



**A HANDBOOK ON
MENTORING
STUDENTS IN
UNDERGRADUATE RESEARCH:
PROVEN STRATEGIES FOR SUCCESS**

PREPARED BY
FACULTY OF THE UNDERGRADUATE RESEARCH COMMITTEE

A Handbook On Mentoring Students in Undergraduate Research:
Proven Strategies for Success

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Pamela Brown, Associate Provost
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Acknowledgements

The Undergraduate Research Committee (URC) at New York City College of Technology (City Tech) of The City University of New York (CUNY) developed this document. The URC is a multi-disciplinary committee that provides unique opportunities for students to participate in authentic research experiences with trained faculty mentors. The committee members are themselves trained mentors who are actively engaged in interdisciplinary and disciplinary research that spans the fields of anthropology, architecture, astronomy, biology, chemistry, communication design, health sciences, history, literature, management, mathematics, philosophy, physics, psychology, robotics, sociology, and theater.

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City Tech professors are the authors (in alphabetical order) of this collaborative publication: Viviana Acquaviva, Ralph Alcendor, Reginald Blake, Mercer R. Brugler, M. Justin Davis, Aida Egues, Pa Her, Elaine Leinung, Janet Liou-Mark, Zory Marantz, Alberto Martinez, Marie Montes-Matias, Hamidreza Norouzi, Katherine (Kate) Poirier, Jonas Reitz, Jody Rosen, Diana Samaroo, Liana Tsenova, Justin Vazquez-Poritz, Selwyn Williams, and Lin Zhou.

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Authors

Viviana Acquaviva, PhD, is Assistant Professor of Physics at New York City College of Technology. She received her doctorate in Astrophysics in 2006 from the International School of Advanced Studies (SISSA/ISAS) in Trieste, Italy. She was a Research Associate in the Physics and Astronomy Department at Rutgers University, and a PIRE postdoctoral fellow at UPenn and Princeton. Her research focuses on using data from large galaxy surveys, together with data mining and machine learning tools, to improve the understanding of the evolution of the Universe.

Ralph Alcendor, PhD, is Assistant Professor of Biological Sciences at New York City College of Technology. He received his BS from the University of the Virgin Islands and his PhD from University of Medicine and Dentistry of New Jersey - Graduate School of Biological Sciences (now Rutgers Graduate School of Biological Sciences). His research interest is in the area of cell survival and longevity.

Reginald Blake, PhD, is Professor of Physics at New York City College of Technology. He is a geophysicist who serves on the New York City Panel on Climate Change, and as a NOAA-CREST scientist. He is a member of the Climate Change Impacts team at NASA-GISS (Columbia University), and he directs the Center for Remote Sensing and Earth System Sciences at City Tech. Dr. Blake has secured grant funding as PI or Co-PI from the NSF (REU, OEDG, IUSE), NOAA, NASA, and DoD. He is the director of the Black Male Initiative program, and he has published and presented extensively on climate change impacts, satellite and ground-based remote sensing, and on STEM education for under-represented minorities.

Mercer R. Brugler, PhD, is Assistant Professor of Biological Sciences at New York City College of Technology. Dr. Brugler is an evolutionary biologist who specializes in the phylogenetic systematics and molecular evolution of deep-sea black corals and sea anemones (phylum Cnidaria). He is also a Research Associate at the American Museum of Natural History where he mentors several minority and underrepresented City Tech undergraduates in his molecular laboratory. Dr. Brugler recently invited an LSAMP Scholar to participate in a week long research cruise to the Flower Garden Banks National Marine Sanctuary (Gulf of Mexico), where the student utilized a remotely operated vehicle to collect mesophotic black corals.

M. Justin Davis, PhD, was Assistant Professor of Humanities at New York City College of Technology. He is a Postdoctoral Research Fellow at Northeastern University. His research interests include communicative texts, cultural memory, and social movements.

Aida L. Egues, DNP, RN, APHN-BC, CNE, Associate Professor of Nursing, is a Fellow at the New York Academy of Medicine. She has numerous national, regional, and local awards in mentoring, teaching, and service, as well as many peer-reviewed national grants, invited lectures, presentations, and publications.

Pa Her, PhD, is Associate Professor of Psychology. Her research interest focuses on three interrelated areas: socialization of beliefs and behaviors across cultures, parent-child relationships, and the effects of family background and culture on social, emotional, and academic development. As an underrepresented, female minority, and a first generation college student, Dr. Her is keenly aware of the need for mentoring. In addition to teaching and research, Dr. Her is also Senior Personnel on the NIH *Bridges to the Baccalaureate* program at City Tech where she oversees the Strengthening Research Interactions through Digital Expression (STRIDE) for underrepresented minorities students in the biomedical sciences.

Elaine Z. Leinung, DNP, RN, FNP-BC, CNE, Assistant Professor of Nursing, is a family nurse practitioner. She is active in the state political arena, holding office in professional organizations. Additionally, she is a peer-reviewed published author and presenter, and has written and produced public education shows on local cable television.

Janet Liou-Mark, PhD, is Professor of Mathematics at New York City College of Technology and the Director of the Honors Scholars Program. Her research focused on the Peer-Led Team Learning instructional model has won her the 2011 CUNY Chancellor's Award for Excellence in Undergraduate Mathematics Instruction. Dr. Liou-Mark is the recipient of several federal and foundation grants which focus on creating pathways for students, particularly women and underrepresented minorities in STEM, to succeed academically. Dr. Liou-Mark has mentored over 125 underrepresented minority and first-generation STEM students where a third of them are continuing or obtaining advanced degrees.

Zory Marantz, PhD, PE, is Associate Professor of Electrical Engineering at New York City College of Technology. He received his doctorate in Electrical Engineering from Polytechnic University in 2006. He teaches undergraduate courses in circuits, power, and communications. Dr. Marantz has published papers in the area of radio resource management and presented his work at numerous conferences. His research interests are in Radio Resource Management (RRM), Game Theory, numerical methods for communication, programming and simulation of algorithms for communication systems, and wireless communications for traffic safety.

Alberto Martinez, PhD, is Assistant Professor of Chemistry at New York City College of Technology. He obtained his PhD in Chemical Sciences in 2000 from the University of Barcelona (Spain). Dr. Martinez had worked as a Research Associate in the Chemistry Department of Brooklyn College, CUNY, and in the Chemistry Department/Massey Cancer Center of Virginia Commonwealth University. His current research focuses on synthesis and development of novel chemotherapies against Alzheimer's disease.

Marie Montes-Matias, PhD, was Assistant Professor of Biological Sciences at New York City College of Technology. She is currently an Assistant Professor in the Biology and Allied-Health Department at Union County College. Her research interests focus on the area of microbial biodegradation and biotransformation.

Hamidreza Norouzi, PhD, PE, is Associate Professor of Construction Management and Civil Engineering Technology and the Director of Undergraduate Research at New York City College of Technology. He has been involved in several undergraduate research and educational grants such as NSF *ATE*, *TUES*, *IUSE GEO*, *REU* as either a Co-PI or senior personnel. He has published and presented the research results from these grants with his undergraduate students. Dr. Norouzi is also PI on several grants with the Department of Defense, *Army Research Lab* and a Co-PI of a project with the *National Oceanic Atmospheric Administration*. Dr. Norouzi is a member of Land Surface Working Group of NASA Global Precipitation Mission. He is a doctoral faculty of the Earth and Environmental Sciences department at the CUNY Graduate Center.

Katherine (Kate) Poirier, PhD, is Assistant Professor of Mathematics at New York City College of Technology. She earned her BSc in Mathematics from the University of Toronto and her doctorate in Mathematics from the CUNY Graduate Center. Her research focuses on algebraic and geometric topology.

Jonas Reitz, PhD, is Associate Professor of Mathematics at New York City College of Technology. His research interests lie in set theory, studying the foundations of Mathematics and the sizes of infinity. He is the Project Director of City Tech's Title V grant *Opening Gateways to Completion: Open Digital Pedagogies for Student Success in STEM*.

Jody Rosen, PhD, is Associate Professor of English at New York City College of Technology and she holds an AB from Brown University and a doctorate and Women's Studies Certificate from the CUNY Graduate Center. As former Writing Across the Curriculum coordinator, she values the role of writing in all courses, and integrates writing-intensive and communication-intensive approaches into her composition and literature courses. Her scholarship focuses on narrative theory, Modernisms, and gender and sexuality studies. Her work has been published in the *Virginia Woolf Miscellany* and in *Forces of Nature: Natural(-izing) Gender and Gender(-ing) Nature in the Discourses of Western Culture*.

Diana Samaroo, PhD, is Associate Professor of Chemistry and Chair of the Chemistry Department at New York City College of Technology. With a doctorate in Biochemistry, she was a post-doctoral fellow in the Department of Neuroscience/Neurology at Weill-Cornell Medical College researching proteins linked to celiac disease, schizophrenia, and ADHD. Her current research interests are in the area of drug discovery, therapeutics and nanomaterials. She also serves on the college's Assessment Committee and is a task force member of the Black Male Initiative.

Liana Tsenova, MD, is Associate Professor of Biological Sciences at New York City College of Technology. She has mentored many students, including Emerging and Honors Scholars. She served as the acting Program Coordinator for the BS in Radiologic Sciences of the Department of Radiologic Technology and Medical Imaging. Currently she is the PI of the *Bridges to the Baccalaureate* program, funded by the NIH.

Justin Vazquez-Poritz, PhD, is the Dean of the School of Arts and Sciences and Associate Professor of Physics at New York City College of Technology. As former Director of Undergraduate Research, he oversaw the Emerging Scholars and Research Scholars programs. His research is on black holes and string theory. He received his BA and PhD from Cornell University and the University of Pennsylvania.

Selwyn Williams, PhD, was the first appointed Director of Undergraduate Research and former Assistant Professor of Biological Sciences at New York City College of Technology. He is currently an Assistant Professor and Program Coordinator at Miami Dade College. His research interest is in cell biology—the extracellular matrix and the cytoskeleton.

Lin Zhou, PhD, is Associate Professor of Mathematics at New York City College of Technology. She received her doctorate in Mathematics from New Jersey Institute of Technology. She has held a visiting faculty position at the University of Delaware. Her research interests are in modeling complex fluids and numerical computation of nonlinear and stochastic differential equations.

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Foreword

Faculty mentors of City Tech’s undergraduate researchers have much to be proud of. Many students have presented their work at regional, national and international conferences and in peer reviewed journals. Students have gone on to graduate school, attributing their success to their mentor. City Tech’s undergraduate research programs have the strong support of the college administration because of their demonstrated role in student success.

Mentoring undergraduate researchers is an important skill for advancing a faculty member’s productive scholarship and preparing their students for employment and graduate school. With good mentoring students engage in the research process, collaborate with others, communicate research findings, improve their analytical and critical thinking skills, and grow as professionals. Some students discover a passion for research and raise their educational and professional aspirations. In order to achieve these gains students need a mentor who encourages them to be actively involved in reviewing the literature, contributing to research questions, assisting with experimental design and analysis of results.

While mentoring undergraduates places extra time demands on already busy faculty members, it can yield significant benefits for the faculty member as well. These include an “extra pair of hands” to advance research projects, a sense of personal fulfillment, and even creation of a research legacy. Just as a family tree traces ancestors, there are research trees tracing the mentoring roles of some of the world’s most accomplished scientists. One of the most famous examples begins with Nobel Prize winner Ernest Rutherford, who was responsible for important discoveries in the fields of radioactivity and nuclear physics. He mentored Niels Bohr, who went on to win a Nobel Prize for his contributions to the fields of atomic structure and quantum mechanics. Niels Bohr in turn mentored Wolfgang Pauli, who won a Nobel Prize for development of the Pauli Exclusion Principle. Just imagine the future accomplishments of the students you mentor!

City Tech’s Undergraduate Research Committee is to be commended for preparing, *A Handbook on Mentoring Undergraduate Research: Proven Strategies for Success*, which should be a valuable resource for both students and faculty. This is a dedicated group of experienced mentors. Valuable topics covered include a definition of mentoring, the rewards of mentoring, best practices and effective strategies, the stages of mentoring, challenges and obstacles, evaluation, resources and opportunities.

Dr. Pamela Brown
Associate Provost
New York City College of Technology, CUNY

Introduction

This introduction provides a context for faculty mentoring students in undergraduate research at New York City College of Technology (City Tech) of the City University of New York. New York City provides fecund educational resources for its inhabitants; this justifies City Tech's participation in mentorship-based undergraduate research activities. Recently, Brooklyn's downtown area, known as the Brooklyn Tech Triangle, is flourishing with STEM-focused activities because of the numbers of public and private colleges and business start-ups. City Tech is the largest public senior-level college of technology in New York State serving over 17,000 students with approximately 43% of the student body originating from outside of the United States representing 152 countries and speaking more than 85 languages (City Tech, 2016). Because of its diverse student population, it is designated as both a Hispanic Serving Institution as well as a Minority Serving Institution.

City Tech's Mentoring Philosophy

Mentoring at City Tech has a unique institutional perspective. In academia, undergraduate research mentoring is widely accepted as a well-established, high-impact practice across institutions of all stripes. The prevalence of the mentoring model is due in no small part, to its versatility and effectiveness within a broad spectrum of institutional contexts. A traditional liberal arts college may employ forms of mentoring whose primary objective is to foster student development that successfully moves the undergraduate to the next academic level, most often graduate or professional schools. Alternatively, apprenticeship-based mentoring may work well as an integrated component of vocational education in a community college setting. As the designated college of technology of the City University of New York, the City Tech Mission Statement is clear that it has historically served *“the city and the state by providing technically proficient graduates in the technologies of the arts, business, communications, health and engineering; human services and law-related professions; technical and occupational education; and liberal arts and sciences.”*

The bi-level structure of the College, currently bearing 51 baccalaureate, associate and certificate programs spanning a broad array of disciplines, presents exciting opportunities and challenges for mentoring. Include one of the nation's most diverse student bodies, in one of the world's greatest cities, and one has a rich academic milieu that is indeed highly distinctive. Mentoring has adapted to City Tech's unique institutional context and assumes many variations across schools, departments, disciplines, and programs. Baccalaureate programs, for instance, may employ conventional long-term mentoring strategies (from freshman to senior) while associate degree and certificate programs necessarily focus on shorter term, semester-based outcomes. Additionally, it is not unusual to find students entering mentoring experiences with faculty “outside” of their chosen programs. This is especially evident within the School of Arts and Sciences where in concert with its own degree programs, it services both the School of Technology and Design and the School of Professional Studies by providing the requisite general education (Gen Ed) curriculum developed and delivered City Tech style by faculty who collaborate on interdisciplinary

themes. The result is often a unique juxtaposition of disciplines, with for example, biology faculty mentoring radiologic technology students, or English professors engaging aspiring dental hygienists in literature research projects. Such situations challenge the faculty mentor to develop Gen Ed approaches that foster student development in ethics, knowledge, and skills that can translate well into the students' chosen major and subsequent career path; these situations will also serve the students well in everyday life. Inter- or cross-disciplinary design can be a natural breeding ground for growing meaningful cross-disciplinary collaboration and interactions among programs, departments, and schools. Taken together, the uniqueness of City Tech's mission, its structural organization, and its vibrant community of students and faculty, can serve as a fertile institutional incubator for the development of typical examples of the Undergraduate Research Committee's (URC) approach to mentoring.

For several years the URC has been systematically engaging faculty in identifying, understanding, and using effective mentoring practices. These years of developing URC's approach to mentoring have culminated in the production of this Handbook. The Handbook was designed and developed to facilitate and to clarify the mentor-mentee relationship. It is intended to aid in the holistic design and implementation of a mentoring program. Both mentor and mentee will find the Handbook explicit, direct, and user-friendly. The nuances and challenges of mentoring are uniquely addressed in a plethora of case studies that are intended to provide guidance and pathways to solutions. It is hoped that the Handbook not only advances the mentoring paradigm, but also demystifies the mentoring journey. Effective communication skills and cultural sensitivity on the mentor's part are key elements for mentoring success. Conscious effort is made in the Handbook to address issues of respect for ethnic and cultural diversity. It is hoped that both the new and seasoned faculty mentors will find the Handbook useful. The first-time mentor will have a valuable guide to begin the mentoring process, while the experienced mentor will have an asset to fine-tune mentoring strategies.

