Eli Lilly/Guidant Applied Life Science Research Center

2004 Report

ROSE-HULMAN
INSTITUTE OF TECHNOLOGY

Message from the Director

I am pleased to provide you with a copy of the second annual report of the Eli Lilly/Guidant Applied Life Science Research Center at Rose-Hulman Institute of Technology. It is our intent to inform you about the current activities and accomplishments of the Center with this annual report.

At Rose, we are enjoying record enrollments in biology and biomedical engineering, and the inaugural year of the new BS degree program in biomedical engineering was a big success.

Through the generous support of Eli Lilly & Company and Guidant Corporation, Rose faculty and undergraduates have access to funds required to support the work necessary to achieve important educational outcomes such as scientific publications, oral and poster presentations, conference attendance, and networking/exposure that increases and affirms student interest in applied biological research.

For example, two RHIT student presentations won awards at the 2004, 40th Annual Rocky Mountain Bioengineering Symposium student paper competition. This result is representative of our goals at the Center; top Rose-Hulman students doing quality scientific research, publishing their results in regional and national publications and conferences.

Not all of the work supported through the Center will result in refereed publications or award winning posters; nevertheless, larger numbers of students are gaining the opportunity to explore and experience the several career opportunities that may arise from an undergraduate education in applied biology and/or biomedical engineering.

At Rose-Hulman, we believe that high quality education in the life sciences, requires a significant research component. Students are introduced to the scientific method and become excited by the opportunity to create new knowledge. Faculty also benefit from increased opportunities for professional development.

Through this Center, Eli Lilly and Guidant are having a significant impact on the education of scientists and engineers at Rose-Hulman.

Thanks very much,

Lee Waite
Director, Eli Lilly/Guidant Foundation
Applied Life Science Research Center

A Brief History of the Lilly/Guidant Foundation Applied Life Science Research Center

In 1994, Rose-Hulman Institute of Technology received a five-year $125,000 grant to establish the Lilly Applied Life Sciences Research Center. The intent of this grant was to establish a central location for multi-disciplinary projects demonstrating the application of engineering and scientific principles to problems originating within the life sciences. The program was intended to encourage the growing interest of Rose-Hulman Institute of Technology faculty and students in bio-related research and curriculum development.

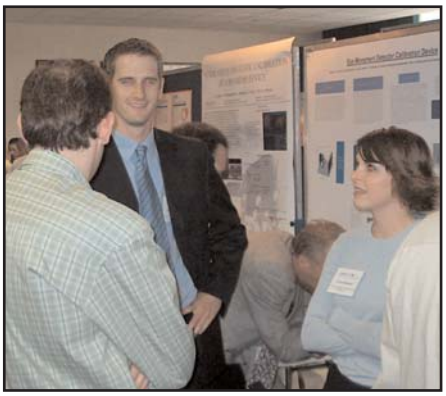
At the time of the initial award, Rose-Hulman Institute of Technology was maintaining a small graduate program in biomedical engineering and seeking to strengthen the biology and physiology curriculum offerings. The LASRC provided mission critical encouragement and support for those efforts. Numerous student and faculty presentations, publications, and undergraduate research projects encouraged yet larger numbers of faculty and students to investigate problems and pursue projects in the life sciences area.

From left, Rose-Hulman President Samuel F. Hulbert, Dr. Ronald Dollens, president and CEO of Guidant Corp., Dr. August M. Watanabe, retired executive vice president of science & technology Eli Lilly Corp., and James Baumgardt, president of Guidant Foundation

In 2001, the initial five-year grant was renewed and expanded to $150,000. The Guidant Foundation entertained a proposal to join Eli Lilly & Company as a co-sponsor for the Lilly Applied Life Sciences Research Center program. The Guidant Foundation awarded Rose-Hulman Institute of Technology a matching grant for $150,000 over a five-year program, and the program was renamed the Lilly-Guidant Foundation Applied Life Sciences Research Center to reflect that partnership.

Rocky Mountain Bioengineering Symposium

With the support of the Lilly/Guidant Applied Life Science Research Center , Jameel Ahmed, Bill Weiner, Lee Waite, AB junior Chad Zarse, and BE graduate student Grant Hoffman attended the 41st Annual Rocky Mountain Bioengineering Symposium in Fort Collins, Colorado, April 23 through April 25. Andy Miesse, Rose-Hulman alumnus and graduate student at Clemson, also attended the conference. Dr. Gabi Nindl, adjunct Rose-Hulman faculty member and assistant professor, IU Medical School (THCME), also attended the conference and presented research. The RMBS is the oldest continually running biomedical engineering symposium in North America. Rose-Hulman students and faculty made three podium presentations and presented two posters.



