

*Infinite Possibilities: Profiles of Summer Research
from the Gattton Academy*

Summer 2011



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CAROL MARTIN GATTON
ACADEMY OF
MATHEMATICS
AND SCIENCE
IN KENTUCKY

*Infinite Possibilities:
Profiles of Summer Research
from Gatton Academy*

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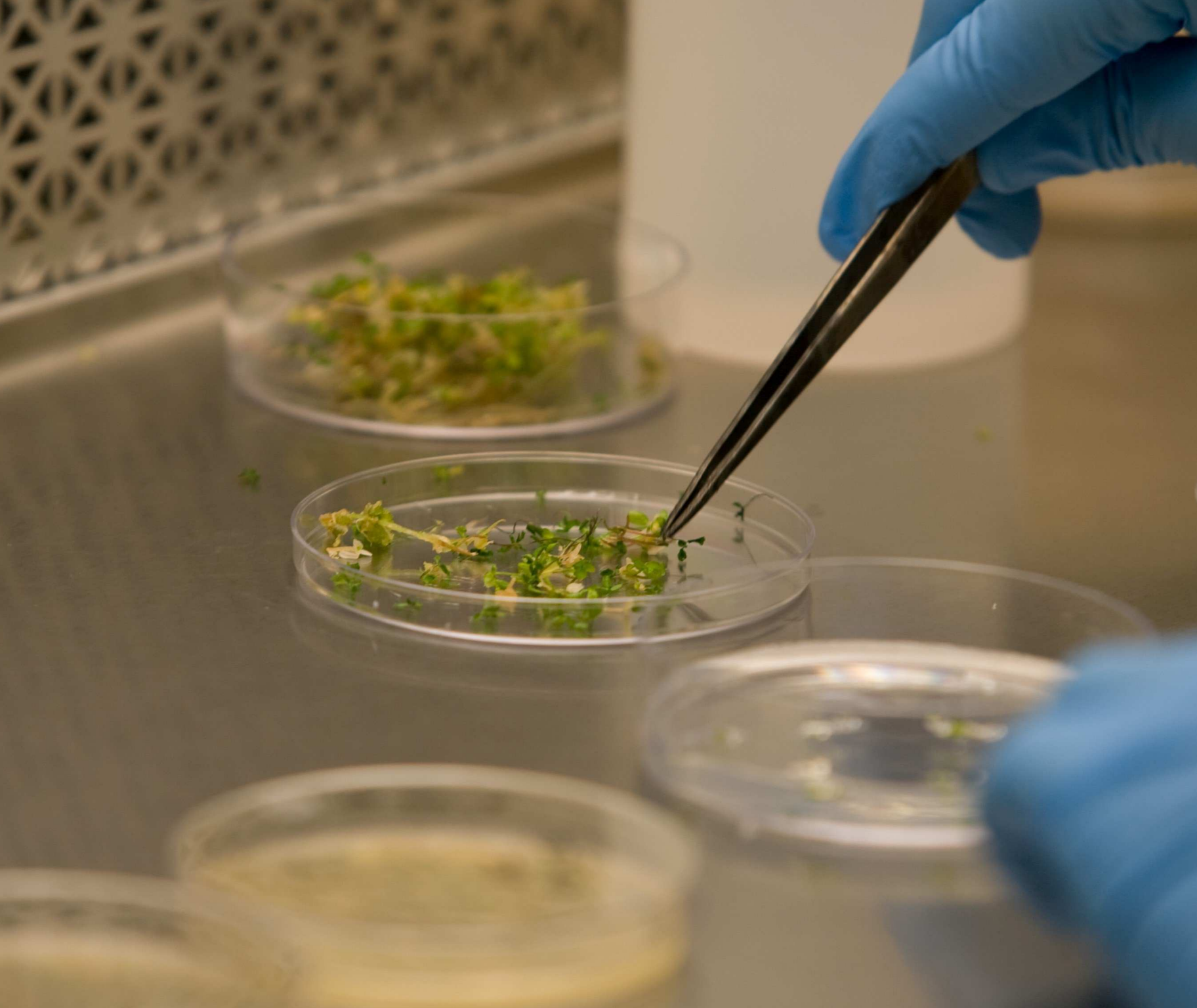


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Dear Mr. Gatton,

Imagine fifteen and sixteen year-olds working alongside professional scientists at research. They may be examining how oxygen therapy can contribute to faster and healthier wound healing, or working on innovative ways to detect explosives. At the Gatton Academy, this is happening! Kentucky's brightest young minds are being put to the ultimate challenge as they conduct mentored research during the academic year and in intensive research internships during the summer months.

Our strategic partnership with Western Kentucky University benefits our students by offering abundant research opportunities immediately outside the doors of Florence Schneider Hall. The partnership that has developed allows our students a broad range of research options in any of the departments of the Ogden College of Science and Engineering and the social science departments of other colleges throughout the university. For the student, this plays out in a one-to-one mentorship from the dedicated faculty of our university.

Two years back, we initiated the Gatton Research Internship Grant program from your gift to our school. This funding directly creates additional research positions for Gatton Academy students to undertake full-time summer research experiences across the Commonwealth and beyond. To date, 23 students have received these grants. You'll learn more about this year's recipients and their experiences in the following pages.

The successes of our student body are very convincing, and we prevail in forging new relationships with excellent research facilities each year. As our research program has grown, so have the achievements of our students. Here are just a few from the 2010-11 academic year:

- 107 scientific talks and posters were presented this year by Gatton Academy students at research symposiums across the country.
- Gatton Academy students become semi-finalists and finalists in the following high school competitions: the Intel Science Talent Search, the DuPont Challenge, the U.S. Department of Education's Presidential Scholars Program, the NYU Poly/Time Warner Inno/Vention Contest, and the national CSAW CyberSecurity Competition.
- Gatton Academy students competed with traditional undergraduate students, and were successful in their applications, for the following awards: the Goldwater Scholarship, the Department of Defense's SMART Scholarship, the Environmental Protection Agency's Greater Research Opportunities fellowship, and the National Science Foundation's Research Experiences for Undergraduates and International Research Opportunities programs.

The students you'll see profiled and read about here today are the students you will see featured in the science breakthrough headlines of tomorrow. They are illustrative of the true power of what young, creative minds are capable of when placed in a dedicated STEM setting and invited to explore their passions. Thank you so much for helping create these wonderful avenues for student success. Enjoy meeting these fine young scientists!

Sincerely,

Derick B. Strobe

Coordinator: Research, Internships, and Scholarships





About the Gatton Research Internship Grant Program

The Gatton Academy of Mathematics and Science in Kentucky created the Gatton Research Internship Grants program in 2010. Made possible from a gift from Mr. Carol Martin “Bill” Gatton, the program offers grants to Gatton Academy students between their junior and senior years to support summer time research internships across the Commonwealth and the world. By providing a funding mechanism, the program directly creates research internships that otherwise would not have existed for Gatton Academy students. In its first two years, the program has already made possible 23 research internships for Gatton Academy students to study STEM problems in their area of interest in a devoted, full-time research setting.

This summer, the program is funding 12 rising high school seniors who attend the Gatton Academy. Performing research in medical, chemical, national security, and computer science settings, just to name a few, these students’ groundbreaking work will shed positive effects in the not-so-distant future. The following pages feature the summer of 2011 Gatton Research Internships Grant recipients. Each student is represented by a headshot, a personal thank you, a glimpse of the research projects from their mentor's perspective, and some photos showing their research in action.



William J. Bickett

Owensboro, KY (Daviness County)

"The thing I love most about the Academy is that it's full of kids like me and that I feel like I belong there."

Dear Mr. Gatton,

I would like to express my sincerest gratitude for your generous gift to the Gatton Academy. Your generosity has allowed me and many others like me the opportunities to go above and beyond the typical high school student and also to fulfill our dreams and desires. We do this by attending and excelling in the Academy and by participating in things like summer research. Both of these made possible by you and your humanitarian efforts.

