IT  departmental Genetics Holiday
Newsletter 2006
Iowa State University
Wishing you all the best!

Fred Janzen, Chair Phil Becraft, Associate Chair
IG Supervisory Committee: Tom Peterson
Roger Wise Max Rothschild David Hannapel
Program Coordinator: Linda Wild

News from Jody Stadler

Jody was the first Chair of Interdepartmental Genetics (1992-1995). She retired and moved to Minneapolis but drops by to visit friends in Ames on occasion. Jody has been busy participating in Art Shows with her original art. Jody is proposing to exhibit an art show called "Running Out of Time" at Iowa State during 2007. She had a piece of work accepted for a juried show in a Chicago gallery WomanMade in the “Signatures of Age” exhibit. Jody creates portraits of elderly women and men in charcoal, pastel, and acrylic. Her drawings have been exhibited regularly in juried group shows in Iowa and Minnesota and have received several awards. One of these works was recently selected as the cover illustration for a national journal. Upcoming exhibitions include: St. John's University, October 2007 and Bloomington Art Center, September 2007, and Grand Marais Johnston Heritage Post, Summer 2007.

IG Faculty in the News

Thomas Baum, Plant Pathology (former IG Chair and now Chair of Plant Pathology) was honored by the American Phytopathological Society as part of a team that has changed the direction of research into nematodes that attack plants. Baum received the Ruth Allen Award for Innovative Research along with two other researchers from other universities. The three researchers have identified more than 100 secretions that nematodes use to infect plants. The long-term goal of the research is to devise new mechanisms against these pathogens. (ISU Plant Sciences Institute Update October 2006, Volume 7, Number 1)

John Nason, EEOB, was recognized this year (2006-2007) as a Master Teacher. The Master Teacher program recognizes teachers who have a reputation for using unique methods to enhance student learning.

Diane Birt, FSHN, was a member of the NIH State-of-the-Science Panel on Multivitamin/Mineral Supplements and Chronic Disease. The Conference was held at NIH, Bethesda MD, May 15-17, 2006. She was awarded the Central States Society of Toxicology John Doull Award on October 6, 2006 in Kansas City, MO. Her talk was entitled "Understanding bioactivity of complex mixtures using Echinacea and Hypericum." Diane was appointed to a three year term on the Food and Nutrition Board of the Institute of Medicine, National Academies of Science

W. Allen Miller, Plant Pathology, has been named director of ISU’s Center for Plant Responses to Environmental Stresses. Through his research, Miller has made significant discoveries in the study of plant-virus interactions and the mechanisms of plant gene expression. Miller’s research achievements include discovery of new species of the cereal pathogen, barley yellow dwarf virus, and detection of how the virus takes over the host’s protein synthesis machinery. (ISU News Service, Teddi Barron, October 23, 2006)
Roger Wise (USDA-ARS) was an invited guest teacher in the week-long Nordic PhD course on Genomics and Plant Breeding. Hosted by colleague Alan Schulman, he presented lectures on microarray analysis, phenotype-based cloning, and use of the PLEXdb plant expression database to 28 graduate students and 6 instructors from Norway, Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, and Iceland, France, Ethiopia and Poland. He also took the opportunity to present an overview of the new CSREES-funded Barley Coordinated Agricultural Project (CAP) goals, objectives, and outreach. Barley is the #1 cereal crop in Finland (planted on 594,200 hectares in 2005) so the CAP overview fit right in with the theme of the course (other major crops are birch, potato, and salmon). Roger Wise, Julie Dickerson and Jean-Luc Jannink, pictured, make up Iowa State's part of the barley research project that encompasses 19 institutions across the country.

Basil Nikolau, Biochemistry, Biophysics and Molecular Biology, received the Regents Award for Faculty Excellence. Nikolau has been one of the leaders in Iowa State’s emergence as a national and international center of excellence in metabolic biology. He brings together teams of talented faculty in different disciplines to address complex issues in plant biology. (Inside Iowa State, September 8, 2006)

Gwyn Beattie, Plant Pathology, has been named to an endowed chair, the Robert Earle Buchanan Distinguished Professorship of Bacteriology for Research and Nomenclature, in the College of Agriculture at ISU. Beattie, an associate professor of plant pathology, specializes in genetics, physiology, and the ecology of plant bacteria. Gwyn studies leaf ecology as it relates to bacteria. She’s working on a project evaluating whether leaf-associated bacteria can actively reduce airborne pollutants. She’s also researching how plants can limit the availability of water to invading pathogens. And she is exploring whether the adaptations that plants use to tolerate drought and salinity influence the growth or survival of plant-associated bacteria. (ISU News Service, August 06, Teddi Barron).

