

The Importance of Space Exploration.

Dr Michael Cowley

SEB104 Grand Challenges in Science: Space Exploration



School of Chemistry and Physics
Faculty of Science

Acknowledgement of Traditional Owners

QUT acknowledges the Turrbal and Yugara, as the First Nations owners of the lands where QUT now stands.

We pay respect to their Elders, lores, customs and creation spirits. We recognise that these lands have always been places of teaching, research and learning.

QUT acknowledges the important role that the Aboriginal and Torres Strait Islander people play within the QUT community.

Space Exploration Challenge

Coordinator: Dr Michael Cowley

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Space Lecture: Thursday 9 - 10 am S303*

Space Workshop: Thursday 10am - 12pm P413/A*

*Lecture and workshop sessions to be delivered online until further notice.

What's Covered?

Space Lectures & Workshops

- Grand Challenge-specific topics
- Group work leading up to the assessment
- Weekly content: See the Unit Guide on Blackboard ⇒ Unit Details

Space Exploration Challenge



Challenge Leader:

Dr Michael Cowley

michael.cowley@qut.edu.au

My Background

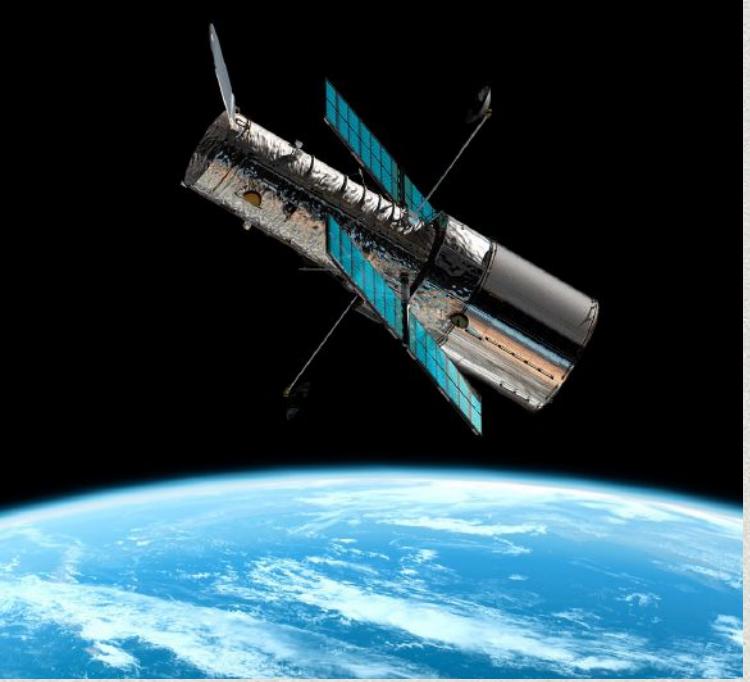
Extragalactic Astrophysics and Cosmology

- Galaxy formation and evolution
- Star-formation
- Supermassive black holes
- Multi-wavelength photometry
- Infrared spectroscopy
- Spectral energy distribution modelling



Astrophysics

Hubble Space Telescope



Magellan Baade Telescope



- I use Australian, international, and space-based telescopes to perform my research
- Specifically, I am a cosmologist – a scientist who studies the structure and history of the entire universe



