[MUSIC PLAYING]

KAREN FOLEY: Well, it is Friday lunch I suppose, and The Student Hub is fun. But in all seriousness, Matt Balme, thank you for coming to the studio.

MATT BALME: That's right.

KAREN FOLEY: Whew. Can you answer some of these questions.

MATT BALME: About my favourite My Little Pony?

KAREN FOLEY: No. No. No.

MATT BALME: Rainbow Dash. Definitely Rainbow Dash.

KAREN FOLEY: I do like Rainbow Dash, yeah, I must say. So this whole idea about if people were born on Mars, could they then live elsewhere, what are your thoughts on that?

MATT BALME: Well, I'm not an evolutionary biologist. But I've read a lot of science fiction. And actually, science fiction tells us a lot. People have done a lot of research into these things.

And there's a famous trilogy of books, *Blue Mars*-- sorry, *Red Mars*, *Green Mars, Blue Mars,* that talks about just this sort of thing. And in those books, the Martians, people born on Mars, are much taller. Their skeletons are much weaker, because they've grown up without this dense gravity. And they find it very hard to go to Earth.

So I can completely see that being the case. If people are born and die on Mars, generations down the line they will look different. That's assuming we can even do it, because perhaps there's something about the gestation period or even becoming pregnant, for example, that gravity's important for. We don't know this yet.

KAREN FOLEY: No. Absolutely. This whole idea, we were talking about *The Martian* earlier and how accurate as a description that was. The whole idea of science fiction, as a scientist, how important is this imagining, this conceptualising from a lay perspective about what things might be like?

MATT BALME: See, I think for Mars it's incredibly important. And I think that's because for Mars, you can imagine yourself going there. You can imagine yourself in the landscapes that you see. It's not

science fiction anymore. The only thing that's stopping us having a colony on Mars is money.

KAREN FOLEY: And the bad weather. The dust.

MATT BALME: I don't think that's even a problem, because the wind wouldn't be very strong.

KAREN FOLEY: Yeah.

MATT BALME: So yeah, it's completely doable. And I've always loved science fiction ever since I was a kid. There's something about Mars that it's part real life, part science fiction. So it's that boundary between the two that makes it more fascinating.

KAREN FOLEY: Because there's this whole thing-- in your session we're talking about the future, which is very apt, I suppose. But there is this whole thing that whilst you are measuring a lot of data, that there is a sort of completeness and a factual aspect to what you're looking at. But imagination, interpretation, and that human aspect are something that can't just be put through a computer and modelled, in a sense.

MATT BALME: Yeah. Especially what I do. I mean, I look at the geology of Mars. And what I get is I get pictures from remote sensing. I might get some results from different models. I might get a different type of information from spectral measurements.

The thing is not one single one of those things can tell you the answer to a question. You have to put it together. It's a bit like Sherlock Holmes. It's inference. But when the weight of inference are all stacked up together, there can only be one hypothesis.

It's not it's sort of catching the criminal red-handed. You actually have to work out the case and find out what it is that you want to know. And that's why I love it. I mean, when you have time to do it properly, it is fascinating, like a crossword and maths all at once.

KAREN FOLEY: But how do you then get this sort of distinction between something very, very specific-- like Rhian and Liam are going to go and look at the data, compare it with their models. And you're sort of saying that actually you need a holistic perspective in saying, where do all of these fit? What may we see and what may we not be seeing as part of this overall picture?

And there's this pressure. I get this real sense of pressure in terms of time, especially with the world having access to a lot of this data. Everyone has access to it. And so there's this whole sort of balance going on. How do you then deal with getting that space and getting that ability

to look at things?

MATT BALME: Well, I mean, you have to make time, which obviously it's really hard when you're a parent and a teacher and a supervisor of students. But I spend a lot of my time looking at pictures of Mars. And I know that sounds sort of like, oh, that's not a job.

But that's where I get my ideas and that's where I come up with the hypotheses that then I phone up a collaborator in Ireland or America and we sit there and we look at the same picture. And we say, what do you think? Oh, no, it can't be that. Then we go back to the quantitative data and see if that supports it. So it's trying to piece everything together.

