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Building New Bonds in Biomaterials

An interview with **Paul Santerre**, Biomedical Engineer
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The field of biomaterials science looks at the interaction of traditional materials with biology. Traditional materials were not designed originally to interact with biology, and biology has a whole set of rules of its own: how proteins, how cells interact with it. And so the field investigates the science of the interactions of biological species with those traditional materials.

Polyethylene is one of the most successful biomaterials that's used in artificial hips. It's the cup component that the metal stem comes up on and rotates around. Anybody who knows somebody with an artificial hip will know the dramatic difference that that has made in people's lives.

The field has evolved for about 40 years now, so there's a lot of knowledge there that is now informing and motivating and inspiring new biomaterials to be made — biomaterials that were designed to interact, in a very, very specific way, with proteins and cells; in a way we can control, to some degree, the events that are going on.

What is your lab focusing on right now?

A polymer is a chemical entity that is made up of many, many units. And we take those building blocks that we call molecules and we hook them up together, and we make very long chains. And the longer that we make the chains, when those molecules are interacting with each other, the more interaction points they have. If they're really, really small, they may only interact in two or three points, so it's very easy to break them apart. But if they're very, very big, they can interact in hundreds, and sometimes thousands of points, and now they stay together. So now we can make coatings and plastics and floor tiles, bumpers of cars, things that when we apply pressure on it, when forces come into them, they don't fall apart, they're being held together through all those interactions.

The very interesting thing about human beings is that we all love being in the most relaxed state that we can be in, and it's probably because a lot of our building blocks — our proteins and our cells and that — try to do things as efficiently as possible, as well.

So, we design plastics that are made up of more than one type of building block. They're made up of three or four different types of building blocks. And if you distribute those properly, you can minimize the denaturation of the proteins that are the first signals to immunity. And that's what we've effectively done: we have a new polymer platform and we're driving all kinds of applications with those materials. We're engineering brand new vessels. We're engineering spinal discs, periodontal tissues. And that's pretty cool, that's pretty hot in recent stuff.