2017 Sigma Xi Symposium
Schedule and Oral Paper Abstracts
Gustavus Adolphus College
May 5, 2017

Session 1: Oral Presentations, Nobel Hall 201	
2:30 pm	**Distinguishing Tills in Minnesota Using Trace and Rare Earth Elements** Glacial sediments preserve a record of their source area, as glaciers erode the bedrock and deposit the eroded material as till. Typically, provenance is determined through physical interpretation, but this method can be inconsistent between observers especially if two till members have similar appearances. Geochemical fingerprinting may distinguish between two visibly similar till members, but this is a relatively new technique and a universal method has not been developed. Most notably, different sediment size fractions have been used in geochemical studies; some use < 2 mm, while others use < 63 µm. To move toward a universal method, trace and rare earth element concentrations were measured for four till members of known provenance from a single core in Renville County, MN. Each sample was sieved to obtain both size fractions, and the same analysis was performed for each size. Discriminant functional analysis was used to distinguish between the till groups, and the classification accuracy for each size fraction exceeded 80% (< 2 mm : 86.9%; < 63 µm: 82.6%). Seven elements were influential in distinguishing members using the < 2 mm fraction (V, Cu, Rb, Ho, Tm, Pb, U), while 10 elements were needed for < 63 µm (V, Cr, Cu, Rb, Y, Eu, Pr, Tm, Pb, U). The results indicate that sieving to and analyzing the < 2 mm size fraction is acceptable for determining till provenance. Russell Krueger Advisor: Julie Bartley
2:45 pm	**Looking Into the Past With Lacustrine Sediment Sequences in Glacial Till** Glacial sediments can present a confusing sequence of lacustrine sediments and glacial till, and can make interpreting past ice dynamics and environments difficult. One example of this is in Becker County, where three cores were collected by MGS, and the lacustrine sediments in them represent sediment deposited in at least one ancient proglacial lake. Core two was taken in Northwestern Becker County, core three about 12 miles south and just east of core two, and core one about 25 miles directly south of core two. Being able to discern between the lacustrine sediments in each core can help reconstruct a more detailed glacial history of the study region. X-Ray Diffraction showed significant mineralogical differences in the lacustrine sediments of core two, which had higher concentrations of calcite than dolomite, inverse to the lacustrine sediments in the other cores. Strew slide data also showed increased crystal size and decreased organic matter content in the lacustrine sediment of core two compared to the other cores. The different mineralogies and organic matter contents suggest that the lacustrine sediments of core two were deposited in a different environment than the other two cores. Correlating this with their spatial relationships, at least two glacial advances can be identified, the first creating the lake with the sediment from core two, and the next creating the lake with the sediment from cores one and three. Skuyler M Ward Advisor: Julie Bartley
3:00 pm	**Emerging Adulthood, Political Attitudes, and Personality Characteristics as Predictors of Voting Behavior in the 2016 Presidential Election** This study set out to test the hypothesis that personality characteristics are significant predictors of voting behavior and candidate preference in emerging adults. It used a variation of a previous study run by Walker and Iverson (2008) to collect data regarding the 2016 presidential election. One hundred and fifty-four students from a small liberal arts college completed a self-report survey containing measures based on characteristics of emerging adulthood, indicators of prejudice, and other personality factors prior to the 2016 presidential election. Participants also completed an additional survey after the election to determine actual voting behavior. Scores on the Modern Sexism Scale and egalitarian social dominance from the Social Dominance Orientation Scale predicted an individual's preferred candidate (Swim et al., 1995; Pratto et al., 1994). Scores on the negative instability dimension from the Inventory of Dimensions of Emerging Adulthood and levels of self-benefit driven political motivation as measured by the Self-Determination Scale of Political Motivation predicted whether an individual intended to vote at all (Reifman et al., 2007; Koestner et al., 1996). The results indicate that certain personality characteristics predict voting intention and candidate preference, allowing consideration of personality as a predictor for other political matters in the current political environment. Jordan Schwakopf Advisor: Mark Kruger

