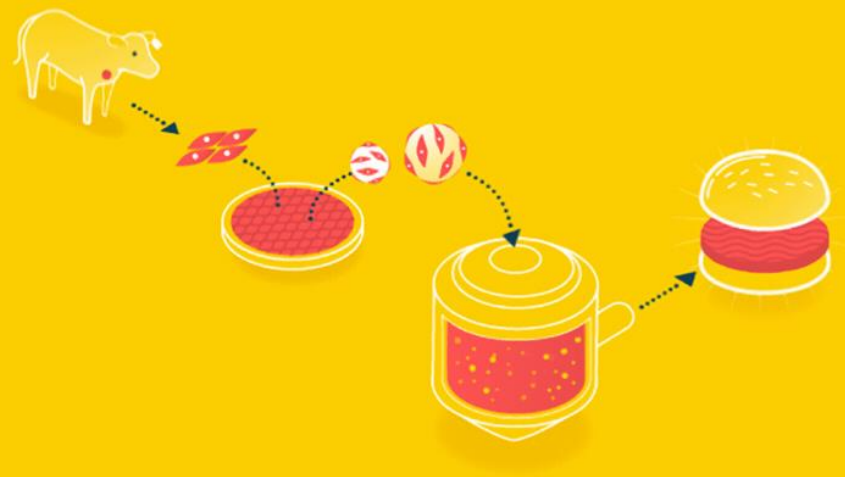
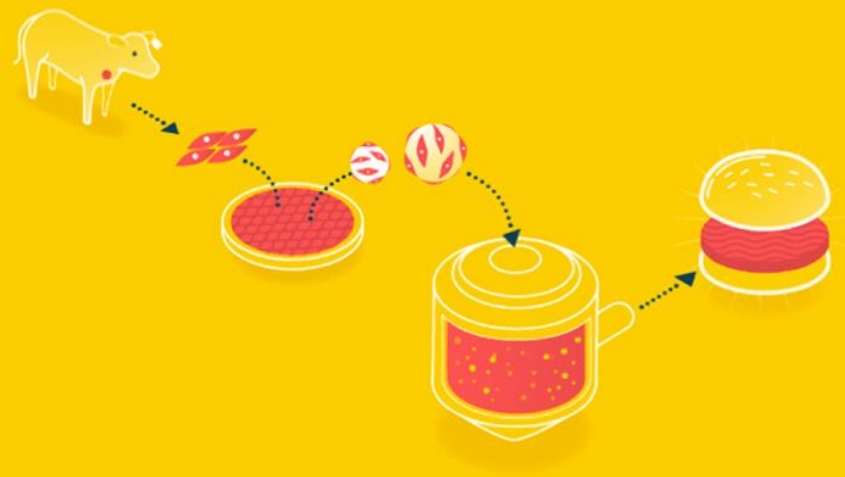
Tufts University BME174 – Cultured Meat Lab



Week 1: Primary Cell Isolation + Culture Media Preparations

Who are your Instructors?



Week 1

Part 1

- Introduction to Cell-Cultured Meat
- General Class Information
- Overview of Today's Objectives
- Key Laboratory Techniques/Info

