



**Book of Posters**

**CUNY Research scholars Program (CRSP) – Fall 2021**



# Mammography and Noise Statistics to Explore Effects of Environmental Metal Toxins on Biologically Active Model Carbohydrate Matrix

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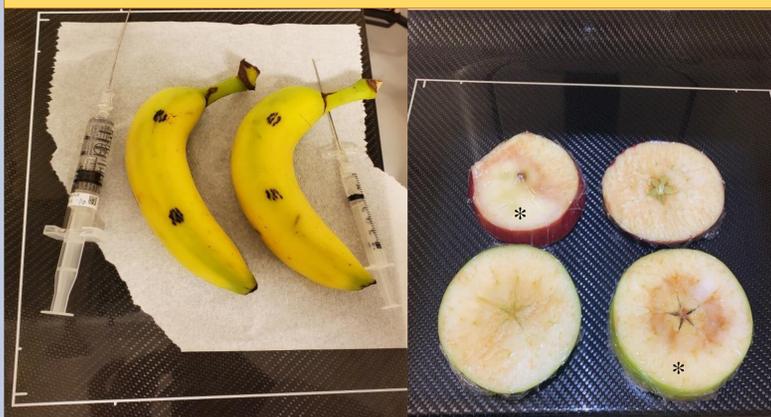
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## Abstract

We are exploring the effects of radiological organometallic contrasts on native metals in biological tissues, in particular, on fresh bananas and apples as model carbohydrate matrix. The contrasts include Omnipaque (an iodinated CT contrast) as well as Gadavist, and Dotarem (two stable MR contrasts); all three have organic molecular arms to protect heavy metals from dispersing in live tissue before excretion by kidneys. We used a Hologic mammography system with low kVp, suitable filtration and low photon flux to minimize scattered radiation and record the inherent scatter in the sample due to the lightweight sample biometals and minute quantities of added radiological contrasts as above. Contrast distributions were mapped by low-dose 2D mammographic exposures at specific time intervals for several days. We hypothesize that the transmitted X-rays in pre and post contrast data may show effects from different minerals, e.g. from iron, calcium and magnesium in the model fruits and eventually could help understand potential risks on human tissues from such external contaminants.

## Methods

The X-ray beam used were optimized for its energy (kVp) for sample penetration and X-ray quantity (mAs flux). Prepared samples are shown below for bananas and apples. The bananas (left panel) contains Dotarem on the left and Gadavist at right. Gadavist, 0.1mmol/kg has twice the amount of Gd atoms compared to Dotarem, 0.05mmol/kg. Apples (right panel) were imaged without any contrast, but two, noted with \*, were treated with 20 sec of microwave heat shock).



## Background

Two unpeeled chiquita bananas and 1 cm thick slices from which 2 heat shocked (20s microwaved) and 2 at room temp of red delicious and granny smith cultivar apples were imaged by a Hologic Mammography system at several time points for 7 days.

### Minerals in 100g (Fresh) Apple:

Fe 0.12 mG Na 1 mG K 107 mG Mg 5 mG Ca 6 mG P 11 mG

### Minerals in 100g (Fresh) Banana:

Fe 0.4 mG Na 1 mG K 358 mG Mg 29 mG Ca 5 mG P 27 mG Mn Trace

## Results-1



Figure 1

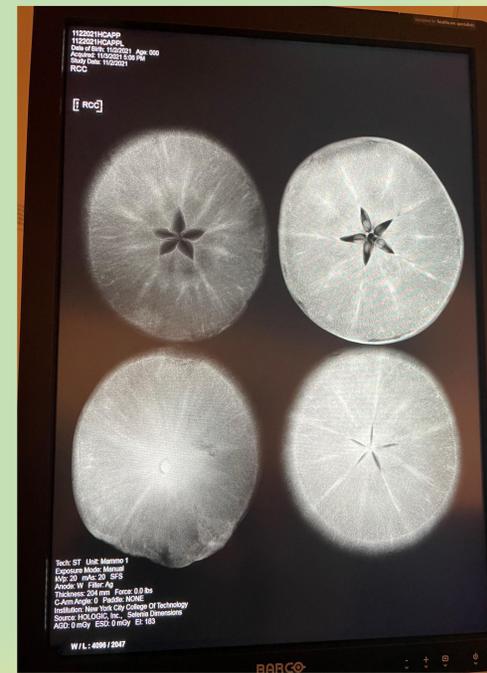
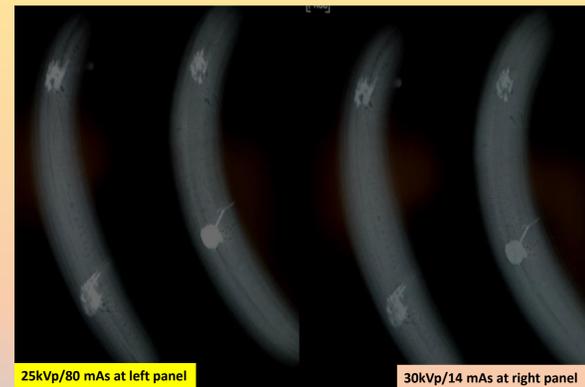
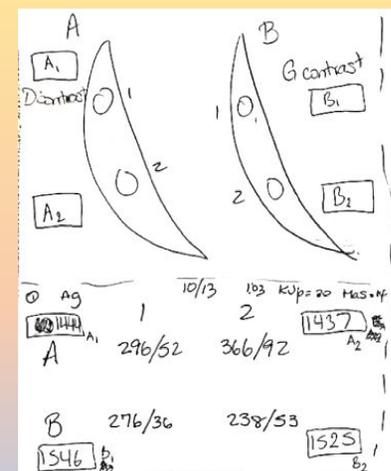


Figure 2

Figure 1. shows exposure of banana with contrast Gadavist and Dotarem.  
Figure 2. shows exposure of apples with no contrast.

## Results-2



25kVp/80 mAs at left panel  
30kVp/14 mAs at right panel  
Dotarem infused on left, Gadavist infused at right banana for both the panels

## Discussion

The Mammography absorption for two MR contrasts is kVp/mAs related. For two Chiquita Banana samples the optimized kVp/mAs were 25/80 respectively. The left panel of result 2 shows the photon flux absorb (e.g. A1: 296/52). After doing the calculations, we found that the Gadavist-Dotarem absorption difference in % = 10.4%. Since k-edge of Gadolinium is 50keV, and our mammo beam energy is 25 kVp, the effective X-ray beam energy (about 1/3 of kVp) which is approx 8 keV. Such a small absorption difference (only 10%) between Dotarem and Gadavist, where Gadavist has twice as much Gadolinium as Dotarem, implies that 100% gadolinium excess leads to only 10% in absorption increase. Hence, near the contrast spots if new mineral species are generated, those may absorb X-rays even if some gadolinium is diffused there.

The goal that we are addressing is to demonstrate X-ray absorption by iron which has photoelectric k-edge at about 6-7 keV. Our hypothesis is that bulk banana matrix may supply iron to replace some of the Gadolinium from the molecular cages and soft X-ray beams from Mammography will be able to detect that iron. Our results show that low kVp X-rays as seen here which is insensitive to Gadolinium concentration can be sensitive to iron exchange that is important for in vivo iron transport. Iron "invasion" may be detectable if we can use it.

## Conclusion

Low kV, Mammographic soft X-rays show intense, inherent sample contrast in apples and bananas presumably from light metals like potassium, magnesium and iron that are more prominent after heat shocks. We suspect heat induced hardening or polymerization of carbohydrate fibers causes greater X-ray absorption. (See also MRI demonstration by Basilicata et al and Mammographic Investigation by Orellana et al of fruits in this symposium).

A key finding for X-ray absorption by the heavy toxic environmental metals like Gadolinium from medical industry is that the MRI contrasts (Gadavist and Dotarem) produced only 10% more contrast for Gadavist compared to Dotarem although Gadavist has 100% more Gadolinium atoms than Dotarem. This suggests that at low kV Mammographic range, higher Gadolinium does not proportionally increase X-ray absorption, a result not observed at high kVp, as seen in CAT Scan. In the medical community, currently there is doubt if these contrasts remain in their original stable form. Low kV X-ray investigation as we demonstrated may open a new method to test the fate and toxicity of heavy metal pollutants in our ecosystem.

## Acknowledgment

We would like to acknowledge valuable help from Jodi-Ann Douglas for mammography training and supervision, and Maria Orellana and Sonia Orellana for data analysis. This work was made possible with student stipends from City Tech to AS, AM and JS under CUNY Undergraduate Research Scholars Program.

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# Fabrication and Assessment of a Flexible Graphene Thin film for Lightning strike protection

CRSP Program- New York City College of Technology, CUNY- Department of Mechanical Engineering Technology

Student: Aaryan Nair Mentor: Prof. Akm Rahman

## Abstract

Lightning strike protection (LSP) have recently been a newly developing field particularly with the emergence of graphene thin film integration into carbon fiber composite structures. This technology has a widespread application in airplanes, wind turbines, and other instruments susceptible to frequent lightning strikes. This study will look at different methods for incorporating GTF (graphene thin film) into Carbon Fiber Reinforced Plastic and assess the electrical conductivity. through methods such as fabrication of a highly conductive functionalized nanosized GTFs, and combined use of carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs). In the current study we will develop GTF using GNP impregnated polymer. Successful development of highly conductive blends could result in increased safety standards of aircrafts, reduced maintenance costs for wind turbines, and increased usage of wind energy.

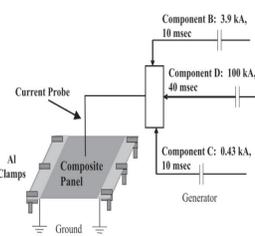
## Introduction

Lightning strike protection (LSP's) have recently been a newly developing field particularly with the emergence of graphene thin film integration into carbon fiber composite structures, particularly in airplanes, wind turbines, and other instruments susceptible to frequent lightning strikes. This study will look at different methods for incorporating GTF (graphene thin film) into Carbon Fiber Reinforced Plastic, and assess the electrical conductivity, through methods such as fabrication of a highly conductive functionalized nanosized GTFs, and combined use of carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs). The following presentation compared three viable methods for graphene lamination- pristine graphene rolling, 3-D stitching, and carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs) integration.