My name is William Joseph Bickett, and I come from a long and rich agricultural background. I was initially interested in the Gatton Academy because I realized at an early age that I was not the ordinary, average student. Luckily, I heard about the Academy where I could exercise my mental abilities to the fullest and earn one of the best educations in the nation. Needless to say that I rose up and snatched that opportunity like a kid in a

candy store. Since attending the Academy, I have realized that I would like to get a PhD in some type of physics and eventually start my own company. I am currently working on nuclear physics research with Dr. Womble. This research has been a great opportunity for me to learn about nuclear physics and get tons of hands-on experience. This will allow me to stand out among the other applicants to the institutions to which I will be applying.

All – in – all, I would like to thank you once again for your generosity which has provided me with a one of a kind education and allowed me to create a rock solid academic foundation that I will use to excel and strive in my future.

Sincerely,

William J. Bickett

**Dr. Phillip Womble, Professor, Physics & Astronomy,
Western Kentucky University**



Students: Benjamin Rice and William Bickett

What is the real-world application/importance of the research project that Will and Ben are taking on this summer?

Will and Ben are working in explosives and chemical agent detection using neutrons. Systems such as the one that Will and Ben are helping to develop are used to clean up former battle fields and firing ranges and to destroy chemical stockpiles.

What promise does Will/Ben show that led you to take them on as a mentee this summer?

Both Will and Ben had enthusiasm and a willingness to learn and try new things.

What importance do you see for the creation of funded student research positions in your discipline?

Physicists are on the endangered species list. The number of physics students has been steadily declining. The US is importing most of its physicists. The importance is that students get to do something other than classroom activities which helps them learn a bigger picture of physics.



"I have been working on subjecting samples to neutron radiation and measuring the emitted gamma-rays at various angles. I'm doing this in order to get a better feel for how the Doppler Shift effects the readings of gamma ray based explosive detectors."



"My research requires me to do a large variety of things, from working in the machine shop, creating various components of our setup, to running complex and expensive equipment such as neutron generators."



"This research experience has allowed me to get first-hand experience in the type of workplace that I hope to one day end up in. My research also makes me an outstanding candidate for just about anything I want to apply for."



Rebecca Brown

Boston, KY (Nelson County)

"To me, research is being able to produce new data. By doing research, you're contributing something new to the scientific community."

Mr. Gatton,

Thank you incredibly for your contribution to this year's research internship grants. I received \$2000 to fund five weeks of research, and I have to say that as time goes on, I keep realizing what a great experience it is. Without your help, I couldn't have afforded to attend, and I'm extremely grateful.

My field of interest is astrophysics; specifically, active galactic nuclei, which are supermassive black holes in galactic centers that are consuming matter from the surrounding environment. AGNs have jets of matter shooting out at extreme velocities; when these jets are pointed relatively in the earth's direction, they're called blazars. My research involves measuring the brightness of these blazars—which is an indication of how active they are—from pictures taken at the Robotically Controlled Telescope in Kitt Peak, Arizona.

I began my research in the middle of last semester with Dr. Michael Carini here at WKU. Although it was a good chance to start research, it's nearly impossible to get too much done by going in for a few hours three times a week. This summer, I'm working eight hours a day. I was happy when I could finally start producing results last semester, but that was nothing compared to how much I'm able to get done in my summer research environment.

Thank you for funding this wonderful opportunity.

Sincerely,
Rebecca Brown



**Dr. Michael Carini, Professor, Physics & Astronomy,
Western Kentucky University**

What is the real-world application/importance of the research project Rebecca is taking on this summer?

Rebecca's work is directly related to furthering our understanding of the physics behind some of the most energetic objects in the Universe, known as Blazars. Her data will be combined with data from scientists world-wide to build a picture of the emission mechanisms at work in these objects.

What promise does Rebecca show that led you to take her on as a mentee this summer?

Rebecca worked with me in the spring, and her enthusiasm for astronomy research, her intellect and excellent work ethic were all important factors in my decision to take her on as a mentee this summer.

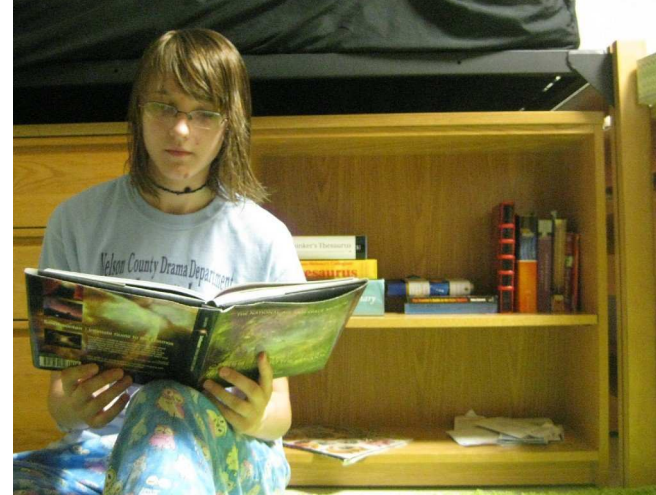
What importance do you see for the creation of funded student research positions in your discipline?

I see a great importance for funded student research positions in physics and astronomy. Our experience has shown that students who we can engage as undergraduates in research projects which allow them to apply their classroom knowledge are far better prepared for advanced study in graduate school and for the workplace.

"My research is in astronomy/astrophysics. I'm staying on the WKU campus for five weeks continuing the research I started last semester. From 9 to 5 on weekdays, I work in the Physics and Astronomy Department reducing data from images of blazars taken from the Kitt Peak telescope in Arizona. The data I'm collecting is a measurement of the blazars' magnitude, or brightness, which in turn indicates whether or not it's actively consuming matter."

"As part of the internship, I will write a research paper. This paper closely follows those for Siemens competition entries, so I hope to use a polished version of the research paper to enter."

"My ability to communicate with other people has by far been the biggest change I experienced during my junior year. Previously I'd been quite literally scared of other people; I was much more comfortable alone. When I came to Gatton I was introduced to like-minded peers and an excellent support staff, and that has been slowly overturning my outlook on merely talking to other people."





John "Jack" Ferguson

Union, KY (Boone County)

"We could all live in our own little worlds and not know each other, but the social atmosphere of the Academy has made me more friends than I've ever had before."

Dear Mr. Gatton,

The Academy has had a serious impact on me more than any other school I've been to. I've always been good at school, but for the first time here, I actually liked school, and I mean that. I know that it isn't an easy school, and I know that it isn't for everyone, but I think that the schools like the Gatton Academy should be available in every state. During my sophomore year at my old high school, I was taking classes only available to seniors. If I hadn't had the privilege of the Academy, I would have been stuck in the back of an empty classroom with a textbook my senior year. Instead I am in multivariable calculus and organic chemistry with university students.

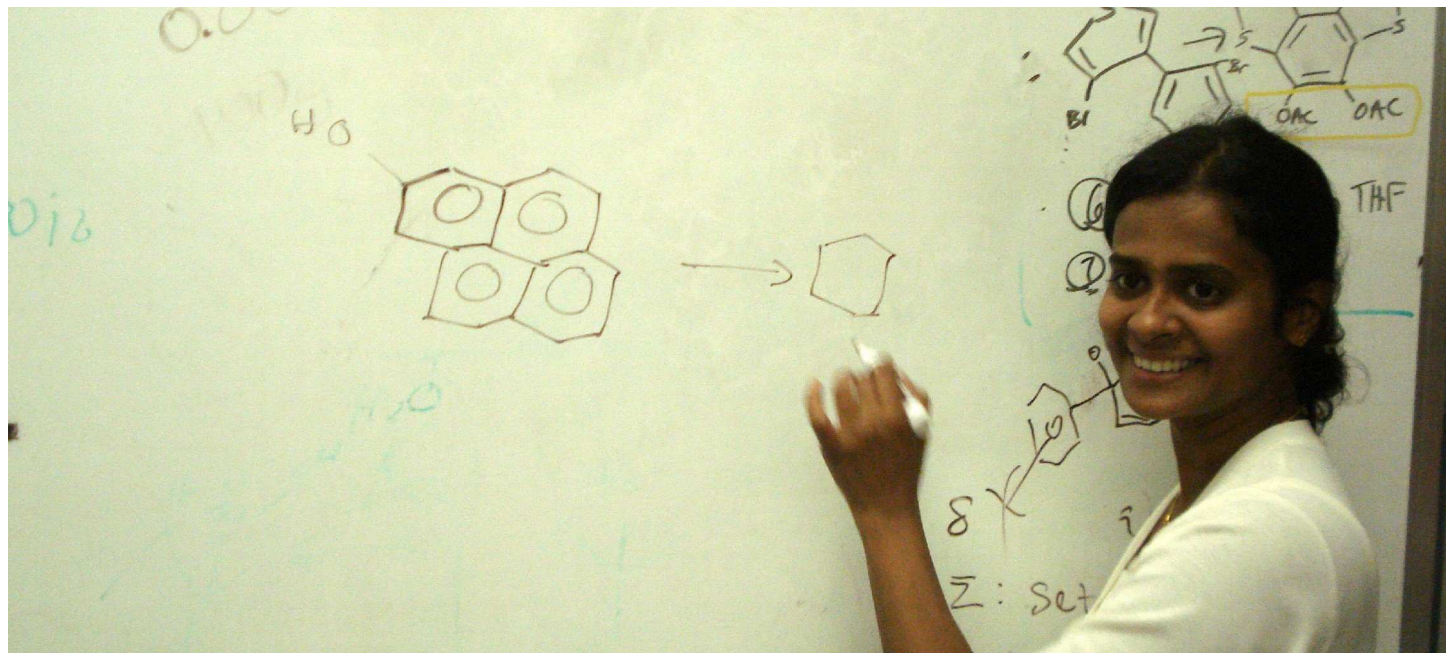
Everyone knew me as the smart kid, but I never had a lot of friends. High school may not be about making friends, but I think its worth noting that I have more friends in our class of 120 then I had in all 1200 kids in my hometown public

