Fall Semester 2015:

Upcoming:

12/3/15 (Ty Tuff, Ecology and Evolutionary Biology)

12/10/15 (Amanda Grenell, Chemistry)

Previously this semester:

9/3/2015 (Carly Matson, Mathematics)

Knots

Knots are ubiquitous in our world. We use them to tie our shoes, knit our sweaters, and prevent our boats from floating away. There are many different kinds of knots, and one can be turned into another through the process of untying and retying. But what happens when you take the two loose ends of a knot and join them together? We obtain the mathematical version of a knot, an object that can be pulled and twisted into different shapes but that has no beginning or end. Intuitively we realize that it is no longer true that any knot can be transformed into any other. In this talk I will discuss a few of the techniques for distinguishing one knot from another as well as some of the connections between this theory and other areas of math and science.

9/17/15 (Sarah Crump, Geology)

Relics of a colder past: Exposure ages from Neoglacial moraines on Baffin Island, Arctic Canada

Temperature changes in the Arctic have been about 3-4 times greater (for both warming and cooling events) than the rest of the Northern Hemisphere during the last 3 million years. This is primarily a result of positive feedback mechanisms related to changes in sea ice, snow cover, and glacier extent, and in turn, this Arctic amplification influences the climate system globally. As such, records of past climate change from the Arctic are particularly important for understanding the Earth's climate system and predicting how future warming might play out. Alpine glaciers respond sensitively to changes in temperature and precipitation, and the deposits they leave behind during advances—specifically, terminal moraines—provide valuable clues about past cold times. In this talk, I will present a brief overview of why and how geologists go about reconstructing climate and glacier history and then focus in on my efforts to date moraines that represent glacier advances during the last ~5,000 years on Baffin Island.

10/1/15 (Ian Martiny, Computer Science)

3n + 1 Problem

The 3n + 1 problem (also known as the Collatz Conjecture, Ulam's Conjecture, the Syracuse Problem, etc.) was proposed in the 1930s and can be stated through iterations of the function:

$$C(n) = \begin{cases} \dfrac{n}{2} & \text{if } n \text{ is even} \\ 3n + 1 & \text{if } n \text{ is odd} \end{cases}$$

The conjecture states that no matter what positive integer is chosen there is a k such that C (k) (n) = 1 for some k ≥ 1. Informally this says that after some number of iterations of the function C we will get an answer of 1. For example C(5) = 16, C(16) = 8, C(8) = 4, C(4) = 2, C(2) = 1. Thus after 5 iterations from the starting number 5, C reached 1 - or C (5)(5) = 1.

This has been numerically verified for numbers as large as 5.764 × 1018, meaning for any given number, x, less than 5.764×1018 after some number of iterations of C on x we will eventually reach the number 1. The conjecture states this will always happens, for every positive integer.

This conjecture is very easy to state but has remained unsolved for the past 80 years. We will discuss basics of this function: how it behaves, and a speed up that lets us compute this a bit faster. We will next talk about one of the reasons this conjecture is so difficult to prove (in general) and go through the process of creating a "common sense" solution to the question of "how many iterations are necessary to reach 1?"

Finally we will discuss the some common but important results on this problem that have given researchers insight on how this function behaves and discuss whether the 3n + 1 conjecture is a good problem.

This talk is accessible to all audiences, and assumes no formal background in mathematics; all necessary background will be covered in the talk.

10/29/15 (Bryce Bjork, Physics)

Simplifying complex chemical kinetics through multiplexed spectroscopy

The complexity of a chemical reaction increases dramatically with the number of molecules that participate. In order to really understand a reaction, it is important to determine reaction rates, quantum yields, and ro-vibrational temperatures for all participating molecules, which can become infeasible for complicated reactions. Traditionally, the experimentalist has had to sacrifice either spectral bandwidth or absorption sensitivity, resulting in instruments that have the capability either detect one molecule very sensitively or many molecules with significantly reduced sensitivity. For chemical kinetics, this means that many experiments can only provide a small amount of the information required to understand the reaction. The optical frequency comb has significantly changed this situation, providing broad spectral bandwidth for multiplexed molecular detection while also containing a spectral structure that permits coupled to an optical enhancement cavity for improved absorption sensitivity. In my presentation, I will describe the basics of cavity-enhanced optical frequency comb spectroscopy (CE-DFCS) and discuss the use of the technique to study an important chemical reaction in combustion and atmospheric chemistry, $OH+CO \rightarrow H+CO_2$, with high-sensitivity and microsecond time-resolution.

