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**PURE**  
PROGRAM FOR UNDERGRADUATE RESEARCH

## ABSTRACT

Bone fractures are wide spread injuries and it is expensive and challenging to treat them. With the development of research and technology in tissue engineering, it has become a goal to design artificial bone scaffold implants to be placed into the injured area to make the bone healing process easier and faster.

## OBJECTIVES

- To understand healing process both biologically and mechanically.
- To find more economical methods for the bone healing process.
- To design and produce an artificial bone scaffold for personal treatment and different situations.

## BACKGROUND

Bones have complex structures with pores and the extracellular matrix (ECM). Thanks to these two, bones are lightweight yet strong and hard at the same time.

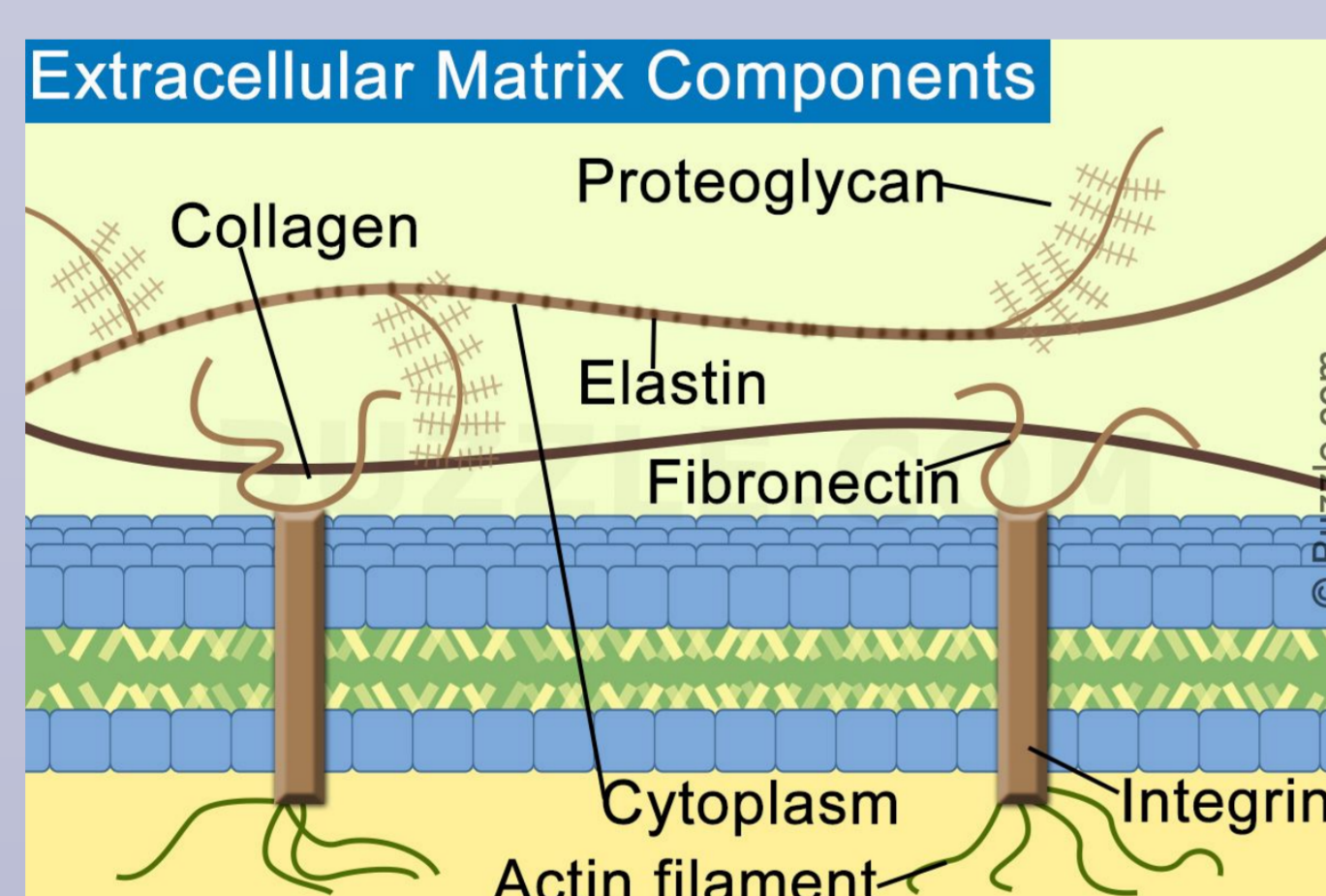
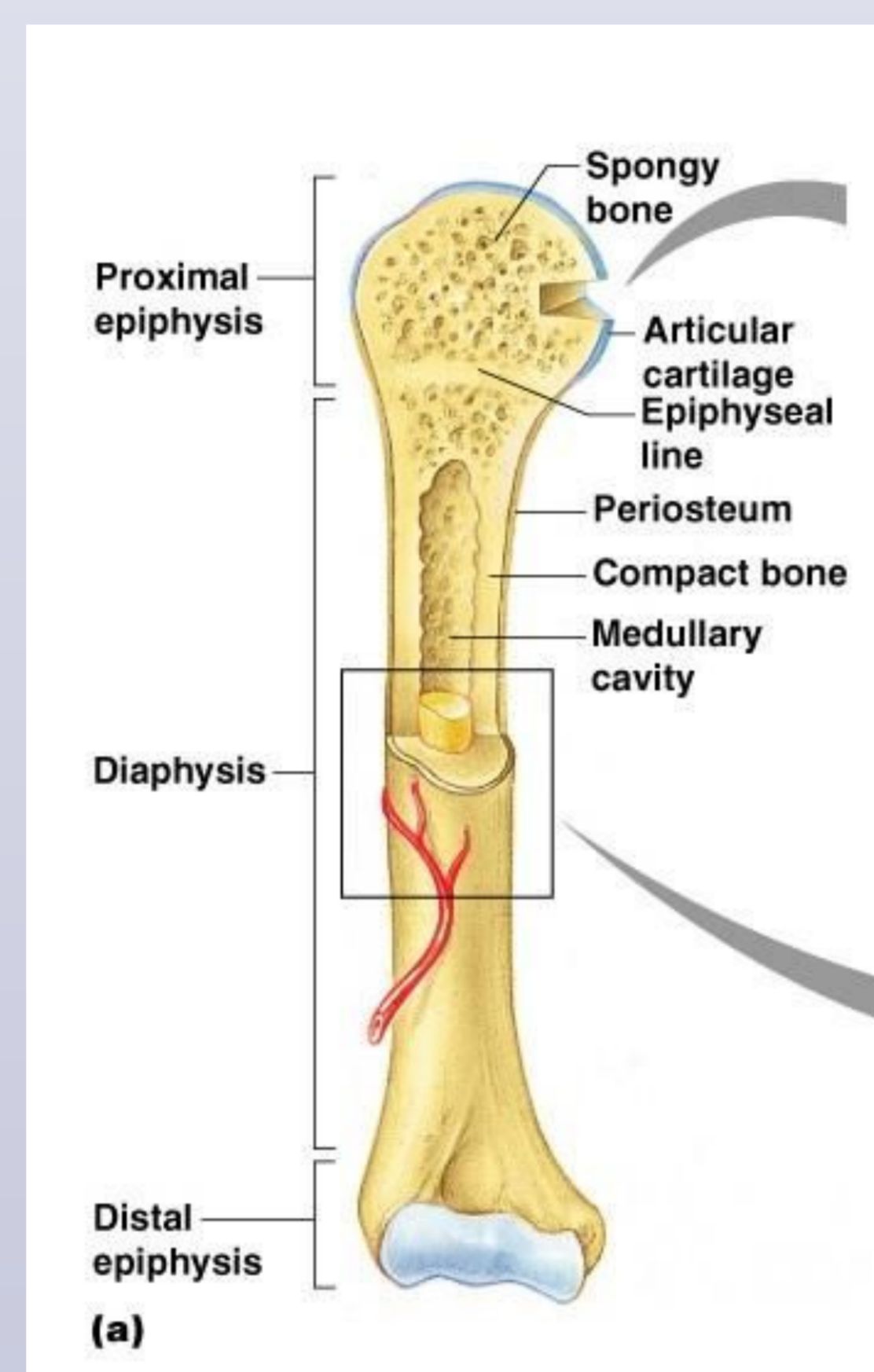
Bones take roles in;

- supporting and protecting organs,
- producing red and white blood cells,
- storing minerals,
- enabling mobility.

The extracellular matrix;

- forms various tissues,
- regulates biological processes,
- provides mechanical support.

