Trash to Treasure: Accelerating Composting

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Compost: The Problem

- Naturally takes a year
- Bacteria operate within different temperature zones
  - 0-40°C – mesophilic topsoil bacteria
  - 40-55 °C – thermophilic bacteria ~ similar to hot-springs
  - Actinomycetes
    - Dirt smell
    - Breaks down complex organics

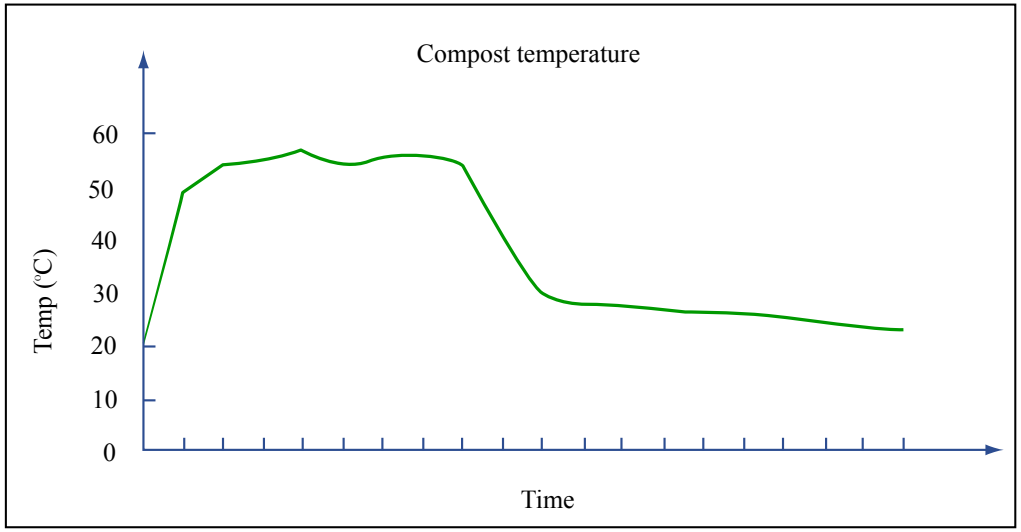
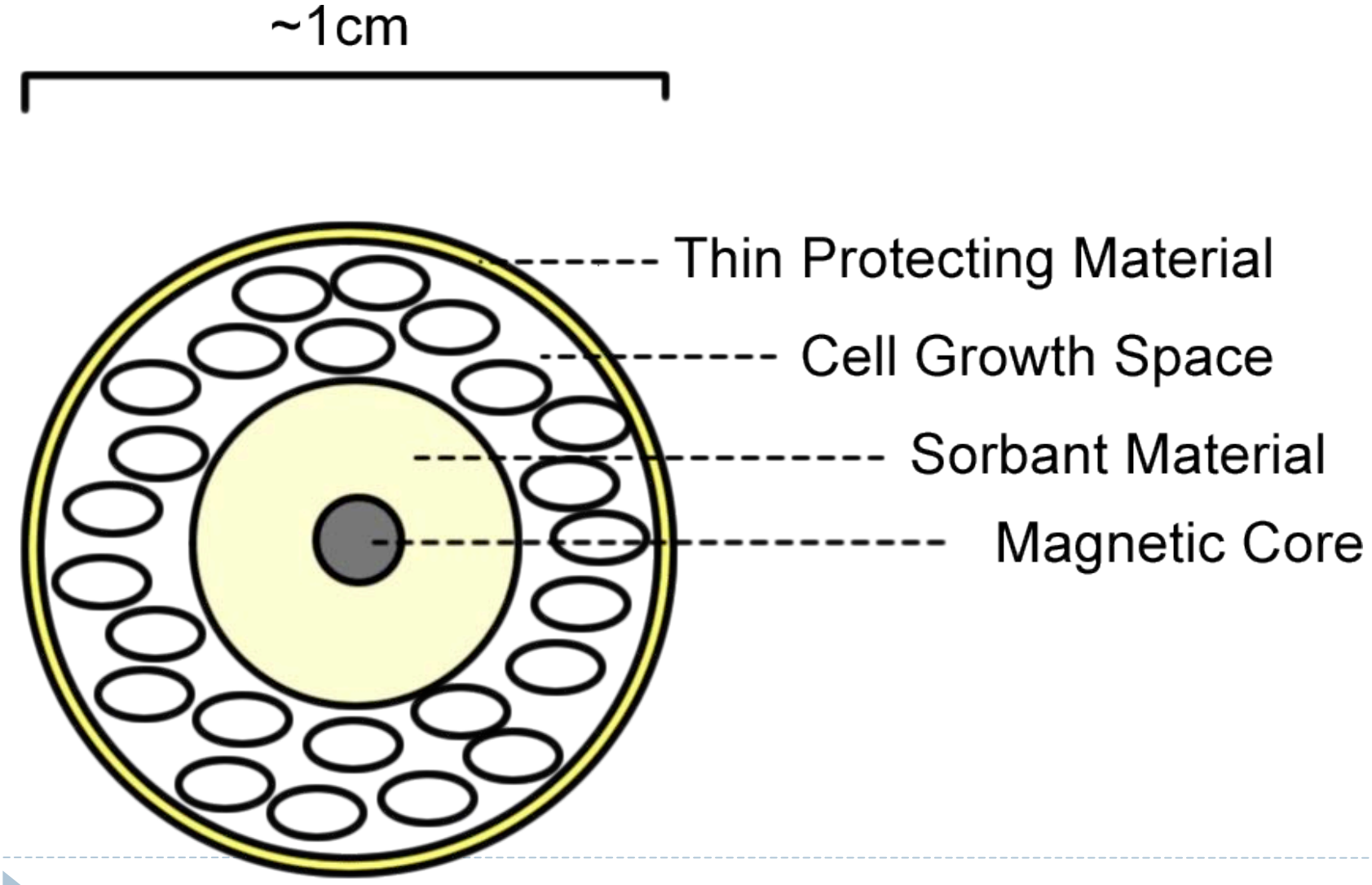