Part 2

- Preparations for the Class + Next Week's Cell Isolations

Cultured Meat

Clean Meat

In Vitro Meat

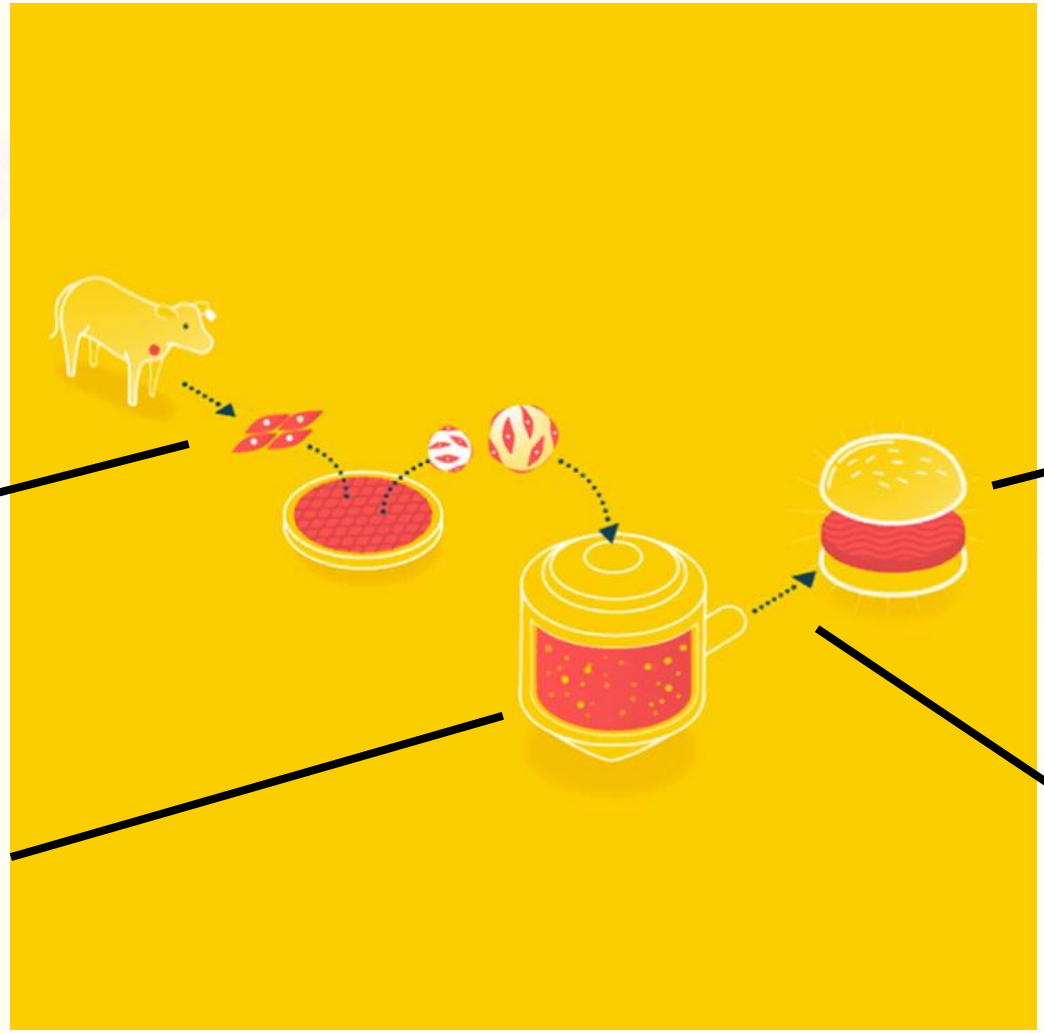
Cultivated Meat

Cell-Cultured Meat

Meat

Cell-Cultured Meat

Process of In Vitro Meat Production

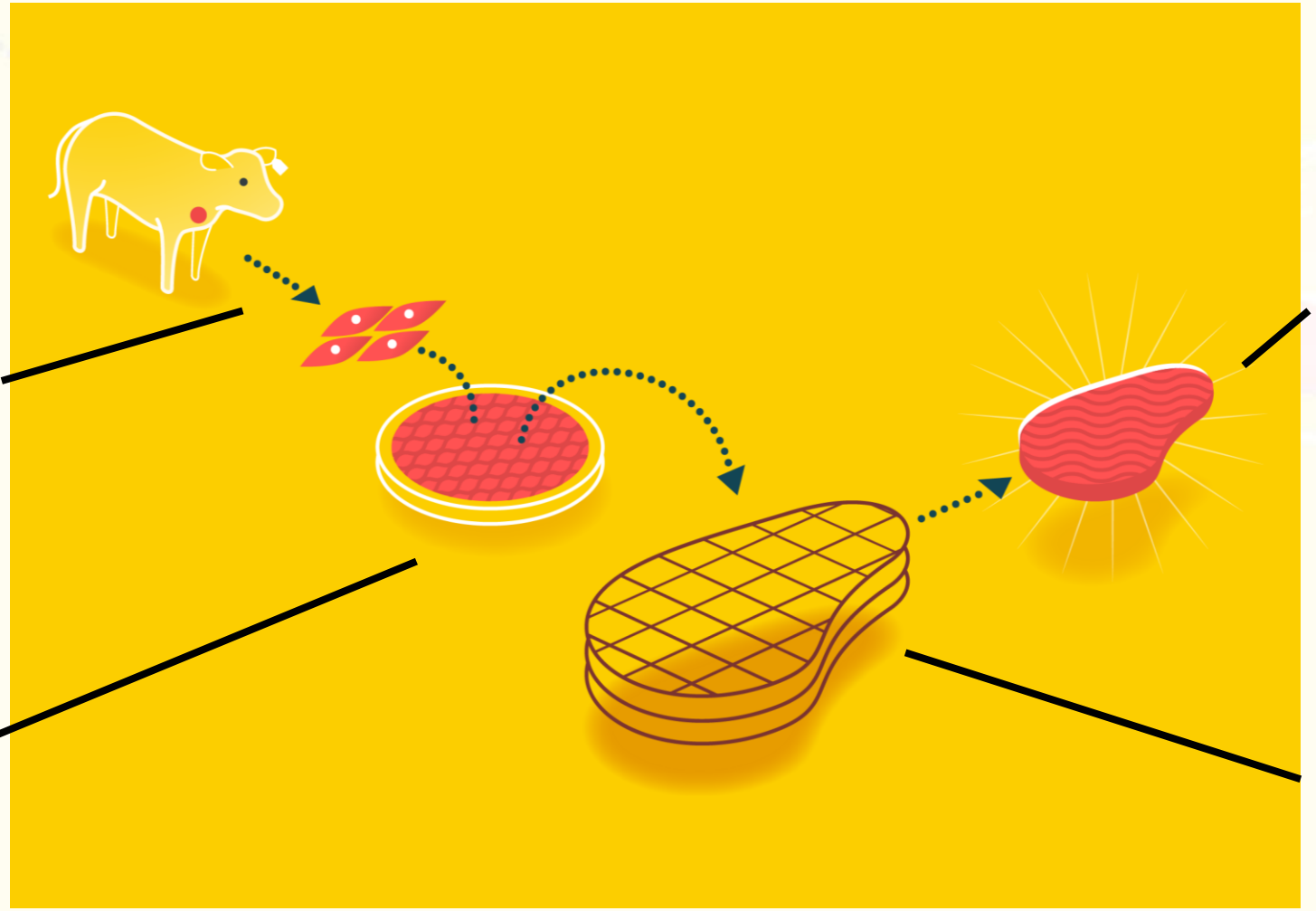


Stem Cell Isolation

Proliferation (Multipy Cells)

Differentiation
(Form Muscle Fibers/
Accumulate Lipid)

Process of In Vitro Meat Production



Stem Cell Isolation

Proliferation
(Multipy Cells)

Differentiation
(Form Muscle Fibers/
Accumulate Lipid)

Why *In Vitro* Meat?

- <u>Potentially:</u>
- 🌎 GHG Emissions, Water Use, Land Use ⬇
- 🦠 Less/No Antimicrobial Use ⬇
- 🍗 Fully Recreate Flavor/Aroma of Conventional Meat

Problems with Meat Production

Kills Biodiversity

Leading cause of reduced biodiversity in the world

Human Health Hazards

Antibiotic Resistant Diseases

Large Contributor to Global Greenhouse Gas Emissions

Responsible for 44% of global methane output

More emissions than all our vehicle exhaust gases!

High Water Use

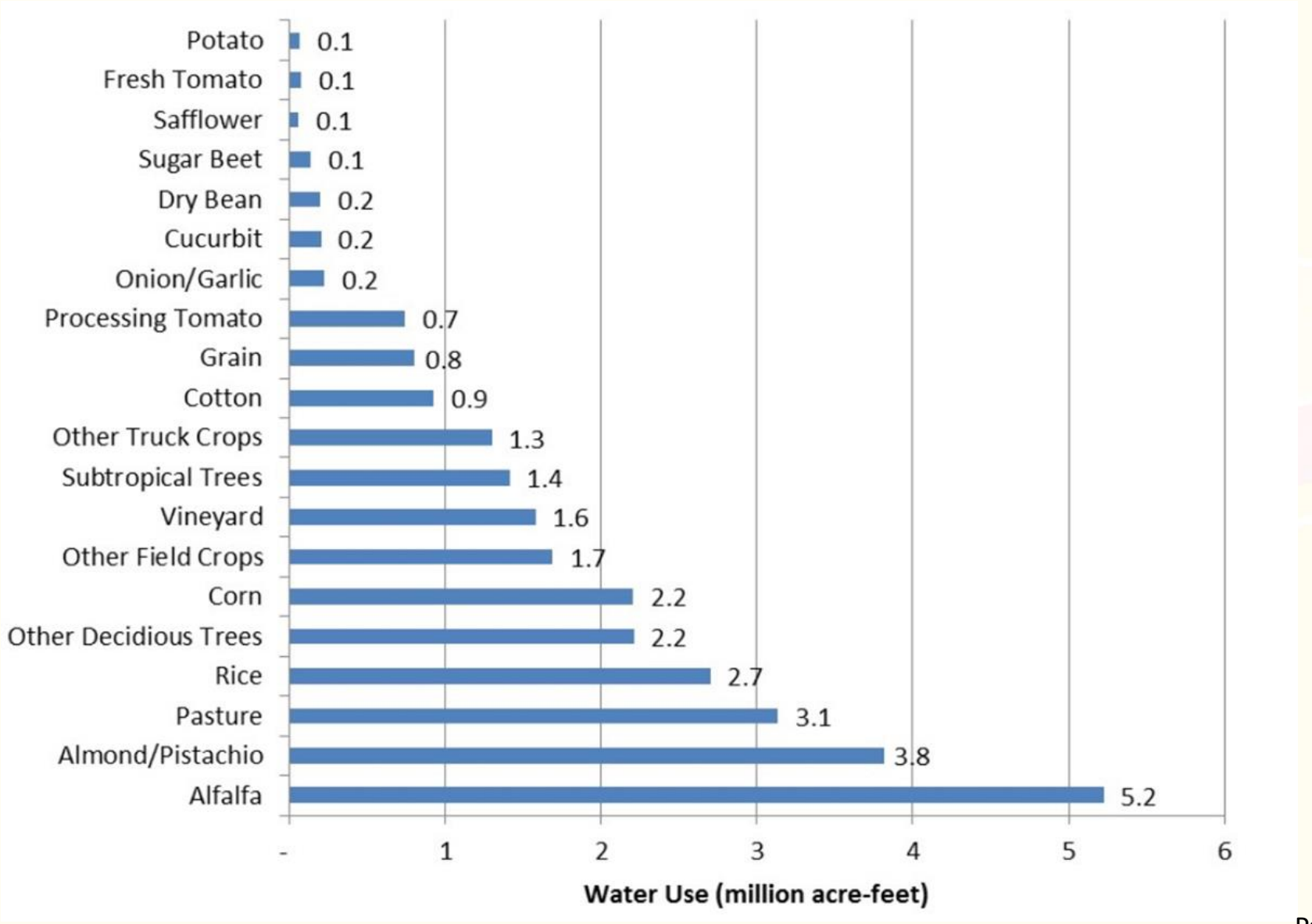
Crops for livestock use more water than almonds

