School of
Math & Sciences

2012

Spring Research Day

Schedule

All presentations will be held in the Moody Science Auditorium, Room 110.

1:00 – 1:10	Welcome Address and Acknowledgements Dr. Herb Grover, Dr. Andrew Kasner
1:10 – 1:25	Presentation 1..... *Richard Ross, Trevor Burrow, Cody Detwiler* **The Waters of Time**
1:30 – 1:45	Presentation 2..... *David Ajibero, Emily Gibson, Joel Thompson* **Estimating Future U.S. Population Using a Logistic Differential Equation**
1:50 – 2:05	Presentation 3..... *Caleb Schumacher, Oscar Rivera, Zane Lewis* **Bungee Jumping: Adrenaline Filled Mathematics**
2:10 –2:25	Presentation 4..... *Corin Olivas* **Effectiveness of Scent Stations, Game Cameras, and Scent Types for Assessing Mammalian Presence and Abundance in an Urban Environment**
2:25 – 2:30	Break
2:30 – 3:30	**Poster Session I** (MSB First Floor Hallway) See Poster List on next page
3:35 – 3:50	Presentation 5.....*Brian Adamson, Dustin Sanders, Richard Ralston* **Up a Creek Without a Paddle**
3:55 – 4:10	Presentation 6..... *Jordan Broome, Keenan Harris, Lucius Lopez* **Velocity and Drag Coefficient of Raindrops**
4:15 – 4:30	Presentation 7.....*Richard Ross* **On Seymour's Second Neighborhood Conjecture**
4:30 – 5:15	**Poster Session II** (MSB First Floor Hallway) See Poster List on next page
5:30 – 7:00	Dinner and Awards Ceremony (Multipurpose Room)

Research Day 2012 Posters

1) Libby Saultz, Jarrett Ross, Trevor Burrow, Jenna Wilson, Stephanie Whitaker, Gary O. Gray, and Adam J. Reinhart
   Cytotoxic and Apoptotic Effects of *Zingiber officinalea* (Ginger Root), *Curcuma longa* (Turmeric), *Trigonella foenum-graecum* (Fenugreek), *Sanguinaria canadensis* (Blood Root) and *Withania somnifera* (Ashwagandha) in 4T1 Murine and MCF-7 Human Breast Cancer Cell Lines

2) Trevor Burrow, Libby Saultz, Jenna Wilson, Stephanie Whitaker, Jarrett Ross, Adam J. Reinhart, and Gary O. Gray
   Partial Purification and Characterization of 4T1 Murine Breast Cancer Cell Cytotoxins from *Curcuma longa*

3) Jacob Kemmer, Corin Olivas, Jodi Schumacher, and Herbert D. Grover
   The Relationship between Seed Pod Production, Number of Seeds, and Seed Mass in *Gleditsia triacanthos L.*

4) Brittnay Walton, Kady N. Pryde, and Herbert D. Grover
   Patterns in Seed Pod and Seed Production between *Gleditsia triacanthos L.* trees on the Wayland Baptist University campus, in Plainview, Texas

5) Jodi Schumacher, David Perez, Edward Taragon, Chelsea Williams, Jenna Wilson, and Herbert D. Grover
   Relationship Between Elevation and Stomatal Densities on the Abaxial Surface of *Populus tremuloides* Leaves

6) Meagan Dixon, Hunter Green, Christal Patterson, and David Schmidt
   Sedimentological and Depositional Interpretation of a Fossil-Bearing Unit Within the Blackwater Draw Formation, Plainview, Texas

7) Chris Caro, Jacob Kemmer, and Erin Miller
   Frequency of Six Diseases in the CDC Regions of the United States

8) Corin M. Olivas, Ryan M. Sauer, and Jarrod W. Smith
   Internet Usage Has No Apparent Effect on Literacy Rates in Middle Eastern Countries

9) Cody McClary, Chelsey Price, and Abria Thomas
   The Effects Weather Has on Health

Acknowledgments

2012 Research Day was organized by the officers and members of the Wayland Baptist University Student Chapter of the Texas Academy of Science.