Bill Weiner and Grant Hoffman at the RMBS poster session.

Grant Hoffman won first place in the RMBS student presentation contest and second place in the student paper competition with his paper titled "A New Technique of Tissue Repair for Ophthalmic Surgery." Chad Zarse won the "Student Contest Committee's Award" for his poster titled "Light intensity appears to be more important than an endogenous seasonal clock for regulating structural rhythms in the lateral eye of the horseshoe crab."

Research results from the Lilly/Guidant Applied Life Science Research Center that were published in volume 40 of the Biomedical Sciences Instrumentation (the proceedings of the RMBS) included:

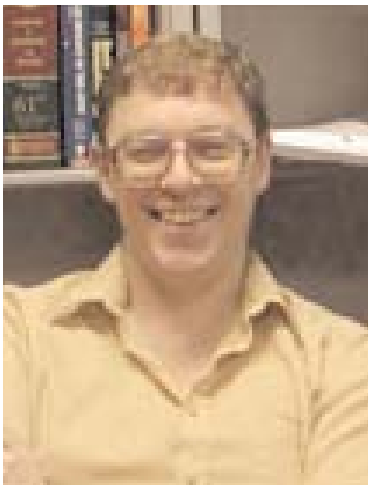
- Design and testing of a fluorescence glucose sensor which incorporates a bioinductive material. H.C. Chen and J. Ahmed.
- A new technique of tissue repair for ophthalmic surgery. Grant T. Hoffman, Eric C. Soller, Jeffrey N. Bloom, MD, Mark T. Duffy, MD, PhD, Douglas L. Heintzelman, MS, MD, and Karen M. McNally-Heintzelman, PhD.
- Potential role of proinflammatory cytokines in nerve damage related bone loss. Andrew M. Miesse, Jeffrey S. Willey, Ted A. Bateman.
- Effect of hydrogen peroxide on proliferation, apoptosis and interleukin-2 production of Jurkat T cells. Gabi Nindl, Nathan R. Peterson, Ellen F. Hughes, Lee R. Waite, and Mary T. Johnson.
- Noninvasive treatment of inflammation using electromagnetic fields: current and emerging therapeutic potential. Mary T. Johnson, Lee R. Waite, and Gabi Nindl.
- Light intensity appears to be more important than an endogenous seasonal clock for regulating structural rhythms in the lateral eye of the horseshoe crab. C.A. Zarse, E.A. Deaton, and W.W. Weiner.

Grant Hoffman, Jameel Ahmed, and Bill Weiner discuss research results with students.

Rose-Hulman Junior Chad Zarse presenting research to RMBS attendees during the poster session.

Jameel Ahmed

Richard Anthony



Mark Brandt

Neural Vascular Interactions in the Retina

Diabetic retinopathy, or blindness occurring as a result of diabetes, is the leading cause of blindness in adults aged 20-74 and causes 12,000-24,000 new cases of blindness every year. Recent studies have shown that the underlying cause of diabetic retinopathy is damage to the blood vessels that supply the retina. Dr. Jameel Ahmed and a team of undergraduate and graduate students at RHIT are working on a project to help increase our understanding of the underlying physiological mechanisms that control the blood supply to the retina. In particular, the program's major goal is to increase understanding of the control system that links retinal metabolic load with nutrient supply from the retinal circulation. Diabetic retinopathy is thought to disrupt this control system by damaging blood vessels.

In these experiments, blood flow will be measured using two techniques. The first technique is a microsphere technique in which labeled microspheres are injected into the left ventricle of an anesthetized rat and become embedded in the retina. After the animals are sacrificed, the retina is removed and wholemounted, and the spheres are counted using a fluorescent microscope. The second technique used in this study is the particle tracking technique. In this approach, very small microspheres (roughly 2 um in diameter) are injected intravenously. These particles are imaged using a microscope with a fluorescence attachment. Images are recorded on sVHS videotape, and blood velocities and flows are calculated.