Rationale

Mentoring via undergraduate research is a proven strategy for individual and institutional transformation. Not only does it provide faculty with a means of giving back by sharing knowledge, skills, experience, and wisdom with students, but it also has the added reward of shaping, molding, and nurturing the next generation of researchers and scientists. The literature [PCAST (2012), Lopatto (2007), Lopatto (2010), Gasiewski et al. (2010), Newman (2011), Espinosa (2011), Toldson et al. (2012), Junge et al. (2010), Blake et al. (2013), Blake et al. (2015), Ghosh-Dastidar and Liou-Mark (2014), and Chang et al. (2014)] is replete with evidence that students who are mentored via undergraduate research become better overall scholars—in their course work and also in their approach to learning. Not only do they become more academically mature, but these students also develop a more distinct, focused vision of their future academic pursuits and careers. Graduate and professional studies become attainable options, internship opportunities are sought after, graduation and retention rates are improved, leadership and communication skills are enhanced, newly found skills and dormant academic dreams are imagined, critical thinking skills are sharpened, academic potentials are realized, ownership of knowledge is coveted, expectations are elevated, and academic passions are born. Undergraduate research, therefore, provides the milieu in which individual transformation via mentoring occurs and thrives. The added value to all the above is that the transformation goes beyond the individual undergraduate research mentee. It extends to the entire institution and becomes the fertile soil in which a culture of authentic research experiences thrive.

The success of undergraduate research programs is predicated on its ability to develop, thrive, and be sustainable. They need the proper environment in which to flourish. For example,

1. Students need to be equipped with the academic background, tools, and skills necessary to conduct research;
2. Faculty must be involved in research;
3. Faculty must be willing to engage students in research;
4. Faculty must be trained to mentor undergraduate research students;
5. Research opportunities must be available;
6. There has to be an institutional climate that encourages and rewards faculty involvement and engagement with undergraduate students and their research projects;
7. Funding must be available.

Undergraduate research is a win-win endeavor not only for students, but for faculty mentors as well. For faculty, among other benefits, undergraduate research: 1) allows for fulfillment and satisfaction of giving back via mentoring 2) transforms the pedagogical experience by elevating student engagement; 3) permits deeper, more probing classroom/student learning experiences; 4) provides a ready cohort of students to become involved in—and to assist the faculty with—research projects; and 5) prompts new avenues of investigation born out of curiosity from a student's perspective.

To be successful, undergraduate research mentoring must be intentional, recognized as an integral part of the institution's work, and faculty must learn how to mentor undergraduate students. The material presented herein may be used to guide the mentoring process for faculty who seek to become engaged in preparing, guiding, and learning from undergraduate researchers. More specifically, the purpose of the Handbook is to:

- ♦ Describe the concepts and benefits of mentoring;
- ♦ Describe the phases of the mentoring relationship;
- ♦ Define the roles of the faculty mentor and undergraduate student mentee;
- ♦ Provide strategies for becoming an effective mentor;
- ♦ Provide strategies for becoming a successful mentee;
- ♦ Provide tools to help the faculty mentor manage the mentor-mentee relationship; and
- ♦ Provide mentoring resources and references.



We have actual scientists teaching at this school who release research papers on the science they're doing. They're willing to mentor us and that's awesome. Our research professors are exploring amazing ideas throughout science. You can be a part of that research, too, and help contribute to the world's knowledge.

- Mario Martin, Applied Mathematics



◆ Section 1

Rewards of Mentoring

Rewards of Mentoring

Grounding the Work

Why is mentoring essential? Human development theory holds that among persons reaching mid-life there is a need to develop and train the next generation (Levinson, Tolle & Lewis, 1989). Investing in the success of one or more persons early in their life and during their career development stage provides the opportunity to fill the need of replenishing the workforce with skilled workers.

What an experienced mentor brings to the mentoring process is access to information and suggestions for academic success. Having a mentor will most likely reduce confusion, frustration, and failure in their mentee's educational path. The mentor can also assist in creating professional networks and extend research opportunities.

The ultimate goal of mentoring, in its simplest form, is for the mentor to help the mentee define educational goals and assist in the process of acquiring skills to achieve those goals. Mentoring is a relationship that enables purposeful, orchestrated conversation. The conversation assists the mentee to reflect on his/her own experience, make informed decisions, and act upon the questions for research that are generated. One of the purposes of a synergetic relationship is the development of the learner's process of inquiry. A consistent commitment from both partners is necessary to achieve the learning and research goals. The sharing of personal experiences and the transmission of knowledge intersects in a trusting learning environment that provides opportunities for both the mentor and mentee to stretch beyond their boundaries. Another goal of mentoring is to encourage individuality, by standing aside and allowing mentees to blossom on their own terms. Domination of and interference in the mentoring process may slow down natural growth and discourage independence, if the mentor "has all the answers".

To begin the mentoring journey, each future mentor must ask the following questions:

- ♦ How does mentoring begin?
- ♦ What kind of mentoring did I experience during my undergraduate years?
- ♦ What kind of research do I envision undergraduate students doing?
- ♦ Am I willing to model ethical research practice with undergraduate students?
- ♦ Do I have the interest and time to learn how to be an effective mentor?

A mentor must have a clear understanding of his or her own personal journey. A mentor who reflects on how mentoring has contributed to his or her scholarly work, professional demeanor, and growth over time may be better focused and ready to make the mentoring process a success for the mentee. A future mentor who has given serious thought to entering into the mentoring process will be in a better position to learn effective strategies for mentoring and recognize the personal and professional rewards to both parties.

1.1 Rewards to the Mentor

There are both personal and professional benefits of becoming a mentor. These benefits, although not all inclusive, include the following:

- ♦ Expansion of a lasting career network;
- ♦ A way to “give back” to the school and to the profession;
- ♦ A way to recruit employees for the mentor’s industry and/or company;
- ♦ Generation of creative ideas from less experienced students: listening to different perspectives;
- ♦ Promotion of curiosity by learning to ask researchable questions;
- ♦ Development of new talent;
- ♦ Enhanced professional life, intellectual growth, and professional development;
- ♦ Expanded engagement through a network of collaborations with like-minded peers;
- ♦ Feedback loop to students and school regarding curriculum needs;
- ♦ Feeling of accomplishment (helping mentee participate in a research agenda that furthers their academic goals);
- ♦ Improvement of teaching practice using evidence-based learning principles;
- ♦ Recognition of service at the college level for participation in fulfilling university goals;
- ♦ Opportunity to present collaborations at local/state/national meetings;
- ♦ Satisfaction from modeling discipline-specific protocols and sharing that experience;
- ♦ Participation as a role model to others; and
- ♦ Respected way to share knowledge in the field.

The process of and the experiences gained from mentoring are relationship based. The mentor who invests time, energy, effort, and expertise in the process expects to receive satisfaction, pleasure, gratification, and pride from the undergraduate research relationship. The rewards to the mentee should also be satisfying both personally and professionally.

1.2 Rewards to the Mentee

There are both personal and professional benefits of becoming a mentee. These benefits, although not all inclusive, include the following:

- ♦ Clear understanding and advancement of academic and career development plans;
- ♦ Development of a lasting career network within a chosen field;
- ♦ Enhanced perspectives on navigating career choices;
- ♦ Increased awareness of career success factors;
- ♦ Expanded engagement through a network of collaborations with like-minded peers;
- ♦ Identification of researchable questions and systematic approaches to inquiry;
- ♦ Well-practiced communication (verbal and written) and organizational skills;

- ◆ Opportunities to apply for internships, scholarships, and conference presentations;
- ◆ Feedback loop to mentor about curriculum ideas;
- ◆ Work in a structured task driven team environment with deadlines and deliverables;
- ◆ Application of problem solving and critical thinking skills; and
- ◆ Psychosocial support (encouragement, open continuous dialogue, and role modeling).

The benefits of mentoring for the mentee can range from a simple validation of the Gen Ed skills, knowledge, and ethical dispositions presented by faculty in the classroom setting to an over-the-top positively life-altering experience. The mentoring relationship developed with undergraduate students and faculty can build, strengthen, encourage, inspire, and challenge both partners to reflect on the process. It can forge and foster relationships that go beyond the attainment of academic and scholarly success. It can produce a cyclical feedback loop that enables and equips mentees to become future mentors, and thus the cycle continues.

1.3 Rewards to the Institution

As supported in the literature, the benefits or rewards of mentoring programs to the institution are vast. Institutional mentoring programs have been shown to increase student engagement and to help students in making broad connections (Center for Community College Student Engagement, 2015) that enrich the learning experience and support the institution's mission. For the institution, the rewards of mentoring may include:

- ◆ Development of engaged citizens by participation in researchable questions to improve society;
- ◆ An increase in retention and graduation rates;
- ◆ An increased likelihood of students being more career ready;
- ◆ An increased likelihood of students being admitted to graduate/professional schools;
- ◆ An increase in alumni relations;
- ◆ Increased eligibility to apply for and subsequently receive grant and other funding;
- ◆ Recruitment of students through positive reports of retention and success;
- ◆ Reported improvements in student-teacher relations;
- ◆ Retention of students by providing meaningful academic and career involvement; and
- ◆ Support for cross-cultural learning.

The benefits of mentoring for the institution ultimately increase its reputation as a center of inquiry, promote the visibility of students and faculty who engage in research techniques, and attract employers who are recruiting graduates who are passionate, articulate, and open to asking questions that lead to creative and cost-effective solutions facing society. Mentoring is one of the institutional pillars that directly reflects the institution's commitment to student development and success.



The most significant part of this project for me was working with an interdisciplinary team. I am proud to say that the results of our research project were later presented on a state level at Cornell University in Ithaca, New York. Finally, the project was selected for presentation at the Annual Biomedical Research Conference for Minority Students in November 10-13, Charlotte, NC. The doors that these research projects opened for me have been incredible! My advice to all students regardless of your major/discipline is to challenge yourself to participate in academic research. I participated without expectations or experience and was amazed by the opportunities that keep presenting themselves because of my experience. I am extremely grateful to City Tech faculty for making these programs available to their students.

- Aionga S. Pereira, Liberal Arts and Sciences



Section 2

Mentoring Defined

Mentoring Defined

An extensive review of the literature on mentoring dating back to the 1970s reveals that there is still no consensus on a universal theoretical definition of mentoring in any discipline, although the notion of mentoring is somewhat familiar both as an experience and as an ideal (Egues, 2010). According to Thorpe and Kalischuck (2003), the concept of mentoring is ancient, dating back to Greek mythology. The word “mentor” was inspired by Homer’s character in the epic poem *The Odyssey*. Mentor, an old and trusted friend of King Odysseus was asked to guide his young son Telemachus during the King’s absence. Athena, the goddess of wisdom, would often disguise herself as Mentor to counsel Telemachus in his time of struggle.

Some synonyms for mentor include advisor, coach, friend, guide, role model, and sponsor. These synonyms do not aptly capture the definition of mentor. For example, a coach is involved in the direction, training, and operation of a sports team or individual athletes. The terms coaching and mentoring are often confused as having the same function. However, a mentor may coach, but a coach does not necessarily mentor. Mentoring is “relational,” while coaching is “functional.” A guide assists and provides direction. A role model is someone worthy of imitation, while a sponsor supports through endorsement. For the mentoring process to begin to be successful, it is crucial to agree on a definition.

In the Handbook, the term mentoring is defined as an experienced person in an educational institution or academic setting who uses his or her greater knowledge and understanding of the work and workplace to support the development and success of students.

2.1 The Characteristics of a Mentor

The characteristics of a good mentor are found in countless studies on the topic. Perhaps the hallmark of effective mentoring is honesty. The mentor possesses the ability to build trust and to harness the full potential of the mentee (Foster, 2001; Straus, Johnson, Marquez, & Feldman, 2013). Other characteristics of a mentor may include the following:

- ♦ Commitment to the mentee’s intellectual growth, academic development, and cultural integration;
- ♦ Effective nonverbal and verbal communication skills;
- ♦ Integrity, trustworthiness, and respect;
- ♦ Willingness to consult with others for advice and assistance;
- ♦ Willingness to be a confidant and a friend;
- ♦ Be tolerant and respectful of different viewpoints;
- ♦ Be understanding and flexible;
- ♦ Be attentive;
- ♦ Be diplomatic;
- ♦ Be perceptive; and
- ♦ Be reflective.

The traits of the mentor have direct bearing on the success of the mentoring experience. A mentor's personality, style, demeanor, and attitude partly influence and shape the mentee's confidence, work ethic, overall academic performance, and outlook on life.

2.2 The Role of the Mentor

Certain criteria should be in place for those faculty members who want to be mentors. Potential mentors should possess a terminal degree in an appropriate discipline and have ongoing research or demonstrated a research agenda of high academic quality. In addition, potential mentors should demonstrate interest and dedicate time to work with undergraduate research students.

Qualified faculty members who seek to be mentors will benefit from participation in professional development seminars designed to initiate those interested to mentoring responsibilities, challenges, and satisfactions. A well oriented mentor can inspire the student researcher to articulate academic goals and make a plan to achieve them. The mentor provides opportunities for the student researcher to develop valuable research skills and to welcome him or her as part of a research team. The mentor needs to provide a safe environment for the student to develop academically and socially, and keep the student "on track." The mentor's role in developing a positive mentoring relationship has many facets including ways to:

- ♦ Act as a sounding board for research ideas, concerns about school, and/or career choices;
- ♦ Give advice, guidance, and feedback;
- ♦ Seek opportunities to increase the visibility of the mentee;
- ♦ Serve as an advocate for mentee whenever opportunities present themselves;
- ♦ Provide insights into applications for scholarships, graduate schools, and/or job opportunities;
- ♦ Recommend resources to support mentee if a personal issue might impede progress; and
- ♦ Help mentees think through important decisions and offer strategies to accomplish them.

Moreover, a qualified faculty member who seeks to be a mentor should understand that part of the role includes being involved in the following aspects:

- ♦ Participating in a mentoring orientation seminar;
- ♦ Introducing yourself to the Director of Undergraduate Research;
- ♦ Placing your research interests on the list of mentors;
- ♦ Selecting the prospective mentee;
- ♦ Assessing prospective mentee's skill sets and degree of interest;
- ♦ Designing research projects that are effective, realistic, and feasible across the disciplines;

- ♦ Establishing mutual research and related mentoring goals;
- ♦ Participating in providing measurable benchmarks and outcomes;
- ♦ Committing time to nurture and develop the mentee;
- ♦ Establishing the parameters of the relationship;
- ♦ Participating in on-going related activities, such as research mixers and graduate/career fairs; and
- ♦ Participating in bi-annual college-wide student poster presentation of research outcomes.

The following exercise will help a prospective mentor gauge how interested and motivated he or she is in starting a mentoring relationship. The readiness checklist below is designed as a preview of the kinds of tasks that are typically expected of a mentor. The future mentor may then meet with a member of the URC to discuss next steps in the process.

Exercise 2.2.1 Mentor Readiness Checklist

Check off all items that apply regarding the prospective mentoring relationship.

1. ____ I have a sincere interest in helping the mentee to succeed.
2. ____ To me, there is a mutual compatibility and interest between us.
3. ____ Our assumptions, expectations, and goals about the mentoring process are ____ the same.
4. ____ The mentor role is clear to me, and I have made it clear to the mentee.
5. ____ The mentee role is clear to me, and I have elicited feedback to clarify it for the mentee.
6. ____ I am willing to use my network of contacts, or find new ones to help this mentee.
7. ____ I can commit adequate attitude, effort, and time to the mentoring process.
8. ____ I am open to communicating in different ways to support the relationship.
9. ____ I have access to the kind of opportunities that can support this mentee's personal and professional growth.
10. ____ I have the emotional and physical support that I need to engage in meaningful mentoring.
11. ____ I am committed to developing my own mentoring skills, through continuing education.
12. ____ I am committed to my own personal and professional growth.
13. ____ I have a mentoring development plan in place, with all the documents needed to record the relationship journey.

Adapted from Bell et al (1996); Kram (1985); and Zachary (2000).

2.3 The Role of the Mentee

For a successful mentor-mentee relationship, the prospective mentee should be aware that the following tasks are typically expected of a mentee:

- ♦ Readiness to follow directions;
- ♦ Learning to take initiative and be politely insistent about desire for active mentorship;
- ♦ Understanding that the mentor also has commitments outside the professional setting;
- ♦ Interest in investing time and also being open to the mentoring experience;
- ♦ Consideration of the effort and time of the mentor;
- ♦ Development of consistency and promptness to appointments and in all forms of communication;
- ♦ Providing honest feedback on the mentoring experience; and
- ♦ Eagerness to learn from the mentor.

The following exercise will help the mentor gauge how interested and motivated the student is in starting a mentoring relationship. A readiness checklist below as adapted from Bell et al (1996); Kram (1985); and Zachary (2000), will help the mentors identify whether or not the student is ready to be mentored.

Exercise 2.3.1 Mentee Readiness Checklist

Check off all items that apply.