3:15 pm	**Relationships Among Morphology, Texture, and Chemistry in Stromatolites of the Green River Formation (Eocene, Wyoming, USA)** Fossil stromatolites are among the earliest records of life on Earth and can be useful in interpreting Earth's past environments. Bacteria and sediment interact to construct stromatolites in two fundamental ways: by in situ mineral precipitation and by the trapping and binding of carbonate grains. From these basic building blocks, stromatolites express a wide variety of microscale textures and macroscopic forms. However, the relationships among their morphology, texture, and chemistry are poorly understood. In the past, stromatolites grew in both marine, and freshwater settings. Lakes, especially closed-basin lakes that experience frequent changes in size and salinity, provide a good record of environmental changes because of their sensitivity to precipitation and evaporation. Likewise, the morphology, texture, and chemistry of stromatolites are greatly influenced by environmental changes. The Green River (Eocene) is a carbonate and clastic formation that spans across parts of Wyoming, Colorado, and Utah. To probe connections between morphology, texture, and chemistry, samples were collected from stromatolite-rich rock layers at Sand Butte and White Mountain. Despite stark differences in large-scale morphology, detailed petrography shows the stromatolites of both localities share the same fundamental building blocks. Stromatolites from both localities are dominated by precipitated and grumeaux microscale textures, with subsidiary trapped-and-bound texture. Trace-element analysis using ICP-MS suggests a correlation between laminae frequency and chemical composition, potentially allowing lamina to be tracked inward to outward in the Green River stromatolites. This approach, in conjunction with detailed petrography, provides a unique opportunity to establish detailed relationships among texture, morphology, and chemistry for stromatolites. Lindsey Reiners Advisor: Julie Bartley
3:30 pm	**Through the Lens of a Rover: Identifying Extraterrestrial Biosignatures** Of the planets in our solar system, excluding Earth, Mars is the most likely to preserve evidence of life. Although Mars has a thin atmosphere today, in its early history it may have been habitable. The rovers sent to Mars share a common mission, to explore whether or not Mars has or ever had a habitable surface environment. These rover missions have identified several ancient environments that were potentially habitable, including fluvial, lacustrine, and subsurface water systems. Like their terrestrial counterparts, habitable environments on Mars have a range of potential for biosignature preservation. At a scale detectable by rovers, water-influenced sediments may preserve evidence of biological activity, including microbially-induced sedimentary structures (MISS) in clastic rocks and microbialites in chemical sedimentary rocks. Identifying these mesoscale structures and confirming whether they are microbially influenced is a challenge due to the size and subtle nature of their features. Research and field tests conducted by the Geo-Heuristic Operational Strategies Test (GHOST) team in the spring of 2016 demonstrated that mesoscale (0.1-10 mm) data is crucial when identifying MISS and microbialites. Without clear resolution on the sub-mm to cm scale, key features that allow confident assessment of biogenicity are unrecognizable. Further understanding the type of instrumentation necessary for identifying mesoscale biosignatures, and the resolution needed for distinguishing MISS and microbialites from abiogenic structures at outcrop scale will increase acquisition of desired data. Ruby Schaufler Advisor: Julie Bartley
3:45 pm	**Survey Response Language, Hispanic/Latino Country Origin, and Other Variables Associated With Pre-Exposure Prophylaxis (PrEP) Awareness Among Men Who Have Sex With Men in the U.S.** Background: Hispanic/Latino MSM are at disproportionate risk for HIV infection. Language barriers could limit knowledge of new prevention strategies such as PrEP. Survey response language (Spanish, English) and PrEP awareness were analyzed in the Hispanic/Latino subsample of a large racial/ethnic minority study. Methods: The 2014 Messages4Men Study included Hispanic/Latino MSM from Chicago, Fort Lauderdale, and Kansas City who self-selected their written survey response language in Spanish (n=99) or English (n=385). During the 1-hour assessment visit, participants completed a self-administered, computer-based survey including personal characteristics (Hispanic/Latino country origin, sexual orientation, HIV status, education level, age group, city), behavioral, and PrEP awareness items. Bivariate and multivariable logistic regression analyses were conducted. Results: Overall, 51% of Hispanic/Latino MSM were aware of PrEP. The primary multivariable model with PrEP awareness (yes/no) as the dependent variable (adjusting for characteristics noted above) found MSM who responded to the survey in Spanish (vs. English) had a decreased odds of PrEP awareness (AOR=0.55, 95%CI=0.31-0.97). MSM of "other" Hispanic/Latino origin (Mexican, referent) had significantly increased odds of PrEP awareness (AOR=2.27, 95% CI=1.20-4.31). A secondary multivariable model with survey response language (Spanish, English) as the dependent variable found Puerto Rican (vs Mexican) (AOR=0.13, 95% CI=0.05-0.32), Cuban (AOR=0.12, 95% CI=0.04-0.35) and "other" Hispanic/Latino origin (AOR=0.40, 95% CI=0.20-0.80) MSM had lower odds of selecting a Spanish (vs English) survey.

