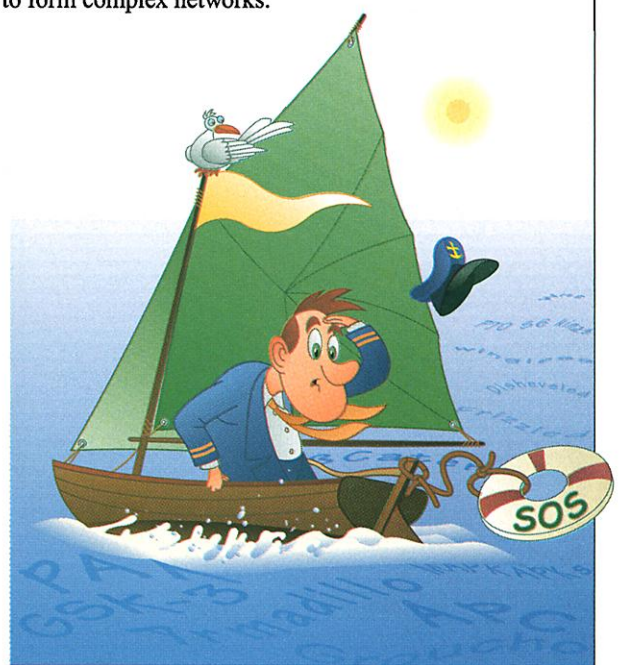
# Signals, Ahoy!

Few fields in science are moving at a more explosive pace than signal transduction: the omnibus of molecular interactions that takes information from extracellular or intracellular sources and then, through a complex cascade of signaling molecules, controls basic processes such as transcription and metabolism. The explosion is monitored not only in the pages of *Science* but in the growth of a new vocabulary of acronyms (Wnt, GSK-3, APC) and enticing names (Groucho, Dishevelled, Frizzled)—all that in one pathway!

When biologists first learned about such pathways, they were seen as linear sequences in which a sensor of one type conveyed a signal to the next molecule, and so on. But there are functionally similar groups of signaling molecules in many different cell types, each molecule being the product of a gene likely to have orthologs in other organisms. Moreover, the connections form more than a set of linear pathways. Knowledge gained from genomic information and high-throughput screens has revealed that signaling modules are connected in particular ways to form complex networks.

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There is good news and bad news in all this. The good news is that the science is exceptionally rich. The bad news is that the science is exceptionally rich: The pathways are lengthening, and the growing alphabet soup of acronyms makes it difficult for even those in the discipline to keep up. It is a challenge for us at *Science* to edit the abstracts and titles of papers in this field so that others can understand them. Indeed, our informal polls even of the experts in signal transduction have revealed a growing concern about information overload. We worry even more about the accessibility of important new findings in this field to scientists who don't make it their own.

Because *Science* would like everyone to be able to approach this area more comfortably and confidently, we have done a couple of things in an effort to be helpful to experts and interested outsiders alike. One is the effort, in this issue, to provide convenient authoritative information on the signals involved in cellular regulation. The other is through the provision, in our Signal Transduction Knowledge Environment (STKE, at www.stke.org), of a variety of features, including original content.

The Viewpoints in this special issue emphasize the multifaceted array of resources we have developed to help readers. These and other resources that go well beyond the printed pages here emphasize the variety of processes, including disease processes, that may now be better understood through advances in our understanding of cell signaling. And at STKE, we have engaged leading authorities on signaling to join us in a new form of authorship. In creating the STKE Connections Map database (http://stke.sciencemag.org/cm), these experts will be contributing to a graphical Web interface for accessing information on signaling components and their relationships. The Connections Maps, stored in a relational database created with our colleagues at Stanford's HighWire Press, are computer-generated and reflect the latest information uploaded by the authorities.

In preparing this editorial, I logged onto STKE in order to try out a Connections Map and clicked the labeled button to get there. Understand that I am a neophyte—once an electrophysiologist, now more of an ecologist, and no computer jock whatsoever. Fascinated with the terminology associated with the Wnt/β-catenin pathway, I summoned it with a click. I was amazed by the web of mapped interactions, each component indicated by a circle with links to others. By clicking on each circle, I got not only an expert's description of that molecule and its role in several systems, I got a bibliography with links to the papers themselves. A click on β-catenin revealed that in flies it goes by "Armadillo," and in the worm its alias is "Wormadillo." Not quite confident yet, I noticed a link to an animation that would show the series of reactions after Wnt attachment to the transmembrane ligand Frizzled. Then I finally got it; I had known that cartoons are a great teaching device, but this was better than I had expected.

It would be nice if all of science could be explained clearly, preferably in words without acronyms. But pleas for simplicity just don't work, not when the penetration into an important specialty has gone deep. We have to live with complexity and then make the tools to deal with it.

**Donald Kennedy**