Women in Science at Columbia
GRADUATE RESEARCH SYMPOSIUM
Empowering women and fostering scientific innovation

Columbia University
Faculty House
New York

Saturday, April 23rd

1ST ANNUAL SYMPOSIUM PROGRAM

2016
# Table of Contents

<table>
<thead>
<tr>
<th>Content</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGRS Overview</td>
<td>3</td>
</tr>
<tr>
<td>Directions to Faculty House</td>
<td>4</td>
</tr>
<tr>
<td>Agenda</td>
<td>5</td>
</tr>
<tr>
<td>Oral Presentations</td>
<td>6-9</td>
</tr>
<tr>
<td>Poster Presentations</td>
<td>10</td>
</tr>
<tr>
<td>Poster Abstracts</td>
<td>11-18</td>
</tr>
<tr>
<td>Reviewers and Volunteers</td>
<td>19</td>
</tr>
</tbody>
</table>
WGRS Overview

The WISC Graduate Research Symposium (WGRS) is a multi-disciplinary research conference that aims to highlight and celebrate emerging research conducted by women graduate students in the science, technology, engineering, and math (STEM) fields. The format of the symposium is designed to encourage discussion across an array of STEM disciplines by sharing the details of current research and placing them in a broader context, making connections and engaging in research networking.

The symposium features an invited keynote speaker, Dr. Chloë Bulinski from the Department of Biological Sciences, in addition to a selection of oral paper and scientific poster presentations. WGRS faculty will award graduate students with awards for the top presentations. The symposium is also featured with a Lab Dynamics Workshop presented by the Joan Waters, J.D. from the Ombuds Office of Columbia University.

2015-2016 WISC GRS Organizational Committee:
   Esther Kim
   Gabriella Sanguineti
   Angelica Patterson
   Ju Yang
   Nicole Benvin

wisc.symposium@gmail.com
womeninscienceatcolumbia.org/symposium/
Directions to Faculty House

Faculty House is located on Columbia University’s East Campus at 64 Morningside Dr., north of 116th St.

Faculty House Presidential Ballroom (3rd floor)

- Follow College Walk (116th St.) across Amsterdam Ave towards Morningside Dr.
- After passing Jerome Greene Hall on the left, enter Wien courtyard through gates.
- Follow courtyard around to the right.
- Faculty House will be the last building on the right.
- Take #1 train to 116th St. (Columbia University) stop.
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 AM - 9:30 AM</td>
<td>Registration and Poster Setup</td>
</tr>
<tr>
<td>9:30 AM - 9:45 AM</td>
<td>Welcome and Introduction</td>
</tr>
<tr>
<td>9:45 AM - 10:30 AM</td>
<td>Keynote Presentation</td>
</tr>
<tr>
<td></td>
<td>• Dr. Chloë Bulinski, Department of Biological Sciences</td>
</tr>
<tr>
<td></td>
<td>• Hear an inspiring talk by Dr. Chloë Bulinski from the Department of Biological Sciences.</td>
</tr>
<tr>
<td>10:30 AM - 12:00 AM</td>
<td>Student Oral Presentations</td>
</tr>
<tr>
<td></td>
<td>• Sophie Jang; Archana Raja; Natalie Labrador; Caroline Patenode</td>
</tr>
<tr>
<td></td>
<td>• Graduate students present their ground-breaking research.</td>
</tr>
<tr>
<td>12:00 AM - 1:30 PM</td>
<td>Lunch and Lab Dynamics Workshop</td>
</tr>
<tr>
<td></td>
<td>• Joan Waters, J.D., Ombuds Office of Columbia University</td>
</tr>
<tr>
<td></td>
<td>• Review the professional and academic roles that exist in a scientific lab with a focus on how to identify, address and resolve conflict between and among members.</td>
</tr>
<tr>
<td>1:30 PM - 1:40 PM</td>
<td>Break</td>
</tr>
<tr>
<td>1:40 PM - 3:00 PM</td>
<td>Poster Session</td>
</tr>
<tr>
<td></td>
<td>• Speak to Columbia University women graduate students and hear about their exciting scientific research! Network and interact with faculty and researchers for potential collaborations.</td>
</tr>
<tr>
<td>3:00 PM - 3:15 PM</td>
<td>Break</td>
</tr>
<tr>
<td>3:15 PM - 3:30 PM</td>
<td>Awards and Closing Remarks</td>
</tr>
<tr>
<td></td>
<td>• The Presentation Review Committee will award the top poster and oral presentations! Also hear closing remarks from WISC co-presidents.</td>
</tr>
<tr>
<td>3:30 PM - 4:30 PM</td>
<td>Networking Reception</td>
</tr>
<tr>
<td></td>
<td>• Network with Columbia alumni, students, and faculty over food and drinks! Exchange business cards and upload to the Whova app to keep in touch with those you meet.</td>
</tr>
</tbody>
</table>
Markers of celiac disease and immune reactivity to gluten in response to the use of proton pump inhibitors

Sophie Jang, *Division of Digestive and Liver Disease*

**Abstract:** Recent studies point to increasing prevalence of celiac disease (CD) in the past few decades, although the causes for this are not known. Increased intake of certain drugs, such as proton pump inhibitors (PPIs), widely prescribed acid reduction drugs, has been associated with increased risk for a subsequent diagnosis of CD. To further examine the relationship between gluten sensitivity and PPIs, we analyzed serum samples from individuals before and after exposure to PPIs, and analyzed them for markers of celiac disease and immune reactivity to gluten. Samples from a study with a crossover design (n=12) were collected at weeks 0, 4, 8 and 12. All patients started taking PPIs at week 4 and continued to week 8. Then half the patients were randomized to continue taking PPIs and half to discontinue taking PPIs until week 12. Serum specimens were tested for CD serological markers, including transglutaminase 2 (TG2) and deamidated gliadin, as well as antibodies to native gliadin. Participants with elevated antibody to TG2 were genotyped for CD-associated HLA-DQ2 and -DQ8 alleles. There were no significant changes during the study in the levels of immune reactivity to gluten and CD serological markers among study participants as a group. However, one individual displayed a substantial elevation of thirteen-fold compared to the group in IgG antibody to gliadin after 4 weeks on PPI. During the same period, the individual became positive for anti-TG2 antibody. Genotyping indicated that this individual was positive for CD-associated HLA-DQ2 and -DQ8. While there was minimal change in immune reactivity to gluten in most study participants, one HLA-DQ2 and –DQ8 -positive individual exhibited a marked increase in the CD-associated antibody levels with PPI usage during the course of the study. These results warrant further investigation into the mechanism(s) involved in the potential contribution of PPIs to the risk of CD and/or enhanced immune reactivity to dietary gluten.
Oral Presentations

