KAREN FOLEY: Hello, and welcome back to the Student Hub Live. OK. This is the last of our evening sessions, sponsored by popular post-it note manufacture and sellotape maker. No, no, it's not. Sorry.

But we're going to talk about the three M's. We've got lots of people here from the science department. And we're going to talk about moons, Mars, and Mercury. And joining me in the studio are Simon Kelley -

SIMON KELLEY: Hello.

KAREN FOLEY: - Susanne Schwenzer, and David Rothery. David, we've had some confusion from the quiz about Titan. Can you clear any of this up for us?

DAVID ROTHERY: Titan is the largest moon of Saturn with a dense atmosphere. Some people may have seen the video about it just now. It has lakes of methane mixed with ethane on the surface and it rains methane from the sky.

Tritan is the big moon of the planet Neptune. And it's got a polar cap of nitrogen ice.

KAREN FOLEY: OK.

DAVID ROTHERY: Both fascinating bodies.

KAREN FOLEY: Yes. No, well there was some confusion there in the quiz. But we hope our John Zarnecki's video that we showed earlier has cleared some of that up for our panel at home. And well done in the quiz. You were very good. Where were you supposed to be last night, though? You were supposed to be at the quiz?

DAVID ROTHERY: I was supposed to be a contestant in the quiz last night. But about lunch time, I was rung up by ITV news, saying, can you come into the studio? There's a NASA a conference.

NASA put out a statement about five days ago saying, we're holding a press conference, 7 o'clock British time, about surprising activity on Europa. Europa is one of the moons of Jupiter.

KAREN FOLEY: So you just dropped the Wheel of Ologies quiz.

DAVID ROTHERY: I dropped the Wheel of Ologies.

KAREN FOLEY: And what was the news all about, then?

DAVID ROTHERY: It wasn't sufficiently surprising or exciting for them to actually use the piece, sadly. But scientifically, it was good. Europa's, think of Europa. It's slightly smaller than our moon with about 100 kilometres of all ice mantling it. And the bottom of the ice is molten water. Minus 160 degrees at the surface, but it's warm enough for water below.

So you've got an ocean sandwiched between warm rock and cold ice. And we think there could be life there. Hot springs on the ocean floor. And all things growing in the tidal cracks that open and close. So it's an exciting place.

And Back at the end of 2012, they found what looks like plumes erupting from it. This is a view. The main picture is from a spacecraft close by. But that cluster of blue pixels at the bottom is from the Hubble Space Telescope. And the ultraviolet's se seeing a glow near the south pole of the planet. But out in space.

KAREN FOLEY: So how come they dropped the story, then?

DAVID ROTHERY: Well, this was what we used to, all we used to know about plumes. On one occasion, they saw this stuff erupting through the ice. Last night, what NASA revealed was a different technique. And that's Europa in front of Jupiter. And their is some absorption of the light coming from Jupiter around here. It's three separate plumes erupting. So water gushing into space at three sites.

And it's interpreted like this. Here you go. This is a cross-section of the outer part of Europa, somewhere near the south pole. Here's the rocky interior. Here's the ocean. Here's the solid ice and here's the crack through the ice. And water's getting out into space.

And if this is occurring, it's cheap and easy, relatively speaking, to go and sample that water and whatever's being thrown out. We don't have to land. We just have to fly by, scoop it up, sniff at it.

SIMON KELLEY: Are these cracks, David, that are opening and closing, or single volcanoes?

DAVID ROTHERY: Well, we don't know. But all we've seen on the surface, in quite high detail, is cracks. You don't see vent like volcanoes. You see cracks.

And there's a moon of Saturn called Enceladus, which has plumes erupting all the time. We have a spacecraft orbiting Saturn at the moment called Cassini. And this is seeing stuff

erupting through crack-like features.

So we're pretty sure now that Europa is like Enceladus. But it's not a surprise. These guys found what they were looking for. It was over-hyped by NASA, basically, saying surprising activity.

KAREN FOLEY: Well, it sounds very interesting. The thing about you guys is that you're always going to press conferences. There are always so many exciting things going on. And I think students are saying, oh, we love studying space and we really want to go and do these things. And there are MOOCs and all sorts of things going on.

But perhaps what they don't know is that The Open University are involved with a lot of missions, with developing a lot of instruments. Can you just give us a brief overview, in terms of what the involvement is, broadly speaking, with some of these things going on?