Committee Members

Natividad Sandoval, TX Academy of Science - WBU Chapter President

Trevor Burrow, TX Academy of Science – WBU Chapter Vice President

Corin Olivas, TX Academy of Science – WBU Chapter Treasurer

Jacob Kemmer, TX Academy of Science – WBU Chapter Secretary

WBU-TAS Faculty Advisor: Dr. Andrew C. Kasner

Special Thanks:

- WBU Student Chapter of the American Chemical Society for assistance with poster setup and other tasks associated with the organization of Research Day.
- WBU Student Chapter of the Mathematics Association of America for providing desserts for the dinner.
- Dr. Scott Franklin, Director of Virtual Campus for setting up abstract submission page and logistical support.
- Dr. Herb Grover, Dean of the School of Math and Sciences for logistical and financial support.

We especially thank the faculty in the School of Math and Science for logistical support, judging of presentations and posters, and tireless support and encouragement of the research students in our program.

Abstracts for Research Day Presentation

1:10 – 1:25 Presentation 1 ..... Richard Ross, Trevor Burrow, Cody Detwiler
Advisor: Dr. Scott Franklin

The Waters of Time

The 4000 year old sexagesimal system of time keeping has evolved through the ages from obelisks that use the position of the sun, to atomic clocks that measure the transition of an electron frequency in the optical, ultraviolet, and the microwave regions. This case study investigates the mathematical explanation of time keeping by gravitational flow of water via differential equations along with functioning water clocks.

1:30 – 1:45 Presentation 2 ..... David Ajibero, Emily Gibson, Joel Thompson
Advisor: Dr. Scott Franklin

Estimating Future U.S. Population Using a Logistic Differential Equation

In this project, we modeled the population of the United States of America using a logistic differential equation based on Census Data. Using linear regression with different approximations of the derivative we fit parameters within the model to match our data. Although our equation fit our points fairly well, we tested our model by comparing current census data to values predicted by the model and had limited success. We also explored how much space each person in the United States will have if our population follows our model as opposed to the amount we all have now.

1:50– 2:05 Presentation 3 .....Caleb Schumacher, Oscar Rivera, Zane Lewis
Advisor: Dr. Scott Franklin

Bungee Jumping: Adrenaline Filled Mathematics

The purpose behind our research was to apply modeling applications learned in differential equations to a real life situation, bungee jumping. We set out to model someone bungee jumping from a bridge above the Malad River Canyon where the water is 174 feet below. The jump is modeled with two linear differential equations: the first modeling the fall before the bungee cord's elasticity takes effect and the second modeling the fall once the bungee cord affects the acceleration. Using several parameters (i.e., the spring constant of the bungee cord, the drag coefficient, the length of the bungee cord, and the mass of the person) we were able to model the person's path. We also developed a script in MatLab that would allow us to modify our parameters to see how far the person would be from the water at the lowest point.

2:10 – 2:25 Presentation 4 ..... Corin Olivas

Advisor: Dr. Andrew Kasner

Effectiveness of Scent Stations, Game Cameras, and Scent Types for Assessing Mammalian Presence and Abundance in an Urban Environment

Scent stations and game cameras are an excellent method of observing wildlife and estimating populations with minimal disturbance. We established scent stations with game cameras at 4 sites in Plainview, Hale Co., Texas. Each site was monitored for 3 weeks using a different scent type (coyote, fox, raccoon) each week to determine mammalian species present and effectiveness of scent types. Sites included 2 alleys in neighborhoods and 2 near the edge of urban extent. Overall, fox urine yielded the most photocaptures (mean=22.75 captures/site), followed by coyote attractant (mean=16.75 captures/site) and raccoon urine (mean=16 captures/site). Species captured included: coyote (*Canis latrans*, n=2, 1 site), gray fox (*Urocyon cinereoargenteus*, n=4, 1 site), domestic cats (*Felis catus*, n=193, 4 sites), domestic dogs (*Canis lupus familiarus*, n=20, 4 sites), eastern fox squirrel (*Sciurus niger*, n=5, 2 sites), and eastern cottontail (*Silvilagus floridanus*, n=48, 3 sites). Because cats are identifiable by pelage, we were able to estimate the numbers of cats at each site. Cat numbers were highest at alley sites (Alley Site 1: N=4 individuals, 64 photos; Alley Site 2: N=5 individuals, 116 photos) compared to sites on the outer edges of town (Urban Edge 1: N=1 individual, 2 photos; Urban Edge 2: N=2 individuals, 11 photos). Our results suggest that scent stations and wildlife cameras can be useful for determining patterns of abundance of urban wildlife and feral or domestic dogs and cats.

