

Colorado Space Science Teachers Summit



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Today's agenda

- What is SETI, the SETI Institute and Astrobiology, Resource Materials
- Education Programs at the SETI Institute
- Planetary Evolution Activities
- Peer presentations
- Concept Mapping Assignment
- Origin Homework

Learning Goals

- Enhance understanding of astrobiology as a discipline and as a NASA endeavor.
- Enhance understanding of VTT
- Activity Learning Goals
- Enhance understanding of Concept Mapping

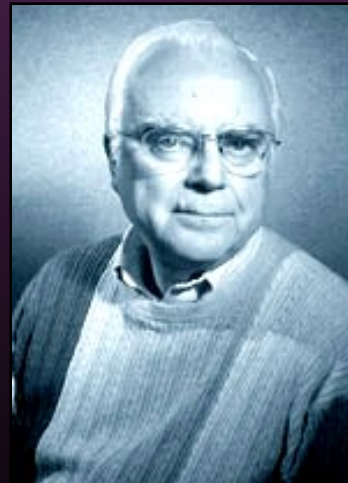
SETI — Are We Alone?



- **SETI** is the **S**earch for **E**xtra-**T**errestrial **I**ntelligence
- SETI Institute is a private non-profit organization conducting scientific research and education surrounding the question of life in the universe.

SETI Turned 48 in 2008!

- First proposed in an article on radio astronomy in 1959 by Morrison & Cocconi
- First search conducted in 1960 by Dr. Frank Drake



Are we alone?

Drake Equation — How many intelligent (technological) civilizations are there likely to be in the galaxy?



$$N = R_* f_p n_e f_l f_i f_c L$$

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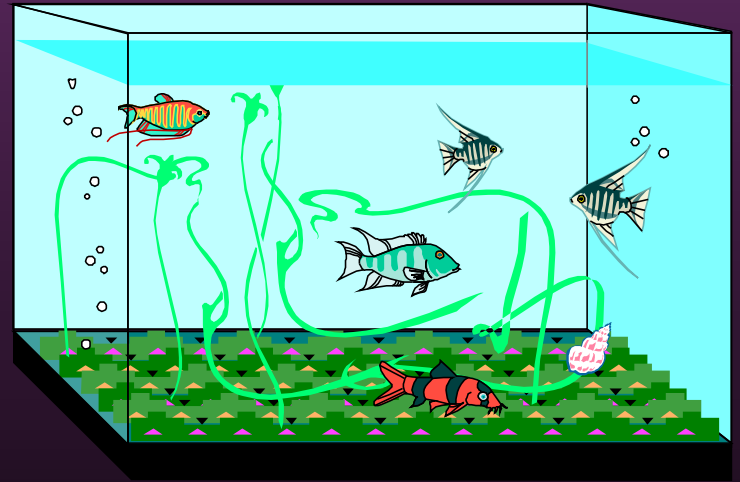
R_* = rate of star formation

