What is Genetic Engineering?

Genetic Engineering is changing an organism’s DNA for a specific purpose. Plants, animals, and even bacteria can be genetically engineered to do something different than they normally would.

Why would you engineer DNA?

- Genetically modified bacteria are used in many vaccines and drugs to prevent and treat diseases.
- Genetic modifications to foods can increase their nutritional value and make them easier for farmers to grow.
- Genetically modified animals can share traits with other species.
- Cells can be modified and cloned to engineer tissues like organs and even bone.

Websites to check out

- A game that models DNA similarity between organisms—Instructions are under the “?” button on the first page.
  
  http://phylo.cs.mcgill.ca/index.html#!/EN/Play

- Biomedical Engineering News for Students
  
  https://student.societyforscience.org/search?tt=31

Activities to try at home

- Extract DNA at home!
  
  http://imaginationstationtoledo.org/content/2012/04/extract-dna-with-stuff-you-have-at-home/

- Cell/Molecular biology activities
  
  http://www.yourgenome.org/activities/
What is the healthcare system?
- People, institutions (hospitals, clinics, medical devices companies, and more), and resources (patient care, health insurance, and much more) that have the goal of delivering health care services in some form

What do Biomedical Engineers do in the healthcare system?
- Clinical Engineers—maintain and repair medical equipment in hospitals
- Research and Development—design, model, prototype, and manufacture new medical devices or procedures
- Rehabilitation Engineers—work on ways to improve quality of life for people with impairments of all kinds

Websites to check out
- Explore the Engineering World Health website
  http://www.ewh.org
- Medicine in Harry Potter—How is magical medicine different from muggle medicine? How is it the same?
- Visible Proof: Forensic Views of the Body—Look around at how the forensic process has changed over time

Activity to do within this topic
- Check out the above websites!
- Research different kinds of devices and the history behind them

  Ask yourself: “Why did someone make this machine?” “What was the issue they were trying to solve?” “Did it work and how did it get better over time?” Asking a lot of questions is very important to being an engineer!

  Biomedical Engineering is a relatively new field of engineering, since most of history’s medical advances have happened within the last 100 years!
What research is done in Biomedical Engineering?

- Research helps us find new solutions for our everyday problems through testing a hypothesis to see whether it is true or not.
- Research can be done about anything; all you have to do is make a hypothesis about something, test it a few times, and record the data to determine whether you were right or wrong.
- A negative result can be just as helpful as a positive result because it helps us narrow in on the desired outcome.

Research done at RIT

- Dr. Ghoranni does research in Biomedical Signal and Image Analysis, focusing on understanding human physiology from an engineering perspective and developing technologies that can benefit global health care and improve quality of life.
- Dr. Lapizco Encinas works on separation, sorting, and detection techniques of nano- and microbioparticles. Our ultimate goal is to create portable laboratories in the style of "lab on a chip".
- The Gaborski NanoBio Device Lab conducts applied research at the interface of nanomaterials and cell biology. The core areas focused on are nanomembranes and nanomanufacturing, cellular microenvironments—stem cell differentiation, and microfluidics.
- Biomedical Modeling, Visualization, and Imagining is also researched at RIT. Focus is on developing innovative imaging, navigation, and visualization techniques and instrumentation to improve the understanding, diagnosis, and treatment of human diseases through minimally and non-invasive approaches.

Websites to check out

- RIT Research website shows some of the projects currently taking place at RIT: [https://www.rit.edu/research/](https://www.rit.edu/research/)
- Biomedical Engineering research at RIT: [https://www.rit.edu/kgcoe/biomedical/research/biomedical-signal-and-image-analysis](https://www.rit.edu/kgcoe/biomedical/research/biomedical-signal-and-image-analysis)
- National Institute of Biomedical Imaging and Bioengineering shows some of the top research being conducted around the country: [http://www.nibib.nih.gov/](http://www.nibib.nih.gov/)
What are prosthetics?

- Artificial Devices that replace something in the body, whether it’s a limb (arm, leg, finger, etc.), joint (hip, shoulder, knee), or even something inside the body, such as a heart valve.
- Biomedical Engineers make devices that act as these body parts so people can live comfortably.
- Engineers are now trying to make prosthetics as easy and affordable as possible.
- Prosthetics can be made with metals, motors, and/or 3D printing.
- Some prosthetics require biomaterials if they are in contact with the inside of the body, so that it can interact with the body in ways that don’t cause infection and problems.

Websites to check out

- Middle school students create prosthetic hand: http://www.wcyb.com/news/middle-school-students-creating-prosthetic-hand/24587356
- e-NABLE: http://enablingthefuture.org/

Activity to try at home


Examples

- e-NABLE - worldwide community that makes 3-D printed hands very affordable (middle picture)
- Cheerleader at University of Arkansas (top picture)
- Double-amputee running in a race (bottom picture)
How do I talk about Biomedical Engineering in the classroom?

1. Ask “What if?” questions
   - “What would happen if DNA was changed?” “What could that do to somebody?”
   - “If you could have one trait from another organism, what would it be?”
     ♦ Inspire creativity
     ♦ Ask why
     ♦ Examples: echolocation like a dolphin, eyesight like a hawk, etc.

2. Urge students to explore how certain aspects affect others
   - Why don’t animal cells have cell walls?
   - How would life be different if we couldn’t use our thumbs/eyes/ears?

3. Support the scientific process!
   - Do experiments with students and allow them to make hypotheses.
   - After they have gathered data, discuss whether their hypothesis was too high or too low and why.

4. Support creative solutions!
   - Have students attempt a task, but alter their ability to do it (don’t use your thumbs, close your eyes, only use one leg). Once they experience the difficulty, have them brainstorm ways to make the task easier.

5. Relate topics to current events and pop culture
   - Search for specific topics in the upper, right-hand corner
     https://student.societyforscience.org/