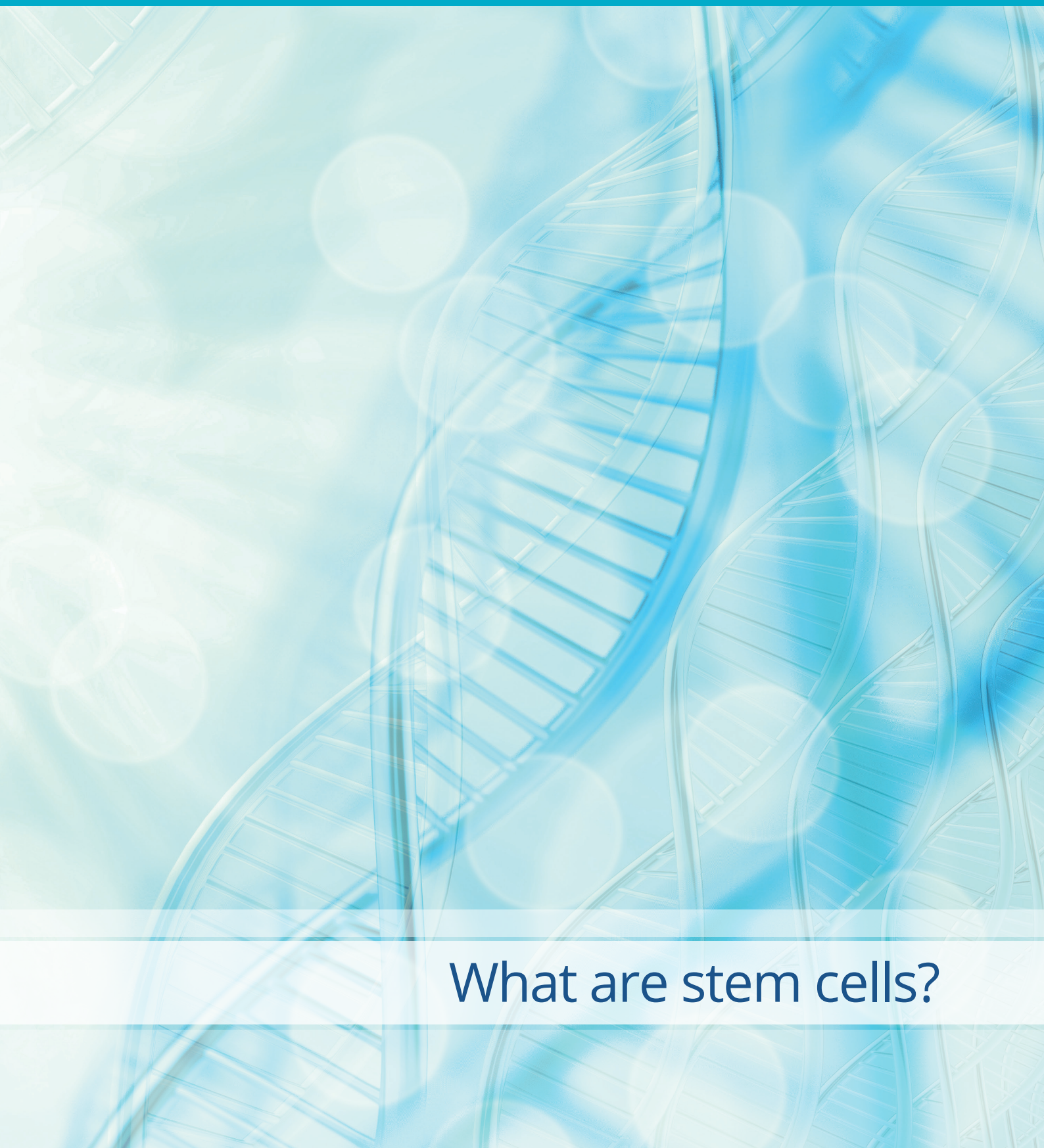
Cells4Life

the experts in stem cell processing



What are stem cells?

An introduction to stem cells: Q&A

What are stem cells and what do they do?

Stem cells are special cells with extraordinary powers; they are the building blocks of life. Stem cells divide through mitosis to create daughter cells. These daughter cells can either become the same kind of stem cells as the parent cell (described as self-renewal) or they can differentiate into specialised cells with a specific, targeted function.