And sort of as you get older, more experienced in your career, you've seen more things. And it's not necessarily being great at maths or super clever. It's just having that experience when you have to figure out which things tie in together. And I'm not advertising old dinosaurs over young, but it is. It's just an experience thing.

KAREN FOLEY: But that experience, I guess, is going to give you an idea that things may not seem to hang together in the way that one could think.

MATT BALME: Yeah. If you're a scientist who's-- well, for example, if you're a physicist who's an experimental physicist, it can be very frustrating to hear a geologist talking about things that are very arm-wavy to their perception. Some of my best friends are physicists. My best man was a particle physicist.

But what we do is interpretive, and there's always more than one answer. But essentially, as you collect more data, more types of observations, you begin to rule out these other hypotheses until there can be either only one hypothesis or one that nobody's thought of. So it's the way geoscience works.

KAREN FOLEY: Has there-- oh, Sophie. Sorry. You've got a burning question.

SOPHIE: Darren's asked a really good question. He's asked-- I mean, he's specified microbes. But if there are microbes on Mars, how will you tell if they are from Mars and not deposited there by some other spatial body, such as meteors or comets? But I'm assuming that's for anything, any dust, anything. How do you know it's specifically from Mars and not from anything else?

MATT BALME: Well, I think from my point of view, I wouldn't care as long as they weren't from Earth, because if you find let's say microorganisms on Mars, if you could culture them and grow them, then

compare them with terrestrial ones, and you can then trace back at what points they diverged evolutionarily-- from their evolutionary past, if there is a divergence, then essentially they came from the same place. And that's interesting.

But if there is no divergence, if they're totally different, if they're not even DNA-based-- we're getting to the limits of what we might know-- then essentially that means there's life out there of a different origin. And that's as important as if it came from Mars or if it came from-- essentially we would just send out a flotilla of spacecraft looking at every planet we can get to to find where these things came from, because "is there life elsewhere?" is such a big question. And I think everyone on the planet wants to answer it.

KAREN FOLEY: They do. And they have been. We've said, has there ever been life on Mars, and most people say that there has. Is there life on Mars today? We're going for mainly no, but it's a little bit more even. What would you say? Is that the general consensus?

MATT BALME: Ah, see. This is the thing. I think there would be more evidence of it if it was there. All we know about life on Earth is it adapts so well to any niche that if there were life on Mars, it would have adapted to a niche and we'd be able to see something. Everything-- well, everything sort of takes in energy and some kind of a gas and releases a gas, some more than others. But we would be able to detect that.

And like I said at the introduction, maybe Trace Gas Orbiter will begin to detect that. So hopefully, there might be signs of life on Mars today. But I don't think that's likely, because I think we would have seen it. But I do think it's likely that we will find evidence for past life on Mars when the atmosphere, the environment as a whole was a lot more clement, just more friendly to life.

KAREN FOLEY: OK. So we've talked about the point of all of this and the idea that possibly Mars might be an option to go and live on via the moon if we kill this planet, for example, or something happens here. So that could be a good bolthole to get to at some point. But of course, you know, this is very, very complicated. A lot of money is spent on space missions. And one of the questions we asked was, how much per person should the UK spend on space exploration--

MATT BALME: Oh, that's interesting.

KAREN FOLEY: --which is a very interesting question. We asked 5 pence per person, 50 pounds, 1 pound, 10 pounds, or 25 pounds. And this is an annual amount. And I guess it's a very interesting

question when you start looking at things that don't necessarily relate to an individual in terms of the benefits that they may get. What do you think most of them said in terms of the amount, 5, 50p, a pound, 10 pounds, or 25 pounds?

MATT BALME: Pound. Go for a pound.

KAREN FOLEY: Do you? 28% said a pound.

MATT BALME: All right.

KAREN FOLEY: Next was 38% who said 10 pounds. And 19 said 25 pounds per person. It'd be very interesting to see some comparables, and those are changing all the time as we're going.