Keck Telescope

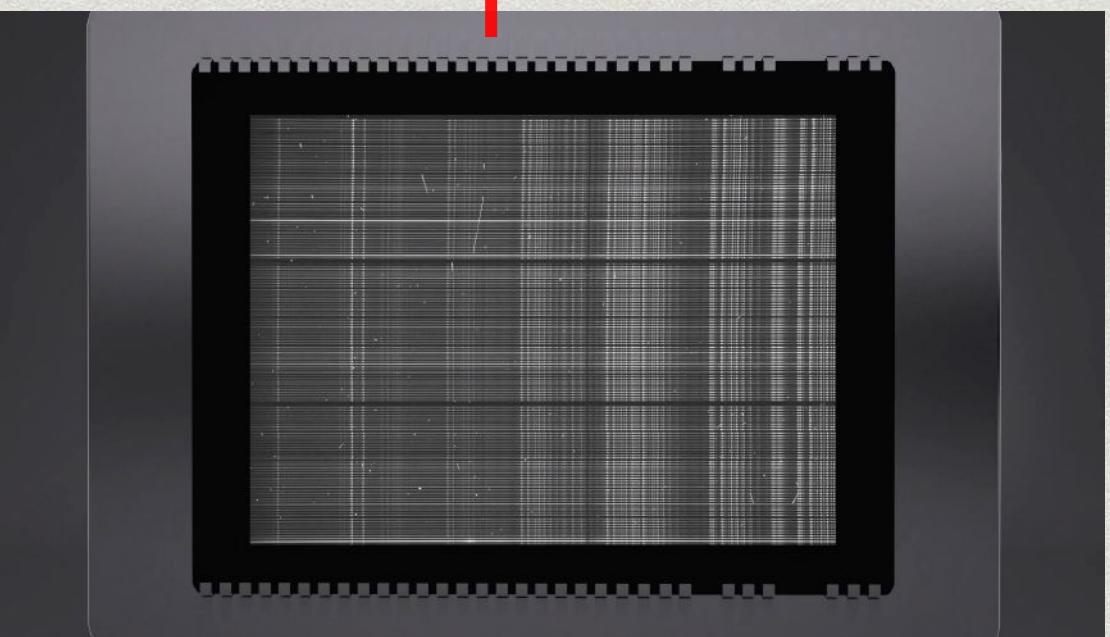
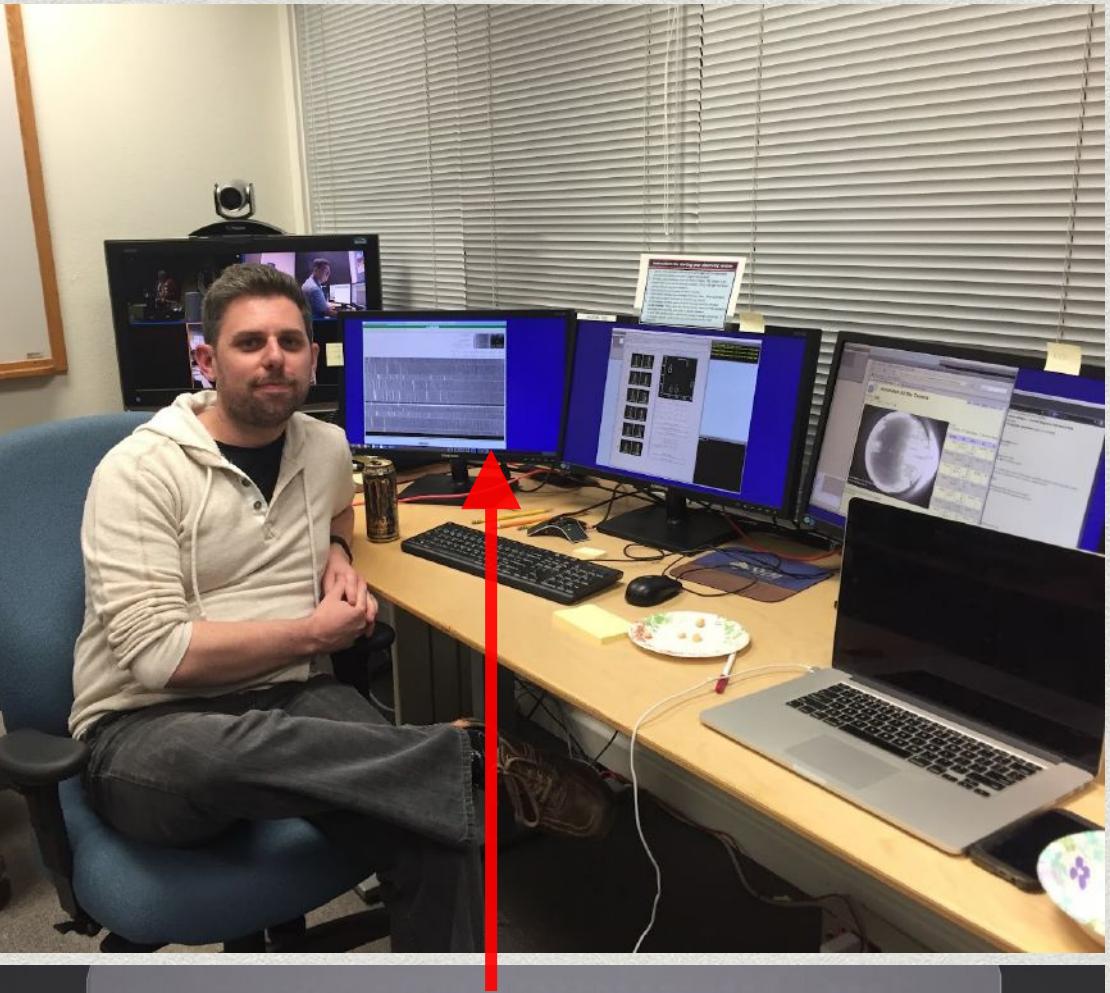


Chandra Telescope

Travel



Science



Communicating Science



Why Space Exploration?



Climate Change



Food Shortage



Security & Defence



Global Health



Space



APPROPRIATE LEVELS OF PUBLIC
FUNDING ARE ALLOCATED TO
RESEARCH THAT ADDRESSES
**THE MOST IMMEDIATE PROBLEMS
FACING THE NATION**

*THE AUSTRALIAN GOVERNMENT'S
SCIENCE AND RESEARCH PRIORITIES, MAY 2015*

Why Space Exploration?



“I don't think the human race will survive the next thousand years, unless we spread into space. There are too many accidents that can befall life on a single planet. But I'm an optimist. We will reach out to the stars.”