f_p = stars with planets

$$N = R_* f_p n_e f_l f_i f_c L$$



n_e = Earth-like worlds

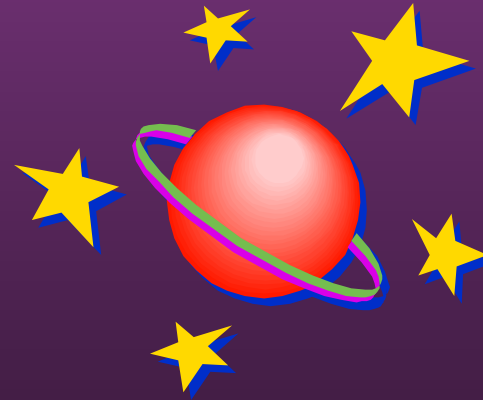


f_l = life arises

$$N = R_* f_p n_e f_l f_i f_c L$$

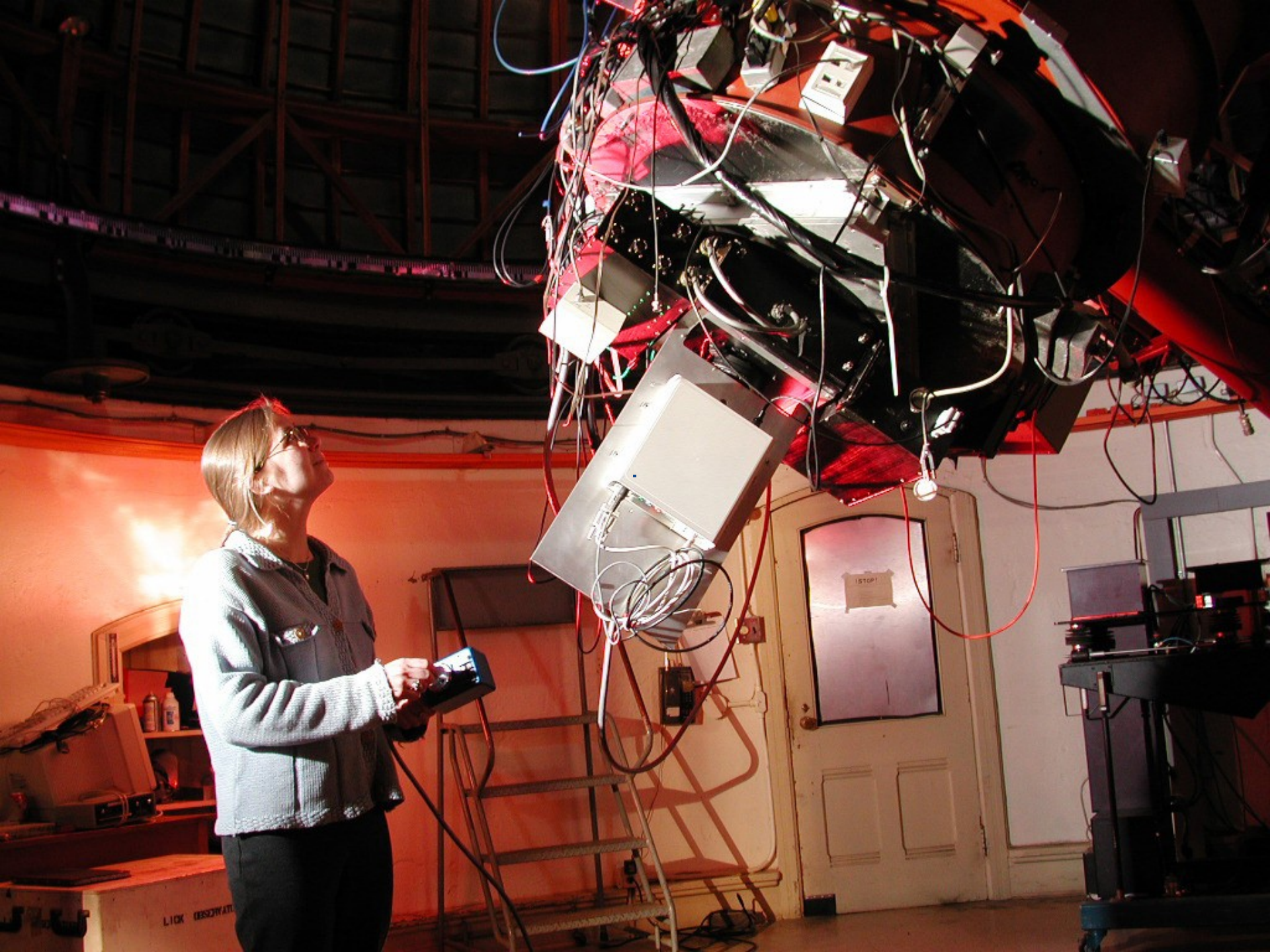


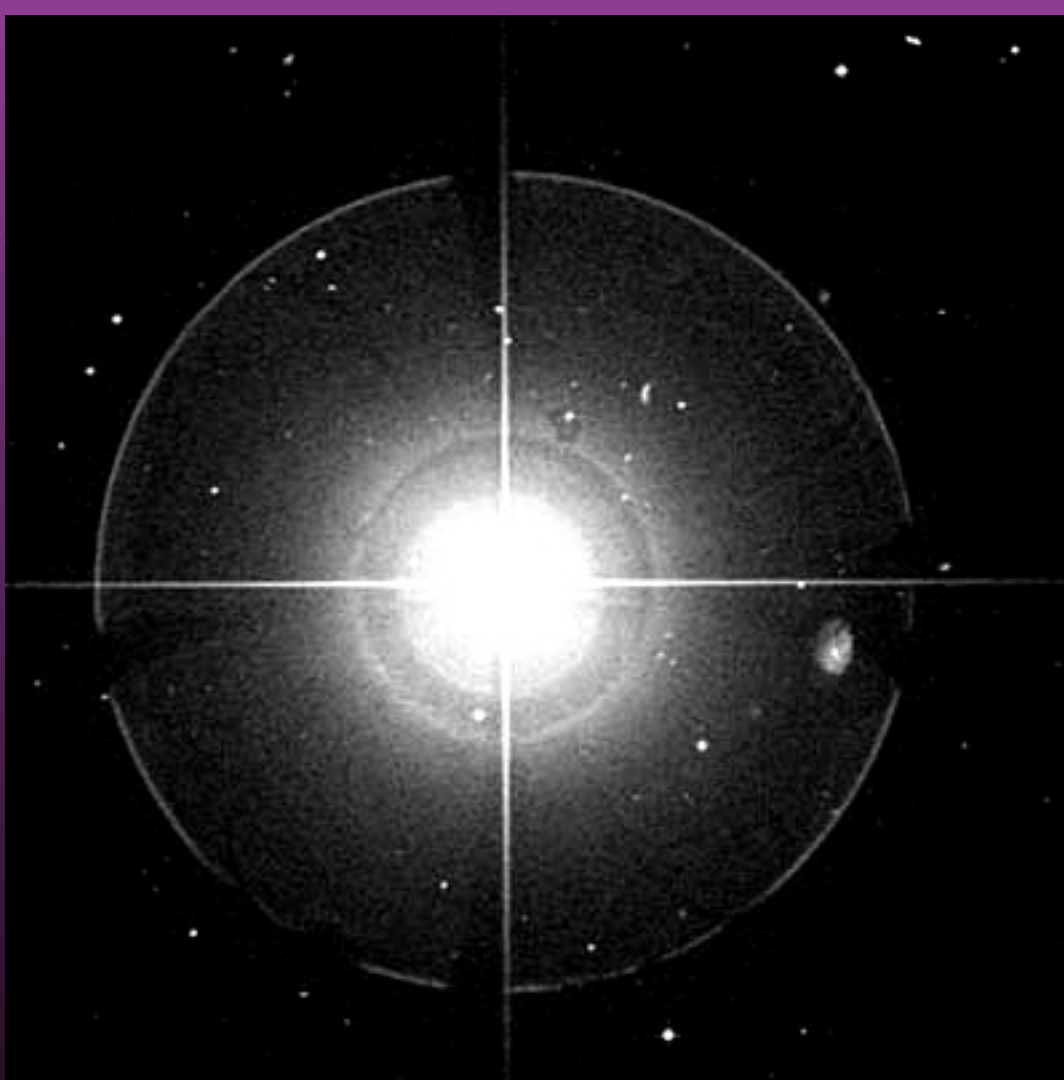
f_i = life is intelligent



f_c = civilization develops detectable technology₉







G-type star: 4×10^{26} watts
 $= 10^{45}$ photons/sec

At 100 light-years, that's
billion photons/sec in a
 1 m^2 telescope mirror

In a nanosecond, that's 0.1
photons/second

Powerful Laser at same
distance 1 photon / second
in a mirror.



