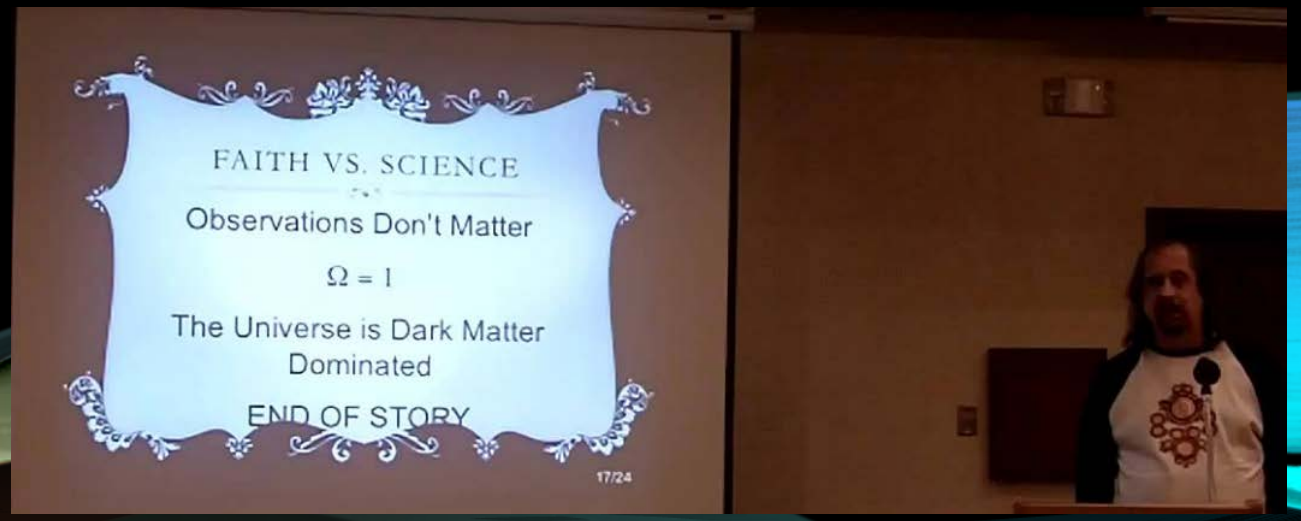
# EMERGENCY KEYNOTE STAND IN GUY WITH STUFF

G. Bothun, University of Oregon

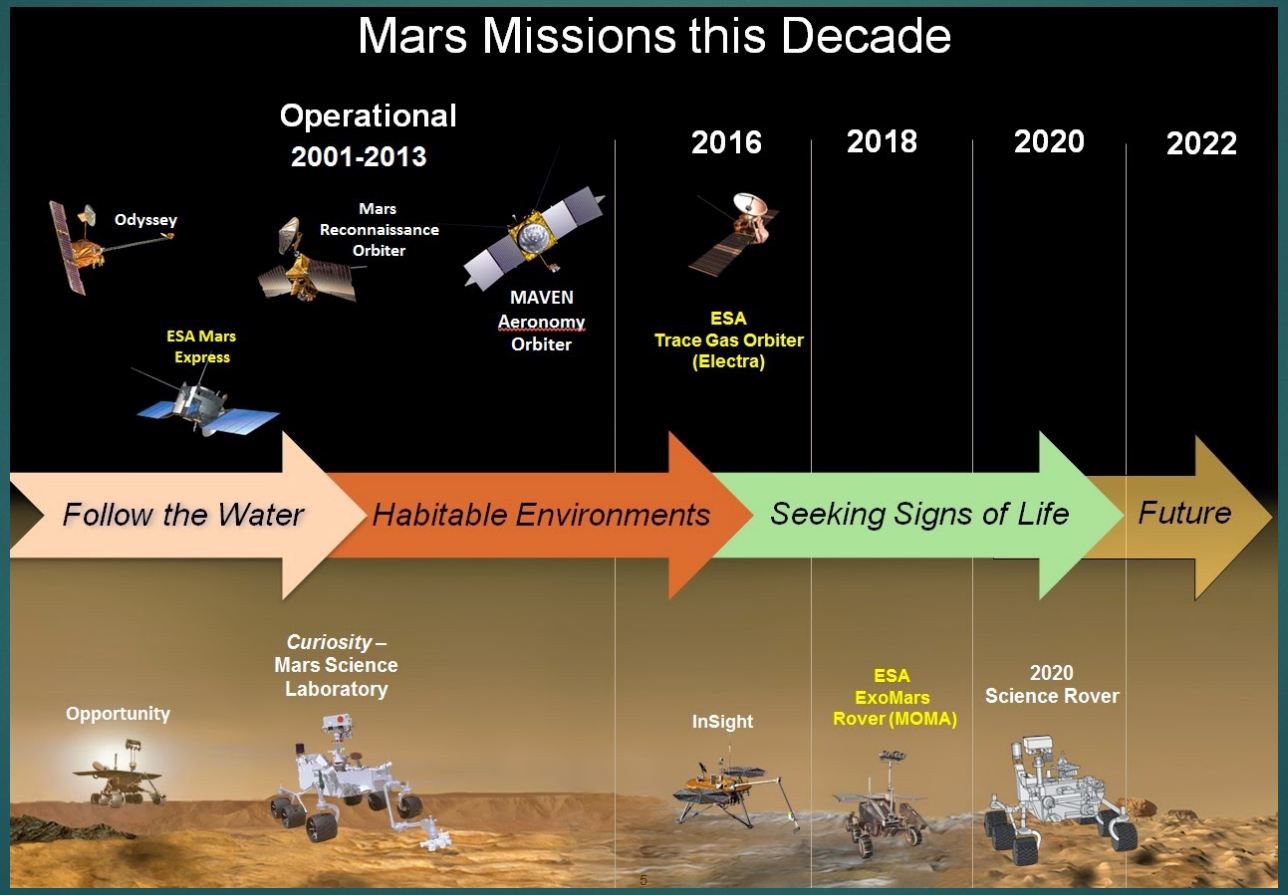


# BASIC OUTLINE OF STUFF

- New Nasa missions and new Big Data
- It's a New World now but still constrained by the old
- Science Literacy and Outreach – the need for a new perspective and approach

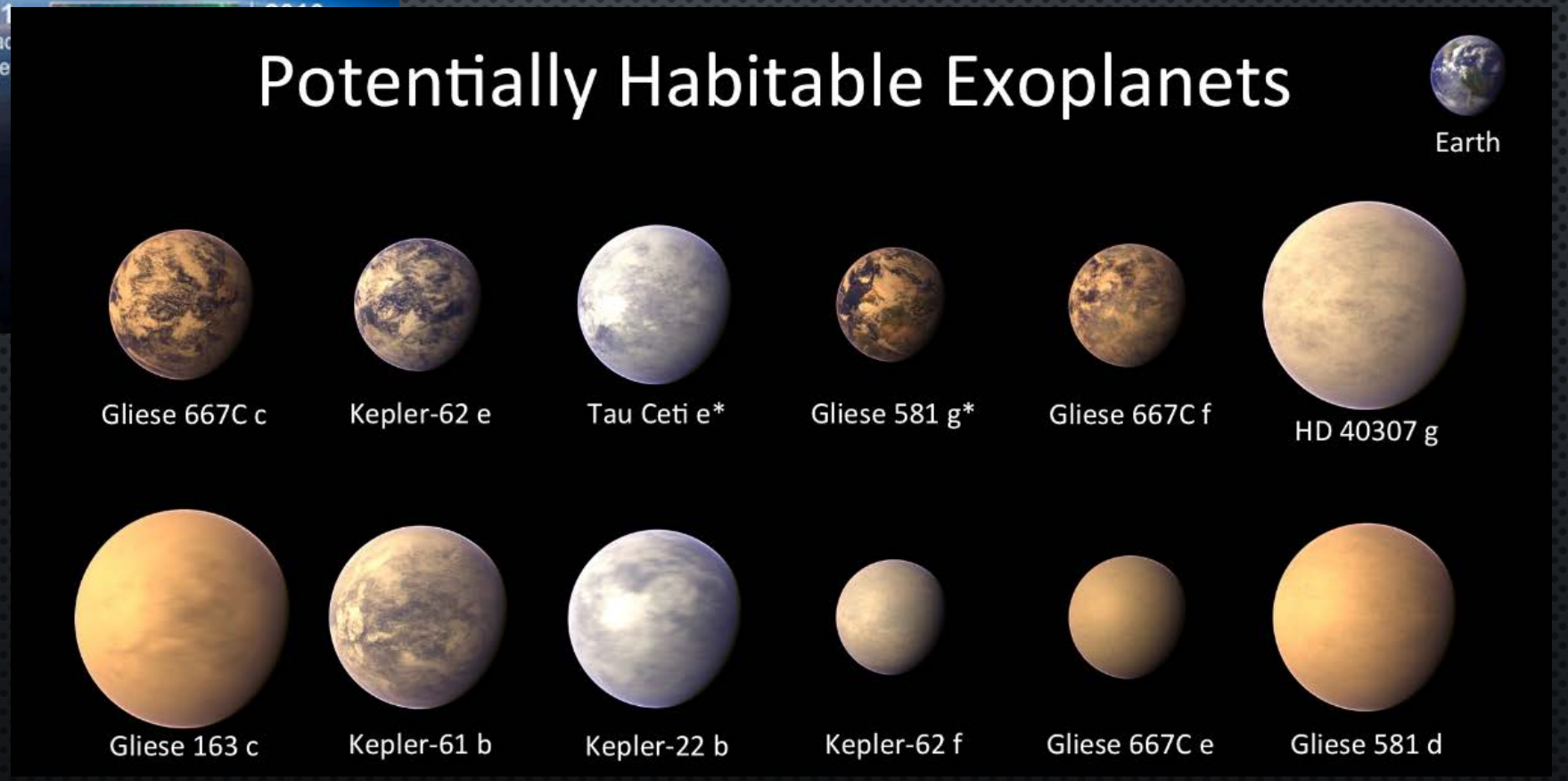
# Missions to Earth are becoming important

