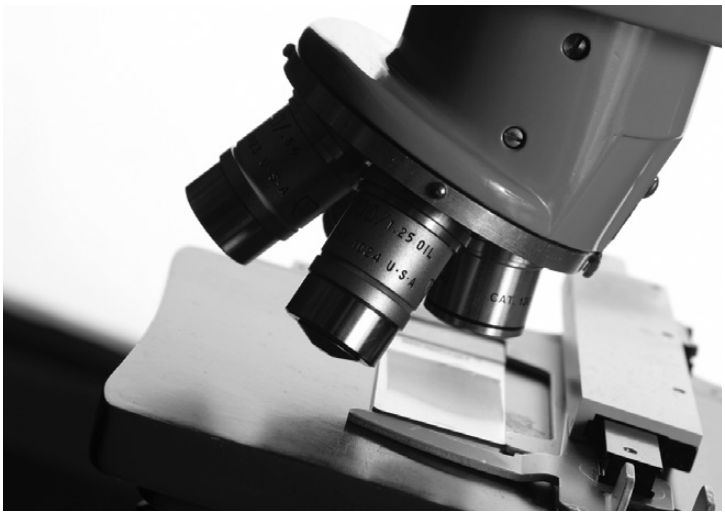
At Andrews, It Pays to Discover!



And how! In just the last six months, AU faculty and students secured 1.2 million dollars in external grants to fund their research projects. *Focus* takes a revealing look at what they're researching and why.

By Lynnette Aldridge Struntz

Can math predict seabird behavior? How might color lead scientists to new ways of fighting deadly bacteria? Teachers and students at Andrews University are working together to find answers to these and many other questions. And government and research foundations are providing the means to help them make discoveries and probe other questions.

In the last six months Andrews has received more than 1.2 million dollars in grant awards to further important research by a number of professors in a variety of fields and to support innovative education in the sciences. "It's kind of a new day to get this much support over such a short time period. We are excited, to say the least," says Dr. John Stout, dean of research at Andrews. A large percentage of the funds provided to the faculty members by these new grants supports undergraduate and graduate students, involved with them in the research. Undergraduates do not have many opportunities at universities to be involved in research. Andrews is endeavoring to change that. "Students may have the opportunity to coauthor papers even before they graduate. That's rare for undergraduates", says Pat Mutch, academic vice president at Andrews. "And it's a terrific asset when students try to apply into top graduate and medical schools. We're pleased we can offer this experience to them."

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For years Andrews has placed an emphasis on its professors conducting research. The university supports faculty research and creative scholarship through its Office of Scholarly Research led by the Dean of Research. Each year, through this office, funds are allocated from the university's budget to assist professors with their creative scholarship and research and support students working with them. Discoveries and preliminary results made during this research process help catch the eye of different government and research foundations that award grants. Most of these new grants grew out of research supported in this way. The new grants enable professors to extend their research, purchase necessary equipment and provide even greater student involvement. The professors' dedication in pursuing and obtaining these grants also enriches the university by enabling more resources, courses and programs to be available to students.

"These sponsored grants from the government and research foundations are indicative that Andrews is maturing as a serious education center," says Niels-Erik Andreasen, Andrews University president. "Faculty who teach here push out the frontiers of knowledge and draw students into a more intense learning experience."

These grants give undergraduates of Andrews a head start into work they may do on the graduate level. It gets them involved in the research process while they are seeking their degrees.

It's a great honor for Andrews to receive grant awards that universities throughout the nation compete for. By receiving these grants the university has an opportunity to step out as a leader in different research communities. "It's a very competitive process," Mutch says. "The fact that Andrews has the ability to compete at a national basis for grant awards is a testimony of the quality work being done here. We are very proud of our professors and students."

Professor Shandelle Henson and senior gulls on Protection Island, Wash.

Although professors and students are conducting research in many departments at Andrews University, the following are projects that have received awarded grants since this past summer.

Seabird Ecology Team Predicts Animal Behavior

Dr. James Hayward, professor of biology, and Dr. Shandelle Henson, associate professor of mathematics, with their team of students and consultants, are creating mathematical models that predict how many seabirds and sea mammals will be in a specific habitat at a specific time. This is particularly important because of recent habitat losses due to human encroachment. Wildlife managers need to be able to predict the movements of animals so they can make appropriate decisions regarding remaining habitats.

"Our models predict habitat occupancy in a seabird colony," Henson

says. "This means I can sit in my office at Andrews and predict how many seabirds are going to be in a certain habitat at a certain hour next summer."

Hayward and his colleagues have worked on the behavioral ecology of seabirds since the early 1970s. "Now with the benefit of input from a mathematician," he notes, "our research is at the cutting edge of science. The prospects are exciting."

Students also express excitement about the Seabird Ecology Team, as it's now called.