high school. You've opened up more doors to me than anyone; I'm taking classes that college juniors struggle with, and I've never been happier with school.

You could have built a normal high school, but instead you built the Academy. Anyone can see that we have the best test scores in the state, but numbers can't show the atmosphere here. I've never been proud to go to high school before, but going to the Academy has been an honor. You really have made a difference in the lives of myself and many others, and I mean it when I say thank you.

Thank You.

Sincerely,
Jack Ferguson



Dr. Hemali Rathnayake, Assistant Professor, Chemistry, Western Kentucky University

What is the real-world application/importance of the research project Jack is taking on this summer?

Jack is working on making fluorescence hybrid nanoparticles. There are promising candidates for bio-imaging, drug delivery and therapeutic applications.

What promise does Jack show that led you to take him on as a mentee this summer?

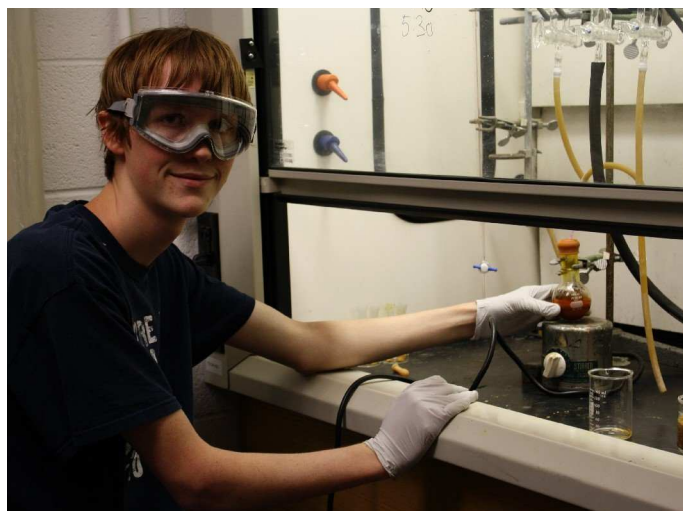
His dedication and creativity to take this project forward.

What importance do you see for the creation of funded student research positions in your discipline?

It will encourage students to become involved in materials science research. The financial support through the Gatton Academy will have an impact on developing nanomaterials research programs under the Physics Institute at WKU.

"I am working on the synthesis of fluorescein silsesquioxane nanoparticles with Benzyl Chloride. It sounds really complicated, but it's basically attaching fluorescent particles onto silica spheres smaller than cells for bio imaging."

"This research will be used on any applications I can fit it on, and I will be sure to enter it into the Siemen's and Intel competitions."





Alex Gutierrez

Mount Washington, KY (Bullitt County)

"It's a good thing when you can say you've taken part in the same research with those twice your age and far along in their career experience."

Dear Mr. Gatton,

I want to thank you for everything you've made possible for me. Before this program, simply attending college was the highlight of my goals. Neither of my parents went to college before, in fact only eight of my relatives actually have attended or are attending college. To find out that I'd be given a chance not only to attend college, but to attend at such a young age and to be granted extra opportunities was just a dream to me! I aspire to be a surgeon one day, and to be honest, I doubt I would have made it with my previous school. It seems I was the only one asking my friends "What do you want to do when you get out of here?" which only lead to an "I don't know." When I ask my friends at the Gatton Academy the same question, I'm hearing careers I didn't even know existed.

Originally, I only wanted to come to the Gatton Academy to attend college early and to hopefully gain an insight on

my career. But now, I see the Academy is so much more than that. It's really a life changing experience. I admit that I wasn't even close to being an overachiever and I simply got amazing grades while sleeping in my classes. But now I've gotten an insight on the real world, the world where everything isn't as it seems and nothing is just handed to you. I see the value of hard work and determination. In essence, I've kept the same goal of gaining an insight on my future career choice. I've seen what it takes to achieve what I want, and I'm fully committed to doing whatever it takes to gain it.

From one of the many lives
you've changed,

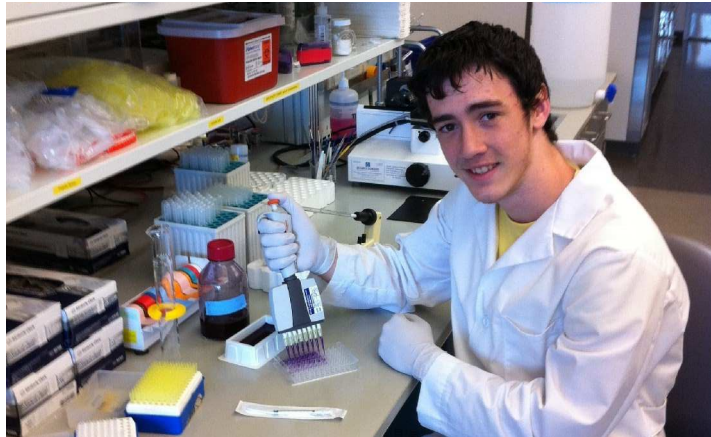
Alex Gutierrez



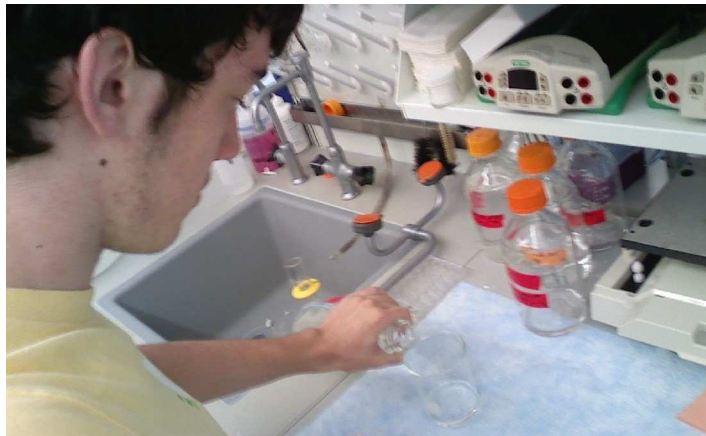
Dr. Kathryn Saatman, Professor, University of Kentucky Spinal Cord and Brain Injury Research Center (SCoBIRC)

Alex Gutierrez is working on a project investigating whether treatment with human insulin-like growth factor-1 (IGF-1) can reduce the extent of brain damage after a contusion type of brain injury in a mouse model. He is helping to provide the first evidence that IGF-1 is able to limit death of neurons in the brain after traumatic injury. Alex's work will hopefully contribute to a growing pool of data that would support the initiation of a clinical trial of IGF-1 in patients suffering from traumatic brain injury. I was excited to have Alex join my laboratory for the summer, based both on my past positive experiences with students from the Gatton Academy and on Alex's enthusiasm and persistence in pursuing a research opportunity. His willingness to jump into a new experience and learn hands-on laboratory

