

Poster Presentations

Guidelines and Tips

Created by Kelly Amundsen

Updated by Benjamin Conklin, Leah Gold



What is a Poster Presentation?

- A visual version of an abstract
 - Not as much detail as a research paper
 - Contains a complete picture of your research
- A 3-5 minute (or less!) spiel
 - “Tell me about your research.”



What is an abstract

- Advertisement for your poster/talk
- Make it interesting
- Try to avoid data/equations
- Give details but not so much that they won't want to see your poster/hear your talk



Submitting an abstract

- Deadlines from 2 weeks to more than 6 months before conference
- Generally submit a short abstract along with the title
- COF-Math abstract must be no more than 900 characters (~125 words)
- COF-Math submission deadline:
March 15, 2017



Sample abstract

How Two-stage Expansion Affects Efficiency of Gas Turbine

Today the world demands more energy than ever before. Because of the economic and environmental costs of electricity production, it is important that the most efficient methods are used. This project seeks to compare the gains in thermal efficiency of a 350 MW gas turbine by adding two-stage expansion. Both designs will have the same compressor inlet conditions, the same maximum temperature, and will both use regeneration.



Sample abstract

Common Sorting Algorithms

Sorting algorithms are very important for computer programmers, and there have been many developed throughout the years. Each algorithm has the same objective: to sort a collection of data in ascending or descending order. We will explore some of the most common (and easy to implement) sorting algorithms, including Bubble Sort, Selection Sort, and Quick Sort, and prove their time complexities.



Effective Posters...

1. Develop a FOCUS
 - What is the ONE thing you want the audience to get from your poster?
2. Tell the story, but use text sparingly
3. Keep things logically ordered
4. Consider the audience



Typical Poster Headings

- Abstract (sometimes)
- Introduction and/or Motivation
 - What is the problem, and why do we care?
- Objectives
- Methods (not too much detail)
- Results
- Conclusions and Future Work
- References
- Acknowledgements



Details on Poster Headings

- Abstract (sometimes)
 - Generally written for your application to participate
 - May or may not get included on poster
 - 1 paragraph (100-200 words)
 - Summary of poster/research project
 - Be clear, concise
 - Communicate 1-3 most important ideas



Details on Poster Headings

- Introduction

- Background on your project
- How does it fit into larger picture?
- May be all the audience reads



Details on Poster Headings

- Methods

- Explain step you have taken
- What observations or experiments or simulations does your data come from?
- What hardware or software are you using?
- Varies from topic to topic
- Consider using bullet points
- Overview, not extensively detailed



Details on Poster Headings

○ Results

- Present raw data
- Use tables, graphs, or images when possible
- Include text that explains visuals



Details on Poster Headings

- Conclusions

- Summary of what you accomplished
- If work still in progress, talk about possible outcomes or future work
- Interpretation of data belongs here
- Need not be a long section



Alternate Poster Headings

- Introduction
 - State the problem, and motivate the work
- Report the main points of your research
- Conclusions or Interpretations
- Policy Recommendations or Proposed Solutions
- References
- Acknowledgements



The Poster Helps Tell the Story

- While giving the spiel:
 - Gesture to the poster **MEANINGFULLY**
 - Don't face away from the audience the whole time
 - Let the audience partly determine how much detail you reveal



Layout

- Our required dimensions: 42in height X 48in wide
- Title and authors at the top
 - Title
 - title top center, use large font (60-65 point?)
 - Should be readable from over 3 feet away
 - Authors
 - below title, somewhat smaller (48-52 point?)
 - order of list varies from field to field
 - for us, list alphabetically
 - include institutional affiliation, especially if varies among authors



Layout

- Columns are good! (three is good at 48in wide)
- Follow “reader gravity”
 - Option: Put in “cues” for order (number your sections), but proceed with caution
- Font and font size
 - Sans serif fonts (arial), are good
 - Everything more than 24 pt. usually larger
 - Bigger font size for title, main headings

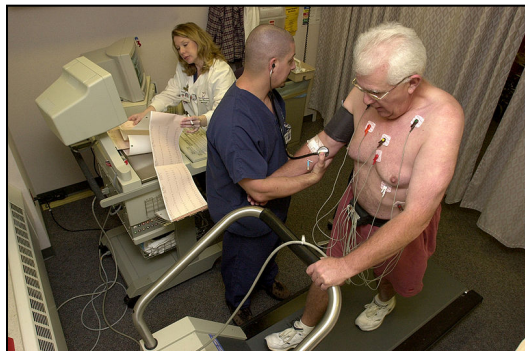
People Who Use Gym Lockers Have Optimum Heart Health

Kelly J. Amundsen, Cleveland State University



2 Methods

- 138 Lockers users were identified as “gym”, “non-gym”, or “no locker”, based on their locker usage:
- Gym locker users (48)
- Non-gym locker users (44)
- No locker users (46)
- Cardiovascular health was evaluated for all subjects via a routine stress test
- Cardiovascular health was rated as “good” or “poor” for each subject

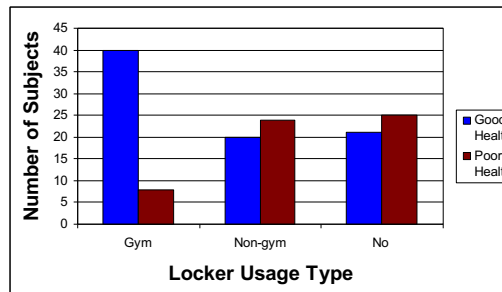


1 INTRODUCTION

- Studies have shown that some individuals have better cardiovascular health than others, despite sharing the same diet and certain genetic factors
- Usage of gym lockers may be a contributing factor to heart health
- We hypothesize that individuals who use gym lockers are more likely to have better cardiovascular health

3 Results

Gym Locker Users Have Better Heart Health



- 83% of gym locker users had good cardiovascular health, compared to:
- 45% of non-gym locker users and,
- 46% of those who do not use a locker

4 Conclusions

- Using a gym locker is highly correlated with good cardiovascular health
- Using a non-gym lockers confers no more protection against poor cardiovascular health than not using a locker

5 Future Work

- How do gym lockers lead to better cardiovascular health?
 - Do the same genetic factors which partially confer good heart health also somehow encourage gym locker usage?
 - Does gym locker usage influence other factors associated with heart health (such as cholesterol levels, or chronic inflammation)?
 - Do gyms somehow confer good heart health?

Special thanks to Balthasar Malcolm Cameron, III for his guidance on this work, and to the Happy Hearts Health Clinic for lending their expertise in developing “garage-ready” stress tests.

People Who Use Gym Lockers Have Optimum Heart Health

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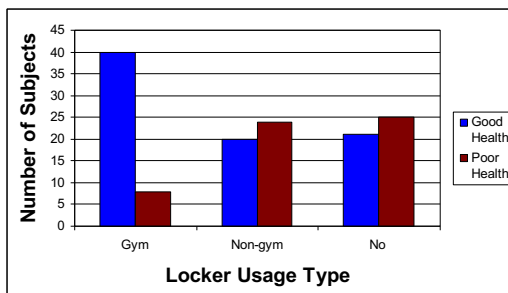
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People Who Use Gym Lockers Have Optimum Heart Health

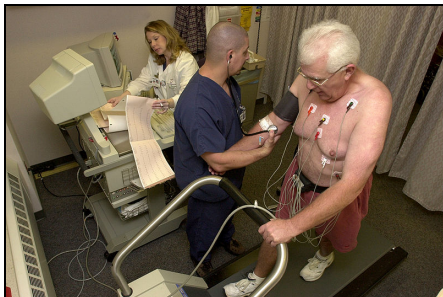
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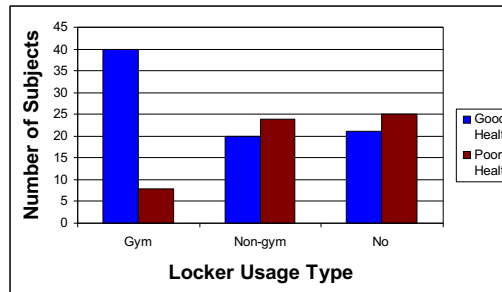
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Layout

- Make use of white space (don't overcrowd)
- Keep text blocks short (50-70 words max.)
 - Paragraph breaks and/or bullet points are helpful
- Dark text, light background (most contrast)

