



Book of Posters

Emerging scholars Program (ESP) – Fall 2021



Investigating Project Success Factors in Post-Disaster Rebuilding Efforts in NYC

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ABSTRACT

On October 29, 2012, Superstorm Sandy caused nearly \$19 billion in damages in New York City including damage to 69,000 residential units. A precipitated amount of roughly \$4.2 billion in Community Development Block Grant was allocated towards PDR construction. These funds addressed a range of needs, including rebuilding and rehabilitating housing, assisting displaced tenants, and providing aid to businesses. Post-Disaster Rebuilding (PDR) is similar to construction in the modification of an existing facility that involves either renovation, additions, or subtractions to scopes of work to assist the overall performance of the facility. However, PDR goes further in a highly coordinated process involving planning for future disaster events, integrating a temporary facility plan for those displaced, and tackling housing issues for all those affected by natural disasters. PSF (project success factors) consist of activities or elements that are required to ensure the successful completion of the project. Researchers have discussed literature PSF for PDR projects on topics including the importance of shared data modeling for interdisciplinary exchange of information for effective communication and risk reduction, formulating a holistic PDR approach that can be effective and adaptable to future reconstruction efforts (and inclusive of all stakeholders), and assessing the experience levels of all team members.

However, existing research into the assessment of the goals for PDR projects is limited, warranting an investigation of construction success factors as it applies to PDR efforts to improve equitable community resettlement and sustainable and resilient structure. A review of the literature was generated to identify accepted project success factors in construction projects, such as the case study of PDR response to Hurricane Sandy in New York City, in helping to identify common themes for success factors. Specifically, three areas will be examined from the case study: 1) Strategy/planning, 2) Resiliency and 3) Communication. Implementing these strategies in PDR projects will assist in the further understanding and success of reconstruction projects in this field of work.

METHODOLOGY

- 1 Reviewed literature to identify key themes for project success factors for PDR projects.
- 2 Used case studies from PDR in NYC for Hurricane Sandy and applied these tools for analysis of PDR success.
- 3 Compared case study findings against key themes from literature.

DISCUSSION

The ability to rebuild, rebound, and recover efficiently and quickly as possible is a critical part of PDR. Revisions in codes guides the professionals in ensuring an enhanced factor of safety rebuilding in at-risk zones of the cityscape. The disaster in severely battered infrastructure, very little left to be salvaged or restored. It also created an opportunity for innovative research designs and “future city” projects such as the Living Breakwaters to be incorporated into the PDR effort, thus rebuilding a more resilient and sustainable city. Impact of low-income residents revealing the demand for equitable communication strategies in promoting a community-based empowerment initiative. Through integration with contractor-based performance goals, total project quality becomes the driving principle towards success.

RESULTS

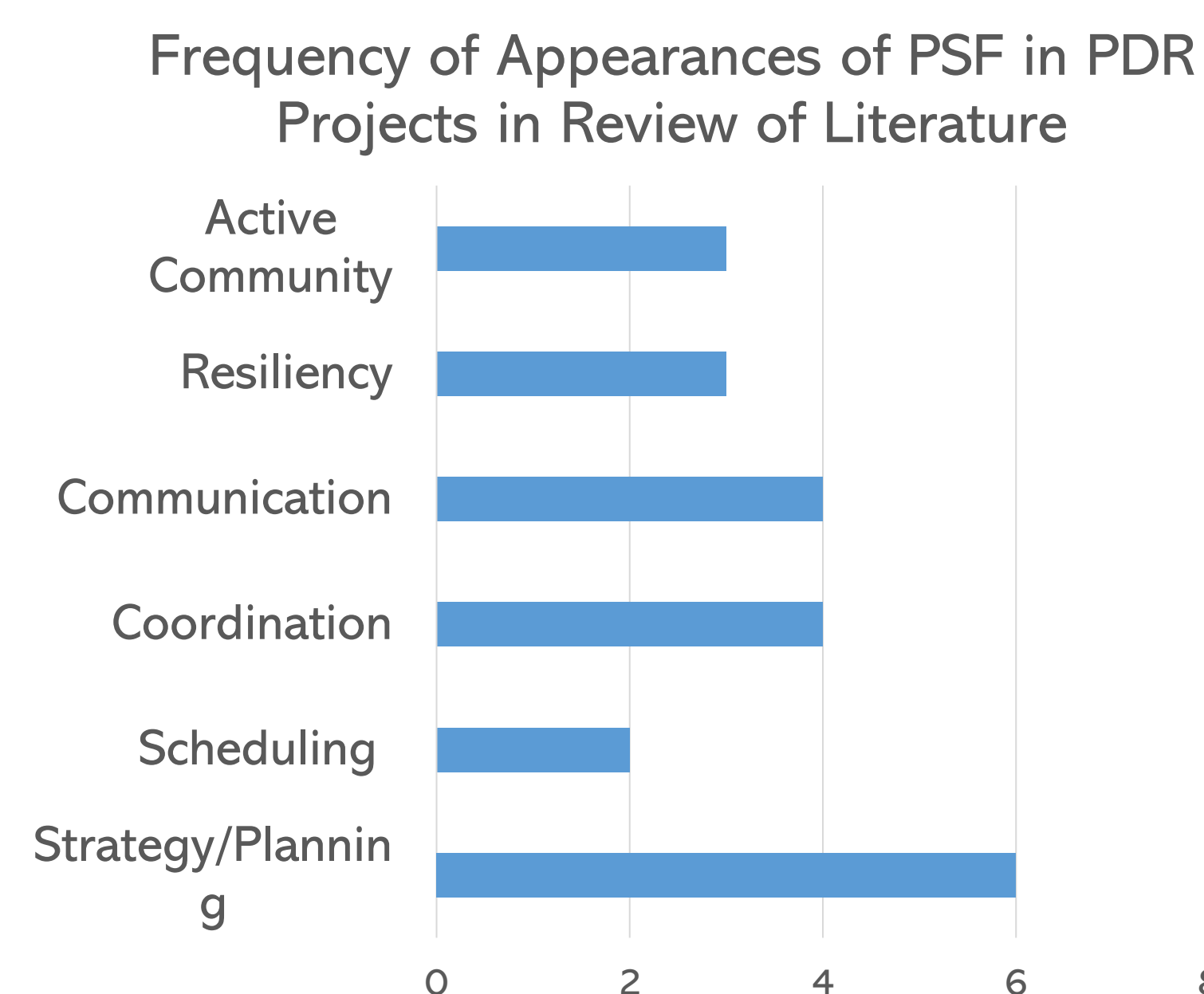


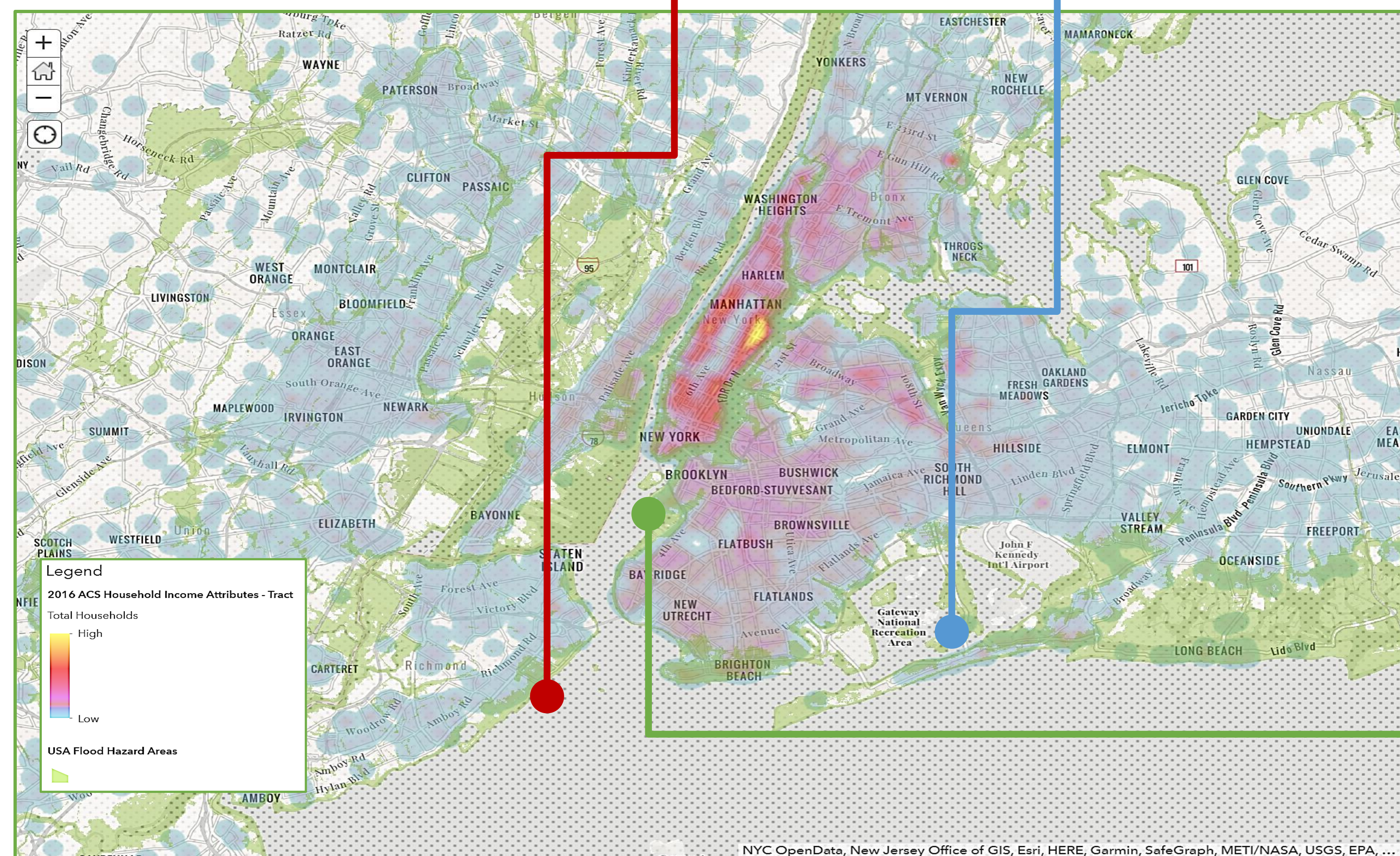
Figure 1: PDR PSF themes that were mentioned in relevant literature and the number of times each appeared in 6 articles.

KEY THEMES APPLIED TO CASE STUDY

Severe damage to aging infrastructure prompted building codes and zoning revisions - *Strategic Planning*

Mitigation of existing cityscape being overtaken by future natural disaster would also require innovative designs such as the Living Breakwater Project - *Resiliency and Sustainability*

Outreach to local communities following Hurricane Sandy found that 64% of registered households for federal assistance in New York City were low-income, further exposing the residents are of permanent displacement - *Equitable Communication*



CONCLUSION

In final analysis, strategic planning, proper scheduling, communication, and resiliency are some of the top PSFs that should be implemented in PDR, to coordinate projects effectively. Active community participation and stakeholder engagement also play a vital role in PDR decisions as it allows the public to offer opinions on their built communities and stakeholders to offer professional insight on the projects at hand, allowing for proper decision-making and PSF integration. The findings strongly suggest that PSFs are key resources and skills that determine the successful implementation of a project in terms of its direction and benefits and proposes that stakeholders and project managers should consider these factors for best practices when managing PDR projects.

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Implication of Energy Loss Due to Natural Airflow Through Entrance Doors

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Abstract

Infiltration through entrance doors and vestibules have had a major effect on calculating a building's heating and cooling loads; as natural airflow impacts climate. The purpose of this research is to: 1. Better understand air movement, heat dissipation, and energy consumption in building entrances; and 2. Find the main factors directly related to unwanted airflow through various types of entrance door; differential pressure, door usage frequency, airtightness, and wind profile around buildings. Some methods that were used in estimating door infiltration rates are qualitative analysis, a pre-experimental design survey, computer simulation, and tracer gas measurements. Future research is needed to design efficient high performing buildings, to reduce air infiltration, energy costs, maintaining indoor occupant comfort, and essentially lower its carbon footprint by decreasing greenhouse gas emissions responsible for climate change.

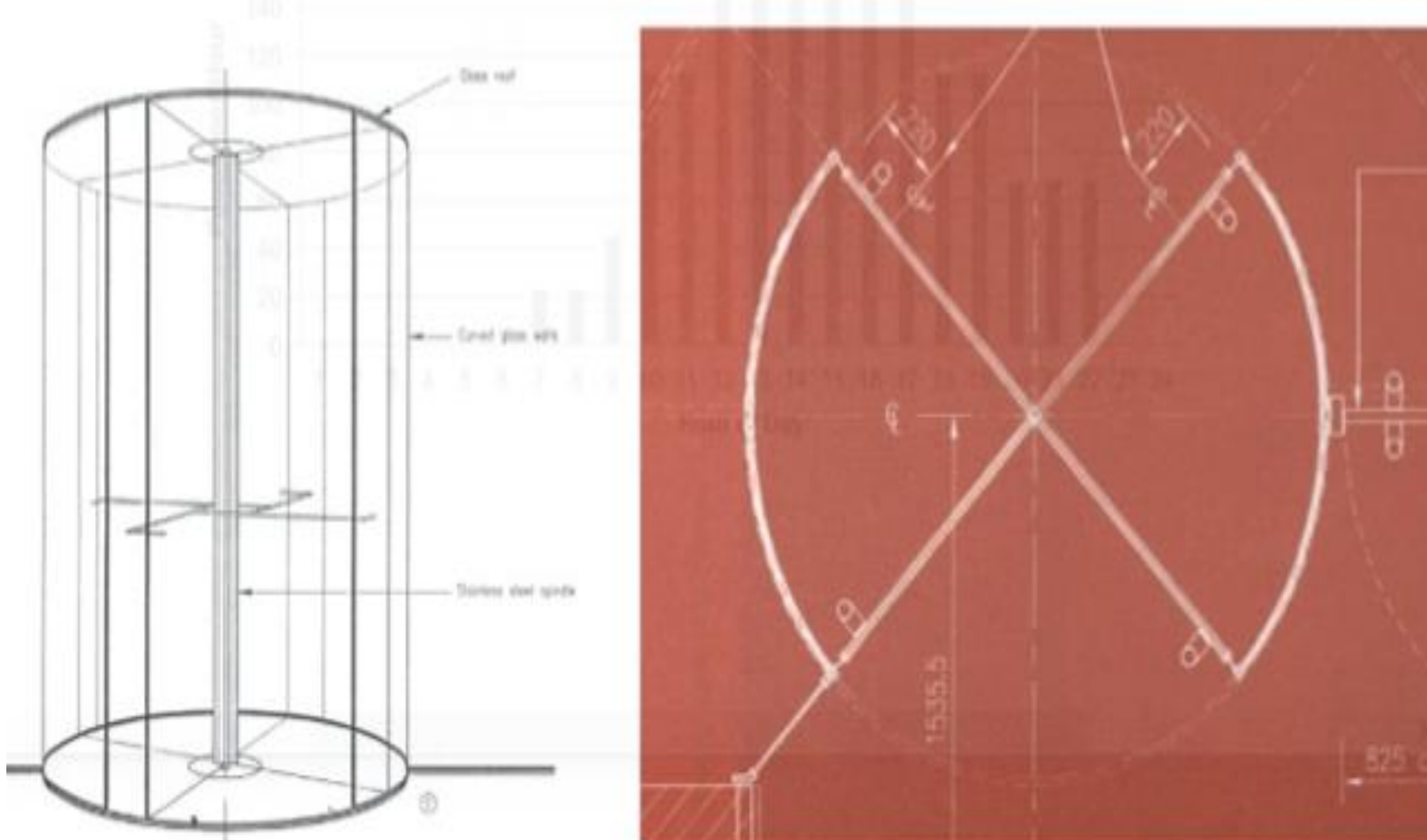


Figure 1. Two diagrams depicting a typical revolving door used today.
(Adapted from 2)

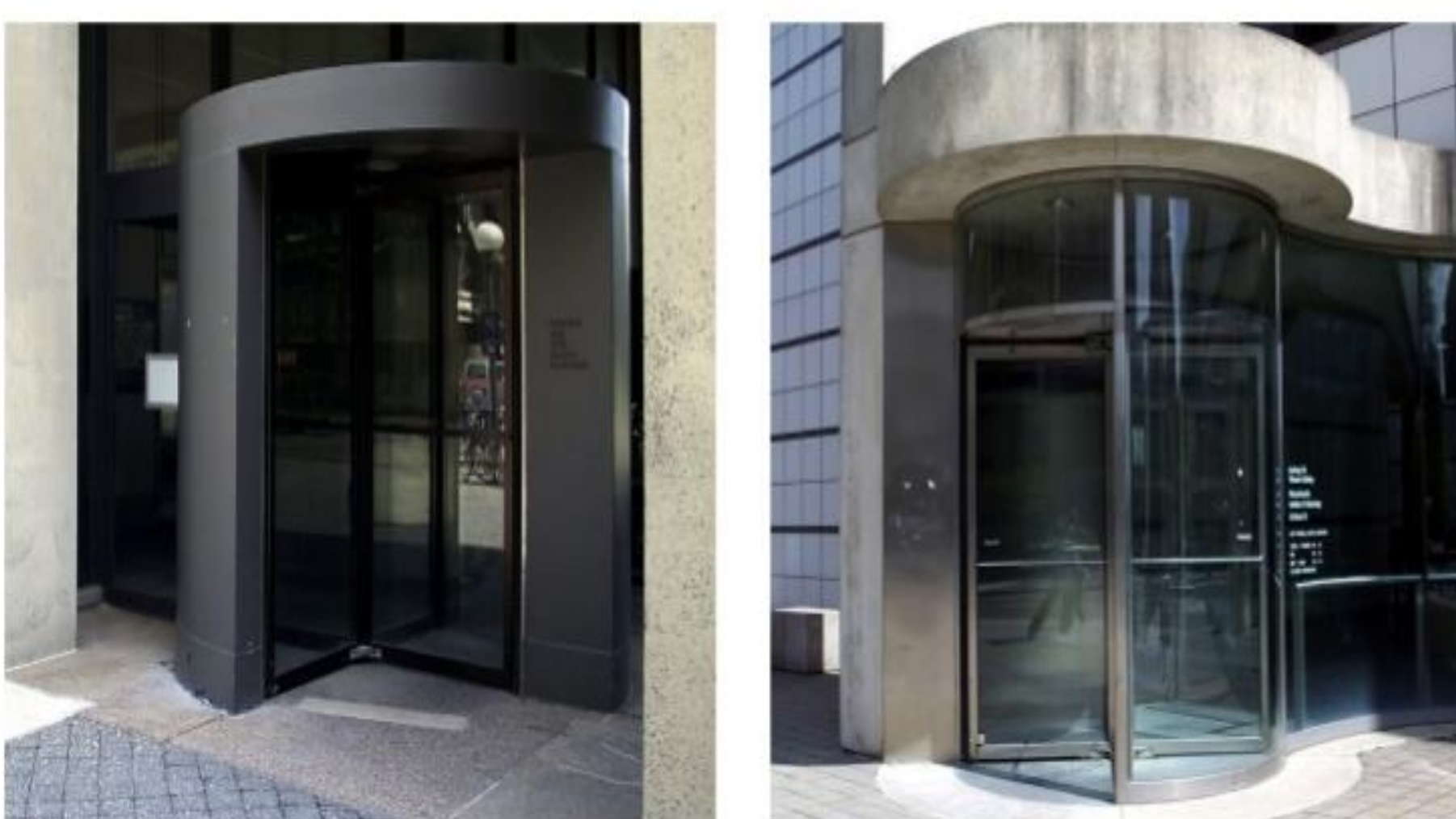


Figure 2. Revolving doors at MIT Campus with hidden swing doors.
(Adapted from 2)

Methods

Empirical Analysis

- First, *ASHRAE RP-1596* studied infiltration rates of automatic doors in retail and supermarket stores were established using tracer gas measurements in intervals of 4 hours; sensors were connected to analyze pressure differentials across internal and external doors.
- Second, a pre-experimental design survey was conducted at MIT to determine if occupants preferred revolving or swinging door types when entering a university building. A controlled and uncontrolled Qualitative Analysis experiment using signage was piloted to observe occupant door movement and habits in buildings 9, 34, 39, 46, 54, 66, E15, E51, NE48, and NE49.
- Third, we examined indoor and outdoor vestibule, curtain type of doors, and a combination of both within different climate zones with all 4 seasons in commercial, residential, and government buildings.

Numerical Analysis

- First, a computer simulation program and approximation equations were used to estimate values for Highrise office building entrance door areas airflow rates in relation to time of day and quantity of occupant usage.
- Second, we studied ASHRAE Standard 90.1's Modeling Strategy by measuring door use frequency, in peak and non peak hours, and simulating any savings to be gained with vestibules.
- Third, reviewed *ASHRAE Standard 1236-RP* which used *NFRC 100" (NRRC, 200a)* to examine heat loss using the *U factor* and *THERM* computer simulation on diverse types of commercial door entrances to understand their heat loss and find energy savings.
- Fourth, the *Whole Building Simulation Method* was used in calculating air infiltration rates simulation per hour, and pressure factor for retail stores with and without vestibule.

Discussion

Continuous research and qualitative analysis is needed in finding new ways to calculate and simulate the effects of air filtration rate through different entrance door types and vestibules in regards to width, differential pressure, airtightness, and energy conservation to reduce the carbon footprint.

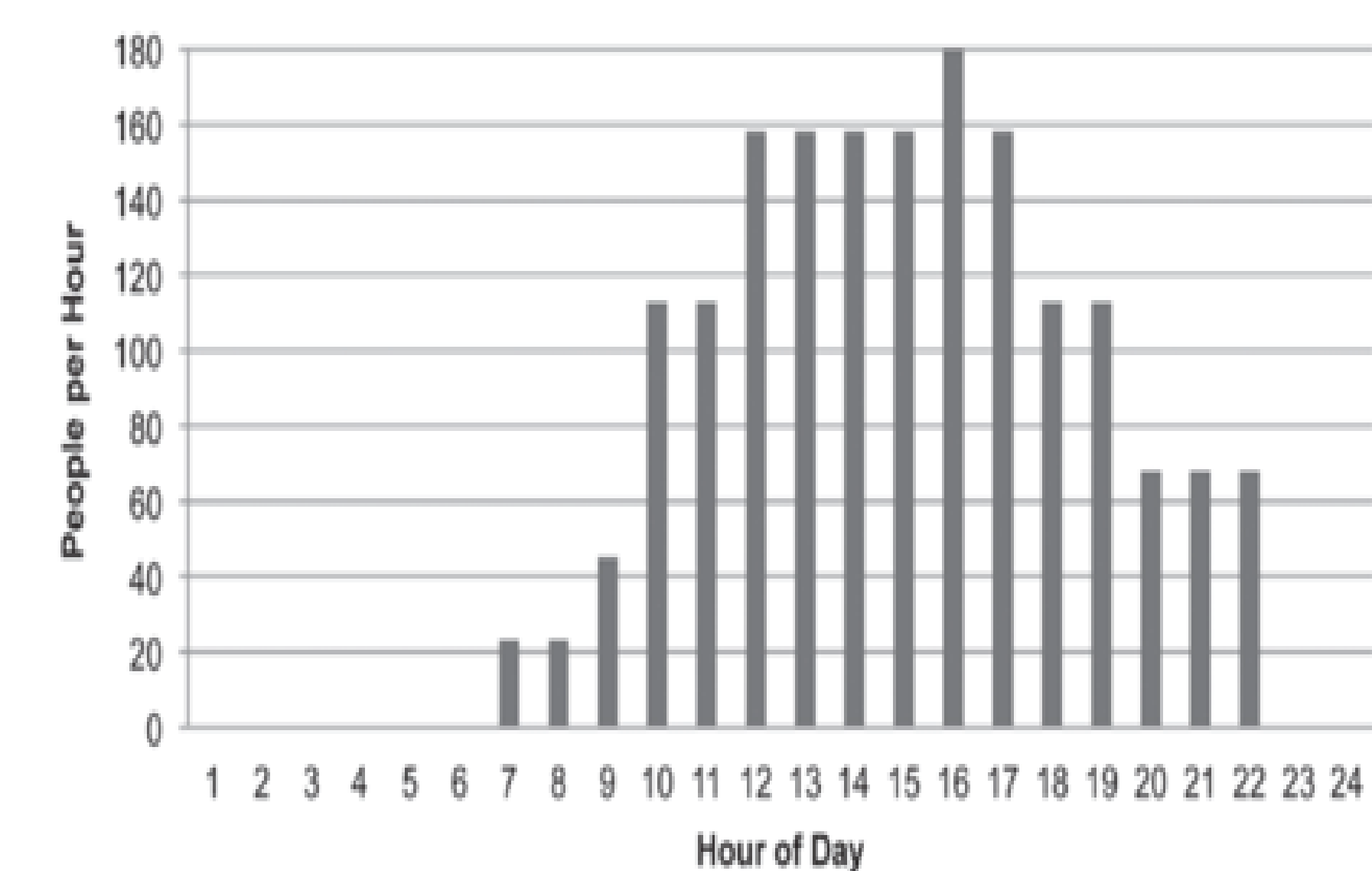


Figure 3. Rate of door traffic for each hour.
(Adapted from 1)

Results

Door Type

- MIT occupants subconsciously used swing doors out of habit and efficiency, until revolving door signage educated energy conservation: revolver use rates of 77 +/-7% (Bldg. 54) and 84 +/- (E15). This compares to a control (unconstrained doors) average 23+/-2%. Recall, the self-revolving reported use rate was 33%".
- ASHRAE 1236-RP* computer simulation heat loss for uninsulated, 3-wing revolving door, and aircraft hanger commercial doors using the total *U factor* equation: **uninsulated-3-wing revolving door**- $0.77 \text{ Btu} \cdot \text{h}^{-1} \cdot \text{ft}^{-2} \cdot ^\circ\text{F}^{-1}$ and **aircraft hanger door**- $0.58 \text{ Btu} \cdot \text{h}^{-1} \cdot \text{ft}^{-2} \cdot ^\circ\text{F}^{-1}$.

Vestibule

- Combine together the vestibule and the curtain door work the best in keeping either the cold or the hot weather away.
- ASHRAE energy modeling strategy* found: Building floors with smaller areas are greater impacted by air infiltration than those with a larger square footage; Vestibules in colder climates have greater energy.

Airtightness

- Findings for stationary door pressure differential range from 20-250 Pa was measured is: 1. When the door with the worn seal is in a closed, the air leakage measured at 75-Pa pressure change, was equal to 95 L/s. When the 4 wings point changed the air leakage was about 75 L/s at 75 Pa.

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BACKGROUND & INTRODUCTION

- A wildfire is an unplanned, unwanted, uncontrolled fire in an area of combustible vegetation starting in rural areas and urban areas.
- Recent studies have shown that the effect of anthropogenic climate change has fueled the wildfire events, leading to an increase in the annual burned areas and number of events.
- California is one of the places having the most deadliest and destructive wildfire seasons. With the global warming effect of 1°C since 1850, the 20 largest wildfires events that have occurred in California, 8 of them were in 2017. (Center For Climate And Energy Solutions)
- Climate change is primarily caused by the burning of fossil fuels which increase the frequency and severity of wildfires. (California Air Resources Board)

RESEARCH QUESTIONS & OBJECTIVES

- Wildfires in California can be caused by human activities and anthropogenic climate change.
- Use table statistic to analyze wildfire time series data:
 - Are wildfire events happening more often in recent years?
 - Has the burning area been increased?
 - When and what month is the time that wildfire happens the most?
- What factors can affect the wildfire events?
- What adverse effects and long-term health risks occur due to wildfire events and forest devastation?
- How can we manage and control future and existing wildfire disasters?

METHODS & DEFINITIONS

- The dataset we use is from Kaggle Dataset where it contains the list of Wildfires that has occurred in California between 2013 and 2019. This data helps to generate insights on what locations in California are under fire threat, what time do Wildfires usually occur and how frequent and devastating they are.
- To obtain the accurate interpretation of how the wildfires have changed in the most recent years in different areas. We analyze the data using table statistics for both intensity and frequency perspective.
 - Count and construct frequency table the selected years of study.
 - Calculating statistic parameter on the acresburn
- Throughout the entire project, we use software such as Excel and Rstudio to conduct the analysis.

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RESULTS

Orographic Lifting

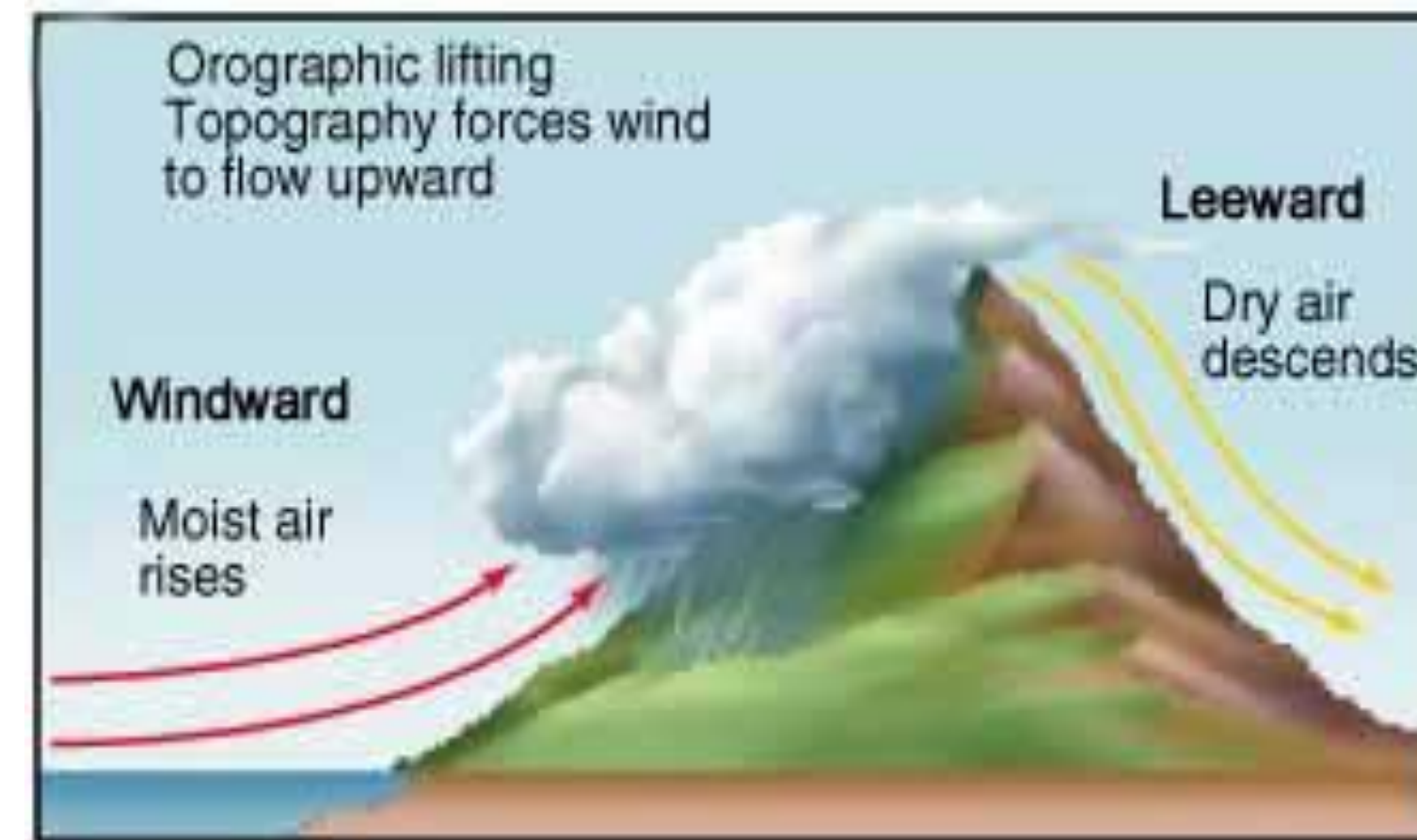


Figure 1: Orographic lifting describes the concept of the air cycle and how dry and hot air is generated after the process of adiabatic heating and cooling.

Orographic lifting occurs mostly in high elevation areas such as mountains. Orographic lift occurs when an air mass is forced from a low elevation to a higher elevation as it moves over rising terrain. As the air mass gains altitude it quickly cools down, which can raise the relative humidity to 100% and create clouds and, under the right conditions, precipitation. Downslope winds occur on the leeward side of mountain barriers when a stable air mass is carried over the mountain by strong winds that increase in strength with height. Moisture is removed and latent heat released as the air mass is orographically lifted. As the air mass descends, it is compression heated. In areas such as California, where the temperature is high and there are many mountains, orographic lifting can be a significant cause that leads to wildfires.

Geographical Location of the Fire Incidents

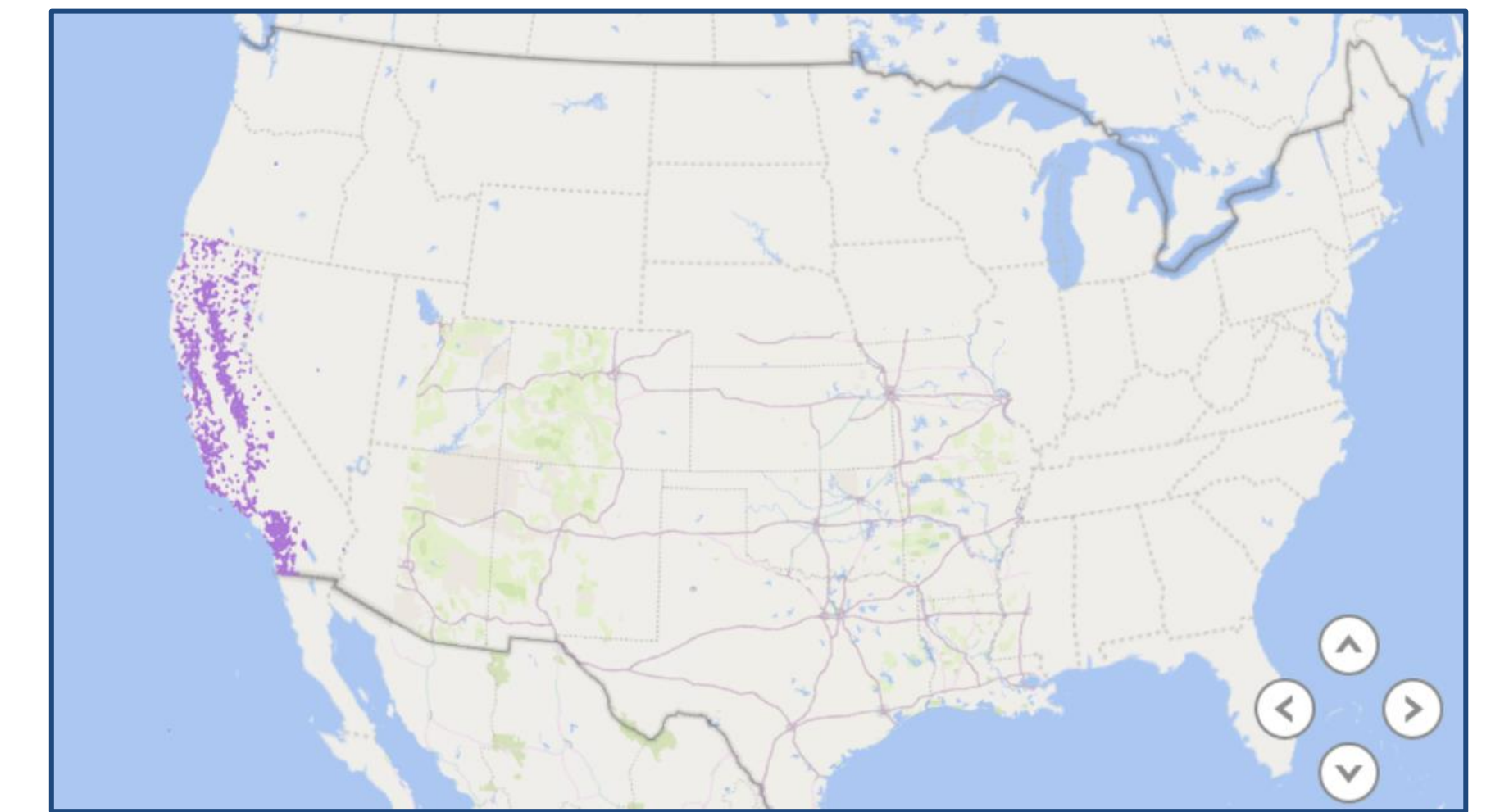


Figure 2: A geospatial plot on the location of wildfire events in California (2013-2019). Each purple data point represents a wildfire incident.

The Frequency of Wildfire Events in California

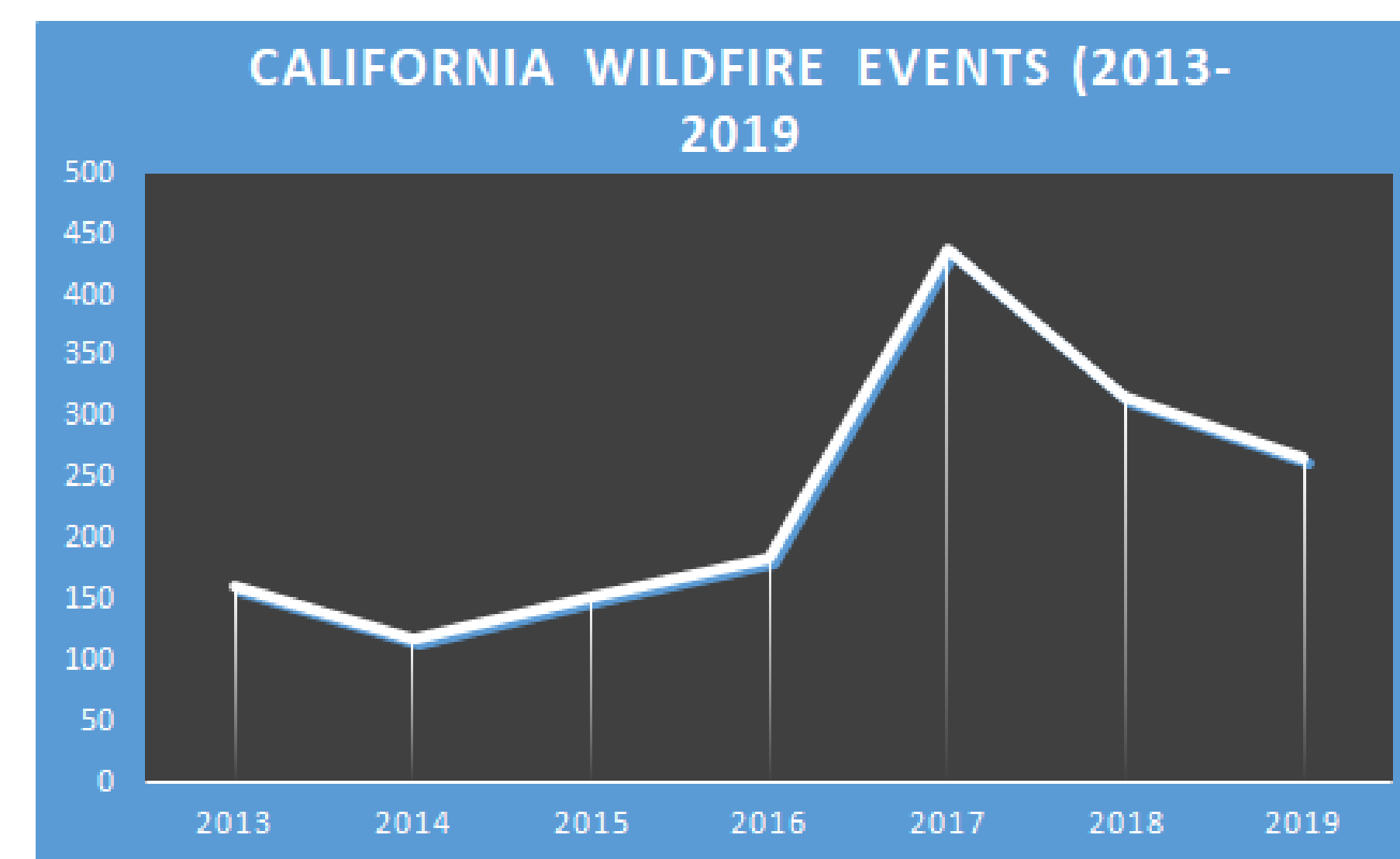


Figure 3: Frequency of California wildfire Events (2013-2019) Each data point represents the counts of wildfire events for each year

Acres Burned

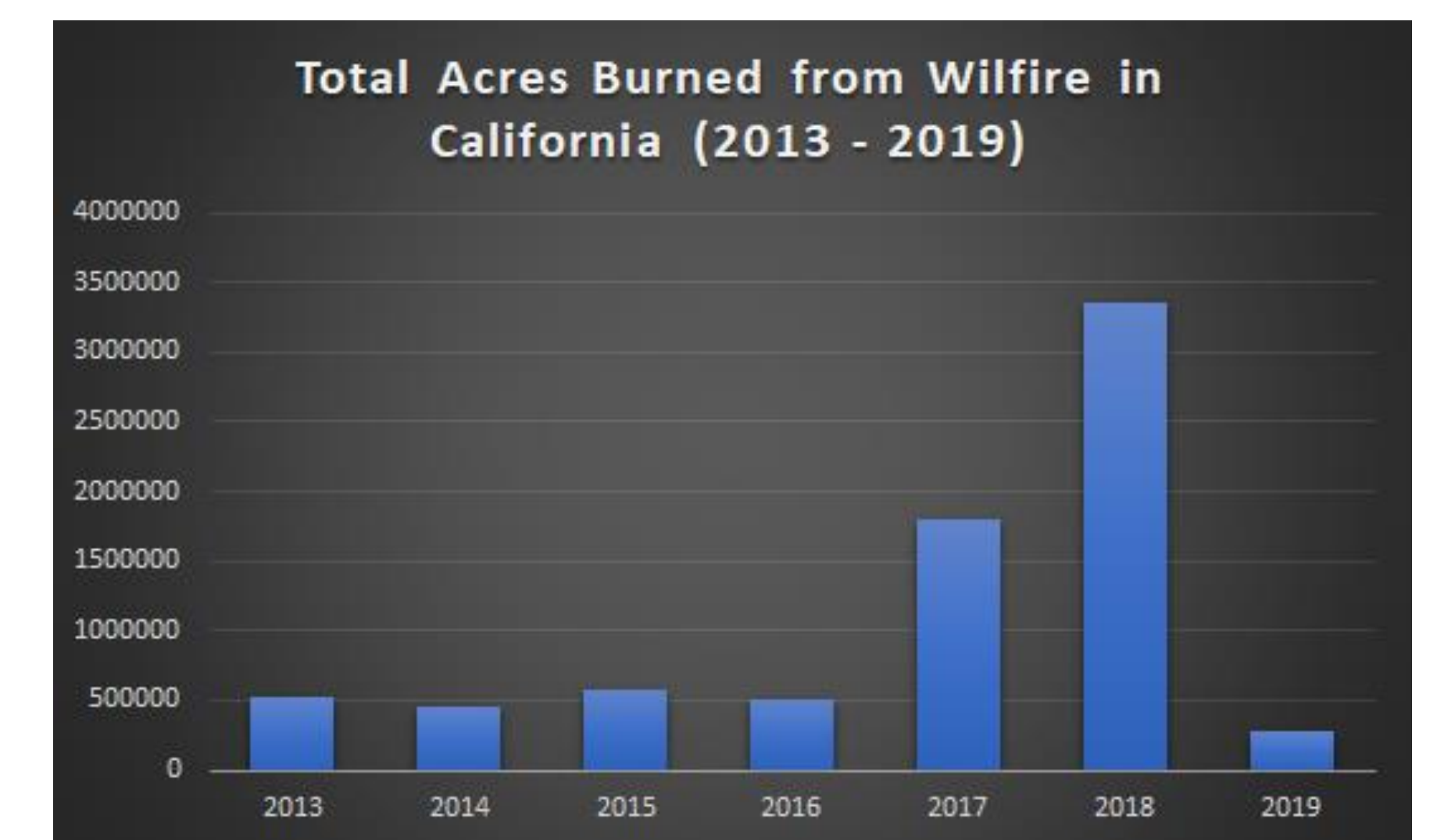


Figure 4: Total Acres Burned from Wildfire in California (2013-2019) Each data point represents burned acres accumulation for each year.

The Monthly Frequency of Wildfire Events in California

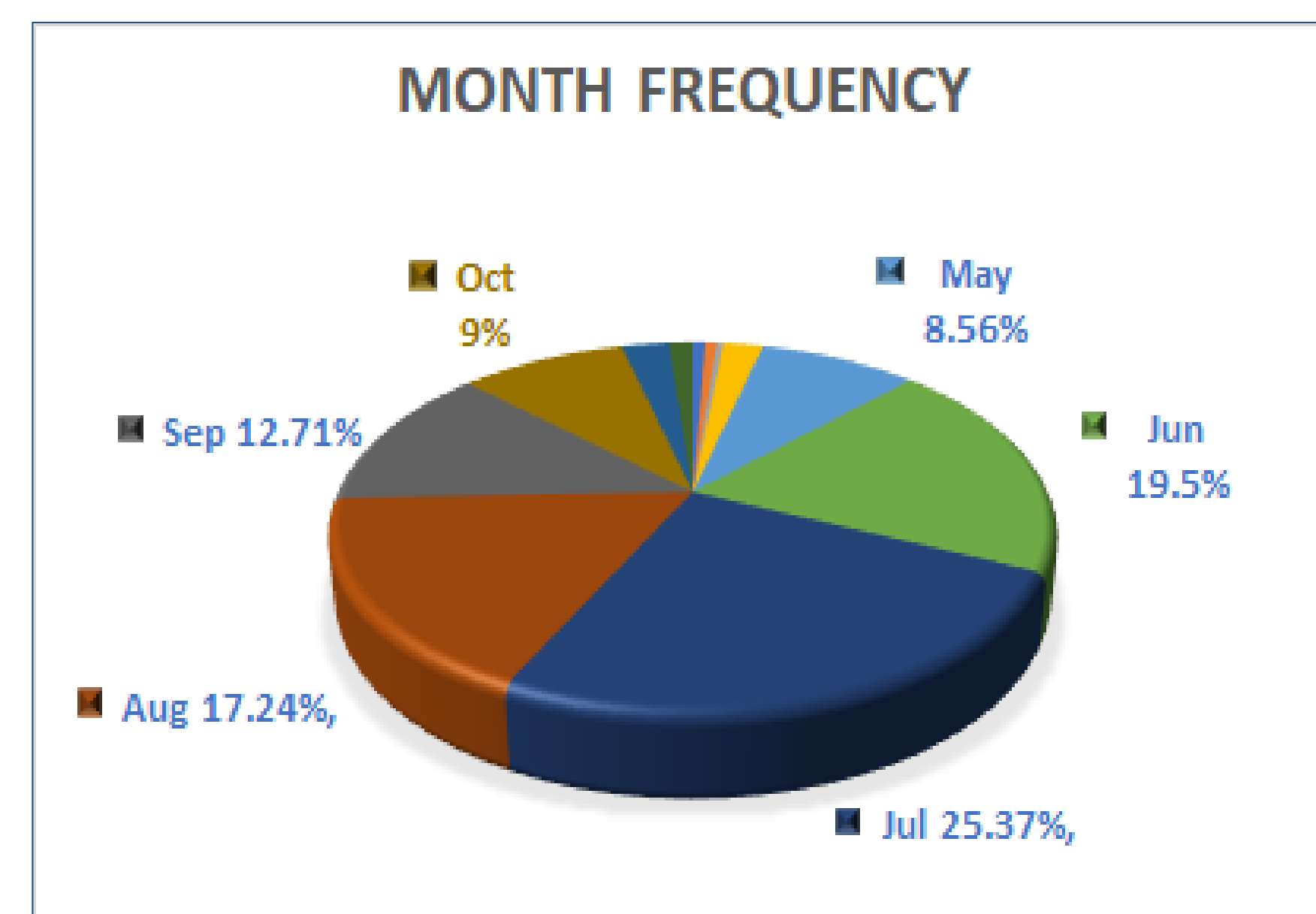


Figure 5: Monthly Frequency of Wildfire Events (2013-2019) Each data portion represents the counts of wildfire events that happened in the specific month.

Daily Air Quality Profile (PM 2.5)

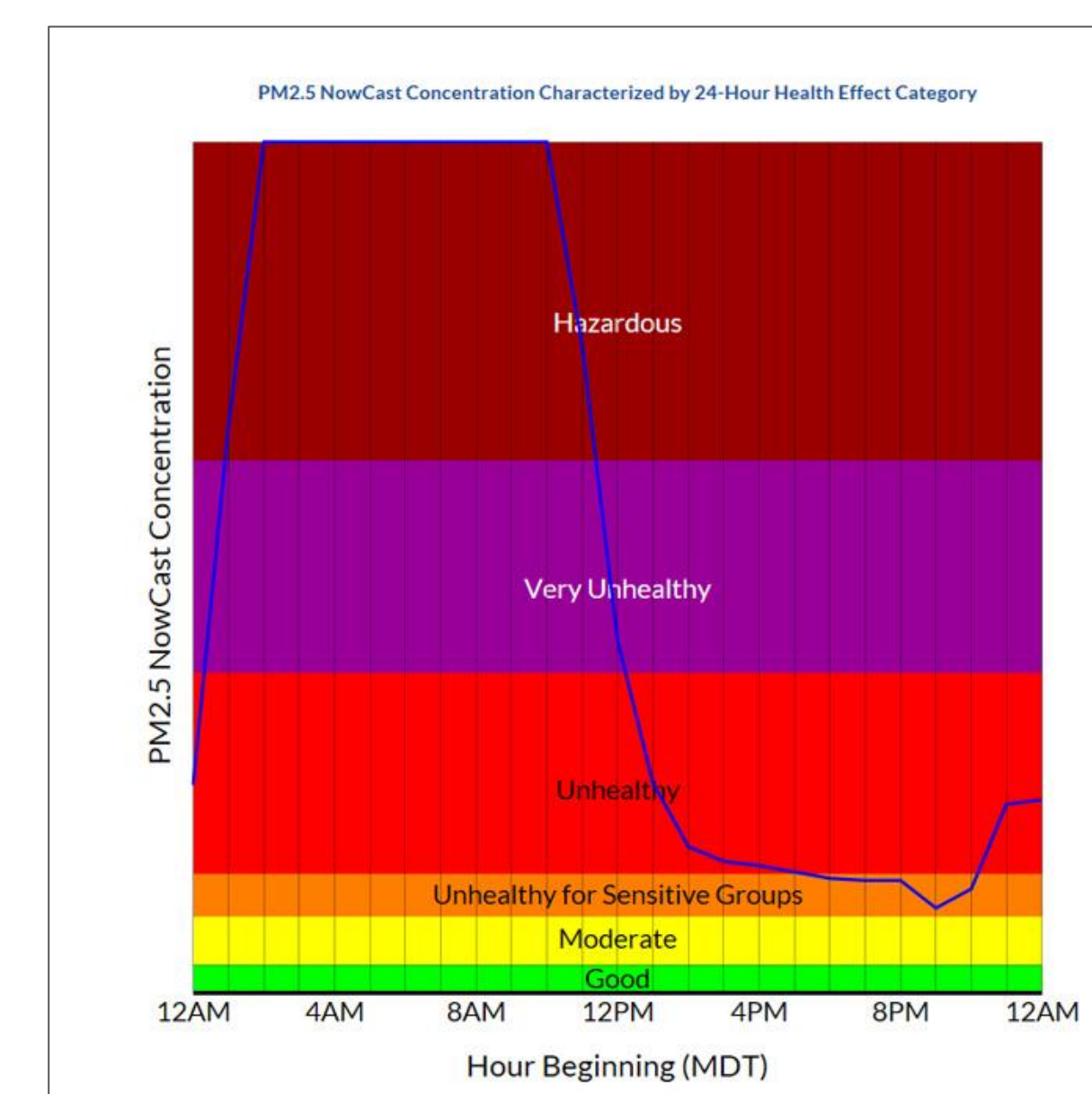


Figure 6: Air quality with measurement of PM 2.5 after wildfire event within 24 hour time period.

The Potential Risk of Wildfire Smoke

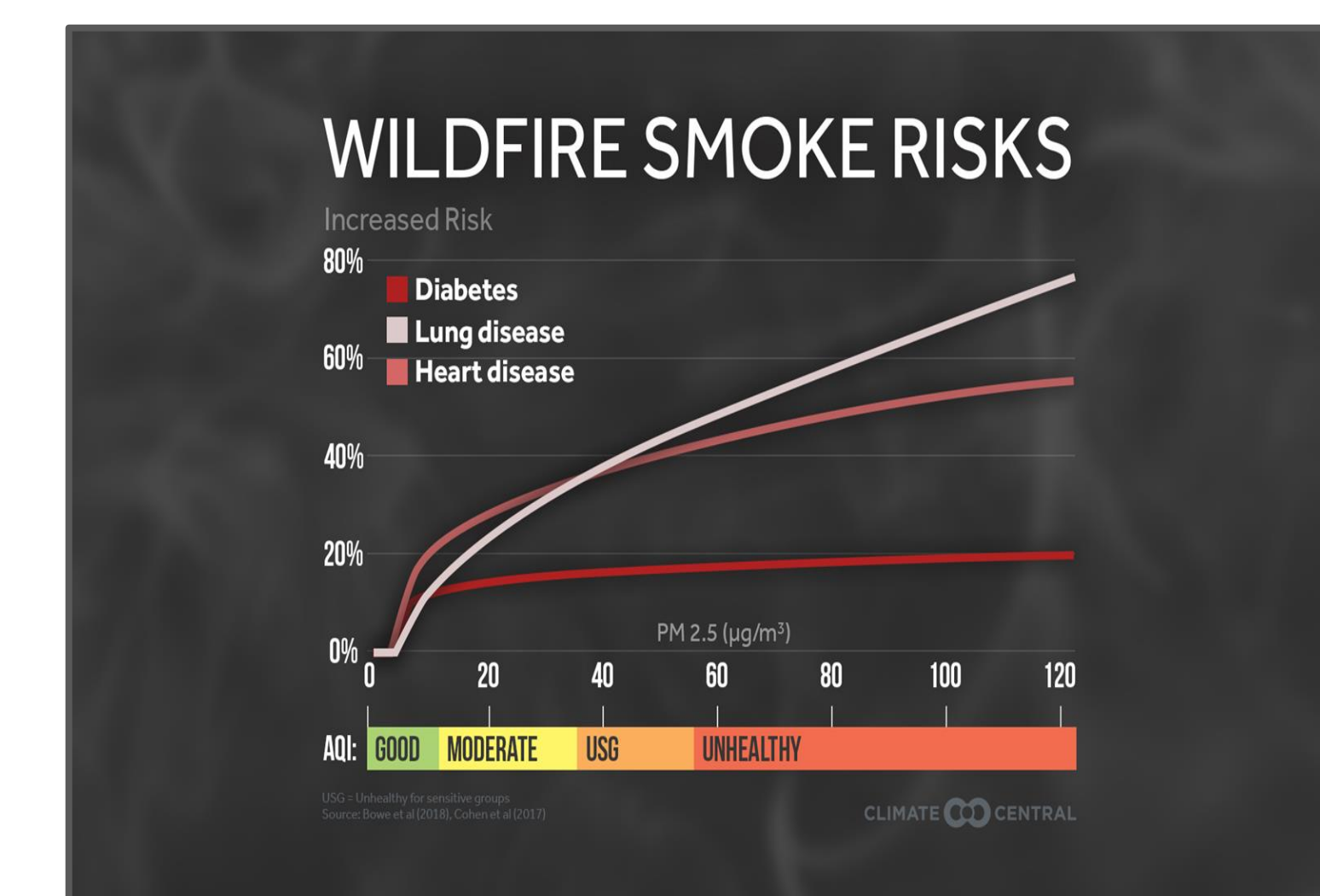


Figure 7: Health problems occurred due to wildfire smoke. The PM2.5 concentration corresponds to an EPA Air Quality Index of 67.

