

Biophysics: The Bridging Science

Physical scientists use mathematics to explain what happens in nature. Life scientists want to understand how biological systems work. These systems include molecules, cells, organisms, and ecosystems that are very complex. Biological research in the 21st century involves experiments that produce huge amounts of data. How can biologists even begin to understand this data or predict how these systems might work?

This is where biophysicists come in. Biophysicists are uniquely trained in the quantitative sciences of physics, math, and chemistry and they are able tackle a wide array of topics, ranging from how nerve cells communicate, and how plant cells capture light and transform it into energy, to how changes in the DNA of healthy cells can trigger their transformation into cancer cells, to so many other biological problems.

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BRIDGING THE PHYSICAL SCIENCES AND BIOLOGY

What Is Biophysics?

Biophysical Society

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Biophysics is the field that applies the theories and methods of physics to understand how biological systems work.

Biophysics has been critical to understanding the mechanics of how the molecules of life are made, how different parts of a cell move and function, and how complex systems in our bodies—the brain, circulation, immune system, and others—work.

Biophysics is a broad and multidisciplinary research leading to understanding nature and human body. By using biophysical fundamentals, scientists can find cure and therapeutic targets for multiple disease such as Alzheimer, aging, cardiac disease, resuscitation, respiratory system etc. Every single molecule in life is based on biophysical and biochemical interactions. Consequently, every single biophysical discovery has a clinical or environmental application.

Biophysics is a vibrant scientific field where scientists from many fields including math, chemistry, physics, engineering, pharmacology, and materials sciences, use their skills to explore and develop new tools for understanding how biology, or all life, works.

What Do Biophysicists Do?

Biophysicists work to develop methods to overcome disease, eradicate global hunger, produce renewable energy sources, design cutting-edge technologies, and solve countless scientific mysteries. In short, biophysicists are at the forefront of solving age-old human problems as well as problems of the future.

DATA ANALYSES AND STRUCTURE

The structure of DNA was solved in 1953 using biophysics, and this discovery was critical to showing how DNA serves as a blueprint for life.

Now we can read the sequences of DNA from thousands of humans and all varieties of living organisms. Biophysical techniques are also essential to the analysis of these vast quantities of data.

MOLECULES IN MOTION

Biophysicists study how hormones move around the cell, and how cells communicate with each other. Using fluorescent tags, biophysicists have been able to make cells glow like a firefly under a microscope and learn about the cell's sophisticated internal transit system.

NEUROSCIENCE

Biophysicists are building computer models called neural networks to model how the brain and nervous system work, leading to new understandings of how visual and auditory information is processed.

BIOENGINEERING, NANOTECHNOLOGIES, BIOMATERIALS

Biophysics has also been critical to understanding biomechanics and applying this information to the design of better prosthetic limbs, and better nanomaterials for drug delivery.

IMAGING

Biophysics has revolutionized medical diagnostics by developing medical imaging techniques including MRIs, CT and PET scans, and ultrasound imaging; all used regularly by physicians around the world.

MEDICAL APPLICATIONS

Biophysics has been essential to the development of many life-saving treatments and devices including kidney dialysis, radiation therapy, cardiac defibrillators, pacemakers, and artificial heart valves.

ECOSYSTEMS

Environmental biophysics measures and models all aspects of the environment from the stratosphere to deep ocean vents. Environmental biophysicists research the diverse microbial communities that inhabit every niche of this planet, they track pollutants across the atmosphere, and are finding ways to turn algae into biofuels.

Where Do Biophysicists Work?

Biophysicists are teachers and researchers in biology, physics, engineering, and many other fields. They work in universities, hospitals, tech startups, and engineering companies developing new diagnostic tests, drug delivery systems, or potential biofuels. Biophysicists develop computer models to find out why a new flu strain eludes the immune system or they make 3D models of new protein structures to better understand how the proteins shape work. They practice law in specialized fields like intellectual property, write about science for print and online publications, and work in government to advise legislatures. Those who are trained in biophysics have unlimited career possibilities.

Biophysics is a scientific field at the forefront of research that is transforming our understanding of biology and the practice of medicine in magnificent ways.