Healthy Planet

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Three Ideas Presentation
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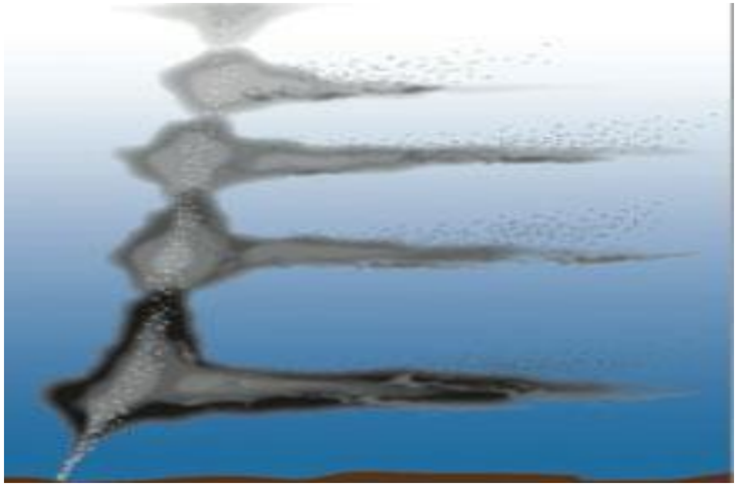
Break it Down

Engineering bacteria to undergo programmed cell death after breaking down hydrocarbons from oil spills.

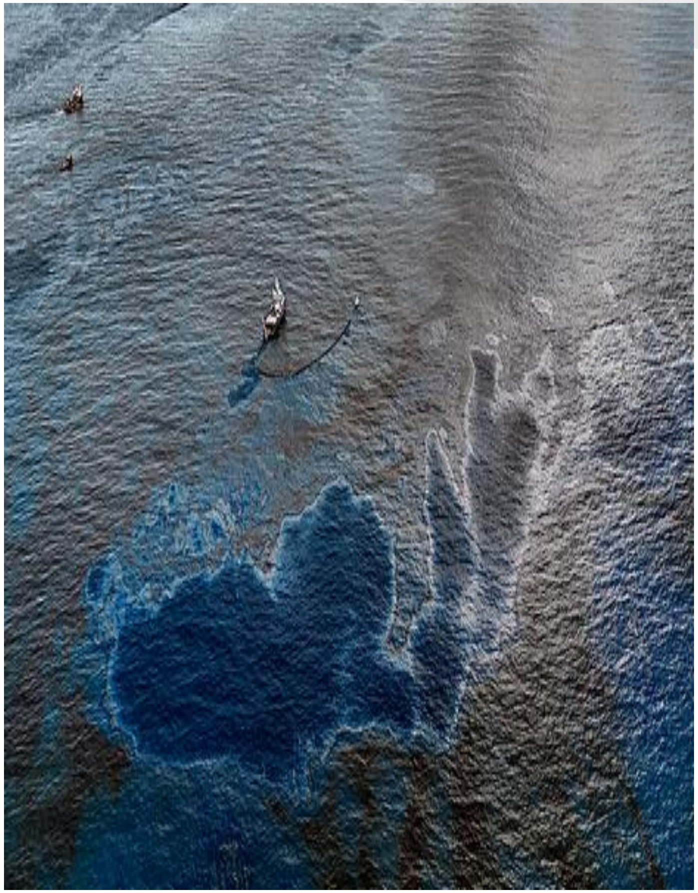
Importance

- Oil spills cause extensive environmental damage
- Increase in offshore drilling
- Stratification causes multiple layers of damage



Impact

- Break down to non-toxic compounds
- Acceleration of a natural process
- Less negative effects than current methods