	Conclusions: Hispanic/Latino MSM populations are diverse in language preference. Addressing heterogeneous groups of MSM is important for effective HIV prevention. Proliferating targeted informational resources in Spanish could help increase PrEP awareness. Kristin Podratz, Gordon Mansergh, Matthew Mimiaga, Jeremy Holman (Health Resources in Action), Jeffrey H. Herbst (CDC Division of HIV/AIDS Prevention) Advisor: Lynnea Myers
4:00 pm	**New Male Contraception: College Students': Attitudes and Perceived Behaviors Related to Non-Hormonal Injectable Gel** Purpose: To explore undergraduate' perceptions regarding a new male contraception (non-hormonal injectable gel [NHIG[) and assess for a difference between attitudes and perceived behaviors related to NHIG amongst potential direct users (i.e., people with testicles and commonly male identifying) compared to indirect users (i.e., people lacking testicles and commonly female identifying). Methods: A survey was designed and distributed to students at a small, Midwestern, college. Eight NHIG variables were measured: eligibility for use, likelihood of use/encouraged use, factors influencing use, behaviors across different sex acts (i.e., vaginal, anal, oral sex), simultaneous use of contraceptives, attitudes toward contraceptive responsibility and contraceptive trust, and previous knowledge of NHIG. Statistical analysis was performed using RStudio®. Results/Conclusion: A greater portion of direct users reported it being unlikely (n = 58, 43.61%) for them to use NHIG, whereas indirect users were more likely (n = 128, 51.41%) to encourage its use. Low cost, reversibility, and infrequent administration were the top factors increasing the likelihood of NHIG use. High cost was the most frequent deterrent, uncertainty arising from the newness of the new product was second, and the third diverged between administration route or lack of STI protection for direct and indirect users respectively. Direct users were less likely than indirect users to intend to utilize protective barrier methods or hormonal methods simultaneously with NHIG. The majority of respondents (n = 374, 95.9%) agreed/strongly agreed that all partners should be equally responsible for contraception and that both men and women could be trusted to use contraceptives. Kirstin A. Buck, Jessica L. Stadick, Marian L. Frazier Advisor: Jessica Stadick
4:15 pm	**Heavy Metal Concentration Analysis for Gastropods Off the Red Sea, Egypt** Human activity has contributed harm to the environment, especially where human and animal life interact with practices such as mining. Mining releases pollutants into the atmosphere and environment which can cause negative side effects to the environment. One location that has had controversy over this issue is mining inland off the coast of the Red Sea in Egypt. There it's believed an iron and as well as a separate lead mine are releasing toxic heavy metals that are affecting the nearby life such as the gastropods. Gastropod samples were collected from between two species Echinolittorina Subnodosauorium and Planaxis Sulcatus. There were ten samples of each species collected from three localities off the coast of the Red Sea, with having thirty samples of each species with sixty total. The samples were dissolved in nitric acid and analyzed with an inductively-coupled plasma mass spectrometer (ICP-MS). The metals tested were Ba, Sr, Cr, Ni, Cu, Zn, Sc, V, Y, Mo, Fe, Pb, and Mn. This process calculated heavy metal concentrations to see whether or not these organisms are exposed to an environment with toxic heavy metals in the three cities of UM Gheig, UM Greifat, and Mersa Alam off the coast of the Red Sea. The calculations determined that the tested toxic heavy metals have accumulated in the gastropods and that the samples closest to the iron have more presence of iron than the other location samples, and the samples closest to the iron mine have more iron concentration than the other location samples. This tells us these metals are spreading from the mines to the coastline where the gastropods live. The gastropods off the coast of the Red Sea are being exposed to environments with toxic heavy metals as a result from human activity. Mike Erving Advisor: Julie Bartley
