20 Questions with… Lucie Germain

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20 Questions with 20 Stem Cell Scientists from Across Canada

1. Where did you grow up?

I grew up in Deschambault. It is a beautiful village, midway between Québec City and Trois-Rivières, situated along the St. Lawrence River, in the province of Québec.

My father had a dairy farm, and my mother was a teacher.

2. Where did you go to school?

I did my primary school in Deschambault and my secondary school in the nearby community of Saint-Marc-des-Carrières. I then attended a private school for my last year of high school and my CEGEP (post-secondary education pre-university, collegiate general and technical college offered in Quebec's education system), called College Notre-Dame-de-Foy, which is in Saint-Augustin-de-Desmaures, just outside of Québec City.

I chose the general science pathway in CEGEP which includes the pure sciences and the health sciences because I wanted to ensure I had many doors open for me in university.

I did a BA in physics at the Université Laval in Québec City. At that time, I wanted to work in radiotherapy or in the application of lasers in medicine.

After my first year of my Bachelor's degree, I had the opportunity to work in two laboratories over the summer. The first one was in CO2 lasers, in a physics lab. I realized at that time that I would be spending hours and hours aligning the lasers to do the experiments. It was not that exciting for me. Of course, today, it is much easier to work with lasers, but back then it was a long process.

The second lab was with Dr. Normand Marceau He was a biomedical engineer with a physics background, doing research on cancer at the Faculty of Medicine at University of Laval. I became fascinated with microscopy and the labeling of the cells that allowed them to use fluorescence to do their observations of the cells under the microscope.

After my bachelor's degree, I decided to do graduate studies and continue directly to PhD without writing my Master's. My doctorate was in experimental medicine. I worked on the role of stem cells in the development of liver cancer.

At that time, the presence of stem cells in the liver was not recognized. People thought they were absent in adults because the liver can regenerate from differentiated cells.

So, I was going to meetings and I was constantly challenged and asked to discuss my results and convince the other doctors that stem cells were, in fact, present in the liver.

During my PhD, I had the opportunity to go to the University of Lausanne in Switzerland and learn techniques for transmission electron microscopy. I followed that up with a postdoctoral fellowship at McGill University with John Bergeron on new imaging technologies in transmission electron microscopy.

Following my fellowship, I returned to the Université Laval to work on skin stem cells and the treatment of burn patients using cultured cells.

Today, we know that stem cells are present in all organs, even in the brain. It was known for a long time that stem cells existed in the skin of an adult, but it was not recognized for most of the rest of the body. I spent a large part of my early career working to prove and convince others that stem cells existed in adults in more than just the skin. I believed strongly in my work and was very confident and able to make my case with a lot of passion.

3. What did you want to be when you grew up?

I liked so many things when I was young. I knew even at a young age that I wanted to work in medicine. I loved science, biology, math, physics, and I enjoyed studying and loved to learn. I was not sure what exactly I wanted to do but was certain it would be in the medical field.

4. What are you working on right now?

I am working on tissue engineering, which means we are reconstructing tissues using stem cells.

The idea is to take a tissue, for example skin. We isolate the stem cells contained in the skin and put them in culture using the right environmental conditions so that the cells are able to multiply. Once we successfully do that, the next step is to use these multiplied cells to produce a large amount of skin that could then be grafted onto a patient.

We can do this for skin, but also for the cornea, which is the transparent tissue on the surface of the eye. Together, with François A. Auger we discovered the self-assembly method of tissue engineering. This is a new approach to produce human tissues from cells only, without adding biomaterials. This helps to make the tissue more similar to natural tissue. It is important to produce a tissue that will function for a long time – for example, to replace burned skin on a patient. The presence of stem cells in the reconstructed tissue is necessary because one's epidermis is always changing. In order to produce all the new cells essential to replace the epithelial cells that are lost in the environment, we need stem cells because of their ability to regenerate and replicate in the transplanted tissue. In the skin, we are continually shedding cells all the time – your epidermis changes every 28 days – so the stem cells are critical as they replicate and replace the discarded cells.

This is the same in the epithelium of the cornea. While stem cells in the skin was discovered in 1960, and it was accepted that the cells were continually renewing in the epidermis, this thinking that stem cells exist in other tissues in our bodies did not necessarily expand until later.

5. Why stem cells?

I like the stem cells because they have a great potential. They can multiply and also give rise to differentiated cells.

What also attracted me was their clinical applications. I did my PhD on liver stem cells. But then later I began to work with skin stem cells and how they can be used as an effective treatment for burn patients. We realized that in order to get a tissue that will renew all the time, we needed stem cells. So that's why I focused my research on stem cells.

