ZERO TO HERO LEARNING JOURNEY

The Zero to Genetic Engineering Hero learning journey

WHAT IS DNA?

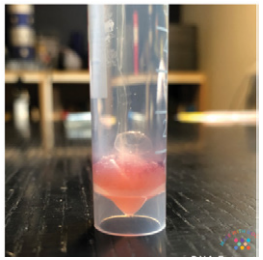
1

HANDS-ON SKILLS

- Suspend cells
- Lyse cells using surfactants
- Precipitate DNA

FUNDAMENTAL CONCEPTS

- Evolution: It is natural for DNA to change
- The road to precisely editing DNA
- DNA extractions in the real world
- Atoms, molecules, and macromolecules (nucleic acid)
- Nucleotides, DNA strands
- Nomenclature of DNA



BIG TAKEAWAY:

DNA is the 'blueprint of living things'. During research and biotech development, DNA is often modified to 'reprogram' living organisms. DNA is at the center of it all; understanding it is a key part of independent research.

MATERIALS:

Zero to Hero Book PME001
DNA extraction Kit
WWG001-S or -G
or your own materials
(Isopropyl alcohol, liquid soap, salt, distilled water, fruit, coffee filter, glasses)

BIOSAFETY & LAB SETUP

2

HANDS-ON SKILLS

- How to experiment safely
- Organizing your space
- Basic supplies such as cleaning & personal protection equipment
- Getting equipment & kits

FUNDAMENTAL CONCEPTS

- The 4 Biosafety levels
- Rules & regulations in biotechnology
- What type of equipment is necessary?
- What is wetware?
- Lab safety & best practices

BIG TAKEAWAY:

Setting up a lab space is straightforward. Doing science safely is simple. Making biosafety a standard part of your routine is an important part of becoming a genetic engineering hero & an independent researcher.

MATERIALS:

Zero to Hero Book PME001
DNA Playground(s)
HWE001-S or -G
Safety set SMG001-G
or your own materials
(Incubator, ice bucket, hot bath, gloves, lab coats/aprons)

GROWING CELLS

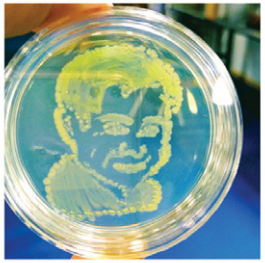
3

HANDS-ON SKILLS

- Make LB agar plates
- Streak & grow cells
- Incubate cells
- Inactivate cells
- See and smell bacteria

FUNDAMENTAL CONCEPTS

- Lab *E. coli vs* 'bad' *E. coli* and its history
- Cells as microfactories - a comparison between factories and cells to learn cell structure
- Macromolecules: carbs, lipids, proteins



BIG TAKEAWAY:

Learning what cells are made of and how to grow them is a very important part of studying biology and creating biotechnology, especially for an independent research project.

MATERIALS:

Zero to Hero Book PME001
Canvas Kit
WWA003-S or -G
+ Ch.2 lab setup & safety

ENGINEERING CELLS

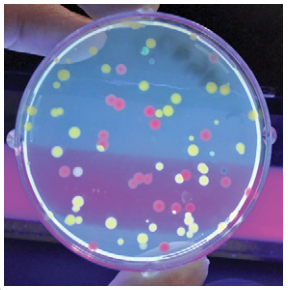
4

HANDS-ON SKILLS

- Make competent cells (take in DNA)
- Handle DNA plasmids
- Engineer cells with DNA plasmids (bacterial transformation)
- Differentiate between engineered & non-engineered cells
- Positive & Negative controls

FUNDAMENTAL CONCEPTS

- Basics operating environment of a cell
- How do cells know how to start, do and stop reading DNA (transcription)
- What is a gene?
- DNA plasmids



BIG TAKEAWAY:

Cells can't think! Chemistry is an important part of how cells operate and how to get DNA plasmids into cells. Learning the chemistry of how to manipulate cells is an important part of doing independent research projects.