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Text Blocks

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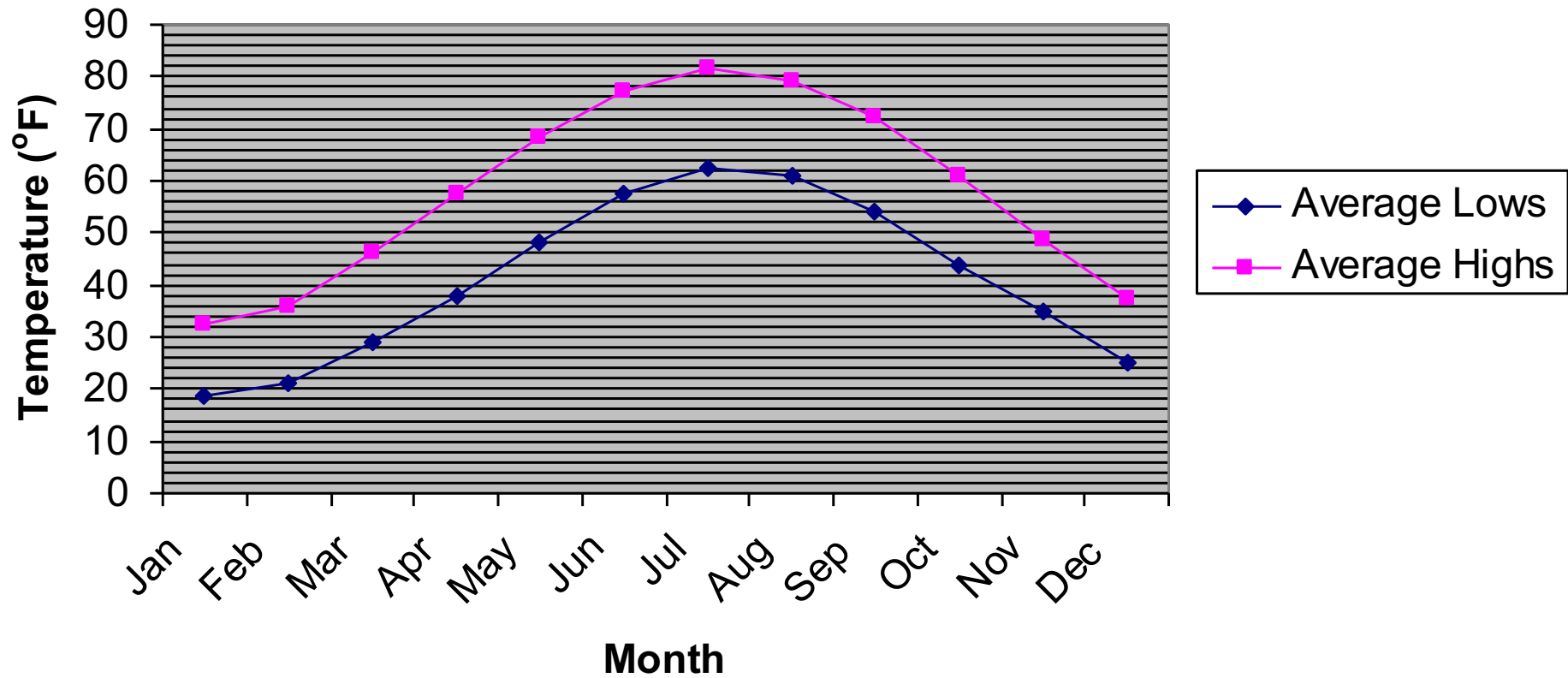
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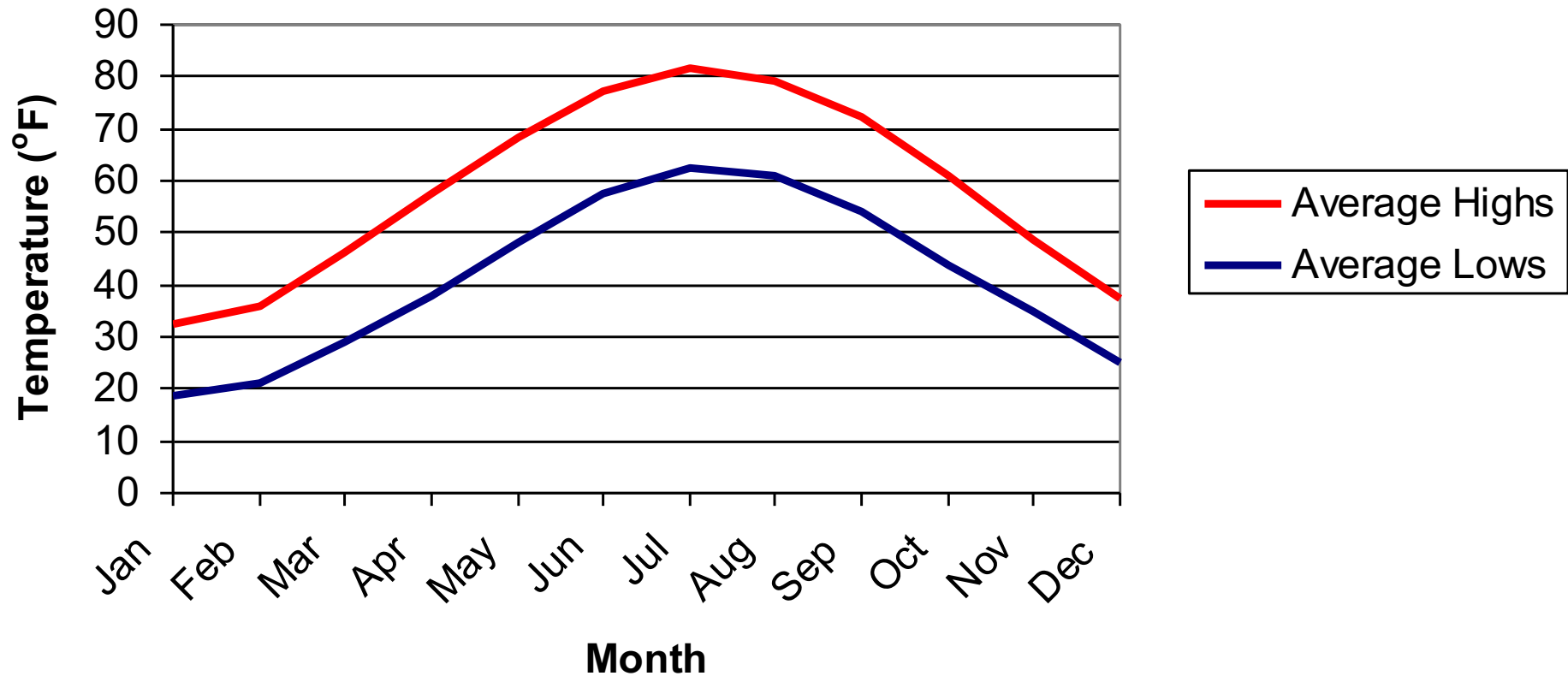
Graphs

- No unnecessary clutter
 - (plain background, no extra tics, etc.)
- Title should show relationships quickly
 - Title may actually state the conclusion about the relationship
- Simple, bold colors
- Simple legends
- Consider color-blindness

Average High and Low Temperatures in Cleveland, OH



Average Monthly Temperatures in Cleveland, OH Vary By Month



Affiliations

- <http://www.csuohio.edu/offices/marketing/logos/>



- In Blackboard: Poster Information > Logos

◦





Additional Thoughts

- Set the PAGE SIZE (42"x48")
before you do anything else!
- Avoid completely saturated backgrounds
 - Or use white blocks (with borders) on top of a colored background



SPACEEXES

PIGS IN SPACE: EFFECT OF ZERO GRAVITY AND AD LIBITUM FEEDING ON WEIGHT GAIN IN CAVIA PORCELLUS

Colin B. Purrington

6673 College Avenue, Swarthmore, PA 19081 USA

ABSTRACT:

One ignored benefit of space travel is a potential elimination of obesity, a chronic problem for a growing majority in many parts of the world. In theory, when an individual is in a condition of zero gravity, weight is eliminated. Indeed, in space one could conceivably follow ad libitum feeding and never even gain an gram, and the only side effect would be the need to upgrade one's stretchy pants("exercise pants"). But because many diet schemes start as very good theories only to be found to be rather harmful, we tested our predictions with a long-term experiment in a colony of Guinea pigs (*Cavia porcellus*) maintained on the International Space Station. Individuals were housed separately and given unlimited amounts of high-calorie food pellets. Fresh fruits and vegetables were not available in space so were not offered. Every 30 days, each Guinea pig was weighed. After 5 years, we found that individuals, on average, weighed nothing. In addition to weighing nothing, no weight appeared to be gained over the duration of the protocol. If space continues to be gravity-free, and we believe that assumption is sound, we believe that sending the overweight — and those at risk for overweight — to space would be a lasting cure.

INTRODUCTION:

The current obesity epidemic started in the early 1960s with the invention and proliferation of elastane and related stretchy fibers, which released wearers from the rigid constraints of clothes and permitted monthly weight gain without the need to buy new outfits. Indeed, exercise today for hundreds of million people involve only the act of wearing stretchy pants in public, presumably because the constrictive pressure forces fat molecules to adopt a more compact tertiary structure (Xavier 1965).

Luckily, at the same time that fabrics became stretchy, the race to the moon between the United States and Russia yielded a useful fact: gravity in outer space is minimal to nonexistent. When gravity is zero, objects cease to have weight. Indeed, early astronauts and cosmonauts had to secure themselves to their ships with seat belts and sticky boots. The potential application to weight loss was noted immediately, but at the time travel to space was prohibitively expensive and thus the issue was not seriously pursued. Now, however, multiple companies are developing cheap extra-orbital travel options for normal consumers, and potential travelers are also creating news ways to pay for products and services that they cannot actually afford. Together, these factors open the possibility that moving to space could cure overweight syndrome quickly and permanently for a large number of humans.

