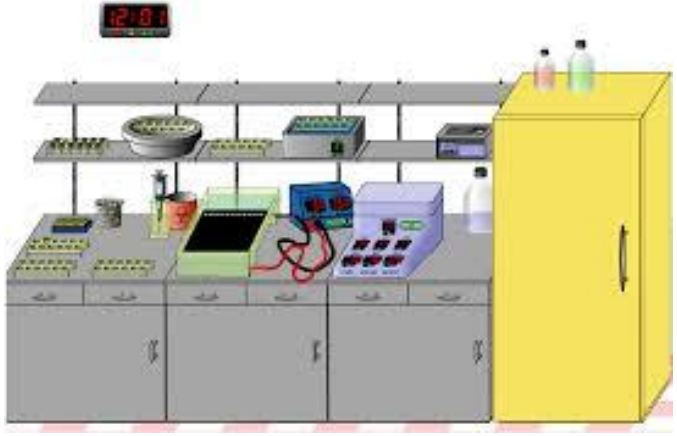
- Wikipedia - for definitions
- Google Images - for images
- Bioinformatics - DNA Model Construction A & B (by: Shirley Luo)

Day #3: Bioinformatics (PCR Virtual Lab)

https://www.youtube.com/watch?v=ZmqqRPISg0g





Hereditary diseases are genetic disorders inherited from the parents

- Eg: Color blindness, down syndrome, diabetes, cancer

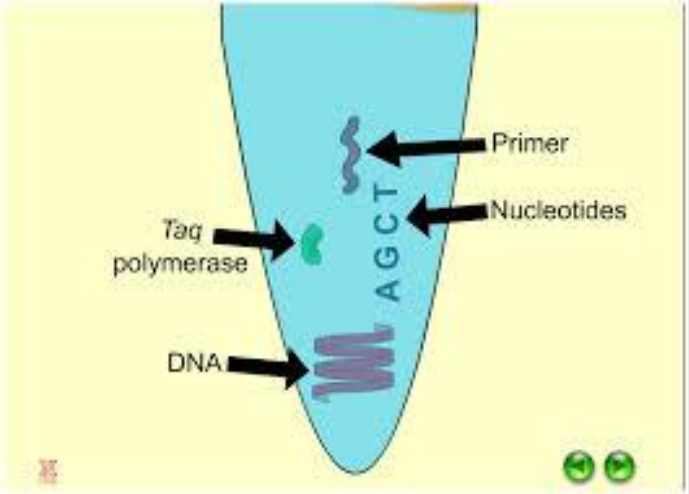
Technology can detect heredity disease by sequencing your DNA (look for patterns of certain disease in DNA)

- Eg. Angelina Jolie's mother died from ovarian cancer in 2007. Using modern day technique, Angelina Jolie was able to detect that she also carry that gene for ovarian cancer.

Biomedical engineers

- Improve health care and quality of life
- Use and build technology to
  - § Study DNA, understand genetic disorders, diagnose, treat, and/or prevent

https://www.youtube.com/watch?v=DkT6XHWne6E

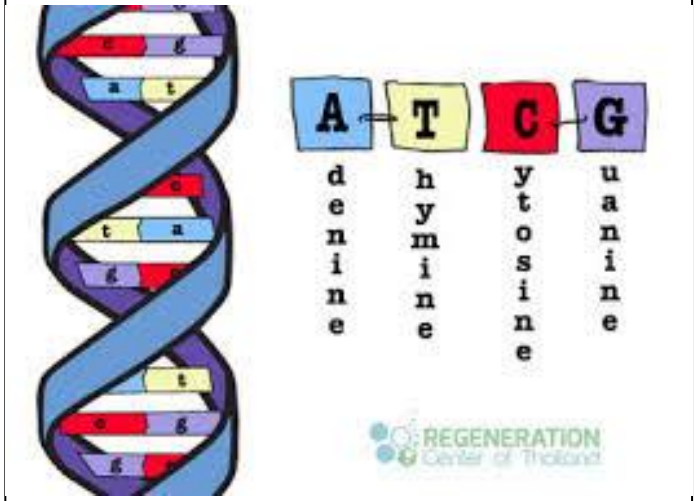


PCR (polymerase chain reaction)

- Commonly used biotechnology technique
- Use to copy pieces of DNA
- Why is important?
  - § Can be used to copy pieces of DNA (where disease might be) and studied
  - § Can be used to diagnose disease
  - § Simple and inexpensive tool

Components in PCR

- Primer – Short pieces of DNA designed to match segment of desired DNA segment (primer 1 matches the starting part of the one strand of the DNA segment, primer 2 matches the starting part of the other strand of the DNA segment)
  - § It is kind of like a block of puzzle pieces of a jigsaw puzzle
- DNA Polymerase – Protein used to start copying DNA
  - § It is kind of like the green light (traffic); signaling GO!
- Nucleotides – Alphabets for DNA (words & sentences)
  - § It is kind of like a puzzle piece of a jigsaw puzzle



DNA structure

- DNA is really long; only a portion of it codes for the essential
- Double stranded
- Complementary characteristics (due to double strand)
- DNA is made of nucleotides (A, T, C, G)

§ A always pair up with T

§ C always pair up with G

We are doing PCR Virtual Lab.

First, Go to
http://learn.genetics.utah.edu/content/labs/pcr/

Second, Follow instructions from website

Creative Challenge:

- What did you see?
- What is DNA?
- What is PCR?
- What do you think PCR can do?
- How is this beneficial for the Society?
- Why do we need technology like this?
- What do you think of the activity?
- What was challenging?

