

A background image of a night sky with a vibrant green aurora borealis over a dark lake. The aurora's light reflects on the water's surface. The sky is filled with stars, and the foreground shows the dark silhouette of a forested hillside.

Off World Living



What on Earth – or should that be
What off Earth?

Andrew Edkins

The Bartlett

UCL

To consider the motivation

To consider our point of
inflection and reflection

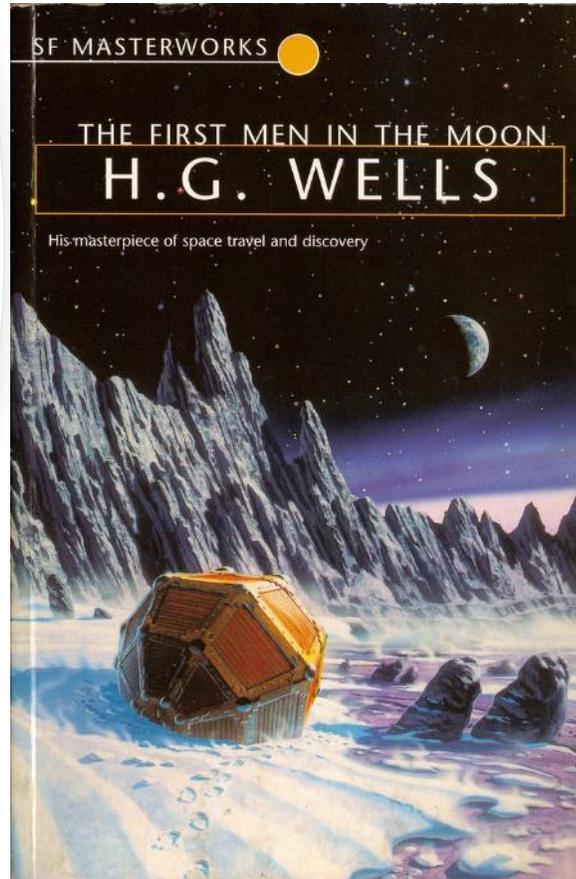
To consider the challenge

To consider the rationale for
OWLI

Our
Motivation:
Curiosity



Our
Motivation:
Imagination



Our
Motivation:
Determination



At a Point of Inflection

BBC Andrew E Home News Sport Weather iPlayer Sci

NEWS

Home Coronavirus Brexit UK World Business Politics Tech Science Health Family & Education

Science & Environment

China space station: Shenzhou-12 delivers first crew to Tianhe module

By Jonathan Amos
BBC Science Correspondent

1 day ago



China has launched three astronauts into orbit to begin occupation of the country's new space station.

NASA Science MARS EXPLORATION PROGRAM

The Red Planet The Program News & Events Multimedia Missions

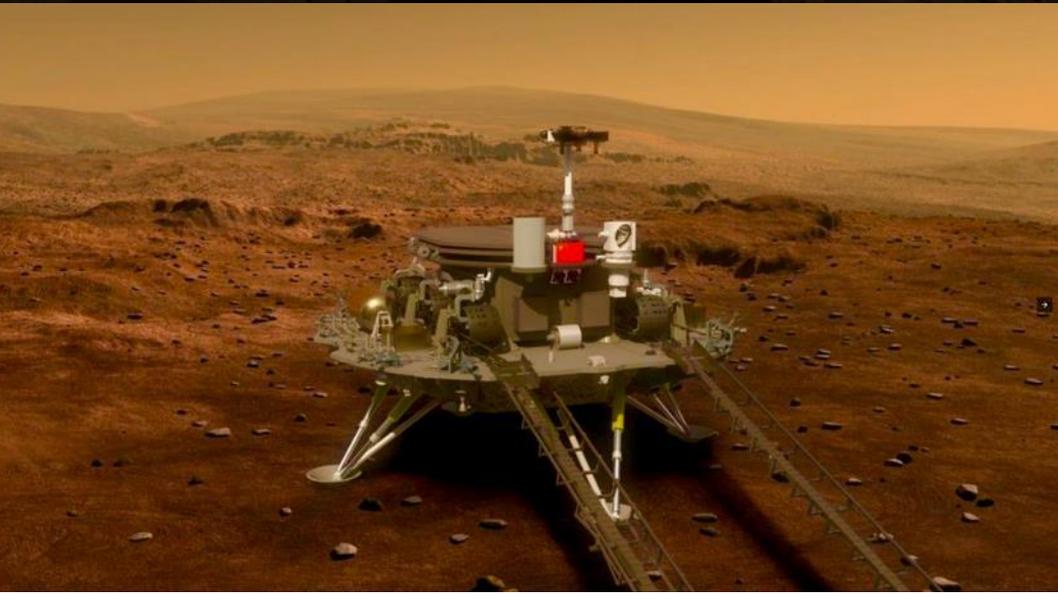
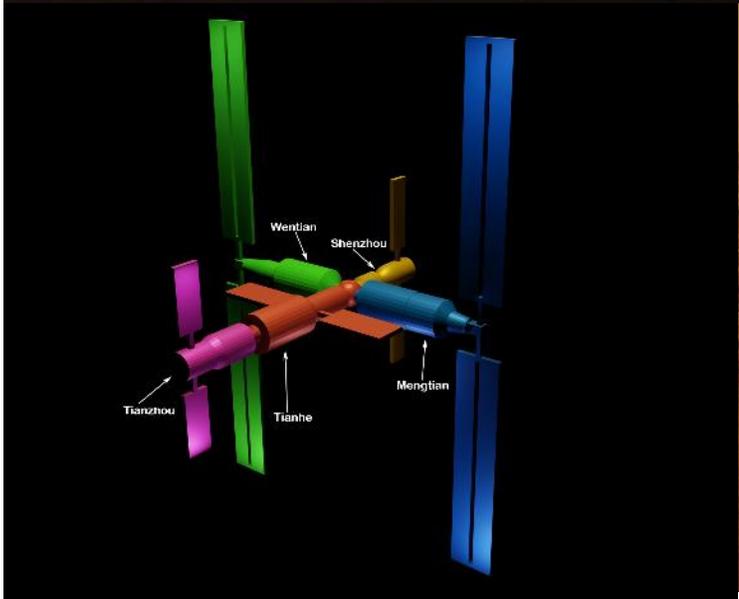
Mars Curiosity Rover