We studied this potential by following weight gain in Guinea pigs, known on Earth as fond of ad libitum feeding. Guinea pigs were long envisioned to be the "Guinea pigs" of space research, too, so they seemed like the obvious choice. Studies on humans are of course desirable, but we feel this current study will be critical in acquiring the attention of granting agencies.

MATERIALS AND METHODS:

One hundred male and one hundred female Guinea pigs (*Cavia porcellus*) were transported to the International Space Laboratory in 2010. Each pig was housed separately and deprived of exercise wheels and fresh fruits and vegetables for 48 months. Each month, pigs were individually weighed by duct-taping them to an electronic balance sensitive to 0.0001 grams. Back on Earth, an identical cohort was similarly maintained and weighed. Data was analyzed by statistics.

RESULTS:

Mean weight of pigs in space was 0.0000 +/- 0.0002 g. Some individuals weighed less than zero, some more, but these variations were due to reaction to the duct tape, we believe, which caused them to be alarmed push briefly against the force plate in the balance. Individuals on the Earth, the control cohort, gained about 240 g/month ($p = 0.0002$). Males and females gained a similar amount of weight on Earth (no main effect of sex), and size at any point during the study was related to starting size (which was used as a covariate in the ANCOVA). Both Earth and space pigs developed substantial dewlaps (double chins) and were lethargic at the conclusion of the study.

CONCLUSIONS:

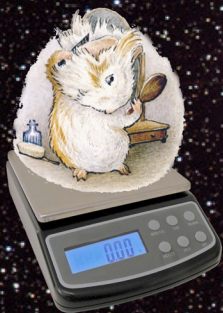
Our view that weight and weight gain would be zero in space was confirmed. Although we have not replicated this experiment on larger animals or primates, we are confident that our result would be mirrored in other model organisms. We are currently in the process of obtaining necessary human trial permissions, and should have our planned experiment initiated within 80 years, pending expedited review by local and Federal IRBs.

ACKNOWLEDGEMENTS:

I am grateful for generous support from the National Research Foundation, Black Hole Diet Plans, and the High Fructose Sugar Association. Transport flights were funded by SPACE-EXES, the consortium of wives divorced from insanely wealthy space-flight startups. I am also grateful for comments on early drafts by Mariana Athletic Club, Corpus Christi, USA. Finally, sincere thanks to the Cuy Foundation for generously donating animal care after the conclusion of the study.

LITERATURE CITED:

- NASA. 1982. Project STS-XX: Guinea Pigs. Leaked internal memo.
Sekulić, S.R., D. D. Lukač, and N. M. Naumović. 2005. The Fetus Cannot Exercise Like An Astronaut: Gravity Loading Is Necessary For The Physiological Development During Second Half Of Pregnancy. Medical Hypotheses. 64:221-228
Xavier, M. 1965. Elastane Purchases Accelerate Weight Gain In Case-control Study. Journal of Obesity. 2:23-40.



Epidemiology of Carbapenem-Resistant *Enterobacteriaceae* at an Academic Medical Center

Charles D. Leiner, MD[†], Lisa L. Steed, PhD[§], Cassandra D. Salgado, MD, MS[‡], Lauren E. Richey, MD, MPH[‡]

[†] Department of Internal Medicine, Virginia Commonwealth University Health System, Richmond, VA

[‡] Division of Infectious Disease, Medical University of South Carolina, Charleston, SC

[§] Department of Pathology and Laboratory Medicine, Medical University of South Carolina, Charleston, SC

Abstract

Background: CRE infections have few treatment options and are associated with poor outcomes. Limited data regarding these infections are available from the Southeastern US. This study describes CRE epidemiology at our hospital.

Methods: A retrospective cohort study was conducted of all patients with a positive clinical culture for CRE from 1/2006 - 12/2013. Data was obtained from chart review. Cultures were categorized as representing infection or colonization (treated vs. not treated by the clinician).

Results: 46 patients had a positive culture for CRE and the rate per 1000 patient days significantly increased over the study (0.0063 in 2006 vs. 0.036 in 2013, $p < 0.001$). Median age was 59, 50% were male, 52% were Caucasian. Median Charlson Comorbidity Index was 5, median number of comorbidities was 3 (hypertension 63%, diabetes 46%, malignancy 20%) and 18 (42%) were receiving immunosuppression. 21 (54%) had antibiotic use within the past 6 months, most commonly a carbapenem (43%), followed by piperacillin/tazobactam (33%) and a cephalosporin (29%). Most (85%) had a history of another multi-drug resistant organism (MDRO), usually VRE or MRSA. 30 (75%) patients had CRE infection. Among these, the urinary tract accounted for 14 (47%), bloodstream for 6 (20%), respiratory tract for 6 (20%), and deep tissue for 4 (13%). Among patients with colonization, urine was the source in 7 (70%) and respiratory in 2 (20%). Overall, *Klebsiella* (54%) was the most common species followed by *Enterobacter* (26%), *Escherichia coli* (11%), *Serratia* (7%), and *Citrobacter* (2%). Median hospital stay was 41 days and median time to positive CRE culture was 16 days. 52% stayed in the ICU a median of 24 days. Overall hospital mortality was 17% (10% in colonized vs. 25% in infected patients) but 95% of infected patients experienced morbidity. Among infected patients who died (7), 3 had urine, 3 had respiratory and 1 had blood as the source of infection. All were treated with appropriate antibiotics.

Conclusion: CRE rates increased at our Southeastern academic hospital. Advanced comorbidity index, history of previous MDRO, lengthy hospital stay and receipt of immunosuppression or broad spectrum antibiotics were common characteristics among patients with CRE. Patients with CRE infection suffered higher morbidity and mortality.

Background

Over the last decade, the United States has seen an increase in carbapenem resistant pathogens, most often *Enterobacteriaceae* (CRE)^{1,2}. Indeed, the CDC reported 12.8% of *Klebsiella pneumoniae* BSI in 2010 were carbapenem resistant¹. Particularly alarming is that CRE infections have limited treatment options³ and have at least a 48% mortality². Furthermore, resistant organisms are associated with an additional \$21B-\$34B per year in medical costs³. It has been suggested that earlier diagnosis could lead to better patient outcomes and decreased costs to the health care system⁴.

While CREs have been confirmed by the CDC in nearly every state⁵, limited data have been reported regarding CRE epidemiology in the southeast². Thus, with this study our aims are twofold: 1) to identify common characteristics of CRE infected individuals in an effort to rapidly identify at risk patients in the future; and 2) to increase awareness of CRE infections at a southeastern medical center.

Methods

A retrospective cohort study was conducted of all patients with a positive CRE culture at our hospital microbiology laboratory from 1/2006-12/2013. Data was obtained from chart review. Carbapenem resistance was defined as an isolate resistant to meropenem or imipenem based on MIC values. A total of 46 isolates were identified. Demographic data, hospital stay information, culture data, and patient outcome data were collected. Charlson Comorbidity Index was calculated on each patient⁶. Cultures were categorized as either infection or colonization (treated vs. nontreated).

Results

Table 1:

Subject variable	Cohort
Age, median (range)	59 (14-87)
Gender, % Male	50
Race, % Caucasian	52
No. comorbidities, median (range)	3 (0-10)
Charlson Comorbidity Index, median (range)	5 (0-11)
Positive history of antibiotic use, total # (%)	20 (44)
- Carbapenem, total # (%) of 20	9 (45)
Positive history of MDRO, %	85
Positive history of immunosuppressant, %	42
Hospital Stay, median days (range)	41 (1-179)
ICU stay, median days (range)	24 (2-69)

Figure 1: Patient Comorbidities

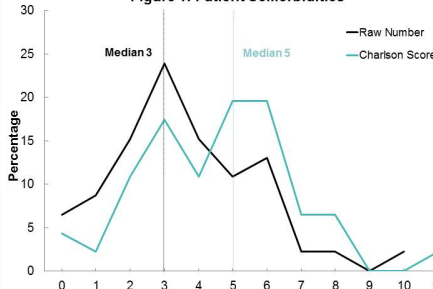


Figure 2: CRE Species

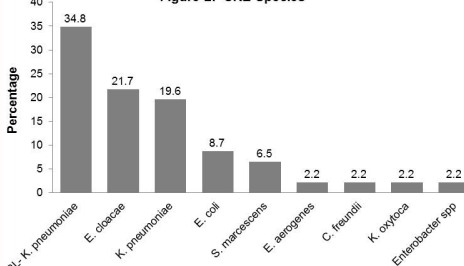


Figure 3: Type of Infection

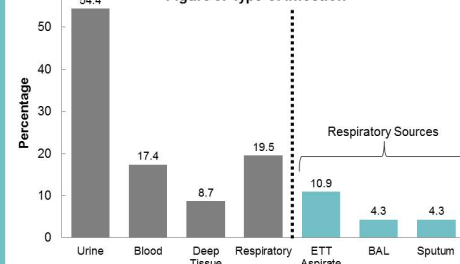


Table 2:

Medical significance	Cohort
CRE Discussed in medical chart, # (%)	40 (85.1)
- Clinical infection, # (%) of 40	30 (75)
Hospital Day of Infection, median (range)	16 (1-133)
Days to CRE clearance, median (range)	6 (1-24)
Morbidity in hospitalization, # (%)	38 (95)
- Morbidity due to CRE, # (%) of 38	11 (28.9)
Death in hospital, # (%)	7 (17)
- Death due to CRE, # (%) of 7	1 (14.3)

Conclusions

These data suggest an advanced Charlson comorbidity index, a previous infection with a multidrug resistant organism, and lengthy hospital stay are common features in CRE infected patients. These findings are similar to those previously reported¹. CREs are associated with prolonged hospital stay. There was also an increase in CRE infections in our southeastern medical center, consistent with the increase seen across the U.S.