Competition

- Skimmers

- Burning

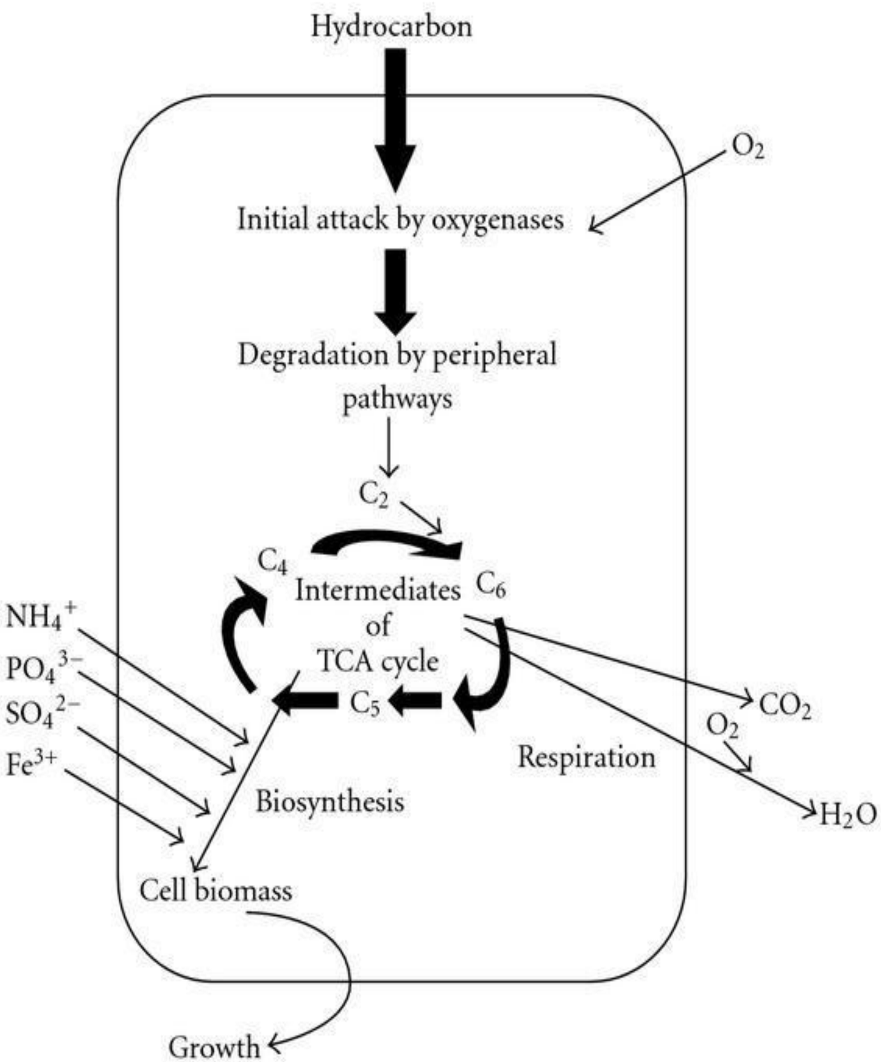
- Chemical Dispersants

Competition: Bioremediation

- Bacteria naturally break down hydrocarbons
- BUT
  - Current techniques require the addition of nutrients
  - No way to eliminate bacteria after spill is cleaned up

Knowns

- Many microorganisms break down hydrocarbons
- Bacteria convert hydrocarbons into CO2
- Increased efficiency is possible
- Cell death can be triggered by color recognition



Unknowns

- How often would bacteria have to be added?
- How much bacteria would we need?
- What process would we use to trigger cell death?

Dust-Free

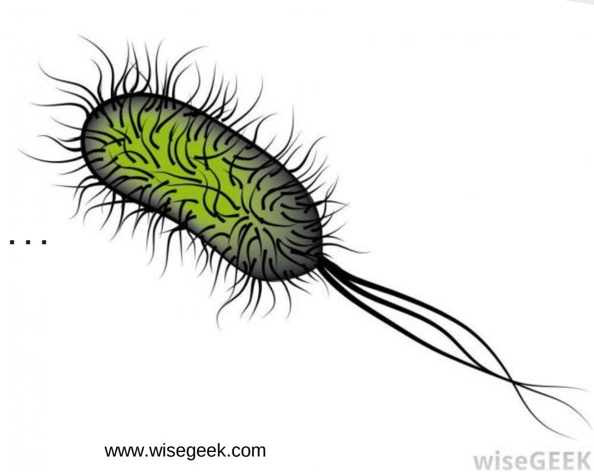
Programmed plant genes that produce more leaf oil and resin to trap PM 2.5[1] from the air in urban area.

1. PM 2.5: particles that float in the air with diameter of 2.5 micrometers or less

Big Picture

www.rbwm.gov.uk

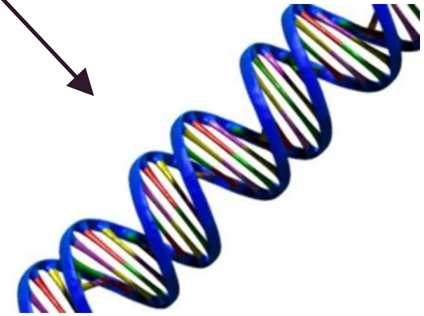
Modify and transfer



www.wisegeek.com

Extract

Modify and transfer



www.prweb.com

Importance

- Desertification

http://www.marketplace.org/topics/sustainability/what-would-your-city-look-beijings-air-smog-simulator