Fred Janzen, Ecology Evolution and Organismal Biology, has been named an ADVANCE Professor at ISU for the next 2-4 years. As an ADVANCE Professor, he will be working with a group of people from across the University to lead efforts to identify and sustain needed change in practices, structures, and policies to transform STEM (Science, Technology, Engineering, and Mathematics) fields for women and faculty of color. Dr. Janzen began a two-year term as Chair of the Interdepartmental Genetics program.

Phil Becraft, Genetics, Development and Cell Biology, was elected Associate Chair of Interdepartmental Genetics. He will become IG Chair in August 2008.

Awards for the ISU Campus

Thomas Gaines, in The Campus as a Work of Art (1991), proclaimed the Iowa State campus to be one of the twenty-five most beautiful campuses in the country. Gaines noted the park-like expanse of central campus, and the use of trees and shrubbery to draw together Iowa State’s varied building architecture. In 1999, a national landscape architects’ group selected Iowa State’s central campus as a “medallion” site. The park-like central lawn was among three central campuses selected for special recognition by the American Society of Landscape Architects (ASLA). To commemorate its centennial, the ASLA selected more than 300 significant landscapes across the country as medallion sites. Thirteen sites were on college campuses, but only three are central campus sites—Yale University, the University of Virginia, and Iowa State. Iowa State’s central campus includes 490 acres of trees, plants, and classically designed buildings. The landscape’s most dominant feature is the 20-acre central lawn. Over decades, campus buildings, including the Campanile, Beardshear Hall, and Curtiss Hall, circled and preserved the central lawn, creating a space where students study, relax, and socialize.
Football 2006-07: It’s a Hawkeye State

It was a Cyclone State until the fall football game with the University of Iowa. We lost, but we will be back next year. Iowa State had two billboards, like this poster, up in Cedar Rapids and in Iowa City. News articles indicated people were causing road tie-ups in Cedar Rapids as people slowed down to “gawk” at the billboards. The panel above was shown at the Iowa State Fair.

Genetics Graduates Fall 2005, Spring 2006, Summer 2006 and Fall 2006

Jin Li (Ph.D./Schnable Lab); Christian Paxton (Ph.D./Reecy Lab); Hongtao Qin (Ph.D./Powell-Coffman Lab)
Jolita Ulthe (M.S./Tuggle Lab); Marna (Yandeau) Nelson (Ph.D./Schnable Lab); Yan Fu (Ph.D./Schnable Lab)
Anna Bennet (M.S./Moody Spurlock); Kalyan Dudala (M.S./Nason); Andrew Slattery (M.S./Phillips); Axel Elling (Ph.D./Baum) (Research Excellence Award); Aigen Fu (Ph.D./Rodermel) (Research Excellence Award); Zhuying Li (Ph.D./Peterson); Jessica Schluerter (Ph.D./Shoemaker); Lacey Luense (M.S./Komar); Jose Rodriguez (M.S./Reecy); Yanling Wei (M.S./Schnable); Hongyu Gao (Ph.D./Bhattacharyya); Ling Li (Ph.D./Wurtele) Research Excellence Award; Colin Shepherd (Ph.D./Scott); Hong-Hua Zhao (Ph.D./Dekkers).

Sample of titles of final examinations this fall included: “The role of peroxisome proliferators activated-receptor gamma in ovarian function” (Luense); “Estimation of genetics parameters, and effects of pinkeye on economically important traits in American Angus cattle” (Rodriquez); “The Roles of Aldehyde Dehydrogenases (AALDSs) in Acetyl-CoA Biosynthesis and Root Elongation in Arabidopsis” (Wei), and “Use of Linkage Disequilibrium for Quantitative Trait Loci Mapping in Livestock” (Zhao).