"It's awesome to be studying in an area where the books haven't been written yet," says Clara Logan, a senior mathematics major and member of the team. "You don't have a textbook as an authority saying this is how to do it. It's more like writing your own textbook as you go along."

Once each week the team meets together for an hour. Research students go up to the board one at a time and explain what progress they've made and what problems they've run into. Then they get feedback from the rest of the group to keep them going. "This is a real team effort and lots of fun," says Henson. "It's also a tremendous opportunity for our students. It gives them a taste of research and helps them get into top PhD programs. Quite a few student team members will go into research mathematics or research biology; I'm really proud of them. We have many outstanding students at Andrews."

Clara Logan count

The National Science Foundation, through a grant to Andrews University, has awarded the Seabird Ecology Team $304,000 to further their research. The funding opens new doors for the team. It has allowed them to expand their research, purchase fast research computers and software to perform computer simulations of mathematical models, provide financial assistance to team members, and offer extra courses to their students. These courses help the students better understand how to carry out interdisciplinary research. Two calculus courses and a mathematical modeling course are specifically designed for biology majors to learn how to use mathematics to solve biological problems.

The Seabird Ecology Team provides a collaborative interdisciplinary learning environment for everyone: mathematics, chemistry, and biology students all work together and help one another. The team is highly active in publication and speaking engagements. Henson and Hayward speak around the country at professional conferences, sharing the results of their research. Already successful at predicting the movements of animals in one habitat on Protection Island National Wildlife Refuge, Strait of Juan de Fuca, Washington, the Seabird Ecology Team is now working on models that predict the movements of the animals among several habitats on the island.

Genetically Engineered Bacteria May Fight Weeds

The United States Department of Agriculture, through a grant to Andrews, has awarded Dr. Robert Zdor, associate professor of biology, more than $65,000 to further his research on a type of soil bacteria that has the ability to live around plant roots. Zdor discovered that by applying a certain type of soil bacteria around velvetleaf, a common weed often found in cornfields, the plant is harmed and growth is reduced. This type of soil bacteria also produces the toxic gas cyanide. Zdor is looking at the genetic basis for cyanide production and is going to test whether or not the cyanide is important in how the bacteria interacts with plants.

"The idea is, if cyanide is important in this interaction, and if we can optimize the cyanide production, then maybe we can optimize the harmful effect of the bacteria on the plant," Zdor explains. The first phase of the project involves constructing genetically engineered bacteria to be used in the soil. Once the genetically engineered bacteria are constructed, undergraduate students will be involved in applying the bacteria to the soil and then studying how they behave.

"It is beneficial for students to see how a science actually operates because they learn that science isn't necessarily a smoothly oiled machine. There are hurdles and things that don't work," says Zdor. "It causes them to brainstorm and problem-solve, plus it allows them to develop their creativity in terms of thinking through how to do something so they have a meaningful outcome."

The grant provides funds for purchasing new equipment, assisting undergraduates involved in the project, and presenting the findings in journals and at conferences.

Zdor hopes his research will lead to a new method of fighting weeds using a biologically based, as opposed to a chemically based, weed control.

Serendipity and Opportunity: A Tale of Unusual Colors

Dr. Desmond Murray, assistant professor of chemistry, recently received a $248,500 National Science Foundation (NSF) grant and a $50,000 American Chemical Society (ACS) grant to study boronic acid substituted flavonoids. This research branched off from a discovery made by an Andrews clinical laboratory science major three years ago who was experimenting with chalcones under Murray's supervision. Chalcones, which belong to a class of plant pigments called flavonoids, have previously been known to have a wide range of biological activity. However, the student found that only one of the 20 chalcones she prepared inhibited growth of the bacterium *Staphylococcus aureus*. Particular strains of this bacterium are becoming increasingly drug-resistant and are leading to hospital-acquired infections that cause complications like blood and bone infections and infections of the heart and valves that lead to toxic-shock syndrome and death. The chalcone that inhibited this bacterium contained a boronic-acid group.

Purple chalcone

The next year a freshman biology major approached Murray about wanting to do research. He decided she should focus on boronic acid-substituted chalcones. While engaged in this research they unexpectedly made a purple chalcone. "This was highly irregular," Murray says, "since both natural and synthetic chalcones are generally yellow to orange in color." This unique chalcone color fascinated them and they continued to pursue making other colored chalcones.

"By applying chemical principles to the gift of serendipity, we were able to make blue and green chalcones," Murray says. They also discovered these chalcones undergo dramatic color changes in the presence of certain molecules or solvents. These preliminary results were submitted to and piqued the interest of ACS and NSF and led to the two grant awards.

A significant part of the grant money will be used to buy new equipment, including a new $70,000 UV-Vis-NIR instrument, computational chemistry software and new computers that will help determine more detailed color characteristics of these chalcones. The software will allow them to investigate flavonoid systems that are difficult to prepare in the lab. The equipment will also be a great addition to the department and will be an asset to the other professors in their classes and research. Grant money will also provide assistance to undergraduates involved in the research.

