ONR S&T

MOLECULAR BIOMIMETICS PROGRAM

Biomaterials, Bioprocesses and Biosensors Thrust

Dr. Harold J. Bright

Molecular Biomimetics

Current Science Portfolio

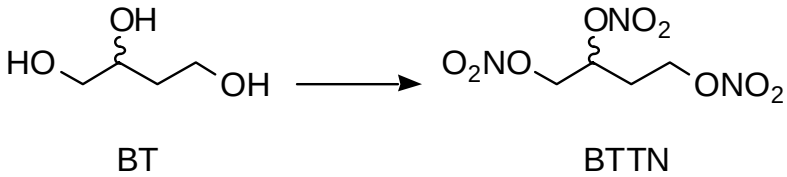
- Stochastic (digital) sensing
- Classification of CW agents
- Next-generation antibiotics
- Biofuel cells – molecular and microbial
- Green synthesis of energetic materials

MEWG

Green Synthesis of Navy/MC Energetic Compounds: Butanetriol (BT) as a Case Study

Current MEWG Project (ONR + NSF) *(J. Frost, Michigan State U.)*

BTTN:



BT BTTN

- made from BT
- used in propellants, explosives (15K lb/yr)
- better than nitroglycerin (NG, >5M lb/yr)
- hasn't replaced NG because BT is ~ $40/lb owing to dirty BT synthesis

Engineer Cost-Effective Microbial BT Synthesis

- no metals, organics, salt streams
- no high temperatures or pressures
- single, engineered microbe
- renewable biofeedstocks (CO_2 ➔ sugars)

Bottom Line:

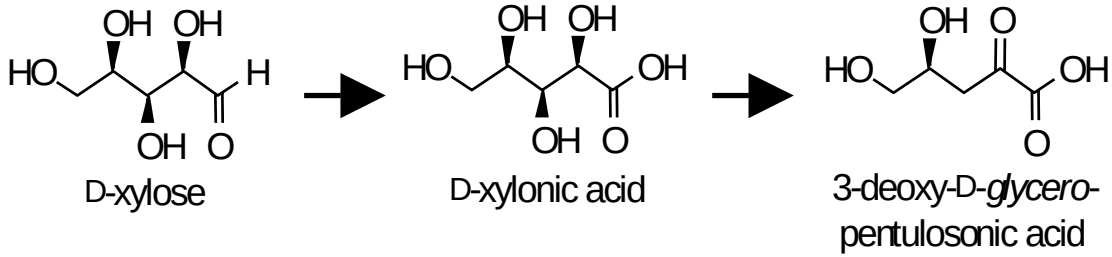
- microbial synthesis of BT at ≤ $10/lb that meets military specs

Green Synthesis of Energetic Compounds: Butanetriol as a Case Study

(J. Frost, Michigan State U.)

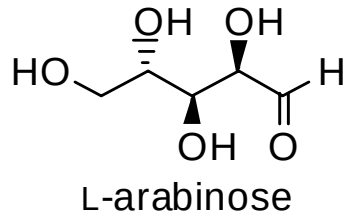
Engineer a microbial, cost-effective, synthesis of BT from plentiful/renewable carbon feedstocks.

postulate



enzymes catalyzing reactions on native substrates

enzymes catalyzing reactions on non-native substrates (**Evolution Required!**)



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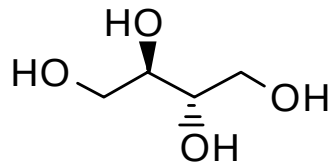


will also be used as feedstocks

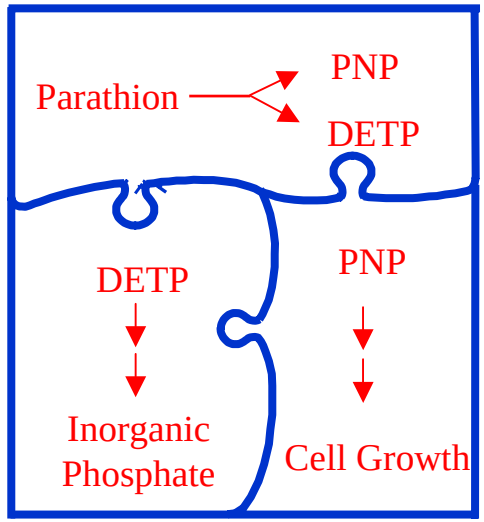
Metabolic Engineering of Environmental Microorganisms for Degradation of Nerve Agents

Completed MEWG Project (ONR + NSF)

(J. Keasling, UC Berkeley)

Objective:

- to metabolically engineer an organism able to completely degrade organophosphates



Approach:

- find/clone a gene for enzyme that degrades diethylphosphate
- clone/express pathway for complete degradation of *p*-nitrophenol phosphate
- clone/express phosphotriesterase that hydrolyzes parathion
- combine all genes in single organism for complete degradation of paraoxon or parathion.

Accomplishments:

- characterized enzyme that degrades diethylphosphate (and cloned the gene)
- developed a co-culture biofilm that degrades parathion
- combined all genes in a single organism for complete degradation of paraoxon

Transitions:

- anticipated that this engineered organism will serve as a prototypical organism for nerve agent degradation