## Methods Adopted and Data Collection

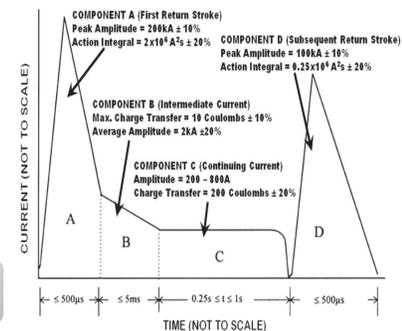
Three different methods were analyzed during the study. According to Zhang et al. (2017), flexible GTF's made of pristine Graphene were made using a process involving sonication. An input power of 50 W was applied on the test side and the energy was measured using open hole measurement of the reception side with a test panel. The difference between the open hole reference and the test-panel was considered as the shielding effectiveness of the material. On the other hand, the GTF fabricated by M Rahman et al. (2019) devised a method involving 3-D stitching of carbon fiber and GTF for the composite layups. The samples were neutralized and filtered. The third paper, Li et al. (2017) attempted to create synergistic effects by spray coating hybrid carbon nanoparticles on CFRP Laminates. Nanoparticles were sprayed using an airbrush system, and encapsulated with resin film, allowing much lower resistivity and increased electrical pathways.

Figure 1- Displays the impulse test applied by Zhang et al. (2017). High current was applied over very short periods of time



The Hybrid CNT/GNP were compared with reference CNT to measure surface electrical resistivity with reference to depth.

Figure 2- Displays the region-wise current test applied by Li et al. (2019).



## Test Data & Results

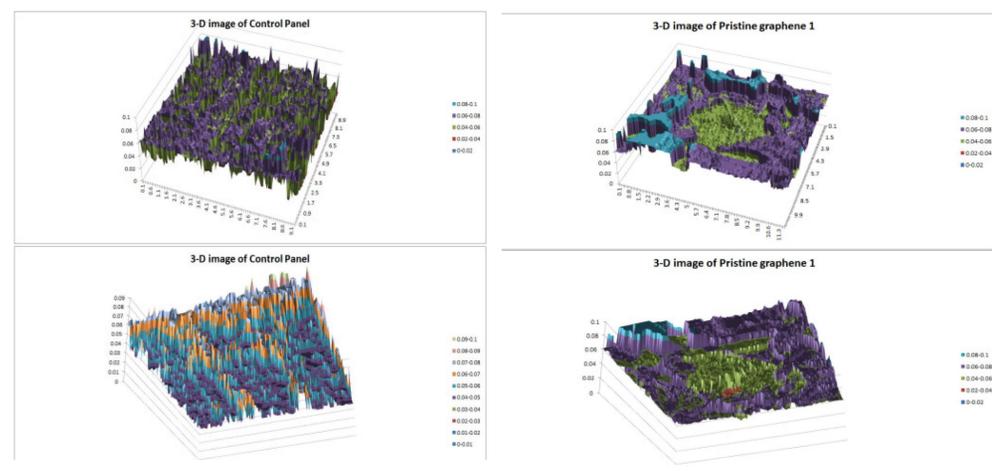


Figure 3- Demonstrates relative damage to the panel after impulse strike. The second diagram shows the area damaged by the impulse strikes. Zhang et al. (2017)

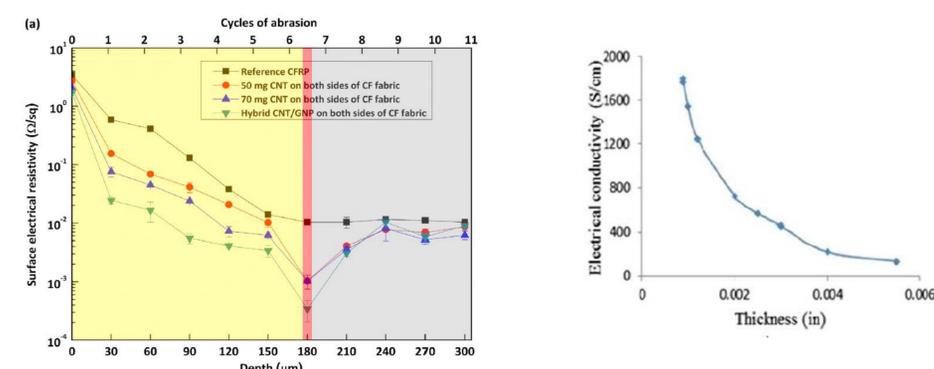


Figure 4- Displays Surface electrical resistivity of different nanocarbon modified CFRPs in relation to surface depth by Li et al. (2019).

Figure 5- Illustrates how the 3-D stitched samples of varying thicknesses displayed with it's electrical conductivity. M Rahman et al. (2019)

	Control Panel (No Coating)	Panel Coated with Graphene Thin Film
Damage Area (mm <sup>2</sup> )	1.39 × 10 <sup>4</sup>	8.77 × 10 <sup>2</sup>
Fraction of Damage Area (%)	5.4	0.3
Damage Area Reduction (%)	-	94
Damage Volume (mm <sup>3</sup> )	7.07 × 10 <sup>3</sup>	3.06 × 10 <sup>2</sup>
Fraction of Damage Volume (%)	2.7	0.1
Damage Volume Reduction (%)	-	96

Figure 6- Demonstrate the Area and Volume Damaged by the GTF in comparison to the control. Zhang et al. (2017)

## Evaluation and Adaptation

From the data, we can clearly see that graphene in any form reduces the resistivity of the medium. Likewise, a larger depth of graphene also showed reduced resistivity, though, there was an optimum region. Readings higher than that resulted in higher resistivity meaning that the conductive pathways seemed to be hindered in some form. Another evaluation which could be drawn was that pristine graphene clearly created conductive pathways and reduced the volumetric damage to the material underneath the film. These properties examined would mean vital progress could be made to the aviation industry, and in large-scale wind turbines.

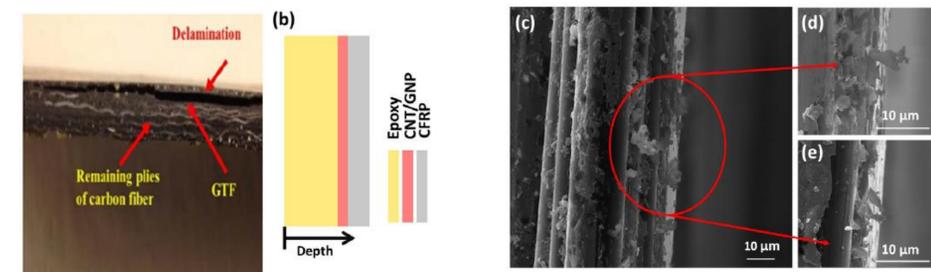


Figure 6 (Left) Demonstrates delamination without 3-D Stitching, while Figure 8 (Right) shows the synergistic GNP/CNT integration by Li et al. (2019)

A future extension of this would be understanding the synergistic relations between the CNT/GNP's, and its conductivity with relation to temperature. In reality, there are a lot of factors which determine materials for aircrafts/turbines. Thus, more intensive testing could be done on the temperature bearing ability, flexural strength testing, and others. Another aspect is the risk of delamination of the panel after repeated strikes. We would also need to study whether the conductive pathways created lead to safe discharge. It is vitally important, that the pathways generated do not risk the safety of passengers in the case of flights. A future extension could be an enhanced understanding of the large area shear crack and warpage of the film.

## Conclusion:

The purpose of the study and the subsequent experiment was to understand the impact of Graphene nanoparticles on CFRPs. This assessment should help us reduce the risks of Lightning Risks. In the case of wind turbines, this would hopefully encourage more people to take up wind-energy, since now there would be a reduced risk of lightning strikes.

## Acknowledgements

I would like to acknowledge Prof. Akm S Rahman for supporting me throughout, and the CBML Lab for its facilities.



# Development of dry sanitation systems with biodigester as a cleaner alternative to modern flush based plumbing system

CRSP Program- New York City College of Technology, CUNY- Department of Mechanical Engineering Technology  
Student: Aaryan Nair Mentor: Prof. Masato Nakamura

In a modern society, access to restrooms is a key indicator of human health and sanitation- yet 40% of the World's population has limited access to it. Furthermore, over 800,000 deaths worldwide are attributed to inadequate sanitation. In developed countries, where flush based sanitation systems are a standard, there are fundamental questions being asked about the restrooms being connected to both the water supply system and the wastewater infrastructure. The purpose of this paper is to evaluate the downfalls of the flush based sanitation system, and to develop decentralized dry restroom systems which potentially use a significantly lesser amount of water and could potentially provide a value-added product in the form of either energy or fertilizers. Restrooms in remote regions are often expensive to connect to the twin-circulation system, and environmentally unsustainable. We plan to design systems using a biodigester with anaerobic bacteria to decompose the fecal matter into treated water, and methane, which could then be potentially used as a fuel source. This would be expected to provide approximately 240KWh of energy for every metric tone of waste released in the restroom.

## Introduction

The flush toilet invented by modern civilization provides us a hygienic and comfortable life. However, the pollution problem brought about with the conventional waterborne sewage system has lately attracted considerable attention. The untreated sewage is polluting groundwater, rivers, lakes and coastal areas. Globally, the energies consumed in water utilization including the construction of water resource development facilities, the arrangement of water service and sewage, and the use of water service and sewage are 10900 trillion kcal. The electric power consumed in water service and sewage in 1997 is 137 hundred millions. Therefore, we are undertaking a double task of trying to improve the imperfections in sanitary condition of conventional toilet systems on one hand and protecting the environment against the waterborne sewage pollution on the other.

This has potential applications even in the US, where there is a shortfall of funding in maintaining public restrooms in remote areas, with 20 million \$ being allocated for the development and maintenance of restrooms in remote regions. Therefore, functionality, and portability of the system was also considered to ensure minimal parts and assembly was required for the system.

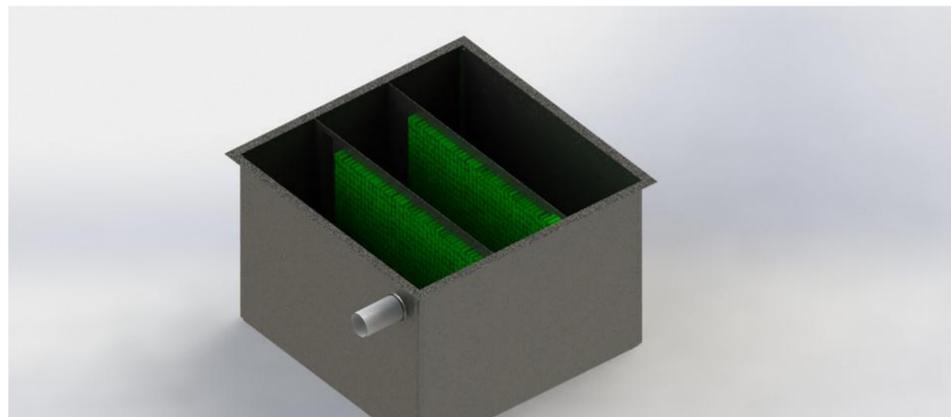


Figure 1 (Top)- Design of Bio-digester. The green area illustrates a wrinkled membrane for maximum interaction with the anaerobic bacteria.

