

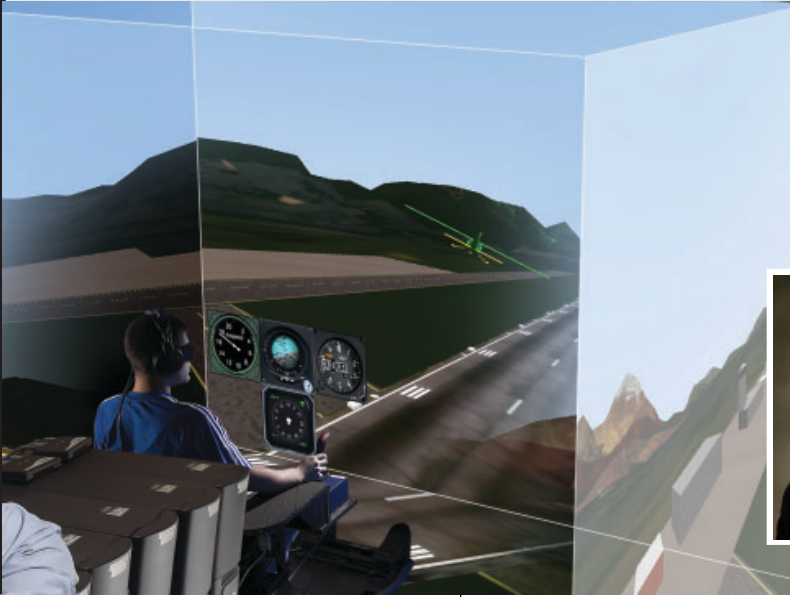
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S O A R I N G   T O   N E W   H E I G H T S

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# Message from the Vice President for Research



Dear Colleagues:

On behalf of Wright State University and the Office of Research and Sponsored Programs, it is a pleasure for me to present this report of research activities for the fiscal year 2002–03 (July 1, 2002, to June 30, 2003). In this booklet, we've tried to combine current successes with some funding history to give our readers a perspective on the steady and significant rise in Wright State University's external funding.

Research plays a key role in the mission of Wright State University. Cutting-edge research undergirds the excellence of our educational programs and enhances the reputation of Wright State University in the community and nationally. It contributes to the economic growth of our region and state. It also allows us to work on problems that are of crucial importance to federal government agencies, particularly the National Institutes of Health and the Department of Defense.

This year our annual report focuses on the various ways that Wright State researchers help the Air Force accomplish its mission, either directly through partnerships with Wright-Patterson Air Force Base or indirectly by means of agreements with local subcontractors.

We are proud of the accomplishments of Wright State University and welcome your comments or requests for further information.

Joseph F. Thomas, Jr.  
Vice President for Research and  
Dean, School of Graduate Studies



**Groundbreaking ceremony for Allyn Hall, first Wright State building, May 31, 1963.** From left: Novice G. Fawcett, president, Ohio State University; John D. Millett, president, Miami University; Major General T. A. Bennett, U.S. Air Force Logistics Command; Robert S. Oelman, chair, NCR Corporation; Stanley C. Allyn, retired chair, NCR Corporation; and Frederick A. White, campus business manager.



## Collaborative Projects

**The Air Force Research Laboratory (AFRL)** serves as the Air Force's primary arm for science and technology development. Over the past five years, Wright State has received over \$5 million to conduct research for AFRL, which houses five of its ten directorates on the base: Air Vehicles, Human Effectiveness, Propulsion, Materials and Manufacturing, and Sensors.

**The Wright Center of Innovation for Advanced Data Management and Analysis** is a historic partnership in which Wright State will serve as the lead institution in a \$43 million information technology initiative. A key component of Gov. Robert Taft's Third Frontier program, the center is expected to support over 500 jobs and \$65 million in research over the next three years, positioning Ohio as an international leader in data management innovation. Other partners include Wright-Patterson Air Force Base, Reynolds & Reynolds, LexisNexis, NCR, EDS, Standard Register, Procter & Gamble, as well as other business and education leaders.

**Dayton Area Graduate Studies Institute (DAGSI)** is a consortium of graduate engineering schools—including the Air Force Institute of Technology and Wright State University—that integrates and leverages combined resources to offer advanced engineering courses and conduct research in aerospace, automotive, and other high-technology sectors. Over the past five years, DAGSI has awarded over \$4 million to WSU researchers. Recently, DAGSI and AFRL entered into an agreement to conduct basic research in aerospace technologies of interest to the Air Force and State of Ohio.

**The Wright Brothers Institute** is a new research and development partnership between Wright-Patterson Air Force Base and regional universities and aerospace companies. The institute has contracted with Wright State to lead a \$1.3 million research initiative in terabyte database mining. Under the title Secure Knowledge Management, the project seeks to develop software programs that can be used to manage large volumes of data deemed vital to national security.