And it's the same for limbal stem cell deficiency. At the surface of the eye, if we lose the stem cells that produce the transparent tissue, the conjunctiva which is the white part of the eye, will grow over to close the wound. The problem is that this tissue is not transparent. At that point you need to replace the stem cells that are able to make a transparent tissue, and this is what we are doing with the cultured limbal stem cells. We culture them *in vitro* and produce an epithelium that can be grafted to the surface of the eye for the patient suffering from limbal stem cell deficiency.

6. Who in your opinion, are the top three Canadian stem cell researchers in history?

This is a very big question and very hard to answer because it's too difficult to choose. There are several researchers that have advanced the field of stem cells. And most of the time discoveries are based on numerous concepts that add upon one another and building on the work of others. Each of these steps is essential to reaching the final result.

So, it is difficult to choose just a few people, but I would say: Charles P. Leblond, from McGill University in the Department of Anatomy. He discovered stem cells with radioautography in 1959. This is the histological detection of the incorporation of radiolabeled precursors, which allowed us to add the dimension of time. This is a dynamic histology and that is how he was able to see the cells that proliferated by incorporating radio labeling into cells and see the precursors and their lineage.

Then there was Till and McCulloch, and their work on hematopoietic stem cells – the cells that give rise to other blood cells.

And Connie Eaves from the University of British Columbia. She characterized the hematopoietic and the breast stem cells that are involved in reconstituting normal and cancer tissues. She has worked with both mouse and human cells and developed assays to better understand the mechanisms involved in the growth of cells resulting in cancer.

7. What is the most significant stem cell discovery or advancement over the last 20 years? The last 60?

In the last 20 years that would be the discovery of induced pluripotent stem cells (iPSc), by Shinya Yamanaka. Being able to dedifferentiate cells – I would not have believed it possible before that discovery. This is molecular biology, and with this work, it became possible to go back in time in a cell and return to the origin – the stem cell. Prior to that, we were only able to work with stem cells and their differentiated progeny, where you move forward with the cell. The iPScs allow you to basically go back in time.

Over the last 60 years, I would say stem cell expansion, which is the possibility to multiply epidermal cells in culture. It was first done by researchers in France who were able to culture human epidermal cells – have them multiply in the culture. Then Howard Green found the method to limit the fibroblasts overgrowth and found the method to detach the epithelial cell sheet. But the problem was that there are two main cell types in the skin: the epithelial cells which are the cells you want, and the fibroblasts which are in the dermis. The fibroblasts are just like the weeds, they grow so fast that if you are not able to limit their growth, you are not able to create a tissue with your epithelial stem cells because the fibroblasts are all around. What Howard Green did was to create a method to stop the growth of these fibroblasts.

8. What are your predictions for stem cell advances in the next 5, 10, 20 years?

This is another very difficult question – reading future is almost impossible. But I would say that in five years, there will be more applications for stem cells: in the field of wound healing, and probably in the field of inflammatory disease such as rheumatoid arthritis.

In 10 years, again, there will be more clinical applications, but for genetic diseases such as epidermolysis bullosa in which the epidermis is not well attached to the dermis. I believe there will be new technologies using stem cells to treat these patients.

And in the next 20 years, I hope that we will have solved the problem of the lack of organ donors for transplant. Not only for skin for burn patients, but some other transplant such as a cardiac valves or other most complex organs. Mastering stem cells and tissue engineering should lead to the production of more complex organs.

9. What are you reading right now?

I am currently reading *The Da Vinci Code*, by Dan Brown.

When I was young, I really enjoyed fiction, and in particular mysteries. One I really liked was *The Mystery of the Yellow Room*, by Gaston LeRoux. I read it in the original French so it was called, *Le mystère de la chambre jaune*. I also really enjoyed the *Arsène Lupin* novels by Maurice Leblanc.

10. Who is your favourite scientist?

You will not be surprised, being a physicist, I chose two physicists:

Albert Einstein. He was a theoretical physicist who developed two pillars of modern physics: the theory of relativity, and the theory of quantum mechanics. His formula on the equivalence of mass and energy – $E=mc^2$ – which is so well known, even by the young. He got the Nobel Prize in Physics in 1921 for the photoelectric effect. The most impressive thing to me about his work is that he predicted these phenomena and these predictions were only proven right several years later, after other physicists realized experiments which very difficult to do. So, he was really predicting the future and how it works, so it is very interesting to me.

