Tiera Guinn

NASA

Marie Curie

Radioactivity

Elizabeth Blackwell

First Woman Medical School Graduate

Maria Goeppert Mayer

Discovered Nuclear Shell of the Atomic Nucleus

Jennifer Doudna

Developed CRISPR

Rachel Carson

Environmentalist
Studied Pesticide Dangers

WOMEN IN SCIENCE

Jane Cooke Wright

Individualized Chemotherapy Treatment

Jane Goodall

Studied Chimpanzees, Animal Rights

Rita Levi-Montalcini

Discovered Nerve Growth Factor

Sara Seager

Contributed to the Modern Understanding of Space

Gertrude Elion

Drugs to Treat Leukemia & Prevent Kidney Transplant Rejection

Barbara McClintock

Discovered Genetic Transposition

Yeshiva University
STERN COLLEGE FOR WOMEN

Volume XVII
2022-2023

WOMEN IN SCIENCE

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STERN COLLEGE FOR WOMEN

Acknowledgments

Many were involved in creating volume 17 of Women in Science and appreciation is expressed to:

Dr. Amanda Katz, Clinical Assistant Professor at Stern College for Women, for advising and overseeing the production of this journal.

Dr. Harvey Babich, Department Chair of Biology at Stern College for Women, for inspiring and overseeing the creation of this publication and for his constant support and advice.

Dean Karen Bacon, the Mordecai D. and Dr. Monique C. Katz Dean of Undergraduate Arts and Sciences, for her support of the many programs and opportunities described herein that continue to empower Stern women in their pursuit of the sciences.

The student authors included in the abstract booklet of undergraduate research for their dedication to scientific research.

YU Undergraduate Admissions for cosponsoring the publication of this journal.

Elisheva Miller and Esther Miller, co-editors of the booklet of student scientific abstracts.

Hannah Bouaziz for the layout of this publication.

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Student Co-Editors

Elisheva Miller

Esther Miller

Layout Editor

Hannah Bouaziz

Introductory Remarks

At no other time in history has the commitment to rigorous and honest scientific research been as important as it is now. The COVID-19 pandemic of 2020-2021 not only illustrated how vital scientific progress is to humanity, but also how vital humanity is to scientific progress. While the past two years forced people apart and showed declined productivity worldwide, the students and faculty at Stern College for Women (SCW) came together to ensure that a top-notch STEM education was delivered, even if the delivery method was novel. SCW students, faculty and staff came together in person or on zoom to learn, to educate, to experiment and to grow, ensuring that the worldwide setback could still provide learning and growth opportunities for our students. Students benefitted from a faculty that quickly pivoted to zoom in March 2020 and pivoted again in August 2020 to provide hybrid lectures, as well as at-home and in-person labs. Our students participated in virtual and in-person internships, worked as EMTs and volunteered at local hospitals, at the university testing facility and at city-run vaccine clinics. Our students, faculty and staff continued to demonstrate a high level of commitment to academic rigor, combined with sensitivity and understanding to ensure that we progressed as best as possible through these trying times. As the rates of vaccination increased, we pivoted again to in-person learning, taking what we had learned from online and hybrid learning to ensure an even better student experience. As the world continues to benefit from scientific progress, we stand ready again to use our experiences from the past two years and apply them to the new future, where a solid STEM education combined with a high level of emotional intelligence is ever more important.

A STEM education at SCW prepares our students for varied careers in biomedicine, health, natural sciences, physical sciences, and behavioral sciences. The Departments of Biology, Chemistry/Biochemistry, Computer Science, Mathematical Sciences, Physics, Psychology and Speech-Language Pathology/Audiology, each unique in its specific discipline, share a proactive approach in promoting the academic and social/emotional success of students at SCW and in helping them achieve their career

goals. Our students leave SCW prepared for their graduate programs in medicine, dentistry, osteopathy, optometry, veterinary science, psychology, physical therapy, occupational therapy, physician assistant, nursing, genetic counseling, pharmacy, nutrition, speech pathology/audiology, education, social work, and law; masters programs in biotechnology, bioethics, public health, engineering, architecture, and bioinformatics; and doctoral programs in the biomedical sciences, computational biology, chemistry, physics, neuropsychology, clinical psychology, and school psychology. A science education at SCW is a stepping-stone to any career and a cornerstone of our students' success

The above-noted direct students to stretch beyond the classroom experience by involvement in scientific research. Both in the academic year and in the summer, students may work one-on-one with on-campus faculty. Beginning in the Summer of 2011, a collaborative interaction between Bar Ilan University and Yeshiva University enabled SCW and Yeshiva College (YC) undergraduates to intern in research laboratories in Bar Ilan University and, thereby, to spend a summer in Israel. In the summer 2022, 11 SCW undergraduates participated in this summer laboratory experience, now termed the YU/Bar Ilan Summer Research Program. The science faculties actively encourage the science majors to apply for competitive undergraduate research internships, locally, nationally, and internationally. Although the COVID-19 pandemic limited undergraduate summer research opportunities, many students overcame this obstacle. In the summer of 2022, an additional 17 SCW students were involved in research in a variety of laboratory facilities, including on-campus at SCW and Yeshiva College, and at Albert Einstein College of Medicine (AECOM), The Rockefeller University, Weill Cornell Medical College, Memorial Sloan Kettering Cancer Center, Hadassah University Medical Center, Icahn School of Medicine at Mount Sinai and the Health Careers Opportunity Program at the Rusk Institute for Rehabilitative Medicine, NYU. Undergraduates majoring in computer science received summer internships at Amazon Web Services. The pandemic put a damper on summer research internships, as SCW usually averages between 60-70 students accepted into summer undergraduate research internships.

The Jewish Foundation for Education of Women (JFEW) Fellowship Program now marks its fourteenth year, with over 120 graduates of the program. The JFEW Program was inaugurated in the 2009-2010 academic year, with a select group of ten participating students with interests in the sciences. Each subsequent year, an additional cohort of students joined the program. The 2017-18 academic year marked the first in which the JFEW Program was expanded to support both science- and liberal arts-focused students. Highlights of the JFEW Program include a partial scholarship, a stipend for a summer research internship, a stipend to support professional conference attendance, one-on-one mentoring by a faculty member, and an enrichment program that provides workshops on academic and professional development. Since its inception, JFEW Fellows have obtained internships in a variety of fields, including psychology, cancer cell biology, veterinary medicine, neurobiology, healthcare, molecular biology, computer science, biochemistry, and sociology. The fellows have interned in prestigious institutions, including the University of Chicago, Emory University, AECOM, The Rockefeller University, Johns Hopkins University, Harvard Medical School, Rutgers University, New York University, Yale University, Barrow Neurological Institute, Hadassah Hospital, Bar Ilan University, Weizmann Institute, Tel Aviv University, and in industry, Citromax. Several of the JFEW students have taken leadership roles in forming and/or leading the Neurobiology Club, the Genetics Club, the Optometry Club, and the Medical Ethics Society. Graduates of the program are currently pursuing careers in various science and health-related fields: medicine, dentistry, physical therapy, occupational therapy, nursing, public health, biomedical engineering, math education, food science, psychology, and veterinary medicine. The JFEW Program provides participants with, in addition to the above, a built-in network and support system of like-minded peers, graduates, and faculty.

The Department of Mathematical Sciences and the Department of Physics owe to the illustrious tradition in mathematics and physics at Yeshiva University, whose notable alumni and former faculty include Paul Dirac, Roger Penrose, Freeman Dyson, and Hillel Furstenberg. Today's B.A. program, M.A. program, and Ph.D.

program, continue offering a high-class education, providing preparation for careers in technology, finance, economics, business, or academia. A personalized curriculum, integrated research and training, and one-on-one mentoring are keys for our students' success. We also offer a variety of enrichment activities at SCW, including the math club, "No Limits", city wide seminars in Dynamical Systems and/or Mathematical Physics, and the Physics Colloquium. Graduates of our programs have been employed by Google, Goldman Sachs, Citigroup, Merrill Lynch, and Bank America, or pursued advanced degrees in physics, mathematics, engineering, computer science, and even law at Harvard, Yale, MIT, Princeton, Columbia, and New York University.

The mission of the Department of Computer Science is to prepare students for employment in various fields of computer science and/or to pursue advanced studies in computer science. In addition to covering fundamentals of Computer Science theory and practice, department courses help students maximize their portfolios of significant coding projects. The courses are structured to expose students to a variety of programming languages in a broad range of application areas. Students who complete this program should be well versed in the disciplines of object-oriented design and development, the architectures of software and hardware systems, the theory and practice of programming language technology, the construction and use of data structures and algorithms for the solution of large-scale computing problems, and the theory and application of database systems. There is a strong emphasis in the Department on preparation for challenging jobs in industry - our faculty and adjuncts come from positions of intensive industrial experience and leadership. Students in the department are involved in Computer Science outside the classroom - through an active ACM-W chapter, by participating in regional and national hackathons, and by working in internships at well-known firms, such as Google, Facebook, Microsoft, Palantir, Goldman Sachs, and many others. Honors students in our program work with faculty on computational research projects, preparing them for graduate level work, and/or prime industrial positions.

The Department of Psychology offers an Honor's Research Seminar for upper-level psychology majors. As part of this seminar, students are involved in ongoing research projects, either at SCW or at off-campus sites, such as the Ferkauf Graduate School, NYU Medical Center and Mount Sinai School of Medicine, among others, and are supervised by an on-site investigator for 6 hours/week for 12 weeks. The primary requirement for the course is a comprehensive literature review and/or scientific report of the students' research projects, as well as a class presentation. The combination of internship and seminar allows the students to gain practical experience in literature review, data collection and management, and scientific writing and oral presentations. Students attending graduate programs in Clinical Psychology have identified the research seminar as being particularly helpful in preparing them for graduate school.

To meet growing student interest in neuroscience, programs in neurobiology were instituted by a collaborative interaction between the Department of Psychology and the Department of Biology. In these programs, students complete a prescribed combination of courses in biology and in psychology (with each Department emphasizing its own requirements) and upon successful completion of the program, the designation "concentration in the neurosciences" is included on the college transcript.

The Speech-Language Pathology/Audiology Department provides the academic and pre-clinical experiences to begin graduate studies, either for an M.S. in speech pathology or a Ph.D. in audiology. As part of the "extra-curricular" activities of the Department, students edit, manage and publish a journal, reflecting either a unique research project or a literature review. The topics include speech language pathology, audiology, or speech and hearing science. Some students participated in a research project involving dysphagia and dysphonia associated with anterior cervical spine surgery. These students were part of a project conducted at the North Shore Hospital, reviewing patient data and research materials. The Speech-Language Pathology/Audiology Club hosted renowned professionals to address clinical experiences, research projects, and career issues.

A specific objective of the science departments at SCW, in addition to nurturing the highest level of academic achievement, is to provide students with opportunities for leadership roles. Upper-level students may be appointed to positions as Teaching Assistants (TAs) for laboratory sections and as Recitation Instructors or Peer Tutors to review materials for the lecture sections of the science courses. Student-led clubs, such as the Biology Club, the Chemistry Club, the Physics Club, the Physical Therapy Club, the Psychology Club, the PreMed Club, the PreDent Club, the Occupational Therapy Club, the Pharmacology Club, the Nutrition Club, the Global Health Club, the Pre-Engineering Club, the Nutrition Club, the Bikur Cholim Club, *etc*., provide opportunities for students to gain skills in organizing events and in coordinating social functions. The 2010-2011 academic year saw the birth of four new clubs, the Nursing Club, the Genetics Club, the Optometry Club, and the Neuroscience Club. The Public Health Club was launched during the 2011-2012 academic year; beginning in the fall semester 2016, the college instituted a minor in public health. The Physician Assistant Club was started in the 2012-2013 academic year to spur interest in an increasingly popular field. These Clubs often invite outside speakers to lecture and to conduct question-and-answer sessions on a variety of interesting topics. Due to the pandemic, in-person events were cancelled after March, 2020, but the clubs rose to the occasion by organizing informative Zoom events and webinars. The Nursing Club has in the past held a number of particularly well-attended events, including an information session with admissions officers from the nursing programs at Columbia University, Fairleigh Dickinson University, NYU and Pace University. It later organized a guided tour of the NYU College of Nursing. The Nursing Club also held a joint information session with the Physician Assistant Club in December 2018. The Occupational and Physical Therapy Clubs likewise joined forces during the fall 2018 semester to run a career panel of Stern alumni in their respective fields. In February 2019, the OT Club invited Nicolaas van den Heever, the founding director of the new Yeshiva University Occupational Therapy Doctorate (OTD) program, to speak about this exciting new program at the Katz School of Science and Health. In May 2021, the Physician Assistant Club organized a well-attended webinar with

Sharon Verity, the director of the new PA program at the YU Katz School. These student-run clubs provide students with the opportunity to develop the social and professional skills needed to succeed in their future careers and provide networking opportunities with Stern College alumni already in the field. The YU Career Center plays a vital role in carrying out this goal and organized a well-attended Allied Health Fair in April 2019, at which Stern alumni from the aforementioned professions provided guidance and counsel to current students interested in these fields. In April 2021, the Career Center conducted a virtual career panel with Stern alumni from the fields of nursing, occupational and physical therapy and physician assistant. In December 2021, the Stern College Nursing and Physician Assistant Clubs held a joint event in which Stern alumni working as nurse practitioners and physician assistants spoke about the differences and similarities between their chosen professions. The YU Katz School held a virtual information session in March 2022 to introduce the exciting new Early Assurance Program for Stern College students applying to their graduate programs in occupational therapy, physician assistant and speech-language pathology.

SURGE, the Student Undergraduate Research Group Exchange, is a faculty-sponsored, student-led club that gives students the forum to present their research as a seminar before their peers and the science faculty. The goals of this faculty-initiated club are to encourage and foster research and the exchange of research information. Meetings are held once a month, usually with two or three students presenting PowerPoint professional seminars. Faculty members also use these meetings to inform students of upcoming internships and fellowship opportunities. Because of the COVID-19 pandemic, SURGE meetings were suspended in the 2020-2021 academic year. After a hiatus in 2020-21 due to the COVID-19 pandemic, SURGE meetings resumed for the 2021-2022 academic year. The meetings featured student presenters as well as a guest speaker, Nobel laureate Dr. Harvey Alter, who played an integral role in the discovery of Hepatitis C.

Each Fall semester, the science departments jointly sponsor a research poster competition in which students present their work.

The posters, and more importantly the student's understanding of her project and the extent of her hands-on participation, are evaluated by the science faculty and winners are selected to present at a national meeting of the American Chemical Society. The costs of attending the meeting, including transportation and hotel, are underwritten by the Dean's Office, SCW, and by faculty research grants.

The SCW Chemistry Club, a student affiliate chapter of the American Chemical Society (ACS), was awarded a Community Interaction Grant from the ACS for recent academic years. The funded proposal described a continuation of educational outreach activities at an elementary NYC public school on the Lower East Side. In the Fall semester, 2022, the ACS awarded the SCW Chemistry Club the Commendable Chapter Award for its activities. Participation in the SCW Chemistry Club, and affiliation with the undergraduate programs office at the ACS, provides our students with invaluable experience in grant proposal writing, budget allocation, and grant reporting activities.

SCW graduates attending AECOM for their medical education are eligible to apply for Anne Scheiber Fellowships. This unique award provides up to full tuition scholarships based on need for four years of medical training (see "Anne Scheiber Fellowship"). This award has been granted to over 150 graduates of SCW.

Students considering careers in the various allied health fields (for example, occupational and physical therapy) or in engineering may wish to consider the YU Pathways Program or one of our several combined degree programs with other universities.

SCW undergraduates may participate in Yeshiva University's Pathway Programs designed to streamline their educational progression to graduate school, including the Katz School of Science and Health and the Ferkauf Graduate School of Psychology, among others. Two Pathway Programs are offered: (a) the Dual Degree Program and (b) the Early Assurance Health Science Programs.

In the Dual Degree Program, in their junior or senior year, SCW undergraduates can begin taking graduate level courses which count both towards their bachelor's undergraduate and master's graduate degrees. The programs specifically relevant to STEM undergraduates include Artificial Intelligence, Biotechnology, Cybersecurity, Data Analytics, Math, Mental Health Counseling, and Physics.

The Early Assurance Health Science Programs gives SCW undergraduates in their junior year the opportunity to secure a spot in the graduate program of their choice. The graduate programs in the Katz School that are participating in the Assurance Program include Occupational Therapy (doctorate), Physician Assistant (M.S.) and Speech-Language Pathology (M.S.). Information on both Pathway Programs is on the web: https://www.yu.edu/pathways.

During the fall of 2010, Stern College signed an articulation agreement to implement a combined program with the NYU Rory Meyers College of Nursing. Students interested in this program pursue a shaped major that leads to the completion of the necessary prerequisites within five semesters for those who study for a year abroad in Israel (or seven semesters for those who come directly to Stern College after high school). If they are accepted to the program, they receive a B.A. from Stern College upon completion of their first semester at the NYU Rory Meyers College of Nursing. Once they have successfully completed the 15-month accelerated program at NYU, they are awarded a BSN from their nursing school. This excellent new program has already admitted more than ten classes of SCW students and has been the basis of a productive and long-term partnership between Stern College and the NYU Rory Meyers College of Nursing" (see "Combined Programs"). The most recent class of 14 admitted students, entered NYU via the joint program in January, 2022. A new group of 15 students has already begun the application process to enter NYU in January 2023.

For students interested in nutrition, a shaped major option exists. Students in their senior year may take up to 12 credits in approved nutrition courses at NYU towards their shaped major. These courses will also count toward the DPD sequence

requirements at NYU should the student continue in that program after completing her BA degree.

An important focus of SCW is to educate the next generation of Jewish women for leadership positions in their professions and communities. Our commitment to the YU mission of *Torah U'Madda* is mirrored in the daily lifestyles of our students and thereafter in their future roles as professionals. Stern College students have academic strengths in both general and Jewish studies; the fusion of these worlds is evident in the student publication, *Derech HaTeva, a Journal of Torah and Science*. This SCW publication is distributed nationally and internationally and has received much praise for its level of Torah/science scholarship (see "*Derech HaTeva,*" for a listing of articles that appeared in volumes 1 through 26).

Specific faculty members are assigned roles to provide an intensive involvement in guiding students with their career choices and specifically in assisting with the application process. Dr. Brenda Loewy, director of the Office of Pre-Health Advisement, has been joined by Dr. Chaya Rapp, to assist those students interested in careers in medicine, dentistry, optometry, veterinary medicine, and pharmacy. Mr. Jeffrey Mollin's focus is those students interested in careers in physical therapy, occupational therapy, physician assistant, nursing, and nutrition and Dr. Harvey Babich assists those interested in a career in genetic counseling.

In the Fall semester, 2012, SCW alumni, who were then medical students in AECOM, initiated The Stern-Einstein Mentorship Program (affectionately known as the "Big Sister Mentor Program"). The intent of this program was to connect pre-med or pre-health undergraduates with SCW alumni at AECOM, who will guide the undergraduates in the medical school application and interview processes, as well to be available to answer simple questions that will save time and prevent unnecessary frustration. The program is greatly appreciated by our undergraduates.

Dr. Loewy organized several seminars in which the guest speakers provided valuable insights into the various professions, as well as information on the admissions process to their graduate and

professional programs. For several years SCW and Yeshiva College (YC) pre-med clubs organized an annual Medical/Dental School Fair in which admission directors and officers from allopathic and osteopathic medical schools, as well as from American medical student programs in Israel, and Dental Schools and Pharmacy Schools attended. After two years of hiatus, due to the COVID pandemic we were able to reinitiate the 8th annual fair. This was the first time we held the event virtually. Schools were able to choose a fifteen-minute presentation slot within the three hour time frame of the fair. During this time, the schools were given the opportunity to present to students, as well as answer students questions. There was a moderator filtering the virtual chat for questions, as well as presenting questions submitted in advance by students to the presenting school. The fair was a great opportunity for the students to learn more about the various schools and learn about what unique attributes each school has to offer as well as the details pertaining to the application process.

The following schools attended the fair this past year.
Philadelphia College of Osteopathic Medicine
Upstate Medical University
Touro College of Pharmacy
American Medical Program-Sackler
Temple University School of Podiatric Medicine
NYITCOM
Ben Gurion University Medical School for International Health
Zucker School of Medicine at Hofstra/Northwell
Boston University Henry M Goldman School of Dental Medicine
Touro College of Osteopathic Medicine
Rutgers Robert Wood Johnson Medical School
Touro College of Dental Medicine
NYU College of Dentistry
Rowan University School of Osteopathic Medicine

The fair has become an invaluable opportunity for our students to learn about pursuing a medical/dental education and career

In the 2011-2012 academic year, Dean Karen Bacon initiated the “Deans' Scholars Academic Enrichment Program.” This Program

offers those outstanding students in Yeshiva University's undergraduate schools an opportunity to participate in one of three cooperative programs. The program of particular interest to science majors is the “Frontiers in Biomedical Science: Theory and Practice.” This project is under the direction of Dr. Edward Burns, Executive Dean of the Albert Einstein College of Medicine. The seminar meets six Fridays during the semester at AECOM and features leading biomedical scientists and their research. A second program, “Frontiers in Contemporary American Law," is under the direction of Dean Melanie Leslie of Yeshiva University’s Benjamin N. Cardozo School of Law. This exciting enrichment program meets at Cardozo School of Law six Fridays during the Spring semester for two hour sessions and is led by Cardozo faculty. Scholars discuss the ways that the U.S. legal system resolves disputes and addresses fundamental questions of justice through legal reasoning and processes. The third program is Frontiers in Psychology. This enrichment program, organized in conjunction with Dean Lawrence Siegel of Yeshiva University’s Ferkauf Graduate School of Psychology, is an undergraduate program at the Ferkauf Campus. Scholars attend two-hour Friday seminars six times during the semester, led by Ferkauf faculty during the Fall semester on campus. The program aims to expose students to a spectrum of fields and specialties within psychology and to show students how the field’s practitioners evaluate and address current societal issues using the science of psychology.

Department of Biology

Faculty: Anya Alayev, Ph.D.; Harvey Babich, Ph.D.; Bill Bassman, M.S.; John Golin, Ph.D.; Amanda Katz, Ph.D.; Brenda Loewy, Ph.D.; Jeffrey Mollin, M. Phil.; Jennifer Odien, Ph.D.; Alyssa Schuck, Ph.D.; Margarita Vigodner, Ph.D.; Richard Weiss, M.D.

The Department of Biology offers a wide range of courses providing students with a thorough grounding in the fundamentals of modern biology, as well as exposing them to the cutting-edge areas of biomedical research. Course offerings include The Biology of Public Health, Cancer Biology, Cell Biology, Genetics, Human Anatomy, Human Development, Human Physiology, Immunology, Kinesiology, Medical Biochemistry, Microbiology, Molecular Biology, Musculoskeletal System, Neurobiology, Nutrition, Pharmacology, and Reproductive Biology, as well as Journal Club.

The Biology Department offers 3 tracks leading to a B.A. in Biology. Track #1 is the traditional course load for a B.A. in biology and requires completion of Principles of Biology I and II and 20 credits of advanced courses in Biology, of which four of the courses must be 4-credit lecture/laboratory courses. Also offered by the Biology Department are rigorous programs focusing on a "concentration in molecular and cellular biology" (track #2) and on a "concentration in neurobiology" (track #3). Upon completion of the appropriate track of study, either the phrase "concentration in cell and molecular biology" or the phrase "concentration in the neurosciences" is noted on the college transcript. To accommodate the science requirements for non-science majors, the 3-credit course, Human Genetics, is offered. Beginning in Spring semester, 2015, a Journal Club course was incorporated into the offerings in the Biology Department. Journal Club courses are taught by Stern alumni, usually 4th year medical students at Albert Einstein College of Medicine (AECOM) or doctoral students in the Ph.D. program at Sue Golding Graduate Division of Biomedical Sciences, AECOM.

The topics of the Journal Club course are varied and have included "Infectious Diseases and Vaccinations," "Preventive Medicine," "Women's Health: Epidemiology Studies," "Oncology," "Immunology and Disease," and "Biomechanics."

