

WHAT ARE STEM CELLS AND WHY ARE THEY CONTROVERSIAL?

Your body is made up of literally trillions of cells. Each cell contains genetic material that is a blueprint for its function. This blue print is made up of genes which are aligned into pairs. One set is inherited from your mother and the other from your father. An egg and sperm each contain half the complement of genetic material required to form a human and when they meet genes from the egg each pair up with a corresponding gene from the sperm.

Fertilization occurs when a sperm penetrates the egg's surface and deposits its genetic material inside the egg. This male genetic material combines with that in the female egg nucleus and creates a single stem cell which now, with its full complement of genes, is capable of dividing and potentially developing into any and every cell of the human body – This type of stem cell is described as “**TOTIPOTENT**”.

This totipotent stem cell immediately begins to divide multiplying exponentially to form a minute ball of totipotent cells. By around day 4 the totipotent cells begin to specialise as they divide. The ball starts to form a hollow sphere with a tiny mass of cells attached to one part of the inside edge.

This sphere is called a **BLASTOCYST** and consists of an **outer casing** and an “**inner cell mass**”. The **outer casing** is capable of going on to develop into the placenta and sac that the embryo will develop in. If the Blastocyst successfully implants into the wall of the uterus the **inner cell mass** can develop into an embryo and eventually a person.

The Blastocyst is smaller than the size of a head of a pin. We know that at many naturally fertilized eggs never implant and even in the case of those that do it is estimated that up to 50% of these end up in spontaneous miscarriage, where in many case the woman is not even aware she had been pregnant.

The cells of inner cell mass of the blastocyst are called “**PLURIPOTENT CELLS**”. They have the capacity to reproduce themselves as well as differentiate into any cell type in the body - with a very important exception. On their own pluripotent cells **CANNOT** differentiate into a complete human because pluripotent cells alone **DONOT** have the capacity to “make” a placenta or sac for an embryo to develop inside. So if the inner cell mass is removed from its casing it is impossible for these pluripotent cells to develop into a complete human being. This is important because it is at this point in development that embryonic stem cells used in research are taken. The inner cell mass is removed from the Blastocyst using a tiny glass needle and the ball of cells transferred to a laboratory culture medium.

However because removal of the inner cell mass from the blastocyst halts any potential for it to develop into a complete human being, those people who believe life begins at conception feel that this process is wrong, and disrespectful to the embryo.

For those who do not have issue with research of this kind the discovery of how to successfully separate the inner cell mass from the outer casing was an Each one of the pluripotent cells of the inner cell mass has the capability of becoming any cell of the body (noting again, that once removed from the blastocyst they cannot become a complete person).

However their time as pluripotent cells is limited as they will eventually differentiate into a specialised cell type. The aim of to the research is to find the key that can program these cells into becoming a particular cell type. As yet there has been little success in this area. But then that's what science is all about – endeavouring to understand how things work.

Pluripotent cells will shortly differentiate into one of the three tissue types –

Endoderm – which makes up all the cells that line the gastrointestinal tract

Mesoderm – which makes up all the cells of muscle and bone

Ectoderm – which makes up all the cells of skin and nervous tissue

Once differentiated in to these three basic tissue types the cells are called “**MULTIPOTENT CELLS**”and will continue to divide to become more specialised. They can never regain their pluripotency or ability to become anything other than a cell of that particular tissue type. It was thought that multipotent

cells could only be found in embryos. However it is now known that while most cells will continue to differentiate until they reach their destination as a specialised cell, some cells retain their multipotent status. These are known as “**ADULT STEM CELLS**” and can be found in certain tissues in fully formed humans. A good example of this is bone marrow which has the potential to form any blood cell. Adult stem cells are limited in what tissue they can become.

ADULT STEM CELL research does not attract the same moral debate that embryonic stem cell research does because consent can be given for the cell harvest. And the cells do not have the capability to develop into a whole human being.

Until the 1990’s much of the debate was theoretical as there were not enough stem cells around to do much research on. However in that decade the right laboratory settings were discovered that allowed harnessing of a stem cell’s ability to self replicate. This meant that scientists could now produce a stem cell line that could, theoretically at least, reproduce itself indefinitely. However recent research has shown that this nut has yet to be completely cracked as stem cell lines are not seeing the distance. Adult Stem cells in particular have a limited life span. Once again at the risk of labouring the point, cells from these lines cannot produce a whole person.

There are various ways to “make” a blastocyst.

1. Use excess frozen blastocysts created during the IVF program but not used by the people who created them (this is currently legal in Australia)
2. Specifically create blastocysts for research purposes (this is currently banned but is recommended by the Lockhart review)
3. Take a human egg and remove its nucleus. Replace this with a nucleus from a somatic cell (eg nucleus from a skin cell or any other cell with a complete complement of genetic material – ie not another egg or sperm). This is **Somatic Cell Nuclear Transfer** – (currently banned but recommended by the Lockhart review under strict provisos - see appendix 2 for more detail)
4. Perform SCNT using an animal host egg and a human nucleus (currently banned but recommended by the Lockhart review)

Objection to embryonic stem cell research is all about the definition of when life begins requires a firm faith in religious doctrine. These days alone this isn’t enough to convince the community. Given the potential for therapeutic gains this position. The pro life movement have realised that such firm faith is waning in the community and so they have begun to use other means to cloud their bias in the debate.

While the overarching objection to embryo research is usually based on life beginning at conception It seems that those who object to this type of research often give different reasons depending on which method is employed. They object to but tolerate the first method because the embryos were going to be “discarded anyway”. They object to the second method based on the premise that it is wrong to create humans beings specifically for the purpose of research, however this pivots on the definition of a human being. They object to the third method by using word pictures involving recollections of Dolly the Sheep and the risk of human clones appearing..... They object to the fourth method using words that conjure up visions of a mix of Dolly and people being produced.

There should be no need to use spin to cloud or enhance the moral view point. People’s objection to embryonic research on moral grounds should be respected as a valid objection in this matter The debate needs to be transparent. It is not up to minority groups or individual politicians to decide. The community should have its collective voice heard in the decision. The Lockhart report is that voice.

Further reading on understanding stem cells: <http://www.lifesciences.umich.edu/research/featured/basics.html>

An interesting perspective in the debate: <http://www.poppolitics.com/articles/2001-07-23-cell.shtml>