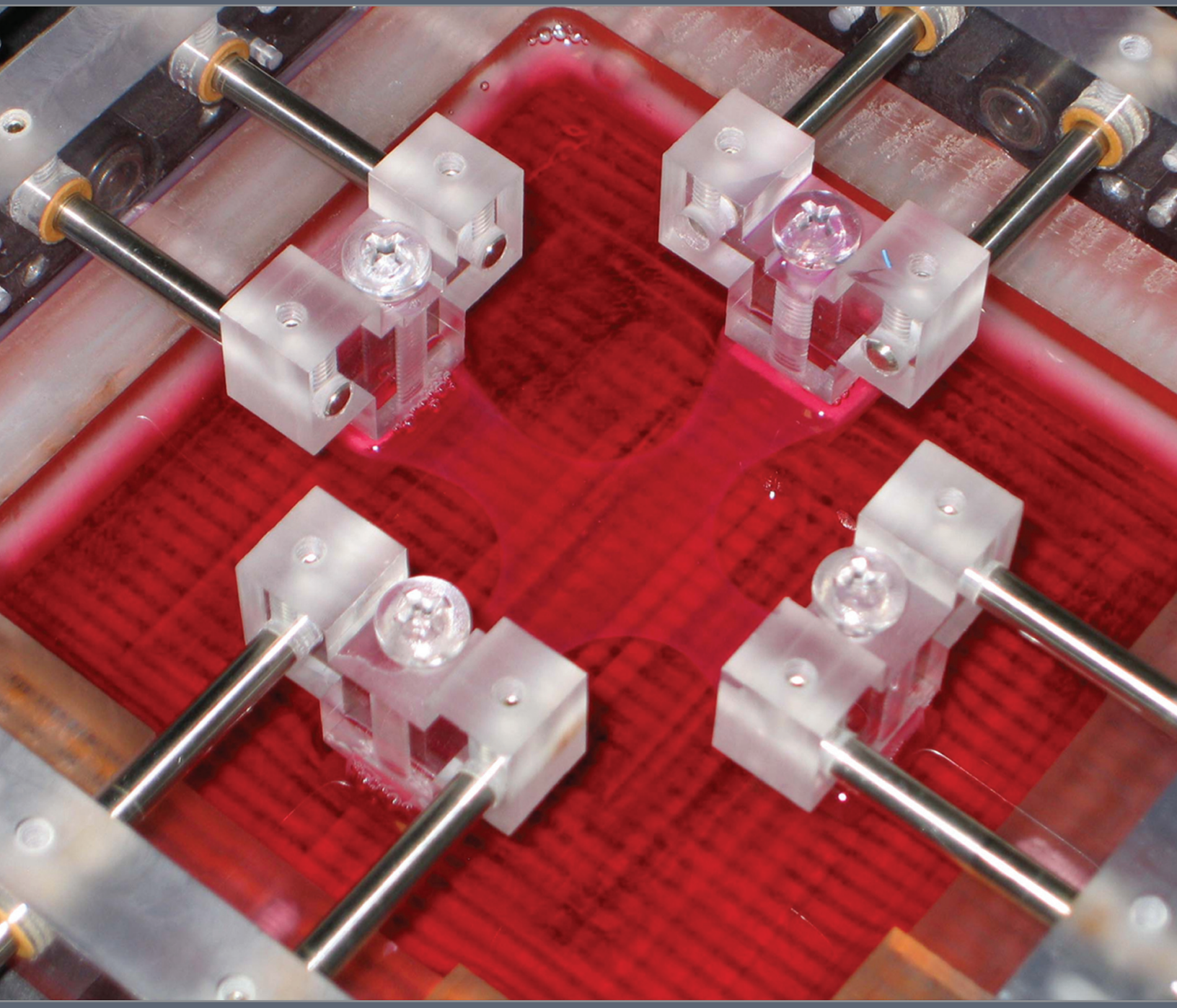
Yale BME NEWS

DEPARTMENT OF BIOMEDICAL ENGINEERING

www.med.yale.edu/bme

VOL. 3/ No. 1/ Spring 2011



INSIDE:

A Letter From The Chair

I am delighted to present you with the third issue of our Yale Biomedical Engineering (BME) newsletter. We continue to be busy in New Haven: our research and teaching programs are growing each month. The Daniel L. Malone Engineering Center, the picturesque home of the BME department, is completely occupied, abuzz with the work of the professors, students, staff members, and postdocs that we have hired over the past years. It is one of the most satisfying experiences of my professional life: walking down the arc of a sun-lit hallway in the Malone Center, listening to lively sounds of women and men engaged in teaching, collaborating, inventing, and learning.

I hope that you will read this issue from cover to cover, but let me give you a few hints about what you will find inside. You will discover that we have continued to recruit exceptional faculty members to the department. In this issue, we welcome Rong Fan, Kathryn Miller-Jensen, and Jay Humphrey. Rong and Kathryn are assistant professors, who joined us within the past year, and it has been exciting to watch them build their laboratories and research groups. Kathryn is an expert in systems biology. Her laboratory is developing quantitative approaches to learn how viruses hijack the signaling pathways in cells; she will use her results to design novel antiviral therapies. Rong is working on translational systems medicine. He uses micro- and nano-scale devices for differential diagnosis of disease and personalized medicine. Both Kathryn and Rong have energized our community with their creativity, their concern for students, and their collaborative spirit.