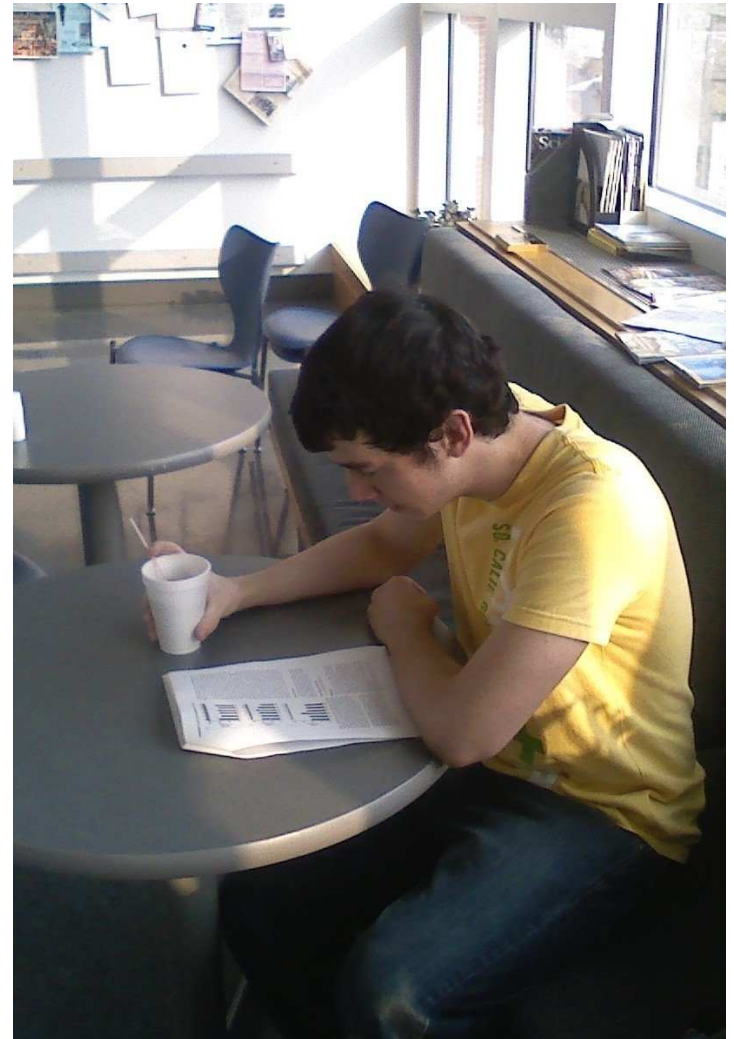
research skills convinced me to bring him into the lab as part of our research team. Support for summer research experiences such as Alex's is so important in exposing bright young minds to the challenges and excitement of laboratory research. Capturing the interest of promising students for scientific inquiry early in their exploration of career possibilities is absolutely vital in encouraging those with curious, logical mindsets to consider further research-related educational opportunities.



"I am working with Insulin-like Growth Factor-1, a natural occurring protein in the body that acts as a neurotrophic factor, inducing the survival neurons after Traumatic Brain Injury (TBI)."



"I love the fact that each trial is significant rather than a tedious repetition of an experiment in which the outcome is fully expected."



"When you've left your home at age 16 and experienced so many things you thought you'd never even see the light of, anything seems possible."



Anthony Gutierrez

Mount Washington, KY (Bullitt County)

"I have a new sense of purpose when it comes to education, as I feel that my goals are closer than I would have thought."

Dear Mr. Gatton,

Hello, I am Anthony Gutierrez. I would like to start off to say that this means so much to be able to take part in research this summer. I wouldn't ever have believed I would be able to do medical research at the age of 17. Usually, I would have spent my summer being unproductive, but since I applied to the Gatton Academy, I have been able to pursue my interests.

I remember when I first heard about the Gatton Academy, I didn't think too much of it. I thought it was just a special school for kids who were only interested in Science and Mathematics, but in a closed school environment. However, once I attended the information meeting, I knew that the Gatton Academy was meant for me.

It is opportunities like this summer research that I feel blessed to be a part of the Academy. This research gives me a head start to exploring my medical interests, as I have received guidance from several other post-doc and student researchers. Also, being able to work with them is a reward in itself, as I am considered an equal in their lab in regards to responsibilities. Once again, that was something which I wouldn't have dreamed of doing for years.

In the future, I plan on attending medical school and then working on becoming a surgeon. This has always been a goal of mine, but I have never been given the chance to pursue it. With research opportunities such as the one I am taking part in, I have the ability to get a head start on my future with experiences that will benefit me in the future. Again, this has meant so much to me, as I know that it will look good on my research resume to show that I have already done medical research. So, thank you very much for the opportunity!

Sincerely,

Anthony Gutierrez



Dr. Alexander "Sasha" Rabchevsky, Associate Professor, Physiology, University of Kentucky Spinal Cord & Brain Injury Research Center (SCoBIRC)

What is the real-world application/importance of the research project Anthony is taking on this summer?

The overall objective of Anthony's experience in my lab is to observe, learn and develop expertise in surgical, histological, biochemical and molecular biological approaches to study the pathophysiology of spinal cord injury (SCI); notably conducted on experimental rats. Moreover, he is to develop an understanding of how complex surgeries are conducted, in conjunction with long-term post-operative animal care, as well as why certain therapeutic pharmacological agents are being tested in my laboratory.

The work that Anthony is undertaking is related to a grant we have examining whether peripheral inflammation, after complete SCI in experimental rats, renders them more susceptible to severe episodes of a hypertensive condition termed Autonomic Dysreflexia (AD).

What promise does Anthony show that led you to take him on as a mentee this summer?

Anthony has already conducted research for two semesters at WKU under the guidance of Howard Hughes Fellow, Dr. Rodney King, for whom he collected soil samples and subsequent isolation of bacteriophages, along with compiling bioinformatics. After meeting, he expressed a potential desire to go into medicine and/or medical research and truly wanted to work in a clinically-relevant laboratory setting with live animals. He is very inquisitive and well-spoken, and he has evident training under a Howard Hughes Fellow regarding understanding of "the scientific method." He is eager to learn about SCI and potential ways to promote recovery and/or alleviate discomfort to the SCI population; understanding that numerous incremental steps are required for publishing data and results from experiments using live, severely injured experimental rats that required labor-intensive care.

"This has been a wonderful research experience so far. From the very first day I was experiencing the daily life of my lab, which revolves around Spinal Cord Injury. I watched dissection performed on rats that were knocked out with anesthesia, so it was a little surprising, as I have never seen a dissection."



"Honestly, in these weeks, I have experienced so much, yet I know there is still more to discover and work on. I have enjoyed my lab mates, as they are all fun to be around, yet they know how to get their work done and are willing to be patient with me and teach me how to do certain procedures. This is because my lab revolves around a certain motto: 'Watch it, do it, teach it.'"



"I plan on attending medical school, so this gives me a head start on my interest and resume. I plan on being a neurosurgeon or orthopedic surgeon, so both can deal with the spinal cord. As I am already learning clinical techniques, such as taking care of the patient pre and post-surgery, I am getting a head start on my education."





Charlotte Humes

Bardstown, KY (Nelson County)

"Last year, going to the Academy felt like embarking upon an adventure. This year, it feels like coming home."

Mr. Gatton,

I would like to express my appreciation for your generous gift. It allowed me to spend my summer in an amazing way—working under the mentorship of a professor and learning firsthand about being gainfully employed by a laboratory.

This summer I'm working under Dr. Nee, learning about a variety of things; the topics we've explored range from fluorescence to Raman to quantum mechanics, and I've performed experiments centered around each. I have spent a large portion of the summer thus far feeling like quite the handyman-- I now can identify Allen keys with ease, know the difference between nuts and bolts, and have confidence in my adroit wrench-handling. It doesn't always seem like working in a Chemistry lab would teach you such practical skills, but this summer has certainly proven that wrong.

