Lucerne University of
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Technik & Architektur
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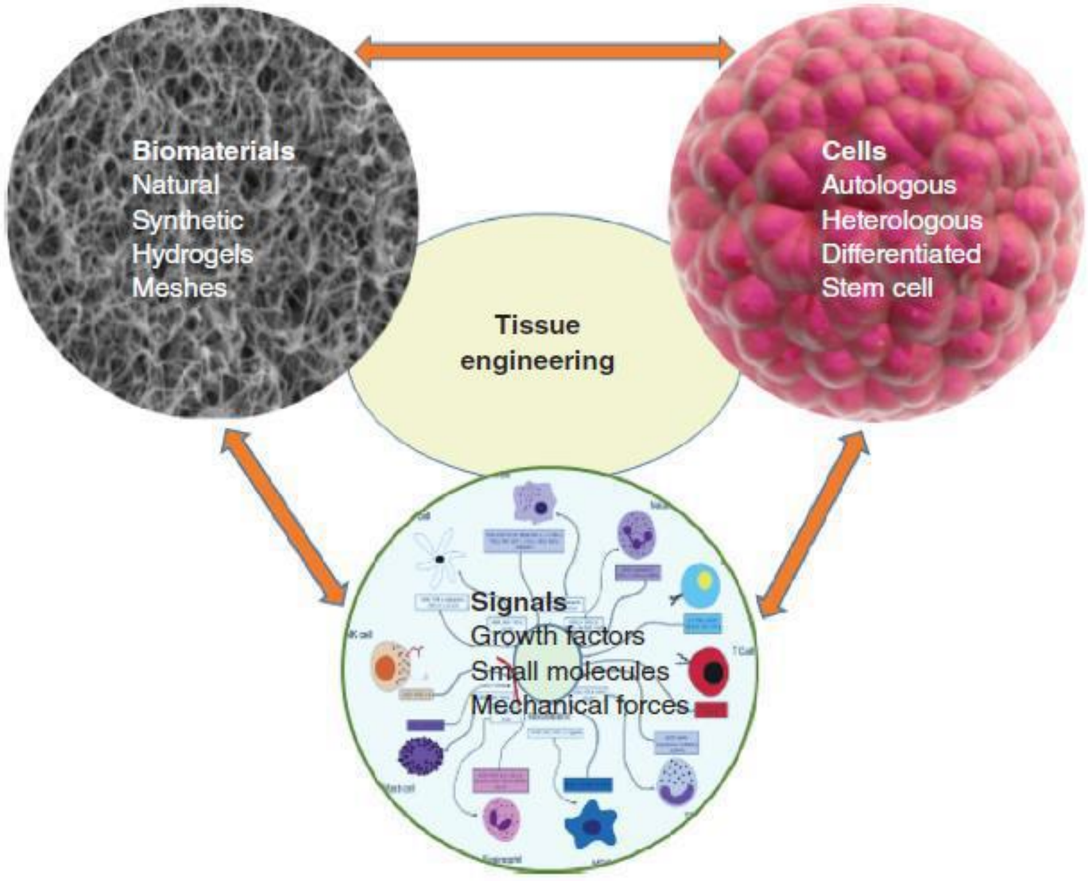
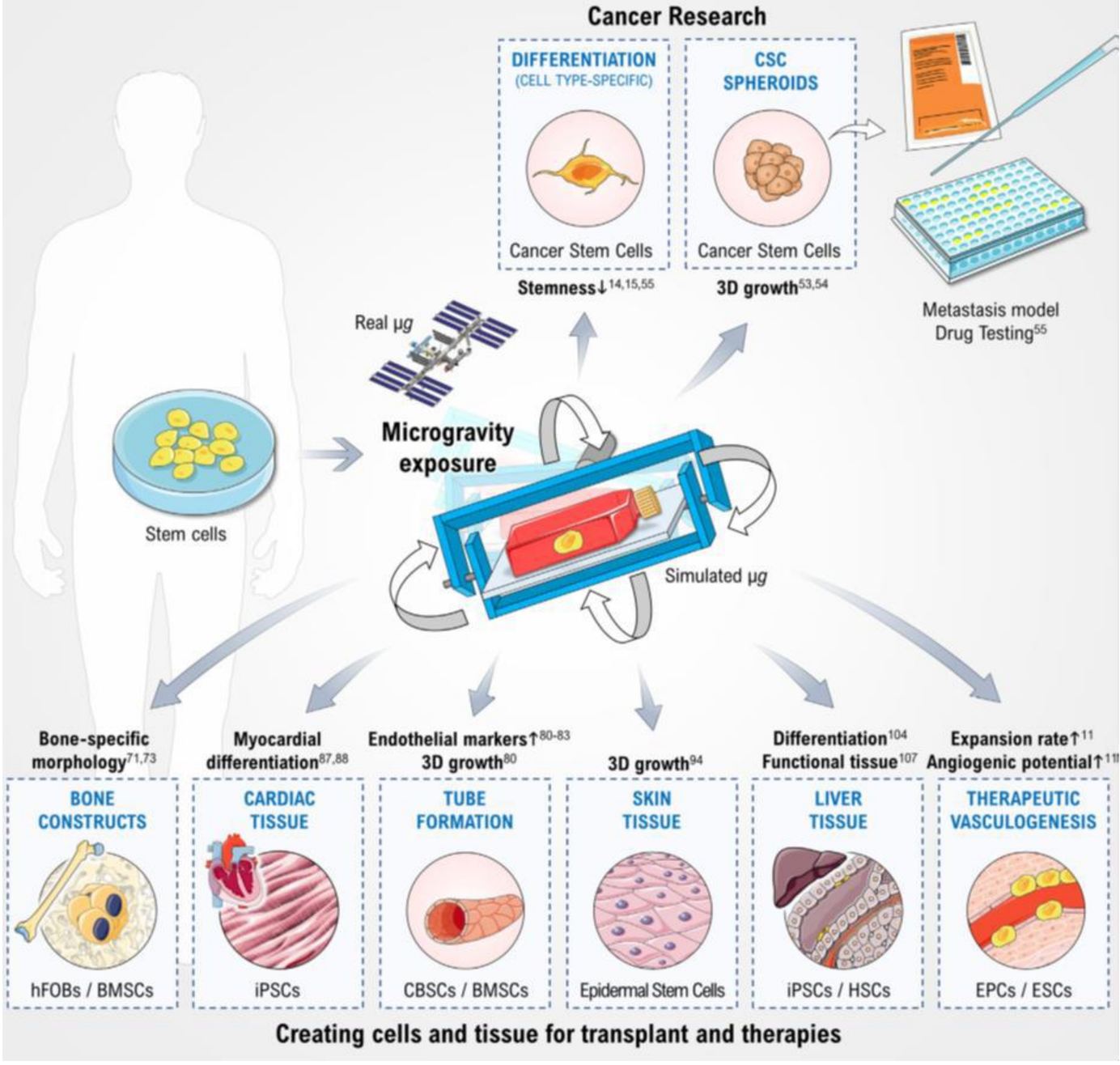
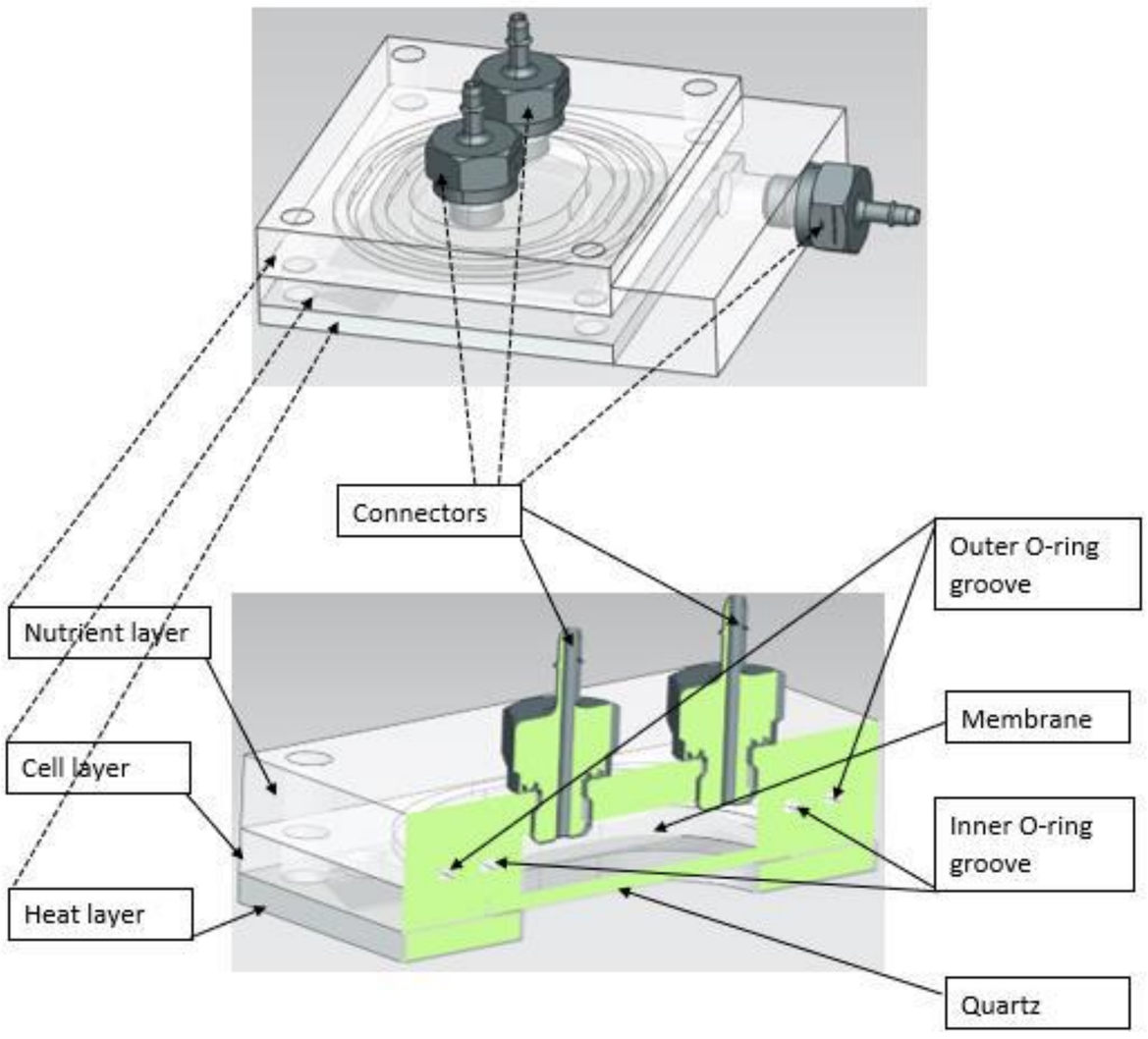
MSE | MASTER OF SCIENCE IN ENGINEERING

