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Commentary

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Physiological Model of Human

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Description

The complex science of life is physiology. Physiology explains living organisms' "vital roles and their muscles, cells, and molecules. The discipline of physiology has been closely associated with medicine for decades. Although structure is not specifically concerned with physiology, as is the case with anatomy, histology, and structural biology, structure and function are inextricably related since the functions are performed by living structures. For others, physiology (e.g., exercise physiology) is the role of the whole body. Physiology can be the role of an individual organ system for many practicing physicians, such as the cardiovascular, respiratory, or gastrointestinal system. For some, physiology may concentrate on the cellular values common to the work of all organs and tissues. Traditionally, this last area has been called general physiology, a concept now superseded by cellular and molecular physiology. While physiology can be divided according to varying degrees of reductionism, a branch of physiology can also be described, such as comparative physiology, which focuses on differences and similarities between different organisms. Indeed, comparative physiology, from the atom to the entire organism, can cope with all degrees of reductionism. In a similar way, human physiology deals with the functioning of the human body, which depends on the functioning of the individual organ systems, which depends on how the component cells work, which in turn depends on subcellular organelle interactions and countless molecules.

The mother of several biological sciences is physiology, which has given rise to the fields of biochemistry, biophysics, and neuroscience, as well as their respective scientific societies and journals. It should therefore come as no surprise that physiology's limits are not sharply delineated. Physiology, on the opposite, has its special qualities. Over the years for example, physiology has developed from a more qualitative discipline to a more quantitative one. Indeed as chemists, physicists, mathematicians, or engineers, many of the leading physiologists were and still are, educated. The human body's existence demands not only those individual organ systems do their jobs, but that these organ systems work with each other "hand in hand." They have information to share. It is important that their acts be interdependent. Knowledge is also exchanged by the cells inside an organ or a tissue, and the individual cells must definitely work in concert to fulfil the proper function of the organ or tissue. In reality, cells in one organ also have to exchange knowledge with cells in another organ and make decisions that are ideal for the individual cell's health as well as for the whole person's health.

In most cases, at the level of atoms or molecules, the exchange of information between organs and between cells takes place. As simple as H^+ or K^+ or Ca2 $^{+,}$ cell-to-cell messengers or intracellular messengers can be. More complex chemicals can also be the messengers. A cell can release a molecule that acts or enters the bloodstream on a neighboring cell or on itself and acts a great distance away on other cells. In other situations, a neuron can send an axon a centimeter or even a meter away and modulate the activity of another cell or other organ rapidly through a neurotransmitter molecule. With its epigenetic changes, the grand organizer, the master who regulates the molecules, cells, and organs and the way they interact, is the genome. In its reductionist journey, historically, the discipline of physiology has always stopped at about the level of cells and certain subcellular organelles, as well as their component and control molecules. The discipline of physiology left the business of how the cell regulates itself by its DNA to molecular biology and molecular genetics. However since DNA encodes the proteins in which physiologists are most involved, the modern discipline of physiology has become closely intertwined with molecular biology. In the modern past, physiologists have painstakingly produced elegant methods for the cloning of physiologically important genes.

A branch of physiology dedicated to the understanding of the roles genes play in physiology is physiological genomics (or functional genomics). Physiologists have historically moved from organ to cell to molecule to gene in a reductionist direction. In physiological genomics, one of the most interesting things is that it closes the circle and explicitly connects organ physiology with molecular biology. The genetically modified mouse is probably one of the most striking examples. Knocking out the gene encoding a protein that is very important, according to traditional wisdom, will often have no noticeable or often unpredictable consequences. It is up, at least in part, to the physiologist to find out why. It is perhaps quite sobering to think that one will have to carefully re-evaluate the totality of mouse physiology in order to better appreciate the effect of a genetic modification on the physiology of a mouse. The physiologist must retrace the steps up the reductionist path to understand the role of a gene product and gain an integrated understanding of the function of that gene at the level of the cells, organs, and the entire body.

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