In the western United States 80% of degradation to streams are due to livestock

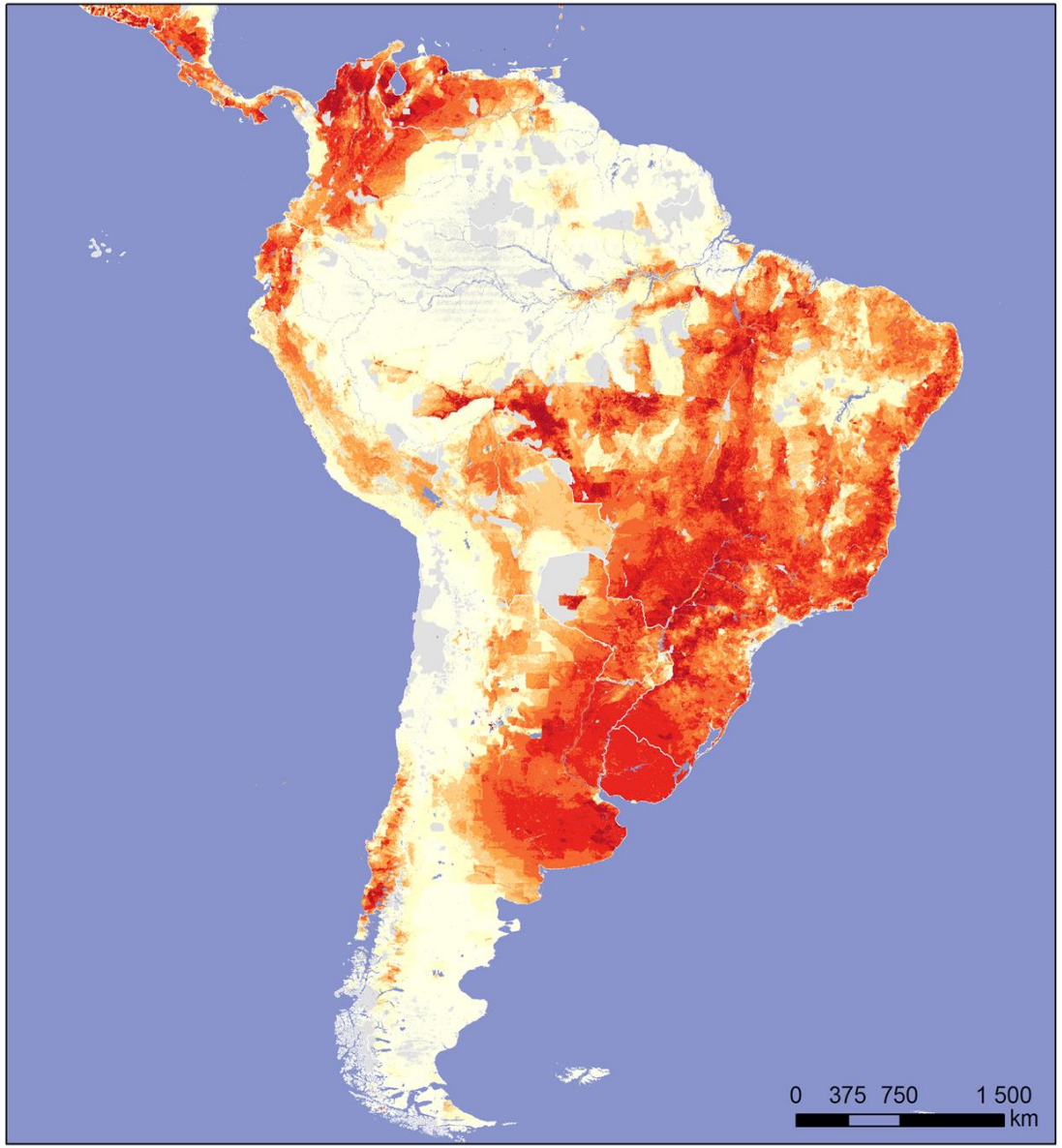
Huge Land Use (⅓ of the world!)

Degrades land (Overgrazing)

70% of deforested land in the Amazon used for grazing



Pacific Institute, 2015



Cattle

Heads per km²

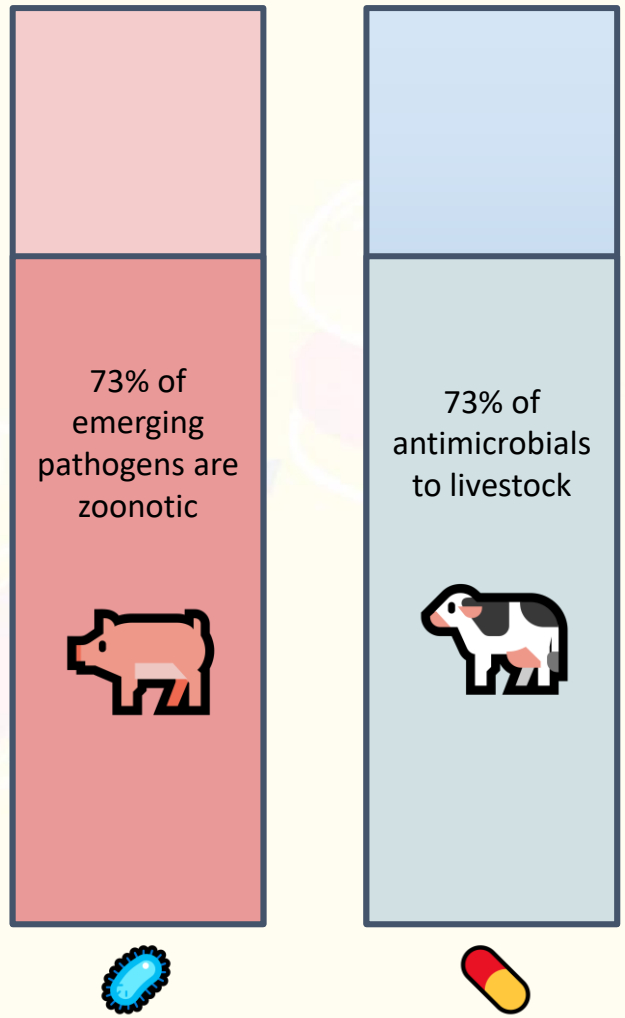
- 0
- < 1
- 1 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 250
- > 250

Robinson et al. 2014

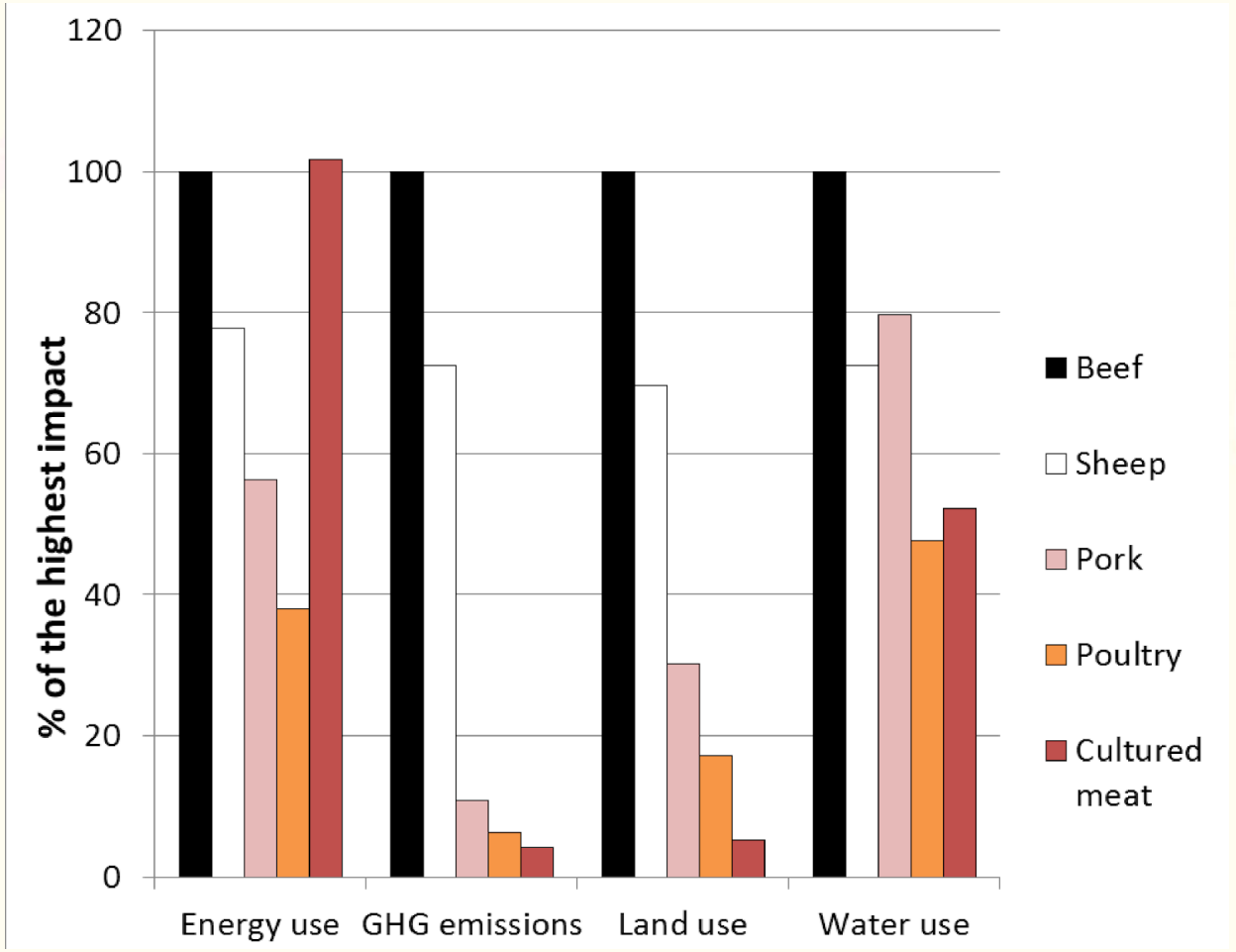
Human Health Hazards (Conv. Meat)