4:30	**Alkylation Reactions of Phthaloylphosphide** William Bragg Advisor: Brian O'Brien

Session 2: Oral Presentations, Nobel Hall 222	
2:30 pm	**Recognition of CTF13 mRNA by a Specialized mRNA Degradation Pathway in Baker's Yeast** The breakdown of mRNA (copies of genetic information in DNA that instruct protein synthesis and regulate protein abundance) is a normal process performed by the cell in order to regulate gene expression, and influence what proteins are present in the cell at any given time and how much of them there are. One of the pathways for mRNA degradation is the nonsense mediated mRNA decay (NMD) pathway. We aim to investigate the mechanism by which mRNAs are recognized for breakdown by NMD. We have manipulated baker's yeast strains to express, separately, variants of CTF13 mRNA, an mRNA known to be broken down by NMD. We will isolate the key NMD mRNA-binding protein that facilitates recognition by the pathway (Upf1p), and measure how much of each variant of CTF13 mRNA is present. By determining the relative binding of each variant by Upf1p, we can determine which parts of the CTF13 mRNA are vital for recognition and subsequent degradation by this pathway. By discerning where physical association occur in the recognition process, we can begin to decipher how and why that respective region of the mRNA recruits NMD proteins and further our understanding of the molecular mechanism of NMD. Madeline Jentink Advisor: Jeff Dahlseid
2:45 pm	**River Terrace Mapping of Rush River** Approximately 10,000 years ago, Glacial River Warren began to carve out the modern Minnesota River Valley. As the river formed, it worked to achieve a state of equilibrium. During this process, the features of the river begin to reflect between the amount of water and the amount of sediment being transported. The Minnesota River's tributaries in turn responded to the new base level of the deepened Minnesota River. The tributaries carved down through the substrate, producing terraces that were left behind high on the stream valley walls. Rush River, about 3 miles south of Henderson MN, is one such tributary. The mapping of these terraces along the Rush River Valley can tell us about past events, like the timing of base level changes of the Minnesota River or the Glacial River Warren. The terraces can also serve mining and excavating companies. By mapping these terraces and noting their consistency, we can help companies can determine if the area is worth excavating for earth materials for construction purposes. Kyle Pinke Advisor: Laura Triplett
3:00 pm	**Explosive Brecciation; Connecting Chemistry to a Source of Ignition** Brecciated deposits host some of the most lucrative and variable concentrations of economic resources, and occur in a range of geologic settings. The mechanisms behind their formation are often poorly understood, and discerning them can aid in the location of resource potential in analogous settings. Drill core of an igneous brecciated deposit intruding the Thomson Formation (Paleoproterozoic), adjacent to the Tamarack intrusion, and located along the boundary of Carlton and Aitkin counties (Northeastern MN) was sampled for major and trace element study. While economically insignificant itself, this graphitic breccia pipe provides a unique opportunity to study the events leading to brecciation and emplacement in subsurface intrusive settings. Previous work by Hendrickson (2011) suggests a syntectonic model of deposition with the Tamarack, and a breccia matrix petrology more closely resembling that of melted country rock (end-of-hole igneous rocks). By adding trace and major element data, this study serves to build upon previous works and provide a higher resolution interpretation of emplacement. Preliminary data show an enrichment of U and Th in both breccia pipe and melted country rock relative to the related Tamarack intrusion, suggesting a component of partial melt. Similarities in trace element enrichment/depletion trends between melted country rock and breccia pipe matrix also suggest the mixing of partial melts to produce a hybridized magma before brecciation. Understanding the mechanisms leading to the emplacement and brecciation of this type of deposit aids in painting a picture of subsurface magmatic processes and tectonic events. Tanner E. Eischen Advisor: James Welsh