CONCLUSIONS

- Result agree with "Center For Climate And Energy Solutions" that the numbers of wildfire events in California have been generally increasing from 2013 to 2019, with the greatest frequency in 2017.
- The annual accumulation of total acres burned has a major peak between 2017 and 2018, due to a few extreme wildfire incidents.
- The wildfire events occur more frequently during the Summer months (June, July, and August) as compared to the Winter months (November, December, January).
- According to a study from Moms Clean Air Force, the hazardous air quality after the wildfire incident can easily exceed the PM 2.5 concentration limit, with potential risks to our human body such as diabetes, lung disease, and heart disease (Climate Central).



Learning to Innovate Websites and Apps Through Knowledge and Understanding of How the Internet Works.

(Originally titled: Developing an App with Social Media Performance Capabilities)

Student Researchers: Alexon Abreu, Ali Abbas, Bilal Badar
Faculty Mentor: Dan Wong

1 Our Goal

We are three Computer Systems Technology (CST) students drawn to this project for diverse reasons. We desire to acquire new skills and improve our existing ones. Likewise, we aspire to have a research experience that showcases and further establishes skills outside our major.

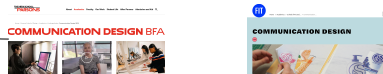
Our focus with this research project is to build an enticing and effective website for City Tech's Department of Communication Design. This website should be a go-to site for any current or prospective student looking to join.

The site will communicate with enrolled students about events and other activities happening within the dept. Faculty office hours, advisement for registration, other questions about student requirements would also be found through this site. For additional value, this site will exhibit student work, the success of graduates, lecture series, and a place to organize club meetings.

But first, we must understand what makes a great website. Our mentor assigned us several tasks that would help us better understand the mechanics of how the internet works.

2 Accessing websites in the communication design department

First, we diagnosed numerous websites with a similar department as city tech's CD dept. During this process, we critiqued the websites to see how they can become better. Simultaneously, we also carefully analyzed what was great with the site and potentially implement it into ours.



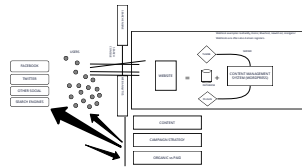
The formatting of the information encourages visitors to explore

Easy navigation to different related links.

The design of the website is outdated

Horrible User experience for prospective students in this department

5 How to attract users and manage your website



The importance of this diagram is to showcase how we plan on managing the site so that we achieve diverse and effective ways of attracting traffic to the site.

We wish to appeal to those who cherish and enjoy creativity. That's why creating a site full of creativity and modern features is essential.

We will achieve this by incorporating a set of themes, plug-ins, and other features we believe embody this goal. Adding these features also assists the site in being easily accessible through search engines. As a result, our audience can easily find and stay engaged on our site.

Lastly, we plan to build a social media presence, broadening our reach.

3 We learned about Search Engine Optimization (SEO)



After thoroughly accessing several websites, our mentor introduced us to Search Engine Optimization and Google Analytics. However, before we dove deep into this subject area, Professor, Wong took us back in time and briefly schooled us on the birth and inner workings of the internet. Which was sort of a cringe moment given we were zen Z babies, all born into a time full of innovation.

SEO can be described as the process of strategically enhancing the quality of a website to improve its rank in search engine results. A few ways of achieving SEO are by choosing critical keywords, using semantic HTML, or simply reducing the amount of duplicate content.

Keywords - Including keywords is heavily important and oftentimes is the difference-maker in whether a searcher finds your site. To rank higher in search results, one must use keywords they believe an online searcher will be using when scouting.

Semantic HTML - This attribute helps to make clear to web browsers what exactly is on your site, and in doing so, helps make your site available to the right audience.

Avoiding Duplicate Content - Most web browsers use a filter system to accurately assess and determine how high or low to rank your site. One is to realize if there is an obsessive amount of duplicate content. Web browsers like Google will automatically hand a lower rank to any site that contains redundant information.

4 How we plan on using Google Analytics to improve our planned site



Google Analytics allows us to monitor and learn from the people using our site. We remain mindful of our ultimate goal, and in doing so, we must learn to recognize how site viewers judge our site by their actions.

With Google Analytics, we can see how long viewers last on the site if they are engaging with site features, how often viewers return, and identify how exactly our visitors found our site.

6 Overall view of what we achieved



This is our current layout for the drop-down menus. So far, this is what we have accomplished as a team. Our focus here is to build an effortless navigation experience where users can find whatever they wish for without much hassle or confusion. Therefore, we made sure to implement different programs like design program, COMD dept, Exhibitions, Student life, and support to help people communicate easily through our website. Given we are in the beginning stages of this project, future adjustments may be required. Once again, this is going to be an all-inclusive site for current and prospective students interested in joining the program.

This Research is Ongoing...

[Redacted]

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Comparative Analysis of 3D Printed Denture Resins with Traditional Denture

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ABSTRACT

The aim of this experiment was to evaluate and identify compression strength between traditionally manufactured acrylic dentures and additive manufacturing resin dentures. Specifically, the dentures produced by Uhler Dental, its Reveal line were compared against samples produced on the Formlabs Form 2 SLA, Stereolithography, 3D printer using their Denture Teeth A2 resin to test compression strength to assure they are compatible with the occlusal forces in the oral cavity. Using the ZwickRoell tensile testing machine, it appeared that the acrylic dentures were half as strong as the resin dentures. Then we went ahead to and did a comparative analysis under a microscope to see the micro-properties such as the isotropic uniformity in the resin, layer adhesion, and the microstructure of the two different materials; in general, these two materials appear that resin denture teeth have lesser mean percent porosity values than the acrylic denture teeth. After doing both the compression test and a micro level analysis under the microscope we have determined that the resin denture has the proper strengths and properties to handle the occlusal forces in a human oral cavity.

MATERIALS AND METHODS

- Extensive Literature Research Conducted on denture material and their properties
- Critical Understanding of microstructure of denture materials.
- Keywords: Denture materials, acrylic teeth, 3D printing
- Research Experts Consulted: Professor Gaffar Gailani

INTRODUCTION

The ideal denture base material should possess several key physical attributes. Some of these properties include biocompatibility, good esthetics, high bond strength with available denture teeth, radiopacity, ease of repair, and should possess adequate physical and mechanical properties. The denture base must be strong enough to allow the prosthesis to withstand functional and parafunctional masticatory forces. In addition, because these prostheses are removable, shock induced fracture resistance, possibly due to patient abuse, is desirable. Many different materials have been used for denture bases. Historically materials such as bone, wood, ivory, and vulcanized rubber were utilized; now many new materials are in the market whether they are traditionally manufactured acrylic dentures or additive manufactured resin dentures.

However, there are significant differences in the mechanical properties among denture materials based on their molecular structures. Usually, it is known that the causes of denture fractures are more often related to design errors of the resins rather than problems with their mechanical properties.

It is determined that denture failures can occur in excessively thin areas or weakened flanges around frenal notches. Midline fractures of denture base resins are especially troublesome, leading some to recommend selectively increasing the bulk of material in regions subject to deformation and fractures. Regardless of how the failure occurred, due to excessive thickness or thinness of the denture it is important to keep in mind of their mechanical strength that decreases the potential for fracture making the use of a stronger acrylic resin very important. Hence, these factors have led manufacturers to develop higher strength denture base materials is why we were determined to test the strengths of the traditionally manufactured acrylic dentures or additive manufactured resin dentures.

RESULTS

This experiment used the tinus olsen tensile tester which is an analog testing machine that provinces either compressive or tensile forces on an object until the point of failure. for this experiment each sample was crushed under a compressive load to the point of failure, while paying attention to the forces equal to the maximum experienced by the human jaw under normal circumstances.

The results of the tensile testing experiment show that the the horizontally printed samples scored roughly 1000 lbf each trial. the 45° samples were showed to have similar strength with one sample scoring lower than average by a wide margin. the vertical samples were shown to have similar results to the 45° samples having one outlier and the rest hovering just below 1000 lbf. the acrylic scored consistently around the 500 lbs mark with was roughly half the average of the 3d printed samples.

The average bite force of an adult human is roughly 170 lbf which each of the samples was able to suppress to some degree. The first test from the 45 degree samples was unable to meet this minimum.

3d Printed resin Vs Acrylic in Compression

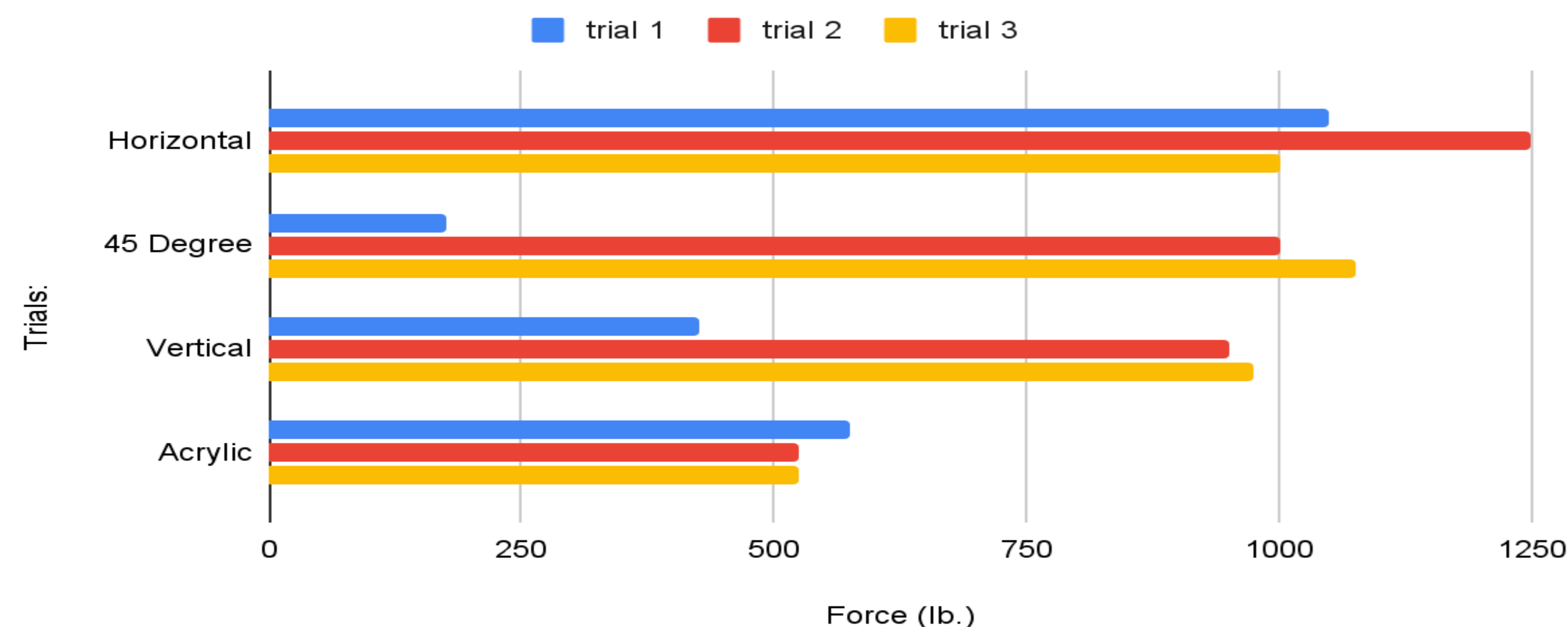


Figure 2. vertical test specimens



Figure 3. Acrylic test specimens



Figure 4. 45 degree Test specimens



Figure 5. Horizontally printed specimens

DISCUSSION

- In this experiment it was shown how the 3d printed samples were able to outperform the acrylic samples. the first trial of the horizontal samples was surprising it successfully surpassed the amount of force produced by the human mouth. the following tests yielded the same results was promising.
- Then the 45° samples started with a very low result which is unknown in origin, however the remaining tests provided comparable results to the horizontal specimens.
- The vertical specimens showed results slightly lower than the 45° specimens, and as well reproduces a similar error to the 45° samples.
- The last test group of the acrylic samples consistently produced half of the same force amount as the 3d printed samples.

CONCLUSION

This work was able to demonstrate that overall 3d printed resin regardless of orientation outperforms the original acrylic. however these results do not accurately show the effectiveness of the acrylic due to a number of limiting factors, such as the quantity of samples for both material types, as well as limiting the scope of acrylic samples tested to just molars, as opposed to canine teeth which deflect force differently.

Further study will see the sample quantity for all datasets increased to gather a clearer picture of the performance of both; as well as using a more modern tensile testing machine to gather more accurate data digitally.

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Sub-Saharan Africa Healthcare Access: Patients Are To Pay Upfronts For Surgical Procedures



OLORUNDAMILOLA OKEMETA

PROFESSOR JEREMY SETO

Introduction

Through this meta-analysis study, it is evident that the structure of healthcare sustainability and accessibility, despite governmental infrastructures, is poor in sub-Saharan African countries. For instance, Kenya, serving a population of approximately 44.6 million is pyramidal and entails complex health centers, sub-district hospitals, district hospitals which are assisted by thousands of private clinics (e.g., seven thousand clinics in 2011), provincial hospitals, national hospitals, and dispensaries as well as nursing homes. With these, the country still suffers from medical problems such as poverty, high illiteracy, inadequate infrastructure, gross inequities in the distribution of health services, dependency on foreign donors, inability to sustain services, low pay and low morale among staff, absenteeism, paucity of specialized physicians, poor training, high rates of staff layoffs, and overloaded doctors and staff. These are some major facets regarding healthcare system in SSA countries like Kenya. With the aid of meta-analysis techniques, comparisons between the United States and sub-Saharan African countries such as Kenya, show poor infrastructural gaps in Kenya and other African regions.

Past studies indicate that healthcare provision in poor countries with private facilities can often deliver services as good as those that the state delivers (public) in places where the state has low capacity, especially for routine care. The private provision of healthcare also does not suffer from the problems of mass absenteeism of healthcare providers that are often seen in public sector provisions. With little or no financial supports in poor infrastructural communities in Kenya, patients are still asked to pay upfront before any medical procedure. This brings us to the Kenyan Constitution of Economic and Social Rights 43(2), which states that "A person shall not be denied emergency medical treatment". Whilst this constitution was implemented, there are certain circumstances especially against private hospitals, where the law requires further clarifications. This is a huge medical factor in terms of attending to patients. The obligations these constitutions bear and how violations can be determined are matters that are equivocal and needs specifications in SSA countries like Kenya.

Objective/Hypothesis

It is evident that the purpose of this study is to look at the financial contributions to low infrastructural sub-Saharan African countries like Kenya in terms of medical attention. This research also indicates the reasons why patients are still required to pay upfront for surgical procedures when sub-Saharan Africa is at its socio-economic crossroads and is grappling for the solutions to such problems.

Methods and Materials

The Gallup Organization has been collecting data in sub-Saharan Africa since 2005 as part of its World Poll. Between 2005 – 2012, this rich resource was used to investigate the approach of well-being and healthcare systems in these regions. This survey also compares outcomes between sub-Saharan African countries such as Kenya with other SSA countries.

- Meta-analysis technique was used to analyze and synthesize multiple academic articles for this study. This is to show similar or contrasting possible trends with the relation to this project regarding sub-Saharan African healthcare disparities.
- Previously, 20 scholarly papers were picked at random. Finally, the data and results were focused on the 6 main descriptive papers.
- The methods were essentially tabulations and graphing of essential data from the surveys and academic papers.
- One of the tools used was an online reference/bibliographical data software, specifically Zotero.
- Papers used were mostly derived from academic sources, namely NCBI and PubMed. These sources helped to compare multiple academic articles on sub-Saharan Africa healthcare disparities.
- National Center for Biotechnology Information (NCBI) is the organization that develops and maintains online databases and tools for biotechnology and biomedicine. The center, created in 1988, is at the National Library of Medicine (NLM), which is part of the National Institutes of Health (NIH).
- However, PubMed (PM) is a search engine for the scientific literature databases MEDLINE (ML), PubMed Central (PMC) and Bookshelf (BS). PubMed is part of the Entrez system. Analogy: Entrez resembles Google. PubMed resembles Google Scholar, "search engine for scholarly literature." Entrez search is limited to the NCBI databases, but Google Scholar is not.

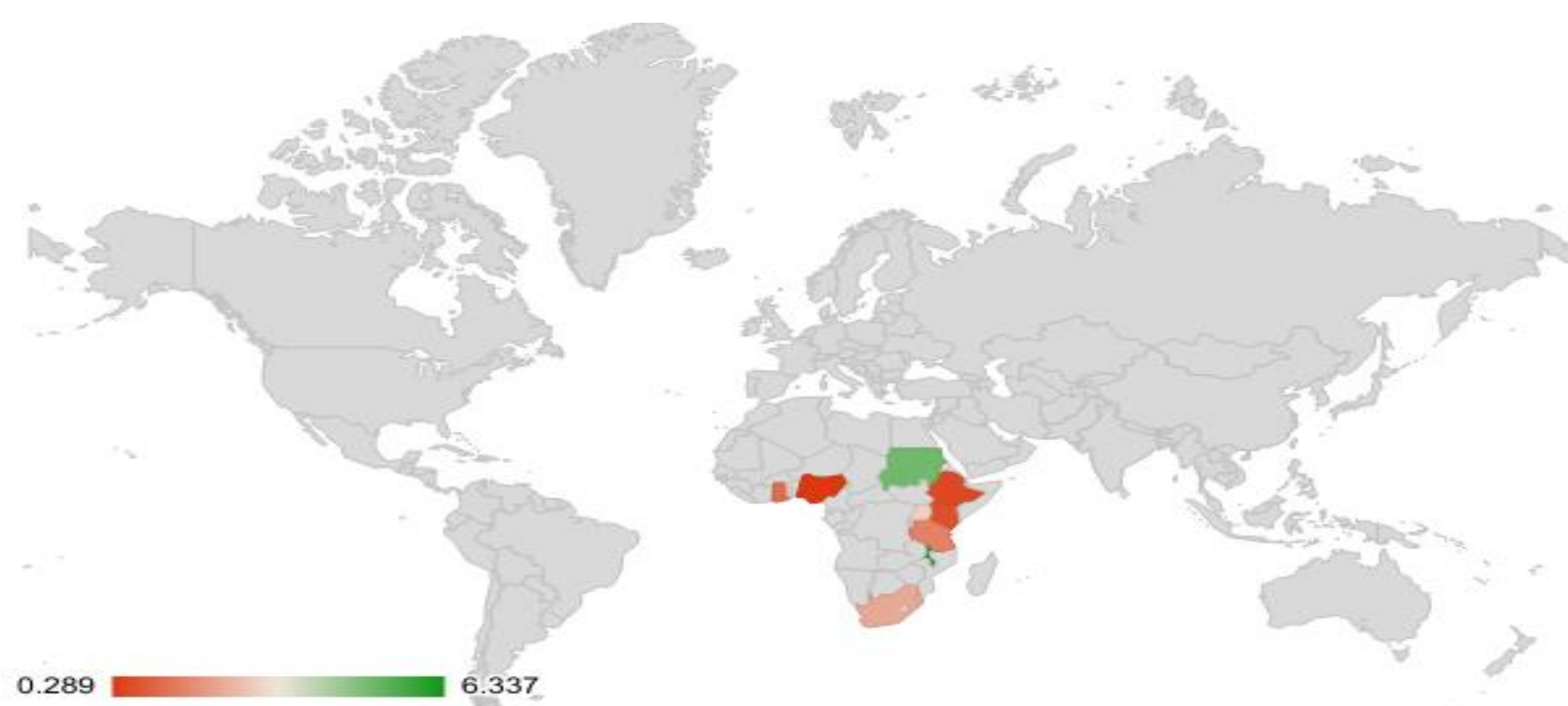
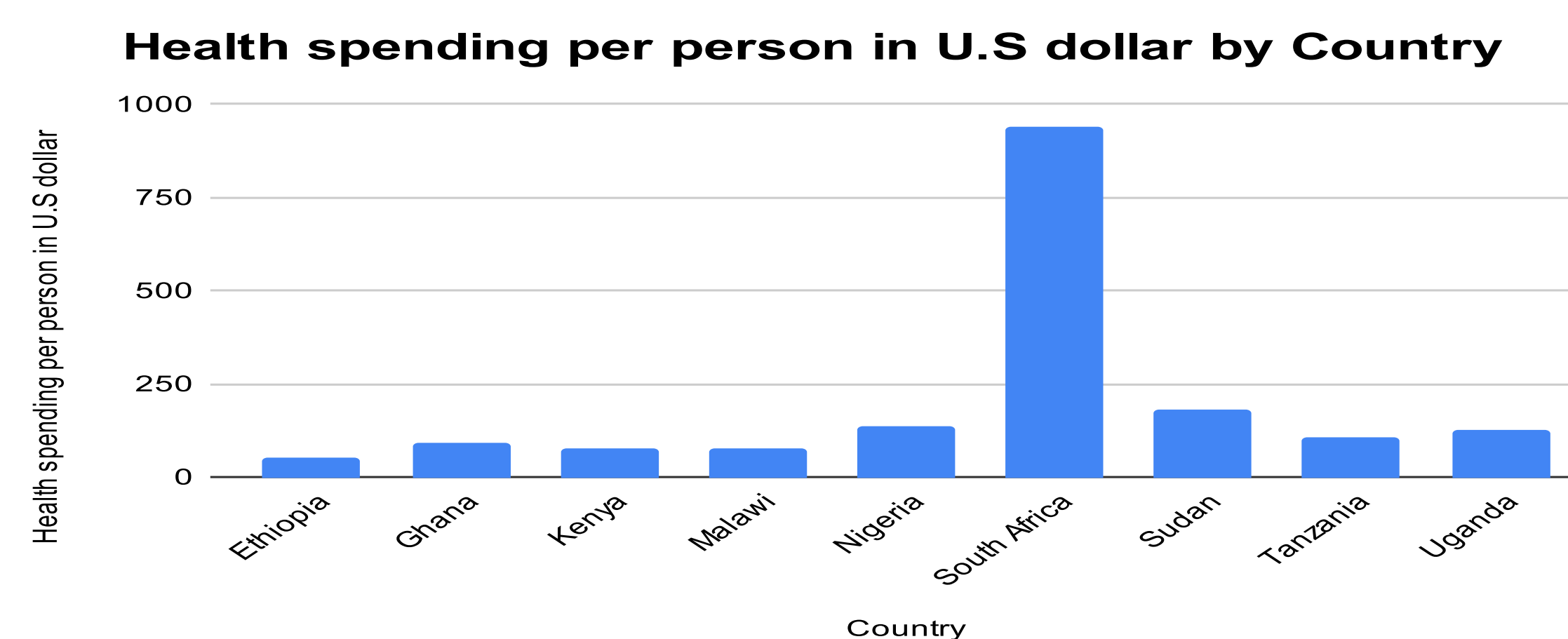


FIGURE ONE (B) mapping

Results

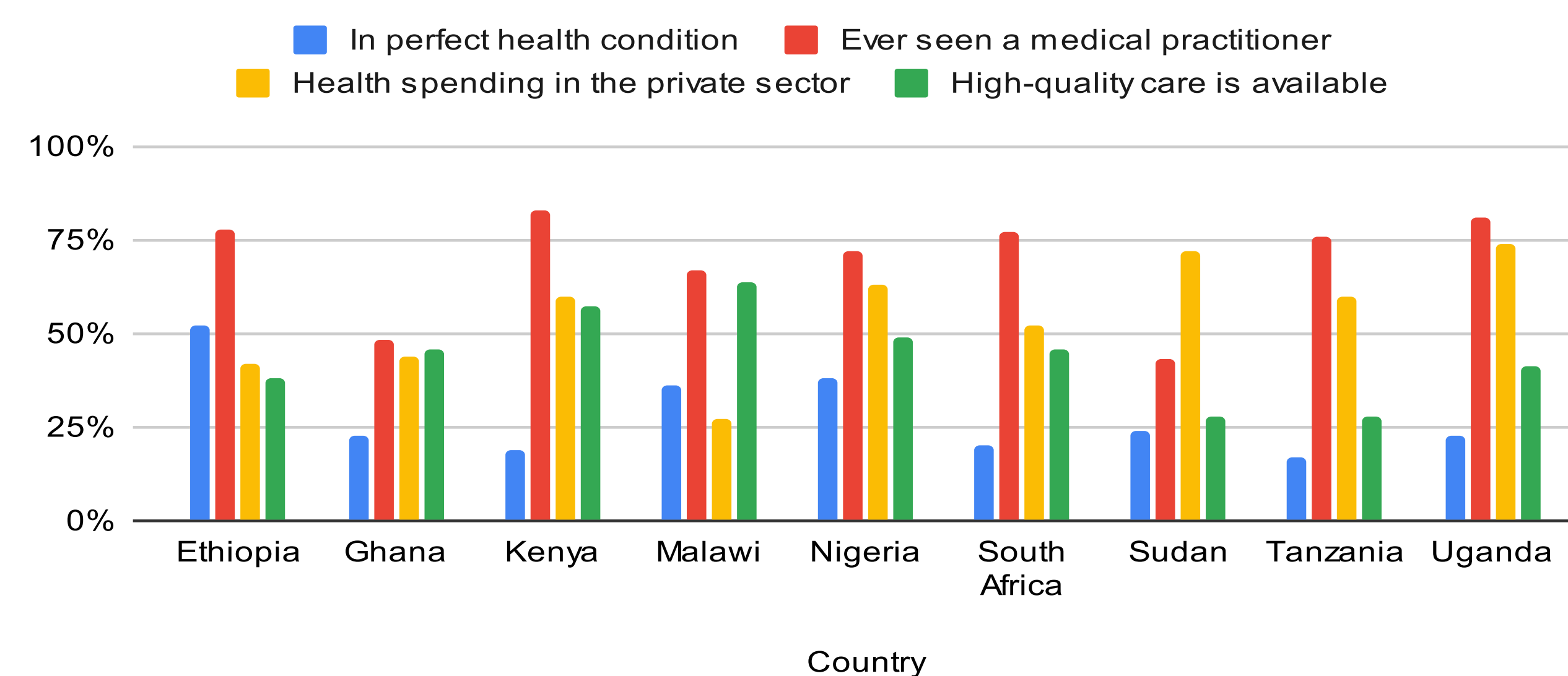
FIGURE ONE (A)



These are nine of the forty-six sub-Saharan African countries in the world. This figure compare the amount of allocated spending per person in each (Deaton, 2015). South Africa has the highest health spending, but much lower compared to other countries like the United States. Interestingly, even though countries like South-Africa has the highest health spending per person, the result shows that they have low health spending per GDP compared to Malawi.

FIGURE TWO

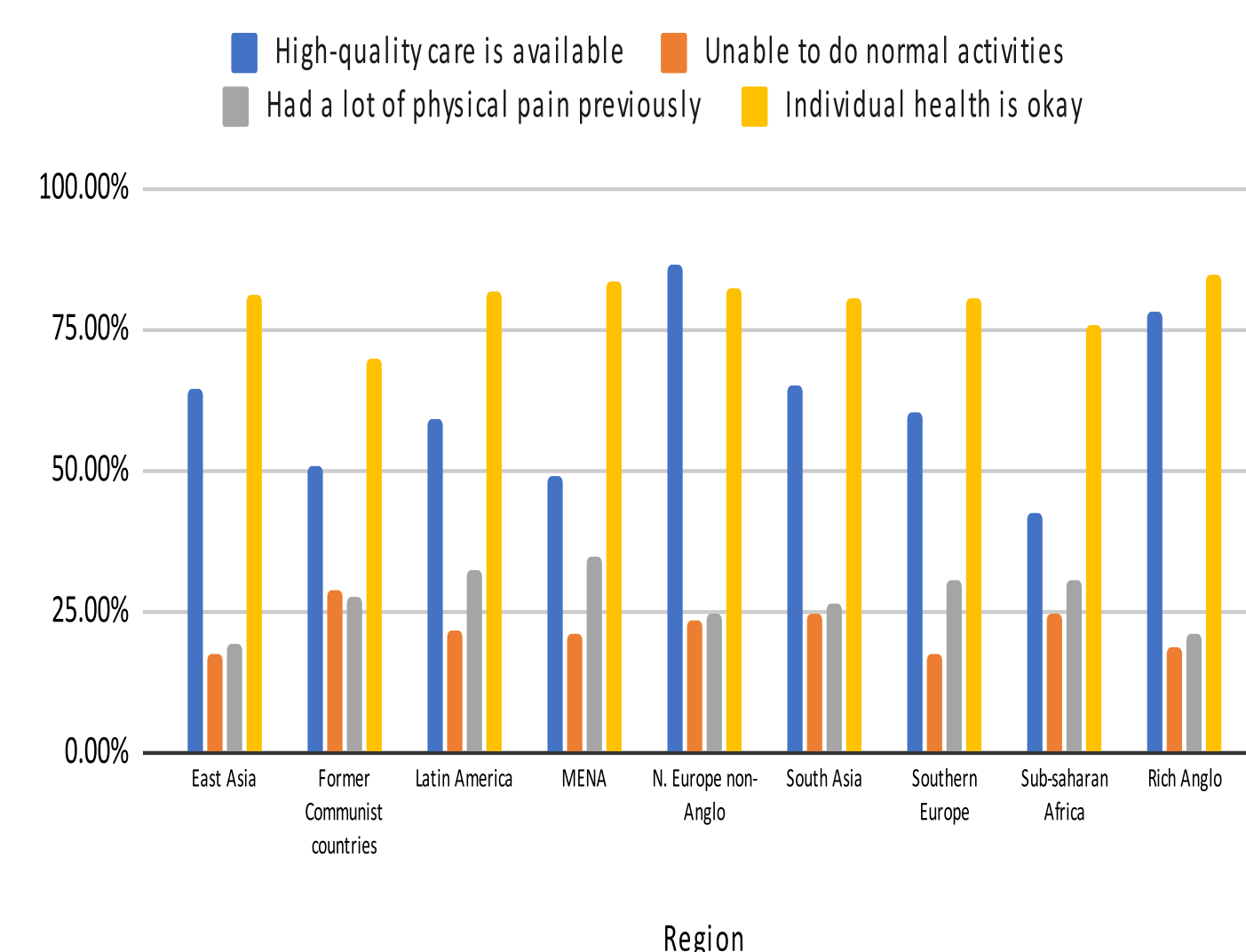
Comparison Between The Health Statistics of Nine Sub-Saharan African Countries



This uses in-person interviews in local languages of fifty-eight languages in sub-Saharan Africa in 2012, to ask 1,000 adults per country ages fifteen and older about various aspects of their lives. This includes but not limited to their health, recent and frequent experience with physical pain, life evaluation questions, and their perceptions of health and health care. Approximately two thousand adults in Ethiopia, Nigeria, and South Africa participated in this study (Deaton, 2015).

FIGURE THREE

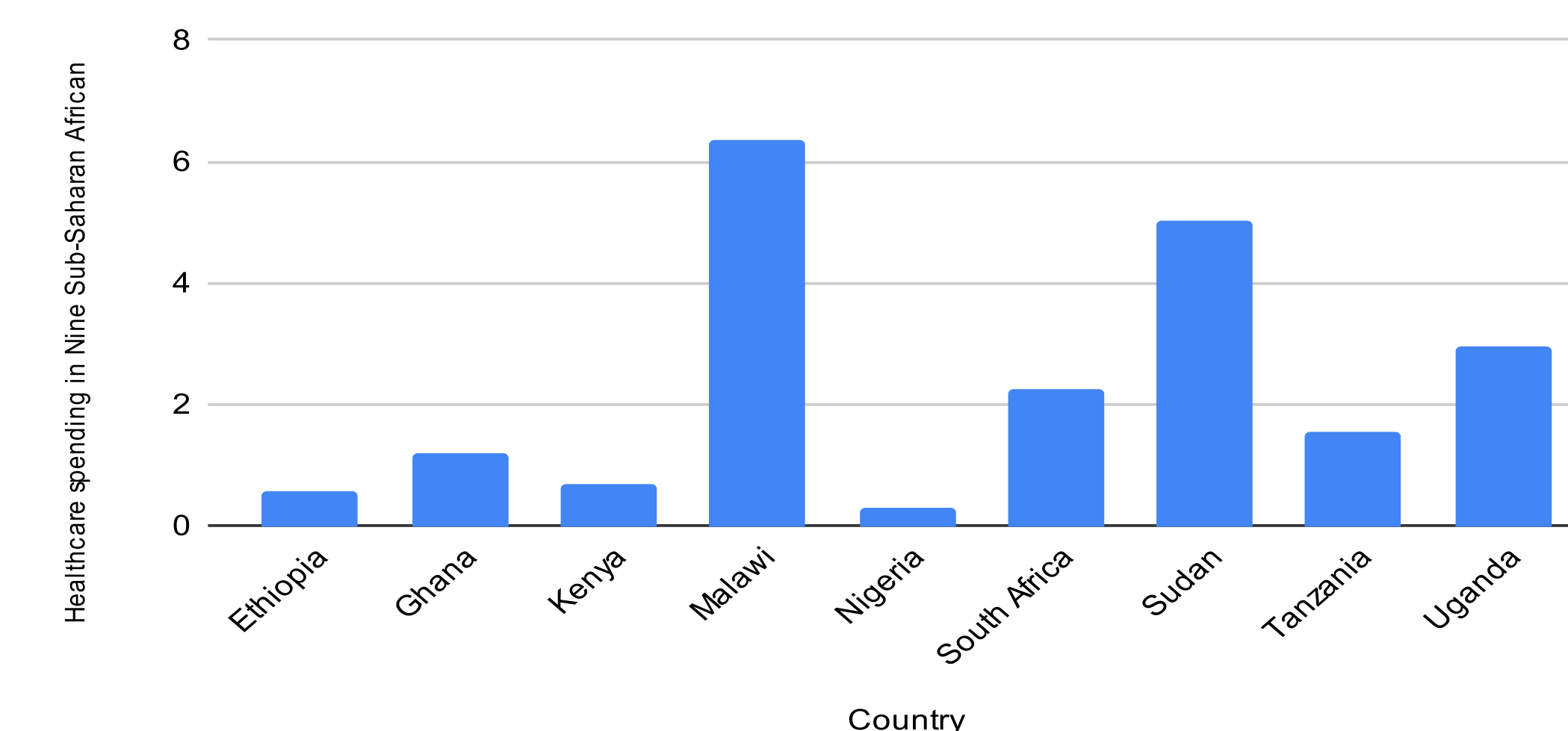
Self-Reported Health and Well-Being Ratings Comparison Between Sub-Saharan Africa and Other Regions



Of the 46 sub-Saharan African countries, nine countries were selected for this study. Weaknesses of the conducted survey includes inability to ask in-depth questions during the in-person interviews, making the questions limited in scope and number. This questions asked includes but not limited to their health and well-being, emotions. However, in the absence of any directly measured health data—such as height, weight, and blood pressure—there is no crosscheck on self-reports, which is a common problem in community health surveys (Deaton, 2015).

FIGURE ONE (B) Bar chart

Healthcare spending per nominal gross domestic product



Summary of Results

- The evaluation of well-being in sub-Saharan African countries is extremely low compared to other populations in the world (figure three).
- Sub-Saharan Africans are also relatively unhappy with their healthcare. Only 42.4 percent are satisfied with the availability of high-quality healthcare in the city or area in which they live (figure two). Note, this is the lowest level of satisfaction in the world.
- There was an astonishing range of health outcomes across the sub-Saharan African countries surveyed in the 2012 Gallup World Poll (figure three). For instance, the fraction of respondents who reported that they were in perfect health ranged from 50 (equal to/or greater than) percent in Ethiopia to only 17 (equal to/or less than) percent in Tanzania.
- The cross-national correlation between those in perfect health and those who had never had contact with a medical professional was -0.285 .
- From one of the models used, it is evident that 84 percent of speculated participants responded while the median refusal rate was 6 percent.

Conclusion

Further research on equity and equality of the devolved healthcare system in Kenya as well as other sub-Saharan African countries should be encouraged. This research advocates for the allocation of resources to counties or communities with poor infrastructure and hope for a better health system globally.

Future Studies

As a continuous project, the scope of this study could be widened by comparing sub-Saharan African countries health disparities with other non-sub-Saharan countries, as well as continents, thereby addressing not just cause and effect, but also explanatory solutions to such problems. Meta-analysis technique is reliable, but models used should be thoroughly and carefully observed since data inconsistency or poor execution of important covariant could occur.

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A special thanks to CUNY - New York City College of Technology and the Emerging Scholars Program (ESP) team for the opportunity given to engage in this undergraduate research. The completion of this project would not have been possible without the scholastic insights gained from my esteemed research mentor Professor Jeremy Seto. Thank you all!



CIL EMULATOR



Roshel Babayev, DeAndre Badresingh, Prof. Jean Boulet, Computer Systems DEPT

Abstract:

The release of .NET framework many languages including C#, VB.NET, and F# compile into bytecode known as common intermediate language (CIL), previously identified as MSIL. For this research project, we've decided to make a CIL emulator. The emulator will emulate the bytecode allowing secure execution, function manipulation, and safely emulate computational functions without having to worry about malicious code execution. The emulator is built for expansion in order to easily add more support for any future introduced instructions. Overall, this project has shown just how much more there is to just making something as an emulator as while emulation of instructions can be quite intricate in of itself, there are other aspects which you must take into account.

Introduction:

An emulator allows a user to simulate instructions being executed. In order to emulate each CIL instruction, we must add support for each one. There are 256 instructions in total but not all of them have to be supported as some of them are reserved or are never emitted.

Setting up the emulator:

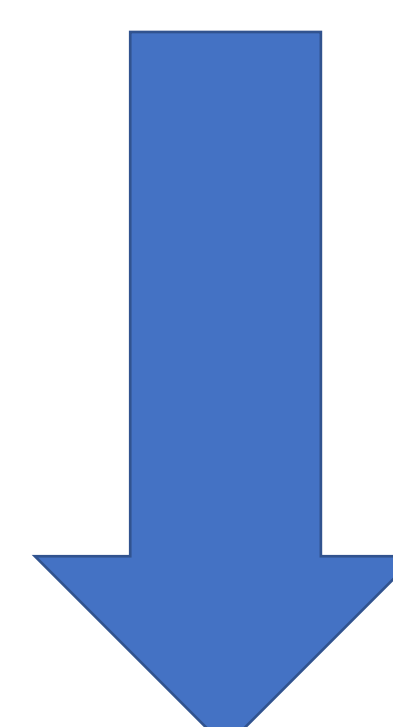
The emulator should allow emulation of CIL instructions and also allow the user to intercept the instructions at any given point and to view the state of the current emulator context. All CIL instructions are created with abstraction in mind so you could easily implement any additional instructions with absolute ease. Modularity is key in an emulator like this as we must allow instructions to be modified at any given point to suit any needs necessary. Keeping all of this in mind we've created a small demo to demonstrate just how easy it is to emulate a method.

```
public int Addition() {
    return 2 + 2;
}
```

We use the reader to extract the instructions of the method



Instructions		Count = 4
[0]	{ldc.i4.2}	
[1]	{ldc.i4.2}	
[2]	{add}	
[3]	{ret}	



We emulate the instructions of the method to get the result

```
CIL Emulator
Result of method [Addition] is: 4
```

Creating the instruction reader:

In order to emulate a method, we must first retrieve the instructions within the method in order to emulate them. For this we've created a method body reader which allows you to simply input a .NET module and it will automatically parse the .NET module in order to get all the classes (types), methods and more in order for you to have everything at your disposal.

Conclusion:

Emulation is not a simple goal. It requires much research in order to first gain an understanding of the architecture and the instructions you'll have to support. Once you manage to gain all of this knowledge there are still many unexpected hurdles that can come your way like they did for me. As development proceeded for the emulator I had realized that I needed a method to read out the instructions and this resulted in me creating the reader for this project as well (which was honestly harder to create than the emulator itself). Overall this was a very enlightening experience in learning just all of the hard work put into creating an emulator and if not for our teamwork, this would be quite a tedious one man job.

Acknowledgements:

<https://github.com/RoshHour/SREmulator>

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The Structure and Analysis of calpains in *Tetrahymena thermophila*

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Background Information or Abstract

Calpains are a family of ubiquitously expressed calcium-dependent, non lysosomal cysteine proteases. Calpains are involved in apoptosis, cellular proliferation, and cell motility. While mostly calcium-dependent, calpains may also be activated through ERK-mediated phosphorylation. Calpains are found in a few eubacteria and almost all eukaryotes, but not found in archaeobacteria. *Tetrahymena thermophila* is a ciliate found in fresh water. Remarkably, these cells have two nuclei, one is the germline nucleus and the other is the somatic nucleus. The germline, the micronucleus, is silent during vegetative growth, while the macronucleus is very active during vegetative growth. Conserved eukaryotic mechanisms have been modified in ciliates to selectively deal with the two genomes. *T. thermophila* has been used as a model to study many cellular processes.

Results

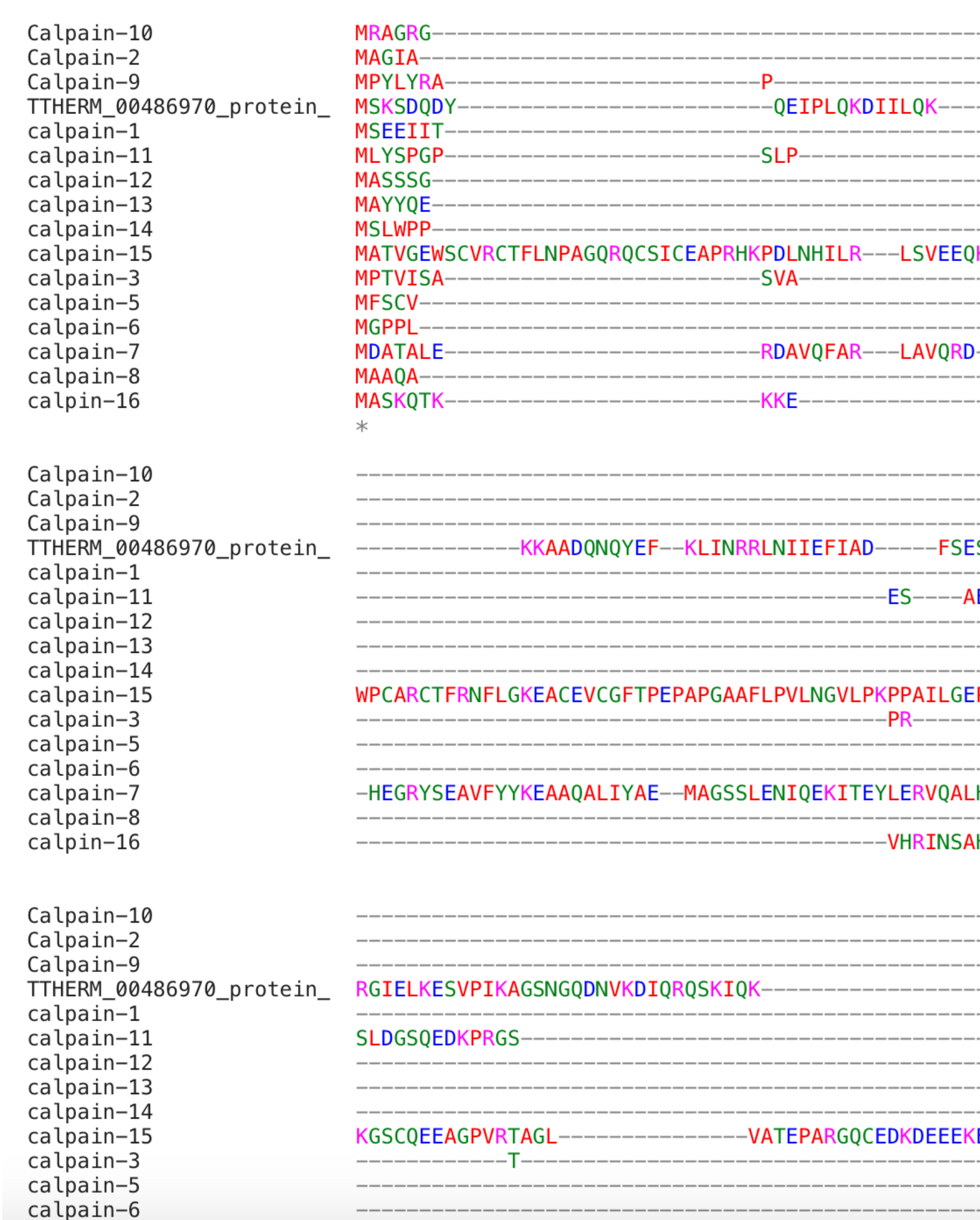


Figure 2: Comparison of human and Tetrahymena calpain sequences. Tetrahymena sequences were compared with CAPN16, CAPN11 and CAPN7.

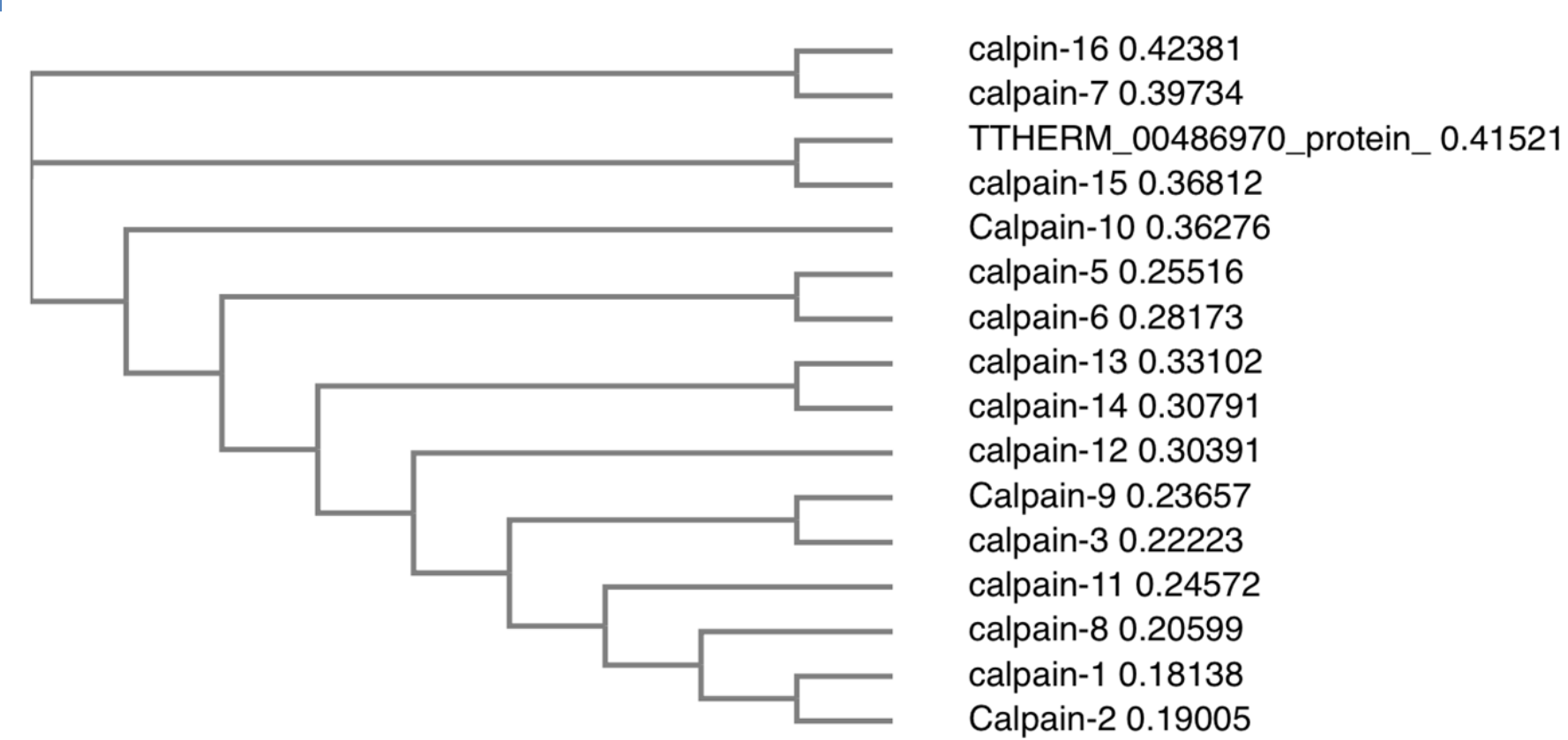


Figure 3 shows us the relations between the human gene and THERM_00486970 with the Muscle alignment and phylogenetic tree.

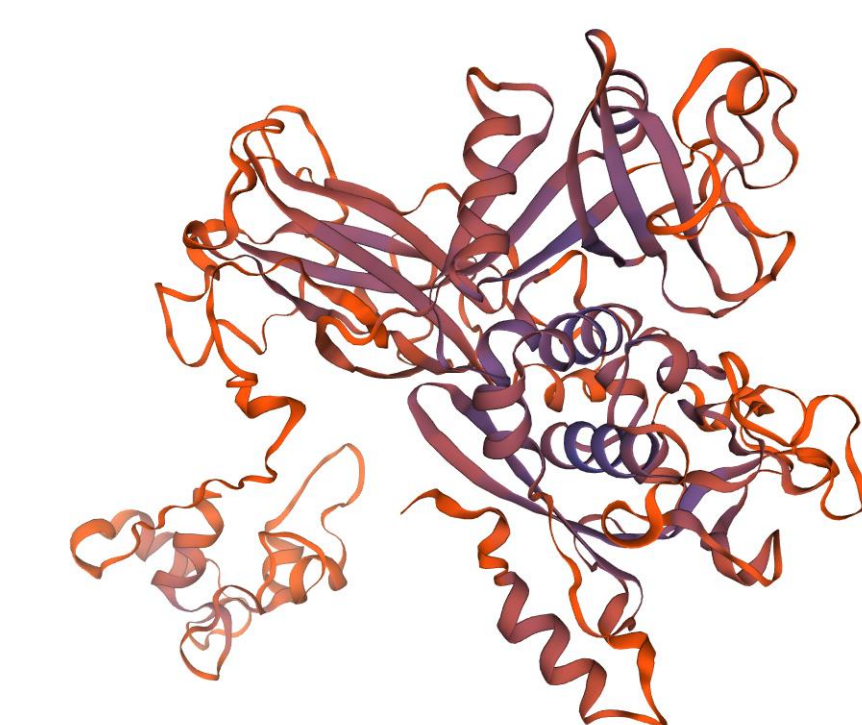
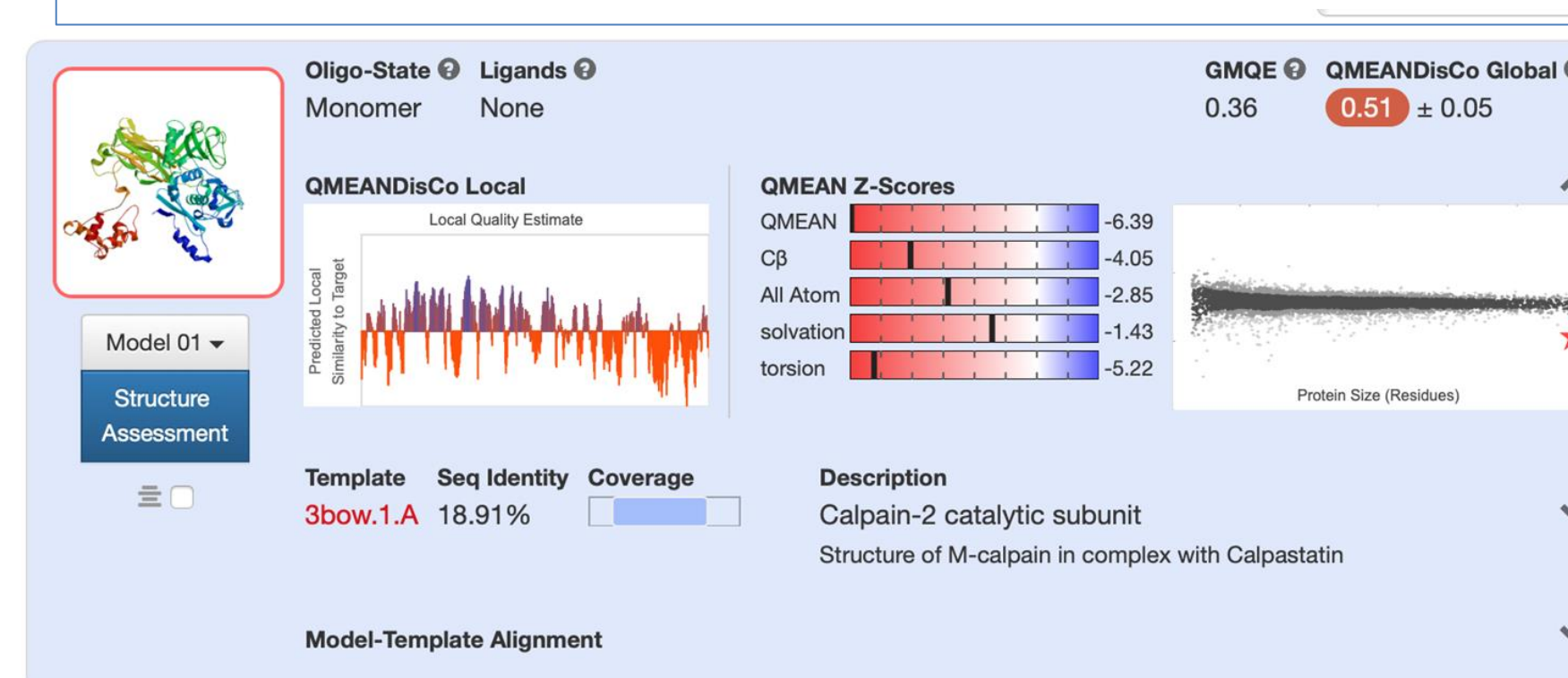


Figure3 and 4 generates reliable three-dimensional protein structure models and practical applications. The SWISS model was used to generate a 3-Dimensional model of the THERM_00486970.

Discussion

The protein sequence of *THERM_00486970* was compared to protein sequences of human calpains. Multiple protein alignments and phylogenetic trees suggest *THERM_00486970* is more closely related to human calpain 7. However, more analysis is needed to confirm these preliminary results. With bioinformatic tools, unknown protein structures, like calpains in *T. thermophila* can be aligned with homologous sequences. The regions of the target sequence that are similar to the homologous sequence is used as a template. Using modelling tools, the secondary structure conformation is formed in the regions where the target alignments with the template. Further refinement of the target sequence regions that do not align must be solved using techniques other than homology modelling.

CONCLUSION

Calpains are remarkable proteins that have similar genes with *Tetrahymena thermophila*, which concludes that these are related to human genes with using bioinformatic tools.

