STEAM

POWER UP YOUR FUTURE

Science Technology Engineering Arts Math

iGEM

GRADUATE! TACOMA

Every Child. One Community. Cradle to Career.

RAIN

READINESS ACCELERATION INNOVATION NETWORK

Bioengineering Summer Camp 2018

July 30, 2018

Brought to you by RAIN, Graduate Tacoma's STEAM Network, & the RAINMakers iGEM Research Team

Who are Graduate Tacoma & the Tacoma STEAM Network

- Graduate Tacoma's Vision: "A Tacoma where *every* child succeeds in school, career, and life."

- Tacoma STEAM Network- dedicated to expanding equitable access, interest, and success in Science, Technology, Engineering, Arts, and Mathematics (STEAM) for all Tacoma students, particularly girls, students of color, and those impacted by poverty.

GRADUATE! TACOMA

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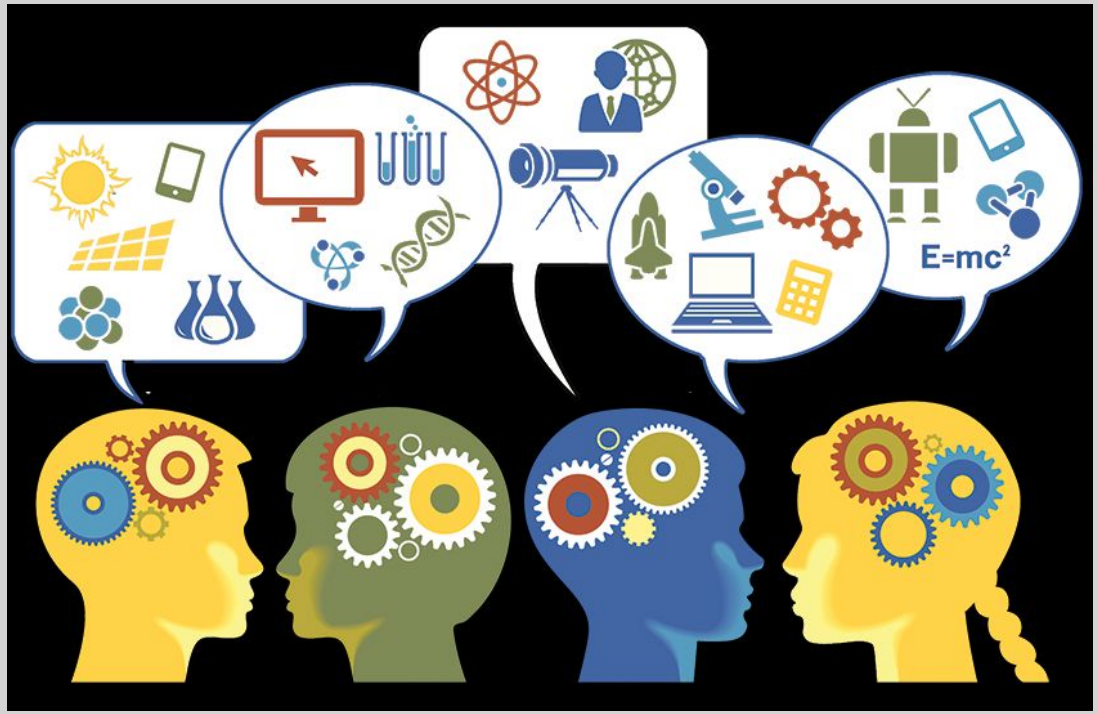
What is RAIN?

- RAIN
  - the **Readiness Acceleration & Innovation Network**
  - a biotechnology innovation hub
  - serves to spark creativity and help innovators overcome the challenges they face by providing direct access to the people and resources needed to succeed



What happens at RAIN?

- Synthetic Biology Research Team, called The RAINMakers, working to compete at the annual International Genetically Engineered Machine (iGEM) Competition

- Community Labs for local students or professionals to use.

What happens at RAIN?

- Co-Working Kitchen to rent for local food vendors and small business start-ups

- Superheroes of Science Lectures – free, open to the community lectures by science professions who tell about their journey and their specific passion in science
  6pm every 2nd Monday of the month

Objectives and Goals of this Bioengineering Summer Camp:

Objectives:

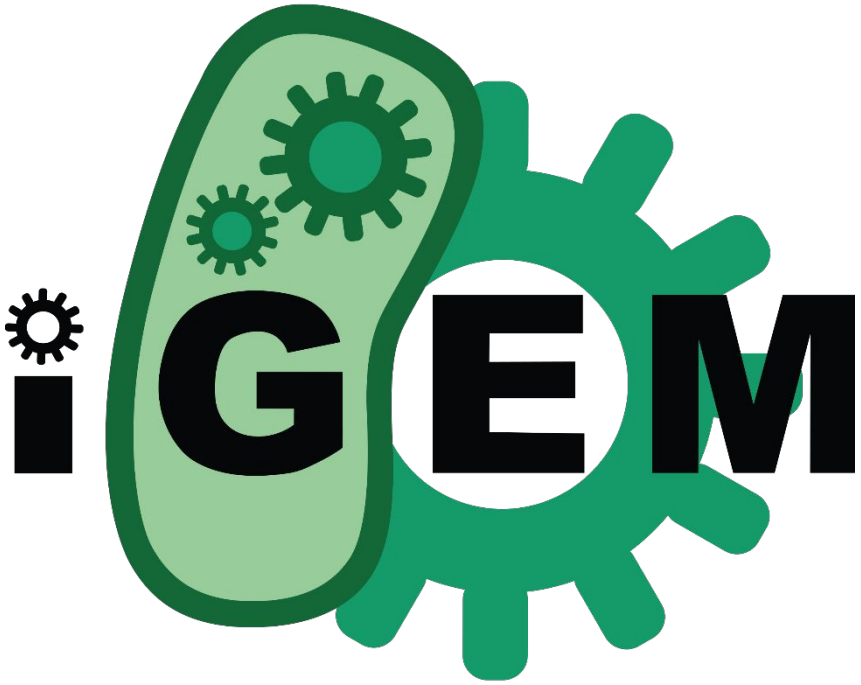
- Give younger high school students an opportunity to work hands-on in a bioengineering laboratory
- Introduce Tacoma students to the opportunity of participating in an iGEM research team
- Increase students' understanding of the basics of molecular biology, bioengineering, and synthetic biology.