3:15 pm	**Monitoring Nitrate and Total Suspended Solids in Two Tributaries of the Seven Mile Creek Watershed** The Seven Mile Creek (SMC) Watershed, located between St. Peter and Mankato in southern Minnesota, is a relatively small watershed that is typical of much of southern Minnesota. Much of the land in the SMC Watershed is used for agriculture, specifically to produce soybeans and corn. Excess water exits the soybean and corn fields through drainage tiles and carries nutrients such as nitrate and phosphorus into SMC. The nutrients then drain into the Minnesota River, followed by the Mississippi River, and are finally deposited into the Gulf of Mexico. This creates algae blooms, which make the water susceptible to hypoxic conditions. In this way southern Minnesotan watersheds like the SMC are contributing to the decline in shrimp and other aquatic populations. This is both an environmental crisis and an economic dilemma for the fishing industry.Working to solve this problem, farmers in the SMC watershed are implementing new methods to mitigate the amount of nitrate entering the SMC. It is imperative

	that some form of monitoring coincides with these strategies to decrease the amount of pollution, so that a definitive answer is reached as to whether or not these mitigation strategies are effective. Over the summer of 2016 three sites within the SMC watershed were monitored for nitrate and total suspended solids (TSS). Four major precipitation events occurred throughout the season causing major fluctuations in nitrate •nitrogen and TSS concentrations. Concentrations of the two variables are dependent on precipitation levels. Connor Smith Advisor: Laura Triplett
3:30 pm	**Differences Between Tributaries of the Minnesota River** The Minnesota River and its tributaries are all the same age and cut through similar geologic substrate. Due to their close proximity to each other, they also receive approximately the same amount of rainfall. However, differences have been observed in the hydrology of different rivers. For example, one flooding while others have more typical flow levels. Rush River, Little Cottonwood River, and High Island Creek are all tributaries to the Minnesota River with similar lengths and drainage areas. This study compared their elevation profiles, underlying geology, and the presence of drainage ditches along their length to look for differences between these tributaries. Drainage ditches are indicative of artificial drainage in the surrounding fields, and the amount of artificial drainage can cause differences in the amount of water flowing through a stream. ArcGIS was used to create the elevation profiles and identify drainage ditches using a 1 meter DEM (Digital Elevation Model), and was also used to line up surface geology with the stream. All three tributaries were found to have very similar slope profiles, but large differences in the amount of drainage ditching present. This study determines that the similarities of the slope profiles are due to the shared geology and glacial history of the region. It also determines that slope profile does not impact the amount of water flowing through the area, but the presence of artificial drainage does. Megan Luick Advisor: Laura Triplett
3:45 pm	**Degradation of mRNAs for Centromere and Telomere-Related Genes in Saccharomyces cerevisiae** Nonsense-mediated mRNA decay (NMD) is a biochemical pathway that healthy cells utilize to maintain proper protein levels. NMD is most known for the degradation of aberrant mRNAs that would produce truncated proteins, and it thereby protects cells from energy loss due to unnecessary biosynthesis as well as potentially deleterious protein fragments. The pathway also affects the level of several "normal" mRNAs, suggesting that NMD plays a broader role in regulation of gene expression. NMD has previously been shown to affect the expression of nine centromere- and telomere-related genes: CTF14, CEP3, EST1, EST2, EST3, SKP1, STN1, and SAS2. Modeling previous studies of the direct effect of NMD on CTF13 mRNA levels, I have begun characterizing NMD's effects on the remaining genes. NMD may affect the expression