- **73%** of emerging/reemerging human pathogens are zoonotic (e.g influenza)
- **58%** of all human pathogens are zoonotic

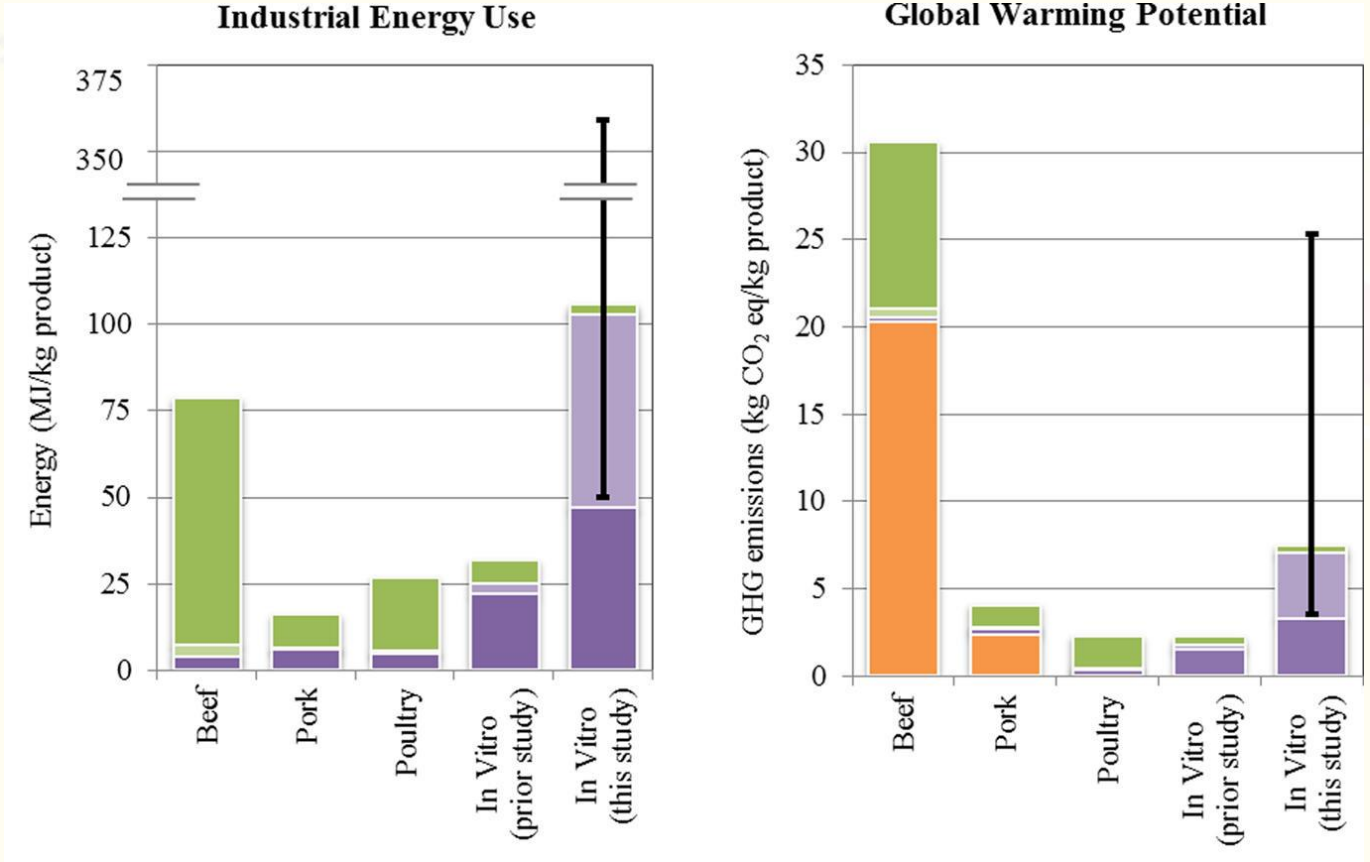
- **73%** of all antimicrobials go to animals raised for food
- Antimicrobial resistance develops and is transferred to humans via animal contact and consumption



