

## FEATURE

# Experiential Learning at the Gatton Academy of Mathematics and Science in Kentucky

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**Abstract:** This article describes the model for The Gatton Academy of Mathematics and Science in Kentucky where Kentucky's young people can extend their learning through university classes, global experiences, and research.

**Keywords:** gifted education, special school programs, talent development

## Overview of School

Since 2007, The Carol Martin Gatton Academy of Mathematics and Science in Kentucky has served remarkable students from across the Commonwealth. The school's mission is

to offer a residential program for bright, highly motivated Kentucky high school students who have demonstrated interest in pursuing advanced careers in science, technology, engineering, and mathematics. The Gatton Academy also seeks to provide its students with the companionship of peers; to encourage students to develop the creativity, curiosity, reasoning ability, and self-discipline that lead to independent thought and action; and to aid students in developing integrity that will enable them to benefit society. (The Gatton Academy of Mathematics and Science in Kentucky, 2015)

The school was carefully designed to allow students to complete their junior and senior high school years, while jointly

enrolling as college freshmen and sophomores at Western Kentucky University (WKU). Academy students enjoy all the academic benefits of a university campus, while living in a supportive community cultivated specifically to meet their social and emotional needs. Ultimately, the goals of The Gatton Academy are to increase economic development within the state by providing rich educational opportunities for Kentucky's highly capable students and to serve as a beacon of excellence in education for all schools across the Commonwealth of Kentucky.

The Gatton Academy is currently home to approximately 120 students, yet the school is undergoing expansion to serve 200 students by the 2017-2018 school year. Students are accepted through a competitive admissions process. To be eligible to

apply, students must be current residents of Kentucky, be considered sophomores in high school, have scored 22 or higher on the math section of the ACT (or 520 SAT math), and be on track to complete geometry and Algebra 2 prior to enrollment. Students submit ACT or SAT scores, four essays, two letters of recommendation, and transcripts as part of the admissions process. From the initial applicant pool, selected students are invited to in-person interviews. Students are selected from the interview pool for admission. Half of the Academy enrollment is female, and half is male. Diversity is valued at the Academy; therefore, geographic diversity as well as ethnic diversity are admissions goals.

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Prior to the admissions window, Academy staff travel the state conducting information sessions for parents and students in schools and community centers to ensure families from all walks of life and in all corners of the state are informed about this

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opportunity. The Gatton Academy is funded through the state budget, allowing each student to receive tuition, housing, and meals at no cost to the student.

The Gatton Academy offers the opportunity for students from all across Kentucky to have advanced learning opportunities. Kentucky regulations allow Academy students to remain enrolled in their sending schools for those schools to continue receiving per pupil funding for Academy students, as well as their standardized test scores for the state assessment. Depending on the sending school's policies, students may continue to participate in some extracurricular activities at their previous schools, like quiz bowl, prom, and commencement ceremonies. High schools and communities across the state take pride in their students' acceptance into The Gatton Academy and their continued accomplishments. Gatton Academy staff, students, parents, and alumni continually work to maintain strong relationships with the students' sending high schools.

The foundation of the Academy was laid by the work of The Center for Gifted Studies through three decades of advocacy, programming, and professional development for gifted education. "While the majority of the residential STEM schools have developed outreach programs throughout their histories, The Gatton Academy of Mathematics and Science in Kentucky represents a novel inversion of the trend" (Roberts & Alderdice, 2015, p. 147). A decade of tireless advocacy educating parents, legislators, decision makers, thought-leaders, and donors across Kentucky led to the establishment of The Gatton Academy and its successful structure. A dedicated team studied other existing state-supported residential Science, technology, engineering, and mathematics (STEM) schools and put together a model that built on these successful schools and adapted their best features for Kentucky.

### Life on a University Campus

Students at The Gatton Academy live on WKU's main campus in a dedicated residence hall and attend classes alongside WKU students. There is only one course in which virtually all enrollees are Academy students. Advanced computational problem solving is a project-based course that combines mathematics and computer science, and it was specifically designed for The Gatton Academy. It is open to WKU students, but only a few choose to accept the challenge. Students are required to complete Kentucky high school graduation requirements along with additional STEM classes specified by The Gatton Academy's curriculum. Students take one course each in biology, chemistry, physics, and computer science, with the requirement to take a second course in any of these four disciplines. Students also complete at least three mathematics courses (through Calculus 2 at minimum) and take at least three STEM electives of their choice from a myriad of university offerings. Students start coursework at their level of proficiency, allowing many students to take advanced coursework well beyond what can typically be offered on a high school campus.

