

Centenary



ACADEMIC RESEARCH CONFERENCE

Spring 2020



Despite having to cancel this year's Annual Research Conference due to COVID-19, high quality student research continues at Centenary. Here are some abstracts of student research and just a few highlights of our students' hard work.

HCMV Induces Distinct and Functional Signaling through the Epidermal Growth Factor Receptor Kinase that Directs Viral Trafficking to the Nucleus in Monocytes

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HCMV has a unique trafficking pattern in monocytes, initiated by two simultaneous signaling events. Our lab has shown that signaling through the EGFR kinase, initiated by the interaction between the host cell epidermal growth factor receptor (EGFR) and the viral glycoprotein B (gB), is essential for the virus to successfully traffic to the nucleus. Like most DNA viruses, HCMV must successfully enter the host cell, avoid cell autonomous defenses, traffic to and dock at the nucleus, and translocate viral DNA into the nucleus – the site of viral replication. Therefore, determining the steps leading to the translocation of viral DNA into the host nucleus is essential for gaining a better understanding of HCMV pathogenesis. Our lab aims to define the role of EGFR signaling in viral trafficking to the nucleus. We initiated experiments to study the downstream signaling molecules of the EGFR kinase: AKT and STAT1, to determine if HCMV induces functional and extended EGFR signaling throughout the course of infection. Our new data support previously published data, demonstrating that EGFR signaling induced by HCMV infection of monocytes is functional, per phosphorylation of AKT and STAT1 at early, middle, and late points during infection. Our new data show that HCMV-induced signaling through EGFR is potentiated longer than that of EGF. This suggests that chronic EGFR signaling is a distinct feature of viral infection. Additionally, we studied the effect that inhibition of EGFR signaling had on the amount of viral genome present in the whole cell. Preliminary

data in our lab suggests that the inhibition of EGFR signaling leads to a decrease in HCMV nuclear translocation, thus we wanted to determine whether the viral genome is still present in the whole cell. Our new data show that there is no significant decrease in the amount of viral genome present in the whole cell at 24 hours post-infection (hpi) or 3 days post infection (dpi). Overall, our new data suggest that HCMV appears to act as a distinct EGFR ligand and that the inhibition of EGFR signaling does not lead to a significant loss of viral genome from the whole cell even though the viral genome is not in the nucleus.

Introduction of mutations in NSP1 RING domain to synthesize rotaviruses with defective NSP1 proteins

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Rotavirus is a double-stranded RNA virus that infects intestinal cells, causing severe diarrhea and leading to approximately 215,000 deaths worldwide each year, mainly in children <5 years of age. Rotavirus contains 11 genes; gene 5 encodes the non-structural protein NSP1. NSP1 binds to and degrades key elements of the interferon (IFN) pathway, stopping the innate immune response and allowing the virus to replicate. The goal of this project is to create mutations in NSP1 to determine if specific amino acids are required for NSP1 function.

The Effect of Proton Radiation on α -Synuclein in Human Neuronal-like Cells

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Astronauts have exposure to low doses of high energy ionizing radiation in space, and NASA is concerned that exposure increases the risk of developing neurodegenerative disease. Parkinson's disease (PD) is a neurodegenerative disease characterized by high levels of oxidative stress and aggregates of mutated/damaged alpha-synuclein (α -SYN) protein in brain cells. The SNCA gene encodes the α -SYN protein. The pathology of PD and the destruction of dopaminergic neurons are related to α -SYN aggregates. Oxidative stress influences the progression of PD by threatening the guanine nucleobase. When adenine is inserted instead of cytosine during DNA replication, mutations occur. Transcriptional mutagenesis is the production of mutant RNA transcripts due to RNA polymerase inserting the wrong ribonucleotide during transcription. Transcriptional mutagenesis could generate mutated α -SYN after radiation. The mutation may occur in replication or differentiated brain cells when RNA polymerase encounters oxidative DNA damage in the transcribed DNA strand.

The predominant type of radiation in galactic cosmic rays is proton radiation. Proteus One radiotherapy unit proton radiation simulated space radiation. Different proton dosages stimulated oxidative stress to test the correlation between aggregates of damaged α -SYN and oxidative stress. Neuroblastoma cell line (SHSY5Y) was differentiated into neuronal-like cells using retinoic acid. Replicating and differentiated cells were irradiated with 0, 0.5, and 2 Gy of protons. RNA was isolated at 1, 5, and 20 hours post-

irradiation. Quantitative real-time PCR processed the transcript level of the SNCA gene and other genes that encode oxidative DNA repair proteins. Protein was isolated from irradiated cells to examine DNA repair and α -SYN protein levels. The SNCA DNA sequence was examined and found that positions in the sequence could produce mutant transcripts by transcriptional mutagenesis. The TANGO computer algorithm predicted an increase in the potential for α -SYN protein aggregation for some mutant proteins. Wild type or one mutant α -SYN protein vectors were created and transfected into SHSY5Y cells to induce aggregate formation.