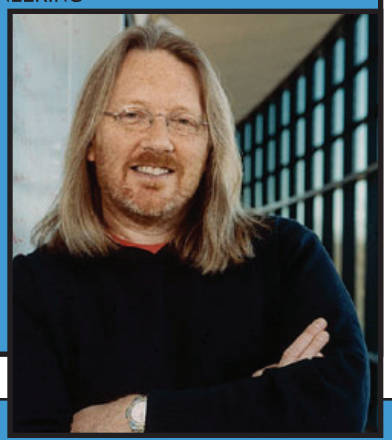
Jay Humphrey comes to us in the midst of a truly exceptional career, most recently at Texas A&M, where he built the world's leading research program on vascular biology and mechanobiology. He is justly celebrated for his research contributions: for example, I recently learned that he will receive the 2011 H.R. Lissner Medal from the ASME-Bioengineering Division, their highest honor. Jay has been in residence in New Haven for a short time, but we already have learned that we can depend on him for his thoughtful approach to research, his passion for undergraduate education, and his warm collegiality. You can learn more about Jay's work in biomechanics, and his vision for the growth of biomechanics research at Yale, in pages 6-7 of this issue.

One of the benefits of life at Yale is the support of our generous alums. In this issue, we celebrate the contributions of Allen Ford, who has supported the growth of BME at Yale in important, influential ways. Allen provides us with a model for successful living: in his leadership at Standard Oil, in his contributions to the biotech industry in Ohio, and in his commitment to the professional development of Yale students. We appreciate his devotion to service and his loyalty to Yale.

Yale BME is a multidimensional place, where students at all levels converge and collaborate. In this issue we also celebrate the work of our postdoctoral associates and graduate students, our undergraduates (see the story on our summer research poster session, p. 10), our high school interns (p. 9), our phenomenal kickball team.

I am delighted to be part of this energetic, surprising, vibrant community. I invite you to learn more about us: through this newsletter, through our website, or by visiting us in New Haven.

W. Mark Saltzman, Ph.D.
Goizueta Foundation Professor of Chemical and Biomedical Engineering
Professor of Cellular & Molecular Physiology
Chair, Biomedical Engineering



In This Issue:

New Faculty Members Join BME

The Biomedical Engineering Department is excited to welcome 3 new faculty members in the past year:

Rong Fan

Jay Humphrey

Kathryn Miller-Jensen

Donor Spotlight: Allen Ford

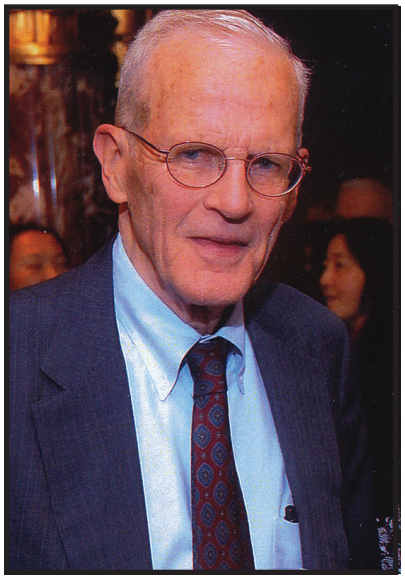
A loyal supporter of biomedical engineering, Allen Ford '50 has made a tremendous impact on undergraduate educational and research initiatives in the Biomedical Engineering department. Mark Saltzman, chair of the department, says that "he is one of BME's leading partners and his generosity has enabled us to engage our students in top-notch research programs with state-of-the-art equipment."

Allen retired as senior vice president of finance and administration at the Standard Oil Company, now BP America, twenty years ago. He now devotes his time to encouraging the development of the biotechnology industry in Ohio. He serves as a director of Copernicus Therapeutics, Inc., a start-up company that has developed a non-viral gene delivery system. Additionally, Allen is an emeritus trustee of Case Western Reserve University and a trustee of University Circle Inc., a development and service organization for the Cleveland community.

When Allen was an undergraduate at Yale, he was a resident of Davenport College and majored in history, economics and politics. He served in the Army in Korea and went on to receive his M.S. in engineering administration from Case Western Reserve University in 1964, and later attended the Advanced Management Program at Harvard Business School.

Allen is "delighted to be able to play a small part in establishing biomedical engineering as an important new department at Yale." His Biomedical Engineering Fund has made possible the purchasing of new laboratory equipment, the hiring of additional teaching fellows, and the continuation of the Undergraduate Biomedical Engineering Summer Internships program. Through the program, a group of remarkable undergraduates gather at Yale in the summer for a 10-week internship working with leading faculty on original research projects in biomedical engineering. Here are highlights of a few exciting projects previous summer interns have conducted.

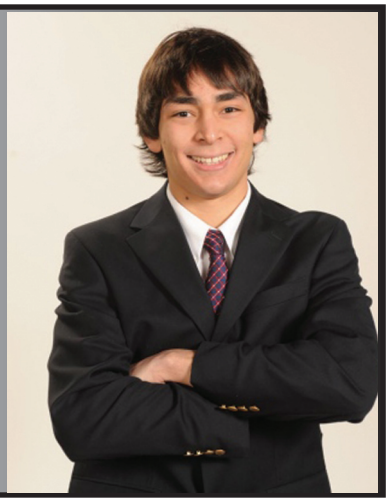
- Maegen Bradley collaborated with Professor Laura Niklason to design a bioreactor to sustain lung tissue growth and development. They successfully created pulmonary cells that are historically difficult to grow and derive. This indicates a promising future for lung tissue engineering that is vital to meeting the demand due to respiratory illnesses and donor organ shortages.
- Andrea Brock worked with Professor Lawrence Staib to use eigenalysis of Diffusion Tensor Imaging, a type of MRI, to characterize white matter in bipolar disorder patients. While further analysis is needed to localize statistically robust differences between people with and without bipolar disorder, they found that eigenalysis has great potential to improve proper diagnosis through quantifiable symptoms such as white matter loss.
- Karlo Perica and Robert Samstein alongside Professors Mark Saltzman and Tarek Fahmy examined a novel formulation for oral drug delivery using bile salt. Drugs administered orally are normally degraded by digestion, but their bile salt nanoparticulate formulation bypasses these problems by providing protection from the acidity of the stomach and has applications to chemotherapy and liver disease treatments.
- Sandeep Saluja and Professor Erin Lavik tested optimal polymers for the controlled and extended release of timolol maleate. Used in the treatment of glaucoma to alleviate pressure in the eye, timolol maleate has a long track record of efficacy but unfortunately causes decreased heart rate and blood pressure. Their development of a biodegradable microsphere delivery system reduces the frequency of drug administration and thereby decreases cardiac risk.



