Feel free to grab a snack. We will begin shortly.

SCHEDULE

1	Lee Rumble	BIO	Forest Pests and Pathogens in Great Smoky Mountains National Park
2	Scott Morton	COMS	Determining the HIV Transmission Bottleneck
3	Daniel Lewis	CS	Multi-lingual Word Definitions for Child eBook Applications
4	Kevin Overall	CONC	Investigating Fly Ash Shortages
5	Matthew Wang	COMS	The Application of Genetic Algorithms For Density Functional Optimization and Development
6	Samuel Reed	MSE	Calculus II Students' Interactions with the Function Machine
7	Naomi Oliver	HORSE	Perceptions of Veterinarians on the Use of Nutritional Supplements in the Horse Industry
8	Katrece Holland	MSPS	The Role of Informatics in Public Health

short break

9	Simeon Adebola	ENGR	A Human-Following Robot for Fall Detection
10	Candace Quinn	MSE	The Evolution of Developing an MKT Coding Framework
11	Paola Molina	MOBI	We Get it from Our Mother: Understanding Mitochondrial inheritance
12	Tucker Dowell	MATH	A Tale of Two Categories
13	Justin Marsee	CHEM	MS in Chemistry through Biophysics
14	Madison Green	MOBI	Identification and Development of Antimicrobial Peptoids Effective against Cross-Kingdom Biofilms
15	Doug Campbell	AERO	UAS Impact on Aviation and Aircraft Registration Analysis

Forest Pests and Pathogens in Great Smoky Mountains National Park

Lee Rumble
M.S. Biology

Forests

- Vast assemblages of species
- Cover ~ 30% of Earth's land surface
- Numerous benefits
- Of critical importance

Forest Pests and Pathogens

Sampling in Great Smoky Mountains National Park

- 200,000 acres (80% forested)
- World renowned for its biological diversity
- Forest pests and pathogens
  - Monitoring programs
  - Reinitiated one of the Park's longest-running forest health studies (1994 – 2012; 2017)
- Beech Bark Disease complex (in American beech)

The loss of American beech is changing forests

	1994	2017
Area	195.7 m^2/ha	92.4 m^2/ha

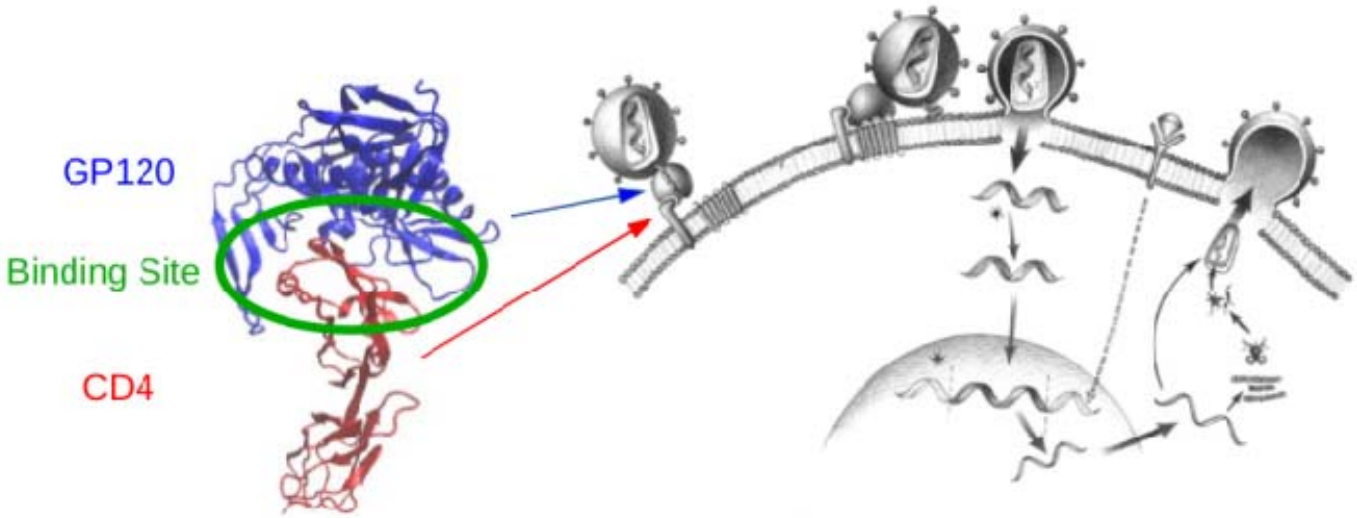
American beech is clonal...