— Stephen Hawking (1942 - 2018),
Theoretical Physicist

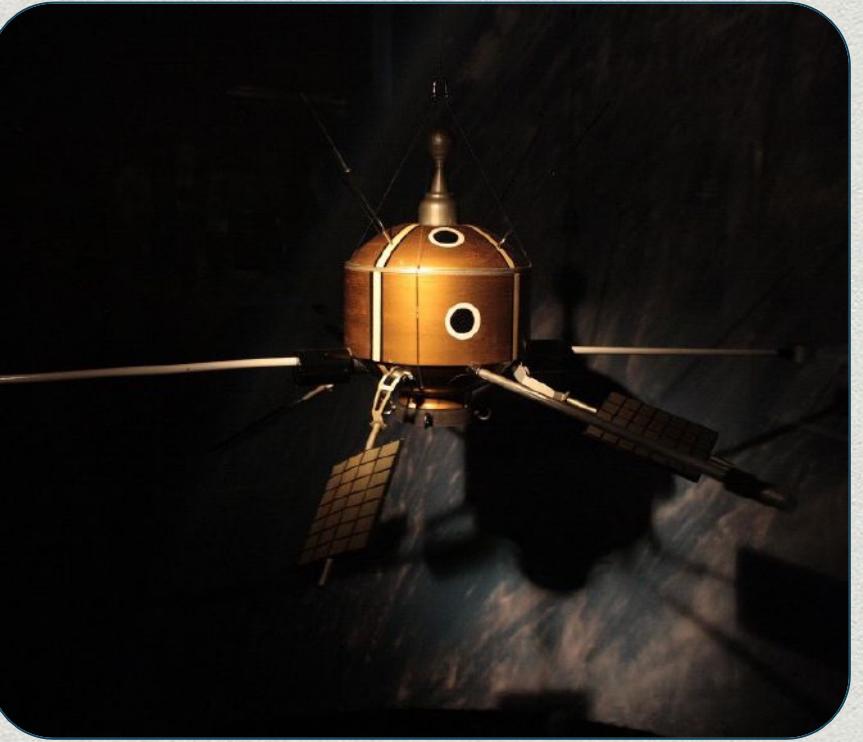
Why Space Exploration?

- Humans have been and always will be explorers
- We explore to understand our place on Earth ... or in the cosmos
- We explore new worlds to see how they compare to Earth
- We explore space to determine if we're alone in the universe
- But also...

