McNair Scholars Journal

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GRAND VALLEY STATE UNIVERSITY

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Message from Nancy M. Giardina

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We are proud to present the thirteenth volume of the *Grand Valley State University McNair Scholars Journal*. It is the culmination of intensive research conducted by our student scholars and their faculty mentors through our Ronald E. McNair Scholars Program.

The Ronald E. McNair Scholars Program, now in its 15th year here at Grand Valley State University, provides an opportunity for students and faculty to apply much of what is learned within the classroom by engaging, outside the classroom, in research activities in a particular area of scholarly interest. These research activities provide a journey through the challenges and affirmations of scholarly work and better prepare students for graduate study and the pursuit of a doctoral degree. In addition, GVSU supports the AAC&U position that student engagement in research activities is one of the "high impact" experiences that better prepares students for academic success, transition into careers and the challenges of the 21st century.

Thank you to the faculty mentors who have worked so closely with our McNair Scholars to propel their research skills towards the next level of educational challenges.

Congratulations to the eleven McNair Scholars whose research is presented here. Your journey and the challenges you have met during this scholarly activity speak to your talents and persistence in pursuing both your educational and life goals. Thank you for sharing your talents with the university community and continuing the spirit of this program.

Finally, thank you to all the people behind the scenes that work to sustain this program, guide students to success and produce this journal. Your work is valued as well.

Nancy M. Giardina, Ed.D.
Assistant Vice President for Academic Affairs

GRAND VALLEY
STATE UNIVERSITY

"Before you can make a dream come true, you must first have one." - *Ronald E. McNair, Ph.D.*

Ronald Erwin McNair was born October 21, 1950, in Lake City, South Carolina, to Carl and Pearl McNair. He attended North Carolina A&T State University where he graduated Magna Cum Laude with a B.S. degree in physics in 1971. McNair then enrolled in the prestigious Massachusetts Institute of Technology. In 1976, at the age of 26, he earned his Ph.D. in physics.

McNair soon became a recognized expert in laser physics while working as a staff physicist with Hughes Research Laboratory. He was selected by NASA for the space shuttle program in 1978 and was a mission specialist aboard the 1984 flight of the USS Challenger space shuttle.

After his death in the USS Challenger space shuttle accident in January 1986, members of Congress provided funding for the Ronald E. McNair Post-Baccalaureate Achievement Program. The goal is to encourage low-income, first generation students, as well as students who are traditionally underrepresented in graduate schools, to expand their opportunities by pursuing graduate studies.

Ronald E. McNair Post-Baccalaureate Achievement Program

The Purpose
The McNair Scholars Program is designed to prepare highly talented undergraduates to pursue doctoral degrees and to increase the number of individuals (from the target groups) on college and university faculties.

Who are McNair Scholars?
The McNair Scholars are highly talented undergraduate students who are from families with no previous college graduate, low-income background or groups underrepresented at the graduate level for doctoral studies. The program accepts students from all disciplines.

Program Services
The McNair Scholars are matched with faculty research mentors. They receive academic counseling, mentoring, advising, and GRE preparation. In addition to the above services, the McNair Scholars have opportunities to attend research seminars, conduct research, and present their finding orally or written via poster presentations. In the first semester of their senior year, the scholars receive assistance with the graduate school application process.

Funding
The Ronald E. McNair Post-baccalaureate Achievement Program is a TRiO Program funded through the United States Department of Education and Grand Valley State University.