Figure by MIT OpenCourseWare.

Goal:

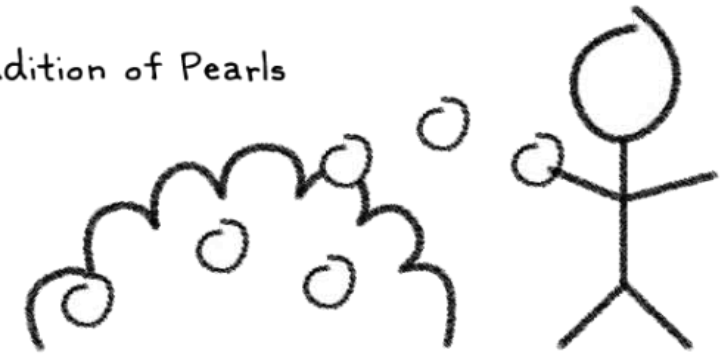
- Accelerate the speed of composting

Solution: Compost Pearls

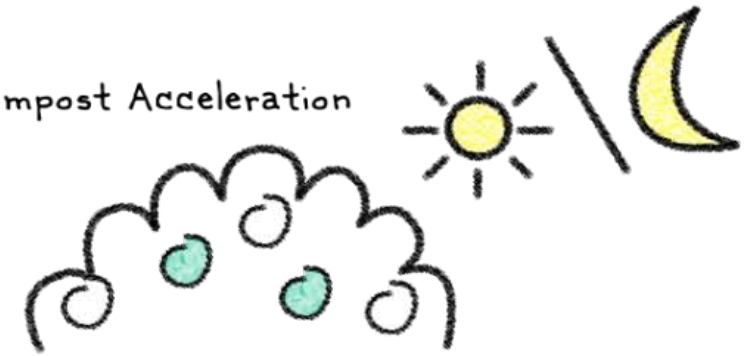


Compost Pile

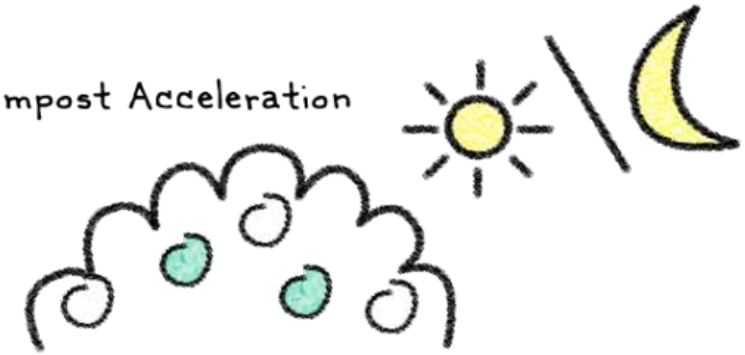
Addition of Pearls



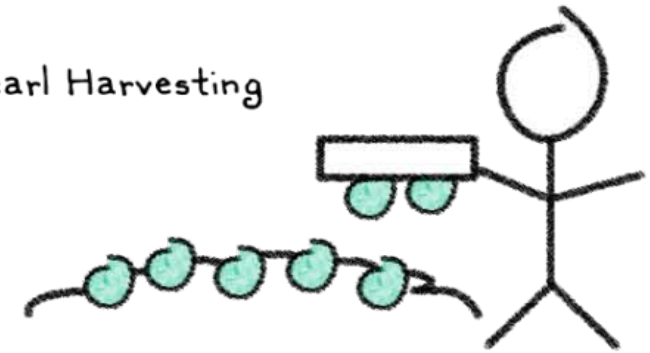
Compost Acceleration



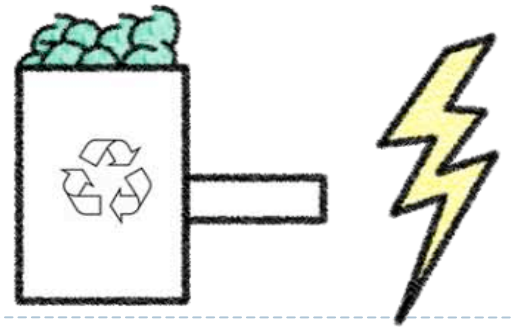
Compost Acceleration



Pearl Harvesting