Recruitment 2007

We hope that you will consider recommending our Genetics graduate program to excellent potential graduate students. We have four USDA National Needs Ph.D. Fellowships to award: three for U.S. citizens interested in the development and application of quantitative methods and tools for animal genomics; and one for citizens interested in biological questions dealing with animal and microbial genomics, food safety and disease resistance, and growth and development of animals. Our students are also eligible to be considered for NSF IGERT Fellowships in computational molecular biology. [http://www.genetics.iastate.edu/fellowships.html](http://www.genetics.iastate.edu/fellowships.html)

Recruitment 2006

Twenty-two (22) new students began graduate training this fall in IG. US undergraduates were recruited from Truman State in MO (3), Iowa State (2), University of Maryland-College Park, Berry College (GA), Lawrence University (WI), Luther College (IA), and the University of Minnesota-Twin Cities. International students were recruited from Fudan University (3), Peking University, Yuannan University, South China University of Tech., University of Science and Technology (Hefei), Huazhong Agricultural Univ., Chinese Academy of Sciences, Institute Pedagogique National (Kinshasa, Congo), East China U of Science and Tech, and Beijing University.
Alumni News

Jin Li (Ph.D./Schnable Lab) is working as a Post-Doc in Dr. James E Haber’s lab at Brandeis University. His research project is studying the regulation of donor preference during mating type switching in budding yeast.

Jason Dinges (Ph.D./Myers/James Lab) will graduate with a law degree from the University of Iowa in December. Following graduation, he plans to move to Madison, WI, take the bar exam, and begin work as a patent attorney with Foley & Lardner LLP in the firm’s biotechnology & pharmaceutical practice group.

Greg Park (Ph.D./Carpenter Lab), after completing post-doctoral training at NIH with Rocky Mountain Laboratories, is currently the lab director for a physician scientist at the University of Minnesota in Minneapolis. His current research activities focus on examining the parasite and host interactions that contribute to cerebral malaria in Kenyan children. On a personal note, he and Carissa Steelman (another IG alumnus, MS/Reecy) will be getting married in September of 2007.

Randy Small (PhD 1999, Dept. of Botany, Wendel Lab) is currently an Associate Professor and Associate Department Head in the Department of Ecology & Evolutionary Biology at the University of Tennessee. Randy continues to use the tools of molecular systematics and molecular evolution to study plant diversification and polyploidy, especially in the genus Hibiscus. While Randy’s research primarily focuses on Malvaceae, his students have studied a wide variety of population- and species-level problems in diverse plant groups. Contributions to professional societies include being Secretary/Treasurer, Vice-Chair, and now Chair of the Genetics section of the Botanical Society of America. Randy and his wife Sarah have three children, Jesse (13), Laurel (9) and Duncan (5). Among the many things they love about living in Tennessee are University of Tennessee football, and being only 20 minutes from the Great Smoky Mountains National Park. [contact info: rsmall@utk.edu; http://web.utk.edu/~rsmall]

Aigen Fu (Ph.D./Rodermel Lab) is a postdoctoral Researcher in Dr. Bob Buchanan and Dr. Sheng Luan's lab at the UC Berkeley. His research project focuses on undermining the function of several Arabidopsis proteins call immunophilins.

GongXin Yu (Ph.D./Wise Lab) was recently appointed as an Assistant Professor in bioinformatics at Boise State University in Idaho. His work is to develop novel algorithms and high throughput computational procedures for biological data mining to improve our understanding of some of the most complex biological systems, bacterial pathogenicity and human diseases in particular, so as to extract knowledge and thereafter generate experimentally testable hypotheses. GongXin, his wife, and 5-year son live in Boise, Idaho. They are very busy, yet happy. Guests are welcome in their home in Boise.

Jennifer Lee (Ph.D./Shoemaker Lab) has a position at UC Davis heading up the bioinformatics side of a Pine re-sequencing, SNP, and genotyping project. They have also just been funded for a conifer comparative re-sequencing project; she will head up the bioinformatics work for this project as well.

