SCIENCE & EDUCATION
Impact
Benefits from USDA/Land-Grant Partnership

Where Do We Go from Here?

Genome studies map future research.

Chromosomes make us who we are. They do the same for corn, for cows, for* E.coli *bacteria and every other living thing. Yet chromosomes and their basic building blocks of genes and DNA are not well understood. The U. S. Department of Agriculture (USDA) and Land-Grant researchers have undertaken the huge job of creating a map of genomes, the full genetic makeup of humans and other living things. In addition to well-publicized advances in medicine, studies of nature's most genetically complex organism are advancing science in agriculture and other life sciences. The potential of this mapping effort is enormous. Just as geographic maps guided explorers to new frontiers, these new genome maps will guide biochemical explorers–plant and livestock breeders, genetic engineers, nutritionists pest and disease researchers and others–who are exploring the frontiers of biology.

Payoff

- **Tracking a bacterial threat.** *E. coli 0157:H7* bacteria is a major public health threat, but genetic differences among *E. coli 0157:H7* populations and their role in causing disease aren't well understood. **Nebraska** food scientists developed a new genetic fingerprinting method that allows them to pinpoint genetic differences on *E. coli* DNA. Researchers identified two distinct *0157:H7* populations in cattle: one that causes illness in people and one that apparently doesn't. This may provide genetic information to help trace the source of *E.coli*-related illness and produce a simpler, less expensive way to do large-scale *E. coli* testing.

- **A quest for tiptop tomatoes.** Tomato growers in New York and other regions lose millions of dollars to crop damage because cultivated tomatoes are susceptible to cold weather. The relationship between the genes that control chilling tolerance is complex, so traditional breeding programs haven't had much success moving chilling tolerance from wild tomato species into improved varieties. **Cornell** and **Texas A&M** researchers are using gene maps to guide breeding and streamline the process that could save millions of dollars in public and private breeding programs and expand the area where tomatoes can be grownprofitably. It also could reduce energy costs for commercial greenhouse tomato production.

RESEARCH, EXTENSION AND EDUCATION AT WORK

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- **Not horsing around.** As part of an international project, **University of California-Davis** researchers developed new research methods that helped them identify nearly 500 genetic markers in the horse, including several that indicate health-related traits. Markers may lead to improvements in health and more informed breeding decisions. **Kentucky** researchers are also involved in mapping the horse's genetic makeup.

- **Cancer potential.** The U.S. poultry industry spends more than $1 billion annually to control a viral disease called Marek's disease. **Arkansas** researchers are studying how the disease spreads in chicken tissue, how the virus can be activated by signals within cells and how it manipulates the chicken's own cells. Understanding these processes could lead to new ways of transforming cells, a finding that could be used to disrupt the virus and shed light on the cause of some human cancers. Only 200 genes out of thousands have been mapped in the chicken genome. **Tuskegee** research has added another 15, improving the map's usefulness for breeding and biotechnology efforts to develop poultry with better reproductive performance, disease resistance and other traits. The work may also contribute to the use of birds to investigate human conditions such as aging.

- **Gene-boosted productivity.** In **Minnesota,** researchers are building genetic linkage maps of the pig, dog and turkey to identify areas where genetic differences affect observable traits and diseases that affect breeding. Researchers are working with producers to confirm laboratory results. Initial experiments indicate as much as a 25 percent increase in breeding efficiency is possible.

- **Code crackers.** Cracking corn's genetic code will allow researchers to develop corn varieties that are more nutritious, require fewer pesticides and are productive in hot and dry conditions. **Missouri** and the USDA corn research is helping unlock the genetic secrets of other cereal grains such as wheat, rice and barley. Gene maps produced by Land-Grant scientists will be widely available to other scientists so that they can build on each other's work.

- **Using genes to track biodiversity. Nevada** researchers are using genetic differences in a fish, the tui-chub, to study changes in biodiversity. By looking at the genetic differences and similarities of the fish, researchers hope to improve water resource management decisions that protect biodiversity.

- **Crop disease busters.** *Phytophthora* plant diseases cause estimated worldwide annual crop losses of more than $10 billion including $3 billion in losses from potato late blight. **Ohio Stat**e researchers are trying to identify all the genes of *Phytophthora*, a fungal disease. Genetic resistance and new management strategies should result in less chemical use and yield loss. Researchers from **Maryland, Iowa State, California** and several foreign countries collaborate on the work. **Wisconsin** researchers identified the chromosome on which the genes for late blight resistance in potatoes reside. Making potatoes resistant to this disease will eliminate the need for fungicides, which can cost producers up to $250 per acre.

- **Fishy genes.** To meet projected global demand for seafood products, aquaculture production will need to increase fivefold. **West Virginia** and USDA researchers are mapping rainbow trout genes to improve productivity. They've identified several DNA sequences that regulate growth and are looking for genes associated with disease resistance, reproduction, meat quality and other traits.

Cooperative State Research, Education, and Extension Service
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