Dr. Brenda Loewy, a faculty member of the Biology Department and the recipient of the 2008, Dean Karen Bacon Award for a Senior Faculty Member, is the college's Pre-Health Advisor. Her directive is to guide students interested in medicine, dentistry, optometry, podiatry, and veterinary medicine through the application process. To accomplish these goals, Dr. Loewy organizes a series of wide-ranging seminars. The overwhelming number of students interested in medicine, dentistry, and optometry, necessitated the recruiting of Dr. Chaya Rapp, Department of Chemistry and Biochemistry, to join the **Office of Pre-Health Advisement**. An important addition to the pre-health advisement staff was the appointment of Mr. Jeffrey Mollin, a member of the Biology Department, to guide students with career goals in nursing, physical therapy, occupational therapy, physician assistant, and nutrition. Mr. Mollin was the recipient of the 2017 Dean Karen Bacon Award for a Senior Faculty Member. Dr. Harvey Babich guides those undergraduates interested in a career as a genetic counselor. Dr. Alyssa Schuck, faculty member of the Biology Department, heads the **Jewish Foundation for Education of Women (JFEW) Science Fellowship** and guides students participating in this program.

Volume 26 of ***Derech HaTeva, A Journal of Torah and Science*****,** was published in the Spring semester, 2022. This issue included manuscripts authored by 12 undergraduates, as well as the article, "*Adom HaRishon* and his Contemporaries - Soulless Humanoids," vol. 26, pp 47-52. In the Spring semester, 2019, Dr. Babich was a recipient of the Senior Class Professor Award of graduating class of May, 2019 and of the Professor of the Year Award, May, 2022.

Faculty of the Biology Department initiated the **Emergency Medical Technician Training Program** for pre-health SCW and Yeshiva College (YC) undergraduates, along with the formation of the SCW-EMS and the YU-EMS. An $8,000 scholarship is awarded

to students in need of financial assistance. The EMS is operating as an extension of *Ezras Nashim* volunteer emergency response service; the on-campus EMS became operational May, 2019.

Dr. Margarita Vigodner, Professor of Biology, and Dr. Anya Alayev, a Clinical Assistant Professor of Biology, have put the Biology Department on the "research map," as attested by their record of **publishing scientific research manuscripts** in prestigious scientific journals. Dr. Vigodner holds a secondary appointment at the rank of Assistant Professor in the Developmental and Molecular Biology at AECOM. Dr. Alayev is the Department's adviser to the Molecular Biology Club.

Dr. Vigodner's past research support included the NIH, NICHD: Academic Research Enhancement Award 1R15HD067944-01A1; "Regulation of Spermatogenesis by sumoylation;" extended until 1/11/2015 as an NIH; NICHD Administrative Supplements to Recover Losses Due to Hurricane Sandy. Through support by the Mitrani Foundation, in the Summer, 2015, the Vigodner laboratory was fully renovated. In addition, the Mitrani Foundation provided a small grant to support student research. **In June, 2019, the Biology Department was extremely proud to congratulate Professor Vigodner on receiving a 3-year R15 grant in the amount of $450,000 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development.** The title of the research project is **"Cell-type specific inactivation of sumoylation during mouse spermatogenesis."** This grant was extended for 2022-2023 with a supplement received in July of 2022. Dr. Vigodner has also received a faculty research award from YU to support undergraduate students in 2021 and with Rana Khan in 2022. In the Fall semester, 2018, Dr. Vigodner was awarded the Doris and Ira Kukin Chair in Biology. In 2020, Dr. Vigodner authored the manuscript, "Identification of sumoylated targets in proliferating mouse spermatogonia and human testicular seminomas, *Asian J. Urol*., 22:569-577. T. Schwartz and R. Levy, SCW undergraduates, were listed as coauthors. In 2021, the Vigodner lab published "Sumoylation and

its regulation in testicular Sertoli cells," coauthored by Sengupta, A., Nanda, M., Tariq, S.B., Kiesel, T., Perlmutter, K., and Vigodner, M., *Biochem. Biophys. Res. Commun*., 580:56-62. T. Kiesel and K. Perlmutter are SCW undergraduates.

Dr. Vigodner serves as NICHD Ad Hoc Reviewer since 2016, and a Reviewer for Nature Protocols, Development, Human Reproduction, FASEB, Toxicology Letters, Andrology, Gene (ELS), Theriogenology Insight, and other journals. She also serves as a Chair of the Membership Committee of the American Society of Andrology since 2021.

Dr. Anya Alayev oversaw the NIH grant, **1R15CA220021-01: "Targeting estrogen related receptor alpha in triple negative breast cancer.** At the 2021 AACR annual meeting, Dr. Alayev presented an abstract of her research, "Ras-Raf-MEK-ERK signaling pathway: A novel target of ERRα and tamoxifen in TNBC cells," coauthored with Dr. David Musheyev and the SCW undergraduates, Adi Ronen, and Miriam Lattin. Recently, Dr. Alayev received notification that her manuscript, "Endocrine therapy resistance: What we know and future directions," coauthored with Dr. Musheyev, was accepted for publication in *Explor. Target Antitumor Ther.* (2022). Dr. Alayev is on the advisory board for the Jewish Orthodox Women's Medical Association (JOWMA) and is the Chair of JOWMA's peer-review committee.

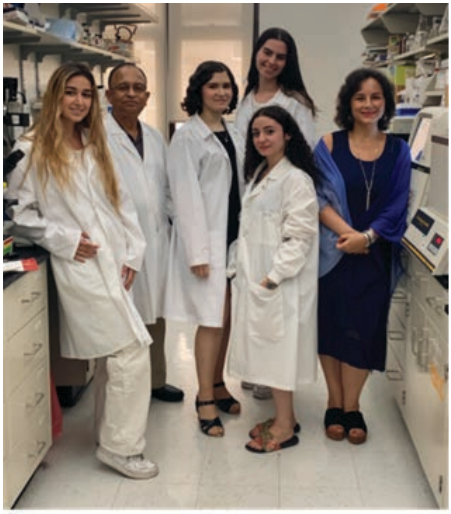
Dr. Alyssa Schuck's research interests involve the response of human oral cancer cells to nutraceuticals, with numerous students participating and developing skills in handling human cells in culture. Dr. Schuck was selected as the Senior Class Professor of the Year, 2013, 2014, 2016, 2018, and 2022 and received the Professor Recognition Award for General Studies in May, 2019. In 2016, Dr. Schuck received the Dean Karen Bacon Faculty Award. In the summer, 2022, Dr. Schuck developed and taught a novel 2-credit college course in biological laboratory techniques for students from Manhattan H.S. for Girls.

Dr. John Golin, recently joined the Biology Department as adjunct faculty, teaching Human Genetics, a 3-credit course tailored to non-science students. The course has received rave reviews. More recently, Dr. Golin published the manuscript, "How fungal transporters mediate hyper-resistance through DNA amplification and mutation," coauthored with Banerjee, A., Rahman, H., Prasad, R., in *Molecular Microbiology* (2022), Doi.10:1111/mini.34947.

In response to the COVID-19 pandemic stimulating student interest in a career in public health, Dr. Amanda Katz developed the course, The Biology of Public Health. This course, in conjunction with her other course, The Biology of Cancer, bolsters the course offerings for a minor in Public Health.

Dr. Richard Weiss, M.D., directs YU's new, joint initiative with AECOM, 'YU/AECOM BA/MD Scholars Program, in addition to his regular courses in the Biology Department. Earlier this year, Rabbi Dr. Weiss presented a lecture, 'Contraception in Halacha,' as part of the Medical Halacha Course at Lander College for Men and authored 'Passover Seder Priorities for Health Care Professionals,' in the *Pesach Torah Journal, National Council of Young Israel,* 2022, vol. 2, pp. 42-45.

Drs. Vigodner, Alayev, and Schuck actively recruit SCW undergraduates to join their on-campus research. The focus on cutting-edge research by the Biology faculty has been the driving force in the publication of numerous manuscripts in peer-reviewed scientific journals. The college has confidence in the continued excellence of its research faculty and has recently invested funds for purchase of a camera for Dr. Vigodner's epifluorescence Nikon microscope, a Biorad gel documentation station, a flow cytometer, and a GloMax® navigator microplate luminometer. For the Alayev lab, the following items were purchased: an upright freezer, a sliding door refrigerator, an upright fridge/freezer, an Eppendorf 4ºC benchtop centrifuge, and a Keyence microscope with fluorescence.



The Vigodner lab (summer, 2022): Noam Levy (UC - Irvine), Dr. Amitabha Sengupta (post-doc), Shaina Matveev (SCW), Amanda Shalumov (SCW), Sara Chemel (SCW, back), and Dr. Margarita Vigodner (PI).

Student research presentation seminar (7/7/2022). Under the initiative of Dr. Vigodner, students from the Drori lab (Yitzhar Shalom), Steinhauer lab (Samuel Intrator, Eliezer Heller), Zypman lab (Yonathan Magendzo, Benjamin Goykadosh), and Vigodner lab (Sara Chemel, Noam Levi, Shaina Matveev, and Amanda Shalumov) presented their research before faculty and students from SCW and YC.

Department of Chemistry and Biochemistry

Anderson de Oliveira, Ph.D., James Camara, Ph.D.; Ran Drori, Ph.D; Donald Estes, Ph.D.; Jianfeng Jiang, Ph.D.; Chaya Rapp, Ph.D.; Rosalyn Strauss, Ph.D.

In keeping with the approach to science education at SCW, the Department of Chemistry and Biochemistry offers a series of high-level courses, opportunities for undergraduate research, and extracurricular programming to foster an enthusiasm for science and an interest in scientific research. The Department of Chemistry and Biochemistry offers two possible majors, Chemistry and Biochemistry.

Graduates of Chemistry and Biochemistry majors have gone on to medical, dental, optometry, and law schools, and careers in science education. Several have entered prestigious Ph.D. programs in the biomedical sciences, at the Tri-institutional Weil Cornell/Rockefeller/Sloan Kettering program, Sloan Kettering graduate program, and the Sue Golding graduate division of the Albert Einstein College of Medicine (AECOM).

The courses in our department are continuously being updated to keep pace with current scientific discovery and new technology. The general chemistry lab was recently revised and is now a one semester, 2 credit course (CHEM 1047L) including pre-lab videos and quizzes offered over Canvas. Formal lab reports are required giving students experience in scientific writing. A course called Biochemistry and Molecular Biology was added to the Biochemistry major to provide students with a more focused and thorough background in Biochemistry. Finally, a new research-based course, Biophysics, was added to departmental offerings for our majors. Students learn principles of biophysics through lectures and research, with a focus on designing and conducting experiments, analyzing results, and presenting their work in oral and written presentations. Eight students are registered in Biophysics in the fall semester and will work in the Drori and Oliveira labs.

Courses in analytical chemistry and biochemistry incorporate experiments that are related to the instructors' research interests allowing content to be taught in the context of current, cutting edge, and biologically relevant research. State of the art instrumentation including a nuclear magnetic resonance spectrometer, an automatic titrator, a multimode plate reader, data acquisition software and probes, and molecular modeling software, have been integrated into laboratory courses on all levels so that our students are trained in the use of current laboratory technology. The department also offers a Science Fundamentals course which is popular among students pursuing education or business degrees, and a Chemistry for non-majors course which serves students entering the allied health fields. These courses focus on chemistry as it relates to the world around us and contemporary environmental issues.

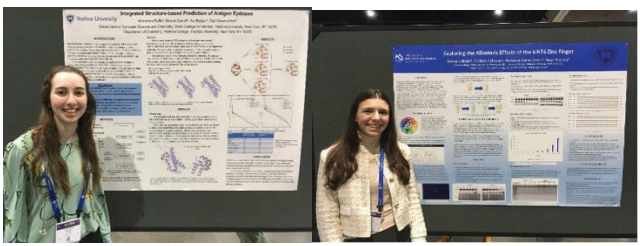
Video shooting in the Drori lab, August 2022.

The Drori laboratory's mainfocus is the study of ice-binding proteins (or antifreeze proteins), which aid a variety of organisms to survive in subfreezing temperatures. A unique combination of sensitive temperature control and a fluidic system allows for the cutting-edge capability to study the interaction of molecules with microscopic ice crystals. The lab has recently awarded a research grant from the USDA to develop ways to improve the quality of frozen food. A novel technique that combines thermal imaging and temperature control will provide a unique tool to study frozen food. A master's student in the lab (Yitzhar Shalom) has graduated with an MA in Physics, and has participated in a video article (Journal of Visualized Experiments) to be published soon (see picture from the filming day in August 2022). Another student (Eliana Lebowitz) was involved in a book chapter titled "Investigating the interaction

between ice-binding proteins and ice surfaces using microfluidic devices and cold stages" to be published later this year. Finally, a new postdoctoral researcher, Dr. Martin Zalazar, will join the Drori lab in September 2022.

A new faculty member, Anderson Garbuglio de Oliveira, has joined our department and has started setting up a research lab studying the fundamental understanding of bioluminescent systems' molecular mechanism and the direct application of the isolated luciferases and photoproteins as reporters in analytical detection systems, imaging, diagnostics and in preclinical trials of pathologies. Projects, in which students will be involved, will use genetic engineering to enhance the properties of new isolated luciferases and photoproteins, such as detection limits, thermostability, and modulation of spectral emission, creating more efficient luminescent proteins for a range of non-invasive studies and applications.

The department supports extra-curricular activities that enhance student interest and appreciation of chemistry and science in general, both on campus and in the broader community. The Stern College Chemistry Club is a student affiliate chapter of the American Chemistry society and is advised by Don Estes and Chaya Rapp. The club received a Commendable Chapter Award for its 2020-2021 activities from the American Chemical Society. In addition to hosting several events on biochemistry, the club's theme for the year, the club members hosted a virtual career panel discussing careers in industry and research for chemistry/biochemistry majors. In addition, two student members, Leeba Sullivan and Alexandra Roffe, attended the national ACS meeting in San Diego and presented posters at the undergraduate research session. Below is Alexandra and Leeba with their posters at the conference.

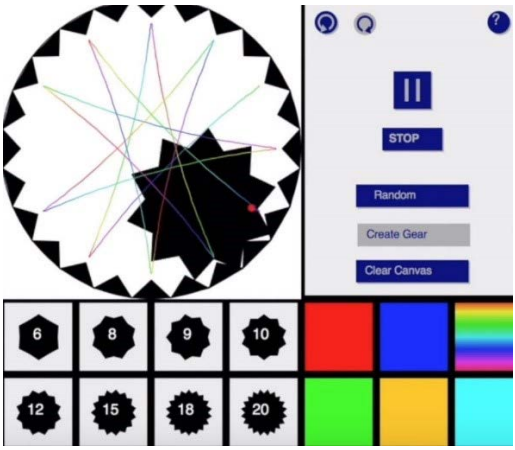


Department of Computer Science
Chair: Alan Broder, Clinical Professor
Joshua Waxman, Assistant Professor
Ari Shamash, Adjunct Assistant Professor
Lawrence Teitelman, Clinical Assistant Professor

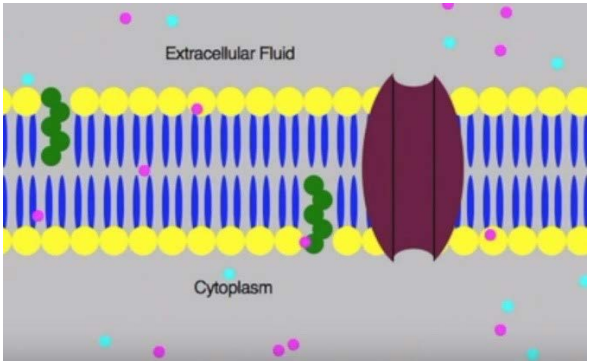
The Computer Science program at Stern College for Women stresses both the practical and theoretical aspects of computing, preparing students for employment in various fields of computer science and to pursue graduate studies. There is a strong emphasis in the department on preparation for challenging jobs in industry – our faculty and adjuncts come from positions of intensive industrial experience and leadership. In addition to covering fundamentals of Computer Science theory and practice, the department strives to help students maximize their portfolios of significant coding projects, via course requirements and through extracurricular activities such as hackathons and internships.

For highlights of a few notable semester capstone projects from our COMP 1300 – Introduction to Computer Science course see the screen shots below, and the video at http://demoreel.sterncs.net/

While these projects seem to be just games, the video demonstrates how much can be accomplished in just a first semester of CS. The semester projects are an inspirational stepping stone to further CS learning, and indeed many of our COMP 1300 students move on to more advanced learning and majoring in Computer Science.



Spirograph Simulator
Tzirliya Plotkin



Simulation of Diffusion Across a Cell Membrane
Tova Narrowe

In the CS degree program, students gain experience with a variety of programming languages including Python, Java, Javascript, R, Go, and C/C++, while learning how to develop applications for Linux, web, and cloud platforms such as Hadoop and Spark.

In 2018, the CS department was the recipient of major private and public grants to build a collaboration lab and technology classrooms for Computer Science students at the Beren campus. The new spaces, operational in the Fall of 2021, emulate similar collaboration spaces in top technology companies, including floor-to-ceiling writable and projectable glass walls, flexible furnishings, and large screen displays.

The new Mitrani collaboration lab – Fall 2021 (architect rendering)

Stern's Computer Science program is ideally situated near the heart of Manhattan's "Silicon Alley", convenient to recruiters from major financial and tech employers. Stern Computer Science students have recently been sought and hired for internships and post-graduation employment by premiere employers such as Microsoft, Palantir, Facebook, Goldman Sachs, Amazon, Naval Research Laboratory, MITRE, JPMorgan, UBS, Nomura, Avvir, TD Bank, Broadridge, Avanade, and Google.

The department also offers the Professor Thomas Otway Memorial Scholarship for exceptional students who choose Computer Science as their major, established in memory of the beloved Professor.

Students in the department run a chapter of ACM-W, the international Association of Computing Machinery - Women's division. In 2019, Stern ACM-W members ran a "tech Shabbat" bringing together CS students and Stern faculty for community building and tech-themed Torah learning. Stern students are key members of the operation of the city-wide Invent YU hackathon, and have also been participants in the nationwide jHacks hackathon held at the University of Maryland Hillel.

The ACM-W chapter also offers frequent events throughout the year, such as guest lecturers by computer scientists from prominent companies, resume workshops, networking events, and coding practice sessions. Stern CS students are committed to helping other women develop as computer scientists, and frequently serve as peer tutors and teaching assistants in the department, they volunteer at local high schools, and are leaders of high school tech events.

High-achieving students in the S. Daniel Abraham honors program will also benefit from an enriched CS educational experience. As part of the honors program, students complete an honors research program and thesis with the mentorship of a CS department faculty member.

Department of Physics, Stern College for Women
Mark Edelman, Ph.D., Clinical Associate Professor
Emil Prodan, Ph.D., Professor
Lea Ferreira dos Santos, Ph.D., Professor

The Physics Department at Stern College for Women (SCW) aims at educating its students of education through research. All faculties pursue an active research agenda, being constantly invited to present their findings in conferences and workshops, and having their articles published in prestigious scientific journals. Their works have been highlighted on several occasions and awarded major research grants. The exposure to such cutting-edge science and the atmosphere of discovery both play a major role in the formation of our undergraduate students and their future career plans.

Stern College students who are interested in physics, physical sciences or engineering have several opportunities to actively participate in faculty research. The Physics Department is always seeking new students interested in doing first class research. They can choose from a variety of projects and work under the guidance of the physics department members. Stern physics students undertake research during the summers and throughout the year. They are co-authors in refereed articles published in physics, chemistry, and materials science journals, and they present their results at national and international science meetings.

Below are the highlights of our Physics Department (2021-2022):

Summary of Research (2021-2022)

4 NSF grants: US$ 1,380,958.00
26 peer-reviewed articles
46 invited talks + 1 contributed by Stern students + 1 contributed talk by postdoc
2 organized conferences
1 postdoctoral fellow
6 research undergraduate students (4 Stern + 1 Yeshiva College + 1 Queens College)
2 Kressel scholars

(a) Dr. Mark Edelman

2021-2022 Yeshiva University Faculty Research Fund grant:

"Stability and chaos in systems with memory and evolution of aging".

1) M. Edelman, "Cycles in Asymptotically Stable and Chaotic Fractional Maps", Nonlinear Dynamics, https://doi.org/10.1007/s11071-021-06379-2, 2021; arXiv:2010.12924.
2) M. Edelman, "Comments on A note on stability of fractional logistic maps, Appl. Math. Lett. 125 (2022) 107787", App. Math. Lett. 107892 (2022); https://doi.org/10.1016/j.aml.2021.107892
3) M. Edelman and A. B. Helman, "Asymptotic cycles in fractional maps of arbitrary positive orders", Fract. Calc. Appl. Anal. (2022). https://doi.org/10.1007/s13540-021-00008-w

Invited talks

1. July 24-26, 2021, ICVE 2021, 8th International Conference on Vibration Engineering. Invited talk. "Asymptotically cyclic sinks of fractional maps".
2. Jun 14-17, 2022; 13th CHAOS 2022 International Conference, Athens, Greece, http://www.cmsim.org/chaos2022.html, Co-Organizer of a special session Fractional Dynamics; "Asymptotically periodic points in arbitrary positive order fractional maps" (Two talks, chair of two sessions). Talks: "Stability of the Fixed Points in Low Order Fractional Maps" and "Asymptotically Periodic Points in Arbitrary Positive Order Fractional Maps".

Editorial Boards

Fractional Calculus and Applied Analysis
Journal of Applied Nonlinear Dynamics.
Communications in Nonlinear Science and Numerical Simulations.
Fractal and Fractional

Students involved in research

1. Avigayil Helman

(b) Dr. Emil Prodan

External funding

Funder: National Science Foundation (DMR 1823800)
Period: **01/09/2019-01/09/2022**
Title: **Topological Aperiodic Materials and Meta-Materials**
Amount: **$378,000**

Funder: National Science Foundation (NSF CMMI-2131760)
Period: **01/11/2021-01/11/2024**
Title: **Topological Dynamics of Hyperbolic and Fractal Lattices**
Amount: **$277,958**

Peer-reviewed articles

(total of 8 published articles, 1 Communications Physics, 1 Nature Communications)

8. Y. Liu, L. F. Santos, E. Prodan, Topological gaps in quasi-periodic spin chains: A numerical and K-theoretic analysis, Phys. Rev. B **105**, 035115 (2022).

7. B. Mesland, E. Prodan, A groupoid approach to interacting fermions, Commun. Math. Phys. **394**,143–213 (2022).

6. E. Prodan, Topological lattice defects by groupoid methods and Kasparov's KK-theory, J. Phys. A: Math. Theor. **54**, 424001 (2021).

5. W. Cheng, E. Prodan, C. Prodan, Revealing the boundary Weyl physics of the four-dimensional Hall effect via phason engineering in metamaterials, Phys. Rev. Applied **16**, 044032 (2021).

4. M. Ruzzene, E. Prodan, C. Prodan, Dynamics of elastic hyperbolic lattices, Extreme Mechanics Letters **49**, 101491 (2021).

3. H. Chen, H. Zhang, Q. Wu, Y. Huang, H. Nguyen, E. Prodan, X. Zhou, G. Huang, Physical rendering of synthetic spaces for topological sound transport, Nature Communications **12**, 5028 (2021).

2. M. Rosa, M. Ruzzene, E. Prodan, Topological gaps by twisting, Communications Physics **4**, 130 (2021).

1. E. Prodan, Fermionic Topological Order on Triangulations, Annals of Henri Poincare **22**, 1133–1161 (2021).

Organized conference

1) "C*-algebras, K-theories and Noncommutative Geometries of Correlated Condensed Matter Systems," Simons Center for Geometry and Physics (May 2021).

Invited talks

12. 'Applications of K-Theory in Materials Science', online lecture for the international MetaMat seminar series, July 2022.

11. 'Spectral and Topological Engineering with Space Groups,' lecture for the 12th International Conference on Elastic, Electrical, Transport, and Optical Properties of Inhomogeneous Media, Besancon (France), July 2022.

9. ‘Design Strategies for Topological Metamaterials,’ lecture for the 19th U.S. National Congress on Theoretical and Applied Mechanics, Austin, June 2022.

8. 'Pushing Cyclic Cocycles over Sobolev Domains and the Extraordinary Consequences for Materials Science', lecture for the conference ‘Cyclic Cohomology at 40: achievements and future prospects’, Fields Institute Sept. 2021.