Future Directions

We will continue to use Cellular Biology and Bioinformatics techniques to observe the gene expression of human calpains. Continue to solve for the structural conformation of the *T. thermophila* calpain using Bioinformatics and Molecular Modelling techniques.

Acknowledgement

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Professor Ralph Alcendor PH. D., Department of Biological Sciences

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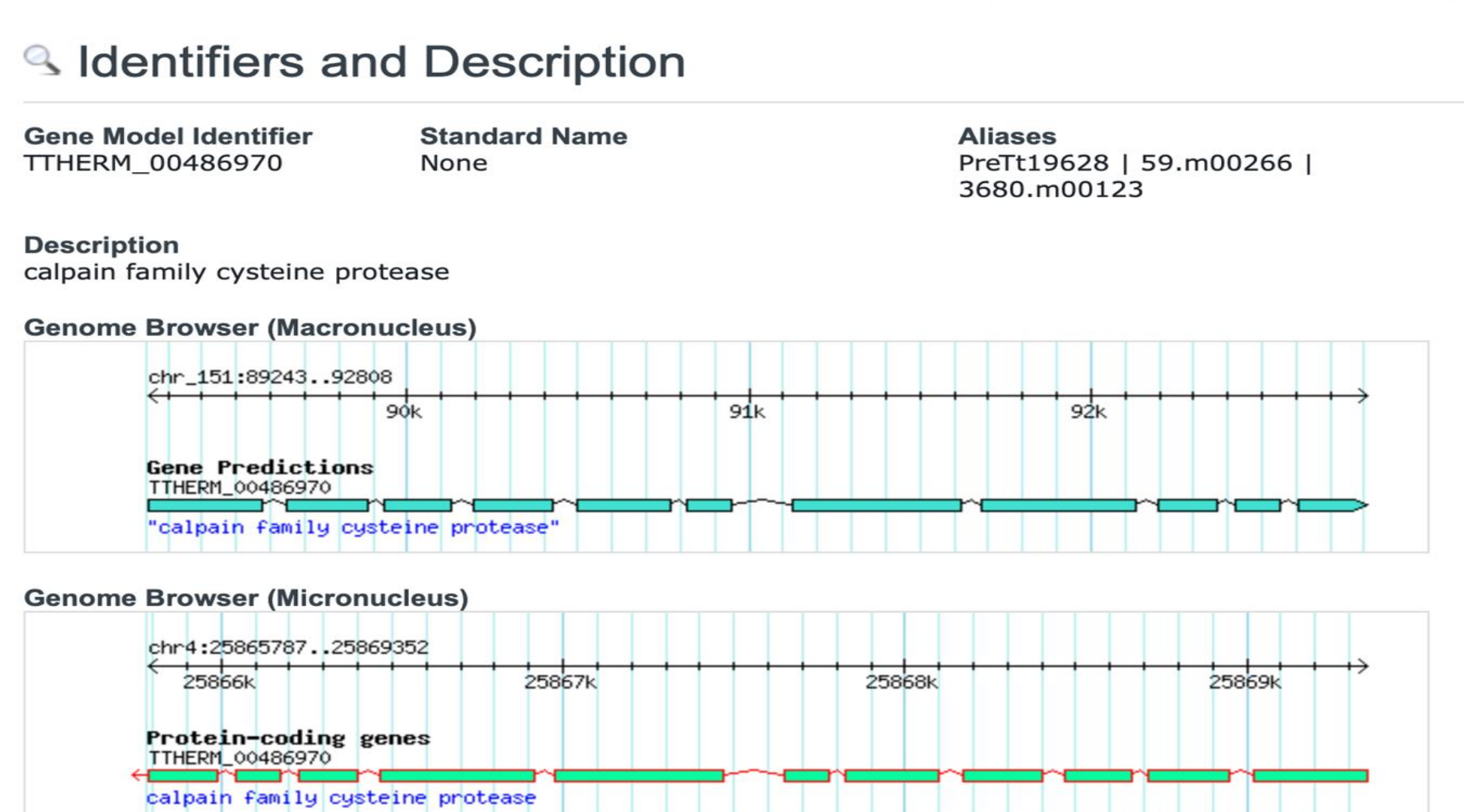


Figure 1 shows the gene THERM_00486970.

Objective

The purpose of this project was to characterize *THERM_00486970*, a calpain family member from *T. thermophila*, using bioinformatics tools.

Materials and Methods

Tetrahymena calpain sequences were compared with human calpains using BLAST, TCOFFEE, and SWISS Model. *Tetrahymena* sequences and gene information were obtained from Ciliate.org, an online database. We used molecular modelling techniques to predict and compare the structure of *T. thermophila* calpains. Using homology modelling, the unknown target protein structure of calpain *THERM_00486970* was aligned with a homologous sequences.



BIFURCATING BROOKLYN: THE CONNECTION TO THE VERRAZANO BRIDGE

Farai Matangira

Professor Michael Duddy



Gowanus Expressway connection to the Verrazano Bridge through Bay Ridge

Abstract

The construction of the Gowanus Expressway as part of the approach towards the Verrazano Bridge in the 1960s led to the bifurcation of a vibrant neighborhood in Bay Ridge, Brooklyn. Its construction was controversial and was met with strong resistance from the surrounding community, with residents fearing losing their homes and businesses. Their concerns were greatly ignored which led to thousands of residents getting displaced, and hundreds of properties destroyed to accommodate the highway. Today, the area where displaced residents used to call home, is now dominated by a highway, which does little to serve the community it runs through. This culminates into an undesirable neighborhood that has been physically split into two by a burrowing transport system.

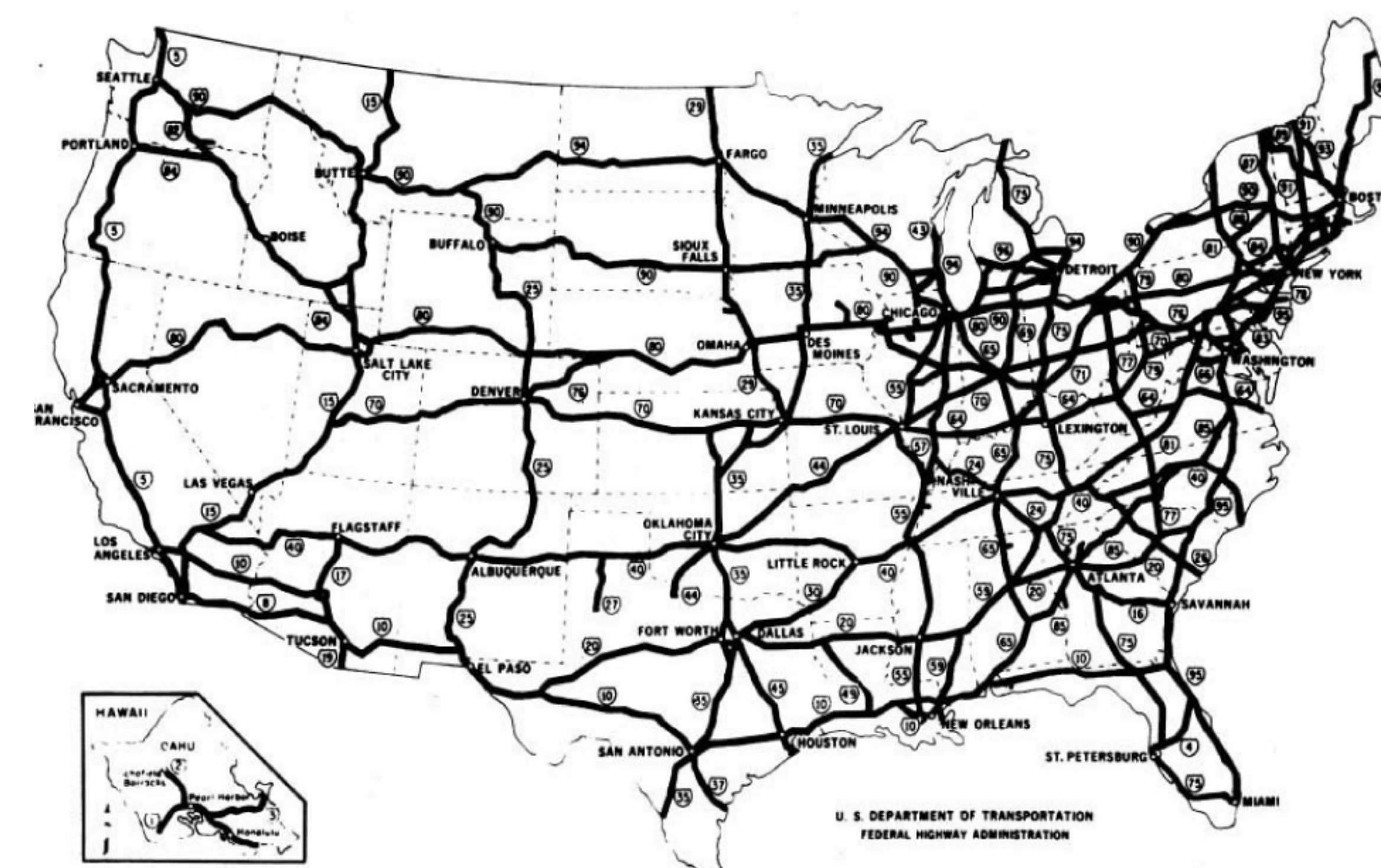
This study explores the construction of the Gowanus Expressway from the lens of the neighborhood it split. It investigates the reasoning behind the decisions made in the construction of such a destructive highway. How was the route of this highway chosen? Could there have been an alternative route? What was this neighborhood like before the highway, and who were the people displaced? These are some of the questions explored in this study.

Construction of the Gowanus Expressway

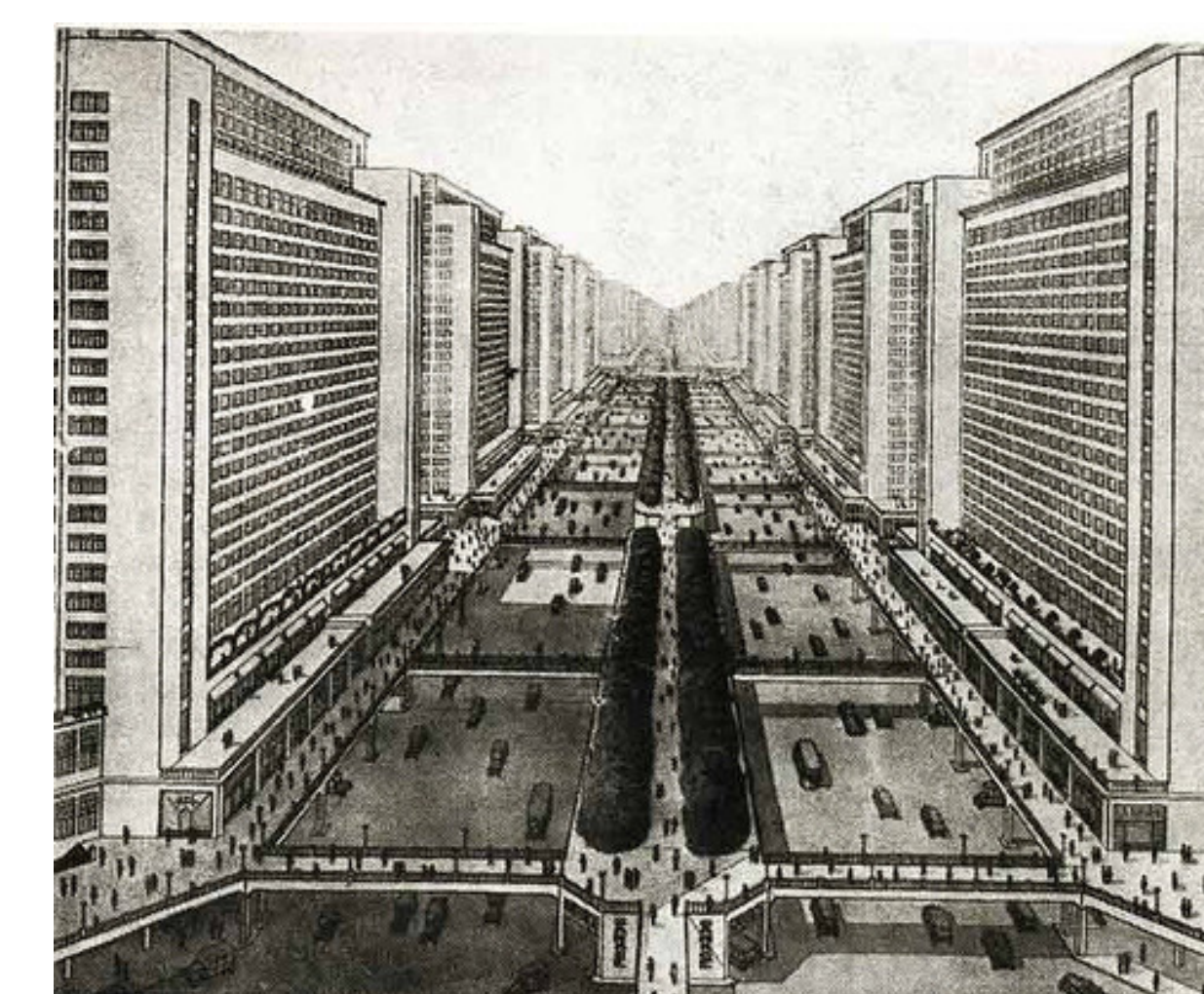
Completed in 1964, the Gowanus Expressway was the culmination of events that shaped many cities in the United States in the 20th century. From the deliberate advocacy by the automotive industry, led by General Motors, to transition to a highly vehicle dependent society, to the passing of the Interstate Highway Act of 1956 which promised to create a 41,000-mile “National System of Interstate and Defense Highways”, and then the Urban Renewal Program which was responsible for the redevelopment of many sections of New York City between the 1930s to the 1970.

The Gowanus Expressway Today

What is left today is a neighborhood has been split in two. The construction of the Gowanus Expressway led to the destruction of hundreds buildings and the relocation of thousands of Bay Ridge residents. The Expressway mainly serves commuters to and from Staten Island, with nearby residents having to live with a pollutant highway that does little to serve them. There is a growing need to question the true importance of the highway in the context of climate change and the impact that transportation has on our cities. This will be the first step in efforts to stitch back the neighborhood that was destroyed in the creation of the Gowanus Expressway.



The National System of Interstate and Defense Highways. Source: dot.gov



Details of the Futurama Diorama presented at the 1939 New York World's Fair by General Motors showing express boulevards and highways as main arteries for city traffic. Source: archive.org

Electron spectrum in topological nodal lines semimetals

Student Research: Fergus Kouakou

Mentor: Oleg Berman (Department of Physics, City Tech of CUNY)

Co-Author: Godfrey Gumbs (Department of Physics, Hunter College of CUNY)

Background

Following the discovery of graphene, nodal semimetals grabbed a lot of attention in condensed matter physics. Topological semimetals (TSM) are defined as systems where the conduction and the valence bands cross each other in the Brillouin zone (BZ), and the crossing is non accidental. The conduction and the valence bands cross each other along a one dimensional curve in the three dimensional Brillouin zone (BZ), and any disturbances on certain symmetry group cannot remove this crossing line and open a full direct gap between the two bands, hence the nodal line(s) is topologically protected by the symmetry group, and can be associated with a topological invariant.

Methods

- Optical and magneto-optical spectroscopy
- Single crystal growth
- Drude SW calculations
- Density functional theory calculations

Results

•An effective Hamiltonian for electrons in nodal line semimetals in the model 1 is given by:

$$\hat{H}(\mathbf{k}) = (m - k^2)\sigma_z + k_z\sigma_x$$

•The Hamiltonian for equation 1 reads as:

$$\hat{H}(\mathbf{k}) = \begin{pmatrix} m - k^2 & k_z \\ k_z & k^2 - m \end{pmatrix}$$

With the eigenvalues being the energy spectrum for the electrons

$$E_{1,2} = \pm\sqrt{(k^2 - m)^2 + k_z^2}$$

•An effective Hamiltonian for electrons in nodal line semimetals in the model 2 is given by:

$$\hat{H}(\mathbf{k}) = k_x s_x \otimes I + k_y s_y \otimes \tau_y + k_z s_z \otimes I + m \tau_x \otimes s_x$$

•The Hamiltonian for equation 2 read as:

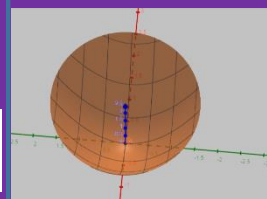
$$\hat{H}(\mathbf{k}) = \begin{pmatrix} k_z & 0 & k_x & (m - k_y) \\ 0 & k_z & (m + k_y) & k_x \\ k_x & (m + k_y) & -k_z & 0 \\ (m - k_y) & k_x & 0 & -k_z \end{pmatrix}$$

With the eigenvalues being the energy spectrum for the electrons

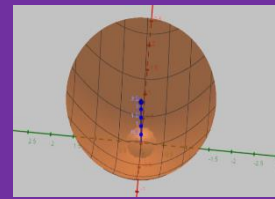
$$E_{1,2,3,4} = \pm\sqrt{k_z^2 + (\sqrt{k_x^2 + k_y^2} \pm m)^2}$$

The following 3D plots are for *model 1: energy spectrum $E(k_x, k_y)$ for electrons as a function as k_x and k_y at $k_z=0$*

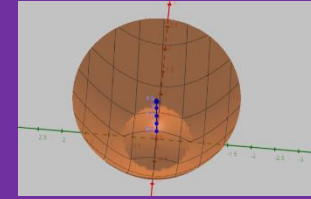
For m=0



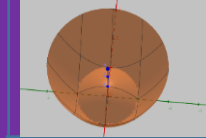
For m=0.1



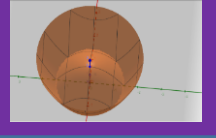
For m=0.5



For m=1



For m=2



Conclusion

For most topological materials, the observation of topological surface states has been considered a definitive confirmation of the nontrivial topology in the band structure. The prerequisites of its application are (i) the symmetry group protecting the topology in the bulk must be unbroken on the edge and (ii) the interaction is weak or the edge can still be gapped into an anomalous topology order.

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DIRECTION FOR PROTECTION:

Multimedia Messaging to Address Racial Health Disparities

Florence F. Litchmore-Smith, City Tech Emerging Scholars Program, Fall 2021
Mentor David Lee, Department of Humanities



Abstract

According to the CDC (2021), black people have higher risks of hospitalization and death from COVID 19. The Kaiser Family Foundation (2021) reports that black adults are less likely to have received the COVID 19 vaccination than white, Asian and Hispanic adults, placing them at greater risk for COVID 19 infection. Lower rates of vaccination focus attention on the need for messages tailored to underserved populations. In this study, we review historical and contemporary events to acknowledge important milestones in public health. Using graphic arts, we present a symbolization of the social determinants of health and a poster highlighting some of the many contributions to microbiology and immunology from African Americans. This was a pilot project for developing more sensitive and culturally relevant vaccine messages.

Symbolizing Social Determinants

The first part of this research involved learning about social determinants of health, including racial and economic determinants. Our source of information was the Healthy People 2030 website. The goal was to gain greater insight into the public health perspective and create a graphic image representing the 5 social determinants of health.



The image symbolizes these five dimensions of life which impact health:

- Education Access and Quality
- Economic Stability and Income
- Health Care Access and Quality
- Neighborhood, Housing and Built Environment
- Social and Community Context

African American Immunologists

Key contributions to the science of immunology were made by African Americans, but systemic racism has obscured their great accomplishments. Here we present just a few of these historic figures.

In 18th century Boston, a deadly smallpox epidemic was spreading rapidly. Before the germ theory of disease was prevalent, an enslaved African man named Onesimus communicated and demonstrated his technique for obtaining immunity. This involved rubbing the suppuration of an infected person into a small incision. The technique was imparted to a physician who used the method to inoculate hundreds and save many lives (Blakemore, 2019).

The Hinton Method is a blood test to detect syphilis, invented by Dr. William Augustus Hinton, an immunologist at Harvard University. In a grim irony, hundreds of African American sharecroppers were not treated for syphilis in the infamous Tuskegee Syphilis Study from 1932-1972, just as Dr. Hinton's test became the diagnostic standard (Levine, 2021).

Dr. Kizzmekia Corbett is an African-American microbiologist and immunologist at the U.S. National Institutes of Health (NIH). By leading preclinical studies, developing testing arrays, and helping design the Moderna COVID-19 vaccine, Dr. Corbett played a major role in the fight against the COVID pandemic. Dr. Corbett's immunology work also involves health communication as she conducts outreach to address vaccine skepticism in African American communities (Levine, 2021). In honor of these and other figures, we created this poster:



This image commemorates scientists and pioneers in microbiology and immunology. It is a prompt to the viewer to do some research and find out more about the history of microbiology, immunology and vaccine science.

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Abstract

The growing human population, industrialization and urbanization leads to water scarcity and has become one of the major problems that the world faces. Globally, it is likely that over 80 percent of wastewater is being released into the environment without proper control and decontamination methods. There is an increasing demand for clean and sustainable treatment of organic and inorganic pollutants in wastewater. Photocatalysis has been widely studied for the efficient conversion of solar light energy into useful chemical energy. On the other hand, nanomaterials structural components such as their small size, large surface area, high reactivity, and catalytic properties, make them effective materials for removal of pollutants from wastewater. This study is aimed to investigate the use of nanomaterials as photocatalysts, specifically, metal oxide nanoparticles, titanium dioxide (TiO_2) for degradation of pesticides, pharmaceuticals waste, organic dyes, heavy metals, and industrial waste. TiO_2 has been very promising material due to its high photocatalytic activity, low price, and chemical and photostability. In addition, advantages, disadvantages, and limitation of TiO_2 photocatalyst will be addressed.

Introduction

Water is a huge essential to our life. Let's think for one sec, what would we use if we weren't able to use water? That's because we need water to practically survive. What most don't really know is over 80% of wastewater is being released into the environment without proper control and decontamination methods. Most developed and developing countries are in desperate need of efficient treatment of wastewater due to the increasing demand in quality water. One of the major concerns lies in the contamination of water resources by organic and inorganic pollutants. Organic compounds, generated from various industries, produce a range of the problematic pollutants such as pesticides, pharmaceuticals waste, and organic dyes. While most of the inorganic pollutants exist naturally within the environment, but due to the increase in manmade activities such as mining, industrial, and agricultural activities, their concentration within the environment has increased. How can we try to reverse this and make a difference in this world? To achieve the goal of providing high quality water, there are many chemical, physical and mechanical methods such as adsorption, precipitation, coagulation, filtration, chemical and membrane technologies and the innovative technology of photocatalysis. Photocatalysis uses semiconductor material such as TiO_2 , ZnO , Fe_2O_3 and other metal oxides. Nanomaterials structural components are sized between 1 and 100 nm, and it's their small sizes and large surface area that makes them effective photocatalysts. Titanium dioxide (TiO_2) uses light to oxidize organic contaminants and degrade them to CO_2 and water, and on the other hand can reduce metals. TiO_2 has proven to be the best option also because of the low costs, high photocatalytic activities, chemically stable and toxic-free.

Results

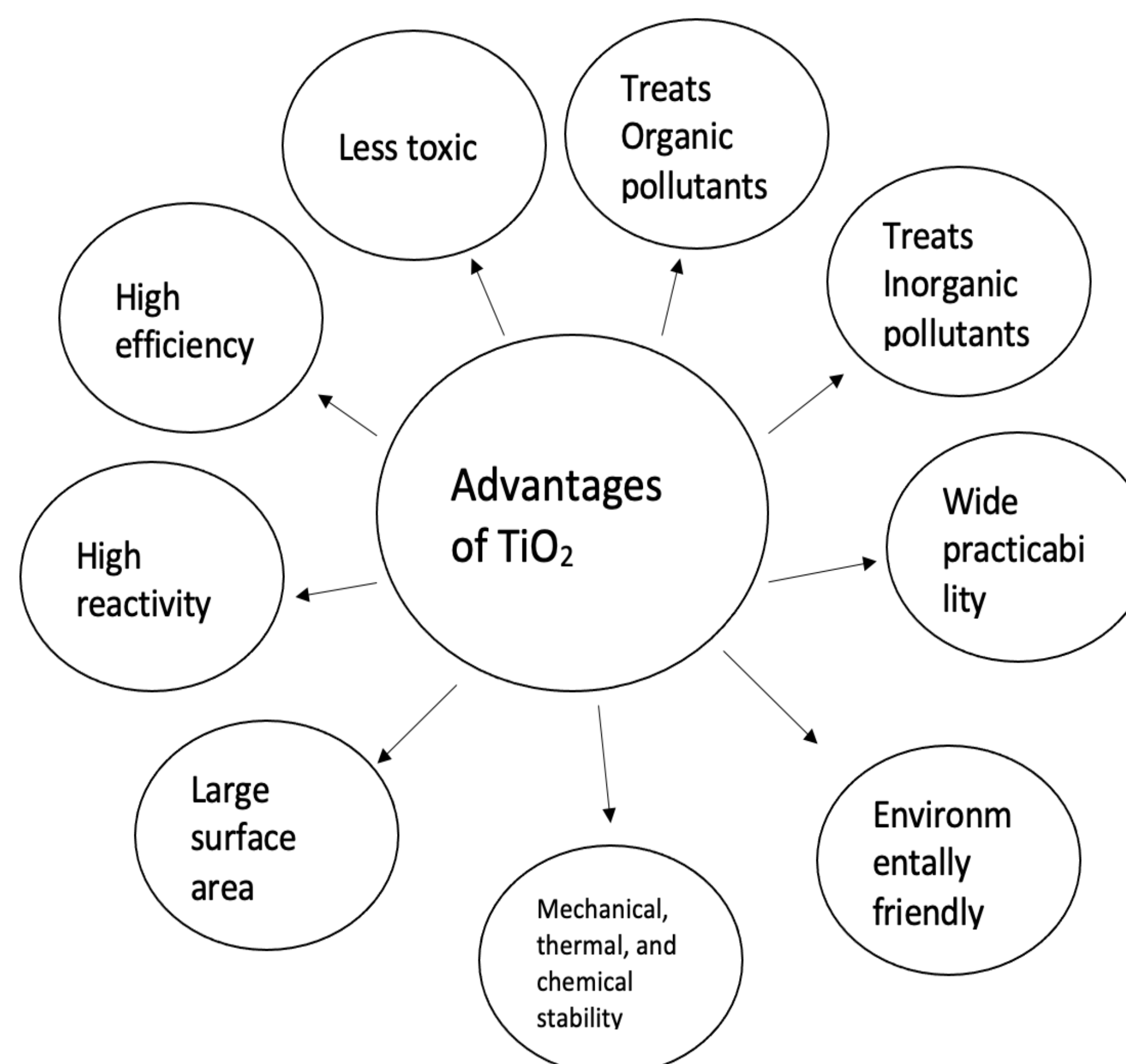


Figure 1: Advantages of using TiO_2 Photocatalysis.

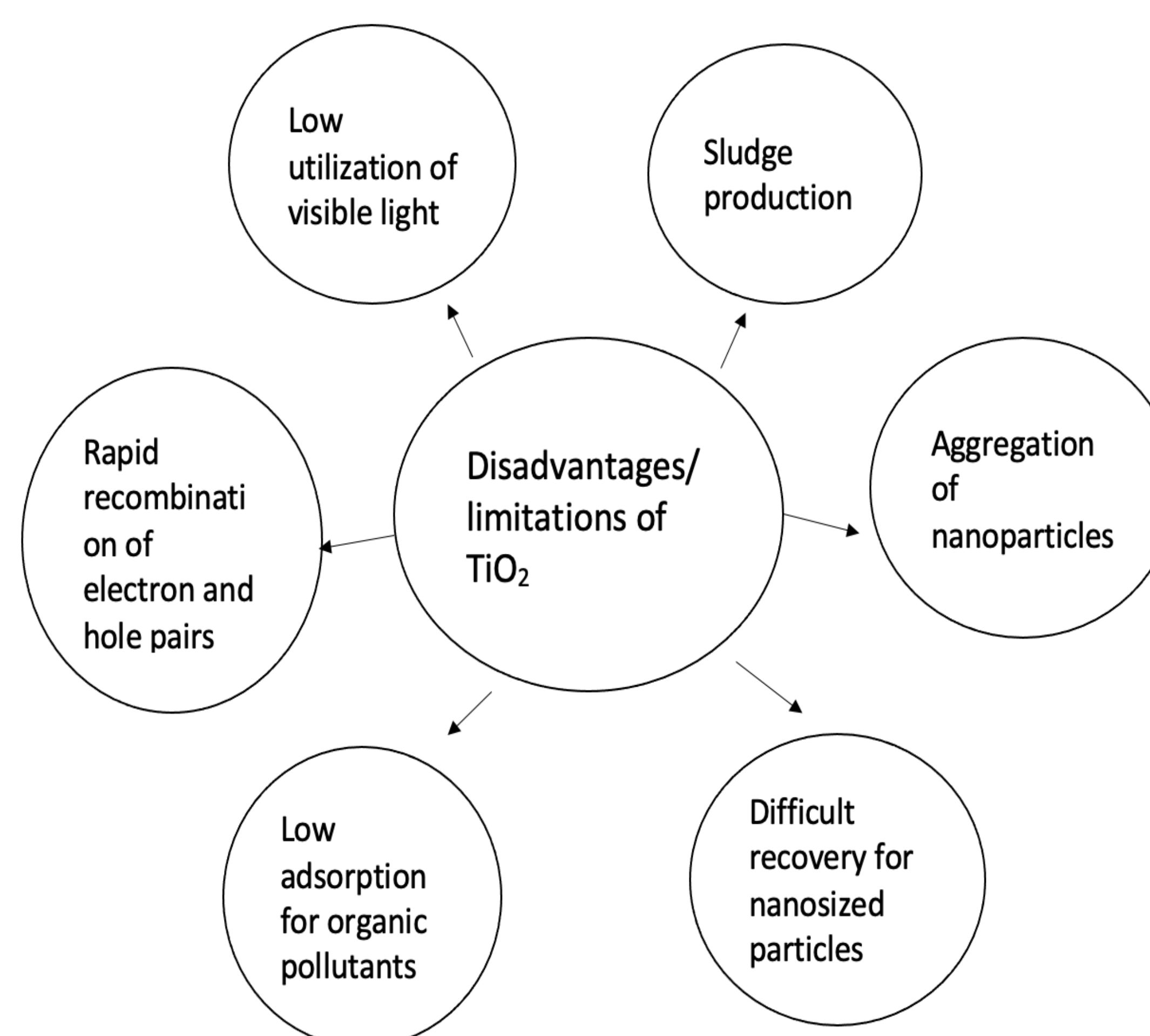


Figure 2: Disadvantages/Limitations of using TiO_2 Photocatalysis.

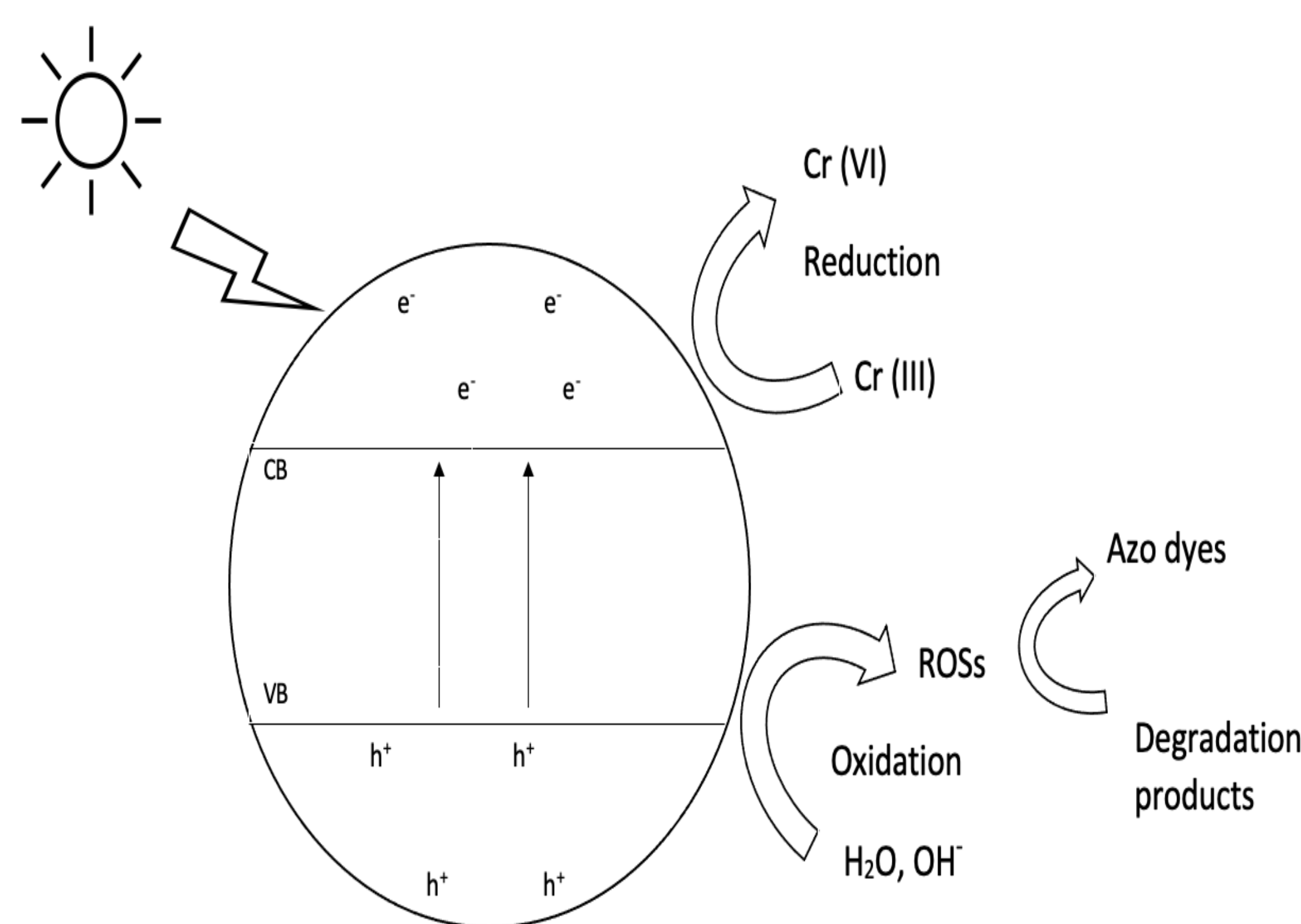


Figure 3: Schematic representation of oxidation-reduction surface reactions with TiO_2 photocatalysis degradation of inorganic pollutants. Chromium (IV) is more toxic and soluble than Chromium (III) and through reduction process Chromium is reduced from toxic to less toxic.

Results

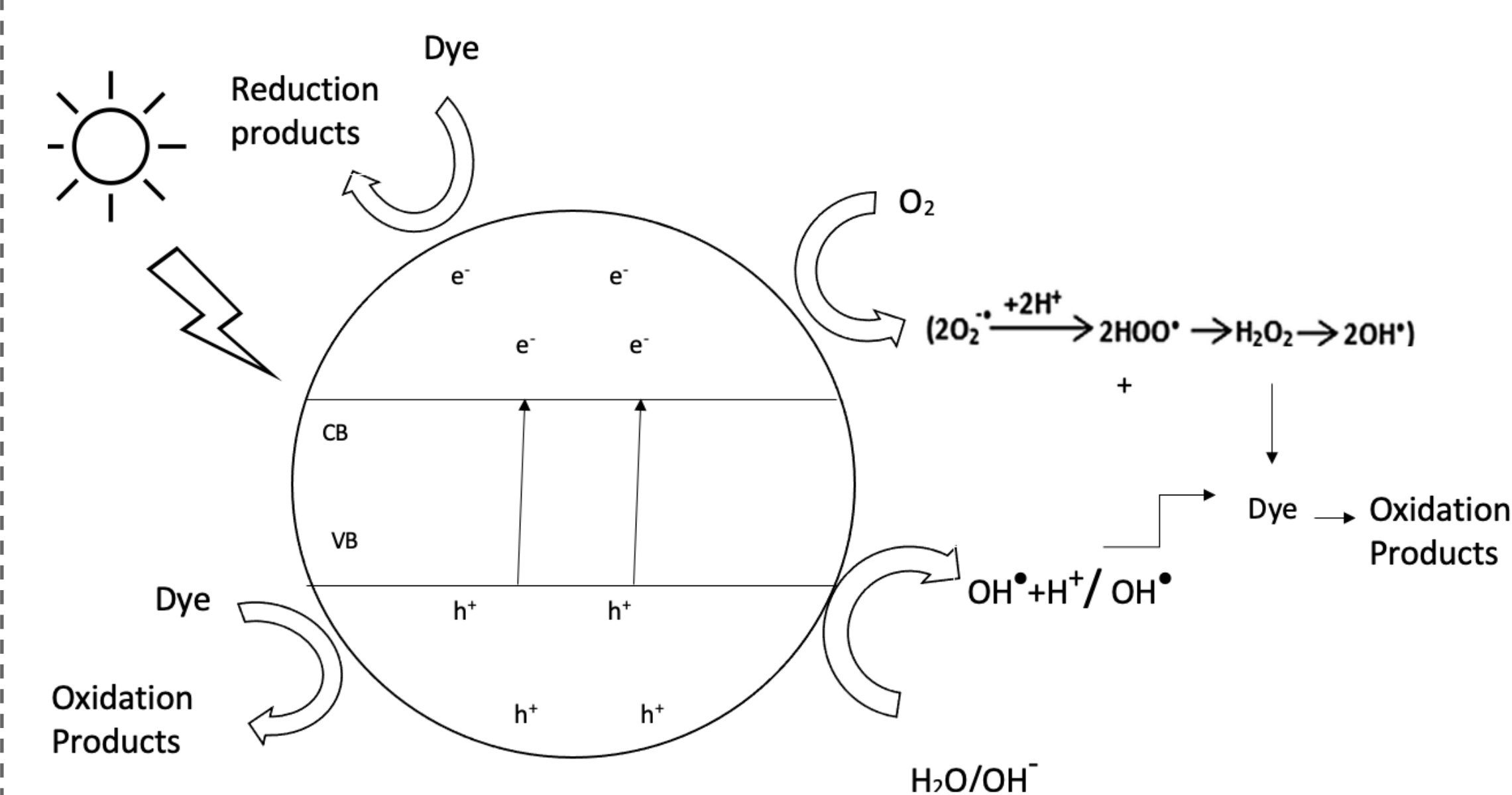


Figure 4: Schematic representation of the organic dye degradation by indirect method. In this mechanism, the dye undergoes excitation by the energy provided by the visible light, enters an excited state, and is converted into a semi-oxidized radical through the injection of electrons from the conduction band. ⁵ (Figure adapted from ref 6)

Conclusion

TiO_2 and photocatalytic technology has proven to be a great breakthrough in terms of degradation of organic and inorganic pollutants in wastewater.

Even though TiO_2 has been proven to be advantageous, it still lacks in many aspects like the low utilization of visible light, aggregation of nanoparticles, recovery of nanoparticles, etc. Therefore, researchers need to find effective ways to fully utilize photocatalytic technology to be able to promote more application of photocatalytic nanotechnology.

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Lookism: An Examination of Inequality in Appearance within Diversity Practices

by

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Introduction

“Lookism” is a term to describe appearance discrimination or “the practice of discrimination on the basis of physical appearance in the workplace” (Ghodrati, Joorabchi, & Muati, 2015, p.1). In culture and popular literature, it has been called “beauty prejudice” (Etcoff, 1999, p. 1). The notion that a *pleasing appearance* results in favorable outcomes (e.g., higher wages, promotions) from others is not necessarily new, as literature on physical attractiveness is rather extensive. *The Washington Post Magazine* first used the term “lookism” in 1978 (e.g., Ayto, 1999), however, the term “lookism” was first recognized as a form of discrimination by authors of the *Oxford English Dictionary* and *American Heritage Dictionary* in 2000 (Ghodrati et al.).

There can be social injustices due to physical appearance, whether physically attractive or unattractive. Rhodes (2010) discussed cultural injustices of being unattractive in a society appearance *obsessed* with potential for “looks” to influence hiring practices, such as better career options and higher pay. Those who feel unattractive in an appearance laden society could suffer certain mental health issues potentially causing anxiety, anorexia, and depression. Research is needed for clarity to combat the issue with regards to how lookism is defined and has been examined. Scholars in the apparel and textile field are positioned to contribute to defining and examining lookism. The aim of this paper is to examine scholarly literature to identify how lookism has been defined and studied.

Treating people in different ways based on physical attractiveness has been studied for decades by psychologists, sociologists, biologists, and anthropologists (Patzer, 2008). How an individual looks influences person life, family dynamics, education environments, work, and even the courtroom. Social scientists have noted the *importance of appearance* on the interaction between individuals with popular literature developing the idea of “lookism” in the 1970s. The term developed during a time when women were entering the workforce in jobs that were usually reserved for men. As women began to make attempts at shattering the “glass ceiling” the importance of appearance was highlighted. Books, such as *John Molloy’s Dress for Success* instructed women how to dress for the workplace.

Purpose of Research

In order to investigate how consumers react to advertisements, the *Stimulus-Organism-Response (S-O-R)* model will be used (Mehrabian & Russel, 1974) to measure how consumers react to luxury brand advertisements containing sexually explicit content and whether they will still be loyal to those brands. Advertisements from luxury brands such as *Louis Vuitton, Dior, and Gucci* will be analyzed and collected from fashion magazines within a 6 month period which signifies one fashion season. The advertisements will be assessed for gender portrayal and the use of sexual objectification, using categories developed by Ivas (2000). After the advertisements have been chosen, an anonymous, semi-structured interview will be conducted after an IRB approval.

Conclusion

Power, privilege, and respect have always been difficult to come by for people of color. They have a difficult time finding their place in a world that has internalized notions about them. This research has shed light on cultural injustices caused by racial microaggressions, racial discrimination, and colorism in relation to lookism. The following were discovered throughout the research: i) The media leads to internalization, which contributes to women’s desire to confide in beauty ideals and harms their mental and physical health; ii) Women are pressured to confide in society ideals; iii) The relationship between income, education, and whiteness is revealed. Prejudice against dark-skinned African Americans, iv) People of color are judged based on their skin tone, making it difficult for them to advance in their careers. This research will inspire other academics and psychologists to see individuals of color as more than stereotypes. They have more potential for advancement in the world.



Defining “Looks” in Lookism

Lookism can be influenced by a number of appearance cues, such as visible demographic traits (e.g. race, gender, age), body size, and clothing. The influence of appearance on others has been noted, particularly on demographic variables race, gender, and age. Literature has supported biases based on race, gender and age. The United States has a variety of races, ethnicities, age groups, and cultural backgrounds. Living in a culturally diverse environments can be difficult as objectification theory due to stigmas in social media can be used to understand eating disorders in Asian-American college women. Some comparisons can be of racial discrimination, persistent anti-foreigner racism, and racial/ethnic taunting as relates to Asian American college have been investigated. Cheng, Tran, Miyake, Kim (2017) conducted a survey of 2,317 Asian American female college students ages 18-46 years were recruited through email sent by the registrar office of a Midwestern University. The survey was 20-25 minutes online with the approval of the university’s Institutional Review Board. Questions included topics of racial discrimination, constant foreigner racism that influences their lives, and causes stress, racial and ethnic mocking, media internalization, body surveillance, body shame, and eating disorder symptomology. A total of 49% had an eating disorder, 48% experienced body shame, 43% had body surveillance, and 8% had media internalization. According to their findings, there was a significant level of racial ethnic taunting or racial prejudice as a result of media internalization. Internalization of media can lead to undesirable behaviors and a persistent need to conform to standard beauty ideals in order to be accepted.

When it comes to appearance, African-American women have encountered numerous hardships to fit in within society. Hair and skin tone, with the internalization of societal beauty ideals, and sexually objectifying experiences are all factors in their current discontent. Dunn, Hood, and Owens (2019) investigated the link between self-worth and gender-related micro-aggression within African-American women’s respect for their bodies. Lighter skin tone, long blonde, straight or wavy hair, the slim body shape are ideals in Western society. Many African- Americans do not conform to Western body ideals, as they have faced racial discrimination and even sexual harassment. African-American women are more prone than their White counterparts to engage in behaviors that are linked to longstanding cultural stereotypes. Sometimes African- women were shown to be more promiscuous, have more sexual partners, engage in unprotected sex, be single moms, and be on public assistance.

Dunn, Hood, and Owens (2019) conducted a study with participants that included 143 African-American women aged 18 to 24, which included their respective relationship status (single, never married, or in a relationship). This is a pivotal age for women as many are figuring out who they are and what they want to do with their lives within society. Findings indicated that participants revealed a high score in both self-worth on one’s physical appearance and experience as stress related to gender racial microaggression. Body image and self-worth among African-American women are a necessity for behavioral health to assist with these two issues studies. The findings will be used by behavioral professionals to give specific attention to coping mechanisms that African-American women might employ to combat gender racial micro-aggression.

In media, the issues of race and racism and the subject of colorism many times have been ignored until recent. Colorism is based on physical appearance, skin color, facial features, and hair textures worldwide. Lookism in this regards is often painful to speak about in the African- American communities because colorism is internalized. Lighter-skinned blacks are preferred over darker skin colors because lighter skins are more widely accepted in the media. From an early age, the media has had a powerful influence on children’s perceptions of image and beauty due to children’s cartoons rarely challenge societal conventions of White. *Proud Family*, a successful animation series about a traditional African American family, was the first show to feature a black production company, a black lead animator, a major black writing crew, and a black family as primary characters widely distributed on a mainstream platform, and it. Previous research on children has focused on the consequences of behavioral changes and exposure to violent programming as a promoter of aggression tendencies. Steele (2016) investigated colorism as this is a pressing issue in society. Children’s media aims to establish morals and values in children, as well as social worth in a culture. Within certain programming such *The Proud Family* were all included in the study. One character is poor as she resides in a tiny apartment. The character of *LaCienaga*, is light-skinned and long hair. Penny’s classmates and school bullies, whose distinctive traits set them apart from other characters in the cartoon series. The bullies are depicted with a deep blue skin tone, which signified their skin’s blackness. This cartoon series is an example of division of people according to their socioeconomic status by using skin tone and European standards. The correlation between wealth, education and Whiteness reveals patterns of prejudice against African Americans with darker skin tones. *The Proud Family* was a popular children’s show that promoted but mainly relied on Eurocentric values.

The media have a role in socialization by propagating global beauty standards like thinness and institutionalizing practices like photography poses. Designers’ messaging must complement the models, clothing, and accessories, as well as reflect the needs of the target demographic. Frith, Cheng, & Shaw (2004) investigated women’s fashion advertisements from countries Singapore, Taiwan, and the United States to see if there are differences in how Western and Asian models are employed in advertising. Three issues from different countries were chosen at random from March 2001 to March 2002 to counteract any possible seasonal effects. The magazines included *Singapore Her World, Female, and Cleo*, and within the United States *Glamour, Vogue, and Elle*; and finally, within Taiwan *Citta, Bella, Jasmine, and Viva*. The study proposed analyzing beauty types for models used in Asian magazines/Western magazine advertisements including the gaze and pose of models. The product categories used in Western women’s magazine advertisements would differ from those used in Asian women’s magazine advertising. A total of 1,130 advertisements were from the above-mentioned nine women’s fashion and beauty magazines used in this study. Results indicated sensual advertisement was most used (27.1%) with Western models compared to Asian models (10.8%). The girl-next-door advertisement appeared more with Asians (25.0%) than with Western models (15.7%). Frith, Cheng, & Shaw (2004) confirmed that 68.5% of Asian models tend to look at the camera more frequently than western models. Western models were seen frequently to dress more seductively and Asian models were dressed more modestly. Asian models were also used more for beauty advertisements. The data showed that advertisers present Western models more frequently than Asian models across cultures because the idealization of western beauty is common. According to studies, European American women choose body-sculpting surgery like liposuction and breast augmentation, whereas Asian American women prefer “double-eyelid surgery,” to appear more European. Asian models are frequently depicted as childlike in order to weaken their status as adults in society. More research is needed to fully understand the motivations of advertising companies when it comes to women of various races.

The slender and flat-chested flappers of the 1920s, the voluptuous “sweater girls” of the 1940s, the supermodels of the 1970s, and the curvaceously thin beauty icons of the 1990s established Western standards of beauty. When it comes to women’s body shapes, there are numerous aspects to consider from facial structures and bodily proportions. Forbes, Collinsworth, Jobe, Braun, and Wise (2007) investigated both men and women analyzes of women’s bodies since the ideal body shape never mirrored the real bodies of most women. Many women have committed so much time, energy, and emotional resources to reach these body ideals. Hostility toward women, traditional sexism, hostile sexism, and, to a lesser extent, benign sexism were found to be connected with acceptance of Western beauty ideals and behaviors. Using the Ambivalent Sexism Theory Scale sparked fresh and essential insights into the nature of sexism, as well as the development of more sophisticated measures to reflect these discoveries. Students in twenty-six (26) sections of *first-year English* at a small mid-western institution participated in the study. The participants’ demographics revealed students were mostly 18 / 19 years old, European- American ethnicity, and single from the 159 college men and 194 college women.

The findings revealed that the feminist claims that beauty rituals for women are repressive. Using two sets of correlations, hostility against women and attitudes toward women, revealed the relationship between beauty ideals and hostility and sexism assessments of beauty. The findings also indicated a link between sexist values and beauty norms. With traditional women’s conventional duties, sexism was an acceptable social form. Men and women both believe that women are inferior, which is viewed as a type of sexism. It was also discovered that imposing beauty ideals benefit men significantly more than they do women.

Even men find discriminatory practices dealing with lookism in corporate America. Despite the fact that corporate America is significantly more diverse, there are still reasons to be concerned about diversity in hiring practices. Only a few African-Americans have become CEOs of Fortune 500 companies, such as Ursala Burns, the first African American woman CEO of Xerox in 2009, and Franklin Raines, the nation’s first racial or ethnic minority CEO of Fannie Mae in 1998. The United States Department of Labor described professionals as people with employment in management, professional, and similar jobs, and the requirement to work in these occupations is a college degree or experience, as well as specialized training. African-American professional men experience gendered racism, which means they face prejudice, negative stereotypes, and oppression, because they are both black and male. Cornelius (2012) investigated how white men’s masculinity differs from that of black men in the workforce. White professionals have stronger access to senior leaders at the highest levels of within certain firms, which has allowed them to advance their careers beyond their best achievements. The purpose of this study’s was to examine the impact of racism on African- American professional men’s career growth in corporate America. The study addressed how African-American professional men describe their career development and how African- American professional men deal with the influence of racism on their professional development?

Fourteen (14) African-American professional men participated which identified as Black or African-American, obtained a bachelor’s degree from a four-year college/ university, worked in a for-profit mid-management or higher position for at least ten (10) years in corporate America, and have spent at least one year with their current company. The age range of the participants who fit the criterion was 35 to 55, with an average tenure of 8 years of experience. The findings resulted African-American professional men navigate the influence of racism on their career growth as they encounter both repressive and facilitative systems. The participants revealed their white coworkers and their superiors who can influence their career advancement; which indicated negative impressions of African-American male behaviors and actions. Several participants believed that the “angry black stereotype” is common in corporate America.

It is well-documented that African-American professional men make their white counterparts feel at ease with how they see them in order to decrease the impact in their career development but still be included in the company’s policies and practices. This regulates corporate performance management, succession management, hiring, and promotions. All fourteen (14) participants learned how to negotiate the impact of racism on their careers using methods such as building relationships and leverage, as well as how to be a part of two corporate worlds: (1) the black underground network and (2) corporate white America. Self-efficacy with the continuance of formal and informal education, and continuous learning, and discovery their respective spiritual purpose all assist with this corporate navigation. According to Cornelius (2012) human resources need to be more conscious of corporate inclusivity in order to provide resources to all people who have been refused access due to race, gender, status, or other social inequalities.

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“An Analysis of Comparison-based Sorting Algorithms”

By: Jacob Gomez , Edgar Aponte, Brad Isaacson

Abstract

Sorting algorithms put elements of a list into an order (e.g., numerical, alphabetical). Sorting is an important problem because a nontrivial percentage of all computing resources are devoted to sorting all kinds of lists. For our project, we implemented 24 comparison-based sorting algorithms from pseudocode and compared them. The algorithms all have their advantages and disadvantages as well as their unique features. We found that introspective sort (which is a modified version of heapsort) and timsort (which is a modified version of mergesort) were the most efficient.

Introduction

A number of different algorithms have been invented for sorting. Their relative advantages and disadvantages have been studied extensively. Out of the 24 that we implemented, we chose 6 to discuss in this poster: (1) bubble sort, (2) insertion sort, (3) heapsort, (4) mergesort, (5) timsort, and (6) introspective sort. Although the latter four sorting algorithms are the fastest by virtue of having the optimal worst-case time complexity of $O(n \log(n))$, bubble sort and insertion sort are straightforward algorithms in which all Computer Science and Applied Mathematics majors should know. For our project, we created an application which included 24 sorting algorithms. We analyzed the running times of these sorting algorithms with various sets of unsorted data. Through this process, we gained a better understanding of the various sorting algorithms and their time complexities. In conclusion, introspective sort and timsort were the fastest and most efficient sorting algorithms we tested, with introspective sort being the very fastest.

Process

The application we used to compile the algorithms was JDoodle. This is an online site where you can run and write out different languages of code like Java, C++, Python and many more. The only limitation on this site is the amount of memory you're given, so printing large arrays caused run-time errors. Nonetheless, we were able to calculate the running time for the various sorting algorithms we implemented. Although we tested various inputs, we preferred to use randomly generated lists of 10,000 integers. The pseudocodes for the 6 aforementioned sorting algorithms we implemented can be found on the right side of this poster.

