A major feature of Drew summers in the past five years has been the summer renovation projects, and summer 2006 was no exception for the Hall of Science. Physics, chemistry, and biology were all winners after this summer's work. And while it's not much fun going through all of the summer disruptions, the benefits are many.

A major federal grant allowed a complete renovation of a third chemistry laboratory on the second floor, and a lab for the teaching of molecular biology and neurobiology on the first floor. While not bringing any additional square feet to our operations, the new labs bring us into the 21st century with newly designed teaching spaces mediated for classroom presentations, and better suited overall for student use of specialized instrumentation in these fields. Lab windows to the building corridors make these labs a showplace for visitors, and more comfortable for their occupants.

The chemistry renovation shared a wall with the introductory physics lab and the complicated process of complying with newer strict building codes required the wall to be removed and rebuilt to exacting fire code standards. This opened the door for physics to receive a bit of the federal largesse as part of this project. Ultimately the intro physics lab gained a new ceiling, new

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“I always wanted to be a scientist,” says Dr. Pamela Gunter-Smith, Drew University's first ever Provost. “I like thinking about a problem and coming up with a solution.” In high school, she greatly enjoyed chemistry and biology. After majoring in Biology at Spelman University, Dr. Gunter-Smith went on to Emory and received a Ph.D. in Physiology because she was “interested in the human body... but more interested in questions related to function than the practice of medicine.”

Although enhancing the Sciences is but one part of the Provost’s responsibilities, there is no doubt that science figures prominently in Gunter-Smith’s planning. “Regardless of your interests...everyone needs to have an understanding of science...particularly its influence on society.” The future is shaped by today’s education, and tomorrow’s “policy makers” need not be scientifically illiterate.

If all goes according to plan, Drew’s tomorrow will be glorious. Rather than simply joining the ranks of more well-known liberal arts colleges, Gunter-Smith hopes to “broaden Drew’s reputation across the country...by creating new academic programs, including niche programs unique to Drew ... and continuing to focus on teaching students how to be good thinkers.” There will also be more “experiential learning,” bridging the gap between coursework and application.

Gunter-Smith also hopes to show that Drew is “not just a place for the humanities.” Science is “very much a part of the Liberal Arts experience.” That being said, there are some very pressing issues facing the Sciences at Drew.

Drew must do a better job of attracting students to the Sciences “by developing new programs of study and highlighting the work already being done” by faculty and students. Gunter-Smith strongly believes that there is a “need” for a new science
Putting that Physics Major to Good Use

Physics Alum, Wife Discuss Secrets of Success

On October 11th Drew Physics Alum Bill Clark ’92 and his wife Julie Aigner-Clark came to deliver the Trapaghan Lecture. There was a reception in the new Hall of Sciences Rotunda, and the lecture itself was held in HS-244. The room was filled nearly to capacity, mostly by students interested in business or economics. Looking around I noticed that Dr. Fenstermacher, Dr. Carter and I were the only physics people in the room.

The lecture began with Julie’s talk, which centered on her overwhelmingly successful venture into business with the Baby Einstein Company. It turned out to be a very entertaining tale of the company’s journey from Bill and Julie’s basement to being a multi-million dollar brand name. The focus of the talk was business, but it was even enriching for a humble physics major with no business background.

After Julie had spoken it was Bill’s turn. He related the story of his own first business venture, a company which put media for astronomy education onto video discs. Though the company was initially successful it fell into a gradual decline which ultimately resulted in its dissolution. He would then go on to become a partner in the Baby Einstein Company, and having learned from mistakes in the past, would help the company grow into a household name. Bill related all of this back to his major in physics, stressing the importance of keeping careful track of the numbers involved in any business. He also made note of the applications that a physicist’s perspective can have in any career and the benefits of such an analytical way of thinking.

While I certainly know more about running a business now than before the lecture, I am also reassured of this: no matter where one might end up after a degree in physics, it will definitely be put to good use.

Dave Newby ‘08

We Know What You Did Last Summer

6 Students’ Spectacular Summer Science Stories

Several Drew physics students took advantage of research opportunities this summer. Their experiences ran the gamut from linear optics to... well, nonlinear optics. Ok, so it was an optics heavy summer. But within the field of optics there was a great diversity of projects explored. But don’t take my word for it, read on to see what our students have to say about what they’ve been up to.