Once these measurement techniques are optimized for use in the rat retina, the effects of neural activity on retinal blood flow will be investigated. First of all, the increase in retinal blood flow that accompanies flicker stimulation will be characterized in the rat retina. In later experiments, the Na+/K+ pump blocker TTX will be used to block action potential generation in inner retinal neurons to see if this activity triggers the increase in retinal blood flow that occurs in response to retinal stimulation.

This research program at RHIT was initiated with support of the Eli Lilly/Guidant Applied Life Science Research Center. This support provided funds for the purchase of basic equipment and supplies as well as support of a summer undergraduate research experience for RHIT undergraduate Alexis Nathaniel. As a result of this support, sufficient preliminary data was gathered that allowed submission of a grant proposal to the National Eye Institute of the National Institutes of Health. The NIH funded this proposal, which will provide summer research experiences for many RHIT undergraduates and graduate students.

ABBE & Chemistry Awarded Grant from Merck-AAAS for Undergraduate Research

The ABBE and Chemistry Departments have been awarded a grant from the Merck-AAAS Undergraduate Science Research Program (USRP). The purpose of the USRP is to enhance undergraduate science education in biology and chemistry and, particularly, to encourage undergraduate research programs that emphasize the interrelationship of these sciences. The $60,000 award was provided to help establish the Interdisciplinary Research Collaborative in Biology and Chemistry (IRCBC) on the Rose-Hulman campus. The program will provide summer stipends, research supplies, and travel funds for eighteen undergraduate researchers over the next three years. Ancillary activities supported by the grant include a yearly undergraduate research symposium and a seminar series focused on the interface between biology and chemistry. Richard Anthony (ABBE) and Mark Brandt (Chemistry) coauthored the proposal.

Study of Isolated Communities in Degraded Landscapes

Janice Bossart

The National Science Foundation awarded $300,000 to Dr. Janice Bossart to investigate the biodiversity of relict forest 'islands' from one of the most biologically unique, critically imperiled, and understudied regions in the world — the tropical forests of Ghana. Research supported by this project will address how fragmentation changes butterfly community composition, which habitats support the highest diversity of endemic species, what features characterize these habitats, and how these attributes correlate with historical and current species' distributions and persistence. The project emphasizes survey and conservation of forest reserves and irreplaceable sacred groves. Sacred groves are isolated forest areas that have been protected for hundreds of years by indigenous peoples and that were, within living memory, part of continuous forest. Butterflies are excellent models for evaluating the status of natural communities in degraded landscapes because they show a wide diversity of relative sensitivities to environmental change, are tightly linked to ecological systems as both primary consumers (herbivores) and food items, and are easily collected and identified. Primary field activities associated with the project will occur over three years and include regular and systematic survey of nine forest sites using baited traps and net collections, intensive spot surveys of at least six additional unique forest sites, measurement of forest characteristics at each site (e.g., size and canopy cover), and purposeful collection of caterpillars and their food plant dependencies to amass much needed, but largely nonexistent, information on species' biology and natural histories. The project will 1) greatly expand our understanding of forest biodiversity in tropical West Africa, 2) test broad ecological and biogeographic hypotheses that have relevance beyond this particular system, 3) establish a data and image-rich library of the Ghanaian butterfly fauna on the world wide web, 4) make species checklists and summary findings rapidly available to local communities and conservation agencies to facilitate science-based conservation plans, 5) help solidify permanent reference and museum collections in the host country, and 6) generate a reference framework for future research in molecular biology, ecology, evolution, and systematics.

The project emphasizes education, training, capacity building, and cultural exchange. It is an international collaboration that includes overseas research and professional opportunities for U.S. and Ghanaian students and scientists, and involves cooperating specialists from the U.S., Britain, Belgium, and Vietnam, and multiple institutions and staff in the U.S. (Rose-Hulman Institute of Technology and Carnegie Museum of Natural History) and Ghana (Forestry Research Institute of Ghana, Kwame-Nkrumah University of Science and Technology, Ghana Wildlife Division, and Nature Conservation Research Centre).

Recent Publications:

Chen H.C., Ahmed J. (2004) Design and testing of a fluorescence glucose sensor which incorporates a bioinductive material. Biomedical Sciences Instrumentation, 39: 149-154

Lucas, J.C., Weiner, W.W., and Ahmed, J. (2003) Do weak adapting backgrounds uncover multiple components in the electroretinogram of the horseshoe crab? Biomedical Sciences Instrumentation, 39: 105-110.