7. 'A Groupoid Approach to Interacting Fermions,' a lecture for the bi-annual workshop Solid Math 2021.

6. 'A Groupoid Approach to Interacting Fermions,' a lecture for the Lorentz Center program 'Learning from Insulators: New Trends in the Study of Conductivity of Metals,' August 2021.

5. 'Topological Dynamics of Fermions: A View from Noncommutative Geometry', lecture for the KITP program 'Interacting Topological Matter: Atomic, Molecular and Optical Systems,' August 2021.

4. ' Phason Engineering in Aperiodic Resonant Structures,' lecture for the workshop `Quasi-periodic spectral and topological analysis,` May 2021.

3. ‘Topological Insulators at Strong Disorder,’ lecture for the international seminar series Noncommutative Geometry and Physics, March 2021.

2. ‘Phason Engineering for Topological Wave Steering,’ lecture for the international MetaMat seminar series, Jan 2021.

1. ‘Noncommutative Geometry and Materials Science,’ lecture for the Global Noncommutative Geometry seminar, Jan 2021.

Editorial work

- Editor of the Elsevier’s “Encyclopedia of Mathematical Physics” for the section Condensed Matter & Statistical Physics.

- Guest editor for the special issue "Noncommutative Geometry and Physics" hosted by Journal of Physics A: Mathematica and Theoretical.

Students involved in research

1. Tara Shtern
2. Rivka Shapiro (Kressel scholar)
3. Tamar Leiser

(c) Dr. Lea F. Santos

External Funding

Funder: National Science Foundation (CHE - 2124511)
Period: **09/01/2021-08/31/2024**
Title: **CCI Phase I: NSF Center for Quantum Dynamics on Modular Quantum** Devices"
Amount: **$325,000**

Funder: National Science Foundation (DMR - 1936006)
Period: **01/01/2020-12/31/2022**
Title: **Nonequilibrium Quantum Matter: Timescales and Self-Averaging**
Amount: **$400,000**

Peer-reviewed articles

15) Wouter Buijsman, Talía L. M. Lezama, Tamar Leiser, Lea F. Santos *Ground-state energy distribution of disordered many-body quantum systems*arXiv:2205.09771

14) Yael Lebel, Lea F Santos, Yevgeny Bar Lev*Chaos enhancement in large-spin chains* arXiv:2204.00018

13) Karin Wittmann W, E.R. Castro, A. Foerster, Lea F Santos *Interacting bosons in a triple well: Preface of many-body quantum chaos*Physical Review E **105**, 034204 (2022)

12) Saúl Pilatowsky-Cameo, David Villaseñor, Miguel A. Bastarrachea-Magnani, Sergio Lerma-Hernández, Lea F. Santos, Jorge G. Hirsch, *Identification of quantum scars via phase-space localization measures*,Quantum **6**, 644 (2022)

11) Y Liu, Lea F Santos, E Prodan *Topological Gaps in Quasi-Periodic Spin Chains: A Numerical and K-Theoretic Analysis* Physical Review B **105**, 035115 (2022)

10) ER Castro, J Chávez-Carlos, I Roditi, Lea F Santos, JG Hirsch *Quantum-classical correspondence of a system of interacting bosons in a triple-well potential* Quantum **5**, 563 (2021)

9) Devendra Singh Bhakuni, Lea F. Santos, and Yevgeny Bar Lev *Heating suppression by long-range interactions in periodically driven spin chains* Physical Review B **104**, L140301 (2021)

8) Thomás Fogarty, Miguel Angel Garcia-March, Lea F. Santos, N.L. Harshman *Probing the edge between integrability and quantum chaos in interacting few-atom systems* Quantum **5**, 486 (2021)

7) TLM Lezama, EJ Torres-Herrera, F Pérez-Bernal, YB Lev, Lea F Santos *Equilibration time in many-body quantum systems* Physical Review B **104**, 085117 (2021)

6) A Solórzano, Lea F Santos, EJ Torres-Herrera *Multifractality and self-averaging at the many-body localization transition* Physical Review Research **3**, L032030 (2021)

5) G Zisling, Lea F Santos, YB Lev *How many particles make up a chaotic many-body quantum system?* SciPost Physics **10**, 088 (2021)

4) Lea F Santos *The quick drive to pseudo-equilibrium* Nature Physics **17**, 429 (2021)

3) S Pilatowsky-Cameo, D Villaseñor, MA Bastarrachea-Magnani, Sergio Lerma-Hernández, Lea F Santos, Jorge G Hirsch *Ubiquitous quantum scarring does not prevent ergodicity* Nature Communications **12**, 852 (2021)

2) M Niknam, Lea F Santos, DG Cory
Experimental Detection of the Correlation Rényi Entropy in the Central Spin Model Physical Review Letters **27**, 080401 (2021)

1) S Pilatowsky-Cameo, D Villaseñor, MA Bastarrachea-Magnani, Sergio Lerma-Hernández, Lea F Santos, Jorge G Hirsch
Quantum scarring in a spin-boson system: fundamental families of periodic orbits New Journal of Physics, **23** 033045 (2021)

Organized Conference and Program

Workshop Ergodicity and chaos in many-body systems (UNAM, Mexico, Feb/16-18, 2022)

Editorial Boards

- Physical Review E

Invited Talks

32) Program: Quantum Many-Body Dynamics and Noisy Intermediate-Scale Quantum Systems (Santa Barbara, CA, Sep/26-Oct/08, 2022)

31) Seminar at Federal University of Parana, Brazil (Sep/15, 2022)

30) CCI Quantum Computing Workshop

(Yale University, New Haven, CT, Aug/27, 2022)

29) Long-range interacting systems: Recent developments and future directions

(International Centre for Theoretical Sciences, Bangalore, India, August/22-26, 2022).

28) FQMT 2022: Frontiers of Quantum and Mesoscopic Thermodynamics

(Prague, Czech Republic, Aug/01-06, 2022)

27) International Conference on Strongly Correlated Electron Systems 2022 (SCES 2022)

(Amsterdam, Netherlands, July/24-29, 2022).

26) 10th International Workshop on Quantum Phase Transitions in Nuclei and Many-Body Systems: QPTn-10

(Dubrovnik, Croatia, July/11-15, 2022)

25) Workshop: Out-of-equilibrium and collective dynamics of quantum many-body systems (Zurich, Switzerland, Jun/27-Jul/01, 2022)

24) University of Bielefeld, Bielefeld, Germany (May/19, 2022)

23) Seminar at NORDITA, Sweden (April/12, 2022)

22) University of Connecticut, Storrs, CT (Mar/24, 2022)

21) QPequi Talks (Federal University of Goiás, Brazil, Feb/10, 2022)

20) Cross-Disciplinary Approaches to Non-Equilibrium Systems Seminar Series, UT

(King's College London, England, Feb/02, 2022)

19) University of Utah, Salt Lake City, UT (Jan/27, 2022)

2021

18) Sherbrooke University, Sherbrooke, Canada (Dec/01, 2021)

17) University of New Mexico, Albuquerque NM (Oct/21, 2021)

16) PROTOC 21: Probing Complex Quantum Dynamics through Out-of-time-ordered Correlators (Oct/11-15, 2021)

15) QDT 2021: Quantum Thermodynamics Conference (Oct/04-08, 2021)

14) KITP (Santa Barbara, CA, Sep/05-17, 2021)

13) Wesleyan University (Middletown, CT, Sep/09, 2021)

12) 2nd International Summer School on Advanced Quantum Mechanics (Prague, Czech Republic, Sep/2-11, 2021)

11) FQMT 2021: Frontiers of Quantum and Mesoscopic Thermodynamics

(Jul/18-24, 2021)

10) University of Luxembourg (Luxembourg, Jun/29, 2021)

9) Les Houches School in Computational Physics: "Dynamics of Complex Systems, from Theory to Computation" (April/12-23, 2021)

8) Perimeter Institute (Waterloo, Canada, Mar/24, 2021)

7) Jozef Stefan Institute and the Department of Physics of the University of Ljubljana (Mar/23, 2021)

6) Ben Gurion University (Israel, Mar/22, 2021)

5) Emory University (Atlanta, Feb/17, 2021)

4) Instituto Técnico de Lisboa (Lisbon, Portugal, Feb/ 2021)

3) The Royal Society (London, UK, Feb/8-11, 2021)

2) Online Workshop Ergodicity and chaos in many-body systems

(UNAM, Mexico, Feb/4-7, 2021)

1) Universität Bielefeld (Germany, Jan/14, 2021)

Postdoctoral Fellow:

Talía Lezama

Students' Presentations:

Tamar Leiser: APS March Meeting, Chicago (March 2022)

Leon Alper: APS March Meeting, Chicago (March 2022)

Students Supervised

- Tamar Leiser
- Leon Alper
- David Roth

Kressel Scholar

- Tamar Leiser (2020-2021)

Department of Mathematical Sciences

Faculty: Edward Belbruno, Ph.D.; Wenxiong Chen, Ph.D.; Michael Dalezman, Ph.D.; Marian Gidea, Ph.D. (Director of the Graduate Program); Morton Lowengrub, Ph.D.; Antonella Marini, Ph.D. (Department Chair); Peter Nandori, Ph.D.; Pablo Roldan, Ph.D.

Visiting Professor: Mina Teicher, PhD, Bar Ilan University.

Affiliate, Quantitative Finance: Yuri Katz, Ph.D.

Affiliates, Physics: Neer Asherie, Ph.D.; Sergey Buldyrev, Ph.D.; Gabriel Cwillich, Ph.D.; Mark Edelman, Ph.D.; Emil Prodan, Ph.D.; Lea Santos, Ph.D., Fredy Zypman, Ph.D.

Mathematics is crucial to the advancement of all other disciplines: biology, medicine, astronomy, robotics, communications, finance, security, technology, and computer science. Students majoring in mathematics enjoy a variety of job opportunities, such as actuaries, computer scientists, quantitative analysts, researchers, teachers and academics. Many other fields that require applied science and technology frequently hire people with a strong mathematical background. This versatility lends itself to a job seeker's market, and the result is a high average annual salary. Professions in mathematics top the best “jobs of tomorrow", in a ranking based on hiring outlook, stress, environment, and income.

The Stern College Department of Mathematical Sciences is leading the way in Yeshiva University’s efforts prepare its students for the marketplace of tomorrow. Our mathematics courses provide students with key knowledge in theoretical and applied mathematics, and help them enhance their analytical abilities and heighten their creative potential. Students in the mathematics program have the opportunity to choose a concentration in Pre-Actuarial/Financial Mathematics. Advanced coursework is focused on modern mathematics, including differential equations,

probability and statistics, mathematics of finance, time series, scientific computing, data analysis, network science, mathematical biology, and chaos theory. In addition to coursework, students may participate in research projects focusing on specific areas of practice, or industrial applications, under the guidance of highly active research faculty or industry mentors. There is variety of enrichment activities organized at Stern College, including the math club "No Limits", Mathematical Colloquia, and citywide seminars in Dynamical Systems and/or Mathematical Physics, which include speakers from around the world.

In addition to an undergraduate degree, the department offers an MA program, as well as a PhD program in Mathematics. An excellent option for math students is the BA/MA program, where qualified undergraduate students can take math graduate classes, and receive up to 12 credit hours of graduate courses towards the BA degree.

Our courses are taught by distinguished faculty with a tradition of excellence in teaching, mentoring, and research. Below are some highlights on our faculty research:

- Prof. Belbruno is the recipient of Humboldt Research Award in 2017, awarded by the Alexander von Humboldt Stiftung/foundation of Germany for lifetime achievements. He designed space missions for NASA and other space agencies, and he created new mathematical models in cosmology, such as for the Big Bang and for black holes.
- Prof. Chen has made significant advances in the theory of nonlinear elliptic partial differential equations and geometric analysis and some of his articles are among the most cited world-wide in the recent scientific literature.
- Prof. Dalezman has done research in the theory of prime numbers.
- Prof. Gidea provided a solution to a long-standing open problem is mathematics, the *Arnold diffusion conjecture*.
- Prof. Katz employs methods rooted in the physics of complex non-equilibrium systems to perform credit risk modeling.

- Prof. Lowengrub is one of the fathers of the WIYN Observatory (Arizona), and a former vice-president of the Association of Universities for Research in Astronomy (AURA). The asteroid 4045 Lowengrub is named after him.
- Prof. Marini discovered new boundary conditions for gauge-invariant partial differential equations describing the standard model of the universe; those are called “Marini conditions” in the scientific literature, in honor of her research in this area; she’s been applying her expertise to provide an answer to the *mass gap problem,* one of the seven *millennium problems* announced by the Clay Institute at the turn of the millennium
- Prof. Nandori’s research expands over the topics of dynamical systems, ergodic theory, statistical physics, and classical mechanics. He has made relevant contributions to the problem of understanding the statistical behavior in mechanicistic models of gases, based on lightweight particles that experience elastic collisions with heavy particles or with the walls of a container, with the purpose of deriving the laws of thermodynamics for both equilibrium and non-equilibrium systems.
- Prof. Prodan’s expertise at the intersection of topology, operator theory, physics, and engineering, obtained him a Keck Foundation research award for a collaborative project involving the engineering of new materials based on topological arguments. He published a monograph titled "Bulk and Boundary Invariants for Complex Topological Insulators: From K-Theory to Physics”. He’s been Interim Director of the Graduate Program for the academic year 2021-2022.
- Prof. Roldan developed a new mathematical theory to explain the existence of “Kirkwood gaps" in the Main Asteroid belt.
- Prof. Mina Teicher is an internationally renowned scientist, with a broad expertise in algebraic geometry, algebra, applied mathematics, and neuroscience. She is a faculty in

the Department of Mathematics and in the Gonda Brain Research Center at Bar Ilan University (Tel Aviv), and the director of the Emmy Noether Institute for Mathematics. She is a VP of International Commission for Mathematical Instruction, a former VP for Research and Development at Bar-Ilan, a former Chief Scientist, and a former chair of USA-Israel Binational Science Foundation.

- Several members of the faculty have written textbooks and monographs in their fields
- Faculty research has been funded by National Science Foundations, National Aeronautics and Space Administration, National Institute of Health, National Cancer Institute, Simons Foundation, Sloan Foundation, Boeing Corporation, etc.
- Faculty members are frequently invited to lectures at major conferences and workshop in the US as well as other counties in America, Europe, Asia, and Africa.

Department of Psychology

Faculty: Joshua Bacon, Ph.D.; Terry DiLorenzo, Ph.D. (Chair); Rachel Ebner, Ph.D.

As a discipline, Psychology is generally categorized as a Social Science together with other fields such as Social Work, Political Science, Economics, and Sociology. However, scientific methodology and empirical research have always been a critical component of the coursework and extra-curricular opportunities offered by our department. Experimental Psychology, as a prerequisite for many of the other courses offered, highlights the fundamental importance that we place on understanding the subject matter of psychology in the context of rigorous empirical analysis, research methodology, and scientific thinking. The Research Seminar, a course taken by psychology majors who are interested in pursuing a doctorate in Psychology, provides students with research opportunities and classroom instruction that advance their understanding of the application of research methodology to a "real world" setting. Courses such as Cognitive Psychology, Learning, and Psychobiology are rooted in the tradition of research and easily fit into the Science framework. Many other courses such as Social Psychology, Developmental Psychology, Personality, and Abnormal Psychology are brought into the arena of science by faculty who are grounded in scientific methodology.

In addition to the general psychology major, the department also offers a specialty track in Behavioral Neuroscience. This Behavioral Neuroscience track option for Psychology majors provides a focused education to students who are interested in the biology behind human and animal behavior. In addition to the core courses that are required of all majors, further requirements and electives come from critical courses in Neuroscience, such as Cognitive Neuroscience, Mind, Language, Consciousness and Behavioral Neuroendocrinology. Students who are planning to apply to Ph.D. or Psy.D. programs in Psychology or to pursue

careers in other health-related fields such as Physical, Occupational, or Speech Therapy, are encouraged to become actively engaged in research. Students have gained invaluable experience outside the classroom by learning about the fundamental role of research in the theory and practice of psychology by working with faculty, such as with Dr Joshua Bacon in the M.S. Care Center at NYU. On campus, students have worked on research projects with Dr. Terry DiLorenzo focusing on health-related attitudes and behaviors. Students have also worked with faculty from Yeshiva University's Ferkauf Graduate School of Psychology. Many of these students have coauthored presentations at both national and international conferences.

Other research opportunities are available in a number of academic, hospital, and clinical settings outside the University. Students who conduct research in these settings may have a Stern College faculty member serve as a supervisor to maintain continuity of the student's experience as an integrated part of her program in psychology. Students engaged in research are encouraged to present their work at university-sponsored events and other professional meetings.

Below, we introduce the members of the Psychology Department and we look forward to the continued contributions of the Behavioral Sciences to Women in Science.

Dr. Joshua Bacon received his Ph.D. from NYU in 1976. During this time, he also conducted research at Swarthmore College with Dr. Hans Wallach, one of the last remaining students of Wolfgang Kohler, the founder of Gestalt Psychology. In 1976, Dr. Bacon obtained a position as Assistant Professor at Tufts University in Boston and received tenure in 1984. At that time, he was recruited by Yeshiva University and joined the Department of Psychology in 1984. He teaches basic courses in Experimental Psychology and Cognition, as well as the Cognitive Neuroscience course that is a basic requirement for the Behavioral Neuroscience track. Dr. Bacon's area of research is perception and cognition and, in particular, cognitive impairment and rehabilitation in patients with

Multiple Sclerosis. He holds a position of Research Associate Professor in the Department of Neurology at the NYU Medical School and is a member of the clinical and research team in the Multiple Sclerosis Care Center of NYUHJD. He is currently working on a cognitive rehabilitation program for MS patients with cognitive impairments and is also the principle investigator of a project to develop a diagnostic battery that will measure subtle cognitive impairments that may emerge in the early stages of MS. Some of his recent studies have looked at the correlation between performance on one of the behavioral tests of cross hemisphere processing he developed and atrophy of the corpus callosum as seen on MRI scans. Undergraduate students from Stern College have been and continue to be involved in this research and have been coauthors on a number of poster presentations at conferences of the Academy of Neurology and of the Multiple Sclerosis Consortium.

Dr. Terry DiLorenzo received a B.A. in psychology from Rutgers University and a Ph.D. in Health Psychology from Ferkauf Graduate School of Psychology of Yeshiva University. She completed a postdoctoral fellowship at Memorial Sloan-Kettering Cancer Center and then was the Director of Research of the Multiple Sclerosis Comprehensive Care Center of New York Medical College until she joined the Psychology Department of Stern College for Women in 1999. Since joining the Department, Dr. DiLorenzo has conducted several studies examining health-related attitudes and cognitions and their relations to health behaviors. Dr. DiLorenzo has also conducted research on the psychometric properties of scales to assess mood and attitudes toward seeking health care. Dr. DiLorenzo also has an interest in sexual health behaviors and has completed a study on sexual health practices in Orthodox Jewish women. Dr. DiLorenzo has published her findings in articles in peer-reviewed journals and has presented at many professional meetings. In addition to her own research, Dr. DiLorenzo has mentored several honors students whose projects have been presented at professional meetings as well. Dr. DiLorenzo teaches several advanced courses including Human Sexuality, the Honor's Psychology Research Seminar, and Introduction to Public

Health, in addition to Abnormal and Social Psychology. Dr. DiLorenzo also coordinates the recently developed Public Health Minor at Stern College.

Dr. Rachel Ebner received a Ph.D. in Educational Psychology from the CUNY Graduate Center, where she concentrated in Learning, Development, and Instruction. She also earned an Ed.M. in Prevention Science and Practice from the Harvard Graduate School of Education and an M.A. in Developmental Psychology from Columbia University's Teachers College. Her postdoctoral research has focused on devising and implementing methods to help students self-regulate their learning, especially when learning online. She has taught a variety of courses on child & adolescent development and educational psychology. In addition to teaching at Stern, she also serves as Yeshiva University's Director of Student Learning Assessment. She works with faculty and administrators on developing and supporting their programmatic learning assessment activities.

Department of Speech-Language Pathology/Audiology

Chair: Elyse R. Granik MS CCC-SLP

Jonathan Jolivette MS CCC-SLP LSLS Cert. AVT

Christina Joubert Kardooni, M.S., CCC-SLP

Melissa Kessler MS CCC-SLP

Dani Weingarten MS CCC SLP

The mission of the Department of Speech-Language Pathology/Audiology (SPAU) is to prepare students for admission to advanced graduate programs in the fields of Speech-Language Pathology and Audiology. Through coursework and clinical observation, students acquire knowledge of the biology, physics, acoustics and anatomy and physiology of the speech and hearing mechanism as well as typical and atypical development of speech, language, hearing, and swallowing, and (re)habilitation of disorders thereof. Students become familiar with evaluation and therapeutic techniques as well as client counseling and rapport building with clients and families. Graduates of the SPAU Department are equipped with the foundational knowledge to continue with their graduate studies and become clinician-scientists who provide compassionate, evidence-based care to individuals of all ages with communication, hearing, and swallowing disorders and their families.

The SPAU course sequence begins with Survey to Communication Disorders and courses continue in a fixed progression building the cornerstones of the field in earlier courses to more advanced study. Coursework also meets the requirements set forth by the American Speech-Language Hearing Association (ASHA) for eligibility for admission to graduate programs. Students in the SPAU department benefit from expert instruction by professors who are also practicing clinicians, allowing for the infusion of case studies and real-life examples into their coursework.

Outside of the classroom, students have many opportunities to enhance their learning. The student-led SPAU Club brings a variety of speakers to campus, helps students prepare for graduate school admission, and organizes both social and philanthropic opportunities. SPAU students are also invited to join the YU Katz chapter of the National Student Speech Language Hearing Association (NSSHLA) connecting them to students across the country studying communication sciences and disorders. The students also write, edit, and publish an annual Speech and Hearing Journal. Past articles have included topics such as autism, bilingual language learning, stuttering, hearing loss, and more.

We are proud of our students' success both inside and outside of the classroom. Several of our students have been awarded Ben Gurion University summer fellowships and have spent their summers in Israel working in speech, language, and hearing research labs. Our students have been accepted to many high-caliber graduate programs, often with academic scholarships including an ASHA student award. Our graduates have matriculated to both speech-language pathology master's programs and clinical doctorate programs in audiology at institutions such as: Yeshiva University, Queens College, Lehman College, Touro College, Brooklyn College, Montclair University, University of San Diego/San Diego State University, Towson University, and others.

YESHIVA UNIVERSITY PATHWAYS PROGRAMS

SCW undergraduates may participate in Yeshiva University's Pathway Programs which offer SCW undergraduates a streamlined path to a graduate degree granted by the Katz School of Science and Health and the Ferkauf Graduate School of Psychology, among others. Two types of Pathway Programs are offered:

(a) **Dual Degree Programs** allow SCW undergraduates, in their junior or senior year, to begin taking graduate level courses that count towards their bachelor's undergraduate and master's graduate degrees. Dual degree programs are offered in several STEM disciplines, including Artificial Intelligence, Biotechnology, Cybersecurity, Data Analytics and Visualization, Mathematics, Mental Health Counseling, and Physics. Each program has its own specific prerequisites; for example, the Dual Degree program for Biotechnology Management and Entrepreneurship requires are 84 undergraduate credits; any college major; B+ or better in Principles of Biology 1011 and 1012. For more information, visit the website: https://www.yu.edu/pathways.

(b) **Early Assurance Health Science Programs** provide SCW undergraduates in their junior year the opportunity to secure a spot in the graduate health science program of their choice at The Katz School of Science Health. Participating programs in Early Assurance include Occupational Therapy (doctorate), Physician Assistant Studies (M.S.) and Speech-Language Pathology (M.S.). Early applicants are encouraged to apply immediately upon completion of their junior (3rd) year of coursework (late May or early June) and must meet the minimum eligibility requirements. For more information, visit the website: https://www.yu.edu/pathways.

STERN COLLEGE FOR WOMEN COMBINED PROGRAMS

The following are the basic elements of combined degree programs in the sciences available to Stern College students in cooperation with other universities. Students interested in these programs generally apply to the cooperating institution during their junior year and are given a special shaped major so that they can complete all of the necessary prerequisites within the required time frame. The indicated years of study at Stern College includes the year of study abroad in Israel for those pursuing that option after high school. These programs are competitive and final admissions decisions are made by the cooperating institutions.