It’s a (Optical) Trap!!

This summer I returned home to Bombay, where I worked at the Tata Institute of Fundamental Research (T.I.F.R). This is probably the only place in India where fundamental research happens, the kind of research that has no commercial aim, the only aim being answering questions about the way things are. I was working on what was to be a joint effort between the Department of Biological Sciences (DBS) and the Department of Nuclear and Atomic Physics (DNAP). Of course, I was part of the latter, given the fact that I am a physics major and also startlingly incapable at Biology. My job was to calibrate an Optical Trap, which would then be used to force measurements of a DNA molecule.

The idea of an optical trap is to use a highly focused laser beam to trap very small particles. Using a 1064nm laser beam focused in a microscope we were able to trap 2 micron polystyrene particles that were floating in water. Now if a DNA molecule was attached to a bead at one end, and fixed to the microscope cover slip at the other, one could do things like pull it apart and find the force required. This was never done, as the student working for DBS had to leave. Finally the people I worked under figured out that if a mesh was placed in the path of the beam, we would get a number of traps which would be the orders of diffraction of the mesh. We made one, and I measured the spring constants for the first 4 orders of diffraction. This experiment should hopefully be published soon in Optics Express.

Varun “Mac” Makhija ‘08

A “Bloch-buster” Summer

I spent this past summer here at Drew participating in the Drew Summer Science Institute. Working on a theoretical project with Professor Supplee, I studied the response of a two-level atom to two time-delayed optical pulses. This was modeled two ways: the atom as a simple-harmonic oscillator being “jiggled” by an oscillating electric field (the Lorentz model), and then as a quantum atom with a time-evolving probability of being in the excited state (the Optical Bloch model). After developing a set of differential equations for each model, I then compared them. After seeing that the two models agree for certain limits, I investigated how they begin to disagree and tried to understand their behavior. I am currently continuing this research, which will hopefully culminate in an Honors Thesis this Spring.

Paul-Michael Huseman ‘07

Optics, Terror at Lehigh

On Tuesday, May 30th of this summer I set out for Lehigh University to participate in the Lehigh Physics Research Experience for Undergraduates (REU). I was looking forward to spending the summer getting paid to conduct

(Continued on page 3)
Franklin Turns 300

Happy Birthday Ben!

Jan 17, 1706

This year marks the 300th birthday of one of America’s favorite scientists, Benjamin Franklin. As such, we all should take a moment to consider what it is about him that draws us to think of him so fondly. Is it his role in the shaping of America as one of our founding fathers? Or possibly his pithy sayings that still apply to our lives today? As physicists, perhaps we admire his contributions to science, most famously his investigations of electricity. Personally, I admire the man’s character, which ironically, along with his intellect, shines most clearly through those very investigations.

Franklin’s interest in electricity began on a visit to Boston in 1746, when he witnessed a few electrical experiments, prompting him to contact Peter Collinson of London, a Fellow of the Royal Society, for more information. Collinson donated some of the most advanced electrical apparatus of that time, which Franklin added to his collection of strange contraptions purchased during that fateful day in Boston.

With the aid of a few close friends, Franklin began to speculate on the nature of electricity, based on the effect of pointed bodies in drawing off electricity. It was decided that electricity was not the result of friction, but that the mysterious force was diffused through most substances. Franklin also concluded that nature always tries to cause a system to reach an equilibrium point, introduced the concept of conservation of charge, and was the first to assign a positive and a negative sign as a way of distinguishing the different electrical charges, a convention we still use today.

Franklin’s flight of a kite during an electrical storm is perhaps one of his most well-known demonstrations, but ironically, it is not his most outrageous. In the demonstration, Franklin drew electricity from the clouds with a key attached to the end of a string, to charge a Leyden jar, thereby proving that lightning is indeed electricity. However, our dramatic and comical visions of Ol’ Ben foolishly flying the kite and waiting to be struck by lightning are not what really happened. In Joseph Priestley’s 1767 History and Present Status of Electricity, the evidence shows that Franklin was insulated, and in no danger of electrocution in the event of a lightning strike. (Others, such as Professor George Wilhelm Richmann of St. Petersburg, Russia, were spectacularly electrocuted during the months following Franklin’s experiment.) In his writings, Franklin indicates that he was aware of the dangers and offered alternative ways to demonstrate that lightning was electrical.