# There is a good story here about exploration and instrumentation

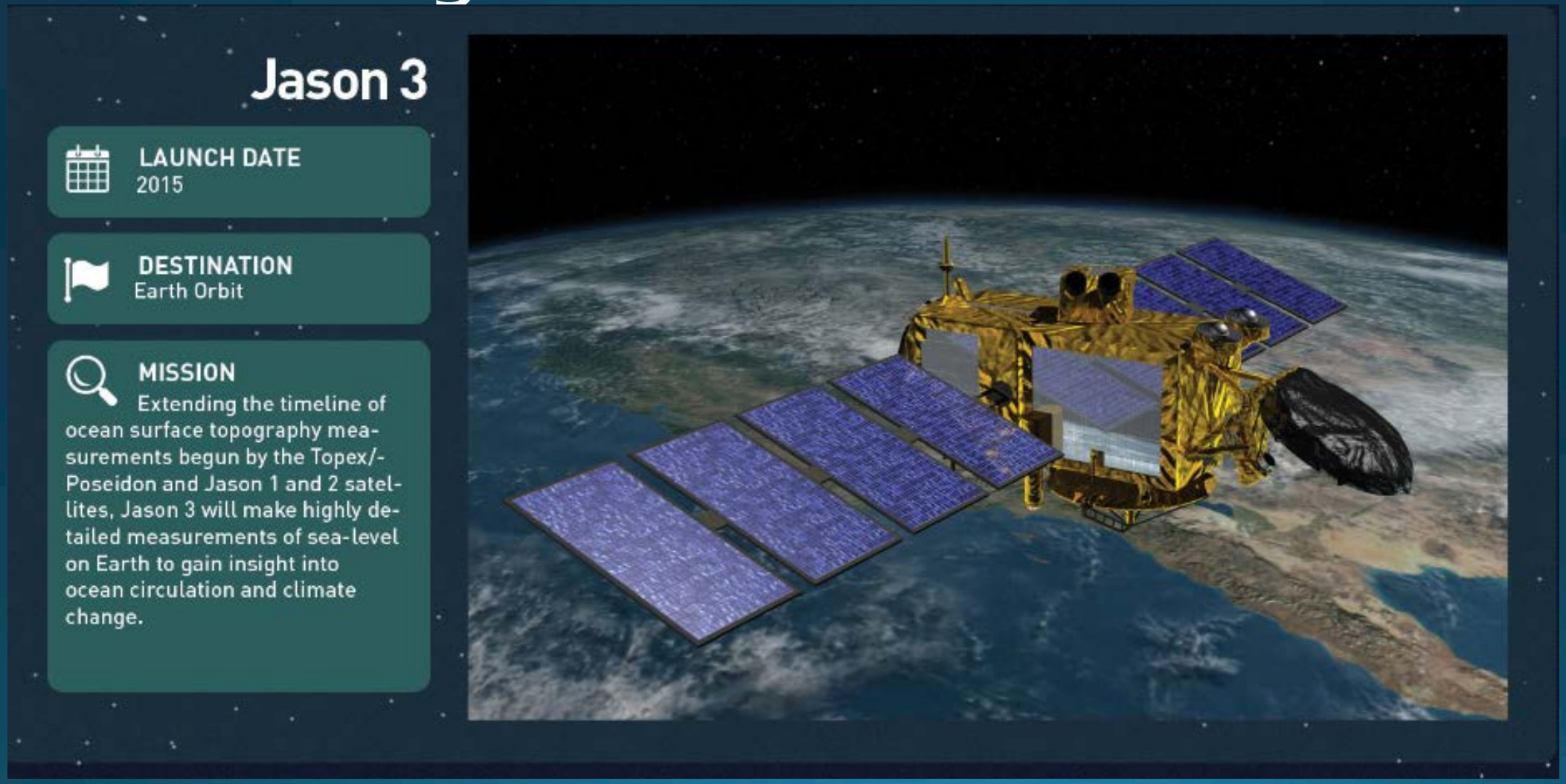



The Story of Life may indeed be Universal (as scientifically expected)