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Reflections of Whiteness: The Origins, Progression, and Maintenance of White Supremacy as a Cultural, Political, and Economic Force in American Institutions

Marcus Bell
McNair Scholar

George Lundskow, Ph.D.
Faculty Mentor

Despite the prevailing national discourse that implicates race as an outdated phenomenon, ongoing social science data identify race as very predictive in determining life outcomes. Over the last 40 years the emergence of "whiteness studies" has sought to redefine racism from individual actions of bigoted persons to institutional systems of privilege and disadvantage. While there have been a number of studies detailing the failures of reconstruction to embrace an equal citizenry fully, and also a number of studies detailing the eventual assimilation of European immigrants, few studies have sought to connect both into one simultaneous entity. Using historiography and historical comparison methodologies, this research examines primary and secondary data sources in order to illustrate how racism, factionalism, and violence doomed radical reconstruction and cemented white hegemony into American culture through its various institutions. It also examines the bloody decades following reconstruction and the early 20th century transformation of the category "white" from an ethnicity to a race, thus creating the badge of whiteness and securing its privileges for generations to come.

Investigations in the Geometry of Polynomials

Neil Biegalle
McNair Scholar

Matthew Boelkins, Ph.D.
Faculty Mentor

Polynomials are among the simplest of all functions and serve as fundamental building blocks for many other types of functions. As such, mathematicians continue to seek deeper understanding of polynomials. It is well known that a monic polynomial with all real zeros is uniquely determined by the placement of these zeros. Our investigations are driven by the question of how changes in root location affect other characteristics of the polynomial. The purpose of this paper is to introduce the central ideas of this field of study through established results and open questions, while making new observations and contributions along the way. We provide full proofs of several fundamental theorems and elaborate upon the important ideas and methods used to prove them. One of the most influential theorems in our research is the Polynomial Root Dragging Theorem, proved by Bruce Anderson in 1993; we use this tool frequently to analyze different problems from a new and more intuitive perspective.

We have narrowed the focus of this paper to monic polynomials with all real zeros that lie in the interval [-1,1]. This is a standard constraint that simplifies our work and enables us to make conclusions about a broad class of functions. In much of our work, we explore situations when certain properties of polynomials are most extreme, with a stronger emphasis on maximality than minimality. We highlight several patterns that arise when analyzing maximal and minimal problems and introduce some important kinds of polynomials that arise naturally, namely Chebyshev and Bernstein polynomials. A central part of the paper is our survey of several different properties that are maximized by Bernstein polynomials, which are polynomials with all of their roots at -1 or 1. We include some already established solutions to some of these problems, new insights and perspectives on others, and offer an alternate proof to a maximal problem related to the Sendov conjecture. The main purpose of this section is to demonstrate the maximality that these Bernstein polynomials frequently possess, which helps explain our desire to find a general explanation for this phenomenon.

Finally, we introduce our search for a general theory to justify the frequent maximality of Bernstein polynomials. This idea is based in the theory of convexity, which tells us that any convex function over a compact convex set must be maximized at an extreme point. In order to use this idea, we first introduce new operations that allow us to think of the set of monic polynomials with all real zeros as a vector space. Then, as we are focused on polynomials with zeros in the interval [-1,1], we may analyze functions that measure certain properties of polynomials over the unit box, which is compact and convex, by identifying each polynomial of interest with a point in. Hence, if we can show any of these characteristic-measuring functions are convex, we can conclude that they must be maximized by Bernstein polynomials. This is a potentially powerful tool that merits further investigation and study.

Campus Triple Bottom Line: College Sustainability and Grand Valley State University

Mary J. Brown
McNair Scholar

Jaideep Motwani, Ph.D.
Faculty Mentor

Colleges and universities in the United States and globally have mobilized around sustainability issues and engaged their campus community and communities at-large in efforts to recycle, reduce carbon emissions, create green space, foster food security, and learn about and participate in creating sustainable communities. This study provides a literature review of sustainability programs within the United States and abroad; commonalities across these programs were identified, grouped into four research streams, and used as the bases for the theoretical framework. This paper further expands on the subject of campus sustainability by presenting a case study of Grand Valley State University Sustainable Community Development Initiative, whose focus is to bring sustainable practices not only to the campus of Grand Valley State University, but also to wider community stakeholders.

