Bioremediation Study

Santa Susana Field Laboratory Area IV
Energy Technology Engineering Center

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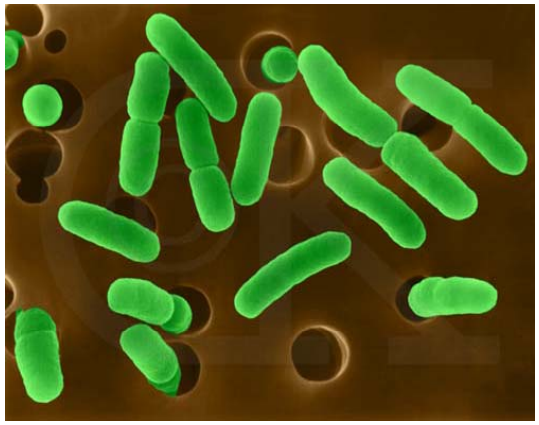
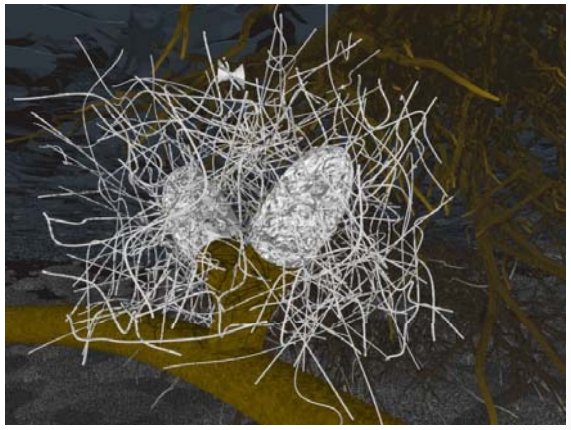
Soil Bacteria and Fungi Biodegrade Contaminants

- Site-specific subsurface conditions determine biodegradability and rate of biodegradation
  - Nutrient availability, oxygen availability, contaminant concentrations, microbial population, pH, etc.



http://www.woodrow.org/teachers/help/temp_presentations/kim/bioremediation.htm



http://www.scivit.de/blog/?p=97

Project Goals:

- Establish a baseline of contaminant biodegradation rates in the field
- Determine which methods could effectively increase biodegradation rates
- Determine which soils in Area IV could be left in place to biodegrade

1. Establish Natural Attenuation Baseline:

- Identify bacteria and fungi at the site capable of degrading contaminants of concern: PAH, TPH, PCB, dioxins, mercury

- Determine contaminant biodegradation rates in laboratory treatability studies without amendments.

2. Investigate *potential* methods to increase biodegradation rates:

- Biostimulation
  - Soil aeration
  - Nutrient fertilization
- Surfactants to increase bioavailability
- Bioaugmentation (add foreign microorganisms)

Research Plan – Part 1: Field Studies and literature review: Identify contaminant-degrading microbial communities in Area IV soils

1. Collect soil samples from Area IV and culture microbes on plates with contaminants
   - DNA sequencing of isolated organisms
     - Bacteria: 16S rDNA
     - Fungi: ITS rDNA
2. Identify hard-to-cultivate microorganisms with molecular biological tools
   - Extract DNA from soils and amplify with polymerase chain reaction
   - ID with terminal fragment length polymorphism
3. Literature review of organisms identified

Research Plan- Part 2: Laboratory Treatability Tests: Soil Microcosms

- Collect soil cores from Area IV
- Incubate in microcosms
- Baseline microcosms: Match field conditions
- Test potential of methods to accelerate biodegradation:
  - Add nutrients (biostimulation)
  - Add surfactant (increase bioavailability)
  - Add microorganisms (bioaugmentation)