LITERACY TEST

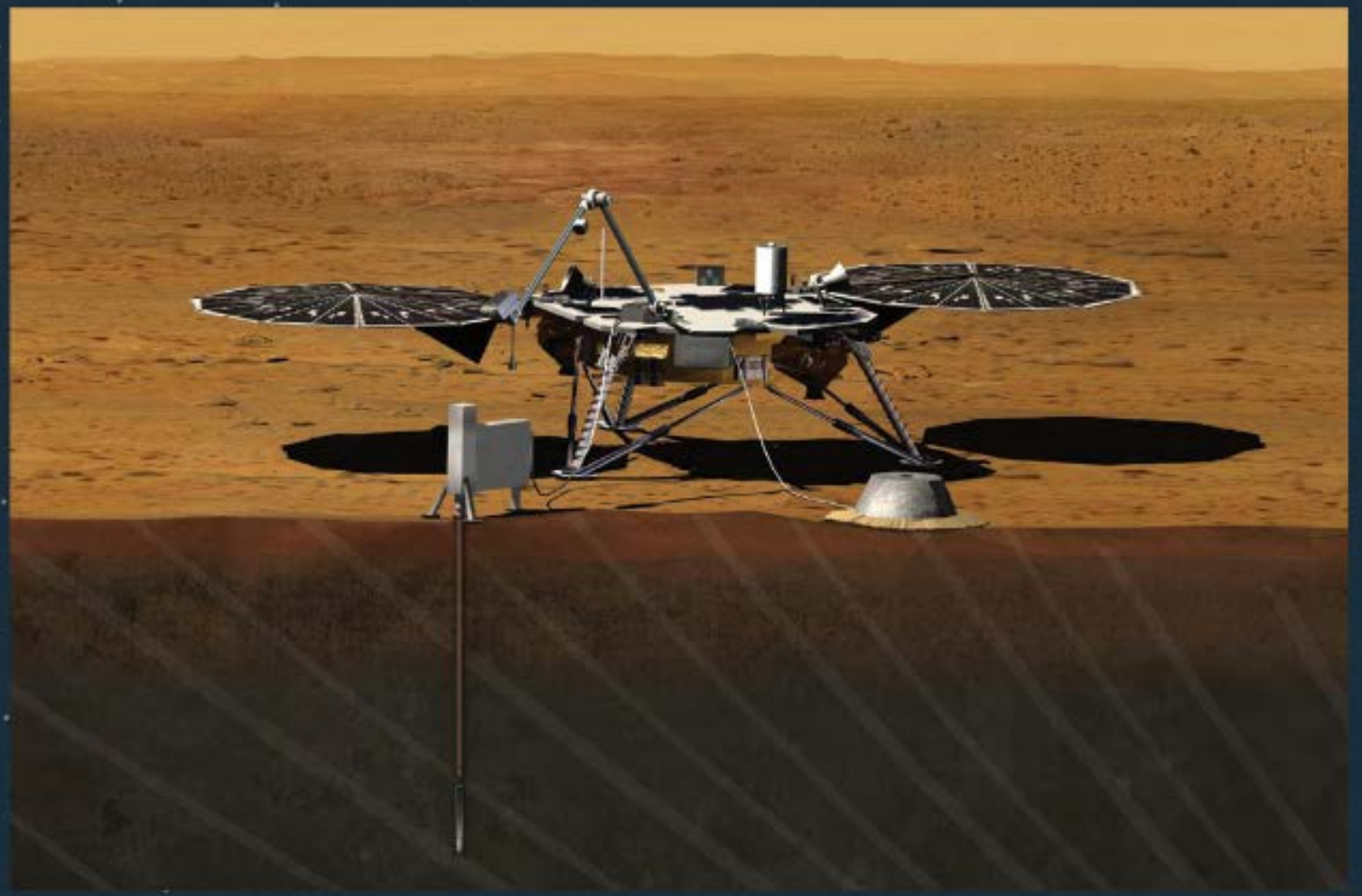


# Actual Launch was Jan 17, 2016 – data now starting to come in



# Expected Launch June 2017 – instruments still being calibrated

# Now suspended to May 2018



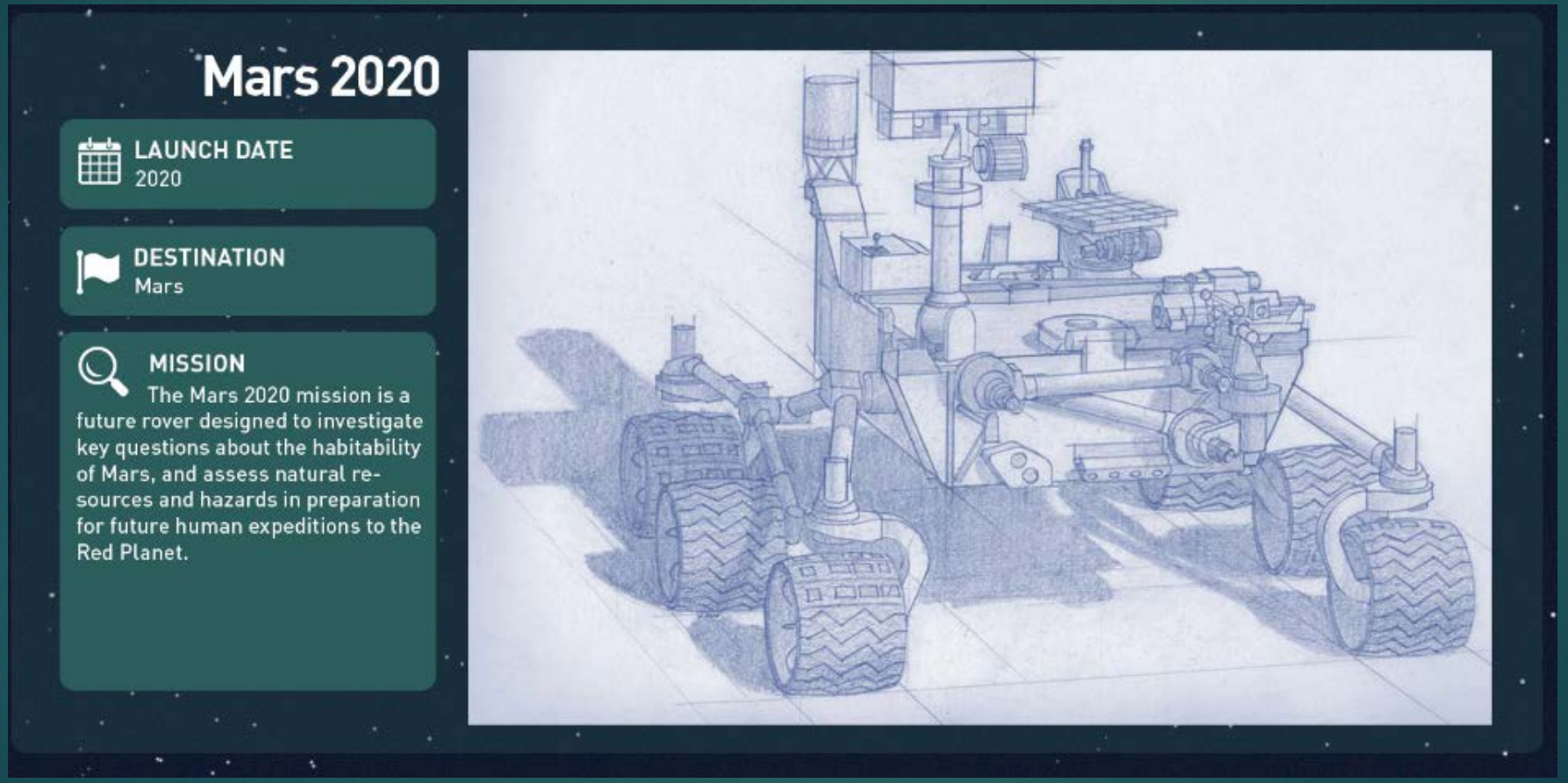
## InSight

**LAUNCH DATE**
March 2016

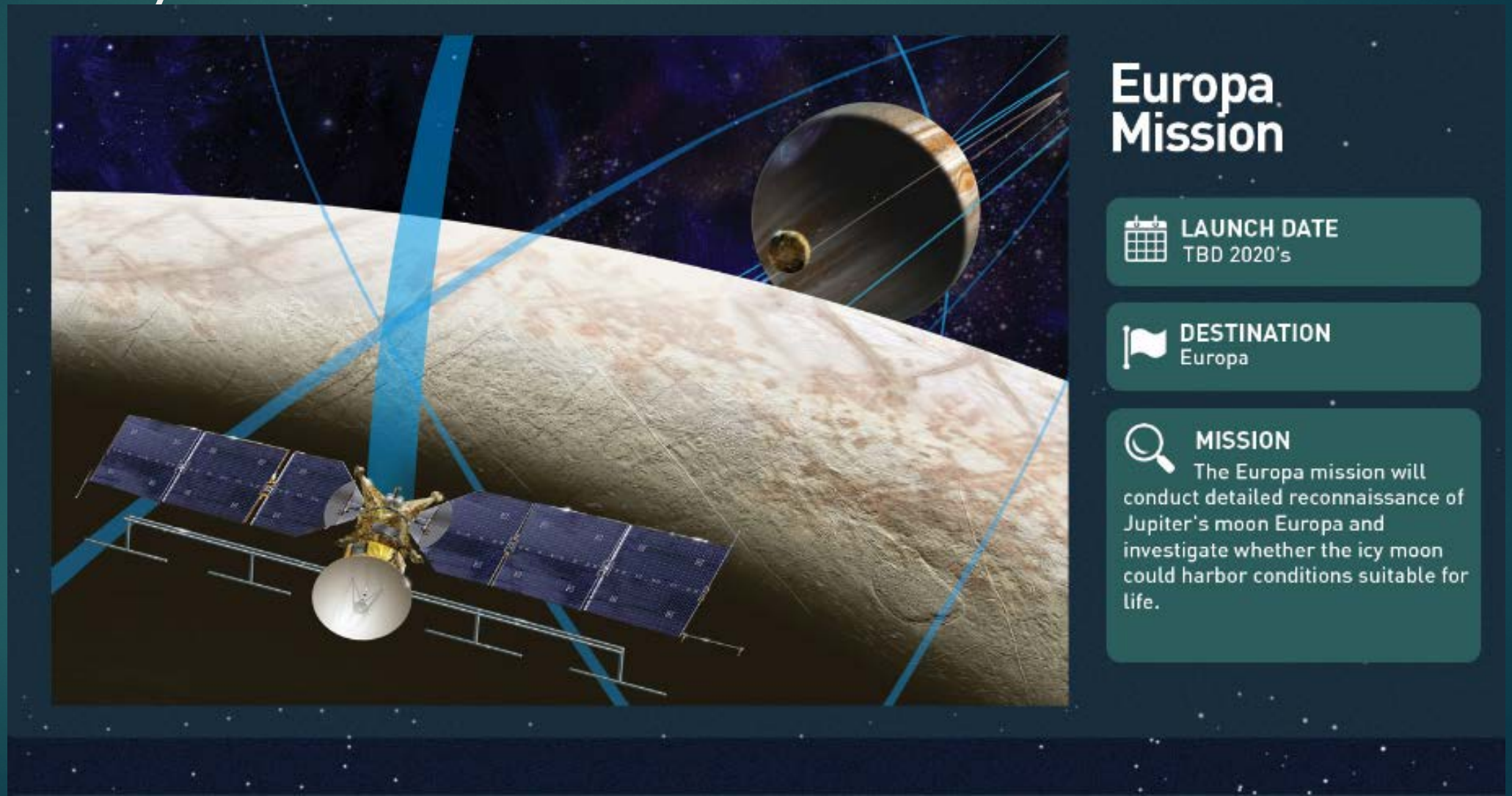
**DESTINATION**
Mars

**MISSION**
The InSight mission (formerly called GEMS), will place a lander on Mars designed to drill beneath the surface and investigate the planet's deep interior to better understand Mars' evolution as a rocky planet. As part of its investigation, InSight will use a seismometer and a heat-flow probe to study the interior structure of the Red Planet.

# Timeline will likely be pushed back a couple more years



# Part of the Discovery of Life Pathway



# Earth Monitoring Mission

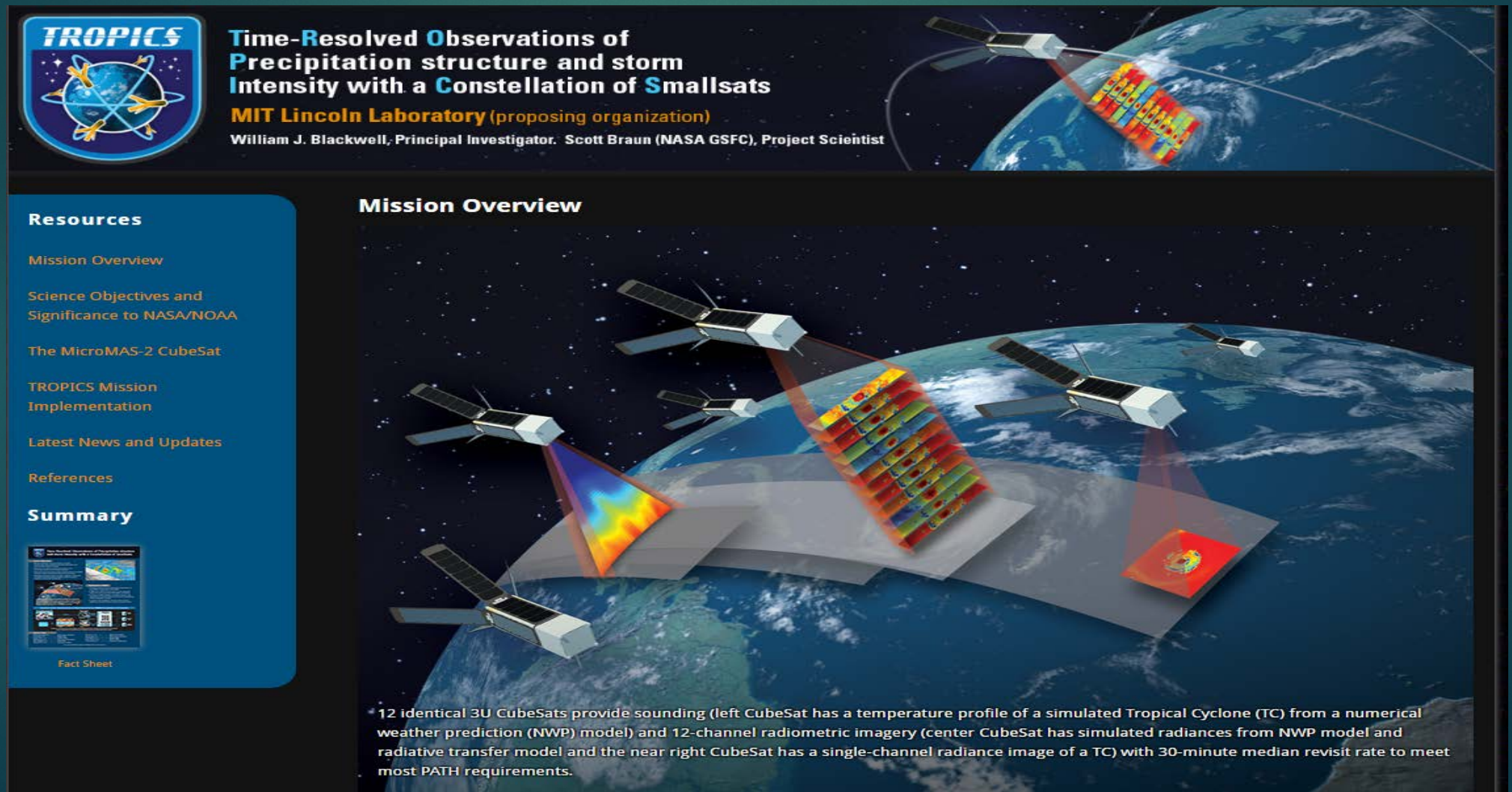
## Orbiting Carbon Observatory 3 (OCO-3)

**LAUNCH DATE**
TBD

**DESTINATION**
Earth Orbit

**MISSION**
The Orbiting Carbon Observatory 3, or OCO-3, is a future space instrument designed to investigate important questions about the distribution of carbon dioxide on Earth as it relates to growing urban populations and changing patterns of fossil fuel combustion.