Robson, J.G., Saszik, S.M., Ahmed, J., and Frishman, L.J. (2003) Rod and Cone contributions to the a-wave of the electroretinogram of the macaque. Journal of Physiology, 547(pt 2): 509-530.

Dr. Ahmed is currently advising several graduate students on projects sponsored by the Eli Lilly/Guidant Applied Life Sciences Research Center.

Blood Supply to the Retina

Dr. Jameel Ahmed's primary research interest is in the physiology of the blood supply to the retina and how nutrient supply to the retina is matched to the metabolic needs of retinal neurons. In order to do this, Dr. Ahmed and Rose-Hulman students are modifying the fluorescent microsphere and pharmacological dissection techniques for use in rats.

In addition to the retinal blood flow project, Dr. Ahmed and BME Graduate Student Saylan Lukas have started a project investigating the biocompatibility of MEMS devices.

Jameel Ahmed

Assistant Professor of Applied Biology and Biomedical Engineering

Jameel Ahmed received a B.S. in Bioengineering from Syracuse University in 1990. This was followed by M.S. and Ph.D. degrees in Biomedical Engineering from Northwestern University. While in Rob Linsenmeier's lab at Northwestern, he developed a technique for measuring retinal blood flow in experimental animals using fluorescent microspheres. After graduating from Northwestern in 1997, Ahmed moved to Laura Frishman's lab at the University of Houston College of Optometry, where he spent two years using a pharmacological dissection technique to characterize the components that combine to make up the dark-adapted electroretinogram of the macaque monkey. Dr. Ahmed is currently Assistant Professor of Applied Biology and Biomedical Engineering at Rose-Hulman Institute of Technology, a position he took in September of 1999.

Graduate Student Advisor to:

Ching-Hsung Chen - MS 2003
Michael McNutt - MS 2004 (expected)
Saylan Lukas - MS 2005 (expected)

Grants:

NIH R15 EY014132 Neural-Vascular Interactions in the Retina

Understanding Ribosomal Proteins

Dr. Richard Anthony's primary research is directed at understanding the role of ribosomal proteins in the antibiotic resistance or sensitivity of eukaryotes, as well as the role these proteins play in maintaining the accuracy of protein synthesis. A number of antibiotics work by binding to various components of the ribosome and perturbing the process of protein synthesis. The specificity of such antibiotics is often dependent on structural differences between bacterial and eukaryotic ribosomes. Anthony uses yeast as a model eukaryote to better understand the ribosomal components that account for the specificity of these interactions. In recent experiments, Anthony and his students isolated mutant yeast that actually requires an antibiotic to survive - normal yeast is not at all affected by this antibiotic. Current experiments are directed at determining the precise nature of these mutations and how they exert their effects.

Richard Anthony

Associate Professor of Applied Biology and Biomedical Engineering

Richard Anthony received a B.S. degree in Biology from Loyola University of Chicago in 1986 and his Ph.D. in Biological Sciences from the Laboratory for Molecular Biology at The University of Illinois at Chicago in 1995. After completing his graduate degree, Anthony worked as a Postdoctoral Research Associate in the Division of Biological Chemistry in the Department of Chemistry at The University of North Carolina at Chapel Hill. Prior to arriving at Rose-Hulman in the Fall of 1997, he worked as a Visiting Assistant Professor in the Biology Department at The University of Southern Florida in Tampa. Anthony is a member of a number of professional organizations including the Genetics Society of America, The American Society for Cell Biology, and the Association for Biology Laboratory Education. He also serves as the Chief Health Professions Advisor to Rose-Hulman's pre-health professions students. Anthony is married and has one son.

Other research interests include the study of complex systems and innovations in biology education.

Recent Publications:

Strack, R., West, S. T., and Anthony, R. A. (2002) Paromomycin-dependence in Saccharomyces cerevisiae. Abstr. 13th Annual Argonne Symposium for Undergraduates in Science, Engineering and Mathematics.

Anthony, R. A. and Gillie, L. L. (2002) Introducing the study of complex systems: Building a conceptual and functional understanding using case-based inquiry. Abstr. Association of College and University Biology Eductaors 46th Annual Meeting.

West, S. T. and Anthony, R. A. (2002) Antibiotic dependence in Saccharomyces cerevisiae. Abstr. Annual Wabash Valley Chapter of Sigma Xi Poster Competition (1st place undergraduate).