This is not to say that Franklin did not have some fun with his electrical demonstrations. Benjamin Franklin’s letters to Collinson tell of some of the tricks Franklin played on his neighbors. With electricity he set alcohol on fire, relighted candles just blown out, produced mimic flashes of lightning, gave shocks on touching or kissing, and caused an artificial spider to move mysteriously. Franklin also killed a fowl and then roasted it upon a spit turned by electricity, sent a current through water and found it still able to ignite alcohol, ignited gunpowder, and charged glasses of wine so that the drinkers received shocks. So indeed, Benjamin Franklin was quite an unusual character, and his story proves once again that fact is often stranger than fiction. So Happy Birthday, Ben; we salute you!

Laura Barclay ’08

Summer Research

(actual research on page 2)

actual research in a professional physics lab. Little did I know what awaited me in Pennsylvania.

It was around midnight on my very first night at Lehigh and I was just climbing into bed when I heard keys jingling at my door. Thinking it was another REU student who had mistaken my room for his own, I got up and opened the door. There stood two Lehigh Campus Police officers, looking very surprised to see me. One of them drew his sidearm and ordered me to get on the ground. Naturally, I obliged. I spent the next two minutes lying on the ground with my hands on my head, being interrogated at gunpoint as to why I was in the dorm. It turns out that somewhere along the line the Campus Police had not received the message that students would be staying in this building, and they had taken me for some sort of delinquent. Once we had sorted out the situation, the officers apologized for the incident and left.

Having had the living daylights scared out of me, the next day we began some serious physics. I worked with Dr. McGee and Nate Woodward in the optics lab of Dr. Volkmar Dierolf. The goal of our research was to write waveguides in lithium niobate crystals with an ultraviolet laser. The apparatus needed to be constructed from scratch, a task which took nearly half of the ten weeks I spent there. We utilized an Innova SabreFRED laser, an eight-foot long beast of a machine that could burn paper with invisible UV laser light. After many weeks spent aligning the setup and taming the beast, we finally began to get results which we could analyze. Though I was not there long enough to get anything conclusive, we had taken the first steps towards consistently writing the waveguides we sought, and the research continues at Lehigh to this day.

Dave Newby ’08

(Continued on page 4)
This summer I spent 10 weeks at Lehigh University participating in an REU/RUI funded research program. I worked with Dr. McGee and Lehigh’s Dr. Ivan Biaggio and one of his graduate students in the field of non-linear optics. My project was to investigate the phenomenon known as Second Harmonic Generation (SHG) in electro-optic polymer films. SHG, also called frequency doubling, is a non-linear effect by which a material converts an electromagnetic wave into a wave at twice the frequency (and half the wavelength). In my case, this meant a conversion of laser light from 1064nm (near IR) to 532nm (green). In dye-doped polymers like the ones Dr. McGee has been working with for years, SHG and the electro-optic effect are linked to the same property, namely, the second order non-linear susceptibility. This property is non-zero only when the alignment of dye molecules in the polymer creates an axis of symmetry. Our goal was to use SHG as an indicator of this alignment, and at this we were successful. I am now continuing this work with Dr. McGee in his lab at Drew, with the ultimate goal of obtaining meaningful measurements of the non-linear susceptibility, and observing how it changes in response to heating of the film.

Ethan Marsh ’07

A “Hyperfine” Experience

This summer I worked on an atomic physics project with Dr. Morgus at Lehigh University. The team also included Dr. Tyler Morgus (her husband) and Dr. Huennekens (her thesis advisor and the only person working on the project who wouldn’t respond to “Tyler”, “Dr. Morgus”, or both). My job involved reading papers to understand the project, (Continued on page 8)
Career Corner: Building a Better Resume

With the change of season comes the time to start thinking about applications—applications to graduate school, job applications, DSSI applications...you get the idea. For almost any application, you will be asked to submit a resume. Now, you may think that resumes only matter when you are looking for “The Job”, and that for temporary college employment like NSF-REU internships it doesn’t matter much. It would be a bit shortsighted to think this way. Programs like REU are typically oversubscribed and a well-executed resume gives you an opportunity to present information that doesn’t always have a blank to fill in on the application form, which of course can help you stand out above other equally qualified candidates. When you do get around to applying for “The Job”, the resume skills you honed as an undergraduate will pay off. As a member of many faculty search committees, I can tell you it is never too early to master the art of resume preparation.

