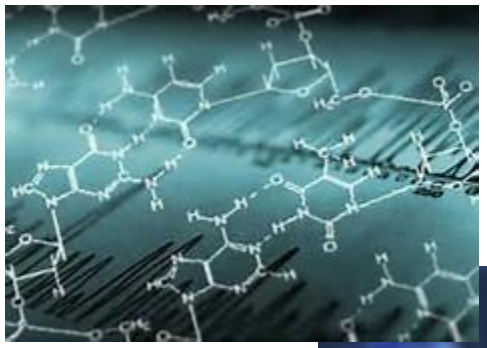
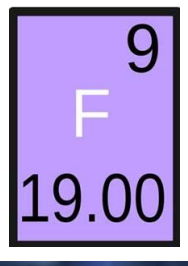
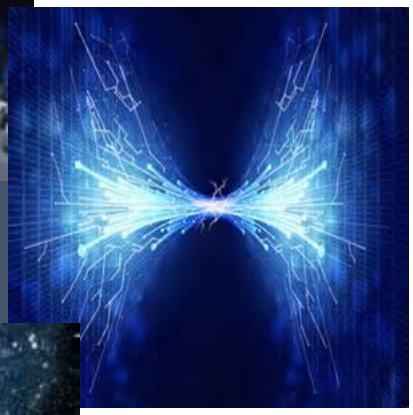
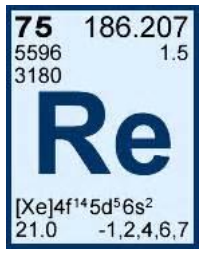


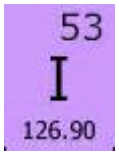


R^1I



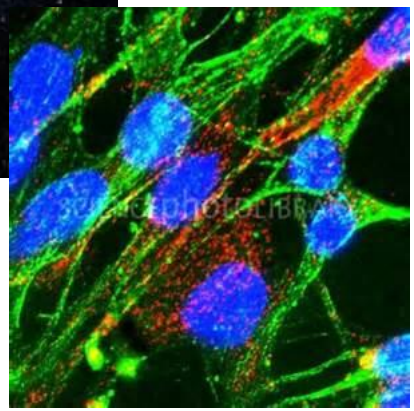
RFI





$$i\hbar\frac{\partial}{\partial t}-\Psi=\hat{H}\Psi$$

$$-\frac{\hbar^2}{2m}\left(\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}\right)+V(x,y,z)\psi=E\psi$$



RESEARCH 1ST INITIATIVE

2017 Research Stream Course Descriptions

NJCSTM
New Jersey Center for
Science, Technology & Mathematics

KEAN UNIVERSITY

What is the Research First Initiative (RFI)?

The RFI is an innovative elective curriculum that allows undergraduate students to engage in authentic scientific research under the mentorship of a faculty research scientist. Enrollment in the RFI is open to qualified students from the NJ Center for Science, Technology & Mathematics (NJCSTM) and the College of Natural & Applied Health Sciences (CNAHS), including the School of Environmental & Sustainability Sciences (SESS).

The program is designed to promote student interest in scientific research and encourage students to pursue careers in STEM. Students enrolled in the RFI become part of a faculty member's research team working on real world problems alongside their peers. In so doing, students experience the thrill of discovery and problem solving in science not through standard classroom lectures but by actively applying the fundamental scientific principles found in textbooks. The ability of students to successfully conduct authentic scientific research builds individual confidence and identity. RFI students gain valuable work experience and the possibility of presenting their findings at scientific symposia or publishing in a scientific journal. Throughout their undergraduate research experience, RFI participants develop and perfect vital career skills in Critical Thinking, Translational Science, Quantitative Literacy, Information & Technology Literacy, and Communication Literacy. Students who complete the RFI requirements will be awarded either an RFI or RFI Honors designation upon graduation.

The ultimate goal of the RFI is to graduate students that are well trained, experienced researchers, who can successfully compete for STEM jobs or post graduate degree programs.

RFI Admission Criteria

- Overall GPA of 3.0, with a 3.25 GPA in science & mathematics
  - Proficiency in Mathematics
  - AP Science & Math courses or High School research experience desirable