Goals:

- Ignite excitement in Tacoma students to pursue a career in a STEM field, particularly biotech.
- Increase participation of underrepresented students (girls and students of color) in STEM education experiences.

Introductory Survey

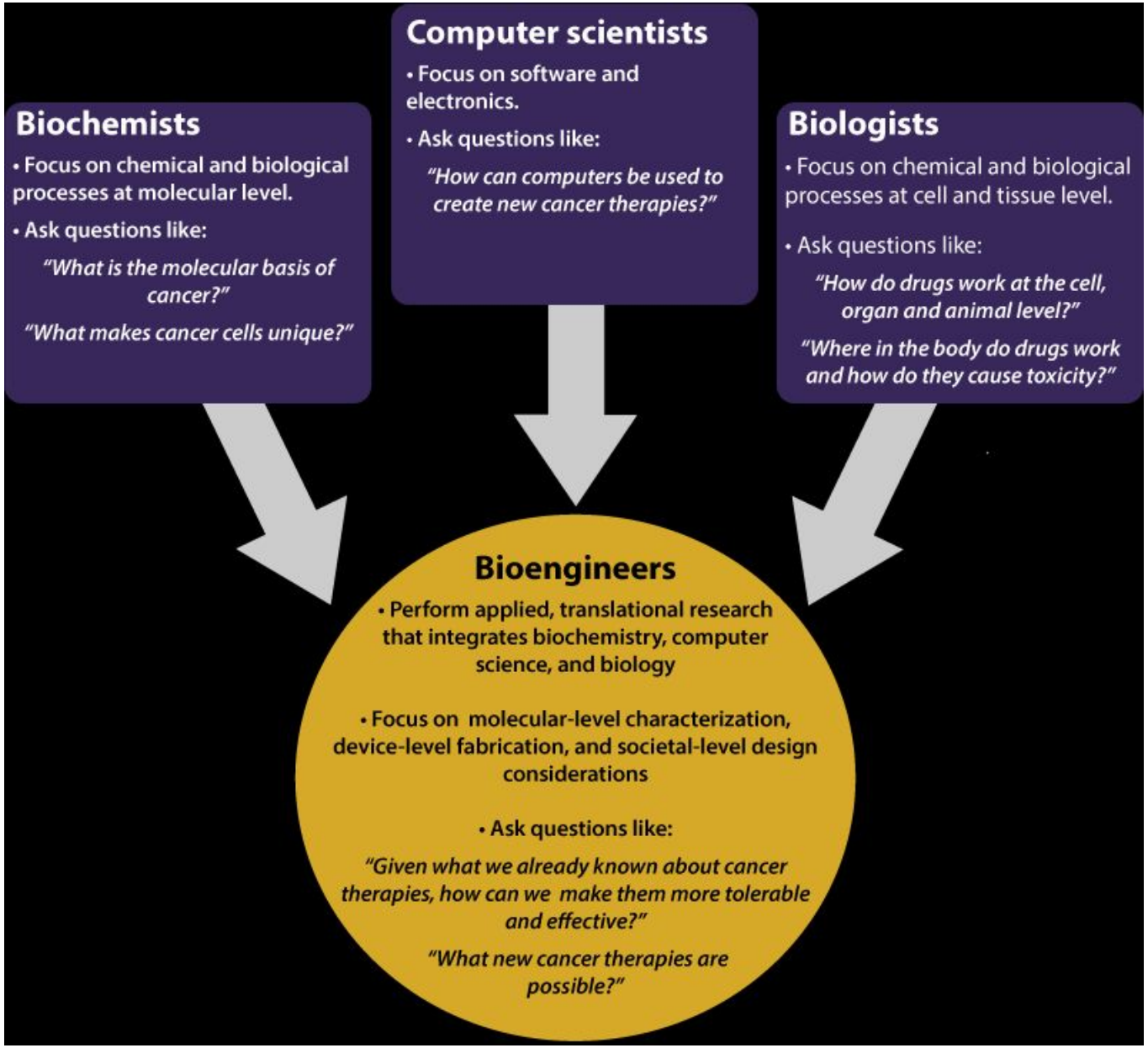
- Tell us about your interests
- Tell us what you already know
- Are there areas you would really like to learn more about this week?