Many benefits accrue from being embedded within a university campus. Students have access to advanced

coursework taught by faculty with terminal degrees, and they have the opportunity to explore a much wider range of courses than their sending high schools can offer. The university schedule—a traditional semester schedule with a 3-week winter term each January—also facilitates additional learning opportunities. Winter term is a 3-week period in January following New Year's Day and prior to the start of the spring semester. Students may take an intensive course, focus on volunteer work, or complete a job shadow during this time between semesters. In addition, students have the opportunity to participate in experiential learning programs such as study abroad and student research that extend their learning far beyond traditional high school classroom boundaries. The Gatton Academy has developed rich programs in these experiential learning areas and capitalizes on the winter term and summer break to offer these programs. The Gatton Academy's internationalization, study abroad programs, and student research program are profiled in depth below, and they offer experiential learning that is a hallmark of The Gatton Academy experience.

### Internationalization and Study Abroad

Internationalizing The Gatton Academy experience has been a priority since the school's foundation. The Academy has developed multiple programs to develop global context for its students. Berdan and Berdan (2013) argue that most globalization efforts occur during students' college years when it is already too late to foster global thinking skills. By providing global experiences to The Gatton Academy students—who are typically between 15 and 18 years old—the school works to bring collegiate-level global experiences to students at a younger age. This section highlights some of the science and internationally focused learning programs that accomplish internationalization at The Gatton Academy.

The Gatton Academy has developed objectives for the school's study abroad program based on an institutional value system aimed at developing the holistic student. Program goals reflect five principles of skill growth: academic, personal and developmental, companionship, education and career understanding, and intercultural. The school's study abroad program goals are listed below.

The Gatton Academy's Study Abroad Program seeks to

1. internationalize the curriculum through intensive, experiential, academic immersion abroad opportunities
2. accelerate the personal growth of each student through increased confidence, self-awareness, and the abilities to think and act independently
3. build upon the companionship of peers and mentors within the Academy community
4. enable students to contextualize internationalization in future educational and career opportunities
5. prepare students to act with integrity, compassion, respect, equality, and diversity when interacting across cultures

The Gatton Academy takes advantage of winter term and summer breaks to offer its students the opportunity to study abroad. In the Academy's first 3 years, there was one travel opportunity each winter term. The Academy's study abroad program has since grown to offer three main travel opportunities per year. The annual program to Costa Rica is profiled below. The Gatton Academy student participation in study abroad is now almost ubiquitous. As an example, 92% of the school's recent graduating class studied abroad at least once during their 2 years at the school, up from 26% in the inaugural class of the Academy. In addition, the school has introduced innovative programs in which students can intensively study a critical language. These programs, dubbed STEM + Critical Languages, are also profiled below.

Fostering parental support has been a crucial component in the development of The Gatton Academy study abroad programs. The programs are generally discussed during information sessions about the Academy around the state. Soon after being admitted, students and parents alike receive detailed program descriptions and itineraries inviting student participation. Information about the programs is shared early on so that families can weigh the various travel opportunities, decide which abroad program best fits the student, and decide when a study abroad experience integrates best with a student's academic curriculum. Furthermore, the Academy works to build these global learning opportunities as part of the expectation of The Gatton Academy experience. By sharing photos, updates, and student profiles from abroad via social media and through school brochures, prospective students are able to picture themselves internationalizing their own learning experiences. Although the Academy is able to subsidize a portion of each student's program, families pay the majority of a study abroad program's cost. Equalizing access to study abroad opportunities for all students is a priority for the school, and through private support, the Academy offers need-based scholarships each year to families with financial hardships.

The Gatton Academy staff members travel with each study abroad program. By facilitating its own study abroad programs, the Academy ensures that its academic rigor can be upheld. In addition, student life policies remain as consistent as possible so that study abroad programs maintain the same expectations as on-campus Gatton Academy life. Study abroad programs are staffed at a 10:1 student-to-staff ratio. By school policy, both a female and male staff person accompanies each trip. Experienced staff members host required orientation meetings preceding each study abroad program. Based on student, staff, and faculty suggestions, the programs' itineraries have evolved. Repeating the programs allows the Academy to perfect the experiences for students. The profile of the experience in Costa Rica below reflects the most recent program.