Results

We tested 6 sorting algorithms: (1) bubble sort, (2) insertion sort, (3) heapsort, (4) mergesort, (5) timsort, and (6) introspective sort. Below are the running times of the 6 sorting algorithms using randomly generated unsorted lists of 10,000 integers as input. Each box corresponds to the same input.

```
Time Shown 9.10285234451294 seconds (Bubble sort)
Time Shown 4.201315879821777 seconds (Insertion sort)
Time Shown 0.05934023857116699 seconds (Heapsort)
Time Shown 0.05082559585571289 seconds (Mergesort)
Time Shown 0.048529624938964844 seconds (Tim sort)
Time Shown 0.0311434268951416 seconds (Introsort)
```

```
Time Shown 8.398186206817627 seconds (Bubble sort)
Time Shown 3.6595122814178467 seconds (Insertion sort)
Time Shown 0.058275699615478516 seconds (Heapsort)
Time Shown 0.04720735549926758 seconds (Mergesort)
Time Shown 0.04487299919128418 seconds (Tim sort)
Time Shown 0.02377605438232422 seconds (Introsort)
```

```
Time Shown 8.795206308364868 seconds (Bubble sort)
Time Shown 3.973356008529663 seconds (Insertion sort)
Time Shown 0.057935237884521484 seconds (Heapsort)
Time Shown 0.04652881622314453 seconds (Mergesort)
Time Shown 0.04422497749328613 seconds (Tim sort)
Time Shown 0.025289297103881836 seconds (Introsort)
```

```
Time Shown 8.60838794708252 seconds (Bubble sort)
Time Shown 3.7742903232574463 seconds (Insertion sort)
Time Shown 0.05784869194030762 seconds (Heapsort)
Time Shown 0.04715633392339844 seconds (Mergesort)
Time Shown 0.043077707290649414 seconds (Tim sort)
Time Shown 0.022817373275756836 seconds (Introsort)
```

```
Time Shown 12.115835666656494 seconds (Bubble sort)
Time Shown 5.603866538505542 seconds (Insertion sort)
Time Shown 0.12464165687561035 seconds (Heapsort)
Time Shown 0.0996091365814209 seconds (Mergesort)
Time Shown 0.06671452522277832 seconds (Tim sort)
Time Shown 0.029980182647705078 seconds (Introsort)
```

```
Time Shown 9.947835206985474 seconds (Bubble sort)
Time Shown 3.817880153656006 seconds (Insertion sort)
Time Shown 0.058432579040527344 seconds (Heapsort)
Time Shown 0.0463566780090332 seconds (Mergesort)
Time Shown 0.043381452560424805 seconds (Tim sort)
Time Shown 0.024059295654296875 seconds (Introsort)
```

Discussion

Based on the results, we found that introspective sort and timsort were the fastest and most efficient. We also found that bubble sort and insertion sort were the slowest and least efficient. Interestingly, bubble sort performed much worse than insertion sort despite them both having the same worst-case time complexity of $O(n^2)$. Heapsort and mergesort were average. Timsort and introspective sort were impressive because they were much faster than heapsort and mergesort for most inputs despite them all having worst-case time complexity of $O(n \log(n))$. Our findings are consistent with timsort and introspective sort being used as the industry standard. What we found most surprising is that introspective sort was the fastest algorithm of them all, being roughly twice as fast as timsort in all of our experiments!

Timsort is a hybrid sorting algorithm derived from mergesort and insertion sort and is designed to perform well on many kinds of real-world data. This is the default sorting algorithm in Python and Java.

Introspective sort is also a hybrid sorting algorithm that provides both fast average performance and optimal worst-case performance. Our implementation essentially calls quicksort (which is a divide-and-conquer sorting algorithm using pivot points and partitions) until the recursion depth reaches a certain level, and then calls heapsort. Further refinements incorporate a third sorting algorithm, insertion sort. Introspective sort is the default sorting algorithm in C++.

Bubble Sort

```
procedure bubbleSort(A : list of sortable items)
  n := length(A)
  repeat
    swapped := false
    for i := 1 to n-1 inclusive do
      // if this pair is out of order
      if A[i-1] > A[i] then
        // swap them and remember something changed
        swap(A[i-1], A[i])
        swapped := true
      end if
    end for
  until not swapped
end procedure
```

It repeatedly steps through the list, compares adjacent elements and swaps them if they are in the wrong order. It repeats until the list is sorted.

Heapsort

```
//(Put elements of 'a' in heap order, in-place)
procedure heapify(a, count) is
  //start is assigned the index in 'a' of the last parent node)
  //(the last element in a 0-based array is at index count-1; find the parent of that element)
  start = iParent(count-1)

  while start >= 0 do
    //(sift down the node at index 'start' to the proper place such that all nodes below
    //the start index are in heap order)
    siftDown(a, start, count - 1)
    //(go to the next parent node)
    start = start - 1
  //(After sifting down the root all nodes/elements are in heap order)

  //(Repair the heap whose root element is at index 'start', assuming the heaps rooted at its children are valid)
  procedure siftDown(a, start, end) is
    root = start

    while iLeftChild(root) <= end do //(While the root has at least one child)
      child = iLeftChild(root) //(Left child of root)
      swap = root //(Keeps track of child to swap with)

      if a[swap] < a[child] then
        swap = child
      //(If there is a right child and that child is greater)
      if child <= end and a[swap] < a[child+1] then
        swap = child + 1
      if swap = root then
        //(The root holds the largest element. Since we assume the heaps rooted at the
        //children are valid, this means that we are done.)
        return
      else
        swap(a[root], a[swap])
        root = swap //(repeat to continue sifting down the child now)

procedure heapsort(a, count) is
  input: an unordered array a of length count

  //(Build the heap in array a so that largest value is at the root)
  heapify(a, count)

  //(The following loop maintains the invariants that a[0:end] is a heap and every element
  //beyond end is greater than everything before it (so a[end:count] is in sorted order))
  end = count - 1
  while end > 0 do
    //a[0] is the root and largest value. The swap moves it in front of the sorted elements.)
    swap(a[end], a[0])
    //(the heap size is reduced by one)
    end = end - 1
    //(the swap ruined the heap property, so restore it)
    siftDown(a, 0, end)
```

It divides its input into a sorted and an unsorted region and it repeatedly shrinks the unsorted region by extracting the largest element from it and inserting it into the sorted region. Heapsort maintains the unsorted region in a heap data structure by calling heapify() to more quickly find the largest element in each step.

Timsort

```
// Iterative Timsort function to sort the
// array[0...n-1] (similar to merge sort)
def timSort(arr):
  n = len(arr)
  minRun = calcMinRun(n)

  // Sort individual subarrays of size RUN
  for start in range(0, n, minRun):
    end = min(start + minRun - 1, n - 1)
    insertionSort(arr, start, end)

  // Start merging from size RUN (or 32). It will merge
  // to form size 64, then 128, 256 and so on ....
  size = minRun
  while size < n:

    // Pick starting point of left sub array. We
    // are going to merge arr[left..left+size-1]
    // and arr[left+size, left+2*size-1]
    // After every merge, we increase left by 2*size
    for left in range(0, n, 2 * size):

      // Find ending point of left sub array
      // mid+1 is starting point of right sub array
      mid = min(n - 1, left + size - 1)
      right = min((left + 2 * size - 1), (n - 1))

      // Merge sub array arr[left.....mid] &
      // arr[mid+1....right]
      if mid < right:
        merge(arr, left, mid, right)
```

size = 2 * size
It iterates over the data collecting elements into runs and simultaneously puts those runs in a stack. Whenever the runs on the top of the stack match a merge criterion, they are merged. This goes on until all data is traversed. All runs are then merged two at a time until one sorted run remains.

Insertion Sort

```
function insertionSortR(array A, int n)
  if n > 0
    insertionSortR(A, n-1)
    x ← A[n]
    j ← n-1
    while j >= 0 and A[j] > x
      A[j+1] ← A[j]
      j ← j-1
    end while
    A[j+1] ← x
  end if
end function
```

It iterates, consuming one input element each repetition and grows a sorted output list. At each iteration, insertion sort removes one element from the input data, finds the location it belongs within the sorted list, and inserts it there. It repeats until no input elements remain.

Mergesort

```
function merge_sort(list m) is
  // Base case. A list of zero or one elements is sorted, by definition.
  if length of m ≤ 1 then
    return m

  // Recursive case. First, divide the list into equal-sized sublists
  // consisting of the first half and second half of the list.
  // This assumes lists start at index 0.
  var left := empty list
  var right := empty list
  for each x with index i in m do
    if i < (length of m)/2 then
      add x to left
    else
      add x to right

  // Recursively sort both sublists.
  left := merge_sort(left)
  right := merge_sort(right)

  // Then merge the now-sorted sublists.
  return merge(left, right)

function merge(left, right) is
  var result := empty list

  while left is not empty and right is not empty do
    if first(left) ≤ first(right) then
      append first(left) to result
      left := rest(left)
    else
      append first(right) to result
      right := rest(right)

  // Either left or right may have elements left; consume them.
  // (Only one of the following loops will actually be entered.)
  while left is not empty do
    append first(left) to result
    left := rest(left)
  while right is not empty do
    append first(right) to result
    right := rest(right)
  return result
```

It divides the unsorted list into n sublists, each containing one element. It repeatedly merges sublists to produce new sorted sublists until there is only one sublist remaining.

Introspective Sort

```
procedure sort(A : array):
  let maxdepth = [log(length(A))] × 2
  introsort(A, maxdepth)

procedure introsort(A, maxdepth):
  n ← length(A)
  if n ≤ 1:
    return // base case
  else if maxdepth = 0:
    heapsort(A)
  else:
    p ← partition(A) // assume this function does pivot selection, p is the final position of the pivot
    introsort(A[0:p-1], maxdepth - 1)
    introsort(A[p+1:n], maxdepth - 1)
```

It selects a 'pivot' element from the array and partitions the other elements into two sub-arrays, according to whether they are less than or greater than the pivot. The sub-arrays are then sorted recursively by calling heapsort() when the recursion depth reaches a level based on the logarithm of the number of elements to be sorted.

Smart Physics

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Abstract

In Modern day, we stand on the shoulders of tech giants who developed the devices we use every day. Almost everyone has a smart device, and almost every one of those devices has a powerful array of sensors that can be used in the pursuit of science.

Expanding upon educational material developed for phyphox, a free-to-use and open-source platform for physics experiments, we are aiming to identify several experiments currently taught in undergraduate physics labs and create versions of the same experiments that take advantage of the existing phyphox toolbox.

To aid in the selection and development of experiments, we outlined several factors associated with how an experiment could be improved by phyphox. The first thing we wanted to look at was whether an experiment could be performed at home, or if extra lab material was needed. Next, we wanted to know if the experiment was already available in phyphox or if custom tools would need to be developed by our team. Lastly, and most nuanced, we needed to learn how the sensor data would be recorded by phyphox. Keeping these factors in mind, our team successfully identified several experiments that could be enhanced by using phyphox and were able to demonstrate how to conduct the experiments with the new tooling involved.

Whats In My Pocket!?

With how quickly portable technology has advanced in the past few decades many people may take their devices, and the capabilities of those devices, for granted. Every year new smartphones are released with different sensors, better cameras, and a suite of new features. Equipment that used fill entire buildings now fits in the palm of your hand.

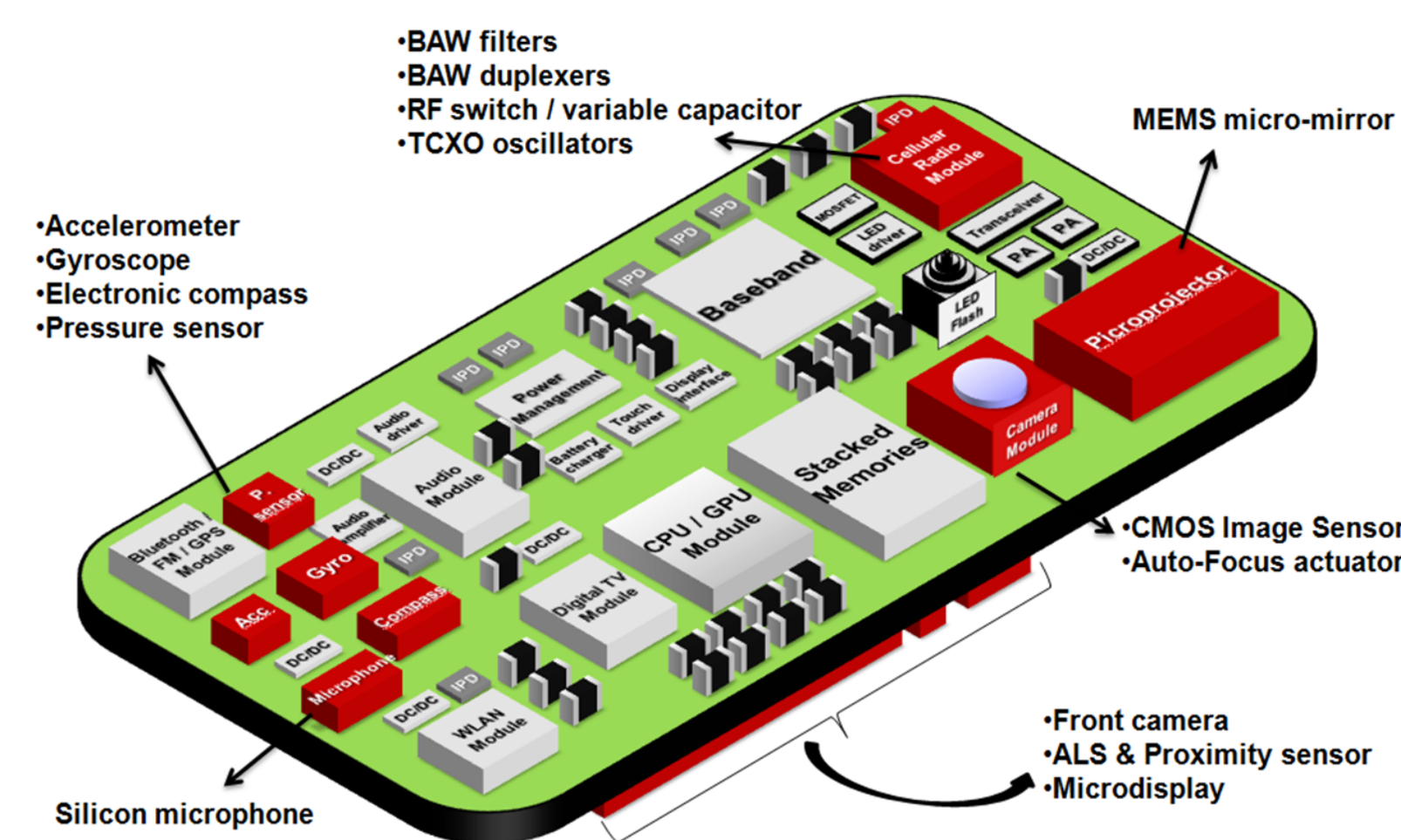


Fig. 1: Faux circuit board showing the range of sensors and electronics typically found in smart devices. [1]

Even though devices have all of these sensors embedded, the end user often doesn't have access to the direct values reported by them. Most of the time applications interpolate the data for their specific use.

In order to make use of these sensors for the purpose of science, an app like phyphox [2, 3] must be used. With phyphox users are able to take direct measurements using a suite of provided tools and export data for external analysis.

Out With The Old, In With The New

Before we started the process of creating new lab material, we first had to identify which experiments could be conducted with the tools provided by phyphox and how we would collect data to make meaningful calculations. With our goal of developing material for introductory courses in physics, we had a wealth of experiments to choose from.

To begin with, each of our team members focused on attempting various experiments that were provided by phyphox and learning how to work with various quantities record by the sensors. Due to the nature of some experiments, multiple sensors could be used to measure the same or adjacent effects.

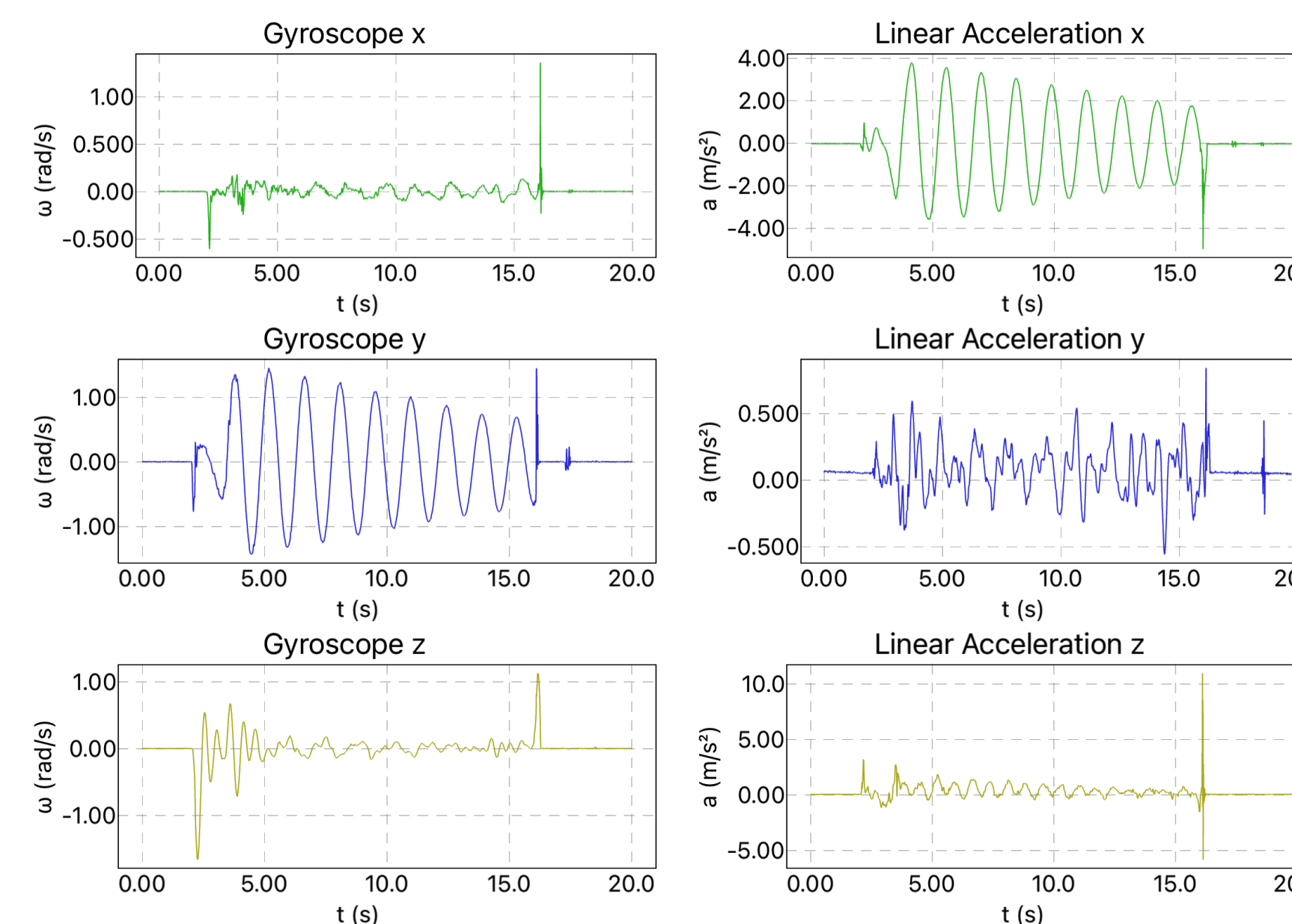


Fig. 2: Showing both the gyroscopic and linear acceleration measurements for the movement of a pendulum.

An example of this can be seen in Figure 2 where both the gyroscopic sensor and accelerometer are used to measure the motion of a pendulum. Curiously, the oscillating movement is recorded by different axes for sensor. This is due to a nuance in the motion of the device, in that as the pendulum moves, it displaces linearly in the x direction, but rotates about the y axis.

What Goes Up Must Come Down

The experiment I decided to focus on was measuring the acceleration due to gravity of an object in free fall. This experiment uses the acoustic stopwatch feature of phyphox which uses the microphone to measures the time between two acoustic events. In order to create these events, a ball bearing inside of an inflated balloon is suspended at some height. The first event is created by the popping of the balloon which drops the ball bearing subsequently creating the second event when it hits the ground.

$$\Delta x = v_0 t + \frac{1}{2} a t^2 \rightarrow h = \frac{1}{2} g t^2 \rightarrow g = \frac{2h}{t^2}$$

Using the time and height of the drop, the gravitational constant can be calculated using the above equation, derived from the kinematic equation for the distance of a free fall.

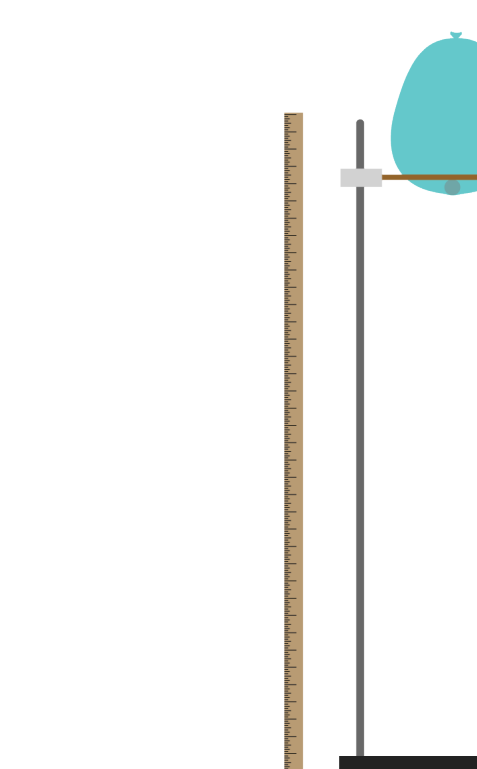


Fig. 3: Basic setup for conducting this experiment.

Building Blocks

While phyphox has a host built-in experiments and tools, there are still times when custom implementations need to be used. An example of this would be an experiment measuring the Venturi Effect, where the pressure of a fluid is reduced as the velocity of that fluid increases. In order to collect data for an experiment where you would travel at a constant velocity, one would need to both collect data from the barometric sensor and record velocity given by GPS data.

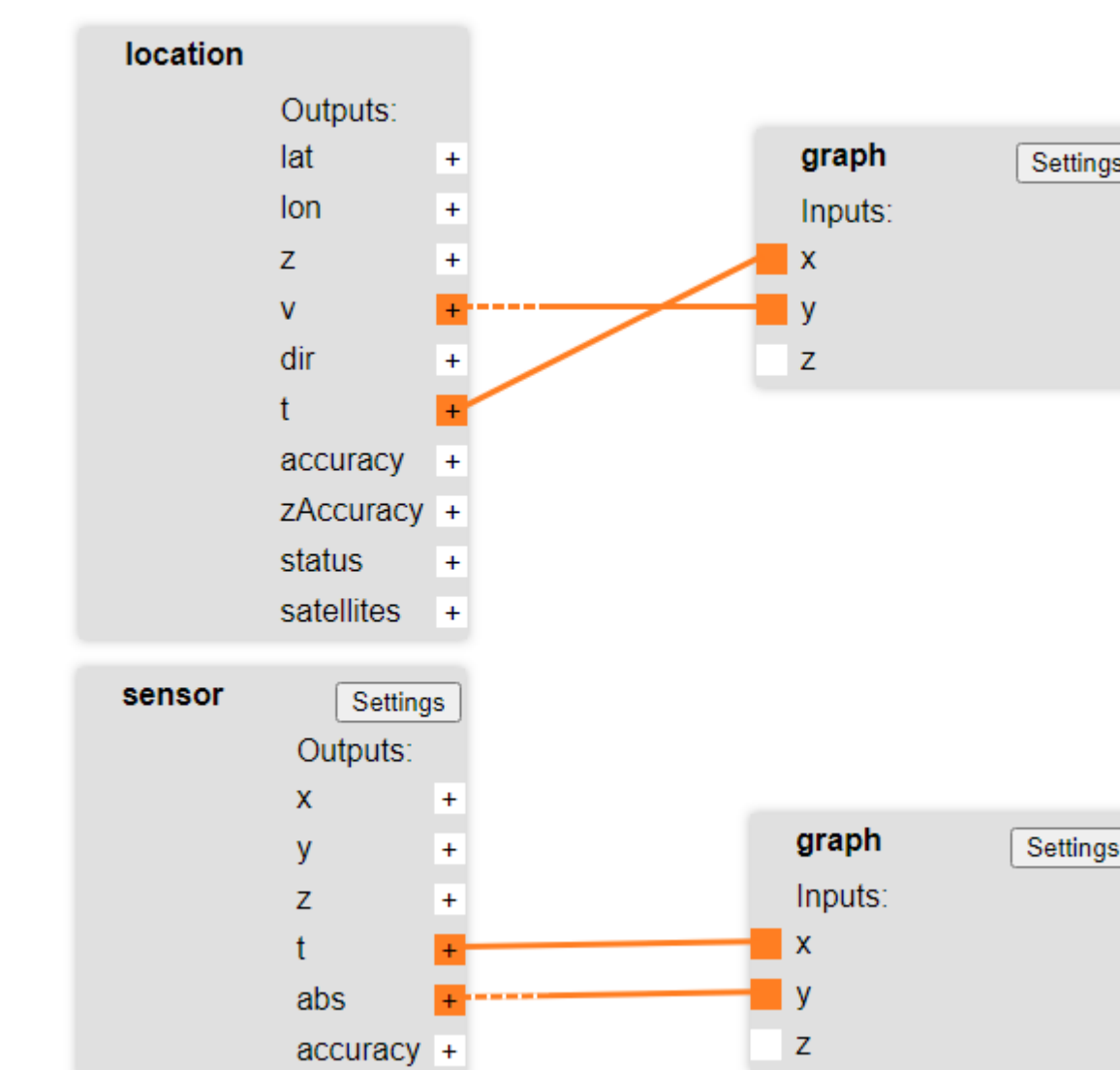


Fig. 4: Showing a basic node graph for displaying data on a two axis graph.

To accomplish this, phyphox provides an online editor that allows for the configuration of tools and experiments. After setting up which sensors will be used in an experiment, detailed views can be created to display data in a several ways, namely as graphs like in Figure 2. In order to take the output from the sensors and display it in a view, the editor provides a node graph with all of the defined components and extra blocks that allow for in-app calculations to be done with the data. The editor also allows for the customized export of data.

Conclusion

As we learn more about the nuances of using the sensors in our smart devices, we gain more insight into the various relationships of our physical world. Looking into the future, our group will continue the development of lab experiences utilizing the various sensors in smart devices with the goal of developing meaningful and interactive learning experiences.

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Diagnostic Potentials of MRI and PET in Alzheimer's Disease: A Meta Analysis

ABSTRACT

The objective of this study is to explore if there exists a relation between brain atrophy in certain cerebral regions and both Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) findings in Alzheimer's Disease. In this regard, endothelial cells are important parts of the Blood Brain Barrier that shield the brain of disease and other pathogens. Certain circulatory proteins also cause inflammation and cognitive impairment. Glucose and other metabolisms can be abnormal in select areas in the frontal lobes, parietal lobes, and deep gray matter such as the pallidal areas, when early onset, for example, Autosomal Dominant Alzheimer's Disease sets in. This young group is a minority, however, shows patterns better than most late onset Alzheimer's Disease and hence may reveal mechanisms of late onset too.

Keywords: Positron Emission Tomography (PET), Magnetic Resonance Imaging in Alzheimer's Disease, Frontal Lobes, Parietal Lobes, Pallidal Area, Autosomal Dominant Alzheimer's Disease (ADAD)

INTRODUCTION

It is difficult to accurately diagnose neurodegenerative diseases such as Alzheimer's Disease. To detect morphologic changes, high-spatial resolution MRI is the modality of choice. To identify amyloid deposition, PiB Positron Tomography (PET) has been utilized. The brain is protected by Brain Endothelial Cells (BEC's) that are included in the blood-brain barrier, which protects the brain from pathogens and certain circulatory factors. The vasculature of the brain is the receiver and transmitter of circulation tasks throughout the brain. The susceptibility of neurodegenerative diseases decline as age increases. Multiple neuroimaging methods have been used to evaluate in-vivo changes in the brain due to Alzheimer's Disease.

METHOD

First, we were able to utilize research-based projects from meta-analysis acquisitions. Second, we perused through ten articles, from 2010 through 2020 by using the keywords provided in the abstract. Then, we carefully analyzed several critically assessing usefulness of various Diffusion Tensor Imaging (DTI) parameters. Finally, we collected data from various credible sources, we were able to find the differences of Magnetic Resonance Imaging and Positron Emission Tomography modalities from patients with Autosomal Dominant Alzheimer's Disease.

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RESULTS

- Aging Brain Endothelial Cells and their capillaries are sensitive to blood aging factors in the brain, ⁽¹⁾
- To evaluate regional volume changes when the progression of Alzheimer's Disease occurs, structural Magnetic Resonance Imaging assists in evaluation of these changes. ⁽³⁾
- Initial changes in the temporal lobes and subcortical regions reveals the progressive atrophy manifesting Alzheimer's Disease. ⁽³⁾
- Amyloid Positron Emission Tomography (PET) can detect earliest changes in Autosomal Dominant Alzheimer's Disease within the subcortical (pallidum, nucleus accubens, caudate, putamen, and entorhinal) versus cortical regions (middle frontal, anterior cingulate, and precuneus). ⁽²⁾
- Fluorodeoxyglucose (FDG) measuring later metabolic changes as disease progresses occurs in the cortical (insula, fusiform, middle frontal, precuneus, anterior cingulate, pericalcarine, and transverse temporal), not the subcortical regions (caudate). ⁽²⁾
- An increase in cortical uptake at β -amyloid imaging is caused by cortical deposition of β -amyloid plaques and are considered abnormal. ⁽³⁾
- The cerebellum is used as a comparative tool to detect gray-white differentiation, since the cerebellum rarely has amyloid accumulations. ⁽³⁾
- Sagittal T1-weighted Magnetic Resonance images best evaluates the precuneus where early onset Alzheimer's Disease can be detected (medial parietal lobe) (Figure 2). ⁽³⁾

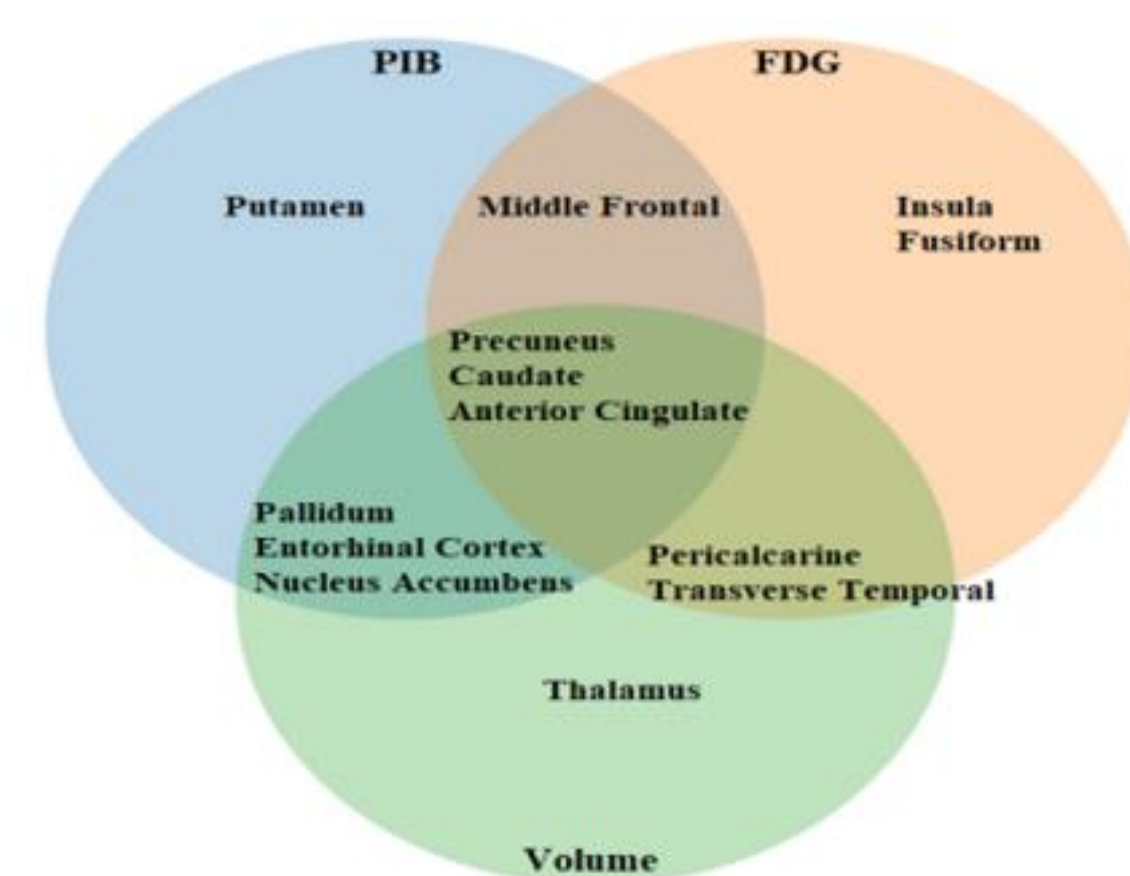


Figure 1. Strongest predictors of mutation carrier status for Autosomal Dominant Alzheimer's Disease (ADAD) as identified by relief algorithms. The strongest predictors across all modalities were the precuneus, caudate, and anterior cingulate. Changes in amyloid positron emission tomography (blue circle), were seen within subcortical regions. Changes in metabolism (FDG, orange circle) showed more cortical involvement. Volumetric changes (green circle) showed both cortical and subcortical involvement. ⁽²⁾

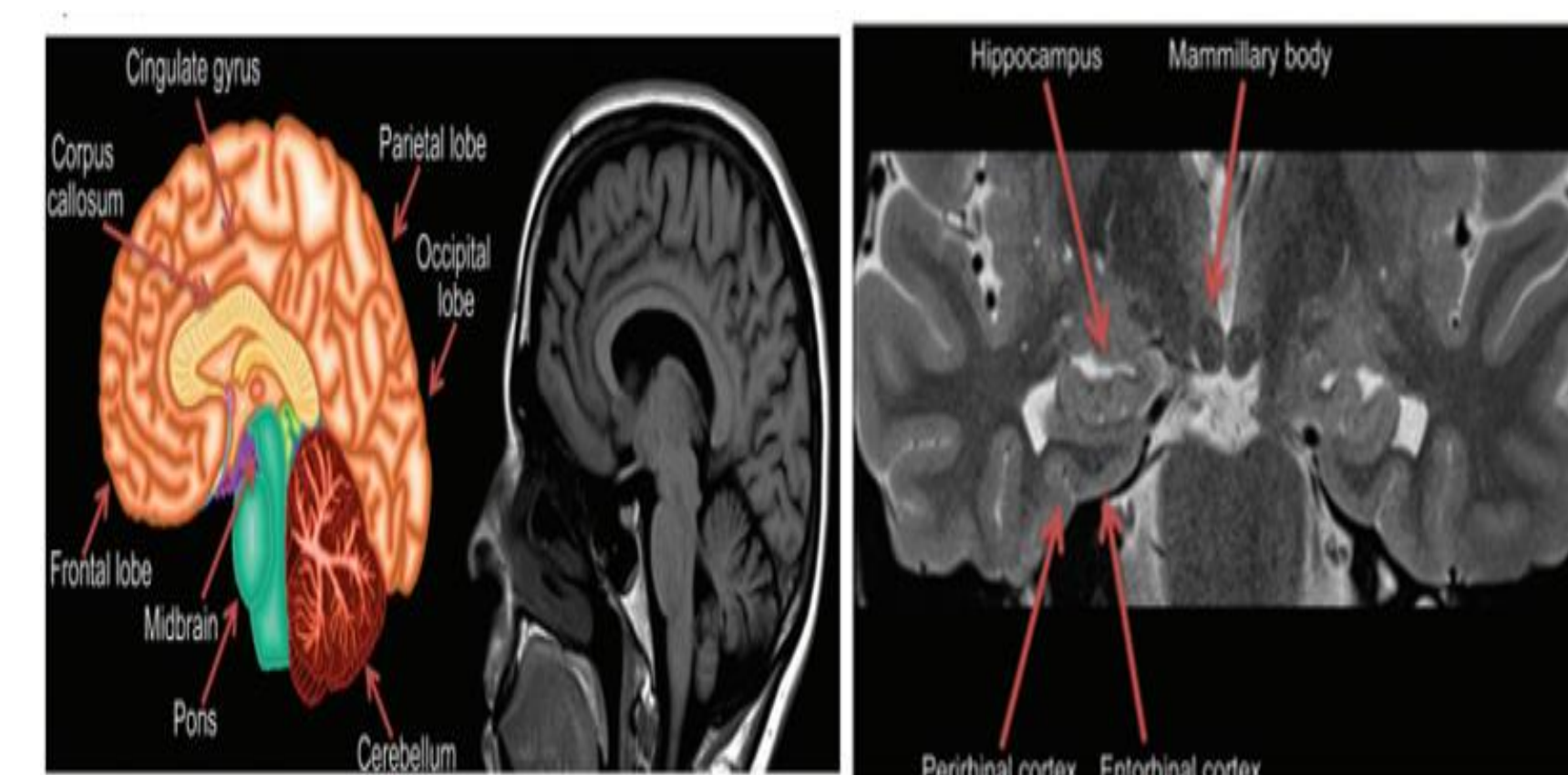


Figure 2: (a) Sagittal illustration (left) and sagittal T1-weighted MR image (right) show the anatomy. Pay attention to the parietal lobe on para-sagittal images, as this is the location of the precuneus that is typically affected in Alzheimer's Disease. (b) Small-field-of-view coronal-oblique T2-weighted MR image with labels, perpendicular to the long axis of the hippocampus for assessment of the mesial temporal lobe, shows structures, specifically the visual rating system for mesial temporal lobe. ⁽³⁾

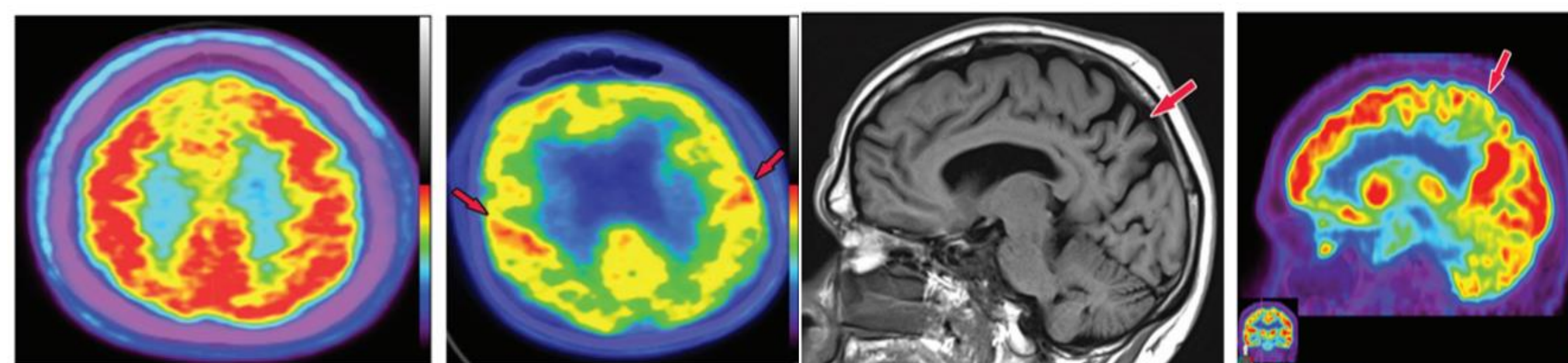
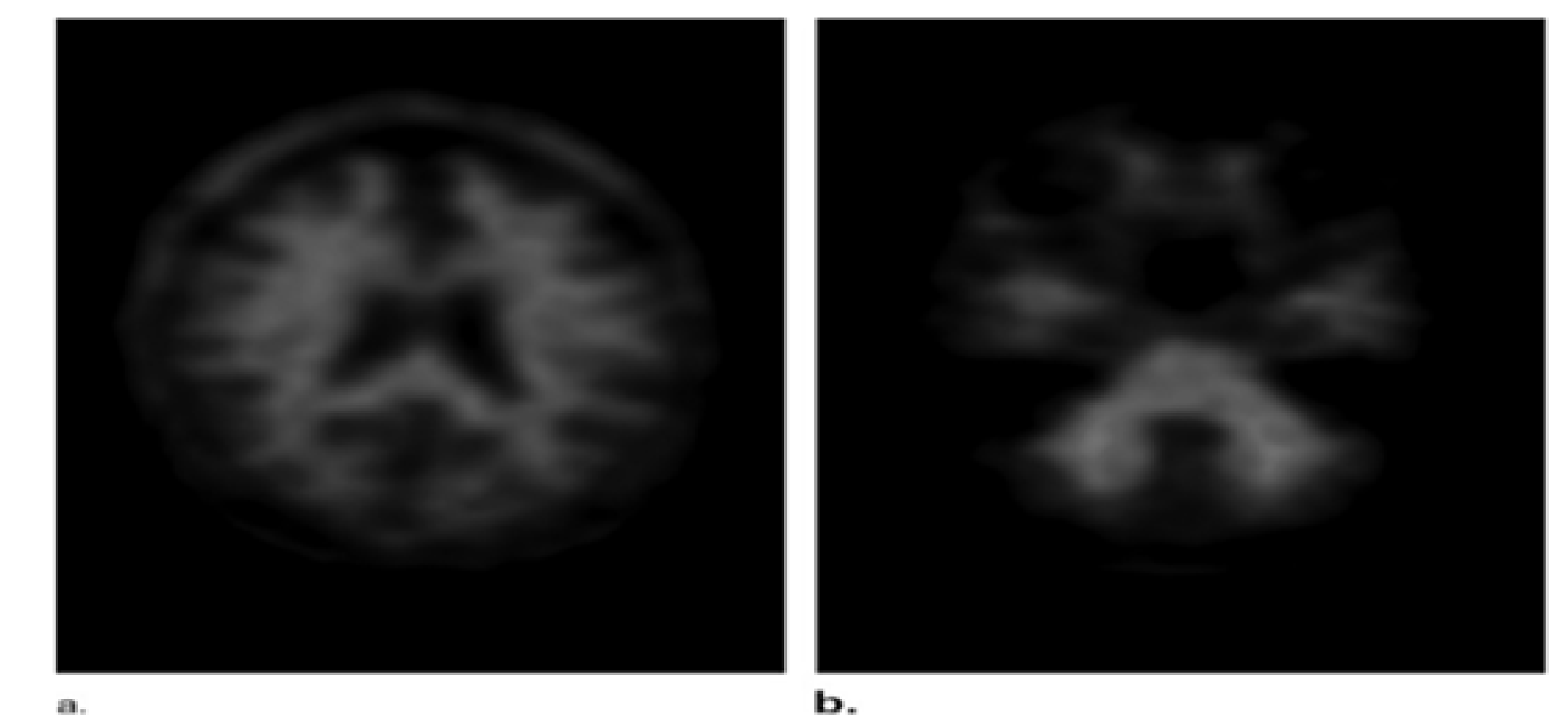


Figure 3: FDG PET images with normal and abnormal findings. (a) Axial FDG PET image in a patient without dementia shows a high level of cortical uptake throughout the brain. (b) Axial FDG PET image in a patient with advanced Alzheimer's Disease shows severe cortical hypometabolism involving both the frontal and parietal lobes. Note the relative sparing of the sensorimotor cortices (arrows), which is a classic finding of Alzheimer's Disease. ⁽³⁾

Figure 4: Alzheimer's Disease (a) Sagittal T1-weighted MR image in a patient with memory loss shows disproportionate moderate volume loss in the precuneus (arrow), a finding suspicious for Alzheimer's Disease. The remainder of the brain parenchymal volume is preserved. (b) Sagittal F-FDG PET image shows corresponding decreased activity in the precuneus (arrow). Image inset shows a coronal section through the middle of the brain in this particular case to aid in lateralization. Normal uptake is depicted in the frontal and occipital regions, reinforcing the diagnosis of Alzheimer's Disease. ⁽³⁾

DISCUSSION

- To identify early abnormalities that have yet affected structural changes, Magnetic Resonance Imaging and Fluorodeoxyglucose Positron Emission Tomography are used in conjunction. ⁽³⁾
- Synaptic losses features in neurodegeneration where Magnetic Resonance Imaging can reveal these losses in brain atrophy. ⁽³⁾
- Performing high-spatial resolution volumetric T1-weighted sequence with multiplanar and a T2-weighted coronal sequence to visualize abnormalities. ⁽³⁾
- Ideally, a T2-weighted coronal sequence should be performed perpendicular to the long axis of the hippocampus for evaluation of the mesial temporal lobe. ⁽³⁾
- Decreased activity in the frontotemporal lobes that resembles Alzheimer's Disease are shown in Fluorodeoxyglucose Positron Emission Tomography images. ⁽³⁾
- The posterior cingulate gyrus is a differentiating factor when determining Alzheimer's Disease. ⁽³⁾
- The hypometabolism of the occipital lobes, helps differentiate Dementia with Lewy Bodies (DLB) from Alzheimer's Disease. ⁽³⁾



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Understanding MR Signal and Noise at Low and High Fields for Weak and Strongly Paramagnetic Substances

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Mentors: Subhendra Sarkar¹, Lazar Fleysher^{1,2,3} and Duke Shereen⁴

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Abstract

We are exploring the paramagnetic effects of common radiological contrasts on various model biological tissues, in particular, on fresh bananas, apples and sweet potatoes that can absorb such contrast media at concentrations similar to in-vivo applications. The contrasts include Omnipaque, Isovist (iodinated CT contrasts) as well as Gadavist, Eovist and Dotarem (macrocylic MR contrasts), all of which have organic chelating groups to protect iodine or Gadolinium ions from dispersing in our carbohydrate matrix. We used low as well as high MR systems (1.5 and 3T from two different vendors, General Electric and Siemens) to compare the paramagnetic roles of these contrasts toward spin relaxation behavior in the bioenvironment of native paramagnetic biometals, primarily iron and manganese in these mineral-rich models. Multi-center, multi-vendor equipment tend to differ in signal and image noise characteristics and require standardization of hardware performance for identical MR software sequences. Hence our protocols have been standardized with baseline comparisons in all MR systems. Relaxation results when radiological contrasts compete with native biometals should be more useful to understand the benefits and potential risks of such contrast agents on human tissues.

Background

Worldwide Gadolinium, Iodine from millions of MRI and CT exams and Ni Co metals from billions of cell phones are changing important metal compositions in our body and in our food. Our work shows that Gd effectively can affect iron (Fe) transport in model systems and may help understand such events in our brain and body.

Dotarem and Gadavist comparison at 1, 2, 5 % was chosen on model fruits like bananas as these have many light minerals (i.e. Na, K, Ca) none of which can influence MRI signal but also have Fe that enhances T1-weighted MR signal at low concentration, and darkens if high.

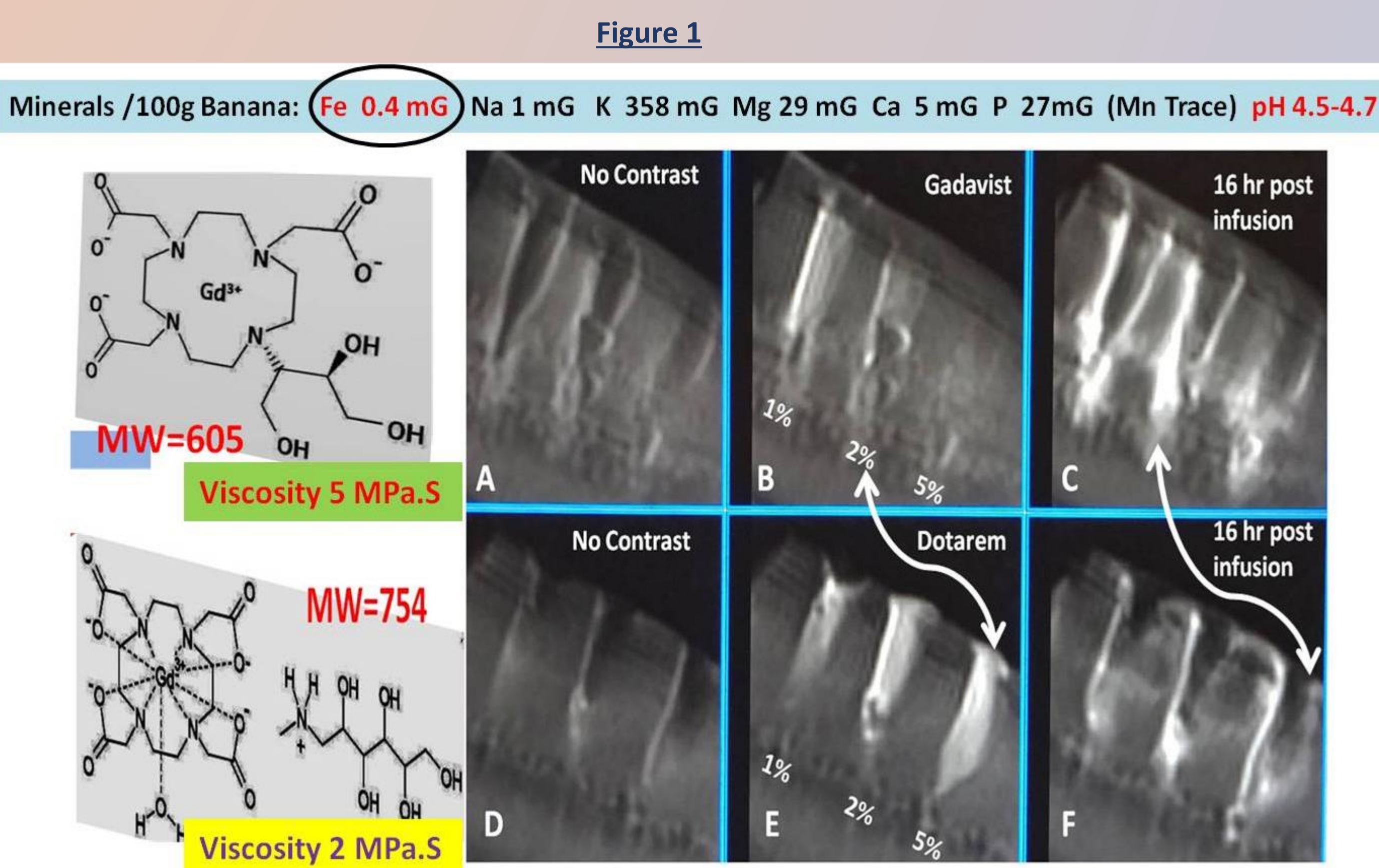
Methods

This project shows how contrast media compounds Gadolinium (Gd) interacts with minerals such as iron (Fe) and manganese (Mn) within bananas, apples, and sweet potatoes. Different types of gadolinium contrast media such as Dotarem and Gadavist that were diluted in water were injected into sample fruits to assess the reaction. Different MRI sequences were performed in both 1.5T and 3T MRI scanners to obtain MRI images of sample fruits with and without contrast. MRI pre and post contrast subtractions were performed to analyze signal changes within the sites of contrast injection and in the background. Imaging was repeated serially with identical set ups for several days. The sample fruits and vegetables were carefully cut with incisions made with plastic utensils. Dotarem and Gadavist were diluted into 1, 2, and 5% solutions. After pre contrast imaging, infusions were done by injecting diluted Gd contrast into the holes in sample fruits and veggies. The holes in the samples were taped and preserved for delay acquiring images.

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Figure 1: A time series of MR images showing Gadavist and Dotarem interaction with biometal Fe in fresh banana.

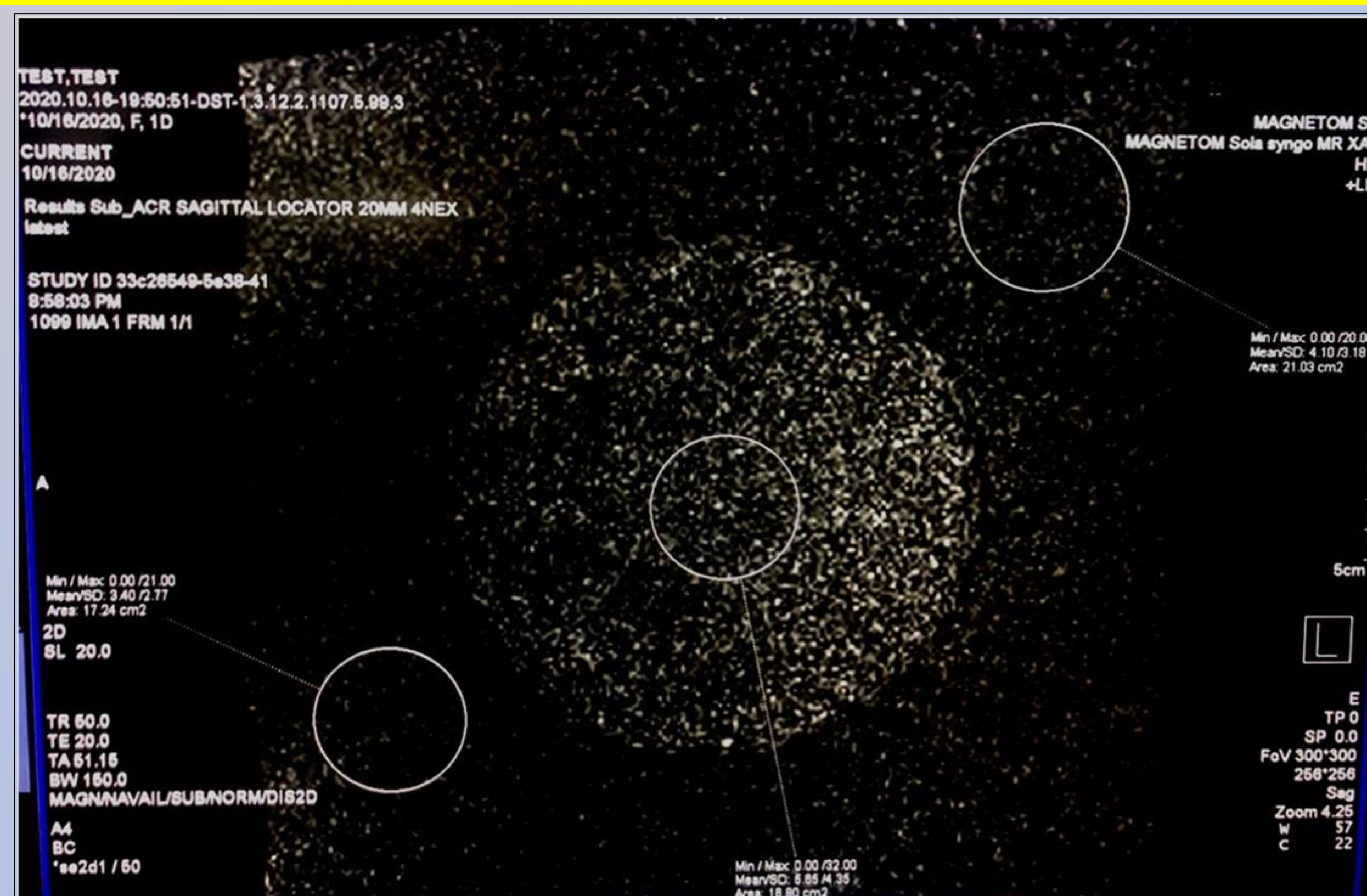


The table below shows 1.5T noise computation using large Agarose Gel Sphere Siemens Magntom Solara, Body Coil Tx/Rx supporting reliable SNR for Tx/Rx coils.

# Signal Averages	Sample M/SD	Anterior Bkgd M/SD	Posterior Bkgd M/SD	SL Thickness
1 nx	47/38	25/20	42/32	5
1 nx	12.5/9.5	5/4.2	8/6.3	20
4 nx	27/21.3	14/11	19/14.4	5
4 nx	6/4.4	3.4/2.8	4/3.2	20

Figure 2

Example of 4nex BC entry is shown below: SE seq 5mm slice, TR/TA 50msec/13sec Subtraction allowed removal of systemic noise.