1. ____ I can make a time commitment and keep it.
2. ____ I am receptive to learning new things.
3. ____ I am open to discussing my goals, plans and aspirations with my mentor.
4. ____ I can construct a plan and let my mentor know if anything changes.
5. ____ I am willing to seek advice when needed.
6. ____ I can commit adequate attitude and effort to the mentoring process that is consistent.
7. ____ I can be honest about my strengths and weaknesses.
8. ____ I am able to accept praise and criticism.

2.4 Types of Mentoring

There are different types of mentoring, each with its own values and opportunities. These types of mentoring and their characteristics include (Buell, 2004):

Formal

- ♦ Structured programs that match mentors and mentees;
- ♦ Generally focuses on specific goals; and
- ♦ Provides accountability based on formal contracts between mentors and mentees.

Informal

- ♦ Mentoring is self-selected;
- ♦ Arises out of an established relationship; and
- ♦ Tends to be more relaxed.

Traditional Face-to-Face

- ♦ Communication as an activity occurs in pre-arranged meetings;
- ♦ Is a two-way learning process with a mutual exchange of ideas; and
- ♦ Relies on a trustworthy relationship.

E-Mentoring

- ♦ Uses electronic technologies as primary tools for communication;
- ♦ Allows convenience of current mentor-mentee contact access;
- ♦ Increases flexibility and further development of technological skills;
- ♦ Facilitates reverse mentoring across generations;
- ♦ Is ecology friendly (reduces need to travel and use of paper); and
- ♦ Complements or extends traditional in-person meetings.

Multiple Mentoring

- ♦ Useful in informal mentoring arrangements;
- ♦ Offers several role models as mentors with one person being the primary mentor;
- ♦ Capitalizes on varying expertise of individual mentors; and
- ♦ Mentors work together in the best interests of the mentee.

Group Mentoring

- ♦ Matches experienced mentors with multiple mentees;
- ♦ Enables robust knowledge transfer among mentors and mentees;
- ♦ Allows for multiple viewpoints and additional learning opportunities; and
- ♦ Useful in complex research projects that can benefit from a greater pool of mentees.

Tiered Mentoring

- ♦ Effective practice for STEM research;
- ♦ Involves scaffolding of faculty mentors, graduate students, undergraduates, and possibly high school students;
- ♦ Allows for the direct cross pollination of research skills and ideas; and
- ♦ Fosters an active community of learners.

Mentoring types vary. They are contingent upon the needs, circumstances, and extant resources of the students or research projects. The mentoring process can evolve from one type to another over time or have elements of several types that suit a particular style of mentor or project.

2.5 Mentoring Styles

A Learner-Centered Mentoring Paradigm

Mentoring styles can affect how mentees learn from mentors. The learner-centered mentoring paradigm is recommended. The case study method is useful when prospective mentors are developing their own style of mentoring. Presented below are two case studies of faculty with distinct mentoring styles.

Case Study 2.5.1 What Just Happened?

Dr. Daniels, a well-published and respected associate professor at a large, public university, had been assigned by his department to be Robert's mentor. Robert, a second-year undergraduate student, was highly motivated to learn how to be an exceptional researcher. Their relationship started out on a mutually positive note, with a relaxed rapport. Yet, shortly thereafter, the level of interaction shifted dramatically. Dr. Daniels expected Robert to shadow him, to work on his projects, and to research topics he would personally assign. As time progressed, Dr. Daniels strictly gave Robert instructions, which Robert followed. As Robert's responsibilities increased, he and Dr. Daniels saw each other less. Before long, the communication between Dr. Daniels and Robert changed from casual discussion to bursts of short reports. Little conversation about Robert's learning experience took place, especially in raising or answering questions. Communication exchanges of any kind between mentor and mentee were brief, few, and irregular. Robert was bewildered and discouraged.

Reflection: What was missing in this relationship between mentor and mentee? What can Robert do to communicate his needs to his mentor?

Case Study 2.5.2 On the Same Page

Linda, a high-achiever, realized she needed to learn and master several skills to achieve a future career in research. She approached Professor Sam, an esteemed and respected assistant professor, and asked him to be her mentor. At the first meeting, Professor Sam worked with Linda to put a contract in place. Linda was able to come away from the meeting with clear learning goals that were attainable and measurable. Each time they met, Professor Sam and Linda reviewed the progress they were making against Linda's learning goals. They set aside consistent and regular time to talk about the level of satisfaction with the relationship, including how each felt they were progressing with their contractual obligations. There was a point in time, when Linda wanted to advance herself, and more of Professor Sam's time was needed. But, Professor Sam had intentionally built in a reflection period into their regularly scheduled meetings, so both he and Linda could discuss issues regarding the progression of the research. Additionally, Professor Sam encouraged Linda to attend conferences, seminars,

and workshops on her own. He explained these experiences could add to Linda's knowledge base and experiential growth as a researcher.

Reflection: What were the strengths of this mentoring relationship?

Case Studies 2.5.1 and 2.5.2 illustrated two mentoring styles with different learning outcomes for each student. The top-down mentoring relationship between Dr. Daniels and Robert is still common in academia; "running after the professor" and the chosen student first awestruck to work with the well-established expert, then questioning what to do. In contrast, the relationship between Professor Sam and Linda was a collaborative learning partnership, where the mentor is less of an authority figure and more of a facilitator. The mentor purposefully created an atmosphere conducive to learning. His mentee felt supported and encouraged to attain reasonable learning goals, contributing to the confidence, persistence, and identification as a researcher.

One of the biggest challenges for mentors is how to best assist their mentees in achieving their learning goals. For undergraduate college students, mentors must create a research environment that is learner-centered. The literature suggests that the more a mentor engages in facilitating the learning process, the more the mentee experiences a climate conducive to learning (Zachary, 2000). Instead of having the mentor take full responsibility for the mentee's learning, the mentee learns to share the responsibility for the following: 1) the learning itself; 2) the priorities of the relationship; 3) the resources to become more self-directed with time; and 4) the setting in which learning takes place. Over the course of the relationship, the mentor helps to develop the mentee's self-direction from dependence to independence to interdependence (Zachary, 2000). As the relationship develops, a partnership evolves where mentor and mentee both share the accountability and responsibility for achieving the mentee's attainable and measurable learning goals. At any time during the mentoring relationship, the mentor and mentee may diagnose, assess, plan, implement, and evaluate existing or new learning goals.

The mentoring philosophy adopted closely mirrors adult learning principles (Knowles, 1980). The elements of the learner-centered mentoring paradigm are further described in Table 2.5.1.

Table 2.5.1
Elements of a Learner-Centered Mentoring Paradigm

MENTORING ELEMENT	PARADIGM SHIFT	ADULT LEARNING PRINCIPLE
Mentee Role	Passive recipient to Active associate	The mentee learns best when involved in assessing, diagnosing, planning, implementing, and evaluating one's own learning goals.
Mentor Role	Authoritarian to Facilitator	The mentor as a catalyst creates and maintains a supportive climate; promoting conditions necessary for enabling mentee learning to take place.
Learning Process	Focus on the schedule to Focus on the purpose of the goals	The process of learning increases when there exists a readiness focused on the specific need to know basis and attain defined goals.
Mentoring Relationship	Single lifetime mentor-mentee association to Multiple lifetime mentor-mentees and multiple types of mentoring	The primary learning resource is life experiences, so that the life experiences of others add to the wealth of the learning process that continues beyond a short time period.
Setting	Face-to-face interactions to Multiple venues/opportunities for interaction (Internet/Social Media)	Adult learners tend to demonstrate need for immediate communication and feedback within changing communication environments.
Focus	Leaning toward the product (knowledge transfer and acquisition) to Leaning toward process (critical reflection and application)	Adult learners tend to respond optimally to learning when the motivation to learn itself is internally driven by the learner.

Adapted from Knowles (1980) and Zachary (2000).

Establishing Professional Communication Protocols

The mentoring relationship should emulate professional behavior. A mentee will learn professional habits if they are explicitly developed as part of the mentoring process. Communication protocols, written and oral, vary with each profession and mentees will benefit from specific models, occasions to practice and receive targeted feedback, and incremental opportunities to present their communication protocols with future and fellow professionals over time. The mentor must be conscious of the expected tone and clearly explain what and why certain language is used and when. What are the kinds of communication that will be developed throughout the research process? How are in-person and digital modes of communication used in a professional manner?

2.6 The Mentoring Journey

The mentor must claim the mentoring process. A mentor must be self-aware, self-reflective, and open to sharing part of his or her journey with fellow mentors and future mentors. Expressing an interest in mentoring, that is the first step on the journey. Becoming aware of and understanding one's personal experience with the mentoring process are essential parts of developing a philosophy of mentoring. Each journey is personal and an opportunity to self-reflect is part of the process. Your journey may have had challenges, changes, dangers, delights, disappointments, doors opening/closing, and/or revelations—all those emotional experiences have direct or indirect implications on how and why you are interested in mentoring. Case Studies 2.6.1 and 2.6.2 illustrate two different mentoring journeys. They are presented below so you can gauge your interest in becoming an effective mentor over time.

Case Study 2.6.1 When a Door Closes, a Window Opens

Ms. Volk had volunteered to serve as a mentor to nursing students. In preparing for her own role as mentor, Ms. Volk reflected upon her journey to become a professor of nursing. When she started out on her journey, she had been hired as a health promotion educator while in nursing school. During school, one of her professors encouraged her to volunteer in several organizations, helping to raise disease prevention and health promotion awareness. Ms. Volk also served in leadership capacities while in school-based clubs. After graduation, Ms. Volk was offered several nursing positions. Over the years, she worked her way up to managerial and administrative roles. Her life was changed when she divorced with two very young children under her care. Ms. Volk decided to leave her high-powered job to make herself more available for her children. She struggled over many years, sacrificing job and educational opportunities that interfered with her children's schedules. When her children were older, Ms. Volk decided to pursue her master's degree, and then she continued on to her doctorate. During her doctoral studies, Ms. Volk's parents were severely injured in an automobile accident. Ms. Volk left her doctoral studies, devoting herself to caring for her parents while taking a low-paying teaching position at a local university that

offered her flexibility in scheduling. After years of emotional and financial struggle, Ms. Volk completed her doctoral studies. She now holds the academic position of her dreams.

Prof. Volk realized that her school and volunteer experiences, divorce, children's life stages, parental care, and advanced studies were all significant life events that helped shape her academic life journey. She realized there were many road blocks in her educational and career journey. However, where there was an opportunity to continue, there were people along the way who devoted time to mentor her. Reflecting back, Prof. Volk was humbled by the people who helped her reach her goal. She, therefore, decided to give back, sharing some of the strength and wisdom she had received from others. It became clear to her as to why she wanted to become a mentor.

Reflection: In what ways did Prof. Volk claim her mentoring journey? How did her own self-reflection provide her with the tools necessary for positively impacting her future mentees?

Case Study 2.6.2 Misguided Mentoring Assumptions

Thomas expected to be mentored. He came from a family with a history of exemplary financial acumen and professional status. Immediately after graduation, a prestigious financial firm employed Thomas. He was assigned to a mentor who knew his family. Within a few years, Thomas became an executive who was expected to mentor a new generation of financial wizards. When Susan came on board, Thomas was assigned as her mentor. He had heard Susan was a recent university graduate from his alma mater, one of the top financial programs in the country. Thomas assumed Susan needed no guidance beyond informal meetings about company politics. He was brusque with Susan, and reminded her of her academic preparation. Susan had specific goals she wanted to achieve, but was hesitant in how to share those goals with Thomas. Thomas, who felt her academic background gave Susan sufficient knowledge to achieve those goals, was surprised when the president of the firm called Thomas into his office. It was clear that Susan was floundering due to Thomas' limited mentoring efforts. Susan was the first person in her family to attend college, and came from an urban environment with its own many challenges. She came from a family who struggled financially. Susan had worked in various jobs to support herself since she was 16, and she had never had a workplace mentor. Susan felt a huge disconnect between her life's journey and that of Thomas'. As such, she became discouraged, and she wanted to leave the company.

Reflection: How serious was Thomas in his role as a mentor? Had Thomas taken the time to self-reflect on his own journey and had he self-directed an investigation into Susan's what would he have done differently?

The following self-reflection Exercises 2.6.1, 2.6.2, and 2.6.3 were designed to help prospective mentors identify their own journey. What impact did mentors have on their personal and professional lives? The first exercise consists of identifying seminal events that had an impact on one's own life development. The second exercise consists of thinking of one's mentoring experiences and

recognizing those individuals who provided guidance and support. The third exercise tests assumptions and identifies factors that may hinder the mentoring process. The exercises are adapted and adaptable, similar to the role of a mentor (Bell, 1996; Daloz, 1999; Zachary, 2000).

Exercise 2.6.1 Constructing a Mentoring Journey Timeline

This exercise, designed to plot a graph of a personal and professional mentoring journey timeline, may help to outline one's own life journey and individuals who helped along the way.

1. Draw a vertical line on a piece of paper.
2. On the left side of the line, write dates and describe the places or events, milestones, and transitions (positive and negative) that influenced you.
3. On the right side of the line, describe: a) instances that have made a positive difference in your life and helped you grow and develop, b) barriers or obstacles that got in your way, and c) unplanned events and experiences that brought you joy or success.

Exercise 2.6.2 Timeline Reflection

This exercise was designed to identify your guides along your own journey. Respond to the directions:

1. List your mentors.
2. Indicate the relationship of each mentor (family member, friend, professional colleague, and workplace colleague).
3. Use the timeline created in the previous exercise to indicate when mentors were helpful.
4. Describe the mentoring experiences.
5. Highlight the wisdom gained from each mentor.

Reflection:

What did you learn from each mentor about being a mentor? What did you learn that might contribute to your own development as a mentor? What did you gain being a mentee?

Exercise 2.6.3 The Mentee Journey

This exercise asks you to test assumptions and recognize factors that may affect the learning relationship between mentor and mentee. Answer the following questions:

1. What was your journey as mentee like?
2. How can you learn more about your mentee's life journey, experiences, and milestones?
3. What insights have you learned from your mentee's journey that informs you about your mentee's readiness to learn?
4. What concerns and issues does the mentoring journey comparison raise for you about your mentee's goals and learning needs?

5. Are there specific actions or approaches that could potentially have a positive impact on the learning relationship between you and your mentee?
6. Are there specific actions or approaches that could potentially have a negative impact on the learning relationship between you and your mentee?

Reflection: Now that the exercises have been completed, what were some of your assumptions regarding a mentor-mentee relationship? Can you think of any examples or situations where biases/judgments may have been made? Can you describe some real differences between your journey as mentor and that of your mentee? How can you demonstrate that you are able and willing to effectively communicate? What have you learned from the successes of your own mentors, as well as from their mistakes? What did you learn about yourself after reflecting upon these questions?



It does not matter if a research project is directly related to your major. What matters is how you can relate to the research project. Students get more passionate about their research when they realize how disciplines are connected to each other.

- Amarou Bah, Telecommunications Engineering Technology



◆ Section 3

Best Mentoring Practices for
Undergraduate Research

Best Mentoring Practices for Undergraduate Research

Historically, mentors are individuals with advanced experience and knowledge who are committed to providing upward support and mobility to their mentee's careers (Hunt & Michael, 1983; Kram, 1985a). Mentors help their mentees by providing two general types of behaviors or functions: 1) career development functions, which facilitate the mentee's advancement in the organization; and 2) psychosocial functions, which contribute to the mentee's personal growth and professional development (Kram, 1985b). The presence of a mentor has long been associated with an array of positive career outcomes, including but, not limited to career satisfaction (Fagenson, 1989), higher incomes (Chao, Walz, & Gardner, 1992; Dreher & Ash, 1990; Whitely, Dougherty, & Dreher, 1991), more mobility (Scandura, 1992), and more promotions (Dreher & Ash, 1990; Scandura, 1992), than individuals who have no mentors. Mentoring has also been found to have a positive impact on job satisfaction (Koberg, Boss, Chappell, & Ringer, 1994), organizational socialization (Ostroff & Kozlowski, 1993), and reduced organizational turnover (Viator & Scandura, 1991). Indeed, these basic tenets and outcomes of mentoring for mentees have remained consistent to the present.

3.1 Mentoring Women, Racial/Ethnic Minorities, and First-generation College and Low Income Students

Research has identified mentoring as a best practice for minority students (Kosoko-Lasaki, Sonnino, & Voytko, 2006). Mentored minority students consistently have higher levels of:

- ♦ Academic integration;
- ♦ Cultural affinity;
- ♦ Encouragement;
- ♦ Improved retention rates;
- ♦ Institutional commitment;
- ♦ Satisfaction with faculty.

