

# Stem Cells

## Unique Properties of Stem Cells

1. Able for long term self-renewal → asymmetrical division
2. Unspecialized and not committed
3. Able to be relocated to other tissue and differentiate into other type of cell
4. Give rise to other specialized cells

Cells Potency		
<ul style="list-style-type: none"> <li>• Specify its differential property</li> <li>• Potential to differentiate into different cells</li> </ul>		
Totipotent	Pluripotent	Multipotent
<ul style="list-style-type: none"> <li>• Able to differentiate into all kind of tissue               <ul style="list-style-type: none"> <li>○ Embryonic tissue</li> <li>○ Extraembryonic tissue</li> </ul> </li> <li>• Came from               <ul style="list-style-type: none"> <li>○ Zygote</li> <li>○ Morula</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Able to give rise to all types of body tissues</li> <li>• Cant differentiate into extraembryonic tissue</li> </ul>	<ul style="list-style-type: none"> <li>• Able to differentiate into more than one type of cells within the body</li> <li>• Limited to the organ of origin</li> </ul>

Types of Stem Cells		
Embryonic Stem Cells	Adult Stem Cells	Induced Pluripotent Stem Cells
Blastocysts of Embryo <ul style="list-style-type: none"> <li>• Inner cell mass in the developing embryo</li> </ul>	Arrived from post-natal tissue <ul style="list-style-type: none"> <li>• Haemopoietic stem cell</li> <li>• Mesenchymal stem cell</li> <li>• Umbilical cord stem cell</li> <li>• Amniotic fluid stem cell</li> </ul> Can be received from <ul style="list-style-type: none"> <li>• Bone marrow               <ul style="list-style-type: none"> <li>○ Mesenchymal stem cells</li> <li>○ Haemopoietic stem cell</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Somatic adult cells which are being reprogrammed to enter an Embryonic stem cell like state</li> </ul>
Pluripotent	Multipotent	Pluripotent

## Embryonic vs Adult Stem Cells

Features	Embryonic Stem Cells	Adult Stem Cells
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Flexible                             <ul style="list-style-type: none"> <li>○ Virtually can become various cells</li> </ul> </li> <li>• Immortal                             <ul style="list-style-type: none"> <li>○ Virtually can divide unstoppably</li> </ul> </li> <li>• Availability                             <ul style="list-style-type: none"> <li>○ In vitro fertilization clinic</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Stem cells received from bone marrow and umbilical cord appear to be flexible</li> <li>• Already “specialized” → easy to induce</li> <li>• Non-immunogenic                             <ul style="list-style-type: none"> <li>○ Receiver who get from their own stem cell wont experience rejection</li> </ul> </li> <li>• Non-carcinogenic</li> <li>• Not harmful</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Difficult to differentiate uniformly and homogenously into target tissue</li> <li>• Immunogenic                             <ul style="list-style-type: none"> <li>○ Received from random embryo of random donor</li> </ul> </li> <li>• Carcinogenic                             <ul style="list-style-type: none"> <li>○ May transform into malignancy</li> </ul> </li> <li>• Destruction of developing human life → gets from embryo</li> </ul>	<ul style="list-style-type: none"> <li>• Limited quantity                             <ul style="list-style-type: none"> <li>○ Unable to harvest in large quantity</li> </ul> </li> <li>• Mortal                             <ul style="list-style-type: none"> <li>○ Unable to differentiate indefinitely</li> </ul> </li> <li>• Less flexible                             <ul style="list-style-type: none"> <li>○ Limited to organ of origin</li> </ul> </li> </ul>

## Principal of Stem Cell Therapy

- Plasticity → Potential to differentiate into different tissue
- Homing → may travel to damage tissue
- Engraftment → able to unite with other tissue

Bone Marrow Transplant	Umbilical Cord Blood Transplantation	Transplantation of Stem Cells Graft
<ul style="list-style-type: none"> <li>• Usage to treat                             <ul style="list-style-type: none"> <li>○ Leukaemia</li> <li>○ Blood disorders</li> </ul> </li> <li>• Multipotent stem cells will replace the damage cells</li> </ul>	<ul style="list-style-type: none"> <li>• Usage to treat                             <ul style="list-style-type: none"> <li>○ Leukaemia</li> <li>○ Blood disorders</li> </ul> </li> <li>• Advantages                             <ul style="list-style-type: none"> <li>○ Less immunogenic                                     <ul style="list-style-type: none"> <li>▪ Cells haven't develop specific features for body to recognize as foreign</li> <li>▪ Lack of T cells</li> </ul> </li> </ul> </li> <li>• Disadvantage                             <ul style="list-style-type: none"> <li>○ Low number for harvest → only for children</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Usage                             <ul style="list-style-type: none"> <li>○ In case of deficiency in local stem cells</li> <li>○ Bone fracture</li> <li>○ Joint diseases</li> </ul> </li> <li>• Technique                             <ul style="list-style-type: none"> <li>○ Harvest bone marrow</li> <li>○ Isolate stem cell</li> <li>○ Culture to increase the number</li> <li>○ Injected into desired part of body</li> </ul> </li> </ul>

### Diseases with potential treatment

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| <ul style="list-style-type: none"> <li>• Parkinson</li> <li>• Alzheimer</li> <li>• Spinal cord injury</li> <li>• Stroke</li> <li>• Sickle cell anaemia</li> <li>• Cancer</li> <li>• Osteoarthritis</li> </ul> | <ul style="list-style-type: none"> <li>• Burn</li> <li>• Heart disease</li> <li>• Diabetes</li> <li>• Muscular dystrophy</li> <li>• Osteoporosis</li> <li>• Liver cirrhosis</li> <li>• Rheumatoid arthritis</li> </ul> |
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