### **Costa Rica**

The Gatton Academy introduced its first credit-bearing study abroad program in winter 2011. Through the school's partnership with WKU, this program was designed using the

short-term faculty-led study abroad program model. The program was designed to offer a short—but intensive—2-week immersion experience with a focus in Neotropical ecology in Costa Rica. The program allows students to experience research settings outside of a laboratory and to interact with researchers beyond the collegiate setting. The program was proposed and passed through the requisite curriculum committees required at WKU, and it was created exclusively for Gatton Academy students. Students do advanced reading, individual literature review research, and write their own species profiles before traveling. While in Costa Rica, students attend lectures, shadow professional researchers, conduct their own field-based team research projects, deliver oral presentations, and take written tests. The program awards 3 collegiate credit hours that meet a STEM elective requirement in The Gatton Academy curriculum. Sixteen students (equal gender distribution) travel to Costa Rica each winter under the guidance of a WKU professor. The program is slated to have a second section created starting in the 2016-2017 academic year to raise the number of student participants to 32 students annually.

The itinerary features 3 days studying leatherback turtle nesting on the Pacific coast where students are paired with professional researchers to patrol sections of the beach during the night. Daytimes during these first 3 days feature class meetings, lectures, an estuary tour, snorkeling in tidal pools to survey marine species, and time for rest. The program then transitions to a cloud forest research station for the next week. Here, students spend their days engaged in three-person, field-based research projects. An experienced researcher from the station guides each small group through the scientific method. Collectively, the student teams form a research hypothesis, collect data in the field, and analyze their findings to draw conclusions. Evenings during this week are reserved for a nightly class meeting or cultural experience. At the end of the week, student teams present their projects in an informal symposium. The trip concludes with a 3-day visit to the intensely biodiverse Osa Peninsula. Students study the abundance of species diversity by hiking in Corcovado National Park and snorkeling to survey marine species of a nearby island.

### **STEM + Critical Languages**

Graduates from STEM degree programs are highly sought after to aid economic development. Similarly, students who study critical languages—those languages deemed by the United States Department of State as high demand for issues of economic development or national security—are also sought after. The Gatton Academy has coupled these essential fields in a rare curricular program. STEM + Critical Languages is the name the Academy has given to specially created curricular pathways in Chinese and Arabic that pair the school's rigorous STEM curriculum with deliberate concentration in one of these two critical languages. Chinese and Arabic were chosen because WKU offers extensive coursework in each language and they are among the critical languages designated by the Department of State. The purpose of the STEM + Critical Languages program

is to equip students who have an aptitude and interest in STEM fields with the specialized language skills to communicate and collaborate with populations in regions of national security interest and economic development.

Students are surveyed each year immediately after the school's admission process concludes about their interest in intensively studying one of these critical languages. Interested students are invited to apply to the STEM + Critical Languages track of their choice. Students selected to each program take an increasingly rigorous language course each semester in addition to the Academy's normal STEM curriculum. This means that participants in these curricular paths finish high school having studied at least four collegiate levels of their chosen critical language.

The Academy's STEM + Chinese and STEM + Arabic programs were designed to be a curricular option among other choices. As a result, these tracks have been kept small. On average, 17% of students from each class participate as members of one of these curricular tracks for the entirety of their 2-year Gatton Academy experience.

Study abroad opportunities are sought for students in these language tracks. Although The Gatton Academy does not have its own annual programs to satisfy these study abroad needs, the school has been successful in helping these students engage abroad. These efforts are profiled below by language.

### *STEM + Chinese*

The Academy first launched its STEM + Chinese program in 2012 after three developments at WKU. First, WKU launched an undergraduate major in Chinese. This new major greatly expanded course offerings in Chinese and provided more advanced language learning options that previously were not available. Second, WKU received federal funding from the National Security Education Program (NSEP) to house a Chinese Language Flagship program. NSEP Language Flagship programs are designed to accelerate critical language learning for select students at universities. Instead of meeting 2 to 3 days each week like traditional American college courses, Flagship courses take place 5 days a week through special one-to-one tutoring. The Flagship program added even more choice and levels of rigor for Academy students. Finally, WKU became home to a Chinese-funded Confucius Institute. The introduction of the WKU Confucius Institute increased Chinese cultural programming in the local community. The Gatton Academy became an official Confucius Classroom partner school in 2014, earning the school annual funds to host its own cultural programming.