RAW IMAGES 706 New | 806,748 Total

MISSION CLOCK 3148 Sols on Mars

LATEST Mission Update

DISTANCE TRAVELED 15.75 miles (25.35 km)





At a Point of Inflection

The European Space Agency says it is "thrilled" by the number of people who have applied to join its astronaut corps.

A total of 22,589 individuals filled out the online form - two-and-a-half times the interest level when Esa last ran a competitive process in 2008.



Come join me: Frenchman Thomas Pesquet is currently working on the ISS

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NEWS

Science & Environment

Sir Richard Branson gains licence for commercial spaceflights

 **Jonathan Amos**
Science correspondent
@BBCAmos

5 hours ago



Sir Richard has been working since 2004 to make real his spaceflight ambitions

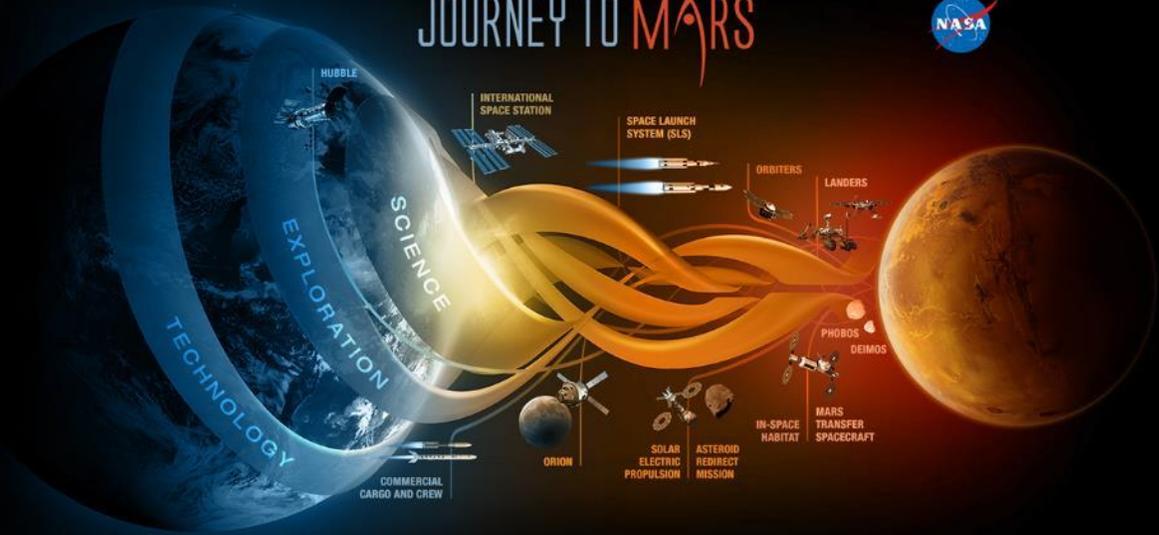
Sir Richard Branson has received the licence he needs to fly paying customers to the edge of space in his Virgin Galactic rocket plane.