Totipotent stem cell:

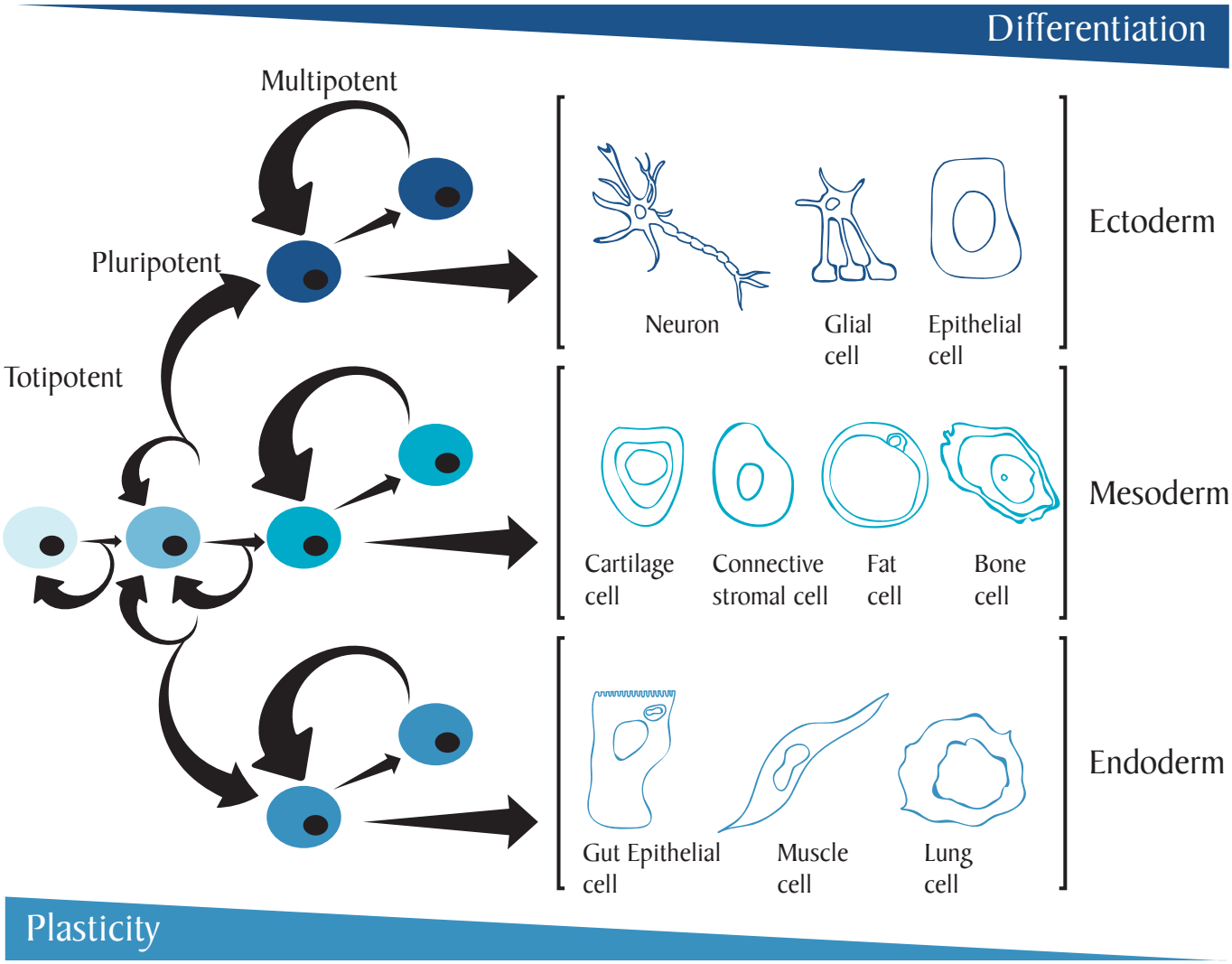
Totipotent stem cells ('toti' being Latin for 'whole' or 'total') have the potential to become any other type of cell in the body, including those of the extra-embryonic membranes.

Pluripotent stem cell:

Pluripotent stem cells have the potential to become any of the specialised cells in the body. Three types have been found so far: embryonic stem cells, embryonic germ cells and embryonic carcinoma cells.

Multipotent stem cell:

Multipotent stem cells only have the potential to become a limited number of cell types..



Where are they found?

Stem cells are found throughout the human body and at various stages of development. The use of embryonic and foetal stem cells has shrouded stem cell research in blanket of controversy due to the controversial nature of these cells. However, not all stem cell sources have ethical quandaries.

Controversial stem cell sources:

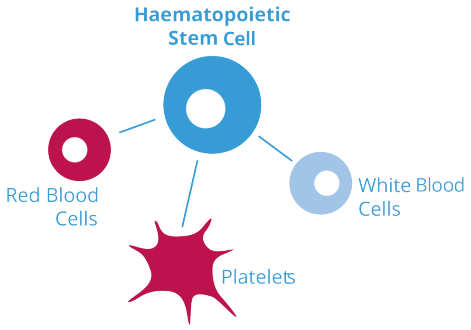
- ***Embryonic stem cells*** — taken from an embryo at the blastocyst stage. A blastocyst is a pre-implantation stage embryo and is formed 5 days after fertilisation.
- ***Foetal stem cells*** — taken from the primitive organs of a foetus.

