Liver Regeneration with Innovative Biomaterials

The **liver** is one of the most vital organs in the human body, responsible for detoxification, metabolism, and the production of essential substances. However, liver diseases such as cirrhosis and fatty liver disease pose a significant global health challenge, causing over two million deaths annually. Current treatment methods are often insufficient to effectively support liver regeneration while also limiting fibrosis — the formation of scar tissue in liver tissue.

The aim of this project is to develop **an innovative biomedical material** that can support liver regeneration and to demonstrate the mechanisms of liver tissue regeneration using such a material. The research team plans to create a biodegradable scaffold based on **PLGA** polymer, enriched with **graphene oxide**, **gold nanoparticles**, and **silybin** — an active compound derived from **milk thistle** (*Silybum marianum*). This material is intended to promote liver cell renewal, limit fibrosis, and support the formation of new blood vessels.

The project is divided into several stages. In the first stage, gold nanoparticles will be produced using a **modern green synthesis** method — an eco-friendly approach utilizing milk thistle extract. In the next stage, the synthesis will be carried out on graphene oxide flakes. The material will then be enriched with pure silybin, and the entire structure will be transformed into a liver-like tissue matrix using electrospinning techniques. The final material will undergo physical, chemical, and advanced biological testing to evaluate its **comprehensive and unique effects** — its ability to support liver cell regeneration, prevent fibrosis, and stimulate blood vessel formation.

Addressing this topic responds to the urgent need for more effective and safer treatments for liver diseases. The use of modern biomimetic materials, combined with the protective properties of silybin, represents a groundbreaking strategy in liver regeneration. The results of this project may contribute to improving the quality of life for patients with chronic liver diseases and could become a milestone in regenerative medicine. The project also supports **the advancement of green nanotechnology** through the development of environmentally friendly nanoparticle synthesis methods.