

ENQUIRING MINDS
EQM EP 2 SEG 1

GIRL: When I grow up...

BOY: I would like to be an animator.

GIRL: A marine biologist.

GIRL: An artist.

BOY: A forensic scientist.

GIRL: A zoo keeper.

GIRL: I want to be a photographer.

BOY: A chef.

GIRL: An author.

BOY: Teacher.

BOY: A surfer.

BOY: Video game designer.

GIRL: A doctor.

GIRL: A fashion designer.

BOY: A builder, cartoonist or stunt man.

VOICE-OVER: Join our reporters as they check out some great jobs, meet interesting people and go on some cool adventures. Enquiring Minds shows you that you can have fun while following your dreams through higher education.

HOLLY: Hi and welcome to the show. On this episode Lachie and Yang Yang head to the hospital to learn how to mend broken bones. But first, let's join Sacha and Aayush as they meet a structural engineer and put their own bridge-building skills to the test.

SACHA: How cool is it to build things? It often starts with blocks when we're very young and just grows from there. I remember creating miniature cars and buildings as soon as I could get my hands on a construction tool. Now Aayush is someone who loves to build things so much so that he's decided that he wants to become an architect or a building engineer when he gets a little older.

AAYUSH: I like to be creative and jot down and draw down whatever comes into your mind. Just this is an amusement park so that's Elephant Bridge over there and kids can ride elephants and go under the bridges and stuff.

SACHA: Is this like a shopping centre or like a building?

AAYUSH: It's like a bridge but shopping centre on them.

SACHA: Oh wow, that's unreal. And what about down here, is that a bridge in itself?

AAYUSH: Yeah, that's a bridge.

SACHA: Wow, how did you build that?

AAYUSH: Just had a design in my book and made it really.

SACHA: That's incredible. Now to build things you have to be sort of like an architect and a scientist and an inventor and a historian so would you like to meet someone who actually does this for a living?

AAYUSH: Yeah, I'd love to.

SACHA: Jennifer, great to see you.

JENNIFER: Hi, good to see you, great.

SACHA: This is Aayush, Aayush, Jennifer.

JENNIFER: Nice to meet you.

AAYUSH: So like when did you get interested into building bridges?

JENNIFER: Well, I think I was probably about your age actually when I first got interested and there was an amazing suspension bridge close to where I grew up and we used to drive over it and I'd look up at the pylons like you can see here and used to think what an amazing structure and it got me interested in bridges at that point.

I was probably one of those annoying kids at school that actually quite liked most of my subjects and I enjoyed school and I was looking for a career that would let me use most of the subjects that I enjoyed.

AAYUSH: This bridge is surrounded by mountains. This bridge there's circles and

every single circle has like a different colour. So this bridge is just glass and you can see through them.

JENNIFER: These drawings are all fantastic and you have a great imagination behind it so I thought I might just show you how some bridges work and that might give you an idea for some more amazing designs. Bridges are a little bit of both being an interesting structure and also a very good teaching tool because it's sort of the bare bones of a structure. A lot of other buildings the structure's hidden within the outside cladding or covering of the building whereas a bridge it's all exposed, you can see exactly how it stands up and what the elements are that hold it up.

The very basic type of a bridge is a beam bridge and that's what humans did back in prehistory when you had to get across a stream and so you'd put a tree or a block of stones down, whatever you had. That's now evolved into these types of beam bridges. So this is still the same type of bridge but you quite often see these over the roads. And then we've got arch bridges, I think you had a few of them in your designs so that's probably the second oldest type of bridge would be the arch. And with arch bridges you get different types. So we've got the overarch where you can see the arch goes up and the road's hanging from it. And then we've got this type where the arch is underneath and the road sits on top. And so these are arch bridges made up of trusses. So we try to make them really light and we make them up with lots of different members. That's the Sydney Harbour Bridge and then we've got one from my country in Scotland there, that's another truss bridge. These are suspension bridges, again I think you had some of them in there. So with these you've got big towers that we call pylons. And then we have cables that drape from them and the road's just hanging from those cables. And then something very similar to the Anzac Bridge that we've been looking at, it's a cable stayed bridge. And what do you think about a glass bridge? Maybe this one here.