The following guidelines and frequently asked questions should help you plan your resume:

Should I include an “Objective” statement?

Probably not. There are likely other opportunities in the application package to express why you want a position with company X. For jobs, it would be in the cover letter. For summer internships you will likely be asked to write a personal statement. In either case, avoid the typical objective statement “to obtain a position within your company”, as it may do more harm than good.

Do not include personal information beyond that which is necessary to identify you.

Height, weight, marital status, and social security number (yes, I’ve seen them all on resumes) do not belong on a resume. Keep in mind that resumes can and do end up in an unsecured file box somewhere. So, unless you’d like your identity stolen in addition to being unemployed, limit personal information to that which is relevant to the job. By the same token make sure you can be contacted easily, particularly if you maintain multiple addresses over the course of the year. Include a mailing address, email, home phone, and cell phone number.

But what if I’ve only had one job so far?

This is a very common situation. The traditional resume is thought of as a listing of job history. Perhaps it is more accurate to think of it as an experience history. College students won’t have much job history to speak of, but they should have experience useful to potential summer employers or graduate schools. Any tutoring or intro lab experience should be listed. Summer and Independent Study work should likewise be highlighted, particularly because it shows motivation and initiative.

What else is useful to include?

A section labeled “Lab Skills” or “Computer Skills” is a chance to highlight skills coveted by many employers. Briefly list what you can do. LabView programming and website development are classic examples of skills that should be on prominent display. Advanced lab students are also familiar with nuclear instrumentation, optoelectronics, lasers, and fiber optics. If you’ve had electronics, it may also be appropriate to include your experience with digital and linear electronics.

Should I obsess over typographical details?

For spelling and grammar, yes. Use computer spell checkers carefully, making sure you double check yourself. For font and length guidelines, you should not vary much from 12 point in a relatively easy-to-read Times New Roman font, and should almost never exceed 1-2 pages. If the employer wants the resume in electronic form, send it as a PDF (unless explicitly directed otherwise) since the indents and tabs of your text document may show up differently in someone else’s word processing application.

Dr. David McGee

New Provost at Drew

New Provost at Drew

building and rightfully asserts that the “program should drive the facility.” Any new building must “have places where faculty and students can be engaged in research.”

The Provost believes that the Drew Summer Science Institute is “very important” because it helps support faculty research, offers outstanding experiential learning for the students, and provides excellent preparation for graduate school. “DSSI represents the best of relationships that exist in an undergraduate environment.” Because of limited funding, Gunter-Smith does not know how large DSSI can reasonably grow, but would like provide a “DSSI-like experience to more students.”

Additionally, the Provost sees the Research Institute for Scientists Emeriti as an invaluable resource because the RISE fellows “bring experience and contacts from the outside and help students bridge classroom experience with its practical application to future careers.”

With a focus on experience and intellectual synthesis, the plan for Drew’s future is euphoric, and very much shaped by the experience of Dr. Gunter-Smith. “Back where I’m from we have a saying: ‘science is a way of knowing.’” Perhaps that should be engraved over the entrance to the Hall of Sciences 2.0.

Paul-Michael Huseman ‘07

Bored? Check out...

the nucleus

Resources for undergraduate physics and astronomy students

http://www.compadre.org/student
The Remarkable Variational Calculus

“The ways of God are subtle but he is not malicious.” This famous saying of Einstein’s is an expression of his faith that it is within the power of humans to comprehend the natural world. Einstein was not a religious man in the conventional sense; he used the word “God” metaphorically.

Two hundred years earlier, Pierre-Louis Maupertuis, a French mathematician and physicist, passionately believed the universe to be God’s creation and tried to derive from a mathematical principle proof of the existence of God. He argued that God must have arranged the material world to behave in the most economical way. The path of a projectile, for example, is such that it seeks out the state of lowest potential energy. A light ray proceeds from one point in space to another in the shortest possible time. Maupertuis conceived the hypothesis that in all natural events there is a quantity called “action” that is a minimum.