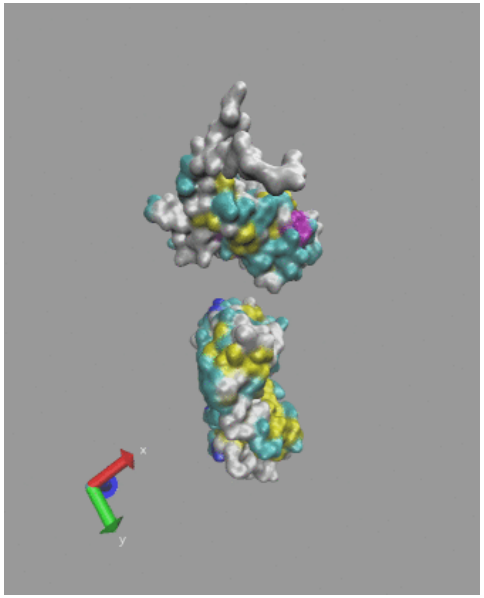
	1994	2017
Count	329 trees	411 trees

Determining the HIV Transmission Bottleneck

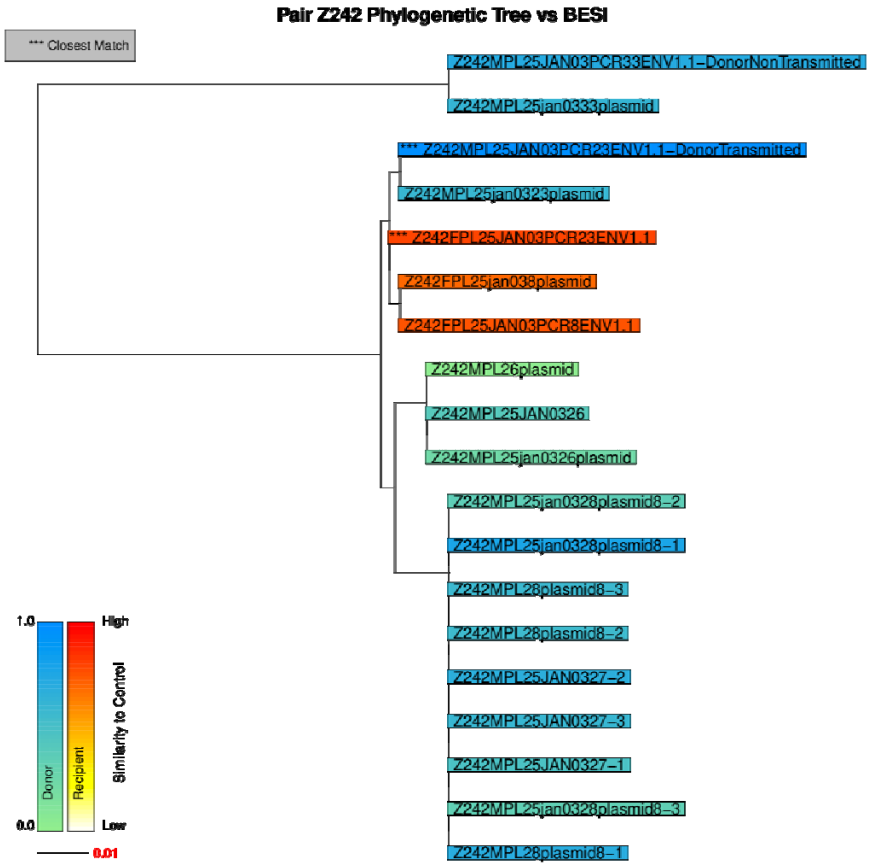
Scott P. Morton

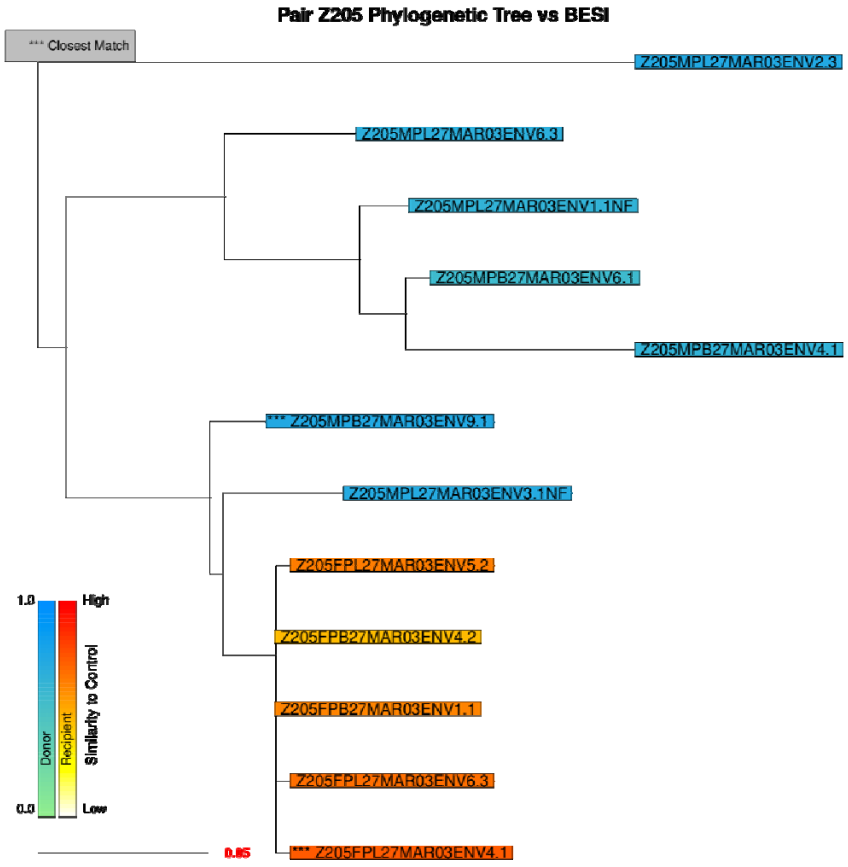
Binding Process



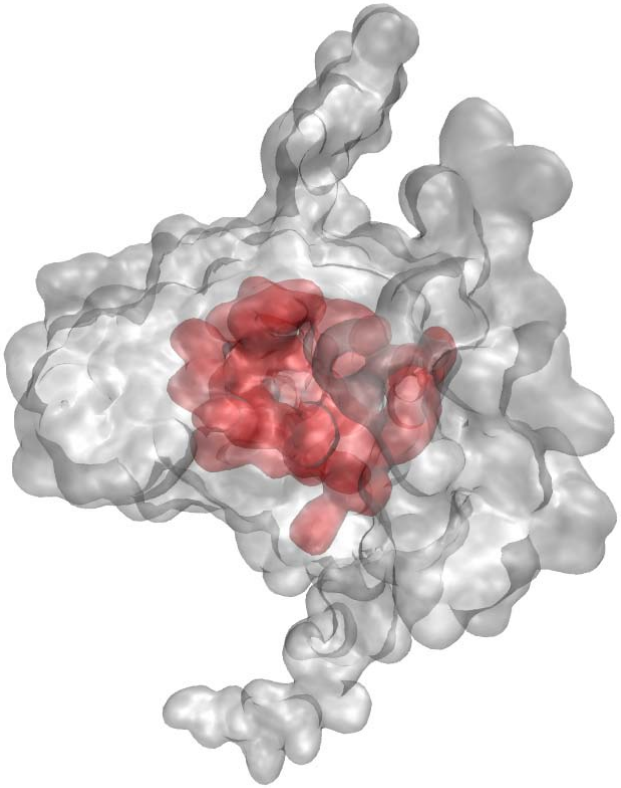


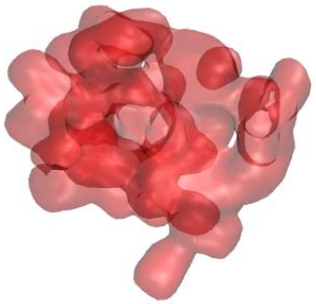
Method of Classification





Detailed Analysis





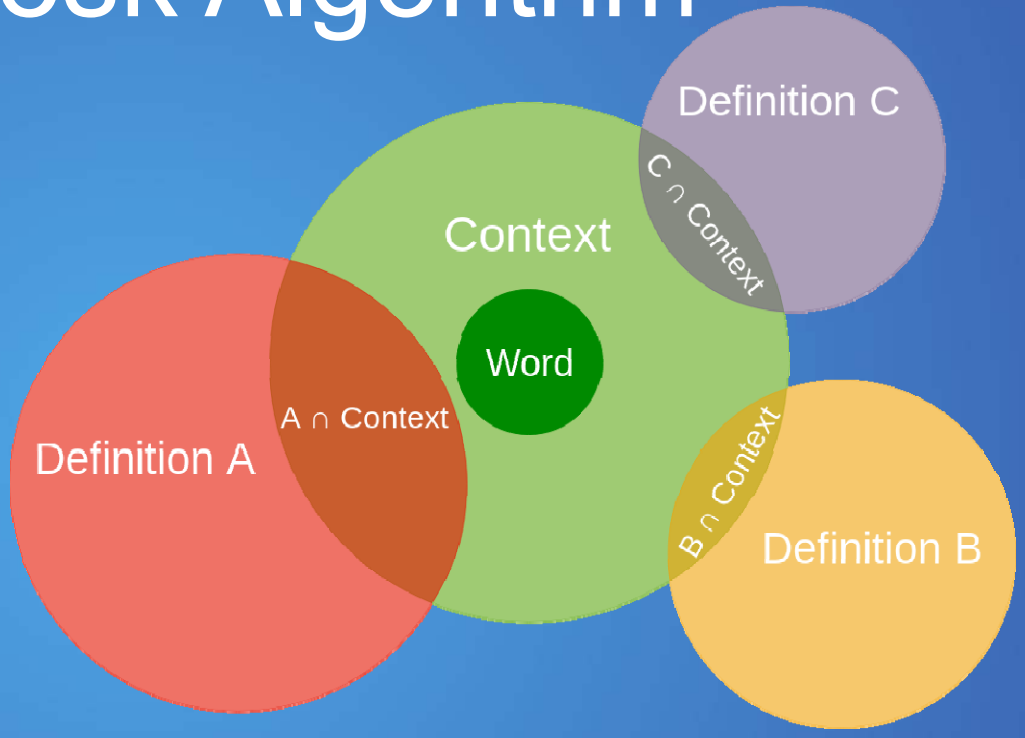
Multi-lingual Word Definitions for Child eBook Applications

Daniel Youree Lewis

Word Sense / Lesk Algorithm

1. Compare words in context to words in the definition / example sentences. Ignore stopwords (a, the, be, ...).

2. Pick the definition with the most overlap. If there was a tie, or the definition is too uncommon to be in a children's book then choose the most common sense of the word.



Daniel Youree Lewis

WordNets

- WordNet®
  - A large lexical database of English. Words are grouped into sets expressing a distinct concept.[1]
- Open Multilingual Wordnet
  - Links wordnets in a variety of languages, all are linked to the Princeton Wordnet of English[2,3]

NLTK – Natural Language Tool Kit

- Used as interface for natural language processing tools

Daniel Youree Lewis

Citations

[1] Christiane Fellbaum (1998, ed.) WordNet: An Electronic Lexical Database. Cambridge, MA: MIT Press.

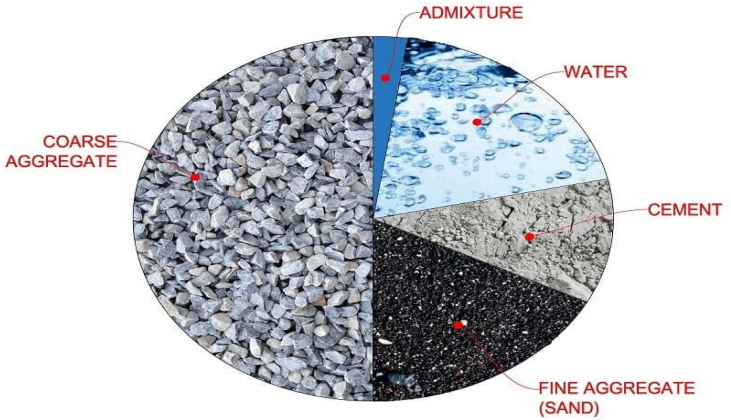
[2] Francis Bond and Kyonghee Paik (2012) A survey of wordnets and their licenses In *Proceedings of the 6th global WordNet Conference (GWC 2012)*. Matsue. 64–71

[3] Francis Bond and Ryan Foster (2013) Linking and extending an open multilingual wordnet. In *51st Annual Meeting of the Association for Computational Linguistics: ACL-2013*. Sofia. 1352–1362

The Fly Ash Shortage Impacting the Concrete Industry

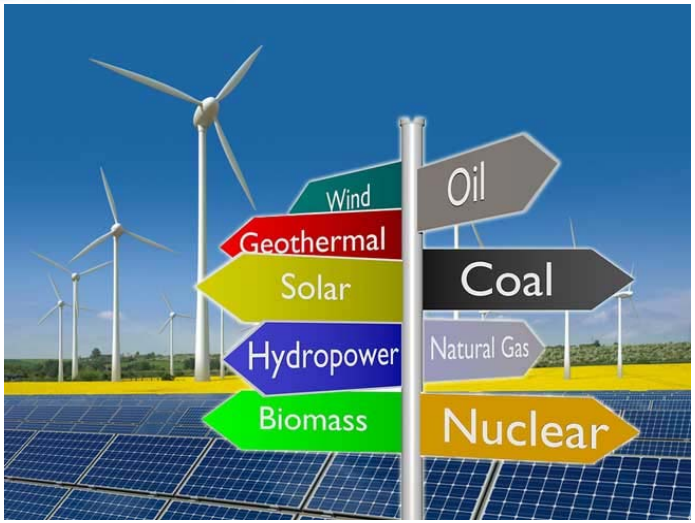
Kevin Overall

What is Fly Ash?



- S.C.M.
- By product of burning coal
- Contributes to concrete durability
- The most widely used cement replacement in the industry
- Dosed at 15% to 40% of the cement content in nearly 50% of all ready mixed concrete sold
- Classified as either C-Ash or F-Ash
  - C-ash derived from subbituminous and lignite coals
    - Composed of calcium, silica, and alumina
  - F-ash derived from anthracite and bituminous coals
    - Composed of alumina and silica

Where is the Fly Ash going?



- Renewable Energy Movement
- Reduction on the dependency of fossil fuels
- Phasing out of coal mining operations
- Increased concrete production
- Low quality coal ash not suitable for Fly Ash
- Tighter EPA regulations resulting in Ash not being usable

Solutions to the shortage

- Aggregate powders as a substitute
- Move to other SCMs: slag, silica fume, metakaolin
- Research other industries for alternative solutions
  - lignans
- Reclaim previously wasted coal ash previously deemed unusable

Research Objective:

By investigating the coal ash crisis that is affecting TVA here in Tennessee, I hope to gain a better understanding of how the coal ash crisis can become a solution for the Fly Ash shortage that is currently impacting the concrete industry.