Engineering - B.A. /B.E. /B.S. or B.A. /M.S.

Yeshiva University offers a combined plan in engineering with Columbia University School of Engineering and Applied Science. Students interested in the Combined Program, must fulfill all the requirements for graduation, including completing a major, whether it be Pre-Engineering, Natural Sciences, or other, and must continue their studies in engineering at Columbia University.

The Pre-engineering major is open to students who can complete the major, general and **reduced** Jewish Studies requirements in 3 years - usually three years at SCW.

To be eligible to apply for admission to Columbia University through the Combined Program in Engineering, Pre-engineering majors must meet the SCW graduation requirements, other than the 128 credits, as well as all Columbia University requirements listed in the Columbia University Combined-Plan Guide (available at the Academic Advisement Center). Admission is to the two-year program at Columbia University. Columbia University will admit students based upon defined criteria, such as GPA in Columbia University-required courses, overall GPA,

recommendations, *etc.* This past academic year, Columbia University admitted 2/2 SCW applicants.

If admitted to Columbia University, students should file a Maintenance of Matriculation Form at SCW. After successfully completing the two-year program at Columbia University, students file for a BA from YU, and a BS from Columbia University.

Nursing - B.A./B.S.N./M.S.N.

Stern College offers a combined program in nursing with New York University's College of Nursing (NYUCN). In this program, students complete 7 semesters of required course work with a minimum of 119 credits at Stern College (5 semesters and 84 credits in residence at Stern College for those students studying in Israel for a year). Eligible students may then be admitted to a 15-month accelerated program at NYUCN which begins in January of their senior year. Students receive a B.A. degree from Stern College for Women after successfully completing one semester at NYUCN. They are awarded the BSN from NYU at the successful completion of the nursing program and officially become a registered nurse (RN) upon passing the licensing exam. Students who maintain a 3.0 GPA while at NYUCN are guaranteed a spot in their MSN program to become a nurse practitioner, which they may apply to after a short period of working as a RN.

Occupational Therapy - B.A./M.S.

Stern College offers a combined program in Occupational Therapy with Columbia University (CU). During their first three years at SCW (two years for those studying in Israel for a year), students complete college requirements and the prerequisites for CU's OT program. They apply to the 2-year CU program during the fall semester of their junior year. Students are awarded the B.A. from Stern College after their first year at CU, and the M.S. upon completion of the program.

Optometry - B.A./O.D.

Stern College and the State University of New York (SUNY) College of Optometry offer an affiliation program to qualified students through which they can receive an undergraduate degree and a Doctor of Optometry degree in seven years. Students accepted into this program attend SCW for three years while they complete college requirements and prerequisites for the College of Optometry. After the first year at SUNY College of Optometry, students receive the B.A. degree. The O.D. degree is awarded after completing the four years at SUNY College of Optometry

Physical Therapy - B.A./D.P.T.

Stern College offers combined program in Physical Therapy with Rutgers, the State University of New Jersey. During their first three years at Stern College (two years for those studying in Israel for a year), students complete college requirements and the prerequisites for entry into Rutgers' Doctorate of Physical Therapy Program. Students are awarded a B.A. from Stern College after completing their first year at Rutgers and the DPT upon successful completion of the 3-year doctoral program.

In addition, though an Articulation Agreement with the New York Medical College Graduate School of Health Sciences (NYMC), students may apply to NYMC's Early Acceptance Program. Qualified students receive provisional acceptance to the 3-year DPT Program after their junior year, while final acceptance is granted upon satisfactory completion of their senior year at SCW.

Physician Assistant - B.A./M.P. S.

Stern College offers a combined program in Physician Assistant Studies with Mercy College. During their first three years at Stern (two years for those studying in Israel for a year), students complete college requirements and the prerequisites for Mercy College's M.S.

program. After completing 111 credits with a minimum overall GPA of 3.0, a minimum 3.2 GPA in the designated science courses and with at least a "B" in prerequisite courses, accepted applicants to the program continue at Mercy College during what would have been their senior year at Stern. After the first year at Mercy College, students receive a B.A. degree from Stern College. The M.S. degree is awarded after successfully completing two years and three months at Mercy and the student becomes a PA after passing her licensing exam.

Podiatry - B.A./D.P.M.

Stern College and the New York College of Podiatric Medicine offer a combined program in Podiatry. During the first three years, students recommended to the program complete college requirements and prerequisites for the NY College of Podiatric Medicine. After the first year at NYCPM, SCW awards the B.A. NYCPM awards the D.P.M. at the completion of the program.

Nutrition

Through an articulation agreement, SCW students may take selected courses in nutrition at NYU during their senior year at SCW and thus accelerate the time required to complete a subsequent graduate degree in nutrition at NYU or another school of their choice.

Student accomplishments

Academic year, 2021-2022 and Summer 2022 Internships

Departments of Biology, Chemistry/Biochemistry, Mathematical Sciences, Computer Science, Physics, Psychology, and Speech-Language Pathology/Audiology

Allopathic medicine ("med school"): 9 students
Albert Einstein College of Medicine (4); NY Med College (1); Ben-Gurion Univ. Med Ctr (1); Technion Med Sch (3)

Osteopathic medicine: 3 students
Touro College of Osteopathic Medicine (3)

Dental school: 4 students
University of Maryland (2); Rutgers (1); NYU (1)

Optometry: 2 students
SUNY Downstate (2)

Biomed./Biol. Sci., Ph.D.: 1 student
Icahn School of Medicine at Mount Sinai

Mathematics: Ph.D. 1 student
Northwestern University

Computer Science, Industry Placement: 15 students
Google (2); Booz Allen Hamilton (1); Blackrock (2); SoftworksAI (1); Credit Suisse (1);
Avanade (2); Apple (1); Waystar (1); Jeffries (1); Chess.com (1); Bond (1); Palantis (1)

Computer science, M.A.: 1 student
Hunter College

Clinical psychology, Psy.D.: 7 students
Ferkauf Grad Sch Psychol (5); LIU (1); Nova Southeastern (1)

Clinical psychology, Ph.D.: 3 students
Ferkauf Grad Sch Psychol (1); Adelphi University (2)

Mental Health Counseling, M.A.: 2 students
Touro College (1); Baruch College (1)

Dance/Movement Therapy and Mental Health Counseling: 1 student
Lesley University

Social Work, MSW: 3 students
Wurzweiler School of Social Work (YU) (2); NYU (1)

Pharmacy, PharmD: 1 student
Touro College

Physical therapy, Doctorate: 1 student
Touro College

Physician assistant, M.S.: 13 students
Katz School, YU (5); York College (2); Touro College (6)

Occupational therapy, M.S.: 9 students
Katz school, YU (1); Columbia Univ. (3); Touro (2); SUNY Downstate (2); Hofstra (1)

Genetic counseling, M.S.: 2 students
Mount Sinai Icahn School of Medicine (1); LIU (1)

Speech-Language pathology, M.A./M.S.: 8 students
Columbia (1); Lehman (1); Touro College (6)

Audiology, AuD (clinical doctorate): 1 student
CUNY Graduate Center

Nursing (accelerated program). 22 students
NYU (joint program) (14); Mount Sinai Beth Israel Phillips School of Nursing (4); Pace Univ. (1); Columbia (1); SUNY Downstate (1); Hunter College (1)

Summer, 2022, undergraduate research internships: 33 students

Bar Ilan-YU Summer Research Program: 11 students
SCW Dept of Biology: 3 students
NYC Health Career Opportunity Program: 6 students
Technion's American Medical School Summer Program: 5 students
YU Summer Research Program - NSF funded: Dept Physics SCW: 1 student
The Rockefeller University: 1 student
Memorial Sloan Kettering Cancer Center: 1 student
Hadassah University Medical Center: 2 students
Weill Cornell Research Institute: 1 student
Hebrew University of Jerusalem: 1 student
Mount Sinai Icahn School of Medicine: 1 student

Student Publications and Presentations

Scientific Journals

(Undergraduate names are in **bold** type)

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Wiener, S.L., Berman, A.Y., Alayev, A., Salamon, R.S., Sun, Y., Schwartz, N.S., Yu, J.J., and Holz, M.K., 2016, The combined effects of resveratrol and rapamycin in TSC null diseases, 251st National Meeting of the American Chemical Society, San Diego, CA, March.

Meyers, D., Martinez, K., and Chang, E.B., 2016, Understanding impaired lipid absorption in germ free mice, 251st National Meeting of the American Chemical Society, San Diego, CA, March.

Wakschlag, N. and DiLorenzo, T., 2016, The association between modest dress and body image in Orthodox Jewish Women. Poster presentation, Annual Meeting of the Society of Behavioral Medicine, Washington, D.C.

Li, Y., Korobko, R., **Lerner**, A., Lubomirsky, I., and Frenkel, A.I., 2015, Origin of giant electrostriction in Gd doped ceria revealed by differential QEXAFS, XAFS-15 International Conference, Karlsruhe, Germany, August.

Applebaum, K., recipient of the 2015 UAN Student Travel Award to attend the American Society for Biochemistry and Molecular Biology Annual Meeting, March 28-April 1, Boston Exhibition and Convention Center, MA

Kramer, M.Y., McNabb, N.A., Guillette, L.J., Jr., and Kohno, S., 2015, The potential impacts of environmental endocrine disruptors on reproductive development, 249th National Meeting of the American Chemical Society, Denver, CO.

Gross, R.A., Wooten, A.L., Lewis, Woodard, P., and Lapi, S., 2015, Manganese-52: cyclotron production and PET/MR imaging, 249th National Meeting of the American Chemical Society, Denver, CO.

Kramer, M.Y., McNabb, N.A., Guillette, Jr., L.J., and Kohno, S., 2014, Drugged wildlife: The potential impacts of environmental endocrine disruptors on reproductive development, National Meeting of the Society for Integrative and Comparative Biology, West Palm Beach, FL, Jan. 4th

Kaufman, C., Fulop, T., Boolbol, S.K., Naam, S., Gillego, A., and Chadha, M., 2014, Are more frequent early follow up mammogram protocols necessary after breast-conserving surgery and radiation therapy, San Antonio Breast Cancer Symposium, Dec.

DiLorenzo, T., Freyberg, R, and **Siegel, A**. 2014, Sex education and adherence to sexual health recommendations in Orthodox Jewish Women. Poster presented at the Society of Behavioral Medicine Annual Meeting, Philadelphia, PA, April.

Siegel, A., DiLorenzo, T., Freyberg, R., and Donath, S., 2014, Factors associated with adherence to gynecologic screening recommendations in young Orthodox Jewish Women. Poster at the Society of Behavioral Medicine Annual Meeting, Philadelphia, PA, April.

Lerner, **A**., Li, Y., Frenkel, A.I., Korobko, R., and Lubomirsky, I., 2014, The origin of giant electrostriction in Gd-doped ceria as studied by modulation excitation x-ray absorption spectroscopy, Meeting of the American Physical Society, Denver, CO.

Herskowitz, J., Victor, R., and Mintzer, E., 2014, Daptomycin interactions with TOCL containing membranes, 247th American Chemical Society National Meeting, March, Dallas, TX.

Schoor, Y. and Jordan, B.A., 2014, Prr7 is a novel regulator of the transcription factor, c- Jun, in neurons, 247th American Chemical Society National Meeting, March, Dallas, TX.

Tishbi, N. and Mintzer, E., 2014, Surface and membrane binding properties of the lipopeptide daptomycin, 247th American Chemical Society National Meeting, March, Dallas, TX.

Tishbi, N. and Rapp, C., 2014, The role of sulfation in the CCR5 chemokine receptor complex, 247th American Chemical Society National Meeting, March, Dallas, TX.

Goldsmith, A., Bryan, R., Broitman, J., and Dadchova, E., 2014, Modification of antibody 2556 recognizing HIV protein gp41 with CHXA ligand for radiolabeling and radioimmunotherapy 247th American Chemical Society National Meeting, March Dallas, TX.

Hseih, S.J., Levi, D., Prince, D., Mills, M., Dayton, C., Shah, R., **Zibak, F., Shamsian, J**., and Gong, M.N. 2014, Staged implementation of the ABCDE bundle improves ICU patient outcomes, Amer. Thoracic Soc., Meeting (abstract).

Hseieh, S.J., Hope, A., Dayton, C., Gershengorn, H., Shah, R., **Shamsian, J., Zibak, F**., and Gong, M.N., 2014, The association between pre-ICU frailty and ICU delirium, Amer. Thoracic Soc., Meeting (abstract).

Weisburg, J.H., Schuck, A.G., **Greenbaum, R.E., Golfiez, M.D., Segal, J.R., Weiss, R.A., Liebman, E.C.**, Zuckerbraun, H.L., and Babich, H., 2013, Grape seed extract, a Mild prooxidant selectively cytotoxic to cancer cells. American Institute for Cancer Research Annual Meeting. Bethesda, MD.

Bonner, C., and DiLorenzo, T., 2013, A review of the literature on cognitive-behavioral therapy for anxiety and depression in school

settings. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Donath, S., and DiLorenzo, T., 2013, Remediating academic impacts of early neglect. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Farzan, Y., and Freyberg, R., 2013, Effects of affect on prosocial behavior: A review of the literature. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Frenkiel, L., and DiLorenzo, T., 2013, Spiritual and religious coping in cancer patients. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Kazlow, C., and DiLorenzo, T., 2013, The effects of terrorism on children: The implications of type of trauma, level of exposure, and individual vulnerability. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Last, T., and Freyberg, R., 2013, Cyberbulling: Predictive factors and harmful effects. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Pasternak, E., and Bacon, J., 2013, A modified sound localization task as a sensitive test of processing speed in multiple sclerosis patients. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Siegel, A., and DiLorenzo, T., 2013, Are knowledge, family and friend history of disease and perceived risk predictive of the uptake of gynecologic health recommendations in orthodox Jewish women? Ferkauf Graduate School of Psychology,Behavioral Sciences Student Research Conference.

Yarmush, D., and Freyberg, R., 2013, The effect of music on cognitive, verbal, and taskperformance. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Schuck, A.G., **Wargon, S.E., Tauber, L., Miller, S.H., Weinstock, H.R.,** Weisburg, J.H., Zuckerbraun. H.L., and Babich, H. 2013. Ellagic and gallic acids, dietary polyphenols with selective cytotoxicity to oral carcinoma HSC-2 cells. Society for In Vitro Biology Annual Meeting, Providence, RI

Tishbi, N. and Mintzer, E., 2013, Surface and membrane binding properties of the lipopeptide daptomycin, 57th Annual Meeting of the Biophysical Society, Philadelphia, PA

Joel, K., **Kollmar, D.,** and Santos, L. F 2013, Spectrum, symmetries, and dynamics of Heisenberg spin-1/2 chains (oral presentation), International Meeting of the American Physical Society, March Meeting, Baltimore, MD.

Kollmar, D. and Santos, L. F 2013, Invariant correlation entropy as a signature of quantum phase transitions in spin-1/2 systems (oral presentation), International Meeting of the American Physical Society, March Meeting, Baltimore, MD.

Laufer, T.S. and Rapp, C. 2013, Effects of tyrosine *o*-sulfation on binding affinity in CXCR4-SDF-1 complexes, 245th National Meeting of the American Chemical Society, New Orleans, LA.

Snow, S. and Rapp, C., 2013, Role of tyrosine *o*-sulfation in the CXCR4-SDF-1chemokine receptor complex, 245th National Meeting of the American Chemical Society, New Orleans, LA.

Robin, E.F., Wietschner, J.K., Zuckerbraun, H.L., Babich, H., Schuck, A.G., and Weisburg, H.J., 2013, Gallic acid, an inducer of apoptosis to human oral carcinoma HSC-2 cells as mediated through oxidative stress, 245th National Meeting of the American Chemical Society, New Orleans, LA.

Schoor, Y. and Velisek, 2013, Different route of administration for melanocortin receptor agonist, melanotan II, in the model of cryptogenic infantile spasms, 245th National Meeting of the American Chemical Society, New Orleans, LA.

Weinstein, A., Baker, M.E.R., Hughes, C.M., Allis, D., McEwen, B.S., and Hunter, R.G., 2013, Evidence for the role of a novel histone mark in hippocampal neurogenesis**,** 245th National Meeting of the American Chemical Society, New Orleans LA.

Sedletcaia, A., **Unger, H.A.,** Maruani, D.M., and Holz, M.K., 2012, New targets of mTORC1 pathway in ER-positive cells, American Association for Cancer Research Annual Meeting, Chicago, IL.

Chitgarha, M.T, Khaleghi, S., Daab, W., Ziyadi, M., Mohajerin-Ariaei, A., **Rogawski, D**., Tur, M., Vusirikala, V., Zhao, W., Touch, J., and Willner, A.E. 2012. Demonstration of WDM OSNR Performance Monitoring and Operating Guidelines for Pol-Muxed 200 Gbit/s 16-QAM and 100-Gbit/s QPSK Data Channels. Optical Fiber Communication Conference and Exposition (OFC).

Amram, R., and DiLorenzo, T., 2012, Prevalence and pedictors of academic dishonesty. Poster to be presented at the Annual Meeting of the American Psychological Association, Orlando, Fl.

Freyberg, R., and **Bart, M**., 2012, Olfactory environment influences close relationships through multiple methods of measurement. Poster presented at the Annual Conference of the Association of Chemoreception Sciences, Huntington Beach, CA.

Gofine, M., and Dilorenzo, T., 2012, How are we doing? A review of assessments within writing centers. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Michalowksi, A., and Freyberg, R., 2012, The effect of directed writing on depression and anxiety. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Pasternak, E., and Bacon, J., 2012, Demystifying insight: A review. Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Zughaft, M., Taylor, D.J., and Harburger, L.L., 2012, Effects of endogenous and exogenous sex hormones on object memory and spatial ability in young and aged women. 16th Annual N.E.U.R.O.N. Conference Program.

Zughaft, M., Taylor, D., and Harburger, L., 2012, Effects of endogenous and exogenous sex hormones on object memory and spatial ability in young and aged women. Ferkauf Graduate School of Psychology, Behavioral Sciences Student ResearchConference.

Gharagozloo, P., Arcasedda, F., Khatamee, M., Gutierrez-Adan, A., Drevet J., Krey, L., **Mandelbaum, M.,** Smith, M., Kramer, Y., Sanchez, X., Lu, L., McCaffrey, C., and Grifo, J., 2012, Age, sperm, & oocyte stress and infertility, American College of Obstetricians and Gynecologists, May 8th, San Diego, CA

Vigodner, M., Nieves,E., Shrivastava, V., Callaway, M.B., **Marmor, H.,** and **Chernyak S.-B**., 2012, Identification of sumoylated proteins in human sperm, American Society of Andrology (ASA) 37th Annual Conference, April 21 – 24, Tucson, Arizona.

Hachen, M., Hunter, R.G., Pfaff, D.W., and McEwen, B.S., 2012, Stress modulates mitochondrial gene expression in the rat hippocampus, 243rd American Chemical Society Meeting, San Diego, California, Spring semester.

Gubin A. and Santos L.F., Quantum Chaos: An introduction via chains of interacting spins 1/2, Oral presentation, March Meeting 2011, American Physical Society, Boston, MA.

Karp, E., Novikov, L., **Klerman, H.**, and Gamble, M.J., 2012, Understanding the role of intronic cis-acting elements in the splicing of macroH2A1 variants, 243rd American Chemical Society meeting, San Diego, California, Spring semester.

Wolf, B.J., Reiss, S.E., Babich, H., Weisburg, J.H., Schuck, A., and Zuckerbraun, H., and **Fertel, S.** 2012, Proapoptotic effects of ellagic acid, a metabolite of pomegranate extract, on human oral carcinoma

HSC-2 cells, 243rd American Chemical Society meeting, San Diego, California, Spring semester, 2012.

Hachen, M., Hunter, R.G., Pfaff, D.W. and McEwen, B.S., 2011, Stress modulates mitochondrial gene expression in the rat hippocampus, Society for Neuroscience Abstracts, Washington, D.C.

Shrivastava, V., **Marmor**, **H**., **Gutstein**, **L**., Chernyak, S.-B., and Vigodner, M., 2011, SUMO proteins may regulate multiple functions in human sperm which can be significantly affected by cigarette smoke, FAMRI Web Symposium.

Bart,M., and Freyberg, R., 2011, Fragrance change impacted interactions of close female friends. Chemical Senses, 36, A100-101.

Bacon, J., Kalina, J., Bochkanova, A., **Ausubel-Strauchler, Y.** and Herbert, J., (2011). Cognitive rehabilitation benefits multiple sclerosis patients only if they are active participants in the program. Neurology, 76 (S4): A85.

Harburger, L.L. and **Taylor, D.J.,** (2010). The effects of age on object memory and spatial ability in women. Society for Neuroscience Abstracts,Program # 605.2.

Huisman, T., Chatterjee, S., Volpi, S., and Birshtein, B., 2011, AID and Gadd45a: Involved in active DNA demethylation of the 3'RR and in class switch recombination? 241st American Chemical Society National Meeting, Anaheim, CA, March.

Rogawski, R. and Mintzer, E., 2011, Elucidating the interaction of LPA with model membranes, 241st American Chemical Society National Meeting, Anaheim, CA, March

Rosenblatt, K., Avogadri, F., Li, Y., Murphy,J., Merghoub, T., Houghton, A., and Wolchok, J., 2011, Detection of TRP-2 antibodies in the serum of TRP-2 immunized mice, 241st American Chemical Society National Meeting, Anaheim, CA, March.

Schuck, A.G., **Cohen, S.S., Lerman, L.T., Haken, O.,** and Weisburg, J.H., 2011, Pomegranate and olive fruit extracts, prooxidants with antiproliferative and proapoptotic activities towards HSC-2 carcinoma cells. Society for In Vitro Biology Annual Meeting, Raleigh, NC, June

Hasten, E., Lazaros, J., and Schuck, A.G., 2011, Pro-oxidant and pro-apoptotic activities of olive fruit extract toward oral carcinoma cells. Columbia University Undergraduate Research Symposium, April.

Hirth, Y.A., Zuckerbraun, H.L., and Weisburg, J.H., 2011, Decrease in intracellular glutathione and induction of apoptosis in HSC-2 carcinoma cells from the human oral cavity due to pomegranate juice extract. Society for In Vitro Biology Annual Meeting, Raleigh, NC, June

Schneider, J., Gutstein, L., Shrivastava, V., and Vigodner, M., 2011, SUMO proteins may regulate head reshaping, capacitation, and stress response in human sperm, Columbia University Undergraduate Research Symposium, Spring, April.

Hirth, Y.A., Zuckerbraun, H.L., and Weisburg, J.H., 2011, Decrease in intracellular glutathione and induction apoptosis in HSC-2 carcinoma cells from the human oral cavity due to pomegranate juice extract. Society for In Vitro Biology Annual Meeting, Raleigh, NC, June

Schneider, J., Gutstein, L.E., Shrivastava, V., and Vigodner, M. 2011, SUMO proteins may regulate head reshaping, capacitation, and stress response in human sperm, XXIst North American Testis Workshop, Montreal, Quebec, Canada, 3/30-4/2.

Maruani, M., **Harris, E., Shachter, A.,** and Holz, M.K., 2011, Co-regulatory relationship between estrogen receptor alpha and the mTOR/S6K1 signaling pathways, American Association for Cancer Research 102nd Annual meeting, Orlando, FL, April.

Schneider, J., Gutstein, L., Shrivastava, V., and Vigodner, M., 2011, SUMO proteins May regulate head reshaping, capacitation, and stress response in human sperm, Columbia University Undergraduate Research Symposium, Spring

Gross, J., Ennis, R.D., Homel, P., Evans, A., Gliedman, P., Choi, W., Hu, K., Shasha, D., Harrison, L.B., and S. Fleishman, 2010, The rapid increase in radiation oncology consultation and treatment of the extreme elderly and its independence from population growth, America Society for Radiation Oncology (ASTRO) Annual Meeting.

Marinkovic, N., Wang, Q., Barrio, **Cooper**, C., and Frenkel, A.I., 2010, Synchronous XAFS/DRIFTS Study of CO adsorption on Al2O3-supported Pt clusters The First North American Core Shell Spectroscopy Conference, Denver, CO.