Unfortunately, Maupertuis’ mathematics was far behind the high standards of the 18th century. He applied his principle to the derivation of the laws of elastic collisions; he obtained the correct result by an entirely incorrect method. Nevertheless, Maupertuis is credited with having discovered the principle of least action, the foundation of the calculus of variations. (Whether his discovery is proof of the existence of God is a moot question.)

It turns out that the great Swiss mathematician, Leonard Euler, discovered the least action principle at least a year before Maupertuis did, and understood the conditions under which it holds – qualifications that completely escaped Maupertuis’ notice. Yet Euler defended the priority rights of Maupertuis and refrained from mentioning his own achievements. Euler’s self-effacing modesty has no parallel in the history of science. Contrary examples are in abundance.

Eventually, Euler received the credit he deserved. Together with the eminent French mathematician, Joseph Louis Lagrange, he created the modern science of analytical mechanics. The so-called Euler-Lagrange equations are a direct consequence of the least action principle. The equations yield the solution of any mechanical problem, provided the kinetic energy and potential energy of the system are known. The method has been universally acclaimed as possessing extraordinary beauty, elegance, and depth.

In our course in mathematical physics this fall, we began with a study of the calculus of variations. We solved problems in central field motion, analyzed the propagation of sound in the ocean, derived the laws of optical reflection and refraction, and saw how the wave equation emerges from the Euler-Lagrange equations for a stretched string. We came to appreciate the applicability of the method in a variety of fields – electromagnetic theory, the general theory of relativity, quantum mechanics, and even particle physics.

When I was exposed to the variational calculus as an undergraduate, I remember hounding professors with the question, “Is this it? Is this the ultimate theory?” They smiled at me and said, “You’ll see.” Today my feeling is that if it’s not the last word, it comes pretty close. Einstein’s faith seems well-placed.

Dr. Ashley Carter

New Lab, and More
(Continued from page 1)

and improved lighting, new laboratory chairs, new paint and blackboard, and new storage cabinets to better keep more of the intro lab equipment in that room. The room has a "new" look and feel, and the physics experiments work better than ever.

A related physics project was to make good on our promise to Professor Laurie Morgus when we hired her a year ago: to provide a research lab for her to begin her experimental work at Drew. The plan was to convert and renovate our current demonstration room off the lecture hall into a small but effective research lab. The project was modest, requiring new lighting, electrical and plumbing work, and some new paint and cabinetry. The outcome was good, and Dr. Morgus and student Tyler Drake '06 are hard at work filling up the lab in preparation for some experimentation. The optics table is installed...stay tuned for more to come.

A major obstacle to the Morgus lab conversion project was what to do with all the demonstration equipment in that room at the time. This is historical stuff! Demonstration equipment was here from the dawn of physics at Drew. And we still needed much of it for ongoing classes today. A clever redesign of our central stockroom storage bins by our assistant Stephen Takacs led to a complete inventory of all of our stored equipment and instrumentation over the summer months. Almost every item on a shelf in the physics department was removed, stored while changes were made, and then replaced on and in newly configured shelving and cabinetry. Beautiful old instruments in oak boxes like ballistic galvanometers were put into our "historical archives" for future display or sale, some equipment was discarded (with great hesitation and some sadness for me), and the remainder of our currently used and useful equipment was put back on re-labeled shelves for service. We can all be found wandering a bit when looking for that special video camera that used to be somewhere else, but all in all, it's a successful outcome that now makes far better use of our limited storage areas. And we have a new research lab and far less junk around. If you've ever renovated a kitchen you have a sense of our adventures. It was quite a summer...again.

Dr. Robert Fenztermacher
So here I am in my first semester of grad school, already being asked to write for “Notes From the Outside.” On one level it is still shocking to realize that I am now officially on the “outside.” However, though I have not traveled nearly as far as my fellow 2006 graduates Elizabeth Bannon (now in India) or Alison Steele (now in Japan), there are some things about this first semester at Kansas State University that have made me feel very far from home. Classrooms seventy-five percent full of males? What happened to the female dominance we had at Drew? I have to pump my own gas? Temperature variations of 50 degrees in one day? One thing that’s always there to remind me of home is... the humidity! Who would have thought Kansas would be so humid? I still don’t get it; we’re landlocked in the middle of the continent!