Energy transfer from quantum dots to graphene and MoS2: The role of absorption and screening in two-dimensional materials

Archana Raja, Department of Chemistry

Abstract: Understanding the transport of energy across nanoscale interfaces is crucial for designing next generation photovoltaic and optoelectronic devices. In this work, we experimentally and theoretically study efficient non-radiative energy transfer (NRET) of photo-excited carriers from semiconductor nanocrystals to quasi-two-dimensional materials that are less than a nanometer in thickness – graphene and molybdenum disulfide (MoS2). Light absorbed by a semiconductor nanocrystal is stored as an electronic excitation. This excitation decays over time by emitting light and this is termed photoluminescence. However, when the nanocrystal is placed near graphene or MoS2, NRET to the 2D material creates an additional decay channel for the excitation and this shortens the photoluminescence lifetime. We use very short laser pulses to excite the quantum dot and obtain the rate of energy transfer by measuring the time-resolved photoluminescence on an ultrafast photodiode. This energy transfer occurs on the sub-nanosecond timescale. We have experimentally demonstrated that the NRET rate can exhibit surprisingly opposite trends with increasing number of layers of the acceptor 2D sheet. The rate increases with increasing thickness of adjacent graphene layers but decreases with increasing thickness of MoS2. Our result is important both from the fundamental science and technological applications points of view since energy transfer processes are ubiquitous at nanoscale interfaces. Using classical electromagnetism we further explain that the competition between the dissipative channels and reduction of the electric field within the 2D material can lead to unexpected trends, and sometimes less can be more, as in the case of MoS2. Looking forward, we hope that the combination of our experimental and theoretical work will make it more transparent for researchers to exploit this interesting phenomenon while designing devices.
Abstract: The major hurdle limiting the widespread use of intermittent renewable solar energy is the lack of efficient and cost-effective energy storage. Photoelectrochemical (PEC) water splitting offers a solution towards producing storable solar fuels like hydrogen. One promising approach to achieving stable and efficient PEC water splitting is the composite photoelectrode architecture known as a metal-insulating-semiconductor (MIS) photoelectrode. Within the MIS design, a metal catalyst is deposited on top of a thin insulating layer that protects the underlying semiconductor from corrosion. Through this composite design, the MIS architecture is able to decouple efficiency and stability and has been applied to c-Si and InP photoelectrodes with great success in recent years. Despite these encouraging results, further improvement in MIS photoelectrode performance is needed if this technology is to become commercially viable. In particular, improved photovoltage and maximized photo-current density generated by MIS photoelectrodes is essential for achieving DOE solar-to-hydrogen conversion efficiency targets.

In this work, electrodeposition has been explored as a potentially low-cost and scalable means of depositing ultra-low loadings of Pt nanoparticles onto SiO2-covered p-Si photoelectrodes. As-deposited MIS photoelectrodes are found to exhibit very poor stability, but we report how this issue can be overcome through application of a thin secondary insulating overlayer to form an insulator-MIS (IMIS) geometry. Surprisingly, it is found that the overlayer also results in a substantial improvement in PEC performance. After describing a side-by-side comparison of MIS and IMIS photoelectrode performance, we highlight reasons for the differences in their performance and stability. The combination of electrodeposition with the IMIS architecture thus offers an exciting opportunity for improving both the efficiency and durability of PEC energy conversion.
Developing New Strategies for the Construction of Novel Natural Product Metabolic Pathway Libraries