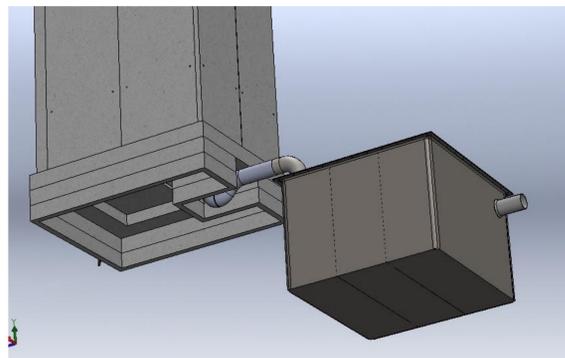


Figure 2 (Left)- The plumbing system connecting the restroom to the underground biodigester

## Design Specifications

- The surface area to volume ratio has been minimized to improve the contact area for the anaerobic bacteria. This has been done by using surface wrinkling patterns. This will work optimally between 70-100 degrees F.
- 6 compartments have been created with 10 mm filters to allow the passage of processed water.
- Piping has been provided for the release of methane. With the use of a combustor, this could be converted to potential energy.
- The water released in the study was found to be gray water. This means that this is not drinkable. Ideally, this can be used for other miscellaneous purposes which do not require contact with the skin, such as irrigation. Alternatively, the water could be further processed to form higher quality of water.
- The size has been adjusted to meet the requirements of a single two-member household. The size could be adjusted with the same volume-surface area for a larger household.
- Mobility has been a key concern while designing this system. The design is set at 540 mm by 1140 mm. The idea that this can be reassembled easily, and that this design is portable means that this can be used in remote areas, and hiking sites. The design is mobile, so it can further be used for specific events, or for short-term housing projects.
- The design is not connected to the grid which allows for increased flexibility in usage.
- The wood chips don't need to be restocked, since they only act as a catalyst, so once this system is placed underground, it can stay without supervision for at least 3 years.
- The strain of anaerobic bacteria being used *Planococcus matriensis* and *Clostridium schirmacherense* is immune to most types of hard cleaning solvents, and detergents used in the restroom. Furthermore, the bacterial nature means that if the restroom is not used for a period of time, the bacteria is simply deactivated.

## Biological Principle

The principle and the structure of the bio decomposition toilet are the same as that of family garbage processing machine. Human waste is decomposed directly along with the slow rotation of the wood tips or sawdust in a box. This is further enhanced by adding anaerobic bacteria, to catalyze the breakdown of the waste. The anaerobic bacteria, in an ideal temperature of 80-90 degrees F should break down the domestic waste completely down to processed water and methane within a period of 48 hours. The anaerobic bacterium used (*Planococcus matriensis* and *Clostridium schirmacherense*) should be self replicating, and therefore the need for supervision and maintenance is avoided. The decomposition of the human waste is further catalyzed about by the microbe (mainly the soil bacteria) settled in the wood tips and the sawdust. A motor can be further used to stir the wood tips and the sawdust. It can further be designed to various sizes from a large toilet such as public toilets to a portable size for the use of nursing.

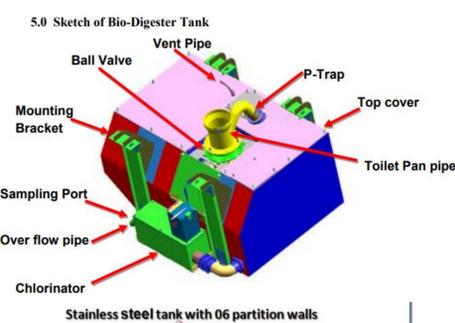
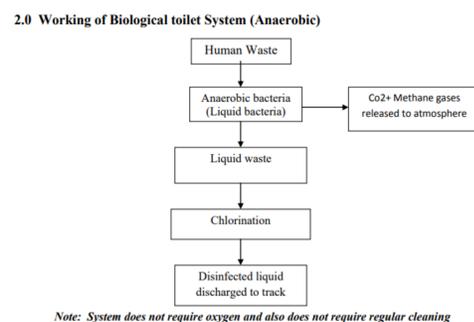


Figure 3 (Top)- Annotated design of the compartments in bio-digester.  
Figure 4 (Top-Right) Steps for processing of fecal waste in bio-digester  
Figure 2 (Right)- Portable nature of bio-digester and lack of connectivity means that this can be used in remote locations



## Environmental Impact

The environmental viability aspect was one of the primary focal points. The system would need to be decentralized and consume a significantly lower volume of water than existing systems. The treated water would also have to be safe to use for farming. Modelling and simulations have also been conducted to study the efficiency, carbon deposition and carbon embodiment of the system to ensure minimal environmental impact. The project is expected to release 20-50% carbon embodiment compared to a conventional flush based system, across its entire system life cycle.

## Conclusion

The purpose of this design is to examine how bio-digestors can be designed as an part of an integrated sanitation unit, or as a sanitation unit. The study examines design pitfalls and creates a design parameter that can be re-adjusted (depending on occupancy or usage), while retaining the original research on the microbes, and the surface area to volume ratio. This line of designs would provide us with an important innovation towards more environmental conscious designs.

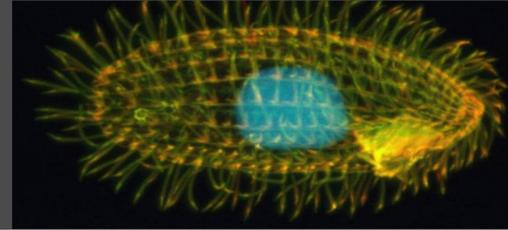






# Computational Characterization Of Calpains In *T. thermophila*

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## Abstract

Calpains are a set of calcium-dependent cysteine proteases that are found in almost every type of living organism, except archaeobacteria. Calpains share a set of common domains that help with their function as proteases. These domains are also used to classify the various Calpains. For example, in animals there are two classes of Calpains, classical and nonclassical calpain. Classical calpains contain C2L, PEF and CysPc domains while the non-classical calpains do not have C2L and or PEF domains. Calpains have been shown to play important roles in cell death, diabetes and neurological diseases such as Alzheimer's disease. Although calpains are being studied extensively, one are or cell model that has yet to be studied is in *Tetrahymena thermophila*.

*T. thermophila* is a ciliated protozoa which lives in lakes, ponds, and streams. These eukaryotic cells have two nuclei, a macronucleus and a micronucleus. The macronucleus is involved in vegetative growth while the micronucleus contains germline information. As a eukaryotic model, *T. thermophila* has been used to study many cellular structures and functions, including histones, cell cycle and cell motility. Although these cells have been studied extensively, they are yet to be exploited to examine the role of calpains. The genome of *T. thermophila* has been sequenced, but information on the thousands of genes in these cells is yet to be assigned. Therefore, the goal of this project was to use computational tools to begin examining the structure and function of TTHERM\_00898290, one of *T. thermophila* family members. This protein was selected from about 27 different calpain family members. Multiple alignment was done using MUSCLE, T-Coffee and MAFFT. Phylogenetic analysis was done using Phylogeny.Fr and MEGA. Protein structure was modeled using SWISS-MODEL and PHYRE2. Preliminary results suggest that TTHERM\_00898290 may be similar to human calpain 7 and 15. However, more analysis is needed to confirm which of these two human Calpains is TTHERM\_00898290 more related to.

## Objective & Hypothesis

The purpose of this research was to characterize human calpains of choice from Tetrahymna thempophila using bioinformatics tools. It can be predicted that TTHERM\_00898290 is more similar to one or more of human calpains.

## Methodology

### Using TGD to get the Gene of interest Protein Sequence

TGD stands for Tetrahymena Genome Database Wiki. It was utilized to obtain the TTHERM\_00898290 protein sequence in order to run various alignment.

### Multiple Sequence Alignments Tools

A multiple sequence alignment is a tool use to analyze closely related genes or proteins in order to determine their evolutionary relationships. Alignment tools like MAFFT, T-COFFEE, and MUSCLE were employed.

### Phylogenetic Trees

In order to see which human calpain is closely related to TTHERM\_00898290 MEGA, MAFFT, and Phylogeny.fr were used. They were employed to create phylogenetic trees in order to gather evolutionary data.

### Protein Structure Modeling

The three-dimensional structure of TTHERM\_00898290 was predicted using SWISS-MODEL software.

## Results

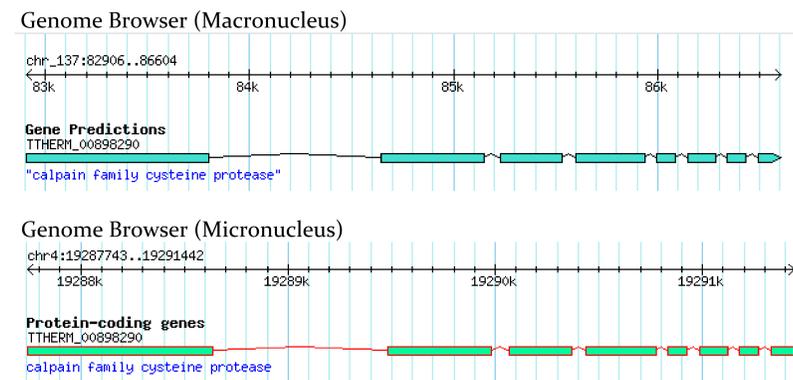


Figure 1: Shows TTHERM\_00898290 gene structure. Macronucleus and Micronucleus both have 8 exons.



Figure 2: Graphic summary from BLASTp shows amino acid sequence of TTHERM\_00898290. It shows that CysPc conserve domain that is common to all calpains.



Figure 3: The alignment shown above is from Muscle, and it indicates that the nucleotides P, W, K, D, and L in the column are identical in all sequences in that alignment. "." indicates conservation between weakly similar property groups, ";" shows conservation between highly similar property groups, and "\*" indicates positions with a single, totally conserved property.