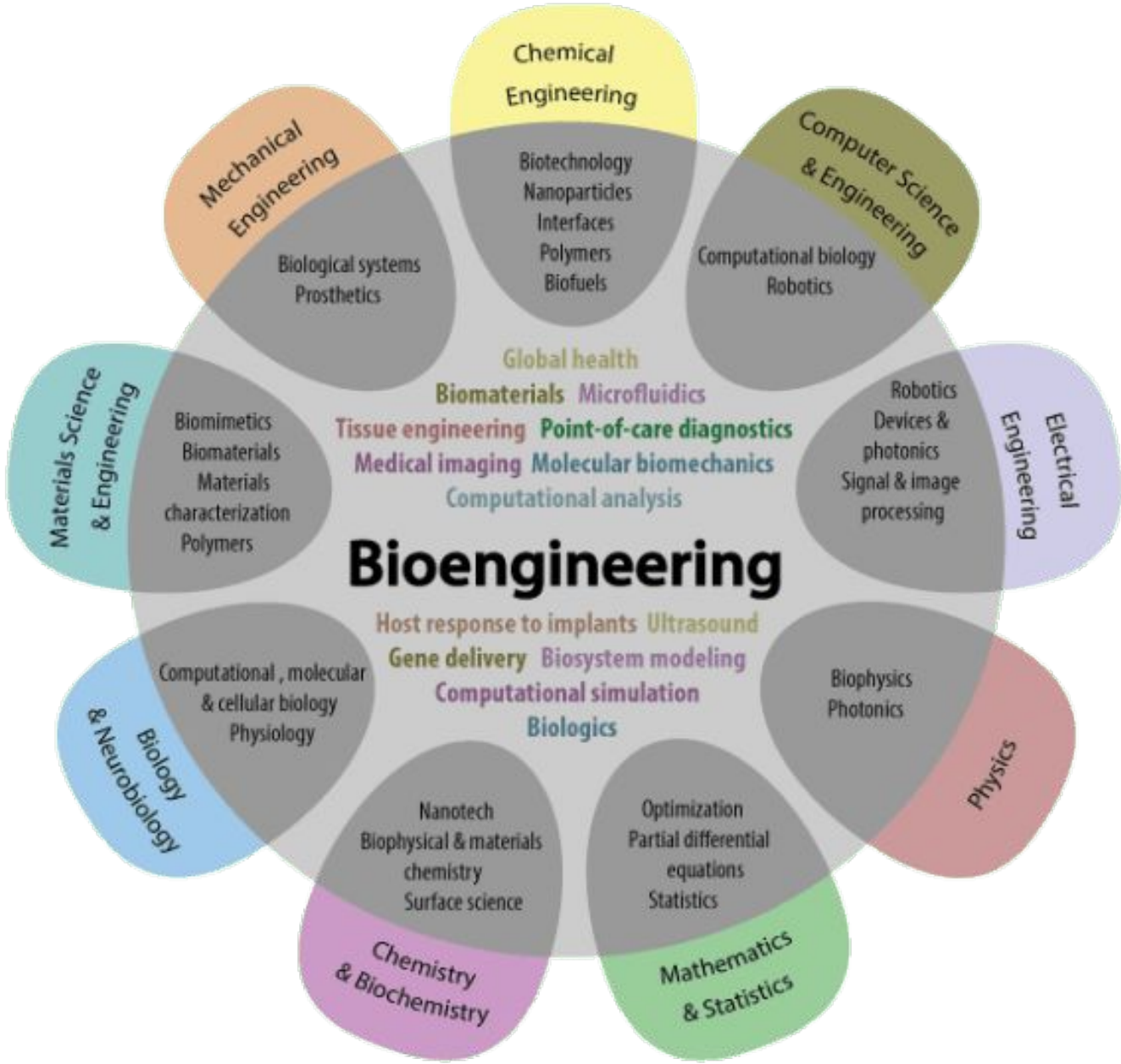
iGEM Presentation

Icebreaker Activity

Blending Academic Disciplines



Blending Academic Disciplines



What is Biotechnology?

- the use of organisms in manufacturing processes to create products or to solve industrial or environmental problems
- **Examples –**agricultural improvements, medicine production, beer and cheese production

What is Bioengineering?

- applies engineering principles of design and analysis to biological systems and biomedical technologies
- **Examples –** prosthetics, surgical devices, insulin pumps, wearable technology, tissue engineered organs

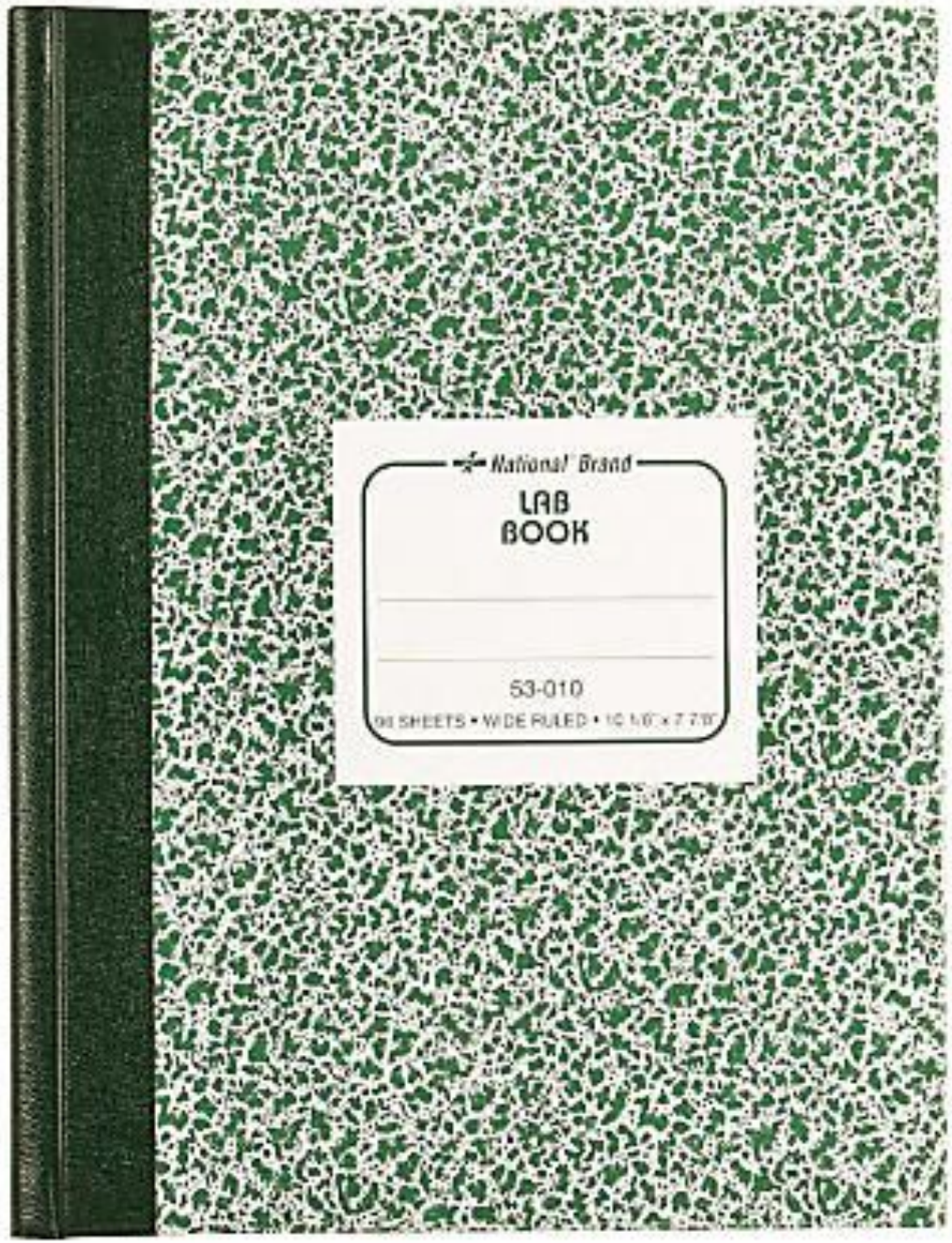
What is Synthetic Biology?