The real-time PCR showed that the SNCA transcript increased two-fold between replicating and differentiated. There were no signs of increased expression with irradiation because there was a slight difference in SNCA transcript expression levels between 0.5 and 2gy.

Two Week Prospective Trial to Observe the Effects of Art Observation and Art Production on Pulse, Systolic Blood Pressure, and Diastolic Blood Pressure

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American medicine and healing practices have been derived from the innovative practices of the Ancient Greeks. One of the most common references to the ancient culture is the Hippocratic Oath, used by all Americans in the medical field as a template for proper, ethical care of patients. The holistic approach to healing used by the Ancient Greeks involved the use of medicine, diet, and art as pillars of overall well-being. Today the focus on science behind medicine dominates this approach. Countless scientific articles defend the importance of diet and medicine in healing practices, but too few studies have attempted to qualitatively evaluate how art affects healing.

An IRB approved 2-week prospective data collection was performed to examine the effects of creating and observing various forms of artwork on pulse, systolic blood pressure, and diastolic blood pressure. Sixteen college students monitored their blood pressure and pulse rates three times a day for sixteen days while traveling on a module in Greece. Fourteen of the students were females with a median age of 18.5 +/- 1.6, and two of the students were males with a median age of 20. The students were asked daily to record a baseline blood pressure and pulse under controlled conditions as well as before and after a 15-minute period of creating art and another 15-minute period of observing art. Recorded pulse data did not show significant changes throughout the sixteen-day period and various activities. Diastolic blood pressure did not demonstrate significant changes throughout the given time periods for art observation or art performance. Conversely, the systolic blood pressure showed a significant decrease after the 15-minute period of art observation but not during the period of art production. Despite the various confounding factors surrounding the trial, the decreased systolic blood pressure delta would indicate that art observation for a 15-minute period has a calming and potentially beneficial effect on health.

The association between viral infection and Parkinson's disease: Adenovirus protein VI peptide accelerates α -Synuclein aggregation

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Parkinson's disease (PD) is a neurodegenerative disorder characterized by loss of dopaminergic neurons in the substantia nigra pars compacta and the presence of Lewy bodies, which are abnormal deposits of the protein α -synuclein. While both genetic and sporadic factors are involved in developing PD, only 10-15% of patients have a family history of the disease, suggesting that the environment plays a crucial role in most cases of Parkinson's. One factor

strongly associated with sporadic PD is viral infection.

The aim of this project was to identify the effect of adenovirus protein VI (Ad2pVI), an internal capsid, on α -Synuclein aggregation. Wiethoff et al. showed that Ad2pVI is an endosomolytic factor for adenoviral cellular entry. Further, they identified that the N-terminal 21 amino acids bind and lyse the membrane independent of pH. Interestingly, α -synuclein displays the same membrane lytic abilities in vitro.

Based on the membrane lytic properties of both the N-terminus of adenovirus protein VI and α -synuclein, we hypothesize that the viral peptide would bind to and affect the aggregation propensity of α -synuclein; this may have a deleterious effect on the development of Parkinson's disease by increasing the rate of fibril formation. This project will hopefully provide insight into the association between viral infections and Parkinson's disease.

HCMV Manipulates Syntaxin-6 for Successful Trafficking and Subsequent Infection of Monocytes

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Our experiments are focused on understanding the trafficking of Human Cytomegalovirus (HCMV) through the trans-golgi network (TGN) in monocytes. Passage through the TGN is required for nuclear translocation of the virus. Previous experiments have shown that HCMV must pass through early endosomes, the TGN, and recycling endosomes in order to effectively transport viral DNA to the nucleus. This process takes around three days to complete, whereas in epithelial cells (ARPE-19 cells) and fibroblasts (HELs), HCMV DNA takes only ~30 minutes to enter the nucleus. Syntaxin-6 (STX6), a target soluble N-ethylmaleimide-sensitive factor attachment protein receptor (t-SNARE), colocalizes with the TGN adaptor protein (AP-1) and is responsible for signal transduction to the TGN. STX6 normally facilitates TGN trafficking with AP-1,