Spin-off Technology



Credit: Jrpvaldi



Credit: Stephen Dickson



Credit: Marus



Credit: tOrange.biz

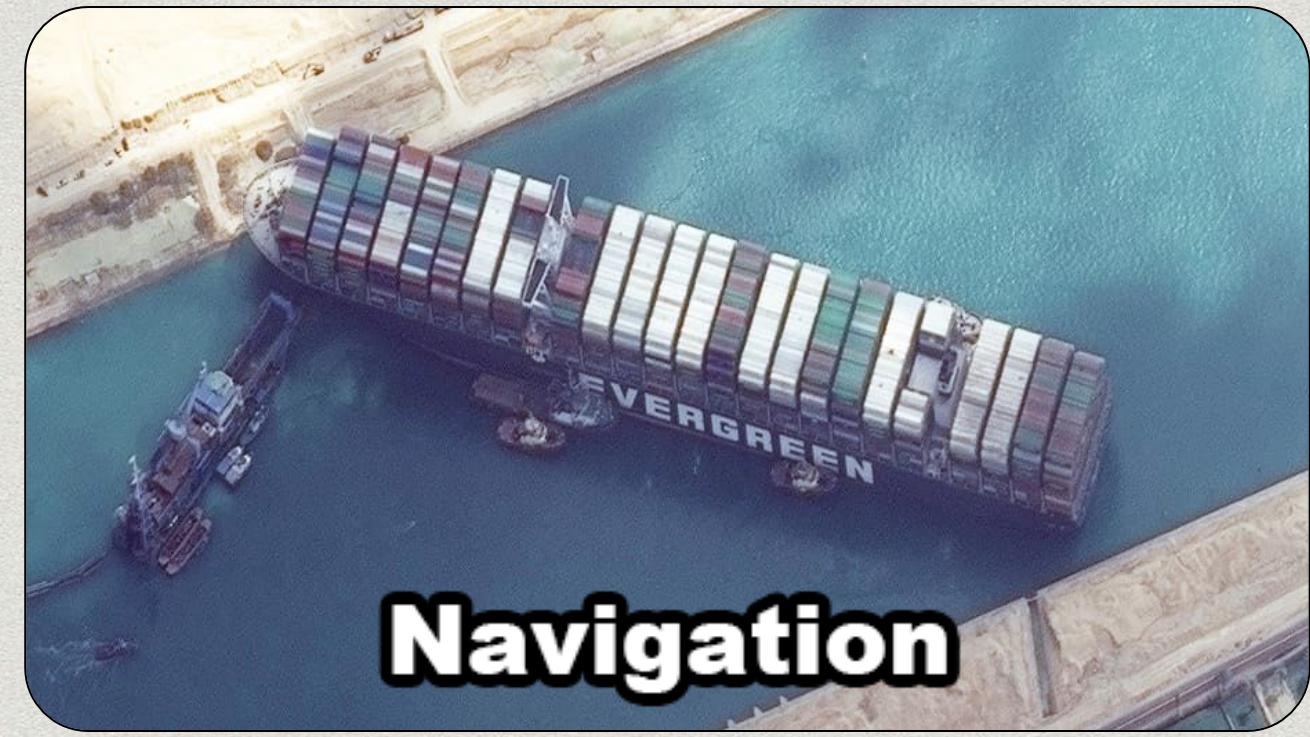
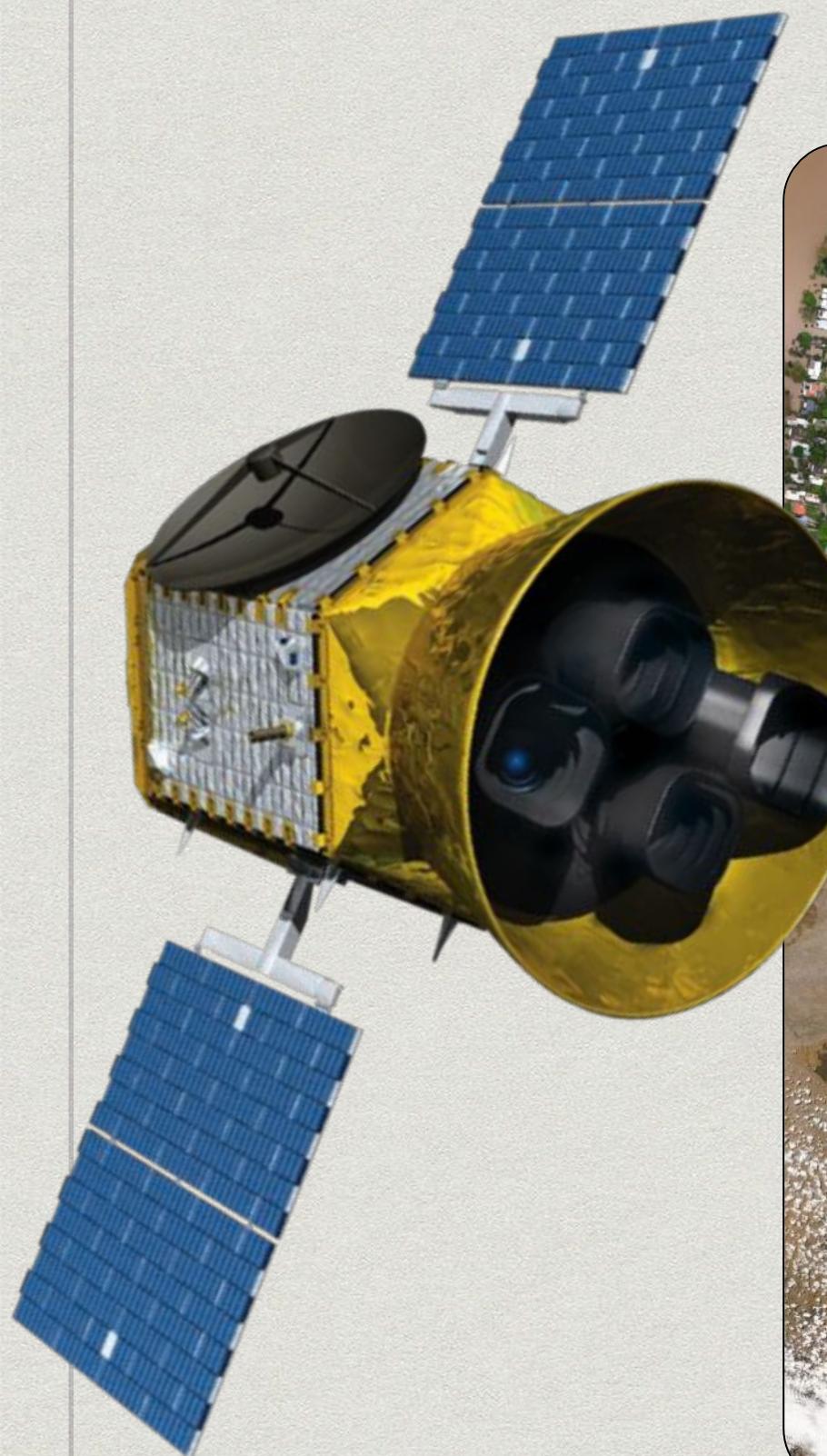