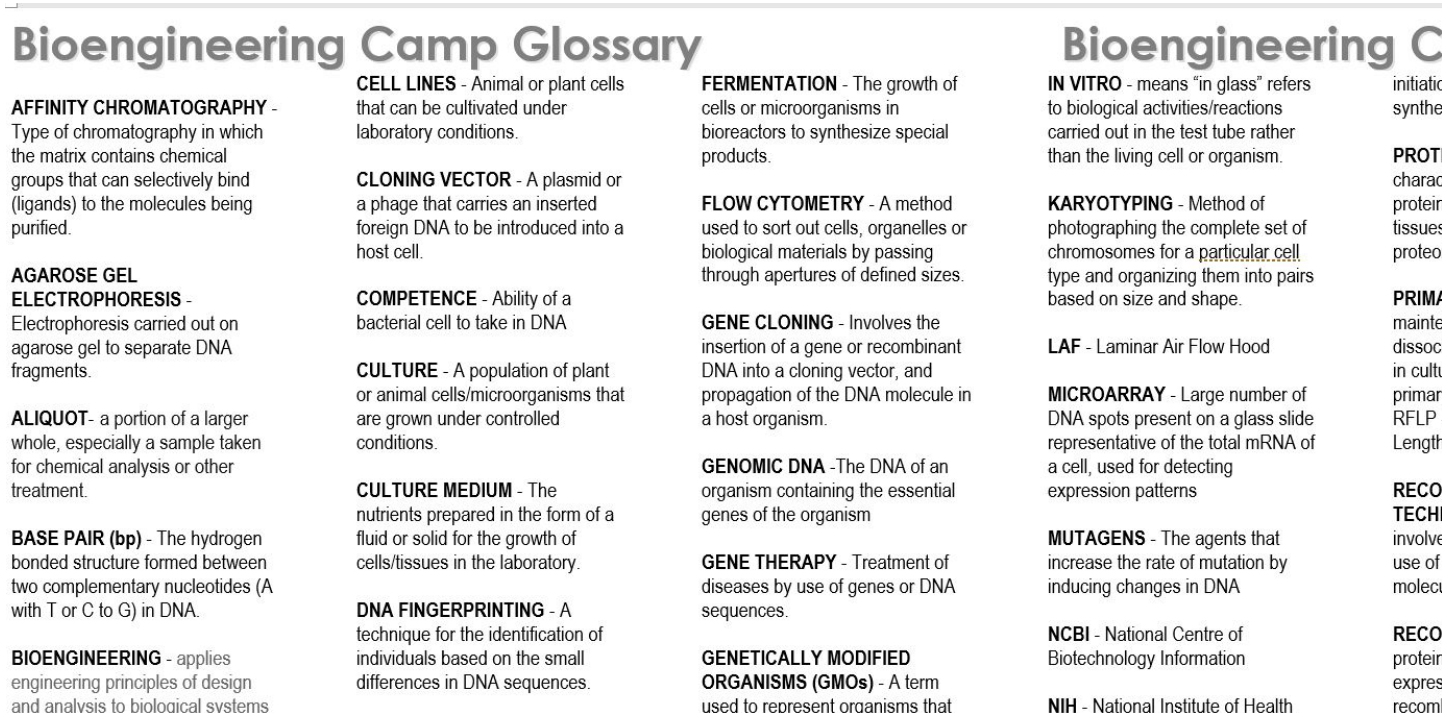
- Synthetic describes a material made in the lab to imitate a natural product.
- the engineering of biology: the synthesis of complex, biologically based (or inspired) systems, which display functions that do not exist in nature.
- Video -6:30 minutes

Lab Notebooks

What should you use this for?

- Taking notes from lectures.
- Reflecting on what was learned and listing any questions you now have.
- Recording processes, data, and results from laboratory activities.





Bioengineering Camp Glossary

AFFINITY CHROMATOGRAPHY - Type of chromatography in which the matrix contains chemical groups that can selectively bind (ligands) to the molecules being purified.

AGAROSE GEL ELECTROPHORESIS - Electrophoresis carried out on agarose gel to separate DNA fragments.

ALIQUOT- a portion of a larger whole, especially a sample taken for chemical analysis or other treatment.

BASE PAIR (bp) - The hydrogen bonded structure formed between two complementary nucleotides (A with T or C to G) in DNA.

BIOENGINEERING - applies engineering principles of design and analysis to biological systems

CELL LINES - Animal or plant cells that can be cultivated under laboratory conditions.

CLONING VECTOR - A plasmid or a phage that carries an inserted foreign DNA to be introduced into a host cell.

COMPETENCE - Ability of a bacterial cell to take in DNA

CULTURE - A population of plant or animal cells/microorganisms that are grown under controlled conditions.

CULTURE MEDIUM - The nutrients prepared in the form of a fluid or solid for the growth of cells/tissues in the laboratory.