MATT BALME: It's a lot less, I think.

KAREN FOLEY: Yeah.

MATT BALME: If everyone in the country spent 10 pounds and there's what, 70 million people in the country, 700 million pounds a year on space exploration.

KAREN FOLEY: So what could we do with that? How much would this cost, for example? What could you get for that sort of money our audience are prepared to spend?

MATT BALME: I think that with the Lander is about that price. And that's one year.

KAREN FOLEY: OK.

MATT BALME: So that's quite good. So bring it on.

KAREN FOLEY: And that was for many, many--

MATT BALME: 10 pounds per person, please.

KAREN FOLEY: Well, we can do that. They're going to Comic-Com. They've got to save their money.

But you know, there were many, many countries involved in this. And we've talked about-- I mean, this is in ISA, Roscosmos. We also had a question which I did want to ask you, which is about after Brexit, will that impact on Britain's relationship with the European Space Agency? Do you predict any changes there?

MATT BALME: Well, ESA is different to the EU. So for example, Canada is a member of ESA. So there

doesn't seem any real reason why it should. I mean, maybe it will, because there's that whole continental-scale cultural issue and politics.

We just won't know, I guess. I mean, I would hope it doesn't. But if it does, I would hope it meant that the UK would put the same amount of money into the same sort of thing. But these are big things to do. And they're better done with expertise from across a continent than they are from in a single place.

KAREN FOLEY: But the European Space Agency isn't as categorical then as the EU. Like so many things, if you're interested, we had a Student Hub Live special just after the results of the referendum actually. So if you want to watch that on the Catch Up, you can do so. There's a whole archive. And we've got a YouTube channel now, so you can go back and check that out several days after that Brexit vote was announced, where we talked about issues to do with funding and particular academic funding, which was a key concern of ours right at the very time.

OK. How political then is all of this? Aside from having a Russian side and a European side of the Trace Gas Orbiter, how political is it when you're actually doing some of this work.

MATT BALME: Not sure I should say, really.

KAREN FOLEY: No, you probably shouldn't. You should say it's very interesting.

MATT BALME: It is very interesting. And the reason is it was-- I can't remember the exact terminology. It's an optional mission, so within ISA, there are science missions, for example. And a certain percentage of every country's budget they put into ESA goes to that mission.

Now, these are optional missions that you opt in with a certain contribution based on what you want to do. So you put in 30% of the cost and you get to do 30% of the exciting things or maybe you get to build the Rover and you get to build the solar panels. A country that puts in maybe 2%, they get to build some thrusters or something.

So part of it is economics. The more you put in, the more you get out. And part of it is political, you want to be seen as being a powerful country with a bold vision for space exploration.

But of course, when things don't go well-- for example, now we're going to have to think about what to do with the Rover-- maybe certain countries will say, no, this is too much risk so we're not going to put our next tranche of funding in. And that's really sad. And they wouldn't have that option, I don't think, if it were sort of a science programme mission.

So there is a lot of political wheeling and dealing. And actually in the UK, we have some really good people who are working at the UK Space Agency who are amazing diplomats and amazing engineers at the same time and amazing managers. And they do somehow seem to navigate the UK through the rocky roads of politics, and do really well for us.

KAREN FOLEY: It's difficult, isn't it, because like you say, you put this in and yet so much of the data then is in the public domain and everyone gets a shot at it. It's a lot more political than just having access to things, because the knowledge can be used by so many more people than those who actually generate the equipment.

MATT BALME: And a lot of it is obviously-- a lot of it is built by industry. So we would much-- the UK would obviously much rather a UK-based industry made 200 million pounds worth of stuff than another country's.

KAREN FOLEY: So Devon wants to know what you could do if-- if-- Student Hub Live were able to donate the OU students' cake fund to a mission, which I believe is 26 pound 50 at the moment.

MATT BALME: 50. It might buy you a space-rated screw or bolt, something like that, something that could survive in the extremes of the temperatures they have to encounter.