The literature review was grouped into four research streams: environmental management systems (EMS) and strategy development; organizational learning and capacity building; student education and involvement; and local, regional, and global initiatives. The campus sustainability programs reviewed varied in form and demonstrated broad and diverse methodologies and applications for data collection, programming, stakeholder involvement, and program measurement.

Research stream No. 1 highlights environmental management systems (EMS) as a strategic tool for implementation and focuses on how colleges have established structural supports to implement, measure, and evaluate sustainability programs. Research stream No.2, organizational learning and capacity building, highlights the campus as a learning organization for sustainable thinking and practice. Organizational learning has helped to create a campus culture that reduces waste, preserves the ecology, contributes to economic stability, and demonstrates socio-community responsibility. Research stream No. 3 is concerned with interdisciplinary approaches to student learning and sustainability. Interdisciplinary learning has allowed students to see the linkages between other areas of studies beyond the sciences, such as social science, community development, and political science. Students have been found to be formidable ambassadors for furthering sustainability both on and off campus. Students have also learned valuable skills that have led to personal job creation and entrepreneurship. Research stream No. 4 looks at how colleges and universities have forged relationships with off-campus stakeholders. Higher education has brought the movement of sustainability beyond the campus to local, regional, and in some cases global initiatives.

In 2004 Grand Valley State University (GVSU) began planning for campus sustainability and released its first Sustainability Report in 2005 (GVSU Sustainability Recognitions, 2009 para 9, 10). Since then, GVSU has offered rich opportunities for students, faculty, and stakeholders to participate in campus and community sustainability initiatives and has become a leading driver and player in regional sustainability.

This paper serves as a resource for colleges and universities that wish to design and implement a campus sustainability program. It provides a theoretical framework and a practical model for sustainability program development, implementation, and monitoring.

Nestling Oral Microbial Colonization in Tree Swallows (*Tachycineta bicolor*)

Heather Danhof
McNair Scholar

Patrick Thorpe, Ph.D.
Faculty Mentor

The characterization of the microbial colonization of the pharyngeal region in nestling Tree Swallows (*Tachycineta bicolor*) is important for two reasons. First, little is known about how the normal microbial communities become established in wild birds; and second, knowing how microbes have a naturally occurring beneficial effect on the host is important to further our understanding of health and disease. Establishing normal microflora in immature birds can occur through the parents that feed the birds as well as through environmental factors, such as the nest and its surroundings. Previous work has shown that the parents have a direct effect on the cloacal microbial communities in Tree Swallows. This study aims to determine definitively the role of the parents in the establishment of the microbial community in the pharyngeal region. Swabs of the pharyngeal region of 23 pairs of adult tree swallows and two randomly chosen nestlings from each clutch at an early juvenile stage nestling day (ND) 3 and a late juvenile stage (ND 18) were collected. The nestlings typically leave the nest around nestling day 19. The microbial community was characterized by the extraction of DNA and amplification of a variable region in the highly conserved prokaryotic16s rRNA gene. The amplified PCR products were separated using a partial denaturing gradient gel electrophoresis (DGGE). Photographs of the gels were analyzed for similarities and differences using the computer program Gel2K. Preliminary results show that the microbial communities of the ND 3 samples were significantly less diverse than the microbial communities of adults, although there were some bands common to all samples. The bacterial diversity found in adults varied anywhere from 5 to 13 bands, in young nestlings (ND3) from 2 to 9 bands, and in older nestlings (ND18) from 6 to 15 bands. The average number seen in each group is 7.7, 5.5, and 10.3 respectively. Bacterial diversity among family groups varied from 16 to 23 bands total, and the average number is 21.1 bands. Bands of interest will be isolated and sequenced to determine the route of microbial inoculation and development in the nestlings.

