STEM CELLS & TISSUE ENGINEERING RESEARCH QUESTIONS

NAME: _____

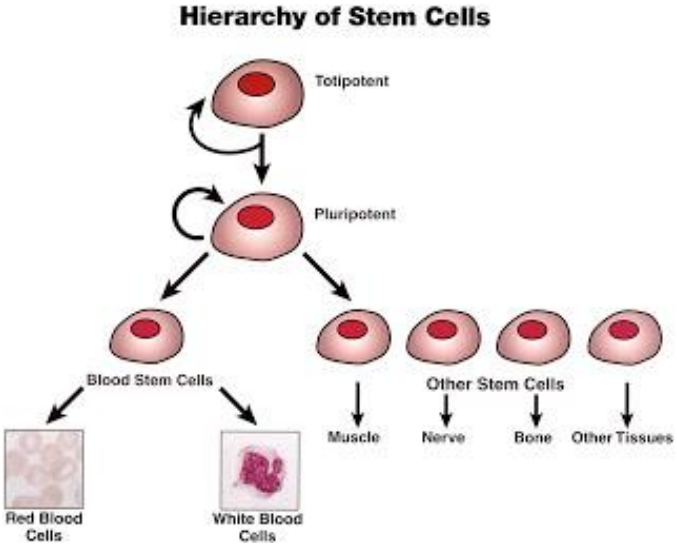
VALIDATION TEST DATE: _____

YOUR TASK: Use your textbook, together with the internet to watch the videos, then research and answer the following questions. You must then study your notes in preparation for an in-class validation test

You will need to watch the following stem cell videos:
https://www.youtube.com/watch?v=_hbgeQzmU9U
https://www.youtube.com/watch?v=8JTw2RpDo9o
https://www.youtube.com/watch?v=i-QSurQWZo0
https://www.youtube.com/watch?v=fGNchPdlaGU

PART A – STEM CELLS & TISSUE ENGINEERING

Stem cells are undifferentiated cells found in multicellular organisms. They are characterised by two features: self-renewal (the ability to undergo numerous cycles of cell division while maintaining an unspecialised state) and potency (the ability to differentiate into specialised cells)



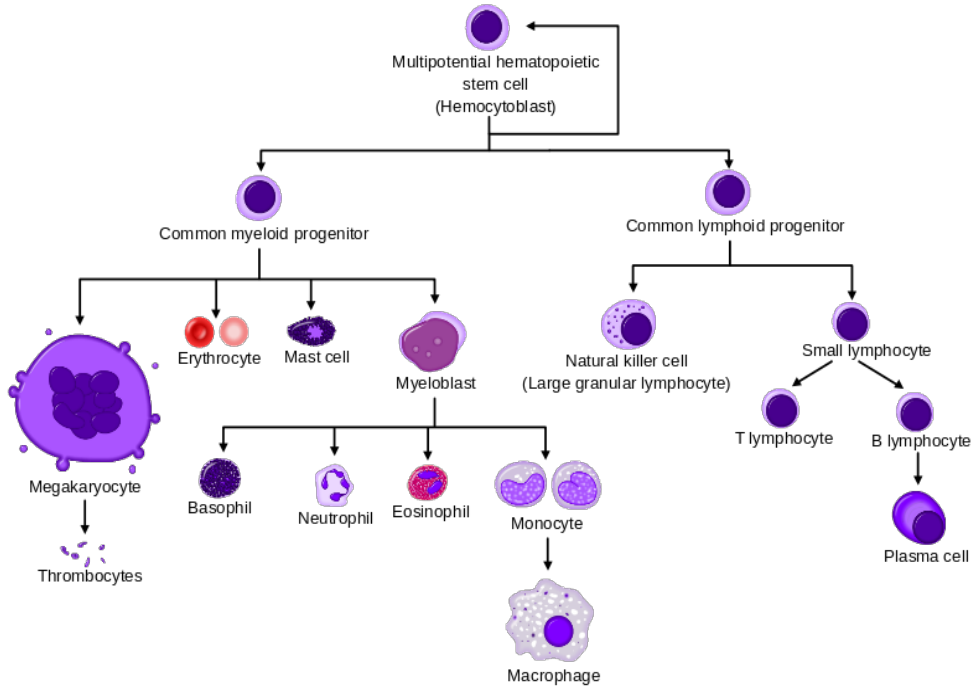
Totipotent cells produced in the first few divisions of a fertilised egg, can differentiate into any cell type, embryonic or extra-embryonic. Pluripotent cells are descended from totipotent cells and can give rise to any of the cells derived from the three germ layers (endoderm, mesoderm and ectoderm) Embryonic stem cells at the blastocyst stage and foetal stem cells are pluripotent. Adult (somatic stem cells) are termed multipotent. They are undifferentiated cells found among differentiated cells in a tissue or organ. These cells can give rise to several other cell types, but those types are limited mainly to the cells of the blood, heart, muscle and nerves. The primary roles of adult stem cells are to maintain and repair the tissue in which they are found. A potential use of stem cells is making cells and tissues for medical therapies, such as cell replacement and tissue engineering