# Wright State University/Wright-Patterson Air Force Base Connection



Allyn Hall was built on land donated by WPAFB.

The groundwork establishing Wright State University was first laid in 1961, when Dayton was the second largest metropolitan area in Ohio that had no public higher education facility. True visionaries, Wright State's founders realized that research and technology would become the catalyst to fuel Dayton's economic engine of the future. Having a local, state-assisted university would not only link the community to the knowledge needed to create jobs for the new economy, it would also provide the highly skilled workers needed to work them.

So it's not surprising that among the earliest and most ardent supporters of building a state university were officials from Wright-Patterson Air Force Base (WPAFB), the foremost aeronautical research and development center in the Air Force and the area's largest single employer.

They knew that having a state university close by would help retain and attract top scientific personnel, provide a pool of faculty and graduate students to collaborate on defense research, offer easy access for base personnel to pursue advanced studies, and provide a direct line to a pool of highly skilled college graduates.

To ensure that the new university would be located in close proximity to the base, WPAFB officials decided to donate 190 acres to the project.

Now, 40 years after ground was broken for Wright State's first building, the collaboration has proven to be a win-win relationship, for the university, the base, and the Dayton community, which today boasts an aerospace economy exceeding \$2.4 billion annually.

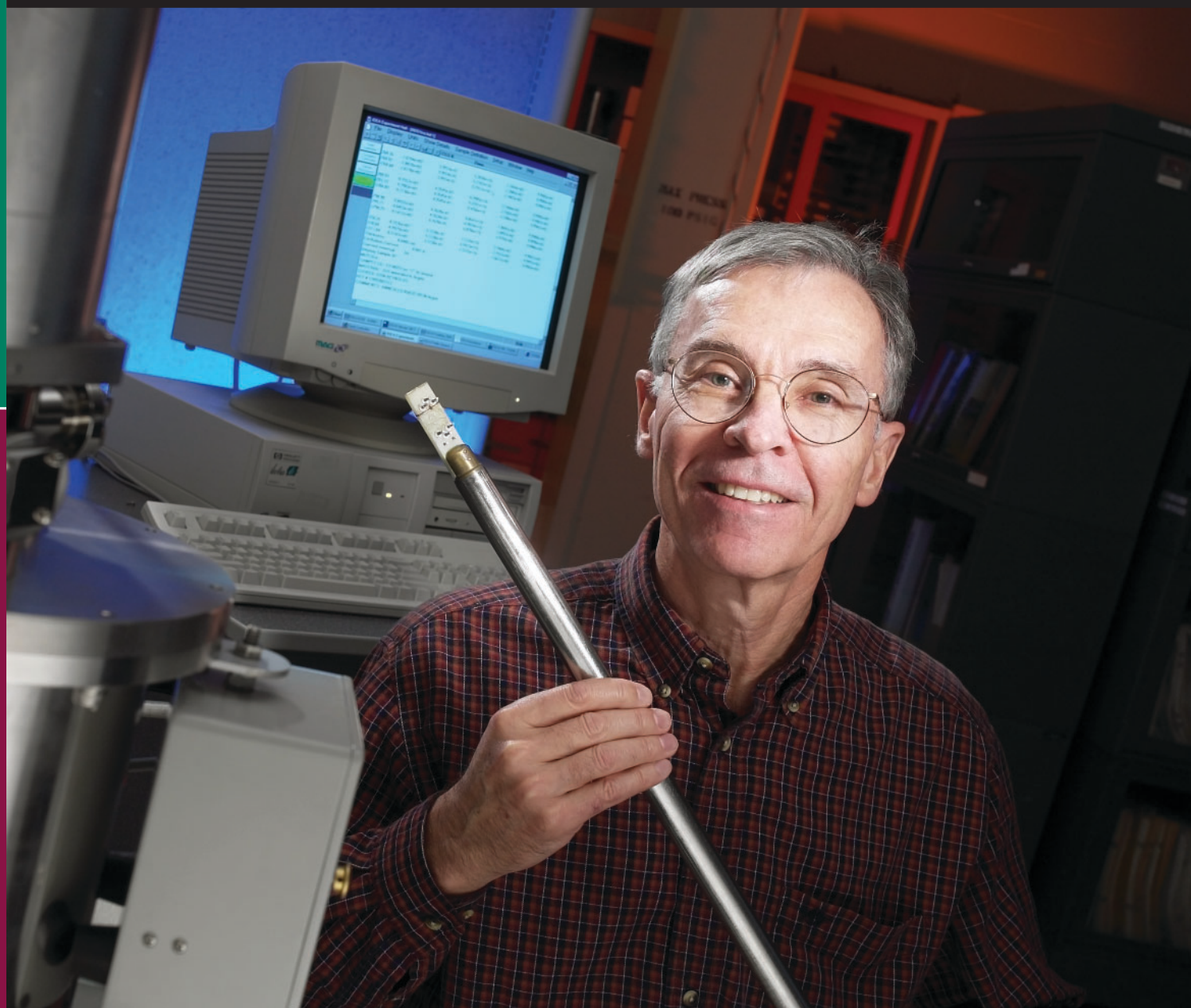
Through innovative educational and research partnership agreements, WSU faculty and graduate students have joint access to the base's advanced laboratories and high-tech facilities, provide the intellectual capital that undergirds the application-based focus of military research, and engage in unique collaborations that help leverage additional dollars for both military and university research projects.