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per group of 1)
Internet	
Computers	1

Pro Tips by Shirley Luo

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- https://www.youtube.com/watch?v=ZmqqRPISg0g
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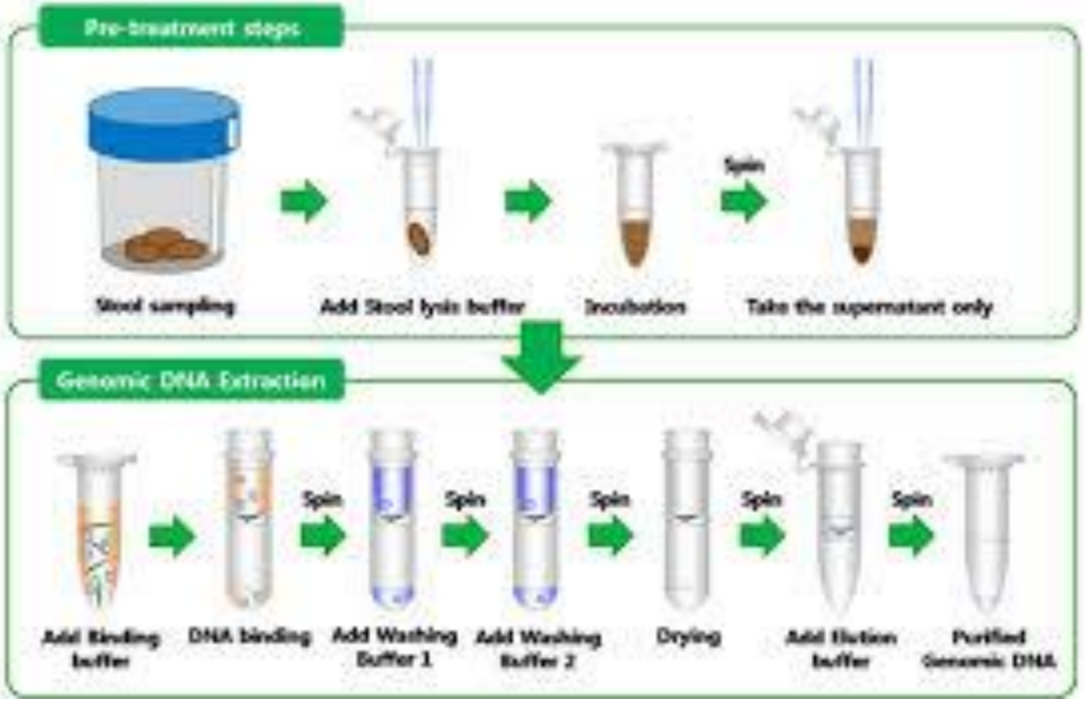
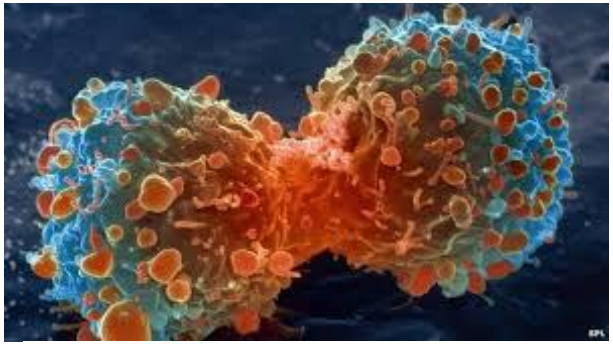
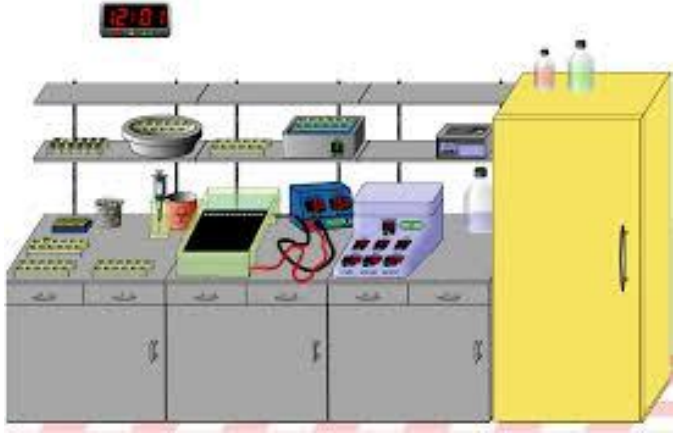
Day #4: Bioinformatics (DNA Extraction Lab)



What is DNA?

- Deoxyribonucleic acid
- Genetic materials for all living things
- It is the recipe that makes you (and all living things)
- 99.9% of our DNA is exactly the same as every other person's
  - § only 0.01% of difference determine the difference of how someone looks
- DNA is made up of 4 bases/nucleotides (A, T, C, G)
- Certain DNA sequences code for specific characteristics
  - § Each sequences is unique





Genetic Disease

- Hereditary diseases are genetic disorders inherited from the parents
  - § Eg: Color blindness, down syndrome, diabetes, cancer
- Technology can detect heredity disease by sequencing your DNA (look for patterns of certain disease in DNA)

Biomedical engineers

- Improve health care and quality of life
- Use and build technology to
  - § Study DNA, understand genetic disorders, diagnose, treat, and/or prevent

https://www.youtube.com/watch?v=hOpu4iN5Bh4

DNA extraction

- Isolated DNA from organism or part of organism
- Use enzymes to separate
  - § Enzymes: something that help break down stuff surrounding DAN
- Used for diagnostic processes
  - § Used to detect bacteria and viruses in the environment
  - § Used to diagnose disease and genetic disorders
- Cell barrier has to be broken; DNA associated proteins and cellular associated proteins are degraded; precipitate DNA and remove unwanted stuff; wash DNA and clean from any unwanted residue; store DNA in buffer; confirm the DNA sequence by electrophoresis
  - § Electrophoresis: technique used to isolated parts of DNA by size and charge