Donington, J.S., Blasberg, J.D., Goparaju, C.M.V., **Hirsch, N.**, and Pass, H.I., 2010, Molecular heterogeneity of osteopontin Isoforms in non-small cell lung cancer, American Association of Cancer Research, International Association for the Study of Lung Cancer Joint Conference on Molecular Origins of Lung Cancer, Coronado, CA.

Goparaju, C., Donington, J., **Hirsch, N.**, Harrington, R., and Pass, H.I., 2010, EphB2 expression parallels malignant behavior in mesothelioma, American Association of Cancer Research, 101st Annual Meeting, Washington, D.C.

Donington, J.S., Goparaju, C.M.V., Blasberg, J.D., **Hirsch, N.**, Harrington, R., Pass, H.I., and Neubert, T., 2010, Extracellular mediation of divergent impact of OPN splice variants in non-small cell lung cancer, Osteopontin Biology, FASEB Summer Research Conference, Steamboat Springs, CO.

Donington,. J.S., Blasberg, J.D., Goparaju, C.M.V., **Hirsch, N.**, Harrington. R., and Pass, H.I., 2010, Argatroban inhibition of osteopontin modulates isoform specific malignant properties in non-

small cell lung cancer. 10th Targeted Therapy meeting, Santa Monica, CA (presented but not published).

Gross, J., Ennis, R.D., Homel, P., Evans, A., Gliedman, P., Choi, W., Hu, K., Shasha, D., Harrison, L.B., and S. Fleishman, 2010, The rapid increase in radiation oncology consultation and treatment of the extreme elderly and its independence from population growth, America Society for Radiation Oncology (ASTRO) Annual Meeting.

Horowitz, D. and Dilorenzo, T., 2010, The efficacy of hypnosis in pediatric cancer care, Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference

Stiefel, E. and Freyberg, R., 2010, Trying to remember: A literature review about improving eye-witness testimony, Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Rollhaus, E. and Freyberg, R., 2010, An analysis of the effects of altering directives in narrative therapy, Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Scholl, C. and Dilorenzo, T., 2010, The issue of "faking good" on self report personality measures in personnel selection, Ferkauf Graduate School of Psychology, Behavioral Sciences Student Research Conference.

Zitter, S., Bryk, D., Fox, A., Narlieva, M., Pan, Q., Chang, T., Cloherty, G., and Lucic,D., 2010, Swine influenza or seasonal influenza? The first clinical adaptation of an automated open platform for swine influenza. The Montefiore experience, Young Research Investigators Symposium at Montefiore Medical Center, Bronx, NY, **third place winner.**

Shrivastava,V., **Miller, R., Lazaros, S.H.,** and Vigodner, M., 2010, Sumoylation as a sensitive marker of a tobacco-induced oxidative stress in the testis, FAMRI meeting, Miami, Florida (May)

Deluty, J., Seto, J., and Sealfon, S., 2010, Elucidating the signaling pathways of the immune response in monocytes, Columbia University Undergraduate Research Symposium, Spring.

Dinerman, J. and Santos, L.F., 2010, Controlling the Evolution of a Quantum System with Dynamical Decoupling Methods, Oral presentation, March Meeting, American Physical Society, Portland, OR.

Holz, M.K., **Seligman F.F., Spiegel T.N.,** and **Maruani D.M.,** 2010, Estrogenic regulation of S6 kinase 1 expression creates a positive feed-forward loop in control of breast cancer cell proliferation, AACR 101st Annual Meeting, Washington, DC.

Huisman, T. and Hodgson, L., 2010, Spectral modification to genetically encoded single-chain RhoA biosensor, 239th National Meeting, American Chemical Society, San Francisco, CA

Liebling, E.J., Asenjo, A.B., De Paoli, V.M., Rath, U., Sharp, D. J., and Sosa, H., 2010, Interactions between microtubules and kinesin-1,3, 239th National Meeting, American Chemical Society, San Francisco, CA

Mintzer, E., and **Rogawski, R.,** 2010, Elucidating the interaction of LPA with model membranes, Columbia University Undergraduate Research Symposium, Spring.

Solodokin, L.J., **Canter, A., Freilich, A., Haken, O., Ovits-Levy**, C.G., Schuck, A.S., and Babich, H., 2010, Anticarcinogenic and prooxidant properties of pomegranate juice extract and olive fruit extract, Columbia University Undergraduate Research Symposium, Spring.

Weiss, R.S., Zhang, C., and Cuervo, A.M., 2010, Identification of markers for autophagy in serum, 239th National Meeting, American Chemical Society, San Francisco, CA

Yamnik, R.L. and Holz, M.K., 2009, mTOR/S6K1 and MAPK/RSK signaling pathways coordinately regulate estrogen receptor alpha serine 167 phosphorylation, Cancer Res., 69:A31S

Holz. M.K., **Digilova, A., Yamnik, R., Davis, D.,** Murphy. C., and **N. Brodt**, 2009, Estrogen receptor alpha is a target of mTOR/S6K1 signaling in control of breast cancer cell proliferation, Cancer Res. 69:269S (abstract).

Bellman, A. and DiLorenzo, T, 2009, The association between feminism, religiosity, and psychological well-being in Jewish women, Yeshiva University Behavioral Sciences Student Research Conference.

Ganz, D, and DiLorenzo, T, 2009, Comorbid suicidality and alcohol abuse in adolescents: Etiologic factors, Yeshiva University Behavioral Sciences Student Research Conference.

Hanau, T. and DiLorenzo, T, 2009, Etiology and treatment of bulimia nervosa, Yeshiva University Behavioral Sciences Student Research Conference.

Hazan, R. and DiLorenzo, T, 2009, Prolonged/imaginal exposure in PTSD: A literature review, Yeshiva University Behavioral Sciences Student Research Conference.

Hazan, R. and R. Freyberg, 2009, Victim of the act or the offender? Exploring the emotional and psychological responses of sexual assault and rape victims based upon the victim-offender relationship, Yeshiva University Behavioral Sciences Student Research Conference

Miller, R. and Harburger, L, 2009, Does Ben Franklin Effect increase with effort? Yeshiva University Behavioral Sciences Student Research Conference

Reichman, D. and DiLorenzo, T, 2009, Influence of family support on PTSD in children, Yeshiva University Behavioral Sciences Student Research Conference.

Rollhaus, E., and R. Freyberg, 2009, Directives in Narrative Therapy, Yeshiva University Behavioral Sciences Student Research Conference

Sonenberg, R. and DiLorenzo, T, 2009, A review of the literature on the psychological effects of 9/11 in children, Yeshiva University Behavioral Sciences Student Research Conference.

Spiegel, T. and DiLorenzo, T, 2009, Does MRI screening have a negative psychological effect on women who carry the BRCA gene? Yeshiva University Behavioral Sciences Student Research Conference.

Stiefel, E. and R. Freyberg, 2009, The multi-faceted Jew: A study on the integration of the interdependent self and the independent self in Jews in America, Yeshiva University Behavioral Sciences Student Research Conference

Dinerman, C., Keller, and B. Herold, 2009, Genital secretions confer anti-*E. coli* activity, Montifiore Pediatric Research Day, 1St prize for a student poster.

Dukesz, F., **Zilbergerts, M.,** and L. F. Santos, 2009, Interplay between interaction and (un)correlated disorder in Heisenberg spin 1/2 chains, March Meeting of the American Physical Society, Pittsburgh

Ackerman, N.J., Burekhovich, F., Schuck, A.G., Zuckerbraun, H.L., and H. Babich, 2009, Gingko biloba leaf extract induces oxidative stress in HSC-2 carcinoma cells, Columbia University Symposium of Undergraduate Research, Spring. (abstract and oral presentation).

Ruderman, E., Zack, E., and A.G. Schuck**,** 2009, Antitumorigenic and prooxidant activities of blueberry extract to human oral cancer cells, Columbia University Undergraduate Research Symposium, Spring. (abstract).

Bromberg, M.R., Patolla, A., Wang, O., Segal, R., Han W.-Q., Feldman, I., Zypman, F.R., Iqhal, Z., and A.I. Frenkel, 2009,

Platinum nanoparticles on SWNT nanopaper support: Synthesis, characterization, and application in electrocatalysis, The 237th American Chemical Society Meeting, Salt Lake City, Utah, March (abstract)

Charles, G., and E.A. Mintzer, 2009, Comparison of the behavior of native cholesterol and two oxidized cholesterol derivatives, The 237th American Chemical Society Meeting, Salt Lake City, Utah, March (abstract)

Charles, G. and E.A. Mintzer, 2009, Oxysterols alter the propensity of lipid raft formation in model membranes, Columbia University Undergraduate Research Symposium, Spring. (abstract).

Herzberg, B.M., Ting, L.-M., Mwakingwe, A., Croken, M.M., Madrid, D., Hochman, S., and K. Kim, 2009, Genetic studies of adenosine deaminase in the rodent malaria parasites, *Plasmodium yoelii* and *Plasmodium berghei*, The 237th American Chemical Society Meeting, Salt Lake City, Utah, March (abstract)

LeVee, A.J., and E.V. Prodan, 2009, Molecular electronics: Tunneling devices with semiconducting leads, The 237th American Chemical Society Meeting, Salt Lake City, Utah, March (abstract)

Liebling, E., Burger, R.F., Zuckerbraun, H.L., Schuck, A.G., and H. Babich, 2009, Protective effects of pyruvate through mediation of oxidative stress, Columbia University Symposium of Undergraduate Research, Spring (abstract).

Merzel, M., Grace, M., and M. Balwani, 2009, Development and validation of a dried blood spot assay for chitotriosidase, an important biomarker for Gaucher Disease, The 237th American Chemical Society Meeting, Salt Lake City, Utah, March (abstract)

Pekar, M., Grosser, E., Goodfriend, G., Im, J. and M.Vigodner, 2009, Stress-induced response and apoptosis in germ and somatic testicular cells: involvement of SUMO proteins, Columbia University Symposium of Undergraduate Research, Spring (abstract).

Schiffmiller, A., Rapp, C., Kalyanaraman, C., and M. Jacobson, 2009, Theoretical ranking of a congeneric series of protein kinase inhibitors, Columbia University Symposium of Undergraduate Research, Spring (abstract).

Holz, M.K., **Digilova, A., Yamnik, R., Davis, D**., Murphy, C., and **N. Brodt,** 2008, The role of S6 kinase 1 in breast cancer, San Antonio Breast Cancer Symposium

Atlas, A., McCarthy, J.W., and M. Feldmesser, 2008, *Aspergillus fumigatus* proteins bound by a germination-inhibitory monoclonal antibody, National Meeting of the American Chemical Society, New Orleans, LA.

Bellman, A. and T. DiLorenzo, 2008, Gender Identity Disorder: A review of the literature. Ferkauf Graduate School of Psychology Behavioral Sciences Student Research Conference

Blau, L., Estes, D**., Seleski, N.** and **S.A**.**Guigui,** 2008, Stabilizing of deoxyoligonucleotide duplexes by base stacking, National Meeting of the American Chemical Society, New Orleans, LA.

Clark, E., Seideman, J., Silverman, J., Gardner, J., Scheinberg, D.A., and J.H.Weisburg, 2008, P-Glycoprotein independent resistance to oxidative stress in leukemia cells, National Meeting of the American Chemical Society, New Orleans, LA.

Dukesz, **F.,** Frenkel, A.I., Bromberg, M.R.,Wang, O., Asherie, N., Blass, S., Rafailovich, M.H., Sun, Y., and J. Kang, 2008, Comparing various methods of synthesis and analysis of gold nanoparticles, National Meeting of the American Chemical Society, New Orleans, LA.

Fathy, J., Seleski, N., Dinerman, E., and M.Vigodner, 2008, Expression of SUMO protein in normal testicular cells and germ cell tumors, Columbia University Spring Undergraduate Research Symposium.

Feldman, A., Benichou, C., Skop, N., and M.Vigodner, 2008, Heat-induced stress response in germ and somatic testicular cells:

involvement of SUMO proteins, Columbia University Spring Undergraduate Research Symposium

Freyberg, R., and **M**.**Bensoussan,** 2008, The impact of fragrance on social Relationships. Poster presented at the 2008 Biannual Conference on Human Development, Indianapolis, IN.

Freyberg, R., **Bensoussan, M.,** and A. **Silver,** 2008, Disruption of olfactory environment impacts close relationships in young women. National Meeting of the International Symposium of Olfaction and Taste, San Francisco, CA.

Greer, D. and R. Freyberg, 2008, Personality type as a predictor of religious identity and conflicts, Yeshiva University Behavioral Sciences Student Research Conference

Guigui, S.A., House, R., Dulyaninova, N. and A. Bresnick, 2008, Characterization of a scfv to non-muscle myosin-II, National Meeting of the American Chemical Society, New Orleans, LA.

Hazan, R., and T. DiLorenzo, 2008, Treatment methods for PTSD: A literature review, Yeshiva University Behavioral Sciences Student Research Conference

Herzberg, B.M., Ramjeawan, R., Sun, Y., Frenkel, A.I., and M. Rafailovich, 2008, Characterizing protein and folate coated nanoparticles and analyzing their toxic effects on cancerous and normal keratinocytes, National Meeting of the American Chemical Society, New Orleans, LA.

Liebling, E.J., Gottesman, R.T., Citrin, N.S., and H. Babich, 2008, Prooxidant ability of black tea flavin monogallates: studies with carcinoma and normal cells, Columbia University Spring Undergraduate Research Symposium.

Oxman, H., and T. DiLorenzo, 2008, Validity of MMPI-2 L scores in Orthodox Jewish undergraduate females. National Meeting of the American Psychology Association, Boston, MA.

Raviv, T., Digilova, A., and A. Schuck, 2008, Synergistic interactions between black tea theaflavins and chemotherapeutics in oral cancer cells, Columbia University Spring Undergraduate Research Symposium. (Note: **Tehilla Raviv and Alla Digilova** also presented this research as an oral presentation).

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Sedletcaia, A. and P. Cohen, 2003, Localization of PMS2 in meiotic cells, 225th National Meeting of the American Chemical Society, New Orleans, LA.

Josovitz, J., Verdier-Pinanrd, P. and S. B. Horwitz, 2003, Analysis of stathmin andMAP- 4 content in taxol resistant cell lines, 225th National Meeting of the American Chemical Society, New Orleans, LA.

Gamss, C.A., Ting, L.-M., and K. Kim, 2003, Inhibition of the purine salvage pathway in *Plasmodium falciparum*, 226th National Meeting of the American Chemical Society,NY, NY.

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DiLorenzo, T, Halper, J, Piccone, MA and **A**. **Lasky,** 2001, Aging with multiple sclerosis: A preliminary investigation. National Consortium of Multiple Sclerosis Centers, Ft. Worth, TX.

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Marton, D., Kang, Y.H., and F. Berthiaume, 2000, Chronic exposure to cytokines suppresses liver-specific function of cultured hepatocytes, 219th National Meeting of the American Chemical Society, San Francisco, CA.

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Ambalu, M. and L. Blau, 1986, The study of ion fluxes across lipid bilayers, 191st National Meeting of the American Chemical Society-7th Student Affiliates Research Symposium, NY, NY.

Gutman, E.A. and L. Blau, 1985, X537A-mediated transport of calcium across phosphatidylcholine bilayers, 189th National Meeting of the American Chemical Society - 6th student Affiliates Research Symposium, Miami Beach, FL [E.A. Gutman was awarded 1st prize, Biochemistry Section].

Blau, L., **Stern R.B**., Wun, T.C., and R._Bittman, 1984, Calcium transport across phosphatidylcholine vesicles, 8th International Biphysics Congress, Bristol. United Kingdom.

Student Presentations at the National Conference of Undergraduate Research

1998: **Malka Skiba** and **Cheryl Younger**

1995: **Lauren Insel** and **Judy Ehrenberg**

1994: **Yaffa Cheslow**, **Debbie Friedman**, and **Stacey Tuckman**

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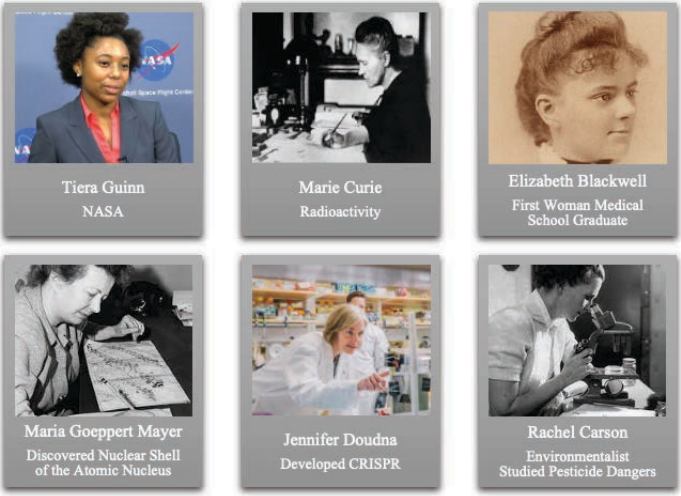
WOMEN IN SCIENCE



Abstract Booklet

Retinitis Pigmentosa: A Cell-based Method and Modeling Approach

By: Nicole Abittan[1], Tamara Pluchenik[2], Tova Florans[3], Meyer Ghanimeh[4], Sara Chemel[1]

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Retinitis Pigmentosa (RP) is a genetic disorder of the retina, the light-sensitive layer of tissue in the back of the eye which receives and organizes visual information. Retinas of individuals with RP gradually degenerate, resulting in loss of peripheral and night vision, constriction of the field of vision, and sometimes blindness. Finding the causative gene can be complicated, as there are over 100 genes that can cause RP, almost 3,100 mutations within these genes, and genetic approaches are unsuccessful at least 25% of the time.

Our research studies a patient with RP, along with eight immediate family members (siblings and parents) of the patient. Genome sequencing showed no known or suspicious causative variants, prompting us to speculate that the cause can be epigenetic or in RNA, a hypothesis which can only be studied with cell-based methods. The lab therefore selected a cell-based approach, monitoring differences in morphology, growth rate, and differentiation process of the cells of the patient and family members.

Skin biopsies were taken from the patient and all immediate family members, allowing for the establishment of primary fibroblast cell lines. The fibroblasts were then reprogrammed into induced pluripotent stem cells (iPSC). Karyotyping of the iPSC ensured the presence of a full set of chromosomes for each family member, with no genetic material lost along the way. iPSC were differentiated into both retinal pigment epithelial cells (RPE) and retinal organoids.

RPE, a layer of specialized cells below the sclera and choroid of the retina, is supportive of the function of photoreceptors. The lab is

awaiting results of RPE sent for RNA sequencing. Upcoming analysis of the RNA, up and down-regulated genes, differences in isoforms, and mutations within the RNA may lead to the possible problem.

Organoids, a three-dimensional mass of cells resembling an organ, can be useful in modeling. Retinal organoids were grown in the lab. After DAPI stained nuclei confirming cells were present, the organoids were stained with various primary antibodies verifying that the organoids developed successfully. Ongoing analysis of the organoids is useful, as organoids develop in three-dimensional time and space and resemble the *in vivo* biological state more closely. Retinal organoids evolve different cell types of the retina such as photoreceptors, which is often the location of RP, and can therefore be helpful in identifying the cause of the disease and eventually its therapeutics.

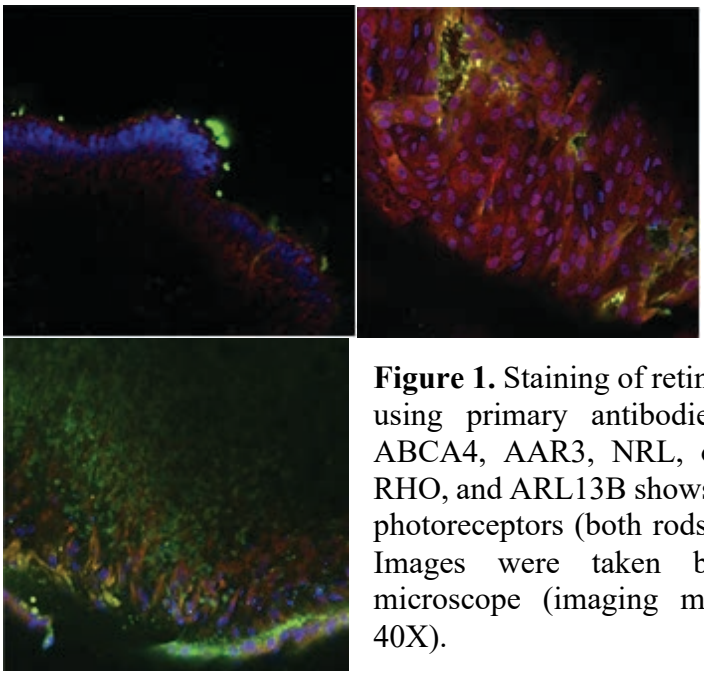


Figure 1. Staining of retinal organoids using primary antibodies including ABCA4, AAR3, NRL, opsin, PNA, RHO, and ARL13B shows presence of photoreceptors (both rods and cones). Images were taken by confocal microscope (imaging magnification: 40X).

Through various experimentation, the lab is gradually eliminating specific genes as the cause of this patient's RP. For instance, in the upcoming experiment of ciliary analysis of starved fibroblasts,

examination of ciliary compositions and measurements of all family members might provide insight into if ciliary genes should become a focus.

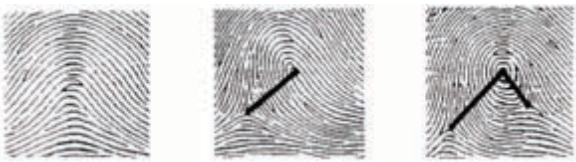
Although our research is ongoing, early results look promising. We hope to not only pinpoint the causative gene(s) and intervene before the patient's retina reaches an ischemic state, but to also attempt to reverse damage through targeted cell therapies. While it was previously thought that retinal degeneration is irreversible, recent stem cell research shows that the conditions of individuals with diseases such as retinitis pigmentosa, macular degeneration, and Stargardt disease may have possibilities for improvement.

Exploring the Fingerprint Total Ridge Count in Jewish Females

By: Gavriella Jutan and H. Babich Stern College for Women, Department of Biology, New York, NY 10016

Fetal fingerprint pads are evident at the 6th week of gestation and reach their maximum size by week 12 or 13, after which they regress, giving rise to elevated dermal ridges. These ridges remain permanent from the 19th week of pregnancy and remain consistent as the child grows.

The dermal ridges form one of three basic patterns: arch, loop, and whorl (Fig. 1). The arch is the simplest and least frequent pattern; it lacks a core and a triradius. The loop pattern has a core (a ridge that is surrounded by a field of ridges that turn back on themselves at 180 degrees) and a triradius (the point at which three dermal ridges, arising from three directions, merge at angles of approximately 120 degrees). The whorl pattern has a core and two triradii. Although the fingerprint pattern is under polygenic control, environmental factors that influence friction in the womb can influence a fetus's fingerprint pattern. These factors include the density of the amniotic fluid and the fetus's size, location, and movement pattern. The fingerprint pattern varies for each finger and differs among individuals, including identical twins. Hence, fingerprint pattern is used in forensics for the identification of individuals.



arch loop whorl

Fig. 1. Three principal types of fingerprint patterns.

A ridge count (RC) is the number of ridges (dermal lines) intersected if you were to draw a line from the core to the triradius. An arch lacks a triradius and is scored with a RC value of zero. For a loop,

the RC is scored from the core to the radius, and for a whorl the RC is scored from the core to the farthest triradius. Each finger has its own unique ridge pattern and RC. The total ridge count (TRC) is the summation of the ridge counts of all ten fingers. TRCs are used often when researching and comparing different populations.

Dermatoglyphics is the study of patterns on fingers, hands, and feet, used especially in forensics. In the 1940 and 1950s, Jews fleeing persecution emigrated from their homelands to the newly formed State of Israel. Studies in Israel in the late 1950s analyzed the fingerprint patterns of 5,000 Jewish males from eight different ethnic groups. The frequencies of whorls and loops in these eight Jewish groups differed from non-Jewish populations in Portugal, England, and Holland. Although Jews differed dermatoglyphically from their former host non-Jewish countries, there was a similarity between Jewish fingerprint patterns and those of non-Jewish populations from the Middle East. Apparently, there is an Eastern Mediterranean gene pool which encompassed all inhabitants of the Middle East [1, 2].

