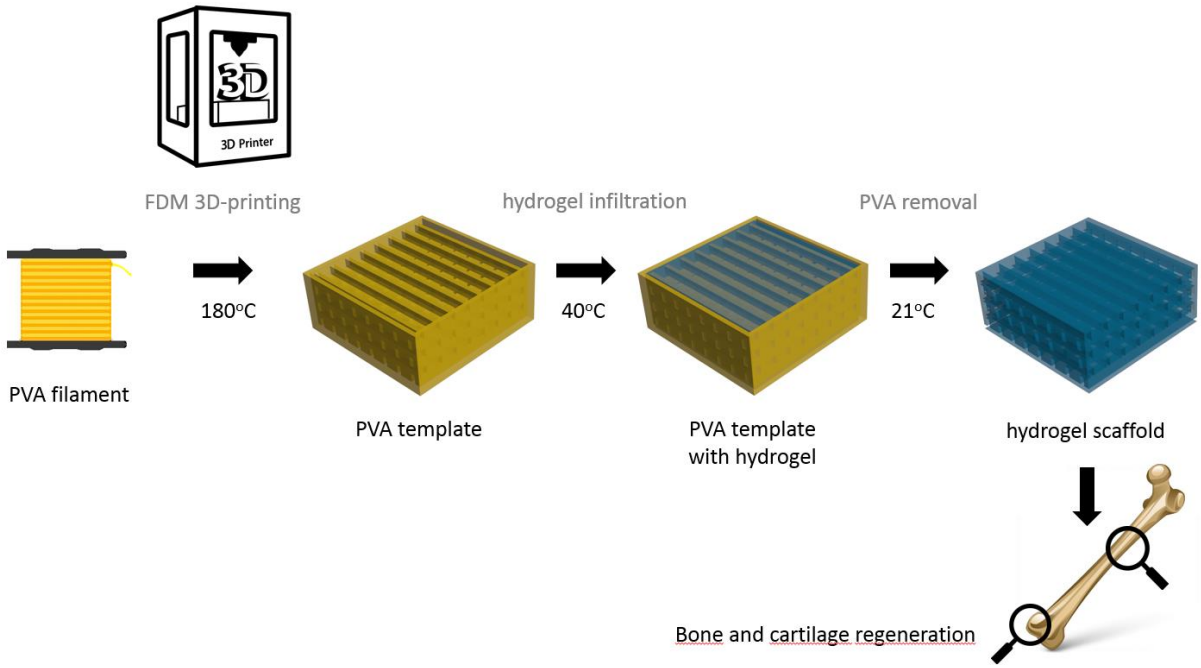
Hydrogel materials obtained by indirect 3D-printing method combined with enzymatic mineralization for bone and cartilage regeneration

In the last decades dramatic changes in the humans lifestyle can be observed. Therefore, the number of trauma related to skeletal system arouse, and hence a demand for more and more effective remedies is increasing. Recently, much attention has been paid to the regeneration of skeletal tissues such as bone and cartilage. Bone and cartilage grafts are used to repair and rebuild diseased skeletal tissue where the human body is unable to heal on its own. There are several risks involved in this procedure, including transmission of pathogens from donor and poor integration or graft rejection due to a host immune response.

Tissue engineering (TE) is a new multidisciplinary field involving biology, medicine, and engineering that could revolutionize how we improve the health and quality of life for millions of people worldwide by restoring, maintaining or enhancing damaged tissue and organ function. In TE combinations of engineered extracellular matrices ("scaffolds"), cells, and biologically active molecules are used to restore damaged tissue. Hydrogels are attractive scaffold materials because they are structurally similar to the extracellular matrix of many tissues, often can be processed under relatively mild conditions, and may be delivered in a minimally invasive manner.

The main aim of this project is to develop simple and inexpensive method for manufacturing porous hydrogel scaffold for bone or cartilage regeneration using easy accessible nowadays and inexpensive 3D printers. Hydrogel will be formed in desired shape water soluble template (mould) specially developed 3D printed. Additionally possible improvement of biological properties of the scaffold will be achieved by mineralization, bone/cartilage cells immobilization and addition biologically active molecules. Method will allow to obtain biologically active, mineralized bone/cartilage scaffold with defined structure. The project will contribute to enhancing quality of life among the people suffering from the skeletal system diseases.



Schematic representation of manufacturing method of porous hydrogel TE scaffolds