KAREN FOLEY: What about if all the students gave the money they spend on cake, which is a considerable amount, actually, per person.

MATT BALME: If they give it to me, I'll make sure it goes to the right place.

KAREN FOLEY: Not allowed to do that, I'm afraid. OK. So in terms of these missions then, I'd just like to talk about some of the relationship between the Open University and some of the work that's here. So we've got to a team at the OU who are involved in a lot more than just the ExoMars mission. Can you tell us then what we're doing at the moment and how important that dialogue is between an academic institution and space agencies?

MATT BALME: So we had a big involvement in Rosetta. That's been a big success. We have involvement with TGO, which is going to be a success, and it's already getting there. We had a small involvement with the Lander, which seems like it wasn't a success, which is sad. And we have got a lot of input coming into the Rover in 2020. And that's mainly to do with looking for the landing sites and working to understand how we might operate that Rover in the future.

But you know, there's a lot more basic science as well. It's not just necessarily individual

missions. So you might ask for some money from ESA to provide a response to one of their calls for a study to find a new widget to do something. And we do that sort of thing.

It's almost like commercial contracting. We need somebody who can do this and we have the skills. We deliver that. But there's other things where ISA says, we're giving money out to fund post-doctoral researchers. so our post-doctoral researchers can win those funds and do basic science.

So it's everything, actually. The academics here at OU are involved from the planning and designing instruments, through to building instruments, through to building spacecraft, through to using the science that the spacecraft generates, and also taking leadership roles on these things as well. So the OU has got a huge involvement in all this stuff.

KAREN FOLEY: And lots of opportunity. HJ.

HJ: I think we've got perhaps-- because we know we're coming to the end, but perhaps two quick questions as well that we really want to know. Davin's interested in if you could choose the focus of a future mission, what would it be? And Paula is wondering, going back to the politics of things, what's in place to stop military country takeovers or stripping resources from other planets? So perhaps you can help us with those questions.

KAREN FOLEY: Interesting. Have you got the answers?

MATT BALME: Well, the first one, I would go to the northern plains of Mars with a mission that had a big drill. Might be quite tricky. And I'd like to drill and core down through the northern plains of Mars until I could find or not find oceanic sediments. I'd like to answer the question, was there an ocean in the northern plains of Mars? That would be cool.

As for taking over-- military countries taking over other places, I don't know.

KAREN FOLEY: Well, it's also collaborative, isn't it? I doubt anyone would let anybody other take their eye off the ball, because it does seem like there's a whole community of people, all working with a certain goal. And equally, they're need to be something very valuable, I guess, to try and get your hands on out there and get back or use for certain things.

MATT BALME: Yeah. I don't think there's anything that's worth going into space and stealing. And also, it's a lot of money to get there. You may as well just build your own, really.

KAREN FOLEY: No, absolutely. Absolutely. No, it is very, very in-depth. Excellent.

I'd like to wrap up with just talking about the Rover, because that's the next sort of massive thing. And obviously, looking at a landing site is the critical thing that we're trying to do right now. So we're going to get the data from the Trace Gas Orbiter, start looking at potential sites, start looking at the data from Schiaparelli and see how that landing can be done better. What would your thoughts be in terms of the work that has to be done now for the next four years when the Rover will hopefully land?

MATT BALME: Well, the work for defining where the Rover lands has been going on for the last four years. It happened a long time ago. So basically, it's working out the geology. And from the geology of a certain site, you can say, these were the types of environments, so was it wet? Was it dry? Could life have evolved and survived here?

And once you've done the geology-- and you can only do that as best you can from orbit-- then you can begin to add in the other things. Is it safe to land here? Are there nice targets? Are there nice outcrops of rock within where the Rover can travel?

So since you're building layers and layers and layers of sort of philtres-- you're not allowed to land here. That one's out. This is too high. You can't land here. That area is out. And so you go from having the whole planet down to a very small area.