Just this past year alone, the Wright State/WPAFB partnership has generated research on topics ranging from groundwater treatment methods, industrial waste sampling, cell dynamics, and semiconductor materials to pilot performance, automatic target recognition, and virtual environment training.

"The collaborative spirit between Wright State and Wright-Patterson Air Force Base serves as a model for how federal and community partners can benefit from shared investments and efforts," says Jay Thomas, vice president for research and dean, School of Graduate Studies. "Through innovative partnerships, knowledge is created and technological breakthroughs are achieved, putting our region and Ohio at the center of innovation and economic opportunity."



## A Brave New World of Semiconductors



The work of Research Professor David Look may just be the stuff of science fiction. As director of WSU's Semiconductor Research Center, he and his team of scientists are working on a brave new world of semiconductor materials that will take the electronic chip where none has gone before: in a light bulb that can burn for 100,000 hours; an electronic billboard display that can dazzle on even the sunniest day; or for use in that holy grail of electronics research—the blue laser.

Established in 1980, the center is a collaboration between Wright State and Wright-Patterson Air Force Base (WPAFB), a major center of research and development for the Air Force. In May 2000, WPAFB announced a five-year, \$8.7 million contract with the center to continue researching semiconductor materials for use in electronic devices such as high-speed radar and computer chips that can withstand everything from cosmic rays and radiation to the 7,000 degrees inside a jet engine.

Although silicon is still the workhorse of the electronic chip industry, finding more versatile semiconductor materials is essential in the growing information/electronics age, adds Look.

"Gallium nitride has become the focus of semiconductor research around the world in the past five years," he says. "Gallium nitride is now a billion-dollar-a-year industry and is used in automobile dashboard displays, airplane lighting, and Las Vegas billboards."

At the center, approximately 60 percent of the research focuses on gallium nitride while the other 40 percent has moved into the relatively unexplored territory of zinc oxide, a crystalline form of the same compound found in sunscreens and paint.

"There is a rush of activity around the world to develop zinc oxide applications," says Look. "Zinc oxide can fundamentally be a better lasing material or a faster transistor than gallium nitride. And zinc oxide is cheaper. However, first some basic research issues involving impurities and defects in the material must be solved."

The center is attracting worldwide interest in zinc oxide research, collaborating with Eagle Picher Corporation in developing the world's first large zinc oxide crystals. In 1999 and 2002, researchers from around the world and leading corporations and universities came to Wright State for the world's only international workshop on the development of new materials using zinc oxide.

"Throughout the international scientific community, Dayton and Wright State are known as the place where the international collaboration on zinc oxide began and where it is making breakthroughs today," explains Look.



## Making Airplanes Safer to Fly



**S**tudies show that spatial disorientation (SD)—a phenomenon in which a pilot’s perception of the aircraft’s position and motion relative to the earth’s surface—is the leading cause of aircraft mishaps, both in the civilian and military sectors.

“It’s something that can happen to even highly experienced pilots,” says Professor of Industrial and Human Factors Engineering Jennie Gallimore, Ph.D. An expert on pilot sensory reflexes and visual illusions in flight, Gallimore’s research centers on designing advanced cockpit displays, including displays that are mounted on a pilot’s head.

“The challenge is to design better ‘people-oriented’ displays as new and more complex technology is introduced in the cockpit,” she says.

Gallimore has worked extensively with the military on the subject, including a year’s sabbatical in 1999 at Wright-Patterson Air Force Base (WPAFB) and the Naval Aeromedical Research Lab in Pensacola, Florida.

Gallimore’s research springs from a physiological reflex discovered through previous WSU research, the Opto-Kinetic-Cervical Reflex (OKCR), an involuntary head movement pilots make to keep oriented to the horizon when flying under visual conditions. When they must switch to instruments, their frame of reference changes. As a result, this transition—from looking outside the aircraft to looking at displays inside the cockpit—makes the pilots prone to control reversal errors.

Author of four papers on OKCR, Gallimore just finished a \$128,000 Dayton Area Graduate Studies Institute research project with the Air Force Research Laboratory at WPAFB. The aim was to see if the electroencephalogram (EEG) could be used to detect the early onset of spatial disorientation. It is the first such study of brainwave patterns in relationship to the onset of SD.