11/5/15 (Steffanie Guillermo, Psychology)

Mechanisms underlying attention to race

Existing research on attention to race demonstrates that attention is more pronounced for racial outgroup versus ingroup faces. The majority of this work examines White participants' attention to Blacks, a racial group stereotypically associated with threat. These lines of work typically conclude that threat-based associations drive attention. However, more recent evidence finds preferential attention to non-threatening East Asian faces, arguing that novelty is sufficient to prompt attentional biases. This raises the possibility that mechanisms other than threat underlie race-based attention. The current research examined attention allocation to racial outgroup versus ingroup faces. Attention was measured with an exogenous cueing task that assessed attentional capture and holding towards faces of each racial group. Across two studies, we found that attention is biased towards Black and Latino versus White faces. In a third study, we tested various possible mechanisms. We found that perceived threat was related to the magnitude of race-based attention; however, results indicated that this relationship was stronger for ingroup, White faces. Implications of these findings will be discussed, as well as future directions to more carefully examine the relationships between threat and attention to race.

11/12/15 (Trey Laurence, Aerospace Engineering)

An alternative method for wind sensing with small UAS

Unmanned aircraft offer many advantages for obtaining meteorological measurements over the more established methods (radar, weather balloons, etc). Currently, one of the best ways to perform wind sensing with sUAS is using a multi-hole probe. While MHPs offer an accurate way to measure the relative winds, they are expensive and require significant consideration as to where to mount on the aircraft. My research is focused on developing an alternative to the multi-hole probe using numerous pressures sensors distributed across the surface of the aircraft. Since wind sensing is only one of the focuses of the Research and Engineering Center for Unmanned Aircraft, I will also talk about other projects the lab has been part of.

Spring Semester 2015:

1/22/15 (Fnu Shikhar, Mechanical Engineering)

Ceramic responses under electric fields

Materials have been broadly divided in 3 major categories: Metal, polymer and ceramics. Some common examples of ceramic are serving plates, bricks, tiles, etc. But do you know Ceramics are the core features in sensors, semiconductors, superconductors, electrical insulation, rocket body, bioengineering, heat insulations? This presentation will try to draw attention towards Ceramics, such as, how is a ceramic different from metal or polymer and why should we care about them? How are they made and how my research would help to improve some fairly old ceramic synthesis problems. We use electric field on ceramics to lower down the temperature and time required for their synthesis. Followed by this, I shall present how this new technique, named as “Flash Sintering”, has altered some of the basic properties of ceramic, what are their potential applications and the science behind them.

2/5/15 (Ulyana Horodyskyj, Geology)

Tracking supraglacial lake changes on Ngozumpa glacier, Nepal

The formation of supraglacial (surface) lakes appears to be a catalyst for ice mass loss on debris-covered glaciers in the Himalaya. Once formed, these lakes can grow through expansion, by melting and collapsing of surrounding ice walls, and through deepening of their ice floors. As lake water volume increases, so too does the risk for glacial lake outburst floods (GLOFs). Spillway Lake, a large supraglacial base-level lake on Ngozumpa, one of Nepal’s largest and longest glaciers, has been growing since the

1980s. This research utilized time-lapse cameras, weather stations, temperature buoys, and sonar to track these changes in real time.

Oblique-view time-lapse imagery of lakes reveals that multiple drain and refill events, on the meter scale, can occur during a melt season. Less frequent overhead satellite imagery cannot account for this volume loss, stressing the importance for continued "boots on the ground" observations. Vertical temperature distribution in the subbasins of Spillway Lake reveal mostly isothermal conditions in the summer, indicating the lake is well mixed due to constant inputs of meltwater both from above ground (ice walls) and at depth, from englacial and/or subglacial channels. Lake floor melting rate is highest in the fall season, after surface melting ceases and the lake bodies have had sufficient time to accumulate heat. However, the presence of thick debris (mud and rock) on lake floors can insulate the ice from melting. Sonar imaging and 3D model construction of lake floors reveal areas prone to future deepening, which should continue to be monitored in the future.