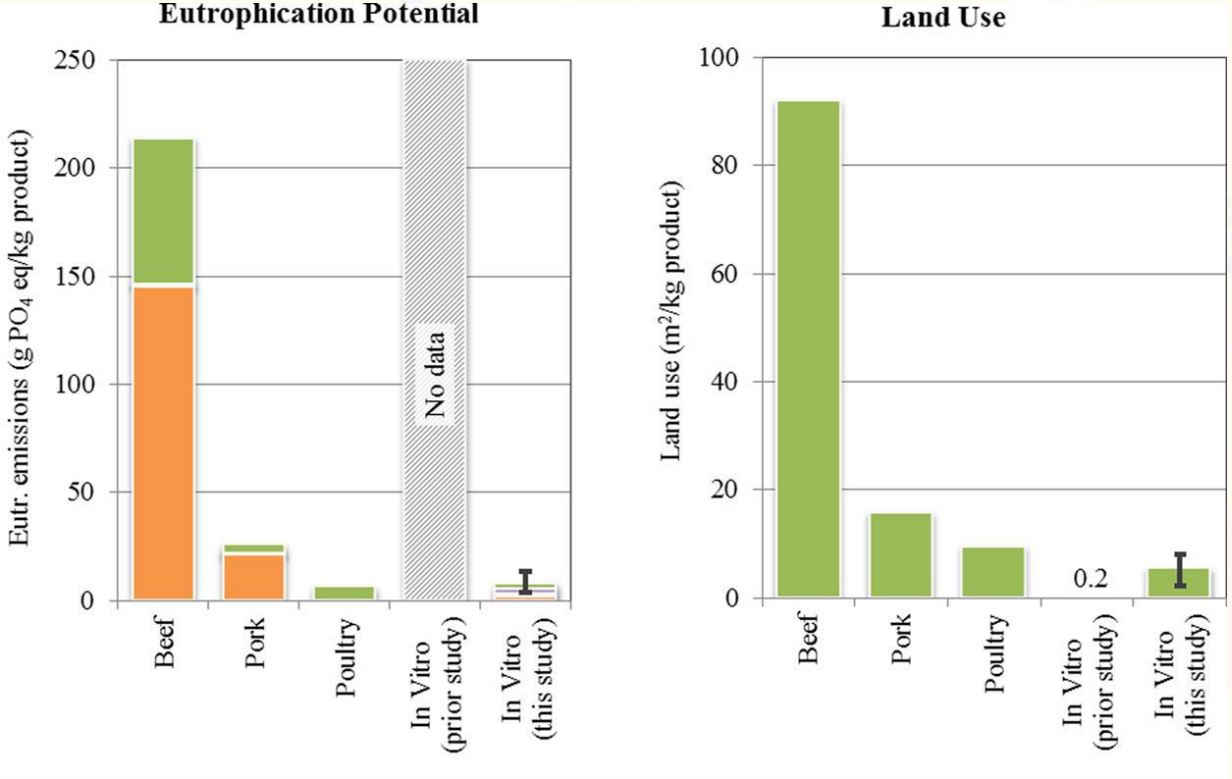
In Vitro Meat Life Cycle Assessment 1



In Vitro Meat Life Cycle Assessment 2

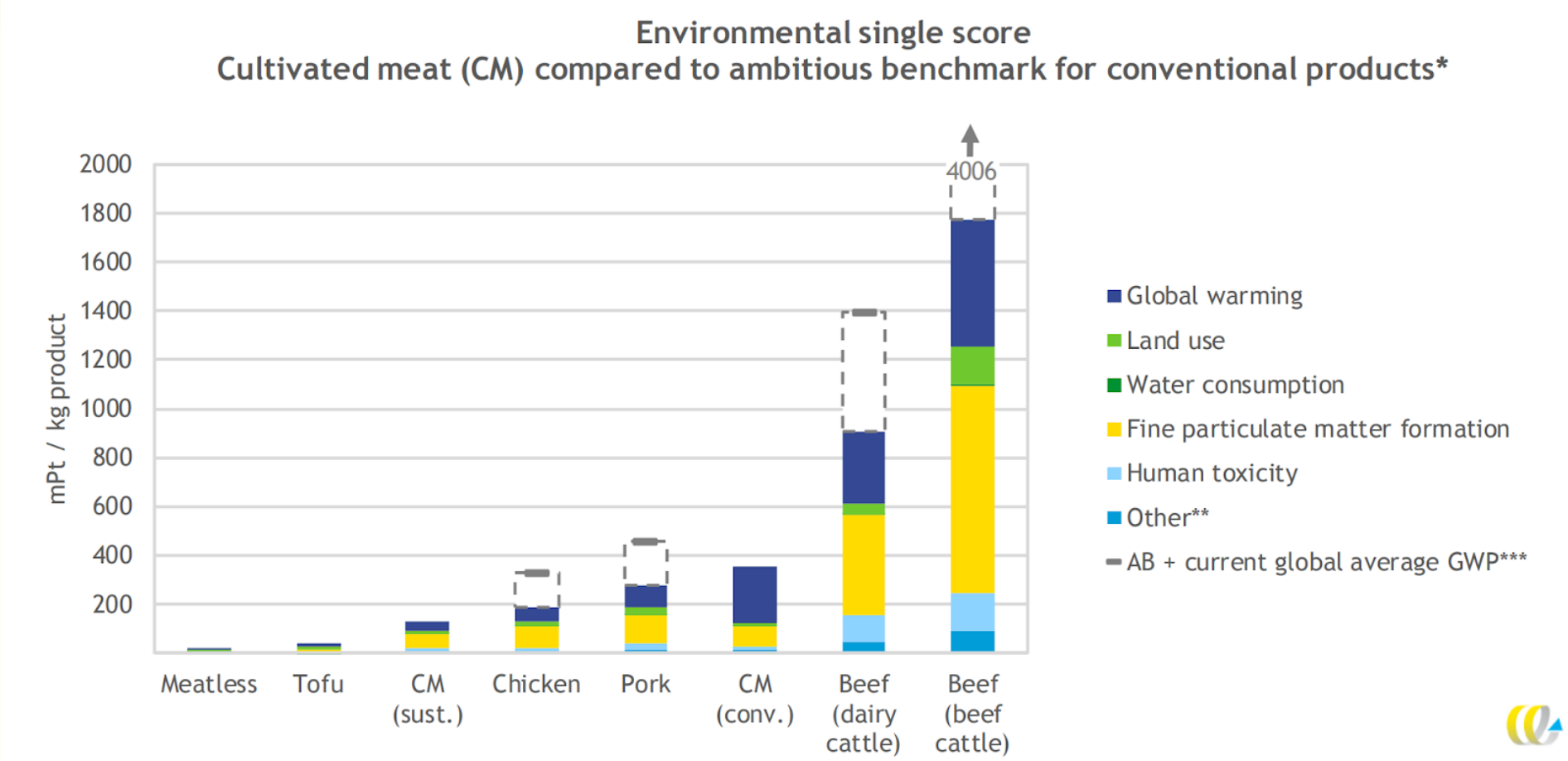


In Vitro Meat Life Cycle Assessment 2



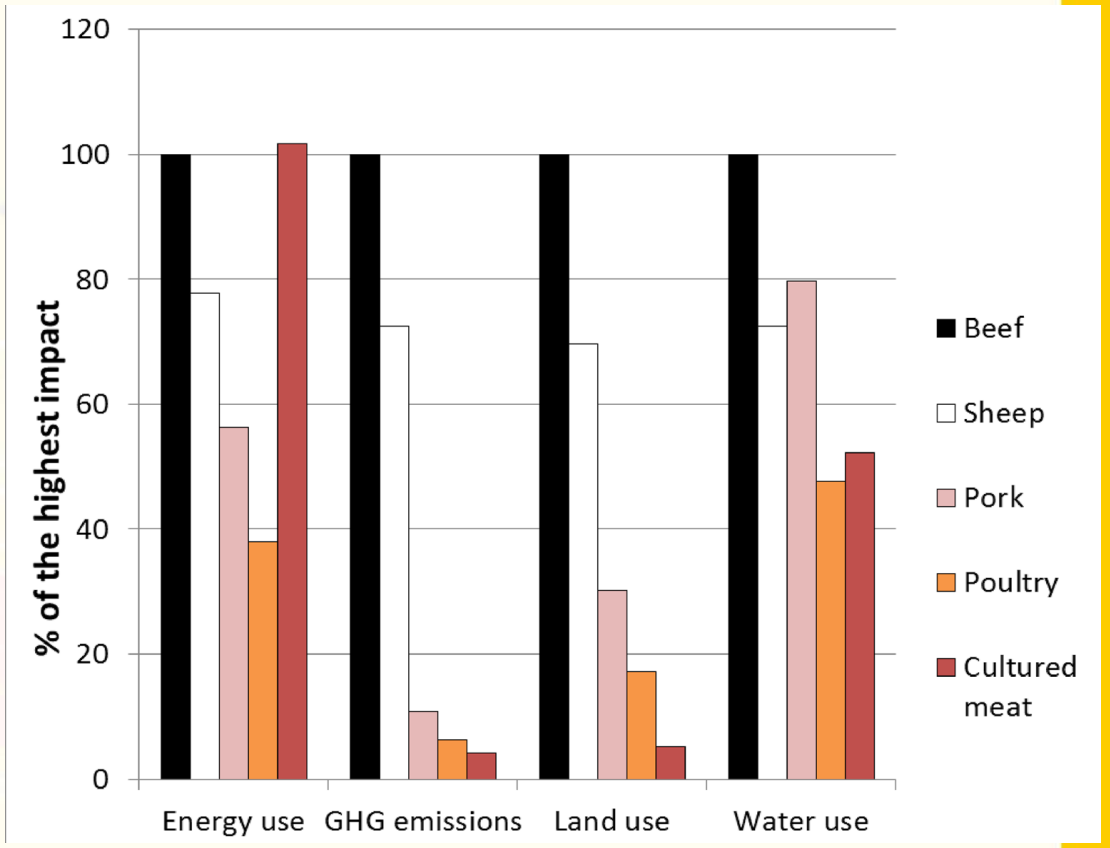
In vitro meat: Less need to worry about 💩

In Vitro Meat Life Cycle Assessment 3



In Vitro Meat Life Cycle Assessment Summary

- Likely in between pork poultry and beef in terms of overall environmental impact
- Energy use could be high
- GHG Emissions high or low depending on variables such as energy mix
- Very low land use and eutrophication potential

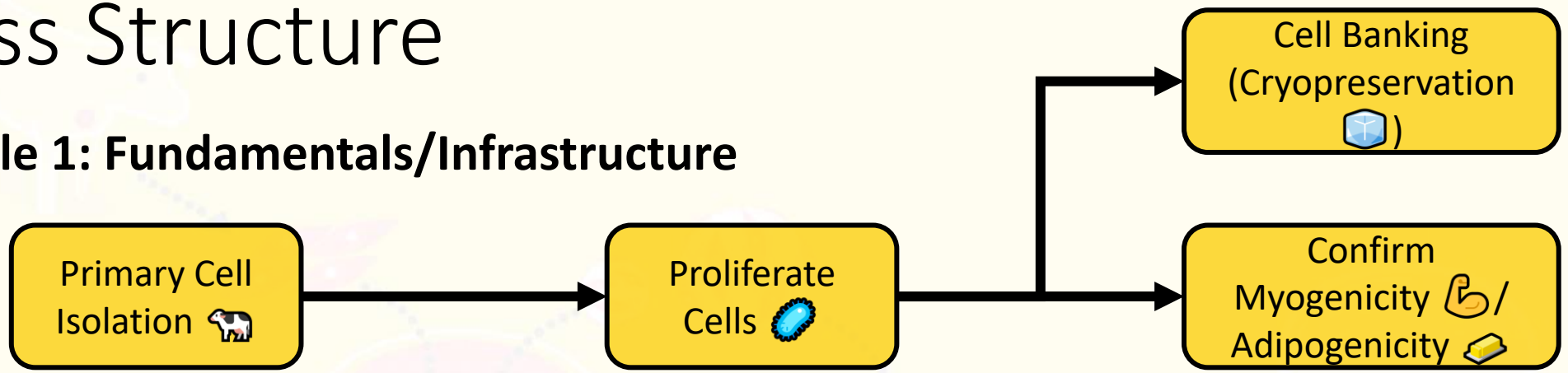


<u>Other Benefits</u>

- Could be grown sterile? (No need antimicrobials)
- Faster growth time (weeks vs months/years)
- Can even make it healthier (add some omega 3 to the meat fat)
- No need to slaughter animals

