Did we *really* land on the Moon?...













Dr Martin Hendry University of Glasgow

Who am I?...

Senior Lecturer, Director of Teaching in the Department of Physics & Astronomy

(the Kelvin Building)





William Thompson (Lord Kelvin) 1824 - 1907

University of Glasgow









William Thompson:

- Attended Glasgow and Cambridge before appointed Professor of Natural Philosophy at Glasgow in 1846 (aged 22!)
- Made fundamental contributions to our understanding of energy and temperature, electricity and magnetism.



- Wrote more than 700 scientific papers, and held 70 patents.
- Pioneering work on telegraphy allowed the first transatlantic cable to be laid, making him a very wealthy man.
- Appointed Lord Kelvin in 1892, first ever 'Scientist Lord'





Lord Kelvin didn't *always* get things right....

- 1895 "Heavier-than-air flying machines are impossible."
- 1897 "Radio has no future"
- 1903 "X-rays will prove to be a hoax"



But overall, he was one of the most influential scientists of all time.







Kelvin's approach put **observation** & **experiment** at the centre – revolution in how we teach science, from pre-school to PhDs !!





Kelvin believed passionately that:

- Science is fun
- Science is fundamental
- Science is practically useful



"The life and soul of science is its practical application"

• Science is all around us

"Blow a soap bubble and observe it. You may study it all your life and draw one lesson after another...from it."

His work extended a legacy stretching back to Galileo.







THE UNIVERSE YOURS TO DISCOVER

INTERNATIONAL YEAR OF ASTRONOMY 2009









•In 1609 Galileo observed:

- craters of the Moon
- phases of Venus
- moons of Jupiter
- sunspots on the Sun's disk
- the stars of the Milky Way





















Gravity Discovery Centre

http://www.gdc.asn.au







http://www.scottishsolarsystem.org.uk





















"Science Fair" projects for primary schools:

- West Dunbartonshire
- East Dunbartonshire
- South Lanarkshire
- North Ayrshire
- Glasgow
- Scottish Borders

Organised in collaboration with the **Scottish Network for Able Pupils**.

Projects aim to build:

investigative skills, critical thinking, IT proficiency, presentation skills







Science Fair Project Format:

Session One (half-day)

Coordinator (MAH) introduces topic to groups from 6 – 8 schools:

- Range of possible project activities highlighted
- Pupils begin web exploration, via project website
- Q&A with mentors; groups select provisional activities.

Project work carried out in schools (approx. 6 – 8 weeks)

- Pupils work in a team, supported by mentor (~weekly meetings)
- Additional support from GU scientists via dedicated email address

Session Two (half-day)

- Pupils present their work to other schools, teachers, VIPs, astronomers
- 'Science Fair' format: builds presentation skills, teamwork















Extra-terrestrial life: Is there anybody out there?... Dr Martin Hendry University of Glasgow

http://www.astro.gla.ac.uk/users/martin/etlife/

1. Grow crystals from **evaporating** salty water



The tiny salt deposits seen by *Opportunity* may have been left behind when an ancient, Martian salty ocean slowly evaporated away.

You can grow your own salt crystals, exploring how they grow, and what shapes and crystal patterns they make!

Learn how the other evidence found by the NASA rovers strongly points to past running water on Mars





2. Build your own spectrometer

The tiny grooves in a CD make its surface a good spectrometer – splitting up light into its colours and spectral lines.

Make a spectrometer from a CD and a cereal packet, and use it to search for the spectral lines in sunlight, streetlights and even lightbulbs in your home.



Learn how spectral lines can tell us what stars and planets are made of.





3. Build your own 'face on Mars'



Make your very own Martian 'optical illusion': using e.g. clay, plasticine or even paper, craft a landscape which – in a certain light or from a certain angle resembles a surprising shape – but when seen more clearly is nothing out of this world!

Learn about other sorts of optical illusions, and how easily fooled our brains can sometimes be!





4. Make a scale model of the Solar System



Using everyday items found in your home or classroom, build a model of our Solar System showing how big – and how far apart – the Sun and planets would be on your chosen scale.

On the same scale, work out where the nearest stars would be, and how long it would take us to travel there.





5. Explore the 'centre of gravity' of a see-saw



Find out how this same rule lets us measure the masses of other planets.





6. Find out about 'hot Jupiters'



Learn more about the very large, hot planets we have found orbiting other stars.

Why are they so hot?

How do we think they formed?

What is happening to their atmospheres?

Could we live there?...





7. Learn about the planets that 'Kepler' might see!



What makes the Kepler satellite special, so that it could find Earth-sized planets?