SIMON KELLEY: The OU has been involved in missions for decades now. Actually, I was just thinking, relating to our moon, what they're talking about doing with this is flying a spacecraft through a plume, which is, in fact, what they've already done on the moon.

DAVID ROTHERY: Yes. We've impacted into the moon to throw up some dust. And we've found water ice and flown through it. Yeah.

SIMON KELLEY: So the Open University is famously involved with the Beagle 2 mission, which was to Mars.

KAREN FOLEY: In fact, that was in this studio, in this very space.

SIMON KELLEY: Yes.

KAREN FOLEY: We had to move it out. But that's by the bar.

SIMON KELLEY: Too many men in white suits. But more recently, we were involved in the Titan. Because John Zarnecki, who was a professor here, was involved in the surface package that dropped onto Titan. It lasted, what, a few minutes?

DAVID ROTHERY: It survived all the way through the atmosphere. It lasted a couple of hours on the surface, I think, before the battery ran out.

SIMON KELLEY: But it measured the surface, it measured what was there, it took the pictures. So, a very important piece of work.

And the thing that was actually built by the OU scientists were the penetrometer, which actually told us something about what they were landing on. They wanted to know if they were going to land on creme brulee, in other words, something with a crisp surface and the soft underneath. Or stones or whatever.

KAREN FOLEY: Very scientific. Don't get our audience on about cakes. They will get terribly sidetracked.

SIMON KELLEY: Creme brulee is a very important concept. It's scientifically proven. It's a very important concept. The crust on the top. And you've got to get the crust right.

Also, of course, more recently, we've been involved in the Rosetta mission. The instrument that was measuring organic molecules on the surface of a comet, again, Open University scientists. Part of the same team, several of the guys that I know who were part of the Beagle team were also working on Rosetta. We're now involved in the Mars -

SPEAKER 1: Trace gas orbiter.

SIMON KELLEY: The trace - I was trying to remember the name of it. The Trace Gas Orbiter, which is just about to start measuring methane in the atmosphere above Mars. And we're also involved in planning for a mission to actually go to the moon again.

KAREN FOLEY: Again. Excellent. So lots and lots going on. And in fact, we have a Student Hub Live event on Mars at the end of October, which will be very interesting, indeed. So Susanne, tell us about, then, what's happening with Mars.

SUSANNE SCHWENZER: Well, Mars is a very interesting planet at the minute because we've got lots of orbiters around. Trace Gas Orbiter will arrive soon and start its mission. Maven has just started, which is also looking at the atmosphere of Mars.

But then there are also two robots active. One is the Opportunity Rover, which has long outlived its lifetime. Because it was made for 90 days and over 10 years later, it's still growing. So that's pretty good.

But there's also Curiosity, which is on the Martian surface since August 6 of August 2012. And exploring Gale crater. And we have found quite a bit of very interesting things there, including, of course, evidence for water. Which is always very interesting if you look for a habitable environment, ask the question, can anybody have lived there? Anybody always means microbes, in that context. And also other questions about the Martian climate change and

generally, how does Mars look today.

KAREN FOLEY: Excellent. Let's go to the Hot Desk and see what people at home are talking about. Sophie and Kate.

KATE: As we expected, there's lots of chatter going on. People seem really interested in this. Had a couple of questions. One from Simon, saying, what problems would we need to overcome to base humans permanently on the moon? And a related one from Sylvia about people going to Mars and whether it would be difficult for them to get back to Earth. I don't know if anyone can answer those questions for our students.

SIMON KELLEY: I think we can take some of them. The main issue with being on the moon is, well, the first thing is getting to the moon. And strangely enough, the issue about that is how much water you can take to the moon. The moon has very little water. And so the big problem is actually getting from the Earth to the moon.

We now know that there's water on the moon. So there is actually a really important resource. And you can use water in all sorts of ways, not just drink it, not just make ice cubes out of it. You can actually use it and break it down and use it as a fuel.

KAREN FOLEY: But do we know how much water?

SIMON KELLEY: In terms of -

DAVID ROTHERY: Several Olympic swimming pools worth, which is not a lot, but plenty to drink if you recycle it all the time.

SIMON KELLEY: Yes.

KAREN FOLEY: Ah, OK.