HUMANITY'S RETURN TO THE MOON



JOURNEY TO MARS



ARTEMIS FIRSTS

2021



First CLPS Mission

In 2021, the first Commercial Lunar Payload Services deliveries will begin with two companies delivering 16 instruments to the lunar surface that will pave the way for human explorers.



VIPER

This golf-cart-sized rover will be the first to investigate lunar polar soil samples to characterize the distribution and concentrations of volatiles, including water, across a large region on the Moon.



CAPSTONE CubeSat

This small satellite will be the first spacecraft to enter the lunar Near Rectilinear Halo Orbit—the future home of the Gateway. There it will test new navigation techniques to validate predictive models, reducing uncertainties about the orbit.



Artemis I

The uncrewed, maiden flight of the integrated Space Launch System rocket and Orion spacecraft will verify spacecraft performance and test Orion's heat shield during its high-speed Earth reentry at nearly 5,000 degrees Fahrenheit.



PPE & HALO Launch

The Power and Propulsion Element (PPE) and the Habitation and Logistics Outpost (HALO) are the first pieces of the Gateway. On-board science investigations from NASA and the European Space Agency will conduct early characterization of the deep space environment.



Artemis II

On this 10-day crewed test flight, NASA astronauts will set the record for the farthest human travel from Earth. They will validate deep space communication and navigation systems and ensure that life support systems keep them healthy and safe.



Artemis III

With confidence gained through Artemis I and Artemis II, Orion and its crew will once again travel to the Moon, this time boarding the Human Landing System that will bring the first woman and next man to the lunar surface.

2024

A snapshot of "firsts" to be achieved through the Artemis program.



At a Point of Reflection



From BBC News (Sunday 13th June 2021)

'Plain to see'

A video message from Sir David Attenborough was played to world leaders in Cornwall on Sunday as they set out their plans for meeting emissions targets.

Speaking beforehand, Sir David said: "The natural world today is greatly diminished... Our climate is warming fast. That is beyond doubt. Our societies and nations are unequal and that is sadly plain to see.

"But the question science forces us to address specifically in 2021 is whether as a result of these intertwined facts we are on the verge of destabilising the entire planet."

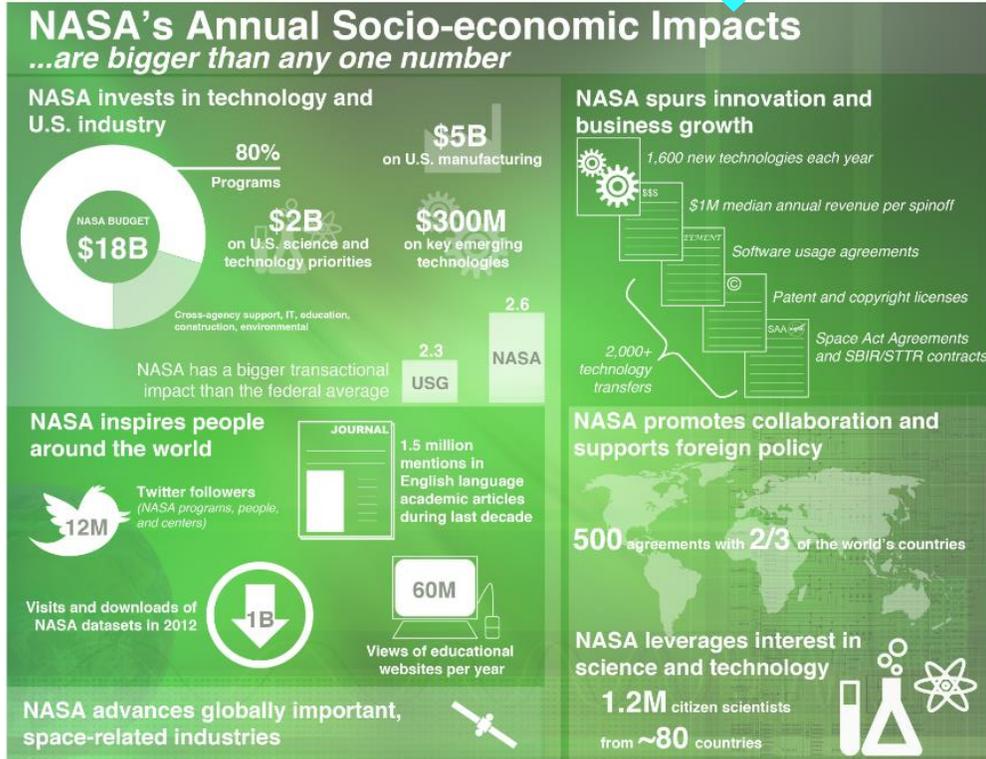
He said the decisions facing the world's richest countries were "the most important in human history".

If this is the state of our home - then shouldn't we address these pressing challenges before looking at off world challenges?



