Life Detection

Biohazard Group 1

Biohazard Group 2

Group 1

- important considerations
  - what is most likely route of exposure
  - store aliquots

- hazards
  - toxic
  - mutagen, teratogen, recombinogen
  - life cycle Δ's
  - phenotype changes
  - transmissible

- model criteria
  - sensitive + meaningful
  - robust
  - well documented
  - economic/ecological importance
  - model for a probable danger
  - suitable for MRF/contained environment
  - fast enough

Models

small/cellular

yeast - S. cerevisiae w/ sensitivi

human -

commensal bacteria

extreme environment bacteria

algi

mouse/egg

fish/egg

neurospora

arabidopsis/rice

C. elegans

fly

organisms

- arabidopsis/rice
- zebrafish
- bird eggs
- mouse

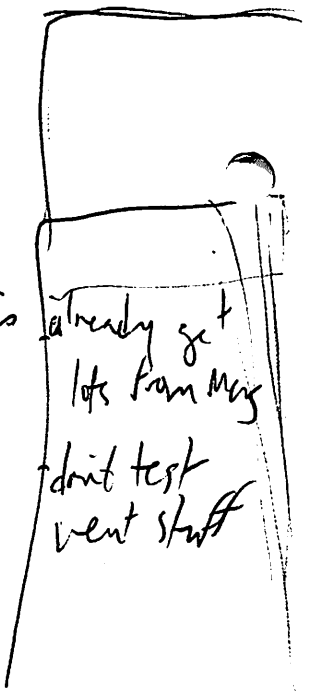
R+D

So. Is - no organics
a PPB

1 cell 10^{-12} g

already get lots from Mag

don't test vent stuff



CAN WE FIGURE OUT IF SOMETHING IS A PROKARYOTIC DOMAIN.