SIMON KELLEY: Yes. There's a long discussion about the International Space Station, how many times they recycled the water and how it gets recycled. But you don't want to go there, probably.

KAREN FOLEY: No, we certainly don't. Not after what Libby told us today. She's hooked on the Student Hub Live and she's been taking her laptop all around the house everywhere, even to the you-know-where. So we're not going to have any sort of discussion about toilets.

SUSANNE Yeah, but Mars is quite interesting in that sense, as well. Because you have additional

SCHWENZER: problems. When you're on the moon, you still can see the Earth and it's this beautiful blue marble in space. If new travel to Mars, our Earth would be a tiny dot of light. And we do not know what this does psychologically to people in that spacecraft.

SIMON KELLEY: There are some practical problems, as well. Because if you're going to be on the moon for any length of time, you either have to take all the buildings with you or you have to build. So there is actually a guy in the Open University doing research on how you use a 3D printing system to print yourself a house.

KAREN FOLEY: Wow.

SIMON KELLEY: Or print yourself a shelter using the moon rocks, the dust that's on the moon. The moon is covered in a very, very fine dust, which you can make stick together just by heating it. And so there's a system you could use to actually print yourself a house.

DAVID ROTHERY: It's very, very expensive to get stuff off the Earth. The Earth's got strong gravity. Get it from the Earth to the moon. You want to take as little as you can get away with. You need to use the resources that the moon provides. Otherwise, it's going to be prohibitively expensive.

KAREN FOLEY: Our audience are having trouble getting to comic-con, which is the first mission they've decided to go on together. But still interested in travelling further afield they are.

But what is this obsession with people wanting to go and live on other planets? It's perfectly reasonable here. Despite the whole climate change thing going on, why is there this persistent idea that we should go and live somewhere else?

DAVID ROTHERY: How long term do you want to think? We're all geologists. I know that asteroids hit the earth very, very rarely.

I know that super volcanoes erupt every 100,000 years or so. That's the likeliest thing to happen. You'll turn the sky black, you'll lose photosynthesis, you'll lose one or two growing seasons' worth of crops.

We won't go extinct at such an event, but would our civilisation be robust enough to survive global famine for two years? You don't really want all your eggs in one basket. So we need to be self-sufficient somewhere else if we're serious about surviving, as a technological situation, in the long term.

SUSANNE SCHWENZER: There is also that we are all natural explorers.

SIMON KELLEY: I think it's also, what horizon? But when man wasn't flying, when man wasn't going to the moon, people went and climbed mountains. People went to extreme things. They explored the poles because it was the outer limits of where you could go to.

It's humanity's desire to push beyond. Now we know we can reach the moon, so we're talking about how do we reach Mars. And then how do we travel to other parts of the solar system? And then it's always what is the impossible thing that you can't do? So OK, let's go and try and do it.

KAREN FOLEY: OK. But there's more to, I guess, what's going on in space than just the missions. Because there's a lot of work being done on the instruments to measure things. So in addition to humans going, we're also trying to, as you say, research what's actually happening. To see, I guess, what's viable, in terms of potential planets or moons that we could look inhabiting.

The Open University are developing some really interesting instruments measuring things. Can you tell us a little bit about some of those? And some of the rovers, maybe, that you mentioned, as well? So things that are going on, in terms of how we get things from here up into space, and then what they're measuring.

SIMON KELLEY: Do you want to do rovers?

SUSANNE SCHWENZER: I could do rovers. Beagle was a lander. There are two different kinds of spacecrafts. There are landers that just have feet and there are rovers. Simon is just holding one up. That's the Curiosity Rover. That's the NASA Rover, which is currently at Gale crater.

And the picture here is, so to say, a selfie. Look what I have just done. Because just down here, these little spots they are the first scoops of soil that Curiosity took and sampled and analysed to see what is the Martian soil looking like, what's in there.

And we want to know this because the long goal of exploring Mars is to find out, could microbes or even more advanced life have lived on Mars? We know that Mars, in its very early history, was warmer and wetter. Because we know that there was water on the surface of Mars. And that there was flowing water on the surface of Mars.

Simon is doing a very good job here.

KAREN FOLEY: He is excellent, isn't he? Yes.