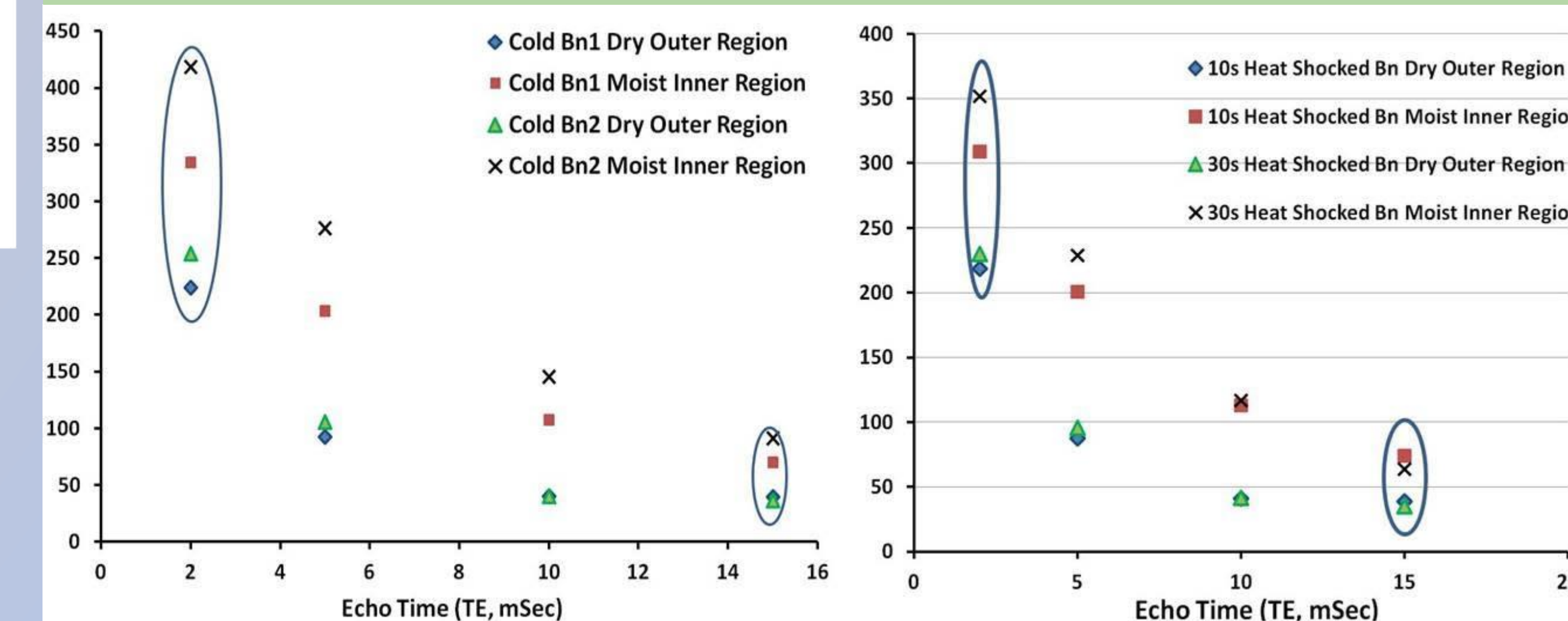
Echo Time (mSec)	Cold Bn1 Dry Outer Region	Cold Bn1 Moist Inner Region	Cold Bn2 Dry Outer Region	Cold Bn2 Moist Inner Region	10s Heat Shocked Bn Dry Outer Region	10s Heat Shocked Bn Moist Inner Region	30s Heat Shocked Bn Dry Outer Region	30s Heat Shocked Bn Moist Inner Region
2	224	334	254	418	219	309	230	352
5	92	203	105	276	88	201	96	229
10	40	107	40	145	41	113	42	117
15	39	70	36	91	39	74	35	64

Cold Banana Signal Ranges: (418-224) = 194 at TE 2 and (91-39) = 52 at TE 15 mSec
Heat Shock: Signal Ranges: (352-219) =133 at TE 2 and (64-39) = 25 at TE 15 mSec

Cold fruit loses 27% or max signal over a 13 mSec TE range, while Heat shocked fruit loses 19% of signal over the 13 mSec TE range. Hence loss of signal does happen with heat shock, one may model it as loss of hydrating water from large carbohydrates.

Figure 3

MR data were using Tx/Rx body coil or CP head without parallel imaging or image filtering and with small # of channels allow reliable SNR comparison for small Fe exchange as hypothesized.



Discussion

Banana has natural iron (Fe) concentration that increases proton MRI signal at low concentrations (presumably from Fe II state and not Fe III, the later is highly paramagnetic. Since Gadavist has >2x viscosity of Dotarem, faster moving bright areas in Fig 1 below Gadavist spots with time are not from Gadavist diffusion but perhaps from another metal ion accumulating that enhances T1 MR signal, i.e. Fe(II). The study seems to confirm the extraction of iron from banana by chelation or transmetallation triggered by MRI contrast media.

Conclusions

- Signal is lost in Fig 3 perhaps due to the polymerization of carbohydrates after partial loss of water of hydration and T2 shortening.
- Bright areas below Gadavist wells are more widespread than those for Dotarem while the viscosity controlled diffusion would suggest opposite situation. Hence the progressive signal enhancement adjacent to contrast wells with time are not from Gadolinium diffusion but perhaps from another metal ion, in case of banana, T1 signal enhancement seems to come from chelated Fe(II) since banana does not have any other MR enhancing metal ions.
- We believe, this is the first imaging demonstration of transmetallation or chelation of biometal in real time in a model biological system with minimal disruption of the biochemical pathways compared to SEM or HPLC approaches for transmetallation.

Acknowledgment

We would like to acknowledge valuable help from ASRC, The Mount Sinai Hospital, The Mount Sinai West Hospital, and NYU Langone Hospital for access to MRI Scanner Suites for our undergraduate research students projects. This work was made possible with student stipends from City Tech to above student researchers under ESP Program.

Using Random Walks to Determine the Equilibrium Temperature



Gianning Luo

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Abstract

We consider a thin trapezoidal plate that is insulated from heat. Given that the temperatures around the edges of the plate are known, we aim to determine the temperature at a single interior point using the Monte Carlo technique. We start by dividing the surface of the plate into a certain number of net lines. The points of intersection of these lines are called mesh points. Starting from an interior mesh point, we define a discrete random walk along the net. We then record the temperature at the boundary mesh point first encountered along this random walk. We obtain an estimate of the specified interior mesh point given by the average value of the boundary temperatures recorded for n random walks. A random walk property guarantees that this average value approaches the desired temperature as n increases without bound.

The Problem

We consider a thin trapezoidal plate whose two faces are insulated from heat. We assume that the temperatures along the four edges are given. Our goal is to determine the equilibrium temperature at a specific point inside the plate.

The Monte Carlo Technique

We divide the surface of the plate into a certain number of net lines. The points of intersection of these lines are called *mesh points*. Starting from an interior mesh point, we define a discrete random walk along the net through the mesh points. The probability of each of the four possible directions (left, right, up or down) is the same.

Random Walk Property

We compute the temperature at a specified interior mesh point using the following property.

Theorem 0.1. *Let W_1, W_2, \dots, W_n be a succession of random walks, all of which begin at a specified interior mesh point. Let $t_1^*, t_2^*, \dots, t_n^*$ be the temperatures at the boundary mesh points first encountered along each of these random walks. Then the average value $(t_1^* + t_2^* + \dots + t_n^*)/n$ of these boundary temperatures approaches the temperature at the specified interior mesh point as the number of random walks n increases without bound.*

The Procedure

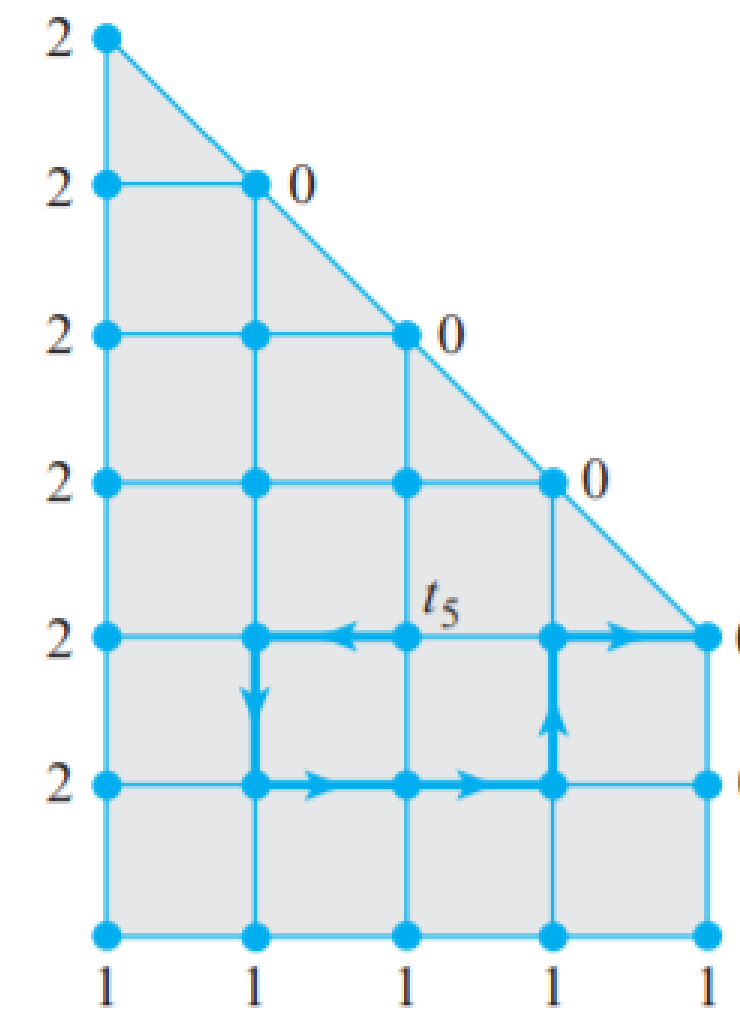


Figure 1: A trapezoidal plate and a random walk.

Figure 1 shows a trapezoidal plate¹ with a partition consisting of 9 interior mesh points and 16 boundary mesh points. The numbers 0, 1 and 2 indicate the temperatures on the edges. The six arrows

← ↓ → → ↑ →

describe a random walk that begins at the point labeled t_5 and ends at a boundary mesh point whose temperature is 0. Our goal is to estimate the temperature t_5 . We use the 100 randomly generated arrows displayed in the following table:

	0	1	2	3	4	5	6	7	8	9
0	↓	←	←	↓	↓	←	←	↓	↓	↑
1	←	←	→	→	←	↑	↑	→	→	↓
2	←	↑	←	←	←	→	←	↓	←	↓
3	↑	→	→	→	→	↑	↑	←	↓	↑
4	↑	↑	←	←	↓	↓	↓	→	←	↓
5	↓	←	→	↓	→	↓	↑	←	↑	↓
6	↑	↑	↑	↓	↓	↑	↑	←	↑	←
7	←	↓	↓	↑	→	→	↑	↓	↓	←
8	←	↑	→	↓	←	↓	↓	←	↓	←
9	↑	↑	→	→	↑	↓	↓	→	↓	→

We proceed as follows.

1. Use a specific row and column as the starting point.
2. Go to the arrow in the array with that row and column number.
3. Using this arrow as a starting point, move through the array of arrows from left to right, and top to bottom. Beginning at t_5 in Figure 1 and using this sequence of arrows to specify a sequence of directions, move from mesh point to mesh point until you reach a boundary mesh point, b_1 . This completes the first random walk.

Record the temperature at the boundary mesh point. (If you reach the end of the arrow array, continue with the arrow in the upper left corner.)

4. Return to the interior mesh point labeled t_5 and begin where you left off in the arrow array; generate your next random walk.

5. Calculate the average of the boundary temperatures recorded.

Results

In Step 1 we choose row 0 and column 1. The following table displays the results for $n = 20$.

n	b_n	$(b_1 + b_2 + \dots + b_n)/n$	n	b_n	$(b_1 + b_2 + \dots + b_n)/n$
1	2	2	11	2	1.25
2	1	1.5	12	2	1.42
3	2	1.67	13	0	1.31
4	1	1.5	14	1	1.29
5	2	1.6	15	1	1.27
6	0	1.33	16	0	1.19
7	0	1.14	17	0	1.12
8	2	1.25	18	0	1.06
9	2	1.33	19	1	1.05
10	1	1.3	20	2	1.1

The conclusion is that the temperature is 1.1 at t_5 . The exact value is 0.7491. We would need to run the procedure many more times to have a better estimate.

Further Work

The procedure needs to be coded so that it can be implemented more efficiently. We wonder how the 100 randomly generated arrows affect the estimation of the temperature. We would also like to experiment the use of other arrows such as ↙, ↘, ↗, ↖. This would diversify the random walks. Another possible investigation is to consider more mesh points to see if the temperature can be obtained more quickly.

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¹This picture was obtained from [1].



Bernoulli Numbers and Bernoulli Polynomials



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Abstract

We begin with the study of Bernoulli Numbers, which are defined as the coefficients of the terms of the power series centered about zero of the function $\frac{t}{e^t-1}$. We show that they are rational numbers and connect them to Bernoulli polynomials. The Bernoulli numbers has applications in the study of p-adic numbers, Fermat's last theorem, zeta functions and combinatorics. This is project C, in [1]. We will also establish that the Bernoulli polynomials are in the ring, $\mathbb{Q}[x]$, i.e they are polynomials with rational coefficients. Our work culminates with a method to find closed form expressions of the finite sums of positive powers of integers.

Introduction

The **Bernoulli numbers** are a sequence of rational numbers which were discovered by mathematicians **Jacob Bernoulli** and **Seki Takakazu** in the 17th century when Bernoulli was investigating the sums of powers of integers [2]. The Bernoulli numbers are the constant terms of the Bernoulli polynomials. The Bernoulli numbers and the Bernoulli polynomials are defined by a *generating function* as follow:

$$\frac{te^{xt}}{e^t-1} = \sum_{k=0}^{\infty} B_k(x) \frac{t^k}{k!} \quad \text{and} \quad \frac{t}{e^t-1} = \sum_{n=0}^{\infty} b_n \frac{t^n}{n!}, \text{ respectively.}$$

It is well known that necessity is the main road to the discovery of new idea in any subjects. The discovery of Bernoulli numbers and polynomials are not the exception. In the 17th century many mathematicians were struggling to solve problems in engineering and physics because they did not have a specific formula to compute the sum of integer powers [2]. After a marathon of hard works by other mathematicians, Bernoulli and Takakazu were the one to come out with an exact formula to compute the sum of integer powers. After Bernoulli and Seki Takakazu were able to discovered the sequence of numbers in the early eighteen century, the discovery of many other connections between sequence and other mathematical field became more common.

The Bernoulli numbers and polynomials are important because of their applications in science, specifically in mathematics. We can find the Bernoulli numbers and polynomials in area such as *number theory, Taylor series, the sum of m-th powers in Faulhaber's formula, Euler-Maclarian formula, the Riemann zeta function, P-adic numbers, Fermat's last theorem, and combinatorics*. We will study Bernoulli Numbers and Polynomials and derive important properties. Some property of the Bernoulli numbers and polynomials are:

1. Bernoulli numbers are rational.
2. Bernoulli numbers are given by letting $x=0$ in the Bernoulli polynomials.
3. $B_k(x)$ is monic.
4. $p-1$ divides k if and only p occurs once in the denominator of b_k .

Results

- The first seven Bernoulli numbers are given by: $b_0 = 1, b_1 = \frac{1}{2}, b_2 = \frac{1}{6}, b_3 = 0, b_4 = -\frac{1}{30}, b_5 = 0,$ and $b_6 = \frac{1}{42}$.

- The Bernoulli numbers are rational. That is, $b_k \in \mathbb{Q}$.

- $b_k = -\frac{1}{k+1} \sum_{j=0}^{k-1} \binom{k+1}{j} b_j$ where $k \in \mathbb{N}$.

- $g(t) = f(t) + \frac{1}{2}t$, where $f(t) = \frac{t}{e^t-1}$ is even. That is, $g(-t) = g(t)$.

- When k is odd, for $k > 1, b_k = 0$.

- The first four Bernoulli polynomials are given by:

1. $B_0(x) = 1$. This is the first Bernoulli polynomial.

2. $B_1(x) = x - \frac{1}{2}$. This is the second Bernoulli polynomial.

3. $B_2(x) = x^2 - x + \frac{1}{6}$. This is the third Bernoulli polynomial.

4. $B_3(x) = x^3 - \frac{3}{2}x^2 + \frac{1}{2}x$. This is the fourth Bernoulli polynomial.

- The Bernoulli polynomials are rational. That is, $B_k(x) \in \mathbb{Q}$.

- The Bernoulli numbers are given by letting $x=0$ in the Bernoulli polynomials.

- $B_k(x) = \sum_{j=0}^k \binom{k}{j} b_j x^{k-j}$

- $B_k(x)$ is monic. That is, the leading term has coefficient one.

- $\int_0^1 B_k(x) dx = 1$ if $k=0$ and 0 otherwise.

- $\frac{d}{dx} B_k(x) = k B_{k-1}(x)$ for $k \in \mathbb{N}$.

- $B_k(1-x) = (-1)^k B_k(x)$ for $k \in \mathbb{N}$.

- $B_k(x+1) - B_k(x) = kx^{k-1}$ for $k \in \mathbb{N}$.

- $B_k(1) = B_k(0)$ for $k \in \mathbb{N}, k \geq 2$.

- $\sum_{j=1}^n j^k = \frac{B_{k+1}(n+1) - B_{k+1}(0)}{k+1}$ for $k, n \in \mathbb{N}$.

- $p-1$ does not divide k if and only if p does not appear in the denominator of b_k .

Result's Continuation

- $N^{k-1} \sum_{j=0}^{N-1} B_k\left(\frac{x+j}{N}\right) = B_k(x)$ for $k \in \mathbb{N}, N \in \mathbb{N}$.

- $\sum_{j=1}^n j = \frac{n(n+1)}{2}, \sum_{j=1}^n j^2 = \frac{n(n+1)(2n+1)}{6}$, and

- $\sum_{j=1}^n j^3 = \left(\frac{n(n+1)}{2}\right)^2$

- $p-1$ divides k if only if p occurs once in the denominator of b_k .

Conclusion

The goal of this project was to study the Bernoulli numbers and the Bernoulli polynomial properties. Our main goal was to derive important properties. We started by calculating the first seven Bernoulli Numbers and explain why the Bernoulli numbers are rational. As a result, we used the method of equating coefficients to justify a recursive formula for calculating the Bernoulli numbers. The fact that we can calculate the Bernoulli numbers using a recursive formula is extremely helpful because we do not have to go through all the hard algebra to get them. Now that we know some of the properties of the Bernoulli numbers, we proceed to calculate the first four Bernoulli polynomials which are linked to the Bernoulli numbers in a very interesting way. As we study the Bernoulli numbers, we continue by justifying a formula to calculate the Bernoulli polynomials.

Many problems in mathematics are easier to solve now than before because of the Bernoulli numbers and the Bernoulli polynomials. Many applications of mathematics use Bernoulli numbers and polynomials. Therefore, it is very useful and important to study and analyze their properties and the reason of their importance. The p-adic, Fermat's last theorem, zeta functions, and combinatorics are among the applications.

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NASA, Boeing, and Defense activities: for the use of Geopolymers for space construction.

Terrance Bisnauth, Saim Wasim, Julio Martinez

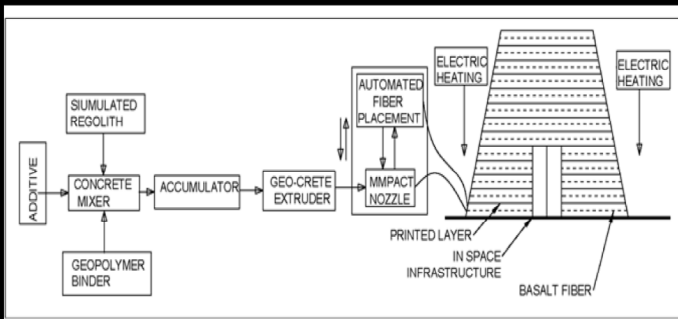
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BackGround

Construction generally comprises inert minerals materials such as concrete, bricks, tiles, and ceramics. Furthermore, using Geopolymer in space construction is very much needed at this time - due to humanity developing a multi-planetary approach towards civilization. Very interestingly, Geopolymers are very high conductive inorganic materials to electromagnetic radiation. Therefore, geopolymer production will require a plasticizer and a concrete-like based material.

Geopolymer Development Concept



Automated Robotic Construction System

• Under the Moon to Mars Planetary Autonomous Construction Technology (MMPACT) project, the MMPACT nozzle is developed to use geopolymer in 3D construction, as shown in the figure.

Method

- A combination of fly-ash as the pre-cursor Barite ($BaSO_4$) and Hematite as the aggregate and metallic chip produced the Geopolymer material.
- Geopolymer showed the ability to oppose radiation penetration after being exposed to several levels of radiation.
- Potassium can be used as an activator on the moon. Potassium is a component of KREEP - and is concentrated in the mare regions in minerals such as orthoclase. For example, in Apollo 12 sample 12013, a KREEP breccia, a granitic rock type that makes up a portion of the sample, contains approximately 50% by volume of orthoclase. Granitic compositions have been located via remote sensing using the Diviner Lunar Radiometer Experiment in the Procellarum KREEP terrain at Gruithuisen Domes, Aristarchus, Hansteen Alpha, Montes Rhipaeus, Helmet, and Lassell Massif features. Potassium is also found in some glasses in the regolith. It is thought to form from very late-stage magmatism
- Sodium-rich phases on Mars include sodium perchlorate, sodium metasilicate, sodium chloride, sodium feldspar, sodium borate, sodium sulfate, sodium montmorillonite (a clay from the smectite group), sodium carbonate, and additional sodium silicates.
- Sodium activator-based geopolymer is a potential building material in Mars/Moon.
- A secondary method of geopolymer production is a mixture of H_2O and lunar regolith comparable to the soil on earth. The mixture will produce a concrete-like geopolymer.



A future moon base, built out of geopolymer concrete.

Results

From this research. The results proved that geopolymers are very effective in blocking out electromagnetic waves of frequencies that are greater than 1 GHz.

Conclusion

The findings of this research showed that geopolymers are highly conductive materials. That is capable of opposing electromagnetic penetration of more than one (1) GHz. Which further proves that these materials are suitable for usage in space construction.

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Covid-19 Infection Impact on Organ Systems & Approaches to Treating & Managing the Impact

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Abstract

Infection by the Covid virus known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causes the coronavirus disease 2019 (COVID-19). We reviewed approaches to treating hospitalized patients infected with SARS-CoV-2 and the symptoms of the disease from published literature. To know whether and how the disease impacts organs and organ systems, we collected information on the effects on organs and organ systems as well as the impact of drugs administered in alleviating symptoms and managing the infection. Common signs and symptoms of the disease caused by the infection which may appear two to 14 days after exposure, include fever, tiredness, and cough. Early symptoms may include a loss of taste (ageusia) or smell (anosmia, hyposmia). Other symptoms include shortness of breath and muscle aches among others. COVID-19 affects mainly the respiratory system and the clinical presentation ranges from asymptomatic cases to severe manifestations. In some individuals with comorbidities (having underlying conditions or diseases) Covid-19 caused severe morbidity and mortality, usually in the form of acute respiratory distress syndrome (ARDS). ARDS, heart failure, renal failure, liver damage, shock, and multiorgan failure precipitated death in some patients. The most common comorbidities were diabetes mellitus, hypertension, and obesity. SARS-CoV-2 viral particles were demonstrated within organ-specific cells in the trachea, lung, liver, large intestine, kidney indicating that the disease impacts multiple organs. Hospitalized patients treated in intensive care units (ICUs) received invasive mechanical ventilation and kidney replacement therapy as determined appropriate. Regarding treatment with drugs, the Food and Drug Administration (FDA) approved the antiviral drug remdesivir for treating hospitalized adults and children aged 12 years or above. Emergency use authorization was granted for the rheumatoid arthritis drug, baricitinib and convalescent plasma therapy. Other FDA-authorized drugs include monoclonal antibody medications such as sotrovimab and casirivimab. The effectiveness of these drug treatment options has not been definitively established

Introduction

The COVID-19 pandemic that first became apparent in Wuhan, China, is now infecting millions all over the world. With more than 30 million documented infections and 1 million deaths worldwide, the coronavirus disease 2019 (COVID-19) pandemic continues unabated (Petrilli et al., 2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the pathogen responsible for the coronavirus disease 2019 (COVID-19) pandemic, which has resulted in global healthcare crises and strained health resources (Dixit et al., 2020; Richardson et al., 2020). The clinical spectrum of severe acute respiratory syndrome coronavirus (SARS-CoV) 2 infection ranges from asymptomatic infection to life-threatening and fatal disease. Since the outbreak and rapid spread of COVID-19 starting late December 2019, it has been apparent that disease prognosis has largely been influenced by multiorgan involvement (Jain, 2020; Peiris et al., 2021; Zaim et al., 2020). COVID-19 is now recognized as a multi-organ disease with a broad spectrum of manifestations. Like post-acute viral syndromes described in survivors of other virulent coronavirus epidemics, there are increasing reports of persistent and prolonged effects after acute COVID-19 (Nalbandian et al., 2021). Our interest is in how the disease manifests, how patients hospitalized with the infection were treated and managed, and the disease progression and impact on organ systems other than the respiratory system.

Causes

Infection with the SARS-CoV-2 causes coronavirus disease 2019 (COVID-19). According to Zaim et al. (2020), data has shown that the infection spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus spreads by respiratory droplets released when someone with the virus coughs, sneezes, breathes, sings, or talks. These droplets can be inhaled or land in the mouth, nose, or eyes of a person nearby. SARS-CoV-2 infects human cells by binding to the cell surface protein angiotensin-converting enzyme 2 (ACE2) through the Receptor Binding Domain (RBD) of its spike (S) protein (Fig. 1)

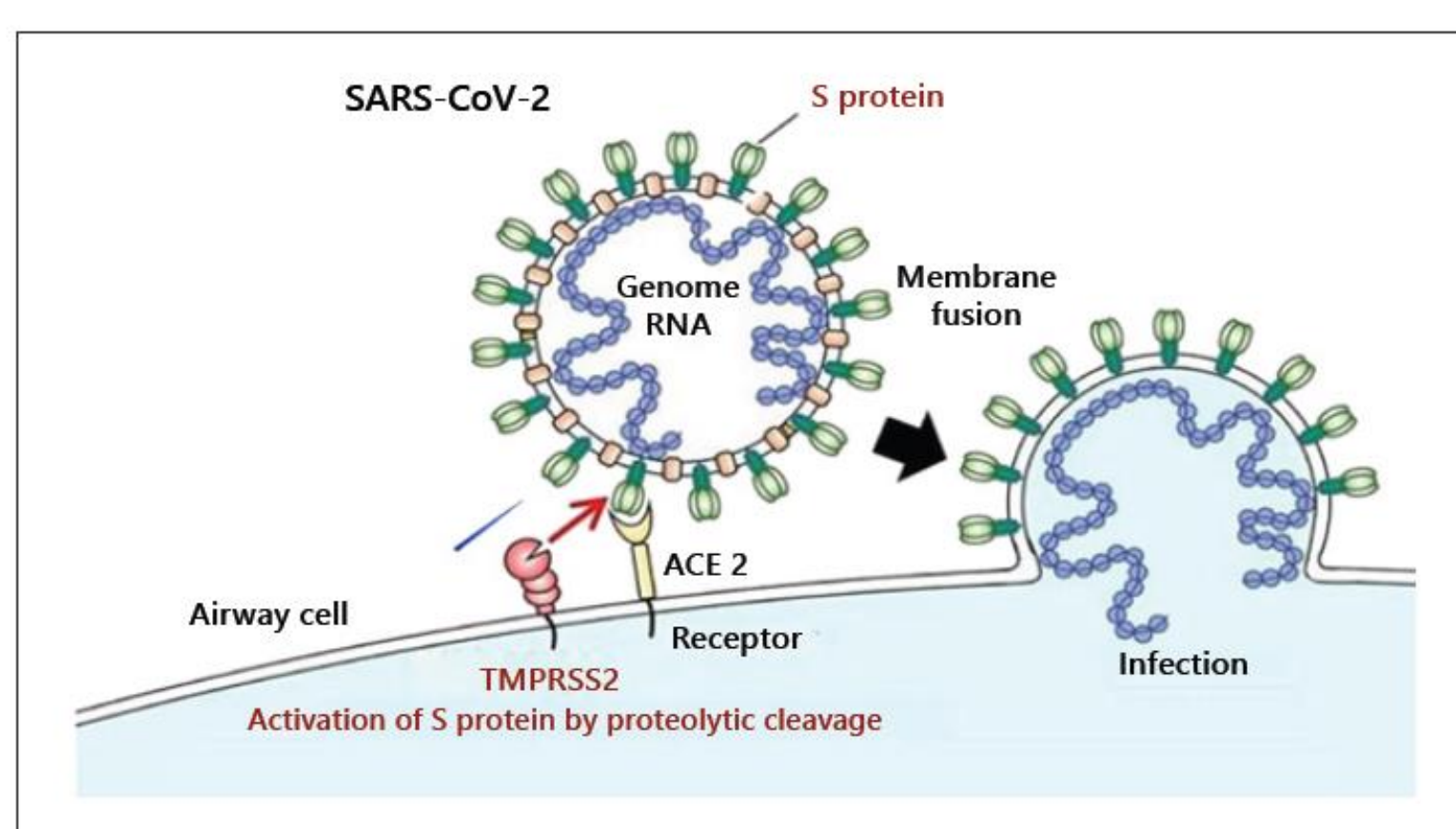


Fig. 1. The dynamics of viral entry into human cells. Spike proteins on the surface of the SARS-CoV-2 bind to angiotensin-converting enzyme 2 (ACE 2) receptors on the surface of the target cell while the type II transmembrane serine protease (TMPRSS2) binds to and cleaves the ACE 2 receptor. In the process, the spike protein is activated. Cleaved ACE 2 and activated spike protein facilitate viral entry, leading to infection.

Symptoms

Signs and symptoms of coronavirus disease 2019 (COVID-19) may appear two to 14 days after exposure (Nalbandian et al. 2021; Mayo Clinic n.d.; Zaim et al., 2020). Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may include a loss of taste or smell. Other symptoms can include shortness of breath or difficulty breathing, muscle aches, chills, sore throat, runny nose, headache, chest pain, conjunctivitis, nausea, vomiting, diarrhea, and rash. This list is not all inclusive. Children have similar

symptoms to adults and generally have mild illness. The severity of COVID-19 symptoms can range from very mild to severe. The timeline for progression of SARS-Cov-2 is shown in Figure 2.

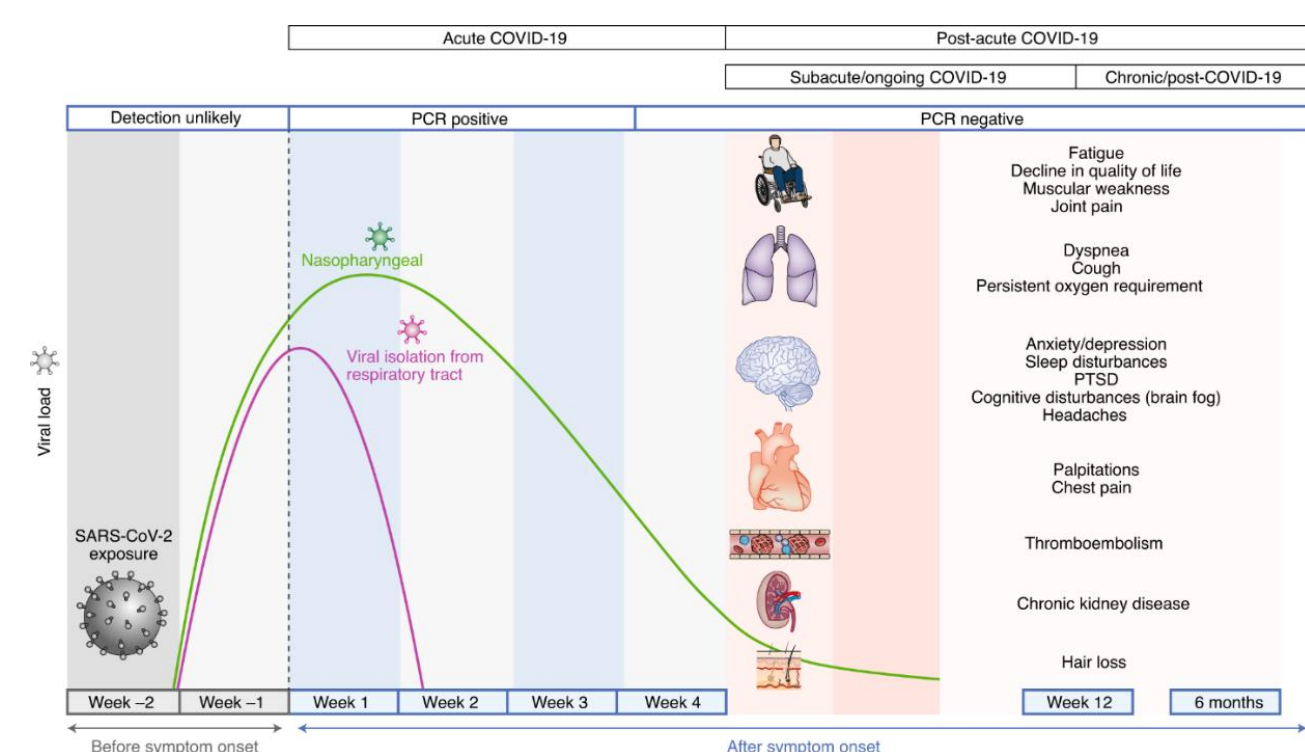


Fig.2. Progression of SARS-CoV-2 resulting from COVID-19 infection. The common symptoms observed in post-acute COVID-19 are summarized. From Nalbandian et al. (2021)

Epidemiology and Comorbidities

Richardson et al. (2020) in their study of patients hospitalized with COVID-19 in the New York City Area found that for both patients discharged alive and those who died, the percentage of patients who were treated in the ICU or received invasive mechanical ventilation was increased for the 18-to-65 age group compared with the older-than-65 years age group. Among the 2634 patients who were discharged or had died at the study end point, during hospitalization, 373 (14.2%) were treated in the ICU, 320 (12.2%) received invasive mechanical ventilation, 81 (3.2%) were treated with kidney replacement therapy, and 553 (21%) died.

Petrilli et al. (2020) found particularly strong associations of older age, male sex, heart failure, chronic kidney disease, and obesity with hospital admission and risk of critical illness among all patients with Covid-19.

Organ/system	Organ Specific n (%)	Microthrombi n (%)	Endothelial Injury n (%)	TE disease n (%)	Vasculitis n (%)	Inflammation* n (%)	H/D compromise n (%)
Upper airways*	-	-	-	-	-	33/33 (100)	-
Lung	DAD† 315/342 (92.1)	132 (38.6)	61 (17.8)	47 (13.7)	10 (2.9)	21 (6.1)**	27 (7.9)
GI	-	2/83 (2.4)	2 (2.4)	-	-	-	15 (18.1)
Liver	-	-	1/236 (.4)	93 (39.4)	-	59 (25.0)	114 (48.3)
Heart	-	-	8/210 (3.8)	15 (21.4)	-	37 (17.6)	-
Kidney	-	55/276 (19.9)	1 (0.4)	2 (0.7)	-	-	147 (53.3)
CNS	-	20/110 (18.2)	-	9 (8.2)	-	9 (8.2)	34 (30.9)
Hem-Lymph	-	-	-	1/136 (0.7)	-	15 (11.0)	7 (5.2)
Skin	-	13/44 (29.5)	1 (2.3)	-	11 (25.0)	15 (34.1)	-
Placenta	-	11/19 (57.9)	-	-	-	1 (5.3)	-

GI: gastrointestinal, CNS: central nervous system, Hem-lymph- hematolymphoid, DAD- Diffuse alveolar damage, TE- thromboembolic, H/D-hemodynamic. *Trachea, pharynx, bronchial, mucosa. † Possible cytopathic effect. ** Inflammation not related to Diffuse Alveolar Damage. Highlighted- most common abnormality by organ-system.

Table 1. Recurrent pathologic findings by organ/organ-system. From Peiris et al. (2021)

Treatment

In the US, the Food and Drug Administration, FDA has approved use of the antiviral drug remdesivir to treat COVID-19 in hospitalized adults and children who are age 12 and older in the hospital. FDA also granted an emergency use authorization for the rheumatoid arthritis drug baricitinib to treat COVID-19 in some cases. Several monoclonal antibody medications such as sotrovimab are used to treat mild to moderate COVID-19 in people who have a higher risk of developing serious illness due to COVID-19. The FDA has also granted emergency use authorization for convalescent plasma therapy with high antibody levels to treat COVID-19.

Multiorgan Impact

The infection routes and sites of potentially SARS-CoV-2 infected organs of the respiratory and other systems are shown in Fig. 3 indicating the wide reach of the virus. Peiris et al. (2021) reported recurrent pathologic findings in organs/organ systems as a result of Covid-19 infection (Table 1). The organ systems affected apart from the

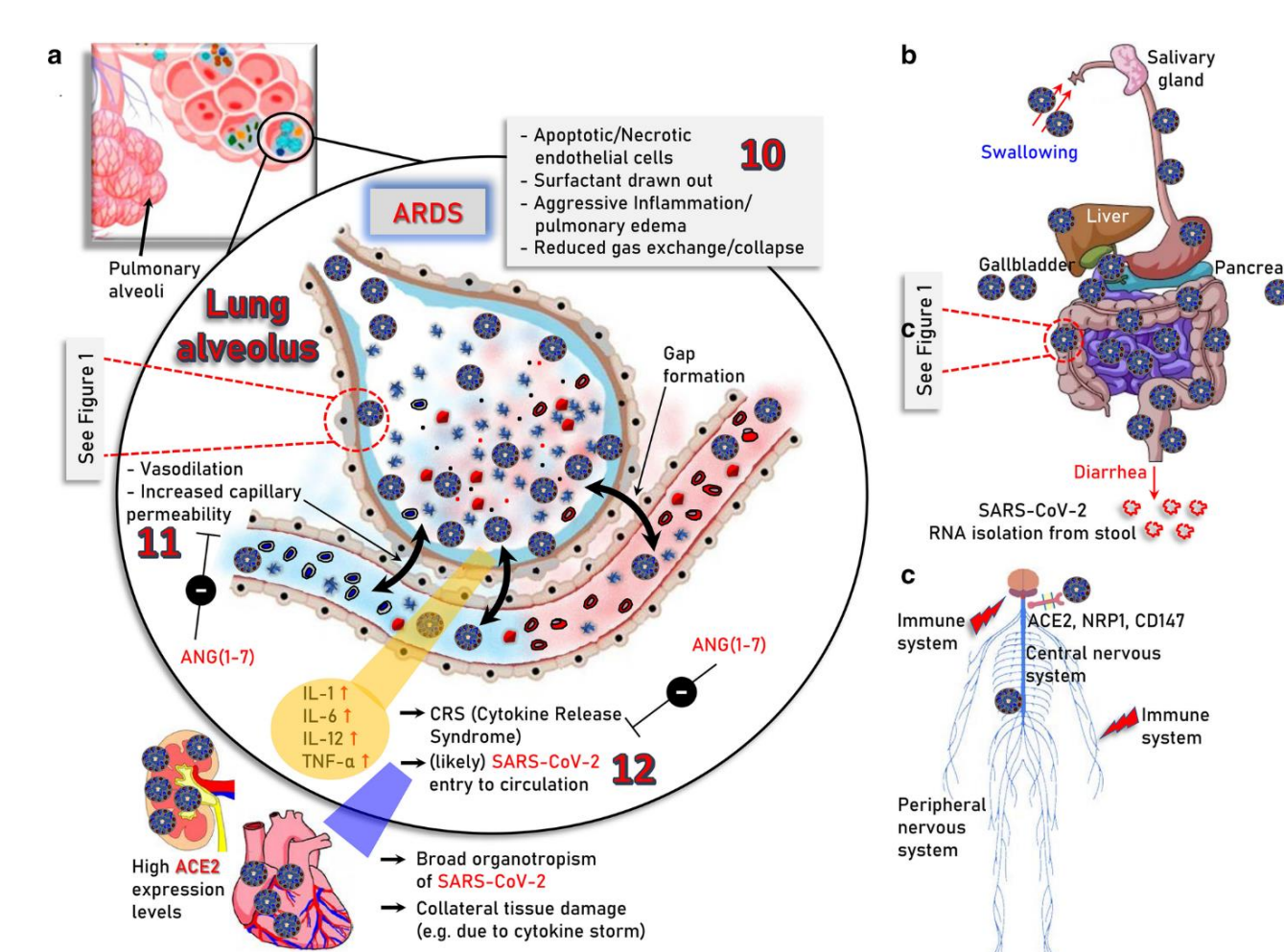


Fig. 3. Major severe COVID-19 pathologies and infection routes. a The modules involved in, 10. acute phase of SARS-CoV-2 infection in the lung (ARDS); 11. vasodilation, increased capillary permeability, as well as 12. ARDS-induced "cytokine storm" and likely virus entry to the circulation b Sites of potentially SARS-CoV-2 infected organs in the alimentary tract of the digestive system and in accessory organs i.e., salivary glands, liver, gallbladder, and pancreas. ACE2 is expressed in relatively high levels in duodenum, small and large intestines, rectum, as well as in gallbladder. c Central (brain, spinal cord) and peripheral nervous system as an infection route of SARS-CoV-2. From Trougakos et al. (2021)

respiratory include the digestive, urinary, reproductive, integumentary, nervous, and cardiovascular. Viral cells were detected in the upper and lower respiratory tracts (pharynx, trachea, bronchi, lungs), digestive tract (large intestine) and the accessory glands (liver, pancreas), cardiovascular (heart, saphenous vein), urinogenital (kidney, testes), lymphatic (tonsils, lymph nodes, spleen); integument (skin), and central nervous system (brain and retina).

Conclusions

Since SARS-CoV-2 is a new virus and there are few (e.g., Remdesivir; an antiviral drug initially used against hepatitis C virus) anti-viral drugs that have been re-purposed for COVID-19 treatment, a better understanding of the underlying COVID-19 pathobiology is required in order to design prophylactic and/or therapeutic strategies. Full attention to comorbidities and potential organ injuries is therefore crucial in the implementation of preventative and protective measures.

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Association between Oral Cancer and Diet

Students: Tashi Choedon, Michelle Klig, Irina Urmi

Faculty mentor: Dr. Laina Karthikeyan

Factors of Oral Cancer and Diet

Data from six cohort studies and approximately 40 case-control studies on the relation between selected aspects of diet and the risk of oral cancer.

Fruit and vegetables were inversely related to the risk: the pooled relative risk (RR) for high vegetable consumption was 0.65 from three cohort studies on upper tract cancers and 0.52 from 18 case-control studies of oral cancer, corresponding RRs for high fruit consumption were 0.78 and 0.55. Beta-carotene, vitamin C and selected flavonoids have been inversely related to the risk, but it is difficult to disentangle their potential effect from that of fruit and vegetables.

Impact of Diet

Drinking green tea may prevent the development of oral cancer, new research suggests.

A study by scientists in the thoracic head and neck Medical Oncology department, at the University of Texas examined the progress of 41 patients with pre-malignant mouth lesions, during a treatment regimen that included either 500 milligram, 750 milligram or 1,000 milligram doses of green tea extract for three months. Other patients were given a placebo.

The study found that 59 percent of those who took the highest dose of green tea extract showed a clinical response, compared to 18 percent of those who took a placebo. According to what the researchers found on biopsy, the green tea extract stops angiogenesis – the process by which new blood vessels form to nourish a developing cancer.

Abstract

Oral cancer and other forms of cancer such as face and neck cancers are the most common malignant neoplasms in the world. Most common causes of oral cancer are the use of tobacco and alcohol as well as diet. The connection between diet and oral cancer is that some nutrients provide protection against cancer, while some can increase the risks for development and spread of cancer.

If you incorporate vegetables, fruits, teas, garlic and cereals in your diet, it may lead to decreased risks for oral cancer, as they contain certain bioactive components.

Oral Cancer



Daily Diet

Eat at least 5 portions of a variety of fruit and vegetables every day. Base meals on higher fibre starchy foods like potatoes, whole grain bread, rice or pasta. Eating a variety of these foods each day will provide the protein you need, as well as a range of other nutrients, including iodine, iron, zinc, vitamins and essential fatty acids.

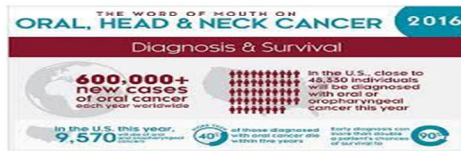
How do certain foods reduce the risk of oral cancer?

Foods such as broccoli, berries, and garlic showed some of the strongest links to cancer prevention. They're low in calories and power-packed with phytochemicals that may help reduce your cancer risk. Consumption of fruits, vegetables and cereals, which are the major source of vitamins and fiber should be adequate in the daily diet. Optimal levels of daily allowance of micronutrients like vitamin C, E antioxidants and folate are effective in prevention of oral cancer.

What is Oral Cancer?

- Detected by dentists or person themselves in most cases
- Usually squamous cell (epithelial)
- Abnormal neoplasm of the mouth

Diagnosis and Survival



Risk Factors for Oral Cancer

A Brazilian case-control study showed that habitual intake of bacon and fried foods was a risk factor for oral cancer. In developing countries, around 80% of cancers of the oral cavity, pharynx and oesophagus are thought to be due to micronutrient deficiencies related to a restricted diet that is low in fruits and vegetables and animal products; it should be noted, however, that the evidence for a protective effect of fruits and vegetables is largely derived from case-control studies. Deficiencies of riboflavin, folate, vitamin C and zinc may all be vital. Consuming drinks and foods at a very high temperature also increases the risk for oral cancer. Yet another study suggested that a diet with a higher glycaemic load increases the risk for oral cancer.

Whole grains and its connection to oral cancer

Refined grains were directly related to the risk of cancer of the oral cavity and pharynx (OR=1.9 for the highest tertile), oesophagus (OR=3.7) and larynx (OR=4.0). In contrast, whole grain cereals were protective, with OR of 0.6 for oral cavity and pharynx, 0.3 for oesophagus, and 0.7 for larynx. For the three sites combined, the OR for the highest tertile was 5.7 for refined grains and 0.5 for whole grains. The trends in risk for refined grains were significant for all sites and their combination, and for whole grain for esophageal cancer and all sites.

Oral Cancer Image



ORAL (MOUTH) CANCER

ORAL CANCER STATISTICS

- 95% of cases traced to alcohol or tobacco
- 8,000-9,000 new cases diagnosed every year
- 45% of cases diagnosed at stage I, the earliest stage
- 84% of cases diagnosed at stage II, III, or IV
- 39% of cases diagnosed at stage V, the most advanced

TIPS FOR PREVENTION

- Stop smoking or chewing all forms of tobacco
- Cut down on alcohol consumption
- Use a lip checkup with UV protection
- Eat a highly alkaline and antioxidant diet
- Never skip dental cleanings and do cancer screenings
- Fluoride & seal

COMMON SYMPTOMS

- Red or white patches that don't go away
- Swollen lymph nodes
- Difficulty swallowing
- Constant sore throat
- Colored patches inside the mouth that last more than two weeks
- Unexplained weight loss
- Human papillomavirus (HPV)
- Alcohol consumption
- Tobacco use

RISK FACTORS

- Alcohol consumption
- Human papillomavirus (HPV)
- Tobacco use
- Age
- Gender
- Family history
- Genetics
- Immune system
- Obesity
- Stress
- Vitamin deficiencies

Ways to prevent oral cancer through diet

While oral cancer can be very unpredictable and happens to many people there are things you can do in your everyday life to lower/prevent your risks of getting oral cancer. The first step would be to stop the use of tobacco. Eating such as broccoli or garlic that's rich in phytochemicals. Lowering your intake of meat also proves to lower your risks of oral cancer.

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 - Dietary factors and oral and oropharyngeal cancer risk charts/pictures: <https://www.dentistrytoday.com/statistics-alone-dont-reveal-oral-cancer-a-terrible-bolt/>

Impact of Diet

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Acknowledgement

The authors thank Interim AP Blake and Profs. Norouzi and Samaroo for their support through the Emerging Scholars Program and Robin Hood grant.



Neutron Activation Analysis Of Heavy Elements in the Environment

STUDENT: LE VAN LA—MENTOR: PROF. VISHWAS JOSHI, MS., PHD./ DEPARTMENT OF CHEMISTRY
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ABSTRACT

The main focus of the research is an application of neutron activation analysis (NAA) to determine concentrations and distribution of heavy metals in environmental samples. Due to human activity and industrialization, heavy metal pollutants have been accumulating in the environment. The principle of NAA is that traces of various elements can be identified and measured by analyzing the gamma rays they give off after being irradiated with neutrons.

The project is conducted online by using, summarizing, analyzing, and organizing relevant literature, articles, and data that are available via open sources, and the world wide web. This project will focus on the application of NAA to the detection of high atomic number elements or heavy elements in the environment which could cause health problems for plants, animals, and human beings.

PRINCIPLE AND METHOD

Figure 1. illustrates the principle of NAA technique of analyzing the gamma rays given off after the target nucleus element was irradiated.[1]

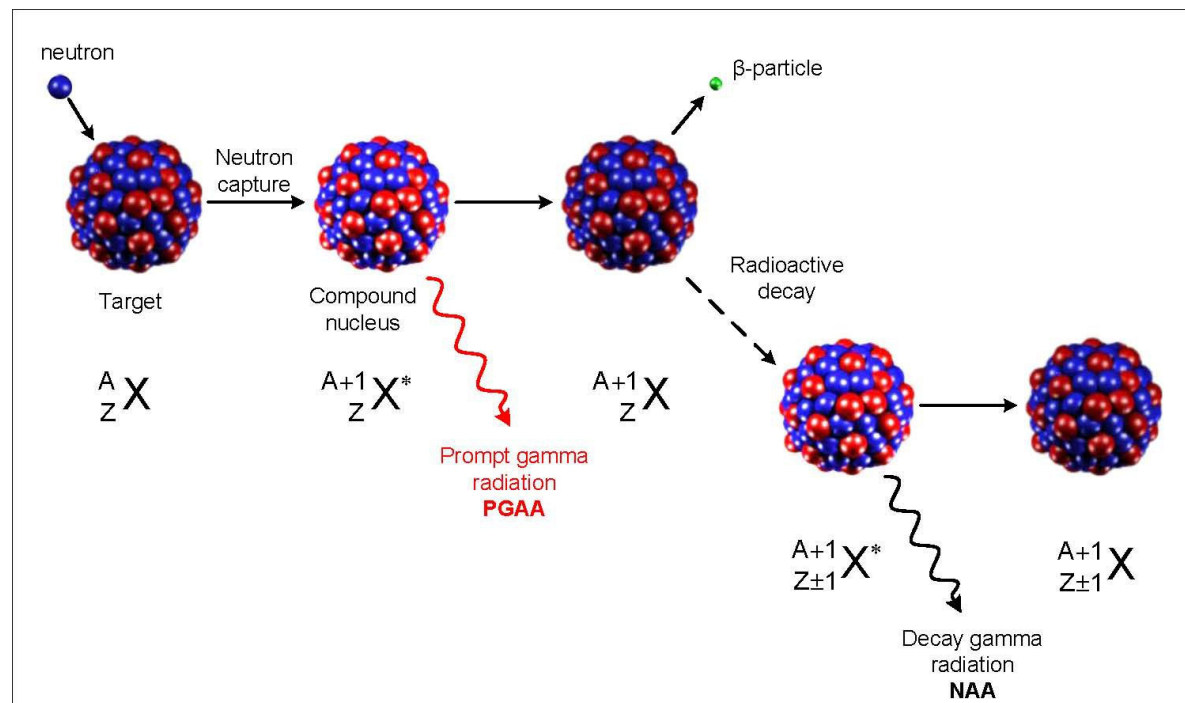


Figure 2. Neutron Activation of heavy metals from a research article shows distinctive gamma-radiation and the decay times of each specific radionuclide produced [Reference 4, Table 1].

Table 1

NEUTRON ACTIVATION OF As, Se, Cd, Hg

(e.g.) $^{75}\text{As} + \text{neutron} \rightarrow ^{76}\text{As} (27 \text{ h})$

Natural Element	Nuclide Produced	γ -Radiations (MeV)	Sensitivity ^M (g)
As-75	As-76 (27 h)	0.56, 1.2	3×10^{-11}
Se-74	Se-75 (120 d)	0.26	2×10^{-9}
Cd-114	Cd-115m (54 h)	0.54, 1.1	6×10^{-10}
Hg-196	Hg-197 (65 h)	0.777	5×10^{-11}
Hg-202	Hg-203 (45 d)	0.28	2×10^{-10}

^M Sensitivity based on 50 h activation at 10^{13} neutron flux minimum detectable radioactivity of 1000 disint./min.

INTRODUCTION AND BACKGROUND

Neutron activation analysis (NAA) is one of the nuclear techniques that has many useful applications, such as bio-monitoring, biological analysis, environmental research, and materials science. One advantage of this technique is that: it is a non-destructive analytical method that is suitable for tracing low concentrations, especially rare elements, and heavy metal elements. The heavy metal elements (such as mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb)) tend to be toxic and their presence in the environment is problematic for the plant, animal, and human health. Using NAA, we can find both the identity and quantity of a specific element. In other words, this technique helps identify the elements in samples, and their concentrations at the same time.

Background:

In May 1932, the neutron was first discovered by James Chadwick as an uncharged particle of the atomic nucleus. After the discovery of the neutron, neutron activation analysis was first suggested by G. Hevesy and H. Levi in 1936. At that time, they were using a neutron source: radium-226 mixed with beryllium (Ra-226 + Be) to measure activated Dy (dysprosium) atoms.[1],[2]

PRINCIPLE AND METHOD

The principle of NAA is quite simple. To analyze samples by NAA, the process involves irradiating them with a neutron source. The neutrons are captured by elements in the sample (Figure 1) to produce **radionuclides**, which are unstable radioactive isotopes (isotopes are different types of atoms that have the same atomic number with a different number of neutrons in their nuclei, in short, a radioactive form of an element). Beta particles (β -particle), and in most cases gamma rays (γ -rays), are emitted from the radionuclides as they decay[1],[3]. According to research conducted by R.E. Jervis and others, the analysis process of applying the radioactivation nuclear method depends on:

- the activation probability factor for the particular element of interest
- the half-life of the **radionuclide** that can be created in it
- the existence of suitable beta(β -) or gamma(γ -) radiations for measurement. [4]

Figure 2 (table 1 from reference 4) shows each radionuclide of a specific heavy element gives off distinct energy of the gamma radiation (γ -radiation), which is distinctive for a specific nuclide and the rate at which these photons are emitted with particular energy can be measured using special radiation detectors.

To **determine the element**: using the distinctive γ -rays that are emitted from the sample in relatively high abundance, the elements of interest can be distinguished in the spectrum of γ -rays from the activated sample.[4] Since the production and decay rate of γ -radiation are dependent on the half-life of the nuclide, elemental measurements can be optimized by varying the irradiation and the decay times (i.e., how long the sample is near a neutron source and when the sample is analyzed). [3]

To **determine the element concentration**: The rate at which gamma(γ -) rays are emitted from an element in a sample is directly proportional to the concentration of that element.[3]

AN EXAMPLE OF NAA APPLICATION

One specific example of NAA application was shown in research[4] published in 1970 conducted by R.E. Jervis and others. Non-destructive or Instrumental NAA (INAA) for determining Mercury (Hg) concentration in fish: The mercury content in the fish samples taken from various water bodies in Ontario and elsewhere were determined in the concentration range from 0.01 to 2 ppm.[4] The result of this research was shown in **Figure 3**.