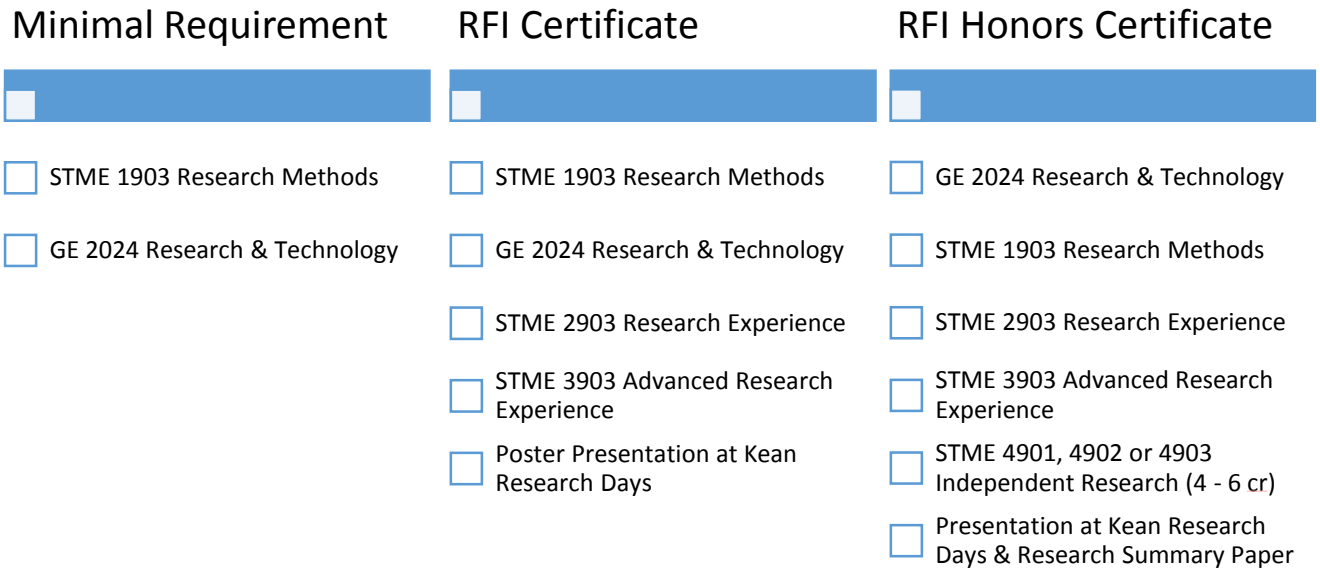
- Enrollment in RFI research streams (STME 2903 & STME 3903) & independent research options (STME 4901, 4902 & 4903) is by petition.
  - Students petitioning to enroll in an RFI research stream must interview with the Faculty Stream Leader, obtain approval of their advisor and / or the RFI Admissions Committee
  - CNAHS students must submit the CNAHS Student Approval Form signed by their advisor and executive director
  - Exceptions subject to Instructor's & Dean's approval

- Prerequisites for Advanced RFI Research Streams for non-STME majors (CNAHS)
  - High School Advanced Placement course(s) in field related to RFI research stream or research experience. *i.e.*, Biology, Chemistry, Physics, Earth Sciences, Computer Sciences or Mathematics (Calculus)
  - Science club, NJCSTM Group Summer Scholars Research Program (GSSRP), Research camp or HS/College science project

- Pre-requisite undergraduate courses may be required for entry into advanced research streams such as chemistry, bioinformatics or astrophysics. Faculty mentors determine pre-requisite course(s) for their research stream.
  i.e., Organic Chemistry 1, Java Programming, Calculus & Differential Equations
  - Exceptions subject to Instructor's & Dean's approval

RFI Tracks

Those students interested in conducting authentic scientific research may elect to pursue either (i) the basic RFI Certificate Track or (ii) the RFI Honors Track. Students should select their RFI track, in conjunction with their advisor, upon entry into their junior year. Upon completion of the track's requirements the selected RFI designation will be awarded to students at graduation. NJSTME students are required to take the minimal RFI track in order to graduate. Students from other colleges at Kean University may participate in the RFI with approval of their advisor and the RFI Admissions Committee.



NJCSTME Pathways to Graduation for RFI Tracks

NJCSTME	
Freshman Year: Fall Semester	
STME 1903 Research Methods	1
	1
Freshman Year: Spring Semester	
GE 2024 Research & Technology (Comp Sci/ChemEd/Eng/Math Ed majors)	3
STME 2903 Research Experience (*prerequisite STME 1903 or equivalent*)	2
	2 – 5
Sophomore Year: Fall Semester	
GE 2024 Research & Technology (BioEd, Biotech, Biomed majors)	3
STME 3903 Advanced Research Experience (*prerequisite STME 2903 or equivalent*)	3
	6
Sophomore Year: Spring Semester	
STME 2903 Research Experience	0 – 2
	2
Junior Year: Fall Semester	
STME 3903 Advanced Research Experience (*prerequisite STME 2903 or equivalent*) **OR**	0 – 3
STME 4901, 4902 **OR** 4903 Independent Research – RFI (*Honors Track only*)	3
	3
Junior Year: Spring Semester	
STME 4901, 4902 **OR** 4903 Independent Research – RFI (*Honors Track Only*)	0 – 3
	0 – 3
Senior Year: Fall Semester	
RFI Honors Thesis (*Honors Track Only*)	NA
	NA
Senior Year: Spring Semester	
STME 4901, 4902 **OR** 4903 Independent Research - RFI (*Honors Track only*)	0 – 3
Kean & NJCSTM Research Days Presentation	0
	0 – 3