The Application Of Genetic Algorithms For Density Functional Optimization And Development

MATTHEW WANG

COMPUTATIONAL SCIENCE AT MTSU

- Interdisciplinary program of Math, Computer Science, a Science Discipline (Biology, Chemistry, Physics, etc.), and High Performance Computing

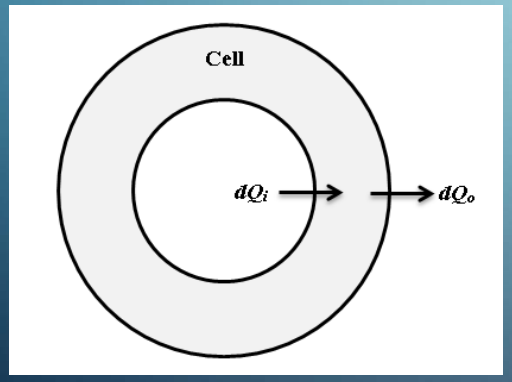
Dr. John Wallin
Director of COMS Phd Program

Summit supercomputer at Oak Ridge National Labs, #1 supercomputer

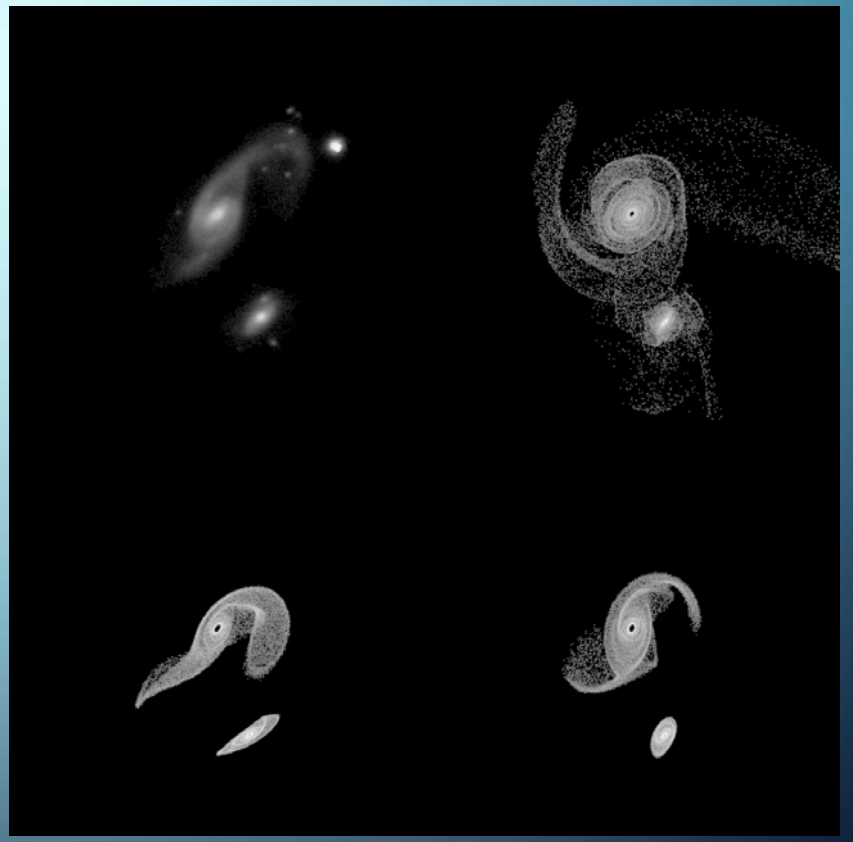
MrGreen and Babbage clusters at MTSU

RESEARCH AT MTSU

K. brevis algae causing Red Tide off of Florida Coast – National Geographic



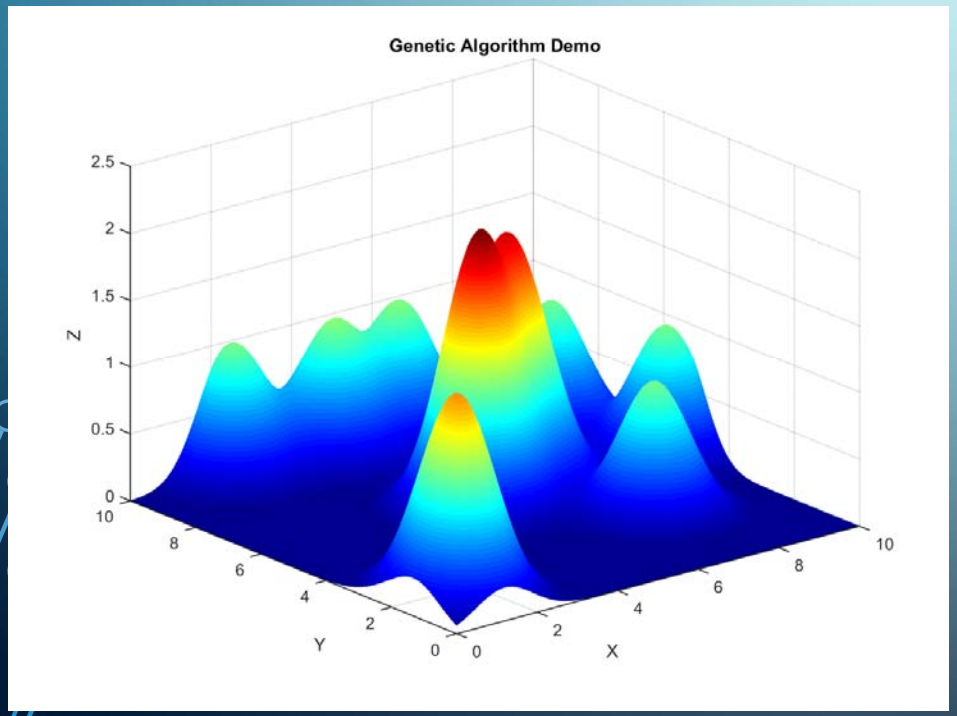
Heat Conduction in a Fluid Dynamic Cell at Los Alamos National Labs

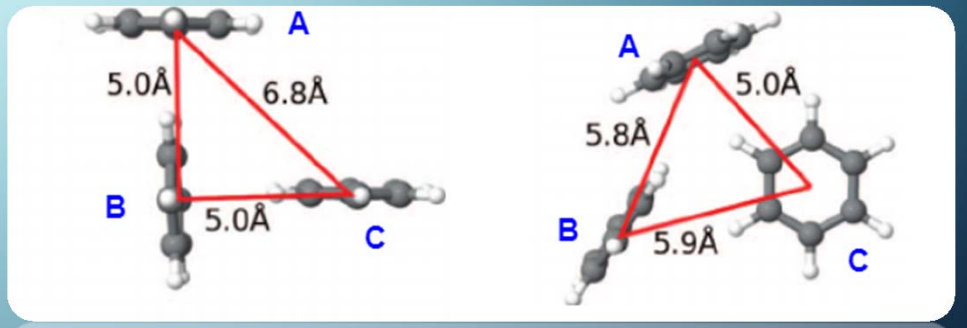


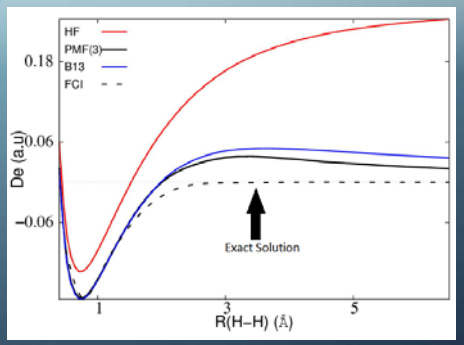
Merging Galaxy Image Classification

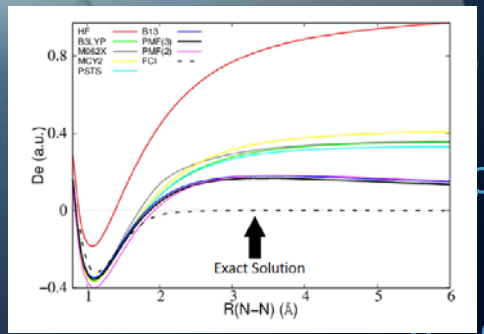
GENETIC ALGORITHMS AND DENSITY FUNCTIONAL THEORY

- Genetic algorithms – machine learning based on genetic and evolutionary ideas
- Quantum Chemistry – Calculation of molecular energy and properties









Mathematics and Science Education
Doctor of Philosopy Program

Calculus II Students' Interactions with the Function Machine

Presenter: Samuel D. Reed
Faculty Advisor: Dr. Jennifer Lovett

WHY FUNCTIONS?

- Research has shown that undergraduate students often display incomplete conceptions regarding the idea of functions

(Oehrtman, Carlson, & Thompson, 2008)

WHY CALCULUS?

- Understanding functions is essential in the development of the mathematical understanding of undergraduate students studying in the fields of mathematics, science, and engineering

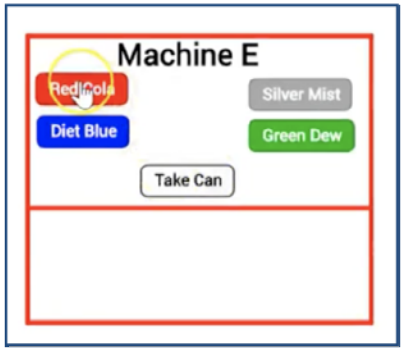
(Cooney, Beckmann, & Lloyd, 2010)

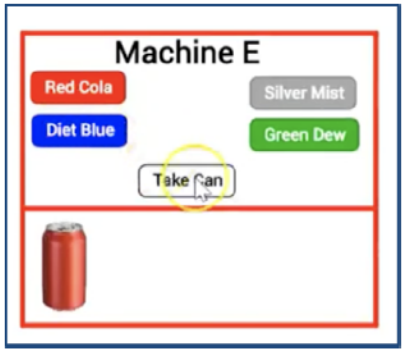
WHY TECHNOLOGY?

Technology can be an effective way for students to make connections between different ways of thinking about function (Dick & Hollebrands, 2011)

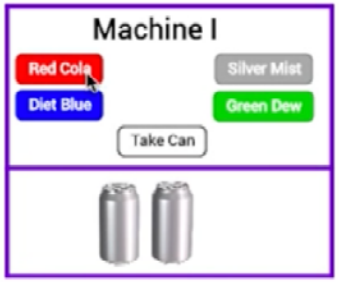
WHAT IS THE FUNCTION MACHINE?

- The function machine was developed by Dr. Jennifer Lovett and colleagues to introduce a *dilemma* to students regarding their concept of function.
- The Function Machine conceptualizes a function in terms of a soda machine





DISORIENTING DILEMMAS



RESEARCH QUESTION

In what ways do Calculus II students make sense of a vending machine applet that produces two cans from a single input?

RESULTS

Overarching Themes

Rationale	Percentage of Students (N=36)
Based decision on number of cans every time	22% (8)
Based decision on consistency and randomness of output every time	22% (8)
Based decisions on both consistency/randomness and number of cans	22% (8)
Various other reasons	34% (12)

CONCLUSIONS

- Calculus II students have underdeveloped understanding and definition of function, or consider functions in too narrow of a scope.
- Students studying advanced mathematics could benefit from reexamining previously learned, essential concepts in mathematics.