MCSA complex amplitude

subband 2744 frame 192

4 dB

left 1 Hz

RF 2291 730002.9 Hz

mean pwr = 26302.679688

MCSA superband

SDS 10 MHz

File

MCSA band

SDS 50 kHz

Redraw

MCSA complex

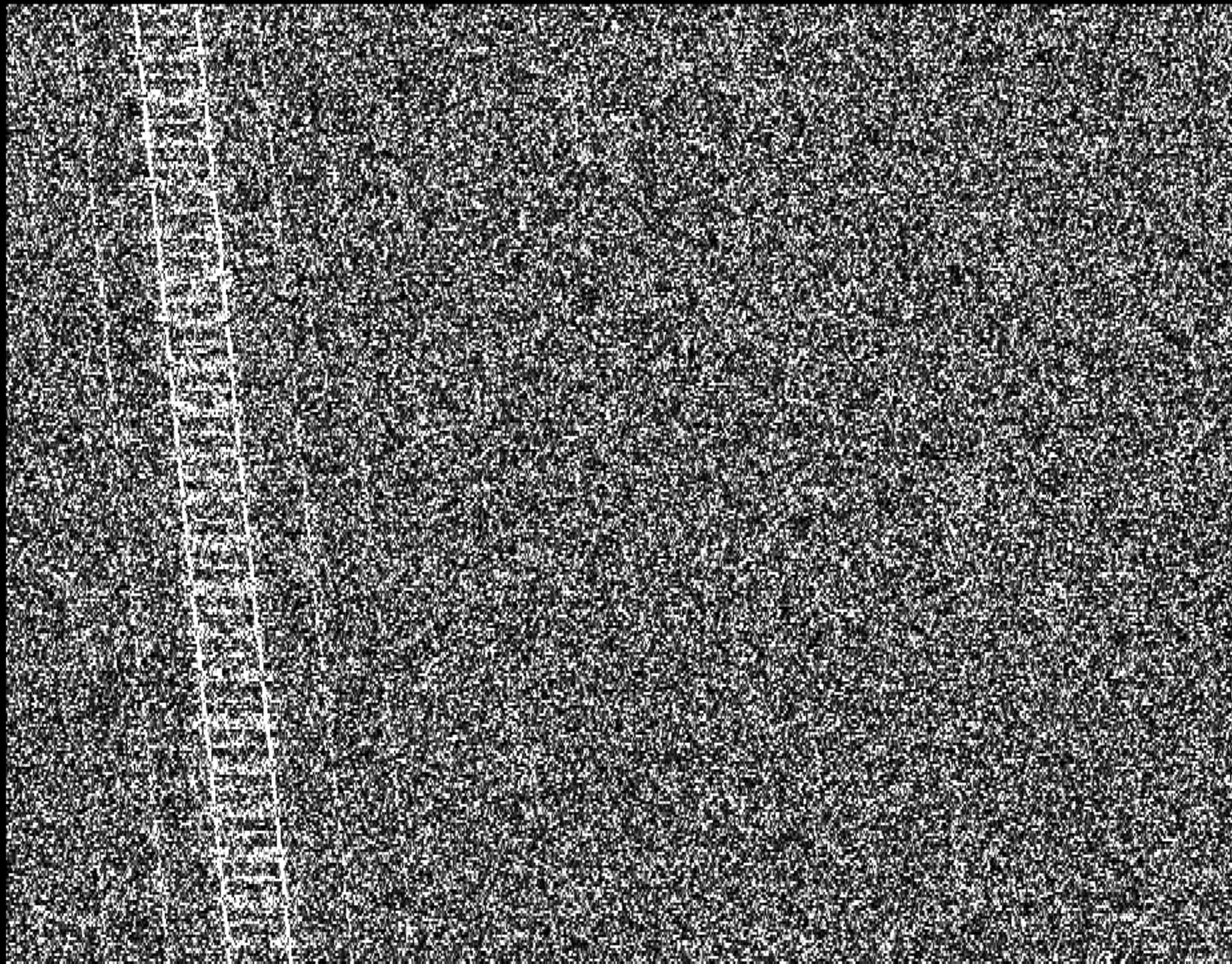
SDS 250 Hz

Print

MCSA waterfall

MCSA all subs

Quit



SETI Searches

- ATA – SETI Institute and UC Berkeley, a targeted star search
- Project Phoenix – completed at Arecibo
- Optical, O-SETI
- All Sky Surveys: Project SERENDIP - SETI@home, UC Berkeley, U of Western Sydney, Italy, formerly Argentina and Harvard
- SETI League - amateur radio astronomers

SETI — Project Phoenix ATA, SKA



NASA
NSF
USGS



Carl Sagan Center

Astrobiology in the Carl Sagan Center

- Interdisciplinary research practice in factors of the Drake Equation
- Over arching questions
 - What is life?
 - Where is life?
 - How do we look for life?
 - How can we learn more about it?
- Search for life in the universe
- Bioastronomy in Europe
- Evolution here, there, everywhere

NASA Astrobiology Institute

- NAI is virtual institute, no brick and mortar
- 16 teams with 5 year grants at 16 locations
- Interdisciplinary teams
 - SETI Institute
 - U of CO

NAI Roadmap

- <http://astrobiology.nasa.gov/roadmap/>
- How does life begin and evolve
- Does life exist elsewhere in the universe
- What is the future of life on Earth and beyond?