Credit: Christoffer Riemer



Credit: U.S. Navy

Satellite Technology



Modern Science is Highly Interdisciplinary



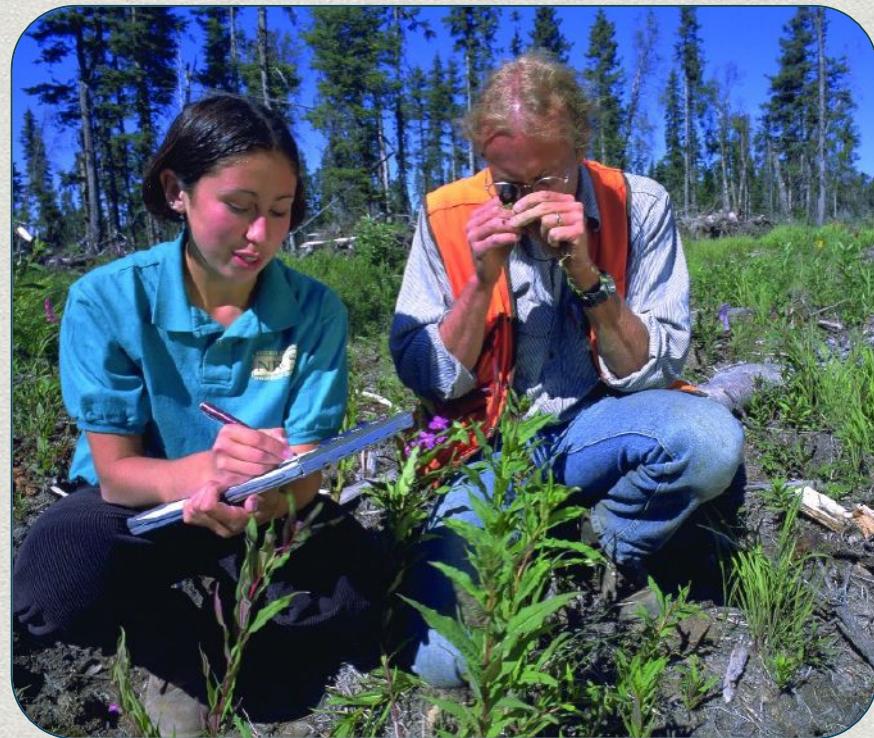
Credit: Evgeny Pelevin



Credit: UGA CAES



Credit: Rhoda Baer



Credit: Ron Nichols



Credit: JM0779



Credit: Michael Cowley

Modern Science is Highly Interdisciplinary



James Watson, Francis Crick, Maurice Wilkins, and Rosalind Franklin all played a role in discovering the structure of DNA, deoxyribonucleic acid — the molecule that encodes genes in all living things.

- Chemical molecule
 - Plays a biological role
 - Structure determined using a physical technique (X-ray scattering)
 - Mathematical processing of the experimental data
-
- James Watson - biologist
 - Francis Crick - physicist
 - Maurice Wilkins - physicist
 - Rosalind Franklin - chemist

