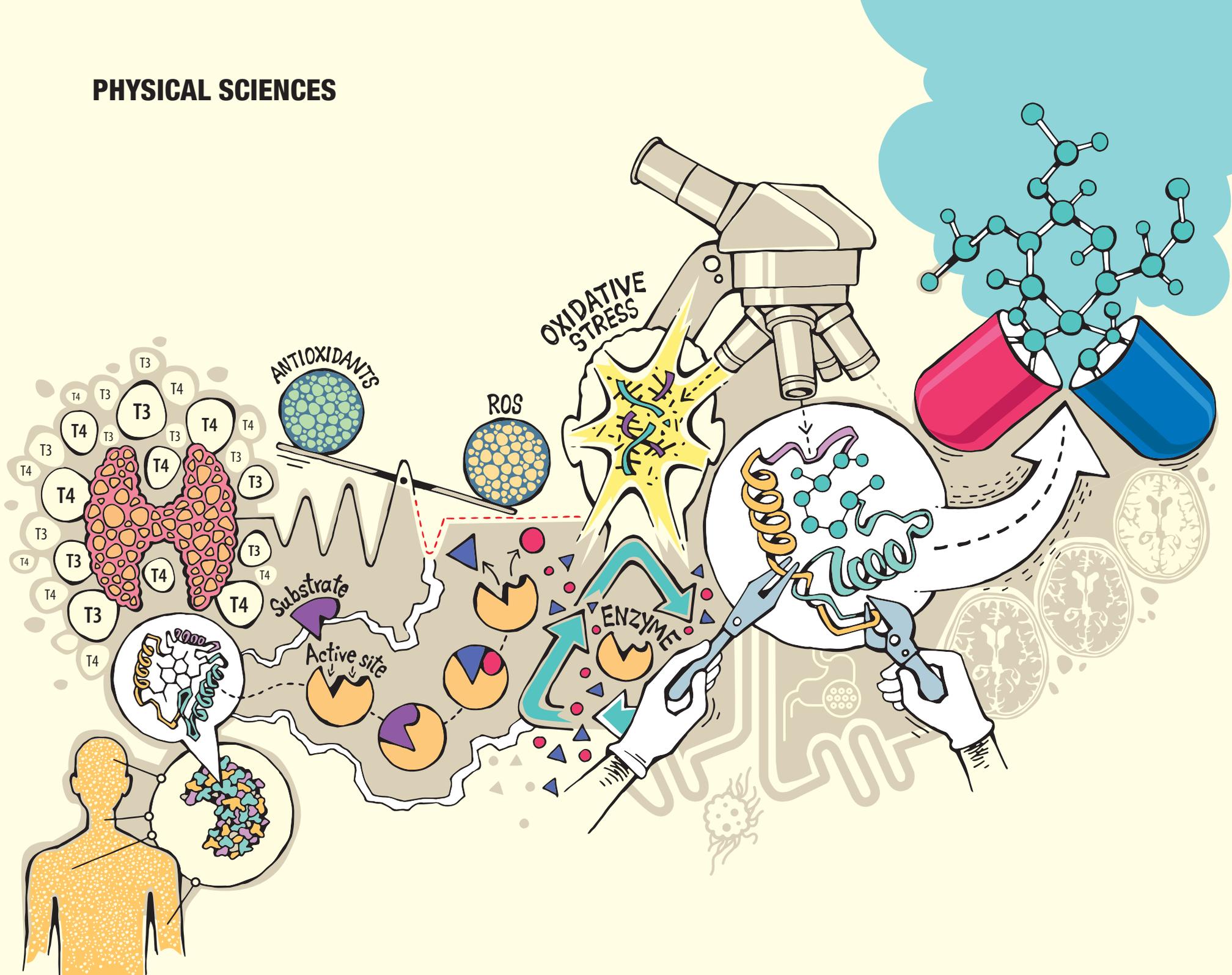


# PHYSICAL SCIENCES



## THE SPARKS THAT FIRE LIFE

Have you ever wondered what enables life? How is it that as you sit here reading this, you're able to breathe and your heart continues to beat while your muscles hold your body in position? Of the many things that keeps it all together are tiny protein molecules called enzymes. They are the stuff of life itself and an absence or malfunctioning have disastrous consequences.

Prof. Mugesh is a chemical biologist. Chemical biology is a discipline that uses chemical techniques, and small molecules produced using synthetic chemistry in order to study and manipulate biological systems. Prof. Mugesh's lab works to create artificial enzymes including small molecules and nanomaterials that could help understand biological processes such as thyroid hormone metabolism and cellular redox signalling.

Redox signalling is a process in which free radicals, reactive oxygen species, and other compounds act as biological messengers. Reactive oxygen is an unstable molecule containing oxygen that easily reacts with other molecules in a cell, a build-up of which can cause damage to DNA and can even lead to cell death.

Enzymes are the proteins that aid everything from digesting food to creating DNA, by speeding up chemical reactions in the body. Even without enzymes these chemical reactions could still occur but they would be too small to support life. The cells of the human body contain hundreds of enzymes that control cell activity and even defend them from invasion by microbes like bacteria and viruses.

All enzymes have some common features. They have an active site, which is a groove in the enzyme molecule where the substrate is captured and broken down or combined together depending on the reaction. Enzymes are also specific when it comes to the molecules they bind with. This specificity is crucial to keep bodily processes going. The third characteristic of enzymes is that they are recycled. This means that only a small amount of enzyme is required for thousands of reactions.

An artificial enzyme is a synthetic molecule or nanomaterial (nanozyme) that recreates some function of an enzyme. They have been widely explored for various applications, such as bio sensing, bio imaging, tumor diagnosis and therapy.

Research into artificial enzymes took off from the late 90s and in 2014 scientists announced that they had managed to produce active enzymes that were made from molecules that do not occur anywhere in nature. These molecules hold the key to new diagnostic tools and drugs.

Prof. Mugesh's contributions to this burgeoning field include pioneering the idea of using artificial enzymes to modulate cellular processes under conditions of oxidative stress. His lab has also found methods to efficiently deliver therapeutic proteins and drugs into human cells. These path-breaking discoveries pave the way for new drug delivery systems and diagnostic tools of the future.