Perceptions of veterinarians on the use of nutritional supplements in the horse industry

Naomi Oliver, Dr. Holly Spooner, Dr. John Haffner, Dr. Rhonda Hoffman

Middle Tennessee State University

Animal Supplement Industry

- Improving health, longevity, and performance

- Companion animal pet supplement industry
  - $1.8 billion and growing (NASC)
  - 50% horses

- Supplement types
  - Behavioral, Joint, Hoof, Coat, Gastric Health, Performance/Energy

Are supplements safe? Do they work?

- Previous research- Nicole Swirsley, 2015
  - Supplement Use and Perceptions: A Survey of U.S. Horse Owners
  - Reported use and beliefs in efficacy and safety
  - 43% reported consulting veterinarians first for supplement information

- Our study seeks to determine the perceptions of equine veterinarians regarding supplement use and efficacy in the horse

Veterinarian Perceptions

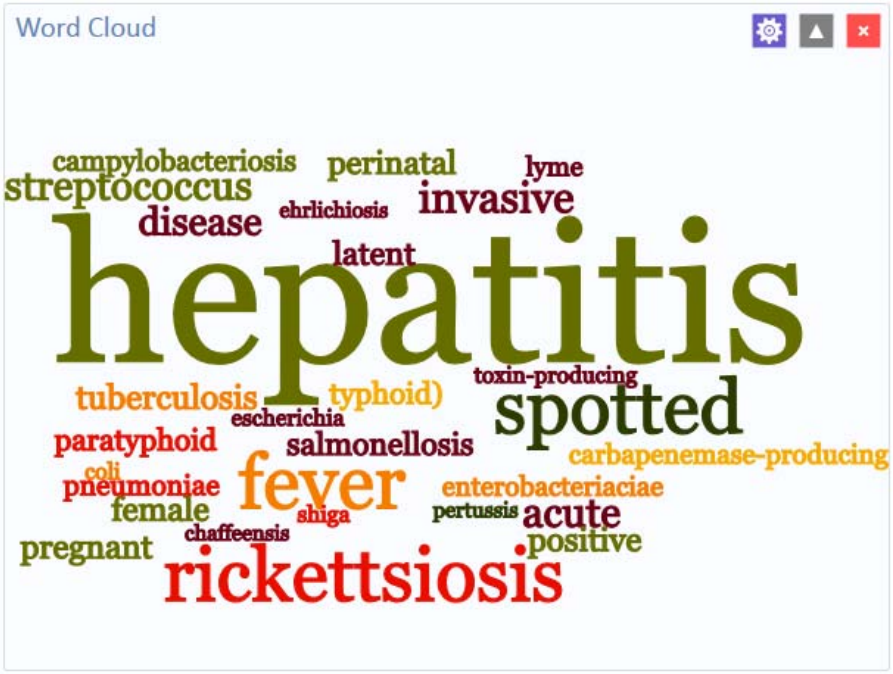
- Internet-based survey provided to equine veterinarians
  - AAEP
- Survey currently available on www.surveymonkey.com
- Data will be analyzed in SAS 9.0
  - Frequency counts of answer responses
  - Relevant correlations between responses
- Relevance
  - Needs for further education for veterinarians on supplement use in horses

The Role of Informatics in Public Health

BY: KATRECE HOLLAND

Public Health Informatics

- Enables effective monitoring and surveillance
- Supports improved decision-making
- Seeks to improve population health

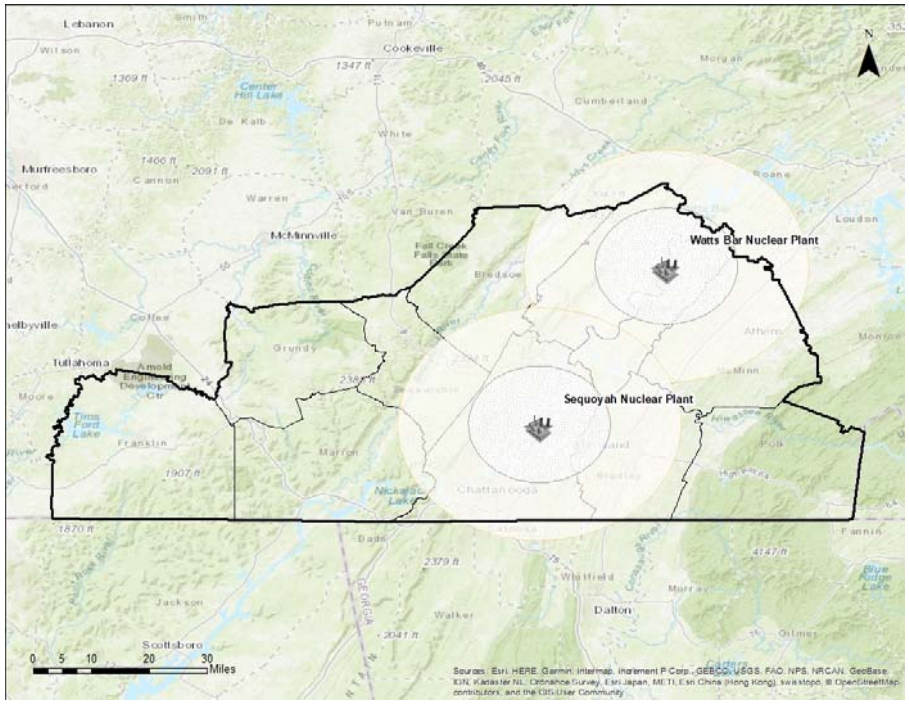


Data courtesy of TN Dept. of Health

Southeast Region of TN

- Sequoyah Nuclear Plant
- Watts Bar Nuclear Plant

- Utilizing geographical information system technology to map pharmacies within a 20 mile radius that could dispense KI in the event of a nuclear incident.



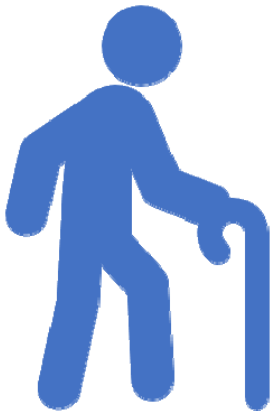
https://www.census.gov/geo/maps-data/data/tiger-line.html

Let's take a short break.

A HUMAN-FOLLOWING ROBOT FOR FALL DETECTION

Presented by Simeon ADEBOLA
Department of Engineering Technology
Supervisor: Dr Lei Miao

Motivation

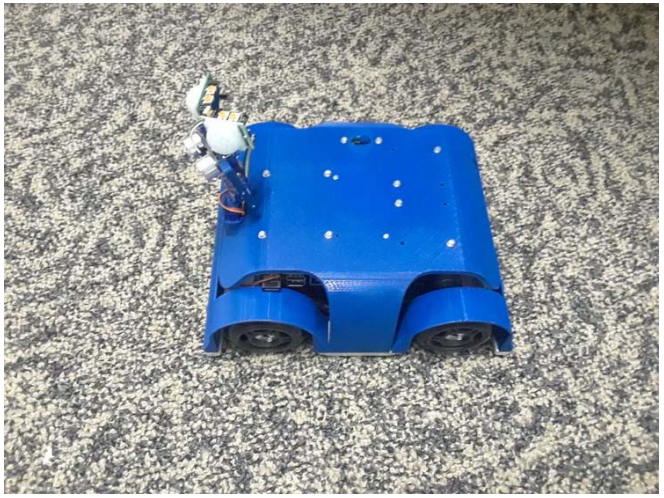


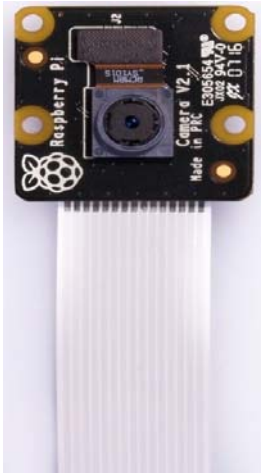
- For elderly people living alone, a fall without help being quickly provided can prove fatal.
- *"Yearly incidence of falls among the elderly population aged over 65 years is 30-50% globally"* [1]
- A constant yet privacy-conscious monitoring of their state and being is needed
- Alternative Options
  - Sensors on the body of the elderly[2]
    - Cons: Invasive, Requires participation of the elderly
  - Wireless signals in the home of the elderly[3]
    - Cons: Non-Social.
- Our Solution: A human-following robot that can track, and follow, the elderly in their homes; can detect if they fall and can then signal for help.
  - Pros : Non-invasive, Non-participatory for detection and tracking, Portable

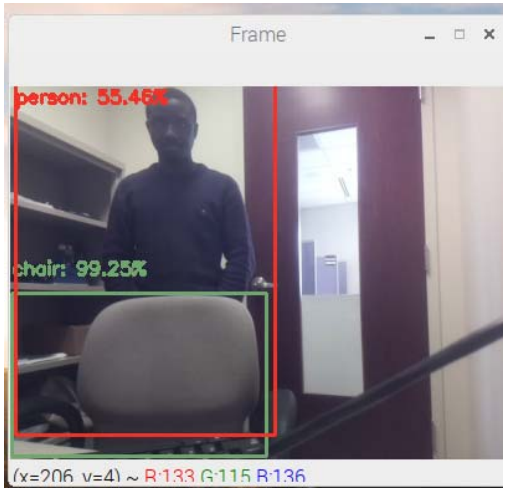
1. J. Hong, HJ. Kong and HJ. Yoon Web-Based Telepresence Exercise Program for Community-Dwelling Elderly Women With a High Risk of Falling: Randomized Controlled Trial JMIR Mhealth Uhealth 2018;6(5):e132
2. Z. Liu, Y. Cao, L. Cui, J. Song and G. Zhao, "A Benchmark Database and Baseline Evaluation for Fall Detection Based on Wearable Sensors for the Internet of Medical Things Platform," in IEEE Access, vol. 6, pp. 51286-51296, 2018. doi: 10.1109/ACCESS.2018.2869833
3. https://www.emeraldinno.com/