To be a successful mentor, one does not necessarily have to be the same gender or even come from the same cultural background as the mentee. However, it is imperative that the faculty mentor be aware of and is sensitive to the cultural background and challenges that the mentee faces. Culturally, Hispanic students experience pressure from their communities and families to observe and retain their customs and language; however acculturation and adaptation to higher education is needed for success—such success is supported through mentorship (Vasti-Torres, 2005). Many minority and women undergraduates are first-generation students (the first in their families to attend college) and low income. Therefore, they may have less expectation, guidance, information, and socioeconomic means than their non-minority counterparts. The mentor must also be cognizant of these factors so as to adequately prepare and work with the mentee.

3.2 Mentoring Students in STEM

“Every person in this room remembers a teacher or mentor that made a difference in their lives. Every person in this room remembers a moment in which an educator showed them something about the world—or something about themselves—that changed their lives... And innovators... are made in those moments. Scientists and engineers are made in those moments...”-President Barack Obama, January, 2010

As the lack of diversity in race and gender persists in US Science, Technology, Engineering, and Mathematics (STEM) fields, it is expected that more than nine million professionals will be needed in these fields by 2020 (Dennis Vilorio, 2014). However, increasing the number of qualified job seekers will not happen without a deep investment in students, particularly those from underrepresented groups. Studies have shown that employees with research experience and support from mentors become more confident, independent, and reliable professionals than their counterparts who did not have a research experience and a mentor. Often mentees are not aware of the path, the challenges, and the required skills for the proposed research project. Clear communication and the recognition of the strengths and weaknesses of mentees are critical when developing a research plan. Mentors may need to organize some skills practice time with their mentee at the beginning of the research project, especially if a particular skill is needed in the project. A well-constructed research plan—one that includes development of both communication strategies and specific research skills, as well as a feedback loop—may encourage students to learn habits that extend beyond the research project.

The lack of confidence and discouragement have been long-term hurdles that deter students from becoming STEM majors. Allowing the mentee to contribute to the research project at an appropriate level will increase the mentee’s confidence and sense of project ownership. Providing the mentee with a holistic perspective of the research project will encourage the mentee to seek the connections needed to bridge the gaps. Tiered mentoring is an effective best practice for STEM research (Blake, Liou-Mark, and Chukuigwe, 2013), and it prevents mentees being isolated, disconnected, and “siloeed.”

3.3 Mentoring Students in the Humanities and Social Sciences

Studies in the humanities and social sciences disciplines increasingly rely on qualitative and quantitative data in conducting research (Patton, 1996). Although they share some research methods similarities with laboratory-based research environments, the processes of measurement, reliability and validity are likely different because of the human-centered perspectives. Traits, emotions, and other behaviors in general are more challenging to assess because of their abstract nature. Assessing variables such as aggression, hardiness, and life-

satisfaction can be subjective and biased in self-reporting. Therefore, it is important for the mentor to discuss the appropriate qualitative and quantitative methodologies currently used in their discipline to achieve the most accurate and representative results. As with any discipline, mentees interested in humanities and social science research need to develop a set of skills. Training in specific skills must be part of the research plan. Typically research methods include focus groups, surveys, ethnographic or more naturalistic observations, and the data may vary from STEM laboratory-based research approaches. However, the process for becoming a mentor is the same across all disciplines and undergraduate students, especially women and minorities, benefit from effective mentoring.

3.4 Cross-cultural Mentoring

Diversity can be defined as differences in individuals' background, education, ethnicity, gender, physical appearance, race, sexual orientation, socioeconomics, and/or other attributes. This particular definition emphasizes the uniqueness of all individuals. Studies have shown that mentors and mentees from the same race and gender have had effective, positive results (Thomas, 2005). Universities—especially public and urban—are heterogeneous and diverse; cross-cultural mentoring has become an imperative. Cross-cultural mentoring is inclusive. It provides access to those who have been traditionally excluded, especially when there are limited mentors from their own race and gender. Each person brings unique experiences, interests, ideals, background, and upbringing to the research project, so respect for each individual learner is the basis for developing a sound mentoring relationship. To be an effective mentor, one needs to be culturally sensitive. With such awareness comes the expectation to address biases and prevent stereotypes from adversely affecting the mentoring relationship.

The mentor should identify his/her own biases and stereotypical beliefs and guard against their potentially adverse impact on effective mentoring. Just to begin the self-reflection process, the mentor should consider how he/she might respond to the phrases that follow:

- ♦ Avoid falling into a “surrogate parent” role, where the mentee expects to be nurtured instead of empowered to make choices. The mentor with attributes of a parent provides more emotional support which has potential to be inappropriate.
- ♦ Be aware of the “benefactor versus victim” syndrome especially if the mentor is from a majority background and the mentee is from an underserved one. The mentor should not perceive the mentee as a helpless victim, and the mentee must not engage in a self-fulfilling prophecy of learned helplessness.
- ♦ Agree that “race doesn’t matter.” However, mentors and mentees need to appreciate the differences that race and/or ethnicity may bring to their relationships.
- ♦ Recognize that accepting differences in gender and sexual orientation may encourage a student who wants to do research.

Diversity training is necessary for all of us, and especially for faculty who want to become effective mentors over time. We must identify and discuss our biases and ask ourselves how they can shape a learning environment in the classroom and in developing a mentoring relationship with undergraduate researchers.

As mentioned in Section 2, effective communication is an essential building block for creating successful mentoring relationships. This is particularly important for cross-cultural mentors to be aware that mentees may lack confidence in their own abilities. It is vital to allocate time to learn about the mentee's background and possible concerns. Successful mentoring relationships are built on honesty and respect for the individual learner, so a mentor should strive to: 1) become culturally attuned and sensitive to other cultures; 2) develop a working knowledge of and appreciation for other cultures; 3) understand traditions that may affect issues of place, space, and time; and 4) become aware of hidden biases. Case Studies 3.4.1 and 3.4.2 focus on self-reflection as a critical component in cross-cultural mentoring.

Case Study 3.4.1 Cultural Unawareness

Nicole, a timid student with an excellent academic record, is in Professor Zimmer's class. Nicole and Professor Zimmer are from different ethnic backgrounds. Nervous and unsure, she approaches Professor Zimmer and asks to conduct an undergraduate research project with him. Agreeing, Professor Zimmer develops an appropriate project and shows Nicole how to use the instrumentation after reviewing the safety laboratory procedures. Nicole does not appear to exhibit the level of care in the lab that Professor Zimmer expects. More glassware than usual has been broken. On two occasions Nicole forgets to filter the sample, causing Professor Zimmer to disassemble and clean the instrument which took several hours. Professor Zimmer finds himself getting more and more annoyed, but he was able to control his temper. He then reminds Nicole of the importance of exercising care and following protocols in the laboratory. In his conversation, Professor Zimmer also warns Nicole that she will not continue the project if the situation does not improve. Nicole was extremely upset. However, she nods and seems to understand but does not say anything because in her culture she is expected to respect authority. An hour later, Professor Zimmer returns to his office and listens to his phone messages. Nicole's father had called and left a stern message demanding to meet with him personally. Professor Zimmer sits at his desk, wondering what to do next.

Reflection: What roles could cross-cultural issues play in this deteriorating mentoring relationship? Where could Professor Zimmer have spent more time with the relationship he established with Nicole? What steps could he have taken to try to learn more about his mentee?

Case Study 3.4.2 Two Different Approaches

Professor Lam serves as a mentor for two undergraduate students, Sheba James and Jake Wall. Sheba is a minority first-generation college female student born and raised in the Caribbean, and Jake is a Caucasian student educated in the United States. Professor Lam has mentored only two male minority students in the past five years at the college, but accepts Sheba because she was in a research program aimed at supporting minority students and was pressured by his colleagues to mentor her. Jake and Sheba are both driven students, and they are capable of reading the literature reviews about the research and understanding the protocols necessary for the project. Nevertheless, both have made only minor progress towards completion of the project. Sheba makes an appointment with Professor Lam, and she gently tells him that she feels alienated because he holds more office meetings with Jake and spends more time mentoring him than her. Professor Lam explains that the expectations for Jake are much higher. Professor Lam points out that they are mentored differently because Sheba does not have plans to continue her education, but instead she plans to find a job after graduation. However, since Jake is planning to go to graduate school, Professor Lam believes more time and effort must be invested in Jake to develop his research skills. Sheba tells Professor Lam that she actually wants to become a professor and pursue a post-doctoral position after a few years of working in the field. Professor Lam seems surprised. Sheba feels there is another reason for the alienation based on Professor Lam's mentoring history. She finally decides to quit the project.

Reflection: Could “hidden” racism be the underlying cause for Professor Lam's treatment of Sheba? If indeed Professor Lam was not racist, what should he have done differently to avoid Sheba's misconception?

How does a mentor check his or her beliefs before engaging in a cross-cultural mentoring relationship? The following Intercultural Communication Checklist is a self-inventory that can be used prior to starting the mentoring process (Morrison, Conaway, & Borden, 1994; Zachary, 2000).

Exercise 3.4.1 Intercultural Communication Checklist

Use this checklist as a self-inventory before entering into a cross-cultural mentoring relationship.

1. Prepare to:

- ♦ explore what your own culture means to you;
- ♦ explore the mentee's culture prior to meeting each other;
- ♦ reflect upon what it is you want from the mentoring relationship; and
- ♦ clarify the mutual expectations and goals of the mentoring relationship.

2. Remember to:

- ♦ ask questions about culture if you need clarification;
- ♦ suspend bias and judgment, and accept cultural differences;
- ♦ consistently show attention, empathy, interest, patience, and respect;
- ♦ learn about differences in communication space, eye contact, gestures, inflection, learning pace, time, and use of silence;
- ♦ ask for feedback with descriptive questions (who, what, when, where, why, how, how many, how much?); and
- ♦ express the need to think about something within a realistic but set time period so that reasonable exploration and self-reflection may take place.

3. Remember to observe:

- ♦ your own assumptions, biases, identity-threats, and stereotypes;
- ♦ any potential or present discomfort, disconnect, or other warning feelings;
- ♦ any contrasts and values that may be present and operating in the relationship; and
- ♦ consistency in keeping appointments, providing feedback, and communicating progress.

3.5 The Ethics of Research

The conduct of research engages the researcher in many formal and informal relationships. These relationships may include the institution, fellow researchers, peers, and colleagues within and outside the institution, government agencies and regulatory bodies, and society as a whole. For these relationships, the following questions need to be addressed: What are the responsibilities of the mentor and mentee in each of these contexts? What pitfalls should be kept in mind, and what guiding principles can be adopted? Ensuring that mentors and mentees have a firm grasp of these issues is essential to a healthy, ethical, and responsible research program.

There are ethical protocols that must be adhered to when conducting research, in writing research papers, and in presenting the project. Research ethics topics such as: the applicability of ethical concepts in each discipline; the philosophical and historical underpinnings of research ethics; ethical principles including issues of misconduct, conflict of interest, intellectual property and patents, authorship, mentorship, and peer review process. Ethical considerations within the scope of the project should be addressed prior to beginning the research project and written into the research plan.

All faculty mentors and mentees are expected to complete the ethical training similar to Responsible Conduct of Research (RCR) course through the Collaborative Institutional Training Initiative (CITI) Program (www.citiprogram.org). There are two online self-paced courses of study—one designed for undergraduate students and one for faculty researchers; both explore a variety of issues around the conduct of research. The course is designed to

raise awareness of the history of research asking the learner to respond to specific questions and examine research conduct case studies. The topics range from interpersonal (mentoring, authorship, collaborative research) to professional (peer review, conflicts of interest) to regulatory (data management, national security). Questions of misconduct and plagiarism as well as social responsibility and professional ethical obligations are also addressed.



I really am very fortunate to have the opportunity to attend the American Meteorological Society (AMS) conference. As a minority student, I was really motivated and inspired by the people in the conference. I will definitely recommend other minority students to join AMS or any other national or international organizations so that they may learn and share their knowledge. This conference had helped me to enhance my leadership skills, public speaking skills, and networking ability.

- Rezwon Islam, Electrical Engineering Technology



◆ Section 4

Stages of Mentoring

Stages of Mentoring

The mentoring process must be carefully and thoughtfully organized. This section outlines some of the key components necessary for implementing a successful mentoring program:

- ♦ Developing mentoring goals;
- ♦ Designing the research project;
- ♦ Selecting mentees;
- ♦ Formalizing a mentoring contract;
- ♦ Implementing an individual research plan;
- ♦ Creating an engaging research environment;
- ♦ Disseminating the final research product; and
- ♦ Planning the next steps.

The above stages of mentoring contribute to an effective paradigm that not only outlines the process of mentoring, but also provides a strategic road map for end-to-end mentoring.

4.1 Developing Core Mentoring Goals

Mentors and mentees need to be clear on how to monitor their responsibility in the mentoring relationship. They should write a contract outlining their agreement within the mentor-mentee relationship, and it should be revisited by both parties throughout the relationship. Both short and long-term goals should be listed and assessed throughout the mentor-mentee relationship. The process of setting goals is iterative. A sample format is as follows:

Short Term Goals

List research goals for the coming year. Be as specific and indicate how outcomes will be assessed.

1. Goal: _____ Expected outcome: _____
2. Goal: _____ Expected outcome: _____
3. Goal: _____ Expected outcome: _____

Long Term Goals

List research goals for the next 1-3 years. Be specific, and indicate how outcomes will be assessed.

1. Goal: _____ Expected outcome: _____
2. Goal: _____ Expected outcome: _____
3. Goal: _____ Expected outcome: _____

Both long and short term goals will vary depending on the scope and the research area of the project. For example, some projects are only given a short window of time, e.g. one semester, while others are longer. For short term projects, the research activities must be completed in

the given time frame. The goal and the expected outcomes should be realistic. For long term projects the mentoring process may include opportunities for a mentee to learn more complex advanced research skills, develop oral and written communication skills, and have more exposure to professional demeanor. In either case, research goals and outcomes are explicit parts of the research plan.

4.2 Designing an Undergraduate Research Project

A good research project and a good undergraduate research project are not interchangeable phrases. A good research project will require intense study and may be slow in achieving results and require a few years to yield results. On the other hand, a good undergraduate research project must be tightly structured to allow for improvements and progress over a shorter time frame and allow modular completion of each part in a semester-by-semester basis.

Breaking down a project into smaller parts is essential for undergraduate research. As such, the generic components of a research project should be comprised of:

- ♦ **Research Question:** The research question should be as detailed as possible. The answer may be conditional on various factors, but it is general enough to be found directly. If the answer to the question is found through more indirect means, i.e. by inference, this may take a bit more time and must be communicated to the mentee, and the topic must also be within the scope of the mentee's skills-range.
- ♦ **Research Methodology:** The research methodology should be designed to illicit answers from a specific niche of the topic being studied. However, the mentor is encouraged to guide the mentee to understand that often times solutions are found outside the boundaries of a particular discipline. That is solutions may be interdisciplinary in nature.
- ♦ **Learning Objectives:** The research project should have learning objectives/goals. The learning process may necessitate the acquisition and application of new knowledge, new skills, and new tools by the mentee. How that learning is scaffolded must be part of the mentoring process. Learning is a natural outcome of research. Learning what to do or what not to do can be a valuable experience. Mistakes can be used as opportunities to teach useful lessons. A mistake is a failure only when nothing is learned from it and no corrective action is taken to prevent it from reoccurring.
- ♦ **Communicating Research:** After the project is completed, the mentee should present the research either orally or in written form or both. The mode of communication should be agreed upon and included in the research plan.

It is imperative that mentees understand that deadlines are important. Deadlines ought to be included in the research plan, and they ought to be reviewed as part of the meetings on research

progress. Employers expect employees to be reliable and dependable. Meeting deadlines is part of the expectation in research as well. Undergraduate research projects should be used as a vehicle to teach mentees accountability, responsibility, and consequences.

4.3 Selecting and Understanding a Mentee

Potential mentees may be recruited from structured and unstructured programs. Such programs may include: honor societies, diverse interest groups, and clubs. Potential mentees may also be selected from classes that are taught by mentors. Mentees can be recruited by way of recommendation from another faculty member.

Each of the mentoring programs has specific eligibility requirements. Some of these requirements include course prerequisites, academic merit (GPA), number of credits completed, gender, ethnicity, citizenship, and residency status.

Initiating the Mentoring Process

After potential mentees are selected, it is incumbent on the mentor to get to know the mentee. Getting to know the mentee will require effort and some time commitment. Some initial mentor actions and strategies for information gathering are suggested in Table 4.3.1.