CNAHS Pathways to Graduation for RFI Tracks

All Other Kean Colleges	
Freshman Year: Fall Semester	
RFI prerequisites (*i.e.*, Biol, Chem, Math, Java Programming courses)	0 – 6 cr
Freshman Year: Spring Semester	
GE 2024 Research & Technology OR other RFI prerequisites (*i.e.*, Biol, Chem, Math, Java Programming courses)	3 cr
	3 cr
Sophomore Year: Fall Semester	
GE 2024 Research & Technology OR other RFI prerequisites (*i.e.*, Biol, Chem, Math, Java Programming courses)	3 cr
	3 cr
Junior Year: Fall Semester	
GE2024 Research & Technology OR other RFI prerequisites (*i.e.*, Biol, Chem, Math, Java Programming courses)	3 cr
STME 2903 Research Experience (*prerequisite: GE 2024 or other with approval of instructor & Dean*)	2 cr
	2 – 3 cr
Junior Year: Spring Semester	
STME 2903 Research Experience (*prerequisite: GE 2024 or other with approval of faculty stream leader*) **OR** STME 3903 Advanced Research Experience (*prerequisite STME 2903 or equivalent with approval of instructor & Dean*)	2 – 3 cr
	2 – 3 cr
Senior Year: Fall Semester	
STME 3903 Advanced Research Experience **OR** (*prerequisite STME 2903 or equivalent with approval of instructor & Dean*)	3 cr
STME 4901, 4902 OR 4903 Independent Research – RFI **OR** CNAHS equivalent course (*Honors Track only*) – *for those who successfully completed STME 3903; approval of CNAHS Advisor & Executive Director required*	0 – 3 cr
	0 – 3 cr
Senior Year: Spring Semester	
STME 4901, 4902 OR 4903 Independent Research - RFI **OR** CNAHS equivalent course (*Honors Track only*) – for those who successfully completed STME 3903– with approval from CNAHS Advisor & Executive Director	0 – 3 cr
Kean Research Days Presentation	NA
RFI Honors Thesis (*Honors Track Only*)	NA
	0 – 3 cr

GE 2024: Research and Technology-Research First Initiative

This course provides an introduction to the research process for those students participating in the Research First Initiative, including conducting original experiments in a STEM field, preparing a formal research paper and an oral presentation with an emphasis on the use of computer technology to design, investigate, and report research activities. Prerequisites: successful completion of developmental reading (if required), College Composition, and Speech Communication as Critical Citizenship (COMM 1402) and Research Methods (STME 1903)*.

Note: GE 2024 is a General Education requirement for all students with majors in the College of Natural, Applied, and Health Sciences (NAHS) and New Jersey Center for Science, Technology & Mathematics (NJCSTM). Typically, students will enroll in GE 2024 sections within their appropriate college (e.g. GE 2024-01 and GE 2024-02 are sections offered to STEM students). This course qualifies towards Research First Initiative credit for those students who elect to participate in the program.

***Research Methods (STME 1903) - NJCSTM students only**

STME 1903 Research Methods

Students will learn the process of scientific inquiry and upon completion may apply to join an RFI research stream that will enable them to perform authentic scientific research before they take upper level college courses. Course content includes: formulating and testing scientific hypotheses, the importance of scientific record keeping, principles of database inquiry and literature searching, evaluating and integrating experimental data from different fields, computational approaches to research, and discussions of professional integrity and scientific ethics. This course will also serve as the introduction to the various research streams that will be available to incoming students. Different STME faculty participating in the Research Experience modules will present their research programs and describe the projects available for RFI credit.

All NJCSTM STEM majors are required to take STME 1903 (1 credit hour). Students taking STME 1903 will be assessed for the following skills: Critical Thinking, Interdisciplinary Connectivity, Quantitative Literacy, Information & Technology Literacy, and Communication Literacy.

STME 2903 Research Experience

Students in this course choose their research stream from an array of faculty research projects. Students will apply proper research procedures and practice established protocols in a laboratory setting, shadowing a research team and the faculty mentor and participating in research, discussions, and presentations. Each section of STME 2903 is focused on a specific stream of original scientific research and is run by the faculty research sponsor. This course prepares students to perform research in STME 3903 Advanced Research Experience-RFI. At the end of the semester participants are required to produce a written scientific report, summarizing relevant scientific background information, the project's goals, the experiments conducted, the data obtained, conclusions drawn from the data and next steps for the project. Experiments cannot always be completed during scheduled class hours. Therefore, students must be willing and able to complete some research experiments outside of normal class hours, ranging from 4 – 6 hrs per week.

Enrollment in STME 2903 is by petition and is limited to 6 students per stream (exceptions with approval of instructor & Dean). Students from other Kean Colleges who wish to enroll in STME 2903 must interview with the RFI Stream Faculty Leader and obtain their advisor's and Executive Director's permission. Acceptance into STME 2903 is contingent upon GPA and interview with the Research Stream faculty leader. Students taking STME 2903 will be assessed for the following skills: Critical Thinking, Interdisciplinary Connectivity, Quantitative Literacy, Information & Technology Literacy, and Communication Literacy.

Check Keanwise or the NJCSTM course catalog to obtain updates on course section offerings.

(3 credit hours)

Prerequisite: Research Methods-RFI (STME 1903) or other pre-requisites for non-STME students (*i.e.*, Biol, Chem, Math, Java Programming courses)

NOTE: To qualify for RFI honors designation, students must take both 2903 & 3903 in sequence.