Virtual Lab

Actual Lab

https://www.youtube.com/watch?v=RIUzkViSB2A

Vocabulary

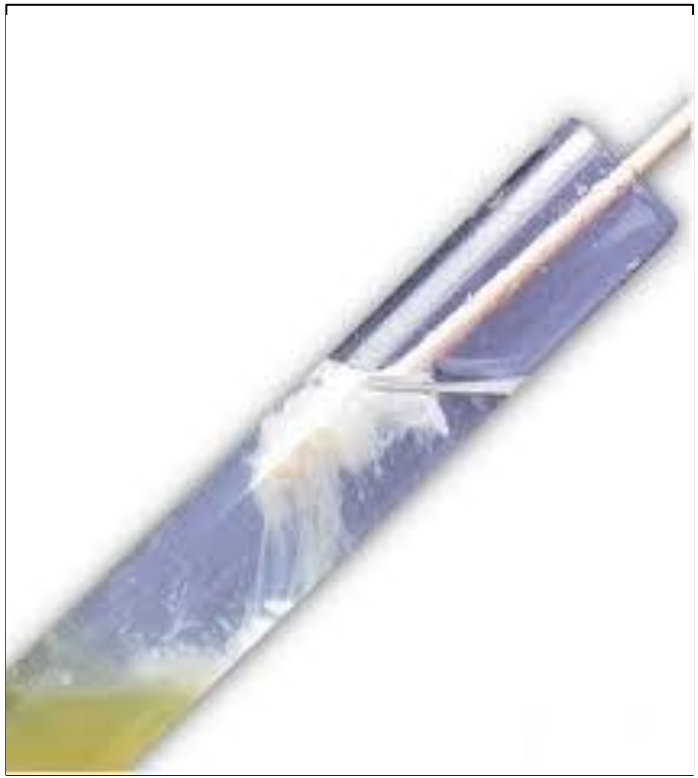
- DNA Extraction: removal of DNA (deoxyribonucleic acid) from cells or viruses in which it normally resides
- Electrophoresis: technique used to isolate parts of DNA by size and charge
- Enzyme: substance (generally protein) used to speed up reaction; without it, reaction may never occur

We are doing DNA Extraction Virtual Lab then actual DNA Extraction Lab.

DNA Extraction Virtual Lab
First, Go to
http://learn.genetics.utah.edu/content/labs/extraction/

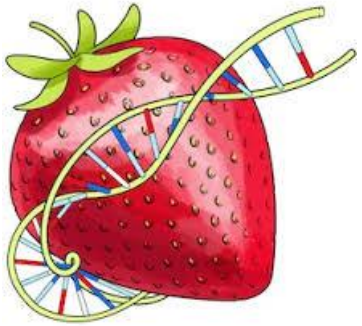
Second, Follow instructions from website

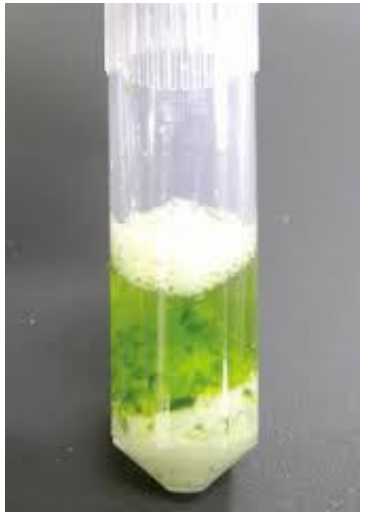
- Add Salt, strawberries, water in blender
- Bend high for at least 15 seconds
- Pour blender mixture (of salt, strawberry, water) through a strainer into a cup
- Add detergent and swirl to mix
- Let mixture sit for 5-10 minutes
- Pour mixture in smaller containers, each about 1/3 full
- Add tenderizer to mixture and swirl to mix (STIR GENTLY!!)
    - § Stirring too vigorously can break DNA



- SLOWLY add rubbing alcohol, pour until you have about the same amount of rubbing alcohol in the tube as strawberry mixture
  - Forms layer on top of the strawberry mixture
  - Rubbing alcohol is less dense than water (floats on top)
- Look for clumps of white stringy stuff where water and rubbing alcohol meet
- The stringy stuff is DNA
  - DNA is tangled

Optional: save DNA (use twig or pencil to grab DNA and store in rubbing alcohol)





Creative Challenge:

- What is DNA?
- What does the DNA look like?
- Which DNA source gives you the most DNA?
- Which soap works best?
- Do only living organisms contain DNA?

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per group of 2)
Activity Part 1	
Internet	
Computer	1

Materials & Supplies

Materials	Quantity (per group of 2)
Activity Part 2	
Ripped Strawberries (or Spinach or Broccoli or Peas) *get creative and have different groups use different DNA source	2 (big) or 3 (small)
Shampoo (or Detergent or Dishwasher Soap) *get creative and have different groups use different soap	2 table spoons
Rubbing alcohol	1/2 cup
Salt	1/8 teaspoon

Materials & Supplies

Materials	Quantity (per group of 2)
Activity Part 2 (continue)	
Meat tenderizer (or contact lens solution)	Pinch
Water	1 cup
Strainer	1
Blender	1
Dropper	1
Cup	1
Clear cup *preferably glass	1

Pro Tips by Shirley Luo

- Review Bioinformatics - DNA Extraction Lab before teaching class
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- https://www.youtube.com/watch?v=RIUzkViSB2A)
- Wikipedia - for definitions
- Google Images - for images
- Bioinformatics - DNA Extraction Lab by: Shirley Luo

