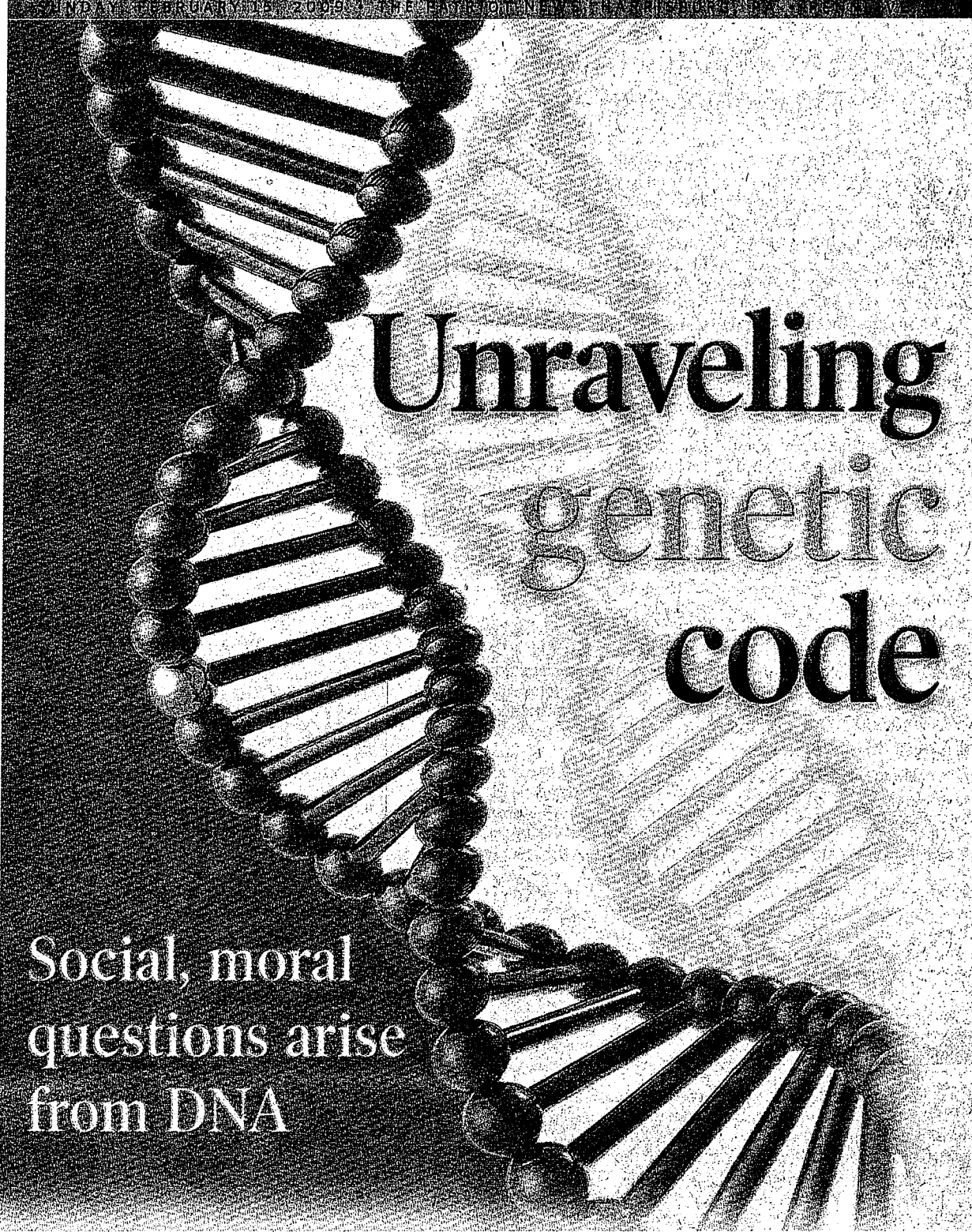


# REVIEW & OPINION

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## Unraveling genetic code

Social, moral  
questions arise  
from DNA



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**I**n 1953, James Watson and Francis Crick discovered the structure of DNA, the helical building blocks of life, and the world has never been the same.

Inspired by that legacy, advances in engineering, chemistry and computer science were applied to the Human Genome Project, in which we set out in 1990 to accomplish the enormous task of sequencing our genome — the instruction book of human life.

The successful completion of this project in 2003 was unequivocally a landmark event, but what did it show and now what?

Armed with knowledge of this human instruction manual, we now know how similar we are to one another, and scientists are gaining new understanding of disease pathology, prevention, and treatment, and applying that understanding to improve patient care. It is remarkable that a string made up of just four letters has created an opportunity for profound conclusions about us as individuals and societies.

What of these letters determines

Please see **DNA** on Back Page.

## **UPCOMING LECTURES**

Tuesday at Penn State  
Milton S. Hershey  
Hospital Auditorium

- 7:30-9 a.m.: "So you sequenced the human genome: Now what?"
- 12-1 p.m.: "The Human Genome Project: The genie is out of the bottle — now what do we do?"

Dr. Alan Guttmacher, acting director of the National Human Genome Research Institute at the NIH.

# DNA: Code opens up moral issues

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our hair, eye and skin color? Is it these letters, or our chosen environments, that make us night owls and to prefer specific foods? What do those letters say about our risk to developing dementia, cancer or heart disease? When will we be able, as human beings, to really understand that we are more the same than different? And what is it that makes us each unique? The Human Genome Project is providing some of the answers.

Some of the issues raised by the genome project must be considered for the first time. Researchers are working hard to determine how best to integrate this new information into medical practice, how to personalize medicine to particular changes in DNA sequence, and to differentiate innate from environmental factors in health and illness.

Policy makers are sorting out the social and legal implications in terms of health care, genetic counseling, access and privacy. Individuals need to be protected from discrimination based on genetic tendencies to chronic (and expensive) illnesses. There are important, if uncomfortable, questions

for us to address as a society; to what extent do we have individual responsibility for our health — should individuals who take care of themselves pay for the health consequences of those who do not by smoking or by eating unhealthy foods?

Genetic testing should be offered when there is potential for improving outcomes with an early diagnosis, but should we even pursue those tests if there is no treatment available? Scientists are scrambling to bring meaning to the variations they see — but what we know already is that most of these variations will mean nothing biologically, a tiny number will cause slight differences in our appearance and make no difference (other than social) to our health, and another small number will tell us about our relative susceptibilities to a variety of common diseases.

So why should nonphysicians and nonscientists care about genomics? The Human Genome Project has revolutionized the field of medicine. It has opened a world of health promoting scientific possibilities that were unimaginable just 20 years ago. The practical applications of this project will inevitably affect us all. It has the potential to do a great deal of good; to be unifying, rather than dividing, and protective, not harmful. This project has the potential to improve our society and to benefit each of our lives.

This will require that scientists and the public work together to determine a best course of action. It will be thoughtful discourse, not one-liners, attention to the public good, not adding gold to million-dollar offices, careful consideration of probabilities, not hysteria generated by greed or narcissism, that will yield the best possible answer after balancing acknowledged difficulties.

Besides health, there is yet another issue for geneticists to address: At the anniversary of Darwin's birth, we have a highly intelligent, gifted president of half-African ancestry that in our recent past would have been subjected to discrimination and worse.

What does the genome project have to say about that? Genomics provides us with an opportunity to shift our focus from differences to a celebration of our shared ancestry. Buried in our DNA are two opposing tendencies: tribalism and compassion. It is up to each of us to choose the latter so that we can fulfill our civic responsibilities.