Caroline Patenode, Department of Biological Sciences

Abstract: Natural products represent a large and diverse array of molecules, many of which play important roles in the human sphere as pharmaceuticals, biofuels, and more. However, the structural complexity of promising natural products often prohibits industrial production sufficient to make full use of their capabilities. One way to address the challenge posed by natural product production is through the use of large libraries of biosynthetic pathways. Our lab has previously developed a robust technology for rapid construction of multi-gene pathways in Saccharomyces cerevisiae, known as “Reiterative Recombination.” We have now expanded this technology to create even greater combinatorial libraries by incorporating the natural randomization of meiotic chromosome segregation, for a novel technique termed “Reiterative Segregation.” This strategy has been validated with simulated libraries of the lycopene biosynthetic pathway, and is being developed for use with alternative sugar metabolisms.
<table>
<thead>
<tr>
<th>Poster No.</th>
<th>First Name</th>
<th>Last Name</th>
<th>Department</th>
<th>Poster Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Haixing</td>
<td>Li</td>
<td>Applied Physics and Applied Mathematics</td>
<td>Conductance of atomic precise silicon and germanium molecular wires</td>
</tr>
<tr>
<td>2</td>
<td>Shuting</td>
<td>Han</td>
<td>Biological Sciences</td>
<td>Automated behavior analysis of Hydra</td>
</tr>
<tr>
<td>3</td>
<td>Anna</td>
<td>Kaplan</td>
<td>Biological Sciences</td>
<td>Small-Molecule-Induced Oxidation of Protein Disulfide Isomerase is Neuroprotective</td>
</tr>
<tr>
<td>4</td>
<td>Ju</td>
<td>Yang</td>
<td>Biological Sciences</td>
<td>Nanomechanical characterization of synapses in live hippocampal neurons via torsional harmonic atomic force microscopy</td>
</tr>
<tr>
<td>5</td>
<td>Julia</td>
<td>Wrobel</td>
<td>Biostatistics</td>
<td>Can we use statistics to compare pictures? An application to brain imaging data</td>
</tr>
<tr>
<td>6</td>
<td>Alison</td>
<td>Fankhauser</td>
<td>Chemical Engineering</td>
<td>Atmospheric photooxidation of 2-methyltetrol, a tracer for secondary organic aerosol (SOA) formation in aqueous aerosols</td>
</tr>
<tr>
<td>7</td>
<td>Michelle</td>
<td>Ziperstein</td>
<td>Chemistry</td>
<td>Breast Cancer Aggregate Cell Morphology Does Not Predict Invasive Capacity</td>
</tr>
<tr>
<td>8</td>
<td>Tarini</td>
<td>Bhatnagar</td>
<td>Earth &amp; Environmental Sciences</td>
<td>Evaluation of ocean crustal sites at Reykjanes ridge, offshore Iceland for Carbon Dioxide sequestration in deep sea basalt</td>
</tr>
<tr>
<td>9</td>
<td>Bor-Ting</td>
<td>Jong</td>
<td>Earth &amp; Environmental Sciences</td>
<td>El Niño’s Impact on California Precipitation: Seasonality, Regionality, and El Niño Intensity</td>
</tr>
<tr>
<td>10</td>
<td>Jen</td>
<td>Tinsman</td>
<td>Ecology Evolution and Environmental Biology</td>
<td>Do ice ages explain modern lemur biodiversity in northwestern Madagascar?</td>
</tr>
<tr>
<td>11</td>
<td>Brandi</td>
<td>Cannon</td>
<td>Ecology Evolution and Environmental Biology</td>
<td>Presentation, aroma, and flavor: Investigation of host cues in the orientation and establishment of Phoradendron serotinum (Viscaceae).</td>
</tr>
<tr>
<td>12</td>
<td>Kaiya</td>
<td>Provost</td>
<td>Ecology Evolution and Environmental Biology</td>
<td>Genetic and behavioral divergence among Northern Cardinal (Cardinalis cardinalis) populations across a biogeographic barrier</td>
</tr>
<tr>
<td>13</td>
<td>Stephanie</td>
<td>Sardelis</td>
<td>Ecology, Evolution and Environmental Biology</td>
<td>Not “pulling up the ladder”: Women who organize conference symposia provide greater opportunities for women to speak at conservation conferences</td>
</tr>
<tr>
<td>14</td>
<td>Grace</td>
<td>Musser</td>
<td>Ecology, Evolution and environmental biology</td>
<td>The Effect of Holocene Climatic Variation on Baja California Rodent Generic Diversity: Evidence from the Abrigo de los Escorpiones Fauna</td>
</tr>
<tr>
<td>15</td>
<td>Holly</td>
<td>Fuong</td>
<td>Ecology, Evolution, and Environmental Biology</td>
<td>Are social attributes associated with alarm calling propensity?</td>
</tr>
<tr>
<td>16</td>
<td>Yunzhe</td>
<td>Li</td>
<td>Electrical Engineering</td>
<td>Image State of Graphene on Iridium Modulated by Oxygen</td>
</tr>
<tr>
<td>17</td>
<td>Jinyu</td>
<td>Liao</td>
<td>Electrical Engineering</td>
<td>Probing Cellular Response to Heterogeneous Rigidity at the Nanoscale</td>
</tr>
<tr>
<td>18</td>
<td>Lin-Chun</td>
<td>Wang</td>
<td>Institute of Human Nutrition</td>
<td>The difference in Oxygen Uptake Efficiency Slope in Healthy Subjects between Treadmill and Cycle Ergometer</td>
</tr>
<tr>
<td>19</td>
<td>Alexandra</td>
<td>Jacunski</td>
<td>Integrated CMBS</td>
<td>Connectivity Homology Enables Inter-Species Network Models of Synthetic Lethality</td>
</tr>
<tr>
<td>20</td>
<td>Yuxi</td>
<td>Lin</td>
<td>Medicine/Nutritional and Metabolic Biology</td>
<td>Lysosomes: a new target for obesity treatment</td>
</tr>
<tr>
<td>21</td>
<td>Georgia</td>
<td>Pierce</td>
<td>Neuroscience</td>
<td>The role of higher order somatosensory thalamus in encoding the behavioral relevance of stimuli</td>
</tr>
<tr>
<td>22</td>
<td>Darshini</td>
<td>Mahadevia</td>
<td>Psychiatry</td>
<td>Developmental perturbation of dopamine signaling increases adult aggression</td>
</tr>
<tr>
<td>23</td>
<td>Subha</td>
<td>Perni</td>
<td>Radiation Oncology</td>
<td>Clinical Outcomes of Stereotactic Body Radiotherapy and Surgery in Elderly Patients with Pancreatic Adenocarcinoma</td>
</tr>
</tbody>
</table>
1. Conductance of atomic precise silicon and germanium molecular wires

Haixing Li, Applied Physics and Applied Mathematics

The progress in modern information technology is enabled by miniaturization of transistors, the sizes of which are currently approaching 14 nm. However, the mechanism of electron transport, which is well known for the traditional transistors, hasn’t been studied and understood very well in nano-scale systems when quantum mechanics comes into play. To address this, we study the electrical properties of one-dimensional atomic chains of Si and Ge with chain-length 0.3-2nm, one order of magnitude smaller than current component of electronic devices. We create a single-molecule circuit by using scanning tunneling microscope-based break junction and measure the electron transport behavior through the single molecule junction. We observe that atomic chains of C(carbon), Si(silicon) and Ge(Germanium) in group VI can form molecular junctions with gold electrodes through methylsulfide chemical groups and show well-defined conductance. The conductance of Si and Ge atomic chains are similar and much higher than C atomic chains at the same length, which mirrors group 14 conductivity trends in solid-state materials. Furthermore, we realize a single molecule conductance switch activated by compressing and stretching the junction. We envision that the understanding of electron transport in atomic precise molecules will inform the design of next-generation electronic circuit materials.

2. Automated behavior analysis of Hydra

Shuting Han, Biological Sciences

Animal behaviors have been studied for centuries, but there are still few efficient methods available to automatically identify and classify all behaviors of an animal. Studies of animal behavior have been limited by the subjective and imprecise nature of human analysis, the limitation of the properties of human visual system and the slow speed of annotating behavioral data. Our group recently established a Hydra model with neuronal transgenic GCaMP6s, which allows simultaneous optical recording from potentially the entire nervous system while the animal is behaving. Here we developed an automatic behavior identification and classification method for Hydra using machine learning approaches. We recorded behaviors from freely moving Hydra, extracted motion and shape features from the videos, and constructed a dictionary of these features. We identified behavior types using unsupervised methods based on the dictionary, and trained classifiers with manual labels for each behavior type. During evolution, Hydra is among one of the first species that developed a nervous system accompanied with a repertoire of behaviors. Studying the behaviors and the underlying neural networks of Hydra provides a unique opportunity of understanding the most basic rules of how nervous system compute and organize behaviors.

