# Regulating Genes

## Interactive Activity: Background Essay

NOVA

Darwin tried to understand how the extraordinary diversity of life on Earth came about. His theory of evolution explains that species adapt and change, resulting in a wide variety of animals. But he admitted that he didn't understand how this change happened. If evolution is the survival of the fittest, how are the fittest made?

Until recently, scientists presumed that the genes involved in making different animals—say a human and a fruit fly—were very different. The genes required to make wings, for instance, must be quite different from the genes required to make limbs. To understand how evolution works, therefore, all you would need to do is identify the genes of every creature and compare their differences.

Between 1990 and 2003, scientists did just that—they mapped the genomes of humans as well as a few other animal and plants species. Scientists expected that complex species like humans would have many more coding genes than simpler species.

They were wrong.

In fact, humans had a fraction of the expected number of genes, and about the same number as some microscopic worms. What's more, the genes that humans do have are remarkably similar to those found in other animals. Theories about the quantity and diversity of genes, therefore, had fallen short in explaining both the diversity of life on Earth as well as the complexity of humans. What, then, explains how similar sets of genes can result in such an incredible diversity of life?

The new science of "evo devo" (evolutionary developmental biology) is applying lessons from the development of individual organisms to a broader understanding of changes in groups over the course of evolution. By studying developing organisms, scientists have learned about "enhancer" regions of DNA that "regulate" genes by controlling where, when, and to what degree they turn on and off. Thus, the same gene can produce very different traits in two species, depending on how it is regulated during development.

Moreover, if species diversity comes in part from differences in how genes are regulated, then it follows that mutations in regulatory mechanisms—not just in the genetic code—can help explain how species develop new traits.

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