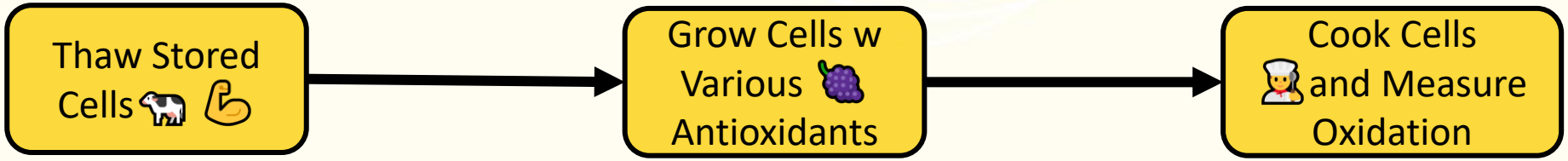
Class Structure

Module 1: Fundamentals/Infrastructure



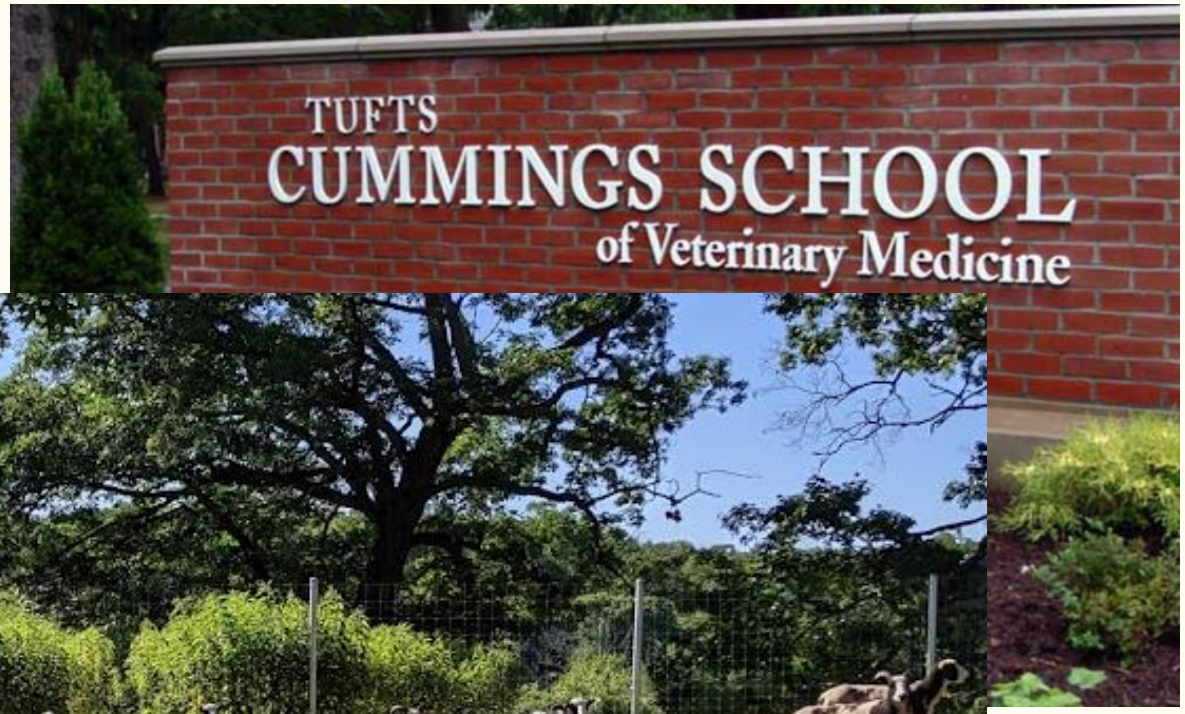
Module 2: Making Cultured Fat

Module 3: Nutritional Interventions



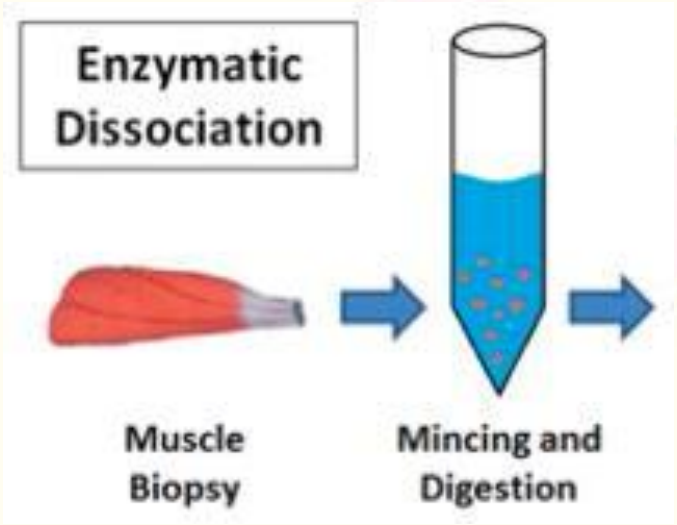
Next Week (Week 2): Primary Cell Isolations

Next Week (Week 2): Primary Cell Isolations



How Primary Cell Isolations Work:

How Primary Cell Isolations Work:

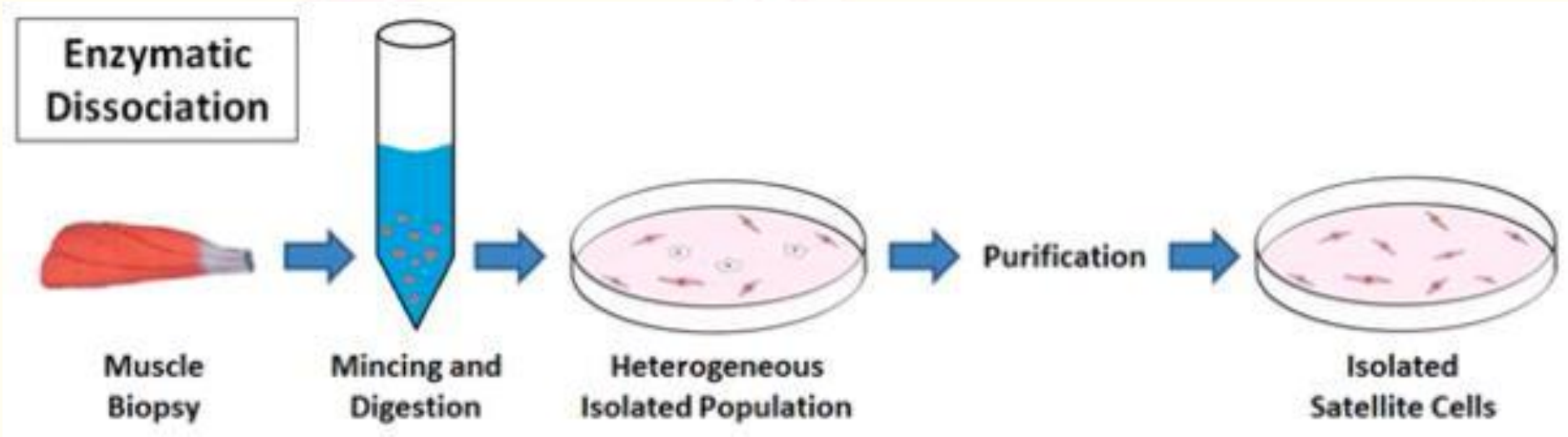


Why does biopsy need to be digested?