An internship has been the perfect way to combine experience with learning. As I've repaired lasers which aren't working, I've learned much about tools and mechanics. As I've come in to work and directed my

projects, I've learned responsibility and the value of curiosity. But not only am I learning new skills, I'm finally using my old ones. Sometimes it feels like you spend years and years in a classroom learning how to calculate molarity (concentration), and how to make a solution of a certain one, how to calculate the grams needed to obtain this solution, and how to calculate the pH after it's been made. And you know what? Until this summer, I'd never actually needed to do any of that. Hours and hours of instruction, for seemingly no reason. Thankfully, the ability to do all of that was finally applied whilst making a laser dye this summer. Talk about validation!

It's been an awesome summer internship. I never could have afforded the rent, etc., without your gift, and I am so grateful that you helped bring about this experience. Thank you so much for helping make this summer *awesome*.

Sincerely,

Charlotte Humes



Dr. Matthew Nee, Assistant Professor, Chemistry, Western Kentucky University

What is the real-world application/importance of the research project Charlotte is taking on this summer?

The efficiency of solar cells is currently too low for them to be used as a widespread alternative energy source. Part of the difficulty is designing materials that can absorb sunlight and convert it to electric current. The efficiency of this conversion process will be studied using the time-resolved laser-induced fluorescence spectrometer that Charlotte is building.

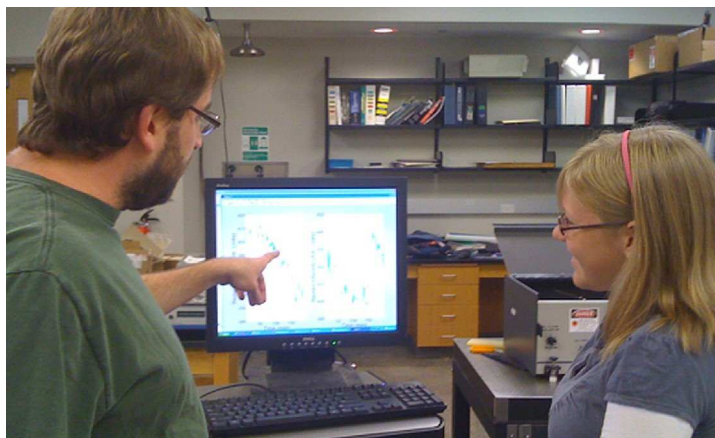
What promise does Charlotte show that led you to take her on as a mentee this summer?

Charlotte has a powerful combination of intelligence and self-motivation, coupled with a strong desire to learn. These qualities help her assess and complete complex tasks and learn

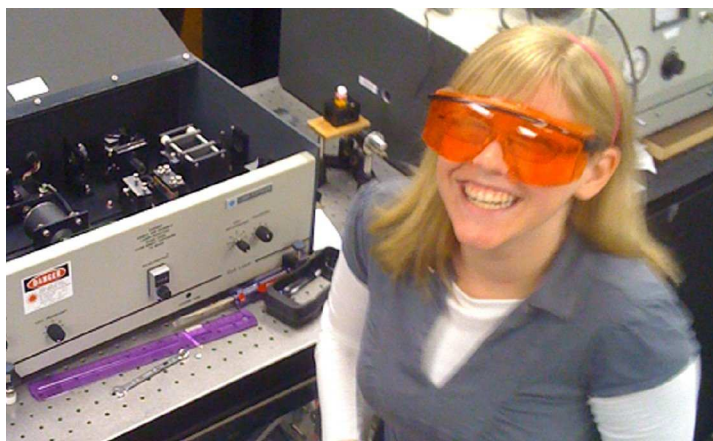
material far beyond the scope of her classroom experiences.

What importance do you see for the creation of funded student research positions in your discipline?

As an assistant professor at WKU, funded student research positions make possible opportunities for student research that might otherwise not be financially feasible. For the students, there is a level of pride in being paid for their own work; in many cases, this is an opportunity for them to see that they can earn a living doing exactly what they love.



"I am working in the Chemistry department under the instruction of Dr. Nee. The lab in which I am working is home to a number of lasers, but unfortunately, most of them are currently not working. During this summer, I'm fixing a couple of the lasers with the intent of making them ready for use in fluorescence measurements."



"I really enjoy the setting of research. Going home to see family during the summer is always nice, but the chance to spend part of my summer in a very independent, highly academic, environment is a great opportunity. It allows me to have a foretaste of what it will be like to live on my own."



"The Gatton Academy has helped me to become more focused. At home, you're constantly being pulled in different directions, but since coming here, I've been able to narrow down my interests."



Christian Jolly

Henderson, KY (Henderson County)

"The Academy shows youth that there are actually opportunities in their home state."

Mr. Gatton,

First and foremost I would like to introduce myself. My name is Christian Jolly. I am a rising senior from Henderson County and I am 17 years old. I am writing you today to extend a much deserved appreciatory thanks for the efforts you have put in to ensuring young people, like myself, have the opportunity to participate in a full-time research position. It has been an amazing experience.

I'm taking millions of blocks of data from two different sources gathered by telescopes. And then comparing those two together to find indicators of likely star formation! It is amazingly exciting work. The most exciting thing about it is I'm getting a first-hand view of what I want to do for the rest of my life. I'd love to go and get my PhD in astrophysics and this experience is only heightening that drive.

This experience is a once-in-a-lifetime opportunity. I have friends back home doing the same thing I would be doing if it wasn't for the grant. Can you guess what they are doing? A whole lot of nothing! Instead of wasting my summer away with the fallacies of video games and sleeping in, I'm getting out in the world! I am working a real, full-time research position.

Again, I would like to just thank you for all of your enthusiasm towards helping people like me achieve their dreams. This summer is a step towards the rest of my life, and a big one at that. Without you this would have never been possible.

Yours Truly,
Christian Jolly



Dr. Steven Gibson, Assistant Professor, Physics & Astronomy, Western Kentucky University

What is the real-world application/importance of the research project Christian is taking on this summer?

Interstellar space contains clouds of hydrogen gas as tenuous as the best laboratory vacuum, but under the right conditions these can be concentrated enough to collapse under their own gravity and form new stars and planets. Our own solar system is believed to have begun this way, but many details of the process are poorly understood. Christian is analyzing radio telescope observations from all around the world -- West Virginia, New Mexico, Canada, and Australia -- to see which interstellar clouds in different parts of the galaxy are the most likely to begin collapsing, and why. In this way we can better grasp what initial conditions are required for stars to form in galaxies, a key question in modern astrophysics.

What promise does Christian show that led you to take him on as a mentee this summer?

Christian took my 400-level astrophysics course this spring, a remarkable feat for a first-year student. He demonstrated a ready grasp of a wide variety of material in the classroom and laboratory. I was impressed by his ability to think on his feet and his good cheer in the face of challenges, so I was very pleased to get him as a summer research student.

What importance do you see for the creation of funded student research positions in your discipline?

I think they are a terrific asset. They give promising students a real opportunity to jump into the research world in the summer, when they can give it their full attention, and see how they like it. It's also a great chance for faculty to get to know these students better and help them gain some real experience that will serve them well in their academic career and beyond.

"The research I'm doing is actually quite groundbreaking making any results fairly significant. This will definitely be a huge selling point for applications and scholarships and you can be sure you'll see this around Intel and Siemens."



"This is exactly the type of work a person of my desired profession will be doing on a daily basis, giving me a strong foundation to base my decision on. "





Tennessee "Tucker" Joyce

Harrodsburg, KY (Mercer County)

"Research, to me means that I can work creatively on a new, unsolved problem. It means that the work I am doing here can have an impact on the world and help people."

Dear Mr. Gatton,

My name is Tennessee “Tucker” Joyce and I would like to sincerely thank you for the opportunity your gift has provided for me this summer. I am currently a rising senior at the Gatton Academy interested in pursuing a Mathematics major. Thanks to your donation, I am spending eight weeks this summer doing research at WKU with a professor from the Mathematics department. I am working in Mathematical Biology analyzing a new model of the healing process for chronic wounds. This is an amazing opportunity for a high school student and I am very thankful.