and endosomes act as target organelles. We hypothesized that STX6 is responsible for the early endosome to TGN trafficking of HCMV observed in monocytes. We argue that the virus manipulates cellular machinery to transport the virion through the cell for nuclear translocation of viral DNA. We now show that HCMV upregulates STX6 levels in monocytes to ensure viral trafficking through the TGN. We also show that this STX6 protein regulation during the early stages of infection is distinct to monocytes and is not found during infection of epithelial cells or fibroblasts. Specifically, we determined that STX6 protein levels were upregulated in monocytes via in-cell western blot analysis. We also noted an upregulation of STX6 protein levels in epithelial cells and fibroblasts via western blot analysis. However, only knockdown of STX6 in monocytes affected the outcome of infection. siRNA knockdown of STX6 significantly decreased TGN trafficking in monocytes, while knockdown of STX6 in ARPE-19 cells had no effects on early infection as measured by immediate early viral protein expression in western blot analysis. Our evidence suggests that STX6 protein levels are increased in all cell types when infected with HCMV, but STX6 protein levels are only vital for early infection of monocytes.

**Phase Chemistry and Thermobarometry
in the Central Mount Bennett Hills,
Central Snake River Plain, Idaho.**

HAYDEN CLASON

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The Snake River Plain is one of the best examples of a time-transgressive continental hotspot. Volcanism began approximately 17 Ma beneath southwestern Idaho and culminates at the active Yellowstone caldera in western Wyoming. The volcanism begins with rhyolitic eruptions followed by basaltic lavas consisting of basaltic shields and fissures. Unlike the rhyolites, basaltic volcanism does not

exhibit a clear time progression. Recently, some investigations have suggested a shallow mantle to lithospheric source for the origin of the volcanism along the Snake River Plain (SRP). The majority of basaltic volcanism is limited to the downwarped feature known as the Snake River Plain (SRP). However, there are examples where basaltic volcanism erupted along the margins of the SRP. The Mount Bennett Hills are comprised mostly of rhyolitic lavas and lie along the northern edge of the Snake River-Yellowstone track, near the intersection of the eastern and western SRP. In addition to the rhyolitic lavas there are numerous small monogenetic basaltic lava flows which overlie these rhyolites. The Central Mount Bennett Hills exhibit the most abrupt uplifting of the entire range and represent where most of our basaltic samples were collected. The range gradually rises out of the SRP to the range's crest and then drops abruptly to the Camas Prairie.

Hand samples of the basaltic lava flows range from black to gray with the darkest samples being aphyric and the lightest samples being plagioclase phyric. The medium gray colored samples tend to be olivine plagioclase phyric. The size of olivines are approximately 0.5-1.5 mm in size, while the plagioclases ranged from approximately 0.5 to 5 mm in size. Approximately one third of the samples were slightly to moderately vesicular. Thirty-eight samples were selected for our study of basaltic volcanism in the central Mount Bennett Hills. These samples were studied petrographically and by Electron Probe MicroAnalyzer (EPMA) and Scanning Electron Microprobe (SEM). Mineral endmembers were determined by both EPMA and SEM-EDS. The basalts consist of olivine, plagioclase, and Cr-spinel inclusions in olivine phenocrysts (pre-eruption) set in a groundmass (post-eruption) phases of olivine, plagioclase, clinopyroxene, magnetite, and ilmenite. Olivine phenocrysts endmembers ranged from Fo88-60. Plagioclase phenocryst endmembers ranged from An69-56. Spinel inclusions are rich in Cr (from 16.5 to 25 wt.%) and Al₂O₃ (from 21 to 38 wt.%). Groundmass pyroxene endmembers ranged from Wo45-35 En59-47 Fs18-8. Groundmass magnetite are Ti rich and range from 1 to 38

wt%. Mantle temperatures provide a key test of the mantle hotspot hypothesis, and mineral compositions provide a means of estimating mantle temperatures. Within our study we will determine temperature and pressure estimates based on how certain element abundances change based on temperature and pressure conditions during crystallization of our lavas.

Whole Rock and Mineral Chemistry of the Square Mountain Flow

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The Snake River Plain (SRP) of southern Idaho is believed to represent a time depend track of a hot-spot (mantle plume). The Mount Bennett Hills lie north of the Snake River-Yellowstone plume track, near the intersection of the eastern and western Snake River Plain trends. The Central Mount Bennett Hills exhibit the most abrupt uplifting of the entire range. Its northern escarpment rises quickly from the nearly flat Camas Prairie to a string of high peaks. The range gradually rises out of the Snake River Plain to the range's crest and then drops abruptly to the Camas Prairie. We have sampled from the early Pleistocene Square Mountain flow. Based on the Idaho Geological Survey mapping this flow seems to be mono-eruptive from a separate vent.