STME 3903 Advanced Research Experience

This course is a continuation of the Research First Experience. Students, in conjunction with a faculty research stream leader will submit a project/research proposal, then apply research methods learned in the initial Research Experience to advance their understanding of the research involved. Students will produce a final paper, progress report and/or presentation of their research. At the end of the semester participants are required to produce a written scientific report and / or a poster exhibit suitable for presentation at Kean Research Days, summarizing relevant scientific background information, the project's goals, the experiments conducted, the data obtained, conclusions drawn from the data and next steps for the project. Experiments cannot always be completed during scheduled class hours. Therefore students may be required to conduct some research experiments outside of normal class hours, ranging from 6 – 8 hrs per week.

Enrollment for STME 3903 is by petition and is limited to 8 students per stream. Students from other Kean Colleges who wish to enroll in STME 2903 must interview with the RFI Stream Faculty Leader and obtain advisor's permission. Acceptance into STME3903 is contingent upon GPA and interview with the Research Stream faculty leader. Students taking STME 3903 will be assessed for the following skills: Critical Thinking, Interdisciplinary Connectivity, Quantitative Literacy, Information & Technology Literacy, and Communication Literacy.

Check Keanwise or the NJCSTM course catalog to obtain updates on course section offerings.

(3 credit hours)

Minimum Prerequisite: Research Experience-RFI (STME 2903)

NOTE: To qualify for RFI honors designation, students must take both 2903 & 3903 in sequence.

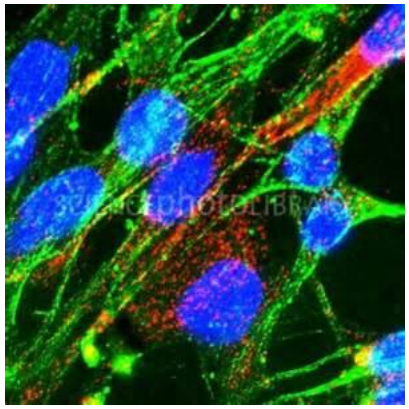
STME 4901, 4902 & 4903 Independent Research (RFI)

A laboratory, field or theoretical investigation of a research problem, performed independently by the student, under supervision of an RFI faculty member. May be repeated for credit, up to a total of six credits, however only 4 credits may be used to fulfill major elective requirements.

Students pursuing a 4 yr BS or 5 yr combined BS/MS degree who are enrolled in the Research First Initiative may use STME 4901 – 4903 to continue working in a research stream in order to achieve the RFI Honors distinction. Students participating in the RFI honors track must take at least 2 full semesters of Independent Research (4 – 6 credit hours total) and complete an honor's thesis or a scholarly research paper. Approval of the faculty research sponsor is required prior to enrollment. Students with the help of their faculty sponsor must submit a proposed research plan for approval by the Dean or Associate Dean in order to enroll in Independent Research. Research proposal forms are available in the NJCSTM Dean's Office.

Prerequisite: minimum of 16 credits of STME coursework and a 3.2 cumulative GPA; requires contract with faculty sponsor and approval of chairperson. STME 2903 & STME 3903 or Dean-approved equivalent required for RFI Certificate or Honors Track designation.

RFI Research Stream Descriptions



About Dr. Coniglio:

Dr. Sal Coniglio is an Assistant Professor of Chemical Biology and Coordinator of the MS Biotechnology program at NJCSTM. Dr. Coniglio's laboratory seeks to understand the communication that occurs between tumor cells and normal cells within the microenvironment, in particular cells of the myeloid lineage. He discovered that the growth factor CSF-1 is secreted by high grade glioblastoma cells and plays a critical role in mediating disease progression. His lab is currently investigating which factors cooperate with CSF-1 in "reprogramming" the microenvironment and potential therapeutic avenues to disrupt these pathways. Assays commonly employed in the laboratory include: quantitative PCR, SDS-PAGE electrophoresis, ELISAs, Immunofluorescence, Flow Cytometry and Sorting and 3D microenvironment simulation in-vitro. Dr. Coniglio received his Ph.D. in Anatomy and Structural Biology from Albert Einstein College of Medicine in 2008. He was an American Cancer Society Postdoctoral Fellow and is a member of the American Association for Cancer Research.

Cancer Cell Signaling: Gene Expression Analysis of Tumor-associated Macrophages

Dr. Salvatore Coniglio

Genes control the differentiation, growth and functions of all cells through cell signaling pathways. In this research stream students will attempt to identify genes associated with signaling pathways controlling the growth and differentiation of tumor cells. In Glioblastoma, a rare form of brain cancer, immune macrophages are reprogrammed and affect the growth of the tumor. The role of these cells in tumor progression is poorly understood and altering their activity in the disease could provide a means of inhibiting tumor growth. In this stream students will begin to characterize the genes involved in cell signaling pathways that control the activity of tumor macrophages. Students will learn Quantitative Real Time PCR as a means of identifying genes involved in promoting or inhibiting the growth various cell types associated with the progression of Glioblastoma.

This research stream is appropriate for students with interests in: cancer, chemistry, biomedicine, biotechnology, drug discovery, immunology, molecular biology, and neurobiology.

