Growing new body parts with stem cells
An evening with Dr. Stephanie Willerth and Café Scientifique

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Is it possible to grow a new set of breasts from our own fat? Can we engineer entire organs and transplant them into animals? Are scientists attempting to renew and rewire neurons by injecting stem cells into damaged spinal cords?

Dr. Stephanie Willerth, assistant professor of Biomedical Engineering at UVic and guest speaker at Café Scientifique “Engineering replacement organs: From stem cells to reality” says yes. Yet she’s also quick to acknowledge that the research currently underway can be difficult to comprehend or even believe.

“People are doing this right now. It’s happening,” says Willerth. “There is so much information out there, so many articles, it can be hard to tell fact from fiction when it comes to stem cell therapies.”

Armed with a black marker and flip chart, Willerth begins with a quick overview of stem-cell basics before launching into regenerative medicine’s most recent source of excitement, induced pluripotent stem (iPS) cells and the 3D matrix.

iPS cells are adult cells that have been genetically reprogrammed to behave like embryonic stem (eS) cells, and are valued for their potential to differentiate into one of the more than 200 cell types found in the human body.

Because iPS cells do not require the harvesting of embryos, they have become an alluring alternative to their controversial eS cell cousins. In addition, because iPS cells can be derived from a patient’s own body, they have the added therapeutic value of providing patient-specific cell lines that eliminate the need for immunosuppressant drugs.

Willerth’s main research focuses on the growth of eS and iPS cells in 3D matrices, which provide a biomaterial scaffold that closely mimics the cells’ natural environment. This 3D environment allows scientists to direct cell growth and differentiation far more effectively than more traditional 2D culture methods.

“Where I see my work fitting in,” says Willerth, “is in encapsulating these cells in a 3D matrix to, not only enhance cell survival, but encourage them to grow into the appropriate type of cell, such as neurons, in order to help restore the function lost to spinal cord injury.”

Passing around a sealed test tube showcasing the protein-based gel, Willerth explains that its use has seen the post-transplantation cell survival rate skyrocket from 5 to 90 per cent. While regenerating breast tissue has already seen success in Japan, growing neural tissue has the added complication of ensuring neural pathways not only re-grow, but re-grow properly.

“If we do make it to the next step of putting it into people,” says Willerth, “I don’t know how easy it is going to be. Everyone is just waiting to see if this can be tolerated by people.”

Working in a field rife with controversy hasn’t hindered Willerth’s ability to field difficult questions. When one audience member peppers her with repeated questions about how to harvest stem cells from human brain tissue, Willerth elicits laughter with her quick-witted response.

“Are you thinking about trying this at home?” says Willerth. “I do not recommend that.”

STEM CELLS 101

Adult stem cells, found in some tissues such as blood, can generate new cells, but only the same types of cells as in the tissue in which they reside. Embryonic stem (eS) cells must be harvested from embryos that are no larger than a collection of 64 cells and can grow into any type of cell. Induced pluripotent stem (iPS) cells, discovered in 2006, are adult cells that have been genetically reprogrammed to behave like eS cells.