Table 4.3.1
Initial Strategies and Considerations for Building a Mentoring Relationship

MENTOR ACTION	STRATEGIES FOR INFORMATION GATHERING	MENTOR CONSIDERATIONS
Take time getting to know each other	Obtain mentee's résumé prior to initial conversation	Establish rapport, exchange information, identify life journeys, and address issues of culture and their importance
Discuss about mentoring	Ask about any perceptions of what mentoring is, any past experiences of mentoring relationships, and what was learned from them	Talk about what mentoring is and share about one's own mentoring experiences, both positive and negative
Determine mentee's goals	Ask what the mentee wants to learn from the experience and set goals	Determine if the mentee is clear about one's own goals and objectives and if the goals and objectives are attainable and measureable

MENTOR ACTION	STRATEGIES FOR INFORMATION GATHERING	MENTOR CONSIDERATIONS
Determine mentee's expectations and relationship needs	Ask what the mentee expects or wants out of the mentoring relationship	Discuss communication styles and ways of learning and be clear about the mentee's expectations and needs
Define the concrete deliverables and expectations	Ask the mentee what would demonstrate personal and professional growth or success	Provide immediate feedback on the deliverables and determine if expectations should be reevaluated.
Honestly share assumptions, boundaries, expectations, limitations, and needs	Ask for feedback and discuss implications for the mentoring relationship	Determine how much time and effort can be contributed to the relationship
Discuss options and opportunities for learning	Ask how much can the mentee be challenged	Provide the mentee with opportunities to present and publish with the mentors at local, regional, and national conferences

Adapted from Bell et al (1996); Kram (1985); Zachary (2000).

Advising the Mentee

Once a mentee has been identified, specific guidelines should be presented in a forthright manner. It is best not to assume the mentee knows what to do and how to do it. The perspectives of mentees may differ from those of their mentors, therefore it may be prudent to advise the mentee of the following:

- ♦ Be mindful of the mentor's time. Be on time for meetings and on assignments;
- ♦ Ask for clarification if expectations and goals are not clear;
- ♦ Commit to making the time to meet on a regular basis and for research;
- ♦ Review the research plan on a weekly basis and prior to meetings with mentor;
- ♦ Consider multiple mentors, especially those who have different expertise;
- ♦ Keep both the resume and cover letter up to date;
- ♦ Keep the content of mentor-mentee research conversations discreet;
- ♦ Look for opportunities to suggest new ideas to the mentor;
- ♦ Practice active listening and self-reflection;
- ♦ Take the initiative to learn new skills;
- ♦ Support other peer mentees.

4.4 Formalizing a Mentoring Contract

Mentoring agreements help to set boundaries, parameters, expectations, and accountability within the framework of the mentoring experience (Galbraith, 1991). A mentoring partnership agreement looks like a learning contract that is consistent with sound learning principles and practices of adult learning. The contract must consider the following (Knowles, 1980):

- ♦ Objectives
- ♦ Evidence of accomplishment of objectives
- ♦ Learning resources and strategies
- ♦ Criteria
- ♦ The means for validating the learning

A mentoring agreement established without conversation between mentor and mentee is a missed opportunity for setting goals, establishing commitment, clarifying expectations, solidifying connections, and arriving at agreements. The agreement must be revisited throughout the relationship. Samples of mentoring contracts and applications are found in section 7.1 of the Handbook. In establishing a mentoring agreement, a scenario similar to Case Study 4.4.1 should be considered.

Case Study 4.4.1 A Tale of Two Students

At the beginning of the semester, Professor Grasso announced in his physics class that he was looking for students to mentor in a research project. He stated that the required background was knowledge of differential equations. After interviewing students and asking them specifically about their mathematical background, he chose David and Michael, both of whom were enthusiastic, confident, and had taken upper level mathematics courses, including differential equations.

However, after several weeks into the project, it became clear to Professor Grasso that David was having a hard time transferring his mathematics knowledge to the types of open-ended problems that one tends to encounter in research. Michael, on the other hand, caught on immediately. When exam time came around, the difference was even more apparent; Michael's exams were neat, well organized, and perfectly correct, whereas David's exams were messy and full of errors. While David had an insatiable scientific curiosity and enjoyed discussing esoteric concepts, Professor Grasso assumed that David lacked the basic skill-sets required for the task at hand. Moreover, David was holding Michael back.

After much deliberation, Professor Grasso decided to continue the project with both students for the remainder of the semester. This enabled the project to reach a natural stopping point with the mentoring program poster session, thereby providing a sense of completion and minimizing hurt feelings. During this time, Professor Grasso discovered that David was the

first person in his family to attend college. While David was extremely enthusiastic, he had no idea what he wanted to do after graduation and was lacking guidance. It was clear that what would benefit David more at this point in his studies than a research project was someone to advise him on career options.

At the end of the semester, Professor Grasso encouraged David to continue strengthening his basic skills and told him that he would always be around to discuss everything from physics to career options. During the following semester, he continued to have conversations with David about his potential career goals and how to achieve them, and he introduced David to graduate students who could play the role of “academic big brothers.” At the same time, Professor Grasso continued to do more technical research with Michael, which led to published papers.

Both David and Michael are now continuing in their Bachelor’s programs majoring in physics, and they both plan to continue in a doctoral program. They still stay in touch with Professor Grasso, and they value him as a source of guidance and reference.

Reflection: How differently do you think it would have been for both students if Professor Grasso had decided to sit with them and set specific mentoring goals, objectives, and timelines? What would have been learned if this had been done and revisited throughout the relationship? How did Professor Grasso modify his mentoring style for both David and Michael?

4.5 Implementing an Individual Research Plan

Depending on the details of the research plan, mentor and mentee have various ways to implement it. A research project proposes questions to be explored. In many cases, the research plan includes the following four components:

- ◆ Literature Reading
- ◆ Information Gathering
- ◆ Research Analysis
- ◆ Conclusion and Summary

Literature Reading

At the beginning of the research project, mentees need to do a general study of the topic(s) by reading the relevant literature. Often mentors help mentees to look for appropriate reading materials. This step helps the mentee to form a big picture of the field or topic by knowing what has been done and what can be done. The process can be short or long depending on how knowledgeable the mentee is with the field of study. If it takes too long for a mentee to read papers or articles, then it might be an indicator that this project is not yet part of the student researcher’s skills set or has to be better scaffolded into the research plan. This may

happen when the student has not had experiences in reading articles in that discipline. After the literature review, the mentee, with the help of the mentor, may propose a researchable question.

Information Gathering

Implementing a research plan often requires gathering information through mentor-recommended methods. These methods may include surveys, scientific experiments, sampling, observations, and literature queries. The quality of the gathered information greatly determines the quality of the research results.

Research Analysis

Analyzing gathered information usually requires knowledge of mathematics and statistics. It includes organizing the information and choosing and applying appropriate methods to draw and present conclusions. The mentee may need help in this process, particularly those who belong to the STEM fields. This process of analyzing real problems will allow the mentee to expand their knowledge and gain deeper understanding of abstract concepts.

Conclusion and Summary

The mentee can learn how to summarize the results from the research and draw meaningful conclusions. As they draw these conclusions, the mentee should be aware that the conclusions may not be permanent. Drawn conclusions in STEM are usually interpreted in light of the constraints placed on the research paradigm, system studied, assumptions made, quality of the data, instrumentation, and methods used.

It is important for the mentors to be able to adjust the research plan as they get to know the mentees and their skills set. The successful implement of the research plan entails open communication of ideas and results between mentors and mentees. The commitment of time and effort from both parties, including the setting and the following of a fixed meeting schedule, is critical in determining whether the research project will be successfully implemented.

4.6 Creating an Engaging Research Environment

Research comes with its challenges, and it can be daunting to potential mentees who do not know what the research environment entails. In order for a faculty mentor to engage a potential mentee in research, there must be clear expectations and understanding of the research process. The faculty mentor needs to be aware of the potential mentee's research interest, and the mentee must be cognizant of the faculty's time, resources, willingness, and capability to mentor. Regardless of the research environment that the mentee is placed in, the

degree to which the research experience is successful and enjoyable is directly correlated to the mentee's determination and enthusiasm to accept challenges and pursue their solutions.

By creating a nurturing and engaging research environment success can be achieved on several levels. For mentees involved in research, there are numerous benefits. Research allows students to:

- ♦ Appreciate theoretical knowledge;
- ♦ Develop a better understanding of real-world problems and applications;
- ♦ Acquire skills necessary for teamwork and simultaneously enhance individual skills;
- ♦ Discover a passion for research; and
- ♦ Consider pursuing advanced degrees.

It is essential that the mentee understands that research is a collaborative effort, and it requires a balance between individual work and team work. It is important that the mentee learns to work with the faculty mentor, and at times with other student researchers, in accomplishing the overall goal. When the mentee is working with other students, often-times friendships and support groups are developed that extend beyond the research environment. Interactions with peers can definitely enhance a mentee's personal and professional growth.

However, as crucial as teamwork is, it is yet important that the mentee is capable of working independently. A mentee who carries through his/her responsibilities are usually successful in the research environment. However, carefully designed support structures (tutoring, mini courses, workshops, and/or counseling) and a supporting cast (mentor, peers, and undergraduate director) are needed to aid the mentee in overcoming research challenges. When the mentee takes ownership of the research project, the mentee develops a deeper understanding and gains more insight to the field of study.

One of the major responsibilities of a mentor is to not only teach the mentee research skills, but to also convey the impacts that the research has in the real world. When these extensions are made, the mentee gains self-confidence and is motivated to pursue other research opportunities. The mentee is now armed with a holistic, comprehensive perspective that enables deeper thought, enhanced critical thinking skills, and keener understanding of the relevance of the research project.

Mentoring success can be achieved by creating and sustaining an environment conducive to research and academic growth (Franez, DeHaan, Demetrikopoulos, and Carruth, 2006; Russell, Hancock, and McCullough, 2007; Wayment and Dickson, 2008; Weldon and Reyna, 2015). Below are key aspects to developing a positive mentee-centered atmosphere:

- ♦ A good fit—the research environment should be ideal for both mentee and mentor;
- ♦ Diligence and teamwork are encouraged and valued;
- ♦ Research support is readily available;

- ♦ Respect is mutual between mentor and mentee – trust and honesty are regarded highly;
- ♦ Integrity is esteemed and practiced;
- ♦ Mentees are academically stretched or challenge beyond their preconceived abilities; and
- ♦ Open and honest communication between mentor and mentee—meeting regularly to discuss research progress.

The research experience will only be satisfying, fulfilling, meaningful, and relevant if the mentee is afforded a safe space where the above characteristics are embodied and evidenced. When one or more of the aspects above is absent, the research experience will be lacking the necessary elements to adequately transform and advance the mentee.

4.7 Disseminating the Final Research Product

The dissemination of undergraduate research projects should be properly planned and intentionally executed. This section highlights key aspects of project dissemination. Some modes of achieving broader impacts of the research project are discussed herein.

Planning for the Research Presentation

Before the mentee presents his or her project, the mentor should review and prepare with him or her. In the first place, the type of the presentation needs to be established and written into the research plan. Suggested presentation techniques, both oral and written, are listed below.

In the second place, the attendees (who they are, how many, their expectation, and their knowledge level on the topic) and the presentation environment (classroom, auditorium, hotel or conference room) should be described.

In the third place, the mentor should prepare the mentee to:

- ♦ Adhere to proper dress code (business casual or business);
- ♦ Know and abide by the designated time limit of the presentation;
- ♦ Inquire if demonstrations are permitted;
- ♦ Respond to questions, if there is a question and answer session following the presentation; and
- ♦ Cite sources.

After the presentation has been planned, preparation should be made for its delivery.

Delivering an Oral Presentation

An effective oral presentation should have the following organization:

- ♦ Comprehensive and clear introduction;
- ♦ Clear central idea;
- ♦ Signposts (words such as: first, second, next, then, last);
- ♦ Connectives (i.e., transition = internal summary + internal preview); and
- ♦ Definitive conclusion.

A good oral presenter should:

- ♦ Make eye contact for 70-80% of the presentation;
- ♦ Be extemporaneous in the delivery;
- ♦ Use the style that the audience expects (if not known, then use a conversational style);
- ♦ Be brief in the use of notes or note cards;
- ♦ Carefully prepare the presentation and rehearse; and
- ♦ Adapt to audience feedback.

If the research project is to be presented as a poster, then proper formatting is critical.

Presenting a Poster Presentation

The mentee must use the rules and guidelines expected for poster presentations. The delivery is less formal than other modes of delivery. The audience may also interrupt with questions/comments, and they may stay for a few- or several minutes. Two of the primary goals of the poster are to catch attention and to serve as a reference.

The mentee should prepare a five-minute “elevator speech” that includes the following:

- ♦ Research background (tell about the research topic and why it is important).
- ♦ What data were collected and how?
- ♦ What method was used to analyze the data?
- ♦ What were the results of the analysis?
- ♦ What conclusion(s) can be drawn from the findings?
- ♦ What are the next steps for the research (i.e., does it lead to a new research question and project? If so, be able to describe that briefly).

Another mode of delivery of research findings may be in a form of a panel.

Participating in a Panel Presentation

Preparing the mentee for panel discussions differs from preparation for poster presentations. Panel discussions are more formal, and they have different communication rules (no verbal interruption from audience).

For all presentations: oral, poster, or panel presentation, rehearsing “a dry run” is recommended.

Rehearsing the Presentation

Irrespective of the mode of the presentation, the following tips may be useful for the mentee:

- ♦ Read through the presentation several times and talk through any examples or stories;
- ♦ Concentrate on gaining control of ideas instead of memorizing the presentation word-for-word;
- ♦ Practice using visual aids;
- ♦ Review the presentation several times from start to finish ensuring that the time constraints are met;
- ♦ For each “dry run,” the presentation time should be approximately the same. If the presentation exceeds the time limit, then the presentation should be condensed;
- ♦ Polish the presentation by practicing both verbal and nonverbal delivery tactics; and
- ♦ Practice in front of the mentor, peers, friends, or family members and solicit honest feedback.

Visual Aids as Effective Communication Tools

Three of the areas in which visual aids are usually evaluated are: 1) clarity, 2) interest, and 3) retention. It is the responsibility of the mentor to establish how well the visual aid is constructed and its effectiveness. Make sure the mentee understands the requirements for citing supporting materials. Citations must include author of publication, date of publication, name of publication, and supporting organization. For figures and images, sources should also be cited.

For most presenters, public speaking usually incites anxiety.

Managing Anxiety

It is important that the mentor conveys to the mentee that nervousness is normal, and indeed, expected. The mentee should be reminded that the presentation goal is to communicate information; it is therefore not a theatrical performance. The mentor should explain to the mentee that practice and preparation are the best ways to manage anxiety before the presentation. Preparation time and practice should be included in the research plan.

Tips to manage anxiety during a presentation are to:

- ♦ Concentrate on the main points;
- ♦ Pace the rate of presentation;
- ♦ Realize that most of the inward nervousness can be hidden from the audience; and
- ♦ Carefully study presentations made by good presenters.

Publishing with the Mentee

Dissemination of research results in a publication (peer-reviewed or non-peer reviewed) with the mentee as a co-author is highly encouraged. Such a publication would benefit the mentee, particularly for plans towards advanced degrees and career development. Exercise 4.7.1 below is designed to assist the mentor in selecting a mentee as a co-author.

Exercise 4.7.1 Choosing a Student Mentee as a Co-author

1. ____ Is the mentee willing to devote extra time to work on the publication?
2. ____ Is there a good working relationship with the mentee?
3. ____ Does the mentee have sufficient knowledge of the basic material?
4. ____ Can the mentee effectively apply prior knowledge to the publication?
5. ____ Does the mentee have the requisite technical and/or writing skills?
6. ____ Can the mentee dedicate time for technical calculations, writing assignments, and the general overview of background material for the publication?

Publishing a paper with a mentee is not a simple task. Many factors must be considered. The following points and related questions may help with the reflection process regarding this undertaking:

- ♦ Writing a paper may involve calculations, the explaining of background material and results, and citing literature:
 - Are there realistic tasks that the mentee can complete?
 - What are the reasonable goals for involving the mentee?
- ♦ Preparing the mentee for uncertainties:
 - Will the calculations work?
 - Will the results be interesting enough to publish?
 - Will the paper be accepted for publication?
- ♦ What to do with a mentee when the manuscript is not accepted for publication:
 - What has the mentee gained from this experience?
 - Can a record of this “failure” provide valuable information for the future?
 - How does the mentor assure the mentee that he or she has made a contribution?
- ♦ Knowing what plagiarism is and how to avoid it:
 - How to distinguish between old and new results and to give proper citations?

- ♦ Addressing the referee's criticisms:
 - What is the best process for responding to the referee's comments?
 - How not to take the reviewer's criticisms personally?

The mentoring relationship does not end with the completion and the dissemination of the research project. Often times, the mentor is needed to assist the mentee in planning for and in taking the next steps.