About Dr. Ramanthan:

Dr. Dil Ramanathan joined NJCSTM in 2008 as Assistant Professor of Analytical Chemistry. Her laboratory research is rooted in analytical chemistry and her instrument of choice is mass spectrometry. Over 15 years, she has applied her expertise in mass spectrometry, analytical chemistry, chemical instrumentation techniques, drug metabolism and pharmacokinetics to develop novel, rapid, sensitive and reproducible methods to qualitatively and quantitatively analyze drugs and their metabolites. Dr. Ramanathan received her B.S. degree in Chemistry from Iowa State University and a Ph.D. degree in Analytical/Physical Chemistry from the University of Florida. She also completed one year as a postdoctoral researcher/faculty intern at the University of Utah, where she applied mass spectrometry to study binding and thermodynamic properties of metal clusters.

Identification & Characterization of Drug-Like Chemical Compounds in Medicinal Plants Using Chromatography & Mass Spectrometry Techniques

Dr. Dil Ramanathan

Analytical techniques are used to determine the chemical makeup of our environment as well as the organisms that inhabit it and are powerful tools that help us understand our universe. Instruments that perform these analyses have been sent to the most extreme and complex environments we know, such as far reaching planets, comets, the deepest depths of our oceans, and the organellar structures of living organisms. In this research stream, students will be trained to have hands-on experience in using chemical instrumentation such as head-space gas chromatography-mass spectrometry and high performance liquid chromatography-high resolution mass spectrometry. Research will involve the analysis of drug metabolites found in the environment as well as the identification of potential novel medicinal compounds found in tropical plants.

This research stream is appropriate for students interested in, astrophysics, biology, biomedicine, biotechnology, chemistry, geology, molecular biology, marine biology, sustainability sciences and physics.

About Dr. Hayes:

Dr. Marshall Hayes is a Lecturer and Acting Coordinator of the Research First Initiative at NJCSTM. He received a B.A. from Williams College, double majoring in Geosciences and Environmental Studies, and then earned a Master's in Science Policy and a Ph.D. in Earth and Ocean Sciences from the Nicholas School of the Environment at Duke University. Prior to coming to Kean, he was a Research Scientist in the Dept. of Plant Pathology and Plant-Microbe Biology at Cornell University. Dr. Hayes' research has ranged from the study of health indicators in the environment to the management of disease in agricultural settings. He has expertise in the molecular microbiology of bacteria and fungi, global biogeochemistry, and the spatiotemporal dynamics of disease in the environment. Dr. Hayes is particularly enthusiastic about promoting innovation in undergraduate STEM education through the use of creative and immersive teaching techniques to enhance student engagement with scholarly material, to influence student attitudes towards learning and to stimulate critical thinking, communication and self-confidence.

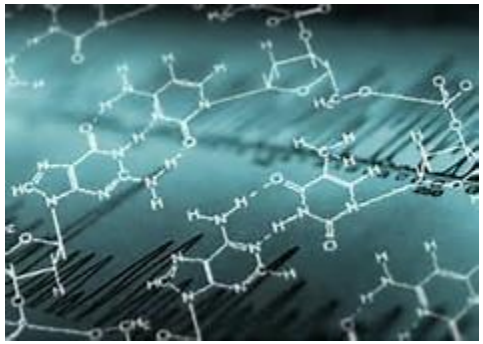
Microbes & Microbiomes

Dr. Marshall Hayes

Earth is a microbial world. Although people generally associate microorganisms *(e.g.* bacteria, viruses and fungi) with life-threatening diseases, scientific research indicates that most microbes are benign and even beneficial in the context of human and environmental health. In this research stream, you will take a hands-on approach to exploring the vast microbial diversity that lies hidden in, on and around us.

Students will gain a working knowledge of concepts that are relevant to environmental microbiology from the fields of ecology, evolution, molecular biology and genetics, while honing laboratory skills in classical and molecular microbiology, including isolating, cultivating and characterizing samples using biochemical, genetic, genomic and bioinformatic techniques. In collaboration with the American Type Culture Collection's Center for Translational Microbiology, we will also highlight the use of culture collections in the search for new targets of therapeutic chemicals, the design of diagnostic tools based on the human microbiome, the identification of novel enzymes for producing next-generation biofuels, and ways to produce highly valued materials from waste streams and other environmentally sustainable sources.

This research stream is directed at students with particular curiosities about biomedicine, ecology, science education, agriculture and engineering, although other disciplinary interests are also appropriate.



Medicinal Chemistry: Synthesis of CCR1 Receptor Antagonists

Dr. James Merritt & Dr. Heather Stokes-Huby

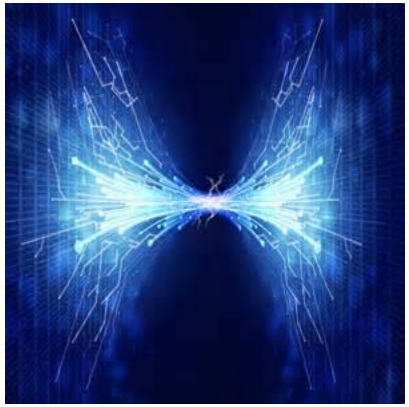
Chemokine receptors are cell surface proteins that direct the movement of cells. Overexpression and activation of these receptors result in over-recruitment of cells particularly in autoimmune disease and certain forms of cancer. Our group has identified novel small molecules that can inhibit chemokine receptor signaling. Such molecules may eventually become new medicines for treatment of diseases such as arthritis, multiple sclerosis, multiple myeloma or glioblastoma. In this stream, students will synthesize novel small molecules based on structure-activity relationships of molecules previously tested in biological assays that mimic these diseases. Students will learn the basic techniques for organic synthesis, purification and characterization of small molecules produced in multi-gram and milligram quantities. This research stream is an excellent primer for students who plan to take organic chemistry and have an interest in how new medicines are created. The advanced research experience in this stream provides students with the opportunity to design and synthesize novel small molecules based on structure-activity relationships of molecules previously tested in a biological assay. The prerequisite for NJCSTM freshmen for the first Research Experience (STME 2903) is completion of Chemical Systems I with a grade of at least B-. Students must complete Chemical Systems II and Organic Chemistry I to enroll in STME 3903. Students with interests in cancer, chemistry, biomedicine, biotechnology, drug discovery, molecular biology and neurobiology may wish to consider this research stream.

