

Cracking the Genetic Code: Competition Was the Catalyst

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Competition often stimulates new discoveries by inducing extra effort and by encouraging alternative approaches to challenging scientific and industrial problems. A telling example of how competition can produce extraordinary results is provided by the efforts during the past decade to map and sequence the entire 60,000 to 80,000 genes that make up the human genome.

In 1990, the National Institutes of Health and the U.S. Energy Dept. launched the Human Genome Project in collaboration with the British government and a few private companies. These public and private participants had decided not to compete with each other but instead to pool their scientists and knowledge into a joint program to solve the mystery of the human genome. The announced completion date was 2005, although they cautioned that this tremendous feat might take even longer.

On the surface, one large, collaborative official project made sense, since it could choose the best approach and avoid the duplication of effort and lack of coordination that would result from competing programs. Yet the value of competition was demonstrated once again through the challenge posed by a somewhat controversial scientist, J. Craig Venter.

HIGH-TECH SPUR. Eight years after the official project began, a small company headed by Venter, Celera Genomics, was created by PE Corp. to develop its own program to map the human genome, in direct competition with the government-sponsored project. Venter boasted that his group would finish by 2000 or 2001, several years earlier than its rival. His forecasts were discounted by the scientific community as unrealistic and excessively optimistic.

Before long, however, Venter revealed that his company was progressing more rapidly than the official project. Celera took a computer-intensive approach that relied on sequencing techniques developed by its own scientists as well as the database produced by the public genome program. Although the competition between these approaches led to bitter public feuding between Venter and Dr. Francis S. Collins, head of the National Human Genome Research Institute, Celera's speedier progress appeared to light a fire under the government's program.

Celera moved quickly by using 300 high-speed DNA sequencers. This encouraged the public project to buy about 200 of these machines. Since they could now proceed much faster, the public project also began to forecast earlier completion dates for its program. A couple months ago, President Clinton and the leaders of both programs jointly announced that they had more or less finished the complete mapping of the genome. By speeding up the process to understand the genetic code—the essence of "life"—by several years, competition from Celera may save thousands of lives through earlier discoveries of ways to prevent and treat deadly diseases.

Contestants in sports have known for centuries that it is easier to run and swim faster and to achieve record times when they are challenged in races with formidable opponents. But this competitive mapping of the genome was built on the foundations of an earlier scientific race: to discover the structure of DNA. In his delightful book, *The Double Helix*, James Watson describes how competition in the early 1950s between a team led by Watson and Francis Crick and one led by Linus Pauling induced both sides to work harder to solve the mystery of DNA. Watson and Crick won this contest, and were quickly awarded a Nobel prize for their magnificent accomplishment, a prize they had realized awaited the winners.

Some government officials have expressed concern about Celera's plan to patent and profit from the information it acquires, although the company has promised to make public all its basic scientific knowledge. These critics ignore the importance of providing effective incentives that lure scientists and companies into races to find breakthroughs. Celera would not have undertaken the task of mapping the human genome, and so would not have successfully challenged the public project to move faster, had it not expected to gain from its discoveries.

Pharmaceutical and biotechnology companies are engaged in many races to develop new drugs, techniques, and procedures to fight various diseases. Winners generally receive patents that allow them to profit from exclusive property rights for a while. The patent system recognizes that while a race to discover new methods and products often produces some duplication of effort, it also provides greater diversity in approaches and puts pressure on participants to move faster.

Perhaps, given its resources and incentive structure, the international consortium was wise to establish a single program to map the human genome. But the world was fortunate that the official project did not have a monopoly on all approaches, since a small private company could then provide powerful competition.