4.8 Planning the Next Steps

The relationship between mentor and mentee goes through changes, and indeed, some will end when the specific goals and outcomes are achieved. Other mentoring relationships endure, and evolve into lasting professional friendships. Whether the mentoring relationship ends with the project or continues thereafter, the reflective process should be part of the mentoring experience, and it should be included in the research plan. In designing the reflection process, the mentor should consider the following:

- ♦ Celebrate achievements and give positive feedback;
- ♦ Elicit lessons learned from failures;
- ♦ Revisit the goals and discuss outcomes;
- ♦ Identify barriers and possible solutions;
- ♦ Provide personal evaluation of the process;
- ♦ Consider ways to improve the next mentor-mentee experience;
- ♦ Redefine the future mentoring relationship; and
- ♦ Develop a plan for future communication.

The mentor and mentee may choose to keep in touch with each other. The mentor may be asked or may offer to assist in the mentee's academic or professional progression.



There is a reason the word “mentoring” precedes the word “parenting” in the dictionary because a mentor has a greater influence on a student’s life than a parent. In my case, as an undergraduate student at City Tech, my mentor is my best friend and my guardian. He has helped me understand the world of “research” as well as helped me with my academic life. I am grateful that I have had a wonderful learning experience with my mentor, and I hope this relationship will continue until I graduate.

- Usaama Van, Mechanical Engineering Technology



◆ Section 5

Challenges and Obstacles of Mentoring

Challenges and Obstacles of Mentoring

The mentoring enterprise is not without challenges. These challenges can be daunting and/or discouraging. They may range from issues that are in or beyond the mentor's control. Taking time to reflect on the most recent mentoring process, and asking what worked well, what did not work well, what was surprising, and how to incorporate received feedback are critical for contextualizing and learning from mentoring challenges. Consulting with colleagues and reviewing parts of this Handbook might also provide ways to refine the mentor's mentoring philosophy and lead to innovative solutions that can turn these challenges into opportunities.

5.1 Challenges of Being a Mentor

There are challenges to being a mentor. Mentoring is dedicated work. There are specific challenges that faculty may face while mentoring. These challenges include the following:

- ♦ Balancing workload as an educator and researcher;
- ♦ Compatibility with mentee (poor match between mentor and mentee);
- ♦ Cultural/religious differences;
- ♦ Biased expectation or identity threat;
- ♦ Investment of time;
- ♦ Incorrect assumptions (skills or knowledge mismatch);
- ♦ Lack of communication;
- ♦ Lack of resources;
- ♦ Lack of departmental/institutional support;
- ♦ Unrealistic expectations;
- ♦ Time constraints; and
- ♦ Unclear boundaries.

Case Studies 5.1.1 and 5.1.2 illustrate some of the challenges of working with mentees with different levels of interest and motivation and also issues of establishing appropriate boundaries.

Case Study 5.1.1 Mentees Interests and Project Completion

One semester, Professor Eli had two mentees. One of the mentees, Alexandra, had been in two of Professor Eli's classes, and he had known her to be an excellent and committed student. Since Alexandra and the professor communicated well, the professor asked her to work on a research project with him. Professor Eli and Alexandra immediately started working together on a research plan that incorporated a topic that Alexandra was somewhat interested in. They outlined the mentoring goals. The project was mutually agreed upon, including steps to be taken and deadlines for feedback regarding the specific parts of the project. Unfortunately, Alexandra could not keep up with the work deadlines, and eventually completely stopped working on the project.

The other mentee was a freshman named Hector who approached Professor Eli to work on an honors project. Although Professor Eli did not know Hector, he was impressed by his strong interest and motivation to pursue this opportunity. Professor Eli suggested a number of research ideas to Hector and asked him to think about them while reading the assigned material. Hector's motivation seemed to increase as the professor explained how getting hands-on experience in new technologies would give him an edge both in class and after graduation. After reading the material, the mentee chose one of the research ideas and asked Professor Eli to help him implement it. Throughout the semester, they had biweekly meetings to discuss the project to ensure student commitment. Both mentor and mentee kept in touch via email. Professor Eli prepared a small lab in his office and gave Hector access to it to start experimenting. Although the mentee was not initially comfortable with the new technology, he was able to catch up quickly. With guidance and advice, Hector was able to finish the implementation, and then started working on the actual demonstration setup. With the help of the department's lab technicians, they were able to move the setup to the demonstration area and have a fully functioning presentation. Hector not only presented at the college, but also at a national conference where he received many compliments.

Professor Eli took away from that semester that a student who does well in class might not do well in research when he or she does not perceive a clear benefit. Interest in a specific topic can certainly help, but might not be enough. The choice of the research topic is crucial because it provides the incentive to rigorously do the work and successfully finish the project.

Reflection: How can Professor Eli avoid project mis-match with the future mentees? What interventions could Professor Eli have administered to encourage Alexandra to continue with research?

Case Study 5.1.2 Establishing Boundaries

Professor Kay taught math at a large research university. She was thrilled when Kirk, one of the strongest students in her class, asked her to mentor him for a research project. Professor Kay and Kirk already had an easygoing relationship and both found their weekly research meetings to be exciting; Kirk was making excellent progress.

As the semester progressed, their conversations during their meetings would sometimes become more personal. Professor Kay quite liked Kirk, and she did not feel that these conversations distracted them from their work together. Kirk felt comfortable sharing with her that he suffered from social anxiety and that he felt like an outcast in his family. Professor Kay's office was one of the only places he felt at ease and could be himself. Professor Kay did her best to be supportive, yet keep a professional distance.

Kirk would often ask for Professor Kay's home phone number. Eventually, after the research project ended, she gave in and gave it to him. Before long, Kirk was calling Professor Kay at times when his personal life was too difficult for him; for example, during a panic attack in the

middle of the night. Professor Kay wanted to continue to support her student, but she knew that a line had been crossed.

Reflection: Describe a conversation Professor Kay could have had with Kirk to establish clear boundaries before beginning the research project. How could Professor Kay have dealt with Kirk's request when she first sensed that those boundaries were being pushed? How could she have handled the situation after those boundaries had already been crossed?

5.2 Challenges of Mentoring in STEM Disciplines

STEM faculty mentors may face unique challenges. These challenges may include the following:

- ♦ Inadequate general preparation of the mentee for STEM research;
- ♦ Weak mathematical and/or background knowledge on the part of the mentee;
- ♦ Lack of interest of mentee in mentor's research field;
- ♦ Limited resources (i.e., computers, equipment, materials, space) and funding;
- ♦ Lack of the mentee's understanding of the importance of the research project with respect to the big picture; and
- ♦ Poor written and oral communication skills of the mentee.

Two common challenges in the STEM mentoring relationship have to do with the time commitment necessary to complete the project and the inadequate STEM background. Case Studies 5.2.1 and 5.2.2 are examples of such challenges.

Case Study 5.2.1 Time-on-Task and Under-preparedness

Professor Hilliard, a Mathematics professor, had mentored Chris on a project in pure mathematics throughout the course of an academic semester. Professor Hilliard was excited about having a mentee, and believed that the overall experience would be positive. The project was designed to introduce Chris to some basic concepts in Commutative Algebra in order to introduce him to Algebraic Geometry and the field of Resolution of Singularities. These objectives were developed with the mentee's interests and background in mind, and the results were presented at a poster session at the institution at the end of the semester.

When Chris joined the project, Professor Hilliard was aware of Chris' weak mathematical background. Chris was, at first, very excited and committed, and his willingness was evident by his enthusiasm. But as time progressed, Professor Hilliard was not informed of Chris' concerns about the difficulty of the material and the amount of background needed for him to actually work on the project. Combined with his regular semester full-time load, Chris' spirit and efforts were dampened. Chris had an adequate undergraduate background in mathematics; however, research in pure mathematics was not easily accessible. Much specialized groundwork and time were needed. Chris became overwhelmed.

In the end, Professor Hilliard helped Chris to complete his project; he did not feel that Chris gained much from the research experience. While Professor Hilliard believed he had done his job as a mentor, he was not able to fully convey to Chris the process necessary to complete a project in pure mathematics without the required background.

Reflection: What is the lesson learned for Professor Hilliard? In what ways could the relationship have been more enriching for both mentor and mentee?

Case Study 5.2.2

Lack of Interest and Misunderstanding of the Importance of the Research Project

Robert had been advised many times by faculty members, industry professional, and peers that the participating in research activities is essential for his future career. Robert then contacted Prof. Irving from the Electrical Engineering Department who was engaged in laser technology research. Prof. Irving asked Robert to perform some laboratory experiments and analysis with the goal of defining a unique a parameter. However, Robert had never done this type of research before. In the process of conducting the research, Robert ran into technical issues that caused him to become discouraged and disconnected from the research project. Furthermore, Robert was unsure how the research project made any difference in the real world. Unfortunately, Robert was unaware that the project might one day contribute to the advancement of the field of laser technology in medicine. Despite Prof. Irving's efforts to guide Robert through the project, Robert became more disinterested and less involved. Prof. Irving noticed a change in Robert's attitude and wondered how is it that Robert lost interest even though he eagerly initiated and pursued this research experience.

Reflection: Should Prof. Irving have insisted that Robert was adequately prepared for this type of research? What could have Prof. Irving have done to ensure and prepare Robert for this type of research? How could Prof. Irving help to keep Robert motivated and passionate about the research project?

5.3 Challenges of Mentoring in Non-STEM Disciplines

Non-STEM faculty mentors may also face similar challenges as STEM faculty mentors. These challenges may include the following:

- ♦ Inadequate general preparation for non-STEM research of the mentee;
- ♦ Weak background knowledge on the part of the mentee;
- ♦ Mentee's research interests are usually too broad in scope;
- ♦ Focusing and scaling research projects to adequately fit both time and mentee's aptitude;
- ♦ Lack of qualitative and quantitative research methodologies of the mentee;
- ♦ Lack of proficiencies in accessing appropriate, pertinent, and valid resources;
- ♦ Poor written and oral communication skills of the mentee.

In the initial meetings with the potential mentees, mentors should frame and pose questions that assess the mentees' familiarity with the related literature. After gauging the mentees' knowledge, the mentors will have a better idea of what research skills the mentee lacks. If mentees come with some previous training, they should be asked to explain the research methodologies they have previously used. They should also be questioned about their understanding of methods that are used in the mentor's project. Teaching mentees additional research methodologies may augment their research experiences, make them more qualified for research programs in graduate school, and provide them with robust methods that can be used to address their research questions (Patton, 1990).

Case Study 5.3.1: Encouraging Empirical Research Questions

Dr. Diaz joined the faculty at Urban East College after 10 years of working in the private and public school systems as a program manager/social worker. In the last decade, he also served as a consultant to the State Department of Education concerning outreach to under-served populations. He has been instrumental in implementing social policies to benefit children and youths from disadvantaged background in the community. One of his main reasons for Dr. Diaz's research initiatives is to share his knowledge and skills with the next generation of learners. Ava, one of his students in his Social Policy course, is from a disadvantaged background. She is interested in participating in Dr. Diaz's research work, so she frequently visits Dr. Diaz to share about her own childhood experiences. Her childhood experiences mirror Dr. Diaz's research results. However, the research questions and theories she had in mind are broad and based on her own experiences while growing up in rural South America.

Reflection: What can Dr. Diaz do to help encourage Ava towards a more focused research project? How does Dr. Diaz guide Ava to be more objective as a researcher?



The Society of Hispanic Professional Engineering conference was a remarkable experience. There was a plethora of information that was made available for everyone regardless of workforce experience, academics, or how far into the major one was. Before attending the conference, I was under the impression that this conference would be most beneficial to only engineering majors. I was surely wrong after spending my first few hours at the conference. There was a career fair, hospitality suite (area for networking), student-led workshops in which students presented their research projects, and presentations were made by national companies. Of course, the biggest and most popular component of this conference was the Career Fair. It was a useful experience being able to be interviewed by recruiters, learn about what types of students they are looking for, or the type of person they seek for their companies. I learned a lot through the interactions with recruiters.

- Ricky Santana, Mathematics Education



Section 6

**Evaluating the Mentoring Process
and Experience**

Evaluating the Mentoring Process and Experience

For the research process to be successful constructive communication between mentor and mentee is critical. Moreover, the learning and research outcomes must be clear. The research experience should be designed to assist the mentee in achieving those outcomes. Careful assessment is necessary to measure the degree to which outcomes were accomplished. The assessment of the research experience including the mentee's performance can be useful in planning future research projects.

6.1 Mentor Evaluation of the Research Process and Experience

Evaluation by the mentor can be done at different levels. On one hand, the mentor can design assessments that will allow mentees to demonstrate their achievement of learning outcomes specifically related to content knowledge of the research project. On the other hand, the mentor should evaluate mentee's performance and achievement of research attitudes including: thinking critically, taking initiative, working independently, and accepting feedback.

The first level of evaluation can be attained by common assessment tasks such as writing essays, submitting written reports, developing a project, preparing an oral or poster presentation, writing a research journal, or preparing a portfolio. The assignment that is selected should align with the research project's learning outcomes. It is also important that mentor and mentee discuss the assignment, the mentee receives proper instructions, and feedback is given during and after the preparation of the assignment. Providing the mentee with examples of similar assignments that highlight the expected quality of work will be beneficial.

The mentee must receive constructive criticism of his/her performance during the research experience. The mentor should be aware that comments and suggestions are usually highly regarded by the mentee so that it is essential for the mentor's feedback to be honest and accurate. Evaluation on this second level requires the mentor to carefully reflect on mentee's attitude gains. This evaluation can be done with the help of rubrics or evaluation forms, samples of which are presented in Tables 6.1.1 and 6.1.2.

Unquestionably, both evaluation levels are closely interrelated; it is unlikely that a mentee achieves content knowledge learning outcomes without applying the proper research attitudes.

Table 6.1.1
Student-Centered Evaluation Form of Research Experience and Student Performance

STUDENT-CENTERED EVALUATION FORM OF RESEARCH EXPERIENCE						
CIRCLE ONE: 1=strongly agree; 5=strongly disagree						
1. Student was adequately prepared academically	1	2	3	4	5	n/a
2. Student was engaged in the research project and took initiative	1	2	3	4	5	n/a
3. Student worked cooperatively with other research assistants	1	2	3	4	5	n/a
4. Student accepted feedback constructively	1	2	3	4	5	n/a
5. Student contributed effort to establish rapport with me	1	2	3	4	5	n/a
6. Student seemed comfortable working on my research project	1	2	3	4	5	n/a
7. Student showed interest in graduate study and research	1	2	3	4	5	n/a
8. Student's interest in graduate study and research increased as a result of experience	1	2	3	4	5	n/a
9. I would like to stay in touch with this student	1	2	3	4	5	n/a
10. My experience with this program was positive	1	2	3	4	5	n/a
11. I would be willing to mentor a student next year	1	2	3	4	5	n/a
Other comments						

STUDENT'S PERFORMANCE EVALUATION

Short description of research performed by student

CIRCLE ONE: 1=strongly agree; 5=strongly disagree

12. Knowledge Application						
• Ability to apply knowledge to solve problems	1	2	3	4	5	n/a
• Ability to search independently	1	2	3	4	5	n/a
13. Problem Solving Skills						
• Ability to identify a real world problem as a member of a certain class of problems	1	2	3	4	5	n/a
• Ability to see underlying connections between concepts from different subject areas	1	2	3	4	5	n/a
14. Lab Skills						
• Use of laboratory equipment	1	2	3	4	5	n/a
• Follows laboratory safety procedures	1	2	3	4	5	n/a
• Ability to design and conduct tests	1	2	3	4	5	n/a
• Ability to analyze results testing	1	2	3	4	5	n/a
• Lab record keeping and data gathering	1	2	3	4	5	n/a
15. Teamwork Skills						
• Ability to give and receive constructive criticism	1	2	3	4	5	n/a
• Ability to take charge of, and complete, assigned tasks	1	2	3	4	5	n/a
16. Communication Skills						
• Presentation Skills	1	2	3	4	5	n/a
• Writing Skills	1	2	3	4	5	n/a
17. Ethics						
• Understanding of professional and ethical responsibilities	1	2	3	4	5	n/a
18. Subject Knowledge						
• Knowledge of current issues in discipline	1	2	3	4	5	n/a

Comment on student's strengths and weaknesses

Other comments

Adapted from: The Leadership Alliance (www.theleadershipalliance.org)

Table 6.1.2
Research Attitudes Evaluation Rubric

	Beginning	Competent	Excellent	Evidence
THE PROCESS				
Thesis	Develops a relevant thesis for the course and assignment	Develops a manageable scope and focus; poses an interesting question or problem	Modifies thesis to incorporate initial findings and surprising insights	__ Paper/Project __ Bibliography
Search Tools	Uses basic tools such as the library catalog, search engines, and full text databases	Uses more tools, such as disciplinary databases, electronic journals, reference indexes or bibliographies	Uses complex tools, archival finding aids and specialized databases	__ Paper/Project __ Bibliography
Search Techniques	Uses keyword searching	Modifies searches iteratively; identifies new keywords including synonyms, related terms, variant spellings; uses subject headings; follows footnotes and references	Modifies searches iteratively; uses search limits; identifies key authors; follows footnotes and references iteratively; uses cited reference searching	__ Paper/Project __ Bibliography
Library Collections	Uses school's collections superficially	Digs deeper into school's collections and services	Exploits school's collections and services to their fullest	__ Paper/Project __ Bibliography