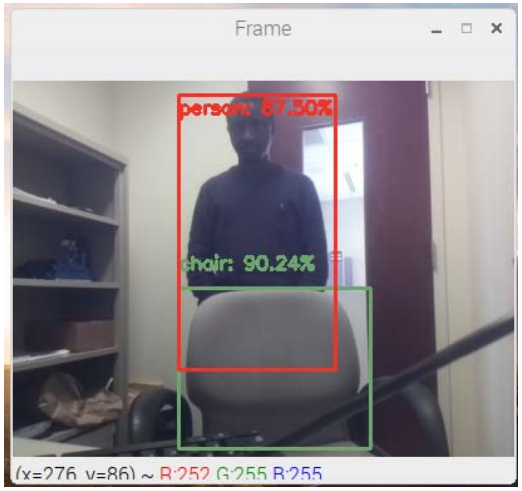
Current Research Methodology

- A robot with an onboard microprocessor unit and a camera to detect, track and so follow them around the house.
- Robot Prototype: FADER
  - Raspberry Pi
  - Arduino
- Computer Vision Using the Pi Camera
- Camera Options
  - Standard (with infrared filter)
  - Pi Noir (Without infrared filter)



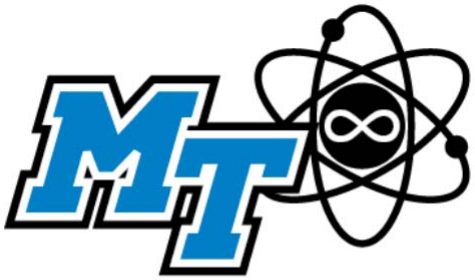






Current Research Methodology

- Computer Vision
  - Object Detection on the Pi Camera
- Interfacing with the FADER
- Tracking and Navigation
- Fall Detection



Mathematics and Science Education
Doctor of Philosopy Program

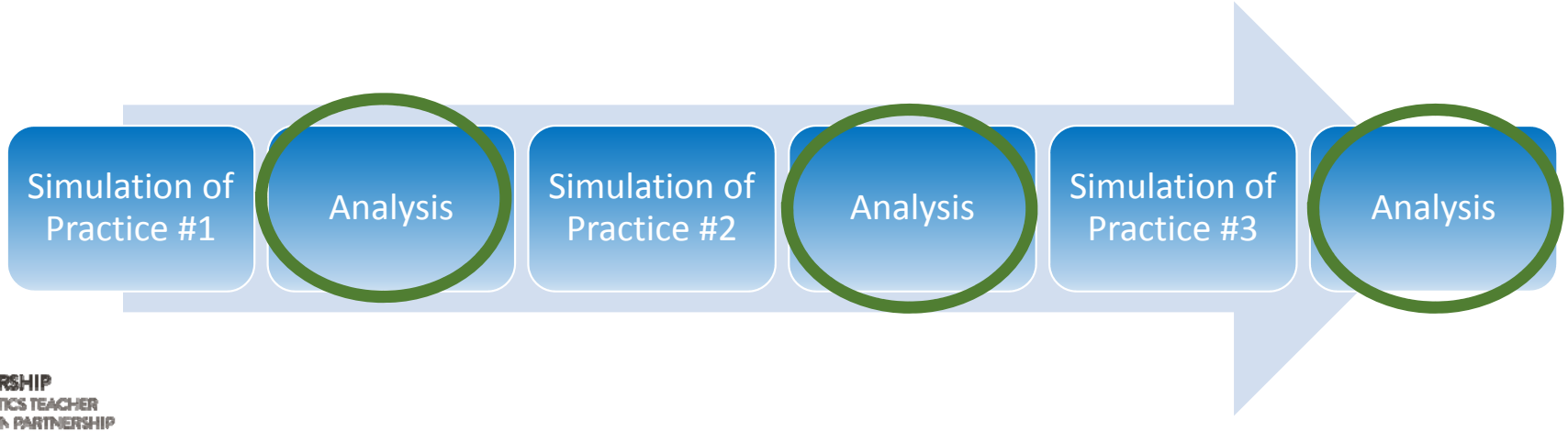
The evolution of developing an MKT coding framework

Candice M. Quinn
Faculty – Dr. Lischka and Dr. Strayer

Developing Activities for content courses to build Mathematical Knowledge for Teaching (MKT) for secondary preservice mathematics teachers.

Geometry | Statistics | Modeling | Algebra

- **Simulation of Practice: Responding to hypothetical student work.**



Analysis – Qualitative

First Analysis

Fall 2016

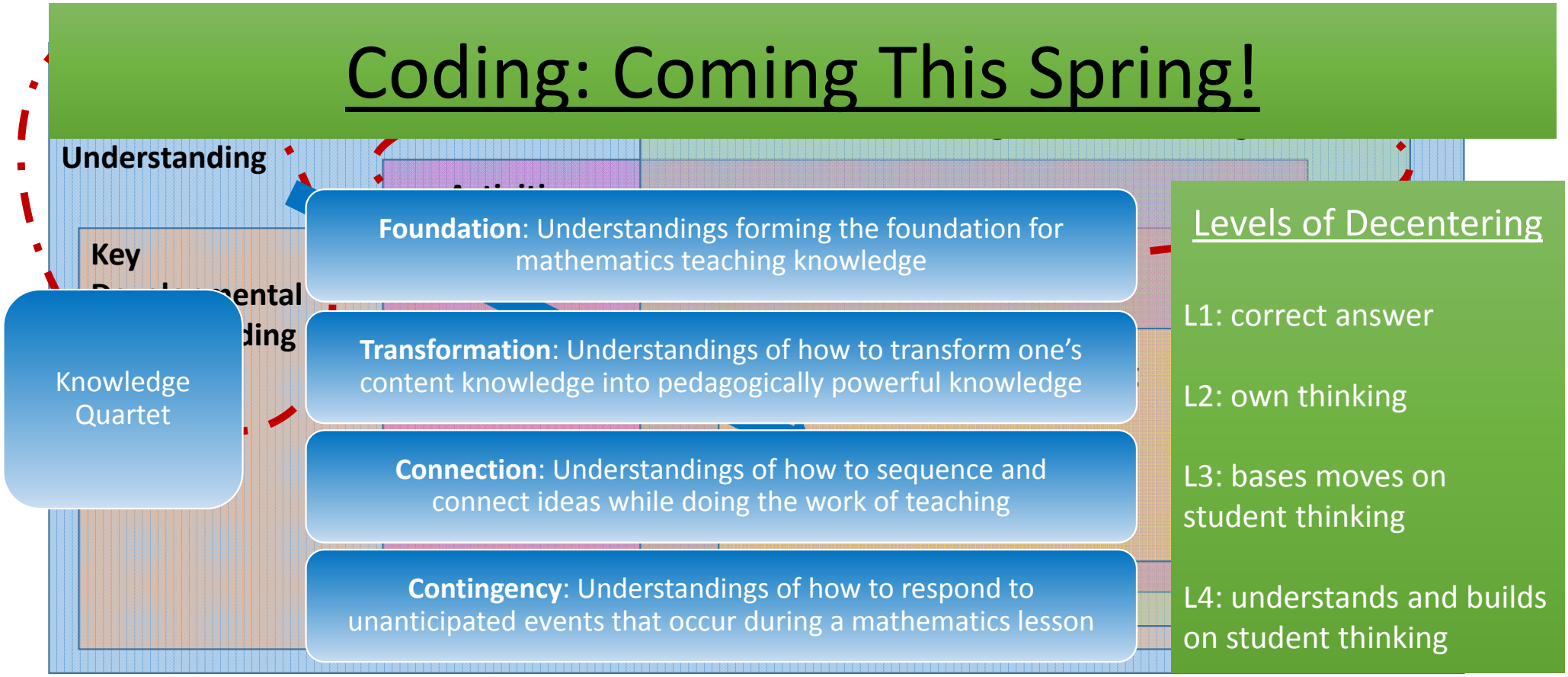
Geometry Module
N = 16

Number of times each category was observed in:	Assessment	
	Pre	Post
Activities	14	25
Connections	0	26
Decentering	0	2
General Discourse	17	13
Incorrect Statement	7	16
Key Developmental Understanding	6	97
Understanding Student Thinking	10	45

MIDDLE TENNESSEE STATE UNIVERSITY

Key Developmental Understanding | Understanding Student Thinking | Activities | Connections | Decentering

Coding: Coming This Spring!



Levels of Decentering

L1: correct answer

L2: own thinking

L3: bases moves on student thinking

L4: understands and builds on student thinking

(Rowland, Thwaites, & Jared, 2016)

(Ader & Carlson, 2018)

We get it from our mother: understanding mitochondrial inheritance.