Co-localization of Histamine and eGFP in the Central Nervous System of *Drosophila melanogaster*

Wendi-Jo L. Ervin
McNair Scholar

Martin G. Burg, Ph.D.
Faculty Mentor

Histamine is a biogenic amine synthesized by the enzyme histidinedecarboxylase (Hdc) and used as a neurotransmitter in the central nervous system of *Drosophila melanogaster*. We are interested in understanding how tissue-specific expression of Hdc is controlled by examining the function of the Hdc 5'-UTR and 3'-UTR in regulating expression of a reporter gene, eGFP, in histaminergic cells. The 5'-UTR containing the Hdc promoter region, previously identified as being necessary for normal Hdc expression, was fused to eGFP in a pGreenPelican vector, to determine whether the 5'-UTR region is sufficient for normal Hdc expression. To determine if all cells expressing eGFP are also histaminergic, examination of histamine-stained preparations from larval stages of transformant and wild type flies for histamine was conducted and analyzed using fluorescence photomicrography. Many histaminergic cells also appear to express eGFP, but not all histaminergic cells expressed eGFP. The results indicate that the 5'-UTR region of Hdc can induce expression of eGFP in centrally located histamine-containing neurons; however, differences in the level of expression between cell types and developmental stages suggest that the 3'-UTR of Hdc may be required for complete expression. In the future, more studies will be needed to determine whether additional copies of the pHdc-eGFP gene interfere with the expression of histamine in the central nervous system. Since the co-localization of eGFP and histaminein cells has been successful, new areas of research now may be conducted to investigate the function of histaminergic cells in culture, leading, for example, to a better understanding of the role that histamine plays in the central nervous system.

From Soldadera to Adelita: The Depiction of Women During the Mexican Revolution

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David Stark, Ph.D.
Faculty Mentor

The Mexican Revolution (1911-1920) created an opportunity for women to break free of limitations imposed by a patriarchal society. Women joined both the Federal Army and the rebel armies to help the soldiers on and off the battlefield. In performing tasks, such as carrying for the troops and fighting with them, the soldaderas (women soldiers) were able to achieve liberation and equality. Although women fought heroically and valiantly, what we often remember about the soldaderas is their beauty and promiscuity. Thus, their achievements and legacy have been obscured. My research seeks to identify the origins of this mistaken image and the reasons for its dissemination and perpetuation in popular culture. Through an investigation of primary sources including newspaper articles and corridos (love songs) from the time of the Revolution, as well as secondary sources on soldaderas and their portrayal in popular culture (film), we can restore the legacy of the soldaderas. The popular image of the soldaderas highlights their physical appearance, rather than their participation in the Revolution, because this depiction of the women was more acceptable to the male-controlled Mexican society. The soldaderas exhibited male-characteristics, like strength and valor, and for these attributes, men reshaped their image into the ideal (docile and subservient) women of the time. The soldaderas' participation in the Revolution helped women achieve limited equality in this era, but men's roles in shaping the memory of their contributions have overshadowed what the women accomplished.

An Exploration of Language, Culture and Limited Perspectives

Alfredo Hernandez Corsen
McNair Scholar

Judy Whipps, Ph.D.
Faculty Mentor

My research suggests that if our cultural identity originates through language, then the foundation for learning and development of worldviews also relies on the existence of language and its cultural components. I present crucial ways in which language potentially shapes perception through culture and propose a new position of awareness that acknowledges the limitations of our shaped perception. Through the recognition of our limited understanding we begin to connect with knowledge through unconventional means and refrain from claiming the truth through narrow standpoints.

This project examines the establishment of our worldviews through culture and language as it explores religious ideologies and the scientific method as potential mediums of understanding that engage with narrow and inflexible principles. My research articulates the need for an open-minded approach that recognizes the importance of diverse perspectives, while it articulates the need for dialogue in order to address mindsets that promote an exclusive agenda without considering the significance of unconventional methods of knowing not fixed on given principles.

My goal is to promote an environment of awareness that welcomes multiple perspectives and recognizes the role that language and culture play in our understanding and acceptance of reality. A medium of openness that encourages dialogue and acknowledges our limited knowledge may begin to unlock the possibilities for unrestricted knowing through unobstructed channels and flexible mediums. Chuang-Tzu reminds us frequently in The Inner Chapters about the disadvantages of limiting knowledge when he states, "My life flows between confines, but knowledge has no confines."