Soil Microcosms: Methods

- 500 g contaminated soil (homogenized contaminant concentrations)
- 4-L glass jars
- Teflon-lined lids
- 15% soil moisture content
- 5 replicate microcosms for each condition tested
- Sterile controls: to differentiate between biotic and abiotic transformations

http://www.loftfield.de/gas/kosmen2.jpg

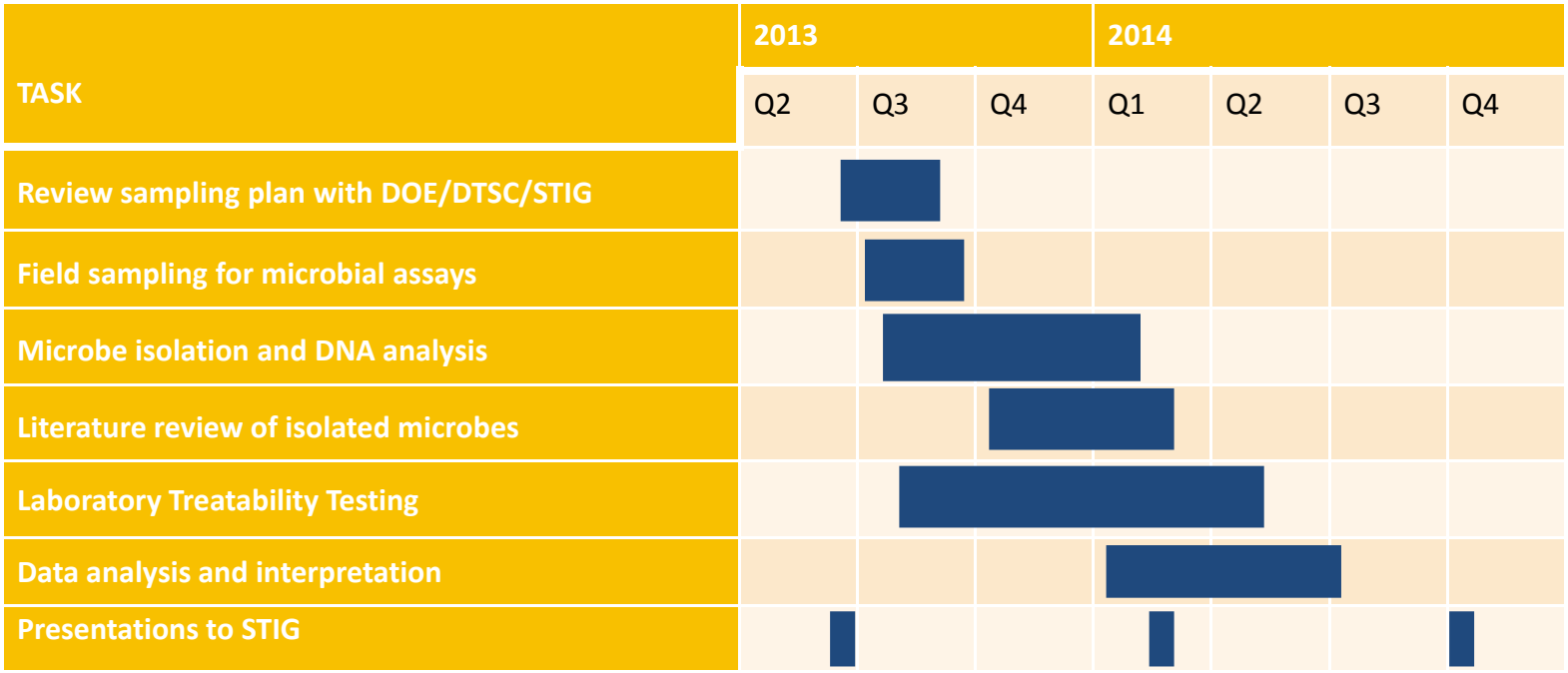
Soil Microcosms: Data Collection and Analysis

- Collect 25-g composite samples
  - 0, 6, 12 months after incubation
- Data analysis in California state-certified laboratory
  - Quality Control procedures:
    - Blind duplicates
    - Blanks
    - Contaminant-spiked soils

Expected Outcomes

- Estimate for natural biodegradation rates in the field
- Knowledge of the benefits of acceleration methods
  - Nutrients
  - Surfactants
  - Bioaugmentation
- Estimate potential for accelerated biodegradation rates in the field
- Identification of soils at Area IV which may be amenable to bioremediation without hauling from the site.

Project Timeline



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Questions?