Yan Fu (Ph.D./Schnable) writes, “I have been very happy to be here at Donald Danforth Plant Science Center for almost a year. The most important event to my family this year was the birth of my new daughter, Janice Fu. She and Yannis made my wife (Shengmei) and myself happy and proud parents. I am extending my strong interests in comparative and functional genomics here. Among several projects I am working on, the most interesting hypothesis I am testing is that protein synthesis initiation via 5S rRNA expression is regulated through alternative splicing in higher multicellular organisms. This hypothesis seems true in several plants that I have tested including moss, three dicots and two monocots.
Corinne Nielsen (M.S./Ambrosio Lab). Several years (five) after completing her M.S. degree at ISU, she decided to return to graduate school and go for her Ph.D. She is currently in her fourth year in the BBS (Biological & Biomedical Sciences) program at Harvard Medical School in the department of genetics. In May 2006, she became happily married to Andrew Tucker!

Charles Kremer (M.S./Holland Lab/Agronomy) is working in a Nucleotide Polymorphism Lab at the Mayo Clinic. The focus of the lab is an area of pharmacogenomics regarding treatments based upon individual genetic makeup. His kids are growing. His daughter started at University of Minnesota in the pre-vet program and both boys are doing well in high school.

Dondra Bailey (M.S./Chitnis/Rodermel Lab). “I am a Science Assistant at the National Science Foundation in the Directorate for Biological Sciences, Division of Integrative Organismal Biology (5/2005-12/2006). I am extensively involved in outreach activities within NSF and a local Arlington, VA high school. I am preparing to return back to graduate school for my PH.D. in developmental biology starting in the Fall 2007.”

Matthew Abbot (Ph.D./Tuggle). “This fall, I accepted a full time teaching position with Iowa Lakes Community College in Northwest Iowa. I teach General Biology and Human Anatomy and Physiology. It's been a very rewarding experience. My wife, DeDe Abbott, recently accepted a job in Ames and is now an Assistant County Attorney for Story County. In May, I will be joining her and my son in Ames as I am currently looking for a job there.”

Lily Huang (M.S./Girton) is working on investigating mechanisms of Huntington's Disease using a genetic approach at the J. David Gladstone Institutes, Neurological Disease in San Francisco, California. She generates transgenic mice and crossing disease model mice to specific mutants to see genetic interaction. The knowledge she learned from IG is valuable and practical for her to apply at work. The working model is different (she was working on flies at ISU and working on mice now), but the fundamental knowledge and techniques are universal. Lily indicates that life at ISU was a lot cheaper and simpler than working in San Francisco. A very nice one bedroom apartment in Ames could run around $500; however, an efficiency in SF costs twice that much.

Axel Elling (Ph.D./Baum) joined the Howard Hughes Medical Institute/The Jackson Laboratory in October. He is characterizing an editing-defective tRNA synthetase that causes neurodegeneration in mice and he is also trying to identify new genes that affect neuron survival.

Marna Yandeau (Ph.D./Schnable) has completed her first year of a post-doctoral position in Mark Guiltinan's lab at Penn State University. She is using genetic and biochemistry approaches to study the roles of maize starch branching enzymes in plant development.

Jeonga Kim (Ph.D./Mayfield) “Hi everyone, I can't believe that it is almost 10 years since I left MOLBIO. I miss many faces from there, warm hearts, and a cup of coffee at the second floor. Oh, I miss snow too. We haven't got snow this year in the Washington D.C. area. I am doing diabetes research at NIH. Now I am looking for a faculty position. My daughter is going to college next year. It is a great pleasure to see that kids grow and reflect yourself. I am sure Ames has changed a lot. Now Christmas is around the corner, everyone should share the spirit. I wish happy and great holidays. Great success in everyone's future!!”
**Featured Present (someday to be alumni) IG Students**

**Ruth Swanson-Wagner** is in her third year of graduate study in the Interdepartmental Genetics major. Her research in the Schnable lab focuses on understanding the molecular mechanisms responsible for heterosis (hybrid vigor). Hybrid corn is generated by crossing specific inbred corn lines (parents). Heterosis has been exploited for nearly a century because hybrid corn produces more seed, develops faster, and grows taller than either parent line. Although heterosis has been exploited and studied extensively, the molecular basis of heterosis remains unknown.