An analysis of fundamentalist perspectives explains the need for diversity of thought as well as it points out the negative effects of worldviews that claim infallibility of their method of knowing, through a less than humble approach, narrowing our thinking process and ignoring potential factors influencing our views. My research suggests a connection with unconventional thought and explores the authority of language and culture through an anthropological and philosophical lens. This influential position of language is explained more in depth by Anthropologist Edward Sapir when he explains, "Once they had become part of a linguistic system, they would then be more likely to be imposed on it because of the tyrannical hold that linguistic form has upon our orientation of the world."

The scientific and religious perspectives offer us an opportunity to study outlooks on reality that accept knowledge through pre-determined methods. This project honors and recognizes the important contribution to our way of life provided by both principles, while it questions the need for a universal method that undermines the existence and validity of diverse views.

Interpretations of knowledge based on fundamentalist points of view narrow the possibilities for the expansion of human thought by constricting our understanding of the truth to limited and prescribed explanations of reality. My research hopes to reveal how fixed principles overlook the importance of diversity of thought, while they establish an inflexible medium of knowing that stresses a dogmatic approach to knowing and reserves the exploration and recognition of the truth to their accepted ideologies.

Assessing the Utility of Genetic Data as a Monitoring Tool: A Case Study of Eastern Red Bats (Chiroptera: Vespertilionidae: *Lasiurus borealis*)

Anne K. McNeely
McNair Scholar

Amy Russell, Ph.D.
Faculty Mentor

High levels of bat and bird mortalities have been documented at wind energy facilities; particularly hard-hit among bats are the tree-roosting migratory species *Lasiurus cinereus, L. borealis*, and *Lasionycteris noctivagans*, which together compose approximately 79% of affected bats. Traditional mark-recapture monitoring methods have proven ineffective for these species due to the fact that these bats roost in small numbers, fly very high, and are difficult to catch. Thus it is hard to tell what effect these deaths at wind energy facilities are having on population numbers. Genetic data may provide a means of monitoring populations when demographic methods are unsuitable. We used coalescent-based simulations to determine the efficacy of genetic data as a monitoring tool for short-term changes in population size. Simulations were run under demographic models parameterized using mitochondrial DNA sequence data and microsatellite genotypes from the eastern red bat, *Lasiurus borealis*. DNA sequence data and microsatellite genotypes were simulated in both panmictic and structured populations using the computer program, ms, and analyzed using statistical software (microstat) to interpret the results. ms is a coalescent-based program that simulates genetic data under specific population models that are parameterized by initial population size, rate of decline, time since the onset of decline, mutation rate of the chosen molecular marker, and pattern of population structure. Initial estimates of these parameters were taken from previous studies on *L. borealis* (initial population size = 3.3 million individuals, rate of decline = −1% per year, mitochondrial mutation rate = 10-5 substitutions per gene per generation, no significant population structure). Simulations were allowed to run from 1 to 1000 generations following the initial onset of population decline to determine the timescales necessary to observe significant loss of genetic diversity under biologically realistic conditions. Loss of genetic diversity was assessed using summary statistics including the number of segregating sites, haplotype diversity, nucleotide diversity, Tajima's D, and Fu's FS for DNA sequence data, and Cox's Δ and the number of alleles for microsatellite data. We found that direct measures of diversity (segregating sites and number of alleles) are much more informative for detecting population declines than neutrality tests such as Tajima's D and Cox's Δ. Between the two types of markers, microsatellites provided more power to detect population declines over shorter timescales (hundreds of generations for microsatellites as opposed to thousands of generations for sequence data). These results demonstrate that even quickly-evolving microsatellite data are unlikely to be useful for the type of year-to-year comparisons needed by monitoring agencies. We conclude that genetic data do not appear to be a useful metric for monitoring red bat population declines due to wind turbine-associated deaths. We emphasize that these conclusions are limited to the population parameters examined in this study, specifically those for eastern red bats facing population declines from wind turbines. Similar questions in other species (e.g., little brown bats facing local extirpation from white-nose syndrome) should be addressed using models appropriately parameterized for those systems.

