## Washington University in St. Louis iGEM

Presentation on Genetic Engineering

#### What we are doing today and tomorrow?

- What is DNA?
- What is Genetic Engineering?
- How is Genetic Engineering being used today?
- · What is our group doing?
- Let's make some bacteria that glow!



## Cells

- All living things are made up of cells.
- Cells range in size.
- Some things are made of one cell. Some have a lot.
- Cells have a nucleus that is full of DNA.



## Cells

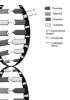
- How many cells do you think are in your body?
- A. 5
- B. 5,000
- C. 50,000,000
- D. 50,000,000,000
- E. 50,000,000,000,000

## Cells

- How many cells do you think are in your body?
- A. 5
- B. 5,000
- C. 50,000,000
- D. 50,000,000,000 → 50 Trillion!
- E. 50,000,000,000,000
- 50,000,000,000 seconds is over 1500 years!

#### Deoxyribonucleic Acid aka DNA

- If you lined up all the DNA in your body, it would be 6 feet long.
- DNA is super coiled so that it fits in a cell so small that you cannot se



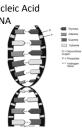
## What is DNA made up of?

- · There 4 bases
- A, C, G, T
- They form a double helix like a spiral staircase.
- The differences in order and number define how the body works.



#### Deoxyribonucleic Acid aka DNA

- · The genetic recipe for your body.
- · It is the same kind of structure for animals, plants, and all other life.



## Similarities?

How similar do you think the DNA is in your body to a fruit fly?

- A. 22% the same
- B. 38% the same C. 60% the same
- D. 72% the same
- E. 99% the same



## Similarities?

How similar do you think the DNA is in your body to a fruit fly?

- A. 22% the same
- B. 38% the same
- C. 60% the same →
- D. 72% the same
- E. 99% the same





How similar do you think the DNA is in your

- body to a chimpanzee?
- A. 43% the same
- B. 77% the same
- C. 84% the same
- D. 96% the same E. 99.9% the same



#### Similarities?

How similar do you think the DNA is in your body to a chimpanzee?

- A. 43% the same
- B. 77% the same
- C. 84% the same
- D. 96% the same → WOWZA! E. 99.9% the same



#### Similarities?

How similar do you think the DNA is in your body to a another human?

- A. 92% the same
- B. 96% the same
- C. 98% the same
- D. 99% the same

#### Similarities?

How similar do you think the DNA is in your body to a another human?

- A. 92% the same
- B. 96% the same
- C. 98% the same
- D. 99% the same

## What does DNA do?



- DNA tells the body what genes to make and contains the genes.
- Genes are sets of DNA with a code of bases to make proteins.
- Proteins form the backbone of the cell's structure, perform the tasks, and help the cell talk with other cells.

## **Proteins**

- · Proteins are necessary for the proper function of the cell. They perform all the "jobs" in the cell.
- · Proteins perform actions that form and break different molecules.



## The Inner Life of a Cell

- This is a video of proteins and other structures in the cell as animated by a group at Harvard:
- http://www.xvivo.net/the-inner-life-of-the-cell/
- "Within us is a little universe." stagedive516

#### **Genetic Engineering**

- manipulation of DNA by humans
- the insertion of DNA from other organisms or even synthetic DNA into an organism's genome
- refers to the direct The modified plants or Genetically Engineered Organisms (GMOs)



## Why mix genes from species:

- Scientists can make things that you can't normally find in nature...
- Lab synthesis versus synthesis through genetic engineering



»We could turn a cell into a factory for our use, and we could control it

## **Current Genetic Engineering Research**

- Business is booming
- Efficiency
- Crops, domestic farm animals, cutting CO<sub>2</sub> in atmosphere, drug development, and more!
- Have you guys heard of any genetic engineering projects?



## Case 1: Biofuels



- Some bacteria are being developed to use cellulose that is currently unused in production of biofuels
- Algae that take up  ${\rm CO_2}$ from the environment and produce biofuels

  - Carbon-neutral, the only carbon used in
- fuels is absorbed from



## Case 2: Fragrances

- Perfumes
- Fruity Smells in garden flowers



- · Like before:
- Insert enzymes into a foreign organism

## Case 3: Insulin

- Need: Diabetes
- · Insert human genes into a bacteria that spits out insulin
- Harvest insulin for human use
- 1982, one of the first applications of genetic engineering



## Case 4: Crops

- · Crops that:
  - Increased vitamin
  - content
- Pest-resistant - Herbicide-tolerant
- Decreased water and energy use
- Faster growth

 STL company Monsanto is a large developer of GMOs



# Summary

 Genetic Engineering is the placement of foreign genes into an organism for the purpose of reproducing a desired function in a more ideal organism.



## Is it safe?



- material."