Day #5: Biomechanics (Balloon Stent)

https://www.youtube.com/watch?v=T8zkvdkzU7A

- What is a heart attack? Stroke? *see **vocabulary**
- How does a heart attack occur? *see **heart attack**
- Why do you think bioengineers study this? *see **engineering**
- What are some heart diseases? *see **examples of diseases**

https://www.youtube.com/watch?v=t-zCBKRg7Cs

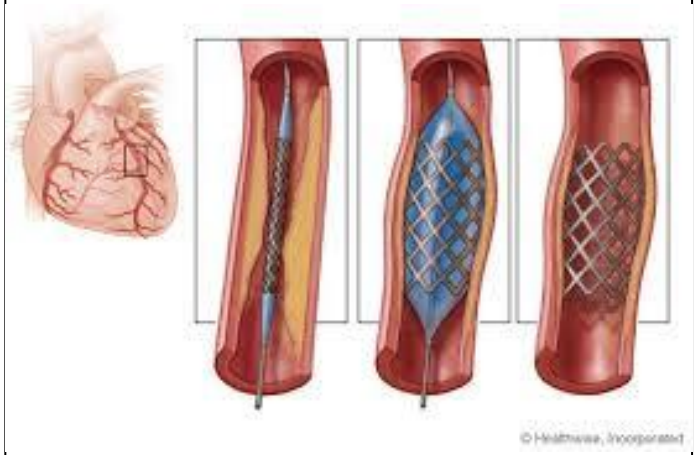
Examples Diseases: coronary artery clotting, heart attack, stroke

Engineering

- Study the cardiovascular system to create technology
  - Eg. Stent to open up clotted artery *see **Stent Video** (Balloon Stent 2 video)
- Ways to study complicated systems is by creating models
- For coronary artery disease, engineers have to find a way to reduce or clear the blockage.

Vocabulary

- Heart Attack (myocardial infarction): damaged heart muscle that deprived oxygen via blood flow (usually due to blockage of coronary artery)
  - § patient usually have chest pain
  - § heart attack could be life threatening
  - § clogged artery --> uneven blood flow --> deprived oxygen to heart
- Stroke: blockage of blood vessel in brain; inadequate oxygen supply; could cause paralysis, speed difficulties, loss of body part function, loss of consciousness, and/or death



Vocabulary

- Coronary artery bypass Surgery – surgery that uses piece of vein (usually from leg) or artery (usually from chest or wrist) to attach it to the coronary artery so blood can bypass blockage
- Balloon: Catheter with an inflatable tip that can be expanded
- Catheter: hollow, flexible tube for insertion into body (cavity, duct, vessel). This expands vessel and other passage for fluid to flow.
- Stent: Small expandable tube used for inserting in a blocked vessel

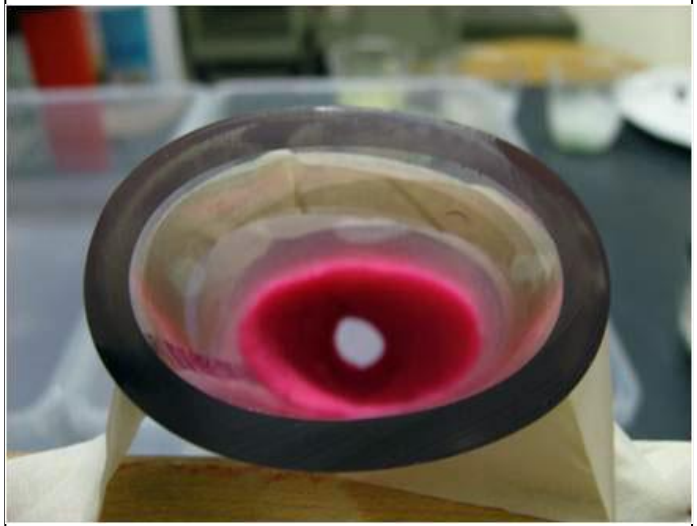
- Each group will have 2 PVC pipes (one will be clotted and the other clean)
- Amount of Plaque for clotted: 1 cm^3, **8 cm^3, 9 cm^3, 16 cm^3**, or 25 cm^3

THIS IS IN VOLUME (WHAT IS VOLUME?)

Volume = length * height * width

For EXAMPLE: 8 cm^3 = 2cm x 2cm x 2cm

- Give each group an equal amount of clay
- Tell them to cut the size of clay they need and save the rest for later (they will have to recombine the clay at the end when they design the stent)



- Building the Clotted Artery

§ Student 1: holds on to the pipe & secure it

§ Student 2: measure out the desire amount of plaque to add into the plaque (**each group will get a different number)**

§ Student 3: place the plaque inside the tube

- Wait till every group is done

- Testing the Clotted Artery

§ Student 1: get a pitcher of water (**each group should have the same amount of water**)