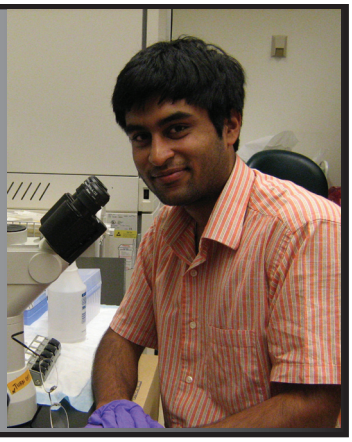
AWARDS AND ACCOLADES:

• May 6th, 2010: Rachael Sirianni, a postdoc in the Carson and Saltzman labs, won first place in the Young Investigator's Competition for her poster presentation at the Molecular Neuroimaging Symposium at NIH in Bethesda, Maryland. Funded by NIH Neuroimaging Training Grant T32, Rachael also won a competitive travel award and her abstract was published in the Journal of Nuclear Medicine (see recent publications).

• March 2010: Levent Alpoge, a former intern of the Papademetris and Kyriakides labs, was selected as one of the top 40 finalists in the nationwide Intel Science Competition 2010 based on the research project he conducted at Yale last summer. He is currently a freshman at Harvard University.



• Nimit Jain '12, is the recipient of a Yale Dean's College Award (Phi Beta Kappa). A double major in Biomedical Engineering and German Studies, Nimit is currently working in Dr. Tarek Fahmy's lab on optimizing nanoparticle-based vaccine design.



The Biomedical Engineering Department is proud to recognize these faculty members for the following outstanding achievements:

Richard Carson: Named as one of the "25 Most Influential in Radiology" by RT Image; Elected member of the Connecticut Academy of Science and Engineering.

James Duncan: Elected as a Fellow of the MICCAI (Medical Image Computing and Computer Assisted Intervention) Society.

Rong Fan: Awarded the Grand Challenges Explorations Award from the Bill & Melinda Gates Foundation, as well as the New Investigator Award from the Alzheimer's Association

Jay Humphrey: Elected to the Academy of Distinguished Engineering Alumni, Georgia Tech; Co-Editor-in-Chief, Biomechanics and Modeling in Mechanobiology, Springer.

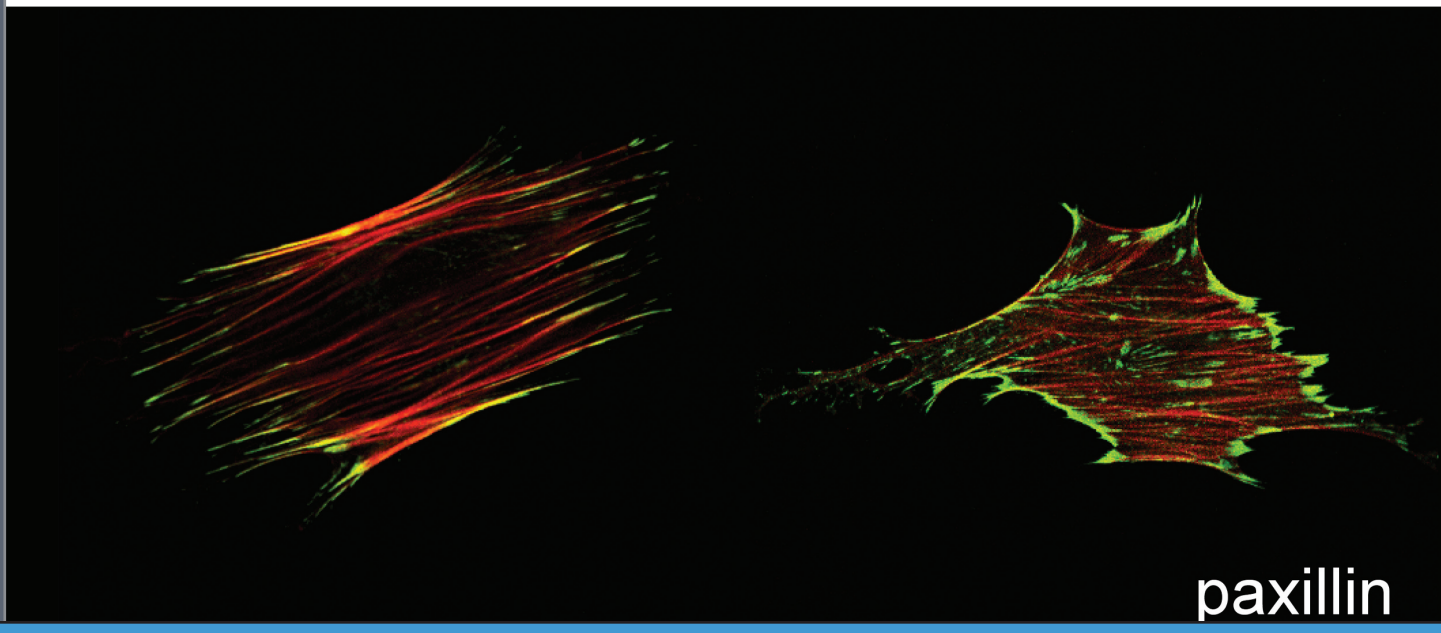
Michael Levene: Received the National Science Foundation's CAREER Award.