Hand samples range from dark black to light gray with the darkest samples being aphyric and the lightest samples being plagioclase phyrlic. The medium gray colored samples tend to be plagioclase and clinopyroxene phyrlic. The plagioclases ranged from a few millimeters to approximately 520 μm in size. Clinopyroxenes range from approximately 200 μm to 1 mm. The groundmass is typically dark gray to black glassy. There are common quartz and plagioclase xenocrysts within the samples.

Seven samples were selected as part of our petrologic survey of the andesitic volcanism in the Central Mount Bennett Hills. These samples were studied petrographically and by

Electron Probe MicroAnalyzer (EPMA) and Scanning Electron Microprobe (SEM). Mineral endmembers were determined by EPMA and SEM-EDS. The samples consist of plagioclase and clinopyroxene microphenocrysts set in a groundmass of clinopyroxene, plagioclase and glass. Plagioclase phenocrysts range from An57-34 while the pyroxenes ranged from En59-39. In addition, groundmass potassium feldspars have been observed in the groundmass. Ti-magnetite is also found in the groundmass of the samples.

The samples were also analyzed for major elements and trace elements using EMP on glass beads and ICP-MS. The Square Mountain Flow is more evolved as indicated by Mg# ranging from less than 35 to 25. The magma exhibits LREE enrichment patterns like the Holocene lavas from Craters of the Moon (COM) National Monument. COM lavas serve as a representative of differentiated lavas. Square Mountain samples may represent COM-like highly differentiated lavas with a parental magma similar to typical SROT or they may represent a mixture between SROT and previous erupted rhyolites from the area. Our modeling of whole rock chemistry will help us try to determine the likely origin of the Square Mountain lava flow from the central SRP.

Geochemistry of Late Miocene-Pleistocene Basalts: Central Mount Bennett Hills, Central Snake River Plain, Idaho

ESSA BADON

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The Snake River Plain of southern Idaho represents the track of a hot-spot. The Mount Bennett Hills lie north of the Snake River-Yellowstone track, near the intersection of the eastern and western SRP. The Central Mount Bennett Hills exhibit the most abrupt uplifting of the entire range. The range gradually rises out of the SRP to the range's crest and then drops abruptly to the Camas Prairie. Voluminous mid Miocene (8-

13 Ma) rhyolitic ash-flows and lava flows are exposed along the Mount Bennett Hills. These rhyolites unconformably rest on Cretaceous granitic rocks of Idaho batholith and are overlain by minor Tertiary basalt flows and sediments. We have sampled twelve Late Miocene to Pleistocene basaltic lava flows from six quadrangles. Based on the Idaho Geological Survey mapping the flows are mono-eruptive flows from separate small vents.

Thirty-eight samples representing ten mono-eruptive flows were analyzed for whole rock major and trace elements. The whole rock data indicate that the samples fall within the Snake River Plain Olivine Tholeiite field (SROT) of previous studies. The twelve Mount Bennett mono-eruptive flows range from the least evolved to the most evolved SROT. The samples have Mg# ranging from 65-39 and have the following chemical ranges: TiO₂ 1.15 – 3.8 wt.%; FeO 9.80 – 16.1 wt.%. The data indicate that the older flows (Late Miocene) have lower TiO₂ of between 1 to 2 wt.% and the younger samples (Pleistocene) have TiO₂ greater than 2 wt.%. Based on whole rock abundances and ratios (i.e. wt% MgO vs CaO/Al₂O₃) the samples suggest that the majority of the chemical range can be the result of olivine fractionation from the less evolved samples. However minor clinopyroxene fractionation cannot be ruled out.

Trace element abundances are characterized by LREE enriched patterns. La/N range from 40x to 350x. Slopes range from (La/Lu)_n = 2.5 to 8.7. Unlike some of the major elements there does not seem to be a time dependence with the REEs. The less evolved samples are the samples with the lowest REEs abundances, thus these samples may be considered “parental.” Simple olivine fractionation modelling suggests the “parental” samples could not fractionate olivine to produce the more evolved samples. The MREE/HREE ratio can be used as an indicator of the presents of garnet vs spinel within the mantle source region. Studies have suggested a (Tb/Yb)_n > 1.8 suggests a garnet peridotite source region. Ratios < 1.8 suggests a spinel peridotite source region. Our samples all have (Tb/Yb)_n < 1.8 indicating a spinel peridotite source.

Chespirito in the Heights

CARLOS AYMA GONZALEZ

Research Advisor: Mr. Don Hooper
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The work of Mexican comedian Roberto “Chespirito (little Shakespeare in Spanish)” Gomez Bolanos has been incredibly influential in Spanish speaking countries but do not have the appreciation in the US it deserves. In this project, I will be bringing together his works and the Tony Award winning musical In the Heights, a musical about a neighborhood of a Latinx community, written by Lin-Manuel Miranda. I will take the classic set from In the Heights and redesign it to appear as if it came from something written by Chespirito.