Hydrocarbon Extraction



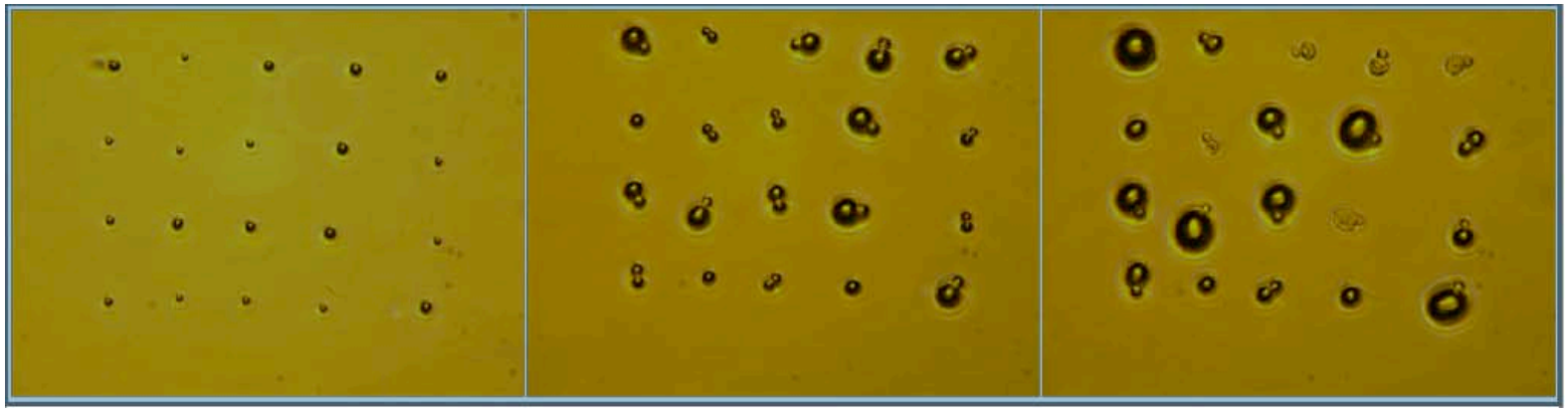
Description

- Pearl covered with 2 cell types: Type A and Type B
- Type A has cellulase over-expression
  - Lyses and releases cellulase into surrounding area
- Type B converts cellulose to hydrocarbons
  - Uses pathway of Gliocladium roseum
- Spongy Core to trap hydrocarbons when they are produced
- Metal at the center for easy retrieval