	Beginning	Competent	Excellent	Evidence
THE SOURCES				
Types and Formats	Uses basic sources: books, websites	Adds other source types used in the discipline	Seeks out a variety of source types used in the discipline	___ Paper/Project ___ Bibliography
	Possible source types include books, articles, conferences, government documents, dissertations, archives, manuscripts, technical reports, working papers, statistics, data sets and audiovisual materials			
Depth and Breadth	Finds obvious references from familiar sources	Finds references from a variety of sources and disciplines	Finds references from multiple perspectives, pursuing comprehensive coverage	___ Paper/Project ___ Bibliography
Evaluation and Selection	Assesses the relevance of sources, which generally apply to the topic	Evaluates the quality of sources, which generally support the thesis	Carefully evaluates the quality of sources, which strongly support the thesis	___ Paper/Project ___ Bibliography
	Evaluation of the sources would take into consideration the authority, accuracy, currency, coverage, and potential bias in the sources as well as the overall appropriateness and relevance to thesis			
Citation Style	Cites all materials, but not in a standard or consistent way	Cites or credits all materials in a consistent way, for the most part	Cites or credits all materials correctly in a standard format, including annotations or notes as appropriate	___ Paper/Project ___ Bibliography

	Beginning	Competent	Excellent	Evidence
THE PROJECT				
Synthesis	Connects several ideas from a few sources to the thesis	Draws on multiple ideas from several sources to form conclusions	Synthesizes ideas from many sources to reach original conclusions or novel insights	__ Paper/Project __ Bibliography
Originality	Interesting topic but not very original	A highly imaginative topic or approach	A new twist on previous research; an original contribution to the field	__ Paper/Project __ Bibliography
THE LEARNING				
Understanding	Develops a basic understanding of research	Develops a deeper understanding	Develops a thorough understanding that seems likely to persist	__ Paper/Project __ Bibliography
Initiative	Closely guided by faculty and / or support staff at all stages of research	Fairly independent throughout, though seeking advice when necessary	Highly independent throughout, though seeking advice when necessary	__ Paper/Project __ Bibliography

	Beginning	Competent	Excellent	Evidence
THE LAB WORK (WHEN APPLICABLE)				
Participation	Did the lab but did not appear very interested. Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Used time pretty well. Stayed focused on the experiment most of the time. Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Used time well in lab and focused attention on the experiment. Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	
Problem Solving	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Refines solutions suggested by others.	Actively looks for and suggests solutions to problems.	
Safety Procedures and Directions	Lab is carried out with some attention to relevant safety procedures and directions.	Lab is generally carried out with attention to relevant safety procedures and directions.	Lab is carried out with full attention to relevant safety procedures and directions.	
Working Area and Equipment	Had to be reminded to clean up area and equipment; and to return materials.	Good job on cleaning up working area and equipment. Returned all materials appropriately.	Outstanding job cleaning up working area, and equipment. Returned all materials appropriately and responsibly.	

Adapted from: http://guides.temple.edu/improving_research and www.teacherweb.com

Tables 6.1.1 and 6.1.2 provide evaluative tools for mentees' learning outcomes. However, if a mentor chooses to devise his or her own evaluation rubric, Table 6.1.3 provides guidance on how to do so.

Table 6.1.3
Stages in the Process of Developing an Evaluation Rubric

Stages	Comment
Decide the Dimensions of Performance or essential elements that must be evident in high quality work [rows].	Rule of thumb: If a student can score highly on all dimensions but not score well overall, you have the wrong dimensions. Revise. Discuss with colleagues.
Decide the levels of achievement - number and type [columns].	Ways of describing various levels of mastery include: <ul style="list-style-type: none"> • advanced, proficient, functional, developing. • sophisticated, competent, partly competent, not yet competent. • exemplary, proficient, marginal, unacceptable. • or others that you choose (between 3 and 5).
For each Dimension of Performance, distinguish between acceptable and unacceptable (failing) performance.	Write the criteria for acceptable performance clearly and unambiguously.
For each Dimension of Performance, write clear performance descriptors (criteria) at each achievement level.	Try to determine qualitative and quantitative differences that characterize work or performance at the different levels.
Include (if possible) the consequences of performing at each level.	For example, the standard of the work would (or would not) be accepted by the profession or a business (as in a charter) or a professional journal (as in publication guidelines), etc.
Add the rating scheme you will use and apply any weighting.	Consider: <ul style="list-style-type: none"> • awarding grades (analytical scheme) or not (holistic scheme). There are arguments for each of these approaches (see below). It's useful to discuss this with your teaching team to ensure a consistent approach. • including weighting criteria if required. • whether grades should be awarded for work below the minimum standard. • the criteria for 'failure'.
Evaluate and revise accordingly.	Few rubrics will be constructed perfectly the first time. They are developmental tools and need to be critically evaluated after use.

Adapted from Huba and Freed, (2000).

Mentoring is a dynamic process. Therefore, if the mentor detects weaknesses in the mentee's performance or attitudes during the research experience, the mentor should address those issues immediately and not at the end of the project when the evaluation is written. By including periodic assessment strategies in the research plan prior to progress meetings, the mentee is given the opportunity to address problems and realign the research project. This type of formative assessment allows for course correction while the summative assessment serves as the overall evaluation of the project.

6.2 Mentee Evaluation of the Research Process and Experience

It is important that mentees are given a chance to provide feedback on the research experience and the mentoring process. For short-term programs, such as 10-weeks or semester-length programs, the mentee's feedback might be requested as part of the final evaluation. However, for longer-term programs, such as year-length programs, it is helpful to request the mentee's opinion half-way through the program, for example after one semester. This strategy allows the mentor and any program officers to make adjustments while still in time to affect the outcome of the research project. Furthermore, mentees will have direct evidence that their opinion is valued and taken into account in the decision-making process, and this might motivate them in increasing their level of effort and performance in the remainder of the program.

A conceptual framework for mentee evaluation may be divided into five components: 1) Pre-mentoring Research Program; 2) The Research Experience; 3) Resources; 4) Mentor/Mentee Relationship; and 5) Program Assessment. These thematic areas may be adjusted for discipline-specific content, and/or expanded based on each mentor's preference and experience. Mentors are encouraged to formulate the evaluation questions in the form of open-ended questions, rather than on the basis of a grade scale (e.g. 1-5) as shown below. These questions might be supplemented by leaving additional room for comments.

Component 1: Pre-mentoring Research Program

- ♦ How did you hear about the program?
- ♦ How easy was it for you to collect information about the program?
- ♦ If you attended any information session about the program, did you find that enough information was provided?
- ♦ How was your experience in approaching possible mentors and collecting information about possible research projects?

Component 2: The Research Experience

- ♦ Were you able to get a clear idea of the scope and goals of the research project?
- ♦ Did you find that the research project assigned to you was interesting / adequate to your skills level / helpful in understanding whether you are interested in pursuing this research topic further?
- ♦ Did you encounter roadblocks during the research projects, and if so, how did you (and your mentor) overcome them?
- ♦ What research skills did you gain from this research project?
- ♦ Did you also gain skills such as time management, presentation skills, and/or networking?
- ♦ Did you feel that the weekly workload was adequate for you?

Component 3: Resources

- ♦ Did you have enough resources to perform the assigned research? (please include tools such as appropriate work space/ computers, as well as reading material or any other resource provided by your mentor)
- ♦ Did you have access to external resources and expertise, if needed?

Component 4: Mentor/Mentee Relationship

- ♦ Were you satisfied with the structure and frequency of your meetings with your mentor?
- ♦ Did you find your mentor to be approachable / respectful? Were you comfortable asking questions or requesting help?
- ♦ Was your mentor adequately prepared for your meetings, and did he/she provide useful feedback on your progress on a regular basis?
- ♦ If you encountered difficulties, were you satisfied with how your mentor helped you overcome them?

Component 5: Program Assessment

- ♦ Do you plan to continue participating in this program? Why?
- ♦ Are you likely to recommend this program to friends or classmate who are interested in pursuing research opportunities, and why?
- ♦ Would you be willing to provide peer mentoring to new students entering the program (for example, meeting with them a few times per semester?)

6.3 Overall Research Program Assessment

After the research project, a summative assessment by the mentor is helpful in reviewing overall program performance and effectiveness. The following open-ended questions are designed to provide insights for appraising the research program.

Program Area 1: Mentee Access and Selection Process

- ♦ How many potential mentees contacted you to inquire about the possibility of research projects? Do you think that more/different advertising of the program might increase that number?
- ♦ Did you pre-select the mentee on the basis of school performance / background knowledge and skills?
- ♦ Were you satisfied with the academic preparation of the mentee prior to joining your research group?
- ♦ Was this the first research experience for the mentee?

Program Area 2: Research Experience

- ♦ Would you consider this research project to have been overall successful? Did the mentee complete the project and generally achieved the goals that were set at the beginning?
- ♦ If the mentee encountered difficulties, please provide a brief description of what they were and how they were able to overcome them.
- ♦ What skills do you think the mentee gained or was able to improve upon during the research project?
- ♦ How would you evaluate the attitude of the mentee to independent research? You can comment, for example, on problem-solving ability, ability to learn and digest new concepts quickly, critical and analytical thinking.
- ♦ How would you evaluate the ability of the mentee to interact with others (mentors and other students if the research was carried on in a group), and give and receive feedback?
- ♦ How would you evaluate the mentee's motivation, grit, and personal maturity level in relation to what you think is needed to succeed in this field of research?
- ♦ What are, in your opinion, the major strengths and weaknesses of the mentee at the current stage?

Program Area 3: Mentoring Experience

- ♦ Were you satisfied with the level of commitment of the mentee (number of hours worked per week, pace of progress, timeliness, ability to meet deadlines)?
- ♦ Did you have a comfortable relationship with the mentee, in relation to overall ease to discourse, willingness to listen to feedback, and level of interaction?

Recommendations

- ♦ Would you, or did you, encourage the mentee to continue participating in the program? Why?
- ♦ Do you think that the mentee would be a good candidate to be a peer mentor for other students in the program?

Summative assessment is a valuable tool for program redirection and enhancement. It also serves as a critical mechanism for future program evolution and growth. This allows an undergraduate mentoring program to be dynamic, systematic, and refined. The overall goal is to provide mentees with the tools and the skills needed for further research endeavors.

◆ Section 7

Mentoring Resources

Mentoring Resources

The mentoring program is easier to administer when appropriate resources are readily accessible. Many mentoring guides and prototypes exist so one does not have to reinvent many components of an effective mentoring program. This segment highlights some key forms and repositories that may be useful in providing guidance for developing a comprehensive mentoring program.

7.1 Sample Mentoring Program Forms

This section provides sample application and contract forms that the mentor may use to assist in selecting a mentee and to provide a formal agreement with the mentee prior to the research.

Application for the Mentee

Faculty mentors may use an application to assist in the selection of prospective mentees. An example of an application for an undergraduate research assistant position follows. Although this example pertains to the Psychology and Human Services areas, the application can be easily modified for other disciplines.

Undergraduate Research Mentoring Contract

Before the research mentoring begins, a formal contract between the mentor and mentee should be in place. This ensures that the commitment from both parties is explicitly stated and understood at the very beginning of the research project. The following are two sample mentoring contracts. The first contract is generic in nature, while the second one is more discipline specific.

Undergraduate Research Assistant Position: Sample Application

Name: _____
 Major: _____ Class year: _____
 Phone number: _____ E-mail: _____

Please list Psychology and Human Services courses you have taken and the respective letter grades.

_____	_____
_____	_____
_____	_____

Please describe your experience working with children and research participants. Attach a separate sheet if necessary, but please do not go beyond one page.

Please provide any other relevant experiences or skills that you think may be helpful in your work in this project.

What is your objective in working on a research project and how does it relate to your personal, academic, or professional goal(s)? Is there anything you hope to accomplish by working in this lab? Attach a separate sheet if necessary, but please do not go beyond one page.

What interests you about working on this particular research?

Please list below the times you are available to work on this research.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY

Please provide two references below who can speak about your reliability, judgment, and sense of responsibility.

NAME	RELATIONSHIP TO THE APPLICANT	CONTACT INFORMATION

Undergraduate Research Mentoring Contract: Sample #1

This agreement is between the Mentor, _____, and the Mentee, _____, and will last for the approximate time period of _____ and then informally thereafter.

Both Mentor and Mentee agree to meet _____ per _____ and maintain communication between meetings via communication methods deemed appropriate by both parties.

The Mentor agrees to:

- ♦ Maintain communication and be available to provide assistance and support as needed;
- ♦ Assist Mentee in identifying goals and projects that would be beneficial to him/her;
- ♦ Advise Mentee as to services at the institution that would benefit him/her;
- ♦ Be honest with the Mentee and give praise as well as constructive criticism; and
- ♦ Send articles and reading materials that would benefit the Mentee.

The Mentee agrees to:

- ♦ Maintain communication;
- ♦ Ask for assistance as the need arises;
- ♦ Complete tasks by the established deadlines; and
- ♦ Read all articles and materials sent by the Mentor.

Discussions between the Mentor and the Mentee will be discreet unless otherwise discussed and agreed to by both parties. Both the Mentor and the Mentee agree to follow the guidelines of this agreement for the period specified and to make a good faith effort to resolve any issues that may arise.

Mentor Signature and Date

Mentee Signature and Date

Undergraduate Research Mentoring Contract: Sample #2

Student Research Contract

Name: _____ Date: _____

Indicate day and time available: _____

Goals:

- (1) To learn more about children's social and emotional development and parental socialization;
- (2) To learn more about quantitative and qualitative research designs;
- (3) To learn how to turn raw data into a form that can be analyzed and discussed as evidence for or against specific hypotheses;
- (4) To learn how to generate ideas about using what was learned from a study to plan future research.

Readings: Assigned as necessary. Some weeks, you may be asked to bring in a journal article you have found for the whole group to discuss. When you bring in an article, you will be asked to write a one-page summary of the article. When someone else brings in an article, you will be asked to write 1/2 page of comments and questions about the article. These will be due at the group meeting. Keep copies of your work to assist me when you need a letter of recommendation.

Hours: You will work about 6 to 9 hours weekly for about 15 weeks. This does not include our hour-long weekly meeting.

Commitments to:

- (1) Thorough preparation for running participants, including appropriate demeanor, appearance, and mastery of study procedure and ethical issues;
- (2) Running participants who are scheduled during your available hours;
- (3) Completing all assigned data entry;
- (4) Transcribing all assigned audiotapes and videotapes;
- (5) Coding all assigned transcripts and videotapes;
- (6) Strictly maintaining confidentiality and the security of all lab materials, including computer files;
- (7) Reading and thinking about any assigned articles;
- (8) Writing responses to assigned articles;
- (9) Attending, thinking, participating, and responding thoughtfully to others in meetings; and
- (10) Working in a timely fashion.

I will provide a written assessment of your work at the end of the semester. In addition, I am happy to meet with you individually at any time in the semester to discuss your progress and your thoughts about the research project.

All parties recognize their own responsibility in maintaining the quality of this academic experience and fulfilling this contract.

Student's Signature

Professor's Signature

7.2 Repository for Mentoring

Many groups have been involved in the mentoring process. Two such nationally-known, respectable mentoring organizations that possess a wealth of mentoring materials that may be used at any stage of the mentoring process are listed below.

Council on Undergraduate Research (CUR)

www.cur.org

The mission of the Council on Undergraduate Research (CUR) is to support and promote high-quality undergraduate student-faculty collaborative research and scholarship. CUR and its affiliated colleges, universities, and individuals share a focus on providing undergraduate research opportunities for faculty and students at all institutions serving undergraduate students. CUR believes that faculty members enhance their teaching and contribution to society by remaining active in research and by involving undergraduates in research.

The University of New Mexico Mentoring Institute

<http://mentor.unm.edu>

The Mentoring Institute was established to instill, foster and promote a mentoring culture at the University of New Mexico. The mission is to further the reach and impact that mentoring has on the world on a local, state, national, and international level.



The National Science Foundation Research Experiences for Undergraduates (NSF REU) program changed my college perspective from “paper and pen” work to conducting laboratory research, traveling and presenting at national conferences, and giving back to the society. Without the NSF REU program, my college experience would have never been as delightful as it is now. Moreover, if it were not for this undergraduate research training program, I would not be a good candidate for graduate school.