About Dr. Merritt:

Dr. James Merritt joined Kean University in 2010 after a 15-year career as a medicinal chemistry research leader at a New Jersey-based biotechnology company. During his industrial career, James was the co-inventor on numerous potential medicines including Navarixin, a Merck drug that entered human trial testing in patients with chronic obstructive pulmonary disease. After receiving his B.S. degree in chemistry at the University of North Carolina–Wilmington, he earned his Ph.D. in organic chemistry at Duke University in 1994. Dr. Merritt leads a thriving synthetic medicinal chemistry research group at NJCSTM, which produces small novel, drug-like molecules for testing as potential medicines. His current research focuses on synthesis of small molecule inhibitors of CCR1, a cell receptor that is implicated in rheumatoid arthritis, multiple sclerosis and multiple myeloma. Dr. Merritt's group has prepared numerous potent CCR1 inhibitors that are able to stop movement of cancerous human multiple myeloma cells and may eventually provide a new route for treatment. In 2013, Dr. Merritt brought combinatorial chemistry research to Kean. Using combinatorial chemistry, a few chemists can make thousands of novel molecules in the time that it would normally take to make dozens. Using this special technique, NJCSTM research students prepared a collection of 60,000 molecules, which are now being screened by a local biotechnology company in search of potential drugs for newly discovered biological targets.

About Dr. Stokes-Huby:

Dr. Heather Stokes-Huby is an associate professor and the Organic Chemistry Coordinator in the College of Natural, Applied and Health Sciences. Her research interests center on the use of transition metals catalysts to influence the outcome of organic reactions. Prior to joining the faculty of Kean University in 1997, she obtained a Ph.D. in organic chemistry at Wake Forest University and completed post-doctoral studies in organometallic catalysis and chiral poisoning at Yale University. While Dr. Stokes-Huby has performed research in diverse areas of synthetic organic and organometallic catalysis her current research focuses on the application of palladium catalysts to produce new bonds between nitrogen and sp^2 hybridized carbon atoms as are found in many natural and pharmaceutical products, including the novel compounds being prepared and evaluated as CCR1 antagonists.



About Dr. Farnum:

Dr. Ted Farnum is an assistant professor of Applied Mathematics at NJCSTM. Dr. Farnum's research interests are in differential equations, mathematical physics, asymptotic analysis and numerical methods and scientific computing. He combines all these approaches to models in nonlinear optical science. In particular, he is interested in constructing and analyzing nonlinear wave models for ultra-short pulse propagation, which may be especially useful in all optical computing and improved fiber optic communications. His teaching interests have a similar applied and computational flavor. His courses feature mathematical modeling, scientific computation, asymptotic analysis and spectral methods. Dr. Farnum received his Ph.D. in Applied Mathematics from the University of Washington in 2005.

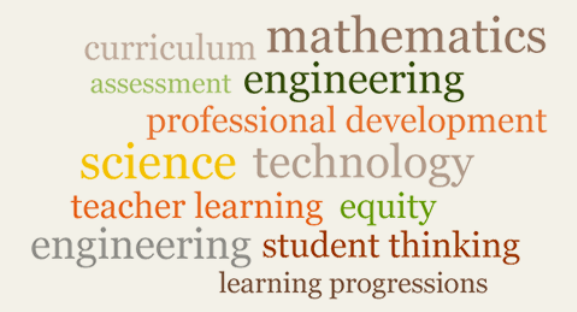
Dynamical Systems & Wave Propagation

Dr. Edward Farnum

Dynamical Systems is a branch of mathematics which uses differential equations to describe the evolution of a system over time. These equations are often nonlinear, and can lead to unexpected or chaotic results. Nonlinear wave equations govern the behavior of a wide variety of phenomena in physics and engineering, including tsunami formation, ultra-short fiber-optical communications, laser mode-locking, and Bose-Einstein Condensates. Improved understanding of these nonlinear wave systems can impact areas as diverse as advanced tidal wave warnings and high precision biological spectroscopy.

The purpose of this research stream is to develop and analyze nonlinear wave models for ultra-short optical pulses. Presently, mode-locked lasers can generate pulses exceeding the bounds predicted by standard models. New mathematical models are needed to guide engineers, and to help determine a feasible range of physical parameters for construction and operation of ultra-fast optical devices.
Students in this stream will learn numerical and computational methods for optimization, root-finding, partial differential equations, spectral analysis, and linear stability analysis.