3:35 – 3:50 Presentation 5 ..... Brian Adamson, Dustin Sanders, Richard Ralston

General Biology Class Project ..... Advisor: Dr. Scott Franklin

Up a Creek Without a Paddle

This project is designed to mathematically model how a swimmer would plan to cross a river, given that he does not want to reach the opposing side farther downstream. In this project a model was developed and solved to find the appropriate ratio between the speed of the swimmer and the river. The Differential Equations Model that was developed can show how the swimmer would progress across the stream through time. The ratio that works best for the swimmer to meet the intended target is, $V_s>V_r$, given that V_s is the speed of the swimmer and V_r is the speed of the river.

3:55 – 4:10 Presentation 6 ..... Jordan Broome, Keenan Harris, Lucius Lopez

Cell and Molecular Biology Class Project ..... Advisor: Dr. Scott Franklin

Velocity and Drag Coefficient of Raindrops

In this project, a raindrop model was set up and tested with the main goal of determining the closest approximate drag coefficient of a raindrop. We were asked to determine the average velocity of a raindrop, and to do so it was necessary to find the most accurate drag coefficient. This was done by first setting up and solving a differential equation that models the fall of a raindrop. Then, specifically designed software and a video camera were used to model the "rain" droplets. We determined this drag coefficient by measuring the velocity of a raindrop in correlation to its volume and inserting these values into our solution equation. Finally, using the performance data we collected, we were then able to calculate an approximate drag coefficient within our design parameters.

4:15 – 4:30 Presentation 7 .....Richard Ross

Advisor: Dr. Emilia Moore

On Seymour's Second Neighborhood Conjecture

Seymour's Second Neighborhood Conjecture claims that every directed graph without multiple or reversed arcs contains at least one vertex in which its out degree is at most its second out degree. While this conjecture has been an open problem in mathematics for quite a while some progress has been made. This talk is intended to lend some techniques to either prove or disprove this conjecture in light of a few discoveries made in the last 15 years.

Abstracts for Research Day Posters

Poster 1 .....Libby Saultz, Jarrett Ross, Trevor Burrow, Jenna Wilson, Stephanie Whitaker, Gary O. Gray, and Adam J. Reinhart

Advisor: Dr. AdamReinhart

Cytotoxic and Apoptotic Effects of *Zingiber officinalea* (Ginger Root), *Curcuma longa* (Turmeric), *Trigonella foenum-graecum* (Fenugreek), *Sanguinaria canadensis* (Blood Root) and *Withania somnifera* (Ashwagandha) in 4T1 Murine and MCF-7 Human Breast Cancer Cell Lines

Ethanolic extracts of medicinal plants were tested to determine their cytotoxic effects on the 4T1 murine and MCF-7 human breast cancer cell lines. The cytotoxic effects of the extracts were measured using MTS and Cell Titer-Glo luminescent cell viability assays. Dose response tests were conducted to determine the IC50 values for cytotoxic extracts. Ethanolic extracts of *Zingiber officinalea* (Ginger Root), *Curcuma longa* (Turmeric), *Trigonella foenum-graecum* (Fenugreek), *Sanguinaria canadensis* (Blood Root) and *Withania somnifera* (Ashwagandha) were found to be cytotoxic to both cell lines. Crude and further fractionated extracts that were found to be cytotoxic to 4T1 or MCF-7 cells were assayed for apoptosis using a Caspase Glo-3/7 assay and a western blot assay of caspase-3 protein.