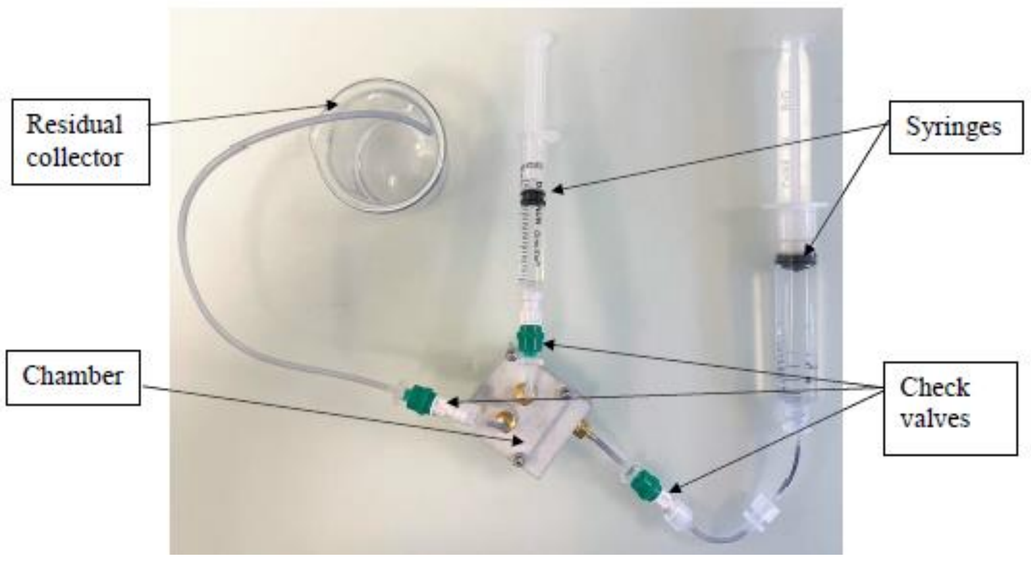
Master-Thesis Engineering, Fachgebiet Medical Engineering