This research stream is appropriate for students with interests in applied mathematics, physics, computational science, engineering, differential equations, and numerical analysis. Familiarity with any of the above fields will be beneficial. Students considering this research stream should have two semesters of calculus and some programming experience. Some background in linear algebra and differential equations is desirable but not required. Exceptions will be considered based on an interview with the instructor and approval of the Dean.



About Dr. Baldwin:

Dr. Brian Baldwin joined Kean University in 2007 as Assistant Professor of Science Education, and Coordinator of STEM Education programs at NJCSTM. He teaches graduate and undergraduate courses in science teaching methods and science education research methods. He is currently directing the $750,000 Kean Math and Science Partnership, providing professional development to science teachers. Dr. Baldwin previously directed the $1.7 Million Kean Math-Science Partnership, which provided professional development opportunities for approximately 225 math and science teachers. He also regularly consults with school districts and provides professional development in science instruction and curriculum matters, as well as providing external evaluation for STEM education funded projects with K-12 and Higher Education institutions. Dr. Baldwin earned his BS in Chemistry and MEd in Secondary Education from Ohio University, and his EdD in Science Education from Columbia University - Teachers College.

STME Education

Dr. Brian Baldwin

Current and recent large-scale policy movements in math and science education have radically changed traditional ways that children learn, are taught, and are assessed. These shifts in state standards, along with the tests for assessment have greatly impacted curriculum and teaching inside of New Jersey's math and science classrooms. As the standards become implemented over the course of the next few years, much work has to be done on a reeducation of experienced teachers on how they can take steps to modify their practices to account for the new standards and curricula. At Kean, we are in the midst of a two year project (called the Kean Math and Science Partnership) which provides professional development opportunities for current science teachers to help them conceptualize their current practice and how it can be modified to fit within the new framework of the Next Generation Science Standards. This research stream will offer opportunities to capture and begin to analyze statewide achievement test data (PARCC, NJASK, BCT) and develop opportunities with school districts to work with teachers in identifying needs for professional development opportunities for future partnerships.

This research stream is appropriate for students with an interest in Science or Math Education.

About Dr. Joiner:

Dr. David Joiner is the Kenneth L. Estabrook Professor of Science, Technology, and Mathematics Education at Kean University, and an Associate Professor in NJCSTM. His work focuses on two areas, the application of computing to the solution of problems in astronomy and the infusion of computational science into secondary and undergraduate curriculum. As an astrophysicist, Dr. Joiner's work focuses on modeling properties of the interstellar medium, particularly through the use of radiative transfer for embedded objects such as asymptotic giant branch stars and cataclysmic objects such as novae. His work in educational technology focuses on building hardware and software tools that enhance the classroom and he is developing software tools for performing scientific visualization in virtual reality environments. Dr. Joiner is a member of the LittleFe team that builds and designs portable cluster computers for classroom use, and has worked with the Shodor Education Foundation helping to design such tools as Project Interactivate and the Modeling and Simulation Tools for Education Reform. He has received awards from the NSF funding research infrastructure at Kean including a 130-node computer cluster that when first built was the fastest computer at a public institution in the state of New Jersey, and a 3-D immersive CAVE environment. Dr. Joiner received his Ph.D. in Physics from Rensselaer Polytechnic Institute in 1999.

Using Game Engines for 3-D Scientific Visualization

Dr. David Joiner

This research stream provides students with the opportunity to utilize computer programming and mathematical gaming theory to design and test novel applications to answer scientific questions. The goal of this research stream is to investigate how video game engines, which have a large user base and robust instructional materials, can be used to solve many of the same visualization problems as are currently done using scientific visualization software, while additionally picking up the features typical of game engines of a rich immersive experience and high levels of interactivity. Students will use the Unity Game Engine to build immersive and highly interactive data exploration environments.

Students should have some experience with computer programming in a C style language (C/C++, C#, Java).

About :

Bioinformatic Analysis of the Human Genome (tentatively offered Spring 2018)

(TBD)

The human genome is composed of approximately 3 billion nucleotide base pairs; yet less than 2% of these encode genes. The functions of the remaining 98% of the nucleotides comprising the genome are unknown and holds the key to further understanding of how genes are regulated, inherited and function in normal and disease processes. Bioinformatics is the study of genomes and how they are organized. In this research stream students will develop software tools using Java programming and will analyze genomic data using mathematical algorithms to identify new functional regions of human and microbial genomes.

Students with interests in, cancer, biomedicine, biotechnology, drug discovery, molecular biology and neurobiology may wish to consider this research stream. Prerequisites include statistics and Java programming.