Figure 3. Typical mercury (Hg) content in Ontario Fish [in reference 4]. Note *Reference (4) is stated [in references 5]

Piscivorous (predatory) Species	Species	Hq Content ^M (ppm, wet wt. basis)	
		Lower Range	Maximum Observed
		0.3	1.6
Deep-water Feeders	Whitfish, Perch, etc.	0.07	0.7
Bottom-Feeders	Sucker, Carp, etc.	0.05	0.5
Ocean	Salmon	---	0.4

^M Reference (4)

TYPES OF NAA

NAA can be categorized into two broad types:

-Destructive or Radiochemical NAA (RNAA):

A method of NAA in which chemical separations are applied after the irradiation to separate activities of interest from interfering activities.[2]

-Non-destructive or Instrumental NAA (INAA):

The most widely applied method of NAA, in which no chemical procedures are applied before or after the irradiation. The selectivity of activities of interest is accomplished by the measurement after different decay times and by the use of special radiation detectors.[2]

CONCLUSION

NAA is a significant and powerful technique complementary with other assay methods for tracing and measuring low concentration heavy elements in specific samples.

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Title: Inflammation, Fracture and Bone Repair: A Meta Analysis

ESP Scholars: Guito Charles (Radiologic Technology & Medical Imaging) and Maleeha Sheikh (Bioinformatics/Biology)
Mentor: Subhendra Sarkar ((Radiologic Technology & Medical Imaging)

Abstract

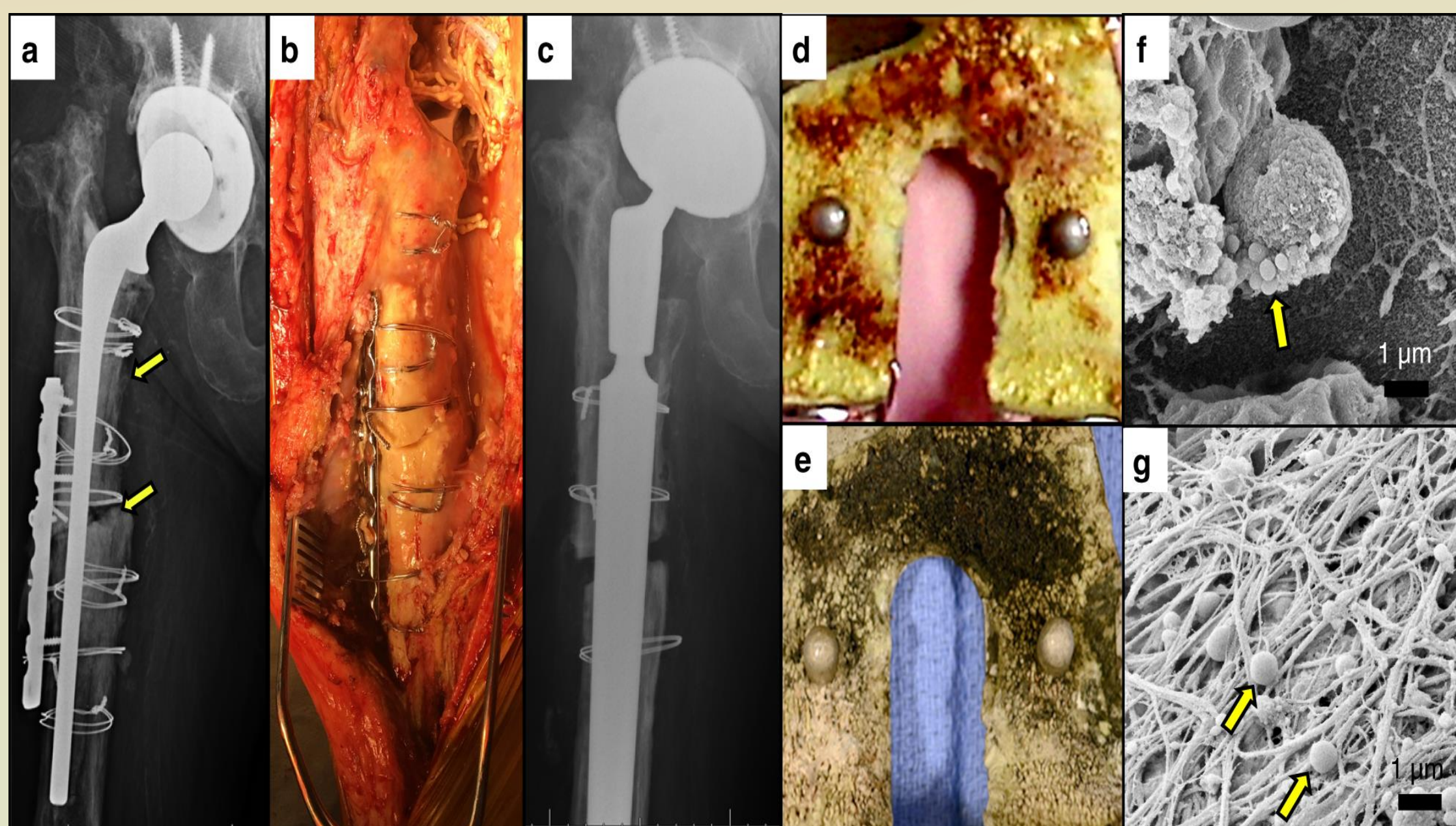
❖ The purpose of this research is to perform a meta-analysis on inflammation, fracture and bone repair mechanisms in the presence of surgical implants as practiced by tissue engineering and materials science today. Inflammation is the human body's natural response to an injury that activates the immune system and sends out inflammatory cells. The result is usually pain, swelling, bruising or redness. However, the inflammation also affects the body systems not visible in diagnostic imaging. An X-ray exam, often followed by CT in diagnostic imaging departments can map the nature and extent of the fracture and help guide surgical repair or internal fixation using orthopedic devices implanted into the area of interest. When metal is introduced as part of the implant, an oxide layer is formed, and metal ions slowly diffuse through the oxide layer and accumulate in the tissue. The implant then becomes surrounded by a layer of fibrous tissue of thickness that is proportional to the amount and toxicity of the dissolution products and to the diffusion rate of metal ions in the adjacent tissues. Our work reviews various advancements in the interfacial interactions of surgical implants that have led to reduced inflammation in patients with metallic implants.

Methods

- ❖ This project involves the combination of nutrient transport in fruit (Granny Smith Apple) and vegetable (Sweet potatoe) with a small amount of Dotarem (MRI contrast) and Iodine Omnipaque (all at 0.5mL volume contrast) and subsequent imaging of diffusion and molecular interaction using CT. First, we need to scan both of them side by side, tape them so they can stay still to avoid Motion, and then we scan them with no contrast. Technical factors used: low kVp range of 70 – 80 and low mAs range from 7-8. Then, the same procedure is repeated with the introduction of a mixture of contrast Dotarem (MRI contrast) and Omnipaque (CT contrast), .5 mL of Dotarem was injected and ml 3 ml of omnipaque for every 3 minutes to track diffusion.
- ❖ Infusions were done by creating two small holes at top of the apple and the sweet potatoe and using 18 Gauge needle to carefully reach at the yolk.

Results-I

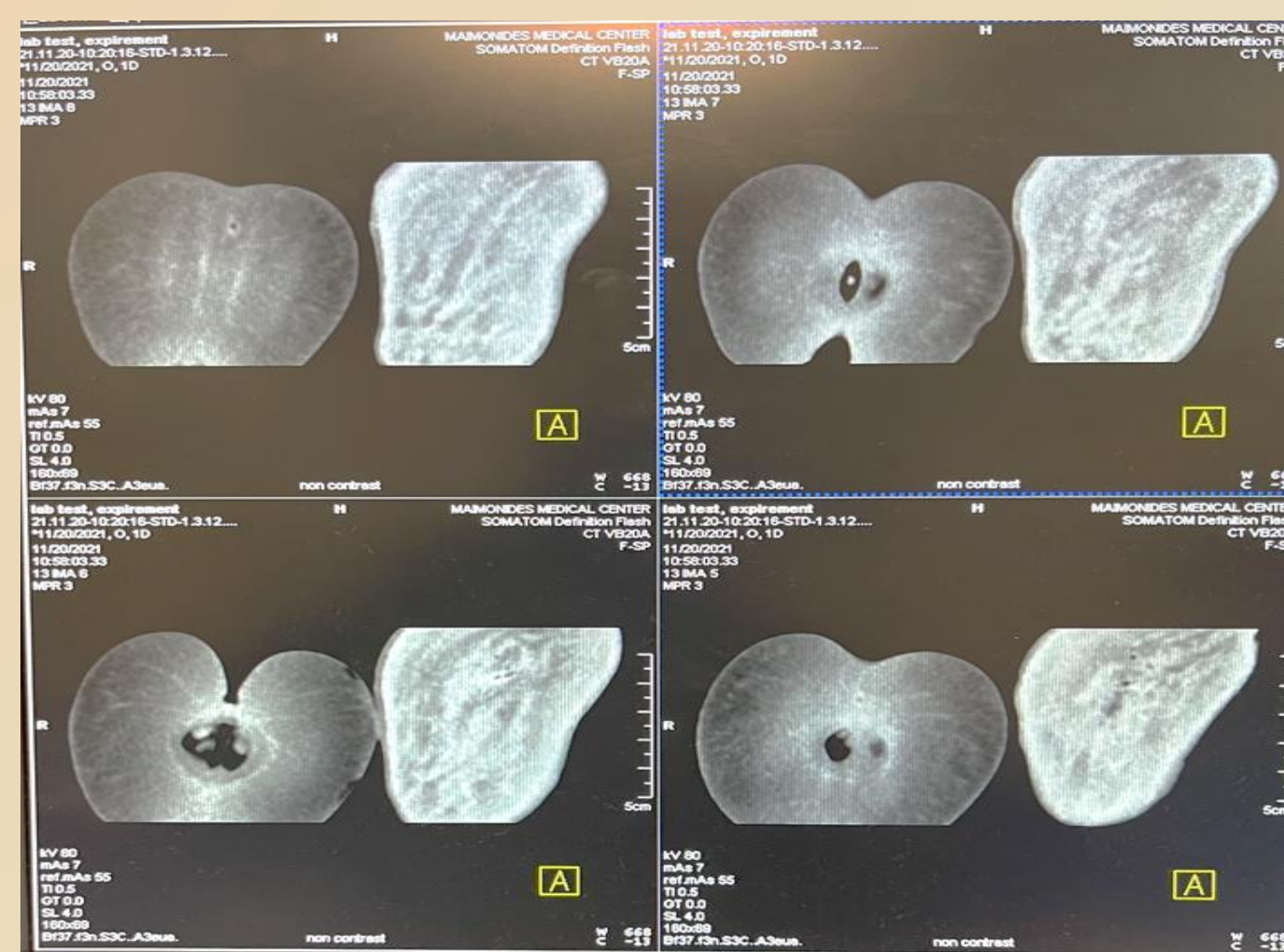
Bone Infection of the Hip Joint - 3



Background

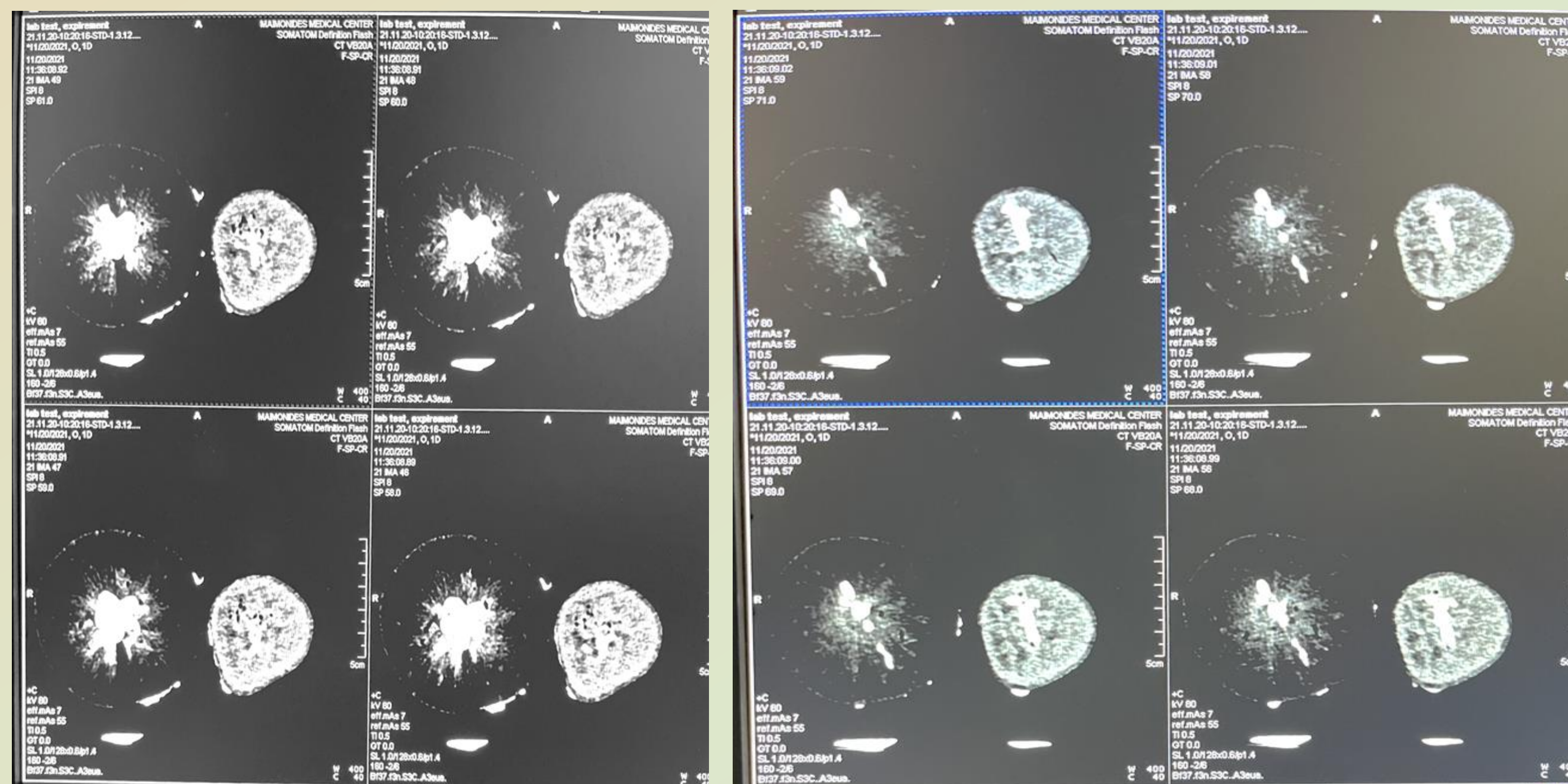
- ❖ This project showcases the use CT to help in diagnoses of inflammation and infection associated with surgical implants. This can be an abscess close to the surgical implant and can appear as an infiltrated, thick-walled collection that is contrast-enhanced. Arthritis on the implant, when a septic prosthesis is suspected, associate's effusion and capsular thickening enhanced by contrast injection. When patients are injected Intravenous gadolinium this will improve the detection of soft tissue abnormalities(tissue inflammation) .

Figure 1. Time series breakdown of the apple and sweet potatoe without contrast.



Methods #2

Fig 2. (Left) residual Gd and Iodine contrasts by planer x-ray at 70kV/7 mAs 2- and 10-days post infusion, and (Right) CT reformats from .6 mm CT slices(80kV) . Note CT detects the residual Gd well but does not distinguish between 2d and 10d old Iodine; CT also misses the edema from metal ion toxicity in surrounding areas presumably due to scatter from high kV



Discussion

- ❖ The use of metallic implants for bone repair gives the patient the ability to function through the course of their lives. The streak artifacts created by metallic implants not only blur the images, but also leads to inaccuracies in diagnosis in Ct . However , these metal shadow provide little information for image reconstruction. When a metal implant such as a prostheses is placed inside a patient's body, an image can be subtracted into two categories and the task here is to get the boundary between the high- and low-density regions from the projection data. With the help of CT scans, we can diagnose infections. Patients receive gadolinium (a common contrasting agent) which helps detect soft tissue abnormalities. Specifically, it is useful for depicting inflammatory edema of soft tissue or bone. Ct scan can limit the need for exploratory surgery by helping diagnose internal injuries and diseases.

Conclusion

- ❖ With the help of CT scans we can develop a better understanding of inflammation induced by surgical implants. When patients receive metal implants after the bone is in a fractured state the risk of infection is high. Orthopedic surgeons may have to do hardware removal surgery if the infection has increased. With the help of CT scans patients can have early detection and treatment of infections. CT scans can also help monitor new surgical implants that provide different types of coatings such as anti-inflammatory coatings. This experiment showcases the use of contrasting agents like gadolinium on fruits which is needed for MRI and CT scans.

Acknowledgment

- ❖ We would like to acknowledge valuable help from Dr. Subhendra Sarkar and Yamark Charmelus the lead CT tech Maimonides Medical Center CT Department for access to radiological equipment for our undergraduate research students. This work was made possible with student stipends from City Tech to above student researchers under ESP.

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How is the disposal of electronic waste contributing to pollution in landfills?

Manjil Itani (CST)

Environmental Economics Interdisciplinary, ECON 2505ID, and Prof. Sean McDonald

Abstract

There has been a rapid increase in the production of electronic devices due to high demand. Electronic devices have a finite life and as we produce more devices, we are also producing more waste. What happens to electronic waste such as old phones, computers, and TVs? In this research, I am going to investigate the impact of electronic waste, commonly known as e-waste, on the health and wellbeing of people and the earth. I will look at how developing countries with low-income groups have been affected by e-waste in landfills. I will also be outlining steps that can be taken to avoid the environmental and economic degradation that e-waste can cause.

How does e-wastes form

Any electronic devices that are not used anymore turn into e-waste. The obsolescence character of electronic devices like computers and mobile phones leads to the production of e-wastes. These e-wastes are in end disposed of in landfills. According to the UN, 50 million tons of e-waste is generated every year and at this rate, e-waste will be the highest contributor of pollution by 2050. There are various harmful effects of e-waste on the environment that also contributes to pollution.

Health impacts of e-wastes

Electronic waste contains bad chemical like lead and mercury, which when not disposed of or recycled has carcinogenic potential, and can cause reproductive disorders, and other health problems. According to the Environmental Protection Agency, 15-20% of e-waste is recycled, and the rest is incinerated or buried in the landfills. When burned at low temperature, the brominated flame retardants used in circuit boards and casings create additional toxins like halogenated dioxins and furans which are some of the most known toxic substances. This incineration can accumulate in the food chain that hampering the health of future generations.

Consequences and Preventions

Currently, the issue of electronic waste is overlooked. An electronic device that can be fixed easily goes to waste contributing to pollution. The electronic companies bring out new devices with small upgrades in their features and people buy them regardless of their current device's performance. If this continues there will be not much chance of bringing change. Measures like waste reduction, reuse, recovery should be considered. The government should take part in regulating agencies vested with the responsibility of coordinating the management of e-waste. New legislation must be drafted with a recycling and reuse policy for e-waste management. And most importantly people must be educated about the result of e-wastes.

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Machine Learning Based Image Processing of Astrophotography Images

Authors: Mazen Maghazy - Mentor: Professor Farrukh Zia
Computer Systems Technology Department



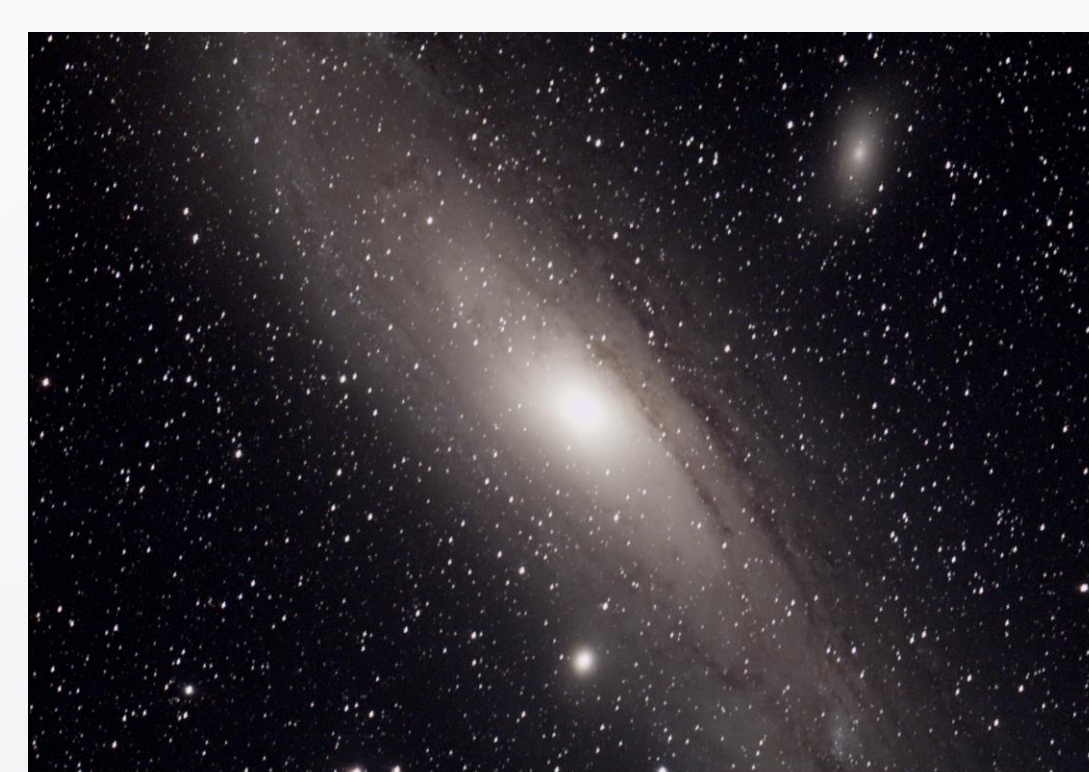
Astrophotography images helped many scientists throughout the history to understand the universe and discover our sky wonders by studying, analyzing, and classifying astrophotography images. In this research paper discusses basic principles to analyze astrophotography images using machine learning. The study focuses on identifying different types of galaxies in astrophotography images obtained through professional telescopes. There are six types of galaxies; elliptical, spiral, intermediate spiral, barred spiral, irregular, and other. But in this research just two types of galaxies, Elliptical and Spiral, will be studied using machine learning. The main goal is to allow the trained model to identify galaxy images using Keras machine learning library written in Python programming language.

INTRODUCTON

There are two aspects of the project: capturing astrophotography images and machine learning based image processing. The astrophotography images part will be captured remotely using professional telescopes and CCD cameras located in Chile and the Canary Islands provided by slooh.com. The analyzing and classifying part is done by using python programming language and that will be divided into two steps. First, separate the taken galaxies images into two folders each folder will have different type of galaxy. Second, training our model using Keras machine learning library.

ASTROPHOTOGRAPHY IMAGES

Slooh.com It is a platform that allows researchers to capture very high-quality astrophotography images remotely. There are two steps in this process: planning and image capturing. The image is planned based on the date and time. Each galaxy appears in the sky during different time of the year. During the research time frame, I was able to capture some of the fall sky galaxies. Next step is setting my mission on slooh.com, mission could be canceled based on the weather and moon position because good pictures can be taken in a clear night sky and low moon light. The darker the night, the better the image.



MACHINE LEARNING

Machine learning and image classification were done using Keras machine learning library in Python programming language in this order:

- Split the images into folders. Each folder contains one type of galaxy Elliptical folder and Spiral folder.
- Visualizing the data using (matplotlib.pyplot) library to show the images in the training dataset.
- Data augmentation, I artificially introduced samples by applying random transformations such as random flipping or rotation. The more data the more accurate image prediction.
- Training the model. After preparing the data it's time to let the model to study and learn the data was provided.

CONCLUSION & FUTURE WORK

The current project has the functionality of classifying and predicting galaxy images either elliptical or spiral galaxy. Still further developments can be made by capturing and gathering more galaxy images and more types of galaxies for better predictions and more accurate results.

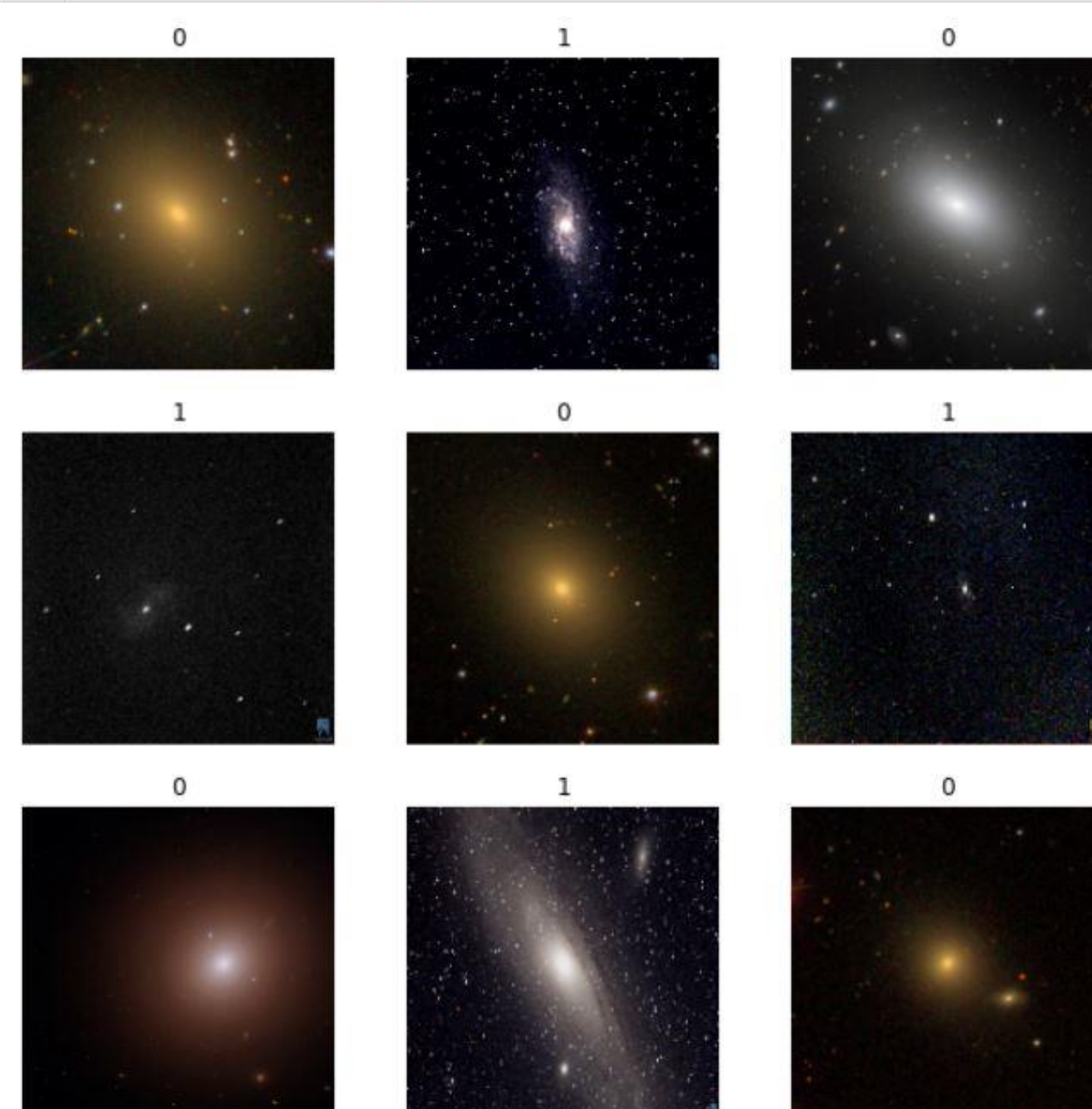
REFERENCE

https://keras.io/examples/vision/image_classification_from_scratch/
<https://www.education.slooh.com/>

ACKNOWLEDGEMENTS

Emerging Scholars Program 2021

```
In [5]: 1 import matplotlib.pyplot as plt
2
3 plt.figure(figsize=(10,10))
4 for images, labels in train_ds.take(1):
5     for i in range(9):
6         ax = plt.subplot(3, 3, i + 1)
7         plt.imshow(images[i].numpy().astype("uint8"))
8         plt.title(int(labels[i]))
9         plt.axis("off")
```



```
1 img = keras.preprocessing.image.load_img(
2     "PetImages/Galactic_Silhouettes.png", target_size=image_size
3 )
4 img_array = keras.preprocessing.image.img_to_array(img)
5 img_array = tf.expand_dims(img_array, 0) # Create batch axis
6
7 predictions = model.predict(img_array)
8 score = predictions[0]
9 print(
10
11     "This image is %.2f percent elliptical and %.2f percent spiral."
12     % (100 * (1 - score), 100 * score)
13 )
14 print(score)
15
16 This image is 21.20 percent elliptical and 78.80 percent spiral.
17 [0.7879706]
```




CO₂ Emissions in the World by the Countries

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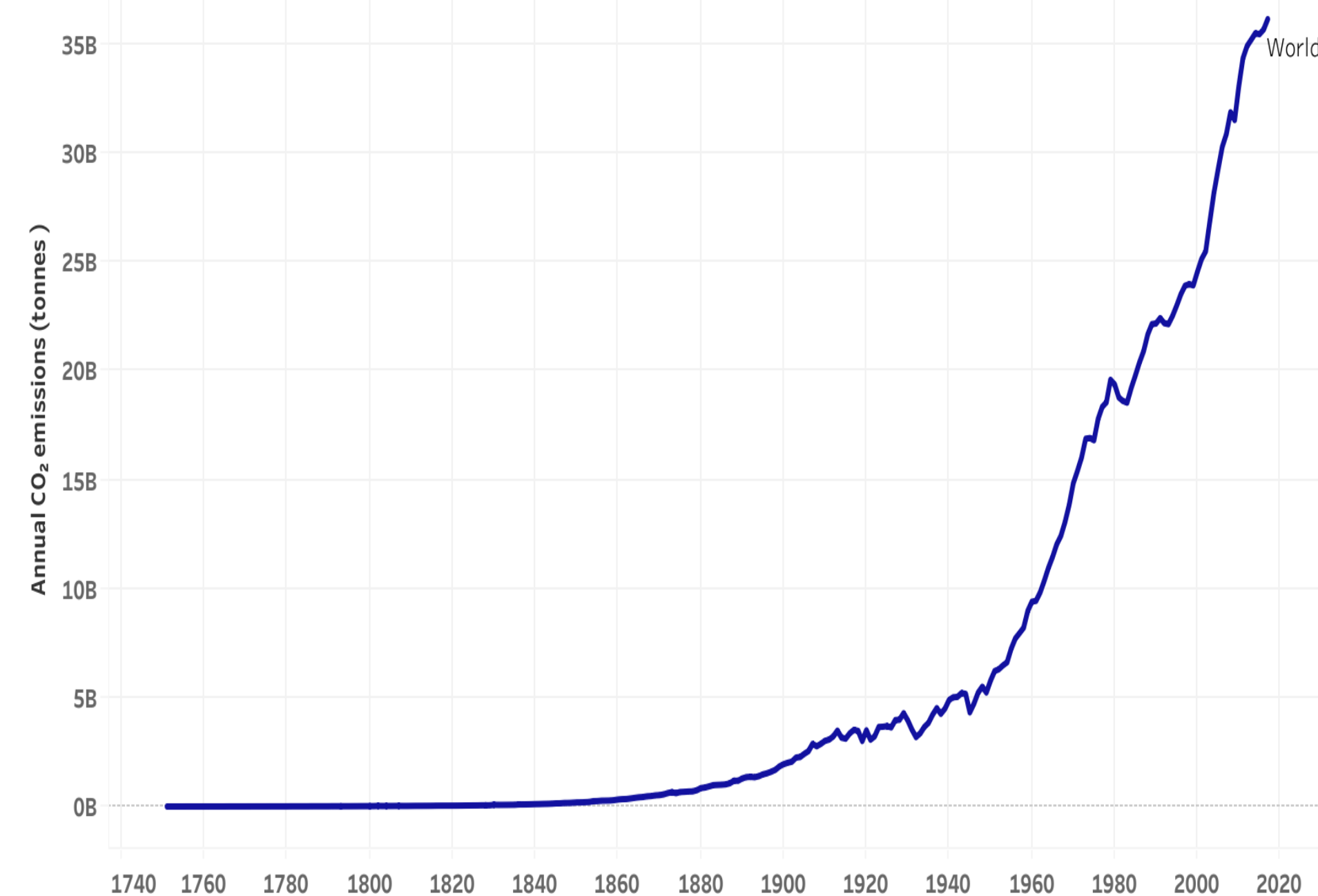
Abstract

The threat of climate change due to greenhouse gas emissions is considered one of the major environmental problems for human beings. Gases that trap heat in the atmosphere are called greenhouse gases. Carbon dioxide (CO₂) is a primary greenhouse gas that enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees, and other biological materials, also, as a result of certain chemical reactions (e.g., manufacture of cement). The goal of this project is to investigate the trend of CO₂ emissions in the world, analyze some specific countries' CO₂ emissions, inspect the change in the amount of CO₂ emissions over the years, and examine the factors of CO₂ emissions.

Introduction

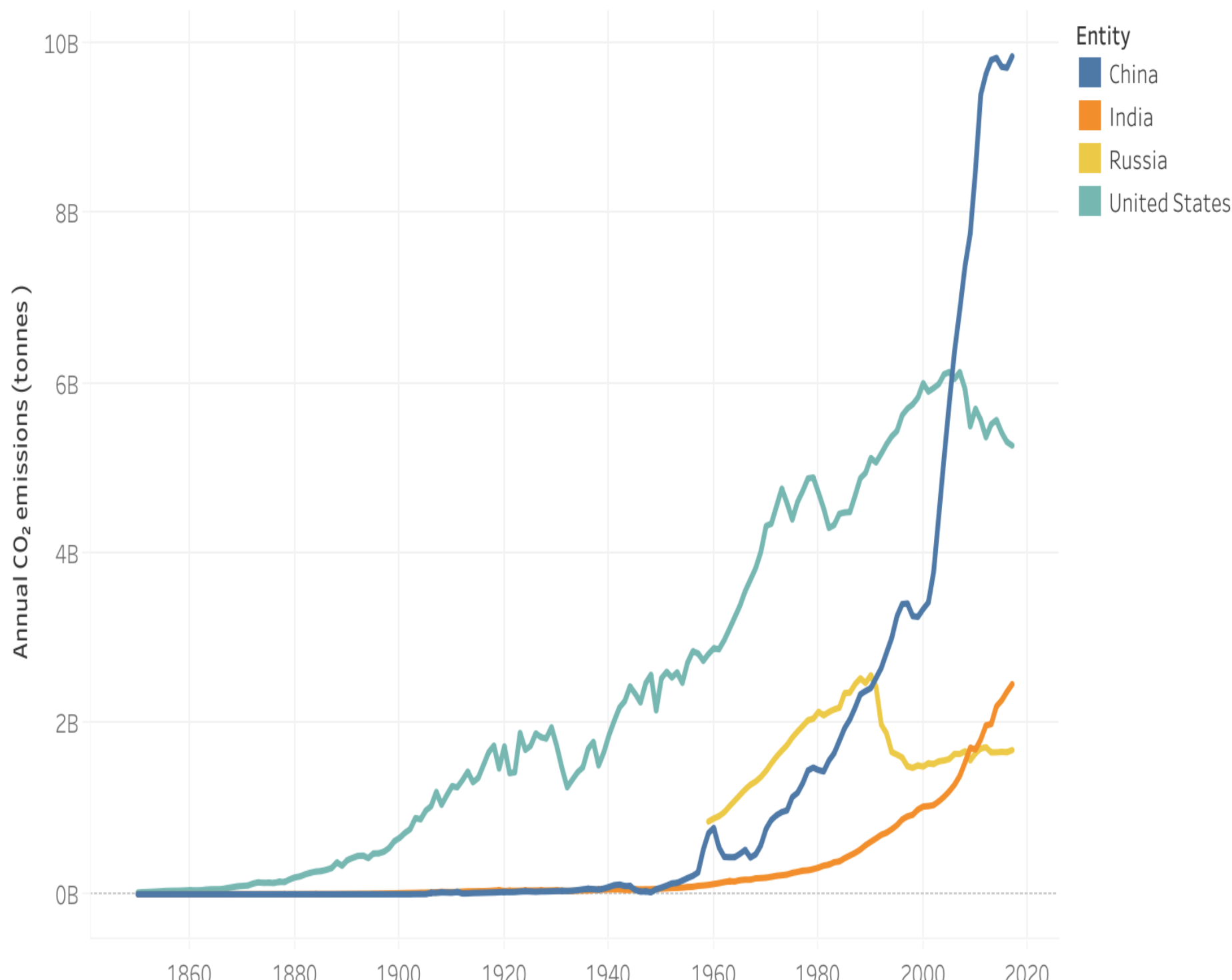
The data contains CO₂ emissions in the world from 1750 – 2017. First, we analyze the trend line of CO₂ emissions in the world. We also look at some specific countries' CO₂ emissions in 1960 and 2017 to investigate the change. Then, we examine the factors affecting CO₂ emissions.

CO₂ Emissions in the World (1750 - 2017)



The CO₂ emissions were 1.95 billion tons in 1900, and they increased to 36.15 billion tons in 2017.

CO₂ Emissions in China, India, Russia, and the United States (1850 - 2017)



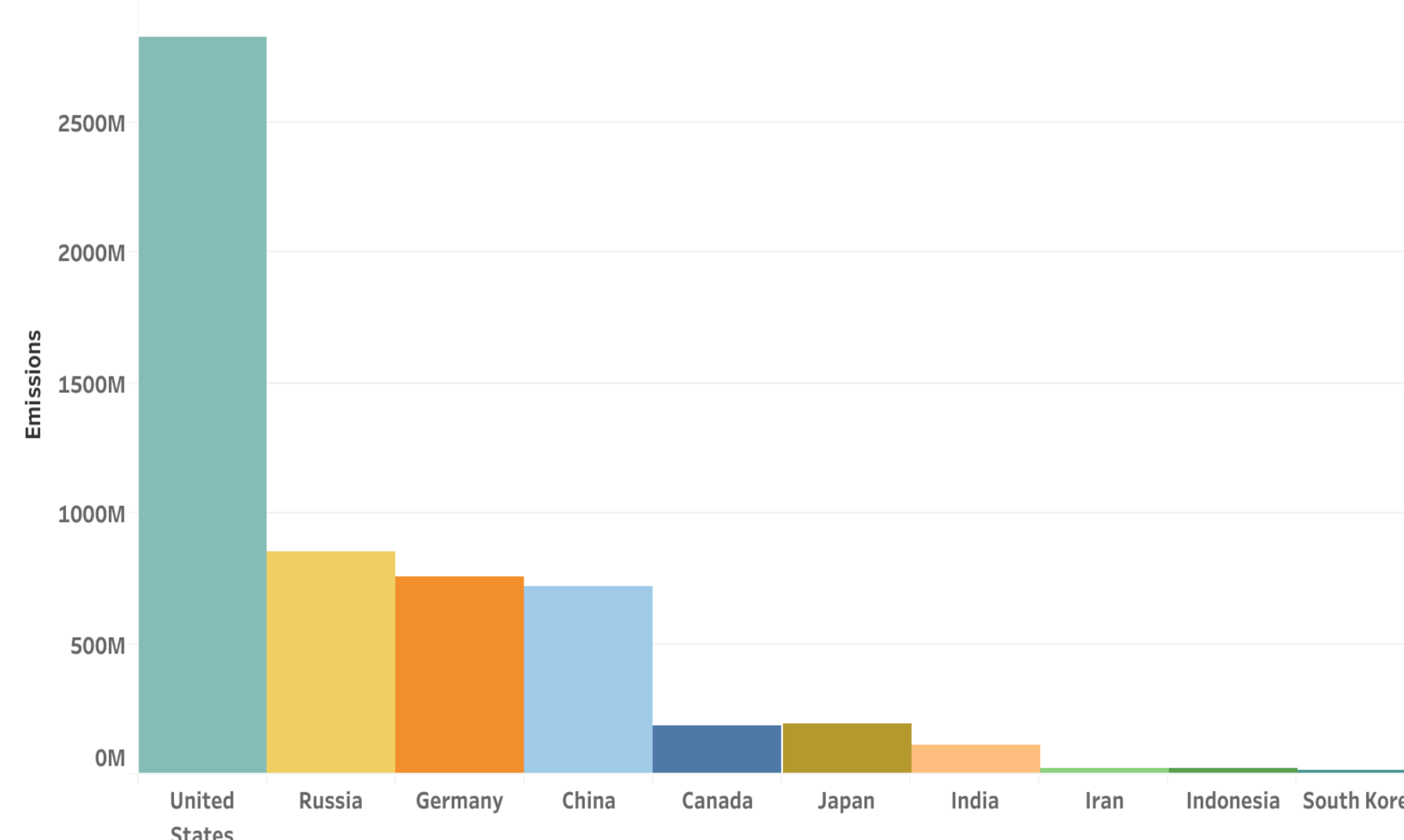
Until 2005, the United States had the highest amount of CO₂ Emissions. After 2000, CO₂ emissions increase exponentially in China. In Russia, we see some amount of reduction in emissions.

Methods

The CO₂ Emissions data was obtained from Kaggle. The original data source is Our World in Data. We created the trend line of global CO₂ emissions in Excel. A trend line is a line drawn on a chart highlighting an underlying pattern of individual values. Then, we created bar charts with ten countries for 1959 and 2017. A bar chart is a graph with rectangular bars that compare different categories.

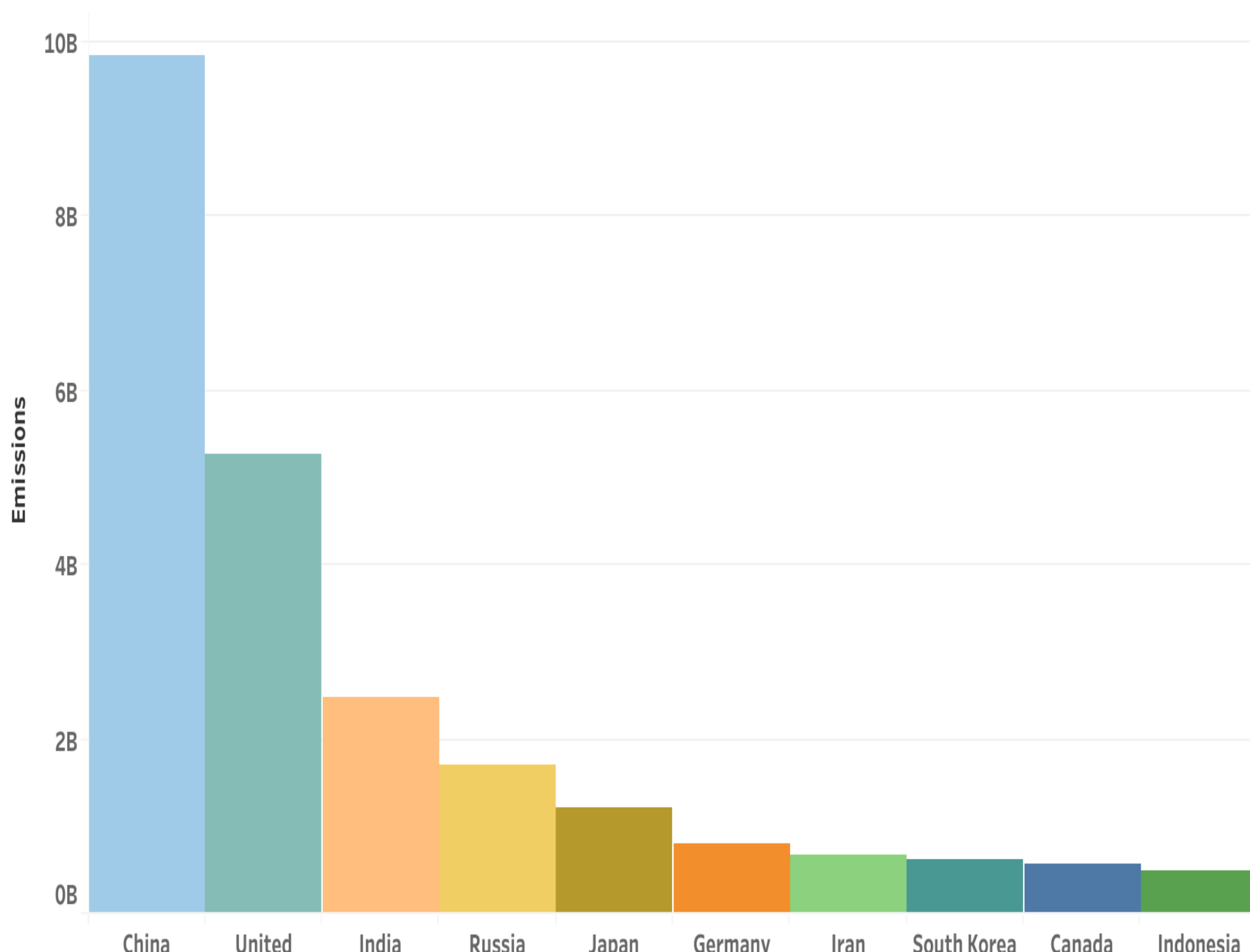
Then, we use a pie chart to show the percentage distribution of global greenhouse gas sources.

CO₂ Emissions of Countries (in tonne) 1959



In 1959, The United States had the highest CO₂ emissions by 2.8 billion tons per capita followed by Russia, Germany, and China.

CO₂ Emissions of Countries (in tonne) 2017



In 2017, China had the highest CO₂ emissions by 9.8 billion tons per capita followed by The United States, Russia, Japan, and Germany.

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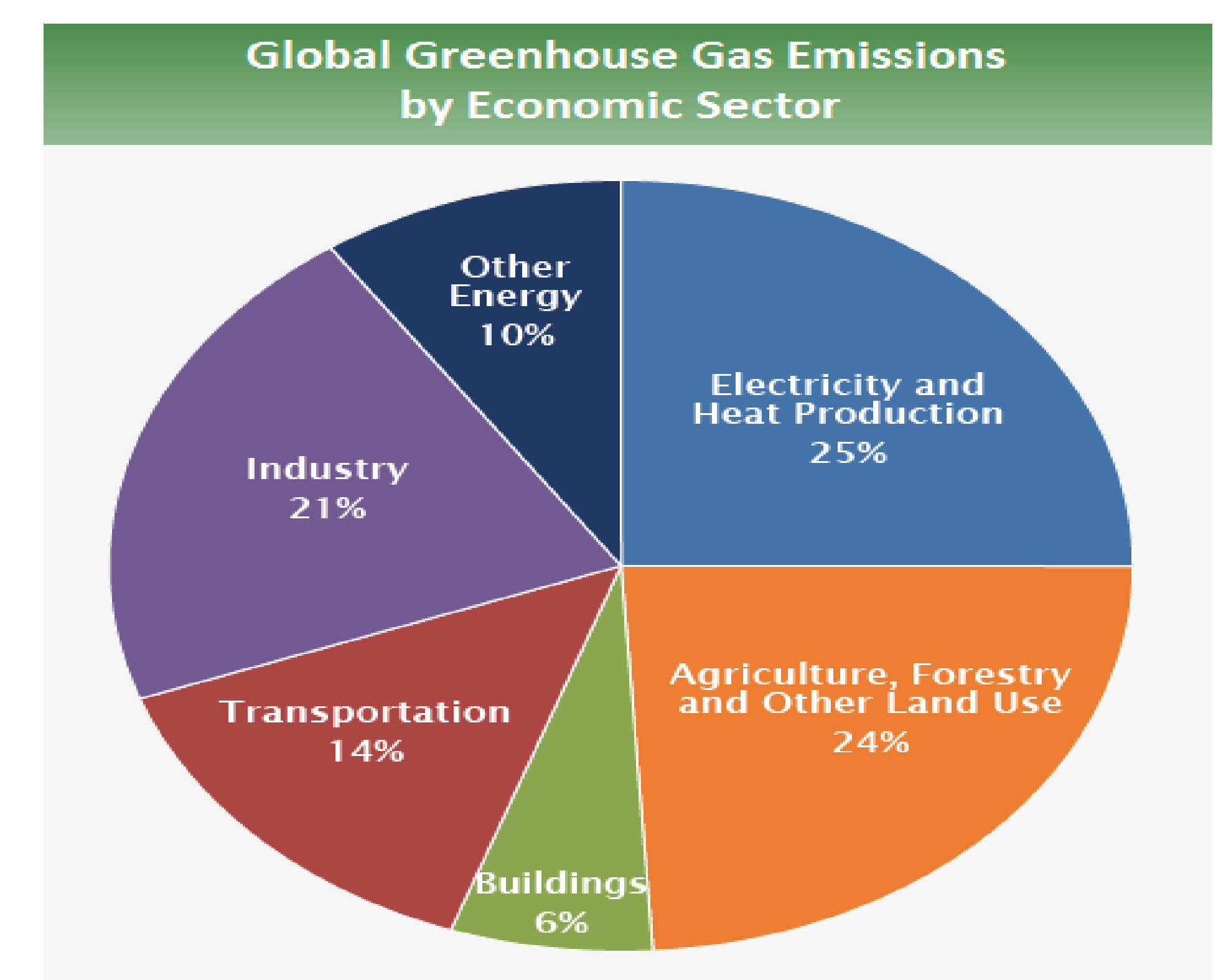
- <https://www.kaggle.com/yoannbovere/co2-ghg-emissionsdata>
- <https://www.epa.gov/ghgemissions/overview-greenhouse-gases>
- <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>
- <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

Acknowledgments

This project is supported by New York City College of Technology, The Emerging Scholars Program. It's funded by The Robin Hood Foundation grant focusing on incoming first semester/freshman students.

Global Greenhouse Gas Emissions by Human Activities (2010)

- Electricity and Heat Production** The burning of coal, natural gas, and oil for electricity and heat is the largest single source of global greenhouse gas emissions.
- Industry** Greenhouse gas emissions from industry primarily involve fossil fuels burned on site at facilities for energy.
- Agriculture, Forestry, and Land Use** Greenhouse gas emissions from this sector come mostly from agriculture (cultivation of crops and livestock) and deforestation.
- Transportation** Greenhouse gas emissions from this sector primarily involve fossil fuels burned for road, rail, air, and marine transportation.
- Buildings** Greenhouse gas emissions from this sector arise from onsite energy generation and burning fuels for heat in buildings or cooking in homes.
- Other Energy** This source of greenhouse gas emissions refers to all emissions from the Energy sector which are not directly associated with electricity or heat production, such as fuel extraction, refining, processing, and transportation.



Results

The trend line indicates that the increase of CO₂ emissions starts by 1.95 billion metric tons in 1900 and increases exponentially from 1945 to 2017. It's observed to be 36.15 billion metric tons in 2017. In 1959, CO₂ emissions were observed to be 2.82 billion metric tons in The United States, 8.55 million metric tons in Russia, 7.56 million metric tons in Germany, and 7.2 million metric tons in China. In 2017, the order of the list of these countries had changed. CO₂ emissions were observed to be 9.84 billion metric tons in China, 5.27 billion metric tons in the United States, 2.47 billion metric tons in India, and 1.7 billion metric tons in Russia.

According to the United States Environmental Protection Agency, the combustion of fossil fuels for transportation and electricity generation is the main source of CO₂ emissions.

Conclusion/Future Work

The line graph shows that CO₂ emissions due to human activities are increasing exponentially in the world. The order of countries with the highest CO₂ emissions was the United States, Russia, Germany, China, and Canada in 1959, however, it changed to be China, the United States, India, Russia, and Japan in 2017. According to the United States Environmental Protection Agency, the combustion of fossil fuels for transportation and electricity generation is the main source of CO₂ emissions followed by industrial processes. In the future, we will investigate the strategies for reducing CO₂ emissions in the world.



ARCscholars – NYCHA’s Washington Houses: Architecture Workshop

TEAM

Professor Naomi Langer-Voss (CITY TECH) | Delma Palma (NYCHA) | Vaidehi Mody (NYCHA) Erickson Diaz | Indya Johnson | Shania Narcisse | Nefer Auset Bookhart
 Myles Rosales | Diamond Smith | Jordon Stennett | Farai Matangira | Alfred Dove | Oliver Hadi | Scarlett Morales | Scott Brathwaite

Abstract

We are a diverse group of scholars ranging in age, gender, and background from all over New York City. We share a common interest in solving our urban challenges through studying and proposing improvements to the built environment. From professors at CUNY CITY TECH to NYCHA Design & Implementation specialists and NYCHA residents, we encompass a group of scholars united by this common purpose.

What are we here to accomplish?

This team of ARCscholars is working collaboratively, sharing lived experiences, creatively thinking & planning and applying our research discoveries to the proposed design interventions. We seek to address and combat critical issues to foster a measurable improvement in community health, understanding, and relationships. Through enhancing the community at large via housing equity and durability and beauty, we hope that the proposed design improvements will have a direct, indirect, and long-lasting positive effects on the NYCHA communities.

How are we doing it?

We have developed an architectural and urban proposal that will enhance the overall quality and design of our case study development: the NYCHA Washington Houses in Manhattan. Our research included a comprehensive site investigation, an informative discussion with the Resident Leader at the development, and an understanding of planning issues. We met weekly to analyze, discuss, and investigate architectural and urban concepts, and develop specific planning interventions. Personal anecdotes from our NYCHA resident students helped inform the design strategy.

What have we found?

The site plan encompasses a global vision for the campus and identifies the design features to inhabit and to observe. The team worked collaboratively to design landscape, urban gardening areas, exercise zones, a food pantry, bicycle pathways, informational kiosks, temporary art installations, benches, fences, and fountains.

How are we developing our proposal?

We chose a collection of traditional graphic exercises that would be accessible to all our students regardless of prior architectural education. The site was first analyzed through photographic collages and sketches that were produced during our first site visit. Details of the landscape, surrounding architectural elements, and built textures provided a basis for site analysis.

Maps of the site and historic research conducted by the ARCscholars formed the foundation for the diagramming studies that were developed during the class sessions. We highlighted the critical elements of the urban form, circulation routes, and areas in need of development. 3D models made of found objects helped bring the specific design components to life. We actively employed the strategy of collage and added "post it" notes to clarify the design elements.

The presentation not only portrays our design recommendations but is also a comprehensive synopsis of our collaboration.





Covid-19 Impact on Dental Hygienists and other Dental Professionals

Students: Nathaly Rojas and Dosyleny Arias

Advisor: Susan Davide



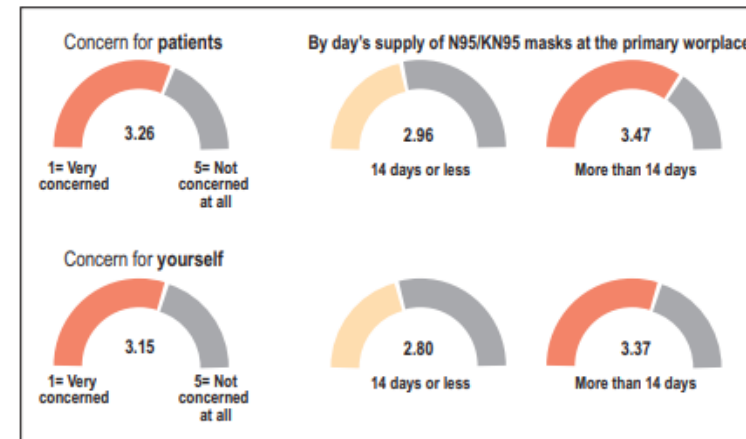
Department of Dental Hygiene

Introduction

The world has been forever changed by COVID-19 and as the science of this disease continually develops, so will preventive measures. It is important to explore how the pandemic has affected patients' concern and need to return to their routine dental visits and enhanced personal protective equipment (PPE) measures used to provide optimum patient and provider protection. Reviewing the history of PPE protocols and how they have changed or improved throughout as a direct result of this pandemic. Dental education was impacted due to the lockdown and change to remote learning, missing out on numerous educational and clinical experiences. This research will investigate these changes and their impact on dental hygienists and other dental professionals.