W. Mark Saltzman: Elected Fellow, Biomedical Engineering Society.

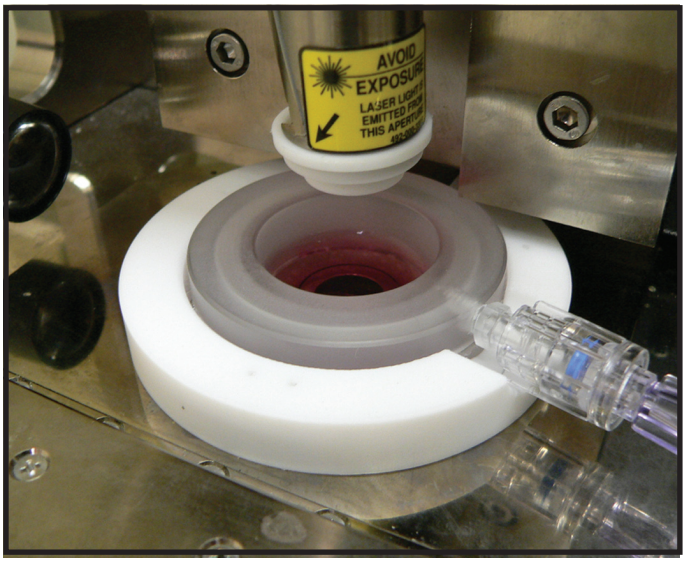
BIOMECHANICS AT YALE

BIOMECHANICS can be defined as the development, extension, and application of mechanics for purposes of understanding better both the mechanical behavior of biomolecules, cells, tissues, organs, and organisms and the structures with which they interact. Biomechanics has a long and storied history. It has been known at least since the time of Galileo, for example, that mechanics strongly affects biological form and function. Yet, it has only been since the mid-1970s that we have known how mechanics affects the biology – many types of cells are extremely sensitive to their mechanical environment and they literally change the genes that they express in response to changes in mechanical stimuli. A goal of modern biomechanics, therefore, is exploit this new understanding and to quantify changes in mechanical environment so that, in combination with modeling in mechanobiology, we can predict responses across biological scales in cases of health, disease, injury, and treatment. The Continuum Biomechanics Laboratory at Yale, directed by Professor J. Humphrey, uses mechanics and mechanobiology to study diverse aspects of vascular disease progression and its treatment. In particular, research focuses on the effects of hypertension and aging on arterial structure, properties, and function; the biomechanical consequences of particular genetic mutations in vascular disease; the dynamic enlargement and potential rupture of aneurysms; and the engineering of replacement arteries for implantation. Novel experimental, theoretical, and computational tools are developed and brought to bear on these important problems, and strong collaboration is enjoyed with experts in vascular surgery, biology, and therapeutics at the Yale School of Medicine as well as with collaborators across the country and abroad.

--Professor J. Humphrey



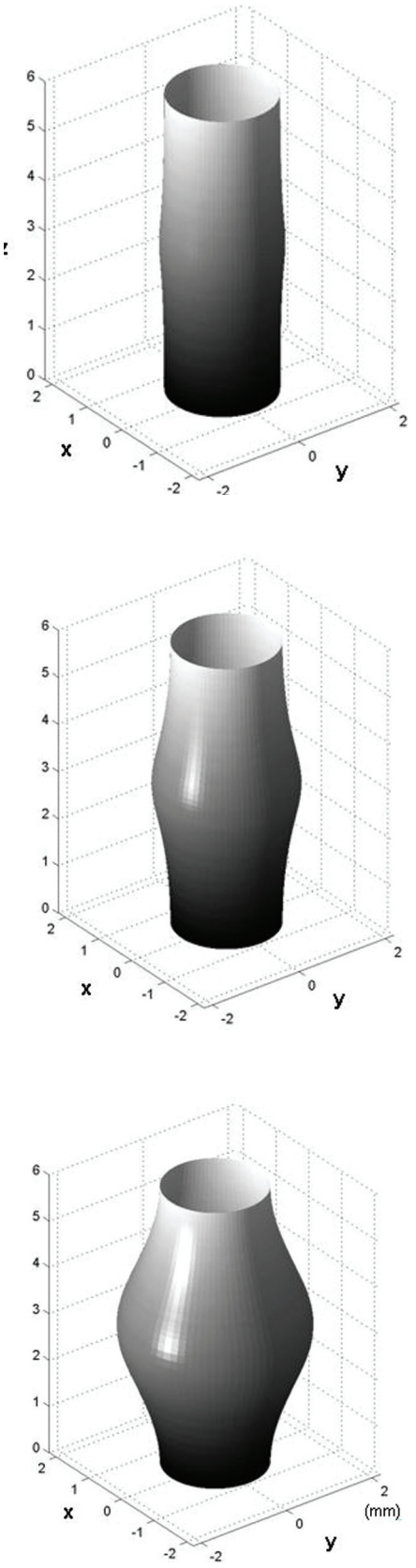
Isolated Smooth Muscle Cell Mechanics



Killing approximately 15,000 people in the United States each year, aneurysms can occur in various places and have many etiologies. Common locations for aneurysm formation include the brain, the aorta, and the mesenteric and splenic arteries. As an aneurysm enlarges, there is a signifcant risk of rupture, hemmorhage, and even death. Current treatments for aneurysms include aneurysmectomy, or excision of the diseased segment and replacement with a synthetic graft, or endovascular repair, where a stent-like graft is passed through the femoral artery and opened over the aneurysm. Even with current treatment options, the mortality rate with rupture and emergency repair is 50%.

Highly expressed in smooth muscle cells, paxillin is a focal adhesion-associated, phosphotyrosine-containing protein that may play a role in several signaling pathways, including those involved in vascular cell migration and differentiation. Thought to act as a scaffold for other signaling and cytoskeleton-associated proteins, paxillin has been shown to play a part in regulating cytoskeletal organization and gene expression associated with cardiac myocyte hypertrophy. Treatment of vascular smooth muscle cells with angiotensin II, a hormone involved in the control of blood pressure, is known to stimulate tyrosine phosphorylation of paxillin in rat aortic smooth muscle cells.