§ Student 2: hold on to the tube

§ Student 3: Pour the water down the tube/artery

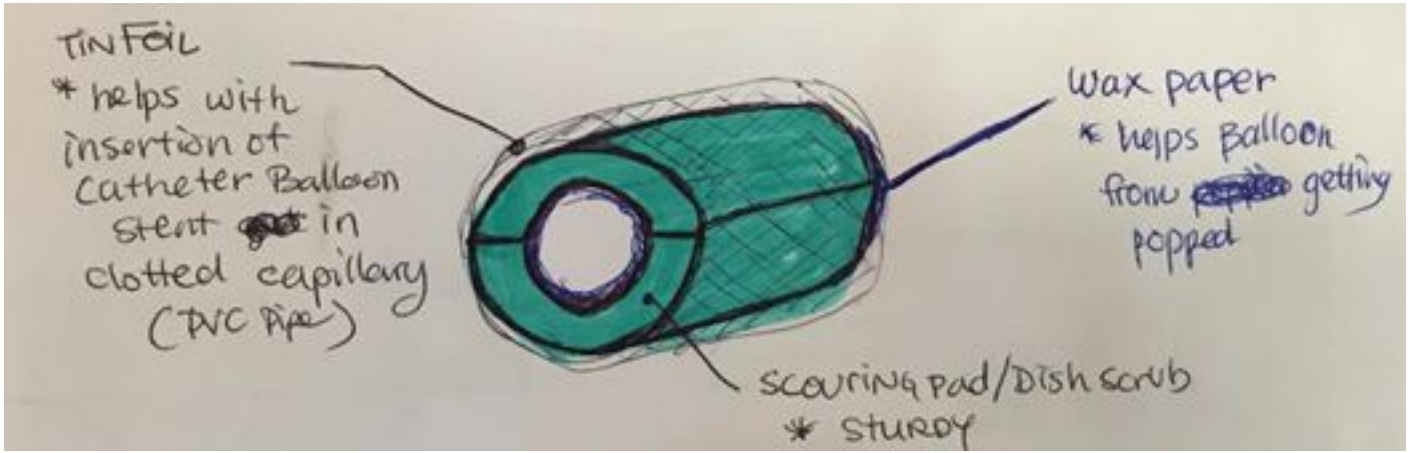
(**IT IS TIMED, DO NOT RUSH,, DO NOT cheat**)

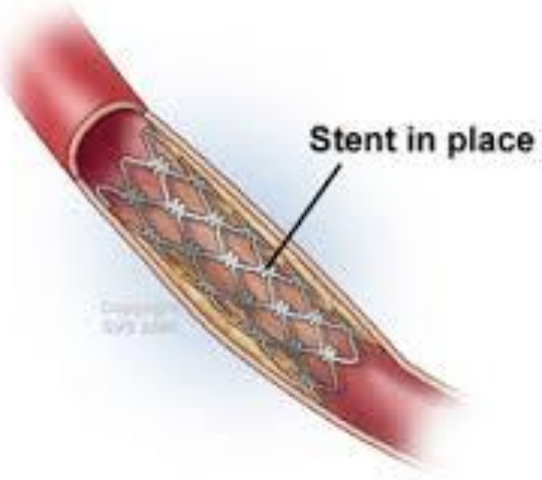
Ready, Set, Begin

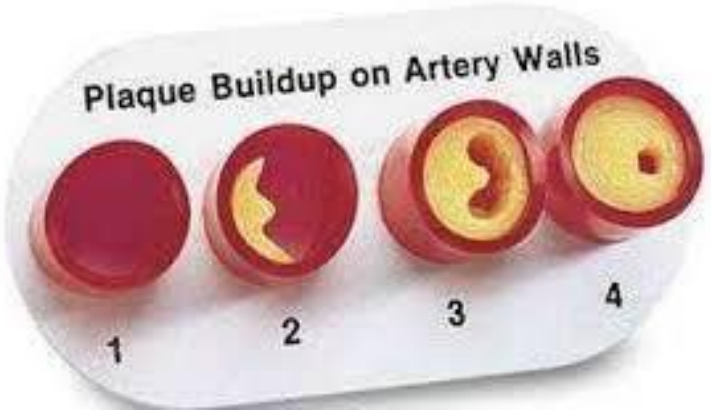
*Note: have groups run pouring water test of their clotted artery (each group should have different size of clot)
***Note: have 1 group run pouring water test on an unclotted artery**

- Remember the video we saw; Coronary Balloon Stents
- Discuss what materials should use
- Students will design a project & create a device to flatten the built-up plaque (every group should have different designs)

§ Some will attempt to remove the plaque (which is a good thing) but have them try to flatten the clot prior to allow them remove it







Creative Challenge:

- What's the difference between the two artery (clean and clotted) models? Why are they different?
- Why does it take less time to pour all the water down for the clean one rather than the clotted artery model?
- What are some of student's stent design?
- Why did they design it this way?
- What materials did they use

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per group of 3)
Pitcher (or some sort of container of water source)	2
Container (large enough to hold water)	2
PVC tubes (Diameter: 4 in Length: 3 ft)	2
Play Dough or Clay (enough to create the clot)	1
Clown Balloons	2
Air pump	1-2 (entire class shares)
Timer	1 (entire class shares)
Other materials for making stents (eg. scouring pad/dish scrub, wax paper, newspaper, pipe cleaner, rubber bands, straws, thin wires, aluminum foil, plastic bag, etc.)	A lot

Pro Tips by Shirley Luo

- Review Biomechanics - Balloon Stent before teaching class
- Review videos (https://www.youtube.com/watch?v=T8zkvdkzU7A & https://www.youtube.com/watch?v=t-zCBKRg7Cs) and Learn it before teaching class !!
- Take video and photos of the kiddos throughout the class and add it to the presentation.
- Have the kids think :)

Resources:

- https://www.youtube.com/watch?v=T8zkvdkzU7A
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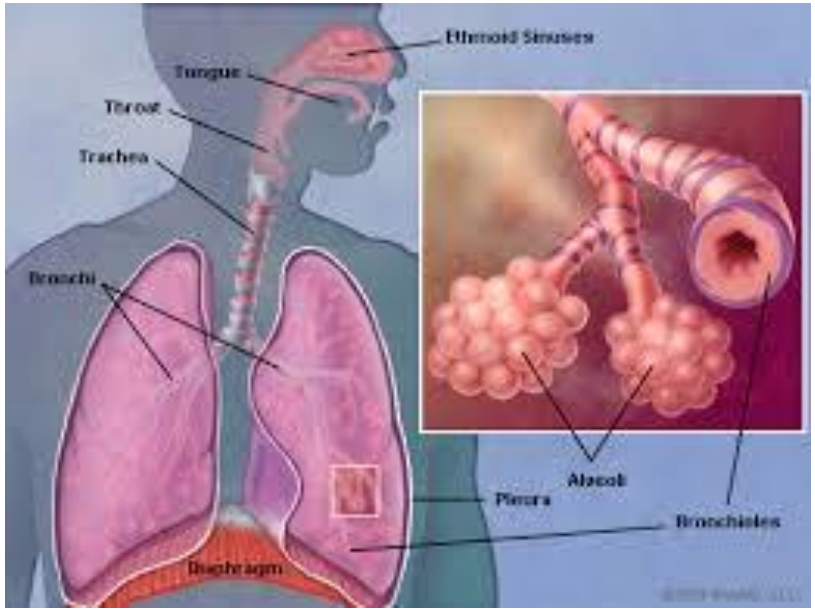
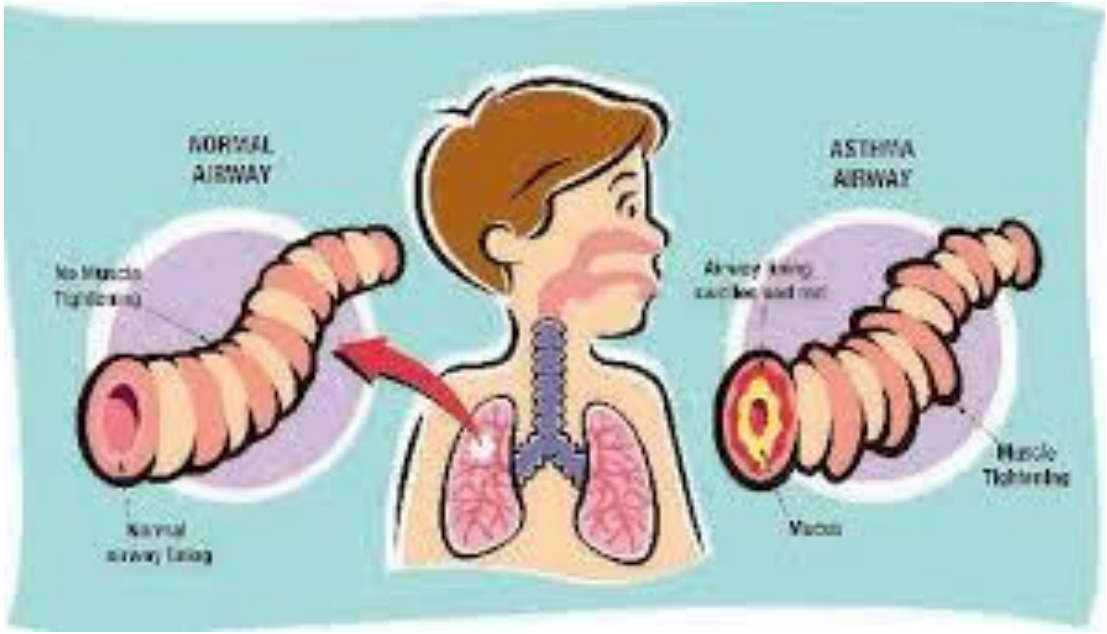
Day #7: Biomechanics (Lung Model)





- What are lungs? *see **vocabulary**
- How do you think they work? *see **air flow in and out of your lungs** & **diagram**
- Why do you think bioengineers study this? *see **engineering**
- What are some lung diseases? *see **examples of diseases**

Examples Diseases

- Asthma
- Bronchitis
- Lung Cancer
- Sleep Apnea
- Pneumonia

Engineering

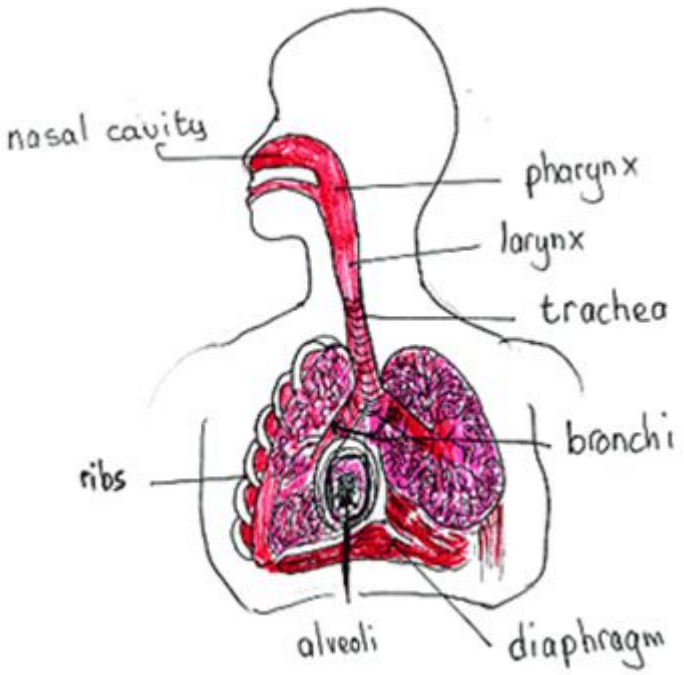
- Ways to study complicated systems is by creating models
- Study the respiratory system to create technology
  - Eg. heart-lung machine keeps patients alive during a heart transplant
  - Eg. inhalers (adrenergic bronchodilator) help people breathe better
- Creating implantable, artificial lung for people with serious lung disease

https://www.youtube.com/watch?v=8NUxvJS-_0k

Air flow in and out of your lungs

- Inhalation: Air molecules are in the environment and want to get into the lungs where there are less air molecules.
  - § Diaphragm muscle contracts downward and rib muscles pull upward causing air to fill the lungs. Why? When the diaphragm moves down and the ribs move up. This makes more space in your chest for air. Pressure is reduced. Air flow out to in.