  The EPA A beeks the insertion of such things as pesticide resistance.
  "FDA does not consider the method of production, including genetic modification, to be meaningful information which is required to be on product labeling unless the modification results in a significant material change in the food product."

  The FDA screens food for general safety.
  Both quotes are from FDA website.

  The information is out there. It is up to you to
- The information is out there. It is up to you to decide if you care to avoid GMOs.

## Brainstorming

- · So if we could combine genes from other organisms to make a hybrid...
- What would you make?
- Your ideas...



Your Projects:

Let's Take a Short Break

## Our Project-iGEM

- "Saffron in a Kan"
- A cheesy title with a big goal
- A cyanobacteria that produces Saffron in a KANamycin vector

## Saffron Price

How much do you think a pound of high end Saffron can cost?

- A. \$25
- B. \$50
- C. \$500
- D. \$5,000

E. \$50,000 F. \$500,000



## Saffron Price

How much do you think a pound of high end Saffron can cost?

Other spices' costs by the pound:

A. \$25

B. \$50

Clyenne Pepper Powder: 59.89 on amazon

Cumin: \$10.00 on amazon

- C. \$500
- D. \$5,000  $\rightarrow$  Why? Let's see.
- E. \$50,000
- F. \$500,000

## Our Project-Background

Saffron



## Our Project-Background

• Saffron



## Our Project-Background

• Saffron



## Our Project-Background



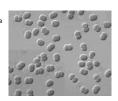
## Our Project-Background

 Saffron-Can we produce the color and taste without the vast required resources?



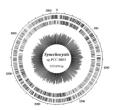
## Our Project-Background

- Synechocystis
- Cyanobacteria
- AutotrophWell-studied
- Set up well to produce our compound



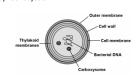
## Our Project-Background

• Synechocystis



## Our Project-Background

• Synechocystis



## Syn Size

- The genetic recipe for your body.
- It is the same kind of structure for animals, plants, and all other life.

## **Our Experiments**

- Synthetic DNA to produce saffron ordered from DNA 2.0
- Put gene into Synechocystis
- Hopefully have saffron color and aroma!







## **Current Results**

#### Today's Experiment: The Fun Stuff

- We brought some glowing E. coli!
- Plates select for these bacteria
- 4 colors: red, yellow, green, and blue
- Be creative!

## **Background-Fluorescent Proteins**

- Most common: Green Fluorescent Protein (GFP)
- Absorbs ultraviolet (UV) light and releases the energy as light you can see! They appear to glow!



## Background - E. coli

- Found in the large intestine in humans, BUT NOT the small intestine



- · Commonly used
- · These bacteria are significantly less harmful and generally would not be able to infect people, but you should always be careful!

#### Bacteria in the Body!

How many bacteria do you think are in the healthy human body?

- A. 10,000
- B. 10,000,000
- C. 10,000,000,000
- D. 10,000,000,000,000



## Bacteria in the Body!

How many bacteria do you think are in the healthy human body?

- A. 10,000
- B. 10,000,000
- C. 10,000,000,000
- D. 10,000,000,000,000

They help you digest your food. It is not only okay to have body, YOU NEED THEM!

## **Transformations and Plasmids**

• Plasmid — a small • "Transform" = insert a circular piece of DNA foreign plasmid into that can replicate like the cell normal DNA and have

cells

functioning genes Plasmids can be easily transferred between



- IMPORTANT!

Let's Be Safe

- INPURIANT!

  Let us know immediately if anything spills so we can properly clean it up.

  Always wear gloves when handling the lab equipment. Only hands with gloves should touch the equipment.

  Before you leave wash your hands with soap and water.
- Don't touch your face or skin with the gloves or afterwards until after you have washed your hands.
- Don't be afraid to ask any questions. We want to make sure you are having fun with science the right
- Unfortunately, you can't take this home, but we will be sure to send you pictures.

#### Procedures:

- Watch the demo!

- Watch the demol
  You will get:

   4 vials labeled with a lid
   4 wooden applicators
   Nitrile gloves
  Dip the wooden applicator into the vial
  Gently wipe the applicator across the plate
- Gently wipe the applicator across the plate
   Don't mix the applicators! Once you place the applicator into a color vail, don't place it another viail.
- We will take the plates back to incubate overnight.

  Tomorrow we will look at the plates under the UV lamp.

## **Experiment Time!**

- · Ask questions!
- · Be safe!
- Be creative!
- We have stencils if you want to try to draw a design!



## The end for today...

• We'll be back tomorrow!

#### First of all... Any questions about yesterday?



## Experiment Time! (Continued)

- Ask questions!
- Be safe!
- Let's look at the plates!



## Results-Did it work?

- Let's talk about it.
- Does anyone want to present their plate?



# Our Results From Preparing this Experiment