SUSANNE SCHWENZER: Because what you see here are rocks with lots of little, little round pebbles. And these round pebbles show us that the water was actually flowing on the surface and we can count these pebbles and we can see how round they are, actually. And so we found out that this stream that put these pebbles down there was about knee- to hip-deep, and a fairly fast, flowing little stream.

SIMON KELLEY: I can remember a few years ago when they first took the picture. I remember that Susanne spent the whole weekend counting pebbles. Very exciting.

SUSANNE SCHWENZER: Yeah. And that's because, in the spacecraft, you only get the picture. If this were a stream on Earth, I would just go and I would take a scoop and I would sieve it. And I would just weigh the different categories of gravels.

Because the distribution, how many big ones and how many small ones I have, tells me about this stream. How deep was it, how fast was it flowing? And so because I can't do that here, I needed to count them.

KAREN FOLEY: Let's go to the Hot Desk.

SOPHIE: We've had loads of really good questions in. A lot about water, actually. Relating back to Mars, Carrie's asked, where did all the water in Mars go?

DAVID ROTHERY: Good question.

SUSANNE SCHWENZER: That is a very, very good question. Because part of the answer is we don't really know all of it. We know part of the story, but we don't know all of it. Partially, parts of the atmosphere got lost, in two ways.

First of all, when the planet was hotter than it is today and in the very early history, part of the atmosphere just got lost to space because the gases, the individual molecules, would be fast enough to just leave the gravity of Mars. But by the time everything cooled down a little bit, that process had slowed down. We can still see it when we measure the isotopes, and that is what the Trace Gas Orbiter is going to do.

SIMON KELLEY: It's difficult to imagine, but actually, Mars is quite a lot smaller than the Earth. I can't remember the exact dimensions, but -

DAVID ROTHERY: Half the size.

SIMON KELLEY: It's half the size or smaller.

DAVID ROTHERY: 1/3 the gravity.

SIMON KELLEY: It's 1/3 - yeah. You'd weigh less. You'd weigh a third of your current weight if you were on the surface of Mars. So that has its advantages.

KAREN FOLEY: That is a benefit.

SIMON KELLEY: But it means that water molecules escape more easily from Mars than they do from Earth. They escape more quickly, so it's dry. It's now incredibly dry.

SUSANNE SCHWENZER: Yeah.

DAVID ROTHERY: Well, there's plenty of frozen water as ice in the polar caps and in the subsoil.

SIMON KELLEY: Yeah.

SUSANNE SCHWENZER: That is true, too. So we have some that's locked up there and you could unlock it if you heat it. For example, with a volcano or when a big, big rock slumps into the surface and makes one of these craters that we observe on the surface of Mars. Then you could unlock it for a while before it freezes again.

But some of it also, in these very big impact events, could have just gone lost to space. So there are lots of processes and we understand some of them. But unfortunately, not all of them. And that's why we send things like -

SIMON KELLEY: But I think the early, the way that Mars's history is described, the early part of Mars is described as wet.

SUSANNE SCHWENZER: Yeah.

SIMON KELLEY: There's different names for the different eras. And the first part is actually, describes it as a wet planet.

SUSANNE Yes. And the picture you just held up is from that early era.

SCHWENZER:

SIMON KELLEY: The rocks are.

SUSANNE SCHWENZER: The rocks are. Yeah.

KAREN FOLEY: OK. Let's take a look at Mercury, then. Because we've been talking a bit about Mars and the moon. And I know that you are very keen on the moon's MOOC, which you are often plugging, aren't you?

DAVID ROTHERY: I'm the educator on the moon's MOOC, but both Simon and Susanne helped me write it.

SIMON KELLEY: Actually we were all involved in it.

KAREN FOLEY: Yeah.

SIMON KELLEY: When it was originally built.

DAVID ROTHERY: But my research is mostly on the planet Mercury. Because I'm involved in the European Space Agency's mission to Mercury, which is called BepiColombo, which is launching in less than two years' time now. It'll get there in 2024 and start doing science orbiting Mercury for at least a year and if we're lucky, three or four years. But there has been a NASA mission there already.

So here is what the NASA mission messenger saw. It's orbited for four years before it descended to the surface. And I've got two more views at progressively higher and higher resolution.

It's an exaggerated colour here. It's not really this colourful. But you can see there's variation. This pale area here is the biggest impact basin on the planet. It's called the Caloris basin. It's filled with lava. But the blue and the red areas outside of lava as well. It's a very volcanic planet.