2/12/15 (Katharine Adamyk, Mathematics)

Decryption of micronuclear precursors of somatic genes in certain ciliate species

It has been postulated that the decryption of micronuclear precursors of somatic genes in certain ciliate species occurs by constrained reversals and block interchanges. Not all permutations are sortable by these constrained sorting operations. We find a linear time criterion for determining which permutations are sortable by constrained block interchanges. For permutations not sortable by constrained block interchanges, we find a linear time criterion for determining which permutations are the final results of attempted sorting by constrained block interchanges. The corresponding theory for constrained reversals appears more complicated and we present partial results for this operation. The constrained sorting operations suggest natural two player games. By a classical theorem of Zermelo, these games are determined that is, some player has a winning strategy. We consider the decision problem of determining which player has a winning strategy in a specific instance of a game.

3/5/15 (Jordan Holquist, Aerospace Engineering)

Direct generation of oxygen from electrocatalytic carbon dioxide reduction

What is the current direction of NASA? Are they going to an asteroid? The Moon? Mars? I can't actually answer any of these questions, but one thing is certain: no matter the destination, technology development to enable upcoming exploration is a critical need. In my presentation, I'll briefly discuss technology development needs to advance human spaceflight and how you can get involved (read: funding sources and research opportunities that apply to all STEM disciplines).

After that, I'll talk about my particular research: the direct generation of oxygen from electrocatalytic carbon dioxide reduction using room temperature ionic liquid catalysts. This will include an overview of the state of the art of oxygen generation/carbon dioxide reduction on board the International Space Station, a brief introduction to electrochemistry, and ionic liquid chemistry. This technology is not only critical for closing the consumables loop on board spacecraft, but also has implications for carbon neutral fuel sources, greenhouse gas emissions, and solvent chemistry.

3/19/15 (Janet Tsai, Mechanical Engineering)

The brutalist engineering center: 1965 - 2015

As the E in STEM, Engineering is typically grouped with its related disciplines science and mathematics. Yet unlike these "pure" disciplines, engineering as we know it is relatively new, having only developed its white collar image in the early days of the Cold War, space race, and founding of NASA.

Here at CU, we have a physical reminder of this 1960s makeover of engineering our Engineering Center Building. Tracing back the conditions which led to this unique building's design and construction, we debunk some contemporary rumors and see how this concrete behemoth still affects how we teach and learn today. While it's no longer the stateoftheart beacon of space age engineering it was once intended to be, the building has successfully contained our activities for the better part of five decades. Janet will present some fascinating research on the Engineering Center, including a glimpse into the era in which it was built, and what the building means for us as researchers and educators today.

4/2/15 (Daniel Feucht, Geology)

Geophysical imaging of the Rocky Mountain Front Range: Implications for support of high topography in Colorado

Have you ever wondered why Denver is the mile high city? Or why the Rocky Mountains are there at all? You probably can guess that it has something to do with plate tectonics, but as it turns out, the Rockies and the adjacent High Plains appear to be something of a special case. The origin of the southern Rocky Mountains, along with their persistence as a mountain range for more than 40 million years, is a hot topic in geology these days and several researchers at CU Boulder are leading the charge to explain this enigmatic landscape of Colorado that we all too often take for granted.