“Many times, the pilot isn’t aware that there is a problem. The idea is that if SD could somehow be reliably detected very early, then perhaps some type of automatic countermeasure or protective action could be initiated, such as an autopilot taking control of the aircraft until the pilot recovered.”

A total of 11 experienced pilots were tested in motion-based flight simulators. And while more research still needs to be done, it was found that the EEG could be a powerful tool for better understanding SD and for determining if new displays or training programs will decrease SD problems.

“The goal of human factors engineers is to develop systems that help people. Our goal is to make airplanes safer to fly.”

Gallimore’s other areas of interest include human performance in virtual environments, medical systems, and designing systems for ground-operated uninhabited combat aerial vehicles.



## Improving Jet Engines





**T**he jet engine is a fascinating mechanical device, especially for Wright State University Research Scientist Mitch Wolff.

As a professor of mechanical and materials engineering in the Wright State College of Engineering and Computer Science, he is interested in improving the durability and efficiency of jet engines.

"My primary research involves mechanical engineering, and particularly thermal sciences and fluid mechanics. I am interested in the flow physics inside a jet engine," he explains. "My goal is to help make jet engines more durable and perform more efficiently. If we can develop a higher thrust-to-weight ratio, we can reduce the size of the engine while producing more thrust, but this must be accomplished in a safe and durable manner."

Wolff works closely in this research with scientists at Wright-Patterson Air Force Base, especially the Compressor Aero Research Laboratory and the Turbine Research Facility. "Wright-Patt has one of the largest Air Force research labs in the world," says Wolff, who joined the WSU engineering faculty eight years ago.

His affiliation with the Air Force started years earlier when he saw an advertisement in an engineering magazine for the Air Force Research in Aero-Propulsion Technology fellowship. Wolff applied, was accepted, and the rest is history. Along the way he has earned B.S., M.S., and Ph.D. degrees in mechanical engineering from Purdue and worked as a research engineer in the private sector.

As an example of his shared research with the Air Force, the Wright State engineer said he has received some \$2.8 million in research funding over the last eight years, and \$2.2 million of this is for collaborative research with the base. This includes a design contract in 1999 with the Air Force Research Lab (AFRL) Propulsion Directorate for nearly \$600,000. It was subsequently renewed for

three more years and \$300,000.

In addition, Wolff recently was awarded a \$650,000 project by the AFRL Air Vehicles Directorate and is now working with Air Force scientists on external aerodynamics for high-speed flow.

To accomplish these tasks, Wolff looks considerably into the future with his basic research projects. "We want to determine how jet planes respond through the air at Mach 10 speed, which is 10 times the speed of sound, or 7,000 miles per hour. This is fundamental basic research which is at least a dozen years away because the fastest jets have only gone to Mach 3, or 2,100 miles per hour."

To help with his fluid mechanics research, Wolff has developed a Beowulf Cluster, a series of computers that functions like a supercomputer and allows scientists to validate improvements in the jet engine computer models they develop. "This work involves computational fluid dynamics, which solves the equations that govern the physics of fluid flow in the jet engines or around the air frame of the planes." He started a computational fluid dynamics lab at Wright State in 1999, which has grown and evolved to the 64-processor Beowulf Cluster.

Wolff teaches undergraduates and graduates in computational fluid dynamics and fluid mechanics. He also collaborates with the Dayton Area Graduate Studies Institute in his research pursuits and has participated as a visiting scientist in the Air Force summer program with the Aero Propulsion & Power Directorate, Compressor Aero Research Laboratory, and Air Vehicles Directorate.

He is currently serving on a National Research Council Review Panel of NASA's Aeronautics Research Programs. He also represents the U.S. as a scientific committee member for both the International Society of Air Breathing Engines and the International Symposium of Transport Phenomena and Dynamics of Rotating Machinery.



**H u m a n   P e r f o r m a n c e   i n   V i r t u a l   S e t t i n g s**

**S**tep inside the darkened 10 x 10 x 10 foot cube and put on the 3-D glasses and stereophonic headphones. The high-resolution, 360° three-dimensional video and audio displays can put you in the pilot's seat of an F-16 flying at Mach 2 speed over a desert landscape or inside a protein molecule, exploring its matrix-like atomic structure.

The CAVE® is a virtual environment generator located in the Air Force Research Laboratory at Wright-Patterson Air Force Base (WPAFB), where Robert Gilkey, Ph.D., is leading a team of scientists conducting leading-edge research in the sensory, motor, and cognitive underpinnings of human performance in synthetic environments. The research has the potential to change the way pilots are trained, military missions are planned, surgery is performed, global business is conducted, and even how war is fought.

"Often, basic research findings discovered in a laboratory don't translate directly into real-world settings," explains Gilkey, associate professor of psychology and director of Wright State's Virtual Environment Research, Interactive Technology, And Simulation (VERITAS) facility, which houses the CAVE®. "The goal is to create a virtual presence where you feel as if you're actually in the environment, interacting with it and manipulating it, rather than just watching. It's the ultimate prototyping environment."