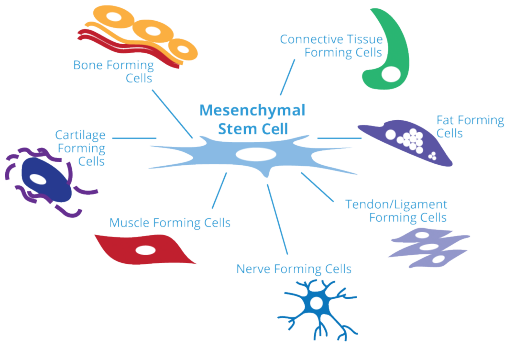
Non-controversial stem cell sources:

- **Adipose** — Fat tissue, a source of stem cells often used in cosmetic surgery.
- ***Bone Marrow*** — A rich source of haematopoietic stem cells found in the cavities of bones.
- ***Cord blood*** — The richest and least invasive source of stem cells from the human body.
- ***Induced Pluripotent Stem Cells*** — Man-made from skin cells, a useful tool in research.

This list is by no means exhaustive but gives an overview of common stem cell sources one of the richest source of stem cell types is the umbilical cord blood and tissue during pregnancy.

For example, umbilical cord blood contains mesenchymal stem cells (MSCs), haematopoietic stem cells (HSCs) and very small embryonic like stem cells (VSELs), all of which are currently being used in stem cell research. Umbilical cord tissue also contains MSCs, in addition to unrestricted somatic stem cells (USSCs), vascular endothelial stem cells and perivascular stem cells, which are also expected to have great therapeutic benefit in the future.



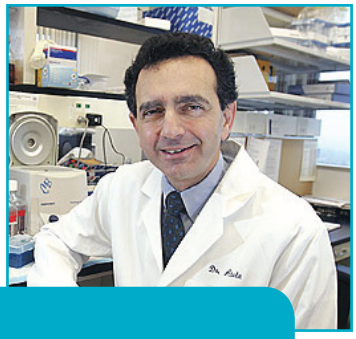


What is the role of stem cells in medicine?

Stem cells play a huge role in medicine; at the forefront of medical research, pioneering new and exciting techniques and therapies. In the lab stem cells can be used to help develop new drugs by allowing drugs to be tested on human tissue grown from stem cells without a person ever coming into contact with the drug. In addition iPS cells can be used to grow tissues with certain diseases for in depth study. Cord blood is also being researched a wide array of human trials, possibly most well-known are the trials utilising autologous cord blood for the treatment of brain injuries.

Outside of the lab, stem cells are already being utilised an approved therapy for over 80 serious illnesses. Stem cell transplants can be used to treat blood disorders, cancers and metabolic conditions. In addition to transplants, stem cells are also being used in tissue engineering to create new organs and body parts.

Dr. Anthony Atala has used a 3D printer printing stem cells to create a functioning bladder which was subsequently successfully transplanted into a patient. The benefit of tissue engineered organs is that using an organ created from a patient's own stem cells greatly reduces the risk of rejection as the body will recognise the cells. Additionally, creating organs in this manner could have an enormous impact upon the organ donor register, freeing up donated organs for other patients and saving lives.



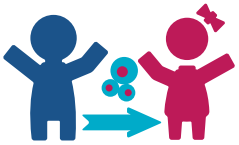
Dr. Anthony Atala is well known for his TED talks on regenerative medicine
Watch his talks here - https://www.ted.com/speakers/anthony_atala

How do stem cell transplants work?

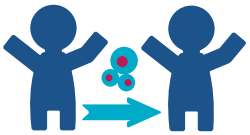
Stem cell transplants leave patients incredibly vulnerable to infection as intensive chemotherapy is used to kill cancerous cells; unfortunately the immune system is also damaged. A stem cell transplant can help patients rebuild their immune system after intensive chemotherapy. Due to the serious nature of a patient having a diminished immune system as a result of chemotherapy, the procedure will only be performed when the benefits outweigh the risks. A physician will also need to decide upon the best type of transplant for the patient.

What are the types of stem cell transplant?

Autologous – These transplants use the patient's own stem cells which have been stored prior to treatment. They could be sourced from bone marrow, peripheral blood or umbilical cord blood. The chance of these stem cells being rejected is minimal as the body recognises these cells as its own.