In my STEMinar talk I'll present an overview of how mountains are built and maintained over geologic time, discuss how these processes relate to the mountains in our own *backyard, and then present my own contribution to the Rocky Mountains puzzle in the form of a large scale magnetotelluric survey of the Rocky Mountain Front Range in Colorado. Magnetotellurics is a passive electromagnetic geophysical imaging technique that provides a measure of the electrical properties of the Earth at depth. By interpreting electrical properties of the crust and upper mantle in a geologic context we can estimate the distribution of temperature, melt, fluids, and altered mineral composition at depth and in turn say something about which of these mechanisms contributes to the high topography that we see today.*

4/9/15 (Chelsea Heveran, Mechanical Engineering)

Bone quality is impaired in chronic kidney disease

What makes a bone strong and tough? What about bone changes to become fragile in aging or disease? In this talk, we will take a tour from the macro to nano scales to explore what makes (and what breaks) this hierarchical and dynamic composite tissue. We will also consider how bone microstructure and material properties contribute to an overall "bone quality." Lastly, we will discuss my progress in understanding how Chronic Kidney Disease, common among the elderly, compromises bone quality to increase skeletal fragility in a large and growing clinical population.

4/16/15 (Sarah Grover, Psychology)

Building bridges: Moving towards a scientific understanding of positive cross-sex interactions in STEM and why we should care

This talk presents social psychological theory and research to understand environmental factors that increase women's belonging in STEM. The talk will be given in 3 parts:

1. On the emergent properties of groups: How group interactions shape our self concept.

2. Present research: Two studies examining the consequences of gender composition in a small group math task for women's performance, the social cohesion they experience with their group members, and self and others' perceptions of their math ability.

3. Future directions: What are the barriers to positive crosssex contact and how can they be overcome? What are the verbal and nonverbal cues of group inclusion, and how can they be measured?

4/23/15 (Navid Shervani-Tabar, Mechanical Engineering)

Complex geometry flows: An approach to simulate the flow over obstacles which has been developed in "Multiscale modeling laboratory"

4/30/15 (Graham Lau, Geology)

Something's eating the yellow snow

Sulfur is one of the most abundant elements in the universe and is essential for life as we know it. Characterizing the role of biology in the geochemical cycling of sulfur from regional to global scales is important for the future exploration of other worlds in our solar system and beyond. For this STEMinar, I will present my research on microbial sulfur cycling within a supraglacial sulfur spring system in the Canadian High Arctic. I'll talk about what we know and have yet to learn about the biological and abiotic processes that are responsible for cycling sulfur at this field site (and I'll also show lots of pretty pictures from my field work).

Fall Semester 2014:

9/2/14 (Noah Williams, Mathematics)

Mathematics and the genome rearrangement problem

Mathematics can be used to help biologists understand evolutionary relationships and diseases such as Neurofibromatosis. In this talk, we will investigate the genome rearrangement problem, whose goal is to find the best way to transform one collection of DNA into another. In particular, we will discuss the Double Cut and Join (DCJ) and Deletion-Insertion models for genome rearrangement and some results pertaining to the distribution of genomes under DCJ distance.

9/18/14 (Osama Bilal, Aerospace Engineering)

PhoNonic materials: The mystery of missing frequencies and their applications

Transmission of everyday sound and heat can be tracked back to a physical particle named "phoNon". Understanding, analyzing and manipulating such particle across multiple scales/disciplines can be achieved using phononic materials. That is a class of material systems composed of a basic building block that repeats in space (i.e. unit cell). Among many features, it exhibits distinct frequency characteristics such as band gaps, where certain frequencies are prohibited from propagation. These properties can lead to tremendous range of applications, ranging from vibration isolation, converting heat waste into electricity to acoustic cloaking. In this seminar, I will give an introduction to the field, explain the main concepts, potential applications and shed some light on its design and optimization.

9/30/14 (Kristen Brown, Mechanical Engineering)

Internalizing air quality and greenhouse gas externalities in the US energy system

This study provides a unique analysis of how the US energy system might be transformed if energy costs internalized the damages caused by air pollution. The US energy system is modeled including fees on emissions that are based on estimates of the external cost of those emissions. The externalities that are internalized include health and environmental effects as well as climate change. Placing fees on emissions provides more of an incentive to reduce pollution than fees on energy use. This interdisciplinary work incorporates knowledge from engineering, economics, mathematics, medicine, climate research, and atmospheric chemistry.