Figure 1. Level of concern regarding risk of COVID-19 transmission in primary work location ¹



Results and Conclusion

- Dental students missed out on educational experiences. 87% of dental students that took survey said that learning online affected their clinical training.
- The estimated rate of COVID 19 among dental hygienists was low. 99.1% respondents to this survey also said they had enhanced prevention control during pandemic.
- COVID-19 limited routine care and prevention care. This may have increased oral diseases for vulnerable populations at high risk of COVID-19.
- During COVID-19 offices could only take emergency patients
- The proper use of PPE was associated with years of experience in the field of dentistry.

Next Steps

- Conduct a survey to NYC dental hygienists and dental professionals to determine their experience from the pandemic and how it has impacted them.
- Securing Institutional Review Board approval
- Report survey findings and results

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Methodology – Literature Review

Numerous surveys sent to dental professional to determine their experience as well as preparedness during the pandemic:

- PPE use and inventory supplies
- Mental health symptoms
- Risk of transmission in workplace
- COVID-19 rates among dental professionals
- Effects of quarantine on patients' oral health
- Infection control measures
- Dental students' educational experience





Advantages of AMP (Accelerated Mobile Pages)

Saira Nazar

Professor Marcos Pinto

Department of Computer Information System



Abstract

The purpose of this research is to enlighten the Advantages of AMP, which is an open-source(free) Google library that provides a quicker way to develop web pages that are compelling, smooth, and load near instantaneously to users of mobile devices. The project goes more into details of this mobile technology with examples and its application to search results, news, and blog contents.

Background

Accelerated Mobile Pages (AMP) was introduced by Google on October 7, 2015, its goal was to improve web performance (alleviating website complexities) and quality of experience (QoE) for mobile device users, and it was published on almost every browsers. However, there are much less research studies on advantages of AMP.

This project specifically answers the following questions,

1. How AMP works?
2. Why need for AMP?
3. How can AMP be beneficial?

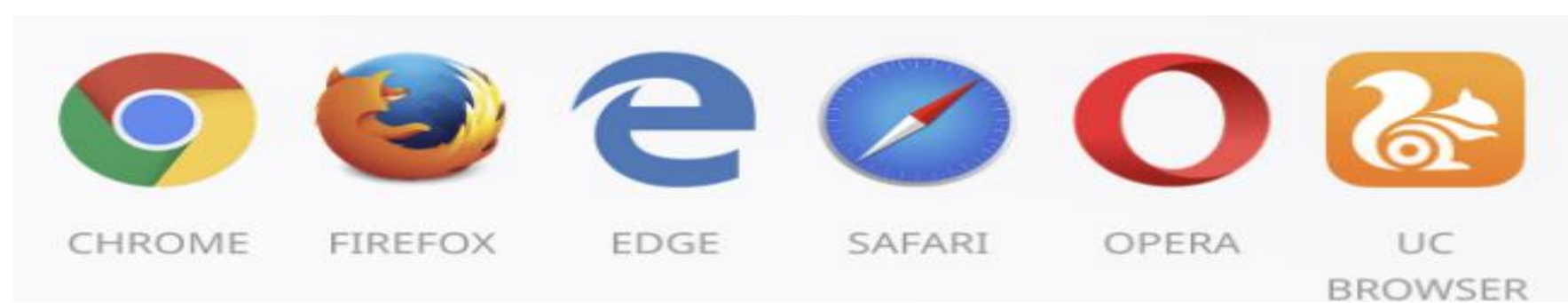


Figure 1- displayed are the AMP supported Browsers

Method

- To analyze how AMP works, we will look at the basics of it, The three major components of AMP : AMP-HTML, AMP-JS and AMP Cache.
 1. AMP-HTML : the standard HTML with web components
 2. AMP-JS : maintain resource loading
 3. AMP Cache : delivers and validates AMP pages, which is also referred to as AMP-CDN (content deliver network). This is the key component for delivering Instant-loading AMP's experience.

```

/ch1/amp.html.
<!doctype html>
<html ⚡>
  <head>
    <meta charset="utf-8">
    <script async src="https://cdn.ampproject.org/v0.js"></script>
    <link rel="canonical" href="https://theampbook.com/ch1/amp.html" />
    <meta name="viewport" content="width=device-width, minimum-scale=1, initial-scale=1">
    <style amp-boilerplate>body{-webkit-animation:-amp-start 8s steps(1,end) 0s 1 normal both;-moz-animation:-amp-start 8s steps(1,end) 0s 1 normal both;-ms-animation:-amp-start 8s steps(1,end) 0s 1 normal both;animation:-amp-start 8s steps(1,end) 0s 1 normal both}@-webkit-keyframes -amp-start{from{visibility:hidden}to{visibility:visible}}@-moz-keyframes -amp-start{from{visibility:hidden}to{visibility:visible}}@-ms-keyframes -amp-start{from{visibility:hidden}to{visibility:visible}}@-o-keyframes -amp-start{from{visibility:hidden}to{visibility:visible}}@keyframes -amp-start{from{visibility:hidden}to{visibility:visible}}</style><noscript><style amp-boilerplate>body{-webkit-animation:none;-moz-animation:none;-ms-animation:none;animation:none}</style></noscript>
  </head>
  <body>Hello World!</body>
</html>

```

Figure 2 – This shows the simplest AMP code

- We will save the file displayed above as amp.html on web server, open it in any browser and we will see **Hello World!** on the web browser.
- To add the AMP's lightning bolt sign ⚡, we can either copy and paste (which is easiest way) or code U+26A1 which is Unicode *high voltage sign* character.

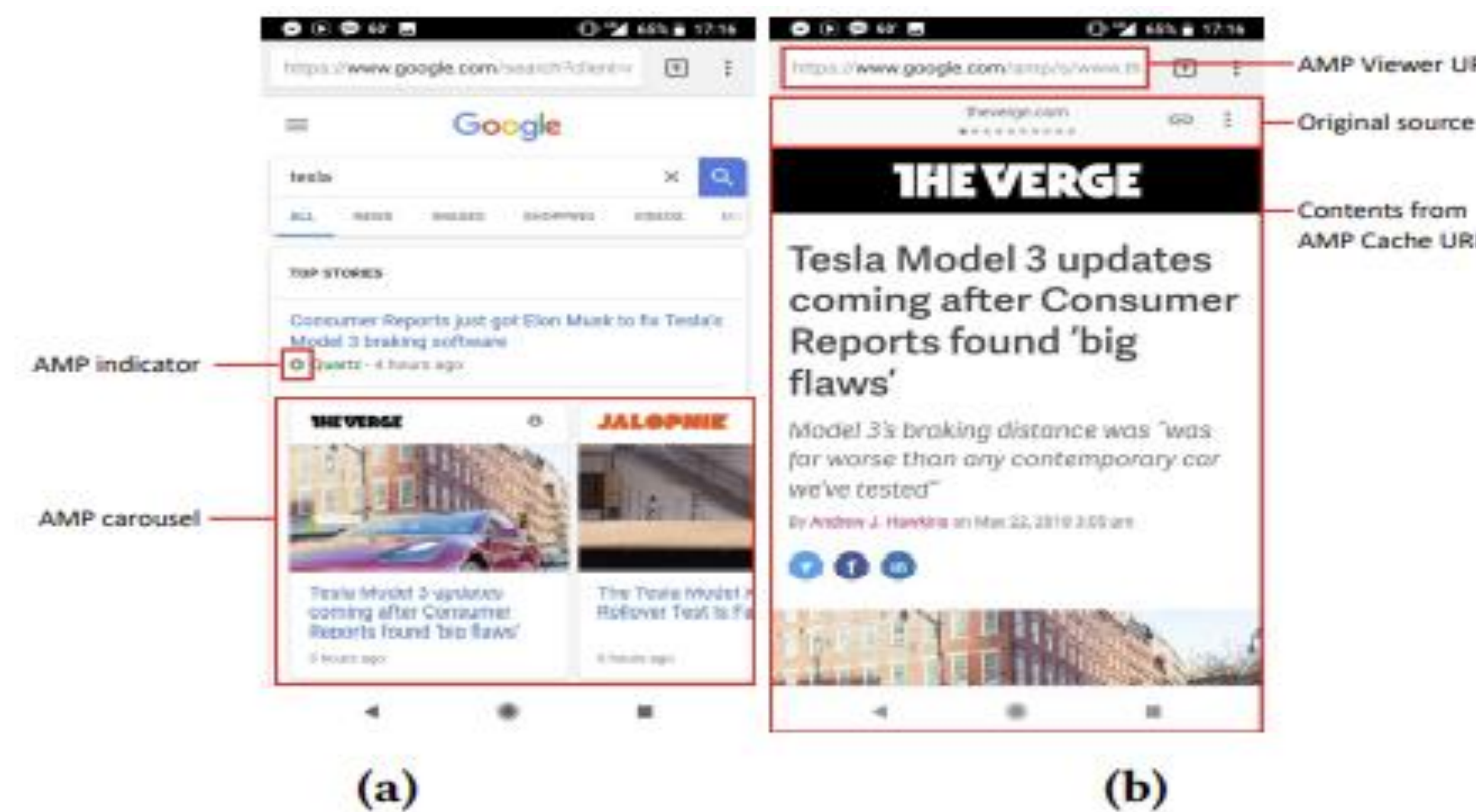


Figure 3 – an example of Google's AMP search result on (a) and the displayed AMP page (b)

Why the need for faster performance?

Everyone wants results in seconds, no one like to wait watching progress bars and spinners while page loads. A survey by O'Donoghue showed how decrease in speed affects negatively.

- Amazon reported 100ms increase in delay caused 1 percent decrease in sales.
- Google researched that ½ second increase in page load time caused traffic to drop by 20 percent.
- Barak Obama's presidential campaign found 14 percent increase in donations due to increase in site overall 60 percent increase.

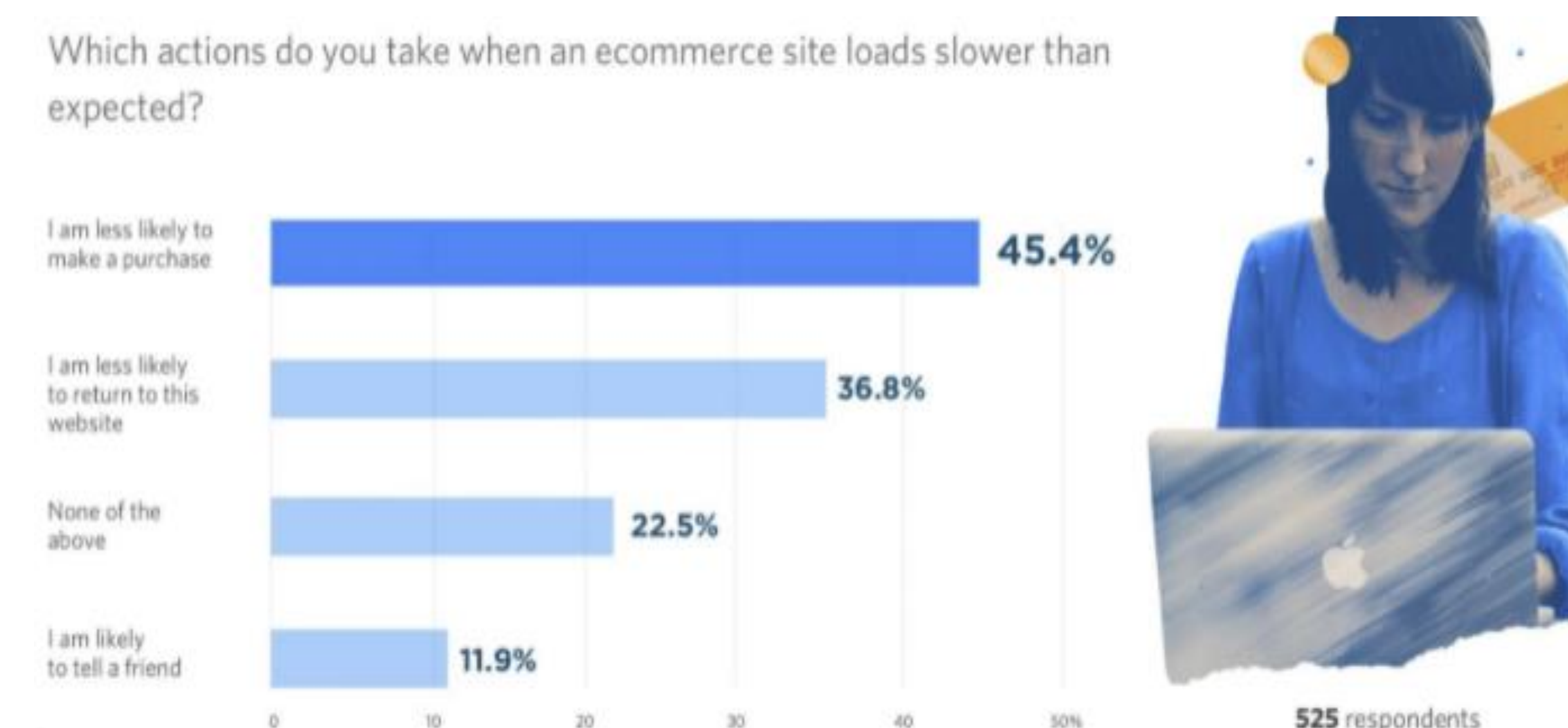


Figure 4 – Shows the percentage how load time causes fewer sales in e-commerce

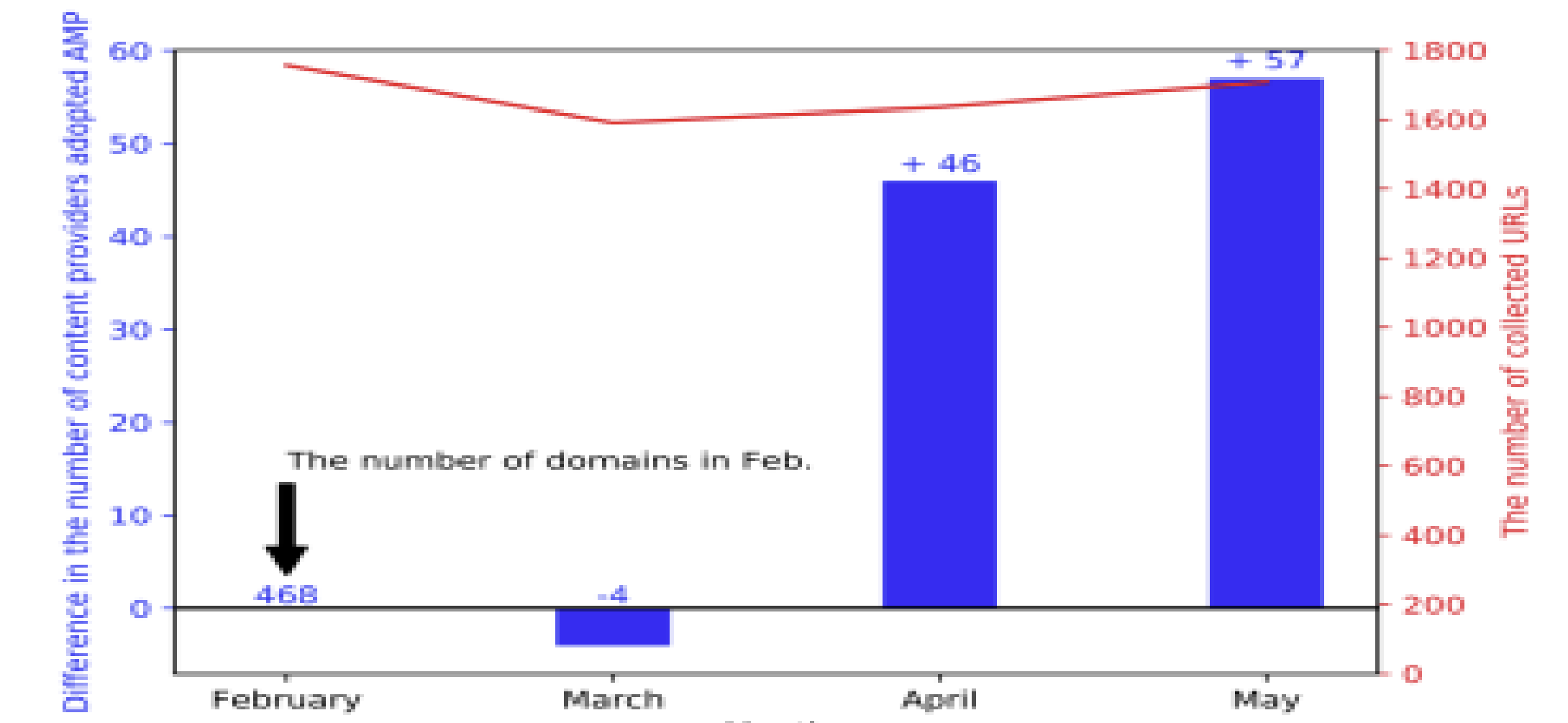


Figure 5 – Displays the four-month growth in the AMP adoption trends

Accelerated Mobile Pages benefits:

- Advertisements
 - Keeping the respective audience bound with AMP
 - Raise campaign performances with AMP HTML ads
 - Maximizing ROI with AMP HTML
- E-commerce
 - User-friendly rapid experiences
 - flexibility and preserves control and Increase in sales
- Advertising platforms
 - Advertise with AMP html ads will boost performance.
- Publishers

Result

The result of our project was very exciting to see. As learned how AMP works, using AMP JavaScript along with AMP html and AMP cache (CND). Although it was very basic level, but it is interesting to see how AMP is makes difference in tech world.

Conclusion

Technology should be fast as our world succeeds in technology continuously. People get frustrated easily if their web browser takes bit longer to load. AMP offers high speed load time, which has proven to increase traffic and sales. Developers and other businesses could benefit a lot if they adopt to AMP.

Acknowledgement

I would like to express our sincere gratitude to our amazing mentor, Professor Marcos Pinto, whose dedication to the success of his students is unmatched.

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Abstract

Calpains are proteins belonging to the calcium dependent, non-lysosomal cysteine protease family. Most cells have one or more calpains. Humans and many other mammals have 15 different calpains classified as classical or non-classical calpains. Calpains have been shown to be involved in many different processes and activities of cells. For example, research has shown that human calpains are involved in diabetes, cell death, cell cycle control and cell motility. *Tetrahymena thermophila* are unicellular eukaryotes larger in size than many mammalian cells. They are ciliated Protozoa, which is a major group of unicellular eukaryotes. Dinoflagellates and Apicomplexans are their closest known relatives. *Tetrahymena thermophila* locate in freshwater, for example ponds and streams throughout the whole world. They have two nuclei, a macronucleus, involved in vegetative activity, and a micronucleus, which is the germline nucleus. These cells have been used as a model organism in many studies, but the role of calpains in these cells have not been extensively investigated. *T. thermophila* has about 27 different calpains. The goal of this project was to begin characterizing THERM_00898290, one of *T. thermophila* calpains, using computational tools. Human calpains and THERM_00898290 sequences were aligned using MUSCLE and T-COFFEE. Phylogenetic trees were drawn using Phylogeny.Fr and MEGA. Both SWISS-MODEL and PHYRE2 were used for modeling the protein structure. Preliminary results suggest THERM_00898290 is more closely related to human calpains 7.

Objective & Hypothesis

The purpose of this research was to collect information on the structure of calpains from *Tetrahymena thermophila* with the use of bioinformatic tools. The hypothesis is that based on structure, THERM_00898290 will be more closely related to one of the human calpains.

Materials and Methods

Identification of Protein of Interest

Ciliate.org database was used to identify *T. thermophila* calpain of interest by performing a BLAST (Basic Local Alignment Search Tool) using human calpain 1 amino acid sequence. NCBI BLAST was also used to verify the sequence information and to identify any conserved domains.

Multiple Sequence Alignment

Sequence alignments to identify similarities between human calpains and THERM_00898290 were done using MUSCLE, MAFFT, T-COFFEE. All human calpains and THERM_00898290 were used as input sequences in these software.

Phylogenetic Tree Analysis

Phylogenetic trees were drawn using phylogeny.fr and MEGA using the same sequences mentioned above.

Protein Structure Modeling

SWISS-MODEL and PHYRE2 were used to model the protein structure of THERM_00898290. These online tools use templates from RCSB Protein Data Bank to predict the possible three-dimensional structure of the THERM_00898290.

Results

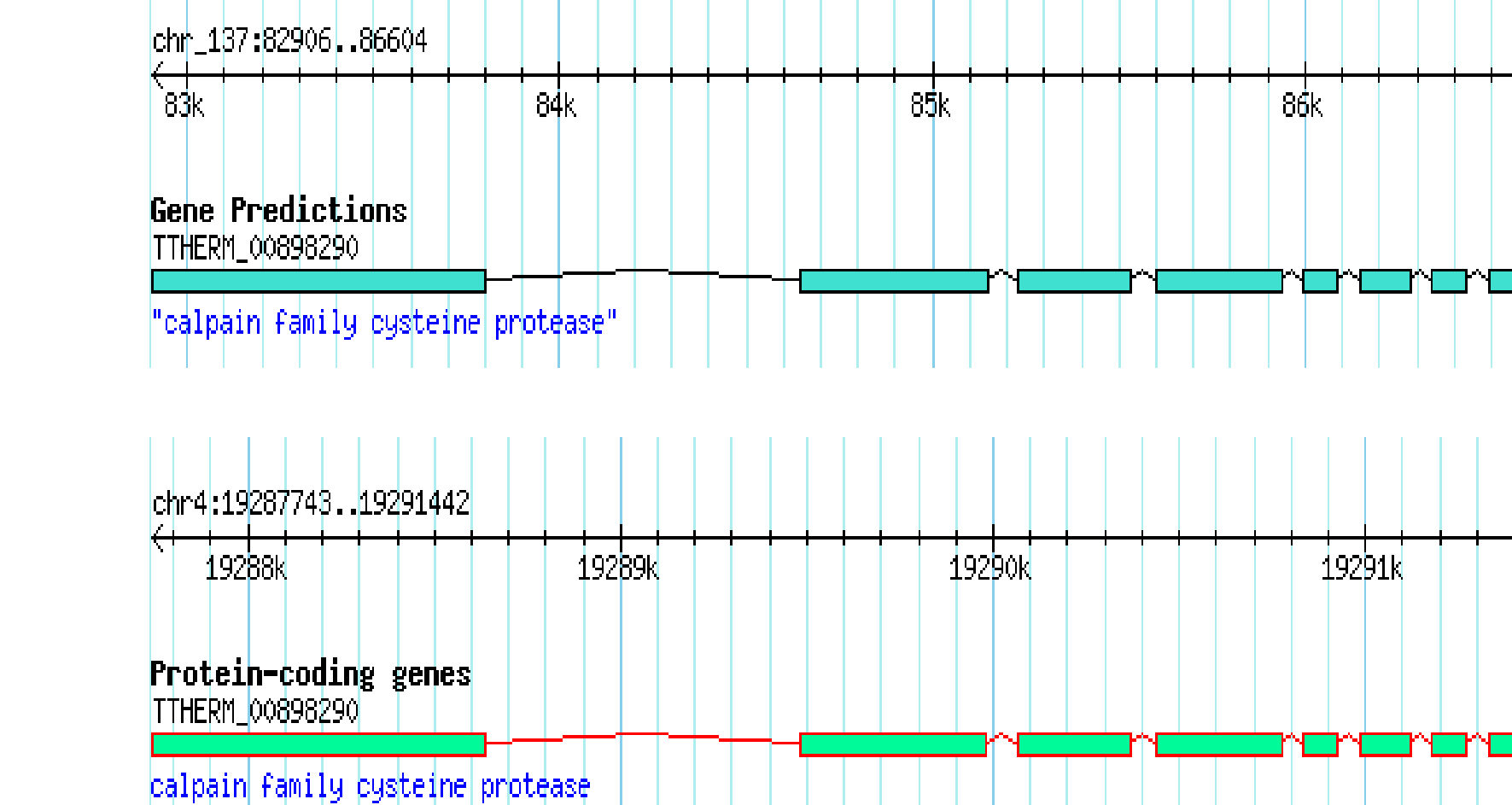


Figure 1: THERM_00898290 gene structure. Both the macronucleus and micronucleus have 8 exons and 7 introns.

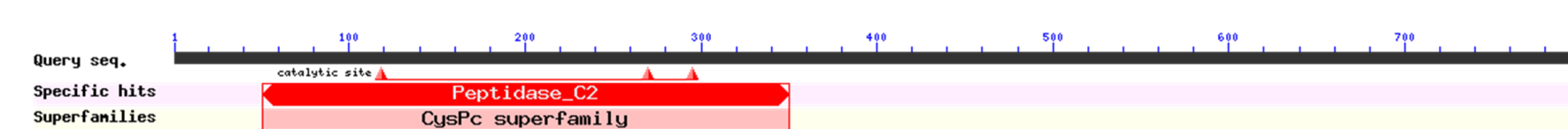


Figure 2: BLASTp domain structure of THERM_00898290. Like all calpains, THERM_00898290 contains a CysPC domain.



Figure 3: Section of THERM_00898290 and human calpain multiple sequence alignment. Conserved regions are boxed. And asterisk "*" indicate fully conserved, one dot "." This alignment was done using MUSCLE software.

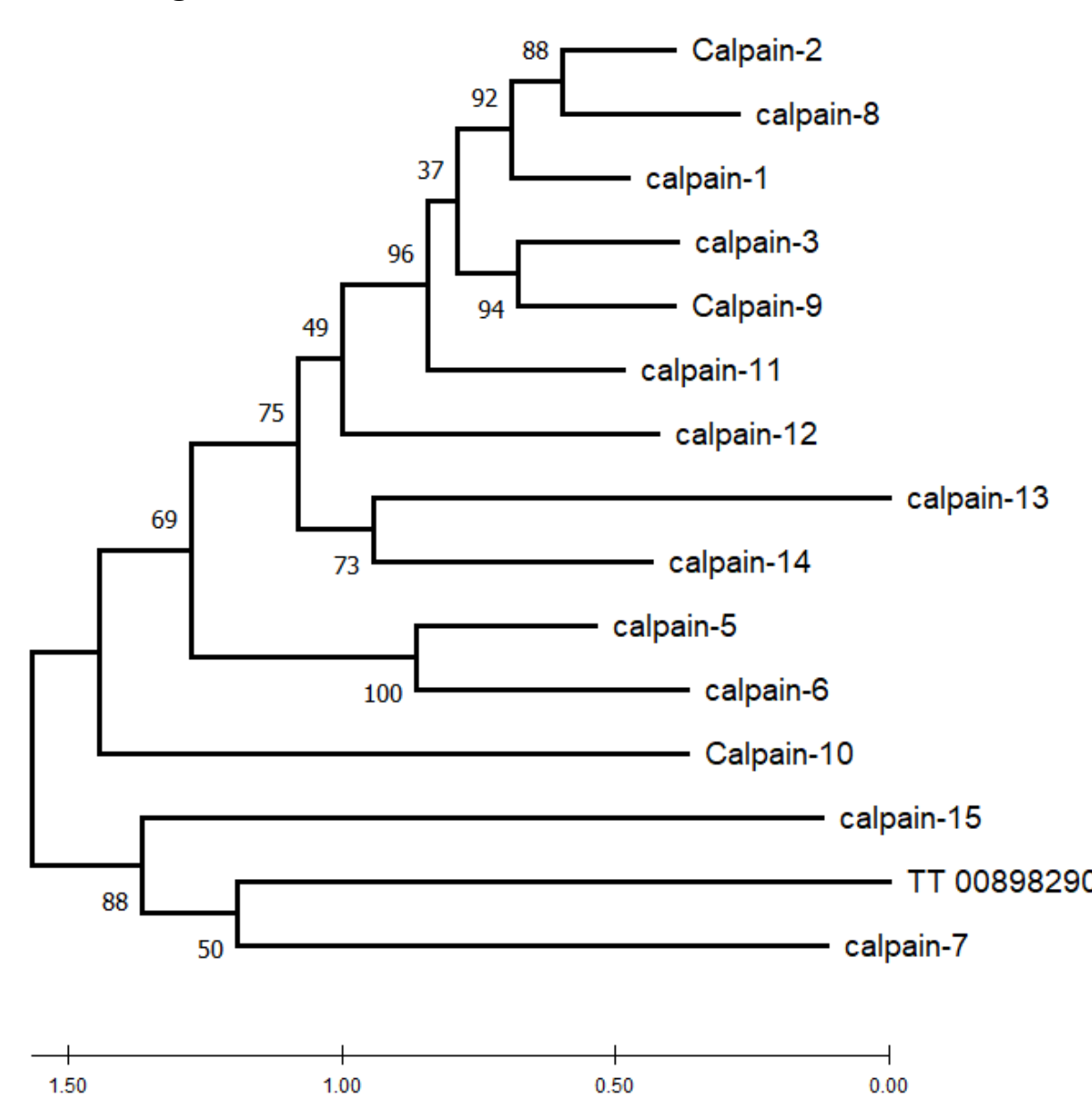


Figure 4: This is a phylogenetic tree that shows the relations between human calpains and THERM_00898290. The phylogenetic tree shows that THERM_00898290 is more closely related to calpain 7 and 15. This tree was drawn using MEGA software using the maximum likely method. Numbers indicate bootstrap values.

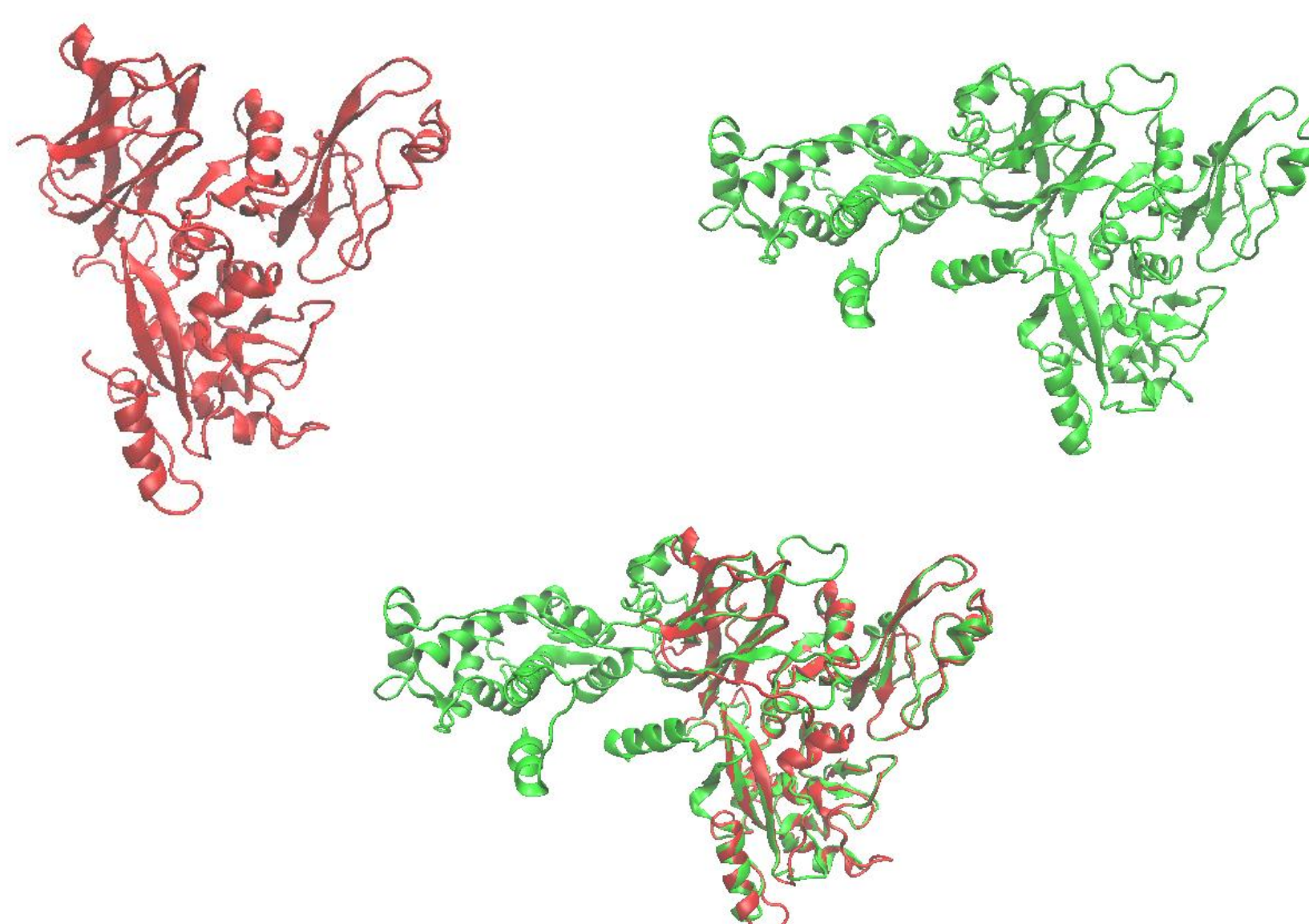


Figure 5: The SWISS-MODEL of THERM_00898290 (red) and the template used (green). Superimposed view of THERM_00898290 and template.

Discussion

- THERM_00898290 is a calpain member of *T. thermophila* calpain family.
- THERM_00898290 gene structure is made up of 8 exons.
- Like other calpains, THERM_00898290 consist of a conserved CysPc domain.
- Multiple sequence alignments of human calpains and THERM_00898290 shows conserved regions.
- Sequence alignment suggest THERM_00898290 is more similar to Calpain 7 and Calpain 15 compared to the other human calpains.
- Phylogenetic tree analysis, using MEGA and Phylogeny.fr, supports THERM_00898290 being more similar to Calpain 7 and Calpain 15.

CONCLUSION

Based on the results presented we can conclude that THERM_00898290 is one of *T. thermophila* calpains and shares more similarity to human calpain 7 and 15, members of the non-classical calpains.

Future Directions

Bioinformatic tools will continuously be used to further understand the structure and function of THERM_00898290.

Acknowledgement

A big special thanks to the Emerging Scholars program of the Fall 2021 semester and most importantly, Professor Ralph Alcendor, my research mentor who guided me throughout this research semester. Without him it could not be possible.

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Data Loss During Natural Disasters

Svetlana Idrovo Shindler

Mentor: Patrick Slattery – Computer Information Systems



Abstract:

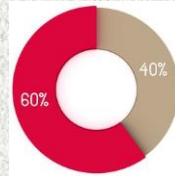
Thousands of business networks and millions of personal computers were damaged because of Hurricane Sandy in 2012. The damage done was estimated to cost billions of dollars for material damages and even more in data loss. Most of the businesses on the East Coast of the United States did not have adequate insurance policies or proper knowledge to guard against data loss. These shortcomings cost those businesses major losses in revenues which drove some to close their business.

This research discusses what lessons are learned regarding data loss during natural disasters and their applicability to small and medium businesses.

Through scholarly research and research of business publications, conference talks, and other artifacts, a summary of highly effective best practices regarding data loss is provided to give every business insight into ways they can protect their data and their business.



Only 1 in 4 small companies says they're prepared for a major natural disaster. Based on Wakefield Research, only 22% of businesses that were impacted by Superstorm Sandy, said they were prepared for another storm.



According to FEMA, 40 to 60% of small businesses permanently shut down after a natural disaster. And among those that survive, less than 30% survive another 2 years before shutting down.



96% of all business workstations are not being backed up. (Contingency Planning and Strategic Research Corporation)



93% of companies that lost their data center for 10 days or more due a natural disaster, filed for bankruptcy within one year of disaster.

What kind of Natural Disasters?

Fires: According to USFA (United States Firefighting Association), non-residential building fires are only 6% of all reported files but accounted for 0.5 billion dollars loss. Besides fire, smoke can destroy technology equipment. The water from sprinkler systems also causes irreparable damage. After a fire, systems are often exposed to the elements.

Flooding, hurricanes, storms: can occur burst water pipes and leaks inside the building what will lead to electrical problems and outages, what can damage physical storage devices that contain the data that your business needs to work on.

Earthquakes: no one knows when and where a big earthquake will occur, not even seismologists. When a big one hits most businesses and buildings with servers may be destroyed. Excessive time and funds are needed to rebuild city infrastructure again with electronics, underground cables and operational equipment. For a small business, such delays without operational and financial data access might be the end of business.



How to prevent data loss from natural disaster:

The best practices that can be affordable and important for small businesses that I found during this research are:

1. Store your information on the cloud

Cloud providers exist that you will store all their company's information on their remote services. Go with a company that her servers are in different city than where you live/work. Hurricane or earthquake might take out your office and their servers' miles away.

2. Set a shorter RPO (Recovery Point Objective)

It's important for a business to recover from a natural disaster as soon as possible. The US Department of Homeland Security (DHS) recommends that businesses have lists and prepared messages for every group of stakeholders. That means that businesses need consider different disaster scenarios for employees, vendor, and clients with a customized message for each group.

3. Develop a continuity plan

The heart of a disaster plan is a continuity plan, since it helps businesses continue operating even after an emergency. Decide what operations are the most critical for business to function and what employees will fulfil them. Work on this plan with your team, as employees might think of weak spots the owner might miss. Use the plan to educate staff about their responsibilities and the steps needed.

Conclusion:

Even if its just 5% of businesses said that natural disasters were the top cause of data loss within the previous year, I found out the statistics of data loss for small businesses can be unreversible. Therefore, I felt that doing research on this topic can raise the awareness and right preparation ahead of time can be helpful and necessary. Using cloud, preparing updated RPO and writing continuity plan can save small or medium business from closer in a year or two after natural disaster.

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Code Cyber: "A Curated Collection of Cybersecurity Career Learning and Preparation Resources"

Team Members: Jason Lin, Tasin Kazi, Mohammed Zaman, and Ethan Pruzhansky
Mentor: Professor Patrick J Slattery

What is Cyber Security?

We rely heavily on our computers and smartphones to do the majority of everyday duties. Consider going without a laptop or a phone for a day. How would you gather information or execute any daily chores required that day? We would be unable to do so because we are so reliant on our smartphones and laptops. Our devices save all of our essential data. Our credit card information is stored for online transactions, as are our social media profiles, email addresses, and personal text messages. I'm making the point that is all of our personal information on these unique gadgets genuinely secure? This is where cybersecurity comes into play.

Cybersecurity is the practice of defending against cyberattacks on systems and sensitive data. Additionally, it is meant to safeguard against digital assaults on computer systems.

Some of the questions you may have are: How does it work? Are there any preventative measures that may be taken to avoid letting these digital attacks?

What are the kinds of Cyber Threats?

Cyber security threats are defined as any vicious assault that aims to obtain unauthorized access to data, disrupt digital activity, or damage data. Cyber risks include corporate espionage, hacktivists, terrorist groups, hostile nation-states, criminal organizations, lone hackers, and dissatisfied employees.

The cybersecurity sector protects against malware attacks, ransomware attacks, crypto-jacking, phishing, emotes, password attacks, and distributed denial of service (DDOS) attacks, among other cyber security threats.



POV: You are getting your credit card info stolen

- Citations:
- <https://www.hackmageddon.com/category/security/cyber-attacks-statistics/>
 - <https://www.nist.gov/>
 - <https://www.pcmag.com/how-to/12-simple-things-you-can-do-to-be-more-secure-online>
 - <https://www.cisco.com/c/en/us/products/security/incident-response-plan.html>
 - <https://cloud.google.com/security>
 - <https://www.symquest.com/cyber-security-for-business/>
 - www.lazorpoint.com

What steps are taken to prevent such attacks?

Cybercrime is pervasive in today's digitally linked world, and many businesses have employed cybersecurity experts to protect their data. The project's objective is to investigate five aspects of cyber security as defined by the National Institute of Standards and Technology (NIST). NIST defines these five areas as Identify, Protect, Detect, Respond, and Recovery.

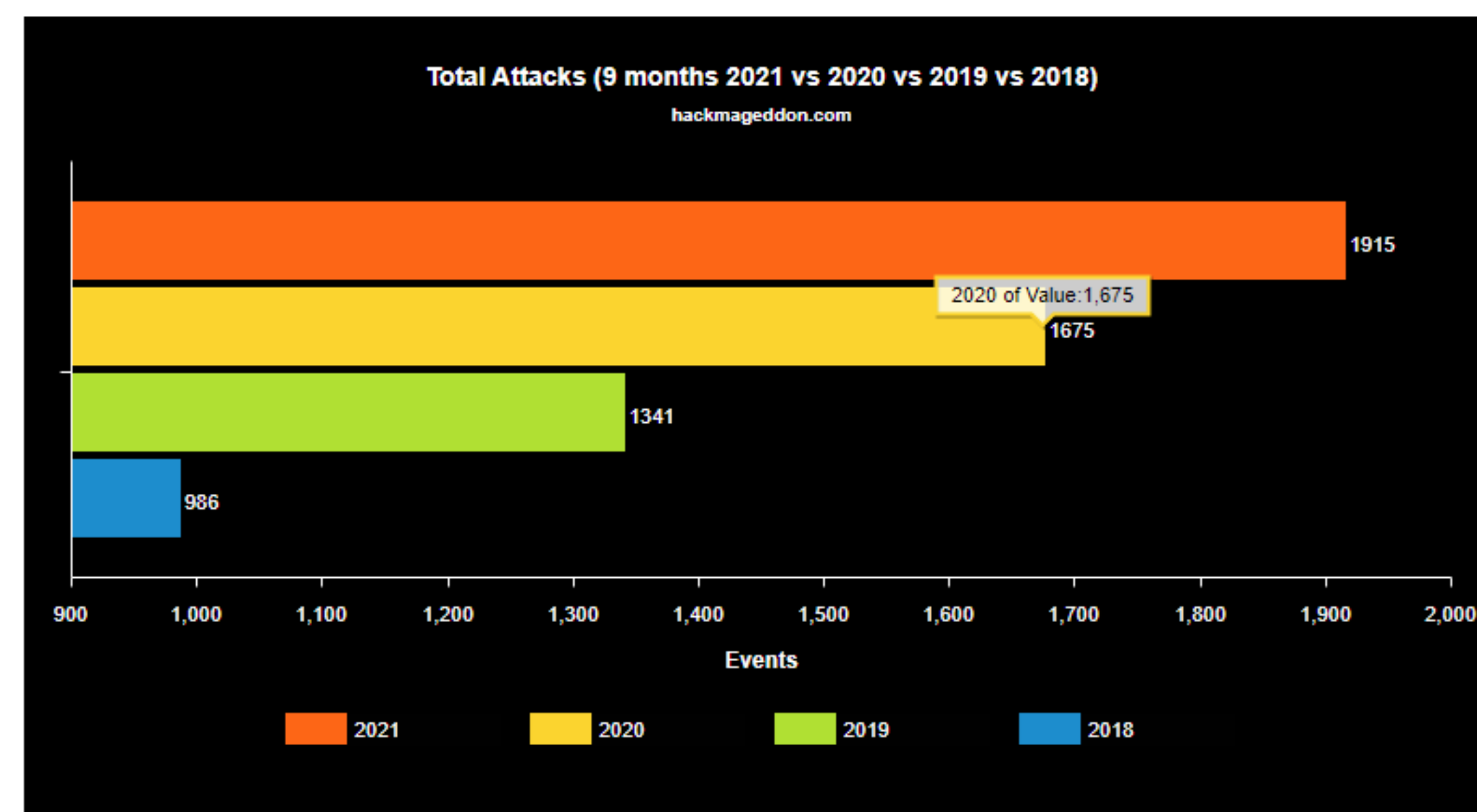
We describe how the cybersecurity industry defends against malware assaults, ransomware attacks, crypto-jacking, distributed denial of service (DDOS) attacks, and other cyber security attacks. Following the NIST standard, the first step is determining what assets are deemed high in value and which attackers or hackers are likely to target.

After the identification of assets, those assets will need to be secured or protected. One of the best ways to protect against cyber-attacks and viruses is to keep the software, browsers, and operating systems up to date.

Protecting data requires robust authentication even with solid authentication and control over access to valuable data, there is a risk that authenticated users open untrusted files from unknown websites or click on nefarious links in an email or message. Those actions make a user's computer more vulnerable to cyber-attacks. It is difficult to detect a problem when something goes wrong with the systems.

Detection and response to an issue working together as quickly as is feasible are critical. Rapid detection and response can cure the problem soon and allow normal work to continue. Detection systems should watch data, networks, and email. Effective response and recovery will require having a backup to restore when information is corrupted.

Recovery requires extensive planning. It is critical to plan how to refresh and improve cyber security software. Documentation of incidents detected, including what happened and what lessons may be drawn from the experience, contributes to improvements in the recovery steps. Recover can establish a plan to reduce the risk of future cyber security attacks.



Total Attacks within the last 9 months of 2021 compared to the past 3 years.
Source: hackmageddon.com

Incident Response Planning

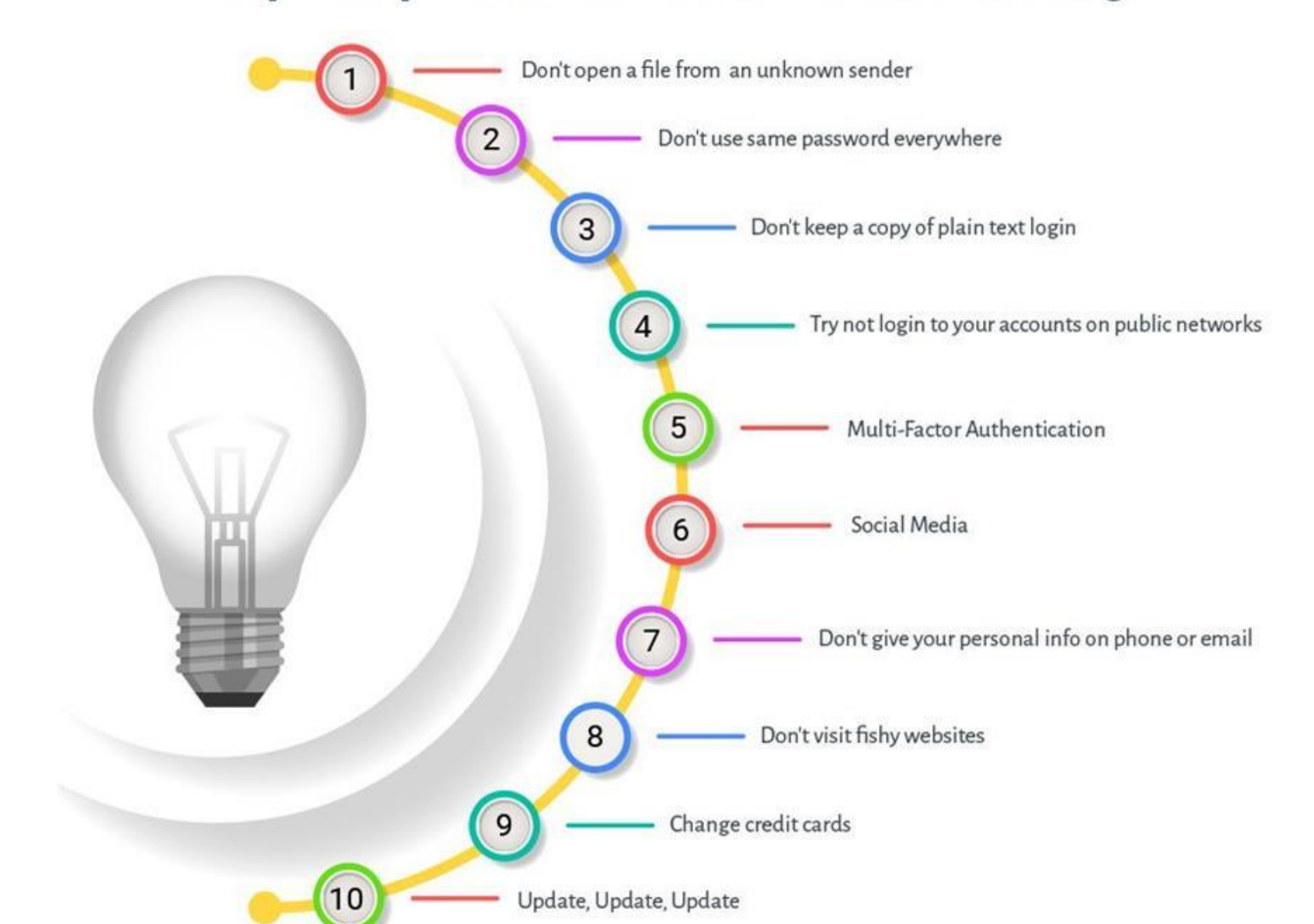
A Cybersecurity Event Response Plan (CISRP) is a document that guides IT and cybersecurity professionals through the process of responding to a severe security incident, such as a data breach, data leak, ransomware attack, or loss of critical data. According to the National Institute of Standards and Technology (NIST), the most effective incident response plans include four phases: preparation, detection, and analysis, containment, eradication, and recovery, and post-event activities.

What is the purpose of an incident recovery team? An incident recovery team is a group of individuals charged with carrying out the incident response strategy. These are primarily IT workers who collect, store and analyze data pertaining to incidents. Your IT staff may need to work with attorneys and communication specialists to guarantee compliance with legal obligations.

What are the ways to protect yourself and your data?

- Review and secure your social media accounts.
- Use an Encrypted Operating System.
- Keep operating systems and software up to date.
- Change your passwords on all other accounts.
- Install an Antivirus and Keep It Updated
- Turn Off the 'Save Password' Feature in Browsers
- Don't Fall Prey to Click Bait or Phishing Scams
- Use Two-Factor Authentication
- Don't access personal or financial data with public Wi-Fi.
- Responding to data breaches

Top 10 Tips To Protect From Online Hacking



Source: www.c-sharpcorner.com/article/top-10-tips-to-protect-from-online-hacking/



Computational Characterization of Calpains in *T.thermophila*

Tayna Gebhardt

Mentor: Professor Ralph Alcendor

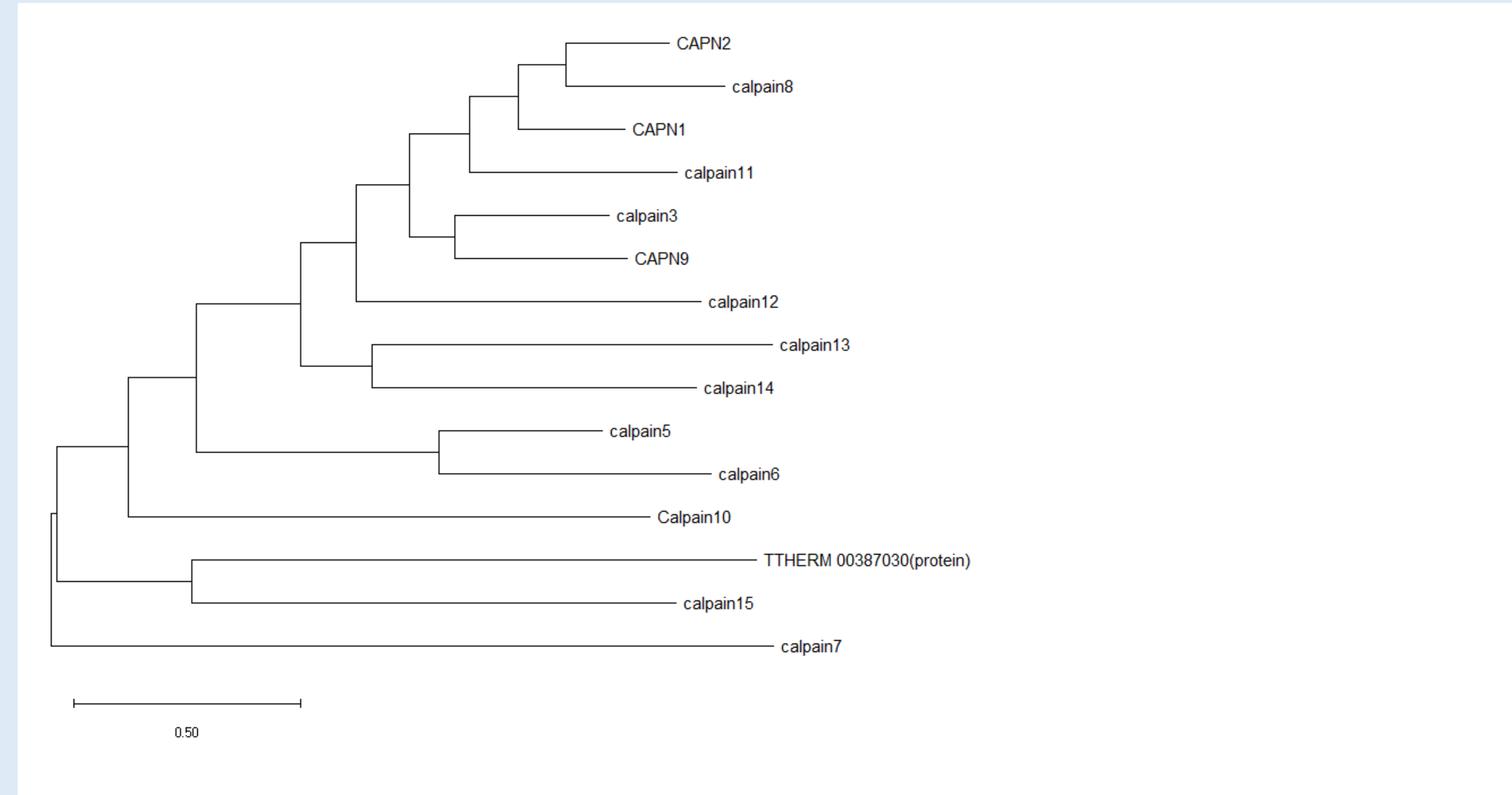
Abstract

Tetrahymena thermophila is a multi-nucleated, unicellular protozoan found in bodies of fresh water. Combined with its short life-cycle and the presence of two genomes within *T.thermophila* make it an ideal eukaryotic organism to study. There has been extensive work done on *T.thermophila* in areas of cell division, programmed nuclear death, and evolutionary phylogeny, all of which has broadened and enriched knowledge about eukaryotes in general. Calpains are a type of calcium-dependent cytosolic protease expressed in all eukaryotes and bacteria. They are important in intracellular calcium-regulated mechanisms and play a role in apoptosis and in diseases such as muscular dystrophy and diabetes. Although the genomes of these cells have been sequenced, calpains and their role in *T.thermophila* is yet to be examined. The objective of this research was to characterize THERM_00387030, one of the family members of *T.thermophila* calpains using bioinformatics tools. NCBI Basic Local Alignment Search Tool (BLAST), Multiple Sequence Comparison by Log-Expectation (MUSCLE), Tree-based Consistency Objective Function for Alignment Evaluation (T-Coffee), and multiple alignment using fast Fourier transform (MAFFT) were used to compare THERM_00387030 and human calpains protein sequences. Phylogenetic analysis was done using Phylogeny.Fr and Molecular Evolutionary Genetics Analysis (MEGA). Protein structure modeling was done using Protein Homology/Analogy Recognition Engine (PHRE2) and Visual Molecular Dynamics (VMD). Using these tools, THERM_00387030 sequence was compared with protein sequences of all human calpains. Initial findings suggest a close relation between THERM_00387030 and human calpain-15 and calpain-7. Further analysis is needed to confirm which of these two calpains THERM_00387030 is more closely related to.