Mammalian cell culture chamber for space applications









The demand in organ transplantation has pushed forward in-vitro culturing of tissues. Different cell culture techniques are being used to create 2D and 3D tissue structures of different organs.

The discovery of stem cells has unlocked a huge potential in the field. Their differentiation and self renewal properties has given birth to a lot of cures. Huge amount of sources are being dedicated to study the stem cells in microgravity conditions. Major breakouts are to be expected by cancer researches on stem cells being done in microgravity conditions.

Although to achieve the goals, the most challenging task is to develop a micro-bioreactor which can be used to culture the mammalian cells in micro-gravity conditions.

This thesis proposes a micro cell culture chamber that can be used to cultivate the mammalian cells for space applications. A hardware design of the culture chamber has been developed as a bioreactor to mimic the human body. The main task of the culture chamber is to host the cells and keep them alive for desired experimental time. It is made of multiple layers and components which will be stacked together in a sandwich like structure and hold together with screws.

Furthermore, it is integrated with an automated fluidic system to perform autonomous experiments in the space. The fluidic system has two main tasks: provide nutrients during the experiment and apply fixation at the end of the experiment. Nutrients are pumped from a plastic bag to the culture chamber with the help of a peristaltic pump. The fixative is held in a syringe-spring structure and inject at the end of experiment by commanding solenoid valve opening.

The hardware setup is the tested by benchwork tests. These include the culturing of THP-1 cells and study their growth and survival with the new chamber. Testing is performed by validating the functionality of the single components first and then integrate them all together.

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