

ENQUIRING MINDS

EQM EP 9 SEG 2

HOLLY: Let's join Lockie and Elliana as they discover how you can explore space using a radio telescope.

LOCKIE: From watching movies about spacemen and aliens a lot of us have become fascinated with space. The thought of life on other planets and astronauts walking on the moon makes that all the more exciting and mysterious. The job of an astronomer is to study the stars, planets and galaxies and I've heard a certain fourth grader thinks that job would be out of this world. So why do you want to be a scientist?

ELLIANA: I want to be a scientist because you can make experiments and sometimes you get to play with really, really cool explosions.

LOCKIE: And what are these?

ELLIANA: These are my competition awards from when I've done maths and science competitions.

LOCKIE: What sort of stuff have you learnt in science class about outer space?

ELLIANA: Last term I learned about solid liquids and gases and how they work and how they form and how they stay together or how they can separate.

LOCKIE: Would you like to go and meet an astronomer who has discovered some pretty cool things about space like exploding stars?

ELLIANA: Yes.

BRYAN: One of the great things about astronomy is that unlike a lot of other careers it can be a profession but it can also be a hobby and so you can really choose your level of astronomy based on your interest, your time and your abilities.

LOCKIE: Hi, Bryan, how are you?

BRYAN: Hi, Lachlan, g'day.

LOCKIE: Bryan, this is Elliana.

ELLIANA: When did you decide you wanted to be an astronomer?

BRYAN: I think I decided I wanted to be an astronomer when I was about 3 years old and I've never wanted to do anything else since.

LOCKIE: What do you love about looking at space?

BRYAN: I love the fact that you never know what you're going to find each day.

There's just so many things we still don't understand. So as we study planets in our solar system we start to understand just what it takes to form a planet like the Earth and then what it might take to finally produce life like ours.

LOCKIE: What do you think the chances are that there's another planet out there with life like Earth?

BRYAN: Nobody knows, I think probably 100% chance. The question is are those sorts of planets everywhere or is there only one in a trillion and that's one

of the big questions that astronomers are working on right now. What a lot of people don't appreciate is just how big and far away things are out there in space. You can't possibly imagine just how distant even things like Mars and the sun are. So what we're going to do is we've set up a scale model to show you just how far away all the planets are from Earth.

Being an astronomer is sort of a mix between solving crimes and finishing crossword puzzles. Something happened billions of years ago and there was no-one there to see it but we have to collect forensic evidence to put the pieces back together and to figure out what happened. But the clues are strange, sometimes you feel like you're doing a crossword puzzle blindfolded where you don't even know the rules or how long the words are or even what the clue is. You have to try and piece together how the whole universe works.

So there are four small planets in the inner solar system and we're representing those by ball bearings of different size. The first planet is Mercury and then the two planets that are almost exactly the same size Venus and then a tiny bit bigger is Earth, a little bit smaller Mars. The biggest planet in the similar system is Jupiter and then a little bit smaller Saturn and then the last two planets in the solar system, again almost the same size, we've got Uranus and then the outer most planet in the solar system in Neptune.

ELLIANA: What's that big orange thing you're holding?

BRYAN: Lockie's going to blow this up in a moment, this is going to be the sun.

LOCKIE: Okay, Elliana, you're going to have to hold the gas giants for me.

BRYAN: So get to work.

LOCKIE: Do I have to really do this?

BRYAN: The sun is really big. We have to do this in the same of science. If you can hold down that end, Elliana, that's going to be where the centre of the sun is and Mercury in this particular universe is 78cm right there. You can barely see it, right, it's pretty tiny. So Venus isn't that much further away than Mercury right here. And then we've got Earth so now we've got Earth 1.8 metres so we've got Mercury, Venus, Earth. Okay, so there's the first four planets, you can see how far out already they're getting. Stand right there, Elliana. Do you want to roll me Jupiter? There's Jupiter. Give me Saturn and start with Jupiter. You hold the tape at Jupiter and we'll go out 8.9 metres. Alright, solar system is getting pretty big but we're still not done. We're going to pull this all the way until it stops.

ELLIANA: Yep.

BRYAN: And then we're going to do it again. Okay, so there's Uranus and we've still got Neptune to go. Okay. Elliana, this is the most distant planet in the solar system, this is Neptune. So if you look back you can see Uranus, Saturn, Jupiter and all the other planets are just crowded in around the sun. Well done, Lockie, this is a very impressive sun.

LOCKIE: Thank you. How long does it take for all the planets to orbit around the sun?

BRYAN: Well the planets all orbit at different speeds. The closer they are the faster they move. So Mercury moves around the sun very rapidly. It only takes about three months to go around once. The Earth, of course, takes one year, 365 days to go around the sun once and Neptune, the most distant planet from the sun, takes almost 165 years just to go around the sun

once.

LOCKIE: Excuse me?

BRYAN: 165 years. When I was a kid we used to think that our solar system was unique but we now know that there are hundreds of other planets around hundreds of other stars all throughout the galaxy. And while there's probably no other solar system exactly like ours, the idea of a whole retinue of planets going around the sun seems to be a very common occurrence throughout the universe.

