BME449 Tissue Engineering

Lecture #5
Cell Sources in Tissue Engineering

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Regeneration in Nature

- Outstanding Examples
  - Planarian
  - Crayfish
  - Embryos
- Inverse Relationship
  - Increased complexity
  - Decreased regenerative ability

Regeneration in Humans

High	Moderate	Low
Skin	Bone	Cartilage

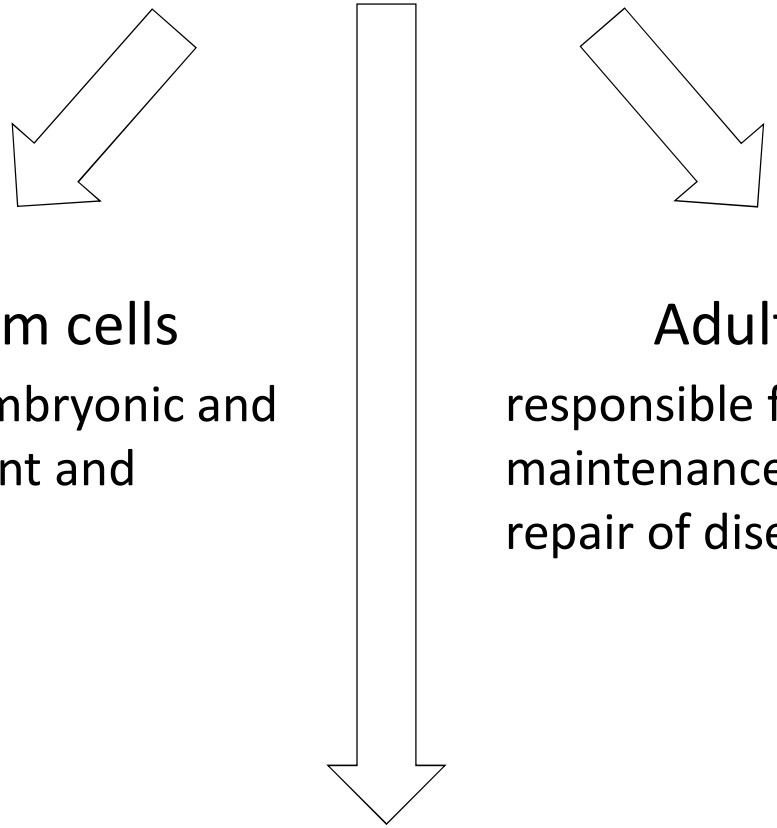
Clinical Need

- Cardiovascular
  - Myocardial infarction
  - Stroke
- Bone
  - Non-union fractures
  - Tumor resections
- Nervous
  - Spinal Cord Injury
  - Degenerative diseases

Stem Cells

- Self-renewal
- Environment-dependent differentiation

STEM CELLS



Embryonic stem cells

responsible for embryonic and foetal development and growth

Adult stem cells

responsible for growth, tissue maintenance and regeneration and repair of diseased or damaged tissue

Induced Pluripotent stem cells

Somatic cells engineered to express embronic markers

DIFFERENTIATION

Totipotent stem cell

Totipotent stem cells have the ability to form an entire organism. The fertilized oocyte and the cells after the first cleavage divisions are considered totipotent.

Totipotent stem cells can give rise to any of the 220 cell types found in an embryo as well as extra-embryonic cells (placenta).

Pluripotent stem cell

Pluripotent stem cells are able to form all three germ layers including germ cells, but not the extra-embryonic tissue as placenta and umbilical cord. Cells of the inner cell mass of the blastocyst are pluripotent. When these cells are brought into culture, they are called embryonic stem cells.

DIFFERENTIATION

Multipotent Stem Cells

Multipotent stem cells can develop into a limited number of cell types in a particular lineage. Ex. Mesenchymal stem cells can differentiate into bone, cartilage and fat cells.

Oligopotent Stem Cells

Ability of progenitor cells to differentiate into a few cell types. Ex. neuronal stem cells with ability to form different neurone types.

Unipotent Stem Cells

A unipotent stem cell refers to a cell that can differentiate along only one lineage. Found in adult tissues, a unipotent stem cell, in comparison with other types of stem cells, has the lowest differentiation potential. Ex. spermatogonial stem cells.