PART B – STEM CELLS & BLOOD CELL PRODUCTION

New blood cells are produced in the red bone marrow, which becomes the main site of blood production after birth, taking over from the foetal liver. All types of blood cells develop from a single cell type, called a multipotent stem cell or 'haemocytoblast' These cells are capable of mitosis and of differentiation into committed precursors of each of the main types of blood cell

Each of the different cell lines is controlled by a specific growth factor. When a stem cell divides into two cells, one of its daughters remains a stem cell, while the other becomes a precursor cell, either a lymphoid or myeloid cell. These cells continue to mature into the various types of blood cells, developing their specialised features and characteristic roles as they do

Development of blood cells can be seen in the diagram below:



1. Define the following terms:
    - Totipotent cells
    - Pluripotent cells
    - Multipotent cells
    - Somatic cells
    - Tissue engineering
    - Growth factors
    - Cultured cells
    - Protein
    - Dermal / Dermis
    - Tissue scaffold
    - Collagen
    - Epidermal / Epidermis
    - Biotechnology
    - Mitosis
    - Daughter cell
    - Precursor cell
    - Lymphoid cell
    - Myeloid cell

2. Describe the two defining features of stem cells ?

3. Distinguish between embryoinc stem cells and adult stem cells with respect to their potency and their potential applications in medical technologies ?