MATERIALS:

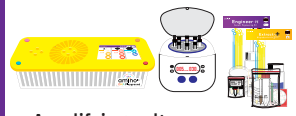
Zero to Hero Book PME001
Engineer-it Kit
WWE004-S or -G or -F
+ Ch.2 lab setup & safety

The Zero to Genetic Engineering Hero learning journey

EXTRACTING PROTEINS

CHAPTER 5

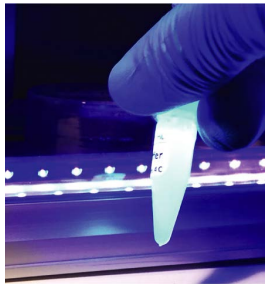
HANDS-ON SKILLS



- Amplifying cultures
- Collect & Lyse cells to free engineered molecules
- Centrifugation & pelleting
- Sterilization with nanofiltration

FUNDAMENTAL CONCEPTS

- How do cells know how to start, do and stop reading RNA (translation)
- Proteins & enzymes
- Promoters *vs* ribosomal binding site
- The other RNAs (rRNA & tRNA)
- The RNA to protein cipher



BIG TAKEAWAY:

Upon engineering cells with a DNA plasmid, cells read the DNA and transcribe RNA, then read that RNA to translate into proteins. Proteins are sometimes the desired end-product and extracting them from cells is an important step to doing independent research.

MATERIALS:

Zero to Hero Book PME001
Engineer-it Kit
WWE004-S or -G or -F
Plate Extract-it Kit
WWG005-S or -G
Microcentrifuge
HWE003 or similar
+ Ch.2 lab setup & safety

ENZYME PROCESSING

CHAPTER 6

HANDS-ON SKILLS

- Processing small molecules to create products (smell or color) using an enzyme.

FUNDAMENTAL CONCEPTS

- Basics of enzymatic chemical reactions
- The Four B's of cell function in action
- Protein enzymes as catalysis in cells
- Basic structure of atoms
- The four major types of bonds
- Metabolic pathways

BIG TAKEAWAY:

Engineering cells is often done to get a protein enzyme used in a chemical reaction with its end-product being what is desired. The engineered protein is a means to an end! Understanding enzymes and enzymatic reactions are key to success in life science research.

MATERIALS:

Zero to Hero Book PME001
Smell-it Kit WWE006-S or -G
or Blue-it Kit WWE007-S or -G
Microcentrifuge
HWE003 or similar
+ Ch.2 lab setup & safety

MANUALLY TURNING-ON GENES

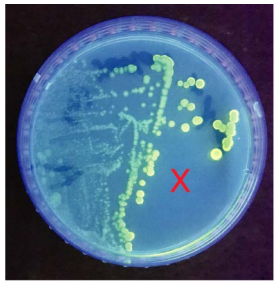
CHAPTER 7

HANDS-ON SKILLS

- Induce gene expression using chemicals, heat or light.

FUNDAMENTAL CONCEPTS

- Mechanisms of gene expression
- Reinforce the coding and non-coding regions of genes learned in Ch. 4-5.
- Setting the stage for designing custom plasmids.



BIG TAKEAWAY:

Gene regulation is a broad topic and an important part of life science research and projects. Learning gene regulation with hands-on examples is key to expanding the independent researcher's imagination & 'toolbox'.

MATERIALS:

Zero to Hero Book PME001
Induce-it Kit WWE008-S or -G
or Heat-it Kit WWE009-S or -G
or RGB Kit WWA010-S or -G +
(HWA010-S or HWE001-G)
+ Ch.2 lab setup & safety

GOING FURTHER: INDEPENDENT PROJECTS

CHAPTER

SCIENCE RESEARCH AT YOUR OWN PACE

- Minilabs, Junior R&D Kits are used for independent research using the methods from Chapters 1-7
- Junior R&D kit is a 'blank' engineering kit with custom antibiotics to be used with a project plasmid.
- Use the BioExplorer to learn liquid culturing and do biomanufacturing with real-time sensing.
- Partner with Amino Labs to turn a research project into an experiment kit and earn revenue!

MATERIALS:

Junior R&D Kit
WWE014
Microcentrifuge
HWE003 or similar
BioExplorer
HWE002-S (optional)
+ Ch.2 lab setup & safety