levels of a gene either directly (by degradation of the mRNA for that gene) or indirectly (by degradation of other mRNAs that encode proteins which regulate that gene). Whether NMD's effects are direct or indirect for each of these centromere- and telomere-related genes can be determined by a combination of gene cloning and mRNA quantification techniques. Changes in mRNA decay rates in cells where the NMD pathway is interrupted indicate that the pathway affects gene expression by direct degradation of the mRNA being studied. Results from these experiments will be presented. Identification of mRNAs degraded directly by the NMD pathway will provide substrates for further study of how NMD recognition of wild-type mRNAs regulates gene expression. Sara Graves Advisor: Jeff Dahlseid
4:00 pm	**Chemotherapeutic Inhibitor Sensitivity in Candida Albicans Neocentromere Strains** Neocentromeres are new centromeres that form when a problem occurs with the native centromere to restore chromosome segregation ability. Neocentromeres are found in 3% of human cancer cells, and previous work suggests that differences in chromosome segregation accuracy between neocentromeres and native centromeres may contribute to genome instability in cancer cells. However, it was unknown if neocentromeres show hypersensitivity to certain chemotherapy drugs. Here, I used the yeast Candida albicans as a model system to study the functions of five different neocentromere loci following exposure to two different chemotherapy drugs: Nocadozale and Radicicol. Overall, the results showed that neocentromere strains are sensitive to active chemotherapeutic agents. Although this is exciting, cancer is often the result of multiple mutations in combination together rather than just a single mutation. Another commonly observed change in cancer cells is overexpression of centromere-associated proteins, such as CENP-A. The functional consequences of this combination have not yet been explored. In particular, it is unknown whether cells with CENP-A overexpression, have a hypersensitivity to the chemotherapy drugs: Nocadozale, Radicicol and Nicotinamide. Using C. albicans once again as a model system, the effects of overexpressed CENP-A within a native centromere strain were examined first. Preliminary results showed promise, so the next step will be looking at strains with both a neocentromere and CENP-A overexpression. By combining these mutations and using it as a model for realistic cancer scenarios, a new method for personalized cancer treatment may be developed. Erica A. Power Advisor: Laura Burrack

4:15 pm **Mitigation of Ravine Hillslope Erosion in Southern Minnesota Using Hydraulic Conductivity and Infiltration Basins**

The ravine networks in Southern Minnesota are facing substantial hillslope erosion due to high levels of run-off from farm fields. The fields are capturing water from rain storms, which drains into drainage tile. Many drainage systems outlet at the top of ravines, leading to fluvial erosion in concentrated areas. The sediment being eroded off of the hillslopes ranges from clay to sand and gravel. The slopes are composed of glacial till, which was deposited from the Wisconsin Glaciation in the Des Moines Lobe. Once this sediment becomes saturated, it is easy for the land to give way, creating landslides and undercutting the hillslope. To mitigate the problem, I designed an infiltration basin for one typical farm that reduces surface water runoff into the ravines. I used geologic maps and hydraulic conductivity to determine whether it would be feasible to create an infiltration basin further away from the ravines. It would have an expedient recharge to discharge the rain water from a 200 acre plot of land. Drainage tile would drain water into the infiltration basin rather than into the ravine. I discovered that an infiltration basin with dimensions of 590ft x 590ft x 7.5ft would discharge at a rate of 789,000 cubic feet/day. This basin could hold 3.6 inches of water from the 200 acre farm field and would take 3 and a half days to discharge the basin. The basin would reroute large quantities of excess water away from the ravines, while still directing it towards the Minnesota River.

Patrick Day
Advisor: Laura Triplett