4. Using an example, explain the purpose of stem cells in an adult ?

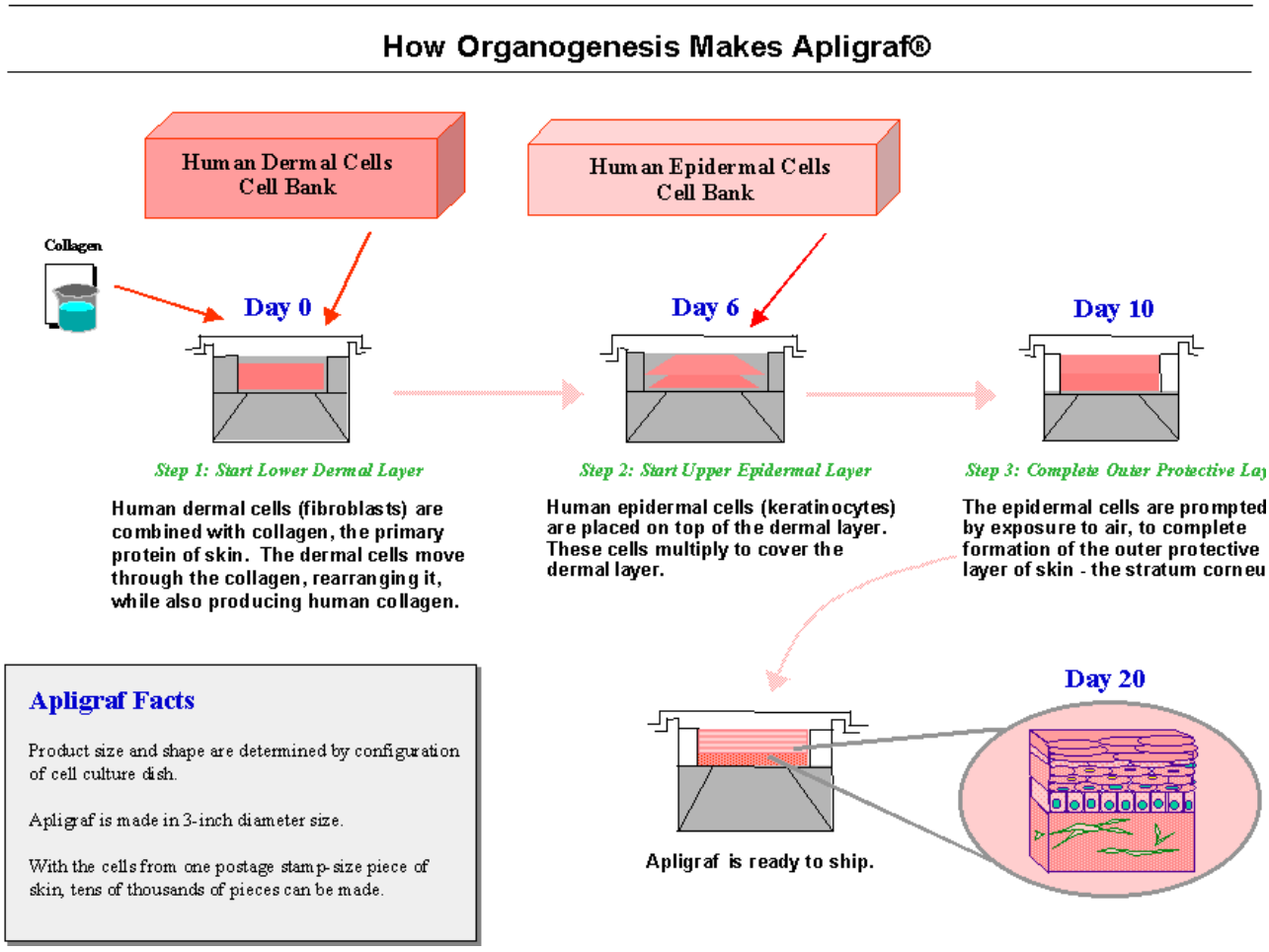
5. Describe one potential advantage of using embryonic stem cells for tissue engineering ?

PART C – ENGINEERING A LIVING SKIN

New technologies such as cell replacement therapy and tissue engineering require a disease-free and plentiful supply of cells of specific types. Tissue engineering, for example, involves inducing living cells to

grow on a scaffold of natural or synthetic material to produce a three-dimensional tissue such as bone or skin. In 1998, an artificial skin called Apligraf became the first product of this type to be approved for use as a biomedical device. It became widely used in place of skin grafts to treat diabetic ulcers and burns, with the patients own cells and tissues helping to complete the biological repair. Producing Apligraf is a three-stage process (as shown below) which results in a bilayered living structure capable of stimulating wound repair through its own growth factors and proteins. The cells used to start the culture are ususally obtained from discarded neonatal foreskins collected after circumcision. The key to future tissue engineering will be the developments in stem cell research. The best source of stem cells is from very early embryos, but some adult tissues (eg, bone marrow) also contain stem cells

Organogenesis is the company who makes Apligraf. Below, a child's burnt hand is treated with Apligraf



A chronic wound is cleaned (A) and treated with Apligraf (B). One week later, wound healing can be observed (C)

6. Describe the benefits of using a tissue engineered skin product, such as Apligraf, to treat wounds that require grafts ?

7. Discuss the present and potential medical applications of tissue engineering ?

8. What are Induced Pluripotent Stem (iPS) Cells and how are they created ?

9. Draw a timeline to show the important events relating to iPS cells since they were first created in 2007 by Yamanaka

10. Describe two advantages and two disadvantages of using iPS cells ?