Ruth’s work focuses on the inbred lines B73 and Mo17 that produce a heterotic hybrid (see photos: in each photo, the inbred line B73 is shown on the left, Mo17 on the right, and the hybrid in the center). The research team includes Dr. Schnable, Dr. Nettleton (Statistics), graduate students Yi Jia, Lisa Borsuk, and Rhonda DeCook. Using a corn microarray chip, the gene expression of nearly 14,000 genes was assayed in the hybrid and its inbred parents. Over a thousand genes exhibited differential expression among the genotypes. Some genes have levels of activity that are significantly higher (overdominant) and lower (underdominant) than both parent lines. Approximately 78% of the gene activity levels are intermediate between the parent lines (additive).

In May 2006, the manuscript, “All possible modes of gene action are observed in a global comparison of gene expression in a maize F1 hybrid and its inbred parents” was published in the Proceedings of the National Academy of Sciences journal. Ruth has presented the research findings at Penn State University and St. Mary’s University of Minnesota as well as presented posters at the annual Maize Genetics and Plant and Animal Genome conferences. “Photos courtesy of Jun Cao and Ruth Swanson-Wagner, Schnable Lab”.

**Jacquelyn Jackson**, Plant Pathology/Miller Lab, is in her final year at ISU studying virus replication. She is one of the few black doctorate candidates working in agricultural molecular biology in the United States. Jackson is studying a virus that has plagued farmers for years, the barley yellow dwarf virus (BYDV). Not only does her research help farmers, it also can help other scientists understand viruses that are genetically similar like SARS and Porcine Reproductive and Respiratory Syndrome Virus (PRRSV). “Her research is another brick in the wall of knowledge and it all adds up,” said Allen Miller, Jackson’s academic mentor. “In terms of agriculture, this research is most economically important in wheat and oats production throughout the world.” Jackson applied and received the Ruth L. Kirschstein National Research Service Award, a competitive grant from the National Institutes of Health. “I’m looking at what the mutant virus does when it is introduced into plant cells, to see how those mutants compare to the wild-type virus,” said Jackson. ISU College of Agriculture, Alicia Clancy, Ag Communications.

**Colin Shepherd**, Agronomy/Scott Lab, had the opportunity to participate in the Big 12 Business Plan Competition in Dallas Texas in March of 2006. This business plan competition consisted of 11 of the 12 Universities in the Big 12 conference where teams of students pitched their business ideas to a group of venture capitalists. His business plan is based upon research that he conducted during his graduate studies in the Interdepartmental Genetics program at ISU. Although the plan he submitted and defended was not accepted as the winner of the competition, it was an extremely valuable experience for him to associate with business leaders who are interested in investing in start-up businesses located in the cities that are home to the Big 12 Universities.

Currently, he is developing a start-up business and they will begin operations in the spring of 2007. The new venture is called AimsBio ([http://www.aimsbio.com](http://www.aimsbio.com)), and the initial technology offering will be a next generation analytical service that measures the digestible amino acids in corn seeds and will be marketed to bioscience companies, seed companies, and corn breeders. The initial feedback for this service has been very positive and we expect to begin analyzing samples beginning in the spring of 2007. AimsBio is also committed to innovation and we have a broad research and development platform that will address emerging problems in agriculture. His goal is to direct AimsBio into becoming a fast growing and profitable bioscience company.
A Sampling of Recent IG Student Publications


Iowa State researcher studies gene families to explore diversity and evolution

Theoretical biologist **Stephen Proulx** studies gene families to explore how genomes become diverse and evolve. The Iowa State University assistant professor uses mathematical tools and computer models to determine how environmental and evolutionary factors — like seasonal change, migration and sexual preference — structure a genome.

One path to diversity in a genome involves the proliferation of genes into multi-gene families.

“The growth of a gene family can occur through rare errors in DNA replication,” Proulx said. “Sometimes in error, a single gene is duplicated on a chromosome, and the duplicated copy can emerge as a new functional gene. Although that gene may have a new function, it’s not fundamentally different from the original gene.”

Proulx wants to be able to explain that process. “We also want to know if changing the size of gene families is a way by which an organism becomes more complex,” he said.