Limitations of this work include those intrinsic to a retrospective study, namely the reliance on documentation for data collection.

References

- Perez F, van Duin D. (2013). Carbapenem-resistant Enterobacteriaceae: A menace to our most vulnerable patients. *Cleveland Clinic Journal of Medicine*. 80(4):225-233.
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- van Duin D, Kaye KS, Neuner EA, Bonomo RA. (2013). Carbapenem-resistant Enterobacteriaceae: a review of treatment and outcomes. *Diagnostic Microbiology and Infectious Disease*. 75: 115-120.
- Bhattacharya S. (2013). Early diagnosis of resistant pathogens: How can it improve antimicrobial treatment? *Virulence*. 4(2): 172-184.
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- Charlson ME, Pompei P, Ales KL, MacKenzie CR. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*. 40(5): 373-83.

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Video analysis of the schooling behavior of Japanese surfsmelt (*Hypomesus japonicus*) under light and dark conditions using a mathematical model

Katsuya SUZUKI¹, Tsutomu TAKAGI², Shinsuke TORISAWA², and Kazushi MIYASHITA³

¹ Graduate School of Fisheries Sciences, Hokkaido University, Hakodate, Hokkaido 041-8611, Japan, e-mail: katsuya@fish.hokudai.ac.jp

² Faculty of Agriculture, Kinki University; ³ Field Science Center for the Northern Biosphere, Hokkaido University

INTRODUCTION

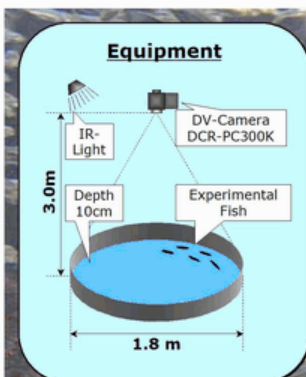
Environmental factors such as light affect the schooling behavior of fishes, and a better understanding of how these factors affect schooling will lead to improved fishing and sampling gear. In this study, we examine the effect of light on the schooling behavior of Japanese surfsmelt *Hypomesus japonicus* using a fish behavior model.



MATERIALS AND METHODS

- Samples were collected from Hakodate Bay (Japan) during January-February 2004.
- To determine the role of the lateral line in schooling behavior, streptomycin sulphate was used to deactivate the lateral line system in an experimental group.
- The swimming behavior was examined in a tank under eight experimental conditions:

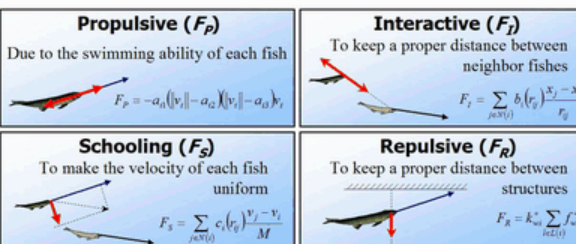
Light Intensity (lx)	80 (Light)	<0.01 (Dark)
Lateral Line System	Normal	Disabled
Number of Individuals	5	10



The schooling behavior under each condition was analyzed quantitatively using the mathematical model of Sannomiya et al. (1996).

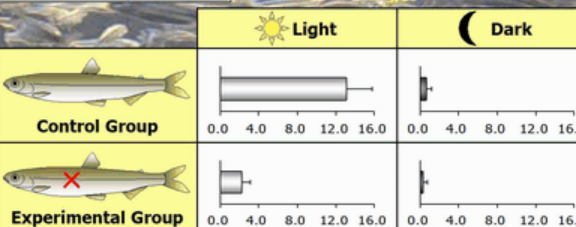
$$\begin{cases} \dot{\mathbf{x}}_i = \mathbf{v}_i \\ m\dot{\mathbf{v}}_i = F_i(t, \mathbf{x}_1, \mathbf{v}_1, \mathbf{x}_2, \mathbf{v}_2, \dots, \mathbf{x}_{N_i}, \mathbf{v}_{N_i}) \end{cases} \quad (1) \quad F_i = F_P + F_I + F_S + F_R \quad (2) \quad i = 1, 2, \dots, N_i$$

The forces examined included:



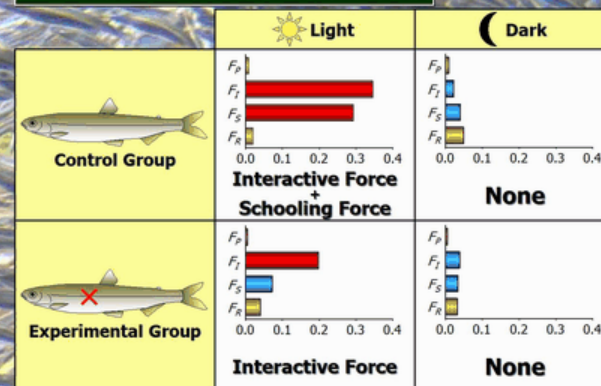
RESULTS AND DISCUSSION

Schooling Force



- In the light, the schooling force was large in the control group and small in the experimental group.
- In the dark, the schooling forces of both groups were nearly zero.

Relative Value of Each Force



These results suggest that Japanese surfsmelt depend on vision when they form aggregations (a non-parallel orientation to other fish), and on both vision and the lateral line when they form schools (a parallel orientation to other fish).

CONCLUSIONS

1. Quantitative characteristics of schooling behavior under different light conditions can be estimated using a mathematical model
2. Japanese surfsmelt appear to depend on vision when they form aggregations, and on both vision and lateral line when they form schools.



Discovering protein functional sites with unsupervised techniques

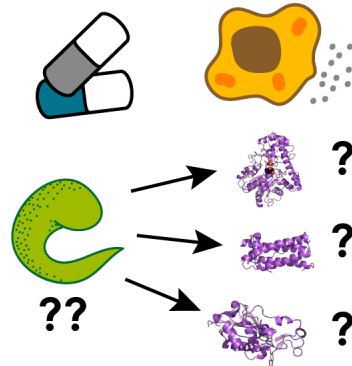
Shirley Wu¹, Russ B. Altman²

1 Program in Biomedical Informatics, 2 Department of Bioengineering

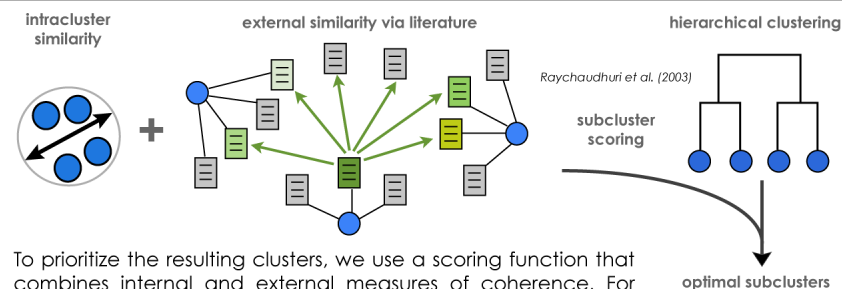
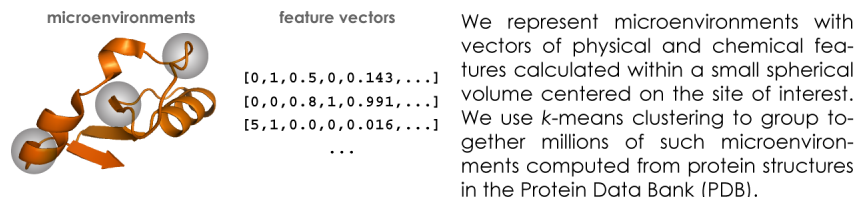
Motivation

Characterizing protein function - for example, what molecules they bind and interact with - is important for understanding biological processes. We can use this knowledge to engineer therapeutics and other beneficial biology.

Computational methods are fast and inexpensive, allowing high-throughput prediction of protein function. Most methods are supervised approaches, i.e. they use available data about known proteins and functions to make predictions. Thanks to genomics, researchers are now discovering novel proteins at a tremendous rate. We therefore need methods to identify new functions in proteins as opposed to methods that only recognize known functions.