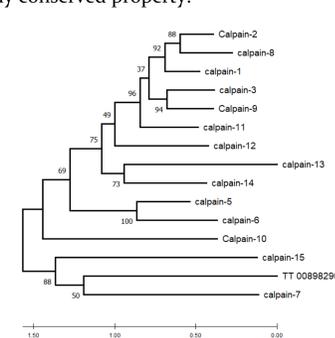


Figure 4: Phylogeny tree of human calpains and TTHERM\_00898290 from MEGA. Result shows TTHERM\_00898290 more closely related to Calpain-7. Tree was draw using Maximum Likely method.

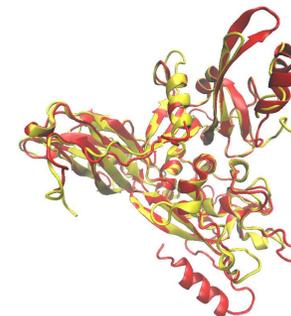


Figure 5: Proteins structure and alignment of calpain 7 (red) and TTHERM\_00898290 (yellow) using SWISS-MODEL. Many similar regions (blend of red and yellow) and dissimilar regions (separate red and light regions) are seen.

## Discussion

- TTHERM\_00898290 is one of the calpain family of *T. thermophila*.
- Both the macronucleus and the micronucleus genes are composed of 8 exons.
- Like other calpains, it has a cysteine protease domain.
- Different areas of the protein are conserved in both human calpains and TTHERM\_00898290.
- Based on phylogenetic and multiple sequence alignments, TTHERM\_00898290 seems to be more closely related to human calpain-7
- In addition to calpain 7, TTHERM\_00898290 is also more similar to Calpain-7 and Calpain-15 compared to the other calpains.

## Conclusion

TTHERM\_00898290 seems to be more closely related to human calpain 7, suggesting these two proteins may have some cellular functions in common.

## Future Directions

This is an ongoing research, and more illustrations can be done to explain why human Calpain-7 and Calpain-15 are so similar to TTHERM\_00898290.

## Acknowledgements

- I would like to thank Professor Ralph Alcendor for being my mentor for CUNY Research Scholars Program. I really appreciate all of his help.
- I would also like to thank the Undergraduate Research for giving me the opportunity to be a part of the CRSP Program.

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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.

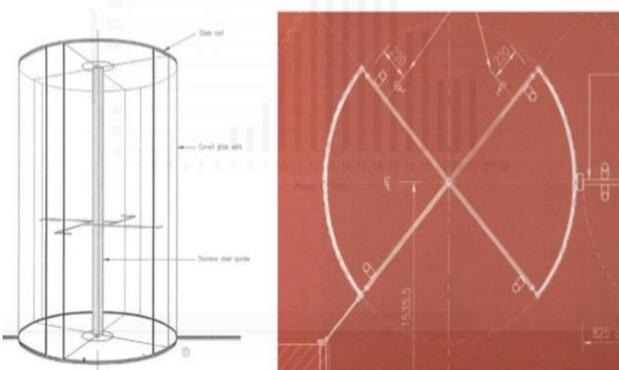


Figure 1. Two diagrams depicting a typical revolving door used today.  
 (Adapted from 2)



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.

## 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**- $0.77 \text{ Btu} \cdot \text{h}^{-1} \cdot \text{ft}^{-2} \cdot \text{°F}^{-1}$  and **aircraft hanger door**- $0.58 \text{ Btu} \cdot \text{h}^{-1} \cdot \text{ft}^{-2} \cdot \text{°F}^{-1}$ .

### 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.

## 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.

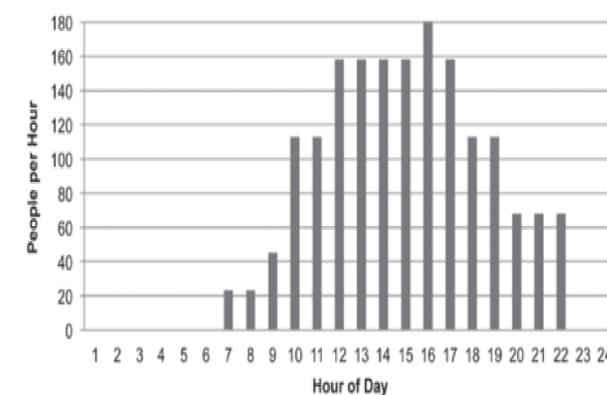


Figure 3. Rate of door traffic for each hour.  
 (Adapted from 1)

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# You Are Prepared: A Browser-Based Performance Using AI and ML

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## Abstract

In today's age of rapidly expanding technology, people around the globe have resorted to extreme measures to "hack" their bodies through technological implants, ranging from NFC chips in fingers to entire hard drives in thighs. Led by Allison Berkoy, You Are Prepared is an interactive browser-based experience, exploring the similarities and intersections between human and machine self-optimization. In the first phase of my contributions, I have been researching content for examples of human biohacking, as well as training a machine-learning platform on AI image generation. The first core task has involved searching for video documentation of biohacking and human augmentation projects from recent years, putting focus on non-medical and more experimental, elective procedures. So far, I have found that humans are looking to self-augmentation as a method of seamlessly integrating technology into their bodies, eliminating the need for a separate or wearable device. The second research area involves Playform.io, a machine-learning platform. We have been training Playform's machine-learning software to generate image sets of flowers and animals based on assets we prepare, then comparing the original assets to the AI-produced images. This training is part of our ongoing image research, and we will conduct further tests to learn more about the particular machine-learning platform that Playform is making more accessible for artists. The final culmination of You Are Prepared will present a code-driven audiovisual experience on human and machine self-optimization.

## Video Research

When starting my video research, the first objective was to find which internet search terms would produce the most relevant results. I started with terms such as "consciousness hacking" and "biohacking." These searches led me to examples of extreme and experimental projects, many of which involved subjects performing surgical procedures in order to achieve their desired results of bodily optimization. Switching gears, I turned to more terms such as "human augmentation" and "transhumanism." This led me down a different path, finding many examples of the implanting of RFID chips to increase the ease-of-use for everyday objects. I was careful to not include examples of medical projects in my research, as our project is focused on the voluntary choice to augment the body in recreational ways. I found both examples from educational institutions like MIT, as well as "garage projects" from everyday people who are looking to change the limitations of the human body.

This preliminary research will be utilized in the final culmination of You Are Prepared as an informative piece of the performance, giving participants a taste of the ways humans have been developing ways to physically integrate technology into their bodies.



Fig. 5: Original asset



Fig. 6: Image generated by Playform



Fig. 7: Asset with BG removed



Fig. 8: Image generated by Playform

## Playform.io Testing and Results

Playform.io is a machine-learning (ML) software that "utilizes a particular class of ML systems called Generative Adversarial Networks (GANs), in which two artificial neural networks play a turn-based game with each other that teaches them the statistical attributes of the training data."<sup>1</sup> Specifically, we are utilizing Playform's Freeform process, which "interprets the [assets] and tries its best attempt to replicate its subject matter...all the shapes inputted will affect the shape of the amalgamated result."<sup>2</sup>

For the purpose of our research, we are experimenting with different assets and how to prepare those assets for testing in order to achieve optimal results. In our initial test, we ran images of flowers without any editing into Playform (Figure 5). The resulting set were images which often lacked distinction between the subject (flower) and the background of the image, as seen in Figure 6. We had the idea to remove the background of the images to include just the flower (Figure 7), hoping to assist the ML software in identifying only patterns and forms from the flower itself. As a result, the second image set showed much improvement in the AI's interpretation of the shape of a flower, as well as the most common colors and petal structures (Figure 8).

We carried this knowledge into testing of another set of assets, this time photos of various animals with their backgrounds removed (Figures 9-12). The resulting image set produced abstract-looking shapes which vaguely resemble animals, often managing to include the rough shapes of legs and a head (Figures 13-14). We decided to take this image set a step further, and ran a second test using the images from the previous iteration. This allowed the AI to continue work on the same images, which gave us much more detail in both the shapes and the patterns of the animal bodies (Figures 15-16). From this second training, we realized how much each stage of the image generation process helps the ML technology learn more about the assets, therefore giving greater details and specificity with each test.



Fig. 1: "AlterEgo is a wearable system that allows a user to silently converse with a computing device without any voice or discernible movements."



Fig. 2: Youtuber Amie DD shows the RFID chip that will be implanted into her hand. The chip will allow her to unlock her Tesla without using the vehicle's key card.



Fig. 3: "North Sense is a small biotech chip that attaches to people's chests with piercings and vibrates whenever they face north — creating a sixth sense — a sense of direction."

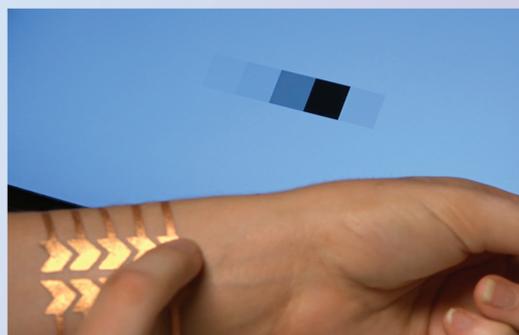


Fig. 4: DuoSkin is a wearable device that looks like a tattoo, while allowing users to control their mobile devices, display, and store information on their skin.



Figure 9

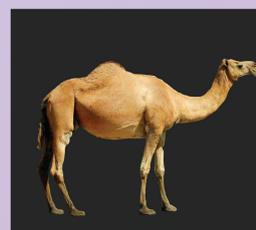


Figure 10



Figure 11



Figure 12



Figure 13



Figure 14



Figure 15



Figure 16

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# The Ethics and Consequences of Cloning

## A CRSP Theoretical and Physical Analysis

Lead Researcher Gabriel A. Martinez & Researcher Ryan M. Donnelly  
 Professor Jose Luis Martinez, MS, RT(R)(CT)(MR)



### Abstract

An investigation into the process of cloning, along with the ethical dilemmas and consequences in the scientific technique of organismal cloning. Student Researchers Gabriel Martinez and Ryan Donnelly will attempt to successfully clone and replicate a living organism (Mint) and record their findings. Furthermore, students will use their research findings in order to produce a conclusion on the possible consequences of cloning, from a moral, ethical, and physical standpoint. Students will also use the public's view on cloning to produce a comprehensive analysis of potential moral and ethical consequences related to cloning and weigh its benefits against its repercussions.

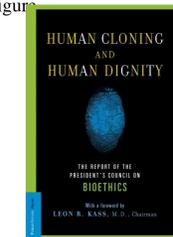


### Introduction

Cloning was first theorized as a process during the times of Ancient Greece, in which people observed the process by which a new plant is created from an olive twig. In fact, the very word 'clone' derives from the Greko-Latin word, klōn, which means 'twig'. This type of cloning is known as Organismal Cloning, and while there are other varieties of cloning, we will be focusing on Organismal Cloning, as it is the most widely known form of cloning. An astounding amount of organisms clone naturally, such as unicellular bacteria, corals, and even jellyfish! Since the initial advancements and biological understanding of cloning during the 1980s, there have been great technological and biological advancements in the field. However, we as student researchers question the different kinds of challenges that cloning poses to us in the fields of morality, ethics, and science overall.