We realise the challenge we face

We need to draw on all sources of possible solution



→ BENEFITS



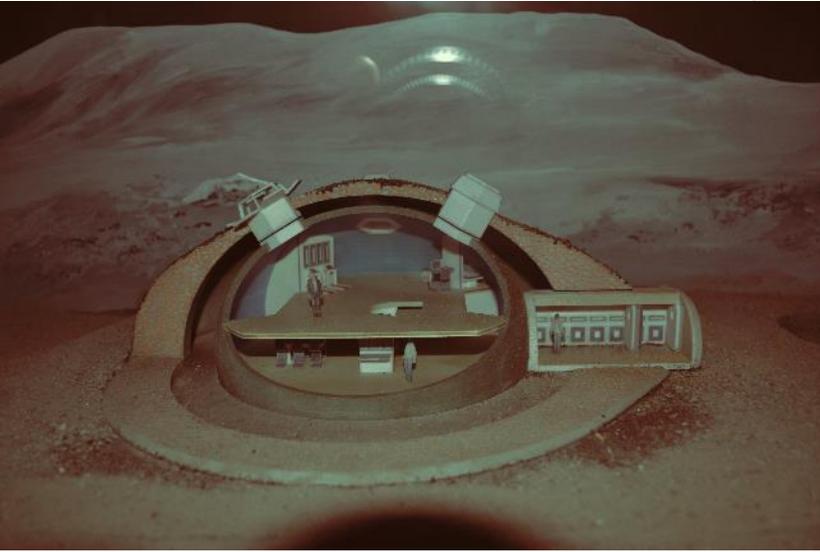
The Challenge of Off World Living

- **The Power and Determination needed - over the timescale required:**
 - Political leadership (capital and lowercase)
 - Regulatory regime
 - Money
 - Public and media support
- **The Science and Knowledge**
 - Hard/soft; pure/applied; natural/social - all sciences - and new blended and new emergent
 - Gathered knowledge coupled with modelling, simulation and rehearsal
- **Technologies**
 - Traditional
 - Emergent
 - New
 - Yet to be imagined:
 - Challenge 'pull'
 - Trajectory 'push'

- **Mission setting and value appraisal**
- **Essential data gathering > Essential reconnaissance technologies**
- **Launchers / Landers / Transit Systems**
- **The machine phase**
- **The human enablement phase**
- **The 'mobile home' phase**
- **The 'cave dweller' phase**
- **The 'trailer park' phase**
- **The 'hamlet' phase**
-

Consider what we must not do

- **Kill those bold adventurers - real risk - hence the essential role for machines**
- **Fail to consider the harm and duress that these adventurers will be exposed to**
- **Fail to appreciate the enormity of the challenge as presented:**
 - **Politically**
 - **Financially**
 - **Scientifically**
 - **Technologically**
- **Fail to manage the uncertainty and the risk**



The rationale for OWLI



- UCL was founded on principles of being radical, realistic and exploratory
- It is now a large and 'full' university with excellent connections across sectors and geographies
- Off World Living is a topic that is 'ripe' for UCL to focus on and contribute to
- Research:
 - Evolving the known - engineering / architecture / anthropology / laws / policy
 - Developing the emerging - autonomous robotics / new material creation (e.g. regolith + lunar water) / AI/ML / 3D printing
 - Founding the new - OWL new scientific areas, e.g. 'one-stop' autonomous 'local' material creation, manipulation and habitat formation
- OWL will require collaboration and cooperation at a scale rarely seen
- Owning OWL is not the point - contributing to it is
- At an OWL workshop held in May 2021 with ESA we touched upon:
 - Recognised that ESA/NASA et al are 'committed' to getting humans to the Moon and on to Mars
 - Considering extreme environments: from humanitarian relief challenges to advanced knitted fabrics for the suits needed for long space voyage
 - That this endeavour is going to involve all sectors: public, private, academic, non-profit, citizens
 - That notions of Off World "Living" are circa 100 years away - the challenge is that great and the fear of failure that strong



- Owls sit well in trees
- OWLI sits well at UCL
- UCL with OWLI has potential for the next 100 years to:
 - **T**each new students OWL issues, challenges and topics - and how we can apply them to our precious planet at a precarious time
 - **R**esearch the many (many) topics that we will need to master
 - **E**ngage with those fascinated by OWL
 - **E**nterprise opportunities for new invention, innovation, collaboration and knowledge exchange



So, what have we learned?

- If humans can – humans will try
- Our state of knowledge, technology and confidence is driving the quest to get humans to the Moon and then to Mars
- To achieve the quest of off world living will require tenacity, collaboration and new solutions and discoveries – with potential payoffs for our planet at a time of need
- The role for a university such as UCL in considering ‘all things OWL’ is clear, obvious and truly exciting