Our study evaluated the TRC values of Stern College for Women undergraduates enrolled in Genetics (Biol 3513) from 1996 to 2022, totaling 1,019 students (Fig. 2). The background of the students varied, and included those of Ashkenazi, Sephardi, and Mizrachi heritage. For this heterogeneous population of Jewish females, the average TRC value was 104.31. Katznelson and Ashbel [3] calculated an average TRC value of 138.21 for 100 female Ashkenazi Jews. Studies of non-Jewish populations have shown TRC values of 127.37 for British females [3], 127.62 for female Germans [4], and 126 and 129 for American females [6]. Research of Jewish [3] and non-Jewish [4-6] populations consistently showed greater TRC values for males than females.

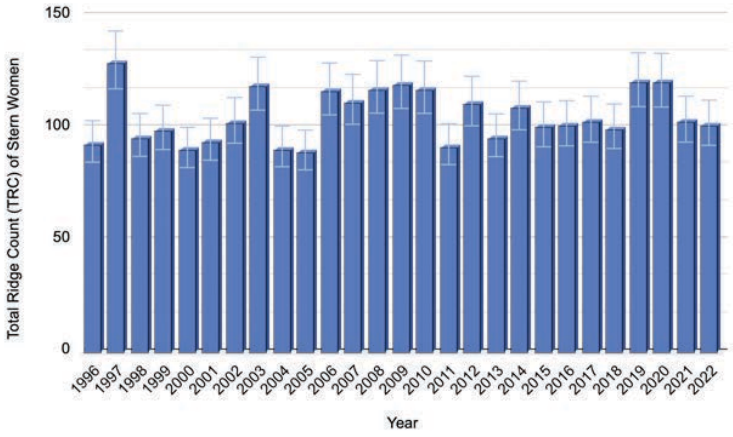


Fig. 2. TRC data for SCW undergraduates in Genetics (BIOL 3513), from 1996 to 2022.

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NMDA Receptors

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N-methyl-D-aspartate ionotropic receptors (NMDAR) are heterotetrameric glutamate gated ion channels in the central nervous system, essential for memory, learning, cell death, and cell signaling. GluN2A is the synaptic subunit of NMDAR associated with cell survival, while GluN2B is the extrasynaptic subunit associated with cell death. Excitotoxicity is the damage or death of neurons due to hyperactivation of a receptor caused by a neurotransmitter, most commonly glutamate. Excitotoxicity is dependent on a calcium influx through NMDAR. Hyperactivity of the extracellular NMDAR is associated with the pathophysiology of neurodegenerative disorders such as Parkinson's disease and Alzheimer's. The suggested pathology of these diseases is a decrease in astrocytic function; for example, they are less able to reuptake glutamate, which leads to excitotoxicity that results in a spillage of glutamate that leads to cell death as it disrupts the balance of extrasynaptic to synaptic activity as extrasynaptic are activated.

The use of NMDAR general agonists has failed due to the dual nature of NMDAR in both cell death and cell signaling. The goal of this lab is to develop specific genetic tools to control specific receptor activation in specific cells. One project is to develop a drug specific to extrasynaptic. There are many methods to deliver such a drug to the neurons. This drug is in the form of a toxin, which will be tethered to the plasma membrane of the NMDAR so that the cell can self-regulate the toxin released to stabilize calcium levels.

HEK-293T and *Xenopus* oocytes were utilized as the heterologous expression system to isolate the different receptor subtypes. The reaction of the cell was then tested by two electrode voltage clamps or whole cell patch clamp systems.

For experimental purposes, neurons removed from the hippocampus of three to five day old mice were utilized to examine the physiological effects of the toxin or protein. Neurons were tested by whole cell patch clamp systems. A cell viability assay was performed to check that the toxin protects the cell of excitotoxic insult.

Our research hopes to further the pharmacological pursuit of treatments of neurodegenerative diseases such as Parkinson's disease and Alzheimer's disease.

Producing the doubly-labeled α-synuclein of yesteryear: a pathway to truly differentiating the dynamics of intrinsically disordered proteins

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Parkinson's disease (PD), as well as other neurodegenerative diseases, are usually associated with one dynamic, ever-elusive protein – α-Synuclein (α-syn). α-Syn, 140 amino acids in primary chain length, tends to aggregate into ordered fibrils becoming the primary component of Lewy bodies, protein deposits that serve as the main pathophysiological phenotype in PD. α-Syn is expressed in everyone's brains, as well as in other cell types, such as in certain blood cells. The tendency of α-syn to form fibrils in some cells versus others remains a mystery. It is known that α-syn is an intrinsically disordered protein (IDP), or a protein known to undergo very rapid conformational transitions. Using single molecule Förster resonance energy transfer (smFRET), Deniz and co-workers, a decade before Sculer and co-workers, identified that α-syn undergoes such conformational transitions in as fast as a few hundreds of nanoseconds (ns). Recently in the Lerner lab, measurements were conducted using single-molecule photoisomerization-related fluorescence enhancement (smPIFE). smPIFE provides information on conformational changes at a spatial scale shorter than smFRET does (i.e., <3 nm versus 3-10 nm). The results indicated that in fact, there were local structural dynamics on the order of milliseconds (ms), not just ns. The Lerner lab developed a new analytical framework for smFRET that is more sensitive to

ms dynamics, so the experiments of Deniz and co-workers could be reproduced with sensitivity to ms dynamics. Therefore, the doubly-labeled α-syn that previous labs used in smFRET measurements had to be reproduced. This is easier said than done, especially considering there seemed to be some gaps in the published protocol. We needed to attempt to reproduce the doubly-labeled α-syn of years ago, as preparation to re-analyze the conformational dynamics of α-syn with the new techniques. By doing this, we can hopefully carve a pathway to understand how IDPs (the suspects of involvement in development of PD and other diseases) truly work.

For FRET to be achieved, we needed to attach two fluorophores to α-syn to act as little flags for analyzing the conformation based on the distance between these flags. The fluorophores attach to cysteines, so we used a slightly modified α-syn with cysteines at positions 18 and 91. α-Syn was produced and purified, then mixed with Thiol-reactive dyes, with a very high dye to protein ratio. The free dye then had to be filtered out. Several different filtration/purification methods were used at different points along the protein dye labeling trial process, including dialysis (before and after dye labeling reaction), ion exchange, desalting, and size exclusion chromatography (SEC). Each method came with their own unique drawbacks, as sometimes not enough dye was filtered out and in other instances the protein stuck to the filter. Fluorescence correlation spectroscopy (FCS) was implemented on the protein using a confocal laser scanning microscope. Fluorophores' excitation drove them to emit bursts of light particles (photons) at high rate (hundreds of KHz), allowing us to observe the relationship between bursts of donor and acceptor photons. If cross correlation was observed between the donor and acceptor photon detection channels, then we had confirmation a fraction of the proteins in solution was doubly-labeled, else it was singly labeled protein or free dye. By repeating this process multiple times, we found that using dialysis and SEC was the most efficient way to gain at the end

a protein that carried the least amount of free dye and had a cross correlation measurement in FCS (Figure 1).

With the doubly labeled α-syn protein acquired, we needed to check if there was, in fact, FRET. FRET occurs when the excitation energy of the donor dye is transferred non-radiatively to the acceptor dye. Therefore, a burst of photons will appear in the acceptor detection channel as well as the donor detection channel. Using a Python package dubbed FRETbursts, we were able to analyze the data acquired from the microscope from multiple different angles. We did find FRET was occurring, so we were then able to attempt to analyze the conformational dynamics of the protein. The tell for a dynamically transitioning α-syn is a transition in the donor and acceptor burst characteristics, within a burst. If close together, the bursts from the acceptor will include more photons than from the donor, while if farther apart, the bursts from the acceptor will include less photons than from the donor. The data was run through burstH^2MM, a new package developed in Python by Dr. Paul Harris of the Lerner lab, to analyze the conformational dynamics of the FRET data (Figure 2).

With the newly acquired doubly labeled α-syn, the Lerner lab hopes to contribute to the multiple studies conducted on α-syn, and on IDPs in general.

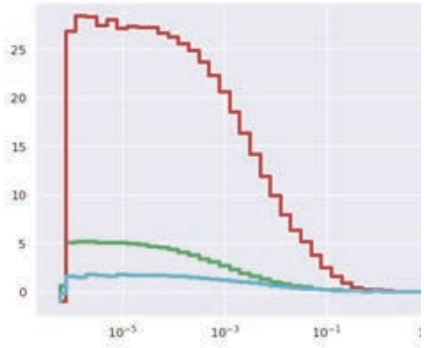

Figure 1: Autocorrelation and cross correlation of the donor and acceptor channels

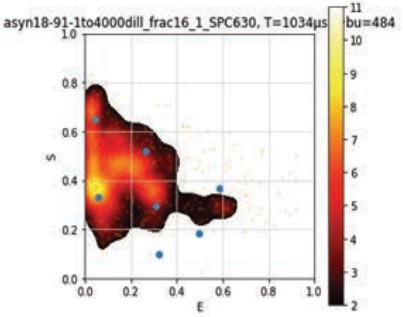

Figure 2: Early data for burst efficiency (E) versus stoichiometry (S) for the alpha-synuclein, acquired using FRETbursts and burstH^2MM

Mapping the Molecular Basis of Protein E2F8 Using NMR Spectroscopy

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Regulatory proteins control the occurrences of various cellular functions. When a protein is regulated, it means that sometimes it will perform a certain function, while other times it will not perform this function, depending on the organism's needs. The more an organism can regulate its various functions, the more adaptive it can be, which makes it more efficient and powerful.

One common method of regulation in proteins is known as phosphorylation. When a ribosome creates a protein in the cell, it builds a specific sequence of amino acids that will then undergo various levels of folding to form the complete protein in its proper form. Out of the 20 amino acids, only serine, threonine, and tyrosine have a hydroxyl group. Phosphorylation occurs when a phosphate group reacts with a hydroxyl group, which means that only these three amino acids have the potential to be phosphorylated. When these amino acids are phosphorylated, the behavior of the protein can change. However, phosphorylation is a reversible process; the enzyme kinase adds phosphate groups, while the enzyme phosphatase cleaves off phosphate groups. Because the phosphate group can be taken on and off, phosphorylation is a typical mechanism for regulation.

The specific focus of this project is the protein E2F8, which belongs to the E2F family of transcription factors that are involved in regulating the processes in the cell cycle that determine whether cells will continue to mitosis or apoptosis. However, the mechanism by which E2F8 operates remains unclear. Therefore, the ultimate

goal of this project is to lay down the molecular basis for what happens in the cell, specifically focusing on the mechanism of E2F8. E2F8 has 8 different sites where phosphorylation can occur, and it was found by previous researchers that the phosphorylation series seem to go in a specific order. This cascade of phosphorylations is another layer of regulation because a certain amino acid can only be phosphorylated if a separate amino acid is phosphorylated first. It is the goal of this project to map out the cascade of phosphorylations and to uncover how the various phosphorylation sites affect each other.

To accomplish these goals, an amino acid, threonine, at position 44 was changed to the amino acid, alanine. Alanine does not have a hydroxyl group, so this site no longer had the potential to be phosphorylated. The purpose of this mutation was to see if this phosphorylation has an effect that propagates to other, seemingly unrelated, phosphorylation sites. By using NMR (nuclear magnetic resonance) spectroscopy to observe the effect of this mutation, we can see if there is a connection between the sites. When the sample is loaded into the NMR spectrometer, the positions of the hydrogens and nitrogens are displayed, and based on this we can see whether a site has been phosphorylated. We can see the differences in the NMR spectrum with and without the mutation and based on chemical shifts we can see if the phosphorylations of other sites were affected by the mutation. The NMR spectrometer allows us to see the specific position of the phosphates, which gives us insights into the mechanism of the protein.

To conduct the experiment, other researchers created plasmids with the various mutations and an antidote to a specific antibiotic. These plasmids were inserted into bacteria, and the bacteria was grown on plates that contained the antibiotic. Therefore, the bacteria were only able to grow on the plates if the plasmid was successfully inserted into the bacteria. This antibiotic selection allowed us to be sure that only colonies that contained the desired DNA were collected. The

colonies were then grown, and IPTG was added to make the cells produce the desired protein. An SDS gel was run to show that the desired protein was being expressed (Figure 1). A miniprep was also done to extract the DNA out of the bacterial colony, and this DNA was sent to be sequenced. This sequence showed that the mutation was present because the codon for threonine was changed to the codon for alanine.

Once the experiment proved successful on a small scale, purifications were carried out on a large scale. To do this, the cells were first lysed and loaded onto a nickel column to extract the desired protein from the bacteria. Then the His-Tags that were still attached to the protein were cleaved using TEV enzyme, and the sample was loaded onto the nickel column again to separate the protein from the His-Tags. HPLC was then used to separate the peptides and the proteins. After this process, the sample was ready to be analyzed using the NMR spectrometer.

The obtained NMR spectrum (Figure 2) shows that we succeeded in making T44A which is an important reagent in the process of discovering the role of different phosphorylations and their order. The next step is to see whether this change influences other phosphorylation sites.

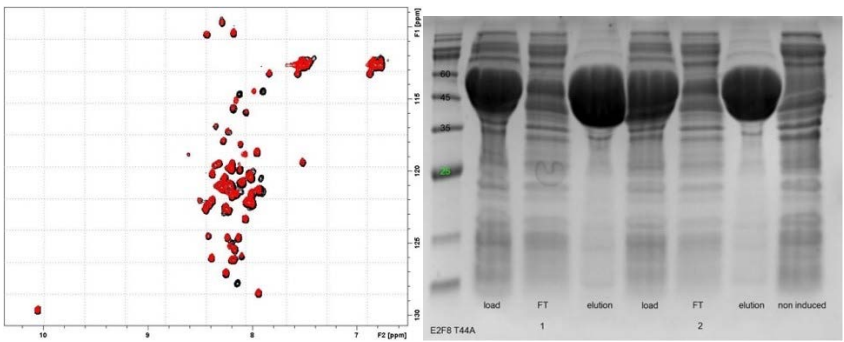

Figure 1. SDS gel showing expression

Figure 2. NMR spectrum of mutation T44A of protein E2F8 (black) and wildtype (red)

Maintenance of Sexual Desire in Long Term Couples

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When approaching the area of relationship research, specific factors must be evaluated within long term couples. For long term couples the sexual relationship is essential for personal well-being as well as overall satisfaction within the relationship. Despite the need for desire within relationships, little is known regarding the factors which help maintain desire within long term relationships. The current project examines the role of certain manifestations of separateness and interdependence between romantic couples in the maintenance of sexual desire in romantic relationships.

Using the Self-Determination Theory (SDT) model, couples are evaluated in three domains- autonomy, competence, and relatedness. Autonomy is the ability to maintain individuality and have self-governance. Competence is the ability to feel capable to overcome challenges when they arise. Relatedness is the ability to feel loved and cared about. Individuals fulfill these needs to varying degrees for their partners. The associations between fulfillment of each SDT factor and relationship satisfaction may differ, and still need to be evaluated.

Another variable which may encompass an experience of dependence and interdependence is a sense of relational power. Power is the partner who possess the greatest amount of dominance within the relationship.

Both the SDT needs as well as relational power will be analyzed alongside intimacy and sexual desire. Intimacy is closeness between couples, both verbal and non-verbal, which does not necessarily have a sensual nature. In contrast, sexual desire is inherently intertwined with sensuality.

Using the Self Determination and Power theories, Professor Rafaeli evaluated long term romantic partners. Specifically, we sought to see if these domains correlate with intimacy and sexual desire in relationships. To evaluate these factors, we coded videos of long-term heterosexual romantic partners. In the videos, couples discussed how they've changed throughout the relationship as well as a conflict in their relationship. Through both verbal and non-verbal communication, the couples' dynamics were noted.

The coding scheme consisted of various variables including SDT needs, power, intimacy, and sexual desire. The SDT variables were defined in the context of fulfilling their partner's needs. Autonomy is supporting wishes and attitudes of their partner and allowing them to speak freely. Overall, the partner supports the various aspects of their partner's individuality. Competence is the ability to support their partner through listening and offering examples of when their partner has succeeded in life. Relatedness is the partner referring to themselves in terms of couple, i.e., saying 'we', as well other signs of closeness such as smiling or physical touch. Power was evaluated in the context of which partner appears to win arguments and their opinions dominate the conversation. Intimacy is displaying signs of vulnerability by sharing personal feelings as well as physical closeness. Sexual desire manifests through touch in a sensual matter as well as flirtatiousness.

The correlational data will reveal which SDT needs are linked to maintaining sexual desire within long term romantic couples. These results can impact long term sexual relationship counseling in the

future by providing empirical data for aiding couples repair relationship by identifying which needs are not sufficiently fulfilled.

Meta Analysis: Effects of Exclusion on Individuals with BPD

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Interpersonal connections are essential for the emotional and psychological wellbeing of all individuals. From an evolutionary standpoint, social rejection is seen as a threat to human survival, causing psychological distress and even physical pain. In 2009, Williams suggested that the immediate impact of exclusion (*Reflexive Stage*) is universal and has no variability among individuals (healthy control and psychopathological states alike) [1]. Reinhard, however, suggested that different psychopathological disorders can, in fact, enhance the effects of exclusion. Reinhard describes this interaction between exclusion and psychopathological disorders as a "vicious circle," and proposes that different disorders will lead to different, and possibly even more severe, reactions, as well as less effective coping strategies in response to the exclusion [2]. This more extreme reaction among clinical patients will compromise their ability to socially interact, leading to further exclusion, hence the name–vicious *circle*. This gap in the research, highlighted by the contrasting views of Williams and Reinhard, emphasizes the importance for further research regarding this topic.

We conducted a meta-analysis which compiled all the results from *Cyberball* research done with individuals with BPD in order to ascertain how much of an effect exclusion has on those individuals as opposed to healthy individuals. *Cyberball* is a virtual ball-tossing game used to manipulate both social inclusion and exclusion in a lab setting. Participants are led to believe that they are playing with two or more other players, when in fact, those players are computer-generated confederates. People diagnosed with BPD are hypersensitive towards rejection, and therefore it is highly relevant

to study how these individuals react to the different conditions they will experience in this game.

By gaining a better understanding on how psychopathological individuals respond to exclusion, we can better characterize the disorder, as well as help those individuals cope with any social rejection they may be encountering.

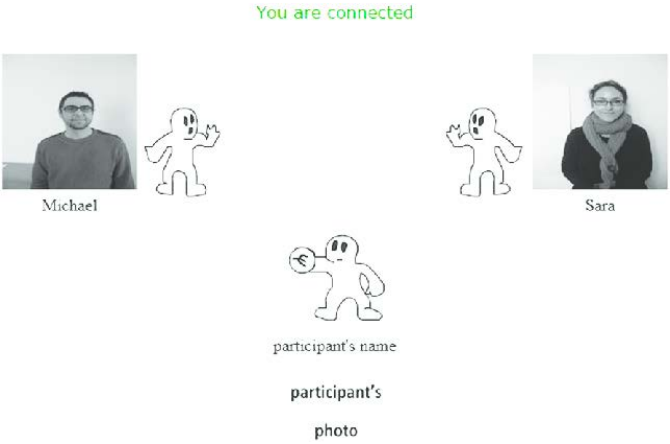

Figure 2. *Cyberball* screenshot of the three players (one participant; two confederates)

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Emotional Congruence and Depression

By: [1]Sharon Khalil, [1]Yaelle Akhavan, [1]Noa R. Atar, [2]Eva Gilboa-Schechtman, [2]Raquel Landau, [2]Itamar Zalkind

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Depression is one of the most prevalent and severe mental disorders today. Due to its prevalence, there is a lack of resources and therapists to help treat all patients. Therefore, the aim of our study was to create an alternative intake resource to be able to treat patients on a need basis. AI is a new possible alternative that can be used to solve this dilemma. Because depression is accompanied by many nonverbal cues, this study works with a *Facial Expression Recognition Software* (FaceReader 9) to determine whether it could be used as a tool in helping diagnose depression [1]. This study runs short intake videos (around 25 minutes) of clinical patients through *FaceReader*, which analyzes the six basic universal facial expressions in order to detect their valence (e.g., happy vs. sad) and arousal (intensity of emotion). The valence and arousal are then compared to the content of speech to determine the level of emotional congruence.

When a healthy individual speaks, the assumption is that the emotion conveyed in the facial expressions are congruent with the emotion conveyed by the content of speech, known as emotional congruence. When the facial expressions do not match the content of speech, there is said to be emotional incongruence, which is associated with an impairment in the individual's psychological functioning and can potentially be indicative of worse mental health [1].

The authors hypothesized that the level of congruence between the different emotional channels (facial expression and content of speech) can contribute to the clinical assessment of depression, even more than the BDI and Hamilton Assessment do; the higher the

incongruence detected by the analysis of *FaceReader* and speech content, the more severe depression an individual may experience. Additionally, the initial level of congruence before therapy begins is expected to predict therapy outcome, as well as symptom severity after the therapy ends.

This study is the first step towards determining whether *Facereader* can be a useful tool in helping diagnose depression more efficiently and promptly, considering the difficulty in gaining access to professional help in a timely manner.

Figure 1. *FaceReader* detecting the valence and arousal.

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The Effect of Glial Activation and Depression in Wild Type and Transgenic Mice

By: Liora Rahmani[1], Gavriella Jutan[1], Yosef Scher[2], Dr. Amit Lotan[3], Yoel Shor[3], Dr. Gilly Wolf[3], Reut Said[3], and Yarden Brock[3]

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Alzheimer's Disease (AD) is a neurodegenerative disease that is characterized by progressive cognitive and physical deterioration that leads to disability and dementia. Depression is a common, episodic, and variable illness that diminishes quality of life and reduces psychological abilities, leading to a variety of emotional and physical problems.

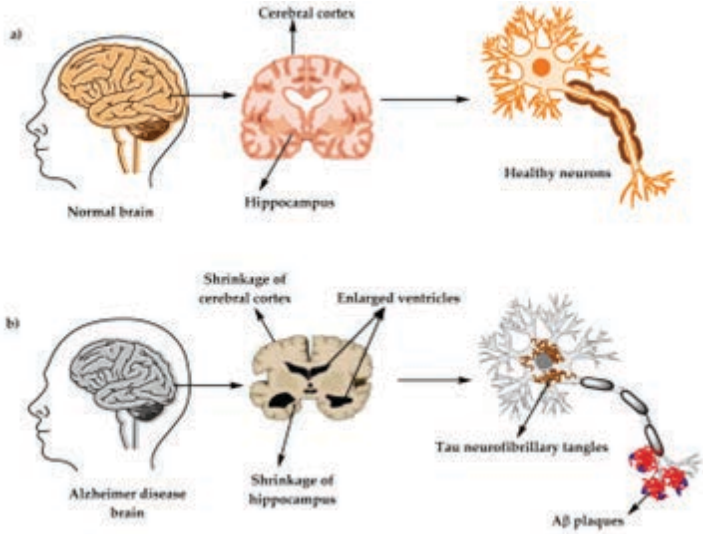

Figure 1: The physiological structure of the brain and neurons in (a) healthy brain and (b) AD brain

Depression is a major risk factor for AD and is highly prevalent among AD patients. 50% of AD patients suffer from depression symptoms and 20-30% suffer from Major Depressive Disease (MDD). The underlying mechanisms that connect both AD and MDD are unclear. As such, the purpose of the experiment was to determine the mechanisms that connect AD and MDD.

It has been hypothesized that neuroinflammation, which is present in both AD and MDD, is a possible link between the two diseases. The present study was designed to test this hypothesis, as it has gained much support in recent years. While both exhibit neuroinflammation, different effects are expressed. In AD, neuroinflammation leads to neurodegeneration, while this does not occur in MDD.

The activation of microglial cells causes neuroinflammation. Microglia possess many physiological functions, as they are essential for synaptic plasticity and neurogenesis. When neuroinflammation occurs, these physiological functions may be affected.