Innovations like 'forced-feedback controls' let the operator "feel" the texture and weight of an object. Such technology helps recreate real-life scenarios to test new cockpit displays, plan and practice military missions,

design and test ground controls for uninhabited aerial vehicles, and develop telerobotic technology to repair satellites in space, to name just a few.

The research can even change the nature of the battlefield itself. Explains Gilkey, "the battlespace is being revolutionized by advances in information technology. Future warfighters will engage in 'network centric' warfare, where they can obtain information at will from sources all over the world. We need to design new interface strategies to make this workable."

Wright State is the lead research partner in the VERITAS facility, created in 1995 with a \$1.6 million award from the Ohio Board of Regents (OBR) to study human-computer interaction. Current research partners are The Ohio State University, the Air Force Institute of Technology, and the Ohio Supercomputer Center.

In 2002, Wright State was again named the lead institution in an OBR \$800,000 Hayes Investment Award to upgrade the VERITAS facility, modernize its equipment, and add seven new virtual work environments in Dayton and Columbus. The project will also explore the potential of Internet 2—an advanced, high-speed network linking research universities, government, and industry—to promote and enhance scientific research and collaboration.

Gilkey has a longstanding research relationship with WPAFB. An expert on how the brain processes auditory information, Gilkey centers his research at the base on designing displays that help pilots more accurately process auditory cues in the cockpit.



## Funding Highlights

### for Awards over \$400,000



#### **Robert E. W. Fyffe**

Anatomy, School of Medicine

#### **Oscar N. Garcia**

Computer Science and Engineering, College of Engineering and Computer Science

#### ***Genome Research***

#### ***Infrastructure Partnership***

Abstract: This Biomedical Research and Technology Transfer (BRTT) Partnership Award proposal, involving WSU, the University of Cincinnati, and several other partners, is used to support, expand, and commercialize the services of a Genome Research Infrastructure Partnership (GRIP) that will take advantage of the opportunities presented by the Human Genome Project revolution.

\$1,497,654

Biomedical Research and Technology Transfer Commission, via University of Cincinnati

#### **Nikolaos G. Bourbakis**

Information Technology Research Institute (ITRI), College of Engineering and Computer Science

#### ***Secure Knowledge Management***

Abstract: Wright State University leads a consortium of regional institutions to conduct core research in critical areas of terabyte database mining.

\$1,300,327

Wright Brothers Institute, Inc.



**Roger M. Siervogel,  
W. Cameron  
Chumlea, Shumei S.  
Sun, Bradford  
Towne, Stefan  
Aleksander  
Czerwinski, and  
Ellen W. Demerath**

Community Health,  
School of Medicine

**Richard C. Rapp**

Community Health,  
School of Medicine



***Subcutaneous Fat, Blood  
Lipids, and Subsequent  
Outcome***

Abstract: The long-term project focuses on the serial analyses of body composition, fat-related variables, and risk factors for growth, development, and disease (the Fels Longitudinal Study).

\$1,194,991

National Institute of  
Child Health and  
Human Develop-  
ment (NICHD)

***Reclaiming Futures:  
Montgomery County***

Abstract: This project examines the existing youth services delivery system—juvenile court, substance abuse treatment, and social services and also seeks to create a complementary system based on strengths-oriented practice, natural helpers, and restorative justice activities.

\$1,000,000

Robert Wood Johnson  
Foundation



**Roger M. Siervogel,  
Stefan Aleksander  
Czerwinski,  
Bradford Towne, W.  
Cameron Chumlea,  
and Ellen W.  
Demerath**

Community Health,  
School of Medicine

***Genetic Epidemiology of  
CVD Risk Factors***

Abstract: This grant is part of a collaborative effort directed toward elucidating the role of genetic factors that may influence risk of cardiovascular disease (CVD) and to ultimately identify specific genes influencing the age-related progression of CVD risks.

\$893,520  
National Heart, Lung,  
and Blood Institute  
(NHLBI)

**Harvey A. Siegal  
and Richard C.  
Rapp**

Community Health,  
School of Medicine

***Reducing Barriers to Drug  
Abuse Treatment Services***

Abstract: These researchers will explore through a case management model, the barriers, real and perceived, to successful follow-up substance abuse treatment(s) and how these barriers may be minimized.

\$782,879  
National Institute on  
Drug Abuse (NIDA)





**Robert H. Gilkey**

Psychology, College  
of Science and  
Mathematics

***State-of-the-Art Infrastructure to Support Ohio Research in Advanced Internet Utilization, Simulation, and Telerobotics***

Abstract: Funding is used to upgrade and expand aging computer, projection, and interface hardware to provide state-of-the-art capability at the Virtual Environment Research, Interactive Technology, and Simulation (VERITAS) facility and build three state-of-the-art virtual environment workstations at Ohio State, Air Force Institute of Technology, and the Ohio Supercomputer Center.

