Exploring Microorganisms Through Biotechnology

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Introduction

During the Biotechnology experience with JSTI, there has been a ton of knowledge about microbiomes, the molecular world that has ben n shared with us and their purpose in life. The major topics that were learned about were Microbiology, Molecular Biology & Genetics, PCR, CRISPR, Gene cloning, and Changing the gene function.

How are microorganisms used to support the development of Biotechnology, and why is it important?

Background

Harnessing the power of molecular biology

- To fully visualize DNA, models were used to observe the behavior of DNA and practice pairing bases
- Due to their soft tissue and enzymes that break down cell walls, strawberries are the perfect specimens from which to extract DNA (they also have 8 copies of their chromosomes as opposed to humans' 2)

Modifying DNA for new applications

PCR

- PCR is the process of rapidly multiplying strands of select DNA/RNA/Genes
- PCR is done so that scientists that don't have a lot of specimens to work with have plenty of data since genes can be multiplied exponentially

CRISPR

- CRISPR is a tool that is used to modify gene sequences to get a desired effect, getting to this point requires a lot of testing and plugging in to figure out which genes to modify
- Uses viral and non viral vectors to transmit the genetic data into the cells

Application to alter the function of GFP and CP

- The reasons behind changing the structure of green fluorescent proteins and chromogenic proteins are about more than just pretty colors. To use these proteins as tracer molecules, scientists need to be able to control when their fluorescence is activated. Spending time analyzing the structure of these proteins has helped us recognize the function of the proteins' amino acids, why their location is important, and therefore, how altering the structure of proteins can change the function.

Methods

Petri Dishes

- Use cotton swabs to collect bacteria samples from different objects and locations
- Keep agar plates upside-down in a warm place (over 75° F) for several days

Foldscope

- Put foldscope together
- Collect sample to show under lens
- Put sample on lens
- Prep lens
- Slide lens into the foldscope
- View against a light source

DNA Extraction

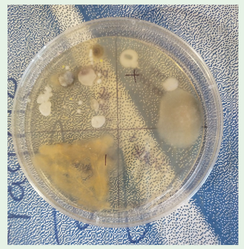
- Create buffer solution
- Squish strawberries and add buffer solution
- Gently mix to reveal DNA

PCR

- Template DNA, PCR primers, DNA polymerase, nucleotide bases, and buffer are mixed in a tube and run through a thermal cycler to complete multiple cycles of denaturation (DNA strand separation), annealing of primers, and elongation (synthesis of new DNA).

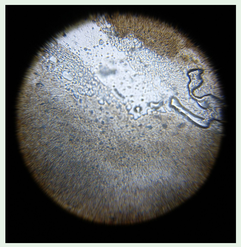
Results

Petri Dishes



Day 4 of microbial sample growth on plate with agar.

Foldescopes

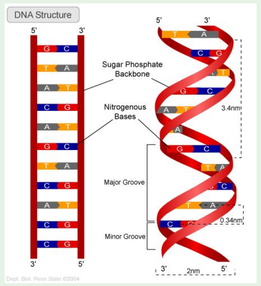


Microscopic view of swabbed bacterial growth sample from plate with agar using Foldscope microscope. Bacteria was removed from colony and placed on sterile plate for foldscope.

The foldscopes allowed more thorough examination of the microorganisms from the petri dishes.

DNA Extraction

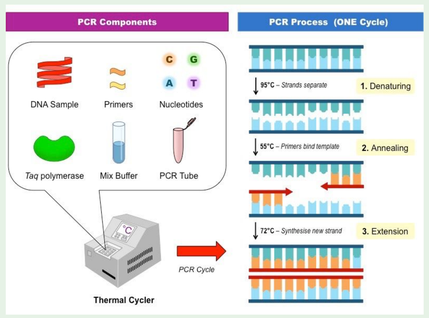
Pictured is the extracted mass of strawberry DNA placed into a microcentrifuge tube.



https://sites.google.com/site/imlovingmygenes/dna-structure

DNA is a crucial part and is used throughout PCR

Polymerase Chain Reaction (PCR)



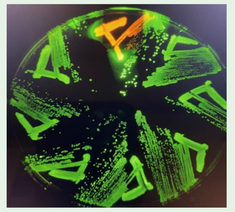
https://blogs.baylor.edu/cili-cure-spring2017/2017/04/30/lab-13-posters-and-pcr-3/

The gel that confirms PCR amplification

Polymerase Chain Reaction (PCR)

1EMA on the molecular level

Mutated strands of 1EMA in test tubes



1EMA in petri dish grown in lab under microscope

Conclusions

Through the various experiments and processes that were studied and examined, microorganisms play a fundamental role in the development of the field of Biotechnology and continue to have a crucial impact on the world and the ways in which living organisms sustain life on this planet.

- Bacterial samples can be grown on nutrient-rich petri dishes that allows the study of their development and function through a controlled medium, which can support certain developments such as antibiotics to eliminate harmful pathogens.
- DNA can be extracted from different cultures of microbial samples that allow us to further reach conclusions about protein synthesis.
- The PCR reaction in microorganisms is a laboratory technique for amplifying segments of DNA and enables scientists to better understand DNA replication and allows manipulation of DNA.
- Through the processes of CRISPR, adapted from bacteria, a greater understanding can be developed in relation to the use of mRNA that guides enzymes to specific sequences of DNA to cut or edit a gene. This develops critical technology such as vaccines and future insights of technology that can edit genes to acquire desirable traits in a species which could potentially be the cure for many hereditary diseases and ailments.

Microorganisms, in general, with their fascinating simplicity and variation enables science further insight of biological processes that help develop technology critical to the development and wellness of larger, more complex organisms such as plants, animals, and humans .

Acknowledgements

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