10/16/14 (Sarah Welsh-Huggins, Civil Engineering)

Integrating green and resilient building design for enhanced disaster recovery

Increased worldwide urbanization in recent years has led to greater vulnerability from seismic and other natural hazards. Integrating performance based design and assessment of green and hazard resilient buildings, however, offers alternatives for urban disaster recovery. Performance based earthquake engineering aims to reduce the dollars, deaths, and downtime associated with a hazard event. Green design, meanwhile, strives to minimize use of natural resources and provide economic gains associated with reduced operating energy or greater occupant productivity. My dissertation research proposes a new life cycle assessment methodology that links the distinct fields of sustainability and hazard resilience, advancing building design and identifying leverage points for improved disaster mitigation and recovery. The "green resilience" framework presented here can be used to analyze the implications of disaster mitigation and reconstruction. The methodology quantifies environmental metrics and socioeconomic indicators of building performance over its lifetime and accounts for potential risk of hazard events. The utility of the framework will be illustrated with a case study of the design and seismic assessment of a hypothetical commercial building in Los Angeles, CA, U.S.A.

10/28/14 (Helen McCreery, Ecology and Evolutionary Biology)

Collaborating with ants: basic bio, shared lessons, and cooperative transport

Ant colonies consist of autonomous, simple units capable of remarkable problem solving through cooperation. Ants build massive, complex, underground nests, and many species work together to transport objects hundreds of thousands of times their own weight. How does this complex coordination emerge from groups of simple individuals? This question is inherently interdisciplinary, and there is a long history of collaboration *and shared lessons among ant biologists, computer scientists, and mathematicians. For example, algorithms inspired by ants and other social insects are used in swarm robots. In this STEMinar, I will give a brief introduction to ant biology and cooperation, and discuss my interdisciplinary research on cooperative transport.*

11/6/14 (Maya Fabrikant, Physics)

Frozen molecules and space chemistry

Cooling molecules allows us to study what kind of chemistry happens at temperatures characteristic of interstellar atmospheres. More practically, cold environments can stabilize very reactive molecules like radicals, which can allow us to study difficult to observe reactions. Exotic ultracold molecules like KrB have been created in the lab with the help of laser cooling and photoassociation, but sufficiently cooling molecules more commonly encountered in nature, like the CH and NH radicals, presents its own unique challenges. I will talk about methods for cooling and detecting these more mundane molecules and what kind of chemistry we might expect to observe.

11/18/14 (Marianne Reddan, Psychology)

Developing neural signatures for discrete emotional states

Despite its research popularity and societal importance, emotion remains elusive to neuroscience. Progress is slowed by the field's concern with local representation, a one to one mapping of structure and function. This has led to the identification of many correlates of emotion (e.g. amydala threat, nucleus accumbens reward), but the complexity and distributed nature of emotional experiences remain neglected. Our laboratory employs a novel and promising approach to the problem of emotion: We apply machine learning to neuroimaging data in order to identify sensitive and specific signatures of emotional responses. We have successfully developed signatures of pain and negative emotion, which have strong implications for the treatment and diagnosis of emotional disorders. In this talk, I will discuss (1) a ongoing study which aims to classify nuanced emotional experiences, and (2) my work investigating the neural representation of threat anticipation, and how imagination can change its expression.

12/4/14 (Joey Hubbard, Ecology and Evolutionary Biology)

Genetic and environmental contributions to a divergent plumage trait in barn swallows

A central theme of evolutionary research is to understand the source and function of phenotypic variation. For most phenotypic traits, sources of variation can be partitioned into genetic or environmental variation. Identifying the proportion of variance due to *these components allows for predictions regarding phenotypic responses to variable environments and selection to be made. Barn swallow subspecies have divergent phenotypes and it appears that the focal trait for female preferences has also diverged. We examined the sources of phenotypic variation of melanin based ventral plumage in two populations of barn swallows: North America (Colorado) and Europe (Czech Republic). In North America, male coloration is the target of sexual selection with darker males achieving higher reproductive success. However, it is unclear what role coloration plays in mate choice decision for our study population in the Czech Republic. In both populations, we found that coloration is explained by both genetic and environmental variation. However, the genetic covariance structure of color traits differed. Together, these results demonstrate that coloration is influenced by developmental environment more than genetic environment. Thus, in North America, where females prefer males with dark plumage, coloration serves as a better signal of developmental conditions than genetic quality. Moreover, divergent selection on plumage coloration may explain the phenotypic differences among these populations, suggesting a role of sexual selection in the diversification of the barn swallow species complex.*