I am 17 years old and am from Mercer County in Central Kentucky. When I heard about the Gatton Academy two years ago, I was immediately captivated. As a high school student, to be able to live on campus and take college classes sounded amazing. I couldn't wait to apply and was overjoyed when I found

out I had gotten in. In the time that I have been at the Gatton Academy I have grown both intellectually and socially. It has been an amazing experience and I can't wait to come back for another year. One of the things I have really enjoyed while at the Academy was the chance to do research. I have been working on this project for two semesters now and it is still very interesting to me. The opportunity to continue this work over the summer in an even more focused environment is great. I am enjoying it very much and I hope to gain a lot from this experience!

Sincerely,

Tucker Joyce



**Dr. Richard Schugart, Assistant Professor,
Mathematics and Computer Science,
Western Kentucky University**

Tucker is continuing his work on a mathematical model for a bacterial infection in a chronic wound. Tucker is using mathematics to analyze the model to ensure that we can obtain biologically realistic from the formulated equations. Tucker is also conducting a number of computer simulations, which represent potentially novel topical oxygen therapies. The importance of computational and mathematical modeling is that it can reduce the number of animal trials and cost of clinical trials, while suggesting guidelines for improved therapeutic treatment strategies.

Tucker is one of the strongest students in the Academy, with tremendous potential for conducting mathematical research if he chooses that direction in the future. I recently presented some of his

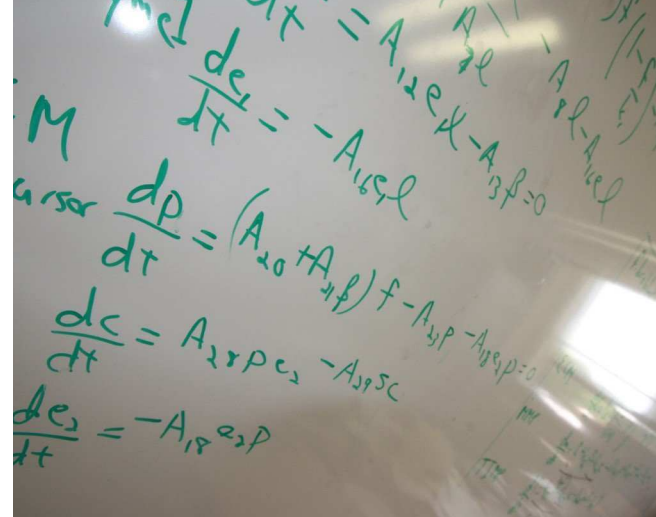
work at a conference, which included part of his final project for the computational problem solving class. The faculty member commented that the work is at the level of a Master's project.

Students have the opportunity to see where mathematics can be used in the real world. By actively engaging students in research, the experience can potentially stimulate a student's desire to pursue further studies, whether it in the area he is or she is conducting the research, or in another field. I would not be in my current position were it not for opportunity of student-funded research positions.

"I plan on applying to the Siemens Competition, Intel Competition, and probably some others too. The research experience here lends itself naturally to such competitions and this is one of the great benefits of doing research."

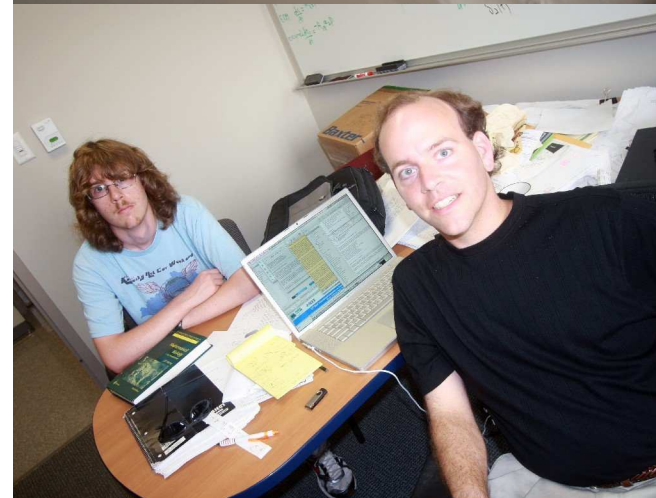
"This summer I am doing research under Dr. Richard Schugart in the WKU Mathematics Department. I am working on part of an ongoing project involving a new model of the process of wound healing for chronic wounds. I am working mostly with the mathematical aspect of the problem, gaining qualitative results and estimating parameter values."

"The thing I love most about the Gatton Academy is the idea that 128 of the most gifted students in the state are able to live and work together in one place. I feel that students as talented as those at the Gatton Academy can achieve much more when they can communicate with each other. The Gatton Academy creates a unique community in which this is possible and the opportunities that this provides are what I love about the Academy."



A whiteboard filled with handwritten mathematical equations in green marker. The equations include:

$$M \frac{dc}{dt} = -A_{15}e_1$$
$$\text{cursor } \frac{dp}{dt} = (A_{20} + A_{14}p)f - A_{13}p - A_{19}p = 0$$
$$\frac{dc}{dt} = A_{21}rpe_2 - A_{17}sc$$
$$\frac{de_2}{dt} = -A_{18}e_2p$$





Benjamin Rice

Somerset, KY (Pulaski County)

"My favorite part about the Gatton Academy is being able to take advanced classes that I would have not been able to take at my home high school."

Dear Mr. Gatton,

Thank you very much for the opportunity that is the Gatton Academy. Without the Academy, there is no way that I would be able to do university-level physics research. In fact, I would not even be able to take a physics class until senior year at my home high school (and the physics that is offered is algebra-based rather than calculus-based). Since I have been at the Gatton Academy, many doors have opened that have given me opportunities to take advantage of many great programs such as research. I have always enjoyed math, and it was always my strongest subject. Since coming to the Academy, I have decided to pursue a career that involves a lot of math. I really like physics, but I think that I would prefer a career in aerospace engineering. Aerospace engineering is not offered

anywhere in Kentucky, so that is why I am doing physics research instead. In order to prepare myself for an aeronautical engineering program down the road, I am loading up with math and physics courses. The Gatton Academy has allowed me to take classes that I could have only dreamed of at my home high school. There is no way that I would have ever been able to take partial differential equations or Physics II.

Thank you again for allowing me this opportunity to do research and the opportunity to attend the Gatton Academy.

Thank you,
Ben Rice

Dr. Phillip Womble, Professor, Physics & Astronomy, Western Kentucky University



Students: Benjamin Rice and William Bickett

What is the real-world application/importance of the research project that Will and Ben are taking on this summer?

Will and Ben are working in explosives and chemical agent detection using neutrons. Systems such as the one that Will and Ben are helping to develop are used to clean up former battle fields and firing ranges and to destroy chemical stockpiles.

What promise does Will/Ben show that led you to take them on as a mentee this summer?

Both Will and Ben had enthusiasm and a willingness to learn and try new things.

What importance do you see for the creation of funded student research positions in your discipline?

Physicists are on the endangered species list. The number of physics students has been steadily declining. The US is importing most of its physicists. The importance is that students get to do something other than classroom activities which helps them learn a bigger picture of physics.



"If I were at home now, I would probably be working, but instead I have the opportunity to do research."

"In the next ten years, I plan to graduate from the Gatton Academy, graduate from the United States Naval Academy with a degree in aeronautical engineering, and become a NAVY pilot."



David Sekora

Franklin, KY (Simpson County)

"We have our own little world in Florence Schneider, with our own culture and sensibilities."

Mr. Gatton,

Thank you for providing me with the means to partake of this amazing research experience. I know it might not sound like much excitement, just me sitting in an office for hours on Mathematica, but to me this is like a dream come true. My career plan is currently to be a mathematics professor at a university. If it weren't for your generous gift however, I would have had to find work elsewhere for the summer, probably working in a small retail store down the street. Instead, I have the luxury of a graduate office (with a hallway view!) in one of the nicest buildings on campus. Not to mention of course, the mentorship of two respected professors as they guide me throughout this experience, as well as the friendships I've fostered with some of the other mathematics instructors on my wing.

This, of course, is just a small portion of the greater Gatton experience which you

have also so altruistically funded. The Gatton Academy has been one of the best things to ever happen to me - it's given me more freedom to learn and grow at MY pace than any other institution! Words can't express how grateful I am to be able to take five high-level math classes in a single semester, and have professors and even peers that I can talk to on an intellectual level. The experiences I've had and the friends I've made over this first year have been just incredible and possible nowhere else but at the Gatton Academy. Thank you again, so much, for all your contributions.