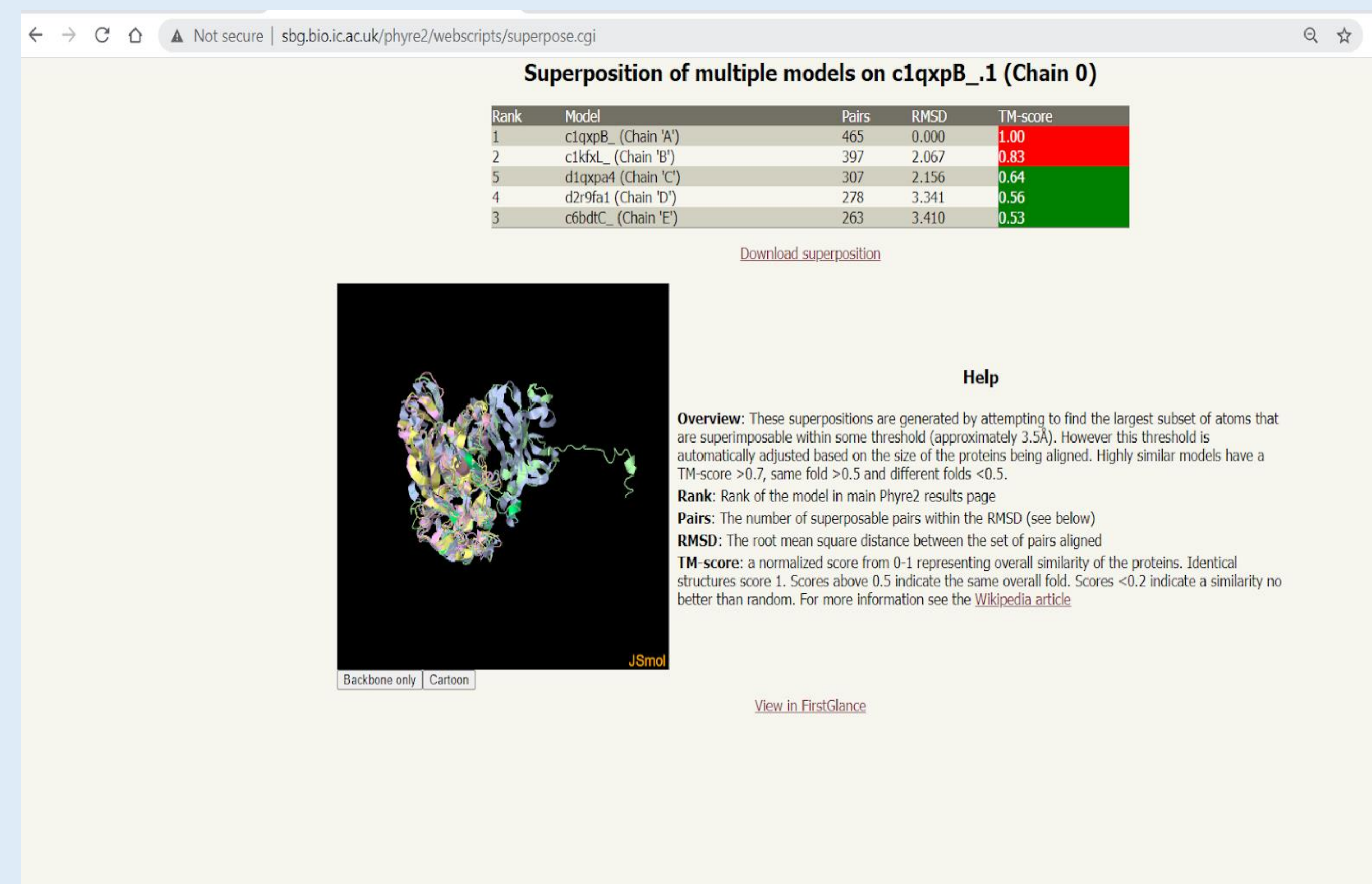
Methodology

The main resource used to compare protein sequences was computer databases. Through the use of NCBI, human calpain homologs were searched for. Using a separate software program housing the sequences of *T.thermophila*, multiple calpain sequences were located. NCBI Blast was the initial tool used to look for similarities between human calpains and the *T.thermophila* calpain 11. Further comparison was done using MUSCLE alignment software, T-Coffee alignment software, and MAFFT alignment software. Protein structure modelling was also used to compare potential structures. These software programs produced results showing both protein alignment similarities, visual representation in the form of cladograms, and structure alignments.

Results



Evolutionary analysis by Maximum Likelihood method
The evolutionary history was inferred by using the Maximum Likelihood method and JTT matrix-based model [1]. The tree with the highest log likelihood (-23551.14) is shown. Initial tree(s) for the heuristic search were obtained automatically by applying Neighbor-Join and BioNJ algorithms to a matrix of pairwise distances estimated using the JTT model, and then selecting the topology with superior log likelihood value. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. This analysis involved 15 amino acid sequences. There were a total of 1387 positions in the final dataset. Evolutionary analyses were conducted in MEGA X [2]



Discussion

This project is to characterize a particular calpain in *T.thermophila* using bioinformatics computer software and to discover potential similarities. Upon the initial comparison using only NCBI, there seemed to suggest a strong similarity to calpain-15 isoform found in homo sapiens. Upon further investigation with additional bioinformatics tools such as MUSCLE, T-Coffee, and MEGA but there was a strong similarity observed between human calpain 15 and human calpain 7. The alignment software provided evidence highlighting similar protein sequences. The cladograms provide evidence of the history of these homologs being closely related and suggests genes once shared a common predecessor. Furthermore, more similarities were confirmed using additional bioinformatics tools used for protein modelling. As seen in the results, structure modelling was done using VMS and PHRE2. The overlapping regions from the generated structures indicate similarities with the gene of interest and similar protein structures tabulated. Further analysis is necessary to determine which human calpain is more closely related to THERM_00387030(protein).

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3. <https://www.phylogeny.fr/>



Solar Analysis and Control for High Performance Residential Buildings - Case Study

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Professor Jihun Kim
Architectural Technology



Introduction

Buildings generate close to 40% of global carbon emissions annually. 28% counts for operational energy that is to heat, cool and power our buildings to create a comfortable indoor environment for the occupants. The commercial sector have been in the forefront of innovation and making buildings more efficient in response to climate change. However, as a result of the Covid-19 pandemic, our spaces have had to be recalibrated, while majority of the office workforce moved their operations into their own homes. This notion brings residential buildings into the spotlight, raising the question of energy use and efficiency within residential buildings.

The purpose of our study was to gain a better understanding of residential building energy usage and identify the environmental factors that are driving energy intensity. Major environmental factors are direct energy from the sun and indirect energy through the Urban Heat Island effect (UHI); intensifying the need for cooling during warm months and providing a soothing heat gain during the cold months. Other factors such as wall assembly, window to wall ratio, natural ventilation, and other building systems also contribute towards total energy use of a building.

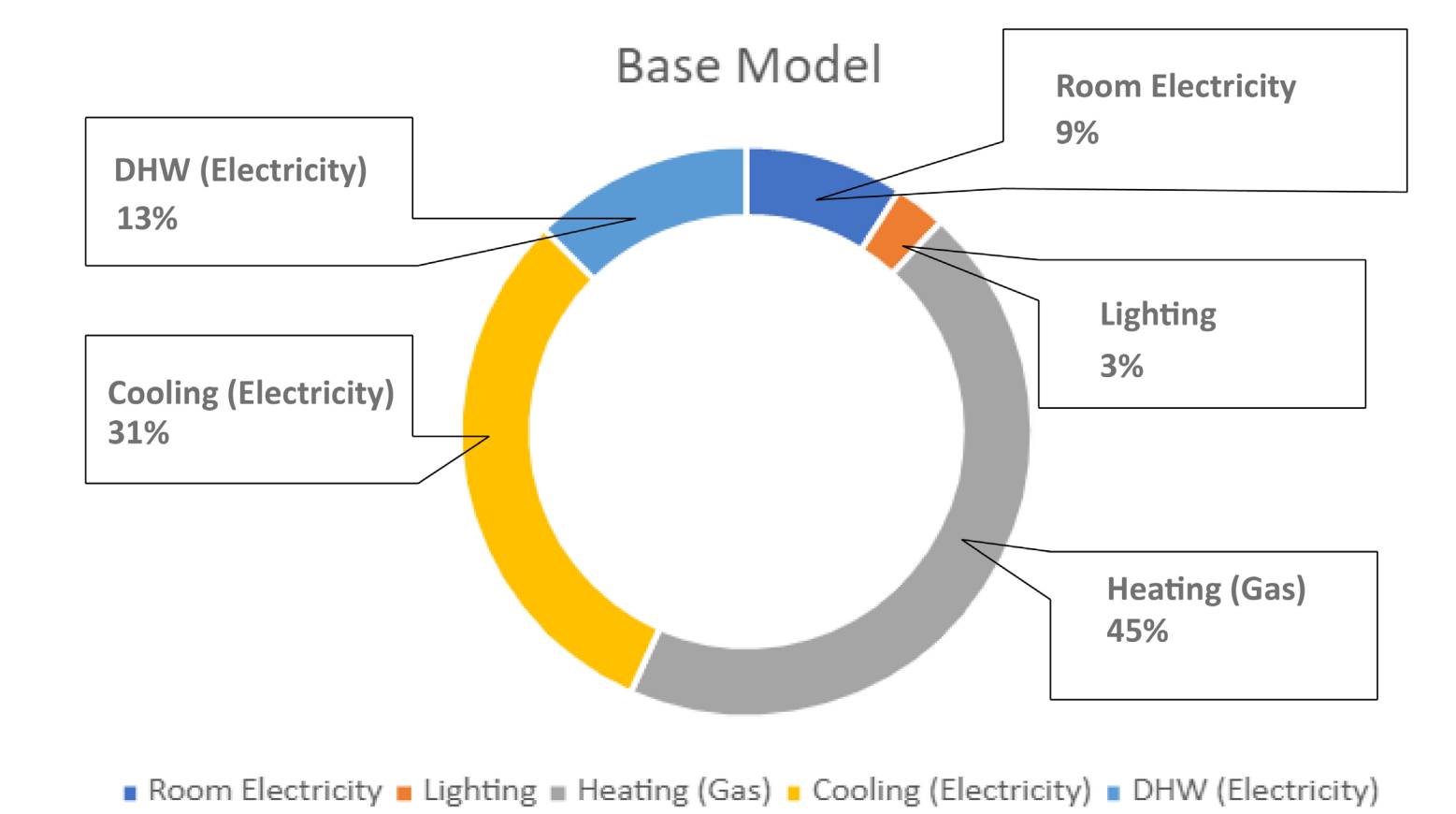
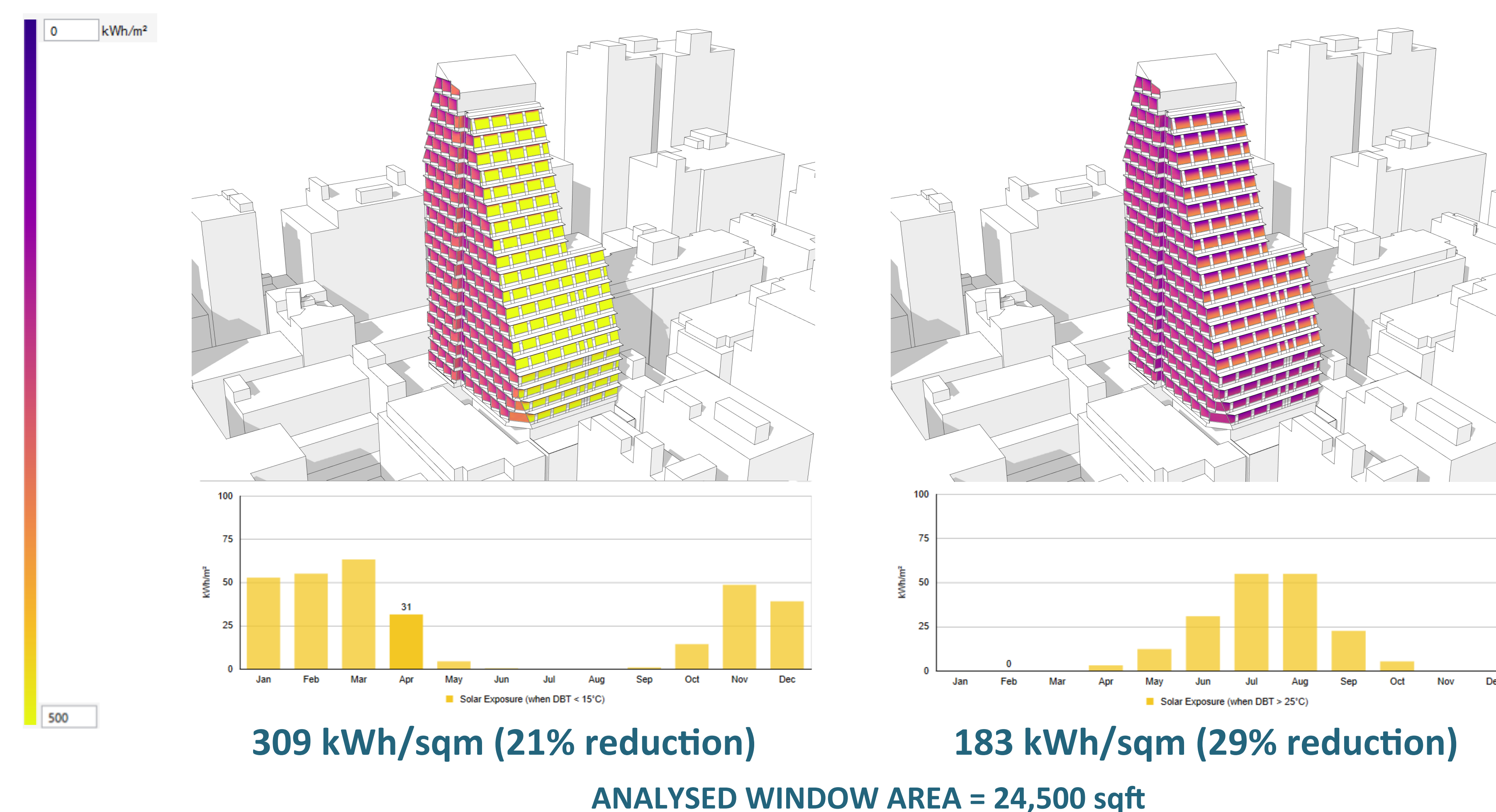
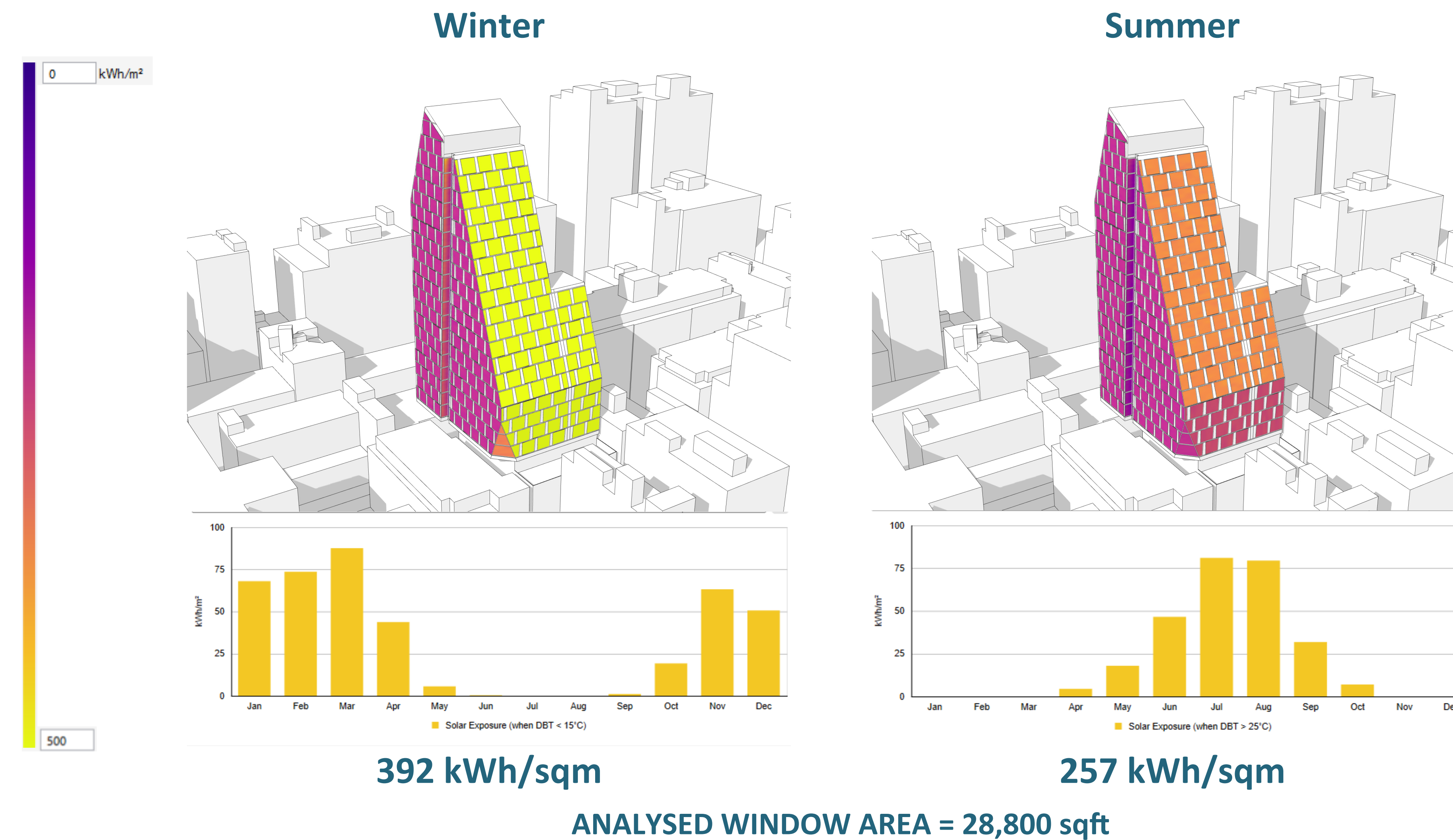
Our goal was to identify and apply effective design principles that can generate better performing buildings while also reducing our negative impact on the environment. By 2050, cities are expected to house 68 percent of the world's population, resulting in an additional 2.5 billion people in need of shelter. Therefore, it is crucial that future buildings are designed to be effective within urban environments.

How can we decrease the usage of heating and cooling while improve the living quality in residential homes?

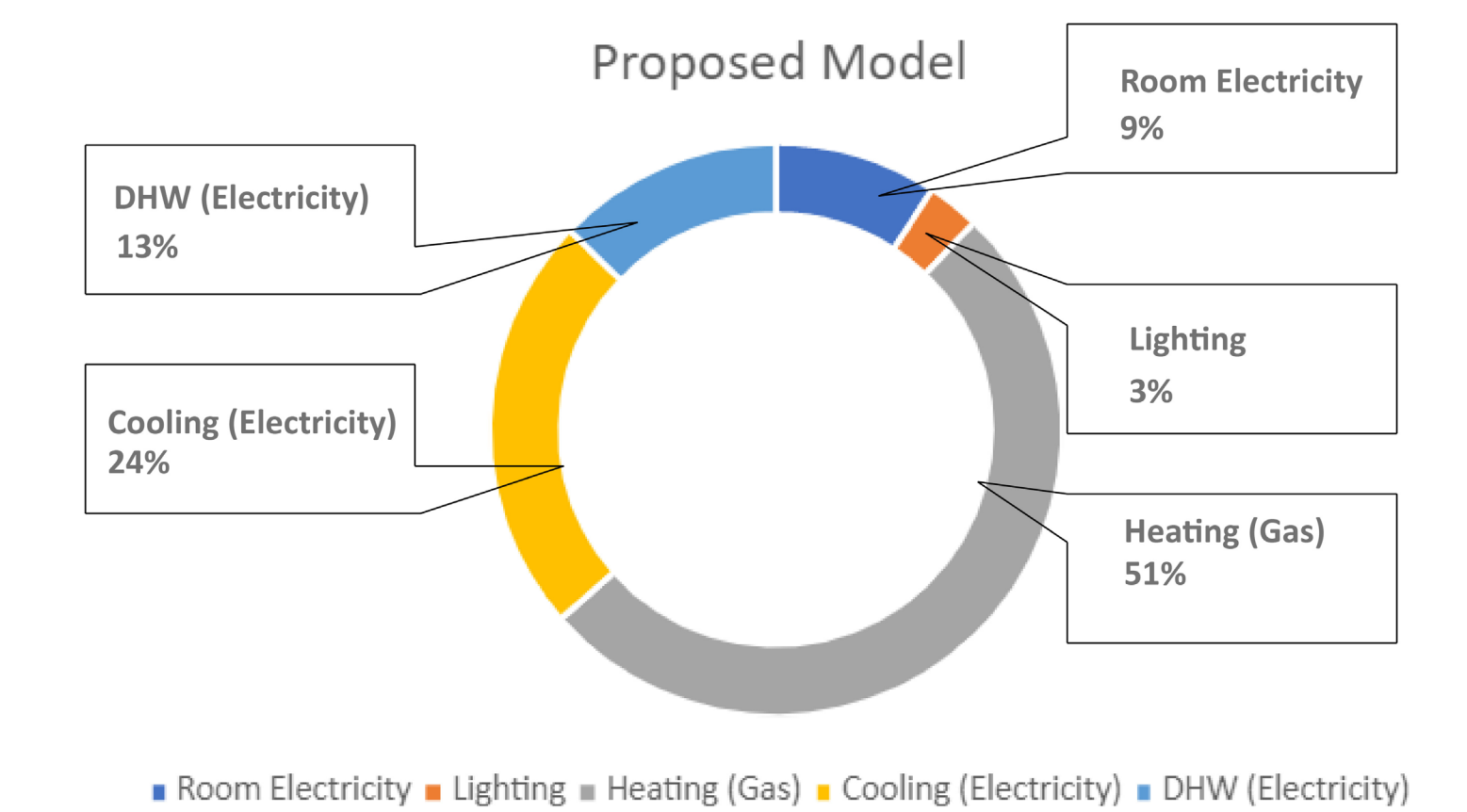
Discussions

To be able to quantify our hypothesis on passive solar control strategies, we chose an existing residential building to do our experiments on. 35xv is a mixed institutional/residential building in New York City designed by FXCollaborative. The 25 storey building presented some unique challenges due to its unusual shape, towering above its neighboring context. The architects maximized the building volume by using the zoning envelope to define its facades. As a result, the building has a slanted South-West facing facade that is defined by the sky exposure plane of the site. The apartment tower enclosure consists of a unitized curtainwall system utilizing plenty of vision glass, as well as spandrel panels and a horizontal aluminum reveal at each floor.

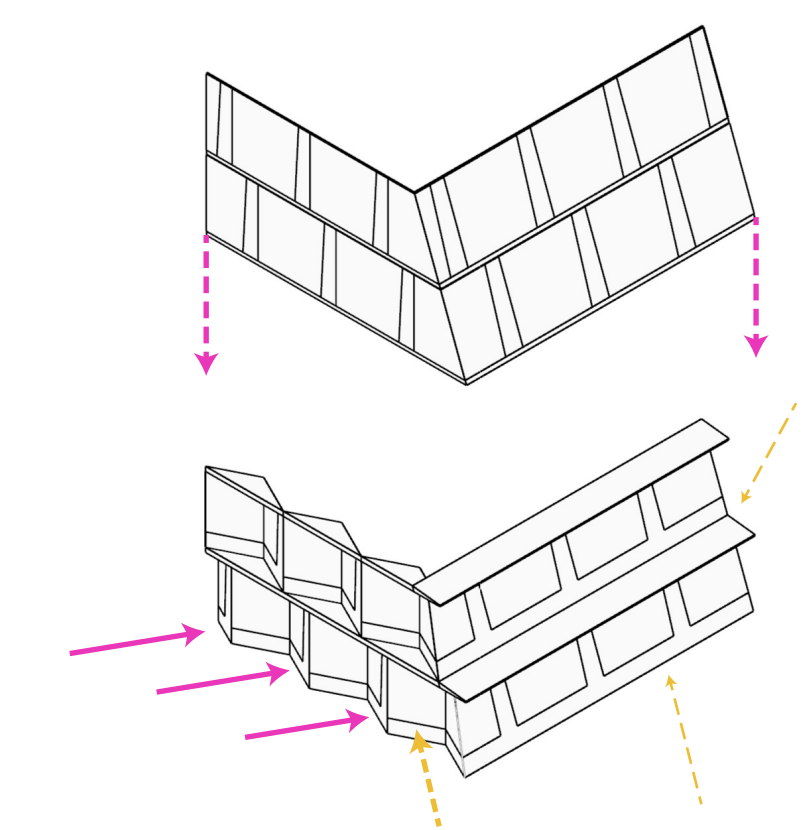
Because of the slant of the South-West facing facade, it was expected that the building will receive large amounts of undesired solar heat gain during the summer, increasing the cooling load that the building needs to meet for



Annual energy consumption mostly consist of large usage for heating (gas) with 45% and cooling (electricity) with 31%.



Annual energy consumption mostly consist of large usage for heating (gas) with 51% and cooling (electricity) with 24%.



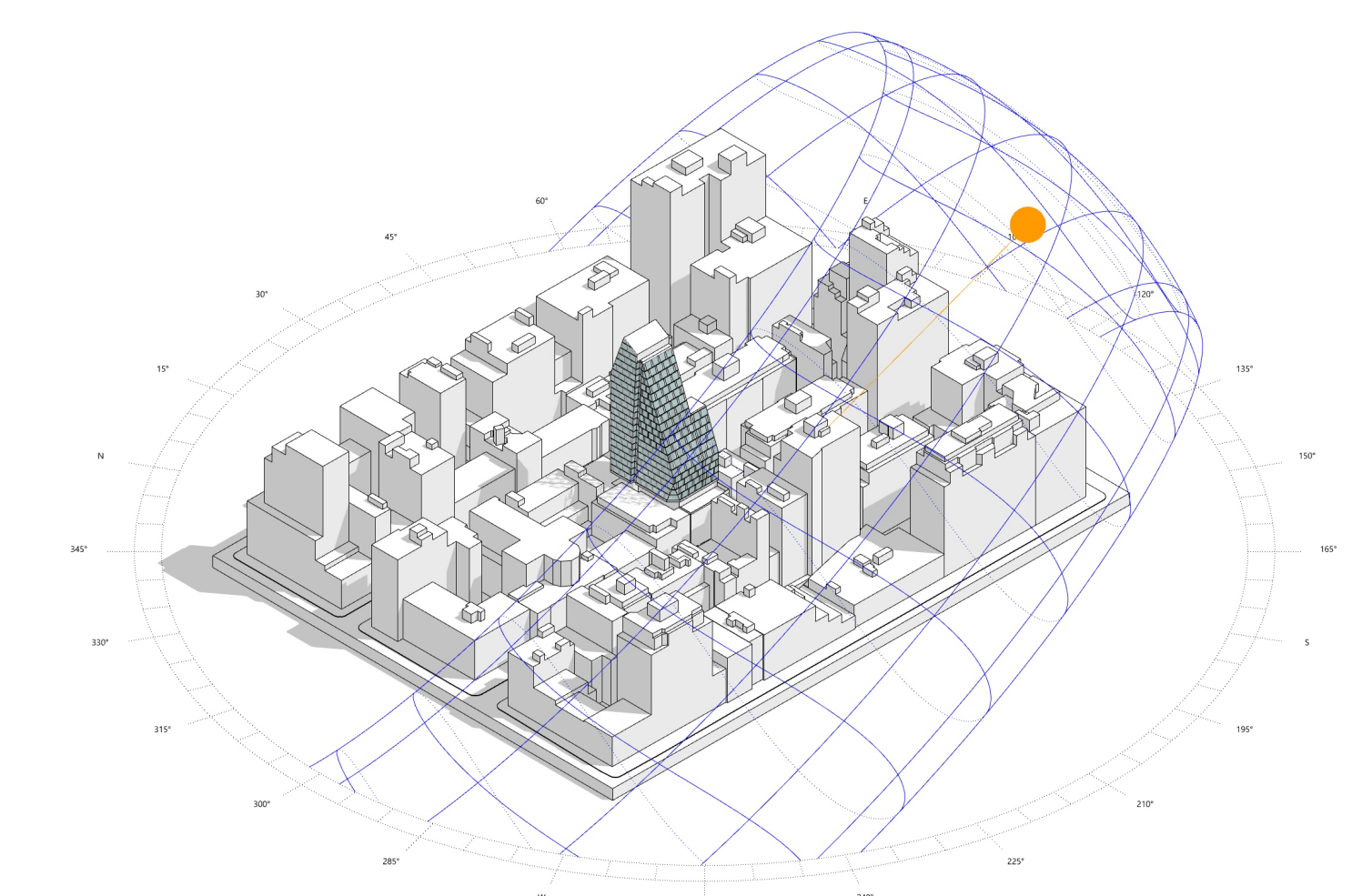
The new implemented North-West facade introduces a zigzag pattern that is able to accommodate the winter sun angles. By turning the faces, the incident angle becomes closer to perpendicular late afternoon, increasing the solar heat gain in the winter.

Conclusions

After the design application, we were able to compare the two sets of data and identify the heating and cooling load changes as a direct outcome of the solar control strategy. With the application of the solar shades, the overall solar radiation was reduced nearly 30% in the summer time; easing the cooling load on the building; and slightly over 20% in the winter, that increased the heating load on the building. After calculating the total source energy use intensity, we can conclude an 8% reduction in the building's Energy Use Intensity (EUI).

Acknowledgment

Jason Voss, FxCollabrative
Professor Kim, Mentor
Professor Shin, Professor



occupancy comfort. This phenomenon is due to the incident of angle that the sun rays make with the receiving surface. The closer the angle is to perpendicular, the higher the intensity of solar radiation on the facade.

To prove our hypothesis of correlation between solar radiation exposure and building energy use, we used DesignBuilder and Climate Studio softwares to run environmental simulations with the existing building. The first set of simulations helped to establish a base case, that later used to for comparison. The next step was to apply solar control strategies such as solar shading to reduce solar heat gain in the summer while allowing it in the winter. On the South-West facade we applied a horizontal shading device to meet the criteria. And redesigned the shape of the North-West facade in order to increase the solar incident angle in the winter time. As a final measure, we will be comparing the Energy Use Intensity for both cases, which is a benchmark measure for buildings based on their occupancy.



Child Detection System For Preventing Hot-car Death

Fahmeda Khanom & Touheda Khanom

Mentor's Name - Dr. Xiaohai Li

Department of Computer Engineering Technology, EMERGINHG SCHOLARS PROGRAM

City Tech Robotics Research Lab

www.citytechrobotics.org

According to the Safety Organization Kids and Cars, an average of 38 children die each year from hot cars due to the lack of attention from parents[1]. Existing alert system uses sensors that detect child presence and care less about detecting temperature inside the car. In order to save children from extreme heat, our research focuses on providing information about the temperature inside the car using very effective sensors with high precision. In our research, we have tested different sensors and figured out three sensors that can provide precise information about the presence of a child without an adult. Our child detection system uses a weight sensor, PIR sensor, and temperature sensor. The weight sensor under the child and adult seat will determine the information about child presence without an adult, and also PIR sensor will be turned on to confirm one more time the presence of a child, and then the temperature sensor will read the information about the temperature inside the car. The main aim of our research is to develop a child detection prototype that will determine the presence of a child left alone inside a hot car with precise information. Our future work will focus on detecting the location of the child inside the car using a GPS module and sending alert messages to parents, caregivers, and emergencies.

INTRODUCTION

In the United States, 52 children died in 2018, and 43 children died in 2017 because of heatstroke in vehicles [1]. The parent's lack of knowledge about temperature rise inside the car and their careless behavior causes the death of the child due to heatstroke. Children's hot car death is still a growing problem that has yet to be addressed and requires effective solution (Table 1). A child's body temperature tends to increase faster than adults in a closed vehicle. A child is more sensitive than an adult when the temperature increases, which can damage the internal organs such as the brain and kidneys. Our child detection system uses multiple sensors to detect the motion of a child and a weight sensor that reads the child's loads and then reads the temperature to send to the parents. This project can alert the parents about their children and might prevent several deaths of children that occurred due to heatstroke during summer season. Our research is still working on sending alert systems to parents, caregivers, or 911 with GPS locations in order for parents to find their child without any delay.

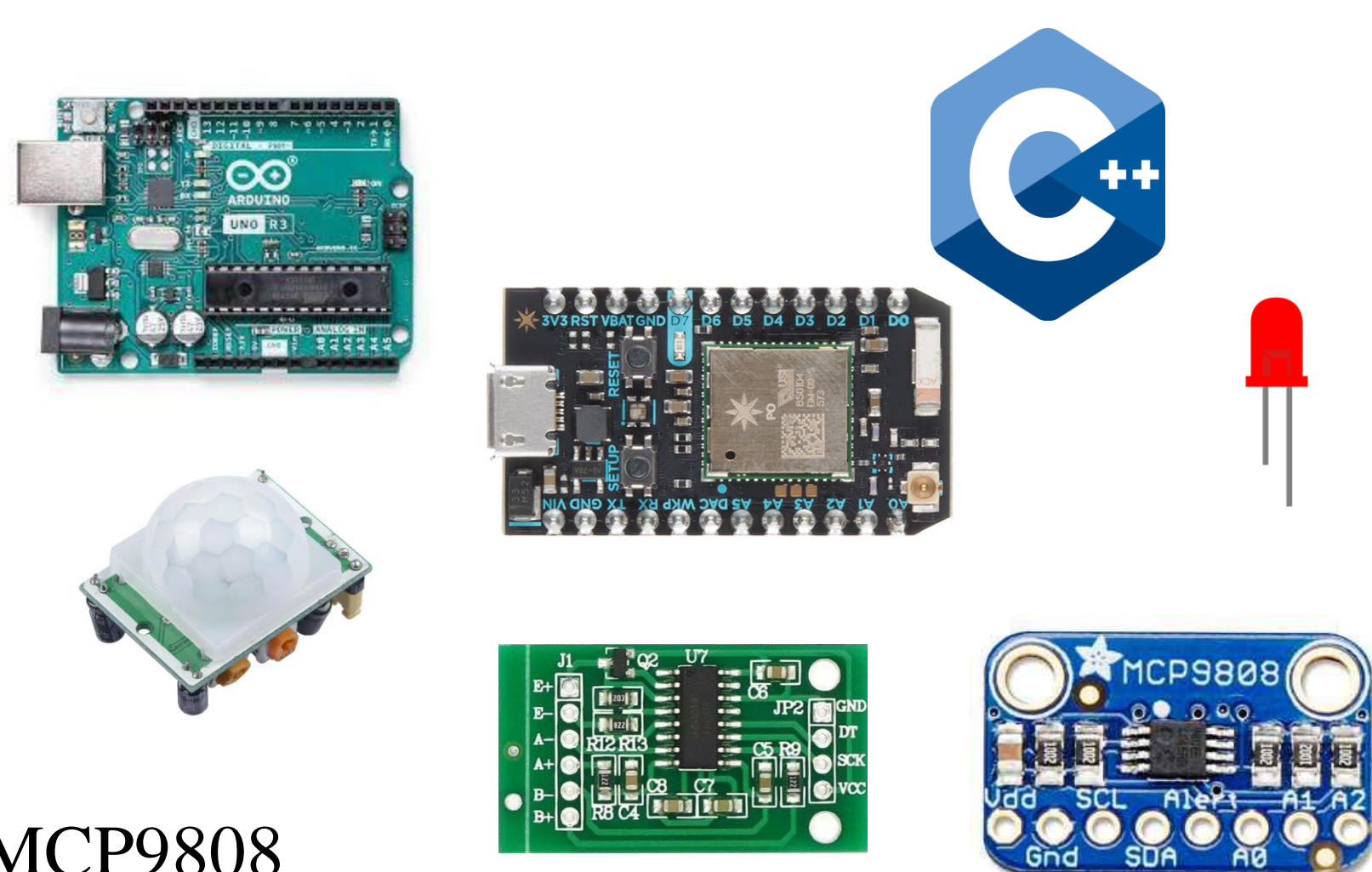
Child Hot Car Deaths Each Year

Year	Number of Babies
2021	23
2020	26
2019	53
2018	54
2017	45

Table 1 [3]

COMPONENTS & DEVICES OPTIONS

- Arduino Board
- Particle Photon Board
- PIR sensor -HC-SR31
- LED
- Weight sensor -HX711
- Temperature sensor – MCP9808



DISCUSSION

In our research, we have used Particle Photon (Figure 1) and Arduino Board (Figure 2) to test our sensors. First, we tested individual sensors to figure out the most precise sensors to build our child detection system to prevent hot car death. We used a PIR sensor with LED attached and when the motion is detected the LED turns on. When no motion is detected, the LED turns off. Then we attached four load cells, each load cell is 50 kg, to determine the weight of the child and adult. When no adult is detected, the temperature sensor which is MCP9808 will start measuring the temperature. We are still working on building the next prototype which will start alerting the parents/caregiver. Some studies used the sensors to detect the temperature and send text messages to alert only the driver's phone (Visconti, 2020). However, the driver might not respond to the alert if the phone battery is dead or the phone is in silent mode. In cases when no response is found from the parents/caregiver our child detection prototype we are working on will reach 911.

RESULTS

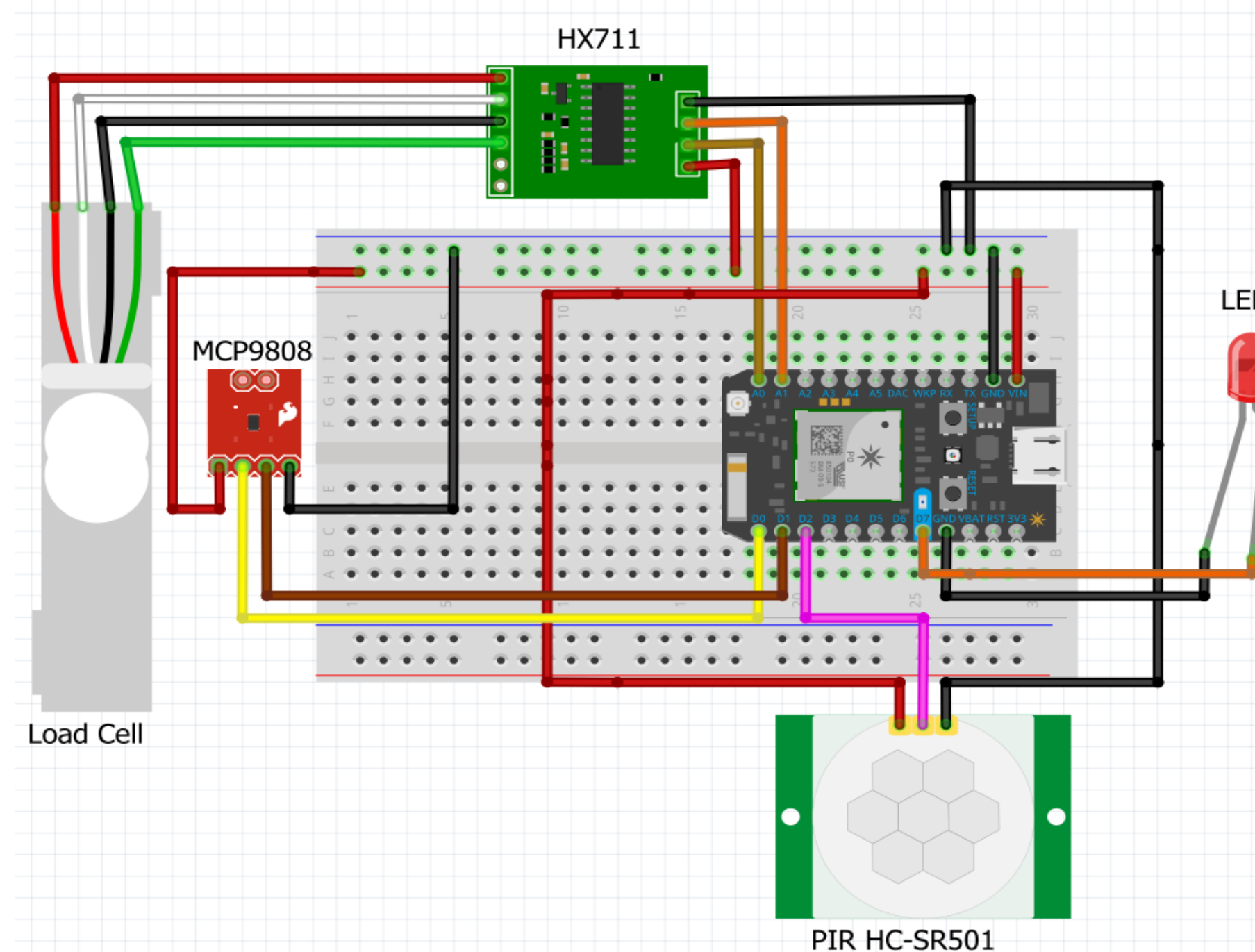


Figure 1: Particle Photon Board

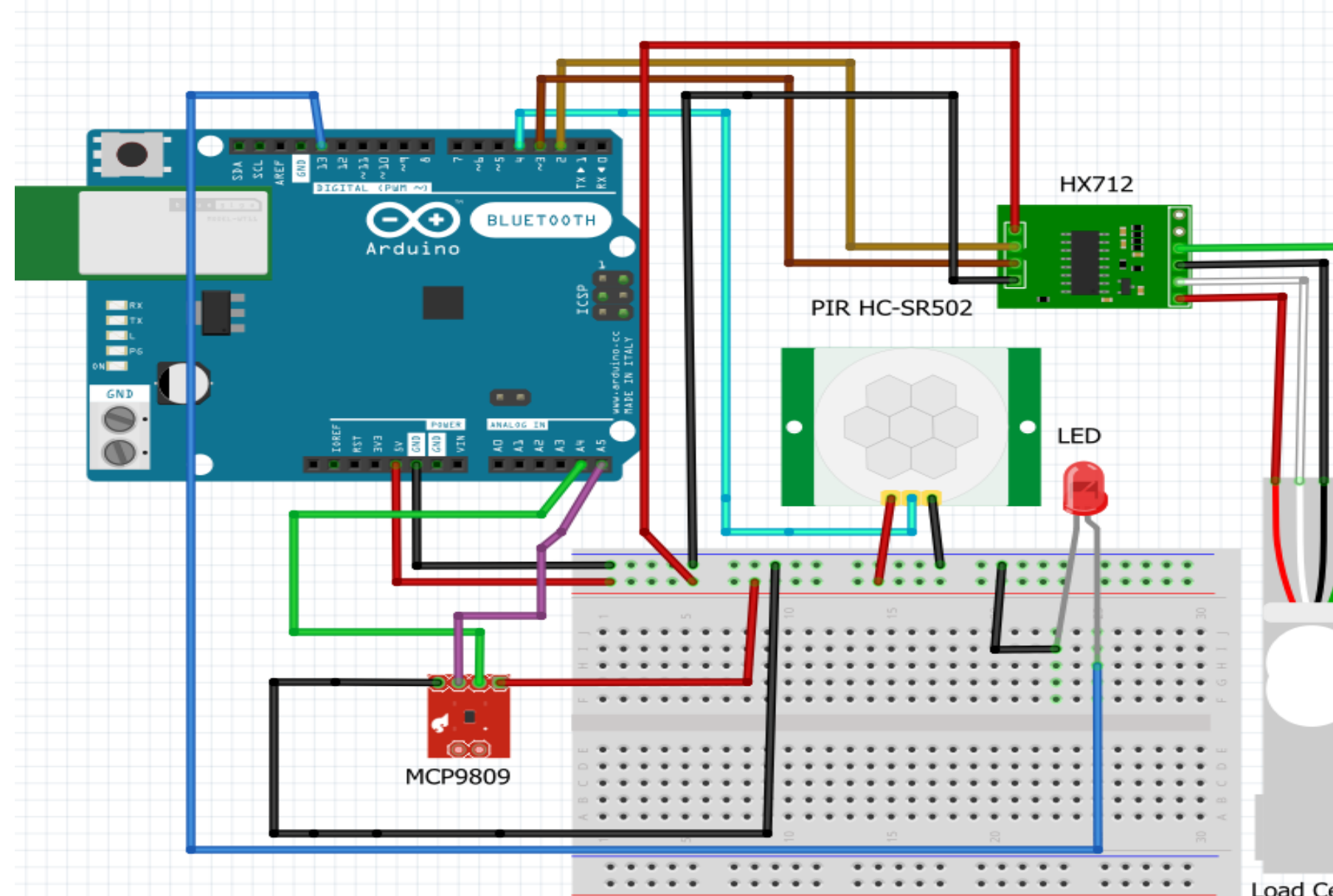


Figure 2: Arduino Board

TESTING CODE

```

1 #include <MCP9808.h>
2 #include <HX711ADC.h>
3
4 HX711ADC scale(A1, A0);
5 MCP9808 mcp = MCP9808();
6
7 int inputPin = D2;
8
9 int ledPin = D7;
10
11 int pirState = LOW;
12 int val = 0;
13 int calibrateTime = 5000;
14
15 void setup() {
16   pinMode(ledPin, OUTPUT);
17
18   pinMode(inputPin, INPUT);
19
20   Serial.begin(9600);
21   Serial.println("HX711 Demo");
22   scale.begin();
23
24   Serial.println("Before setting up the scale:");
25   Serial.print("read: \t\t");
26   Serial.println(scale.read());
27

```

CONCLUSION & FUTURE WORK

In the research project, we have designed our child detection prototype system that will be low-cost and easy to use for most of the users with the support of sensors. We have used multiple sensors which were individually tested. The goal of the final project is to implement an alert system to inform the parents about their children in hot-car that can reduce the death of the children. We will also use a GPS module to send the parents/caregiver the location of the child if they forget where they parked the car.

ACKNOWLEDGMENT

EMERGING SCHOLARS PROGRAM
Special thanks to Dr. Xiaohai R. Li

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Mechanical Characterization of Nano-material Doped Polydimethylsiloxane (PDMS)

YeHun Jeong

Prof. Dr. Ozlem Yasar

Department of Mechanical Engineering Technology, New York City College of Technology, CUNY



Abstract

In this project, dog-bone shaped PDMS testers are fabricated at the Research Laboratory SET in the Department of Mechanical Engineering Technology. Tensile tests are performed to investigate the mechanical properties of the PDMS. Similar procedure are also repeated for the nanomaterial doped PDMS to investigate the effects of nanomaterials on the mechanical properties of PDMS. Our preliminary results indicates that engineered scaffolds' mechanical properties can be improved with nanomaterials.

Introduction

Tissue engineering is a relatively new multidisciplinary field involving cell regeneration and shaping in order to grow new organs. Generated organs require scaffolds to build upon for cell growth and to guide tissue development. The scaffolds created must be biocompatible, biodegradable, and provide enough stiffness and strength relative to the organ that it is replacing/repairing. Fabricated organs will require Angiogenesis (The growth of blood vessels from the host to the organ) or Inosculation (Prebuilt blood vessels in the organ that then connect to the host) in order to provide nutrients to it.

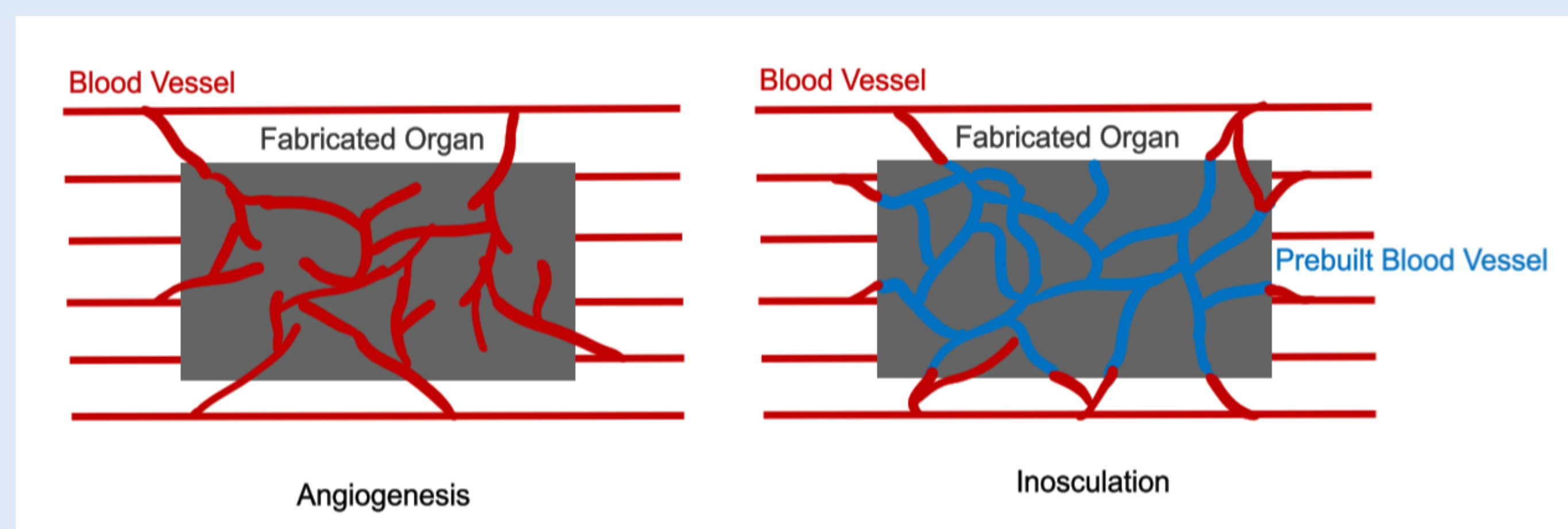


Figure 1. Angiogenesis and Inosculation.

There are many different fabrication techniques for scaffolds that usually revolve around creating porous structures such as Porogen leaching and Phase separated scaffolds, or a form of additive manufacturing with 3D printing.

Results

Due to the current pandemic, the SET Research Laboratory has been closed, suspending research activities there. Research at the lab will resume starting next semester.

Literature Review

The basic background of tissue engineering, its components and methods are listed in 'Tissue Engineering. Second edition'. Scaffolds and their fabrication techniques such as micro molding and photolithography are briefly covered. 'Direct-Cell Photolithography and Optical Soft Lithography Using PDMS Cell Imprints' goes more in depth for the fabrication method used for this research.

Acknowledgments

The authors acknowledge the research support from Dean's Office, Research Scholars' funds and SET-CUNY

Method

For this research two methods of fabrication will be used. Micro molding and photolithography. Photolithography can be separated into 2 parts, Direct-Cell Photolithography and Optical Soft Lithography.

- Micro molding is used to mass produce previously created structures. The molds can be created with micrometer precision and can be used to create similar structures out of different materials from the original cast. The molds allow a wide array of flexibility in design while retaining the original shape.
- Direct-Cell Photolithography is arranging cells on glass wafers to use as a photomask. The photomask is placed over a substrate that solidifies with UV light exposure. UV light is shown over the photomask and solidifies the substrate into a specific structure based on the photomask.
- Optical Soft Lithography is the same method as Direct-Cell Photolithography but replaces the cells with a PDMS mold of the photomask. PDMS is transparent to most UV light and would create a similar structure on the substrate as Direct-Cell Photolithography.

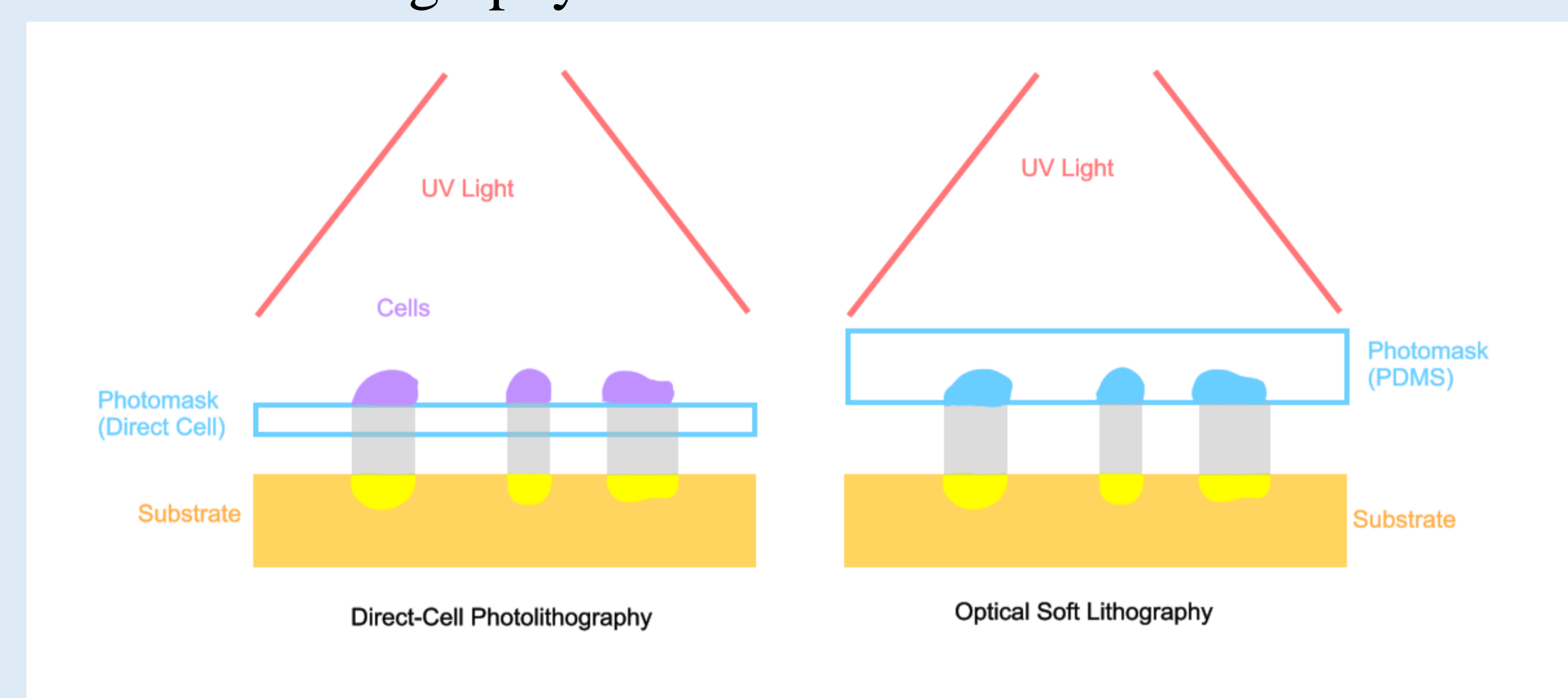


Figure 2. Direct-Cell Photolithography and Optical Soft Lithography.

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