RFI Student Learning Assessment Course Rubrics*

Course / Major Deliverable	Student Learning Assessment*	Track
GE 2024 Research & Technology	Communication Literacy; Information & Technology Literacy	RFI Minimal Requirement
STME 1903 Research Methods	Information & Technology Literacy Critical Thinking	RFI Minimal Requirement
STME 2903 Research Experience	Critical Thinking Quantitative Literacy	RFI Certificate
STME 3903 Advanced Research Experience	Critical Thinking Transdisciplinary Connectivity Quantitative Literacy	RFI Certificate
STME 4901, 4902, 4903 Independent Research	Critical Thinking Transdisciplinary Connectivity Quantitative Literacy	RFI Honors
Kean Research Days Poster **OR** Oral Presentation	Communication Literacy Critical Thinking Literacy	RFI Honors
Senior Honor's Thesis - Research Paper	Communication Literacy Critical Thinking Literacy	RFI Honors

The Student Learning Outcome Rubrics listed above are used to evaluate student progress and insure that the RFI experience focuses on the critical skill sets required of STEM career professionals. NJCSTM's SLO assessments are aligned with the competency requirements recommended by the National Science Foundation STEM Education Panel for students seeking employment or acceptance into advanced degree programs in STEM fields.

**SLOs subject to change depending on course content and skill requirements.*

SAMPLE

New Jersey Center for Science, Technology & Mathematics

Research First Initiative (RFI)

The Research First Initiative (RFI) provides undergraduate students with the opportunity to engage in broad-based authentic research experiences early in their academic careers. The RFI sequence of courses consists of a Research Methods/Scientific Inquiry course (STME-1903 – *NJCSTM students only*), followed by two Research Experience courses generally offered during the Spring semester of Freshman year (STME-2903 Research Experience) and the Fall semester of Sophomore year (STME-3903 Advanced Research Experience). The first Research Experience course provides students with the opportunity to apply proper research procedures and practice established protocols in a laboratory setting while the second course allows students to apply the research methods to advance the overall project. Students will join a research team and faculty mentor and learn to search and analyze research data and participate in research discussions and presentations. Course information, including descriptions of the research streams being offered during Spring 2017 are below.

**Students must complete an application and be accepted into a research stream before they are eligible to enroll in the course.*

Class size:	6 – 8 per section (limited)
Credit hours:	2.0 (STME 2903) & 3.0 (STME 3903)
Enrollment:	Open to qualified students by petition

Admission Requirements:

- Overall GPA of 3.0, with a 3.25 GPA in science or mathematics
- Interview with faculty stream leader(s) and/or RFI Admission Committee
- Highly Recommended: High School Advanced Placement course(s) in field related to RFI research stream (*i.e.*, Biology, Chemistry, Physics, Earth Sciences, Computer Sciences or Mathematics (Calculus)
- Flexible schedule and availability outside regularly scheduled class time, possibly including weekends.
- *Exceptions to above requirements subject to Faculty & RFI Admissions Committee review*

Summer 2017 Research Streams*

STME 2903-26 (Dr. Sal Coniglio): Cancer Mechanisms
STME 2903-36 (Dr. Heather Huby-Stokes): Drug Discovery STME 3903-36 (Dr. James Merritt) Drug Discovery

**Time/titles subject to change*

April, 2017

NJCSTM
New Jersey Center for
Science, Technology & Mathematics

KEAN UNIVERSITY

SAMPLE

New Jersey Center for Science, Technology & Mathematics

Research First Initiative (RFI)

Course Application

*Please submit this form by **Monday, March 27, 2017** to the NJCSTM main office (paperwork inbox) or email njcste@kean.edu. You should arrange an interview with the faculty member of the research stream you wish to join prior to submitting your application.*

Student Name:

Student ID Number:

Email Address:

Department:

Major:

Academic Standing: ☐ Freshman ☐ Sophomore

Kean University GPA *(not required for Freshmen)*: _____

1. Course Section / Research Stream (select one):

☒ STME 2903-26:	Dr. Sal Coniglio	sconiglsa@kean.edu
☒ STME 2903-36:	Dr. James Merritt	jmerritt@kean.edu
☒ STME 3903-36:	Dr. James Merritt	jmerritt@kean.edu

2. High School GPA: _____

3. Performance in High School and Kean Science Courses - Please list all science courses (including general, honors and AP level) taken in high school and include grade (if known):

4. Are you able to participate in Research activities outside of regularly scheduled class time, including possibly on weekends? ☐ YES ☐ NO

5. Have you completed an interview with the research stream faculty? ☐ YES ☐ NO

April, 2017

CNAHS STUDENTS - SAMPLE APPROVAL FORM

CNAHS Student Approval Form for Participation in the STEM Center's

Research First Initiative (RFI) Research Streams

Please be aware that if you participate in the STEM center's RFI experience by enrolling in either **STME 2903** OR **STME 3903** course sections that there are credit restrictions on how they are incorporated into the Biology Degree depending on Major. **BA Biology Degree: Only 4 credits from the RFI may be used to fulfill major electives. BS Biology Cell and Molecular: Only 6 credits from the RFI may be used to fulfill major electives. B.S. Biology Health Professions require all RFI credits to be used in the Free Elective area.** The credits will be substituted into your degree program as either a major elective or free elective based on the above restrictions and in discussion with your academic advisor.

For example, a BA Biology student that has done two sections of BIO 4963 would be required to use any credits from their RFI experience as free electives.

Enrollment in STME 2903 and/or STME 3903 require signatures from both your CNAHS Advisor and Executive Director or Coordinator from the respective program.

Student Name _____

Student ID# _____

Student signature: _____

CNAHS Faculty Advisor Name _____ Advisor Signature _____

Executive Director/Coordinator Signature _____

Please bring this form to Ms. Judy April for RFI registration