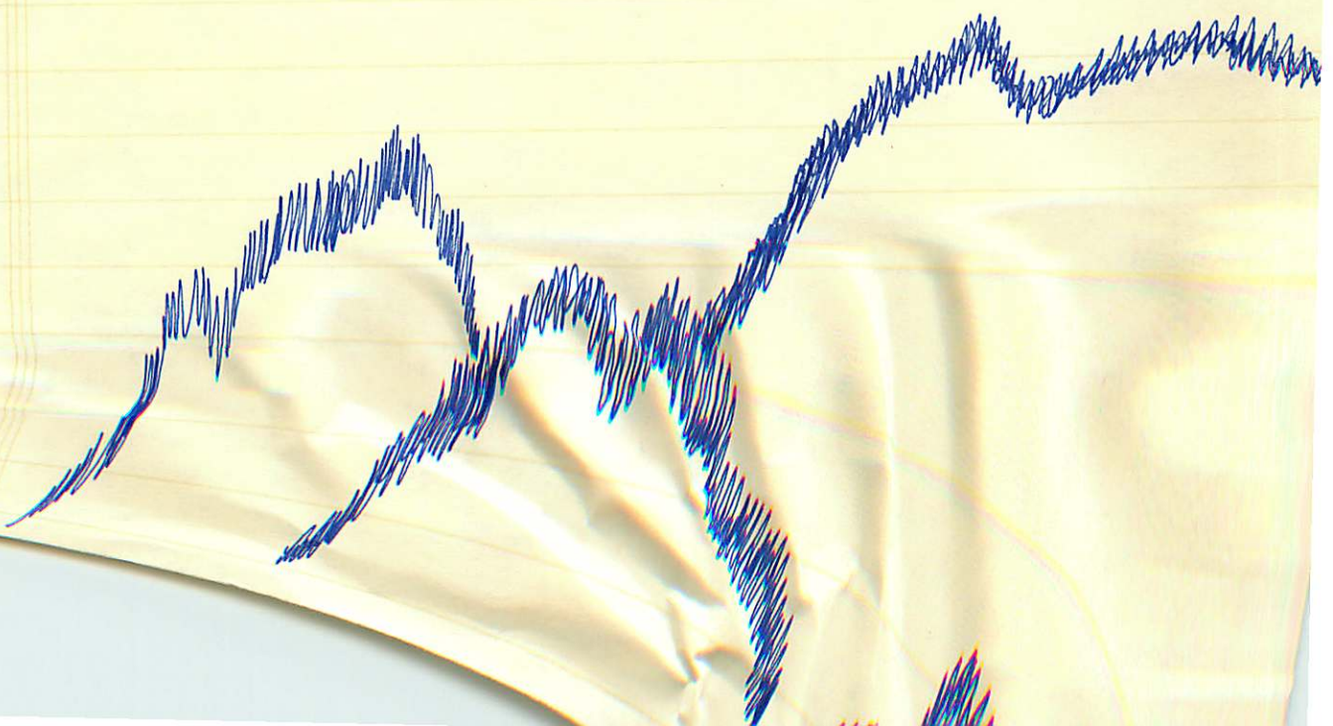
Molecular Tests

1) primary samples from returned materials
   a) assess terrestrial contamination
   b) martian life

- extraction of DNA
- culturing
- PCR → clone + sequence
  - universal primers
  - species specific primers
  - random
- mass spec
- HPLC
- electrophoresis

2) biological materials exposed to martian samples

- Mutagenesis
  - reversions assay
  - ames test
  -



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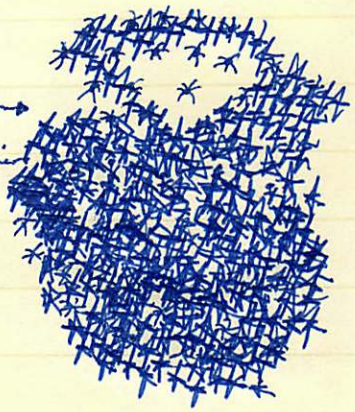

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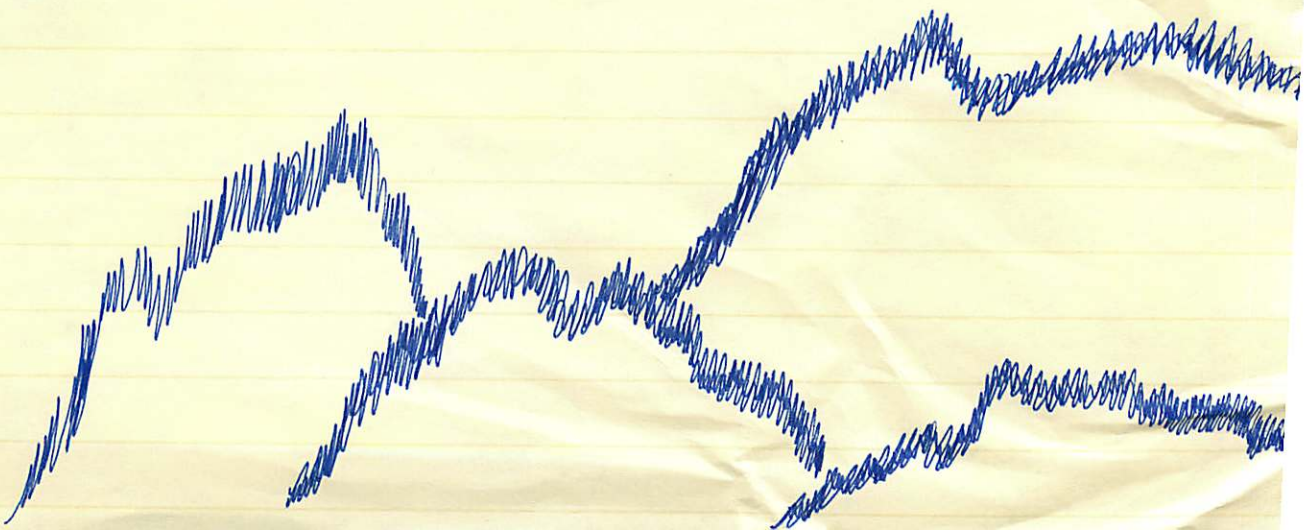


MARS SAMPLE HANDLING PROTOCOL WORKSHOP SERIES

WORKSHOP #2 AGENDA

(10/16/00 DRAFT)