And it doesn't quite stack up. Because as well as all the volcanic activity, there are lots of volatile elements. There's too much sulphur, there's sodium, there's potassium. And there's stuff we don't know what it is, but we can tell it's mobile and volatile. It shouldn't be like that, close to the sun. We want to understand why.

So if I just go to the edge of the Caloris Impact Basin and show you what it looks like, well,

here's the whole basin for starts. And there's some little red patches around the edge, which maybe the camera can pick up. When you go close into those, they're actually volcanic vents.

That's a hole in the ground, which isn't an impact crater. It's not around enough. But it's in a volcano, where there's been explosions at several different points, sequentially, throwing out this red stuff across the surface. And there are more volcanic vents here.

It's a weird place and I'm writing a paper at the moment about how the blue lavas are cascading down a kind of waterfall. Or they were cascading down a kind of waterfall from the high ground into the basin. It's got a very exciting history if you're a volcanologist like me.

And there's loads of other things which don't stack up. And there's a British instrument going on, BepiColombo, which was built mostly by my colleagues at Leicester University. It's an x-ray Spectrometer and it's using x-rays to look at Mercury.

It's not seeing through Mercury, like when you break a bone. And it's x-rays from the sun striking the surface and making Mercury fluoresce back in x-rays. And from the fluorescence, we can measure the abundances of several different elements at the surface.

And we'll hopefully try to understand what it's made from and work out how it came to be like it is. Because it just doesn't stack up. I've got a PhD student who's described this as the problem child of the solar system, which I think is a great phrase. If anybody at home's got a problem child, they'll know what I'm talking about.

KAREN FOLEY: You're using so many different sources of information, in terms of some of the instruments that are measuring things. And here, you're talking, I guess, about a very visual pictorial image that I guess you're getting from a NASA mission. How exciting is that when you get some of this data, and then you're wildly speculating about what all of this could mean, I guess, with a lot of other people in the global community? What happens when you get some of this?

DAVID ROTHERY: Well, you're quite right to suggest that it's many different kinds of information. This is a colour photograph and you can only go so far with that. There are measurements you take, as well.

You look at the different wavelengths of light and how they're reflected. You look at the magnetic field. You look at the x-rays fluorescing. You look at the thermal infrared coming off, which Messenger didn't do, but BepiColombo will.

You look at the gravity, you look at the topography. You have to fit it all together. There's no

one single instrument that will work it all out.

SIMON KELLEY: But you're also getting elemental information. You know how much, you know, roughly, the amounts of iron and magnesium and things like that, as well.

DAVID ROTHERY: We know the elements which are there and we know what minerals, what crystal structures they're bonded together in. And we know the grain size at the surface. And we try to measure as many properties as we can because the data are always ambiguous somehow. But if you've got several independent lines of evidence, you can get a consistent story.

KAREN FOLEY: I was talking with Hazel Rymer last night about this and I was asking her about the various sources that she measures. And asking her whether she'd like to go into space to look at volcanoes. She said no. But someone's got to do it.

And I was asking her about how she got into this. And Davin would like to know what inspires you, which incidentally, as I'm sure you're aware, she didn't really intend on being a volcanologist. She just somehow got into it.

So being in space, that's clearly a very glamorous job, going on the news all the time. What got you guys into it? asks Davin.

SIMON KELLEY: I'm not a space scientist. I'm, at heart, a geologist. I'm interested in rocks and I've been obsessed about rocks and understanding the earth since I was very small. If you go back and look at my first-ever school project when I was seven, it's about volcanoes and about dinosaurs. And I picked up crystals and I picked up things on the holiday. So I'm afraid I've been like this since I was very young.

KAREN FOLEY: Like many academic careers, it all seems very glamorous. But I actually think, deep at the heart of it, there's a lot of hard work and grafting, isn't there?

SIMON KELLEY: You've got to enjoy just the basic understanding. There's nothing as interesting as being the first person to pick up a rock and understand it. And actually be able to interpret and say, actually, I know what happened here. I know what was happening when this rock was formed.

And it's the same as what Dave's doing with Mercury. You can look at that and you say, actually, no, I know what that means.

DAVID ROTHERY: Susanne, with the rounded pebbles on Mars. It's the same as a geologist does on the ground.