Computational Modeling of Aneurysm Growth



Introducing the Connecticut Chapter of the Controlled Release Society

In July of 2010, a Connecticut Student Chapter of the Controlled Release Society was established as a collaborative effort of Yale University, the University of Connecticut, and the UConn Health Center. With members from all three institutions serving as officers, the mission of the Connecticut Chapter includes goals to unify the multidisciplinary fields involved in drug delivery, with hopes to encourage future collaborations between campuses.

The first official meeting of the Connecticut chapter kicked off on September 8th, 2010 at the UConn Storrs Campus. The latest chapter symposium and poster session were held at Yale on December 11th, 2010.

Any person interested in the society is encouraged to join, however, voting privileges will be limited to undergrads, graduates, and post-docs. Visit their webpage at www.CRSConnecticut.com for more details.

CRS
Connecticut Student Chapter

"Being a joint organization, it is the goal of our chapter to contribute to the advancement of the field of controlled drug delivery by providing a comfortable atmosphere in which students and faculty members can interact and share information about drug delivery, controlled release and more broadly the science and engineering related to pharmaceuticals and biological agents"

-Jill Steinbach, Vice President (pictured above: front row, third from left).

New Haven Reads: A Great Place to Volunteer

• Located just blocks from Malone, New Haven Reads is also a place rich with creativity and learning. While Malone is home to dozens of scientists and engineers, New Haven Reads hosts 400 young students per week. These New Haven gradeschoolers receive tutoring in reading, writing and math by Yale students and community members who volunteer their time to work with the students one-on-one each week. Graduate students Alyssa Siefert and Erin Steenblock each tutored a student this year and were drawn to the organization's energy and impact. With over 200 students on the waiting list, you can help New Haven Reads by signing up to become a tutor at NEWHAVENREADS.ORG or by donating used books to their book bank, which is located in the tutoring center at 45 Bristol St. in New Haven.

-Erin Steenblock

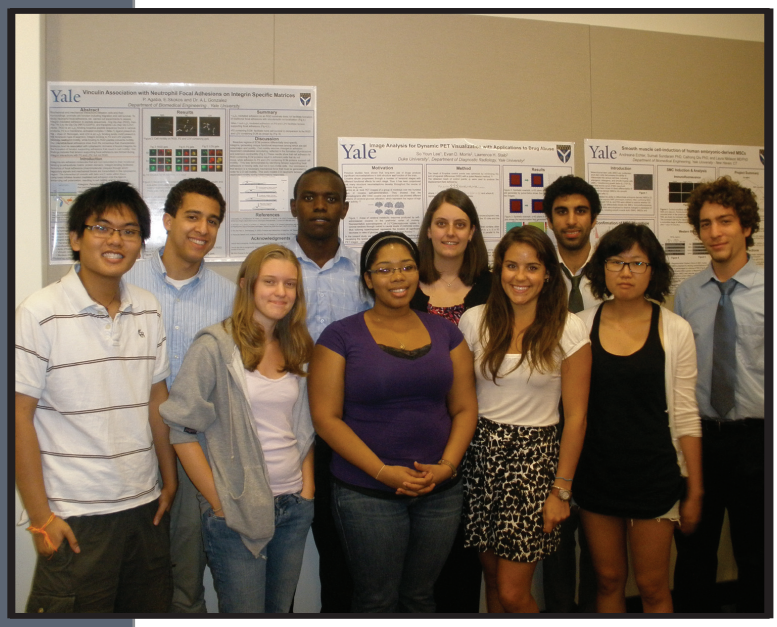
"I tutor 3 students, and it's been very rewarding seeing them progress and their attitudes toward reading and school in general improve. Many of these children are problematic in their classes because they don't understand the material they are being taught, and instead of asking for extra help, they act out; New Haven Reads provides a safe place for these children to voice their lack of understanding and receive the guidance they need to understand and enjoy what they are being taught in school." -Alyssa Siefert

Summer 2010 High School Interns

During the summer, the Malone Engineering Center opens its doors to a select number of tenacious high school students, where they have the opportunity to shadow lab members and learn the basics of conducting research. This year, Sophia Szymkowiak from Hopkins School in New Haven (left) and Adele Shenoy from Staples High School in Westport (right) joined the Saltzman lab for 4-8 week rotations. Working with Jenny Saucier-Sawyer, Kseniya Gavrilov, and Jill Steinbach, the students learned routine lab techniques such as cell culture and SEM. "Seeing all the different experiments going on in the lab and being able to take part in some of them was a wonderful experience that really served to bring science out of the books I've learned it in and into real life", said Sophia. Both students are planning to go to college and major in the sciences.

2010 BME UNDERGRADUATE POSTER SESSION

Each year, the Biomedical Engineering Department provides a select number of motivated undergraduates with funding for a 10-week research internship. Students have the opportunity to work with groups in a variety of areas, including drug delivery, magnetic resonance imaging and spectroscopy, optical imaging, tissue engineering, positron emission tomography (PET), biomedical image analysis, and biomechanics. In August, these interns, along with other undergraduate summer researchers, participated in a poster session held at the Amistad building to showcase their work.



From left to right: Bernie Kuan, Kevin Critchlow, Nina Kristofik, Perez Agaba, Victoria DeSormeaux, Andreana Echter, Myra Trivellas, Sam Vesuna, So Youn Lee, and Andre Shomorony.