DNA FINGERPRINTING - A technique for the identification of individuals based on the small differences in DNA sequences.

FERMENTATION - The growth of cells or microorganisms in bioreactors to synthesize special products.

FLOW CYTOMETRY - A method used to sort out cells, organelles or biological materials by passing through apertures of defined sizes.

GENE CLONING - Involves the insertion of a gene or recombinant DNA into a cloning vector, and propagation of the DNA molecule in a host organism.

GENOMIC DNA -The DNA of an organism containing the essential genes of the organism

GENE THERAPY - Treatment of diseases by use of genes or DNA sequences.

GENETICALLY MODIFIED ORGANISMS (GMOs) - A term used to represent organisms that

Bioengineering C

IN VITRO - means "in glass" refers to biological activities/reactions carried out in the test tube rather than the living cell or organism.

KARYOTYPING - Method of photographing the complete set of chromosomes for a particular cell type and organizing them into pairs based on size and shape.

LAF - Laminar Air Flow Hood

MICROARRAY - Large number of DNA spots present on a glass slide representative of the total mRNA of a cell, used for detecting expression patterns

MUTAGENS - The agents that increase the rate of mutation by inducing changes in DNA

NCBI - National Centre of Biotechnology Information

NIH - National Institute of Health

initiatic
synthe

PROT
charac
protein
tissues
proteo

PRIMA
mainte
dissoc
in cultu
primar
RFLP
Length

RECO
TECH
involve
use of
molecu

RECO
protein
expres
recomb

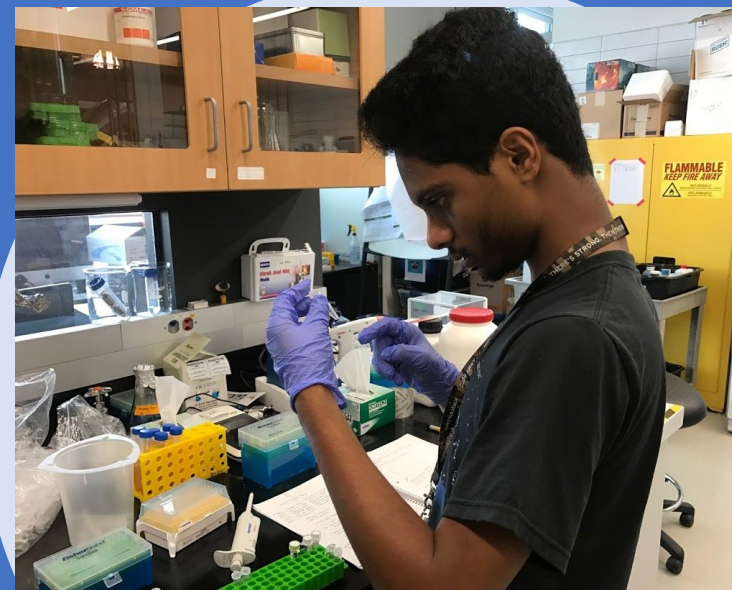
Camp Glossary

- Advances in genetics, bioengineering, and biotechnology have become a huge component of our modern culture.
- Becoming familiar with these terms will help you better understand the activities in camp and will prepare you for future work in these fields.

What you can expect:

Agenda & Topics-

- **Day 1**
  Introductions
  iGEM Team Pres-Who are we? What are we doing?
  DNA, RNA, & Proteins Lecture
  DNA Scavenger Hunt Activity
  Crime Scene Simulation w/ Gel Electrophoresis
- **Day 2**
  Cell Types using Microscopes
  DNA Extraction Necklace
  Protein Concentration Artwork
  Guest Speaker-Dr. Jutta Heller – “Central Dogma”
- **Day 3**
  PTC Lab-Run PCR, Amplification, & Gels
- **Day 4**
  Banana Bacteria Transformation
  GFP Bacteria Transformation
  Food Science with Rev. Albert
- **Day 5**
  Results of Bacteria Transformations
  Guest Speaker-Josh Haney – “Biofuels”
  Poster Prep
  Guest Speaker-Dr. David Hirschberg – “Wearable Technology”
  Poster Presentations