In a recent paper published in the journal *Evolution*, Proulx and colleague Patrick Phillips, professor, University of Oregon, Eugene, show that the process of gene family expansion can begin even before a gene is duplicated. The first step in the process involves specialization of different variants of a gene that can then take on different functions once the gene is duplicated by chance.

The article was recently featured as a “Hidden Jewel” on the Faculty of 1000 Web site, a journal review site that posts expert opinions on current research papers. Proulx thinks it has generated considerable interest in the biological community because it shows how the process of adaptation can play a role in generating organismal complexity.

Proulx’s model calculates the exact conditions under which evolutionary pressures cause genes to diverge.

“One of the things I’m trying to do is provide an ecological and environmental context for genome evolution,” he said. "And what I continue to see is that these ecological factors can play a really large role.”

(Graph copyright 2002 Stephen Proulx; article ISU News Service Teddi Barron, July 31, 2006)

**Chasing mutants**

Studying mutant plants helps scientist determine and analyze the functions of specific genes. Among the first things you notice when walking into **Erik Vollbrecht**’s office are the funny looking ears of corn. He has a couple of shoeboxes full of them, and the ones that draw your attention right away have several small branches jutting out in different directions. Then you take a closer look and notice the kernels on these ears—some are discolored, while others are considerably misaligned. They’re definitely not what you’d find at your local grocery store.

Follow Vollbrecht to the greenhouse on the third floor of the Molecular Biology Building or to his field at Curtis Farms near Ames, and you’ll see him peeling back the husks of ears of corn, looking for defects. When he finds an anomaly, he pulls the ear from the stalk and takes it back to the lab to study. For Vollbrecht, a GDCB assistant professor, it’s the mutated seeds from these malformed ears that help him learn how a gene functions in normal situations.

“In a mutant, the function of exactly one gene is removed,” Vollbrecht explains. “We analyze how that removal changes the plant and consider the differences in the context of the molecule produced by that one
gene. Looking at a collection of different mutants that cause similar visual changes allows us to catalog the parts that make up the system and the potential an organism might have.”

Vollbrecht focuses on corn because the ear is a good system for branching, which is his main area of study. Branching, he explains, is the main characteristic that controls the differences between the form and appearance of different plants—for example, trees and shrubs. Critical factors in branching include when and where branches are made and how long they grow.

“The traits I learn about in the ear of corn can also be applied to other plants,” Vollbrecht offers. “In grasses and cereals such as rice, wheat, and sorghum, branching in the grain head is beneficial to yield. We’re studying how subtle changes to a core gene set create the diverse architectures seen in grasses.”

Vollbrecht’s research has led to the identification of the gene ramosa1, which impacts the architecture of corn. In a normal ear of corn, each kernel is positioned on the end of a small branch. Ramosa1 tells those branches to grow short and in straight rows. The examples in Vollbrecht’s office show how much of an effect a missing ramosa1 gene can have.

There’s strong evidence that farmers, as far back as 10,000 years ago, realized the value of active ramosa1, Vollbrecht notes. “Our DNA sequence analysis shows that modern varieties of corn contain just a few versions of the ramosa1 gene, which is unusual for a maize gene,” he says.

“Early farmers bred maize from teosinte, a tall grass, over thousands of years, and we now know that they were careful to select corn that had lots of activity in this gene. That understanding pinpoints this gene as a master regulator of how the ear is constructed and implies that the ramosa genes may be manipulated to control ear or seed-head architecture in maize and other cereals.”

Vollbrecht’s research also focuses on functional genomics. He says new DNA sequencing and analysis technologies are critical because they essentially allow researchers to identify all of the more than 50,000 genes contained in the corn plant. “Simply identifying a gene, however, tells us very little about what it actually does,” he says.

And that’s why the mutants are so important. “We’re knocking out 10,000 of those genes by making mutants,” Vollbrecht explains, “which jumpstarts the analysis of the gene function.”

Eventually, those mutant genes will be listed in a public database for use in a wide range of plant sciences. From basic research questions like the control of branching to biotechnology applications like biorenewables, this mutant collection will be used to determine the importance of each gene in the process being examined. (Text by Iowa State Engineering Communications and Marketing)

Fishing for answers

The National Center for Health Statistics reports cancer as the second leading cause of death in the United States. Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. Jeffrey Essner, GDCB assistant professor, is looking for genes in zebrafish that could lead to new treatments for humans that would stop the spread of abnormal cells.