Thank you,

David Sekora



Dr. Claus Ernst, Professor, Mathematics and Computer Science, Western Kentucky University

What is the real-world application/importance of the research project David is taking on this summer?

David Sekora is part of the team working on an NSF-funded, 3 year project (2010-2012) that currently involves three faculty (Professors Ernst, Ziegler (WKU) and Professor Diao (UNCC) and one graduate student (Anthony Montemayor (WKU)). The goal of the project is to create random polygons in confinement and study their properties. This simulation is motivated by data from bacteriophage P4 viruses about

DNA molecules (modeled by polygons) packed into capsids (modeled as confinement).

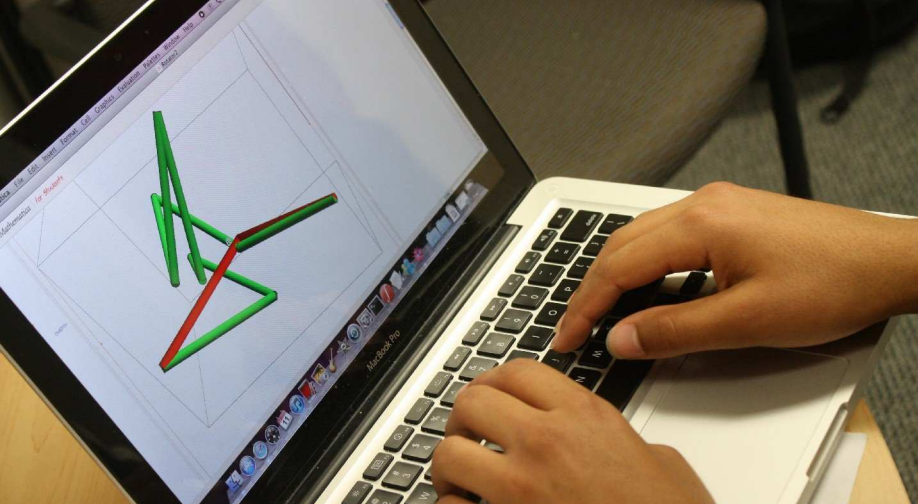
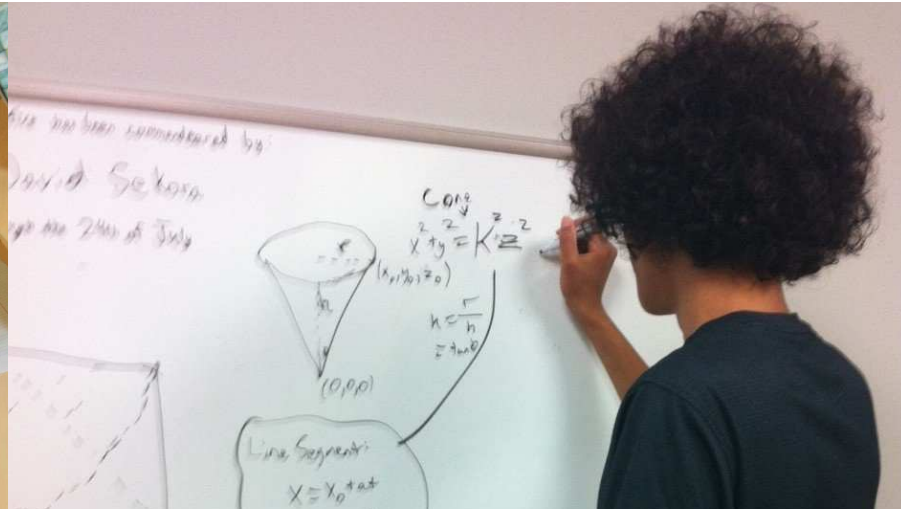
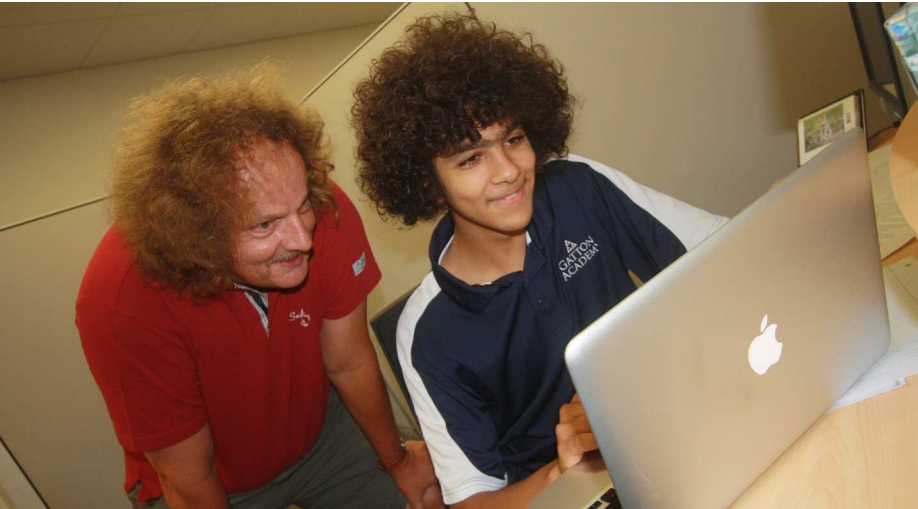
What promise does David show that led you to take him on as a mentee this summer?

I had David in one of my classes this spring (2011) and he proved himself to be one of the top Gatton Academy students. He has excellent skills not only in mathematics but also in programming which makes him ideally suited to work on a research project that mixes mathematical research with computation and programming.

What importance do you see for the creation of funded student research positions in your discipline?

Such positions allow students to excel. It allows students that have self-motivation, abilities and determination to make a contribution to a research project. Students experience first-hand the difficulties, failures and successes that are part of the life of research scientists. It will help them grow and mature. In some instances such project will enable students to have their name on a publication. Without funding for such positions only very few students would decide to do this entirely for free.

"I am enjoying the fact that this summer program is pretty much like being at Gatton, without the classes! Most of my friends are here doing research, and I am immersed in math!"



"This summer, I am researching knot theory under Dr. Claus Ernst here at Western. I am mainly working on various Mathematica functions to help analyze and understand knots, but I am also learning a considerable amount of knot theory and sitting in on a complex analysis class too!"



Keaton Smith

Alexandria, KY (Campbell County)

"At Gatton, I have loved the increased independence that has come with the greater possibility to perform."

Mr. Gatton,

I would like to thank you for the generous gifts you have made for the benefit of the Gatton Academy. It is truly a great program that sets no boundaries in education and allows passionate students to really challenge themselves and explore vast new areas. I have experienced this firsthand; my time at Gatton has been one of the best experiences of my life. While at the Academy I have had the opportunity to feed my passion for computer science in a way I never could have done at my home high school. Through taking classes in which I could not have enrolled at any other school, participating in research which gave me the chance to gain real-world experience in programming, and simply being in an environment with so many other like-minded, motivated individuals, I have had a truly unique opportunity that has helped me grow as a student and as a person.

This summer has also been an incredible chance for me to experience more applications and areas in the field of computer science. I am involved in research at Northern Kentucky University in exploring methods that could be used to randomly generate music that sounds good according to several criteria. I never imagined that programming could be used to solve problems of this sort, and as a result I have learned a lot about music, programming techniques, and applications of computer science.