Methods

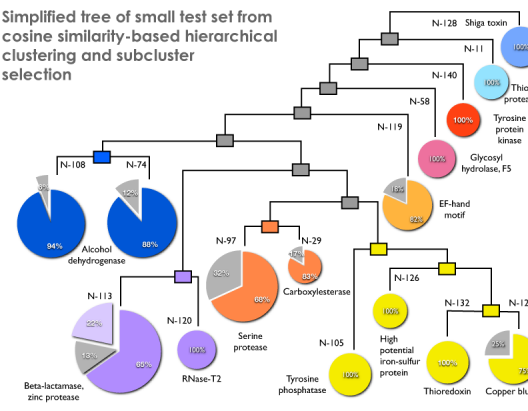


To prioritize the resulting clusters, we use a scoring function that combines internal and external measures of coherence. For larger or less coherent clusters, we first group the microenvironments hierarchically based on similarity and then use the scoring function to determine optimal subclusters.

Evaluation

Results from the subcluster selection approach on the small test set seem reasonable. We then evaluated different distance metrics on a larger test set. Cosine similarity produced subclusters with better purity (external coherence) and silhouette values (internal coherence).

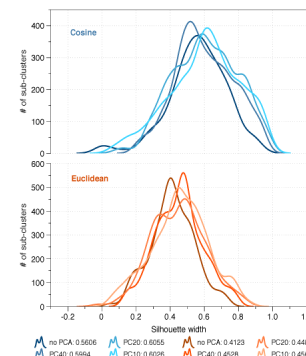
Simplified tree of small test set from cosine similarity-based hierarchical clustering and subcluster selection



Small test set
~150 vectors
15 functions

Large test set
~1400 vectors
168 functions

Distribution of silhouette values for large test set



Application

We are currently applying the subcluster selection approach to the whole-PDB k-means clustering. We then use a number of term enrichment methods to gain insight into the possible biological role of the microenvironment represented by each candidate subcluster.

Cluster 257:
30 proteins

MeSH terms

Insulin
Hydrogen Bonding
Ribosomal Proteins
Peptides
Pancreas
Amino Acids
Chymotrypsin
Electrophoresis
Protein Folding

Raw text terms

structur monomer
sequenc c-peptid
monomer insulin
conform insulin
hexam crystal
2zn insulin
protein-protein
coordin zn
zn atom

Boyle et al. (2004)

Gene Ontology terms

hormone activity
glucose metabolic process
receptor binding
hexose metabolic process
insulin receptor binding
monosaccharide metabolic process
negative regulation of catabolic process
positive regulation of cytokine secretion
insulin-like growth factor binding

Conclusion

We use unsupervised, automated techniques to identify biologically interesting groups of protein microenvironments, creating a potential pipeline for discovering novel functions.

References

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Boyle EI, Weng S, Gollub J, Jin H, Botstein D, Cherry JM, Sherlock G. (2004) Bioinformatics 20(18):3710-5.

People Who Use Gym Lockers Have Optimum Heart Health

Kelly J. Amundsen, Cleveland State University

INTRODUCTION

- Studies have shown that some individuals have better cardiovascular health than others, despite sharing the same diet and certain genetic factors
- Usage of gym lockers may be a contributing factor to heart health
- We hypothesize that individuals who use gym lockers are more likely to have better cardiovascular health

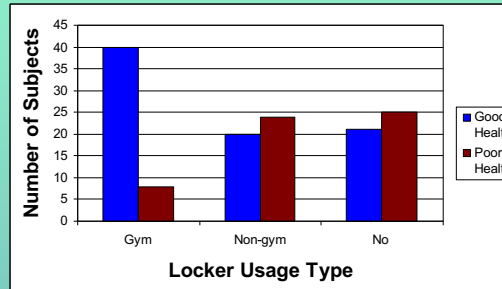
METHODS

- 138 Lockers users were identified as “gym”, “non-gym”, or “no locker”, based on their locker usage:
 - Gym locker users (48)
 - Non-gym locker users (44)
 - No locker users (46)
- Cardiovascular health was evaluated for all subjects via a routine stress test
 - Cardiovascular health was rated as “good” or “poor” for each subject



RESULTS

Gym Locker Users Have Better Heart Health



- 83% of gym locker users had good cardiovascular health, compared to:
 - 45% of non-gym locker users and,
 - 46% of those who do not use a locker

CONCLUSIONS

- Using a gym locker is highly correlated with good cardiovascular health
- Using a non-gym lockers confers no more protection against poor cardiovascular health than not using a locker

FUTURE WORK

- How do gym lockers lead to better cardiovascular health?
 - Do the same genetic factors which partially confer good heart health also somehow encourage gym locker usage?
 - Does gym locker usage influence other factors associated with heart health (such as cholesterol levels, or chronic inflammation)?
 - Do gyms somehow confer good heart health?



Special thanks to Balhasar Malcolm Cameron, III for his guidance on this work, and to the Happy Hearts Health Clinic for lending their expertise in developing “garage-ready” stress tests.

People Who Use Gym Lockers Have Optimum Heart Health

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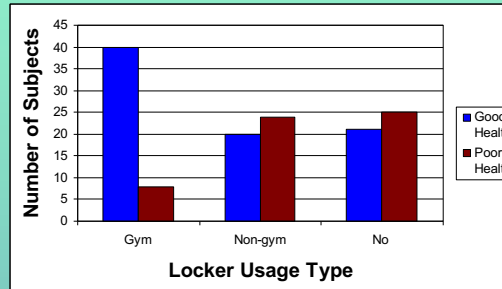
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Some award winning posters

- Here are several award winning posters from last year
- More posters can be seen at <http://www.csuohio.edu/choose-ohio/success-in-mathematics-poster-archive>

How Does Two-Stage Expansion Affect Efficiency of a Gas Turbine?

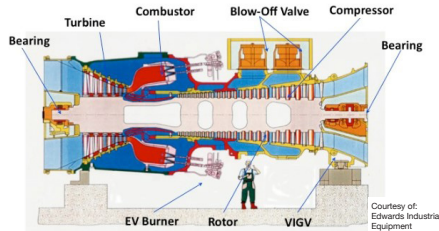


Lucas Kuhns¹ and Dr. Mounir Ibrahim²
¹ Mechanical Engineering, Cleveland State University, Cleveland Ohio
² Chairman Mechanical Engineering Department, Cleveland State University



Introduction: Today the world demands more energy than ever before. Because of the economic and environmental costs of electricity production, it is important that the most efficient methods are used. This project seeks to compare the gains in thermal efficiency of a 350 MW gas turbine by adding two-stage expansion. Both designs will have the same compressor inlet conditions, the same maximum temperature, and will both use regeneration.

Gas Turbine GT-13E2



Background Information:

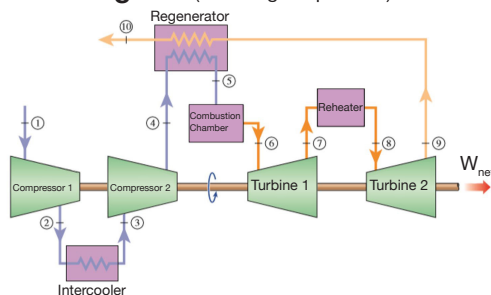
The Brayton cycle is a thermodynamic cycle used in gas turbines such as those in aircraft or a natural gas power plant. Air is compressed then passes through a combustion chamber where it is heated. These hot, gases at very high pressure and temperature, then pass through a turbine which produces shaft work. In a power plant, this shaft work is used to power a generator and produce electricity.

As with all thermodynamic cycles, the process can be plotted on a temperature-entropy diagram. The enclosed area of the plot represents the net power output of the cycle per kilogram of air passing through the turbine. The numbers on the flow diagram correspond to the state on temperature entropy diagram.