NAI Roadmap Goals 1-2

- **Goal 1 - Understand the nature and distribution of habitable environments in the Universe.**
- **Goal 2 – Determine any past or present habitable environments, prebiotic chemistry and signs of life elsewhere in our Solar System.**

NAI Roadmap Goals 3 - 5

- **Goal 3 - Understand how life emerges from cosmic and planetary precursors.**
- **Goal 4 - Understand how life on Earth and its planetary environment have co-evolved through geological time.**
- **Goal 5 - Understand the evolutionary mechanisms and environmental limits of life.**

NAI Road Map Goals 6 - 7

- **Goal 6: Understand the principles that will shape the future of life, both on Earth and beyond.**
- **Goal 7: Determine how to recognize signatures of life on other worlds and on early Earth.**

NAI Web resources

- Life on Earthand Elsewhere? Educator Resource Guide (Gr 5 -8) PDF (ERG)
- “Ask an Astrobiologist”
- Workshops, other resources
- **<http://astrobiology.nasa.gov/nai/>**

ERG

- 1. What is Life? Chemical System that undergoes Darwinian Evolution, reproducing perpetuating variation in offspring.
- 2. What does life require?
Water, Nutrients, Energy: Sun, Chem, Stored.
- 3. What makes a world habitable?
- 4. What can life tolerate?
- 5. Is there life on other worlds? Drake Eq

SETI Institute Education Programs

- Astrobiology Curriculum Development and Teacher Professional Development
- NASA Kepler Education and Public Outreach Search for Earth – size extra solar planets – [**http://kepler.nasa.gov/**](http://kepler.nasa.gov/)
- NASA SOFIA Education & Public Outreach
[**http://www.sofia.usra.edu/**](http://www.sofia.usra.edu/)

Kepler Mission

- Transit Method of Detecting Extrasolar Planets
- Launches in Feb 2009 (IYA)
- Visit For Teachers on Website for Activities
- Mission Ops here at LASP
 - Send commands to Spacecraft
 - Receive data downloads

Voyages Through Time

- Astrobiology Curriculum Grade 9 – 12
 - Cosmic
 - Planetary
 - Origin of Life
 - Evolution of Life
 - Hominid Evolution
 - Evolution of Technology

VTT

- Standards Based
- Inquiry Based – examining evidence
- Nature of Science
- Science for All Americans
- <http://www.project2061.org/default.htm>



Cosmic Evolution

Overview

Intro, What's in the Sky, Cosmic Distances, Origin of the Universe, Formation of Galaxies, Evolution of Stars, Closing

- What is Gravity? Inquiry based using simulation

Planetary Evolution

- Module overview
 - Intro
 - Planets Take Shape
 - Surface Changes
 - Oceans and Atmospheres
 - Living Earth
 - Closing

VTT Navigation

- Buttons on left
- Buttons across top
- Buttons across bottom of Media pages used when teaching in the classroom

More information? Sample lessons?



Make contact —
<http://www.seti.org>
pharman@seti.org

Planetary Evolution

P 2.2 : Density and Differentiation

Day One

Day Two

P 2.3 : Radioactivity

P 5.3: Habitable Worlds

marked the homework on Teacher copy

TAK for homework, ask PH

Group Roles

- Everyone completes SAS
 - Materials Handling
 - Image handling (hard copy or from CD, Videos from CD)
 - Homework Assignment summary
 - Teacher copy TAKs as necessary
 - Recorder for peer presentation
 - Reporter for peer presentation

Everyone completes SAS

Materials Handling

Image handling (hard copy or from CD,
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Homework Assignment summary

Teacher copy TAKs as necessary

Recorder for peer presentation

Reporter for peer presentation

Learning Goal(s)

Prior Knowledge

Misconceptions

Previous Activity

Following Activity

Atlas insights

Highlight the activity

Teacher and learner view points

Peer Presentations

1:30 pm

- Learning Goal(s)
- Prior Knowledge
- Misconceptions
- Previous Activity
- Following Activity
- Atlas insights
- Highlight the activity
- Teacher and learner view points

Workshop Bonus

- Habitable Worlds Extension at
<http://www.voyagesthroughtime.org/>

Planetary Evolution

Sample Activity

Extension

Complete Activity

Organism Cards

Students consider what different organisms need to survive on a planet.

Concept Mapping

- Pre and Post concept map for each module
- Scoring methods provided
- Pre-assessment for teachers
- Metacognitive activity for students

Homework

- Evaluation your concept map Share
 - Highlight or circle what you have learned in the last 2 days
 - Or Design one for your classroom
- Origin of Life Background Science
- Origin Detailed Lesson Plan by Group
 - Group 4 O 2.1
 - Group 3 O 3.3
 - Groups 1 and 2 O 4.2

Playground sand??

- Borrow a VTT module & reader?