Study abroad opportunities for STEM + Chinese students have been available through two avenues. First, the Department of State's National Security Language Initiative for Youth (NSLI-Y) scholarship is highly promoted with Academy students. This scholarship program provides full funding for selected high school-aged students to travel abroad to study critical languages—including Chinese—while living with a host family and taking intensive language courses. To date, three Gatton

Academy students have received NSLI-Y Scholarships to study in China. Second, through The Gatton Academy's partnership with the WKU Confucius Institute, significant funding has been made available to support sending Gatton Academy students on travel abroad opportunities to China. These travel opportunities average 2 weeks in duration. In 2015 and 2016, The Gatton Academy was funded by Hanban—the Chinese headquarters for global Confucius Institutes—for two Gatton Academy Research Programs that allowed 27 Academy students to travel to China.

### *STEM + Arabic*

After the successful launch of the STEM + Chinese program, The Gatton Academy introduced the STEM + Arabic curricular track in 2013. WKU created a major in Arabic that year, giving the Academy a deep course list to challenge its students. To date, five Gatton Academy students have won NSLI-Y Scholarships to study Arabic in either Morocco or Jordan. These students have studied abroad during summers, living with host families, and intensively studying Arabic in U.S. Department of State-designed courses. The Gatton Academy is seeking opportunities to build a study abroad program in an Arabic-speaking country while keeping students' safety as a top priority.

### **Student Benefits**

Aside from The Gatton Academy's goal to foster global thinking skills among its students, participants report many other benefits. Kentucky is, after all, among the bottom five states for passport ownership per capita (Florida, 2011). For a majority of Gatton Academy students who travel abroad with the school, they are first-time passport holders who have not previously left the United States, and many report having never traveled on an airplane before. The experiences they encounter have significant impact as they broaden their world perspective. This section outlines benefits reported by Gatton Academy students and a faculty member about their global experiences. The quotes were culled from written post-program evaluations.

The act of experiential learning itself draws new excitement to learning. The Gatton Academy has designed study abroad programs that go beyond tours, seeking to involve students with local experts to tap into deeper learning. As one example, at Playa Grande in Costa Rica, students study the endangered leatherback turtles that nest on the national park-protected beaches. While there, they meet a local resident who guides them through an estuary teeming with wildlife. The guide points out places of ecological interest, birds, aquatic life, and monkeys. Then, in a quiet moment on a boat, he shares with the students his own personal history. Previously, he harvested and sold leatherback turtle eggs as a family business. With later awareness of the species' importance and how egg harvesting was playing a major role in the population's decline, he was forced to change his lifestyle. Students meet a former egg poacher who is now making his living educating others on environmental protection. Such encounters leave forever-lasting impressions on the students, revealing the depth and complexity

of the problems they study. One former student participant from the Costa Rica program reported, “The program went beyond eco-tourism. I was allowed to explore, I felt challenged, and I felt connected.”

Students also enjoy unusually deep relationships with their teachers and the Academy staff who accompany them. Traveling together around-the-clock, students and professionals interact in unconventional situations, fostering deeper relationships and learning. This also allows for better teaching, granting teachers the opportunity to concentrate more individual energy on each student. Dr. Keith Philips, one of the WKU faculty who teaches the Costa Rica course said,

The informal setting and close interactions that occur with the students every day enable me to teach in a unique and personal manner that improves the student learning. There is no better way to teach a course and the learning outcomes are outstanding.

Dr. Martin Stone, the other WKU faculty member who teaches the Costa Rica course added,

Students and professors begin each trip as strangers, but at the end, saying goodbye is a tearful departure. The intensity on a study abroad trip greatly speeds up the learning process with each other. By the end of the trip I already know a lot about the students and am better able to guide them towards collaboration on research projects, honors augmentations, or simply advice on life.