3. Small-Molecule-Induced Oxidation of Protein Disulfide Isomerase is Neuroprotective

Anna Kaplan, Biological Sciences

Protein disulfide isomerase (PDI) is a chaperone protein in the endoplasmic reticulum that is upregulated in mouse models of, and brains of patients with, neurodegenerative diseases involving protein misfolding. PDI’s role in these diseases, however, is not fully understood. Here, we report the discovery of a reversible, neuroprotective compound, LOC14, as a modulator of PDI. LOC14 was identified using a high-throughput screen of ~10,000 lead-optimized compounds for potent rescue of PC12 cells expressing mutant huntingtin protein, followed by an evaluation of effects of compounds on PDI reductase activity in an in vitro screen. Isothermal titration calorimetry and fluorescence experiments revealed that binding to PDI was reversible with a Kd of 61.7 nM, suggesting LOC14 to be the most potent PDI inhibitor reported to date. Using chemical shift perturbations from 2D-NMR experiments, we were able to map the binding site of LOC14 as being adjacent to the active site, and to observe by HSQC NMR that binding of LOC14 forces PDI to adopt an oxidized conformation. Furthermore, we found that LOC14-induced oxidation of PDI has a neuroprotective effect not only in cell culture, but also in corticostriatal brain slice cultures. LOC14 exhibited high stability in mouse liver microsomes and blood plasma, low intrinsic microsome clearance, and low plasma-protein binding. These results suggest that LOC14 is a promising lead compound to evaluate the potential therapeutic effects of modulating PDI in animal models of disease.

4. Nanomechanical characterization of synapses in live hippocampal neurons via torsional harmonic atomic force microscopy

Ju Yang, Biological Sciences

Synapses are mechanically interesting structures. They are enriched with dynamic actin networks and undergo fast twitching. Also, axons are under physiologically critical mechanical tension and a variety of trans-synaptic adhesion proteins tightly connects pre- and post-synaptic terminals. While biochemical, morphological and electrophysiological characteristics of synapses and neurons have been widely investigated, little is known about the mechanical behaviors of synapses and
measuring their mechanical properties remains difficult. Here we develop an approach to study the mechanical behaviors of synapses using torsional harmonic atomic force microscopy (TH-AFM) and report that active mature synapses are substantially stiffer (up to 20 fold) than other neuronal structures and the stiffness of synapses falls into a wide range. We combined optical microscopy with TH-AFM to record the morphology and stiffness of synapses in live hippocampal neuron cultures. To verify the identity of synapses, we performed post hoc immunofluorescence staining after AFM imaging and found that all stiff synapses are mature excitatory synapses. High magnification fluorescence images indicated that there are two subtypes of synapses: spiny and shaft. We hypothesize that the stiff synapses revealed by AFM are spiny synapses. To elucidate such heterogeneity, we are combining transmission electron microscopy with TH-AFM and aim to acquire the ultrastructure of stiff synapses and compare them with synapses that do not show high stiffness. Additionally, we monitored the activity of synapses with FM dyes and showed stiff synapses are also active, suggesting stiffness may be related to synaptic activity. The extremely high stiffness could help maintain the unique morphology of synapses in the presence of strong adhesion forces and those mechanical processes may be important in synapse formation and function.

5. Can we use statistics to compare pictures? An application to brain imaging data

Julia Wrobel, Biostatistics

Modern imaging technology has provided us with complex collections of images, or pictures. Developing new mathematical tools to analyze these rich data sets is needed. In classical statistics, the basic unit of observation is a single data point. In the applications with images, however, the basic unit of observation is the image itself, and in order to draw inferences about different populations based on pictures we need tools that are specifically developed to deal with this complex data structure. We propose a method which treats an entire brain image as one “data point”. This allows us to order a set images based on how each image differs in magnitude from an average picture, analogous to how one would order a set of numbers from smallest to largest in order to determine the median value. We can then detect outliers and develop robust tests for differences based on a snapshot. An important clinical question in neuroscience is to detect whether there are statistically significant differences in the brain structure or function between healthy individuals and patients with some psychiatric disorder. We propose non-parametric tests, a rank test and permutation tests, for comparing different two groups of images based on our ordering technique. The performance of these tests is measured on a dataset of PET brain images from 29 subjects with major depressive disorder and 39 controls. We also test performance across several hypothetical scenarios via a simulation study. In order to generate simulated data we took the original PET data and boiled it down to its most basic features using principal components analysis. We then took this simplified data and applied random variation hundreds of times to obtain new sets of images. One can check and see that these simulated brain images retain the key features of the original data even though they do not come from a specific subject, a result which in itself is cool and worthy of further study.

6. Atmospheric photooxidation of 2-methyltetrol, a tracer for secondary organic aerosol (SOA) formation in aqueous aerosols

Alison Fankhauser, Chemical Engineering

2-methyltetrol (2-MT) is a well-known particle-phase tracer for isoprene photooxidation, yet very little is known about the rates, mechanisms, and products of the photochemical aging of this species in the atmosphere. To this end, we conducted a series of laboratory experiments using an aerosol flow tube reactor coupled with an Aerosol Chemical Ionization Mass Spectrometer (Aerosol-CIMS) for analysis of the gas and particle phase composition and a scanning-mobility particle sizer (SMPS) to monitor particle size distributions. First, gas-particle partitioning experiments were conducted on aqueous sulfate particles containing 2-MT in order to measure the effective Henry's Law constant. Then we exposed these particles to hydroxyl (OH) radicals in a continuous flow photocell reactor in order to study the photooxidation of 2-MT. In the presence of OH, 2-MT particles decreased in size, indicating a volatilization of organic material, and small-molecule products such as formic acid were observed in the gas phase. Although the reaction between OH and 2-MT takes place in both the gas and particle phases, kinetic analysis shows that the dominant effect is reaction at the particle surface, allowing us to model the loss process as reactive uptake with gamma ~ 0.02. We model this multiphase process using GAMMA (Gas-Aerosol Model for Mechanism Analysis) [McNeill et al. 2012] in order to provide additional mechanistic insight.