We will perform our experiment to enhance and further our understanding of the basics of cloning. However, the idea and prospect of cloning, both plants and animals, brings about numerous moral, ethical, and physical consequences that certainly need to be addressed. Cloning human beings, as an example, would bring up the ethical dilemma of whether or not the cloned being would be treated with the same dignity and respect that a born and bred human being would receive. It could also bring up the dilemma of whether or not the cloned being is a true member of the human race. All these possible dilemmas are ones that certainly deserve to be addressed, and they will be addressed with our due diligence later in our research.

For our research, we decided to go forth with cloning a mint plant. This experiment involves taking a 'cutting' from a plant and using that as the backbone of the new organism. We will furthermore utilize surveys and readings to obtain public opinion on cloning as a scientific technique, and translate our results into comprehensive graphs and figures.



### Methodology

Our experimentation contained 2 critical parts.

#### EXPERIMENT PART 1

- The first part was successfully cloning a mint plant to gain an understanding of the process. The steps are listed below
1. Fill 4 cups with equal amounts of distilled water, label cups 1-4
  2. Measure and put 1 gram of auxin into cups 1 and 2. Add auxin to cup 3 halfway through experimentation (12 days roughly). Add no Auxin to cup 4
  3. Take 4 cuttings of equal size from the donor mint plant, taking all leaves off in the process.
  4. Affix each cutting with the cup, so that the pruning wounds are completely submerged in the water
  5. Place in a well-lit, room temperature area. Record growth of roots daily.

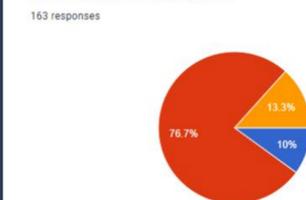
#### EXPERIMENT PART 2

The second part of our experimentation involved surveying people from all walks of life in New York City and Long Island. We used Google Forms to ask over 150 people their opinions on cloning, and we also asked hypothetical questions such as "Did you know that cloning is already used in real-world applications?" and "Is a cloned human truly a human, and does it deserve to be treated as such?". We also asked participants to briefly write their opinions on cloning. We then turned this data into charts and graphs.

If a human was successfully cloned, do you believe that the cloned human should be treated with the same respect and dignity as a naturally conceived human?



Is a cloned human truly a human?



### Results

#### FOR EXPERIMENT PART 1

We quickly realized the benefits of cloning and using growth hormones during our experiment. It took only 2 days for our cuttings with auxin to take root, while it took over a week for the cutting without any auxin to take root. We also noticed that the root growth of cup 3 (The one with auxin added midway), began to take root much faster with the addition of the auxin. Despite our initial success, we soon came to realize something very grim. The cuttings soon began to die slowly, which was evident due to the brown withering of the sprouting leaves. Despite following common plant-cloning practice to the tee, the clones ended up dying, despite showing initial promise.

#### FOR EXPERIMENT PART 2

According to our data, over 77% of people believe that cloning humans is NOT morally acceptable, while only 19.4% of the same group believe that it is acceptable. Not only this, but 85% claimed that they would never clone themselves, and only 10.7% said they would.

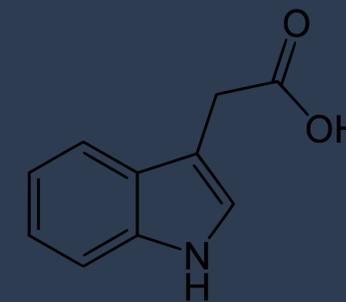
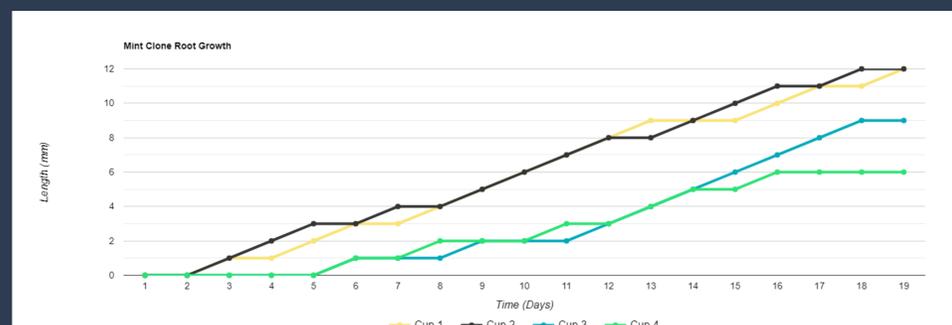
Another interesting statistic was that 65% of our study group said that a hypothetically cloned human deserves to be treated with every area of respect that a normally conceived human deserves, but 76% of the same group said they would not consider a cloned human to be a "real human".

#### MOST COMMON RESPONSES AGAINST CLONING

- It defies the will of God (57%)
- It would be abused by the rich and powerful (49%)
- We don't know enough about cloning (39%)

#### MOST COMMON RESPONSES FOR CLONING

- For the sake of furthering Science (53.9%)
- To better treat diseases (41%)
- To stop food shortages (35.6%)



### Conclusion

#### EXPERIMENT 1

We reached the conclusion that, while humans may have occasional initial success in cloning organisms, such as our plants and "Dolly the Sheep", humans simply do not fully understand the complex art of cloning to produce effective and independent organisms.

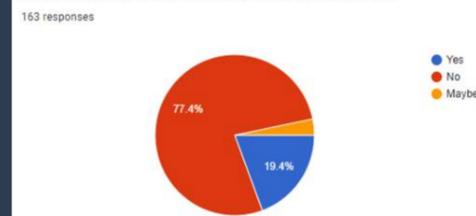
The results and final outcome resulted in catastrophic failure. There was promising growth for an entire fortnight, but unfortunately, we hypothesize that the regrettable fate of our cloned specimens can be linked back to a biological process that plants undergo. This process is known as 'Transpiration', which is the exhalation of water vapor through the stomata. According to Jackson, Phillip's "Genetic variation in transpiration", "There was a significant genetic variation for all traits (transpiration)". With this, we hypothesize that the genetic makeup of our host simply was not adequate to handle the stresses of being subject to cloning. We further go as far to hypothesize that this same theory of genetic inferiority can be applied to humans; Most human clones would not survive very long.

#### EXPERIMENT 2

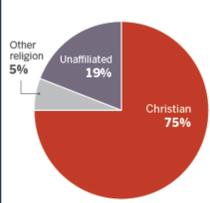
We met our highly hypothesized conclusion that the vast majority of Americans do not agree with cloning due to religious reasons. An estimated 80% of Americans subscribe to some form of religion, with nearly 75% of Americans aligning with Christianity.

Religion is by far the most motivating factor of opposition to cloning. Other reasons include distrust in the government and large corporations to utilize the technology correctly, and that cloned animals and especially humans would face significantly higher levels of mental, social, and physical abuses. The consequences of large scale cloning would be devastating, as more than 75% of the nation would disagree with it.

Do you believe that cloning humans is morally acceptable?



GENERAL PUBLIC



### Acknowledgements

We, the Student Researchers, would like to extend our gratitude to our great mentor, Jose Luis Martinez, MS, RT(R)(CT)(MR), the New York City College of Technology, and the CUNY Research Scholars Program. Our research would have not been possible without the graciousness and good will of all the aforementioned entities. We would also like to extend our gratitude to all other researchers whose work impacted that of our own.

Finally, we would like to bestow our gratitude to the National Institute of Health for providing such readily available information on biological sciences and surveying methods.



# The History of Quadratic Equations

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## Abstract

The objective of this project is to explore the history of quadratic equations, to have a better understanding of why ancient civilizations (Egyptians, Babylonians, Greeks, Persians...) needed to solve these equations. We will learn about the tools and methods that were used to solve these equations, and how these evolved over time. Furthermore, examples of solutions will be presented by using a geometric approach. Additionally, the relevance and application of these equations in an everyday setting will be discussed.

## Introduction

- A quadratic equation is any equation that can be written in the form  $ax^2 + bx + c = 0$  where  $x$  represents an unknown,  $a, b$  &  $c$  are constants and  $a \neq 0$ .
- In the algebra class, we learn how to solve quadratic equations using different algebraic methods: Factoring, the Square Root Property, Completing the Square and the Quadratic Formula.
- Some of the questions that students ask in the algebra class are:
  - Why do we learn about quadratic equations?
  - How was the quadratic equation discovered?
  - Who discovered the quadratic equation?
  - How did the problem of finding the solution of the quadratic equation evolve overtime?
- In this project, we will provide some answers to these questions.
- We indicate that the algebraic methods that students learn in their algebra class rely on symbols and arithmetic operations across these symbols that were unknown for many centuries. Even negative numbers and the number 0 were not used by mathematicians for a long time. Algebra is derived from the word "al-jabr" when Al-Khwarizmi published his famous book "Al-jabr wa'l muqabalah" in 820 A.D.

## Timeline

- Quadratic equations can be traced to the Babylonians around 1700 B.C. They were interested in finding the length of sides of a rectangle if the area was known. This problem was related to a tax problem "how much crop does a farmer needs to grow to pay for the tax on his farm that was required by the taxman?". The Babylonians used a geometric method for completing the square to solve quadratic equations. They recorded their findings using cuneiform script on tablets.



Babylonian Tablet with mathematics text and geometric figures

## Timeline - Continued

- The Egyptians around 1500 BC kept tables for all possible sides and areas of rectangles. Evidence of Egyptians attempt at solving quadratic equations can be found in the Berlin Papyrus



clay tablet



The Berlin Papyrus

- Greek philosophers, including Pythagoras (500 B.C.) and Euclid (300 B.C.) used geometric approach, i.e., applications of areas, for solving the quadratic equation. In his seminal work "The Elements" Euclid presented a geometric construction of the square root of a number.
- Indian mathematician, Brahmagupta came up with the solution to the quadratic equation in his 628 A.D. treatise *Brāhmasphuṭasiddhānta* (Doctrine of Brahma), using the decimal system. Brahmagupta recognized that there are two solutions in a quadratic equation. Years later, an Indian astronomer Bhāskara mathematically confirmed the possibility that any positive number has two square roots.
- Around 820 A.D., Persian mathematician Muḥammad ibn Mūsā al-Khwārizmī, developed algebra. He solved the quadratic equation using algebraic expressions. His work spread to Europe by around 1100 AD, where it was translated into Latin.
- By 1545, Italian scientist Gerolamo Cardano had compiled works related to the quadratic equations, including both Al-Khwarizmi's solution and Euclidean geometry. In his works, he allows for the existence of roots of negative numbers.
- Flemish engineer and physicist Simon Stevin gave the general solution of the quadratic equation for all cases in his book "Arithmetic" in the year 1594.
- Later, French scientist René Descartes published the special cases of the quadratic formula in his 1637 work "La Géométrie", which also used the mathematical notation and symbolism that had been developed by mathematician François Viète. The manuscript *La Géométrie* contains the form of the quadratic formula that we learn in the algebra class today.