Paola Molina

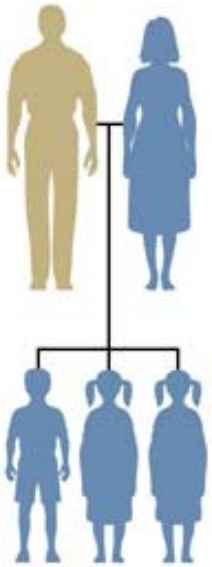
Boyd Lab

Molecular Biosciences PhD Program

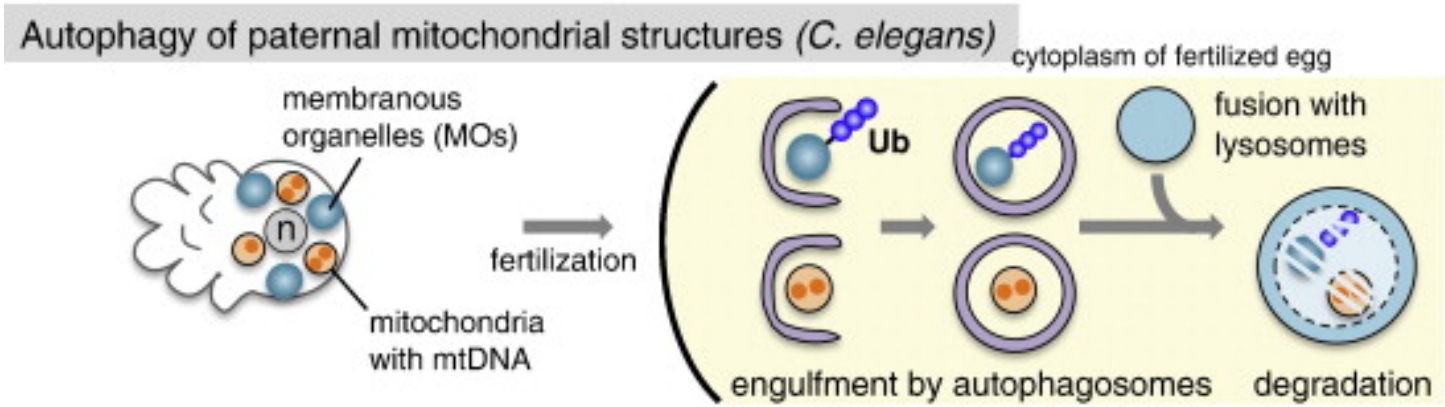
Cell Biology

https://www.puzzlewarehouse.com/Busy-City-8748.html

Mitochondrial Inheritance

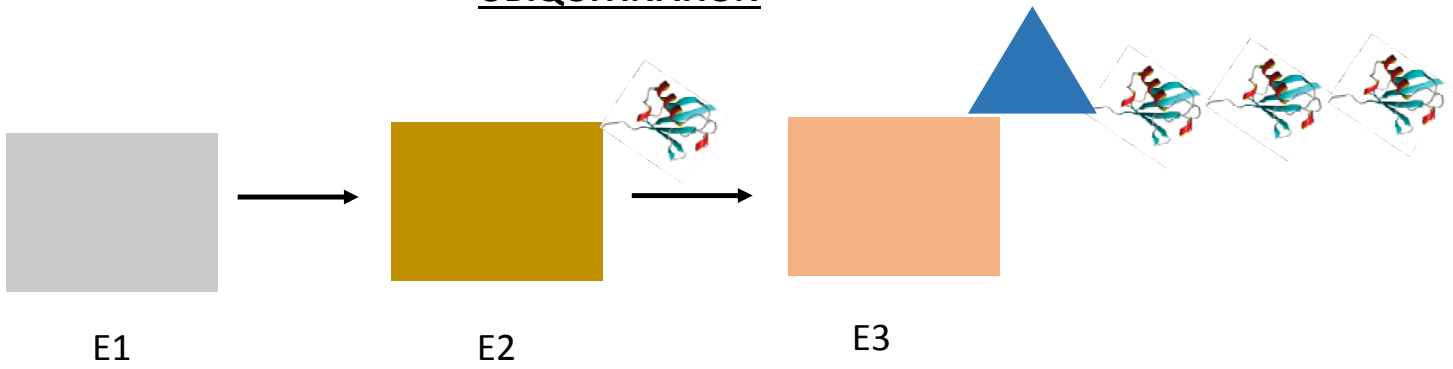


https://embryology.med.unsw.edu.au/embryology/index.php?curid=2960

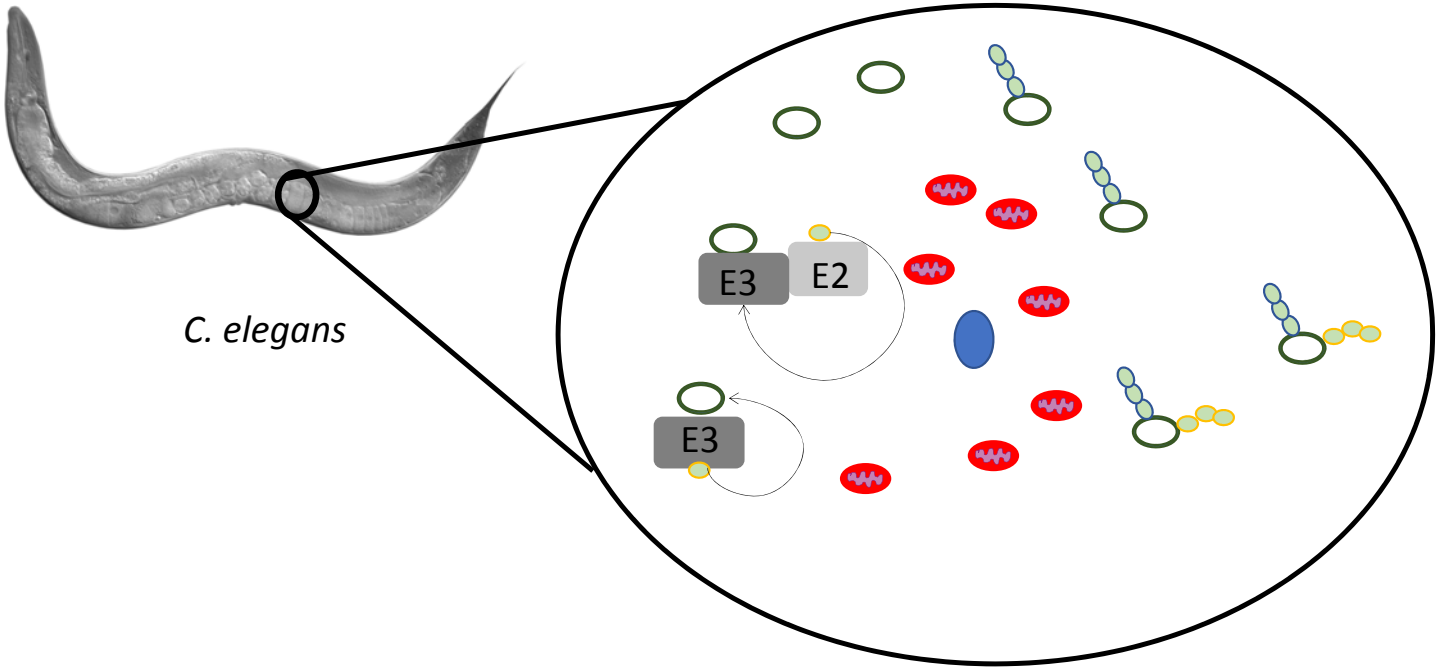


Sato and Sato, 2013

UBIQUITINATION



How does the embryo select for paternal mitochondria?



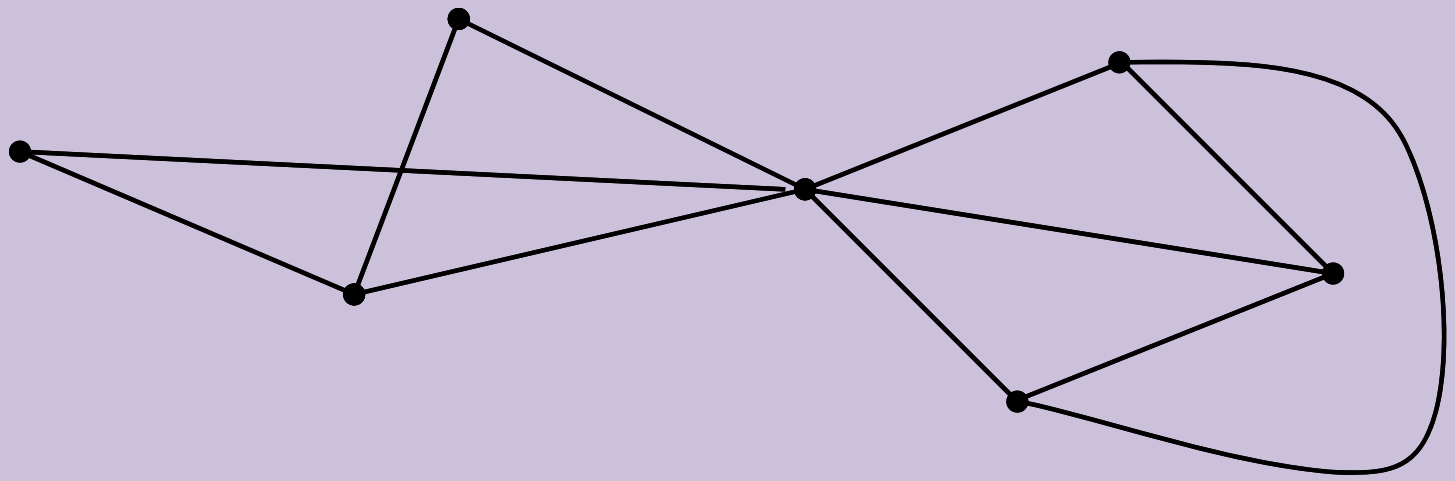
- E2 required for early removal of mitochondria
- Degradation machinery of the cell acts during two distinct events to remove paternal mitochondria
- Ubiquitin dependent and ubiquitin independent pathway

A Tale of Two Categories

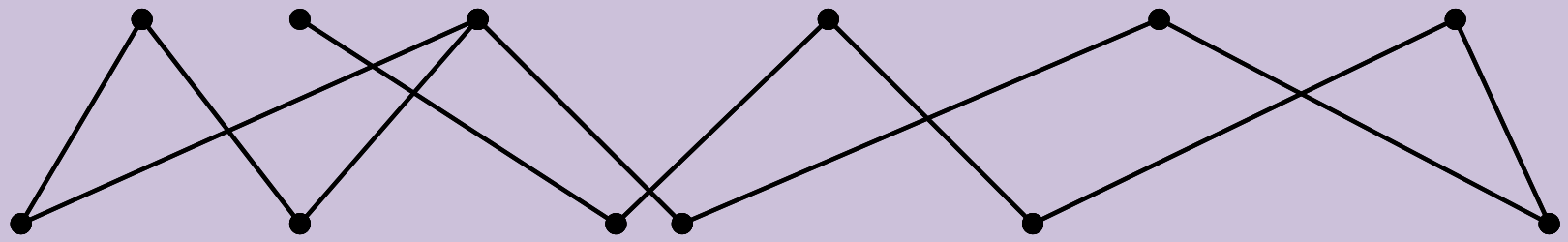
Tucker Dowell
Dr. James Hart

9 November 2018

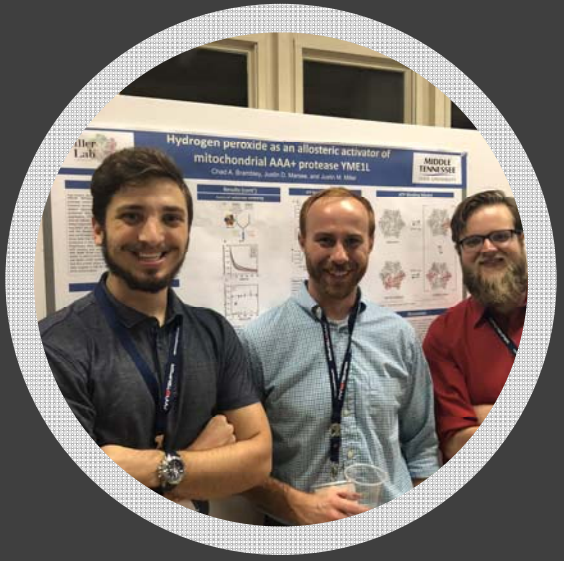
What is a Graph?