I think you had some glass bridges, that's over the Grand Canyon.

AAYUSH: Why do you use different materials to make bridges?

JENNIFER: That's a great question. So there's lots of things we think about when we're picking the materials for our bridges. You know, you might want to build your bridge out of gold or platinum but you don't have the money for it so that's one thing. We also look at what size, so how far the bridge has to span. You could stick a big bit of stone a short distance but if you tried to make it span it it would be very heavy so that's strength and cost and then we also look at environment and if we can get the materials locally then that's much better than having to transport them.

SACHA: So bridges are made out of all these different types of material but how is it that they actually don't fall under all the pressure and the weather and all the cars that are on there?

JENNIFER: That's the job of the engineer to try to make sure that doesn't happen and we don't want everything collapsing around us. What we do is we try to imagine all the kind of loads that our bridges are going to have to hold.

This one's called the Tacoma Narrows Bridge. It had only been open a few months and it was very light weight, it was a really innovative design at the time but the winds would whip up and down the valley and the bridge was so light it started vibrating. We definitely don't want that happening to your bridge but they learned from this and they improved the way that we design bridges. So as engineers if things do happen we go back and look at why they went wrong and then how do we stop this happening in future.

Well all of our structures, whether that's a bridge or any kind of building, we need to design them to support loads and that's often the first job when

you start working as an engineer after uni is to work out all the loads and the structures. I guess with engineering you need to have skills in maths and physics, they are important and the problem solving that you're taught helps you as an engineer.

I thought I'd show you what it's like to be a bridge. So I've got these buckets of water here. So if you take one in each hand. Okay, so how are you feeling at the moment?

AAYUSH: Weighed.

JENNIFER: Weighed down, that's what the poor old Anzac Bridge feels like. So you're like the pylon, the big tower in the Anzac Bridge and those are the cables, your arms are the cables. Can you imagine as cars and everything are going over the bridge and it's being moved a bit that's what's happening to those cables, they're being stretched a bit. You should feel sorry for the bridge next time you go over it.

AAYUSH: How are the wires made?

JENNIFER: Okay, well the wires are made up of lots and lots of strands. So it's something like a similar idea to this rope. So see how the rope's made of up lots of tiny little strands, and then each of those strands is woven into a bigger cable and then those cables are all twisted around each other. If you imagine that on a much bigger scale that's what the Anzac Bridge ones are like. I'm going to get you to just to pull on the end of that. See if you can pull me over. Okay. So what that's going into is tension, so you see how strong it is in tension? So we look at how tight we want the cables, that's one of the considerations we have in bridge design.

AAYUSH: How do arch bridges work?

JENNIFER: Arch bridges are pretty amazing structures because they transmit load right around the arch. So it's all in compression. So compression is where things are being squeezed. So nature gives us some really good examples of arch structures. In fact the egg, have you ever tried smashing an egg or having an egg fight? So eggs work in a similar way to the arch, they spread that load all the way around the egg.

Well, nature is an amazing engineer. For example, a little spider can make a web many times stronger than steel in terms of its strength to weight. We have tried to borrow a bit from nature in some of our own structures. If you look at the Sydney Opera House it's what we call a shell structure. It uses some principles in egg shell and its design, if you take an egg and try to squeeze it between your fingers from the pointy end to the base you can't break it but if you squeeze it around the edge where the little chicken is trying to break out it's quite easy to break.

Okay, you might wonder why I've got you set up like this but you're going to be the first man at this university and possibly in Sydney to walk on eggs. Lift your feet up and then down. Can you lift your hands up? Okay, just try and do it evenly.

I thought we'd finish off by building a bridge and we're going to use all the skills and knowledge that you've learned today.

It's quite exciting as a career, there's very few other jobs where you can go out to your friends and say I built that and that's my bridge and that's my building or my column even or my beam. So it's nice to be able to contribute to the world in some way.

SACHA: The next time your parents drive over a bridge or pass a very interesting

building, you will know how much effort structural engineers have put in to make it safe and hopefully last a lifetime and, you know, I think that Aayush may have learnt a few things today that helps him when he starts planning his first bridge or building.

HOLLY: Coming up next – Lachie and Yang Yang suit up and head into surgery.

END OF TRANSCRIPT