2010 Poster Session Participants

Perez Agaba (Indiana University-Purdue University Indianapolis)- Vinculin association with neutrophil focal adhesions on integrin specific matrices

Kevin Critchlow (Yale University)- Functional Networks in Social Tasks in Autism Spectrum Disorders

Victoria DeSormeaux (Claflin University)- Differential Interference Contrast Ultrasound

Andreana Echter (University of Rochester)- Smooth muscle cell-induction of human embryonic-derived MSCs

Nina Kristofik (Yale University)- Transfection on Layer-by-Layer DNA/PEI Coated Electrospun Scaffolds

Bernie Kuan (Yale University)- Tunable Poly(ethyl)Glycol (PEG) Gels to Emulate Cell Microenvironments

So Youn Lee (Duke University)- Image Analysis for Dynamic PET Visualization with Applications to Drug Abuse

Andre Shomorony (Yale University)- DNA-directed Cell Assembly towards Heterotypic Tissue Micro-constructs

Myra Trivellas (Yale University)- Therapeutic Revascularization- an in vitro model for cell transplantation

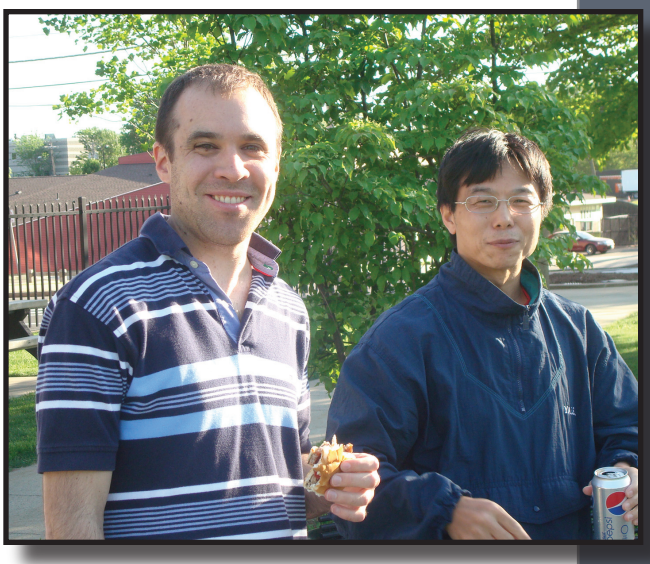
Sam Vesuna (Yale University)- Fluorescence Lifetime Imaging of Cleared Mouse Organs

KICKBALL: MALONE VS. AMISTAD- IT'S ON!

During the summer months, students and faculty alike can be seen playing kickball on the Amistad Green.

What started out as a friendly competition between both buildings has become an annual BME/VBT tradition, complete with food, fun, and good company.

Anyone is welcome to play. Look for the return of the sign-up sheets for kickball as the weather warms up!



RECENT PU

Here are a few of the many recent con

A. Joshi, A. Papanastassiou, K.P. Vives, D.D. Spencer, L.H. Staib, and X. Papademetris. Light-sensitive visualization of multimodal data for neurosurgical applications. In Biomedical Imaging: From Nano to Macro, 2010 IEEE International Symposium on, pages 884 -887, Apr. 2010.

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BLICATIONS

TRIBUTIONS BY OUR FACULTY AND STUDENTS

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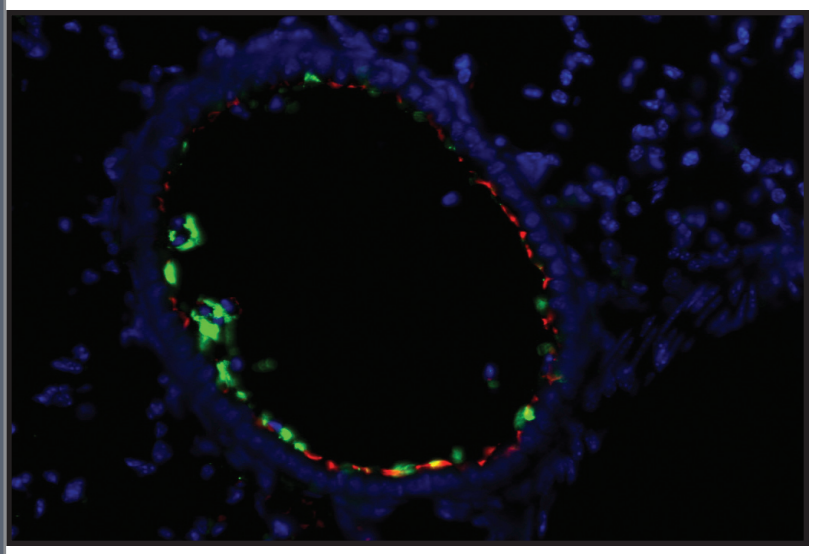
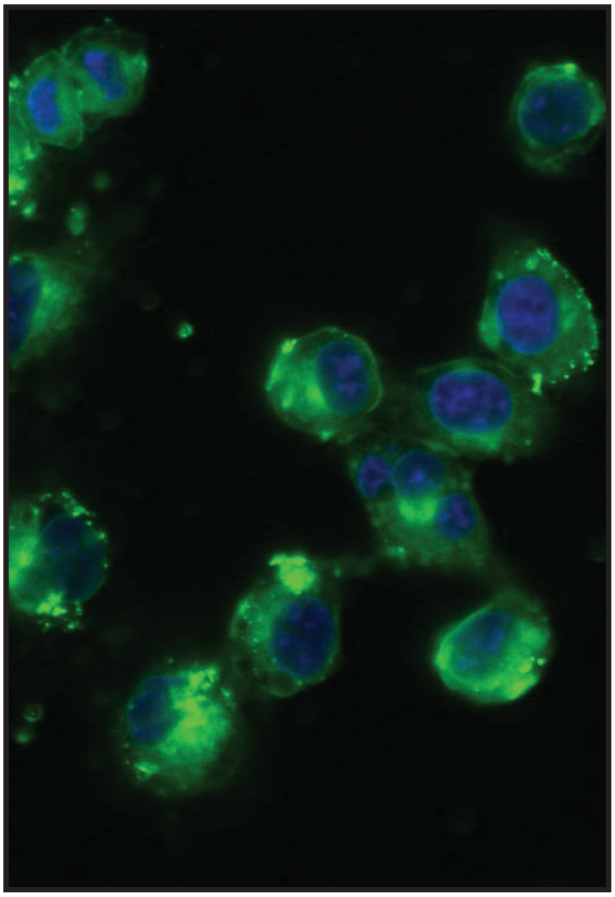
CONFOCAL MICROSCOPY PICTURES OF COUMARIN-6 NANOPARTICLES