Governing Equations:

Compressor Power = (Mass Flow Rate) X (Enthalpy Difference)
 Turbine Power = (Mass Flow Rate) X (Enthalpy Difference)
 Net Power Output = Turbine Power – Compressor Power
 Cycle Efficiency = Net Power Output / Heat Input

Flow Diagram (two-stage expansion)

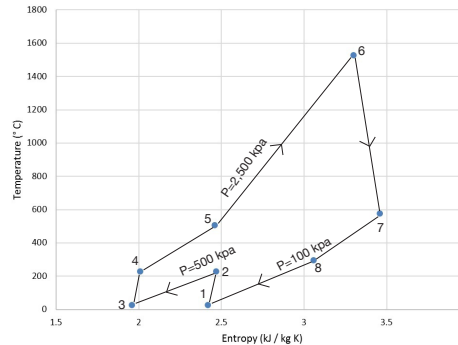


Conditions:

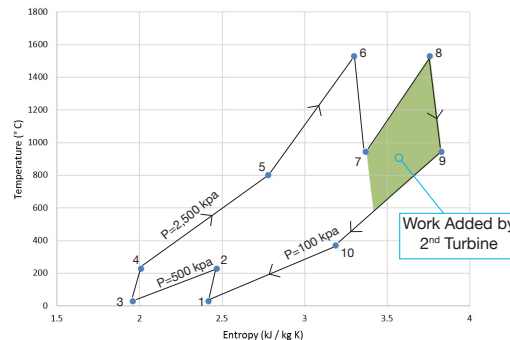
Brayton Cycle
 Working Fluid: Air
 Intended Net Power = 350 MW
 Compressor Inlet = 100 kPa and 23°C
 Turbine Inlet = 1527 °C
 Overall Pressure Ratio = 25
 Compressor Efficiency = 88%
 Turbine Efficiency = 88%
 Regenerator Effectiveness = 80%
 Using CyclePad software

Comparison of Temperature-Entropy Diagrams:

Temperature vs. Entropy for Single-Stage Turbine



Temperature vs. Entropy for Two-Stage Turbine



Analysis:

	One Turbine	Two Turbines	Change
Thermal efficiency	54%	59%	+5%
Carnot efficiency	83%	83%	+0%
Net Power (kW)	350,000	350,000	0
Heat Input (kW)	646,000	596,000	-50,000
Mass Flow Rate (kg/s)	629	453	-176
Specific Heat Input (kJ/kg)	1,026	1,316	+290
Specific Net Work (kJ/kg)	556	772	+216

Observations:

- Adding the second turbine increases thermal efficiency by 5%.
- Although the heat input per kilogram is higher with two turbines (+28%), the net work increases by a greater percentage (+39%) which increases the overall efficiency.

Conclusion:

When using regeneration, the overall efficiency of the Brayton Cycle can be improved by also adding a second turbine. In this analysis, the heat addition required to get 350 MW of power is reduced by 7% when using a second turbine. This reduction in heat requirement will also mean a reduction in carbon emissions.



Blue Carbon as Buffer to Global Climate Change: Value to Increase with Installation of Polluter Pays Policy

Literature Review by: Nadia Swit, Rachael Bucey Leopold & Jordyn Stoll Advised by: Dr. Julie Wolin

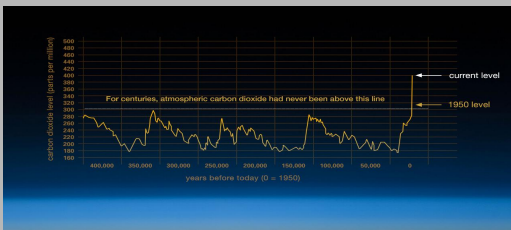


What is Blue Carbon?

Blue carbon is the carbon sequestered by coastal ecosystems, including seagrass meadows, salt marshes and mangrove forests. Coastal blue carbon ecosystems provide numerous ecosystem services, including stabilizing coastal sediment, nursery habitats for fish, refuge areas for migratory birds, and carbon sequestration. Known for their role in mitigating global climate change, coastal areas capture more atmosphere CO₂ than any other ecosystem. Due to this, these ecosystems value is of increasing interest to be used as a tool to combat global climate change and may be critical in future legislative action. Polluter pays principles would be drastically impacted by the amount of blue carbon sequestered and may lead to the conservation and implementation of more coastal wetland ecosystems.

What is Climate Change?

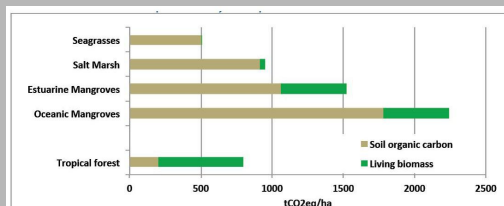
Climate change is described as the change in patterns of regional precipitation, wind, humidity, and seasons. It has become a significant environmental issue since the 20th century because of the escalation of CO₂ emissions. Climate change affects all classes of people, plants, and animals. Health risks, availability of water, and growth and production of food are essential aspects of life that climate change brings damage to. The change in climate contributes to an increase in atmospheric CO₂, and is generally associated with the increase in air temperature and the rise of sea levels.



VOSTOK ICE CORE DATA/J.R. PETIT ET AL.; NOAA MAUNA LOA CO2 RECORD

Carbon Sequestration/Storage

- Coastal blue carbon is captured and stored the most effectively out of all carbon sinks
- Carbon sequestration is the process of capturing carbon from the atmosphere and transforming it into a state that can be stored; measured in carbon uptake per year (NOAA)
- Carbon storage is the long term confinement of carbon within organic material and is measured in total weight (NOAA)



*Data is per unit area, where tCO₂eq/ha is tons of carbon dioxide equivalents per hectare

Source: Murray, Brian, Linwood Pendleton, W. Aaron Jenkins, and Samantha Siffert. 2011. Green Payments for Blue Carbon: Economic Incentives for Protecting Threatened Coastal Habitats. Nicholas Institute Report. NR 11-04

Polluter Pays Principle

- The Polluter-Pays Principle (PPP) allocates costs for pollution prevention and control measures to encourage rational use of scarce natural resources and to avoid distortions in international trade and investment
- Cap and trade is an economic approach to controlling greenhouse gas emissions. A "cap" sets a limit on emissions whereas "trade" creates a market for carbon allowances
- Cap and trade creates an incentive for companies to decrease pollution output as the cap is lowered
- Carbon tax is a tax levied on the carbon content of fuels. It encourages the investment in green energy sources.

Conclusion

Implementing more coastal wetland ecosystems such as seagrass meadows, salt marshes, and mangrove forests that sequester atmospheric carbon (also called blue carbon) would be a considerable impact for global climate change and is encouraged by the Polluter-Pays Principle. The future of environmental health, including deterring the increase in air temperature and rising of sea levels, depends on the support of allowing companies to participate in a market of trading carbon allowances to encourage the limitation of greenhouse gas emissions. Additionally, creating and enforcing legislation to prevent the destruction of existing blue carbon ecosystems is absolutely vital; the devastation of these systems releases the stored carbon and contributes to instead of buffering global climate change.



SUBSURFACE MEDIA: WONDERFUL MANGROVES

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Tri-C Metro – 2016 eXtreme Green Experience

SUSTAINABLE • RENEWABLE • ALTERNATIVE

Team Members

Anita Whitlow, Steven Fairley, Aminat Adebayo,
Shavon Castro, Charielle Lewis, and Raekwon Brown

Mentor

Dr. Bilal M. M. Bomani

A Self-Sustainable Ecosystem Utilizing eXtreme Green Concepts

ABSTRACT

The three most important global resources are water, food, and energy. We investigated using an eXtreme Green solution that can potentially optimize the world's water and food resources. eXtreme Green is a concept originally developed at NASA's GreenLab Research Facility and focuses on combining renewable, alternative, and sustainable techniques. We conducted an 8-week feasibility study optimizing a portable self-sustainable renewable ecosystem by evaluating three plant species (Lima camelina, Salicornia virginica, and Salicornia subterminalis). We used Poecilia species (freshwater Mollies) fish waste as a natural fertilizer to provide essential nutrients for the plants. Our goal is to develop portable self-sustainable renewable ecosystems that can be implemented worldwide. We present the results of our 8-week study, and our recommendations for adapting our ecosystem to future eXtreme Green Concepts.



FUTURE GOALS

We hope to climatically adapt the entire portable ecosystem to salt water levels. We also hope to have our portable ecosystem replicated and used in STEM classrooms across the United States to promote eXtreme Green concepts.

SAND

Week 1



Sand	pH	Temp
Week 1	7.02	75.4°
Week 2	7.62	73.9°
Week 3	7.64	76.4°
Week 4	7.92	78.5°
Week 5	7.84	78.5°
Week 6	8.12	74.0°
Week 7	8.42	78.0°
Week 8	8.47	76.3°

Week 4



Sand	Phosphate
Week 1	NA
Week 2	0.13 ppm
Week 3	2.5+ ppm
Week 4	2.43 ppm
Week 5	0.66 ppm
Week 6	0.77 ppm
Week 7	0.20 ppm
Week 8	0.13 ppm

Week 8



Sand	Phosphate
Week 1	NA
Week 2	0.13 ppm
Week 3	2.5+ ppm
Week 4	2.43 ppm
Week 5	0.66 ppm
Week 6	0.77 ppm
Week 7	0.20 ppm
Week 8	0.13 ppm

SAND VS. SOIL



Sustainable

The ability of an ecosystem to maintain ecological processes, functions, biodiversity and productivity into the future

Renewable

Energy from natural sources that are naturally replenished (e.g., sunlight, wind, rain, tides)

Alternative

Energy sources that have no undesired consequences and have lower carbon emissions when compared to conventional energy sources (e.g., biomass, wind, solar, geothermal, and hydroelectric)

SOIL

Week 1



Soil	pH	Temp
Week 1	6.89	77.4°
Week 2	7.39	74.6°
Week 3	7.46	76.6°
Week 4	7.85	76.2°
Week 5	7.63	78.5°
Week 6	8.14	75.3°
Week 7	8.37	78.4°
Week 8	8.49	76.4°

Week 4



Soil	Phosphate
Week 1	NA
Week 2	2.5+ ppm
Week 3	24.5 ppm
Week 4	30.0+ ppm
Week 5	30.0+ ppm
Week 6	29.1 ppm
Week 7	27.5 ppm
Week 8	26.3 ppm

Week 8



Soil	Phosphate
Week 1	NA
Week 2	2.5+ ppm
Week 3	24.5 ppm
Week 4	30.0+ ppm
Week 5	30.0+ ppm
Week 6	29.1 ppm
Week 7	27.5 ppm
Week 8	26.3 ppm

ACKNOWLEDGMENTS

Cuyahoga Community College (Metro Campus)
Barbara Mikuszevski, MS, RD, LD
Associate Dean Health Careers, Science, Medical Assisting and Education
Dr. Pamela Ellison, Professor/Associate Dean Business and Technology

Choose Ohio First Mentor
Vaniha Parameswaran—Assistant Professor of Mathematics

Special thanks to
Dr. Bilal M. M. Bomani, Adjunct Faculty—Tri-C Metro
National Technical Association—Cleveland Chapter

REFERENCES

Bomani McDowell, B. M., Hendricks, R. C., Ebulik, M., Okon M., Lee, E., Gigante, B. (2011). NASA's GreenLab Research Facility: A Guide for a Self-Sustainable Renewable Energy Ecosystem. NASA Technical Publication (NASA/TP-2011-217208).