Many students use the word *confidence* to describe what their international experience left them with. Indeed, it is a priority for The Gatton Academy to create study abroad programs that offer students measured degrees of independence. For example, students are asked to remain in small groups of four or greater, but are encouraged to seek out destinations to visit on their own in their free time. The Gatton Academy staff work hard to teach students how to use public transportation to access sites without adult supervision, and then trust students to access destinations in small groups. Students apply their new confidence and independence beyond study abroad programs. The Academy students have relied on their new skills as they travel independently to present their research at regional, state, national, and international conferences in various STEM disciplines. A student from a recent Costa Rica program wrote, “Traveling to Costa Rica submersed me into a life I was not used to. It brought out my strengths and weaknesses, and by doing so, I had to improve upon them.”

Many students report a better understanding of the United States as a result of their time abroad. Whether this be through historical context, ecosystem connections, or the influence on food or architecture, students often come face-to-face with the youth of the United States and the global interconnectivity that permeates our world. Studying abroad, after all, highlights a

comparison and contrast between cultures. Sarah Herricks, who participated in the 2014 Costa Rica program, reported, “I found myself not only learning about Costa Rica, but I learned a lot more about the U.S. and the way I think.”

Finally, and most difficult to describe, is a sense of self-development that students report experiencing. Study abroad offers these young students a chance away from familiar places, faces, and attitudes to engage in self-introspection and to embrace new perspectives. Jonathan Kyle Bailey, who participated in the 2012 Costa Rica program wrote, “I gained a large understanding about ecology and diversity. More importantly, the time I spent in Cloudbridge was a very spiritual experience. As weird as it might sound, I have never felt so ‘close’ to life itself.”

## Student Research

From The Gatton Academy’s foundational days, another experiential learning program was imagined for the school—a robust student research program. The vision grew out of the tradition set by other state-funded, residential STEM schools that preceded the Academy’s 2007 opening. Student research programs from peer National Consortium of Secondary STEM Schools (NCSSS) were used as initial models. Scheppler (2002) advises that 21st-century students need “the abilities to ask good questions, collect and reason from data and facts, analyze information, and verify conclusions” (p. 43). As soon as its first students arrived in 2007, The Gatton Academy began maximizing its on-campus location and key partnership with WKU to create original, mentored student research projects to foster these skills. In The Gatton Academy’s first years, a vigorous student research program was established, and this program relies on the key relationships with WKU STEM faculty.

Research is optional for students at the school, yet today, the Academy’s student research program thrives. It has always been important to the school leaders that students go willingly into their scientific inquiry. As a school value, students are guided by their genuine curiosity—not requirements—to drive their research pursuits. The student research program is also extracurricular, meaning that students arrange their research windows above-and-beyond their weekly class schedules and affiliated study. Students are advised to plan for 5 to 10 hr per week to devote to a research project during the semesters. Students participate in research between classes, during afternoons and evenings, and occasionally, on weekends. Although it is optional, student participation in the school’s research program is now robust. Participation rates have grown from 57% of the inaugural class of 2008 to 90% participation most recently in The Gatton Academy’s class of 2015. This section profiles the unique, university-partnered student research program at The Gatton Academy.

## Varied Opportunities

Because The Gatton Academy’s mission is to provide opportunities to students with demonstrated STEM interests, the

school's student research program has relied on key partnerships with the programs and departments at WKU that concentrate in the STEM fields. The Academy's first key partner has been WKU's Ogden College of Science and Engineering, which houses departments in agriculture, architecture and manufacturing sciences, biology, chemistry, computer science, engineering, geography and geology, mathematics, physics and astronomy, and the psychological sciences. The Gatton Academy has looked to other WKU colleges and departments as hosts for STEM-based research projects, including the College of Health and Human Services and the archaeology and economics departments.

Having access to such a diverse array of disciplines has proved a major strength to the school's student research program. Students may choose from any of the disciplines that are taught at WKU when seeking a research mentor. Still, The Gatton Academy's key partnership with WKU has its limits. Some students enter the Academy with pointed interests that are not taught at the university. These students are assisted in finding research matches that have peripheral connections to their field of interest and that will still enliven their interests. During summer, the Academy expands its scope of possible partners. Because students are not required to live in the school's residence hall during the summer break, they can seek research opportunities virtually anywhere. The Academy assists students and their families arranging summer research opportunities and internships. Initiatives for placements begin in November each fall for the summer to come. These opportunities may be at a university or industry near a student's hometown, so that the student will live at home while working on their summer project. Or, the opportunity may be across the country or globe, where the student must have parental support to locate alternative housing for the summer while undertaking the project. During the summer of 2015, 90% of Gatton Academy rising seniors were involved in some form of summer learning. Many of these were full-summer research projects.