My first semester has been a somewhat less-than-typical experience I would guess. I’m taking some upper-level undergraduate courses to catch up with the material covered in the undergraduate program here (and to get ready for the departmental exam). Additionally, I am working as a research assistant rather than as a teaching assistant. Things worked out this way because I returned to the same school at which I completed a summer research program in the summer of 2005. So I have had the opportunity to continue work on my project from that summer. This has both good and bad sides. Getting to do research in my first semester is a great opportunity professionally. I was able to give a talk at a sectional AAPT meeting a few weeks ago, and should be attending at least one more conference this summer. This puts me at conferences a year ahead of most students in my research group. The difficult part, however, is balancing my homework and research. While teaching and research responsibilities are both supposed to take about twenty hours a week, research is more open-ended as I’m never really “finished.” Luckily, my advisor is very supportive, and encourages me to put my studies before my research. After all, you need to pass your classes in order to stay in graduate school!

For those of you who may be going on to graduate school, I can offer a little advice on two different fronts:

First, some general graduate school advice. From what I can tell so far, graduate school is about balance: balancing your research or teaching obligations; balancing your efforts in quantum mechanics with your efforts in thermodynamics; balancing working time with sleeping time; balancing your coffee and water intake so you’re awake but don’t have a debilitating headache. You must be careful to maintain the balance. Homework assignments will most likely require some late nights in your office, which might make you feel pretty lonely. Take a walk around the building and there are probably many other students up and working, maybe even some from your class; you’re not alone after all! One of the more important decisions you will need to make fairly early in your graduate school career is to choose a research advisor. Some things you may want to consider are how long his or her students take to graduate, what hours they keep, how many conferences they attend, and how many papers they publish. Talk to his or her students and make sure you will be happy with their life!

Second, some advice for those who may share my own interest in physics education research. It is our goal in physics education research (PER) to develop strategies that help students best learn physics, and to publish these results so physics instructors do not need to constantly “reinvent the wheel” and re-discover these best methods by themselves. That said, we are well aware that there is no one “best” way to teach a subject. Research results are presented at regional and national AAPT meetings, so attending those may provide you with new ideas. Also articles accessible to the general physics community are published in The Physics Teacher and The American Journal of Physics (the latter being more technical in nature). Additionally there are a few books I would suggest to those interested in applying some general research findings to their teaching. You may want to look at Five Easy Lessons: Strategies for Successful Physics Teaching by Randall D. Knight, Guide to Introductory Physics Teaching by Arnold Arons, or Teaching Introductory Physics: A Sourcebook by Charles E. Schwartz and Thomas Miner.

So, that’s what I’ve been up to in the past few months. If you have any questions or would like to discuss anything about graduate school or physics education research, please contact me at haynicz@phys.ksu.edu. I look forward to hearing from you!

Jackie Haynicz, ‘06
alignment and operation of lasers, machining, plumbing, statistics, electronics, crawling under tables, computer simulation, and playing outfield among other things.

Our project, studying hyperfine state changing collisions in atomic Cesium, was a difficult one. We worked hard, and even though it was sometimes frustrating, it was enjoyable to see and help solve some of the many problems that arose. We ended up with presentable data at close to the deadline, which was also satisfying.

Tyler Drake ’07

Senior has Great Summer, Forgets to Write Article

Senior Evan Smith spent part of his summer working in Dr. McGee’s lab on various projects. He fired up the new spin coater and started making some new polymer films. He also continued working on the prism coupling experiment he started last semester. He is currently continuing the work with Dr. McGee for Independent Study.

Upcoming Events

November 10: Science Day
Welcome prospective students!

December 12: Taco Party
Tacos, physics toys, and holiday cheer. What more do you need?

In the Spring look for:
Our year-end banquet and induction into ΣΠΣ, Dr. F’s annual picnic, and commencement!

Don’t forget to visit the physics department website at: http://depts.drew.edu/phys/

Drew University
Department of Physics
Madison NJ
07940

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