\$660,789

Ohio Board of Regents—Hayes Investment Fund

**Katherine L. Cauley**

Community Health,  
School of Medicine

***HealthLink Miami Valley Network***

Abstract: The HealthLink Miami Valley Initiative goals include developing an integrated electronic management information system to identify community members without appropriate health care, a community-wide network of health and human services providers to serve as HLMV Portal Agencies, articulating the roles and responsibilities of Network members, and expanding the existing structure to improve communication.

\$655,436

Health Resources and Services Administration



**Harvey A. Siegal,  
Russel S. Falck,  
Robert G. Carlson,  
and Jichuan Wang**

Community Health,  
School of Medicine

***Crack and Health Service  
Use: A Natural History  
Approach***

Abstract: The project team will continue to obtain longitudinal data from the original sample population regarding crack-cocaine use and health services utilization, primarily drug abuse treatment, and to assess the feasibility of extending the study to adolescent crack-cocaine users.

\$605,390  
National Institute on  
Drug Abuse (NIDA)

**Roger K. Gilpin,  
Thomas O. Tiernan,  
Joseph G. Solch,  
Garrett F. VanNess,  
and John H. Garrett**

College of Science  
and Mathematics

**G. Allen Burton**

Institute for Environ-  
mental Quality

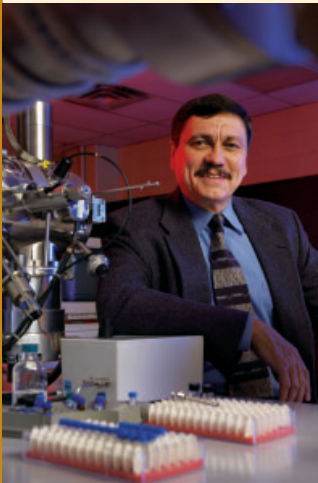
**Robert W. Ritz, Jr.**

Geological Sciences

***Consortium for Environmen-  
tal and Process Technologies***

Abstract: The Consortium for Environmental and Process Technologies provides state-of-the-art measurement capabilities and serve as a focal point for research related to all aspects of monitoring, evaluation, and remediation of dioxin and dioxin-like agents.

\$600,000  
Ohio Board of Regents  
—Hayes Investment  
Fund







**Stanley R. Mohler**

Community Health,  
School of Medicine

**Robert G. Carlson  
and Harvey A.  
Siegal**

Community Health,  
School of Medicine



**Harvey A. Siegal**

Community Health,  
School of Medicine

***Aerospace Medicine Resi-  
dency Program***

Abstract: This grant provides continued support for the training of residents in Aerospace Medicine.

***MDMA/Club Drug Use and  
STD/HIV Sex Risk Behavior in  
Ohio***

Abstract: Funds are used to initiate a longitudinal epidemiologic study of methylenedioxymethamphetamine (MDMA) and other "club drug" users relative to their drug use and their "high-risk" behaviors.

***Crack Cocaine and Health  
Services Use in Rural Ohio***

Abstract: Dr. Siegal has received continued funding to conduct health services research among small town and rural crack users in four non-metropolitan counties in west-central Ohio.

\$600,000

National Aeronautics  
and Space Adminis-  
tration

\$572,979

National Institute on  
Drug Abuse (NIDA)

\$565,173

National Institute on  
Drug Abuse (NIDA)



# A w a r d s

**Table 1 Awards by Major Funding Source FY03**



## Major Funding Source

- Federal Agencies
- State Agencies
- Industry/Business
- Other Government Agencies
- Non-Profits
- Educational Institutions
- Foreign Sponsors
- Miscellaneous

## Number of Awards

## Amount Awarded

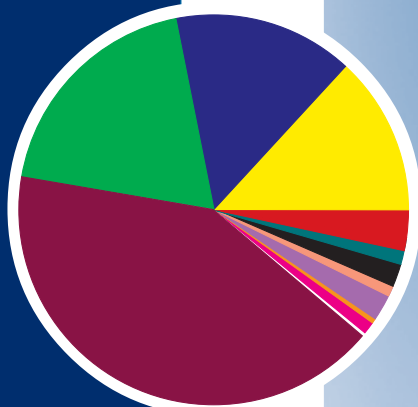
129	\$19,500,720
72	\$13,179,878
161	\$4,674,130
31	\$1,150,625
55	\$3,385,300
63	\$4,036,452
2	\$5,520
41	\$322,659

**Total**

**554**

**\$46,255,284**

**Table 2 Awards by Campus Area FY03**



## Campus Area

- School of Medicine
- School of Graduate Studies
- College of Science & Mathematics
- College of Engineering & Computer Science
- College of Education & Human Services
- College of Nursing & Health
- University wide/Miscellaneous
- School of Professional Psychology
- College of Liberal Arts
- Student Services
- Raj Soin College of Business
- Lake Campus