It is aimed in this project to make the scaffold mimic the pores, the structure and the functions of the extracellular matrix of the bone.



## PROJECT DETAILS

The experiment was performed with 13 weight percent Hydroxyapatite (with respect to Polycaprolactone) to prevent fast congelation in syringe caused by high densities.

The materials used:

- Solvent: 100 mL THF (Tetrahydrofuran)
- Non-solvent: Ethanol
- The compounds to form the composite solution (for the scaffold):
  - 10 grams PCL (Polycaprolactone)
  - 1.3 grams HA (Hydroxyapatite)



Figure 1: The beaker with PCL left to mix at 40°C for 24 hours

100 mL THF was heated to 40°C in a beaker first. Then 10 grams of PCL was added gradually. After the whole system reached equilibrium at 40°C, the mixture was left to be mixed by a magnetic rod for 24 hours. When a solution formed with no visible PCL left, 1.3 g HA was added to the system and they were mixed homogeneously until the next day.

The mixture of THF, PCL and HA was ready to be extruded into the non-solvent that is ethanol in this experiment.

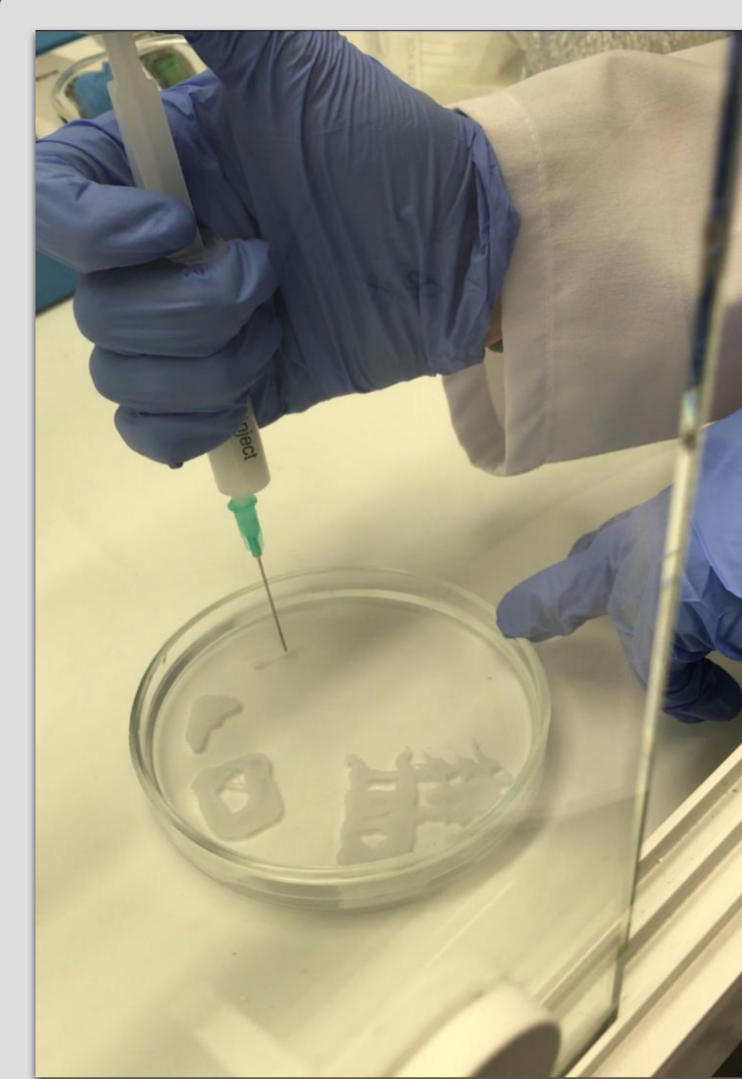


Figure 2: Paste-like mixture extruded by using a syringe onto the bottom of the petri dish, into the ethanol

The mixture was extruded by using a syringe into the ethanol to form parallel lines. Due to the manual application and the low density (13 %) the parallel lines generally tended to expand and ended up as thick and close lines.