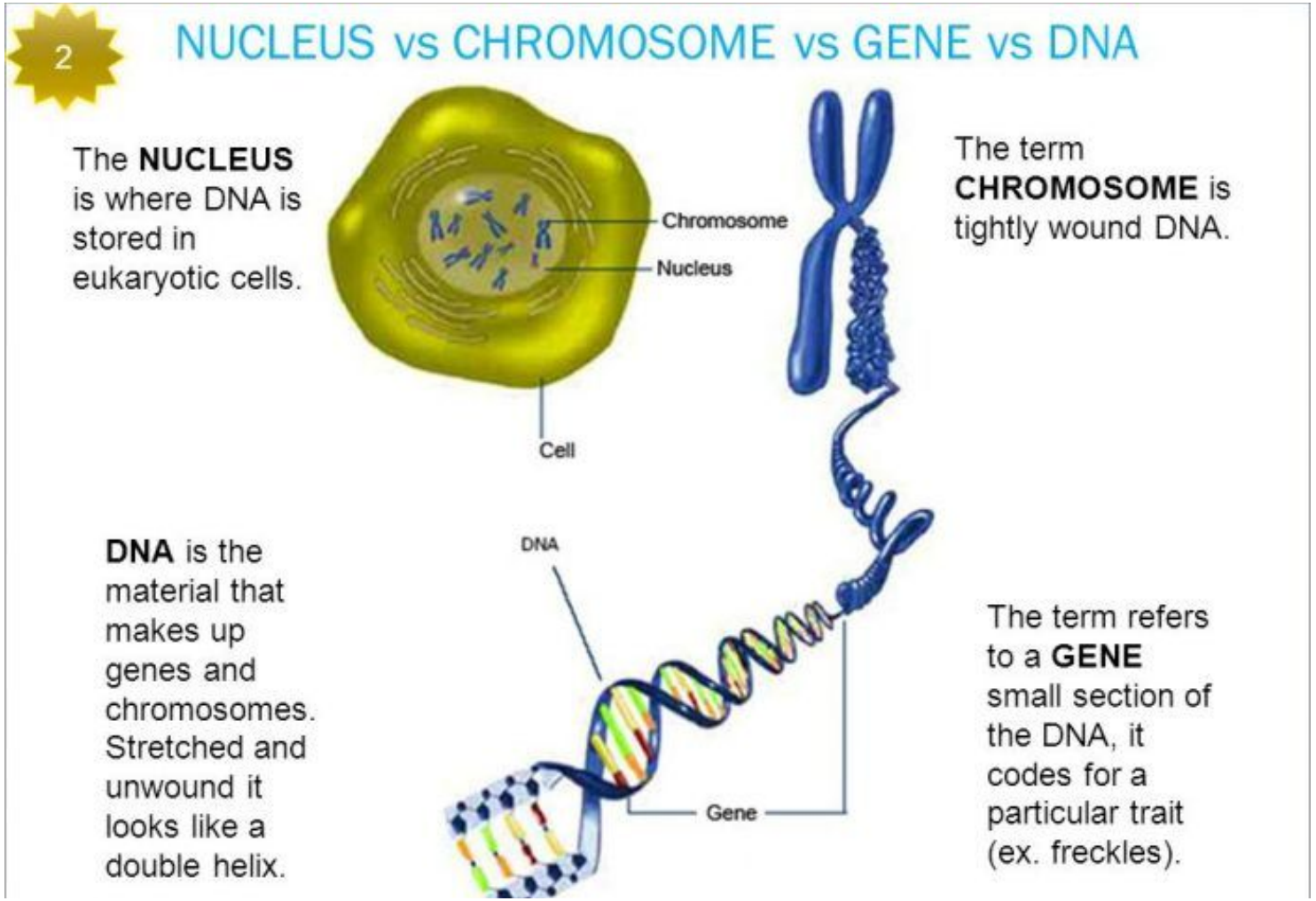
Special Thanks to:

What is DNA?

- Deoxyribonucleic Acid
- The code of life.
- Shaped like a twisted ladder or double-helix
- Steps of the ladder made of 4 chemicals that determine the “message” or instructions.
  - A = Adenine
  - T = Thymine
  - C = Cytosine
  - G = Guanine
- The bases connect to each other like pieces of a jigsaw puzzle.

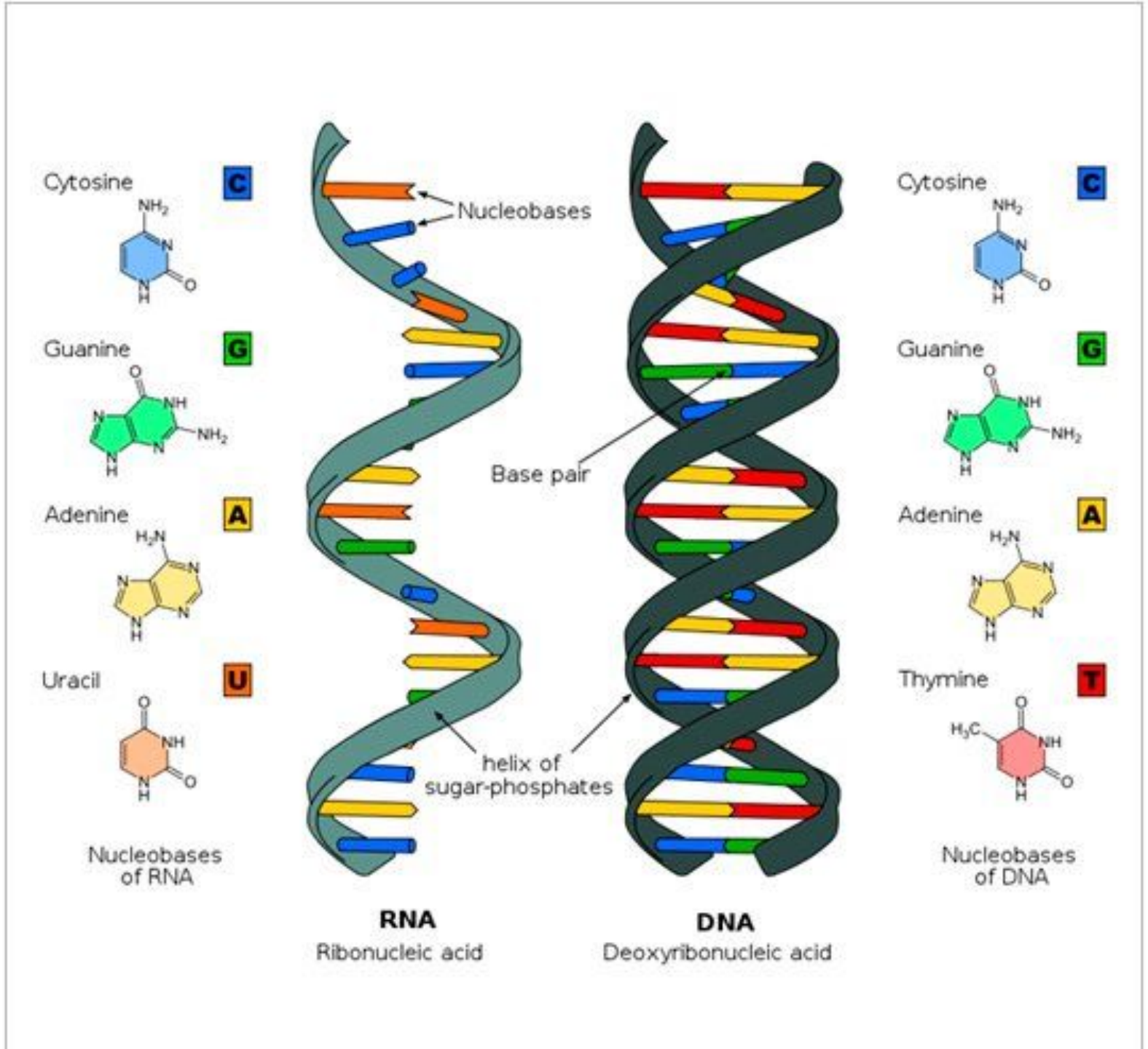
Where is DNA located?