Michelle Ziperstein, Chemistry

Breast cancer is dangerous not for its activity at the initial site but due to the ability of cells within the primary tumor to breach the surrounding basement membrane, invade
dense collagen I-rich breast tissue, and ultimately reach and form secondary tumors in distant organs with critical functions. Previous studies on breast cancer cell lines have shown correlations between measures of invasion and static properties including cell aggregate morphology. Specifically, it has been shown that cells demonstrating stellate aggregate morphology typically outperform cell lines demonstrating other aggregate morphologies in the Transwell invasion assay. To further assess whether morphology can be used as a predictor of invasive capacity, six cell lines that have previously been identified as forming putatively aggressive stellate aggregates or less aggressive grape-like aggregates were evaluated for their ability to invade in various contexts- from a simple two dimensional gap migration assay to a more complex three dimensional spheroid invasion assay that recapitulates cell-cell and cell-environment contacts as they exist in vivo in the context of the primary breast tumor. We found that morphology alone was insufficient to predict how well cells performed in each of these assays. Migratory ability on a two dimensional substrate, contractility of the three dimensional environment, and presence of proper integrins for binding to the extracellular matrix also failed to fully predict invasive capacity in a three dimensional environment. Correlations between performance in the three dimensional spheroid invasion assay and gene expression profiles suggest this assay can be used to identify invasive breast cancer cells independent of their morphology.

8. Evaluation of ocean crustal sites at Reykjanes ridge, offshore Iceland for Carbon Dioxide sequestration in deep sea basalt

Tarini Bhatnagar, Earth & Environmental Sciences

Over the last few decades, extensive industrialization has led to significant increase in the rate of greenhouse gas emissions. Minimizing the impacts from increasing atmospheric carbon dioxide concentrations has become one of the main challenges of this century. Mitigation strategies include improved efficiency in burning fossil fuels, using renewable energy, and capture and long term sequestration of carbon dioxide. Among these, injection of anthropogenic carbon dioxide into deep geological formations is quite promising due to their large storage capacity and geographic ubiquity. This study presents an investigation of oceanic crustal sites along the Reykjanes ridge, offshore Iceland for their potential to store carbon dioxide in deep-sea basalt aquifers. In the ocean crust, pillow lavas, breccia, and flows form large permeable reservoirs capped by sea floor sediments, and provide other deep-sea protections that significantly reduce the risk of post-injection leakage. An initial geographical reconnaissance identifies target areas using bathymetry, sediment thickness, heat flow and crustal age datasets. Based on these data, we investigate potential sites on the flank of Reykjanes ridge, south of the Reykjanes peninsula. Establishing whether fresh basalt exists, or can be assumed to exist near these sites, whether the reservoir is physically capped, and an assessment of their storage volume will be critical findings in this study. We also consider the reservoir’s thermal characteristics, mainly temperature and pressure, as they will determine the feasibility of injecting carbon dioxide in the supercritical phase. In-depth evaluation of each storage reservoir is required to ensure that the injected carbon dioxide will remain safely underground over the intended life of the sequestration project.


Bor-Ting Jong, Earth & Environmental Sciences

As California battles severe drought, it becomes increasingly important to understand the atmospheric and oceanic conditions that could interrupt or even end the drought that began in 2011. Since the current 2015/16 strong El Niño has brought several severe storms to California in this winter, an important question emerges as to the likelihood of this El Niño moderating drought conditions. In this study, the sensitivity of El Niño’s impacts on California winter precipitation is examined, focusing on seasonality, regionality, and the strength of El Niño based on observational data for the period 1901 to 2010. The El Niño influence on California precipitation strengthens from early to late winter and is stronger in the south than the north. A moderate-to-strong El Niño in the late winter can make southern California very likely to be extremely wet and northern California very likely not to be dry. El Niño’s impact on California late winter precipitation is associated with the strengthening of the “teleconnection” (the influence of El Niño on the climate in remote regions, forced by positive sea surface temperature anomalies (SSTA) and enhanced deep convection in the tropical Pacific) from early to late winter even though SSTA decreases. The possible cause of the apparent nonlinear relationship between SSTA amplitude and teleconnection strength for early and later winter may be the warmer basic state in late winter. That is, even though the SSTA weakens from early to late winter during an El Niño event, the smaller anomalies in late winter are imposed on a warmer climatological SST, which may lead to a more favorable environment for deep convection, triggering stronger teleconnection. The information of the El Niño – California precipitation relationship will be of use in seasonal forecasting for California, including the alleviation and/or...
termination drought conditions, important to water management and precaution of hydrological hazards.

10. Do ice ages explain modern lemur biodiversity in northwestern Madagascar?

Jen Tinsman, *Ecology, Evolution & Environmental Biology*

Most of the world’s biodiversity occurs in the tropics, but the processes that generate this abundance of species are still poorly understood. Isolation in refugia, or remnant pockets of forest during Pleistocene ice ages, has been proposed as a major geographic driver of diversification. However evidence for this is often based on modern species distributions instead of past ones. This study used Maxent ecological niche modeling to test whether historical distributions of lemurs actually support divergence in ice age refugia in northwestern Madagascar. Three sets of sister species exhibited significantly diverged ecological niches during the most recent ice age, indicating they were isolated from each other during that time (p<0.01). Despite geographic overlap during the Pleistocene and modern day, the niches of Lepilemur ankaranensis and L. milanoii were functionally diverged. Although Propithecus deckenii and P. coronatus’s geographic ranges do not overlap today, they did during the Pleistocene, but their niches were divergent. So too with Eulemur flavifrons and E. macaco. Although these species were not completely physically separated from each other, a combination of greatly reduced gene flow and climatic conditions acting as strong selective pressures may have supported diversification. This approach to studying historical causes of speciation is applicable to other tropical environments and could help determine the importance of past climatic conditions in shaping the present distribution of biodiversity.

11. Presentation, aroma, and flavor: Investigation of host cues in the orientation and establishment of Phoradendron serotinum (Viscaceae).

Brandi Cannon, *Ecology, Evolution & Environmental Biology*

Obligate parasitic plants cannot survive without the influx of water and/or nutrients from host plants. Therefore, successful establishment of haustoria (vascular organs of penetration and transport) is necessary for the survival of an emerging seedling. Extensive studies have been performed on the effect of host cues on germination, orientation, and development of haustoria in root parasites. For root parasites, host cues must be transmitted through the rhizosphere and are largely chemical. Plants that are parasitic on the aboveground stems of host plants must be able to detect hosts in a much different milieu. Phoradendron serotinum (leafy mistletoe) is a water parasite of broadleaf trees. While P. serotinum parasitizes many different hosts across its range, populations are most often locally host specific, preferring a single host even when other hosts are available. The underlying cause of this pattern of host preference is unknown, and will remain so until host cues responsible for successful establishment of haustoria have been identified. In this study, we examined the effects of light cues, physiochemical cues associated with the host surface, and gaseous chemical cues on the viability, orientation, and successful establishment of emerging haustoria on host plants. Light and physiochemical cues associated with the host substrate had a significant effect on haustorial establishment. Gaseous cues had a significant positive effect on viability and orientation. This latter result was foreshadowed by a similar finding in the stem parasite Cuscuta, which responds to gaseous cues emitted by host plants. Cuscuta, and other weedy parasitic genera are known for their widespread damage to agricultural crops, particularly in developing countries. Decreases in crop yield is estimated to affect more than one hundred million people worldwide.