The solution of the quadratic equation  $ax^2 + bx + c = 0$  is given by  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

## A Geometric Justification (Completing the Square)<sup>5</sup>

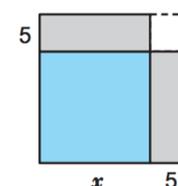


Figure from Reference 5

In this problem, we are solving the quadratic equation  $x^2 + 10x = 39$ . We start with a (blue) square of area  $x^2$ . We attach two (gray) rectangles of sides of length 5 and  $x$  as shown in the figure. The area of this shape is then  $x^2 + 5x + 5x$  which is equal to  $x^2 + 10x$ . We notice that if we attach another square with side of length 5 to the top right corner, then the figure is itself a square with side of length  $(x + 5)$ . By completing the square, we obtain that the total area of the completed figure is  $x^2 + 10x + 25$  which is equal to  $(x + 5)^2$ . Thus we have  $x^2 + 10x + 25 = 39 + 25 = (x + 5)^2$ . Since  $64 = (x + 5)^2$  and  $64 = 8^2$ , we have  $x + 5 = 8$  which gives the value of  $x$ , i.e.  $x = 3$ .

## Applications of Quadratic Equations

Quadratic equations were introduced to us because people needed to find the length of the sides of different shapes if the area was known. Quadratic equations are more relevant now than ever. Quadratic equations are used to analyze the performance of athletes; to calculate the speed of missiles, of moving vehicles, and aircrafts; to find the landing coordinates of planes, tanks, and jets; to make car parts, pension plans, insurance models; to find the area of fields; for the construction of monuments, offices, flats, roads, and bridges; to determine the angles of a satellite dish to catch signals, and anything else that relates to area. Students learning how to solve a quadratic equation in their algebra class will most likely be using this knowledge in their life later on.

## Conclusion

I learned from this project that quadratic equations are very useful to solve problems in different contexts, and there is a possibility that I might be solving a quadratic equation in my future career. I have also learned how solving a problem (as simple as it might seem to us these days) can take several centuries and involve scientists from different countries. I find this fascinating.

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# Force-feedback Design for Robotics Hand: Bio-based Design and Simulation

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Department of Mechanical Engineering Technology

## Abstract:

The great challenge for the Virtual Assembly Platform is how to make the users have the in-person feeling with the augmented tools. Hands are the most important organs that are used to provide touch feeling. In a real assembly scenario, the force from the components and tools will be feedback to the brain via the hands. Unfortunately, the virtual assembly failed to mimic the in-person scenarios since it will not provide such kind of feedback. As a result, the users' real identities are lost. Then, the users' slower-progressing wrong habits will prevent them from success in the future. Therefore, it is necessary to design a robotics hand that can provide force feedback. The proposed robotics hand will combine the motion synthesis of the human body, kinematic, dynamics, and computer graphics to reproduce the movement of a hand. Besides, spring, damper, and servo motors are integrated into the hand design. All the components will contribute to the force-feedback. After that, this project will be integrated into the project of "Procedure-Oriented for Engineering Education" to improve users' immersive feeling when they implement the virtual assembly.

## Advantage:

Among the products and research, two methods are employed to provide the force feedback: passive and active actuation. Passive ones generate resistance with the dampers, springs, or electromagnetic clutches, and they are inherently safe since the resistance is one kind of reactions of the inertia system, and only effect when the motions detected. The active ones usually use motors and pneumatic systems to realize force-feedback. Its advantage is the force can adapt the changes of the motion to provide a more realistic feeling. The disadvantage will be the potential risk due to the malfunctional motions. Therefore, the specific design to safety is critical for the active haptic gloves: limit the maximum output loading, and design the emergency stop equipment. The proposed design can solve the conflict and provide an optimized trade-off between safety and force-feedback.

## Disadvantages

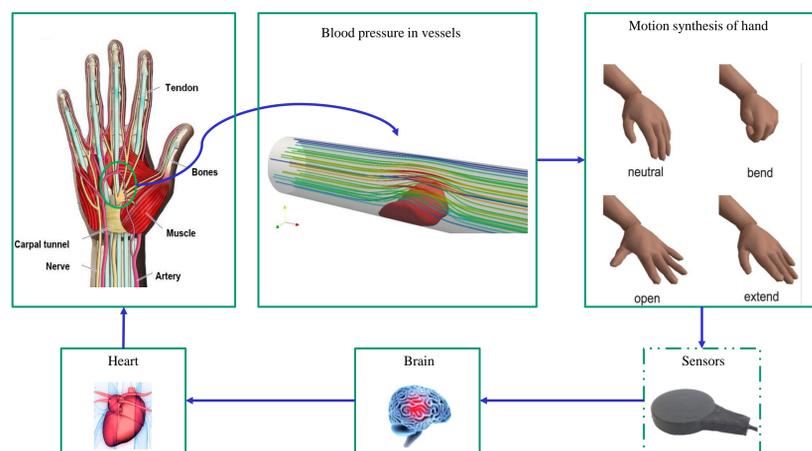
Bio-inspired design needs to employ the motion synthesis to figure out the relation between the hand motion and force generated according to the motion. It means that the complicated non-linear problems are involved. As a result, the complexity and the cost of computation will be a great burden for the research.

## Applications:

The success of this project will benefit a diverse application as virtual rehabilitation, virtual training, virtual assembly, gaming, prosthesis, dynamics analysis of fluid etc.

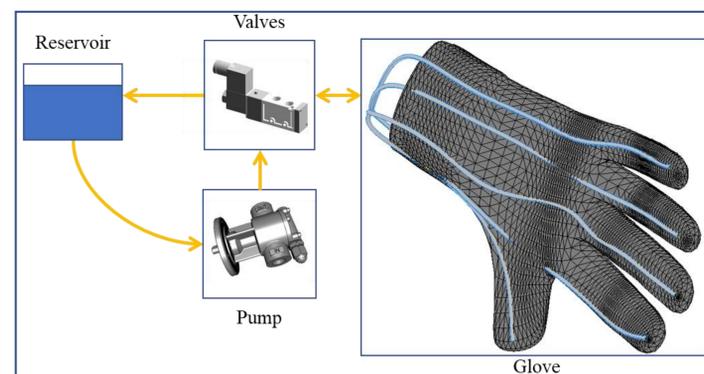
## Conclusion:

In this project, a force-feedback hand is designed. It is inspired by the real hand, and simulated with Autodesk CFD. This project has the potential to provide the users with an immersive feeling when they use the virtual reality systems. After the simulation and design, the hand will be fabricated with additive manufacturing. To mimic the real hand, the filament of the 3D printer will use thermoplastic elastomers (TPE) that is flexible enough to make the hand.



**Bio-inspired Design of Hand**

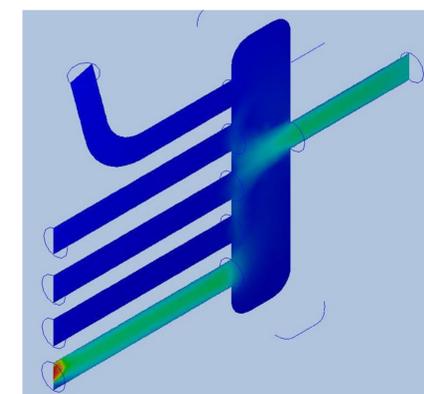
The procedures that the hand generates the force feedback are demented: the hand is motivated, the sensors (nerves) detect the actions, the brain will process the data, and control the heart to power the vessels of the hand.



**Hydraulic Control for Force-feedback**

The pipes inside of the glove mimicking the vessels of the hand are powered by the hydraulic control system and used to generate the appropriate force based on the operations to the machines. It can spontaneously invoke the feeling of real operations to the various machines, and provide the users with an immersive virtual environment.

## Tentative Simulation:



**Distribution of Pressure in Pipes**



# Polydimethylsiloxane (PDMS) Degradation Rate Studies

Kina Wu

Professor. Dr. Ozlem Yasar

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



## Abstract

In recent years, Tissue Engineering is utilized as an alternative approach for the organ transplantation. Success rate of tissue regeneration influenced by the biomaterials, cell sources, growth factors and scaffold fabrication. Design and precise fabrication of scaffolds are required to support cells to expand and migrate to 3D environment. At the SET Research Laboratory at City Tech, photolithography is used to fabricate the scaffolds. Main components of the photolithography are “photo-curable material” and an “elevator system”. In current scaffold fabrication set-up at SET, only 2D scaffolds are generated due to the lack of an elevator stage. In this research, to carry the scaffold fabrication from 2D to 3D, elevator stage is designed and fabricated. Our preliminary research showcased that scaffolds can be successfully fabricated with the use of elevator system.

## Introduction:

-Tissue Engineering also known as Regenerative Medicine is biomedical engineering that creates human tissues within a laboratory, and it is meant to be a cure rather than a treatment. Being able to repair/replace tissues in organs that fail due to disease, genetic errors, congenital abnormalities, or traumatic injury.

-Tissue engineering researched start in 1980s by an American bioengineering & scientist named Yuan-Cheng Fang. She submitted her proposal to the NSF(National Science Foundation)

-There are 4 important factors:

- The right cells to do the job.
- The right environment such as scaffold to support the cells.
- The right biomolecules for the growth factors to make those cells healthy and productive.
- The physical and mechanical forces to influence the development of the cells.

-To limit any rejections within the growth of the cells. Cells are harvested from the target organ ideally from the patient.