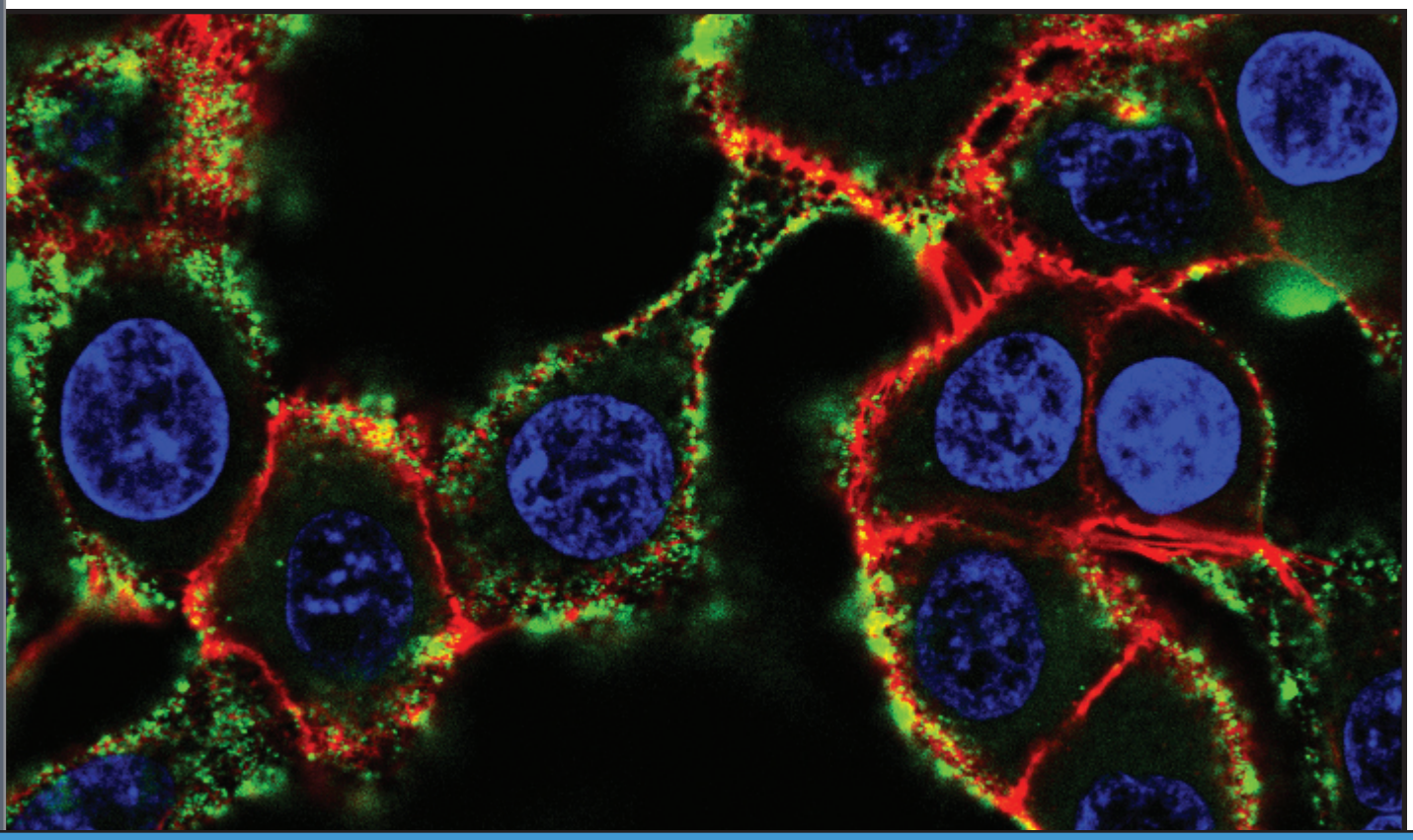


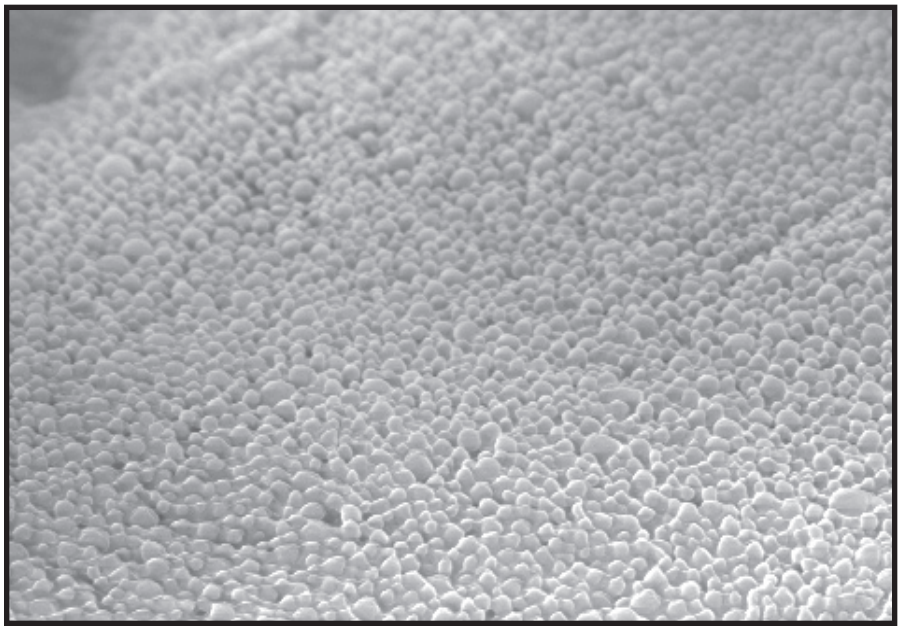
Above: Coumarin-6 loaded nanoparticle distribution in the mouse airway after intranasal delivery



Right: Coumarin-6 loaded nanoparticle uptake by HELA cells

Below: Distribution of Coumarin-6 loaded nanoparticles coated with cell-penetrating peptide (TAT) in A549 human lung cancer cells.