Common Sorting Algorithms

Michael Hinton, Cleveland State University
Jacob Katzenmeyer, Cleveland State University



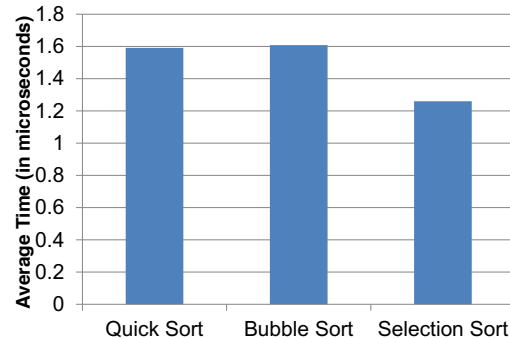
1. Introduction

- Three common (and easy to implement) sorting algorithms are: Quick Sort, Bubble Sort, and Selection Sort.
- Average time complexities:
 - Quick Sort: $O(n \log n)$
 - Bubble Sort: $O(n^2)$
 - Selection Sort: $O(n^2)$
- Big-O notation: Upper bound growth rate of a function.
- Quick Sort: Divide-and-conquer; recursively sort left and right sublists.
- Bubble Sort: Compares adjacent values and swaps them if necessary.
- Selection Sort: Divides list into two sublists: sorted and unsorted. Smallest value of the unsorted sublist is added to the end of the sorted sublist.

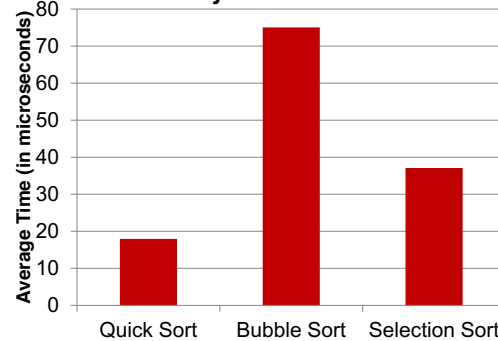
2. Methods

- Each algorithm sorts identical, randomly created arrays.
- The size of the array to be sorted is increased exponentially.
 - Sizes tested: 10; 100; 1,000
- Each size of array is tested 10,000 times and the quickest algorithm is recorded.
- The average time is also recorded.
- Run on a Dell Inspiron 15R

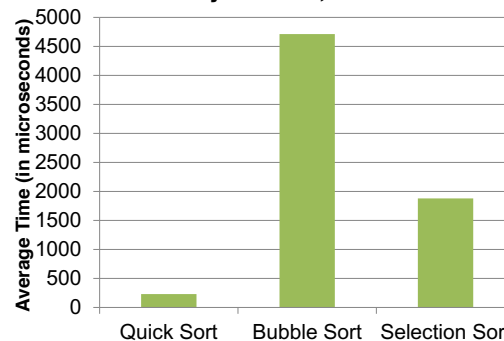
Array Size: 10



Array Size: 100



Array Size: 1,000



3. Results

10 Item Array

Average times:

- Quick Sort: 1.591 ms
 - Quickest 954 times
- Bubble Sort: 1.608 ms
 - Quickest 905 times
- **Selection Sort: 1.260 ms**
 - Quickest 6653 times

100 Item Array

Average times:

- **Quick Sort: 17.946 ms**
 - Quickest 9973 times
- Bubble Sort: 75.054 ms
 - Quickest 1 time
- Selection Sort: 37.081 ms
 - Quickest 26 times

1,000 Item Array

Average times:

- **Quick Sort: 230.256 ms**
 - Quickest 9997 times
- Bubble Sort: 4711.951 ms
 - Quickest 0 times
- Selection Sort: 1879.145 ms
 - Quickest 3 times

4. Conclusion

- Quick Sort was the fastest algorithm with larger data sizes.
- However, it was not the quickest algorithm at sorting a small data size (10).
- As expected (from their accepted time complexities), all algorithms are more than 10 times slower as the data size is increased 10 times.

Acknowledgments: Thanks to Choose Ohio First and Cleveland State University for the opportunity to conduct this research.

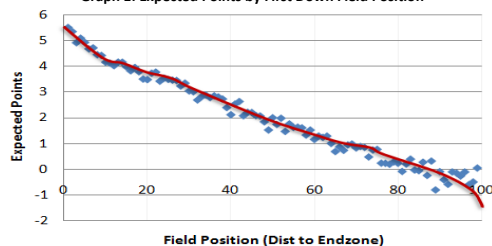
Introduction

The NFL is a multi-billion dollar industry. Although a lot of a team's success can be attributed to the players, some of the success is dependent on the coaching decisions. A better understanding of the probability associated with various critical in-game coaching decisions could give coaches and their teams an advantage over their opponent. All data was collected from the 2000-2015 NFL seasons. We combined our data with data collected by Brian Burke of Advanced Football Analytics from the 2000-2008 NFL seasons. Burke's research created the idea of Expected Points, which are the average potential points a team has at a certain yard line. We used Burke's idea of Expected Points in combination with more recent data to form a blueprint for NFL coaches on fourth downs. We also used data from 2001-2015 to create a guide for coaches potentially tying the game with a touchdown late in the fourth quarter.

Methods and Results

Burke's research created the idea of Expected Points, which are the average potential points a team has at a certain yard line. Expected Points are the average of all next score values at any given yard line. It's not necessarily the average points scored on the current possession because possession could be exchanged several times before the next score. Expected Points are positive when the offense will usually score next, and negative if the defense will usually score next.

Graph 1: Expected Points by First Down Field Position

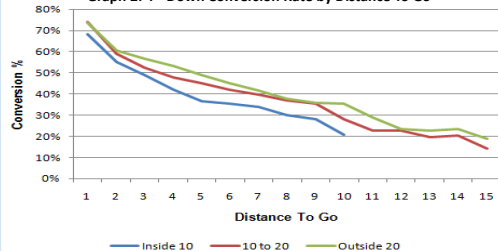


We analyzed every fourth down attempt from the 2015-2016 NFL season. We excluded all of the attempts that occurred while a team was losing in the fourth quarter and attempts with no intention of succeeding (ex. taking a knee to have time run off of the clock). The fourth quarter attempts were excluded from our data because teams were desperate to attempt those conversions in order to have any chance of winning. Including these results would have included desperate long fourth down attempts which are very unlikely to be converted and would skew the results of real fourth down conversion rates. These adjusted fourth down conversion rates were then broken down into pass and run plays as shown.

Table 1: 4th Down Conversion Rates

Type of 4th Down	Conversions	Attempts	%
League Average (Unadjusted)	233	476	48.9%
League Average (Adjusted)	126	214	58.9%
Total Runs	76	111	68.5%
Total Passes	50	103	48.5%
Types of Attempts	Percent of Conversions	Percent of Attempts	
Run Plays	60.3%		51.9%
Pass Plays	39.7%		48.1%

Graph 2: 4th Down Conversion Rate by Distance To Go



NFL Coaching Decisions

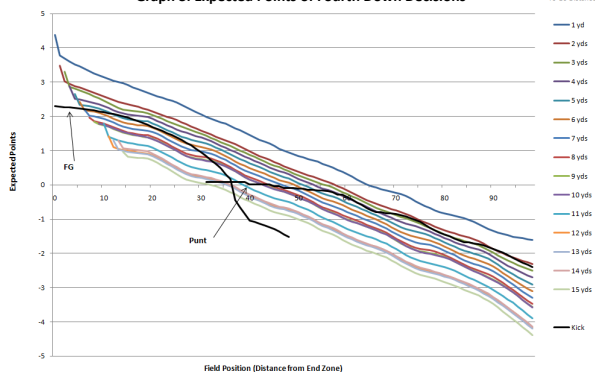
Authors: Bryan Ritchie and Kory Slusser
Advisor: Jun Li

The EP (Expected Points) value of a punt is calculated using the average net distance for punts from each yard line. Using the net distance of the punt we know the expected subsequent field position for the opponent and therefore their EP (Your EP is the opposite of the opponents EP). The EP value of a FG attempt is based on the probability of making the kick, which is dependent on kick distance. The EP of the FG is then:

$$(\text{Probability of making FG} \times \text{EP value of a FG}) - (\text{Probability of a miss} \times \text{EP of the opponent at the yard line of the miss})$$

The value of a successful 4th down conversion attempt would be at least the EP value at the 1st down marker. The minimum value of an unsuccessful conversion attempt would be the EP value of a 1st down for the opponent at the spot of the attempt. The probability of a successful conversion is primarily dependent on the distance to go. Field position also affects the chances of success due to the compression of the field in the red zone. The graph below plots the EP of a successful 4th down conversion by distance to go along with the EP of Punts and FGs.