Dr. Amit Lotan's study was designed to test the effect of glial activation and depression in wild-type and transgenic mice. Sixty-four mice were used in the experiment. Half of the mice were transgenic to AD, while the other thirty-two mice acted as the control. The mice were then placed in stressful conditions through the chronic unpredictable stress protocol that consisted of various psychological stressors, which caused their emotions to mimic those of humans with MDD. A series of cognitive behavioral tests were then performed to test the cognitive function of the mice. A series of chronic mild stress (CMS) tests were administered, which included cage tilting, and exposure to many stressors including white noise, flashing lights, light during the night, and predator's urine. The behavioral tests administered included an open field test, various mazes, a fear conditioning test, and a forced-swim test. The different tests targeted different sections of the brain and represented

certain psychological domains, including anxiety, depression, locomotor behavior, and cognition.

The affected brains were extracted and studied. The neurons and microglial cells were counted to compare the differences between the brains of mice with AD and those of wild-type mice, as well as the brain sections of stressed mice and the control group.

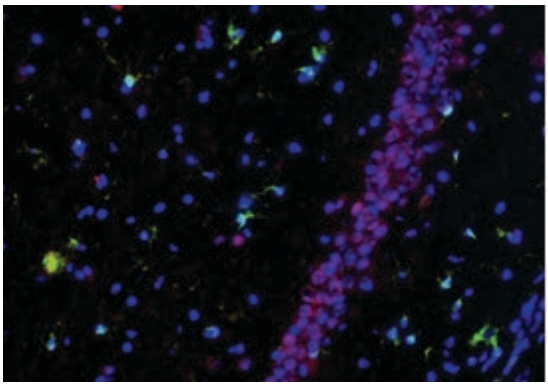

Figure 2: Example of microglia and neurons in segment of stained mouse brain

Dr. Lotan's lab is now studying whether there is an altered function in the brains of the mice that may correspond with an altered function of their behavior. The study is still in progress. It is hoped that the transgenic mice exhibit a greater amount of glial activation and fewer neurons, as this would mean that the chronic unpredictable stress protocols activate glial cells and induces neural decline.

Using RAN-ASO to explore the effects of ASO based therapeutics on fertility related cells in *FMR1* premutation cell line model

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Among the many neurological disorders that emerges from nucleotide repeat expansions (NREs) is Fragile X Syndrome (FXS). In patients expressing the "full mutation', mainstream FXS manifests in the form of mental retardation and intellectual disability. This general disease results from a CGG trinucleotide repeat expansion, above 200 repeats, in the 5' untranslated region (UTR) of the Fragile X gene, *FMR1.* This discrepancy transcriptionally silences the *FMR1* locus and results in the loss of translation of the fragile X protein, FMRP. However, patients who possess CGG repeat expansions between 55-200 repeats likely exhibit FXS sub-disorders, such as Fragile X-associated Tremor/Ataxia Syndrome (FXTAS) predominantly in males, and Fragile X-associated primary ovarian insufficiency (FXPOI) in females.

Fragile X-associated primary ovarian insufficiency (FXPOI) exemplifies one of the many genetic disorders plaguing the fertility world today. Within the pool of *FMR1* premutation carriers about 25% experience fertility challenges[1]. This area of infertility augmented the intense studying of this dilemma and catalyzed many research studies all with hopes to solve this problem.

Researchers established that non-AUG repeat translation (RAN), initiated by the CCG repeats, enables the production of mainly FMRpolyG, which proves a causative mechanism of cell toxicity

and shortened lifespan in male mice premutation carriers[2]. Therefore, we assume a similar cellular process ensues in women, resulting in the production of FMRpolyG which suspectedly causes infertility based on previous Fragile X-associated Tremor/Ataxia Syndrome (FXTAS) findings in male brains[3].

Antisense Oligonucleotide (ASO) based therapy, a process by which single stranded ASO selectively inhibits RNA transcription, may typify a possible therapeutic solution to several genetic disorders. Synthetic ASOs perform two mechanisms of action; RNA cleavage via the recruitment of RNase H1 and RNA blockade, where RNA based ASO binds to the gene of interest, sterically blocking specific segments, and modulation of the RNA splicing and protein translation thus catalyzing a downregulation of the targeted RNA[4]. These processes proved compatible for NREs diseases. With the goal of ceasing RAN translation and its products, mainly FMRpolyG, Rodriguez et al. experimented with ASO based therapy (RAN-ASO), in vitro, in FXTAS cells and neurons[5]. Thus, we aimed to implement RAN-ASO into folliculogenesis related cells with hopes of exploring the effect of ASO based therapeutics on fertility related cells.

To achieve this, we used a *FMR1* premutation transfected cell line (COV434) model. Following gradient concentrations, we assessed RAN translation blockage by Western Blot evaluation of *FMR1* protein expression. First, COV434 cells were cultured for 24 hours at a confluence of 70%. The cells were then transfected with premutaion plasmid (99 CGG and FMRpolyG expression), and, 24 hours later, treated with a gradient of RAN-ASO, using Mirus according to the manufacturer's instructions. After 24 hours, harvesting and protein extraction, using RIPA and a BCA kit for determining concentrations, were performed. The western blot was then carried out, with 35 micrograms of proteins for each treatment, and loaded onto a gel. The material was then transferred to a nitrocellulose membrane and incubated with anti-FMRP (1:5000), anti-FMRpolyG 8FM and 9FM (1:10,000), anti-glyceraldehyde 3-phosphate dehydrogenase (GAPDH) (1:10,000), and anti-Vinculin (1:10,000) as internal loading controls. The membrane was scanned with ChemiDocTM XRS+ imager and the intensity of the bands of

interest was quantified using Image Lab software (Biorad, CA, USA).

Our results indicated elevated endogenous *FMR1* protein levels with a peak of 1.4 fold at 150 and 200nM of RAN-ASO concentration and a decline at 250nm in the disease model, COV434 cells (Figure 1).

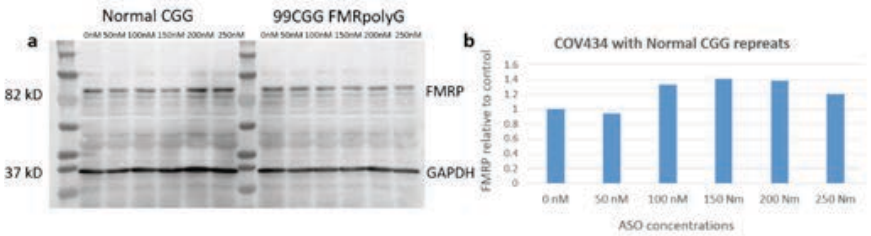

Figure 1. A slight elevation in FMRP expression in COV434 cells with normal CGG number following RAN-ASO treatment.

a. Western blot of COV434 treated with indicated concentrations of RAN-ASO.
b. Quantification of a. FMRP levels relative to GAPDH presented in mean relative to 0nM control.

The results are promising and imply a correlation between FMRP elevation and RAN-ASO treatments in a dose dependent manner. The elevation begins with 50nm and peaks at 150 nm suggesting that the concentrations are cell and treatment dependent. However, we need to repeat these processes twice more to strengthen the claim. In conclusion, assuming FMRpolyG plays a role in FXPOI pathogenesis, RAN-ASO could serve as a potential treatment for *FMR1* premutation carrier fertility and improve future conception.

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Characterization of proteins regulated by sumoylation during mouse meiosis

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According to the World Health Organization, 15% of reproductive-aged couples worldwide are affected by infertility. Although half of these fertility issues are ascribed to the male partner, the cause of most male infertility cases is unknown. While past research has investigated factors that may contribute to male infertility, such as low sperm production and quality, genetic mutations, and certain lifestyle choices, male infertility is a multifactorial condition which makes identifying the precise mechanisms by which it occurs complex. Continued research surrounding the key pathways involved in male infertility, such as the critical regulation of spermatogenesis, is imperative in the development of effective treatment options for infertile males.

Spermatogenesis, the process of producing mature sperm cells, is regulated by an intricate network of protein post-translational modifications (PTMs). This occurs by the addition or removal of molecules through processes such as acetylation, glycosylation, phosphorylation, ubiquitination, and sumoylation. Sumoylation consists of modification by small ubiquitin-like modifiers or SUMO proteins, which are highly expressed in the testes. As displayed in Figure 1, Ginkgolic Acid (GA) was found to chemically inhibit sumoylation and arrest the cell cycle in purified mouse spermatocytes in vitro, with inhibited synaptonemal complex disassembly and reduced spermatocytic chromosome condensing.

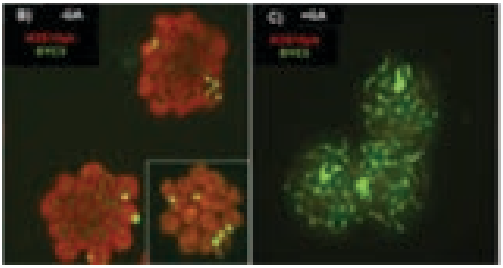
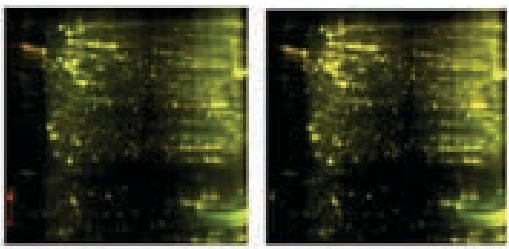


Figure 1. Inhibited synaptonemal complex disassembly (depicted in green) and reduced spermatocytic chromosome condensing (depicted in red) upon treatment with GA compared to control.

Two-dimensional gel electrophoresis (2-DE) was used to separate proteins according to their isoelectric points and molecular weights, allowing key kinase targets of sumoylation to be identified. An analysis of phosphorylated proteins was performed before and after inhibition of sumoylation by GA, with control cell proteins dyed green and proteins of cells treated with GA dyed red. Two 2-DE gels with different concentrations of GA were compared as displayed in Figure 2.



DMSO/ 30um GA DMSO/ 50um GA

Figure 2. Two-dimensional gel electrophoresis analysis with two concentrations of GA.

Based on the results of the 2-DE, nucleophosmin was further analyzed with western blotting to confirm that the inhibition of sumoylation causes a decrease in the phosphorylation and activity of the protein. Nucleophosmin was also specifically chosen to study as it is involved in several processes in the cell cycle, is highly expressed in the testes, and is known to be regulated by sumoylation and phosphorylation in cell types outside of the testes. Genetic inhibition of sumoylation was performed with GC-1 cell lines being

transfected with UBC-9 Small Interfering RNAs (SiRNAs) and KAP-1 SiRNAs.

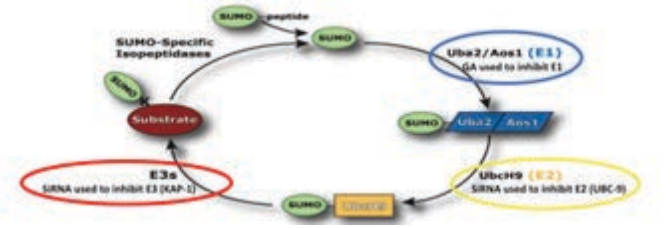


Figure 3. The sumoylation/desumoylation cycle and points of chemical/genetic inhibition.

Western blots were performed to confirm that the downregulation of sumoylation downregulates nucleophosmin. As identified in Figure 4, the introduction of UBC-9 SiRNA and KAP-1 SiRNA led to a decrease in sumoylated proteins and an increase in free SUMO, as the free SUMO could not bind to the targeted proteins. An actin antibody applied to the same blot confirmed equal loading of the sample. In the wells containing samples with UBC-9 SiRNA and KAP-1 SiRNA, the protein expression of nucleophosmin was considerably reduced as compared to the control wells, confirming the initial results of the 2-DE. Additionally, two bands were observed in the protein expression of nucleophosmin.

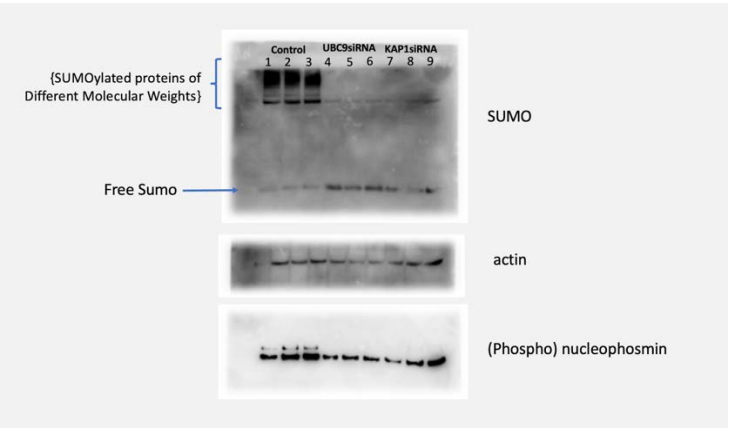


Figure 4. Western blot analysis of UBC-9 SiRNA, KAP-1 SiRNA, SUMO proteins, actin, and nucleophosmin.

Abcam, the company that supplied the antibody used for the western blot, stated that the antibody had been validated in humans with both observed nucleophosmin bands representing phosphorylated isoforms. To determine whether both bands represented phosphorylated isoforms in mice, lysates were treated with phosphatase, an enzyme that removes phosphate groups from proteins. As identified in Figure 5, upon treatment with phosphatase, the expression level of the upper band decreased while the expression level of the lower band increased. An actin antibody applied to the blot confirmed equal loading of the sample. These results suggest that the upper band is likely phosphorylated while the lower band is likely non-phosphorylated.

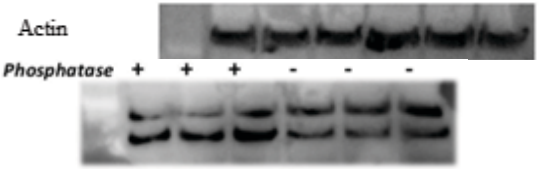


Figure 5. Nucleophosmin with phosphatase treatment, nucleophosmin without phosphatase treatment, and actin.

The characterization of these proteins can be confirmed through the use of additional antibodies, which will allow for the conclusion that the chemical and genetic inhibition of sumoylation causes a decrease in both the phosphorylation and expression level of nucleophosmin. These

results serve as a vital foundation in better understanding the role of nucleophosmin in meiosis

and understanding the effects of the downregulation of nucleophosmin in vitro and in vivo. Additionally, these results substantiate screening the testicular biopsies of infertile patients for mutations in sumoylating enzymes, nucleophosmin, and other targets of sumoylation.

Correlation Between Clinical Biomarkers and Response to Combination Immunotherapy in Patients with Advanced Cancer.

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Increased knowledge in recent years of the mechanisms of tumor immunosuppression has paved the way for the development of immune checkpoint inhibitors (ICIs), medications that impede immunosuppressing molecular pathways with the hope of employing the immune system to attack tumors. However, ICIs are only effective in a fraction of patients, so predictive biomarkers of response to such therapies are of great interest. Recent literature suggests that several clinical factors may be predictive of response to ICI therapy. Gender (males as opposed to females[1]), Increased age[2], higher BMI[3], low neutrophil-to-lymphocyte ratio (NLR)[4], and low c-reactive protein[5] (CRP) serum levels are also associated with response to ICIs. We conducted a retrospective analysis of HPV-related cancer patients treated with a combination of immunotherapy drugs including an anti PDL1 immune checkpoint inhibitor-based immunotherapy to determine predictive characteristics of response to this regimen.

The retrospective analysis was performed on a cohort of 34 patients with HPV-related cancers (e.g. cervical, throat, anal) treated with anti-PDL1 immune checkpoint inhibitor-based immunotherapy. Out of 34 patients, 13 had objective responses, 3 had mixed responses, and 18 did not respond to treatment. We looked at patient response rates with respect to the aforementioned factors, adding a category of race, as well as the site of tumor metastasis (e.g., lymph node only disease, liver mets). We also looked at a few medications that were commonly used in this patient population. We then ran chi-squared and Fisher's exact tests (due to the small sample size) to determine

statistical significance twice for each clinical factor: once including patients with mixed responses as responders, and once including them as non-responders.

III. Chi-Squared Test Results Including Mixed Responders as Responders

Factor	*Chi-squared p-value*	*Result*
Lymph Node Only Disease	**0.049804**	**Significant**
Pre-Tx CRP Using 5 as cutoff	**0.089**	**Trend**
Age Using 56 as cutoff	0.169327	Not significant
Race Caucasian vs. other	0.594525	Not significant
Race African American vs. other	0.5509	Not significant
Pre-Tx NLR Using 5 as cutoff	0.824479	Not significant
Synthroid	0.545285	Not significant
Antidepressants (SSRI/SNRI)	0.288986	Not significant
Statin	0.346722	Not significant
Gabapentin	0.53564	Not significant
Oral Anticoagulants	0.2994	Not significant
BMI Using 24.45 (median) as cutoff	1	Not significant
Liver Disease	0.100271	Not significant
Gender	0.681314	Not significant

IV. Chi-Squared Test Results Not Including Mixed Responders as Responders

Factor	*Chi-squared p-value*	*Result*
Age Using 56 as cutoff	**0.077643**	**Trend**
Pre-Tx CRP Using 5 as cutoff	0.183226	Not significant
Race Caucasian vs. other	0.891284	Not significant
Race African American vs. other	0.785413	Not significant Not significant
Pre-Tx NLR Using 5 as cutoff	0.891284	Not significant
Synthroid	0.876578	Not significant
Antidepressants (SSRI/SNRI)	0.513464	Not significant
Statin	0.185414	Not significant
Gabapentin	0.603593	Not significant
Direct Oral Anticoagulants	0.664001	Not significant
BMI Using 24.45 as cutoff	1	Not significant
Lymph Node Only Disease	0.114295	Not significant
Gender	0.800205	Not significant

Figure 1: Results of Fisher and Chi-Square test analysis.

I. Fisher's Exact Test Results Including Mixed Responders as Responders

Factor	*Fisher's p-value*	*Result*
Lymph Node Only Disease	**0.0782**	**Trend**
Age Using 56 as cutoff	0.3028	Not significant
Race Caucasian vs. other	0.7146	Not significant
Race African American vs. other	0.6602	Not significant
Pre-Tx NLR Using 5 as cutoff	1	Not significant
Synthroid	0.7166	Not significant
Antidepressants (SSRI/SNRI)	0.3872	Not significant
Statin	0.6041	Not significant
Gabapentin	0.6933	Not significant
Oral Anticoagulants	0.7289	Not significant
BMI Using 24.45 (median) as cutoff	1	Not significant
Liver Disease	0.1801	Not Significant
Pre- Tx CRP Using 5 as cutoff	0.1679	Not Significant
Gender	0.7385	Not significant

II. Fisher's Exact Test Results Not Including Mixed Responders as Responders

Factor	*Fisher's p-value*	*Result*
Liver Disease	**0.0617**	**Trend**
Age Using 56 as cutoff	0.1571	Not significant
Race Caucasian vs. other	1	Not significant
Race African American vs. other	1	Not significant
Pre-Tx NLR Using 5 as cutoff	1	Not significant
Synthroid	1	Not significant
Antidepressants (SSRI/SNRI)	0.6529	Not significant
Statin	0.2994	Not significant
Gabapentin	1	Not significant
Oral Anticoagulants	0.7271	Not significant
BMI Using 24.45 (median) as cutoff	1	Not significant
Lymph Node Only Disease	0.173	Not significant
Pre- Tx CRP Using 5 as cutoff	0.2906	Not significant
Gender	0.7385	Not significant

Our Fisher's and Chi-Squared test analysis showed that most variables didn't have an effect on response to combination immunotherapy. However, when we included mixed responders as responders, the burden of disease including sites of metastases seemed to be associated with the likelihood of response. A low volume of disease as reflected by either lymph node-only disease or

a lower CRP was associated with a higher likelihood of response, while a higher volume of disease as reflected by liver disease or higher CRP was associated with a lower likelihood of response. When we included mixed responders as non-responders, age also had a possible association with the response with younger individuals more likely to respond. Otherwise, no other factors showed an association of response.

We concluded that there are a few possible laboratory and clinical variables that are associated with response to combination immunotherapy in patients with HPV-related cancers. Our analysis suggested that a higher burden of disease (higher CRP and liver disease) was associated with a lower likelihood of response and a lower burden of disease (lower CRP and Lymph Node only disease) was associated with a higher likelihood of response. This analysis was done on a relatively small sample size, in a specific set of tumor types, so additional studies are necessary to further evaluate variables that may be associated with response to combination immunotherapy.

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Using the Optogenetic Organ Gut Culture System to Study Neuro-Immune-Microbiome Crosstalk in the Gut

By: Leia Rubinstein[1], Dr. Nissan Yissachar[2] and David Jessula Levy[2]

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[2]Bar Ilan's Institute for Nanotechnology and Advanced Materials (BINA), Bar Ilan University, Ramat Gan, Israel

The gastrointestinal tract is densely populated by microorganisms collectively known as the gut microbiome. Previous research has established the critical role the gut microbiome has in an individual's overall health including assisting in digestion, synthesizing nutrients, and developing the immune system. The gut also contains many immune cells and neurons of the enteric nervous system– a subset of the autonomic nervous system that controls peristalsis. To maintain homeostasis, the enteric nervous system, microbiome, and immune system need to remain in balance. Changes in this equilibrium are associated with inflammatory bowel disease, cancer, and pathologies of the central nervous system [1]. It has already been determined that neurons in the gut are affected by the microbiome, immune cells, and epithelial cells [2]. However, the specific role of these neurons is a topic that has been poorly explored. This research seeks to determine the function of neurons inside the crosstalk of the immune system and microbiome, specifically focusing on cholinergic neurons– those that carry the enzyme choline acetyltransferase (ChAT).

As opposed to using agonists and antagonists which are nonspecific, optogenetics, neuronal activation by a light sensitive ion channel, has the advantage of triggering the response of specific neurons. Here, blue light was used to open the light-gated ion channels,

channel rhodopsin, causing an influx of ions and activating the mutant cell. The experiment was carried out using a modified version of the gut organ culture system (Figure 1), a unique device created by Dr. Nissan Yissachar that facilitates the studying of an entire colon without causing damage but is easier to manipulate than an *in vivo* model. This device allows six intact colons to be placed in monitored conditions to study gene expression and observe the interaction between the microbiome and immune system [3]. The gut organ culture system was improved to create the optogenetic organ gut culture system that has all the advantages of the original system with the addition of a software that can control the stimulation of neurons (Figure 2).

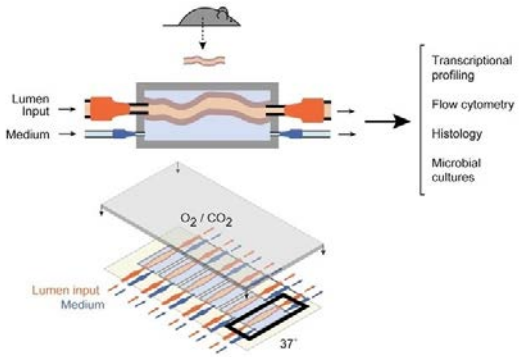

Figure 1. <u>Gut organ culture system.</u> Intact colons are connected to the input and output pumps of the device that control the flow of the medium into the gut lumen. Gas outlet in the lid allows the flow of an oxygen and carbon dioxide mixture into the device.

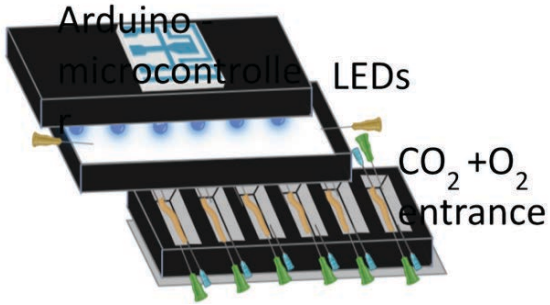

Figure 2. <u>Optogenetic gut organ culture system.</u> An improved version of the original gut organ culture system that incorporates a microcontroller with blue or yellow light embedded and a software that enables the control of light stimulus.

To validate the new system, the gut from mutant mice was connected to the device and triggered with blue and yellow light. An increase in fluorescence signal of cFos was detected after blue light stimulus compared with yellow light stimulus, indicating that blue light can activate the neurons in this system (Figure 3).