You know that to move something that size, you can't blow it by wind. You know it's been transported and the corners have been knocked off. It has to be flowing water. It's just applying geology that we learn here on another planet.

KAREN FOLEY: So what got you into it, Daven, then?

DAVID ROTHERY: Well, I wasn't a geologist as a lad. I wanted to be an astronomer. I borrowed every book I possibly could by Patrick Moore from the library. And I used to go with my binoculars looking at stars and so on. And I went to university to do physics, but fell in love with geology. Well, also, I couldn't cope well enough with the maths that they require at Cambridge, to be honest.

KAREN FOLEY: Yeah, yeah. Now we get to the bottom of it.

DAVID ROTHERY: But geology is great and you do need maths for a scientist, so carry on working hard at it. Physics, the maths they wanted me to do was ridiculous. So I became a geologist. And it's great going out, mapping an area, trying to understand.

And I was able to go to Arabia and map part of Arabia, using images from space to help me, which was great. And now the tables are turned and I'm actually using satellites around other planets to do geology there. So I'm back in space. So I've had an interesting ride.

KAREN FOLEY: In a roundabout way.

DAVID ROTHERY: Yeah. I enjoyed it.

KAREN FOLEY: Susanne, what about you?

SUSANNE SCHWENZER: Well, I was mostly interested in analytics. I wanted to do chemistry, but in my year, there were so many people and it was really hard to get a place in chemistry. And so I thought that mineralogy is actually inorganic chemistry, but there were very few people every year. And you got to work with all the fancy instruments because they were much less students and the ratio of student to professor was much better for the student.

And so I started mineralogy. And I really fell in love with analytics, with chemistry, with getting those numbers that help us understand these rocks. And when I was looking for a PhD, it was mainly the instrument about noble gases, measuring noble gases, which is a very rarely used technology, that got me interested. That this came on Martian meteorites, that was the icing on the cake.

KAREN FOLEY: OK. So it's all been a massive fluke, but some of our students, they will be saying, I want to be studying science. And Susanne, you came and told us about some of the moon rocks, which I know Simon wants to talk about, as well. And how we're using a virtual microscope to actually allow students and, in fact, anybody to have a look at some of these and to make measurements and to collate data. This is an exciting way that we're, I guess, enabling people to study and to get a piece of space. Could you tell us a bit about that, Simon?

SIMON KELLEY: Yeah. We've been talking about looking at things at a distance and what you can do. There's absolutely no substitute for getting something in your hand.

So you may not be able to focus on it, but I'm just going to, there's a very thin piece of glass and stuck to the surface of that very thin piece of glass is a rock which is ground so thin you can see through it. Susanne, you can hold that one. That's a larger one, where you can see writing through it.

SUSANNE SCHWENZER: But yours is from Mars.

SIMON KELLEY: This is a piece of Mars.

KAREN FOLEY: Wow.

SIMON KELLEY: What I'm holding there is not a moon rock. It's a piece of Mars.

KAREN FOLEY: How did you get that?

SIMON KELLEY: It's a meteorite. There are a class of meteorites, we'll come back to that, I promise.

SUSANNE SCHWENZER: Yes.

SIMON KELLEY: There's a class of meteorites which we know are from Mars. Several classes of meteorites. The point of showing this is, this a thin section. This is how we study rocks, as a standard on the virtual microscope.

So you can hold that one. On this website we've created, for students to use, to look at rocks. And the wonderful thing about digitising these images which are just pictures of these very thin sections with light shining through, you can discover and understand all sorts of things about rocks.

But you can do that from rocks from Earth, but you can do that with rocks from the Moon. The difference between Mercury and Mars and the Moon is, on the Moon, we've been there. People have been up there. Apollo 11 landed in 1969, in July. They jumped out of the pod. "One small step for man, a giant leap for mankind" kind of stuff.

They were on the surface for a whole two and a half hours. And in that time, they collected about 40 rocks. NASA still have those rocks. And so what the Open University's been doing is working with NASA to digitise the images of those thin sections. So lots of little things like this.

KAREN FOLEY: They are beautiful, aren't they?