- Respiratory Diseases

http://en.paperblog.com/are-dust-mites-causing-your-child-s-allergies-155569/

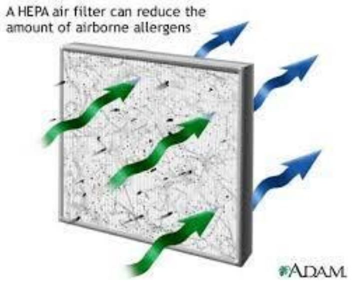
Impact

- Reduce the incidence of respiratory diseases
- Relieve visual impairment
- Relieve Global Warming

http://vacciana.blogspot.com/2009/08/earths-intangibles.html

Competition

- Natural solution
  - Low efficiency
  - Limited space in urban area
- Filters
  - Costly
  - Limitation to individuals
- Standard emission for engines
  - Emission still existing



Knowns

- The common constituents of resin: terpenes
- Pathway for resin production in conifers[1]
- Success in transformation of genes that can synthesize resins (monoterpene) into bacteria[2]
- Organs for producing leaf oil: pellucid glands[3]
- Pathway of oil accumulation and biosynthesis[4]

Unknowns

- Efficiency of the cleaning
- Method of transferring modified genes back to plants
- Impact on ecosystem (insects, birds)
- Type of tree (evergreen)
- The amount that leaves can absorb before the pores fail to perform its function.

Poly-B-Gone

Use naturally occurring compounds to break down plastics prevalent in landfills

Better Disposal of Plastics

- Recent increase in the drive to recycle plastics and produce new biodegradable plastics

- Long lasting plastics still clog up significant portions of landfills.

The Problem

- Polystyrene, the third most widely-used plastic, degrades very slowly and accumulates in landfills.
- Landfill plastics take up large amounts of space and leech toxins into the ground and water over time.

POLYSTYRENE:

- takes over 500 years to decompose
- takes up 30% of our landfills
- Polystyrene manufacturers are the 5th largest toxin producers in the world: this mean that polystyrene is very prone to leaking toxins

Solutions and Impact

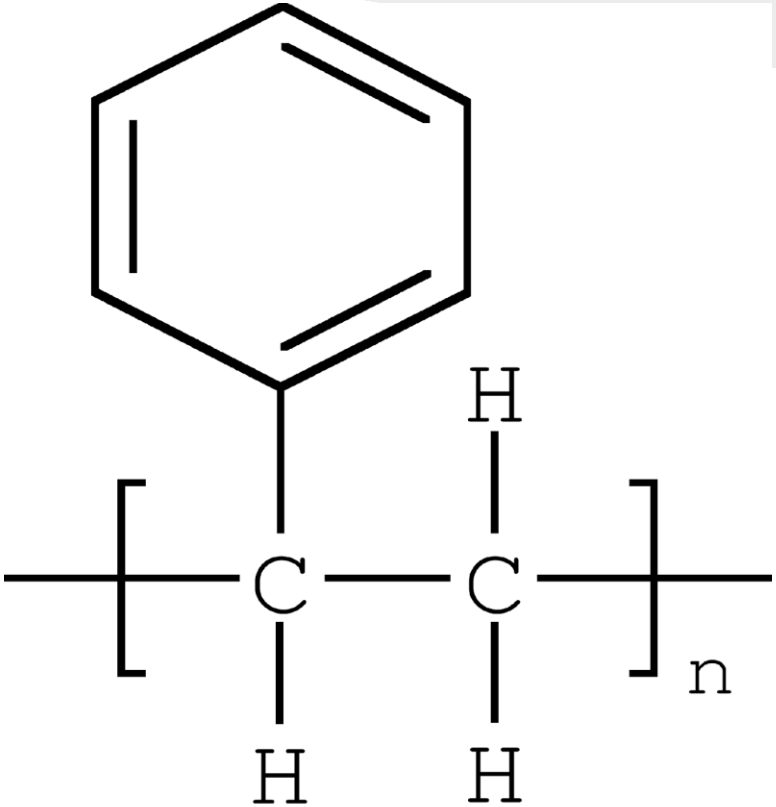
- The key goal is to create a bacteria able to easily synthesize a compound that can down PS.

- We would be able to significantly reduce the amount of PS in landfills, as well as facilitate its recycling.

Competition

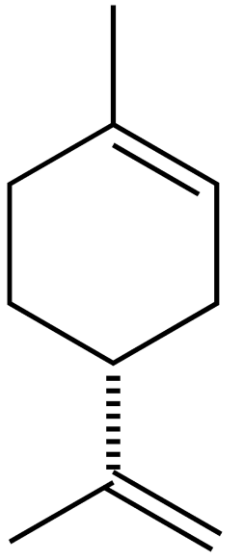
- Landfills are being treated with bacteria and fungi to break down other trash
- Biodegradable plastics
- Most plastics are high in energy and can be burned
- PS can be melted and reused: when PS is put in a vacuum, heated, and fed to a certain bacteria, the result is a new biodegradable plastic material

Polystyrene (PS)