How can we digest the muscle biopsy?

http://europepmc.org/article/PMC/4582791

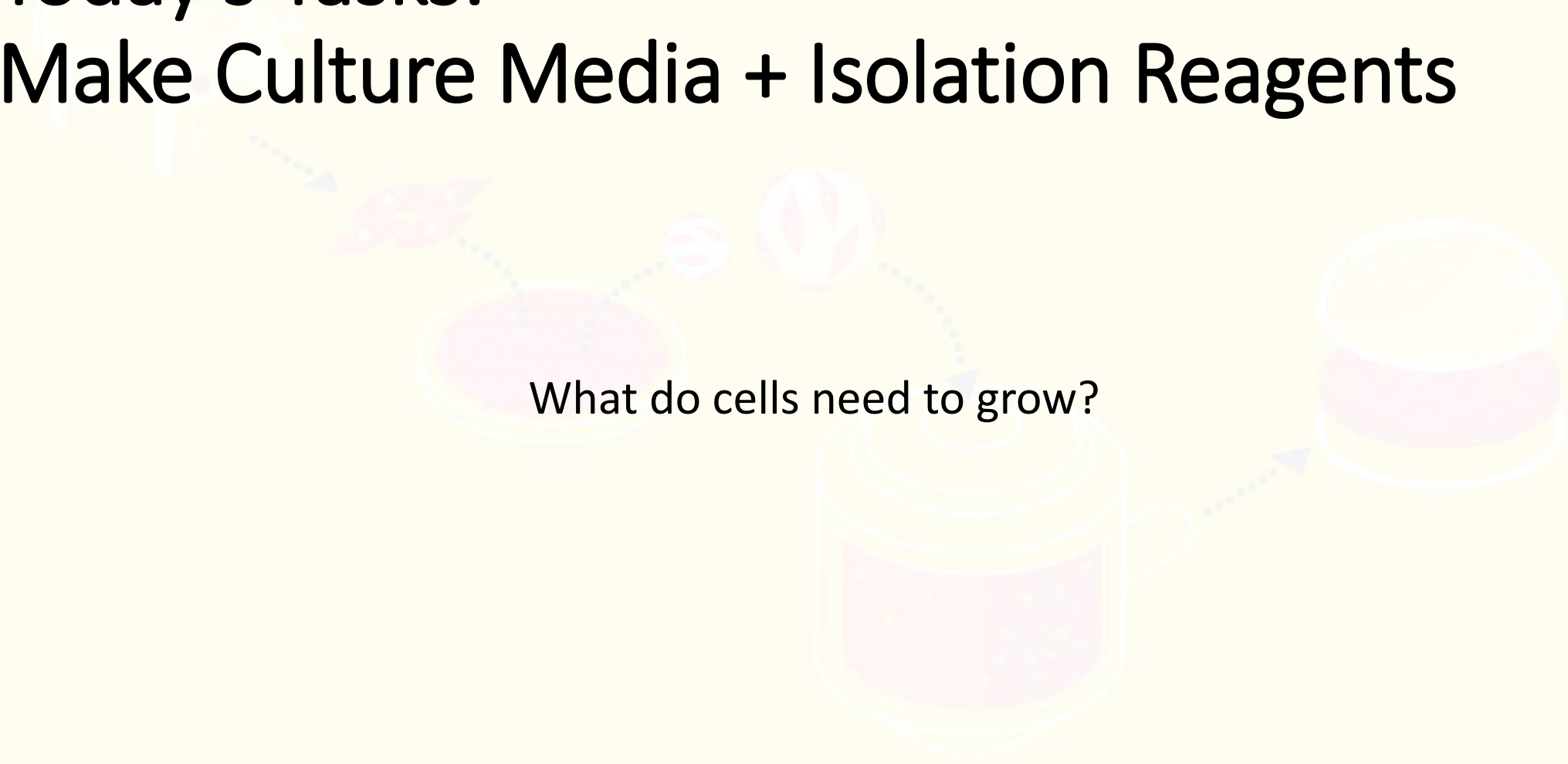
How Primary Cell Isolations Work:



How do we purify the satellite cells?

http://europepmc.org/article/PMC/4582791

Today's Tasks:
Make Culture Media + Isolation Reagents

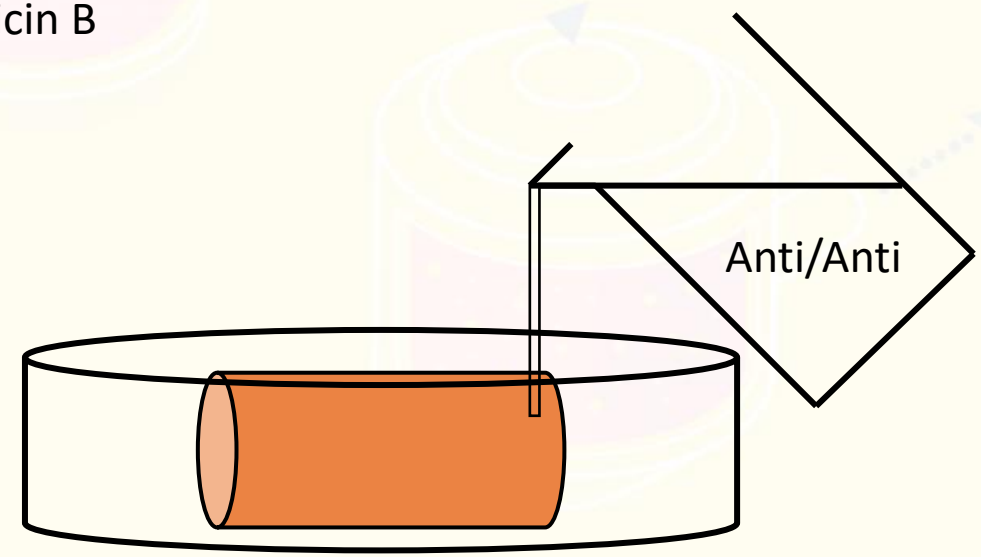


What do cells need to grow?

Today's Tasks:
Make Culture Media + Isolation Reagents

90% Dulbecco's phosphate-buffered saline (DPBS) + 10% Antibiotic/Antimycotic

A/A:
Penicillin, Streptomycin, Amphotericin B



Today's Tasks:
Make Culture Media + Isolation Reagents

Cell Proliferation Media:

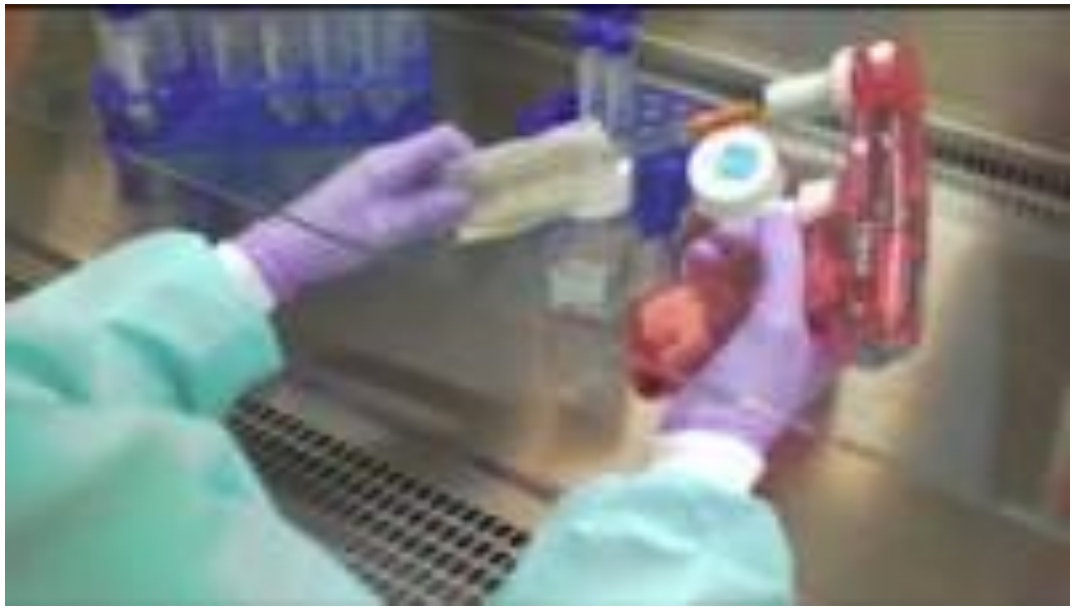
Dulbecco's Modified Eagle Medium (DMEM) + 10% Fetal Bovine Serum (FBS) + 1X Primocin + 2 ng/ml FGFb