"This is a great opportunity for undergraduates to develop laboratory and research skills while working on new and exciting research," Murray says. "This class of compounds has never been systematically made and studied before, so the students are working at the cutting edge of their field. Students will also benefit by coauthoring publications arising from the research. I credit two Andrews undergraduates, Michelle Miller and Teresa Han, and a Benton Harbor high-school student, TaMira Jennings, for significant contributions to this research."

Murray anticipates that extending the chalcone work to other classes of flavonoids can potentially lead to applications in molecular sensing, antimicrobials and new functional materials.

Virtual Realities May Create Better Teachers

The United States Department of Education recently awarded five universities with an $899,000 grant to strengthen the instruction of special-education teachers. Andrews received more than $116,000 of the total grant award. Dr. Candice Hollingsead, associate professor of teacher education, is working on this collaborative project with four other universities to implement new methods of teaching special-education teachers through virtual-reality case-based instruction and then evaluate its effectiveness in an effort to create a new instruction model.

Using CDs with video clips that show 10 actual special-education child cases, teachers can test and strengthen their skills in a realistic environment. These CDs were created during the two previous stages of this project. The final phase, which Andrews is involved with, incorporates these elements into the teaching instruction of special-education teachers, records how the special-education teachers interact with these elements, and then evaluates the effectiveness by how the teachers incorporate learning in their own classrooms.

"We usually teach method classes using simulations like role-playing to show how to interact and help teach children with special needs," Hollingsead says. "But with this virtual-reality case-based instruction, special-education teachers don't have to role-play or pretend they are the psychologist, principal, parents or social worker; they actually get to see and hear the real specialists talking about each actual child. This enables our teachers to become proficient in their skills in a 'practice field' first."

At Andrews, this virtual-reality case-based instruction will be implemented in special-education master's degree classes. Andrews will also help Benton Harbor area schools integrate this instruction in their teacher in-services. Although the other four universities involved in this project will also be implementing this instruction in their schools, Andrews is unique because it is the only university that is also helping integrate this instruction through the in-service setting. These results will be a vital component to the research project.

After the instruction is implemented in Andrews University and Benton Harbor schools, two Andrews' graduate students funded by the grant will track the teachers, collecting data about how they used and integrated the knowledge and tools gleaned from the virtual-reality case-based instruction in their own classrooms. The graduate students will also assist in analysis of the collected data.

The Science Complex at Andrews University

"We want to see how using these real cases affect teachers in perceiving, teaching and relating to their students in special ed in an effort to provide better methods for special-education teacher instruction," Hollingsead says.

The goal of the project is to develop a new special-education teaching theory model that can be used for national emulation.

Transformational Learning Paves the Way for New Opportunities

Graduates of Andrews' biology department are unusually successful compared to the national average. The facts speak for themselves: Eighty-five percent of these graduates who apply to medical school are accepted, which is nearly double the national average. And students who graduate from the biology program, on average, score above the 90th percentile on national exit exams.

These percentages are substantially higher than would be predicted based on students' grades and SAT or ACT scores from high school, which suggests that Andrews' biology program is transformational for students. But which components in the biology program are most effective in promoting the high success of Andrews biology graduates? Dr. John Stout, dean of research, with his core team of Dr. Gordon Atkins, associate professor of biology, Dr. Shandelle Henson, associate professor of mathematics, and Dr. Duane McBride, behavioral sciences department chair, are working to find out. And the National Science Foundation is giving them the funding to do it.

The NSA has awarded Andrews a $490,600 educational grant to help the team develop a successful new undergraduate program in Behavioral Neuroscience modeled on the very successful biology program. The new program will result from collaboration between the biology, behavioral science and mathematics departments. It is designed to give students exceptional backgrounds in understanding and evaluating human or animal behavior based on the latest advances in understanding the brain and its control of behavior.

At the same time Stout and his team will carefully track each element of this new program. The results will help determine the factors that underlie the transformation of students to achieving higher levels of success than would be predicted by their entry scores. The National Science Foundation believes that the teaching model that develops from this study can be adapted for use in other disciplines or situations and provide a model for national emulation.

But it's the students at Andrews who benefit the most. The grant provides money to create this new interdisciplinary program at Andrews. It will provide new courses at Andrews, sophisticated equipment, many research opportunities for undergraduates in this discipline and give the students another choice when deciding their field of study. "Behavioral neuroscience is an area that's really growing nationally and provides tremendous opportunities", Stout says. "Our interdisciplinary program will open opportunities to successfully enter this field or go on for advanced training programs in psychology, the neurosciences or medicine. We are really excited that we can offer this great program to our students."

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