SIMON KELLEY: When you look at them in different light conditions, you get these rather beautiful pictures. And some of the students watching are maybe thinking about earth sciences. Some may be thinking about all sorts of different subjects. But these images are just beautiful, from the colours, from the shapes, from the textures. And I think you can appreciate beauty in these without actually needing to understand them.

KAREN FOLEY: Yeah, absolutely. Aside from making a nice screensaver, what would be the point of -

SIMON KELLEY: Oh. Been there, done that.

KAREN FOLEY: Yeah. What would be the point of going and looking at some of the things? What might people be measuring or looking for?

SIMON KELLEY: With something like that, you can measure crystal sizes because the virtual microscope has a built in measuring. You can understand what crystals are. Dave was talking about the sorts of minerals that you get on Mars. Well, you can tell looking at a rock like that. You look at it and you might see beautiful blues and oranges, and I see pyroxene and I see plagioclase and minerals. Because I know how to recognise those minerals.

And when the guys jumped out on Apollo 11, there are two types of rock. There's this kind of rock, which is a smashed up mess of rock that's been pulverised and melted and remelted. And if you go on the virtual microscope, you'll see lots of these.

There are basically two types of rock in the Apollo 11 collection. These smashed up ones and beautiful bath salts like that. So that's a lava flow. This is a lava flow that's been broken many, many times by meteorite impacts.

KAREN FOLEY: With these meteorites, then, how do you know where they're from?

SIMON KELLEY: These were collected on the moon, so these are, we know where they come from because we collected them. I'm going to let Susanne talk about Martian meteorites. That's called passing the buck.

SUSANNE SCHWENZER: Yes. The Martian meteorites, we had in our collections long before we knew they were from Mars. And it took the Viking spacecraft, in 1976, to land on Mars and measure the Martian atmosphere.

And in Simon's picture, you saw that black. That black is actually glass that is happening when a rock smashes into a planetary or lunar surface. And on Mars, when there is also the atmosphere around, you press this atmosphere into this glass and the meteorite that then flies off Mars and comes here will have a piece of this glass. And in this glass, we found the Martian atmosphere.

And because the Martian atmosphere is very special, now I come back to the noble gases that I did for my PhD. There is the noble gas, xenon, and that has a very, very special composition. The isotopes, for those who still remember their chemistry A-levels, the isotopes of xenon are very special in the Martian atmosphere. And we found that very same, call it a fingerprint that Viking saw on Mars in the atmosphere in these meteorites. And that actually connected the two.

KAREN FOLEY: OK. So Stuart, that's a little bit more complicated than having "Made on Mars" on the back of it, I'm afraid. And it takes a specialist, I guess, to do it. Dave, can we have a final word from you?

DAVID ROTHERY: Well, I can talk a little bit about water on Mars if you like. Because here we have Mars and here we have some water on Mars. And you saw it here first.

KAREN FOLEY: This is terrible. This is not on not on at all.

DAVID ROTHERY: Water on Mars keeps being discovered. It's a bit of a joke because when the first spacecraft went there, they saw craters. But subsequent spacecraft saw channels carved by flowing water, valley networks. Oh, there's water on Mars. And then you find that the polar caps have water in.

And then you find gullies, which appear to be formed by flowing water. Then you find minerals,

which have been hydrated. And then you find little damp patches that seep down the slopes. We found water on Mars how many times?

SIMON KELLEY: There's also the scoop.

SUSANNE SCHWENZER: 15 or 20?

SIMON KELLEY: Do you remember the scoop that scooped up and there was ice just under the surface?

DAVID ROTHERY: Absolutely.

SIMON KELLEY: That's, again, water on Mars.

DAVID ROTHERY: Yes. We found water on Mars many, many times.

SIMON KELLEY: At least half a dozen times.

DAVID ROTHERY: People are now saying we're going to find plumes on Europa time after time after time. The way NASA are hyping it, it's the new water on Mars via the plumes on Europa.

KAREN FOLEY: OK. So we've talked about some various things. This obsession with finding water and the like. But Mars and Mercury and the moon, what's really exciting, we've got another Student Hub Live on Mars at the end of October. So if you'd like to know about that, press the Count Me In button on the website and give us your email address and we'll keep you up to speed with when that's happening. What's the next big thing that we know about or that we can predict, I guess?

SIMON KELLEY: For each of them? On the moon, the next big thing is we are sending probes to the poles of the moon. The reason for that is the poles of the moon, we know have water.