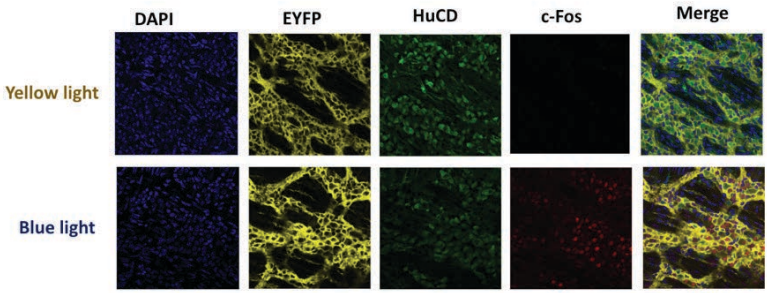

Figure 3. <u>Imaging analysis showed an increase of cFos intensity in tissues that were triggered by blue light compared with yellow light stimulus.</u> Tissues were fixed with 4% PFA and stained with: DAPI (Blue), HuCD (green), EYFP- endogenous (yellow) and c-Fos (red).

The results from RNA extraction and RT-PCR analysis showed an increase in proinflammatory cytokines IL6, IL17, neuropeptide VIP and epithelial cells ICAM in the tissue following neuronal activation from the blue light indicating that activation of the neuron modulates many processes in the tissue. A preliminary experiment is currently incorporating the bacteria *C. ramosum* (known to repress many genes) into the experiment to determine the effect neurons have on the gut microbiome. The results showed that the proinflammatory

cytokines TNF alpha and IL22 are suppressed in tissues co-cultured with *C. ramosum* despite blue light stimulation. This research is still ongoing, but the results are promising that neuron activation in combination with *C. ramosum* bacteria may play a role in limiting the immune response in the gut.

While the crosstalk between the gut microbiome, enteric nervous system and immune system is a topic that has been previously studied, the specific role of the neurons has yet to be extensively researched. Using the optogenetic organ gut culture system, the effects of the neurons can be uncovered, paving the way for further research on the specifics of communication in the gut.

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Quality of Life Outcomes and Behavioral Response to Melanoma in Children and Young Adults

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Melanoma is the most common skin cancer diagnosed in children, adolescents, and young adults, and its survival outcomes are generally very favorable. Given that most of these patients survive for decades following their cancer diagnosis, it is important to understand the impact of melanoma at an early age on the overall quality of life and whether or not this diagnosis impacts future preventative behavior in this patient population. Additionally, the vast majority of melanoma survivorship research has been focused on those diagnosed after the age of 50, due to the prevalence of such a diagnosis, and as a result, the younger cohort of melanoma survivors has not been thoroughly explored. The purpose of our study was to conduct a systematic review of the literature to determine if health related quality of life and preventative behavior are impacted by a diagnosis of melanoma in childhood or early adulthood.

The relevant literature on Medline and EMBASE databases from January 2000 to May 2021 was searched for studies in English surrounding general melanoma survivorship, and survivorship of childhood, adolescent, and young adult cancer. The studies were then filtered based on relevance and then summarized and analyzed for the purposes of the study. The study was done according to PRISMA guidelines.

Our original search was confined to pediatric melanoma, and after removing duplicate entries, 133 citations remained. Of these 133, only 17 were relevant to our topic. We expanded the search to include pediatric, adolescent, and young adult melanoma, which yielded 673 citations, of which 161 were duplicates. After removing duplicates, we had 512 citations of which, 166 were germane to our topic. The total number of citations included in the full review was

183. After removing articles that either did not include patients within our age range or did not include melanoma patients, 130 articles remained in the final review.

Our findings demonstrated that a diagnosis of melanoma as a child, adolescent or young adult adversely affects the quality-of-life metrics later in life. However, the quality of life of melanoma survivors was generally better than that of survivors of other malignancies, in both physical and emotional metrics. Additionally, we found that the adult survivors of pediatric, adolescent, and young adult melanoma will be more likely to practice sun-exposure prevention behavior than the general public due to their prior experience undergoing the hardships of cancer treatment. This has been observed with regards to sunscreen application, use of protective clothing, and seeking shade when outdoors. However, there was also a trend towards less protective behavior as time since treatment increased.

This research project has the potential to help clinicians, patients, and families understand the broader implications of a melanoma diagnosis in early years on the patient's future adult life. Furthermore, it will provide health professionals with a better understanding of how to structure public health interventions regarding sun safety for patients diagnosed with melanoma at a young age. Melanoma survivors have a greater risk of being diagnosed with various types of skin cancer in the future than the general population. Thus, understanding the common preventive practices of survivors can help uncover the most effective types of educational and practical interventions to prevent such relapse.

Completing Case Studies for Medical School Sexual and Reproductive Health Lab

By: Chloe Schreiber[1] and Tamara Kalir[2]

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The genitourinary system, ovaries, vagina/vulva, uterus, and breasts are the organs which play a major role in a person's sexual and reproductive health. As part of the lab curriculum for students in their second year at the Icahn School of Medicine enrolled in the course "Sexual and Reproductive Health," students must work through prepared case studies relating to these organs and answer guiding questions to come to a diagnosis. As the number of students enrolled in the course grew over the years, the more case studies and corresponding answer keys were needed to be prepared.

The case created for the genitourinary lab is that of a middle-aged male presenting with infertility during his four years of marriage. The guiding questions then lead students to consider causes of infertility in males, and as more information is revealed about the patient as students work through the case, it is determined that the patient has a Leydig cell testicular tumor which was causing azoospermia. After reaching a diagnosis, students are then asked to provide information such as disease incidence, symptoms, treatment, and prognosis.

In the ovary lab, the new case presentation was a nine-year-old female with abdominal distention that has persisted for three months with accompanying abdominal pain and respiratory distress, and after a physical examination, a pelvic mass was revealed. Students are then guided to consider the possible causes of the girl's

condition, and after blood results are shared and more questions answered, it is determined that the patient had a yolk-sac tumor.

The gynecology lab, which involves the vulva, vagina, and uterus, focuses less on patient diagnostics and more on prognosis and patient guidance. The clinical presentation is a female in her 20's whose pap smear came back positive for a high-risk HPV which the HPV vaccine (Gardasil-9) does not protect against. Students are then asked to consider the implications of this diagnosis- for both the patient and her sexual partner- as well as about the HPV vaccine in general and the possibility of the patient getting another HPV infection in the future.

The clinical case in the breast lab is also focused less on diagnostic skills and more on ethics and proper medical practice. The presentation is a 14-year-old female who comes in with her mother and father who has been diagnosed with prostate cancer and is a carrier of the BRCA I gene mutation. The students are asked basic questions about the genetics of the BRCA I mutation such as chances of inheritance and risks of developing certain cancers, as well as more thought provoking questions about the psychological ramifications of testing for the BRCA mutation in a young person and possible follow-ups for a young person known to carry the mutation.

My role in preparing these new case studies was to conduct a literature search for the answers to the guiding questions provided by the professor and help her create the "teacher's copy" of the case presentations.

Nuclear Structure and Aging: The relationship between lamin A/C, H3K9me3, and SIRT6

By: Bina Rosenblatt[1] (and Yonit Krebs), Prof. Haim Cohen[2], and M.Sc. student Ron Nagar[2]

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In the modern age, there has been a growing interest in the study of longevity and increasing human lifespan and reducing aging-related illnesses. Specifically, a growing body of research has indicated that sirtuin 6 (SIRT6), one of the seven mammalian sirtuins and an NAD+ dependent protein deacetylase that has several other functions, is associated with longer and healthier lifespans in mice. Overexpression of SIRT6 in mice has been shown to increase mouse lifespan and decrease some effects of aging such as genomic instability, inflammation, cancer and cognitive decline. In contrast, SIRT6-deficient mice begin aging prematurely at two weeks and die within one month [1].

The deterioration of the cell nucleus is one place where one can see the effects of aging. Old nuclei lose the rigidity in the structure of their nuclear membrane, have greater DNA damage, and less heterochromatin. Lamin proteins are responsible for the nuclear membrane structure and interact with the lamin-associated domains (LAD) of the chromatin. Progeria, a rare disease of which one of the symptoms is premature aging, is the result of a mutation in the gene that codes lamin A/C [2].

Previous analysis of protein acetylation in the livers of SIRT6 mice found four lysine residues on the lamin A/C protein that had statistically significant higher acetylation rates: K97, K114, K171, and K180. However, SIRT6 is normally associated with deacetylation, presenting a puzzling question: Why do SIRT6 mice have increased lamin A/C acetylation? How does this effect the cell phenotype and what might be its connection to aging related disorders?

We used two different methods to investigate the relationship between nuclear structure and aging. First, we stained mouse liver tissue samples for tri-methylated lysine on histone three (H3K9me3) via immunofluorescence and visualized the results on a confocal microscope. Second, we planned to mutate the lamin A protein to be either acetylated or deacetylated at those four residues and transfect lamin A deficient cells with these mutated lamin A proteins and visualize the resulting phenotypes. As seen in figures 1 and 2, both H3K9me3 and lamin A are associated with SIRT6 such that in SIRT6 knock-out (KO) cells, they are no longer expressed typically.

Previous research indicates that H3K9me3 is associated with the highly condensed sections of chromatin that make up the lamin-associated domains (LAD) [3]. This means that immunofluorescent staining for H3K9me3 can provide another way to visualize lamin, and the effects of aging on its interaction with the LADs. We preserved livers from young and old wild-type mice as well as young and old transgenic (SIRT6) mice in para-formaldehyde (PFA) and then used paraffin blocking and the microtome to cut the tissue samples into 8 μm slices that we placed onto positively charged slides. The purpose of the slides' positive charge is this helps the negatively charged tissue sample adhere to the slide. We then dissolved the paraffin using xylene and rehydrated the tissue sample with ethanol and water. We calibrated an antigen retrieval method (TRIS buffer, 5 minutes) to break the covalent bonds between proteins formed during PFA fixation and retrieve the epitope. We then blocked the samples in Bovine Serum Albumin (BSA) with triton to prevent all unspecific protein binding and permeabilize the nuclear membrane. We incubated the samples with the primary and then the secondary antibody (conjugated to a fluorophore, Alexa) and stained the DNA with Hoescht as well. We used the Leica Stellaris confocal microscope to view the results.

Figure X shows the results of this experiment. Although, due to the limitations of our project, we were not able to fully analyze the data and quantify the results seen in these images, we were able to observe promising phenotypic differences among the four groups. First, the nuclei in the old groups were larger than those in the young groups, an expected result of aging. Second, while the H3K9me3 is localized to the nuclear membrane in the young WT and TG groups,

the H3K9me3 in the old WT sample is more dispersed and looks somewhat similar to the SIRT6 KO phenotype observed in figure 3. However, the old TG group seems to have preserved some of the nuclear membrane localization of the H3K9me3, indicating the SIRT6 might play a role in this process. Ultimately, this technique can be used to observe the tissues of mice from other experiments and provide another way to look at their results. For example, we began this process for another experiment investigating the impact of exercise on SIRT6 expression and aging.

As previously discussed, lamin A/C acetylation is associated with SIRT6 overexpression. To understand how lamin A/C acetylation might affect cell phenotype and aging, we mutated the lamin A/C protein in the four residues (K97, K114, K171, and K180) to be either constitutively acetylated or permanently deacetylated. We mimicked permanent acetylation by replacing the lysine with glutamine (Q), an amide-containing amino acid. We imitated deacetylation by replacing lysine with arginine (R), the other positively charged amino acid. We confirmed a successful mutagenesis with Hy Labs sanger sequencing and then hoped to transfect lamin A/C KO cells with each of these plasmids to visualize how each residue's acetylation might impact the cell phenotype. Although, due to time constraints, we were not able to finish the transfection experiment, these results will shed light on the effects of lamin A/C acetylation on nuclear structure.

The Use of Magnetoencephalography in Brain Studies

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MEG, or magnetoencephalography, is an innovative, non-invasive neuroimaging technique. This technique differs from EEG, or electroencephalography, in terms of the data collection. EEG measures the brain's electrical activity, while MEG measures the magnetic oscillations from the brain. This allows for extremely accurate detection of brain activity in terms of both temporal resolution (milliseconds) as well as spatial resolution (millimeters). The activity of the brain is acquired utilizing a whole-head, 248-channel magnetometer array (4-D Neuroimaging) in a magnetically shielded room. This is done in order to avoid the collection of conflicting data from those electrical fields that can be found in the atmosphere. Since the MEG machine does not produce an anatomic image of the brain, a specific anatomical MRI image of each subject is needed to analyze the source of activity in the brain. In an ideal study, each and every subject would have their own unique MRI scan in order to precisely pinpoint the source of brain activity. Since most studies cannot afford to conduct an MRI scan for each subject, a sample MRI template is used instead. The MRI template needs to be resized and readjusted in order to fit each specific subject's head. As a result of this, the size of every subject's head is measured and recorded at the beginning of most experiments involving MEG. The entire analysis of the data was performed using MEG and EEG data analysis with MNE-Python (Alexandre Gramfort *et al*., 2013).

The process of converting the raw data from MEG to localizing the source of the brain activity is a multistep process. The first step is recruiting suitable subjects for the experiment. When using MEG technology, the subjects cannot have anything metal in their mouths,

since the metal in the mouth can interfere with the data collection of the electrical fields in the brain. Once the subjects are adequately recruited, an electronic digitization system draws a specific head shape file for each subject. After this, the subjects' brains are analyzed (usually for a one-hour period of time or shorter), and the data is collected. Once the data is collected accurately, the process of analyzing the data can begin. The first step of analyzing the data is cleaning the data from any noise that could have interfered with the data. This includes clearing any conflicting electrical signals from the building in which the MEG machine is located, movement from body parts, and any electrical wires or metal. After the noise is cleaned from the data, the data can be processed further. This processing includes firstly fitting each individual head shape file to the template MRI, then loading the data onto that specific head shape file, and then, converting the electrical brain waves from Hz to a number that can be used for source localization. Once all of this is done, source localization can be done and conclusions can be drawn based on those calculations.

During my internship this summer at Professor Goldstein's MEG lab at Bar-Ilan University, I aided in processing data and matching the MRI template file to each specific subject's head shape file. The experiment that I processed the data for was Barack Atia's experiment, which researched the effect of positive or negative priming on the brain activity of the followers of charismatic speakers. I helped in the resizing and realigning process to create a unique file that is tailor fit for each subject, using MNE-Python technologies. Additionally, it was the first time in Professor Goldstein's lab that the MNE-Python software was used in tandem with processing the data and matching the head shape files to the MRI template.

MRI template head shape realignment using MNE-Python

Cannabis as potential treatment for insomnia and brain regions responsible for possible effects.

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Insomnia is a very common disease with main causes including stress, depression, and anxiety. Many innovative solutions have been researched and marketed for those with sleeping problems; some that help more than others. Cannabis, a drug used primarily for recreational purposes, has been found to have many benefits for people suffering from pain and chronic disorders. Among its many benefits it has been found to help with sleep.

The active component in marijuana that people find so desirable was mostly unknown until the 1960s when a research team in Israel found that after injecting THC into aggressive rhesus monkeys, they became calm and sedate.[1] The team discovered that there was a receptor in the brain that fit THC like a glove leading them to name these receptors cannabinoid receptors. It was not until the 1990s that this same team discovered why we have these receptors in our brain. They discovered compounds produced by our bodies that fit into these receptors which they named anandamides, a Sanskrit word for "supreme joy." These receptors are found all over the brain and are still called endocannabinoid receptors. The main endocannabinoid in marijuana is THC but there is also one called CBD.

CBD1 and CBD2 are the endocannabinoid receptors which THC and CBD bind to. CBD1 is mainly in the brain, in the central nervous system (CNS) but can also be found in the lungs, liver and kidneys. CBD2 is expressed mainly in the immune system. Therefore, changes in brain activity following cannabis intake can be attributed to the binding of THC to CBD1.

With its ability to bind to both CBD1 and CBD2 receptors, THC achieves its extremely powerful effect on the body.

The Endocannabinoid system, ECS, is a system that consists of many chemical signals which are received by receptors that are extremely affluent in our brain and body. The cannabinoid receptors in our brain regulate many different functions including learning and memory, emotional processing, sleep, temperature control, pain control, inflammatory and immune responses, and eating. To stimulate these receptors to do their functions, the body releases endocannabinoids, which are molecules that bind to and activate the cannabinoid receptors and are produced naturally by the body. Anandamide was the first natural endocannabinoid to be discovered and the roots of the word are Ananda, meaning joy.

Astrocytes which perform regulatory brain functions have been found to modulate the process of sleep homeostasis. When astrocytes are active, they release adenosine which binds to Adenosine A1 receptors which promote sleep. In the brain adenosine acts as an inhibitory neurotransmitter and it depresses the CNS by inhibiting processes that cause wakefulness, which induces sleepiness. During sleep adenosine detaches from its receptors gradually, giving us a wakeful feeling in the morning. If Astrocytes activity increases with use of cannabis, this may suggest its positive on sleep disorders through the release of adenosine. As such astrocytes were chosen to be determine changes in sleep.

To see areas of brain activity following cannabis injection 10 TRAP mice were injected with cannabis and shortly before the 90-minute mark the mice were anesthetized. At the 90-minute mark the brains were harvested. The mice were perfused with PBS injected into the heart and then the tissue was harvested and frozen in liquid nitrogen. After the brains were frozen, they were placed in the negative 80C freezer for 3 three days and then the sectioning process started. Cryostat was used for sectioning and brains were divided coronal, and sagittal sections. Slices were cut 14 micrometers thick and placed on slides which were stored at -20 C°. The 14-micrometer size was chosen since this is the average thickness of a cell. Staining was performed for Cfos, Gfap, and DAPI. Cfos is the immediate early gene which shows areas with brain activity. It is a marker used for brain activation. Gfap shows astrocytes which can also indicate

cytokine activity. DAPI stains for cell nucleus, this is used as a baseline to see where the cells are. They were fixed with PFA. Blocked and washed. The slides were then mounted and stored in the 4 C° fridge for a few days until they dried and then transferred to the -20 C°. A microscope was used for imaging at 5x and 10x magnification.

The results of imaging indicated that there was a difference in the astrocytes between the experimental and control mice. Astrocyte activity was increased with the injection of cannabis into the mice. Additionally, to the general increase in activity an increase in the hypothalamus, the area of the brain responsible for sleep was observed. This confirms that cannabis might have positive effects on sleep and suggests that there is need to investigate further if there is statistical significance to these results and into the exact areas of the brain where astrocyte activity increases.

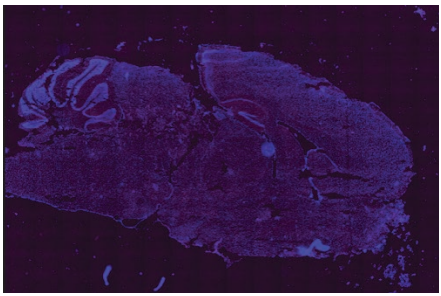

Figure 1. A sample of sagittal images that were obtained.

Phosphorylation and Expression Level of Nucleophosmin is Regulated by Sumoylation in Mouse Spermatogenic Cells

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Infertility affects 8-12% percent of American couples, 50% of which is male affiliated. Of these male cases, a surprising 30-50% are idiopathic. Therefore, there is a great need for increased research into the causes of male infertility, including in the regulatory processes involved in spermatogenesis.

SUMOylation is a post-translational modification in which a SUMO protein is added to a target protein in order to modify its function. Previous studies in the Vigodner Lab established SUMOylation as being involved in regulating spermatogenesis in mouse spermatogenic cells. Furthermore, some kinases were identified as targets of sumoylation. Therefore, to study the cross-talk between sumoylation and phosphorylation, a 2D gel electrophoresis of phospho-proteins was used after inhibition of SUMOylation (Figure 1). It was found that the concentration of some phosphorylated proteins decreased after inhibition of SUMOylation with the SUMOylation inhibitor Ginkgolic Acid (GA, indicating cross-talk between the two posttranslational modifications). Our study focused on supporting the results of the 2D-gel electrophoresis through confirming that the inhibition of SUMOylation affects phosphorylation of specific targets.

One of the target proteins in which phosphorylation was significantly decreased was identified as being nucleophosmin. Nucleophosmin, a protein involved in several processes in the cell cycle, is known to be regulated by both SUMOylation and phosphorylation in other cells and is highly expressed in the testis. However, its role in the testis is unknown. It was therefore chosen to be studied.

To confirm the result of the 2D gel, we used the germ-like cell line GC-1 which was treated with and without the inhibition of SUMOylation using UBC9 siRNA and KAP-1 siRNA, which inhibits the translation of the activating enzyme and the conjugating enzyme in the SUMOylation / deSUMOlyation cycle, respectively. A Western blot was performed using ti-SUMO and anti-Nucleophosmin antibodies. Equal loading was confirmed using actin (Figure 2). The results confirmed that the SUMOylation cycle was inhibited using si-RNAs as the lanes with inhibition showed lower concentrations of the higher molecular weight conjugated proteins formed by SUMOylation and an increased concentration of free SUMO.

The nucleophosmin antibody is recognized by both the phosphorylated and non-phosphorylated isoforms of nucleophosmin (as supported by a treatment with a phosphatase, not shown) and the level of both isoforms were significantly reduced upon inhibition of SUMOylation. Thus, our study supported the results of the 2D-gel electrophoresis through confirming that the inhibition of SUMOylation decreases the phosphorylation and the overall level of nucleophosmin.

Further studies can be done to better understand the role of nucleophosmin in meiosis and to understand the effects of downregulating nucleophosmin *in vitro* and *in vivo*. Additionally, screening of testicular biopsies of infertile patients for mutations in SUMOylating enzymes, nucleophosmin, and other targets of SUMOylation can be performed.

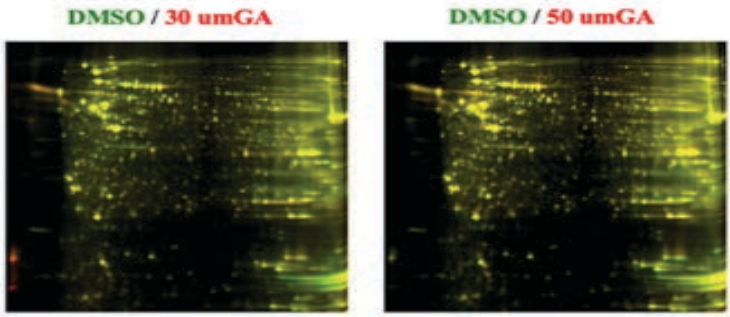

Figure 1: 2D gel analyzing phosphorylated proteins before and after inhibition of SUMOylation at two concentrations of GA (30 umGA, 50 umGA). A decrease in the concentration of some phosphorylated proteins after inhibition of SUMOylation indicates that these proteins are target proteins of SUMOylation. Nucleophosmin was identified as a target protein.

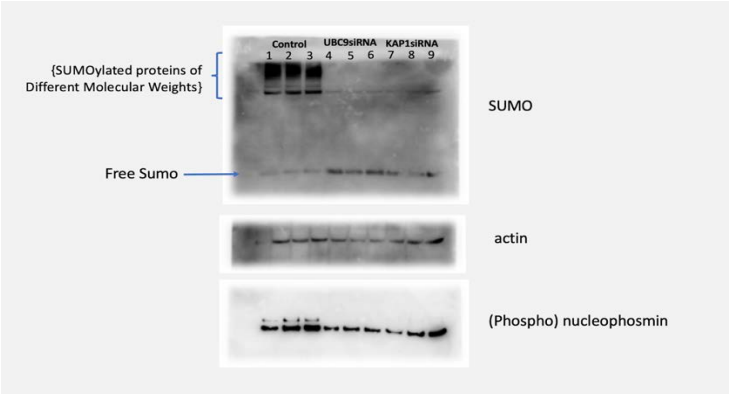

Figure 2: Western blot analysis of proteins of control cells (lanes 1 - 3) and proteins of cells treated with the sumoylation inhibitor UBC9 siRNA (lanes 4 - 6) and KAP1 siRNA (lanes 7 - 9). Decreased concentrations of the SUMOylated proteins of different higher molecular weights and increased free SUMO are observed in the treated lanes as compared to the control lanes. Two nucleophosmin bands are observed in the control lanes, while one is observed in the treated lanes. Actin confirmed equal loading.

WOMEN IN SCIENCE

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Volume XVII
2022-2023