

Nervous System Engineers | Students Ask Scientists

Transcript

- What is your lab and what do you research there?

- Randy Ashton: So my lab, we work at the interface between engineering and biology, um and that simply means that we're trying to engineer the human body, particularly the brain and spinal cord. And if we can create models of the brain and spinal cord here in our lab, then we can use those models to study how those organs develop, and to study how they go wrong when you have some type of disease or defect in those particular tissues.

So engineers in general take raw materials such as oil or trees and we turn them into usable products, such as gasoline and paper. And so for my lab we're trying to create human tissues, and so we start with human stem cells.

- What is a stem cell?

- Nisha Iyer: So a stem cell is the very earliest primitive cell type that we have in human body. So when an egg meets a sperm and you have a zygote that forms very, very early, right? The very first cell of your body, the very first couple of cells that form off of that, we call humans embryonic stem cells. And that's because they have the potential to become any cell in the human body.

- Frank Seipel: So a stem cell is essentially a cell that hasn't decided what function it wants to perform within the body. So they can become a brain cell, a heart cell skin, cell, lung, cell, um, any kind of cell.

- How are you able to engineer with stem cells?

- Carlos Marti-Figueroa: One technique that we use out of many, um, in the lab is to use engineering tools to shape the growth of the stem cells. So if you can imagine baking, for example, let's say you're making a Valentine's day cake, and you want to create a shape of a heart. Well, to do that by hand is very difficult, right? You don't really shape the cake with your hands to do the heart. You take a mold, And then you can pour your liquid, um, mixture into that. And then you provide, uh, you put that in the oven to provide some sort of heating so that it can become a cake, right. And it'll have the shape of that cake. So we create the shape that we want to have our cells grow into and because we're making a neural tube, we're interested in making tubular shapes.

- How do you make stem cells do what you want them to do?

- Randy Ashton: In a similar way that you smell some cookies being baked and that can make you hungry, or you touch something that is hot. You can think of it that, uh, essentially we can apply, cues to those, to that cell culture dish, where the stem cells in a similar manner will react to those cues. We can make the surface, they grow on hard or soft. Uh, we can make the environment they grow in, um, only able to fit, uh, for example, a hundred stem cells or able to fit a 10,000 stem cells. And when you change all those factors, it changes the collective environment around the cell. Um, and we sort of, uh, tune

those, uh, factors in order to try to get the stem cells to differentiate and create tissues in the manner that we see fit.

- How do you engineer something so small?

- Carlos Marti-Figueroa: This is a big challenge, right? And trying to engineer something this small, I can give you an example of one of my experiments. So the way that we create our, our tubes is actually injecting stem cells inside of a mold, right. A hydro gel mold. But I cannot actually see the channel or the cells by eye at all. To do this, what we use is a microscope. So we have a microscope that can, we can put our, our gels or hydrogels in, so that we can actually see a channel that is 250 microns in size. And you can imagine that that's like the size of a, basically a hair, so one hair, or maybe smaller than that. So it's very, very small, but the microscope basically, um, magnifies the image so that we can see it as big as a pencil basically.

- Nisha Iyer: If you think about the fact that computers used to take up full rooms, and now we're able to communicate with each other, uh, with laptops that have all of this little micro-circuitry, we're doing really similar things, we're using chemistry and we're using physics in order to make smaller and smaller structures that can help the cells organized into the ways that we want to.

- Do you think your experiments will change the world? If so, how?

- Carlos Marti-Figueroa: I think our research is going to be very impactful. It's going to take a lot of time, because there are a lot of things that we don't understand about the body, um, and that we're still learning. And to really make something that is impactful and useful is important that we take our time, that we do our experiments correctly, and that we're able to then really make things that are relevant for patients.

- Nisha Iyer: It's about changing lives, about educating the people around us, just learning more about the human body works, how the human body works and making small contributions really lead up to in the long run people, being able to make great discoveries and great medical advances that are going to help human lives.