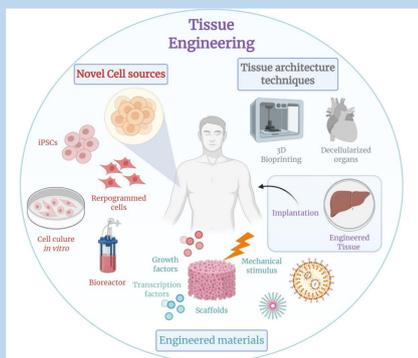


Fig 1. Tissue Engineering

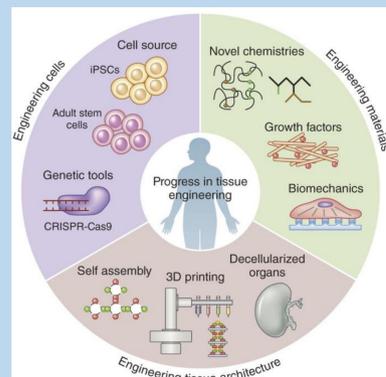


Fig 2. Progress in Tissue Engineering

## Results

In this work, our experiment results show that both single layer and multi-layer 3D structures can be design and can be fabricated with micro-molding. The core advantage of this process compared to other laser-based fabrication techniques is that the entire layers can be obtained simultaneously in a short period of temperature exposure.

Any biocompatible and photolithography biomaterials can be used for this fabrication technique. In our work, PEGDA was chosen to form the hydrogels. This system is also capable of fabricating complex shape structures.

## Conclusion

Tissue Engineering has achieved remarkable success and it has helped many people in repairing tissues for patients that need without having to rely on organ donors. However, precise fabrication of tissue scaffolds always has been a challenge. Our research showed that 100% PEGDA scaffolds has the lowest yield strength whereas 20% PEGDA has the highest yield strength. This is still expanding and still in progress on improving tissue engineering for more complicated body parts and organs.

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## Literature Review

Today in the research world many successful research institutes are working in this promising field Tissue Engineering. MIT, North Carolina University, Texas A&M, Drexel and many more universities are using different biocompatible materials for scaffold fabrication.

## Methods

### PDMS:

PDMS also known as Polydimethylsiloxane is widely used in biomedical research and technology. Mixing ratio of base polymer to curing agent or additives enables its mechanical properties to be manipulated and fit to mechanical properties of biological tissues.

In this research, 5 test tubes of 40ml capacity are filled with 5 PDMS mixture and then it is laid out in a think layer that was prepared by the mixing curing agent.

In the next step, PDMS were mixed with nanoparticles. Then they were baked in different temperatures.

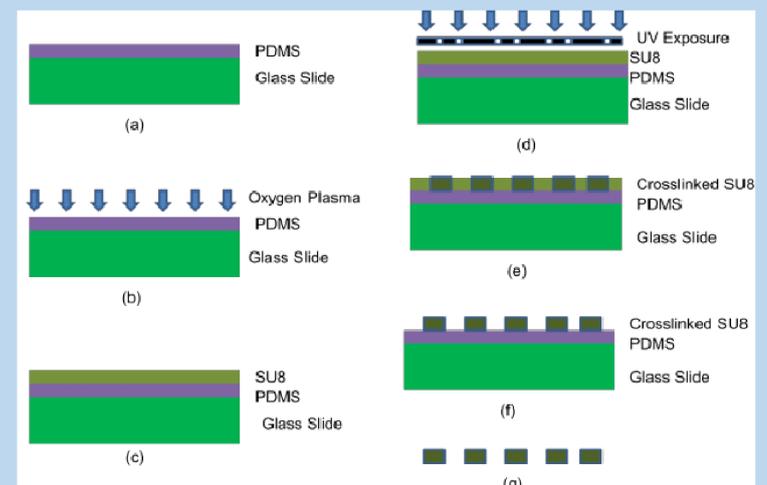


Fig 3. PDMS Substrates

Fully solidified PDMS samples will be studied to investigate the toxicity rates. Then, INSTRON Machine will be used to do the compressive tests for PDMS mechanical characterizations.

## Acknowledgment

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

# COVID-19 IMPACT ON RADIOLOGICIMAGING STUDENTS' LEARNING

By Rohini Mattan, Navdeep Kaur, Safraz Harun, Ralph Lauren Ocampo

Department of Radiologic and Medical Imaging. Faculty Mentor- Professor Zoya Vinokur



## Abstract

The spread of COVID-19 has impacted how students learn. Traditionally, information is delivered face-to-face. In-person learning provides students the ability to engage, participate, and encourages one-on-one student-teacher interaction. Distanced learning has caused students to transition online due to the unprecedented spread of COVID-19. Classes are conducted via zoom, where students can join a class through a zoom meeting ID and password. The objective of this study is to analyze data gathered by the Radiologic Imaging department at New York City College of Technology on how students feel about this academic transition. This research aims to analyze the impact of COVID-19 on the academic and educational experience of Radiologic Imaging Students. We will analyze the Radiographic Imaging department's student's ability to understand concepts via zoom as compared to an in-person class. The ability to understand radiographic concepts and apply them in the lab and clinic is crucial for the development of that student. Lab practice is a necessity to conceptualize topics and apply the material that was given to us to upskill our knowledge. Reducing the spread of COVID-19 is a substantial concern for everyone, but we aim to survey the impact of distanced learning and the change in the structure of these students' academics and educational experiences.

## Introduction

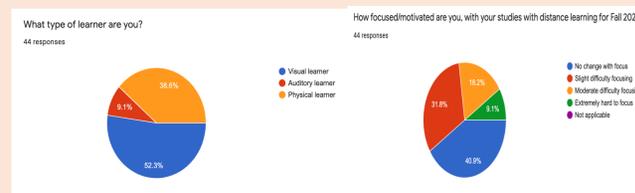
Covid-19 has affected students' learning in many ways. We conducted two surveys to figure out how the transition to online learning has affected our fellow classmates- in the Radiologic Technology Imaging major. This research aims to analyze the impact of COVID-19 on the academic and educational experience of Radiologic Imaging Students. We will analyze the positive and negative effects of the transition to distanced learning. This change has had effects on every student's ability to learn either positively or negatively. Some students find distance learning to be rather difficult. Many factors that contribute to the difficulty are things such as the age of the student, how tech-oriented that student is, and the ability to understand concepts via zoom. We used Google Survey to create a survey for the Junior class, and a survey for the Senior class. We asked objective questions with objective answers, to make sure our data was all unbiased and efficient. We were able to use those answers submitted by our fellow classmates and turn them into concise data, using percentages and graphs. (As seen down below) A total of 49 seniors out of 52, and a total of 44 juniors out of 63 have filled out the questionnaires. We asked different types of questions such as how online learning has affected focusing skills, were there any internet issues, how easy it was to adapt to online learning, etc. As you go below you will see all of the following data that was collected.

## Methodology

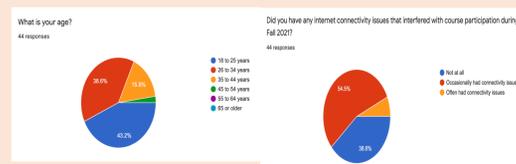
In order to conduct our research, we followed a longitudinal research design continuing the Radiologic Imaging Department's previous research. We analyzed the incoming junior class of radiologic imaging student's ability to conceptualize and understand topics for their didactic education and clinical application via distance learning. Having learnt most of the core radiographic concepts as well as preparing to utilize these concepts in real clinical application, we felt it was the right time to distribute surveys in order to evaluate how distanced learning has impacted the way in which these students tackle clinical. Receiving the content through online lectures is vastly different from an in-person lecture. In order to observe the change in pattern from the start of the first online lecture to some of the last lecture topics before clinical, 44 out of 63 junior students were sampled resulting in 70% of the total junior student body in the Radiologic Imaging Program. While a total of 49 out of 52 seniors were also sampled resulting in 95% of the total senior student body in the Radiologic Imaging Program. To get the most accurate results we would compare the results of both juniors and seniors together to see if both classes would yield the same results and have similar data to the following questions that was answered in the surveys. For the senior survey, we decided to distribute a similar survey based upon the fact that we received the junior's survey from the previous year's research. The survey from last year's research were based off our experiences throughout Fall 2020 year. The way the surveys were distributed to both seniors and juniors were using Blackboard Collaborate and zoom. We had multiple Radiologic Imaging professors distribute the surveys amongst the junior and senior students. In order to observe the change in pattern, we waited for the students to have their first online lecture and compared the learning experience to their last lecture contents. A total of 44 out of 63 junior students were sampled resulting in 70% of the total junior student body of the Radiologic Imaging Program. A total of 49 out of 52 senior students were sampled resulting in 95% of the total senior student body in the Radiologic Imaging program.

## Results Junior

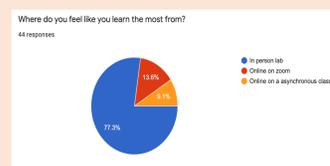
Many factors such as age, internet connectivity, type of learner that student is, and where that student can study as well, as how they study contributed to these students' ability to comprehend radiographic concepts. Age groups range from 18-25, 26-34, 35-43, 45-54 years of age. 83.6% of juniors are ages 18-34 in the 2021 class. These age groups would primarily find adapting to online learning very easy as most people in this age group are very tech-savvy. In-fact, 32.7% of junior students found it easy to adapt to distanced learning during the Fall semester of 2021. However, a total of 32.7% students in the junior sample found it a little hard, and 22.4% found it difficult to adapt to distanced learning.



Taking into consideration that these students are taking classes such as Radiographic Protection, Radiographic Image Production and Evaluation, Radiographic Procedures, and Patient Care and Management online. These classes are conducted via zoom or blackboard collaborative as well as attempting to teach new radiographic concepts to juniors over these platforms. Almost 54.5% of students amongst the junior sample experienced some sort of connectivity issue while in the lecture. Internet connectivity is crucial for quizzes, midterms, and finals. The most common problem amongst students taking classes distanced learning was internet connectivity issues. Many students got logged out of exams and were unable to resume.



These students got penalized for being unable to complete the exam despite it being out of their control. Where students learn plays an important part in how these students are able to retain and articulate the content that is provided to them. 77.3% of juniors learn the most in person lab.



In Fall of 2020, the ability to go to lab was reduced due to the spread of COVID-19. Students' lab time had been reduced from once a week to once every two weeks due to COVID-19. This made learning concepts such as radiographic positioning very difficult. We found that 84.1% of junior students in Fall of 2021 were studying on their own. Approximately 9.1% of the junior sample formulated some sort of in-person study group. Many students miss a lot learning from home such as interaction with other students, interactions with educators, extracurricular activities such as student government and undergraduate research, and access to school resources. In a sample, 21 (48.8%) students attested to missing all of the above because of distanced learning. Distanced learning has forced students to learn via their devices course content that would be better conceptualized in an in-person lecture, in fact 38.6% of junior students are hands-on learners and 52.3% of the junior crop are visual learners.