# CubeSat Array - key to understanding hurricane evolution



# Launch for sure – also key to understanding tropical storm evolution – can take data similar to scale of simulations

## CYGNSS Mission

### NASA's Weather Prediction Project

The Cyclone Global Navigation Satellite System (CYGNSS) aims to improve extreme weather prediction.

CYGNSS will use a constellation of eight small satellites carried to orbit on a single launch vehicle. In orbit, CYGNSS's eight micro-satellite observatories will receive both direct and reflected signals from Global Positioning System (GPS) satellites. The direct signals pinpoint CYGNSS observatory positions, while the reflected signals respond to ocean surface roughness, from which wind speed is retrieved.

The mission will study the relationship between ocean surface properties, moist atmospheric thermodynamics, radiation and convective dynamics to determine how a tropical cyclone forms and whether or not it will strengthen, and if so by how much. This will advance forecasting and tracking methods.

### Count Down to CYGNSS Launch

| 52 | 15 | 35 | 45 |
|---|---|---|---|
| DAYS | HOURS | MINUTES | SECONDS |

November 21, 2016

Launch Window Open at 06:00 EST on 21 Nov 2016

### CYGNSS Team

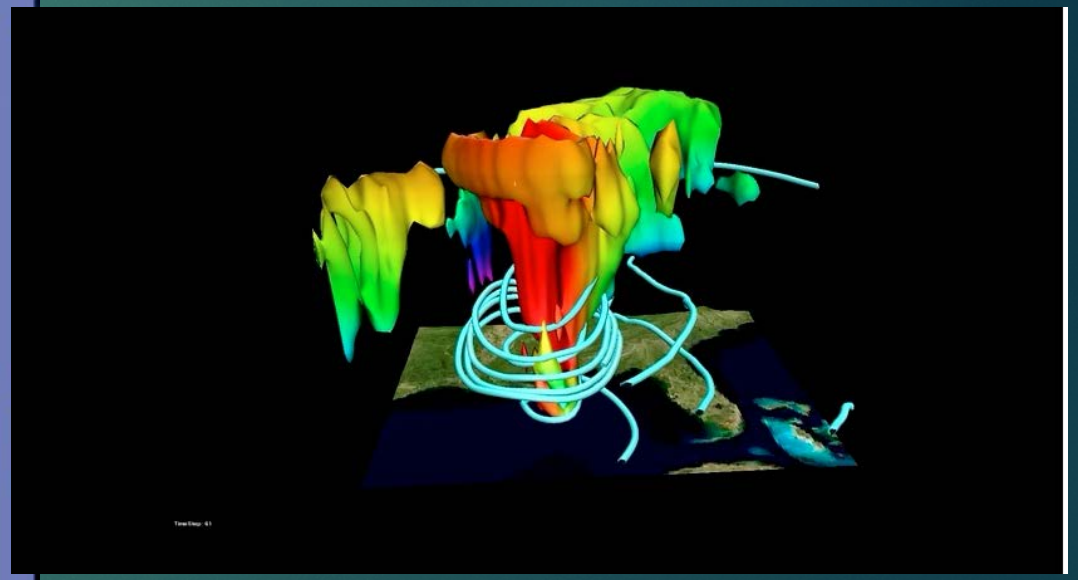
**University of Michigan Department of Atmospheric, Oceanic & Space Sciences**
Principal Investigator: C. Ruf