Diversification, Extinction, and Conservation of Biodiversity

Dr. Janice Bossart's research seeks to understand how evolutionary and ecological factors integrate to shape the distributions, abundances, and diversification of species. Bossart explores these issues using insects as her model system and integrates a combination of molecular techniques, population and quantitative genetics, and field studies of populations, communities, and habitat and resource use. Three primary lines of research are actively being pursued: conservation ecology and dynamics of forest butterfly communities in human-transformed landscapes; evolutionary ecology of life-history traits relating to resource use and the differentiation, extinction, and/or persistence of insect biodiversity; and molecular ecology and identification of the historical and contemporary factors that promote molecular genetic pattern across environmental landscapes. Multiple fundamental theoretical issues in evolutionary biology and ecology are being investigated within these three broad domains. But insights being discovered also have direct relevance to a number of important contemporary applied issues. For example, how do human activities impact non-human species and how can we mitigate these effects? Why are some insect species pests of crops, and how can we manage these with minimal environmental impact? How can we best preserve natural landscapes and the species they harbor?

Janice Bossart

Visiting Professor of Applied Biology and Biomedical Engineering

Janice Bossart embarked on her professional studies as a single parent and after a seven year hiatus from academics. She graduated magna cum laude with a B.S. degree in Basic Science from West Virginia University in 1985. This was followed by M.S. and Ph.D. degrees in Entomology/Ecology & Evolutionary Biology at Michigan State University. After graduation, Bossart worked as a postdoctoral researcher at the University of Maryland and as a postdoctoral fellow at Louisiana State University. Prior to arriving at Rose-Hulman in the Fall of 2003 as a Visiting Assistant Professor, she was a faculty member at The College of New Jersey (TCNJ). While at TCNJ, she guided the research projects of 11 undergraduate students, seven of whom have gone on to pursue graduate degrees. Dr. Bossart has been awarded nearly $400,000 in support of her research, including grants from the National Science Foundation and the National Geographic Society. She has 15 scientific publications and has given more than 40 scientific presentations.

Recent Publications:

Bossart, J. L. Nestedness, passive sampling, and rare species. Oikos - In Review.

Bossart, J. L., E. Opuni-Frimpong, S. Kuudaar and E. Nkrumah. Butterfly species assemblages in relict sacred forests and forest reserves of Ghana. Journal of Insect Conservation - In Review.

Bossart, J. L. (2003) Covariance of preference and performance on normal and novel hosts in a locally monophagous and locally polyphagous butterfly population. Oecologia, 135:477-486.

Bossart, J. L. and C. E. Carlton (2002) Insect conservation in America: status and perspectives. American Entomologist, 48:82-92.

Stracey, C. M.* and Bossart J. L. (2002) Temporal survey of butterfly species in the Pine Barrens of New Jersey. In: Identification and protection of reference wetland natural communities in New Jersey: Pine Barren Savannas. Report for NJDEP, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program. **undergraduate research project*

Focus on Biomaterials

Dr. Christine Buckley's research interests can most broadly be described as biomaterials. This includes studies of the biocompatibility, corrosion resistance, and mechanical properties of traditional biomaterials used in orthopedic implants. She is currently collaborating with a group of orthopedic surgeons in Indianapolis on several research projects related to the biomechanics of orthopedic implants and the effect that implant placement has on the long-term clinical success of the implant. Dr. Buckley is also interested in new approaches to replacing damaged or diseased tissue, which falls under the umbrella term "tissue engineering." She is working with a student to evaluate a novel material for use as a scaffold for seeding bone cells in a device that could be used to engineer bone.

Christine Buckley

Associate Professor of Applied Biology and Biomedical Engineering

Christine Buckley received the B.S.E. degree in Biomedical Engineering from Duke University in 1988. She then attended Northwestern University where she received the M.S. (1990) and Ph.D. (1994) in Biomedical Engineering. Since 1994, she has taught Mechanical and Biomedical Engineering at Rose-Hulman Institute of Technology in Terre Haute, Indiana.

In 1998, Dr. Buckley spent one year working at LifeCell Corporation in Houston, Texas. LifeCell is a tissue engineering company whose products are based upon their patented AlloDerm® tissue processing technique. The company currently markets processed acellular human dermis for use in burn, plastic and reconstructive, periodontal, and urogynecological surgery.