Spring Semester 2014:

1/16/14 (Alex Hopkins, Chemistry)

Man vs. bacteria: Our failing weapons and how to make more

Antibiotic resistance genes are ubiquitous in the environment. The use of antibiotics naturally selects for bacteria with resistance genes that allow them to survive in the presence of antibiotic drugs. These resistant bacteria can share their resistance genes with other bacteria, enabling the spread of resistance across species. These and other mechanisms have led to the emergence of multi-drug resistant pathogens, which no longer respond to the current arsenal of antibiotic treatments. To combat this growing problem, scientists seek out novel targets for the development of new antibiotic drugs.

I will discuss current antibiotics and their mechanisms of action, the rise of antibiotic resistance, and the Sousa lab's approaches to define new targets for the next generation of antibiotics.

1/28/14 (Katy Barnhart, Geology)

Sea ice and arctic coasts

I will discuss whole-Arctic sea ice change and associated coastal impacts and details of coastal erosion at Drew Point, Beaufort Sea, Alaska.

Coasts form the dynamic interface of the terrestrial and oceanic systems. In the Arctic, and in much of the world, the coast is a zone of relatively high population, infrastructure, biodiversity, and ecosystem services. A significant difference between Arctic and temperate coasts is the presence of sea ice. Sea ice influences Arctic coasts in two main ways: (1) the length of the sea ice-free season controls the length of time over which nearshore water can interact with the land, and (2) the sea ice edge controls the fetch over which storm winds can blow over open water, resulting in changes in nearshore water level and wave field. The resulting nearshore hydrodynamic environment impacts all aspects of the coastal system.

Arctic coastlines are responding rapidly to climate change. Remotely sensed observations of coastline position indicate that the mean annual erosion rate along a 60-km reach of Alaska's Beaufort Sea coast, characterized by high ice content and small grain size, doubled from 7 m yr^{-1} for the period 1955-1979 to 14 m yr^{-1} for 2002-2007. Over the last 30 years the duration of the open water season expanded from ~45 days to ~95 days. Time-lapse photography indicates that coastal erosion in this environment is a halting process: the most significant erosion occurs during storm events in which local water level is elevated by surge, during which instantaneous submarine erosion rates can reach 1-2 m/day. In contrast, at times of low water, or when sea ice is present, erosion rates are negligible.

I use a combination of field and remotely sensed observations to understand the process of coastal erosion in this environment and consider how ice-rich coasts will respond to a changing Arctic.

2/13/14 (Matthieu Talpe, Aerospace Engineering)

Defying gravity... into telling us about the Earth

As the story goes, the fall of an apple on the head of a man named Isaac Newton triggered the first formulation of the gravitational attraction. Historical accuracy aside, gravity, an intrinsic property of mass, is commonly known to equal approximately 9.8 m/s^2 at the surface of Earth. However, higher fidelity measurements of the Earth's gravity obtained from satellites have become both so precise and accurate that the motion of mass at the surface of the Earth is clearly detectable. Two of the largest examples of surface mass motion are the seasonal filling and draining of the Amazon basin and the melt of the Antarctica and Greenland ice sheets. In this seminar, I will talk about NASA's designated gravity-observing spacecraft and how its measurements contribute to monitoring the Earth's dynamic environment and, most notably, the recent climate change.

3/13/14 (Jen Gifford, Chemistry)

Continuing the antibiotics conversation: M. smegmatis growth inhibition with thiol-modified Au nanoparticles

As discussed previously this semester, the emergence of multi-drug resistance (MDR) by pathogenic bacteria has become a significant global public health threat. Our laboratory uses a small molecule variable ligand display (SMVLD) method to develop novel and highly potent nanoparticle antibiotics for various pressing bacterial concerns. These conjugates have been shown to delay resistance mechanisms, have similar effective concentrations as many commercially available drugs, and lack cytotoxicity. In particular, I will discuss my research on the application of our method to M. smegmatis, a non-infectious model for M. tuberculosis.