Constellation Scientist: A. Ridley

**Southwest Research Institute**
Project Manager: J. Scherrer
Project Systems Engineer: R. Rose
Spacecraft Lead: J. Eterno
Mission Operations Lead: J. Redfern

**Surrey Satellite Technology, U.S.**
DDMI Program Manager: G. Hockenberry

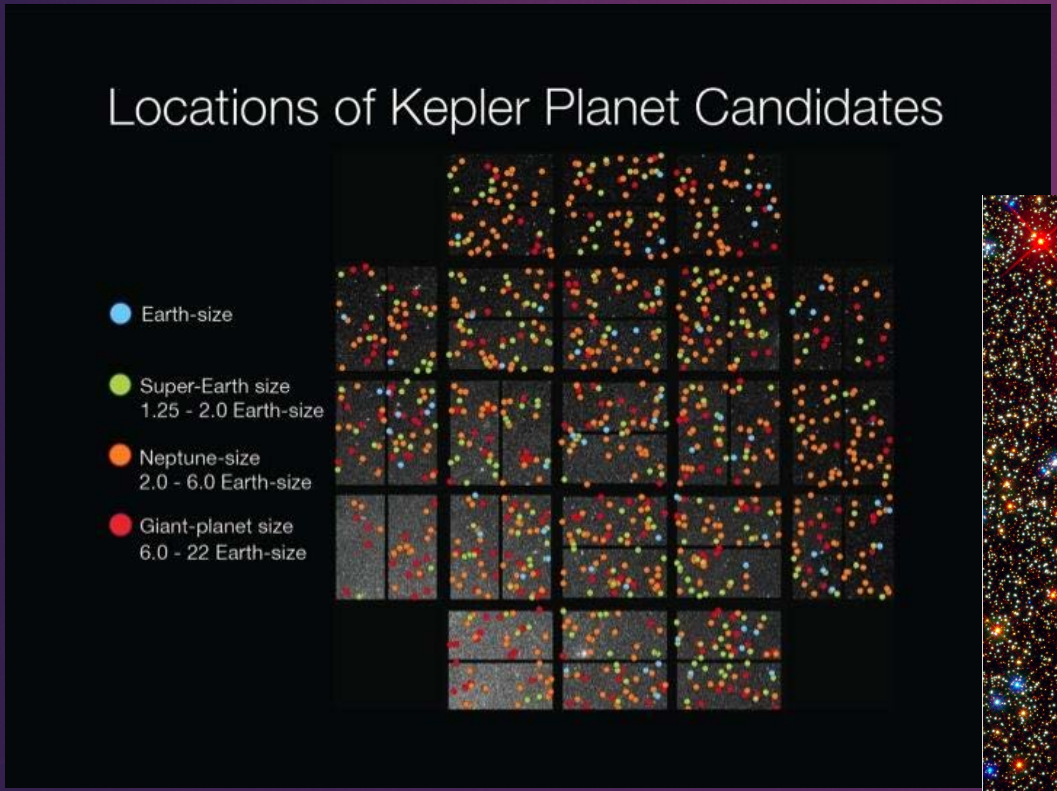
**Sierra Nevada Corporation**
Deployment Module Lead: W. Boyd

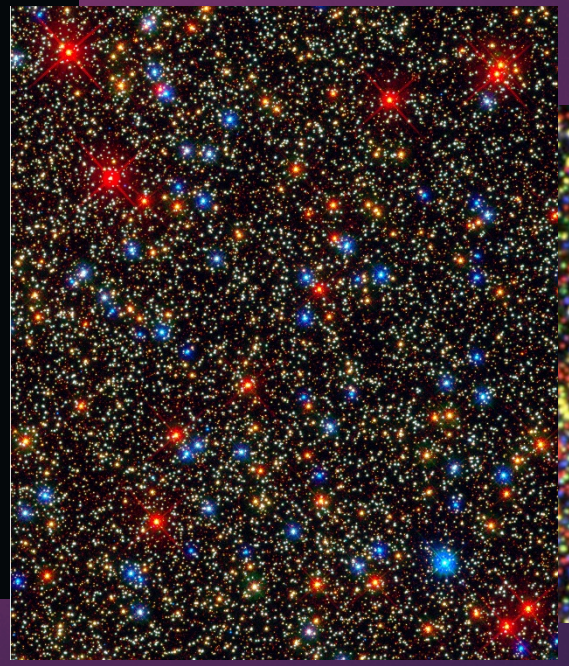


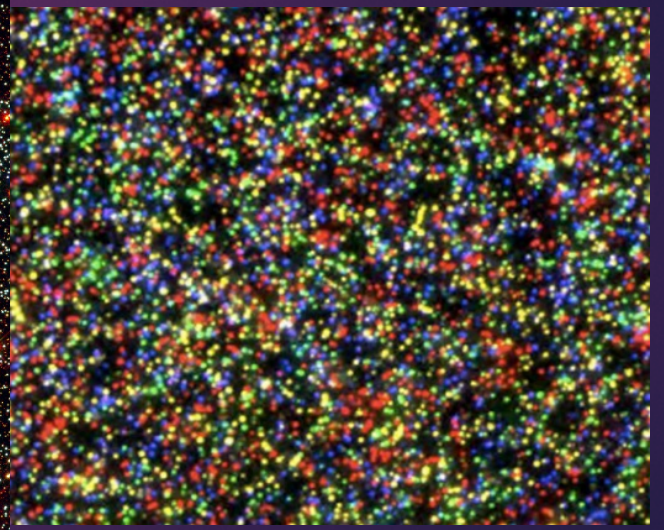
# Part II: A Brave new World? Complexity Revealed

# Big data, discovery and new kinds of Astronomy – are we prepared?

**MOVING TO THE TEMPORAL DOMAIN**



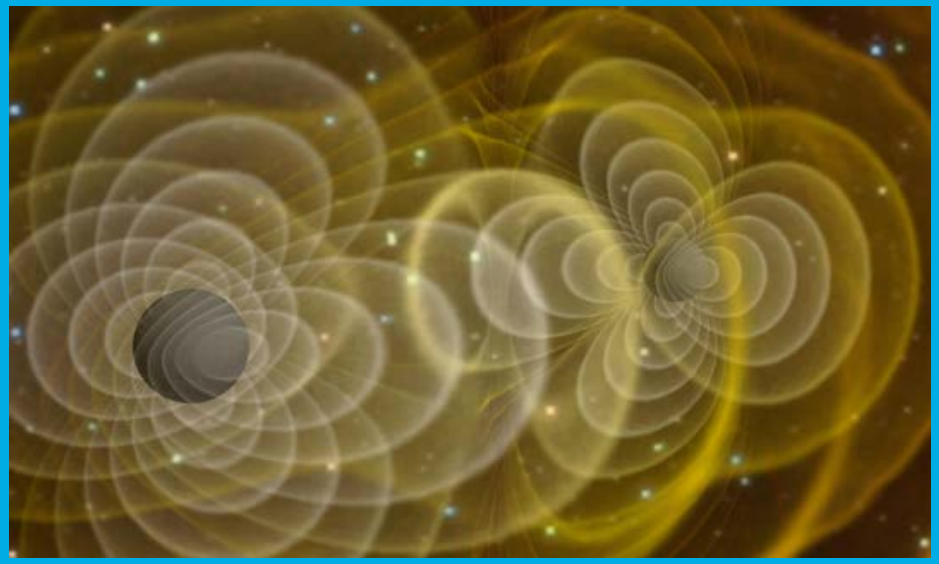





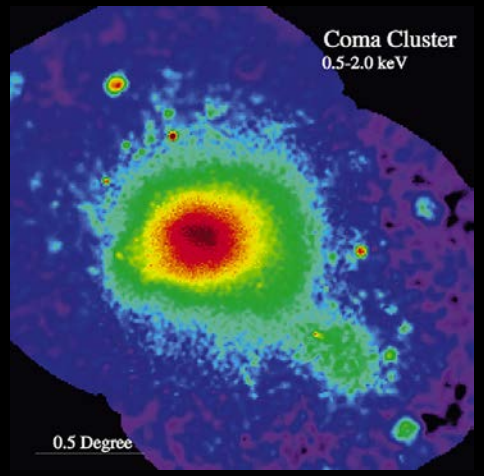
# DISCOVERY IN ASTRONOMY

- Has almost always progressed by building new Detectors (Not Necessarily Large Apertures!) and opening up new wavelengths to survey the Universe.
- The Universe reveals most of its interesting physics in wavelengths other than the optical regime
- The New Gravitational Wave Source Discovered in 9/2015 is an excellent example