The second is Maria Salomea Skłodowska Curie, or Marie Curie. She was a Polish-French physicist and chemist who also worked at the beginning of the last century conducted pioneering work on radioactivity. She received two Nobel prizes. The first Nobel Prize in Physics in 1903 she shared with her husband Pierre and the physicist Henri Becquerel for the theory of radioactivity. The second was a Nobel Prize in Chemistry in 1911 for her discovery of the elements polonium and radium. These radioactive isotopes were applied to medicine for the treatment of cancer.

So, several physicists are working in the medical field, or their discoveries are being applied to a medical field.

11. What in your opinion is the single most important health science or biomedical breakthrough?

There are a lot, so this is once again, difficult to choose. But I chose antibiotics because this discovery has saved the lives of so many people.

During this time of pandemic, we can understand well, power of the minuscule living entities – the virus, the bacteria and the fungi. The antibiotics and the anti-fungi limit the health problem caused by bacteria and fungi. In contrast, they do not work against viruses, so that's why we have the pandemic. So, for the viruses we have to wait for vaccines that have to be designed for each virus. Antibiotics could work on several strains of bacteria.

If I could choose a second, it would be radioactive isotopes. This has allowed us to cure cancer and it is a big discovery that is still being used today for treating cancer.

12. What is your favourite place to visit? Why?

I like traveling and I like a lot of the countries I have visited. If I had to mention just one, it would be Hawaii, because I really enjoy snorkeling and the nice flowers and gardens.

The best snorkeling I ever experienced was in Eilat, in Israel. But unfortunately, it is no longer a good site as it has been destroyed by tourists. I was there in 1978, when I was 19. It was not touched by tourists it was just incredible, the number of fish I saw and the vibrant colours. It was the best thing I had ever seen in my life. The amount of fish that were there was just incredible. After Eilat, the best I have seen was in a park in Hawaii. I would also really like to snorkel again at the Coral Reef in Australia and also one day snorkel in Polynesia.

13. What are the top three songs in your personal playlist?

They are three French songs, that probably the young will not have heard of. They are:

- *Gens du pays*, by Gilles Vigneault
- *Le Petit Bonheur*, by Felix Leclerc
- *Évangéline*, by Michel Conte and Marie-Jo Thério

14. If not a scientist, what would be your dream job?

I really like the job I have, but maybe another job could have been Professor of Music.

But the advantage of music is that one can have their scientist job and still do music as a hobby. That is why I chose the path I did.

15. What is the best piece of advice you have ever been given? What advice would you give to a trainee just starting out?

Do what you like, while being rational in order to have a good livelihood. Follow your passions and your dreams and do not plan out your entire life. Take opportunities when they appear and do not be afraid of trying new roles with novel challenges.

For a trainee I would advise you to find what you like, do it the best you can and never regret your choices. Work to have balance in life – have a good career but also have hobbies.

For younger school children, I would tell them to work hard and study all subjects. You cannot say that you will not need math, for example – you will understand later why it is so important.

16. What is something you think everyone should do at least once in their lives?

Travel overseas. It is important to meet people from other nations and learn from these trips about nature and culture. It is really worth it.

17. What skill would you most like to master?

Western concert flute, which is a family of *transverse woodwind* instruments. They have such a nice sound.

18. Who is your favourite Canadian?

Again, this is really, really difficult to choose. I would say that I am inspired by people who realize their dreams, so I will say:

- Céline Dion. She is a great singer.
- Bernard Labadie, a conductor who founded Les Violons du Roy in Québec City. He is a really great musician.
- Robert Lepage, a screenwriter, actor and also a producer. He founded Ex Machina and created several pieces for theatre including, The Seven Streams of the River Ota and he created an ingenious installation for The Rings opera by Richard Wagner for the Metropolitan Opera of New York.

These three Canadians are known throughout the world.

19. What do you wish you knew more about? What mystery do you wish you knew the answer to?

Nature and the diversity of the animal and plant world.

And the more scientific answer would be, the origin of cancer and all the details resulting in the uncontrolled growth of cells that can kill an individual.

20. Your work is all about discovery and innovation. What is one thing (personally or professionally) that you still like to do the old-fashioned way?

Cooking – I like the old recipes. For example, making fruit pies with strawberry, raspberry, blueberry, or pecan pie. Another is Pouding Chômeur. It literally means, unemployed worker pudding. You don't need much to do it, it is made with simple, inexpensive ingredients, including flour, sugar, milk and butter, with maple syrup. It is very simple to make but it is so good.