Poster 2 ..... Trevor Burrow, Libby Saultz, Jenna Wilson, Stephanie Whitaker, Jarrett Ross, Adam J. Reinhart, and Gary O. Gray

Advisor: Dr. Gary Gray

Partial Purification and Characterization of 4T1 Murine Breast Cancer Cell Cytotoxins from *Curcuma longa*

Turmeric (*Curcuma longa*), a plant used in Ayurvedic medicine, contains bioactive polyphenols. Previous work demonstrated that ethanolic extracts of turmeric were cytotoxic to cultured 4T1 murine breast cancer cells. Objectives of this study were to identify and characterize the 4T1 cell cytotoxins. Powdered turmeric was extracted by reflux in dichloromethane. Dichloromethane extract was precipitated with hexane, and precipitated material was subjected to silica gel TLC. TLC bands were scraped, eluted in DMSO and analyzed via UV-visible spectroscopy, HPLC and MALD-mass spectrometry. Cytotoxicity of eluted TLC bands was determined (MTS assay and Glow assay) on cultured 4T1 cells. Two cytotoxic TLC bands BV1 and BV2 were observed, consistent with the molecular weights of curcumin and demethoxycurcumin, respectively. Additional characterization is ongoing.

Poster 3 ..... Jacob Kemmer, Corin Olivas, Jodi Schumacher, and Herbert D. Grover

Dr. Herb Grover

The Relationship between Seed Pod Production, Number of Seeds, and Seed Mass in *Gleditsia triacanthos L.*

The purpose of this project was to examine how Honey Locust, *Gleditsia triacanthos L*., trees on the Wayland Baptist University campus in Plainview, Texas partition their resources which affect seed production. This study was performed as a General Ecology class project in the fall 2011 semester and is an ongoing project for this course. Eight trees were selected across the campus based on their location and evidence of seed pod production. Twelve 25 m2 quadrants were placed in a radial pattern from the tree trunk out to the canopy edge. Pods were collected from these quadrats weekly for each tree for ten weeks starting in early September. The data collected by the class included: number of seed pods, number of seeds per pod, the number of seed compartments per pod, and seed mass. The average number of pods per tree ranged from 3.64 to 0.17; the average number of seeds per pod ranged from 24.79 to 1.63; and the average seed mass ranged from 9.57 grams to 0.27 grams. Based on our results, we found that the number of pods produced by a tree is correlated with an increase in the number of seeds produced and individual seed mass.

Poster 4 ..... Brittnay Walton, Kady N. Pryde, and Herbert D. Grover

Advisor: Dr. Herb Grover

Patterns in Seed Pod and Seed Production between *Gleditsia triacanthos L.* trees on the Wayland Baptist University campus, in Plainview, Texas

The objective of this study was to quantify variability in seed pod and seed production between *Gleditsia triacanthos L*. (Honey Locust) trees found on the campus of Wayland Baptist University in Plainview, Texas. Eight trees were selected for the study based on their location and evidence of seed pod production. Twelve, 0.25 m^2 permanent quadrats were located in a radial pattern extending from the trunk to the canopy edge under each tree selected for study. Weekly collections of seed pods were made over a ten week period starting in early September 2011.Data collected included the number of seed pods; the number of viable seeds per pod; and the number of seed compartments per pod. Average values ranged from 0.17 to 3.64 pods per 0.25 m^2; 1.53 to 7.68 viable seeds per pod; and 2.15 to 30.45 seed compartments per pod. The results of this study indicate that trees could be separated into high-yield and moderate-yield groups. The high-yield group had five trees. Total average values were 2.12 pods per 0.25 m^2; 5.81 viable seeds per pod; and 6.76 seed compartments per pod. The moderate-yield group had 3 trees. Total average values were 0.39 pods per 0.25 m^2; 2.72 viable seeds per pod; and 3.62 seed compartments per pod. Field observations confirmed a third group of Honey Locust trees – those that produced no pods. These findings may corroborate the reported polygamo-dioecious character of this species; a finding that will be discussed in greater detail on our poster.

Poster 5 .....Jodi Schumacher, David Perez, Edward Taragon, Chelsea Williams, Jenna Wilson, and Herbert D. Grover

Advisor: Dr. Herb Grover

Relationship Between Elevation and Stomatal Densities on the Abaxial Surface of *Populus tremuloides* Leaves