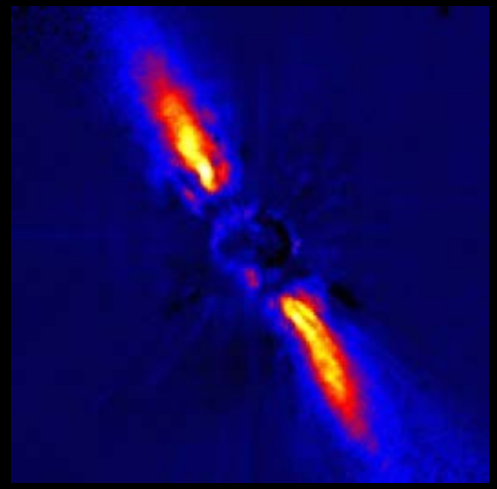
**Unforeseen objects now exist In this "known" Universe – outreach has emphasized the triumph but not the discovery of these new objects**



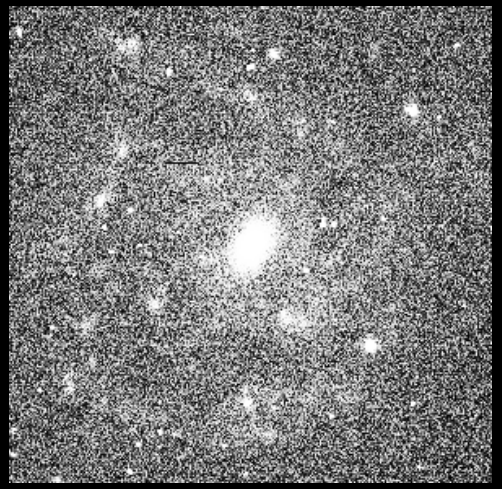
# DISCOVERY MILESTONES



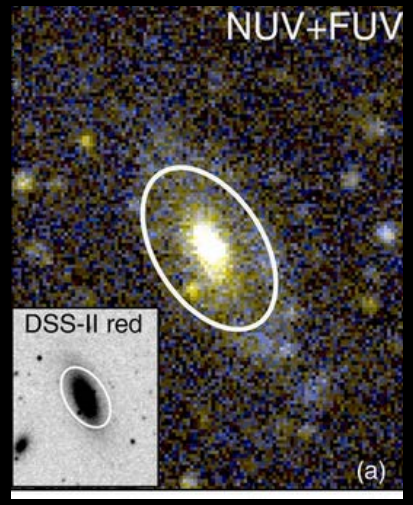

X-Ray Clusters



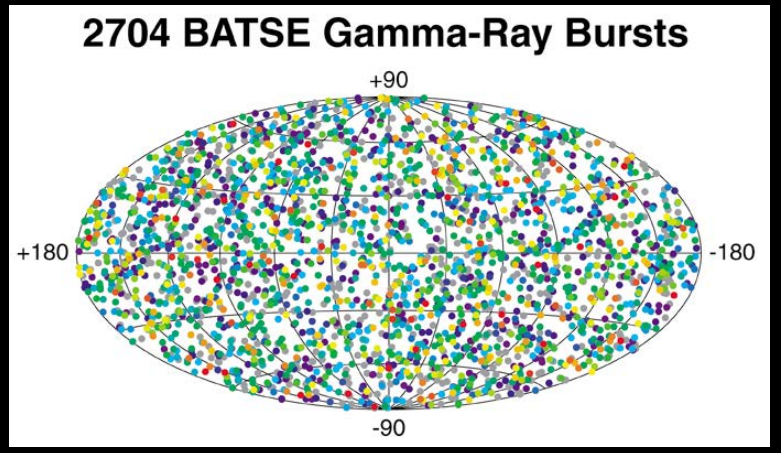
Dusty Proto-planet Disks



New Kinds of Galaxies



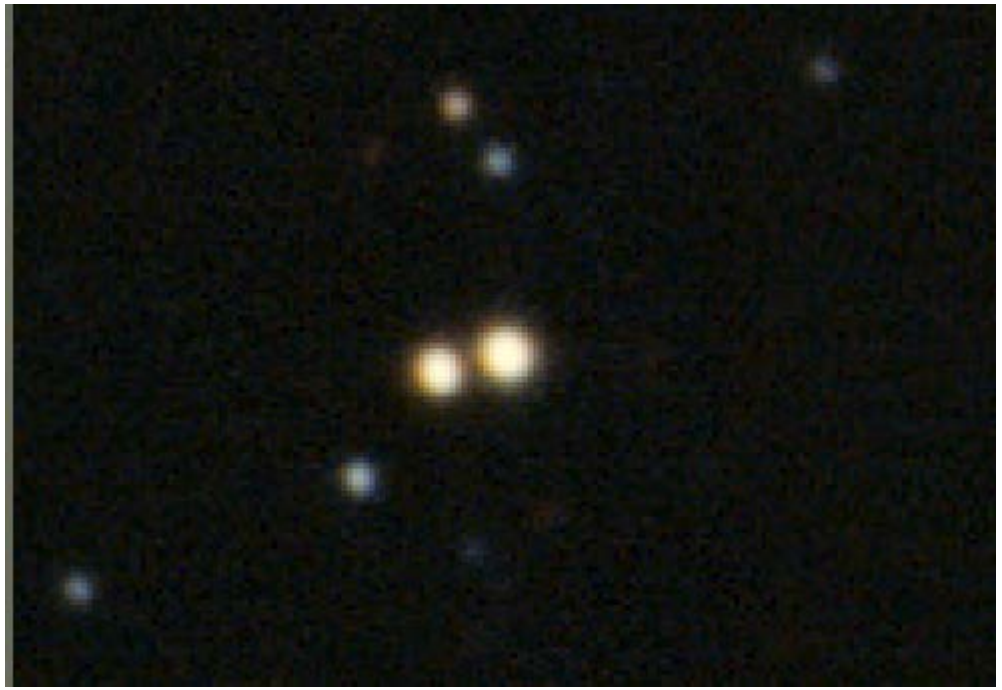

XUV Disks



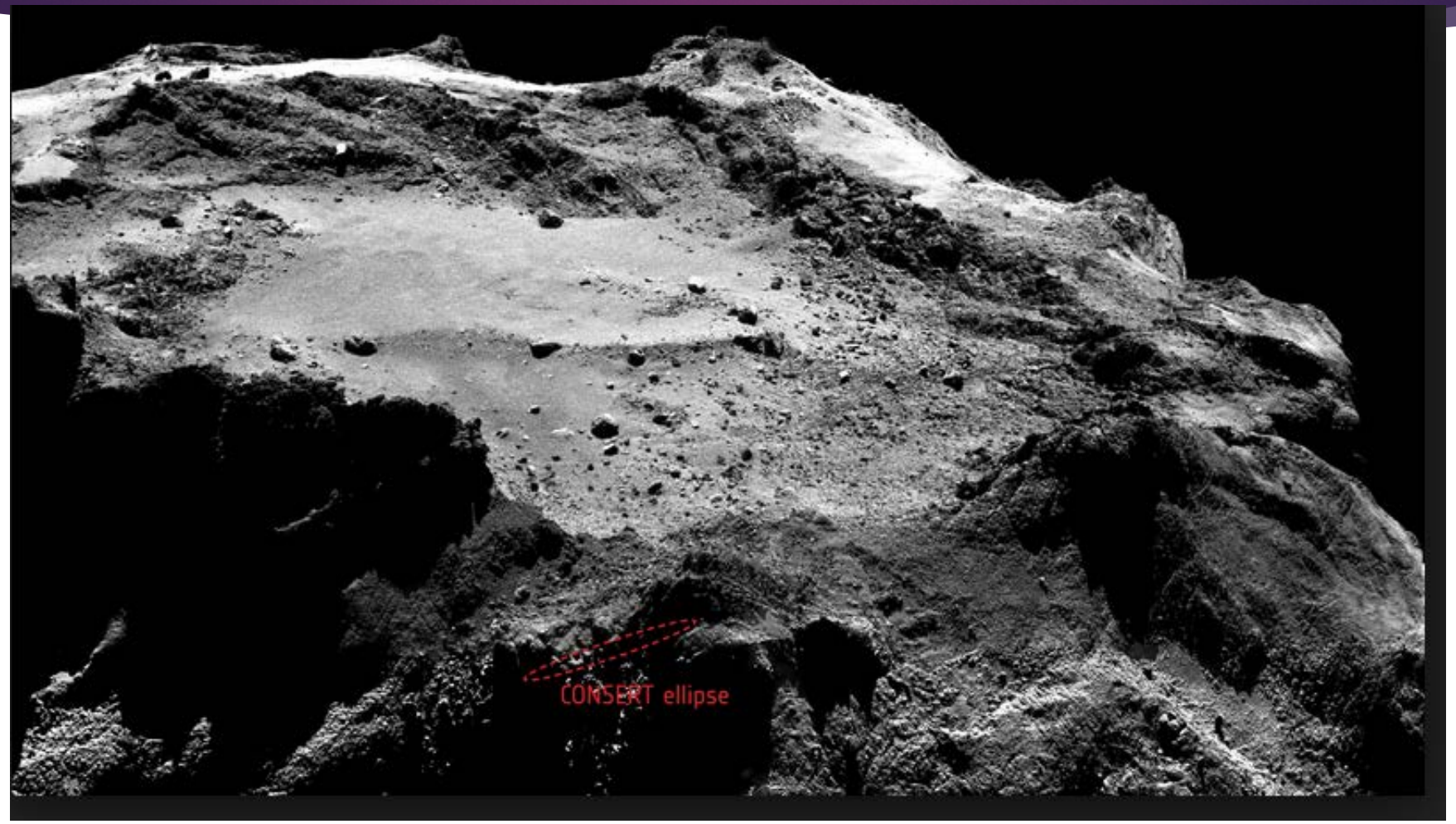

The Gamma Ray Universe

# Too many pixels, too little Screens

- A 36 million pixel image (displayed here on 1 million pixels)



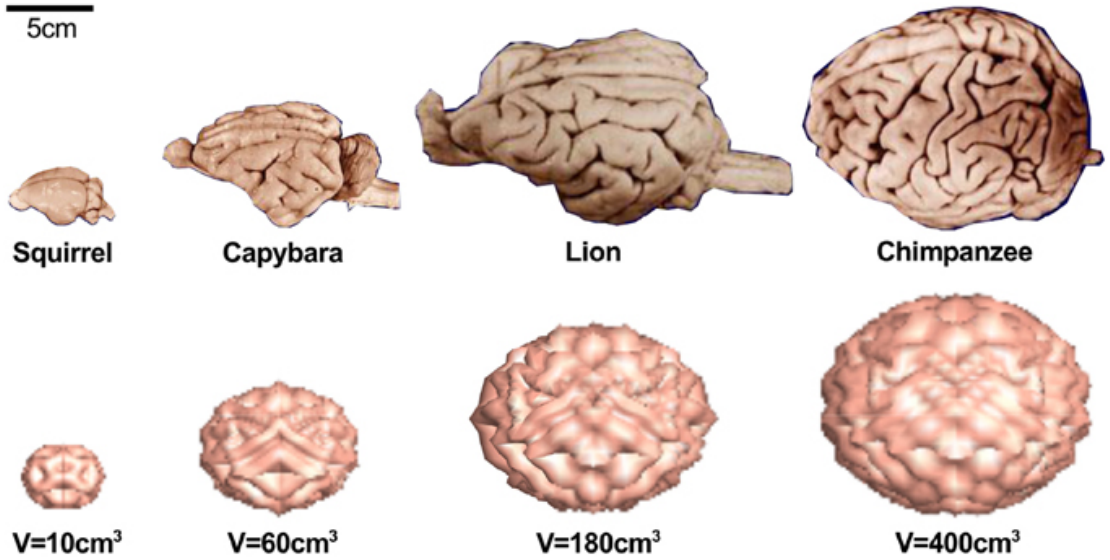
# 35 Million Pixel Native Resolution – 1 cm per pixel



# Coming to the UO


50 Million pixels