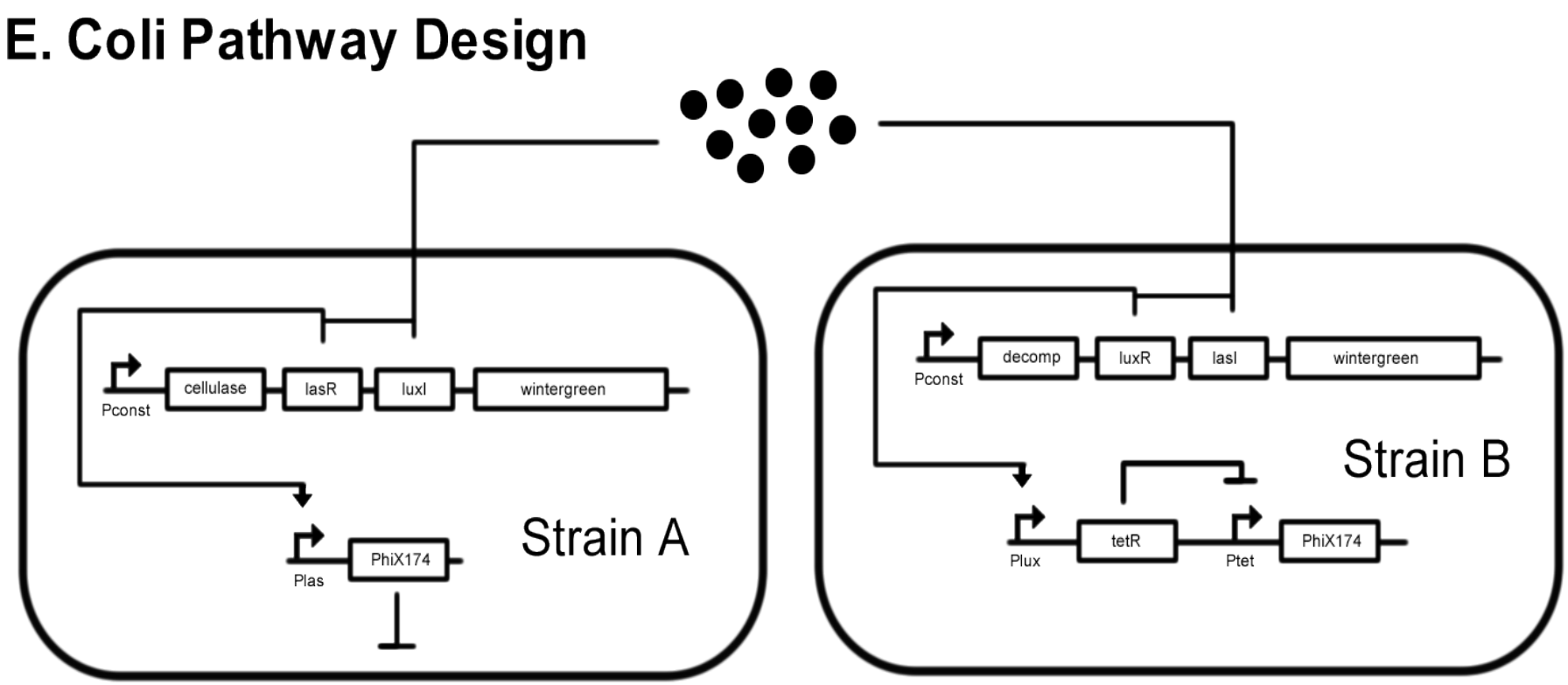
Overall System

2 Methods

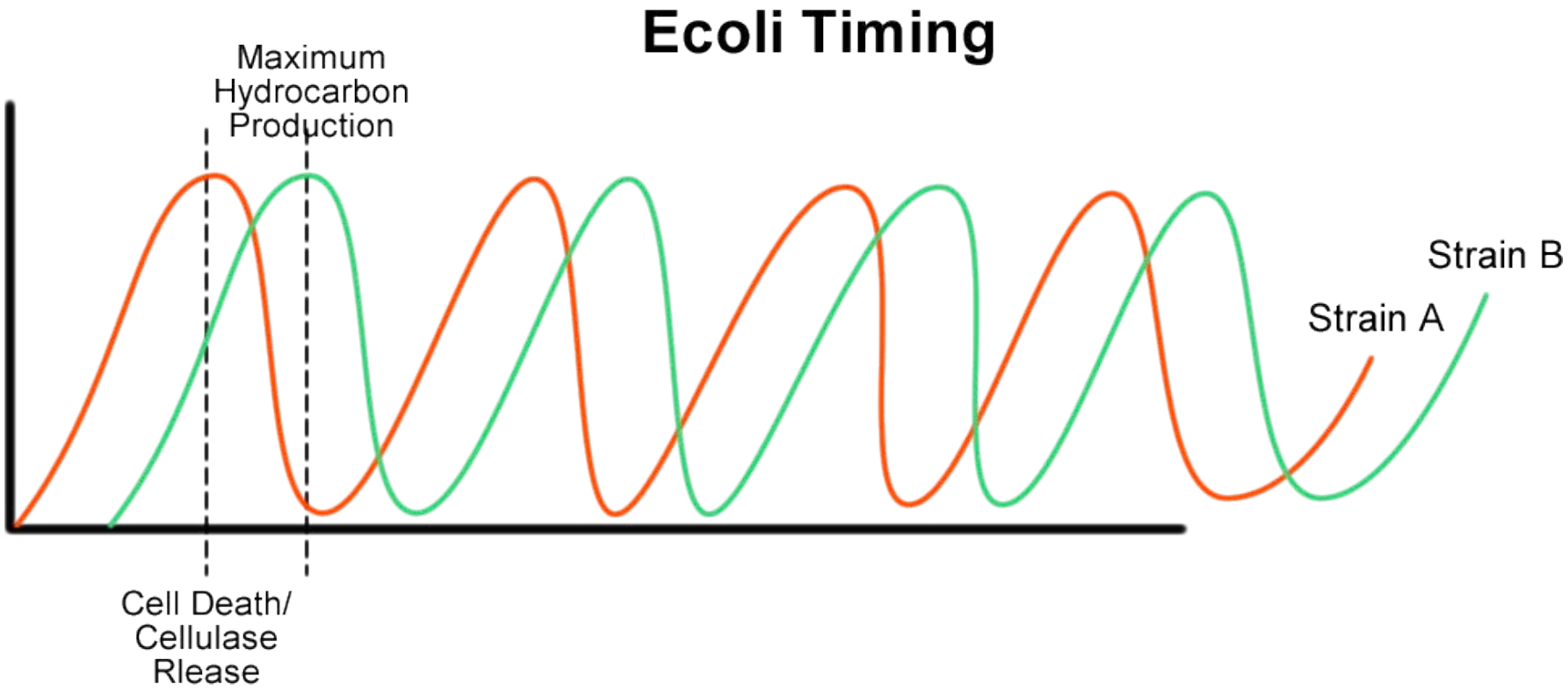
- E-coli
  - Uses predator-prey model to regulate level of strain A compared to strain B
- Yeast
  - Uses mother-daughter cells to regulate level of strain A compared to strain B