- Francois Mertil, Telecommunications Engineering Technology



◆ Section 8

New York City College of Technology
Mentoring Research Opportunities

New York City College of Technology

City Tech sponsors several programs that foster an environment conducive to undergraduate research. This section provides information on the Research Mixer and a list of nationally- and locally-funded research programs at City Tech for undergraduates. For more information, visit the Faculty Commons website (<http://facultycommons.citytech.cuny.edu>) and the Undergraduate Research website (<http://openlab.citytech.cuny.edu/undergraduateresearch>).

8.1 Research Mixer

The Undergraduate Research Committee organizes a research mixer event biannually for both faculty and students. It is a networking event for faculty to find students and students to seek out faculty interested in conducting research. It also provides an opportunity for undergraduate students to be introduced to national and local research programs and to learn about the research interests of City Tech faculty. At the Research Mixer, students also present their research projects and research experiences, and participate in a 'wandering scholars' segment which allows them to network with faculty. Information on summer research opportunities, internships, and scholarships is also provided, and a brochure listing the research interests of City Tech faculty is distributed.

8.2 Undergraduate Research Programs

City Tech offers several nationally- and locally-funded programs for undergraduates interested in conducting research.

Nationally-Funded Undergraduate Research Programs

Table 8.2.1 lists the research programs at City Tech that are currently and previously supported by federal grants. The list is organized by the target audience beginning from the freshmen year and ending at the senior year.

Mentoring Research Opportunities

Table 8.2.1
Present and Past Programs Supporting Undergraduate Research

Program	Target Audience and Number of Participants Supported	Project Duration (Years)	Funding Agency	Program Goals
Bridges to the Baccalaureate at New York City College of Technology	Freshmen in majoring in Liberal Arts (psychology), Chemical Technology, and Undeclared Health. Supports 15 students/year	07/01/2014-06/30/2019 (5 Years)	National Institutes of Health	Bridges to the Baccalaureate at City Tech, in partnership with Brooklyn College, provides a variety of services including intensive academic advisement, peer mentoring, and paid authentic research experiences. The program facilitates transfer of students to Brooklyn College to earn their Bachelor's degree in biomedical or behavioral sciences (Biology, Chemistry, or Psychology), after earning an associate degree at City Tech.
Research Experiences for Undergraduates in Satellite and Ground-Based Remote Sensing at NOAA-CREST	Sophomores/Juniors/Seniors in STEM Supports 10 students/year	08/01/2008-07/31/2016 6/1/2016-5/31/2019	National Science Foundation Research Experiences for Undergraduates (NSF REU)	Provides selected students in an intensive academic year-long research experience under the supervision of a NOAA-CREST scientist in satellite and ground-based remote sensing. Encourages continuation to master's and doctoral study.
Metropolitan Mentors Network: Growing a STEM Talent Pool in New York City	Freshmen/Sophomores	01/01/2007-12/31/2011 (4 Years)	National Science Foundation STEP	Provides career development and research opportunities for students in STEM disciplines from a pre-freshman summer seminar through graduation, employing a cyclical mentoring system that enables mentees to become mentors and supports students through graduation and into employment or further study.

Program	Target Audience and Number of Participants Supported	Project Duration (Years)	Funding Agency	Program Goals
Achieving Proficiency in Engineering Research through NASA-Related Initiatives	Freshmen/ Sophomores in Mechanical Engineering Technology Industrial Design Supports 30 students/year	09/01/2010- 08/31/2013 (3 Years)	NASA CI-PAIR	Supports a partnership between City Tech and Hostos Community College to provide under-represented minority students with the opportunity to strengthen their research and communication skills, to transfer to baccalaureate programs, and to participate in internships at NASA labs.
Automated Computation	Freshmen/ Sophomores in Physics	10/01/2011- 9/30/2014 (3 Years)	National Science Foundation	This project will provide our undergraduate students with a non-technical but logically coherent view of the current status of particle physics research.
Constraining Gravity Dual Models	Freshmen/ Sophomores in Physics	10/01/2010- 09/30/2012 (2 Years)	National Science Foundation	Broaden the participation of underrepresented groups by involving students in research projects. This will enable the students to apply technical skills learned in the classroom, develop their investigative skills and participate in the scientific enterprise.
Creating and Sustaining Diversity in the Geo-Sciences Among Students and Teachers in the Urban and Coastal Environment of New York City	All Academic Levels in STEM	09/01/2011- 08/31/2013 (2 Years)	National Science Foundation OEDG	The proposed activities combine geoscience research experiences with focused, multidimensional/layered mentoring, and a robust learning community that produce holistic and engaging stimuli for the scientific and academic growth and development of our K - 12 student and teacher participants.

Program	Target Audience and Number of Participants Supported	Project Duration (Years)	Funding Agency	Program Goals
GP-EXTRA: Recruiting and Retaining Non-geoscience Minority STEM Majors for the Geoscience Workforce	Juniors in STEM Supports 12 students/year	09/01/2015-08/31/2018 (3 Years)	National Science Foundation IUSE GEO	The goal of this grant is to pilot a model to train and prepare STEM students for the geoscience workforce through training, research, and internships.
Learning Product Design through Hands-on Mechatronic Projects	Juniors/Seniors in Mechanical Engineering Technology, ElectroMechanical Engineering Industrial Design Supports 50 students	08/15/2010-07/31/2013 (3 Years)	National Science Foundation ATE	The goal is to change the paradigm for technician education in mechanical engineering, electromechanical, and industrial design programs by making concurrent design and mechatronics the hallmark of these programs at City Tech.
Louis Stokes Alliance for Minority Participation	All Academic Levels in STEM	Continuous	National Science Foundation LSAMP	Strengthen the preparation and increase the number of minority students who successfully complete baccalaureates in STEM fields.
Remote Sensing and Earth System Sciences	All Academic Levels in STEM Supports 50 students/year	Continuous	National Science Foundation, Department of Defense, City Tech	Provides formal, integrated, interdisciplinary, and comprehensive implementation of Earth Systems Science and Remote Sensing technologies and applications. The Center engages and stimulates the curiosity of both City Tech's faculty and students to the varied applications of Remote Sensing to the cryosphere, the biosphere, the lithosphere, the atmosphere, and the hydrosphere.

Program	Target Audience and Number of Participants Supported	Project Duration (Years)	Funding Agency	Program Goals
Advancing STEM Futures	All Academic Levels in STEM Supports 40 students/year	2015-2019 (4 Years)	National Science Foundation S-STEM	Provides scholarship support for students in Computer Science, Chemical Technology, Applied Mathematics, and Biomedical Informatics.
Engineering the Future	All Academic Levels in STEM Supports 30 students/year	2012-2016 (4 Years)	National Science Foundation S-STEM	Provides scholarship support for students in Computer Engineering Technology, Computer Systems Technology, Electrical and Telecommunications Engineering Technology, and Mechanical Engineering Technology.
Strategic Changes to Increase and Sustain the Participation of Women and Underrepresented Minority Students in Computer Science	All Academic Levels in STEM	2015-2018 (3 Years)	Department of Education MSEIP	Provides academic support for women and minority computer science and computer-related majors.
Opening Gateways to Completion: Open Digital Pedagogies for Student Success in STEM	All Academic Levels in STEM	2015-2020 (5 Years)	Department of Education Title V	Provides support for Opening Gateways Research Assistants to build Open Educational Resources for the math department.

Locally-Funded Undergraduate Research Programs

The following segment highlights the locally-funded research programs at City Tech.

CUNY Research Scholars Program (for Associate Degree students)

The CUNY Research Scholars Program provides funded laboratory experiences for associate degree students over a one-year period. The goal of the program is to encourage undergraduate participation in authentic research and to increase persistence in STEM disciplines.

Associate degree students at any stage in their academic career can participate. Students should commit to being part of the program for one full academic year plus the summer. It is understood that some students will transfer to the baccalaureate during the program and this may entail students leaving the college. Accordingly, some students may take a partial scholarship for work done during the semesters or the summer.

The Research Scholars Program will provide students with the opportunity to study and do research with a faculty mentor in a STEM field. In addition to the student's participation in the research, the program will include lectures about lab safety, responsible conduct in research, and other guidance on research, and will culminate in a summer symposium. For participation in the program, students will receive the following:

Fall semester:	60 hours at 6 hours per week	\$1,000
Winter/Spring semester:	60 hours at 6 hours per week	\$1,000
Summer:	280 hours at 35 hours per week for 8 weeks	\$3,000

Students are required to attend the orientation which includes a Laboratory Safety workshop. In addition, all students must complete the responsible conduct in research online training through the Collaborative Institutional Training Initiative (CITI) within six weeks of their first semester of participation. More information on CITI training can be found at:

www2.cuny.edu/research/research-compliance/training-education/citi-training

Students are expected to submit an abstract summarizing their accomplishments and submit it to their mentors by a specified date. Students will be asked permission to publish their abstracts on the college website and in the book of abstracts (fall and spring).

Students must also attend the following:

- ♦ Writing Abstracts for Research Projects (fall)
- ♦ Workshop on Advancing Library Research Techniques (fall)
- ♦ Workshop on Developing and Delivering Effective Research Presentations (fall)
- ♦ Workshop on Designing a Research Poster Presentation (fall)

- ◆ Honors and Emerging Scholars Poster Presentation (fall and spring)
- ◆ Spring events - TBA

Some funding to support student travel to conferences to present their work is available.

Location: Namm Building, Room 320
Phone: 718.260.5560
E-mail: Dr. Pamela Brown, *Associate Provost*
pbrown@citytech.cuny.edu

The Black Male Initiative (BMI)

City Tech’s BMI program is a coordinated initiative that attracts, retains, and graduates students from under-represented groups, particularly African- American and Hispanic male students in the fields of Science, Technology, Engineering and Mathematics (STEM). The program focuses on student success in the college’s flagship programs in the sciences and engineering technologies because these are among the college’s strongest programs and because they are areas in which African-Americans and Hispanics are notably underrepresented. Increasing the numbers of underrepresented minority students who succeed in STEM disciplines is important not only to the economic vitality of the New York metropolitan area, but to the nation as a whole. Inasmuch as the purpose of this project is to strengthen the engagement and success of African-American and Hispanic male students in STEM fields, the project also serves as a prototype for future cohort-based initiatives that address the needs of other educationally underserved populations in higher education that have not been advantaged equally. The vibrant student support system that the BMI offers include:

- ◆ A structured mentoring program
- ◆ Paid STEM research internships
- ◆ Tutoring, particularly for STEM “gatekeeper” courses
- ◆ Preparation for graduate school and professional studies
- ◆ Outreach/service learning activities
- ◆ Exposure to STEM laboratories and industries

All programs and activities of the BMI are open to all academically eligible students without regard to race, gender, national origin, or other characteristic.

Location: Midway Building, Room 210
Phone: 718.260.4910
E-mail: Dr. Reginald Blake, *Director of the BMI Program*
rblake@citytech.cuny.edu
 Ms. Sonia Johnson, *Assistant to the Director of the BMI Program*
sjohnson@citytech.cuny.edu
Website: **<http://bmi.citytech.cuny.edu>**

Emerging Scholars Program

The Emerging Scholars Program provides a stipend for a student researcher assisting a faculty member with research or other scholarly endeavors. The purpose of the program is to help students develop a close relationship with a faculty member and promote a practical understanding of material learned in courses, while providing the faculty member as mentor with some assistance. In order to be awarded the stipend, students are expected to:

- ♦ Attend an organizational meeting
- ♦ Work a few hours every week (~50 hours total) with their mentor*
- ♦ Attend the workshop on Writing Abstracts for Research Projects
- ♦ Attend the workshop on Advancing Library Research Techniques
- ♦ Attend the workshop on Developing and Delivering Effective Research Presentations
- ♦ Attend the workshop on Designing a Research Poster Presentation
- ♦ Participate in the Honors and Emerging Scholars Poster Presentation
- ♦ Prepare abstract summarizing accomplishments and submit it to the mentor by specified date. Students will be asked permission to publish their abstract on the college website and in the book of abstracts.
- ♦ Be a full-time student in good academic standing (exceptional part-time students are eligible for 50% stipend for 25 hours of work with their mentors).
- ♦ Complete the responsible conduct in research online training through the Collaborative Institutional Training Initiative (CITI) within six weeks of their first semester of participation. More information on CITI training can be found at:
www2.cuny.edu/research/research-compliance/training-education/citi-training

* Due to restrictions in funding, students must be US residents or permanent resident aliens (they must have a social security number) to receive the stipend. They must be recommended by a faculty member into the program and be in good academic standing. In rare cases advanced part-time students are accepted into the program.

At the Honors and Emerging Scholars Awards Ceremony, students and mentors receive a certificate of accomplishment and a copy of the book of abstracts.

Location: Voorhees Building, Room 424
Phone: 718.260.5410
E-mail: Dr. Hamidreza Norouzi, *Director of Undergraduate Research*
hnorouzi@citytech.cuny.edu
Dr. Pamela Brown, *Associate Provost*
pbrown@citytech.cuny.edu
Application: **Part I:** www.surveymonkey.com/r/EmergingScholars

Honors Scholars Program

The Honors Scholars Program at City Tech is dedicated to providing academically gifted students with the opportunity to develop their intellectual potential. The program is open to students who have completed at least 16 credits with a cumulative grade-point-average of 3.4 or better. Transfer students entering City Tech with 16 or more college credit hours and a transfer grade-point average of 3.4 or higher are eligible to apply.

The Honors Scholars Program encourages students who have demonstrated high academic achievement to undertake honors level work in any appropriate course through the Contract for Honors Credit in a Regular Course agreement. Honors work normally involves substantial independent research projects in addition to the normal requirements of the course. Specific expectations for contract honors credit must be negotiated between the student and professor and approved by both the department chairperson and the Honors Scholars Program Director. Honors credit is noted on the transcript as “HONORS PROJECT” followed by the course and semester.

The Contract for Honors Credit in a Regular Course should be completed and signed by the student and professor. The original contract needs to be submitted six weeks after the first day of class to the Honors Scholars office. Copies should be retained by both professor and student to avoid any misunderstanding about the expectations for Honors credit. Upon completion of the course, the professor should report satisfactory performance of this contract, with a grade of B or better, to the Honors Scholars Program Director in order for Honors credit to be placed on the student’s transcript. A final copy of the research project must be submitted to the Honors Scholars office.

Students who complete a Contract for Honors Credit in a Regular Course are required to participate in four required undergraduate research workshops and the Honors Scholars Poster Presentation. The workshops will assist students in the following areas:

- ♦ Writing Abstracts for Research Projects
- ♦ Advancing Library Research Techniques
- ♦ Developing and Delivering Effective Research Presentations
- ♦ Designing a Research Poster Presentation

Location: Midway Building, Room 308
Phone: 718.254.8668
E-mail: Dr. Janet Liou-Mark, *Director of the Honors Scholars Program*
jliou-mark@citytech.cuny.edu
Dr. Reneta Lansiquot, *Assistant Director of the Honors Scholars Program*
rlansiquot@citytech.cuny.edu
Ms. Laura Yuen-Lau, *Coordinator of the Honors Scholars Program*
lyuen-lau@citytech.cuny.edu
Website: <http://cue.citytech.cuny.edu/honorsscholars>

Baccalaureate Student Research Scholars (BRSP) Program

BRSP is an extended research opportunity for full-time baccalaureate students (registered for 12 or more credits in spring 2016) which provides a \$1000 stipend for spring 2016 for full-time students (enrolled for 12 or more credits) and an addition \$1500 stipend for summer (June) 2016, for conducting research with a faculty member. Typically students will work with their faculty mentor a total of 60 hours during spring 2016, plus attend four advanced professional development workshops. Students will spend 35 hours per week on the project for four weeks in June. They must also complete training through Collaborative Institutional Training Initiative (CITI) within the first six weeks, submit an abstract towards the end of the spring semester and June and participate in the poster sessions. The purpose of the program is to provide experienced undergraduate researchers with an extended opportunity to apply what was learned in the class room to discover new knowledge, solve real-world problems and develop professionally while working with faculty to advance their scholarly endeavors. Highly qualified students who have not had a prior, formal research experience may also apply. Some funding for student travel to professional conferences to present results is available.

Stipends are limited to US citizens or permanent residents and those not receiving undergraduate research stipends concurrently from another program.

Location: Voorhees Building, Room 424
Phone: 718.260.5410
E-mail: Dr. Hamidreza Norouzi, *Director of Undergraduate Research*
hnorouzi@citytech.cuny.edu
Dr. Pamela Brown, *Associate Provost*
pbrown@citytech.cuny.edu
Application: **Part I: www.surveymonkey.com/r/BRSPCityTech**

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