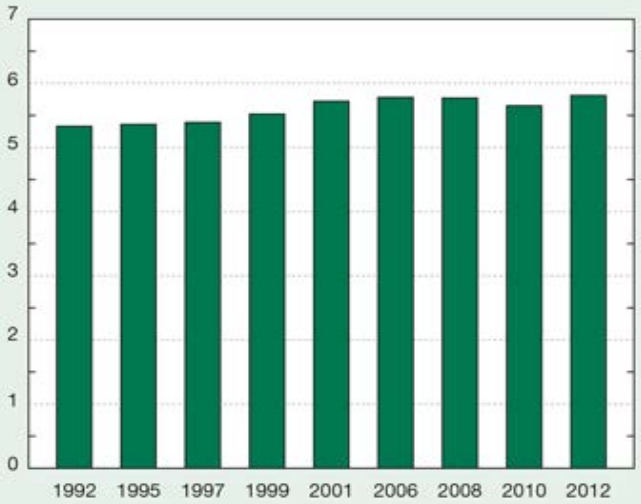
# Okay Great, Can I get a bigger Brain? – This is the principal limitation with Big Data



# Science Literacy – what is it? How do we improve it?

PRINT CLOSE

Figure 7-6
**Mean number of correct answers to trend factual knowledge of science scale: 1992–2012**




NOTES: Mean number of correct answers to the nine questions that are included in the trend factual knowledge of science scale; see appendix table 7-8 for explanation, list of questions, and percentage of questions answered correctly. See appendix tables 7-9 and 7-10 for responses to individual questions.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1992–2001); University of Chicago, National Opinion Research Center, General Social Survey (2006–12).