Day 1 (Wednesday, October 25th)

noon	LUNCH (also, Sub-group Chairs meet with Rummel et al.)
1:00 p.m.	Plenary (Intros and tutorials – 2 hours, max)
	* Mars program status
	* Workshop #2 process (Organization and Objectives)
	* Workshop #1 recap
	* NRC life detection recap
	* COMPLEX Mars sample return report (if available)
	* Introduction to Strawman Protocol
3:30	Establish three Sub-groups to deal with key questions from framework:
	* Life detection translation
	* Biohazard testing group 1
	* Biohazard testing group 2
6:30	WELCOME RECEPTION

Day 2 (Thursday, October 26th)

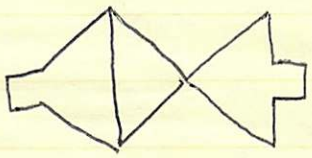
7:30 a.m.	BREAKFAST
8:00	Day 1 Sub-groups caucus individually (until noon)
noon	LUNCH
1:00 p.m.	Plenary – Day 1 Sub-group reports (1/2 hour each)
2.30	Discussion of Day 1 Sub-group reports
5:30	Establish three new Sub-groups
	* Physical and chemical test sequencing
	* Molecular tests
	* Organism-based tests (cellular & microbial; plant; animal)
6:00	ADJOURN

Day 3 (Friday, October 27th)

7:30 a.m.	BREAKFAST
8:00	Day 2 Sub-groups caucus individually (until noon)
noon	LUNCH
1:00 p.m.	Plenary – Day 2 Sub-group reports (1/2 hour each)
2:30	Synthesis and discussion (assignment of final writing assignments)
5:00	ADJOURN

MARS SAMPLE HANDLING PROTOCOL WORKSHOP

NASA WORKSHOP #2



Greg Kovacs - Stanford

Scientific Issues

to what extent prebiotic chemical evolution?
replicating system capable of Darwinian evolution?
life on mars today? from earth or mars?

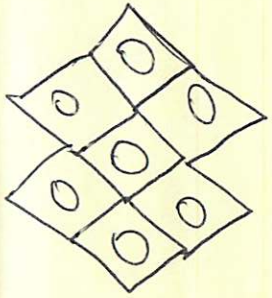
Biohazard / Bioeffect?

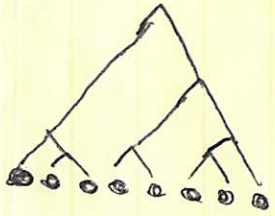
Why think possible on mars?
- channels suggest H_2O
- volcanism / energy
- H_2O vapor in atmosphere

Surface experiments

MARS MISSIONS?

2003 - Lander / Air bag x2
2003 - Orbiter
2005 - Orbiter - Major
2007
2007 - Lander / Rover
2009 - Sample return (back 2011)





500g

↓

if 1 bug

↓

24 hr doubling

↓

1, 2, 4, 8, 16, 32 64 128

2^n n = # days

① amt of starting sample

② growth rate

③ single organism vs ecosystem

500 g

sample division

TYPES/LEVELS OF ASSAYS

- WHOLE ORGANISMS
- CELL-BASED ASSAYS
- MUTAGENESIS
- ECOSYSTEMS
- ENVIRONMENT

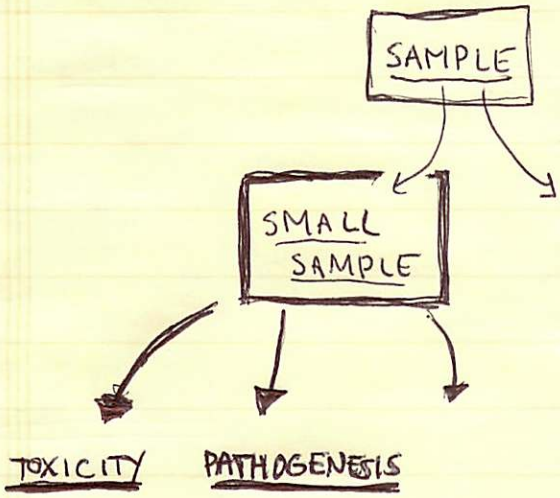
- what range of growth rates could we detect
- what known biohazards could we detect
- what if it is a hazard as a community

- long term effects

- controls — how know toxicity vs. food

REPLICATIVE BIOHAZARD VS. NON-REPLICATIVE

PASSAGING/USING EXPERIMENTS OVER



is it sealed?