12. Genetic and behavioral divergence among Northern Cardinal (Cardinalis cardinalis) populations across a biogeographic barrier

Kaiya Provost, *Ecology, Evolution & Environmental Biology*

Biogeographic barriers can cause genetic isolation and initiate the speciation processes. These barriers are important isolators of biological populations, but in some species barriers are extremely potent and cause rapid divergence, while in others the barrier is easily surpassable and cause no inhibitions of gene flow. The underlying mechanisms which modulate these differing responses - including ecological, functional, and behavioral mechanisms - are not well quantified. The Cochise Filter Barrier is one such biogeographic barrier separating the Chihuahuan and Sonoran deserts of North America. Here we quantified the degree of isolation between Northern Cardinal (Cardinalis cardinalis) populations and tested one potential behavioral mechanism for the maintenance of isolation. We sequenced individuals from both sides of the barrier using double digest restriction associated DNA sequencing. We further performed playback experiments to the Sonoran population using recordings from multiple locations distributed across the barrier. In this population, genetic isolation and behavioral isolation are congruent, leaving behavior as one potential modulator of how species diverge in response to biogeographic barriers.
13. Not “pulling up the ladder”: Women who organize conference symposia provide greater opportunities for women to speak at conservation conferences

Stephanie Sardelis, *Ecology, Evolution & Environmental Biology*

The scientific community faces numerous challenges in achieving gender equity among its participants. One method of highlighting the contributions made by women scientists is through their selection as featured speakers in symposia held at the conferences of professional societies. Because they are specially invited, symposia speakers obtain a prestigious platform from which to display their scientific research, which can elevate the recognition and standing of women scientists. We investigated the number of female symposia speakers in two professional societies (the Society of Conservation Biology from 1999 to 2015, and the American Society of Ichthyologists and Herpetologists from 2005 to 2015), in relation to the number of female symposia organizers. Overall, we found that 31.7% of symposia organizers and 27.4% of symposia speakers were women at the Society of Conservation Biology conferences, while 18.8% of organizers and 28.15% of speakers were women at the American Society of Ichthyologists and Herpetologists conferences. We also found a strong positive relationship between the number of women organizing a symposium and the number of women speakers in that symposium. We did not, however, find a significant increase in the number of women speakers or organizers over time at either conference, suggesting a need for revitalized efforts to diversify our scientific societies. To further those ends, we suggest facilitating gender equality in professional societies by removing barriers to participation, including assisting with travel and making conferences child-friendly.

14. The Effect of Holocene Climatic Variation on Baja California Rodent Generic Diversity: Evidence from the Abrigo de los Escorpiones Fauna

Grace Musser, *Ecology, Evolution & Environmental Biology*

Rodent diversity and abundance are significant indicators of climate structure and change in both modern and archaeological contexts. Reconstructing Holocene paleoclimate through analysis of rodent remains is especially critical in prehistoric North American archaeology as climate variation has considerable impacts on both human and non-human faunal populations. The El Niño/Southern Oscillation (ENSO) climatic phenomenon was a major cause of such climate fluctuation throughout the Holocene and continues to impact human and faunal populations worldwide. While several modern studies support positive correlations between ENSO frequency and rodent diversity, little work has focused on ENSO effects on rodent diversity over millennial time scales. The Abrigo de los Escorpiones volcanic rockshelter on the coast of Baja California provides an excellent faunal record from which to study the effects of ENSO on rodent diversity due to its large, well dated and distinctly stratified Holocene rodent assemblage that was largely accumulated due to raptor deposits. Rodent cranial elements from 10399 BP to present were identified to the genus level and diversity values were calculated for each 100-year temporal unit using the Shannon-Weaver index. Spearman’s rho correlation of Shannon-Weaver values with geologically-derived El Niño frequencies from Ecuador exhibited a positive and significant correlation. Correlation of Shannon-Weaver values with oxygen-isotope based sea surface temperature variation from the Santa Barbara Basin also showed both a positive and highly significant correlation; however, only one unit from the site was analyzed and thus further study of Abrigo de los Escorpiones rodent remains is required in order to advance knowledge of ENSO effects on generic rodent diversity.

15. Are social attributes associated with alarm calling propensity?

Holly Fuong, *Ecology, Evolution, & Environmental Biology*

Emitting alarm calls may directly benefit individuals if callers have an increased chance of surviving, if calling increases the caller’s status, or if calling functions through reciprocity. Although previous studies have examined the costs and benefits of alarm calling, few have examined how an individual’s social position can influence the propensity to emit calls. An individual’s position in its social network may vary and individuals differ in the strength and degree to which they are connected to others. We hypothesized that this variation could influence the rate at which individuals emit calls. We examined how various social attributes (degree centrality, closeness centrality, eigenvector centrality, strength, and embeddedness) were related to the likelihood that yellow-bellied marmots (Marmota flaviventris) emitted alarm calls. To do so, we first defined 2 principle components—‘popularity’ and “relationship strength”—and used generalized linear mixed effects models to explain both the natural rate of alarm calling and the rate of trap-induced calling. We found that the natural rate of alarm calling increased for marmots that were less popular (i.e., involved in fewer connections with other marmots) and that the rate of trap-induced calling increased for marmots involved in weaker relationships. These findings refute the reciprocity hypothesis. However, less popular marmots could be seeking to enhance their social status by calling, or they could be deterring predators without the aid of others. Similarly, marmots in
traps are faced with an imminent personal threat. Thus, marmots in weaker relationships that cannot rely on other marmots may call to deter predators.

16. Image State of Graphene on Iridium Modulated by Oxygen

Yunzhe Li, Electrical Engineering

Image potential state is one type of surface states which is generally observed on the surface of metallic crystal. The image potential states in graphene has been theoretically calculated by DFT based on a “LDA + image tail” potential, predicting the existence of a double Rydberg series of even and odd symmetry image potential states.

Epitaxial graphene is prepared by cycles of temperature programmed growth, followed by a chemical vapor deposition, to form exactly one graphene monolayer on Iridium substrate. And the oxygen can be exposed or intercalated to the system. All the process of forming the sample should be manipulated under ultrahigh-vacuum-chamber.