And it's a unique place on the moon, maybe in the solar system. Very, very cold, but we know there's water on the moon at the poles. So we are actually developing a mission which is going to go to the poles and measure that water to see what sort of water it is. Is it water like is on the Earth or is it water that's from a different source?

DAVID ROTHERY: But also, watch out for some Chinese-manned landings on the moon in the next five years, maybe. It won't be at the poles, but they'll go somewhere where Apollo didn't, for sure.

KAREN FOLEY: OK. And what about Mercury?

DAVID ROTHERY: Mercury, well, it's almost, it's an eight-year wait till we get there. But it's a planet which isn't right, we don't understand it. Where did it begin? Did it begin further out and bounce off of Venus on its way in? We don't know. There's a lot more to find.

KAREN FOLEY: So right at the start of that journey, in terms of discovering.

DAVID ROTHERY: Yeah.

KAREN FOLEY: And Mars.

SUSANNE SCHWENZER: We don't have to wait eight years. We've got the Trace Gas Orbiter arriving very soon. And then in 2020, there is ExoMars, another rover. And that will do something super interesting. It will attempt to drill two metre deep.

And that's because around Mars, there is a lot of radiation that would destroy any organic material. So if we want to study organic material, we need to get below that irradiated outer surface. And that's what ExoMars is going to do in 2020.

KAREN FOLEY: Thank you very much. Well, Dave, Susanne, and Simon, thank you so much for joining me. And as I've said before, we're going to have a Student Hub Live special in October all about Mars. So join us for that, where there'll be lots more space discussion. Sophie and Kate, how's everything there?

SOPHIE: Really good. There are loads of questions and we're really sorry if we didn't get a chance to get through all of them. There's a lot of discussions on water, parallel universes. Carrie is eating jaffa cakes made with lime. Apparently they've come from her parallel universe.

KAREN FOLEY: Did she make them?

SOPHIE: I don't think so. Back to our biscuit discussion, as always or cake discussions. Yes. It's all gone really well, and thank you ever so much for joining us. It's been a pleasure this afternoon. Thank you.

KATE: Yeah. It's great. And of course, lots of people are saying, oh, is Student Hub Live not just a Freshers Week thing? So just to restate what you've just said, Karen, there'll be lots more events coming throughout the year. And you should click on the Count Me In button if you want to be kept informed.

KAREN FOLEY: Excellent plug, Kate. That's absolutely right, so thank you for that. Yes, we have a lot of events for the Student Hub Live.

And in fact, you can catch up on some of them. So when something big happens, like the Olympics and the Referendum and things landing on Mars. We like to have a Student Hub Event about them. This Freshers Week is just but one of many activities that we could have that you can join in. So if, like Davin and Ben, you like coming along to all of them and we do appreciate that, then please do click on the Count Me In button, as Kate says, give us your email address, and we will make sure that we keep you up to date with when we've got more events on.

All right. Well, that's all we have time for tonight, I'm afraid. It's been a really, really brilliant day and we're going to come back tomorrow because we like to do that. And on Thursday, we have a special event, as well, for the faculty of business and law.

The law school and the Open University Business School, we're going to be holding a special event for freshers there. But we also have a lot of activities then, as well. We're going to be having a moot and doing all sorts of interesting things that anybody can come to.

But tomorrow, we're back for our Freshers Fair. And again, we have a packed day for you from 11 o'clock. The chat will open at half 10:00. So I do hope you can enjoy it.

If you haven't been able to watch all of it, it is available on catch up, as are the boot camps, which we've been running over the last few weeks on a Monday. And those have been about getting yourself ready to start studying. We've been doing all sorts of things like time management, in fact, Susanne did a session on that, reading and note taking, essay writing, the virtual learning environment, how to submit a TMA, assessment, how to deal with feedback. So all sorts of really, really useful things that you can tap into if you have time.

And we're going to go home, we're going to have a break. But do keep chatting. The chat room will be open for another 20 minutes or so. So please feel free to say your goodbyes.

We'll share a short video after this, just to wind down. But from us at the Student Hub Live, that's all for tonight. I hope you can come back tomorrow. Do click on the Feedback button, as well, and tell us what you thought of the show. And you can always email us any thoughts, any selfies, at studenthub@open.ac.uk. Bye for now. See you tomorrow.