- In organisms called eukaryotes, DNA is found inside a special area of the cell called the nucleus. Because the cell is very small, and because organisms have many DNA molecules per cell, each DNA molecule must be tightly packaged. This packaged form of the DNA is called a chromosome.
- The complete DNA instruction book, or genome, for a human contains about 3 billion bases and about 20,000 genes on 23 pairs of chromosomes.



What is RNA?

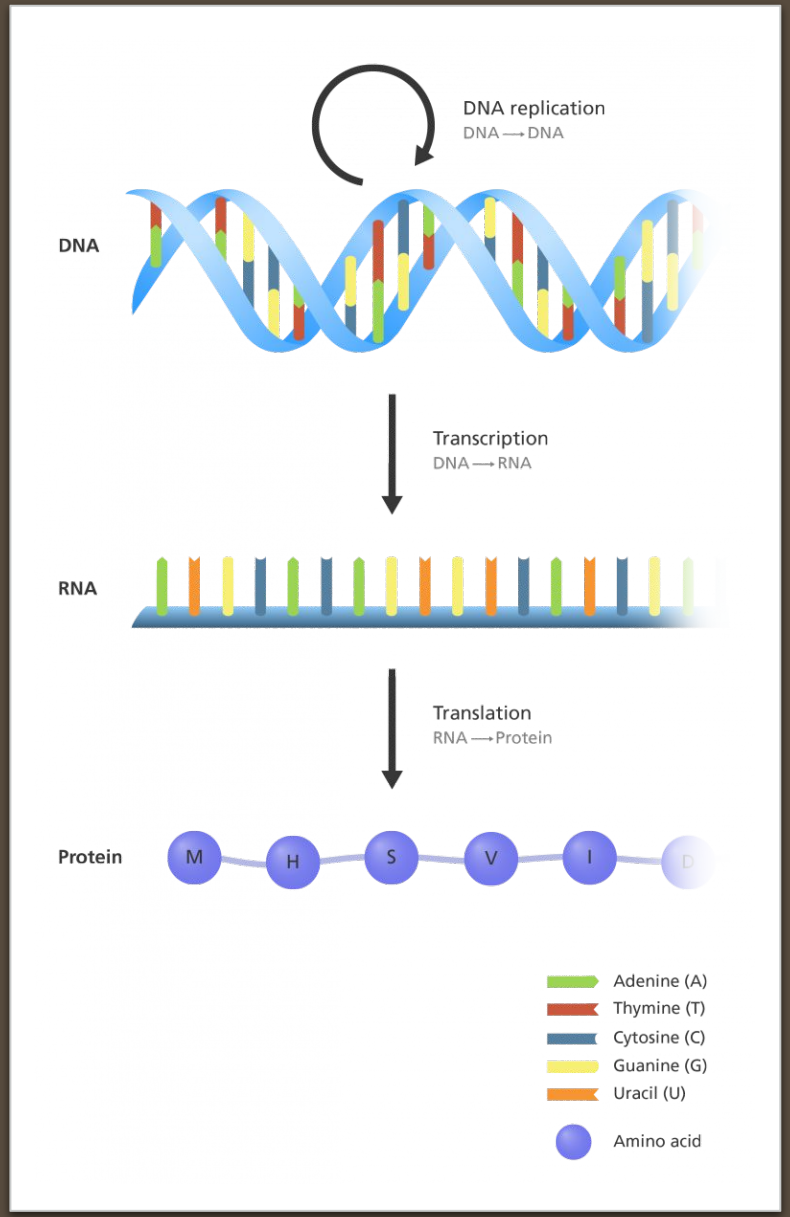
- Ribonucleic Acid
- Carries out instructions encoded in the DNA
- Structured the same as DNA except
  - Single strand, not double strand
  - Has Uracil, not Thymine.
  - Backbone made of the sugar Ribose, not Deoxyribose.
- Three types of RNA
  - mRNA-messenger RNA
  - tRNA-transfer RNA
  - rRNA-ribosomal RNA



Replication, Transcription & Translation (Central Dogma)