4/1/14 (Chelsea Cook, Ecology and Evolutionary Biology)

Stay cool: Social context influences a thermoregulatory fanning behavior in honeybees

On January 25th 2014, a headline from The Australian, Australia's main newspaper, stated that the country would likely have to import honey from China as they were in the midst of a honey shortage. The reason: due to the hottest year on record, honeybees were spending too much time cooling their hive and not enough time collecting nectar. If the hive gets too hot, then the developing bees inside may die. To cool their hive, honeybees stand at the entrance and fan their wings. This helps to circulate cooler air. But how do honeybees know when it is the most efficient time to fan? I explore how social context changes the performance of this fanning behavior, and how this fits into the larger organization of division of labor in the honeybee society. Understanding how groups perform jobs efficiently furthers our understanding about societies in general, from bacteria to humans.

4/17/14 (Sarah Grover, Psychology)

Group problem-solving in a threatening environment: Women's math expertise is discounted in male dominated groups

Researchers in social psychology and allied fields have conducted over 300 experiments on stereotype threat, which is the threat of being judged or treated in terms of a stereotype, or the fear that one will inadvertently behave in a manner to confirm a stereotype. Stereotype threat has been shown to lead to consequential negative outcomes for the academic achievement of women and minorities (e.g., impaired test performance, de-identification with the academic domain). I will provide a brief overview of nearly 20 years of stereotype threat research, including causes, consequences and interventions to mitigate stereotype threat. After providing some relevant background on stereotype threat research, I will introduce some new research that I have been *conducting with my advisors Bernadette Park and Tiffany Ito examining the effects of cues known to elicit stereotype threat in a group problem-solving context. Specifically we vary the gender composition of the groups to be either male dominated (three male and one female) or all female (four female participants) and examine how group gender composition affects self and others' perceptions of a female participant with task-relevant expertise. I encourage you all to attend so that we can have a lively discussion of the research over some tasty pizza.*

5/1/14 (Christine Fanchiang, Aerospace Engineering)

The human element: Quantifying human spacecraft design impacts on crew performance

The design of a system has a considerable influence on the performance and behavior of the users. While this concept applies to any tool or system used in everyday life, the effects are magnified when applied to more complex systems such as the Space Shuttle. The added challenges faced by astronauts increase the need for careful and well-planned spacecraft designs. This presentation reviews the history of human spacecraft design and provides a general methodology for quantifying the impacts of human spacecraft design choices on the crew's performance.

Fall Semester 2013:

9/5/13 (Trubee Davison, Mathematics)

An introduction to fractals

Fractals can be thought of as objects that exhibit the same pattern at different levels of zoom. Examples of fractal-like objects found in nature include, to name a few, snowflakes, ferns, trees, shorelines, clouds, leaves, and crystals. The goal of this talk will be to give a mathematical framework for constructing fractals. In particular, we will discuss how fractal construction relies on an important mathematical relationship that exists between the notion of ‘shrinking’ and the notion of a ‘fixed point’. The talk will be non-technical and accessible to everyone.

9/17/13 (Halley Profita, Computer Science)

The social acceptability of wearable technology: A case study of interacting with an on-body electronic-textile interface in public.

Wearable technology, specifically e-textiles, offers the potential for interacting with electronic devices in a whole new manner. However, some may find the operation of a *system that employs non-traditional on-body interactions uncomfortable to perform in a public setting, impacting how readily a new form of mobile technology may be received. Thus, it is important for interaction designers to take into consideration the implications of on-body gesture interactions when designing wearable interfaces. In this study, we explore the third-party perceptions of a user's interactions with a wearable e-textile interface. This two-prong evaluation examines the societal perceptions of a user interacting with the textile interface at different on-body locations, as well as the observer's attitudes toward on-body controller placement. We performed the study in the United States and South Korea to gain cultural insights into the perceptions of on-body technology usage.*

10/3/13 (Will Levandowski, Geology)

The math and mechanics of making mountains

Why do mountains exist? Topography is like an iceberg; elevation excess above sea level reflects mass deficit below. Using techniques to estimate density variations in the earth based on seismological characteristic and other geophysical properties, I describe the physical basis for modern topography of the entire western United States. I also offer a look at the rise ancient rise of Colorado Plateau and the relatively recent rise of the Sierra Nevada, CA. Finally, I investigate the stresses generated by density variations with a study of earthquakes in southern California.

