



Inside Your Inner Fish

'Your Inner Fish: A journey into the 3.5 billion-year history of the human body', by Neil Shubin

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Open 'Your Inner Fish' by Neil Shubin and you immediately begin peeling back the layers of human evolution that reveal the deep origins of human anatomy and physiology. Shubin's multidimensional narrative intertwines scientific discoveries in physiology, cell biology and genetics with an autobiographical account of his quest for a fish with a neck and elbows. This creates a beautifully written 'short story' with a series of examples of how human biology is linked to its evolutionary past. The book presents an historical account of what we currently call 'human' and reveals how the human organism is an accumulation of successful biological solutions to environmental problems that were faced by organisms that preceded us.

Shubin is an articulate writer with the accuracy of an anatomist, the perseverance of a paleontologist and the humor of a comedian. While looking for a fish with a neck and elbows in a hole in the Arctic per-

mafrost, Shubin finds a way to teach human anatomy to medical students, explain evolutionary relationships and show the importance of learning where we came from. Shubin begins with his expeditions searching for fossil fish in the hills of Pennsylvania and the Arctic permafrost. He recounts his initial modest successes, and some failures, with a sense of humor and adventure. These expeditions eventually lead to the incredible discovery of an elbowed fish with a neck. He continues with the insights he gained about human anatomy from looking at the anatomy of this fish that lived 375 million years ago. Each chapter builds on this theme as he links the structures, physiology and genes in one organism to another and demonstrates how these characteristics relate to human biology and disease.

He called his elbowed fossil fish Tiktaalik, the Inuit word for 'large freshwater fish'. Tiktaalik symbolizes how nature is connected as a fish that lived at the interface of two worlds – water and land. Shubin lives and works at the interface between the two worlds of paleontology and human biology, and pulls together what were previously considered to be diverse fields of genetics, paleontology, archeology and anatomy. This unique perspective culminates with his book *Your Inner Fish* – an elegant convergence of science that is written for readers at all levels.

For the scientist, this book demonstrates how arbitrary the boundaries are that we draw between disciplines, and emphasizes why we need to work across and between disciplines to understand the whole of mammalian biology. As the barriers between disciplines dissolve and a common language develops, we can achieve greater integration in science that will enrich our understanding by approaching problems from alternate perspectives. Such borderless science can enable biomedical insights from holes in the permafrost and other unlikely places. Shubin's account reinforces the necessity of looking for answers outside the boundaries of single fields and using an integrative approach in scientific discovery.

This journal, *Disease Models & Mechanisms*, is dedicated to understanding

human biology and disease through the study of model organisms. *Your Inner Fish* emphasizes the fact that humans share a great deal of biology with all organisms on this planet. From human anatomy to signaling pathways and individual molecules, humans are a composite of the species that preceded human existence. Shubin discusses examples of these relationships in his book, and lays to rest any doubts about the biological relevance of flies, fish, worms and mice to understanding and treating human disease. The close relationships that Shubin describes between humans and the unlikeliest of creatures, suggest that even the currently used animal models lack sufficient diversity, and that research would benefit by reaching across phyla and looking back through time to increase the depth and breadth of comparative medicine.

If there is a unifying theory in biology analogous to that in physics, Shubin has pointed the way with this insightful and clearly written book. He demonstrates that human biology is a snapshot in evolution that reveals a complex evolutionary path linking the present to the past and unifying the study of biology. Humans are an amalgam of little packets of evolutionary history – an assembly of evolutionary parts that persist because they have worked in the past. Although we may not like it, these packets are a retrofit that, although successful in the past, may not always be a perfect fit for the human organism. Thus, this collection of successful solutions to past physiological problems has led to some common health issues in humans. After all, we are part fish, part worm and completely human, so mistakes are inevitable. The unifying principle that

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Shubin conveys is that all organisms share their biology with other organisms, both extant and extinct, and we can understand our present health issues by knowing the evolutionary origins of the affected organ structure, biological process or gene.

This book is a compelling read for all levels from the scientist, to primary and secondary school educators and laypersons. For the scientist, the book emphasizes the importance of developing and studying animal models of human biology, and using these to

reveal the mechanisms of disease. Even though one may be familiar with human biochemistry, physiology or anatomy, the breadth of Shubin's discussion still keeps even the most informed scientist enthralled. For the layperson, Shubin explains why scientists use worms, fish, flies and mice to reveal mechanisms of human disease and to understand human biology. He states, 'The best road maps to human bodies lie in the bodies of other animals', and this rings true in the articles published in *Disease Models & Mechanisms*. It is clear that all life on Earth is profoundly interrelated and that we share much of our anatomy, physiology and genetics with extant and extinct organisms. However, it is quite apparent that humans are the 'new kids' on the planet, and Shubin's book reveals that we are kids with a rich inheritance that should not be squandered.

Humans are the product of a long set of evolutionary experiments where time tests potential solutions and the answers are then

passed to the next generation. In this way, nature recycles and reuses traits to create an incredible unity of life on Earth. In the book 'The Future of Life', Edward Wilson discusses the possible and probable futures for the totality of life on Earth, or the biosphere¹. The biosphere is the thin membrane of organisms wrapped around the Earth, and Shubin points out the profound interrelatedness of all the species that have comprised this living membrane. Since extant species are much easier to study and learn from than those that are extinct, preservation of this diversity is imperative. Wilson proposes actions we can take to preserve the diversity of life on Earth. Without initiating these actions we will continue to witness the demise of both our close relatives, such as the primates, and our more distant cousins. A piece of the evolutionary story is buried with each species that becomes extinct. We need to nurture the health of the biosphere and preserve the

lives of organisms that share our genetics, our biology and our anatomy. These creatures provide a living historical record of our evolution and hold keys that can unlock solutions to our pressing health problems.

Shubin reminds us that, 'virtually every illness we suffer has some historical component'. With the extinction of even the simplest microbial relative that has overcome similar failings of physiology or genetics, we destroy important information about human disease. With his book, Shubin asks us to respect our biological grandparents and gather the wisdom contained within their unassuming forms: the yeasts, the flies, the fish and the countless other creatures that are just swimming around waiting to be investigated.

¹Wilson, E. O. (2002). *The Future of Life*. New York: Random House. ISBN: 0-679-45078-5 (hardcover).

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