Mercury is the smallest planet in the system. It's so hot that it's essentially just a burnt, almost melted lump of completely lifeless rock. Mercury is the closest planet to the sun but it's not the hottest planet. That record goes to Venus. Venus is further away from the sun than Mercury but it's completely covered in this thick deck of clouds. This traps the heat near the surface in what we call a greenhouse effect and so the result is that the temperature on Venus is so hot it could actually melt iron. Earth is in what we call the Goldilocks zone. Just like in the story of 'The Three Bears' Earth is not too close, it's not too far away but it's just right. And so this is the only part of the solar system where the temperature and the other conditions are favourable for life like us to exist. The last of the four inner rocky planets is Mars. Mars is about half the size of the Earth and it has this dull red colour and that red colour is essentially rust. All of the iron in the rocks on Mars has rusted and so the whole planet, you can see even with your naked eye, has this orangey red shade. Jupiter is huge compared to all the other planets but still tiny compared to the sun. It's essentially a giant ball of gas with perhaps a liquid or solid core at the very centre.

LOCKIE: Why do you say perhaps?

BRYAN: We have no way of actually knowing what's at the centre. If you tried to send a probe down there it would be crushed by the incredible pressures so we can calculate on our computers, we can run simulations but what's happening at the centre of Jupiter is as much a mystery as what might be happening at the centre of the Earth. Probably the most magnificent planet in the system is Saturn, the other big gas giant. It's somewhat smaller than Jupiter but still enormous but what makes Saturn so incredible is not that it's a big ball of gas but it has these beautiful rings around it. Now these aren't real rings, they're actually lots and lot of shards of ice. Everything ranging from something the size of a speck of dust to things bigger than houses but all orbiting in formation to make these beautiful, delicate rings.

LOCKIE: So what have we got here?

BRYAN: So we're now moving towards the last couple of planets in the solar system. This is Uranus, another ball of gas but much, much smaller than Jupiter and Saturn. Now the interesting thing about Uranus is that unlike all the other planets that sort of spin like this, it actually spins like this which means that the summers and the winters last for tens of years at a time.

ELLIANA: Was there ever really a big bang?

BRYAN: Yeah, we're pretty sure that the universe began 13.7 billion years ago in something that we call the big bang where everything came into existence at once and the universe began expanding from a tiny, tiny small point rapidly outwards in all directions. So this is the outer most planet in the solar system Neptune. So we've travelled 60 metres in our modelled solar system and we've just come to the eight planets but the solar system keeps going. There's all sort of other smaller rocks and pieces of junk

further out and then there's nothing at all until you get to the next star. On this scale 60 metres from the sun to Neptune the next star is 500 kilometres away.

It turns out that stars that don't just shine in the light we can see with our eyes. Stars shine in other types of light too. And one of the very important types of light that stars give off are radio waves. And here we are at Molonglo Observatory and one of the most powerful radio telescopes in the world, a telescope designed to gather those radio signals from those distant stars and to make a radio picture of what the sky actually looks like. Instead of looking at the sky you can think of this telescope as listening to the sky.

LOCKIE: Can we have a look at some stars?

BRYAN: Absolutely. Let's go inside and I'll show you the sorts of things that we can see with these telescopes.

One of the most embarrassing things in astronomy but also one of the most exciting things in astronomy is that we know almost nothing about the universe. One of the things we're beginning to appreciate is just how unusual the planet Earth is. This is an amazing photograph of the Earth taken by a satellite called 'Voyager'. 'Voyager' was sent by NASA to explore the solar system and when it was almost at the edge of the solar system they asked 'Voyager' to turn back and take a photo of the Earth from 10 billion kilometres away. Can you see that dot there, that's not a speck of dust, that's the planet Earth, that's everything, that's everybody who ever lived. That's everything that's important to you and me and to everybody else. And that's the only place we know of in the whole universe where there's life.

So if you're really good at maths and physics and you want to have a career in astronomy then the path through an undergraduate degree and a PhD is there for you. But the best thing about astronomy is that moment when you discover something. It doesn't happen too often that moment but when it happens it's just like nothing else you've ever experienced.

Probably the most exciting and important thing I had a chance to be involved in was something incredible that happened in December 2004 when a little star 50,000 light years away gave off a huge flash as you can see here. This flash was 1,000 times brighter than every star in the Milky Way put together and when the radiation reached Earth it slammed the atmosphere, disrupting satellites, changing the Earth's magnetic field knocking out communications. It's quite amazing that this little star 50,000 light years away could have such a dramatic effect on Earth. When I have that discovery moment for about a minute or two I just sit there by myself savouring it thinking that just for this one person I'm the only person in the history of humanity who knows this.

There's a lot of smart people who decide they want to become astronomers but what they find when they go to university is that everybody studying astronomy is actually pretty smart. So if you want to succeed it's more important that you be prepared to work hard than whether you're smart or not.

One of the things we'd like to do with this and other telescopes is to understand how the sky is changing. Telescopes like this one are going to be really good at seeing big chunks of the sky at once and we hope to be able to essentially patrol the whole sky all night all the time and see all these flashes of explosions.

LOCKIE: I know I've learned a lot about space, the planets and stars from Bryan

and maybe Elliana might just take her love of science that little bit further and study physics at university and become the next stargazer.

HOLLY: Next episode – Laura will dig up a few facts in archaeology and Bec will explore the world of writers. See you next time, bye.

VOICE-OVER: If these stories have inspired you then check out our website for activities and loads of information on all of our experts. Plus don't forget to challenge yourself with our Enquiring Minds game.

END OF TRANSCRIPT