Essner, who joined the faculty last fall, is setting up a zebrafish facility in Science II this summer. This facility, with a thousand plastic fish tanks holding thousands of fish, will introduce a new model system to Iowa State for researchers who are studying vertebrate development.

Zebrafish, as far as model systems go, are low maintenance and don’t take up much space. Adults grow to about an inch, and a three-litre tank can hold up to 60 of them. They also develop quickly. Twenty-four hours into development, there is a beating heart. In addition, the embryos develop outside the mother. “The wonderful
thing about these fish is that they give these optically clear embryos,” Essner says. “You can simply look at them under a microscope and see what’s going on inside.”

Though these tiny fish might seem a far cry from humans, many genes in the zebrafish have the same function as their human counterparts.

In his research, Essner is working to find genes in the zebrafish related to angiogenesis, the development of new blood vessels formed by the budding of cells from existing vessels. Specifically, he wants to understand the genes that are required for tumor angiogenesis. These new blood vessels allow the tumor to receive nourishment for further growth and provide a route for cancer cells to metastasize to other parts of the body.

Once Essner finds the genes responsible for this vessel growth, he’ll try to figure out how to turn them off and thus starve and kill tumors.

Of some 30,000 zebrafish genes (roughly the same number as humans), about one of every 200 is important for blood vessel formation. To find those genes, Essner knocks down the expression of one gene at a time. Then he watches the development of the embryo to see if or how the gene would have affected blood vessel formation.

“We’re really searching for that small subset of genes that are important for this process,” says Essner. “By screening for these new genes, we hope to identify new candidates for anti-tumor agents.” Once an anti-tumor agent is discovered, researchers will test it on other model systems. The hope is that it makes its way to a clinical trial stage for humans, and that it works.

Essner began using the zebrafish as a model while working on his PhD at the University of Minnesota. Following a postdoctoral appointment at the Scripps Research Institute in La Jolla, California, and a research faculty appointment at the Huntsman Cancer Institute, University of Utah, Essner became scientific director for Discovery Genomics Inc., a Minneapolis biotech company. That’s where he began to see the applications of his research.

“It was my experience in industry that led me to believe I could make an impact on human disease; that you can easily transition basic research into therapeutic products,” Essner says.

Essner’s spouse, Maura McGrail, an associate scientist in GDCB, will also use the zebrafish facility. She is developing a cancer model in zebrafish embryos, essentially creating a fish that gets cancer. Often, cancer growth in zebrafish is quite similar to that in humans. McGrail’s long-term goals are to find chemicals that will inhibit tumor formation and growth.

In another collaboration, veterinary specialist Dusan Palic will look at how the zebrafish immune system responds to different stimuli, in turn giving information about how the immune system functions. Essner is interested because cancers develop the ability to evade the immune system.

“We have become fairly proficient at curing mice of cancer,” Essner explains. “However, when we go to the clinic with these same tools, they don’t seem to work so well on humans. So it’s really asking for a different kind of approach. Maybe screening more genes and understanding what those genes are doing will lead to more effective therapeutics.” (Original text by Samantha Beres, adapted by Engineering Communications and Marketing. Photo by Bob Elbert).
Protein predictions

Understanding the structure of proteins and how proteins interact with each other is crucial to designing effective new drugs to treat specific diseases.

“There are two driving questions in our lab,” says Drena Dobbs, GDCB associate professor. “One is, ‘Can we predict the overall structure of a protein, given only its amino acid sequence?’ And the other is, ‘How do proteins recognize and interact with their correct partners (other proteins or DNA) in cells?’”

Using their experience in computational biology, Dobbs and her graduate students are looking for those answers by developing models based on data from biologists and other scientists. That data, she says, includes information about the interactions of specific proteins in a cell. Dobbs hopes scientists will eventually be able to understand the rules of nature that establish how amino acid sequences determine the structures of proteins and how proteins interact with other proteins to carry out their functions in cells.