2PPE experiments are conducted by monochromatic or bio-chromatic femtosecond pulses. An optical parametric amplifier, driven by 250kHz Ti-sapphire laser, generates tunable laser pulses from 1.5-6.1 eV with bandwidth 20 meV, pulse duration 90 fs and pulse energy 100 nJ. Photoemission electrons are detected along the M-G-M direction of the Brillouin zone using a spherical-sector energy analyzer with 50 meV energy resolution.

The state energy, dispersion and decay time of the first-three image potential states of the graphene on iridium modulated by oxygen will be measured and analyzed. This dynamic process can provide new insight on image potential state engineering.

17. Probing Cellular Response to Heterogeneous Rigidity at the Nanoscale

Jinyu Liao, Electrical Engineering

The ability of a cell to sense the rigidity of its environment has recently been recognized as an important factor that influences cell function and behavior and is involved in disease development. For example, atypical response to rigidity is a hallmark of cancer. Understanding the mechanisms that support cellular rigidity sensing can lead to potential new therapies as well as new strategies for tissue engineering.

We have developed a technique for the creation of biomimetic surfaces comprising regions of heterogeneous rigidity on the micro- and nanoscale. The surfaces are formed by exposing an elastomeric film of polydimethylsiloxane (PDMS) to a focused electron beam to form micro- and nanoscale regions of increased rigidity. Finite element analysis of nanoindentation measurements performed on irradiated PDMS shows that in a thin layer near the film surface, the Young’s modulus of the elastomer undergoes an increase as a function of electron beam dose, up to two orders of magnitude.

Human skeletal stem cells plated on PDMS having a pattern of rigid spots with diameters ranging from 2µm to 100nm displayed a differential focal adhesion that colocalized on the exposed features, with the degree of colocalization depending on the spot stiffness and feature size. On 250nm spots and below, focal adhesion colocalization was completely lost, suggesting the existence of a length scale for cellular rigidity sensing. CD4+ T-cells showed a similar trend to form adhesions on patterned PDMS but the length scale is apparently different. Further, Ca2+ release, a functional indicator of immunoresponse, is significantly enhanced on patterned PDMS relative to both soft and hard PDMS. Different responses to heterogeneous rigidity were also observed for different breast cancer cell lines. These results are suggestive of possible new approaches to adoptive immunotherapy and to the exploration of mechanisms of cancer cell invasiveness based on rigidity modulation.

18. The difference in Oxygen Uptake Efficiency Slope in Healthy Subjects between Treadmill and Cycle Ergometer

Lin-Chun Wang, Institute of Human Nutrition

Objective: Based on previous study in Dr. Garofano’s lab, the consistency of Oxygen Uptake Efficiency Slope (OUES) values were not obtained between Treadmill and Cycle Ergometer. We sought to evaluate this difference in OUES.

Background: Maximal oxygen uptake is the most reliable measure of exercise capacity, but seldom attained in exercise testing. While the OUES is an objective, non-invasive, reproducible measure of cardiopulmonary function that does not require a maximal exercise effort. OUES plots the relationship of minute ventilation (VE) to oxygen uptake (VO2). The equation is VO2=a log10VE+b, where “a” is the OUES. The steeper the slope, the more efficient the oxygen uptake during exercise. OUES has been utilized as prognostic marker in patients with heart failure, coronary artery disease and pulmonary hypertension. Theoretically, the consistency of OUES values should be obtained when different ergometers were used, cycle or treadmill. Ten Healthy adults participated in previous study. This year, so far, two Healthy adult participated. Subjects are 21–40 years old, free of heart and lung diseases and nonsmokers. Forced vital capacity
(FVC), forced expiratory volume in 1 second (FEV1), and maximum voluntary ventilation (MVV) were measured using spirometer. During all tests, respiratory variables and 12-lead ECG were continuously monitored. VO2 was plotted against the logarithm of VE, and the OUES was determined. In previous study, 17.1% difference between different ergometers was found (p=0.014). There is also a mathematical difference in OUES of the two subjects this year.

Summary: OUES does not demonstrate strong consistency when compared between the cycle and the treadmill ergometer. We are recruiting more participants, hoping to find an accurate cut point for the determination of the OUES. At this point, it may be necessary to limit patients to exercise on a single ergometer so as not to erroneously detect changes in exercise tolerance.

19. Connectivity Homology Enables Inter-Species Network Models of Synthetic Lethality
Alexandra Jacunski, Integrated CMBS

Synthetic lethality is a genetic interaction where two non-essential genes cause cellular death when knocked out simultaneously. Although this phenomenon is well studied in yeast, few interactions have been elucidated in humans, in spite of its potential applications to predicting drug-drug interactions and cancer combination therapies.

Here, we develop SINaTRA (Species-INdepen TRAnslation), an algorithm that uses the normalized parameters of a source species' protein-protein interaction network and experimental data of synthetic lethality to create the model; we then apply this model to the target species' network data. We use S. cerevisiae as our source species; we first validate our in S. pombe, then apply it to humans.

In humans, we perform genetic filtering and generate approximately 100 million SINaTRA scores, describing a gene pair's synthetic lethal status. Using these SINaTRA scores, we explore novel targets of cancer combination therapies. This study is the first genome-wide, inter-species model of SL in humans.

20. Lysosomes: a new target for obesity treatment
Yuxi Lin, Medicine/Nutritional and Metabolic Biology

Obesity is one of the most devastating epidemics in the modern world. Its comorbidities, such as cardiovascular disease and cancer, are among the major causes of death. With 13% of the world’s population affected, the rising rates of obesity will exacerbate the effects on world health unless a viable cure is found. Fortunately, with the discovery of brown adipose tissue (BAT), an organ that is capable of using energy to produce heat, an effective therapy may be possible.

At the core of BAT is a heating phenomenon known as nonshivering thermogenesis (NST), which occurs when reactions are uncoupled from the creation of chemical energy. As a result, NST increases energy expenditure. Only two organelles are known to generate heat: the mitochondrion of BAT and the sarcoplasmic reticulum of muscle. The role of other organelles in NST has not been studied. We have recently implicated lysosomes with NST in BAT, and now we provide evidence that lysosomes are involved through three possible methods: substrate provision, signaling regulation, and heat generation.