*Science and Engineering Indicators 2014*

**Overview of Knowledge Questions Related to Earth Sciences and Energy Issues**

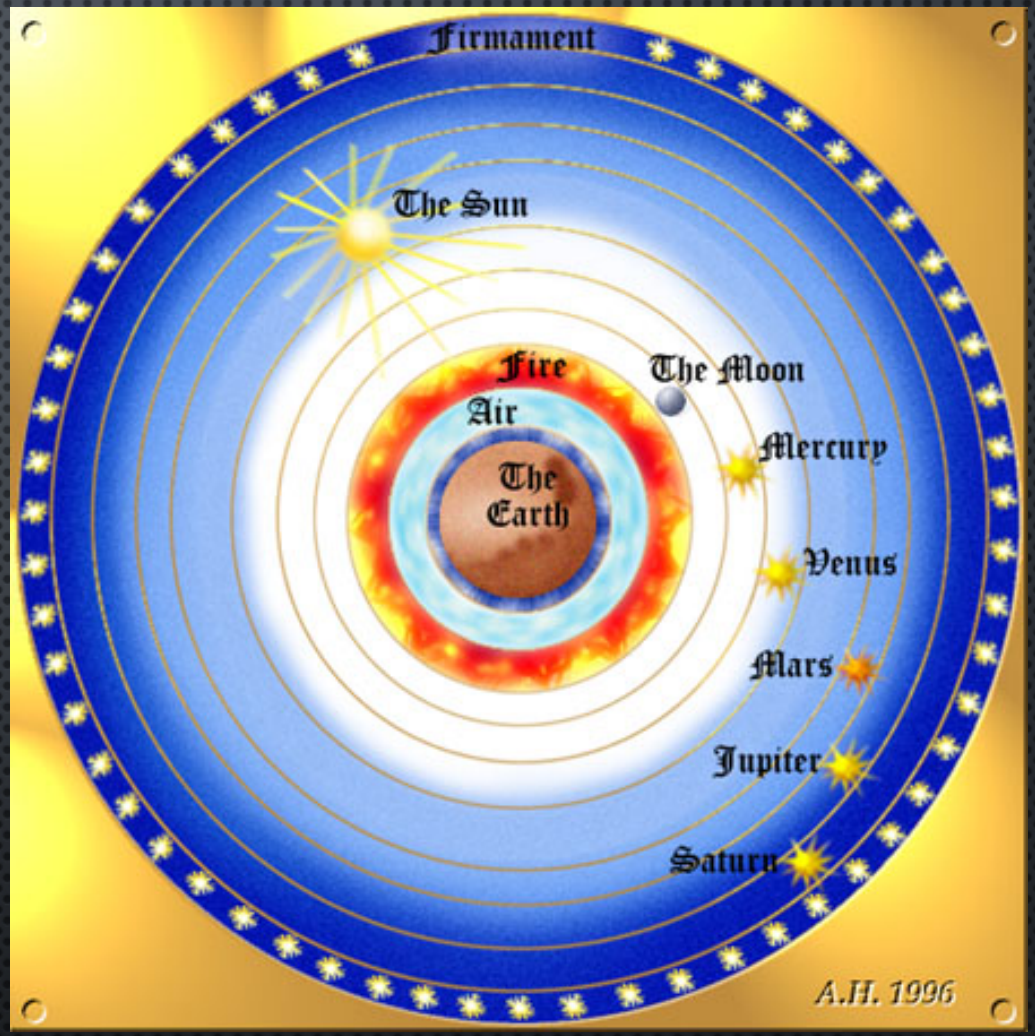
*% answering each item correctly*

| | U.S. adults | HS or less | Some college | College grad | Postgrad degree | Men | Women | Source |
|---|---|---|---|---|---|---|---|---|
| **Science in the news/daily life** | | | | | | | | |
| The most electricity in the U.S. comes which source: coal | 49 | 36 | 52 | 61 | 69 | 59 | 40 | ATP (wave 5) 2014 |
| Which natural resource is extracted in fracking: natural gas | 51 | 39 | 53 | 61 | 75 | 58 | 45 | Mar. 7-10, 2013 |
| U.S. energy output has been ... increasing (2014) | 54 | 44 | 54 | 63 | 74 | 61 | 47 | Dec. 3-7, 2014 |
| Gas believed to cause rising temperatures: carbon dioxide | 71 | 64 | 69 | 80 | 89 | 83 | 60 | Aug. 15-25, 2014 |
| Ocean tides are created by ... gravitational pull of moon | 76 | 65 | 79 | 90 | 91 | 83 | 71 | ATP (wave 6) 2014 |
| Which may cause a tsunami: an earthquake under the ocean | 77 | 67 | 83 | 88 | 88* | 80 | 74 | June 18-21, 2009 |
| Element needed for nuclear energy/weapons is uranium | 82 | 73 | 85 | 93 | 94 | 90 | 75 | ATP (wave 6) 2014 |
| **Textbook knowledge** | | | | | | | | |
| Which gas makes up most of the Earth's atmosphere: nitrogen | 20 | 12 | 22 | 28 | 36 | 27 | 14 | Mar. 7-10, 2013 |
| The continents have been moving over millions of years and will continue to move (true) | 77 | 68 | 83 | 83 | 87 | 83 | 72 | Mar. 7-10, 2013 |
| Identify hottest layer of Earth as the core (with labeled image) | 86 | 79 | 89 | 93 | 93 | 89 | 84 | ATP (wave 6) 2014 |

# Outreach Oregon "O" Style

Once upon a Time:

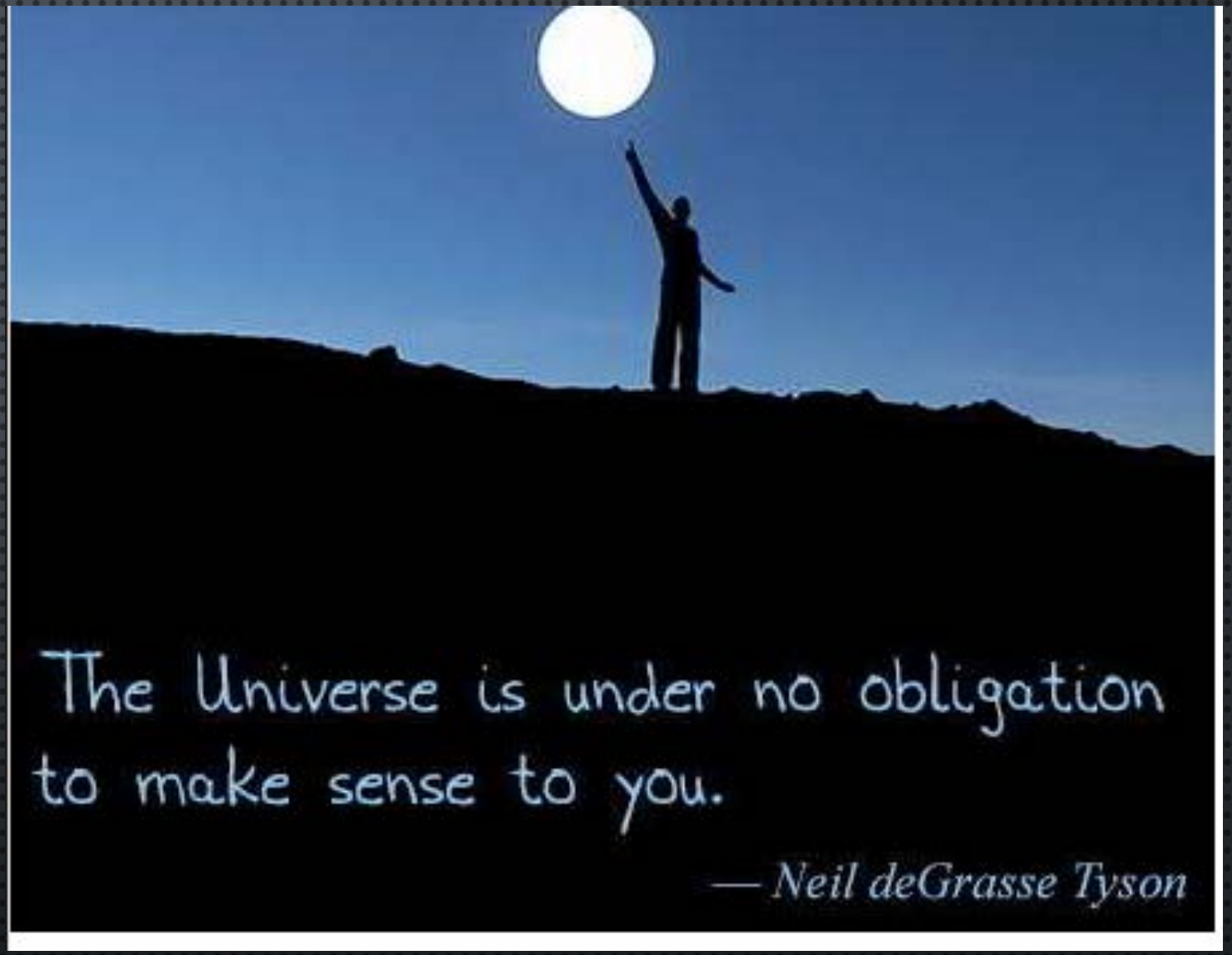
- Everything Was Known
- Every thing was Simple
- Every thing was logical and ordered
- Uncertainty DID NOT EXIST
- Tell the people the Known Truth
- Impress people with how clever we are And how impressive science is, since we have figured it all out



Yet Science is NOT a pathway to the truth – in fact, just the opposite – Science is a process that maps out everything which is unknown.

Science is a process that should produce humility not a process that produces arrogance because we think we understand everything

The current management of the planet is very arrogant – this needs to change – this is the big picture of science literacy



Most people when they visit the beach look out upon the vast ocean and reflect.

Is this an ocean of Truth or an ocean of the unknown;  is it an ocean of opportunity?  - certainly it is an ocean of exploration

Science is the process of exploration that maps out the uncertainty – Science literacy is the understand of that as the mission of Science

Outreach should stress this at all times