How will Kepler tell us the size of the planets it finds?

How will we tell what the planets are made of?





8. Work out how many ETs there are in our Galaxy



In 1960 astronomer Frank Drake devised a formula, now called the Drake Equation, to calculate how many alien civilisations there might be in our Milky Way galaxy.

There are lots of parts of the formula that we're unsure about, but it is fun (and instructive) to predict how many ETs we think could phone us!





9. Find out how life could be *wiped out* from space



If life does exist out there, maybe it doesn't last so long...Even on the Earth there have been regular **mass extinctions**, and many astronomers think they were caused by impacts or radiation from deep space.

Learn about the different threats from space, what risks they present to us here on Earth and what we are doing to protect ourselves!





10. Compose your own message to ET!



If you could talk to an ET, what would you say? How would you describe life on Earth? How would you describe *your* life?...

Learn more about the language of mathematics and science used on the Voyager 'Sounds of Earth' disk.

Think about how you could use this language to compose *your* message.





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Top ten Moon Hoax theories



1. The Waving Flag?



Although there is no air or wind on the Moon, hoax theorists say you can see the American flag waving, as if being blown by a breeze.

Some questions to think about

- · What could be causing the flag to wave?
- Is there anything strange about the Apollo flag?
- · What would a flag really do on the Moon?

2. No stars?



Despite being taken in the "clarity of deep space", the Apollo photographs show no stars in the lunar sky.

Some questions to think about

- · Should we see stars in the Apollo photographs?
- · What determines if we see stars in any photo we take at night?
- · What sources of light were there on the Moon?







3. Strange shadows?



The shadows don't appear parallel in the Apollo photographs, which some hoax theorists say mean they were shot in a film studio, with multiple light sources.

Some questions to think about

- Do we expect shadows in photographs to run parallel to each other?
- · If there were bright studio lights, what would the shadows look like?

4. Slowed down film?



The hoax theorists claim that video footage of the astronauts, when played at twice normal speed, looks as if it was filmed on the Earth – suggesting (to them) the faked videos were played in slow motion.

Some questions to think about

- Does the Apollo film really look like it was shot on Earth?
- · How manoeuvrable would their spacesuits be on the Earth?





5. Disappearing crosshairs?



The hoax theorists point to photographic 'cross hairs' that appear *behind* foreground objects (as if drawn on a studio wall?...)

Some questions to think about

- · What are the cross hairs supposed to be?
- · Is there any pattern to the photos in which they appear behind things?

6. Lit in the shade?



Despite (they say) the Sun being the only source of light, astronauts are still clearly visible, even when they should be in deep shadow.

Some questions to think about

- What are the sources of light in the Apollo photographs?
- · Would we expect there to be deep shadows on the Moon?





7. Dust problems?



Hoax theorists claim the Lunar Excursion Module (LEM) rocket engine would have left a blast crater, and blown away all the dust from the surface, so no astronaut footprints would be visible.

Some questions to think about

- How rapidly would the LEM descend? Would it make a blast crater?
- How would dust thrown up by the LEM behave on the Moon?

8. Radiation?



According to the hoax theorists, the Earth's "deadly" radiation belts would have killed the astronauts long before they reached the Moon.

Some questions to think about

- Where does the radiation in space come from? What kinds are there?
- What would different types of radiation do to an astronaut?
- What if the astronaut were going to Mars? Onboard the ISS?





9. Identical backgrounds?



The hoax theorists point to photographs which appear to have identical backgrounds, but very different foregrounds, as if a studio set was accidentally re-used?

Some questions to think about

- How far can we see on a clear day? How can we judge distances?
- What happens to our view of nearby and distant things when we move?

10. No fuel jets?



When the LEM takes off, no fuel jet is visible, making some hoax theorists claim it looks like the LEM is being pulled up by a wire.

Some questions to think about

- · Do all fuels burn with the same colour of flame?
- When might we not see a burning flame, and how would we still know it was there?





































Project summary:

- More than 50 schools participated so far
- Wide range of activities undertaken exploring diverse scientific topics: gravity and forces, materials science, mechanics and engineering, colour and spectroscopy, atmospheric pressure and evaporation, air resistance, geometry and optical illusions, radiation, distances and scaling relations.
- Excellent grasp of experimental methodology: control principle, importance of reproducibility, documenting of procedures, consideration of alternative hypotheses.
- Varied and innovative presentation styles: laptops, short video segments, demonstrations, models, posters, etc...
- The participants had fun!











If you would like to find out more about Moon Hoax theories, or get involved in Science Fair projects, please get in touch!

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