Quaternary Geology, Toco, Trinidad, West Indies

Mallory Morell
McNair Scholar

John Weber, Ph.D.
Faculty Mentor

Pablo Llerandi-Román, Ph.D.
Faculty Mentor

Geomorphic features in northern Trinidad reflect westward sinking and tilting into the active Gulf-of-Paria pull-apart basin. This basin has formed as a result of the ~20mm/yr eastern movement of the Caribbean Plate in relation to the South American Plate. Raised terraces deposits have been found ~15 meters above modern sea level along the northeastern coast and along the northern coast as far west as Blanchisseuse, but no further. The purpose of this study is to determine if the raised terraces in the east are related to sinking in the west. There are two possible hypotheses for these terraces: (1) as the western end of the island is sinking, the eastern end is rising in a seesaw-like effect; or (2) as the western end of the island is sinking, the eastern end is remaining horizontally constant.

To test these hypotheses we studied 11 locations near Toco (the northeastern corner of Trinidad), and 4 locations near Blanchisseuse (~41 km west of Toco), in the field by measuring and describing stratigraphic sections and collecting 1-2 hand samples for grain size and shape analysis and 1-2 samples in tubes for optically stimulated luminescence (OSL) dating. Five samples were sieved, and the mean of the samples ranged from -0.84 to -0.23ϕ. Fifty pebbles were randomly selected and measured from one outcrop using a Vernier caliper to create a size analysis. Sediments ranging in size from 4.00 to 4.25ϕ from each of the five sieved samples were studied using x-ray diffraction (XRD). We dated 5 samples using OSL.

We found the terrace deposits to range in thickness from 60 to 280 cm, to be a mixture of sand and gravel, and to follow geographically the units traditionally labeled as Quaternary on geologic maps. The results were plotted on a Zingg diagram with the data points clustering to the right side of the diagram, meaning they were rounded. XRD samples were found to contain almost entirely quartz. The OSL resulting ages ranged from 40,000 to 150,000 years old. The two reliable OSL ages (40,090±3000, 74,020±5,650 y.b.p.) indicate that sea level was probably not high enough to form these terraces at current elevations.

The sedimentary analysis and the field mapping supported that these terraces are marine in origin. Their coastal location and similarities in sedimentology to modern beaches made this obvious. The ages of the terraces, when plotted on a global sea level curve, do not seem to fall near high stands, indicating that sea level could not have been high enough to create terraces at this height. These data give a good indication that the first hypothesis, with the terraces being raised tectonically out of the sea, has more potential than the second, which is the terraces remaining horizontally constant as sea level changes. Therefore, provisionally we accept the see-saw hypothesis.

Computer-Aided Student Study Group Formation

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McNair Scholar

Roger Ferguson, Ph.D.
Faculty Mentor

Computer supported collaborative learning (CSCL) provides the potential for novel approaches to improving meaningful learning, especially pertaining to education. Furthermore, research has ascertained that students thrive in a variety of collaborative learning environments, especially through the use of study groups. Our research project developed an artificially intelligent, Internet-based system that aids in formation of study groups outside the classroom setting.

The challenges students have faced during study group formation have included arranging meeting times around busy schedules, knowing high-compatibility study-mates, and limiting study-mate selection to one's class. Our system began to rectify these problems by controlling the scheduling of study group meeting times and locations, the selecting of "best-matching" group members to maximize meaningful learning, and the composing of study groups across sections of the same class.