### University Faculty Model

Because The Gatton Academy is located and partnered with a university, every teacher that Academy students have is a university professor or instructor at WKU. Students can conduct their research projects with mentorship from any of the university's research-track faculty. Warrick (2009) offers a template for maximizing university and faculty resources to build great experiential learning programs for students. The access to and partnership with WKU lead to many benefits for Gatton Academy students. Because the student research mentors are university professors, they often hold terminal degrees in their disciplines. They are also engaged in their own significant research endeavors, making it easier to mentor a student through a related project. These professional researchers often have a sidebar research inquiry that they can hand off to a student for ownership. These mentors are experts in their fields with active research agendas, who publish, edit journals, and share findings at discipline-specific meetings. The most prolific

student researchers often get invited to participate in these same scholarly activities.

Having access to university faculty as mentors also widens students' research options significantly. WKU faculty members are not only well versed in their discipline generally but also hold specializations in sub-disciplines. This means that students can find research mentors that can help them navigate extremely sophisticated and specific research topics. This model helps Academy students eventually become experts on narrow topics within broader disciplines. Having access to a diverse number of topics within each subject area offered at WKU widens Academy students' research choices immensely.

### Supporting Students as They Begin Research

Because The Gatton Academy students are only at the school for 2 years, it is a high priority to help facilitate the right research matches early on in a student's time at the school. Students need adequate time with their research projects to learn the background of their topics, pose original questions, form methodologies to test their questions, run their experiments, analyze results, and draw conclusions. Therefore, starting early in the Academy experience is vital.

The Gatton Academy application process concludes with notification of acceptance each March. Immediately upon a student's notification of acceptance, the process of helping students get started in the student research program begins. An online research survey is given to each student. This survey guides students through an overview of what research subjects are accessible at The Gatton Academy and allows students to self-report their interests. Students rank interests through quantitative and qualitative measures in this brief survey.

Survey results are then used to arrange students' course schedules or to make initial research connections. As one example, some disciplines at WKU ask that students take a background course as a prerequisite before starting a research project. Knowing that a student's top research interest area is astronomy, for example, allows Academy staff the foresight to schedule a student into the prerequisite astronomy course that leads the student to start a research project as soon as possible. As another example of how the survey results are used, WKU has some research cohort-based programs that require separate application. An example of such a program is the Genome Discovery and Exploration Program based out of the WKU Department of Biology. Knowing that a student may have interests in this area allows Academy staff to inform new students about the program and guide them to the application before their first school year even begins.

Academy staff members work to help students understand that the right research match rests on two principles. Students expect the first principle: seek research with a mentor based on genuine curiosity and interest in the subject matter. The second principle is the matching of personality and fit with the mentor. A mentor's role with a student researcher and the relationship they form together is vital to the success of a project. Therefore, students are advised to talk with multiple potential mentors

through in-person conversation and interviews before asking to take on a project. Students are advised to weigh both principles as they identify research projects.

### Student Achievements

Another dimension of The Gatton Academy's student research program is helping students find appropriate venues, competitions, and scholarships to submit their projects. The school provides students assistance in both finding the right programs and cultivating applications. Additional assistance for developing applications is available through WKU's Office of Scholar Development. Because The Gatton Academy students are jointly enrolled as both high school juniors and seniors and as college students at WKU, a wide range of programs are available for student researchers.

At the high school level, there are science fairs hosted at the regional and state levels that can lead to invitations to the Intel International Science and Engineering Fair. The Siemens Foundation and Intel each host fall competitions for high school students who conduct STEM research to submit comprehensive, written research reports. In addition, a host of other science competitions, hackathons, fairs, and scholarships exist for high school students in the STEM fields.

Because the Academy students conduct research at a university with mentorship from university faculty, their projects are well suited for the same sorts of scholarly endeavors that the most involved undergraduate students achieve. For example, in the 2014-2015 school year, The Gatton Academy students made 86 presentations at scientific meetings and conferences. These conferences ranged from the WKU Student Research Conference to discipline-specific national meetings that attract expert professionals working in the field. Furthermore, three of the recent graduates from the class of 2015 were listed as authors in peer-reviewed journals during their 2 years at the Academy.