Basic Nutrients

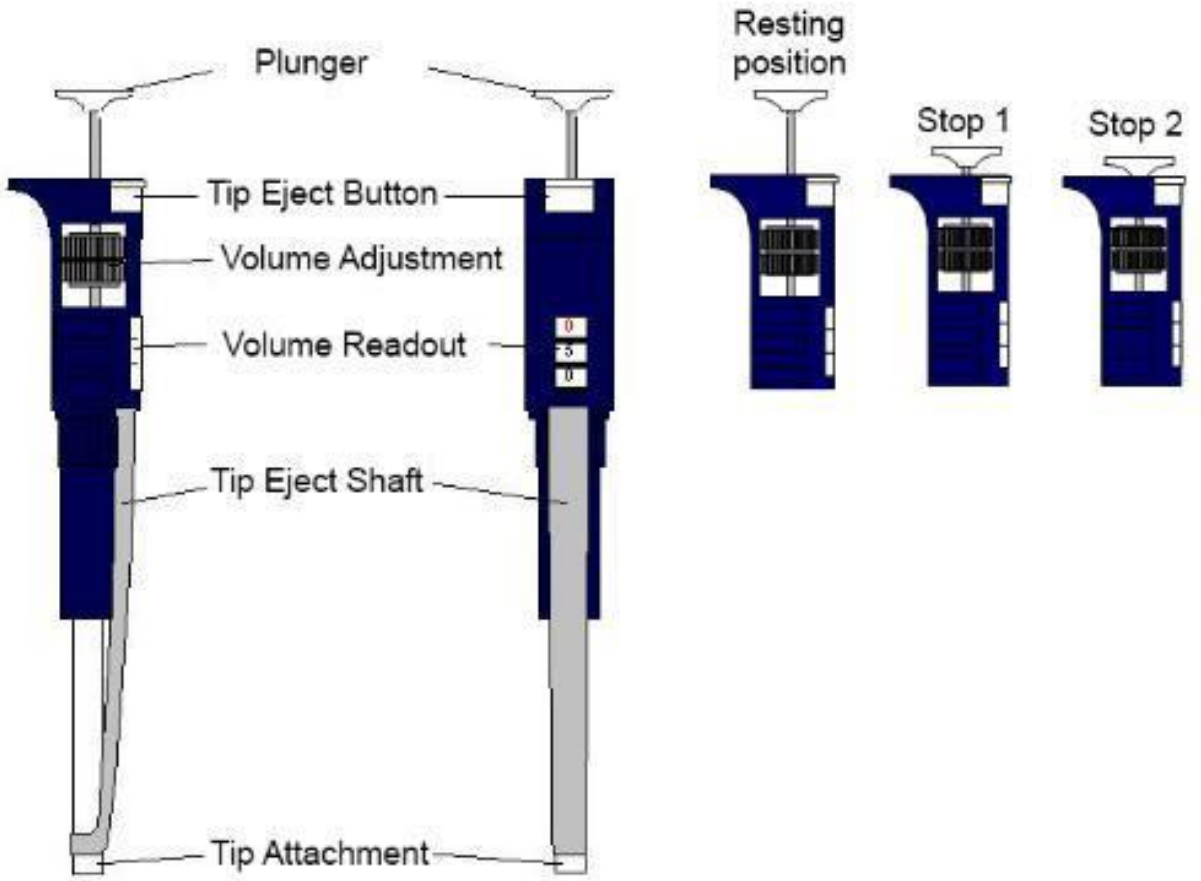
Growth Factors

Proprietary Antimicrobials

Proliferation Promoting Growth Factor



Sterile Technique



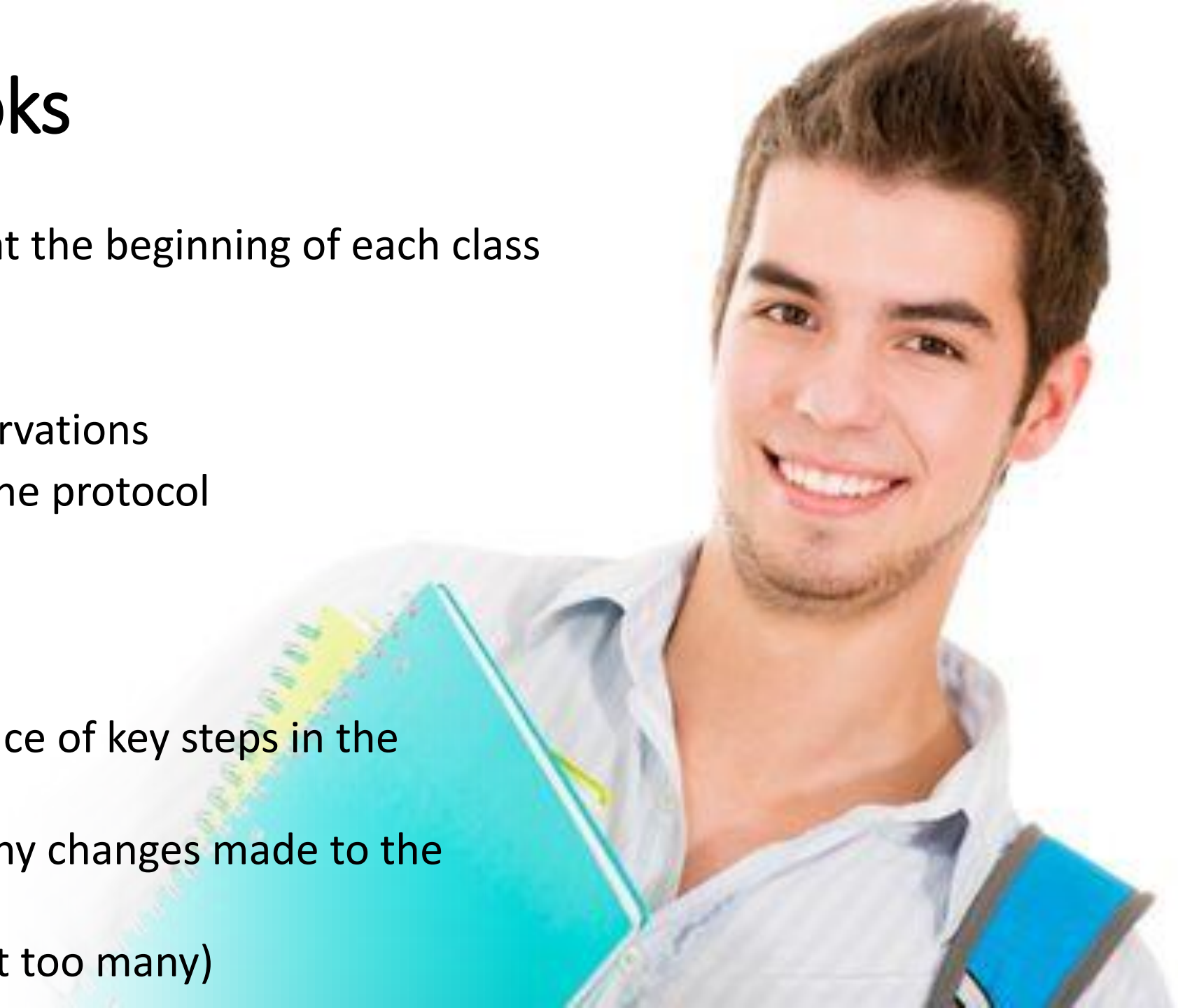
Micropipetting

- Biohazardous Waste + Sharps Bins
- Coming during the week (<1h) to feed/passage cells
- Mandatory attendance unless medical exemption

#justclassthings

Lab Notebooks

- Lab notebooks due at the beginning of each class
- Objective
  - 1-2 sentences
- Procedure and Observations
  - Any changes to the protocol
  - Calculations
  - Observations
- Discussion
  - Explain significance of key steps in the protocol
  - Implications of any changes made to the protocol
- Photos (relevant, not too many)



Questions?

Week 1

Part 1

- Introduction to Cell-Cultured Meat
- General Class Information
- Overview of Today's Objectives
- Key Laboratory Techniques/Info

Part 2

- Preparations for the Class + Next Week's Cell Isolations