## Number of Awards

## Amount Awarded

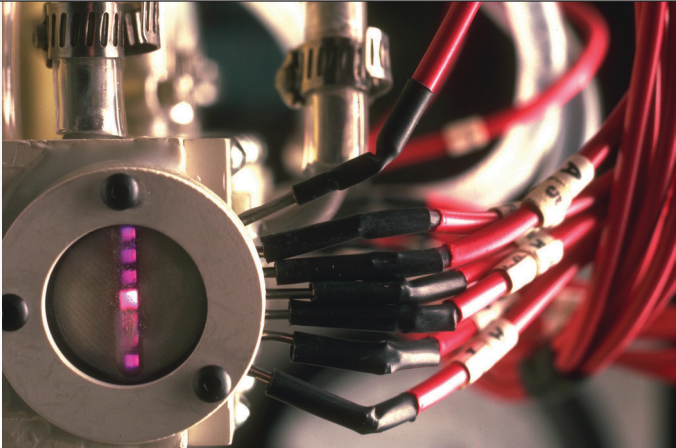
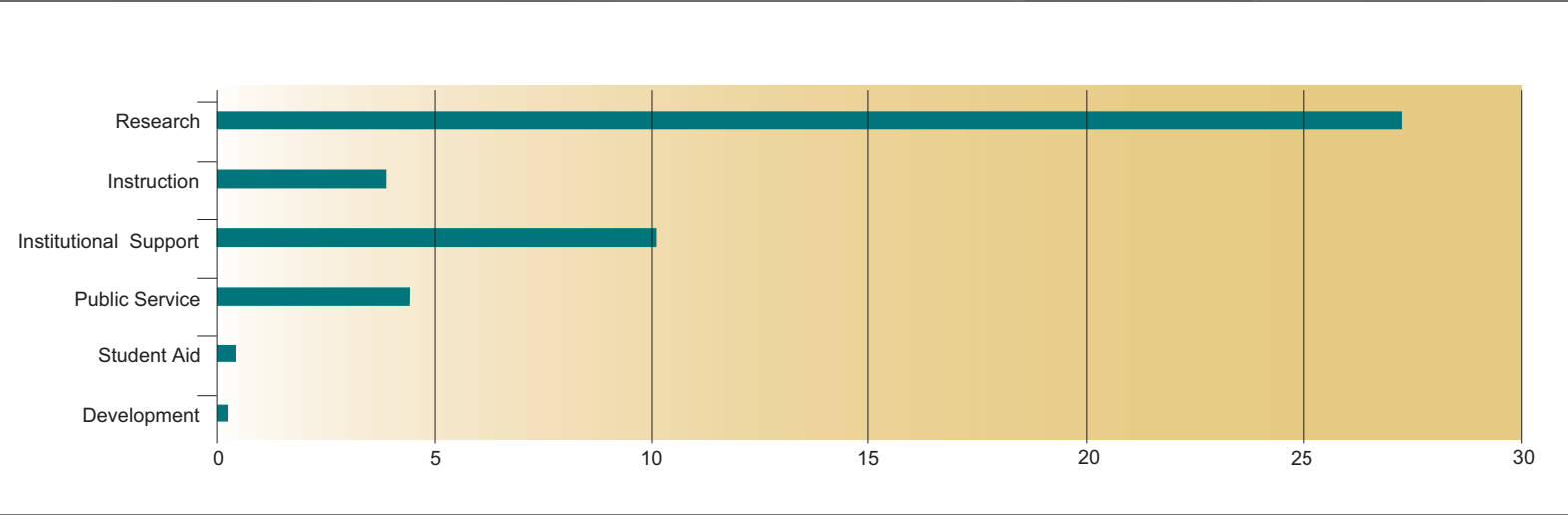
125	\$18,948,426
9	\$7,923,089
175	\$7,156,586
100	\$7,114,072
15	\$1,484,528
7	\$705,663
21	\$453,741
32	\$542,460
39	\$901,880
7	\$362,384
11	\$483,184
13	\$179,271

**Total**

**554**

**\$46,255,284**

Table 3 Awards by Type of Activity FY03		
Type of Activity	Number of Awards	Amount Awarded
Research	332	\$27,559,114
Instruction	69	\$3,289,174
Institutional Support	34	\$10,115,078
Public Service	82	\$4,823,577
Student Aid	15	\$284,786
Development	22	\$183,555
<b>Total</b>	<b>554</b>	<b>\$46,255,284</b>