- Exhalation: Air molecules want to get outside because there is too many molecules inside the lungs.
  - § The diaphragm relaxes. Both ribs and lungs are pushed. This causes air to be pushed out.



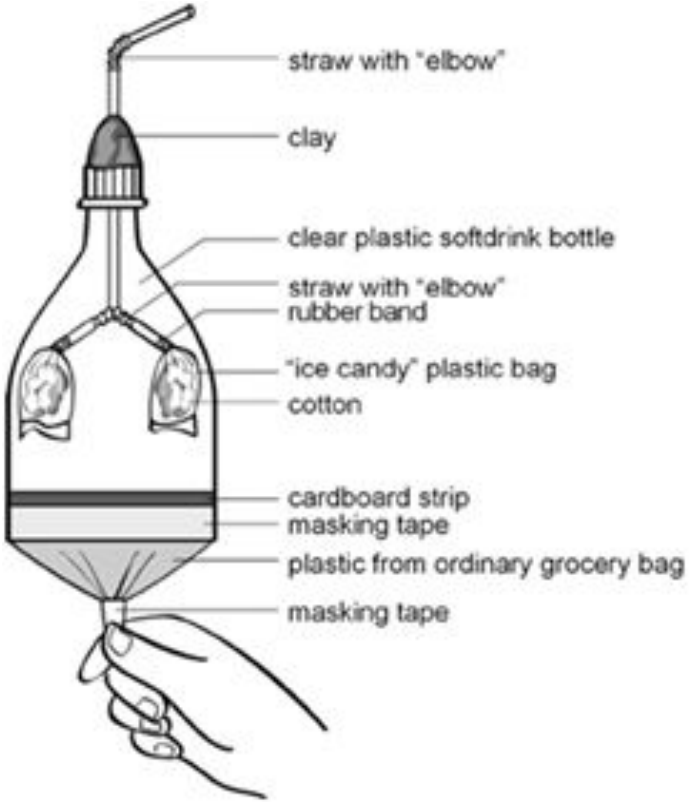
Vocabulary

- Trachea – Tube that allows passage of air to flow from outside to inside
- Bronchi – Consist of 2 tubes that are connected to the trachea. They carry air to and from the lungs.
- Diaphragm – Muscle at the bottom of the ribcage that aids in breathing.
- Lungs – Located in the chest cavity. Organs that works with the heart by providing oxygen to the blood and removing carbon dioxide from it.

You will Build

Model 1

Model 2



MODEL 1

Make Lungs

- Stick the 2 straws through the predrilled holes of the bottle cap. Stick the balloon ends of the straws through the bottle opening and screw the lid on tightly.
- Secure the 2 straws in the playdough/clay. Stick the balloon ends of the straws through the bottle opening and cover the opening of the bottle with playdough/clay

Make Diaphram

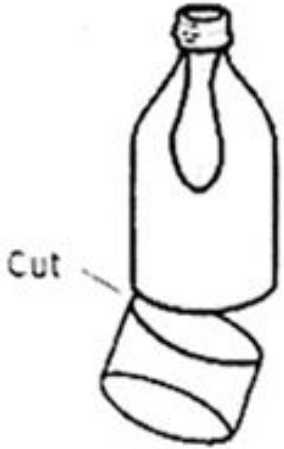
(use either ballon *top, or plastic bag *bottom)

- Stretch out the larger balloon and place it over the open bottom of the bottle.
- Cover the bottom of the bottle with plastic bag. Seal it with tape and rubber band

MODEL 2

Make Lungs

- you are only using 1 balloon for the lungs not 2 balloons
- Put balloon inside (near the lid) like the picture below



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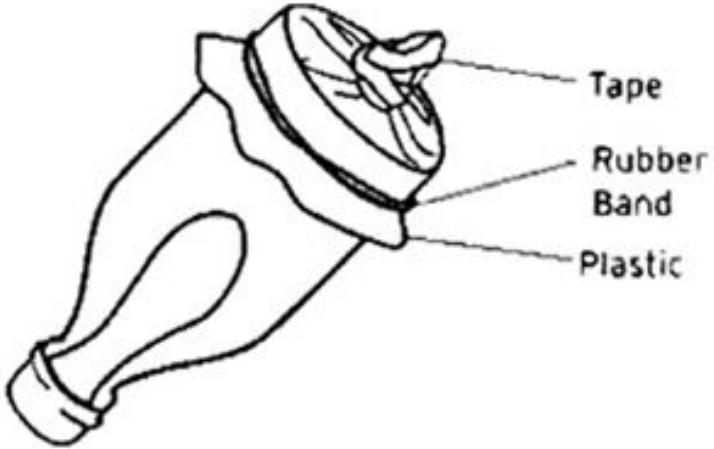