Astrophysics is Highly Interdisciplinary

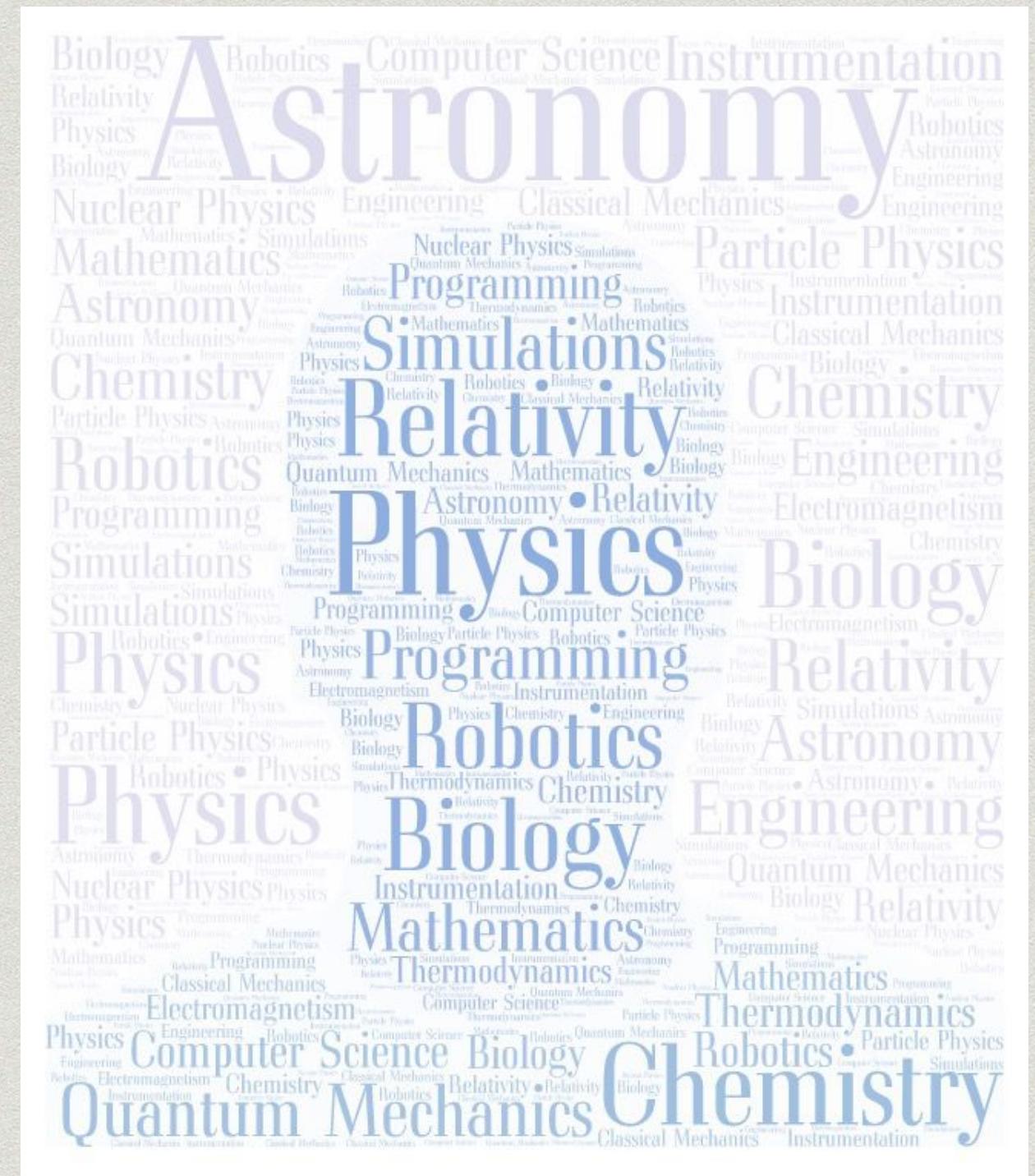


Astrophysics is intrinsically interdisciplinary, bringing together knowledge in physics, chemistry, biology, computer science, mathematics, engineering and instrumentation technology, all for the goal of exploring and understanding the Universe at large

My Background

Extragalactic Astrophysics and Cosmology

- Galaxy formation and evolution
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Space Exploration is Highly Interdisciplinary

Biochemistry

Nutrition for space conditions

Mathematics

Control theory and mission optimisation

Computer simulations of space missions and planetary orbits

Robotics

Remotely controlled vehicles

Psychology

Crew selection

Computer Science

Computer systems and software for mission control

Geology

Planetary tectonics
Mining of other planets

Chemistry

Rocket fuels
Batteries
Novel composites and polymers

Engineering

Designing and building efficient and reliable space vehicles

Medicine

Well-being of flight crew

Biology

Looking for life in space

Physics

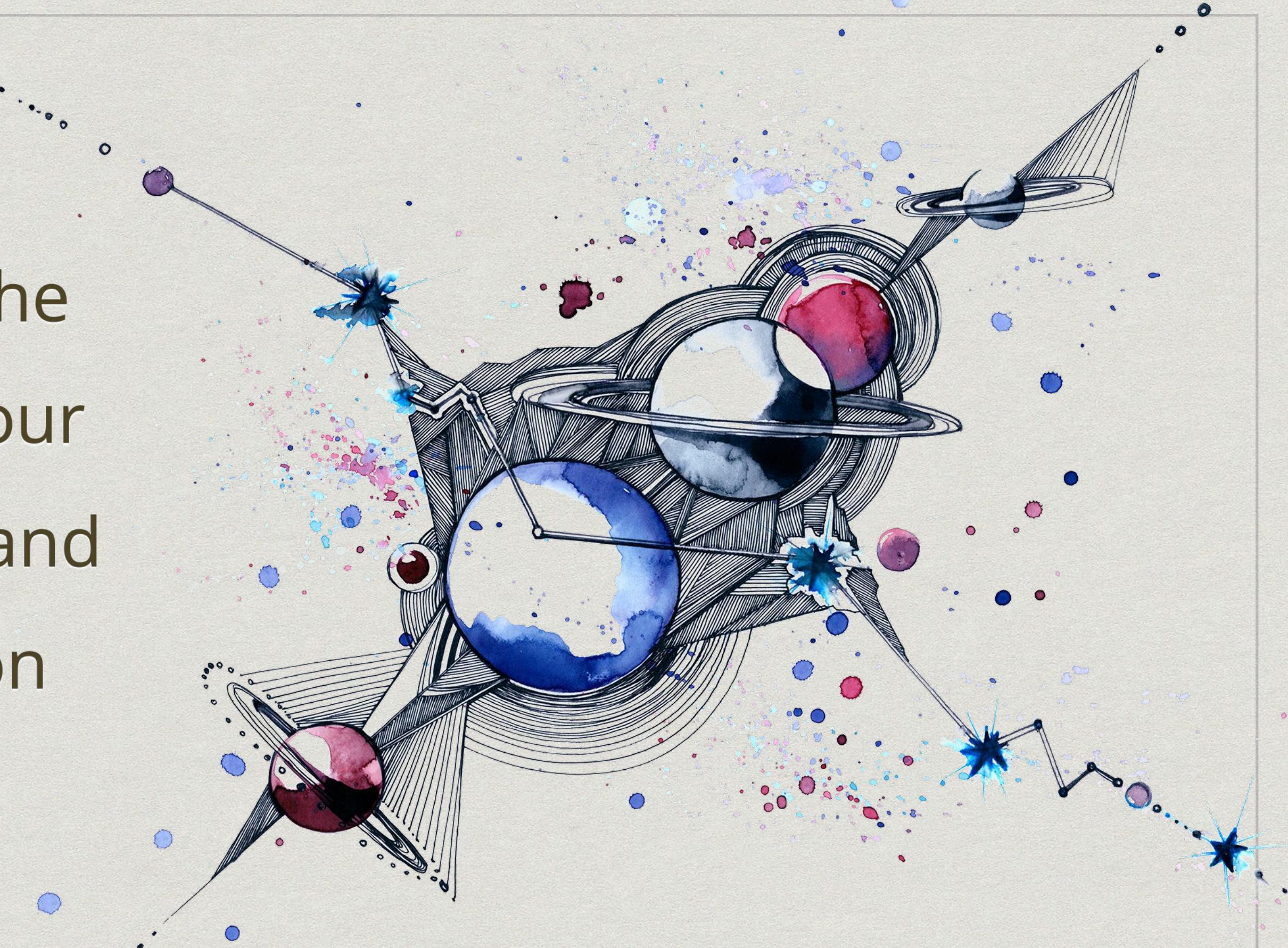
Fundamentals of space flight
Dynamics of celestial objects