Recent Publications:

M.H. Ware and C.A. Buckley, "The Study of a Light-Activated Albumin Protein Solder to Bond Layers of Porcine Small Intestinal Submucosa (SIS)," Biomedical Sciences Instrumentation, Vol. 39, p. 1, 2003.

Z.R. Nicoson and C.A. Buckley, "Bond Strength of Fibrin Glue Between Layers of Porcine Small Intestine Submucosa (SIS)," Biomedical Sciences Instrumentation, Vol. 38, p. 179, 2002.

Recent Publications:

Focusing on understanding the response of macrophages

Dr. Alicia Cecil's laboratory efforts are focused on understanding the response of macrophages to various stimuli. Macrophages are leukocytes that play a critical role in immune responses to infection. They are also implicated in the rejection and failure of implanted medical devices. Experiments in the lab are designed to study the genes that are activated in macrophages in response to foreign molecules from both bacteria and biomaterials. Additionally, the lab focuses on the activation to the signaling pathways in these cells as they respond to foreign materials. Comparing the reaction of the cells to both biomaterials and bacterial sources may help us to gain a full knowledge of the pathways involved in implant failure. Strides in these areas will also lead to improved methods for preventing or treating failure.

Another long-term project in the lab involves an investigation of the patterns of antibiotic resistance in E. coli from local lakes and streams.

Alicia Cecil

AssistantS Professor of Applied Biology and Biomedical Engineering

Alicia Cecil received a B.S. in Biology from the University of Southern Indiana in 1998. Cecil received her graduate training at Indiana University School of Medicine where she received a Ph.D. in Microbiology and Immunology in 2003. She joined the faculty at Rose-Hulman Institute of Technology in the fall of 2003 as Assistant Professor of Applied Biology.

Heart Function Assessment

Assessment of heart function and quantification of heart valve pathologies are important in clinical practice as well as in physiological research. Approximately 400,000 patients are diagnosed with congestive heart failure in the US each year. Elevated diastolic filling pressure in these patients leads to the development of congestive heart failure symptoms. Non-invasive assessment of diastolic function that does not require the use of intracardiac pressure has been an important goal; and in recent years, Doppler electrocardiography has become the "diagnostic modality of choice" to assess diastolic function. For the past several years, Professor Lee Waite has collaborated with surgeons at the Heart Surgery Laboratory at the University of Heidelberg to develop a mathematical model of blood flow through the mitral valve. The goal is to use this model to assess diastolic function clinically based on Doppler velocity waveforms and other non-invasive heart measurements. Other research interests include sports biomechanics and the controversy over stem cell research.

Lee Waite

Professor of Mechanical Engineering and Biomedical Engineering
and Head of the Department of Applied Biology and Biomedical Engineering

Lee Waite received a B.S. degree in Mechanical Engineering from Iowa State University in 1980 and went to work as a design engineer for Fisher Controls International, Inc., Marshalltown, IA. In 1983, he returned to graduate school and received the M.S. and Ph.D. in Biomedical Engineering from Iowa State in 1985 and 1987, respectively. Waite is currently Professor of Mechanical and Biomedical Engineering at Rose-Hulman Institute of Technology in Terre Haute, Indiana. He is also the Head, Department of Applied Biology and Biomedical Engineering. He worked as a visiting scientist at the University of Heidelberg, Heart Surgery Laboratory, in Heidelberg, Germany, during the summers of 1999 through 2003 and taught at Kanazawa Institute of Technology in Kanazawa, Japan, during the 1993-94 academic year. His research interests include modeling blood flow and biomedical instrumentation. His hobbies include foreign languages (German and Japanese), mountain climbing (Mt. Kilimanjaro in 1997), travel (25+ foreign countries), and reading.

Graduate student advisor to:
Chaitanya Sathe - (2005 expected)

Recent Publications:

Nindl, G., Peterson, N., Hughes, E., Waite, L., and Johnson, M., 2004 Effect of hydrogen peroxide on proliferation, apoptosis and interleukin-2 production of Jurkat cells, Biomedical Sciences Instrumentation, Volume 40, p. 123-128

Johnson, M., Waite, L., and Nindle, G., 2004, Noninvasive treatment of inflammation using electromagnetic fields: current and emerging therapeutic potential, Biomedical Sciences Instrumentation, Volume 40, p. 469-474

Waite, L. R. & Nindl, G. 2003. Human embryonic stem cell research: an ethical controversy in the US & Germany. Biomedical Sciences Instrumentation, Volume 39, p. 567-572.