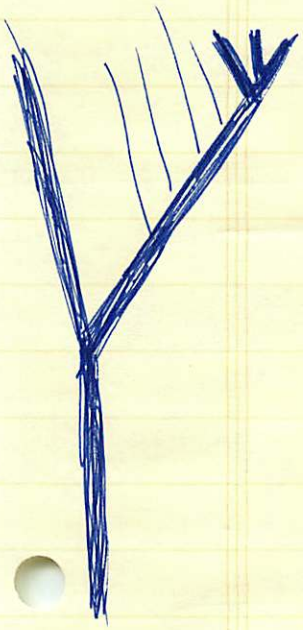
1g rock or soil

1 → At best 1×10^3 cfu/g

Earth soil 1g

2.5×10^6 cfu/g
4.2×10^{10} cells/g

1mg soil = 2×10^3 cfu
1g soil = 2×10^6 cfu



organic matter = 9.7% of dry weight

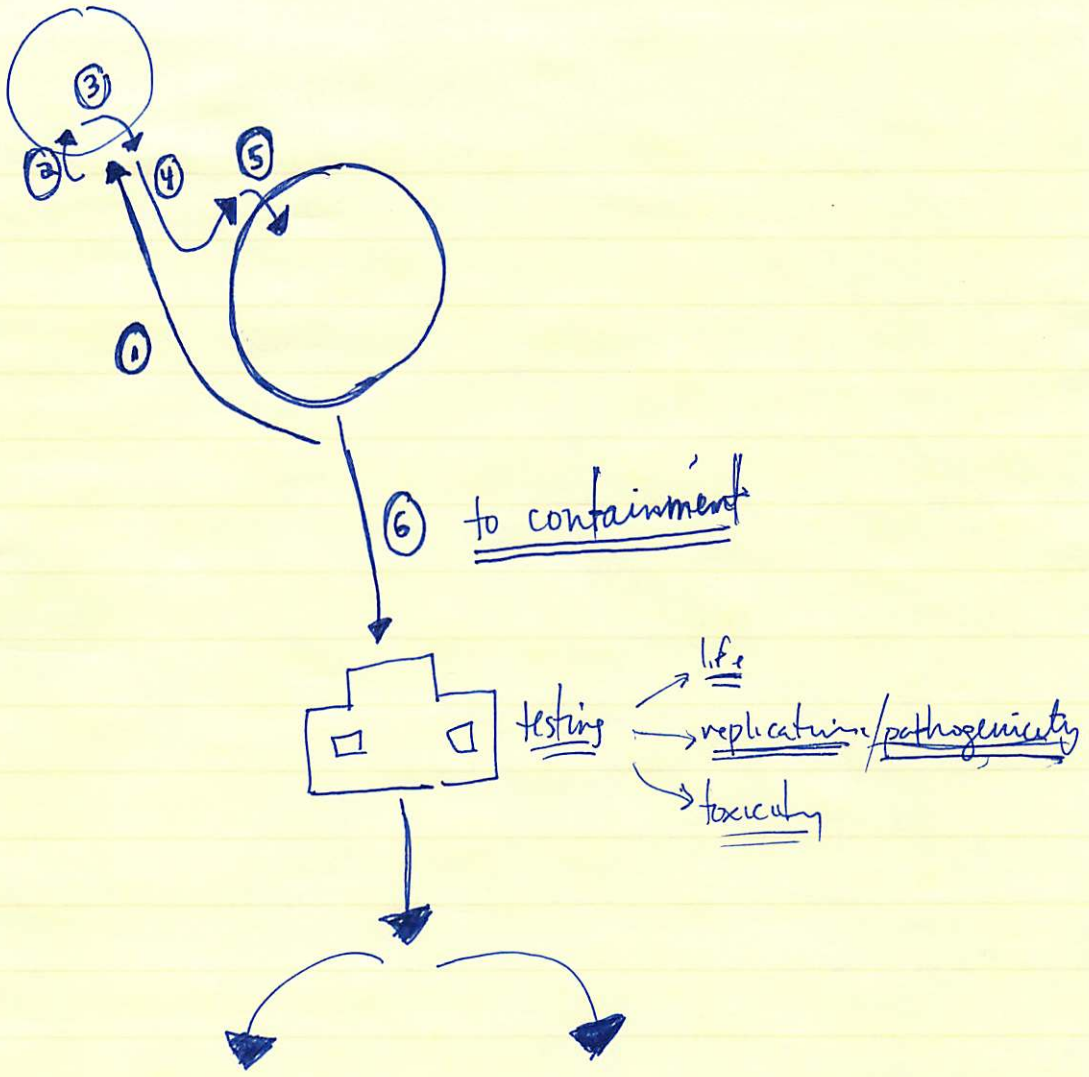
①
② sample size
③ current methods

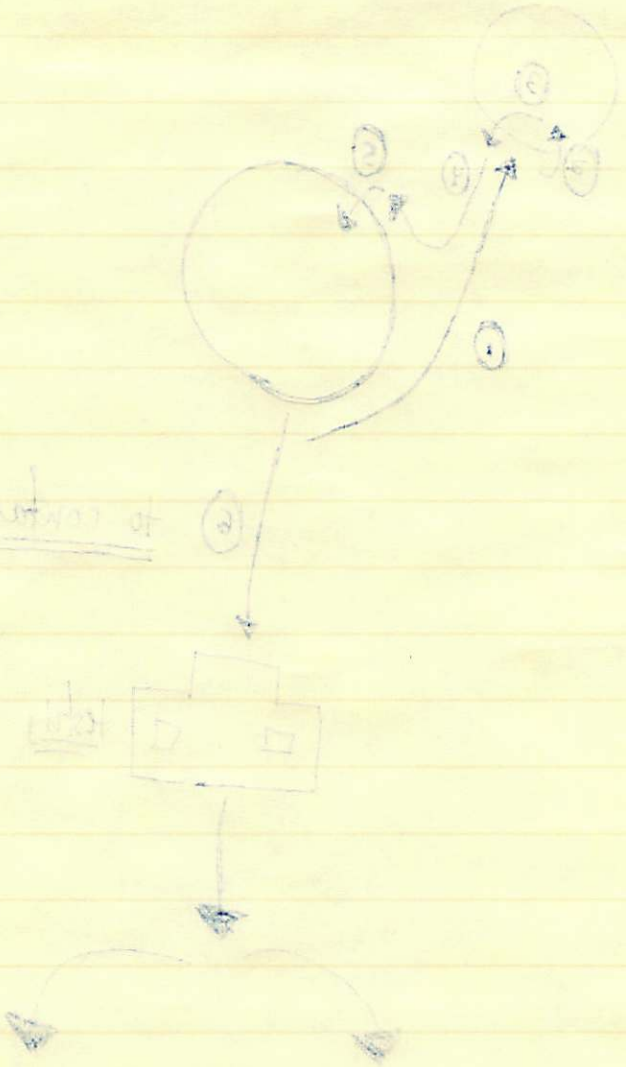
WHAT PHYLA?

- Humans + human commensals
- - Human
- -
- -
- Evolutionary diversity
  - Eukaryote ← mammals, plants, fungi
  - Bacteria
  - Archaea
  - Virus

Ecological diversity
- Aerobes
- Photosynthetic
- Anaerobes

How get microbes out of rock


3
2
4
5
1
6 to containment
testing
life
replicating/pathogenicity
toxicity



FUTURE RESEARCH

- SEALING SAMPLES
- ENZYME E(x) ON TERRESTRIAL SAMPLES
- FILTERING & LOOKING AT ICE

MOLECULAR

HOW PROCESS MARS SAMPLES?

- what if spores?

Bello Mondo

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AMERICAN GRILLE

Marriott