What is a Poset?



Why Do We Care?



Justin M.

Miller Lab

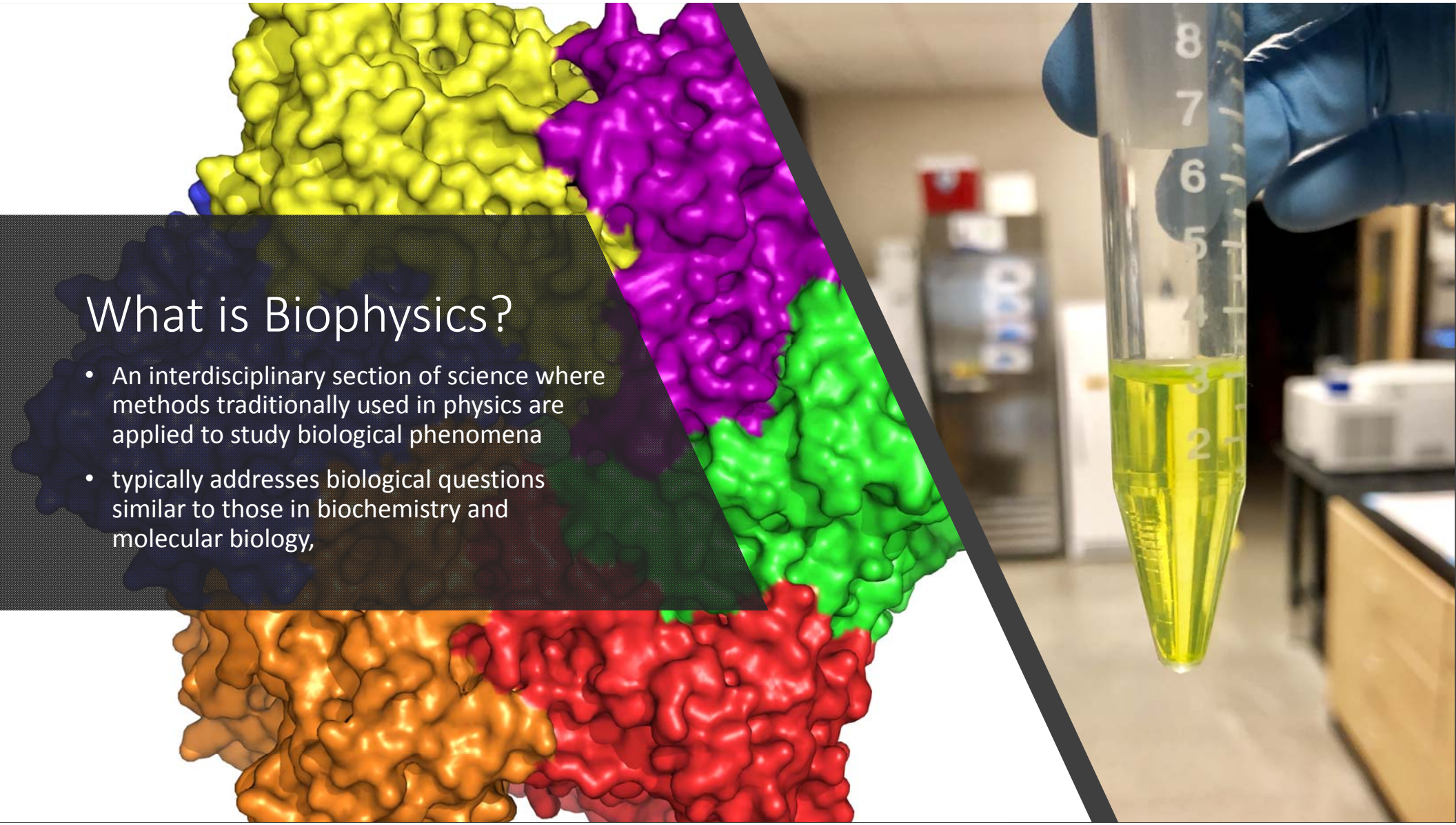
@ Middle Tennessee State University

Justin D. Marsee, B.S.

M.S. in Chemistry with Biophysics

What is Biophysics?

- An interdisciplinary section of science where methods traditionally used in physics are applied to study biological phenomena
- typically addresses biological questions similar to those in biochemistry and molecular biology,



Techniques & Data

- Being an interdisciplinary field of study, biophysical techniques come from a wide range of the sciences.
  - The Miller Lab practices biological, chemical, biochemical, biophysical, and organic techniques on a regular basis:

Rapid Mixing Spectroscopy

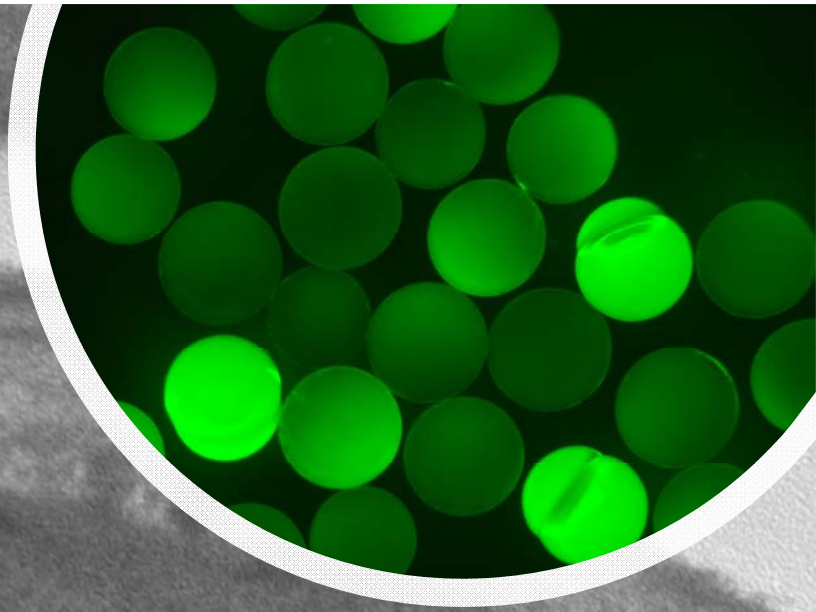
Solid Phase Synthesis

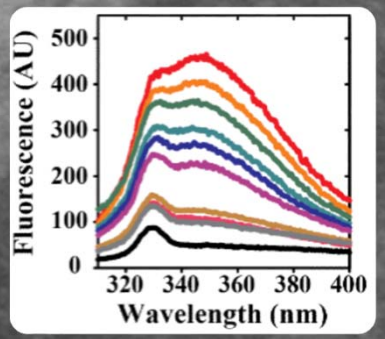
Molecular Dynamics

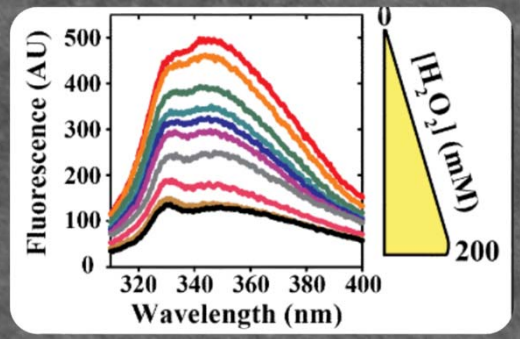
Gel Electrophoresis

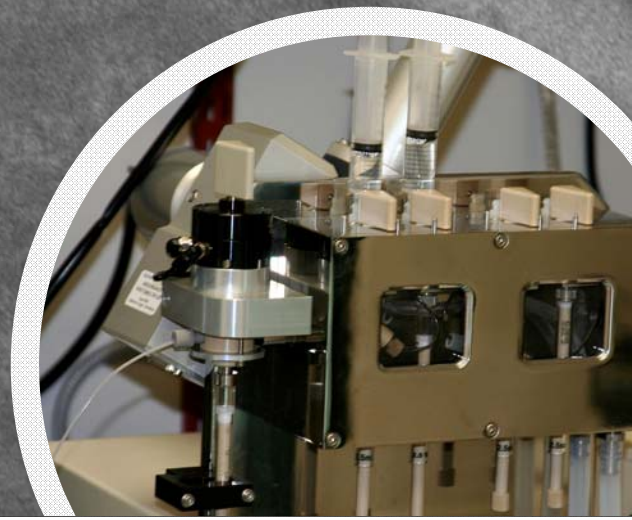
Chromatography

And that's just to name a few …

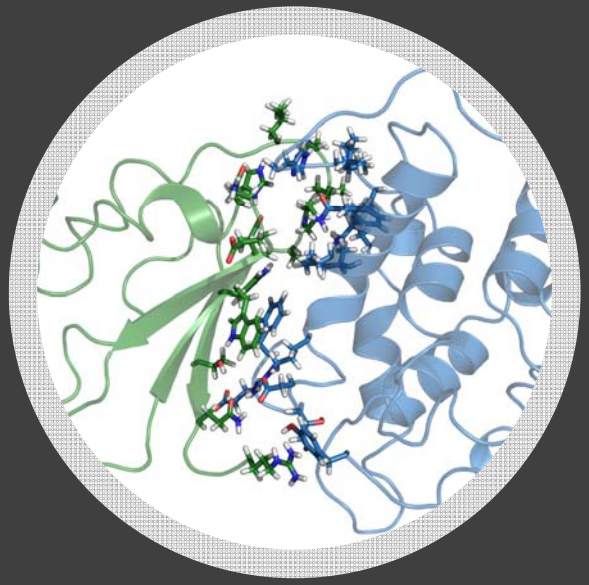


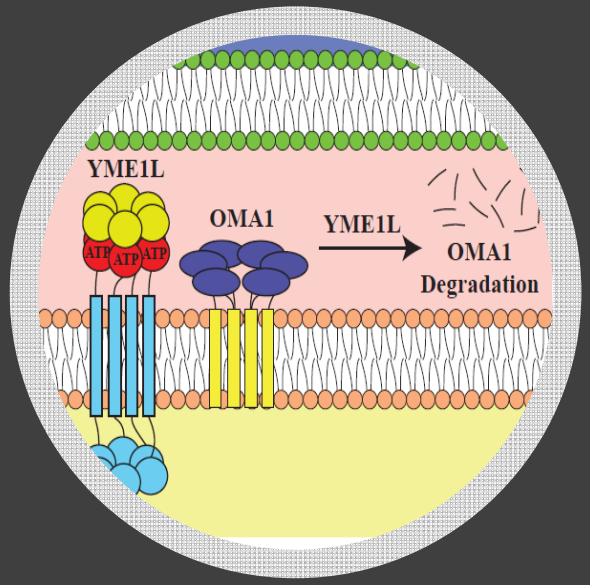






Projects





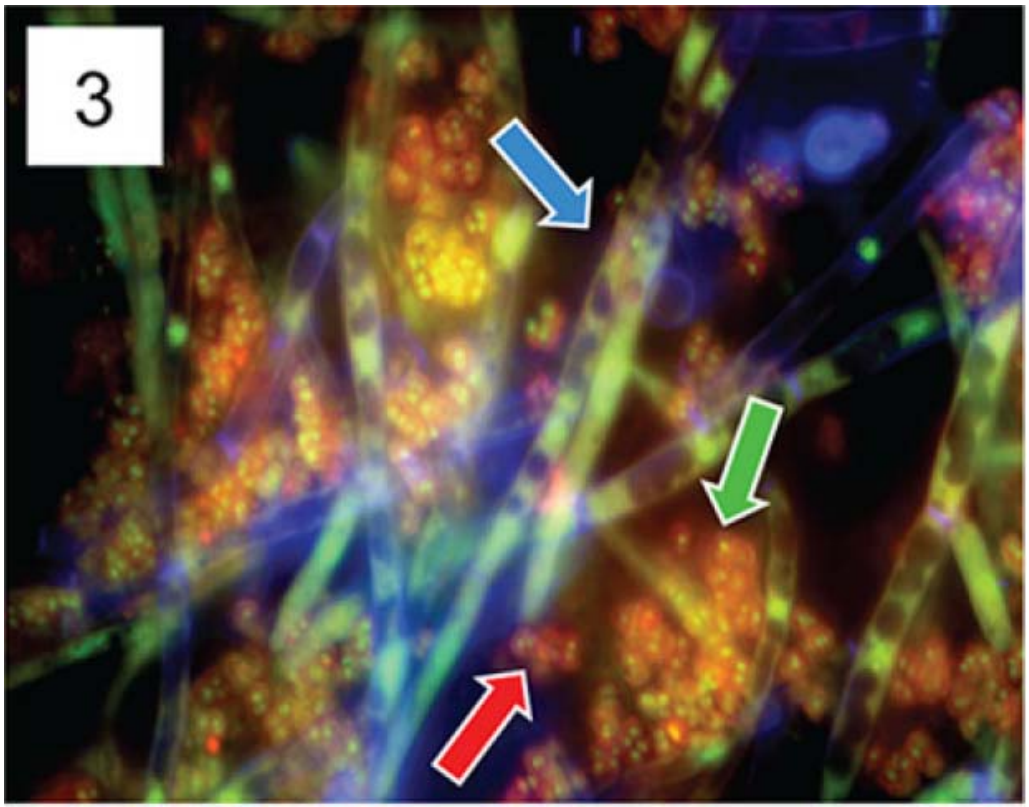
The Miller Lab at MTSU studies molecular complexes involved in regulating critical pathways in both humans and bacteria. Our ultimate goal is to characterize these underlying molecular foundations of clinical issues.

Identification and Development of Antimicrobial Peptoids Effective Against Cross-Kingdom Biofilms

R. Madison Green

Cross-Kingdom Biofilms

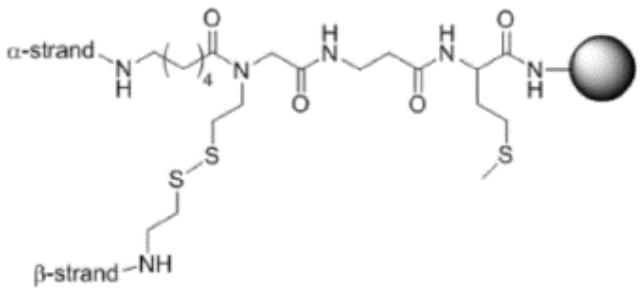
- *Candida albicans*
  - Number 1 nosocomial fungal infection
  - Can infect prostheses as well as mucosal membranes
- Biofilms
  - 3D matrix of polysaccharides
  - Protection from host defense
- Cross-Kingdom Biofilms
  - Synergistic and antagonistic
  - Quorum sensing molecules

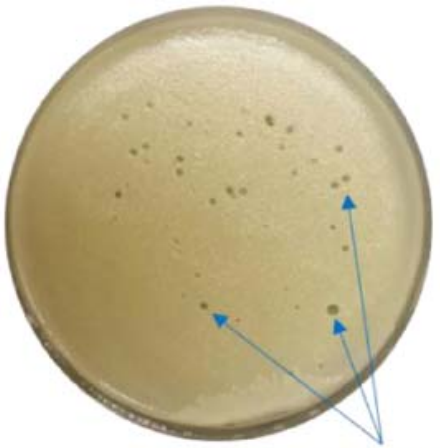


Harriott and Noverr. Antimicrob. Agents Chemother. **2009.**

Peptoids Library Agar Diffusion Assay

- Peptoids
  - Peptide mimics
  - Improved bioavailibity
- PLAD
  - High through-put screening
  - Same peptoid sequence on both strands
  - Analyze by ESI-MS



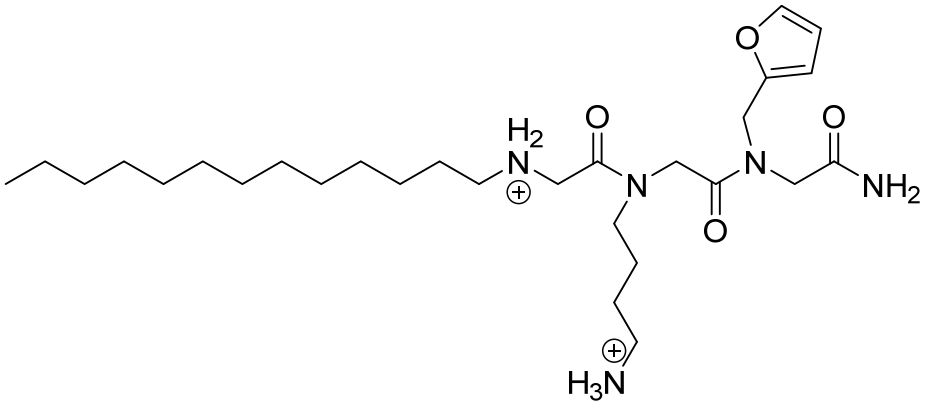


Corson et al. ACS Med. Chem. Lett. **2016**.

AEC5

organism	assay	potency/toxicity (μg/mL)
C. neoformans H99S (serotype A lab strain)	MIC (IC_{50})	6.3 (0.68)
C. neoformans 24067 (serotype D lab strain)	MIC (IC_{50})	6.3 (3.9)
C. neoformans serotype A clinical isolate B18	MIC (IC_{50})	25 (12.2)
C. neoformans serotype A clinical isolate B24	MIC (IC_{50})	12.5 (10.7)
C. neoformans serotype D clinical isolate AD 12−27	MIC (IC_{50})	25 (4.0)
C. neoformans serotype D clinical isolate AD 12−30	MIC (IC_{50})	25 (6.9)
NIH/3T3 mouse fibroblasts	IC_{50}	48.6
HepG2 human hepatocellular carcinoma	IC_{50}	56.2
HPL1A human peripheral lung epithelial cells	IC_{50}	36.3
Human erythrocytes	HC_{10}	68.7

[a]MIC = minimum inhibitory concentration; IC_{50} = inhibitory concentration 50%; HC_{10} = hemolysis concentration 10%



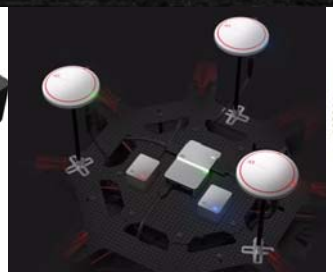
Corson et al. ACS Med. Chem. Lett. **2016**.

UAS Impact on Aviation and Aircraft Registration Analysis

Doug Campbell
Aerospace

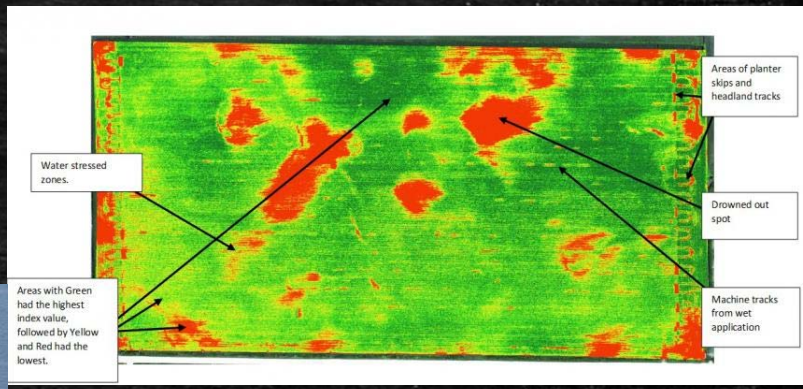
History of UAS

- Initial development of UAS for military applications
  - Began in 1918
  - From target drones to aerial surveillance
    - Advanced camera/sensor technology that trickled down to civil UAS today
- Hobbyist model aircraft history
  - Started in the 1930s
  - Aviation education outreach and flying competitions
  - Many of the components UAS use today were developed through flying model aircraft
- Developments to enable small UAS of today
  - Computer technology
  - GPS
  - Cameras



UAS Impact on Aviation

- UAS regulations in the US and abroad
  - US is catching up with other countries to permit flying UAS in more areas
    - August 2016 UAS regulations
  - International research and development for UAS use cases
- UAS interdisciplinary use cases
  - Agriculture
  - Construction
  - Search and Rescue
  - Disaster Response
  - Delivery



Unmanned Aircraft Registration Analysis

- UAS registration trends as population increases in large cities
  - As population increases, commercial UAS registrations increase
  - UAS use in and by rapidly growing urban areas
    - Growth of the area provides business opportunities
    - Municipal growth means more work for government departments
      - UAS can be a force multiplier
  - As cities grow, consideration must be made for safe (legal) spaces to fly UAS
    - Congested areas no longer mean UAS are kept out

Closing Remarks: Dr. Chuck Higgins