Sharma, H.A., Balcavage, W. X., Waite, L. R., Johnson, M. T., Nindl, G. 2003. Characterization of a real time H2O2 monitor for use in studies on H2O2 production by antibodies and cells. Biomedical Sciences Instrumentation, Volume 39, p. 554-560.

Soans, D., Szabo, G., Bolind, C., Waite, L., 2002.
A variable valve area, lumped parameter model of left ventricular filling. Biomedical Sciences Instrumentation, Volume 38, p. 483-488.

Recent Publications:

Zarse, C.A., Deaton, E.A., and Weiner, W.W. 2004. Light intensity appears to be more important than an endogenous seasonal clock for regulating structural rhythms in the lateral eye of the horseshoe crab. Biomedical Sciences Instrumentation, 40:407-412

Pieprzyk, A.R., Weiner, W.W. and Chamberlain, S.C. Mechanisms controlling the sensitivity of the Limulus lateral eye in natural lighting. 2003. The Journal of Comparative Physiology A 189 (8): 643-653

Lucas, J.C. Weiner, W.W. and Ahmed, J. 2003. Do weak adapting backgrounds uncover multiple components in the electroretinogram of the horseshoe crab? Biomedical Sciences Instrumentation, 39:105-110.

Sacunas, R.B., Papuga, M.O., Malone, M.A., Pearson, A.C., Jr., Marjanovic, M., Stroope, D.G., Weiner, W.W., Chamberlain, S.C. and Battelle, B.A. 2002. Multiple mechanisms of rhabdom shedding in the lateral eye of Limulus polyphemus. Journal of Comparative Neurology, 449(1):26-42.

Circadian Rhythms and Behavior Regulation

Dr. Bill Weiner's primary research goal is to understand the role that circadian rhythms play in regulating behavior. Advancements in this field have led to a number of important discoveries. For instance, it is now clear that the efficacy of certain drug therapies are dependent upon the time of day at which they are administered. Likewise, seasonal affective disorders and some other forms of depression have been linked to improper entrainment of the biological clocks of afflicted individuals. Even attempts to minimize jet lag or accidents in shift workers require a detailed understanding of how circadian rhythms affect behavior.

To investigate some of these issues, Weiner is using horseshoe crabs as a model system for studying basic circadian and visual processes. One of the projects that he is currently working on is to determine the seasonal effects of natural lighting on structural light adaptation in the lateral eye of the horseshoe crab. Preliminary data suggest that retinal structure is more affected by ambient light levels than time of year. Weiner also is in the process of designing a LabVIEW virtual instrument that will enable circadian data from horseshoe crabs to be collected and analyzed more efficiently. A third project that he is working on is to characterize the photoreceptors in the telson of the horseshoe crab. These light-sensitive cells have been shown to shift the phase of the animal's circadian rhythm, and it is believed that they make direct synapses with the cells of the clock. Thus, localizing and recording from these cells may provide a novel opportunity to study the molecular and cellular basis behind how the input to a circadian clock resets its phase.

Some of Weiner's other research interests include:

(1) studying the regulation of membrane renewal in photoreceptor cells,
(2) determining how retinal sensitivity and daily quantum catch are affected by changes in the duration or intensity of the photoperiod,
(3) identifying the source of the electroretinogram in the lateral eye of horseshoe crabs, and
(4) applying a novel statistical algorithm (Ozturk Algorithm) to the analysis of biological data.

Bill Weiner

Assistant Professor of Applied Biology and Biomedical Engineering

Bill Weiner received a B.S. degree in Bioengineering from Syracuse University in 1991 and his Ph.D. in Neuroscience from Syracuse University in 2000. After completing his graduate degree, Weiner accepted a position as an Assistant Professor of Applied Biology and Biomedical Engineering at Rose-Hulman Institute of Technology where he currently is employed. Weiner is a member of a number of professional societies, including the Association for Research in Vision and Ophthalmology, the Society for Research on Biological Rhythms, the Biomedical Engineering Society, and Sigma Xi. He also serves as the coadvisor to the campus student chapter of the Biomedical Engineering Society. Weiner is married with one child.

Graduate Student advisor to:
Ryan Harris - M.S. 2004

Undergraduate researchers supported by Lilly/Guidant:
Chad Zarse, Elizabeth Deaton, Matt Sung and Katie Harrigan

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