Stomatal densities in relation to elevation along with leaf area and nearest neighbor distance measurements were examined on abaxial (lower) leaf surfaces of *Populus tremuloides* (aspen) growing in the Sangre de Cristo mountains of New Mexico. The objective of our study was to find out if there was a correlation between stomatal density and elevation. Leaves were gathered from the ground floor, the lower canopy, and the upper canopy from the various sites ranging in elevation from 2,700 m (8,894 ft) to 3,184 m (10,445 ft) and stored in a plant press for approximately three months. Aspen leaves were tested from different elevations by using fingernail polish to extract impressions of the stomata. With clear tape, four impressions of each leaf were attached on a slide and then five pictures were taken of each impression. Data of stomatal densities were determined using digital images acquired at 100x magnification and analyzed using Manifold image processing software. Stomatal densities range from 40.2 stomata/mm² to 127.04 stomata/mm². The results showed a negative correlation between elevation and stomatal density. Furthermore, no relationship between leaf area and stomatal density was found, but there was a negative relationship between stomatal density and the nearest neighbor distance. This study provided evidence of an inverse relationship between elevation and stomatal densities on abaxial leaf surfaces for *P. tremuloides*. These results do not match some of the previous research from the literature for *Populus deltoides* in moist environments. The difference in results could be related to either climate or species.

Poster 6 .....Meagan Dixon, Hunter Green, Christal Patterson, and David Schmidt

Advisor: Dr. David Schmidt

Sedimentological and Depositional Interpretation of a Fossil-Bearing Unit Within the Blackwater Draw Formation, Plainview, Texas

A fossil bearing unit within the Blackwater Draw Formation of mostly fluvial origins was sampled laterally at three locations (PCP 1, 2, and 3) for composition and grain size analyses. Compositionally, grains are predominantly quartz with minor amounts of feldspars. All three locations exhibit similar grain size histograms, but variable distributions. All three sampled localities contain bimodal frequency curves that are skewed negatively and indicate low stream flow velocity. However, location 3 exhibited the greatest variability. Samples PCP 3B1 and 3B2 appeared texturally different than samples PCP 3A1 and 3A2 in outcrop, and in contrast, show a negatively skewed unimodal frequency curve which is more typical of eolian sedimentation. Samples 3A1 and 3A2 contain a higher concentration of carbonate grains, carbonate coated quartz grains, and the abundant presence of *Gyraulus parvus*. Such characteristics are uniquely different from the other samples and are more representative of sedimentation in isolated standing water. Therefore, the current data regarding modal and grain size variations may suggest changes in stream flow dynamics, and that sedimentation is more complex and not completely restricted to fluvial processes.

Poster 7 ..... Chris Caro, Jacob Kemmer, and Erin Miller
Advisor: Dr. Robert Moore

Frequency of Six Diseases in the CDC Regions of the United States

People who have a high sensitivity to certain diseases may not want to live within specific regions of the US where the disease is more prevalent. We evaluated the frequency of disease contraction each week of 2011 of syphilis, varicella, animal rabies, salmonellosis, legionellosis, and pertussis in each of the nine CDC regions of the United States. For most of the diseases, there was no obvious indication that one region was more favorable than another, however a few did. Also, some diseases show seasonal variation or unique trends.

Poster 8 .....Corin M. Olivas, Ryan M. Sauer, and Jarrod W. Smith
Advisor: Dr. Robert Moore

Internet Usage Has No Apparent Effect on Literacy Rates in Middle Eastern Countries

Education is very important for developing countries. To determine if computers influence education, we compared the components of education (literacy rates and amount of schooling) in select Middle Eastern countries with the percent usage of the Internet. While literacy rates are strongly influenced by the amount of schooling, our results would indicate that there are no correlations between having access to the Internet and the quality and quantity of education in the majority of the selected countries.

Poster 9 ..... Cody McClary, Chelsey Price, and Abria Thomas
Advisor: Dr. Robert Moore

The Effects Weather Has on Health

Is there a reason people move to a more stable climate region concerning their health? To answer this question precipitation, humidity, and temperature data was collected from weather stations in the most populous city of each of the nine CDC regions. Death rates for each of those cities were then collected using Morbidity and Mortality Weekly Reports published by the CDC. When analyzing individual cities' temperature vs. death data, certain cities such as Houston showed a remarkably close correlation; however as a whole there was no consistent correlation. Similar trends were apparent when analyzing precipitation vs. death, where only one city, Phoenix, seemed to have an interesting relationship. No cities showed any correlation between humidity and death rates.