And from that, you are then saying, so which of these areas that we're allowed to go to have got the type of rocks that we might want to sample? And some of those areas have never been studied before, so you have to do a few years of sort of geologic studies of those and try to work out what the environments were. And on top of that, you've got to make sure they're old enough so they're not young things that wouldn't have had any life in them potentially.

So it's a big complex process selecting a landing site. And every year for the past three years, there's been a big European workshop where it seems like one landing site gets kicked out, so it's like *Bake Off,* where one after one you kick one out. And there's an OU-led one, which is in the final three, so that's good.

KAREN FOLEY: Very exciting.

MATT BALME: Yeah. Fingers cross we make the final.

KAREN FOLEY: Yes. No. Absolutely. No, it's all very exciting.

Well, thank you so much, Matt Balme, for coming and talking to me about all of that. The future is going to be very, very interesting. I'm going to keep my eye on all of that.

And thank you all in the chat for having such a fabulous time and talking about such a range of things. Sophie and HJ, I see that most people feel part of an academic community, they've been voting on the widgets. Everyone's enjoyed the Student Hub Live events. And a lot of people are prefering that to a study skills event. I hope you're not all procrastinating out there, those of you who have just started your new modules. But I am really, really pleased you've enjoyed it.

Sophie and HJ, can I have final comments from you?

HJ: Well, I think I've had a great time chatting with everyone on the chat. And some people have sent us in, and we really want to get to those before we finish up.

SOPHIE: Yes. We have a couple of selfies. We didn't get to print them all off, I'm afraid. I like this one. This one is Simon. He's the one who started our My Little Pony conversation, I might add. But he's actually sat in the library--

KAREN FOLEY: From Portsmouth?

SOPHIE: Well, no. This is Simon. He's sat in the library at the moment. He's in Milton Keynes with us.

KAREN FOLEY: All right.

SOPHIE: We've also got Chantelle, who's got her study buddy with her cat who's joined us today. We got some cloud pictures. We've got one here from Christine in Essex, and we've also got another one here from Stewart in Leighton Buzzard.

KAREN FOLEY: Oh, lovely clouds.

SOPHIE: Yes. Lovely cloud pictures. Thank you very much. There were a few others, but unfortunately we didn't get time to print those off and show them. But thank your very much for sending them in, and we will be getting post out to you soon.

HJ: But I think one thing that was just brought up, Stu says, when is the next Student Hub event? And if you keep up to date of Twitter, @StudentHubLive, and keep looking on our website and press the Count Me In button and give us your e-mail address, then you'll always stay up to

date with our next events, because we always enjoy these and we hope to see you at the next one too.

KAREN FOLEY: No. Thank you both very much. Well, you should have spent more time printing things off and less time on My Little Pony and Comic-Con. But thank you, Sophie and HJ. You've been absolutely fantastic, as usual.

Right. And yes, do count us in, so go to that button on the website. Press Count Me In and give us your details, and then we'll let you know when the next event is. We're going to be busy planning a lot of those.

But I am very, very pleased you've enjoyed it. And I'd like to thank all my guests who've been with us today, Jon Mason, Liam Steele, Rhian Chapman, Jan Raack, and Matt Balme, who've done a fabulous job telling us all about the Trace Gas Orbiter, Schiaparelli Lander, what it's like to be a planetary scientist, and what it's like to be involved in post-doctoral research here at the Open University. I hope it's whetted your appetite. There's a moons MOOC that you can go and join if you've got a bit of spare time. And you can find out lots more about studying with the Open University by clicking on the website and checking out the science prospectus there as well.

Do let us know what you thought about this event also. There's a quick form on the Feedback section of the website, so if you've got any suggestions or things that you'd like us to improve, do let us know. And if you'd like to email us also, we'd love to hear your thoughts and feedback. That's studenthub@open.ac.uk.

So we're going to keep the chat room open for another half an hour so you can say your goodbyes and we'll let you know, again, on the e-mail when our next event is lined up. But that is all from us here at the Student Hub Live, so thank you very much for watching, and we will see you very soon.

[MUSIC PLAYING]