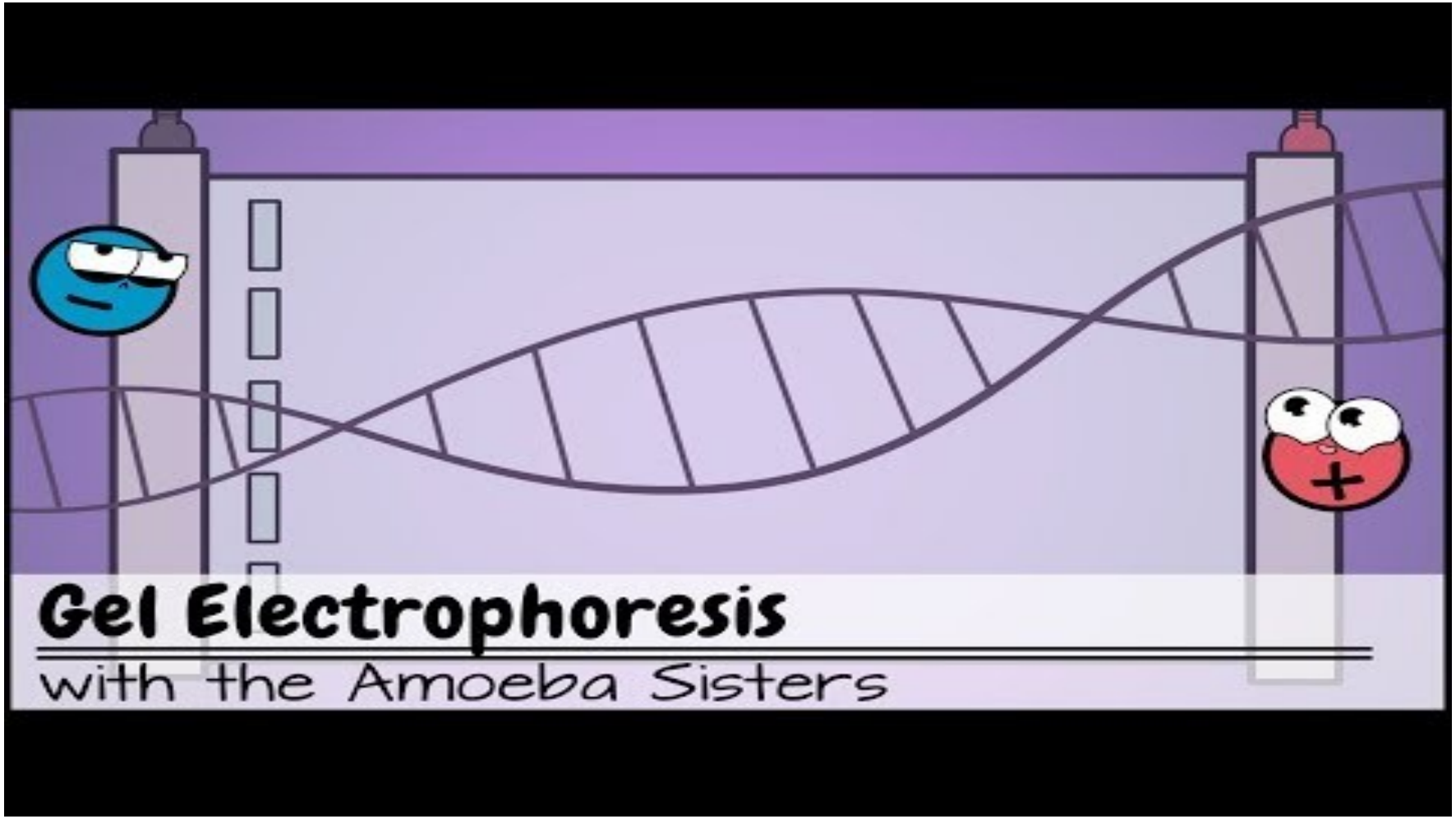
- Replication→
  making new copies of DNA
- Transcription→
  going from DNA to RNA
- Translation→
  going from RNA to Proteins

- Video on Transcription & Translation (12 minutes)



DNA Scavenger Hunt

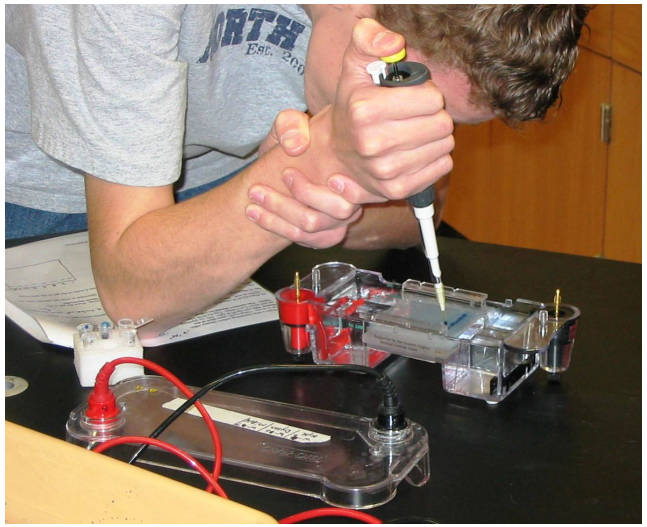
Gel Electrophoresis with the Amoeba Sisters (8:07)

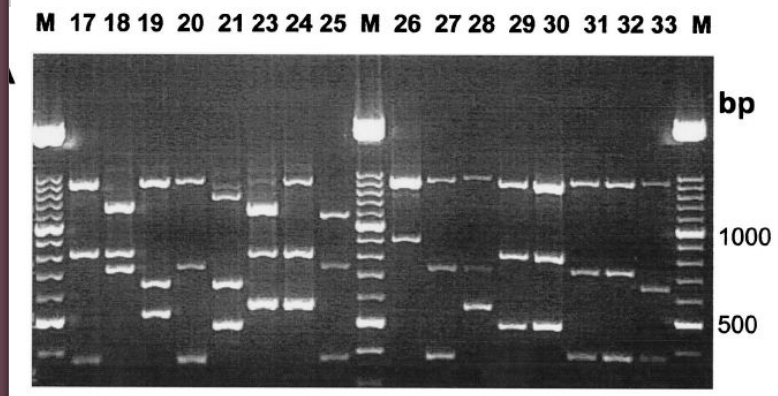


Using DNA to solve crimes:

Most DNA samples submitted to a laboratory undergo the following process:

1. **Extraction** is the process of releasing the DNA from the cell.
2. **Quantitation** is the process of determining how much DNA you have.
3. **Amplification** is the process of producing multiple copies of the DNA in order to characterize it.
4. **Separation** is the process of separating amplified DNA product to permit subsequent identification.
5. **Analysis & Interpretation** is the process of quantitatively and qualitatively comparing DNA evidence samples to known DNA profiles.
6. **Quality Assurance** is the process of reviewing analyst reports for technical accuracy.





What is Gel Electrophoresis?

- Gel electrophoresis is a technique commonly used in laboratories to separate charged molecules like DNA, RNA and proteins according to their size.
- Charged molecules move through a gel, called migration, when an electric current is passed across it.
- Small segments of DNA migrate faster than larger segments.
- Segments are measured in Base Pairs (bp)

Crime Scene Simulation