E-coli

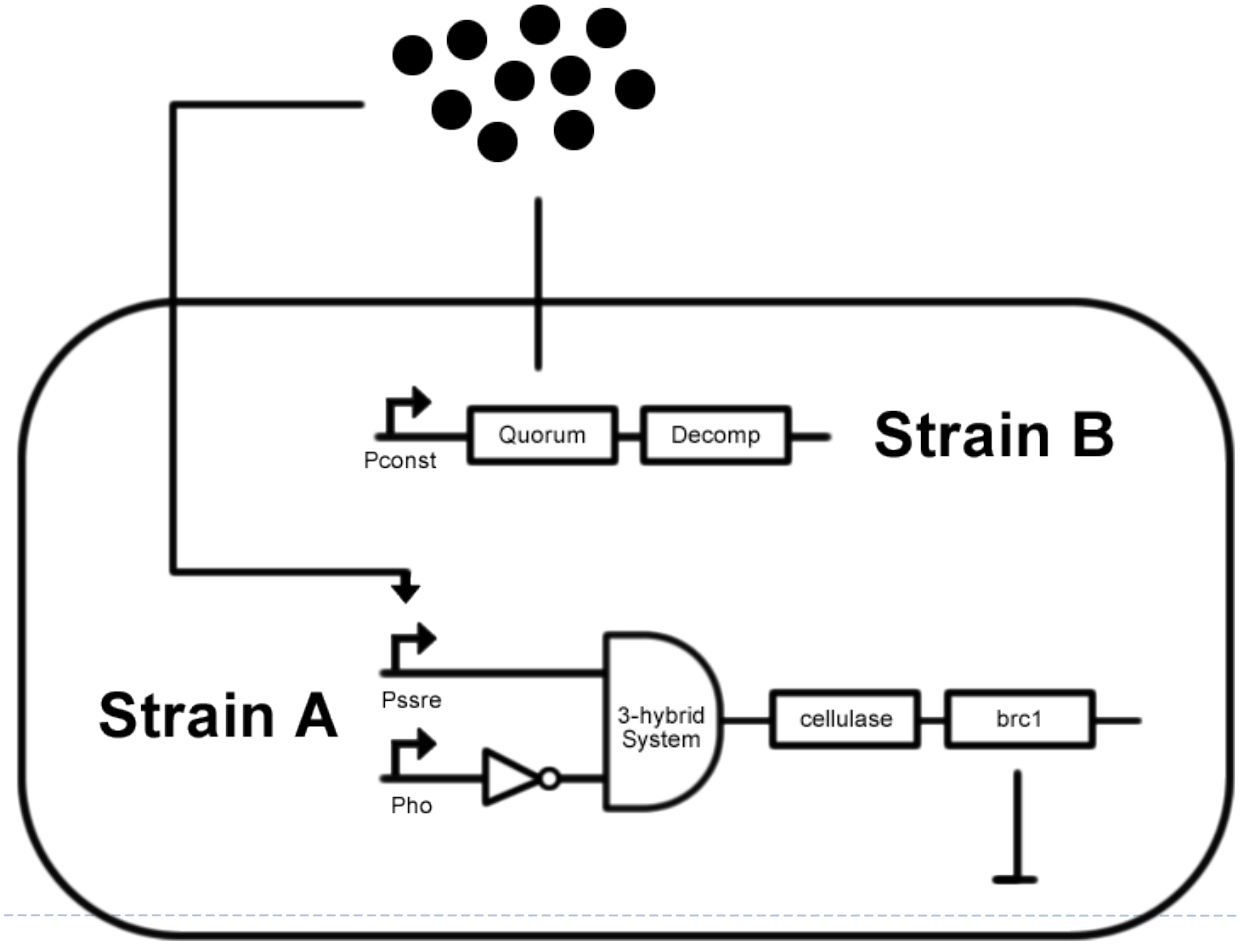

E. Coli Pathway Design
Pconst
cellulase
lasR
luxI
wintergreen
Plas
PhiX174
Strain A
Pconst
decomp
luxR
lasI
wintergreen
Strain B
Plux
tetR
Ptet
PhiX174