Materials Science

High-performance materials for space vehicles

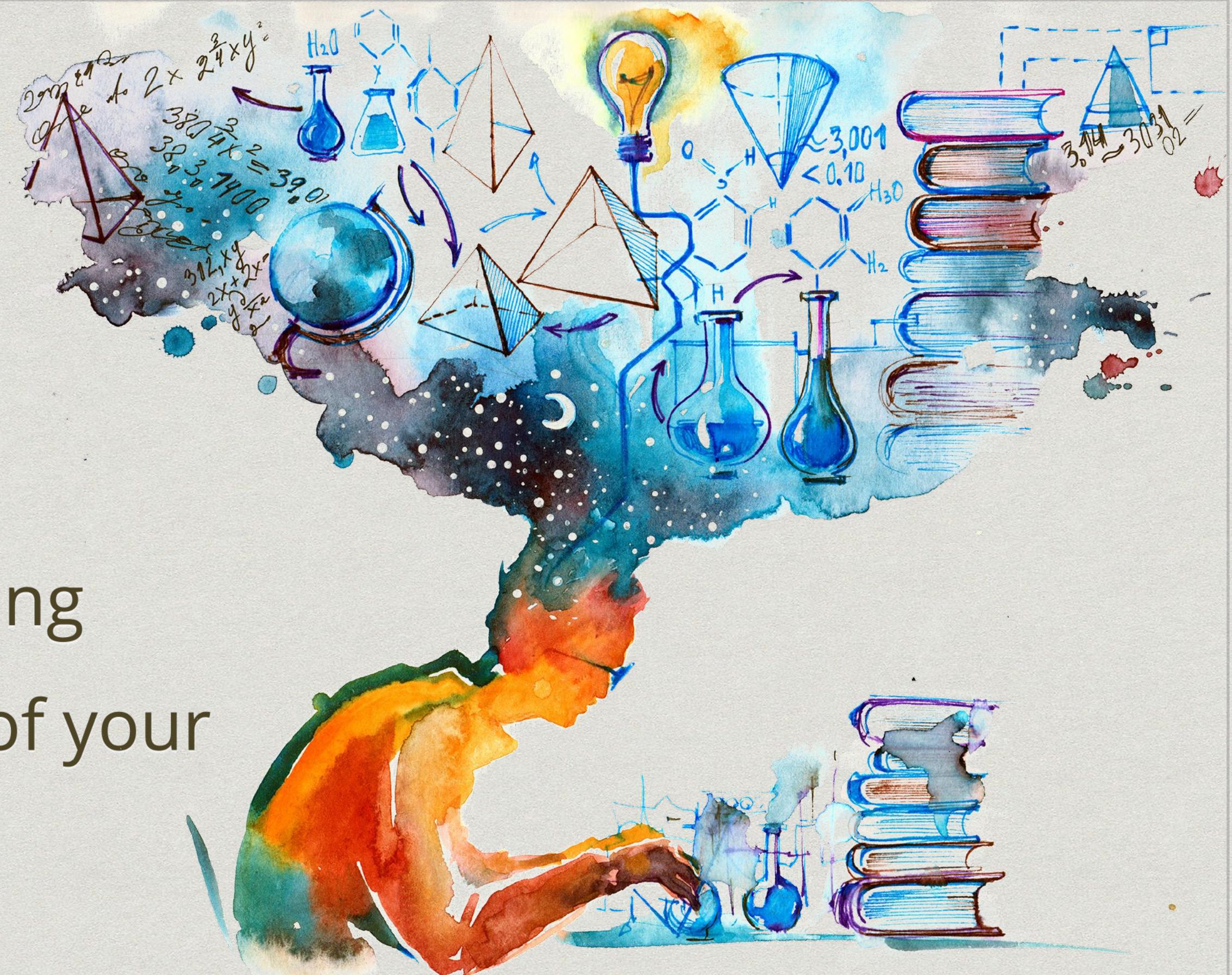
Objectives

To learn about the science behind our space missions and space exploration efforts



Objectives

To consider how different scientific disciplines can contribute to solving different aspects of your Grand Challenge



Objectives

To consider how fundamental and applied science can underpin our efforts to develop future space technologies