We reasoned that the lipid breakdown products of the lysosomal acid lipase (LIPA) are substrates for NST in mice. Unexpectedly, we found that deficiency of the cytosolic lipase products does not impair NST, whereas deficiency of LIPA products does. Using fasting and refeeding challenges, we show that substrate availability alter lysosome activity and cold survivability, suggesting that LIPA provide substrates necessary for NST. Further, we show a novel relationship between lysosomes and NST signaling via the master regulator, transcription factor EB, using protein analyses. Finally, by measuring heat production by healthy versus lysosomal deficient cells, we show that lysosomes may generate heat directly.

These data suggest not only three entirely new roles for the lysosome that transform our understanding of its cellular function, but also provides a new target to activate NST in BAT for the treatment of obesity.

21. The role of higher order somatosensory thalamus in encoding the behavioral relevance of stimuli
Georgia Pierce, Neuroscience

In sensory systems, information from the external world is relayed from the sensory receptors to the cerebral cortex via two pathways in the thalamus. The pathway through a “primary” thalamic nucleus to primary sensory cortex is known to be a temporally and spatially precise relay of sensory information to cortex. However, the second pathway, through “higher order” thalamus, remains poorly understood. Lesions of visual higher order thalamus in primates result in an inability to respond to task-relevant visual stimuli, despite having fully functional vision. These studies suggest that higher order thalamic nuclei may signal behaviorally relevant stimuli (i.e. stimuli that predict reward outcomes). We investigate the role of higher order thalamus in a genetically tractable and anatomically well-characterized model: the mouse whisker system. The
posterior medial nucleus (POm, somatosensory higher order thalamus) is well-placed to influence activity in primary somatosensory cortex (S1). POm axons synapse in layer 1 on the apical dendrites of S1 neurons and therefore have the potential to powerfully modulate the gain of sensory responses in cortical neurons. We hypothesize that this projection from POm to S1 signals the behavioral relevance of objects, thereby enhancing S1 representations specifically of relevant objects. We have designed a novel whisker-based behavioral task in which mice respond to poles stimuli that differ in behavioral relevance. To record activity in the POm to S1 projection during behavior, we transfect POm with a calcium indicator and image the activity of POm axons in S1 with two-photon microscopy. Preliminary data indicate that POm inputs to S1 are stronger for rewarded objects, which are intrinsically relevant. We next plan to identify how this projection modulates activity in S1, thus elucidating a pathway by which cortex could associate sensory stimuli with their behavioral importance.

22. Developmental perturbation of dopamine signaling increases adult aggression
Darshini Mahadevia, Psychiatry

Adult pathological aggression has been associated with hyperactivity of the dopamine (DA) neurotransmitter system. To that end, our lab has identified an adolescent (postnatal days 32 to 41) sensitive time window during which increased DA signaling affects the development of circuitries underlying adult aggression in mice. We established that DA transporter blockade, which enhances DA signaling, during adolescence increases adult aggressive behavior. Our hypothesis of an altered dopamine circuit-based mechanism in these aggressive mice was confirmed by their heightened sensitivity to psychostimulants. When we probed underlying DA physiology we noted that the behavioral changes were associated with hyperactivity of the ventral tegmental area (VTA) DAergic neurons, both in vivo and in slices. We are now dissecting the role of the DA-associated circuitry in adult aggression using in vivo optogenetics. Using this technology we are able to render genetically modified mutant mice with DA cells that have photosensitive channels (ChR2). This highly specific circuit of cells is then activated by using flashes of light delivered through a fiberoptic wire. We found that ChR2-based activation of VTA DAergic neurons increases aggressive behavior in real time, supporting the hypothesis that increased DAergic function underlies altered aggression. To further dissect the DA-associated circuitry underlying adult aggression, we optogenetically probe VTA-target regions. We have thus far identified that VTA DA appears to be acting through the lateral septum to induce aggression. Together our data provides insight into a dopamine period that determines the developmental trajectory of aggression circuitry. This might ultimately aid prevention and treatment approaches for neuropsychiatric disorders characterized by unprovoked violence, an issue that carries serious consequences in society today.

23. Clinical Outcomes of Stereotactic Body Radiotherapy and Surgery in Elderly Patients with Pancreatic Adenocarcinoma
Subha Perni, Radiation Oncology

Objective: More than 60% of patients with pancreatic adenocarcinoma (PDAC) are 65 or older. Stereotactic body radiation therapy (SBRT) in combination with surgery has recently emerged as a promising approach that shows excellent local control rates, but there have been some concerns about associated toxicity. Its use has not been well characterized in the elderly. We aimed to evaluate the results of SBRT in treating PDAC in elderly patients.

Methods: We identified 29 patients aged 65 or older with PDAC treated with SBRT between 2011 and 2015. Recursive partitioning analysis (RPA) identified age cut point associated with overall survival (OS). Kaplan-Meier calculations were used for local control (LC) and OS. Comparisons between groups were made using Wilcoxon tests. Cox regression, univariate, and multivariate analyses were performed.

Results: Median follow-up was 55 weeks. 5 patients (17%) had resectable disease, 15 (52%) had borderline resectable disease, 8 (28%) had unresectable disease, and 1 (3%) had unresectable disease due to medical comorbidities. Most patients had neoadjuvant SBRT (79%) and/or surgery (62%). Median survival for all patients was 64 weeks. 1-year LC rate was 86%. RPA identified age cut point of 70 years associated with OS. 76% of patients aged 70 or older were alive at 1 year as compared to 95% of younger patients (p = 0.035). However, this association was non-significant when patients with Karnofsky performance status (KPS) of 60 were excluded. Patients who had surgery had significantly improved LC of disease, with only 5.9% experiencing local failure as compared to 27% of patients who did not have surgery (p = 0.027). In multivariate analysis, only KPS was associated with OS (p = 0.0067).

Significance: This study has shown that SBRT and surgery may be effective and well-tolerated for treatment of elderly patients with pancreatic cancer. Performance status may be important than age in selecting patients for this treatment approach.
Reviewers and Volunteers

Reviewers

Volunteers
Ananya Jain, Beyza Bulutoglu, Elham Azizi, Ellie Ransom, Iva Dincheva, Jennifer Ziegenfuss, Jingya Zhang, Kerry Goodman, Ling Bai, Lorelei Curtin, Man Su, Maryam Majeed, Meaghan Ferguson, Nikki Herndon, Oscar Jimenez Gordillo, Qianyi Zhao, Sandhya Prabhakaran, Sarah Kramer, Yiren Wang, Yushu Chen, Zhao Jingmei