Timing Diagram

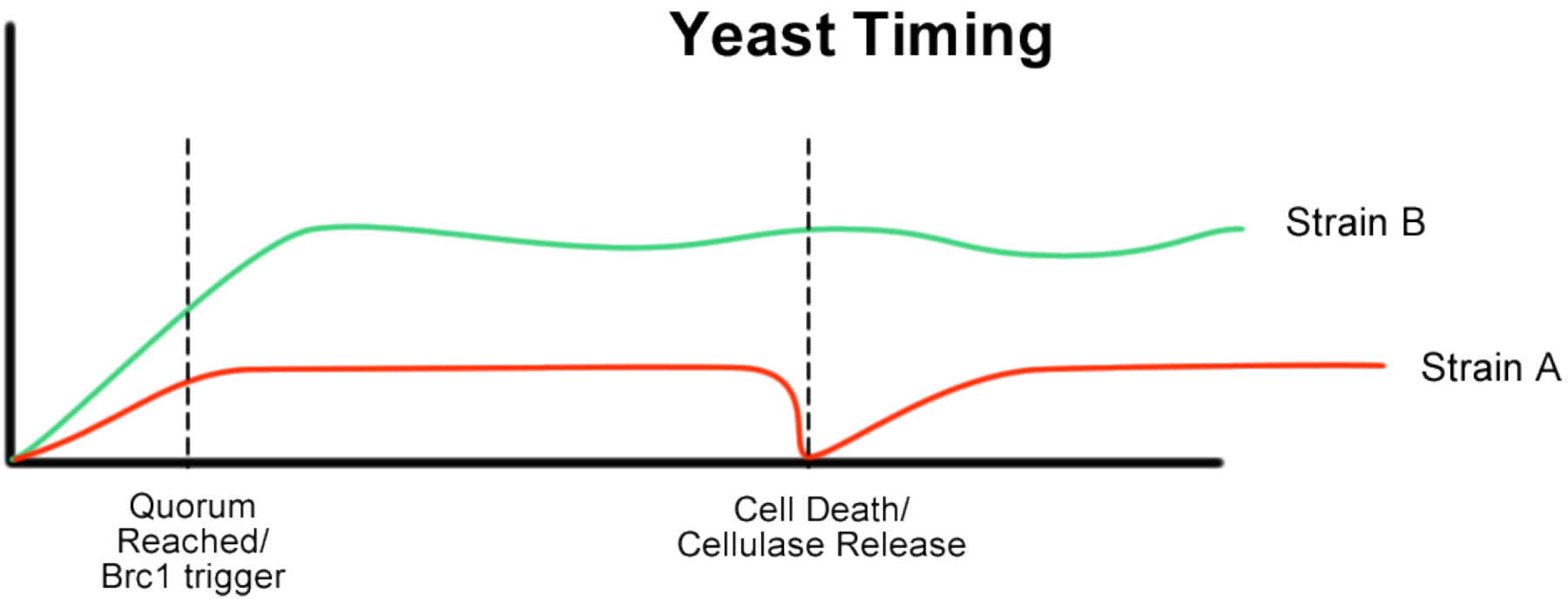


Yeast

Yeast Pathway Design



Timing Diagram



Description of Parts

Main Parts	
Cellulase	Trichoderma reesei
Hydrocarbon Production	Gliocladium roseum

Yeast Chassis:	**18AR**	
Part	**Name**	**Availability**
Const. Promoter	BBa_I766555	RSBP
Inverter	n/a	Unknown
Three-hybrid System	n/a	Genome
Brc1	n/a	Synthesis
Cytokin Quorum System	n/a	Weiss
Daughter HO Promoter	n/a	Genome

Description of Parts

E. Coli Chassis:	**Indole Deficient**	
Part	**Name**	**Availability**
Constitutive Promoter	BBa_I14018	RSBP
LuxR	BBa_C0062	RSBP
LuxI	BBa_C0061	RSBP
Plux	BBa_R0062	RSBP
Plas	BBa_K091117	RSBP
lasR	BBa_C0079	RSBP
lasI	BBa_C0078	RSBP
Wintergreen GD	n/a	MIT
PhiX174	n/a	Sequence
Tet Inverter	BBa_Q04400	RSBP

Plan for Testing/Debugging

- Debug each pathway separately
- Build basic population functions first
- Test hydrocarbon synthesis

Impact of Solution

- Faster compost
- Can be used in places like restaurants
- Collectable balls with hydrocarbons to use as fuels
- Non industrial solution

Concerns

- Difficult to synchronize populations
- Animals will eat pearls
- Lack of research done on gliocladium roseam pathways
- Yeast vs. E. coli

Proceed with caution…

20.020 Introduction to Biological Engineering Design

Spring 2009