A STEM CELL STORY - TRANSCRIPT

Narrator
We hear a lot about stem cells these days. But what are they, where do they come from, and what do we really know about them? Inside our bodies there's a microscopic world busy and complex like the world around us. Stem cells build and maintain this world.

This is a story of stem cells and their lives inside and outside our bodies.

Life begins with one cell, the fertilized egg. Throughout development cells divide over and over again to produce the billions of cells that make up the body.

At certain stages most cells stop making copies of themselves and start to specialize. When we are fully formed almost all of our cells are specialized.

Austin Smith
Cells are very beautiful things when you see them down the microscope. Normally they are so miniscule we can't see them, even though they are what make us all. And each type of cell has its own characteristic. Some types of cell grow together, very closely together and form beautiful patterns, other types of cell will move away from one another. Some cells become big, other cells are always very small. It depends on what type of cell they are.

Narrator
These different cell types work in specialized teams. Some carry oxygen through the blood system. Some do the stretching and contracting in our muscles. Some carry messages between our brain and the rest of our body.

Austin Smith
Stem cells are very special cells and they act as a reservoir really because the specialized cells can no longer make copies of themselves so if they die or get used up then they have to be replaced from somewhere and this is where the stem cells function.

Stem cells are used in the blood system, we need to make millions of new blood cells every single day and these are generated from stem cells.

These cells actually live in the bone marrow and altogether the blood stem cell can make eight different types of specialized cell.

They are used in the skin. We need to make new skin cells all the time because we are always wearing away our skin.
And actually now we know that they are present even in the brain.

We always have to make new stem cells so that they are not completely exhausted because otherwise we would lose the capacity to make any new cells at all.

So the stem cell has to make a decision, every time it divides it produces two daughter cells and those daughter cells can be new stem cells or they can be specialized cells.

Stem cells in the adult tissues can normally only make the type of cell in that tissue so a stem cell in the skin can make cells of the skin but it can't make blood cells and vice versa.

Narrator
Stem cells are already useful in medicine. One skin stem cell alone can produce enough specialized skin cells to cover the whole body. This produced a breakthrough in the treatment of extensive burns.

Yann Barrandon
When a person is heavily burned, we take a sample from an unburned area and we take this skin sample apart and we get the cells out of it and we seed the cells in a culture flask like this one. We feed the cells with a special liquid, which is full of protein and sugars. They need to eat like you. At some point these cells will divide, will multiply and they will cover the entire bottom of the flask.

We remove these cells using a special chemical and we get this sheet of cells into the surgery room and we transplant the patient with it.

We can do only part of the skin today which means we can do the most outermost layer of the skin. This is very important because without this layer you would not be able to survive however we cannot reconstruct sweat glands or hair follicles. So these burn patients, their lives have been saved with stem cells but they have no hair and they don't sweat. That is obviously a problem. I mean they are alive but I cannot say they have a normal life like you and me. So that's why many laboratories around the world are trying to understand how the skin is built, to be able to reconstruct it in the lab so we can improve the lives of these patients.

Narrator
Stem cells are also used to treat patients with blood disorders such as leukemia. A transplant of just a few blood stem cells is enough to repair the entire blood system. Stem cells for specific tissues and organs can only make the cells of that tissue. We know there are stem cells in skin, blood, guts and muscles but we don't know whether other organs have their own stem cells or how useful they will be.

Back along the chain of development there is another kind of stem cell. It's controversial. It can become any specialized cell. The embryonic stem cell. This cell comes from a blastocyst, the stage of development before implantation in the uterus.

For fertility treatment blastocysts are produced in the laboratory. If they are not used for a pregnancy they can be donated for research.

Jenny Nichols

In the early embryo there is a group of cells that can give rise to all the tissues of the body. These cells are the ones that we are very, very interested in because we know that we can take the cells from the early embryo and grow them in culture and maintain them in a state where they can contribute to all the tissues.

What we are seeing here is the blastocyst stage of development. It is smaller than a pinhead actually. You can't see it without the microscope.

So basically at this stage the cells in the embryo - these are the cells here - they can make any tissue at all. What we have to do is isolate these cells. One way is we can remove the trophectoderm cells so that we are just left with a clean inner cell mass.

So we can grow these in culture and they will grow, multiply until we have large numbers of these cells that still have the capacity, are still able, to form any tissue at all.

Narrator

Embryonic stem cells can become heart, blood, brain or skin cells depending on the way they are grown. These stem cells have turned into heart cells.

Austin Smith

When you are working with stem cells you are always observing the cells and you try to understand how it is they can do what they can do. And you try and actually make them do what you want them to do. It is almost like a battle of wills.

Narrator
A stem cell goes through a long series of decisions to become a specialised cell. A combination of internal and external signals, guide each stem cell along the path towards specialization. These signals are normally provided by the body. By figuring out how to recreate these signals in the lab, scientists aim to grow pure populations of almost any cell type.

Austin Smith
The challenge to us then is to understand each decision and how it is controlled and then how to provide those signals to impose the direction on the system. Once we get to a point where that begins to happen then you suddenly see, well actually we could use this then to address medical conditions and medical problems.

So work that we have been doing recently has been focused on trying to make stem cells for the brain from embryonic stem cells and it turns out that we are able to do this. And that these neural stem cells, as we call them, are now no longer able to make every type of cell, they can only make three types of cell, the three types of cell that exist in the brain. So this is an important first step we believe in creating a useful and very powerful system that can be applied both for drug screening and perhaps in the end for transplantation.

Narrator
These lab grown human cells produced in large numbers provide improved models for testing and screening new medical treatments and may reduce the need for animal testing. The same cells may also help us understand what goes wrong in complex diseases like Alzheimer's, Parkinson's and diabetes.

Daniel Pipeleers
Diabetes is a chronic disease defined by these high blood sugar levels that stay high just because there is not enough insulin. We know that the insulin is produced by cells in the pancreas. We call them beta cells. Transplantations of those cells are now done in clinics, where those cells are isolated from donor organs. After transplantation with those cells you can normalise diabetes. You can correct diabetes.

The major obstacle to beta cell transplantation in diabetes is the shortage in donor cells. We can transplant only 25 patients per year while there are more than 50,000 patients in Belgium that are treated with insulin. We have to look for other techniques to produce insulin-making cells in the laboratory. What the researchers try to do is first examine this path, this evolution, between the embryonic stem cell and the insulin producing beta cell and then to also try to isolate the different stages, the different kinds of stem cells on the way to beta cells. And if one can then isolate them and let them grow, proliferate in the laboratory then you can make as many insulin-producing cells as you want and that is the goal of many investigators in the world.

The embryonic stem cell area is a very exciting area. It really has opened a new world, that of regenerative medicine. We now have bridges between all the laboratories that have a particular expertise. Working together we will be in a good position to examine, to investigate its enormous potential. But the enthusiasm should not cover all the technical and scientific questions and obstacles that exist and that will have to be studied very carefully.

Narrator
Stem cell research is a fast moving field. Around the world new findings are constantly reported, creating new questions and fresh challenges for scientists seeking to harness these cells and to shape future medicine.

Austin Smith
So cells are the building blocks of the different tissues and organs of the body and many people are interested in this. But what captured my imagination was when I realised that in development cells actually have to make choices and decide to become different types of cell. And understanding how that is controlled, how that decision is made - if you could understand that then it seems to me, you would really understand the most important thing about life.

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