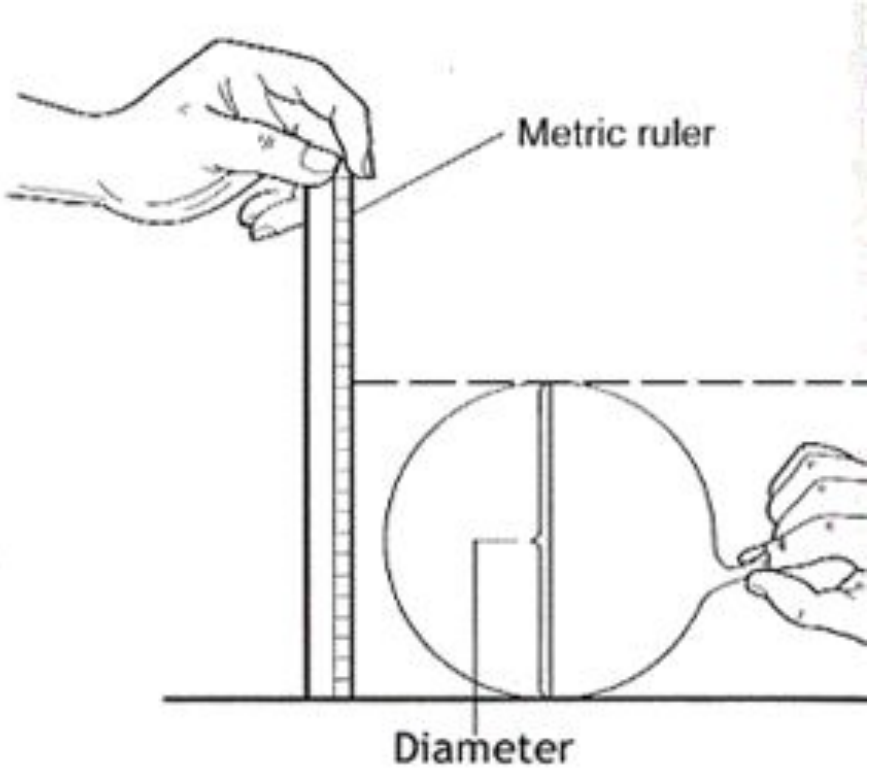

Test the Capacity of your Lungs

- Have students work in Groups of 2
- Have one student blow up a balloon (make sure to tell them to hold onto it & don't let the air escape) while having another student hold the rulers. (see image à)
- Repeat the same process for the other student
- Make sure to have them record their measurements.

Creative Challenge:

- Compare your lung models
- Compare your lung capacity measurements; Why are they different?

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per group of 2)
Activity Part 1	
2 Liter Bottle (*if 2 holes in bottle caps are not drilled, use optional material; set 2 is preferred)	1
Balloons (2 small & 1 big)	(2 small) & (1 big)
Plastic bags and coffee filter (if you don’t have 1 big balloon)	1
Straws	2
Rubber bands (3 small & 2 big)	2-5
Tape	1 roll

Materials & Supplies

Materials	Quantity (per group of 2)
Activity Part 1 (continue)	
Cotton balls (optional – set 1)	3 balls
Cardboard (optional – set 1)	1
Paper (optional – set 1)	1
Play Dough/Clay (optional – set 2)	1 (size – golf ball)
Activity Part 2	
Balloon	2
Ruler	2

Pro Tips by Shirley Luo

- Review Biomechanics - Lung Model Construction before teaching class
- Review videos (https://www.youtube.com/watch?v=8NUxvJS-_0k) and Learn it before teaching class !!
- Do the prep work
  - Cut off the bottoms of each of the 2-liter bottles
  - Drill 2 holes (just big enough for a straw to fit through) in some of the caps of the 2-liter bottles. (Note: make sure to drill the holes far enough apart that the holes do not become one big hole!)
    - If you can't drill holes before hand be sure to include playdough/clay, cardboard, and paper for the students.
- Take video and photos of the kiddos throughout the class and add it to the presentation.
- Have the kids think :)

Resources:

- https://www.youtube.com/watch?v=8NUxvJS-_0k
- Wikipedia - for definitions
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Day #7: Biomechanics (Prosthetic)

https://www.youtube.com/watch?v=MjaRS9xtL70

- What is a Prosthetic?
- Why do we invest in developing better prosthetic?
  - Many people require replacement body parts
  - Durability: how long could it last based on the frequency of use
  - Strength: how much weight could it support?
  - Longevity: how long will it last?
  - Lifelikeness: does it feel like a real limb?

https://www.youtube.com/watch?v=N1jbEvhFzQM

Vocabulary

- Amputee: a person who has had a limb removed
- Prosthesis: an artificial body part to replace
- Prosthetic: Replacement body part
- Prototype: Preliminary model of device or machine. First model/output from design/input.

- Evaluate the main limb materials (PVC pipe, metal pipe, wood pipe)
- sketch of how their prototype would look like
- have your sketch get validated
- build a prosthetic prototype

Creative Challenge:

- Why did they select the materials they selected?
- What is the property of this material?
- Why did they build their prosthetic like that?
- What material would you use that is not here? Why?

(Enter photo/videos of student work here. Duplicate this slide as needed)

(Enter photo/videos of student work here)

Materials & Supplies

Materials	Quantity (per group of 2)
Materials for making prosthetic limb: PVC pipes (plastic) *structure Metal Pipes *structure Wood Pipes *structure new Toilet Plunger *structure Cardboard Tubes *structure Sponges *comfort Bubble Wrap *comfort Scrap cardboard *comfort Bath towel/Rags *comfort 2 Liter Bottle *comfort *lifelikeness Pair of Pants *lifelikeness (optional) Shoes *lifelikeness (optional) String/Rope	Preferably 1 or 2 of everything

Materials & Supplies

Materials	Quantity (per group of 2)
Strong Tape	1 roll (the class may share 1 roll of tape)
Scissors	2
Yard Stick/Ruler	1
Pencil	1
Paper	1
Prosthetic Lab Worksheet	1

Pro Tips by Shirley Luo

- Review Biomechanics - Prosthetics before teaching class
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Day #8: Biomechanics (Robot Hand Model)

To Be Continued...