10/15/13 (Marty Baylor, Visiting Professor of Physics from Carleton College)

Taking charge of your future from grad school to beyond: Strategic use of IDPs and negotiation skills to mold your career and find work life balance

For most of my life, I wandered through my career without an intentional plan for what I wanted to do or why. I took my experiences for granted and didn't think about how I could maximize what I gained from each opportunity that I was presented with. Despite this lack of direction early on, I worked at NASA in high school and college, participated in multiple REU programs, taught K-12, worked at NASA (again, after college), completed an internship at a laser company in China obtained a PhD in physics, and became a professor at Carleton College. I have found that toward given to me towards the the latter part of my career have allowed me to be more intentional about by career. As a result, I have been able to discover and nurture my passion for teaching (i.e., my career) and make room for the things that keep me sane: alone time, family/friends, exercise, international travel and whitewater rafting. During this talk, I would like to spend a little bit of time telling you about my research in analog optical signal processing and integrated optofluidic devices. Then, I would like to spend the rest of my time sharing tips and strategies for directing your career and creating a balanced life during grad school and into the future.

10/31/13 (Janet Tsai, Mechanical Engineering)

Current trends in engineering education

This talk will explore the current state of engineering education at CU and beyond, explaining some of the historical motivations and current funding opportunities for engineering education research projects. Attendees will be invited to consider their own experiences being educated as engineers or scientists and how they align with the main research thrusts in the field. A slew of interesting findings will be presented for discussion, as well as explanation of the educational research process and qualitative methods in contrast to the quantitative methods we are more familiar with as STEM practitioners.

11/12/13 (Steven Moses, Physics)

Creating really cool forms of matter

The advent of laser cooling and the creation of a dilute Bose-Einstein condensate of alkali atoms (which was first done in Boulder) sparked an exponential growth in the field of atomic physics. We can now create and study quantum degenerate gases in the lab with exquisite precision. The applications of atomic physics are widespread, and include precision measurements and timekeeping, building better sensors and detectors, and studying fundamental physics that can help to elucidate the processes that govern the behavior of complex materials that are very relevant to everyday life. In this talk, I will start by giving an overview of the field of atomic physics. Then I will describe some of the tools, such as laser cooling and evaporative cooling, that are necessary ingredients to making really cold matter. Finally, I will describe the experiment that I work on, in which we create ultracold polar molecules in their ground state at temperatures of around 200 nK. I will focus on the particular example of exothermic chemical reactions that occur at ultralow temperatures and how we have been able to control these reactions very precisely. The talk will be self-contained and accessible to everyone.

12/5/13 (Megan O’Brien, Mechanical Engineering)

Movement under risk: a decision-making process

Nearly every aspect of our behavior is framed by risk, and people can respond to risk very differently. While some individuals readily confront high-risk situations in order to obtain high rewards (risk-seeking behavior), others may prefer low-risk situations even if it means obtaining low rewards (risk-averse behavior). Presently, the role that risk plays in our decisions about movement is poorly understood. For example, when do we choose to hurriedly cross a busy street versus sacrifice a few minutes and cross when *the road is clear? Deciding on an appropriate movement strategy is not a trivial matter, and yet most of the time our brains find a solution to this problem with minimal hesitation.*

In this talk, I will describe human movement using a decision-making framework. Such a framework allows us to formulate movement tasks in statistical terms, where we combine the probability of a movement outcome and the reward associated with that outcome to find an optimal solution for how to move. I will also present my doctoral work to date, examining how implicit and explicit risk can affect our movement decisions.