BBC BITESIZE

Hello, I'm Dr Alex Lathbridge and this Bitesize Biology.

This is the second episode in a nine-part series on The Cell.

In this episode, we're going to learn about stem cells: how they are different in plants versus animals and why they are really useful for scientists.

But before we get into that we need to back up a little.

All living things are made of cells. Remember, they're the building blocks of life. (If that doesn't sound familiar, go back and listen to Episode 1 again.)

Plants and animals (like us humans) are made up of combinations of thousands of different types of cells, all working together to make the organism thrive. Remember the word organism. It just means an individual living thing like a plant or animal or human.

You're going to hear it a lot and examiners like it – so write it down:

Organism. I'll give you an example: each human is an organism made up from about 200 different types of cell, these are things like blood cells, muscle cells and nerve cells.

Humans began in the womb as a fertilised egg cell or ovum called a zygote. One single cell.

And that means that those hundreds of different cell types all come from the division of that original cell.

So how do we get from one, single, fertilised egg cell to the complex being that you are?

It's all to do with stem cells. This process is important to remember. Grab a pen and make some notes.

We start with the zygote, the fertilised cell or ovum. This is a stem cell. An undifferentiated cell.

As that cell divides, it becomes what's known as an embryo, that's a small clump of stem cells.

Key here is that these embryonic stem cells have the potential to become anything that the body needs.

As you develop and grow in the womb, they receive signals that tell them to switch on certain genes, or differentiate, to become specialised for a specific role.

And that makes sense, because the cells in your eyes need to be very different from the ones in the skin.

This process, where cells change in different ways to have a specific job is called differentiation.

You need to remember that cells differentiate to become specialised.

Stem cells haven't been through this process yet, so they are undifferentiated.

Just imagine that all of your cells are being laid out on a family tree.

The trunk of the tree would be the fertilised egg and the leaves would be all of the 200 or more types of differentiated cells.

And in between the leaves and the tree trunk are the branches, our stem cells.

(Why aren't they called branch cells? Yes, that would have made things far easier but some of the first work came from German scientists and they probably thought the word Stammzelle was cool).

You start with one undifferentiated stem cell. That's a fertilised egg cell, a zygote.

This divides into an embryo, a clump of stem cells. So you've gone from a zygote into a clump of stem cells.

As the embryo divides, grows and develops in the womb, the stem cells receive signals that cause them to differentiate, to become specialised for a specific role.

This is complicated stuff so don't worry if you don't get it first time round. Listen back a few times, and remember you can always pause if you need to make notes, or ask a friend a question.

So those are embryonic stem cells.

Adults also have stem cells, called adult stem cells. We need them because we still need new cells to help us heal from injuries as well as replace our cells when they wear out.

Adult stem cells are left over from the embryonic stem cells that didn't differentiate and they can only specialise into a few different cell types, unlike embryonic stem cells that can do all of them.

These are only found inside certain places: like the brain, bone marrow, blood, muscle, eyes, skin, liver and heart.

Stem cells are pretty useful inside us humans, but they are also useful outside the body.

Scientists can take stem cells and encourage them to grow into different types of cell, which we can then put back into humans, transplanting them into the bodies of people who need them to replace their own cells because they have become damaged.

Scientists are finding out more and more each day about the ways they might use stem cells to treat all kinds of diseases.

In terms of treating disease, adult stem cells are useful, to a certain extent, because although they can differentiate, they can only specialise into a few cell types, so they have got fewer options for what they can be.

For example, stem cells found in the bone marrow can be used to make new blood cells.

This means that a person could donate their bone marrow to someone who has a blood cancer like leukaemia. This bone marrow would be transplanted into the donor and, if successful, they would then make new, healthy blood cells to replace the damaged ones.

Now this science is relatively new and there are some issues.

Not everyone might want to donate their bone marrow and even if they do, not all donations are successful.

We could use embryonic stem cells, but many people question whether it is right to use human embryos for scientific research.

These are examples of ethical arguments which are constantly being debated.

Despite this, we've made brilliant strides. Researchers are even trying to work out how we might be able to turn regular cells back into stem cells, opening up potential ways to develop artificial organs and heal major injuries in the future.

Finally, you also need to know about stem cells in plants, because they work slightly differently from the ones in animals.

Stem Cells in plants are only made in special parts of the plant: the tips of roots and shoots called meristems (which makes it easy to remember).

The cells made in the meristem can differentiate to become any of the kinds of cells that the plant will need over its lifetime. This is why you can take cuttings of a plant and use that to grow a whole new plant.

You couldn't grow a human from a chopped off finger.

I'm Dr Alex Lathbridge and this Bitesize Biology.

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