### Learning Outcomes From the Student Research Program

Participating in The Gatton Academy's student research program offers many benefits. Gretchen Walch, a 2014 graduate who was involved in biology and bioinformatics research while at the Academy, said of her two mentors, "They focus on challenging their students to ask questions and they expose them to a number of skills." The Academy's student research program was designed to help students form academic questions and then develop the critical reasoning and evidence gathering skills to find answers to those inquiries through investigation and data collection. Yet, the benefits of the student research program far transcend the academic exercise and related thought development. The student research program also unearths self-discovery. This section outlines learning outcomes of the student research program and draws from student voices from past research program evaluations.

One benefit to The Gatton Academy's student research program is the opportunity for students to try out majors or to

explore career options at a young age. Students recognize their interests and passions from courses, but sometimes it is hard to know precisely what a day-in-the-life of a chemist is really like or what it means to be a computer scientist without actually seeing behind the professional curtain. Sometimes, there may be confusion whether an interest is truly a valid passion or if a teacher was just especially skilled at making a subject attractive. The Academy's student research program allows students the opportunity to take their learning far beyond the classroom and experience the field in an applied setting which can help students validate their interests. At worst, it can help students discover that a field is not as intriguing to them as they once thought, perhaps helping them avoid costly semesters of declaring a major that is the wrong fit, or worse yet, eventually taking a career path they will grow to dislike. Justin Bunch, a 2015 graduate who conducted biology research while at the Academy, wrote, "Conducting research has truly aided in my pursuit for the perfect career that best fits me."

Because so many students have the opportunity to present their research findings at scientific meetings and conferences, the student research program at The Gatton Academy introduces students to an academic world that is not seen by other students until they are in their graduate school years. Connections made at these events have led to internship and graduate school offers. Students also learn the process of writing and submitting abstracts, registering for meetings, and preparing presentations. Camille Turner, a 2011 graduate who conducted chemistry research while at the Academy is one example of a student who presented her findings at national meetings—including the American Chemical Society's national meeting. She wrote, "I have met new people and traveled. Research has opened so many doors for me and my future."

Students also learn the workplace skills necessary in professional settings that transcend academic curiosity or intelligence. Students must learn skills like punctuality, clear communication with a mentor, protocols, and balancing their personal and school lives with the goals of their research projects. Andrea Eastes, a 2012 graduate who conducted biology research while at the Academy, wrote of her project that she had to find "intrinsic motivation, responsibility for the work, and the time to put into the project" to meet the research goals. The Gatton Academy student research program also helps students understand the tedious but rewarding nature of research work. Hannah Graff, a 2014 graduate, wrote the following about her research experience in WKU's Genome Discovery and Exploration Program: "Genome was a wonderful experience. It really allowed me to gain insight into what research really is. Even though much time and effort was required, I would definitely recommend this."

Students develop meaningful and deep relationships with their mentors. These mentor-mentee connections matter for many reasons. First and foremost, they give the students

guidance through the decision-making processes that are abundant at this stage of life. As students are choosing colleges, considering majors, thinking of graduate school options, and considering career paths, having a trusted mentor is vital. In addition, great mentor–mentee relationships give the student the benefit of a trusted professional who can provide recommendations for application processes that range from college admissions to internship and scholarship applications. Marcus Hughes graduated from the Academy in 2014, having conducted research with an astronomy faculty mentor for 2 years. Hughes wrote of his mentor, “He’s phenomenal. He understands his field and is super excited to work with people. He understands students may come with limited knowledge and helps build them up wherever necessary.”

## Concluding Statement

In 2007, Kentucky became the 14th state to have a residential high school with a focus on STEM supported by the state budget. The model implemented was one located on a university campus, taking full advantage of the expertise and services already in place at a university. Students at The Gatton Academy remain enrolled at their home high school while also fully engaging as a student at WKU. The Gatton Academy offers opportunities for Kentucky’s young people to extend their learning through university classes, global experiences, and research. Experiential learning is the hallmark of The Gatton Academy of Mathematics and Science in Kentucky.

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