Graph 3: Expected Points of Fourth Down Decisions



The figure below on the left illustrates the best decision on fourth down according to EP and the figure on the right illustrates what NFL coaches do on average at every position on the field with various 4th down distances. The chart helps explain that NFL coaches are not attempting enough 4th down conversions according to the numbers.

Figure 1: 4th Down Suggestions According to the Numbers

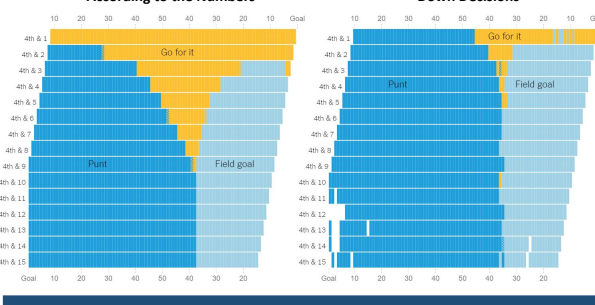
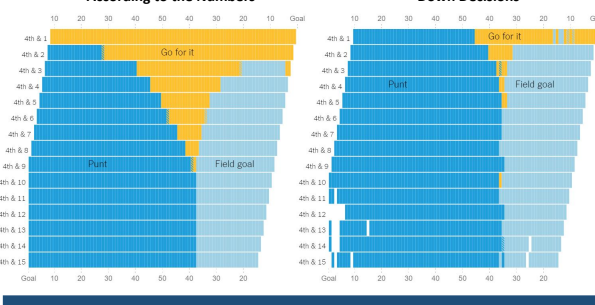


Figure 2: Average NFL Coach's 4th Down Decisions



Another crucial game situation occurs when a team down 7 points scores a touchdown near the end of the fourth quarter. The team can either kick an extra point and likely send the game into overtime or attempt a two point conversion and likely win the game if they succeed (barring any kickoff return for a touchdown or, if there is any time remaining, a quick drive for a score by the opponent). We analyzed the outcomes of 242 overtime games in the NFL since 2001 in order to determine the probability of the home team (54.5%) and away team winning (45.5%) in an game that is sent to overtime (OT). Next we looked at two point conversion rates since 2001 (431 of 913 or 47.2%). Then we examined the extra point success rates for each NFL team during the 2015-2016 season (This was the only season that could be used because prior to the start of the season extra points were moved from the 2 yard line to the 15 yard line).

Next we analyzed the win probabilities of each team if they chose one of three approaches: Attempting an extra point and sending the game into overtime (OT) as the home team, attempting an extra point and sending the game into overtime as the away team, or attempting a two point conversion. To find the win probability in the extra point attempt cases, we multiplied each team's extra point conversion rate by their probability to win in overtime depending on if they are the home or away team. The win probability was then compared to the 2 point conversion rate. The two point conversion rate is considered the win probability of the team because it's unlikely that another score will happen after the two point conversion. The two point conversion rate is considered to not be affected by home or away status. The two win probabilities (EP and OT vs 2-Point Conversion) were then compared for both home and away situations and the higher probability is the recommended decision.

Table 2: Win Probability Late in 4th Quarter After Scoring Touchdown to Tie Game (Before Extra Point (EP) or 2-Point Conversion)

Team	EP and OT (Home)	EP and OT (Away)	2-Point Conversion	Best Decision (Home)	Best Decision (Away)
49ers	51.9%	43.3%	47.2%	OT w/ EP	2-Point Con.
Bears	52.6%	43.9%	47.2%	OT w/ EP	2-Point Con.
Bengals	53.4%	44.6%	47.2%	OT w/ EP	2-Point Con.
Bills	46.3%	38.7%	47.2%	2-Point Con.	2-Point Con.
Broncos	53.0%	44.2%	47.2%	OT w/ EP	2-Point Con.
Browns	50.0%	41.7%	47.2%	OT w/ EP	2-Point Con.
Buccaneers	49.7%	41.5%	47.2%	OT w/ EP	2-Point Con.
Cardinals	49.8%	41.6%	47.2%	OT w/ EP	2-Point Con.
Chargers	47.7%	39.8%	47.2%	OT w/ EP	2-Point Con.
Chiefs	51.8%	43.3%	47.2%	OT w/ EP	2-Point Con.
Colts	49.8%	41.6%	47.2%	OT w/ EP	2-Point Con.
Cowboys	54.5%	45.5%	47.2%	OT w/ EP	2-Point Con.
Dolphins	50.0%	41.7%	47.2%	OT w/ EP	2-Point Con.
Eagles	52.0%	43.4%	47.2%	OT w/ EP	2-Point Con.
Falcons	54.5%	45.5%	47.2%	OT w/ EP	2-Point Con.
Giants	53.3%	44.5%	47.2%	OT w/ EP	2-Point Con.
Jaguars	44.7%	37.3%	47.2%	2-Point Con.	2-Point Con.
Jets	53.2%	44.4%	47.2%	OT w/ EP	2-Point Con.
Lions	50.3%	42.0%	47.2%	OT w/ EP	2-Point Con.
Packers	54.5%	45.5%	47.2%	OT w/ EP	2-Point Con.
Panthers	51.7%	43.2%	47.2%	OT w/ EP	2-Point Con.
Patriots	54.5%	45.5%	47.2%	OT w/ EP	2-Point Con.
Raiders	53.1%	44.3%	47.2%	OT w/ EP	2-Point Con.
Rams	50.7%	42.4%	47.2%	OT w/ EP	2-Point Con.
Ravens	54.5%	45.5%	47.2%	OT w/ EP	2-Point Con.
Redskins	53.2%	44.4%	47.2%	OT w/ EP	2-Point Con.
Saints	52.1%	43.5%	47.2%	OT w/ EP	2-Point Con.
Seahawks	49.5%	41.4%	47.2%	OT w/ EP	2-Point Con.
Steelers	51.3%	42.8%	47.2%	OT w/ EP	2-Point Con.
Texans	48.4%	40.4%	47.2%	OT w/ EP	2-Point Con.
Titans	51.0%	42.6%	47.2%	OT w/ EP	2-Point Con.
Vikings	48.6%	40.6%	47.2%	OT w/ EP	2-Point Con.
Average	51.3%	42.8%	47.2%	OT w/ EP	2-Point Con.

Discussion

Our research has led us to form many suggestions relating to critical football coaching decisions. The data very strongly supports the idea that coaches should attempt more fourth down conversions. The numbers simply say the rewards of successes outweigh the risks on shorter attempts and even on some mid distance attempts, depending on field position. The next conclusion that can be made relates to the type of play on fourth down attempts. Our research shows that run plays were far more successful than pass plays and accounted for a larger number of the total conversions even though there were roughly equal pass and run attempts. Therefore, on fourth and short attempts, especially fourth and 1, a run play has a higher probability of succeeding. Lastly, our research provided us with each team's best option to win after scoring a touchdown when they were down 7 late in the fourth quarter. The probability states that all away teams should attempt a two point conversion in this scenario and all but two teams should kick the extra point and send the game into overtime as the home team. With such a low margin for error as an NFL coach, it would be wise for coaches to stop ignoring these probabilities and keeping his team from a better chance for victory. These statistics could prove to be the difference in securing a win to help a team into the playoffs or even moving on to the next round of the playoffs, generating more money for the team and securing the coaches job for a while.

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Judging at COF-Math Conference

- ABSTRACT (out of 10 points)
 - Contains relevant information about the study; succinctly written.
- PRESENTATION (out of 10 points)
 - Speaks clearly, loudly, confidently, and with appropriate enthusiasm.
 - Stands comfortably; makes appropriate eye contact.
- CONTENT (out of 40 points total)
 - Ideas flow logically from one point to another. Poster is well-organized.
 - Contains clear purpose/methods/results.
 - Conveys how this project relates to broader body of knowledge.
 - Explains conclusion.



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- DISCUSSION (out of 10 points)
 - Allows time for Q&A. Responds professionally and knowledgeably to questions.
- APPEARANCE (out of 10 points)
 - Step back... the poster is attractive and inviting. Appropriate visuals; very easy to read and follow.
- DEPTH OF RESEARCH OR EXPOSITION (out of 10 points)
 - The project is more than a superficial or routine exercise.