The system utilized a HTML/PHP/CSS web interface with a MySQL database backend for the system design. Specifically, the system operated using the following four cyclical steps: 1. the user entered information into the system; 2. the user data were stored into the MySQL database for processing; 3. once all student data were stored in the database, an artificial intelligence program containing an algorithm for forming study groups was run by an administrator; and, 4. communication between groups and the system using e-mails occurred to notify users of group formation.

To perform the above steps, the following components were developed. HTML and PHP web pages styled by CSS were written for user and administrator interfaces. The user interface consisted of three web pages (i.e., user account login, user customization, and user information processing, accessed in this order). These pages shared a common purpose, to obtain user information needed to form groups, such as age, available study times, gender, group size, knowledge level, and other characteristics. This information was retained in the MySQL database (i.e., step one and two of the procedure). The administrator interface served three purposes: 1. to access user information in the MySQL database and debug the system; 2. to perform administrator functions (i.e., insert, delete, search by specific keywords and categories, change passwords); and, 3. to run a program written with an algorithm to form groups and communicate to users (i.e., step three and four of the procedure).

After development, we conducted prototype analysis by demonstrations to four summer classes in 2009 at Grand Valley State University. Following the demonstration, students were asked to complete an anonymous survey on the project viability and potential usage. Statistics revealed that an overwhelming positive response (above ninety percent) of students thought our system that formed student study groups was a feasible, worthy idea. Figures on potential usage of our system were also supportive: approximately half of the students said they would use our system if it was available. Research confirmed that our computer system is viable, usable, and well-received by students. This preliminary study has paved the way for a more formal study and assessment of a professionally-developed computer-aided study group formation system.

Development of the Innate Immune Response in Nestling Tree Swallows (*Tachycineta bicolor*)

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McNair Scholar

Michael Lombardo, Ph.D.
Faculty Mentor

The innate immune system provides an immediate, short-term, first line of defense; its appearance early in development in vertebrates is evidence of its critical importance. Even so, few studies have investigated the development of the immune response as juveniles transition into adults. Ultimately, the ability to respond to pathogens confers fitness benefits in terms of health, survival, and reproductive success, and it follows that functions such as rapid growth cannot be fully met simultaneously since energy is a limiting resource. As a result, defense mechanisms are compromised at an early age due to energy allocation to rapid growth; therefore, immunity should increase as individuals mature. I studied the development of innate immunity in nestling Tree Swallows, *Tachycineta bicolor*. Microbicidal assays were conducted in vitro to assess the ability of the immune system to kill *E. coli* via lysis. I used blood drawn from nestlings at three stages of development: day 6 after hatching when the eyes open, day 12 when endothermy has developed, and day 18 just before fledging. The results show an increase in lysis as birds matured. Additionally, the innate immune system and wing chord in 18 day olds were not fully developed relative to adults, indicating that development of the innate immune system and growth continued after fledging. These data suggest that nestling Tree Swallows allocated energy to rapid growth, with apparently less energy towards the development of innate immunity. This may reflect a balance of predation and pathogen pressures on nestlings, ultimately favoring selection on rapid growth.

TRiO
RONALD E. McNAIR
POST-BACCALAUREATE
ACHIEVEMENT PROGRAM

About the TRiO Programs

To fight the war on poverty, our nation made a commitment to provide education for all Americans, regardless of background or economic circumstances. In support of this commitment, Congress established several programs in 1965 to help those from low-income backgrounds and families with no previous college graduates (first generation). The first three programs established were Talent Search, Upward Bound, and Student Support Services. Thus, they are known as the TRiO Programs.

Since then, other programs have been added, including Upward Bound Math and Science, Educational Opportunity Center, The Training Authority, and in 1989, The Ronald E. McNair Post-Baccalaureate Achievement Program. The goal of all of the programs is to provide educational opportunity for all.

The Ronald E. McNair Post-Baccalaureate Achievement Program is designed to prepare highly talented undergraduates to pursue doctoral degrees. In addition, the goal is to increase the number of students from low-income backgrounds, first generation college students, and under-represented minorities on college and university faculties.

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