Allogeneic – These transplants use stem cells from a donor. The donor may be a family member or could even be a stranger who was found to be a match in a registry such as NHSBT. HLA matching will be used to find the best possible match between donor and patient thus reducing the risks of rejection.



Syngeneic – These types of transplants are incredibly rare. A syngeneic transplant uses stem cells from a donor; the donor and patient are siblings who are identical twins or triplets. Due to the genetic make-up of identical siblings, the chances of rejection are greatly reduced than that of a regular donor and the patient's body should accept these stem cells willingly.

What is HLA matching?

When a patient is in need of a stem cell donor, the patient and donor will need to be suitably matched. A patient and donor are matched by comparing at the 6 major HLA (human leukocyte antigen) proteins. The stem cell donor source can affect the amount of proteins which need to be matched between donor and patient. For example, a minimum match of 5 out 6 HLA proteins is required for bone marrow and peripheral blood. However, because cord blood stem cells are more naïve a minimum match of 4 out of 6 HLA proteins is required, making cord blood easier to match to patients than other stem cell sources. The better the HLA match between donor and patient, the lower the risk of rejection.

What is regenerative medicine?

Regenerative medicine is an emerging area of medicine which uses the body's own cells to repair and replace damaged or diseased tissues. There are many facets of regenerative medicine with some therapies using cord blood infusions to treat brain injuries; others use patient's stem cells to grow replacement body parts and organs. It is important to note that because the field of regenerative medicine is so new that many regenerative therapies are still in trial stage. However, the research being performed in the regenerative medicine field is pointing to a future of tailor made medicinal therapies.

What can stem cells treat?

Stem cells can be used to treat disease and injury, and are considered to be the cornerstone of regenerative therapies. Although there are many fields of study, two types of therapy are receiving particular focus. These are transplants and regenerative therapy.

TRANSPLANTS

Haematopoietic stem cells (HSCs) can transform into any type of blood cell and are currently being used in the treatment of various blood cancers and disorders. This includes leukaemia, lymphoma and myeloma

Available today to treat:

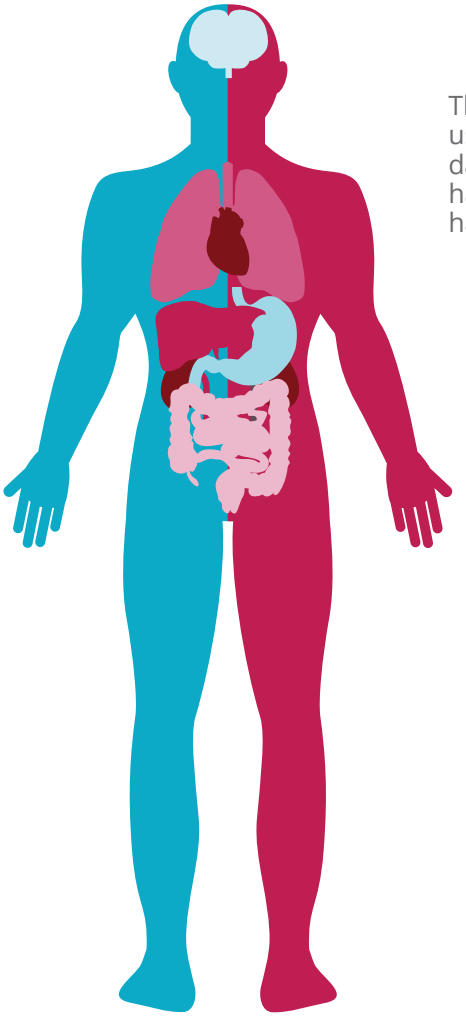
Metabolic Disorders:
- Krabbe Disease
- Hurler Syndrome

Blood Cancers:
- Leukaemia
- Lymphoma
- Myeloma

Solid Tumours:
- Neuroblastoma

Immune Disorders:
- SCID
- Wiskott-Aldrich Syndrome

Blood Disorders:
- Sickle Cell Anaemia
- Aplastic Anaemia
- Fanconi Anaemia



REGENERATIVE THERAPY

This groundbreaking medical field uses stem cells to repair or replace damaged tissues and organs. Over half the samples released by Cells4Life have been used in this area.

Being researched to treat:

- Cancer
- Brain Injury
- Multiple Sclerosis
- Cerebral Palsy
- Parkinson's Disease
- Alzheimer's Disease
- Cystic Fibrosis
- Hearing Loss
- Bone Fractures
- Burns
- Stroke
- Heart Disease
- Cardiac Regeneration
- Liver Failure
- Diabetes
- Spinal Cord Injury

ONE MILLION

Haematopoietic stem cell transplants have been performed worldwide