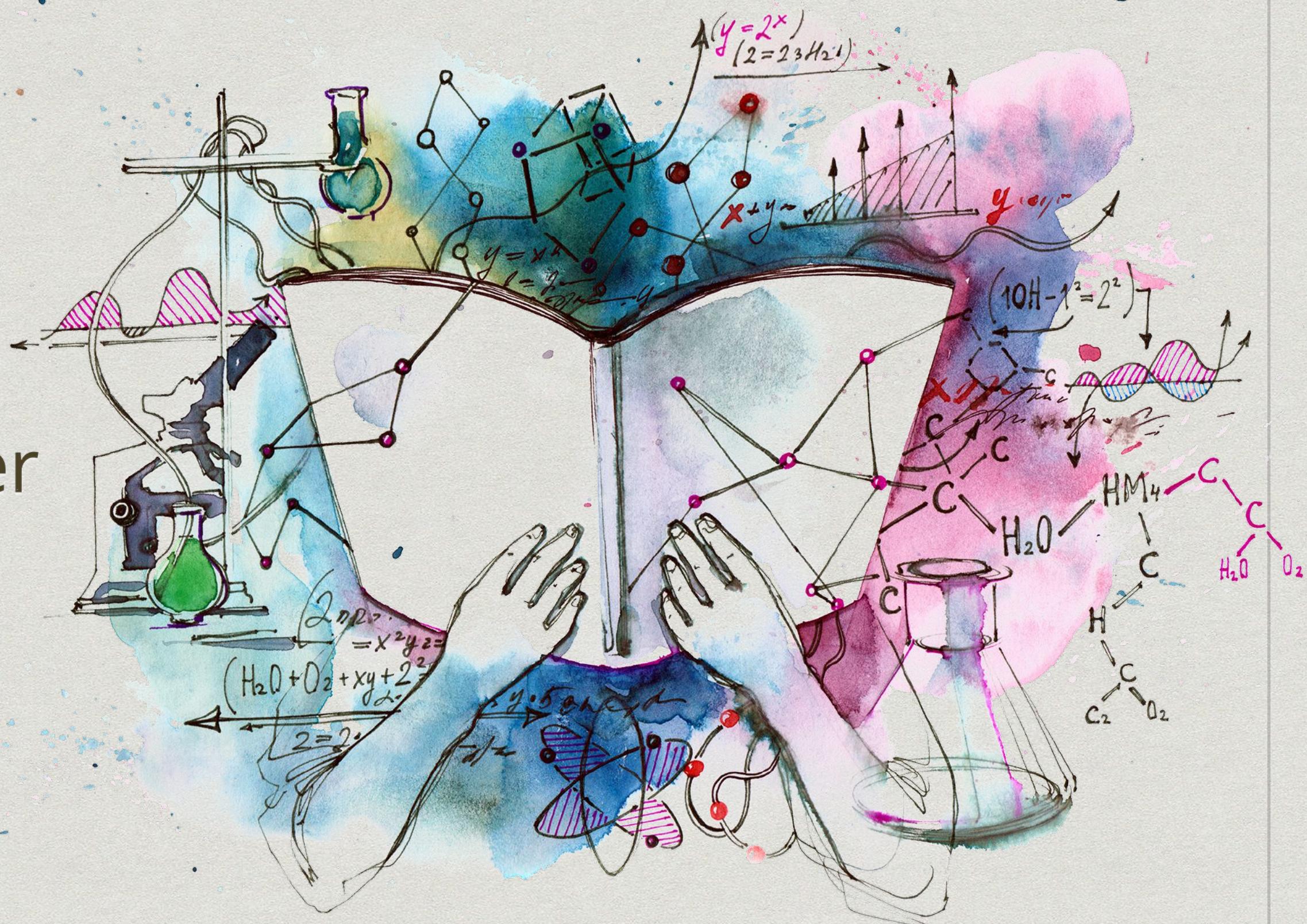
Objectives

To learn to critically evaluate available data and be able to communicate scientifically-sound advice to a variety of audiences



Objectives

To learn about the ways science and scientists work (peer review, evidenced base, experimental validation,...)



Objectives of this Grand Challenge

We want you to make an intellectual transition from school to university!

We want you to start developing your thinking and analytical skills, perform a sophisticated approach to scientific literature and scientific writing, hone your presentation skills, and obtain a greater understanding of how science actually works.

- This unit is an inquiry-led unit
- That means you get to do the work!



What will I provide?

- Series of lectures on space-related topics
- Various resources through BlackBoard
- Workshop sessions to assist with the assessment in SEB104

Assessment

1. Workbook 20% (individual)
 - ♦ Annotated Bibliography (10%) – Due Week 7
 - ♦ Reflective Writing Submission (10%) – Due Week 12
 2. Poster 30% (group) – includes individual component
 - ♦ Poster Presentation – Due Week 7
 3. Essay 50% (individual)
 - ♦ Discussion Forum (5%) – Week 10
 - ♦ Research Essay Submission (45%) – Week 13
- Discussed in more detail in the Workshops!*