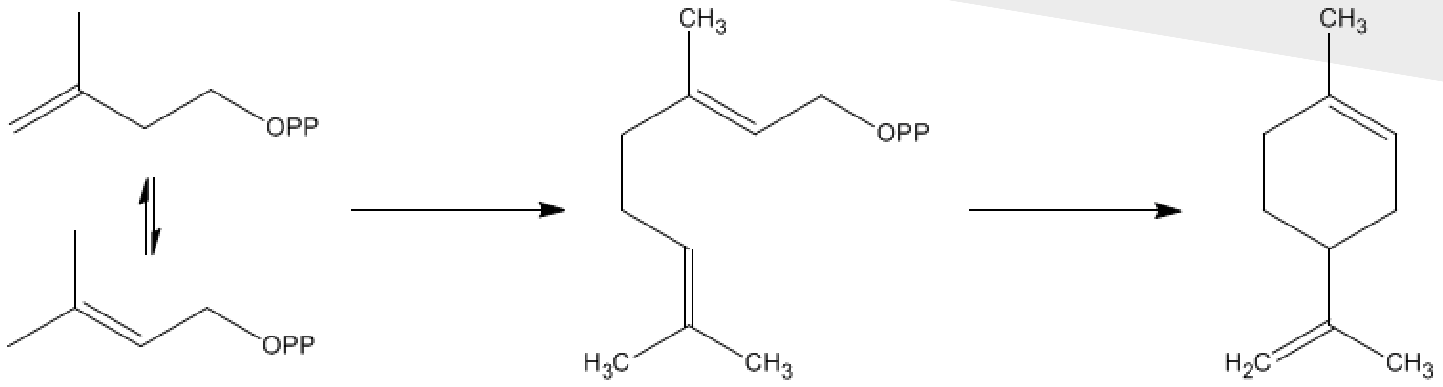


Knowns

- PS is recyclable, but the nature of most PS products makes it inefficient to collect them for recycling.
- PS converts into an easily transportable and recyclable gel when exposed to D-limonene, a molecule found in citrus fruits.



Knowns

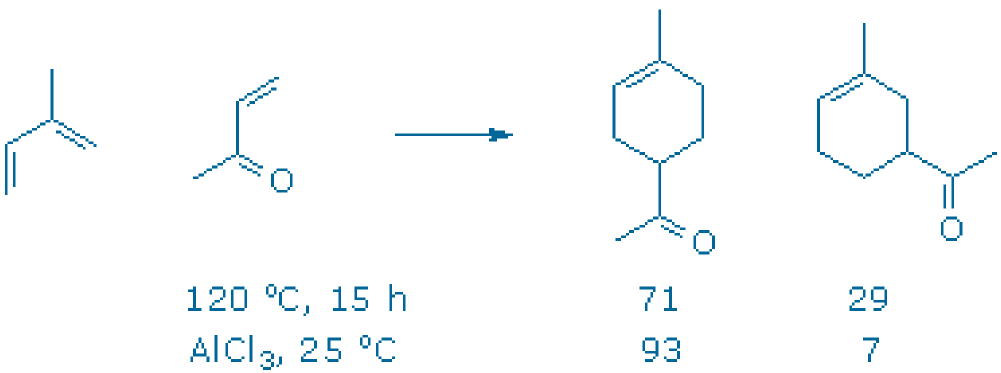


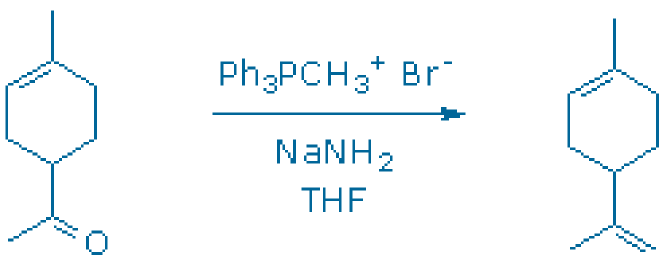
- Natural limonene synthesis pathway in citrus fruit

- The original compound (IPP) can be synthesized from Acetyl Co-A, a central molecule in the Krebs cycle

- Problem: 2012 iGem Wisconsin team tried this pathway to synthesize limonene in E.Coli and failed.

Knowns





- Chemical synthesis of limonene
- Starting reactant, isoprene, can be produced by certain strains of bacteria (*Bacillus*)
- Problem: this requires high temperature

Unknowns

- What are the possible side effects of limonene and the recycled gel plastic ?
- What other potentially negative effects could the bacteria producing the limonene have?
- What would the efficiency of the bacteria be? This is especially important as the 2012 iGem team produced a limonene yield of 0%.

Break It Down References

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Dust-Free References

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Poly-B-Gone References

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Acknowledgement

Thank you Ryan and Kristine!

Any questions?