Will You Speak Up? Exploring the Role of the Self in Prejudice Confrontation.

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Many people view themselves as having a positive attitude towards gender equality, but not everyone will speak up when a sexist comment is made. For some, these pro-gender-equality attitudes may be closely tied to the self-concept, and for others, completely unrelated. The purpose of this study is to evaluate whether more self-defining attitudes predict confrontation intentions.

Self-defining attitudes are attitudes that help people define who they are and are held close to their self-concepts (Zunick, Teeny, & Fazio, 2017). For instance, pro-gender-equality attitudes may be more self-defining for some individuals than for others, and this might predict confrontation intentions following a sexist comment. In the current study, participants will report their attitudes towards workplace topics, including gender equality, and how self-defining those attitudes are. Next, participants will read a hypothetical sexist workplace scenario and complete a survey regarding their responses to a sexist comment using the Confronting Prejudiced Responses model (Ashburn-Nardo, Morris, & Goodwin, 2008). We plan to collect 160 participants based on a power analysis. We hypothesize that the extent to which people's attitudes toward gender equality are self-defining will predict their intentions to confront, over and above the extremity of those attitudes. The more we learn from this research, the better educated people can become about how to encourage confrontation of prejudiced and sexist comments.

Setting and Meaning in Public Sculpture: An Analysis of Steinunn Thórarinsdóttir's *Borders*

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Art is often commissioned for, inspired by, or created for a specific location. This is especially the case with public sculpture. However, it is inevitable that a work of art—if it is not destroyed—will at the very least be moved and reassembled from its original location. If art is relocated to a museum, gallery, or park, does its meaning change? Moreover, is its artistic integrity compromised? This study examines public sculpture, specifically Steinunn Thórarinsdóttir's *Borders*, because of its frequent relocation. Consisting of twenty-two statues originally made for Dag Hammarskjöld Plaza (outside of the United Nations Headquarters), *Borders* has been featured in settings throughout Dallas, Chicago, Baton Rouge, and for the last two years, Centenary College. This study examines audience interaction with *Borders* using three of its previous locations: Dag Hammarskjöld Plaza, Westlake Park, Seattle, and Centenary College of Louisiana. As the exhibit moves from one setting to the next, the background and visual composition dramatically change. All audiences interpreted *Borders* differently not because of its change in composition, but because each audience interpreted it through their own cultural lens.

Two Week Prospective Trial to Observe the Effects of Art Observation and Art Production on Pulse, Systolic Blood Pressure, and Diastolic Blood Pressure

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The holistic approach to health and healing used by the ancient Greeks involved the use of medicine, diet, and the arts as pillars of overall well-being. Traces of their medical practices still exist, from the Hippocratic Oath to canonization of the “Mediterranean diet.” Our Hellenized health paradigm reveals a significant departure from the ancient Greeks, however. Countless scientific articles defend the importance of diet and medicine in healing practices, but too few studies have attempted to quantitatively evaluate how art affects healing. An IRB approved 2-week prospective data collection was performed to examine the effects of creating and observing various forms of artwork on pulse, systolic blood pressure, and diastolic blood pressure. Sixteen college students monitored their blood pressure and pulse rates three times a day for sixteen days while studying in Greece. Fourteen of the students were females with a median age of 18.5 +/- 1.6, and two of the students were males with a median age of 20. The students were asked daily to record a baseline blood pressure and pulse under controlled conditions as well as before and after a 15-minute period of creating art and another 15-minute period of observing art. Recorded pulse data did not show significant changes throughout the sixteen-day period and various activities. Diastolic blood pressure did not demonstrate significant changes throughout the given time periods for art observation or art performance. Conversely, the systolic blood pressure showed a significant decrease after the 15-minute period of

art observation but not during the period of art production.

Despite the various confounding factors surrounding the trial, the decreased systolic blood pressure delta would indicate that art observation for a 15-minute period has a calming and potentially beneficial effect on health.

Spread of novel Corona Virus across time and region in the United States

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The novel Corona Virus (COVID-19) has spread rapidly through the United States. I analyzed the data of confirmed cases of the virus over the course of February and March 2020 by geographical region with a repeated measures ANOVA. The analysis tracks the number of confirmed cases by region and by time, showing differences in spread of cases by region. The US first tested for the virus on January 20, 2020, in Washington State. However, widespread testing did not begin for some time, so our results necessarily include both changes in infection rates and increases in test availability by region of the United States.