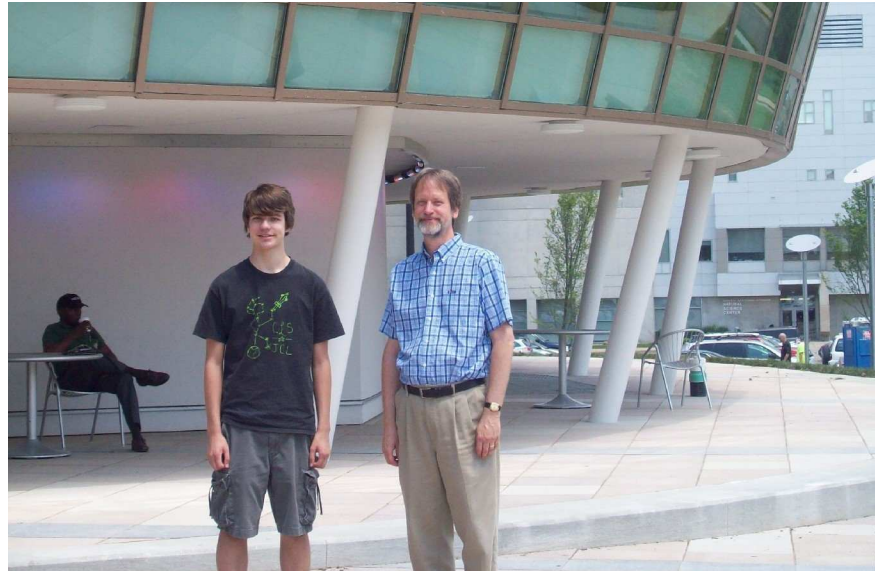
This internship has been, and promises to continue to be, extremely helpful in nurturing my interest in computer science, and would not have been possible without the funding you provided for the Gatton Research Internship Grant. Thank you very much for your contribution.

Sincerely,

Keaton Smith

Keaton's project objectives include improving the state of the art in computer-generated music. He is doing this by exploring new ways to utilize genetic algorithms. Such algorithms can in turn be applied to a wide range of other optimization problems in engineering and economics.

Keaton showed a very good grasp of computer programming principles, even though he had completed only two college computer programming courses. Also, during the previous summer, we had an excellent experience with another Gatton Academy student, Mr. Derek Fox, who was exceptionally productive in his computer science research project. All of



**Dr. Jeffrey Ward, Chair (Interim),
Department of Computer Science,
Northern Kentucky University**

this speaks very well for the preparation provided by the Gatton Academy computer science and mathematics programs.

Funded student research projects are very important in computer science for attracting excellent students and providing

an early opportunity to immerse themselves in the field. There is a real shortage of students who are trained in computer science and other computer-related fields, as reported annually by the U. S. Bureau of Labor Statistics. So research programs like this meet a real need in our society.

"I am working with Dr. Jeffrey Ward and Dr. Richard Fox at Northern Kentucky University on writing a program able to generate a musical composition that sounds good according to user input, music theory, and some other criteria. The program will use genetic algorithms in the generation process: several compositions will be selected by a scoring process from a pool of many, and those selected will be randomly changed and scored in turn. This can happen for many "generations" and at the end the one with the highest score will be output."

"Research has been a big consideration for me throughout my interest in computer science. It is a great opportunity to explore previously unknown areas and gain experience in real-world applications of classroom learning. I hope to submit this project to the Siemens competition; regardless of the outcome, I think it will be good to have the experience of my work undergoing professional review."

"The Gatton Academy is really one of Kentucky's biggest assets; it gives talented, motivated individuals the chance to achieve above and beyond what could be expected at a more traditional high school. The education that Kentucky's young minds receive at the Academy can only help throughout their lives as they grow to become major influences on the world."





Nicholas Zolman

Mount Sterling, KY (Montgomery County)

"I'm taking more math classes next year than my high school could offer through their entire curriculum."

Dear Mr. Gatton,

I would like to thank you for all you have done for me. The Gatton Academy has been an experience of a lifetime. At Montgomery County High School, I was considered an exceptional student; I received all A's, and was at the top of my class. However, MCHS did not challenge me at all. I was able to give a minimal amount of effort, and still receive top grades. I quickly passed through all of the math classes my high school offered. The very minute I heard about the Gatton Academy, I knew that it was the place for me, and after completing my first year, I *know* it is the place for me.

At the Academy, I am able to take courses that I would never have dreamed of taking at my old high school, such as Multi Variable Calculus, Linear Algebra, and Partial Differential Equations! My high school offered up until AP Calculus AB, the equivalent of Calculus I. At the Academy, I have already taken three more math courses. By the time I graduate from high school I will be a few credits short of a Math major at WKU!

Even though I excel in math, my passion is physics. In particular, I am interested in particle and astrophysics. This summer, I received the Gatton Research Internship Grant in order to do physics research at the University of Kentucky. Currently my project has two main goals. The first is to figure out how to use a Wii remote's accelerometers in order to acquire data for physics experiments. The second is to study double pendulums by observing its chaotic behavior and trying to derive equations that could apply to a particular system. I feel that this research is a great experience for me because it gives me a real taste of what mechanical physics research is like. Even though mechanical physics is not the particular field that I am interested in, the methods of accomplishing the research are basically the same for all of the disciplines in physics, therefore I can definitely benefit from everything I am doing.

Not only have I had the most invigorating, intellectual experience of a lifetime, but the Academy has also provided a wonderful social atmosphere for me. When I came to the Academy, I did not know anyone. I was fairly timid and a little shy around everyone (to be honest, I felt almost like I was betraying my friends back home). Today, however, I have about 127 best friends. Everyone is different at the Academy, each person is unlike anyone I have met before. Because of this, you never know what will happen on a given day! The diverse atmosphere is amazing! Again, I am appreciative of your contribution to the Academy; it has provided me so much experience that I can carry with me for the rest of my life. I'm not the only one though. Each year roughly sixty to seventy students are accepted to the Academy; each one having an experience like no other. Whether you know it or not, by providing this education for us, you are building a better and brighter future for Kentucky, America, and even the world.

Sincerely,

Nick Zolman



Dr. Tim Gorrige, Professor, Department of Physics and Astronomy, University of Kentucky

What is the real-world application/importance of the research project Nick is taking on this summer?

Nick is working on using a Wii remote as a simple, cheap device for measuring positions, velocities and accelerations of moving objects. We like to apply the device to use in student experiments (at colleges, schools or web-based/distance learning) and physics demonstrations.

What promise does Nick show that led you to take him on as a mentee this summer?

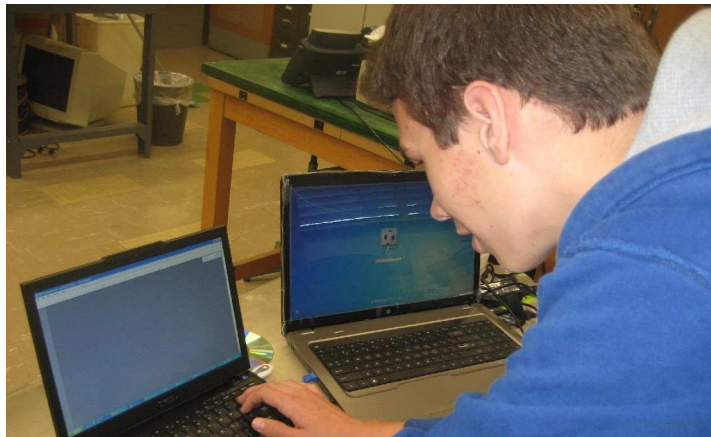
Nick is an outstanding student. He's highly motivated and hard working. He has an excellent background in math, physics and computing that was ideal for this project.

What importance do you see for the creation of funded student research positions in your discipline?

Such research projects are great for introducing students to what research is really like - some ideas work, some ideas don't, but step by step you learn new things. It's lots of hands-on experience with problem solving.



"My project has two main goals. The first is to acquire data from a Wii remote, so that one could cheaply perform physics experiments in a high school, university, or some other setting. The second is to observe the chaotic motion of a double pendulum and apply the idea of Lagrangian Mechanics in order to come up with a good model of the motion."



"At first glance, double pendulum research seems to have nothing to do with particle physics. However, if one were to look deeper into the confines of my research they would notice that the ideas and concepts of Lagrangian Mechanics are vital to the structure of Quantum Mechanics."



Rebecca J Brown

Tommye Joyce

Anthony Gutierrez

Christian Jolly

Will Bickett

Alex Gutierrez

Jack Ferguson

Keaton Smith

Br R

Charlotte L. James

David Sekora

Nick Bolman

Thank You, Mr. Gatton!



“Research allows me to really become involved in a subject I love. It allows me to use my interests and curiosities as a springboard for ideas—I can pursue the questions I truly care about answering.” - Charlotte Humes, Class of 2012