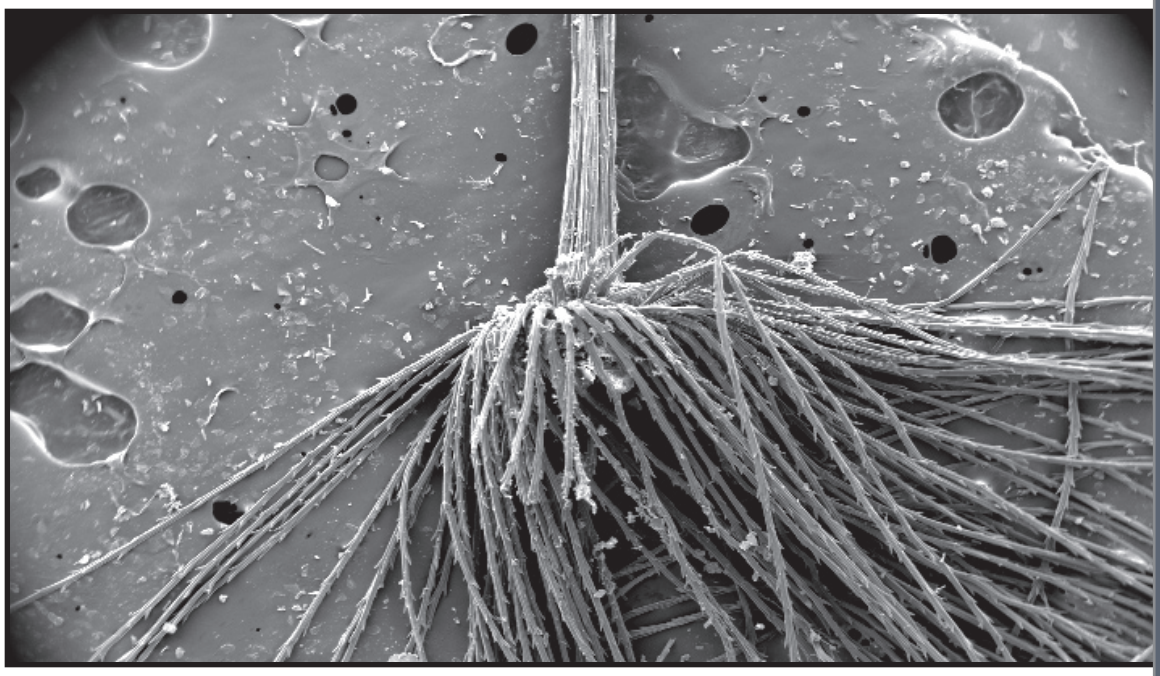




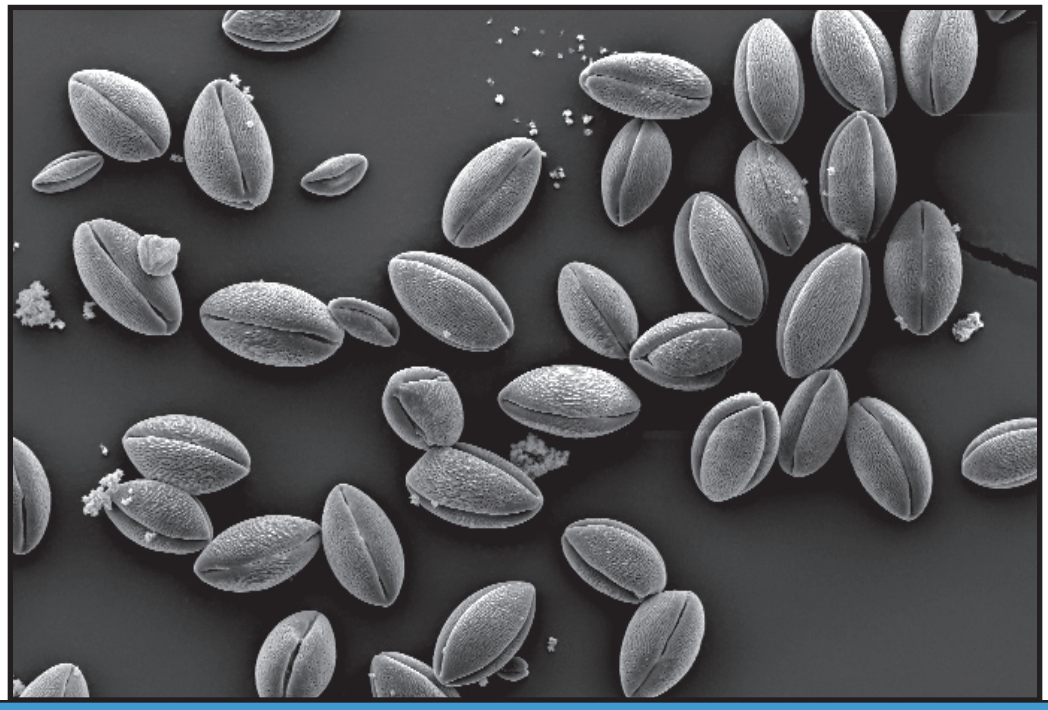
FUN WITH SEM:

SCANNING ELECTRON MICROSCOPY PICTURES

Above: 3-D view of PLGA nanoparticles



Right: Dandelion seeds



Left and Below: Dandelion pollen

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