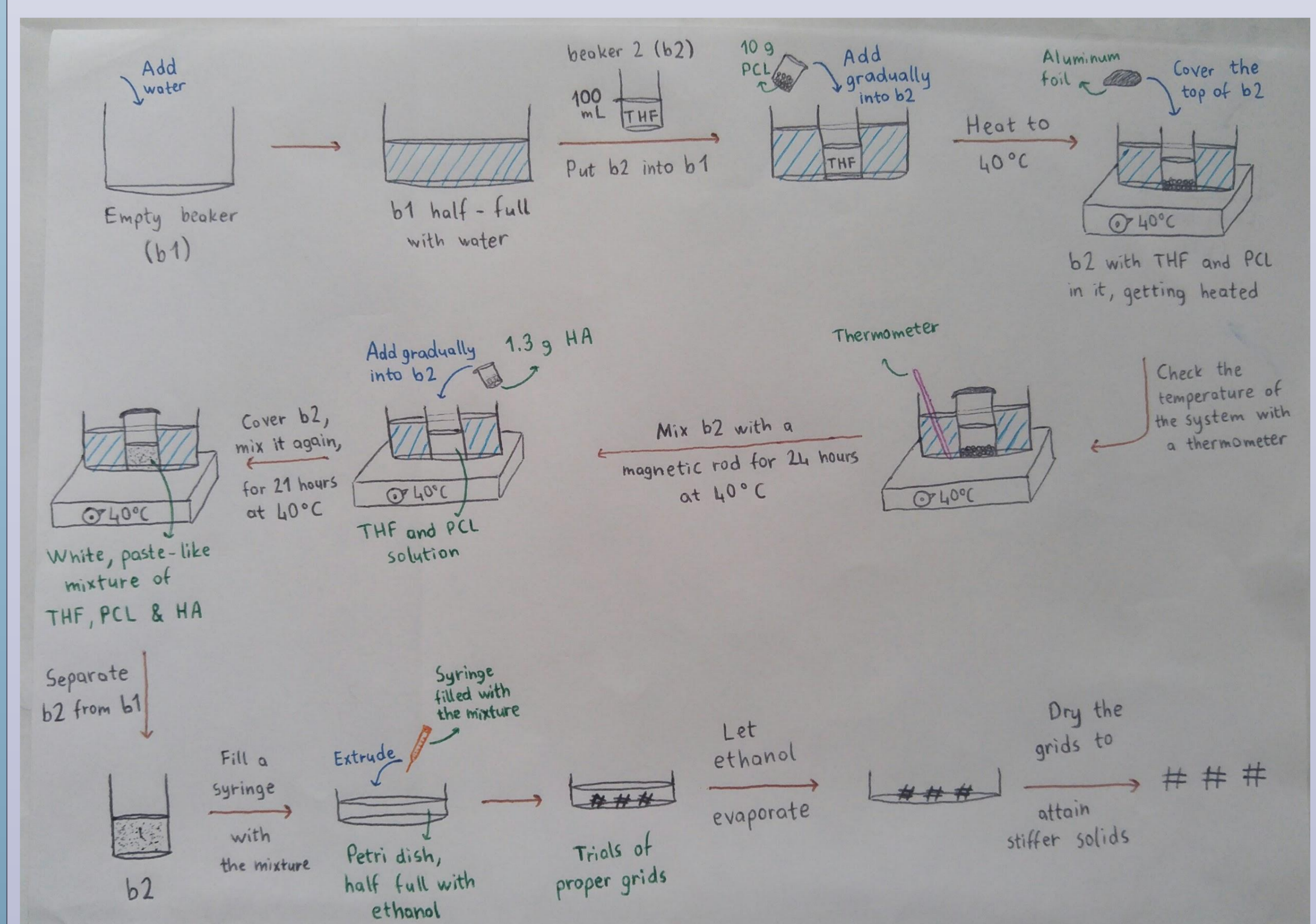


Figure 3: The trials to attain a proper grid

When the first layer which consisted of 4-5 parallel lines was completed, the mixture was extruded vertically with respect to them, in order to create a second layer thus forming a grid to observe the interactions between different layers more easily. The third layer couldn't be successfully applied because the lines expanded too much.

The trials to attain a proper grid were repeated until the surfaces of two petri dishes were covered with the grids. The white mixtures solidified substantially within several minutes in ethanol. After ethanol vaporized, the solids got stiffer by drying.

## EXPERIMENTAL PROCEDURE



## CONCLUSIONS

The main goal of the project was to combine the right amount of solvents and other compounds to create the optimal mixture resembling a bone scaffold, thus PCL/HA composites with different parameters were tested. Experiments showed that the method of application is as important as the mixture itself and it is seen that further experimentation is required to obtain the desired and most suitable concoction.

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