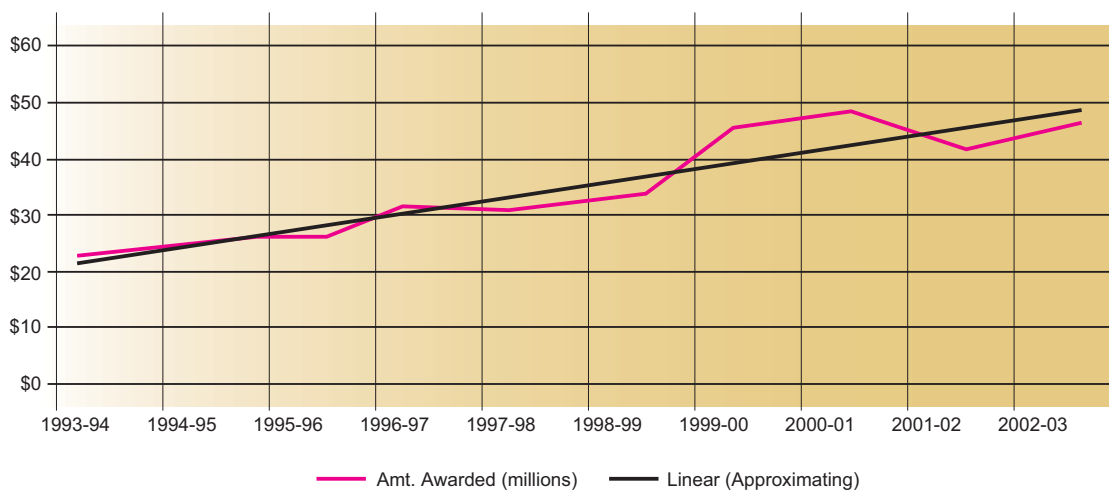


**Table 4**

**Ten Years of Funding: Grant and Contract Awards FY94 to FY03**

<i>Fiscal Year</i>	<i>Number of Awards</i>	<i>Amount Awarded</i>	<i>Increase/Decrease Vs. Prev. Year</i>
1993-94	378	\$22,972,429	
1994-95	439	\$25,207,174	10%
1995-96	457	\$26,104,247	4%
1996-97	535	\$31,336,991	20%
1997-98	462	\$30,283,100	-3%
1998-99	460	\$34,642,162	14%
1999-00	475	\$45,339,049	31%
2000-01	481	\$48,510,950	7%
2001-02	537	\$41,362,186	-15%
2002-03	554	\$46,255,284	12%

**10 Year Trend FY94 tp FY03**







## Office of Research and Sponsored Programs

### **Wright State University**

3640 Colonel Glenn Hwy.  
Dayton, OH 45435-0001  
Telephone: (937) 775-2425  
Fax: (937) 775-3781  
E-mail: [rsp@wright.edu](mailto:rsp@wright.edu)  
On the Web: [www.wright.edu/rsp/](http://www.wright.edu/rsp/)

### **Vice President for Research; Dean, School of Graduate Studies**

Joseph F. Thomas, Jr., Ph.D.  
[jay.thomas@wright.edu](mailto:jay.thomas@wright.edu)

### **Director, Office of Research and Sponsored Programs**

William K. Sellers, Ph.D.  
[william.sellers@wright.edu](mailto:william.sellers@wright.edu)

### **Senior Associate Director**

Eugene P. Hern, Ph.D.  
[eugene.hern@wright.edu](mailto:eugene.hern@wright.edu)

### **Associate Directors**

Ellen Reinsch Friese  
[ellen.friese@wright.edu](mailto:ellen.friese@wright.edu)

Glen Jones  
[glen.jones@wright.edu](mailto:glen.jones@wright.edu)

Isabelle Gorrillot (Technology  
Transfer)  
[isabelle.gorrillot@wright.edu](mailto:isabelle.gorrillot@wright.edu)

### **Assistant Director**

Jackie Frederick  
[jackie.frederick@wright.edu](mailto:jackie.frederick@wright.edu)

### **Senior Grants Management Specialist**

Marianne Shreck  
[marianne.shreck@wright.edu](mailto:marianne.shreck@wright.edu)

### **Grants Accountant**

Sheri Coyle  
[sheri.coyle@wright.edu](mailto:sheri.coyle@wright.edu)

### **Sponsored Programs Assistants**

Robyn James  
[robyn.james@wright.edu](mailto:robyn.james@wright.edu)

Cheryl Nickoson  
[cheryl.nickoson@wright.edu](mailto:cheryl.nickoson@wright.edu)

Christine Piekkola  
[christine.piekkola@wright.edu](mailto:christine.piekkola@wright.edu)

Jan Power  
[rsp@wright.edu](mailto:rsp@wright.edu)

Bonnie Hebert  
[bonnie.hebert@wright.edu](mailto:bonnie.hebert@wright.edu)

S O A R I N G T O N E W H E I G H T S



**WRIGHT STATE**  
**UNIVERSITY**

Office of Research and  
Sponsored Programs  
3640 Col. Glenn Hwy.  
Dayton, OH 45435-0001