“We understand the genetic code that translates information from genes in DNA through RNA to protein sequences,” Dobbs explains. “But we don’t yet understand the protein folding code that determines how a linear sequence of amino acids gives rise to a functional, folded three-dimensional protein.”

Dobbs adds that the complexity of the problem is overwhelming because the number of ways that a protein can fold is astronomical—about 100 to the 20th power. “We’re still a long way from understanding all the rules that determine folding,” Dobbs admits, “but if we can, we’ll also begin to answer the second question of how proteins interact with other macromolecules. When that happens we can begin to design new drugs that could be used to treat many diseases.”

Dobbs notes a few humans aren’t susceptible to AIDS, so understanding which gene variants are responsible for protecting them from the HIV-1 virus could lead to new treatments or a vaccine for the disease. “We also know that people respond differently to drug treatments,” she adds. “Medications for high blood pressure and heart disease are effective in certain individuals, but not in others; certain cancer treatments work great for some patients, but not for others.”

Part of the reason that’s true, Dobbs says, is the natural variations in human DNA that determine whether we are likely to get a disease, how we respond to treatment, and how rapidly the disease will progress. “Those variations, by and large, are expressed in protein structures,” she explains. “If we can predict how a tiny change in a sequence will change the shape of the protein, we can understand a lot more about how things really work in living cells. And that would help us find treatments for many diseases.”

“And that’s our ultimate goal,” Dobbs continues. “We want to understand how things work so we can develop models that will help us make better decisions about which experiments to do or which treatments to consider.”

Dobbs considers collaborations with enthusiastic students and scientists from other disciplines as the most rewarding aspect of her research. “I like learning about other people’s work and synthesizing information,” she explains, “and computational biology allows me to do that. My students and I analyze large sets of data in our lab, generate hypotheses, and then we experiment to test our predictions. When our predictions are wrong, we go back, knowing that we need to improve our algorithms. If our experiments validate our computational predictions, we hope these approaches will ultimately lead to clinical therapies.”

Slowly, but surely, Dobbs and her students are getting there. The number of tests to run is down to about 4 to the 100th power. (Text and Photo by Iowa State University Engineering Communications and Marketing)
A few odds and ends

A Video Look at Student Experience

Mostly intended for prospective undergraduates but with campus scenes you likely will recall from your graduate training at Iowa State. Explore the student experience at Iowa State in a new online video, narrated by President Gregory Geoffroy: http://www.iastate.edu/~president/video/video.shtml

Streaming, Virtual and Snapshots of Iowa State University: http://www.iastate.edu/webcam/ Lots of streaming Webcam action showing building construction at Vet Med, the Memorial Union (great shot of Lincolnway), Alumni Center, Dairy/Animal Science Education and Discovery Facility and on the main campus—Coover Hall, Hixson-Lied Student Success Center, and Morrill Hall.

Miss the great community of Ames. Everything you ever wanted to know can be found here: http://www.genetics.iastate.edu/ames.html Picture below is of Main Street running West to East. Mary Greeley Medical Center is in the upper center of the picture. Railroad in the foreground.

Selections from a Commencement Address at Iowa State University
By Graham B. Spanier, August 5, 2006, 9:30 a.m.

“I want to give you a simple message today: Put people first. That’s it.

“It is my deep belief that humanizing society is our best shot for moving forward as a nation and as human beings. Every action in our lives touches someone else in some way and we are accountable not only for what we do in life, but also for what we do not do. Remember that small gestures matter and grand gestures often have small beginnings.

“Many of you will graduate and go into the workplace believing that all decisions are business decisions. But they are not. Most decisions are also people decisions. You need to be accessible, reach out to people, and strive to understand diverse viewpoints. Putting people first involves more than good deeds. It involves an attitude and a way of life.

“As one American author has noted, “People will forget what you said, people will forget what you did, but people will never forget how you made them feel.” It is my deepest hope that you will care enough about humanity to work toward solving some of the world’s most pressing problems. I urge you to strive to make a genuine difference in the world by always putting people first.”

A big birthday calls for a big celebration

Iowa State's 150th birthday bash will span an entire year. The fun starts with the Veishea celebration, April 21, 2007, and runs through spring 2008: http://www.iastate.edu/~isu150/