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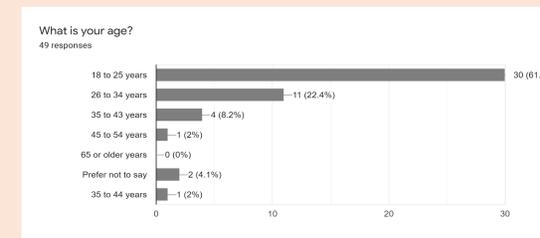
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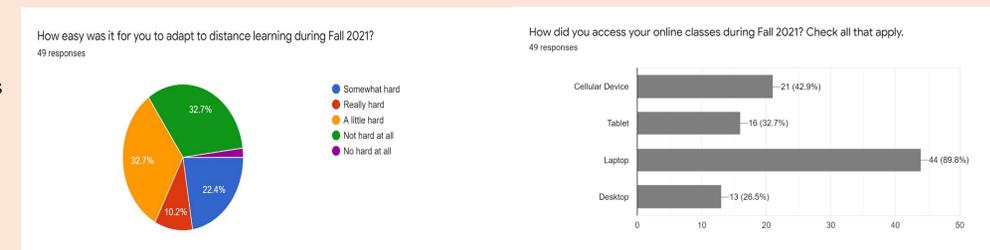
Giving an Effective Poster Presentation. Retrieved from <https://www.youtube.com/watch?v=vMSaFUrk-FA>

## Result Senior

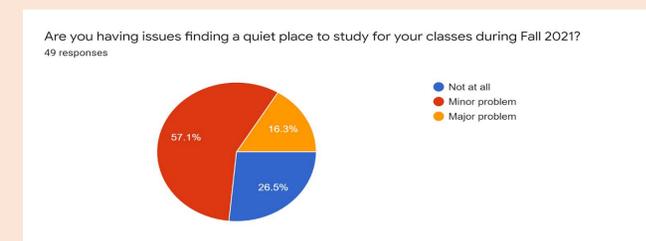
Based on the results of the survey, The data suggested that 61.2% of the whole student body are in the age range 18 to 25 years old and 38.8% of the students were 26 and older. Age is definitely an important factor because with online learning, there was a huge new reliance on technology.



Which can be an issue for some people because they might struggle with learning new technology. In addition, 37.2% of the whole senior student body have no issue adapting to Online classes such as zoom and blackboard collaborate while the 65.3 % of the total student body stated that online classes made it more for them to difficult to adapt to different types of factors, such as Access to Online (phone, tablet, etc), Internet Connection, and place to study.



These factors greatly affected 51% of the student body to take their classes online due to Internet connectivity issues. Where natural factors such as bad weather is enough to make one student's internet connection to be out of service and miss the class or test entirely due to the connection being interrupted. Also, in terms of finding a suitable place to study 57% of the overall student body stated that finding a quiet place is a minor problem. Due to the facts some of the Senior Students are taking classes in their house where they can't control the noise level around them.



## Conclusion

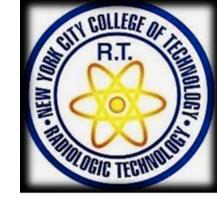
COVID-19 has changed many lives around the world. Education is a major subject that affects many adults and children, and COVID-19 has impacted the way they are receiving it. Our research was to analyze how COVID-19 has affected the education system for students. We collected data from our junior and senior peers who are currently in the Radiologic Technology program at New York City College of Technology in order to see what their thoughts and opinions were. Besides COVID-19 affecting the way people learn, we also have to take into consideration that every age, and ethnicity learns in their own way of learning. Everyone also has their own pace at which they can grasp information. One thing we found based on our results is that many people are visual and physical learners, which can mean two things. One thing it may mean is that some students would need to be physically in person to really understand what they are learning. While for others, online learning was beneficial to them. Some people also had difficulty focusing with online learning because some people have many distractions at home, while some people had no issues with the transition from in person learning to online learning. Another issue with learning online and in person during covid is many people prefer in person learning but they are adjusting to the online method because they are scared to come back in person and be around a lot of people since you don't know who can have the virus or not. 53% of the senior students are scared for many reasons if another wave happens, such as delaying our clinicals and classes which means it will also cause graduation to be delayed as well. To conclude our aim was achieved, using the data we have collected we can definitely tell how online learning brought upon some drawbacks and some positive outcomes. Lastly, we will be monitoring these results and we will compare them with the Spring 2022 semester to see if any changes occur.





# Effectiveness of Collimation In Radiation Protection

Student: Ollana John, Mentor: Professor Eric Lobel  
Department of Radiologic Tech and Medical Imaging



## Introduction:

Collimation is reducing the exposure field to radiate only the body part of interest. According to Long et al, restricting the radiation field serves two purposes; First it reduces the amount of radiation to the patient and second it reduces the amount of scatter radiation that will reach the IR.

The purpose of this investigation is to determine if increasing collimation is effective in reducing the amount of radiation dose exposed and if collimation is necessary for body part. Collimation was open starting at 11Wx15L for the lumbar spine and 11Wx14L for the hand. Increasing collimation is reducing the radiation exposure field. The exposure field is increased by 1 inch and will then adjust to 10Wx14L for the spine and 10Wx13L for the hand, and so forth.

## Methods:

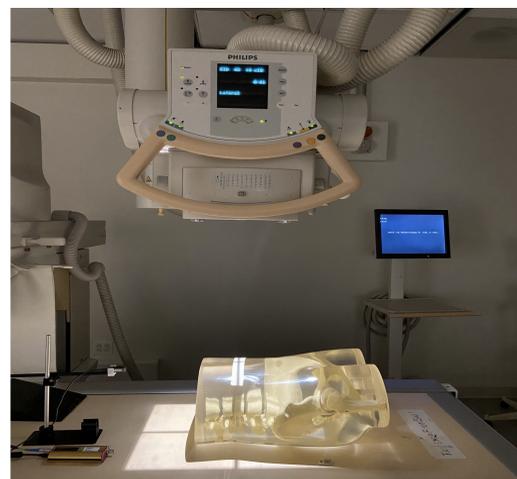
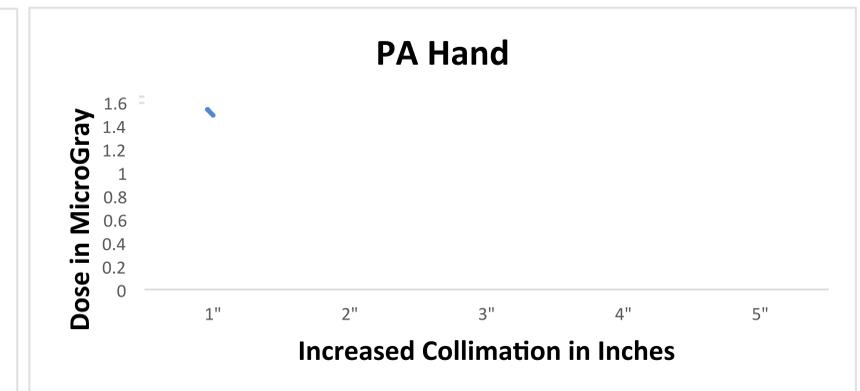
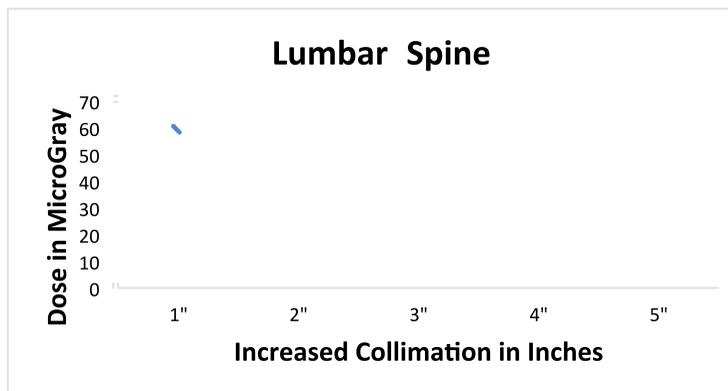
- An adult hand and adult lumbar spine was used
- Technical factors were set on the Philips direct radiography (DR) x-ray tube and on the computer.
- The lumbar spine was placed in AP position. CR set at 3rd lumbar vertebrae
- The hand was placed in PA position. CR set on the 3rd metacarpophalangeal joint
- Multiple exposures of the lumbar spine and of the hand were taken
- Exposure readings were recorded on the DR machine; Absorbed Dose measured in  $\mu\text{gym}^2$

## Technical factors used:

- Kv set at 80 for all lumbar spine exposures
- Kv set at 52 for all hand exposures
- SID set at 40" for all exposures
- OID kept minimum
- Small focal spot used for the hand
- Large focal spot used for the lumbar spine
- A grid was used for the lumbar spine (to reduce scatter)

Lumbar Spine		
Collimation (WxL)	Absorbed Dose (D)	% (D) reduced
11x15	58.66 $\mu\text{gym}^2$	63%
10x14	52.32 $\mu\text{gym}^2$	
9x13	45.74 $\mu\text{gym}^2$	
8x12	41.29 $\mu\text{gym}^2$	
7x11	36.96 $\mu\text{gym}^2$	

PA Hand		
Collimation (WxL)	Absorbed Dose (D)	% (D) reduced
11x14	1.49 $\mu\text{gym}^2$	46%
10x13	1.31 $\mu\text{gym}^2$	
9x12	1.14 $\mu\text{gym}^2$	
8x11	0.93 $\mu\text{gym}^2$	
7x10	0.69 $\mu\text{gym}^2$	



## Conclusion:

Collimation is important for radiation protection to reduce the dose that the patient receives as well as reduce the amount of radiation scatter. A grid was also necessary for the lumbar spine since it was a larger body part, to further reduce scatter. In conclusion when collimated, dose was reduced by 63% for the lumbar spine and dose was reduced by 46% for the hand.

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## ABSTRACT

The urban heat island (UHI) is a major environmental and public health issue in big cities. In order to study and better understand the phenomenon, high spatio-temporal land surface temperatures are required. However, there is no satellite that provides LST data with both high spatial and high temporal resolution. In this study, we use a linear regression model to downscale the Geostationary Operational Environmental Satellites – R series (GOES-R) LST data to the spatial resolution of Landsat observations (30 m) over New York City. The GOES-16 delivers land surface temperatures at a spatial resolution of 2 km but at a high frequency of every 5 minutes. On the other hand, Landsat 8 Thermal Infrared Sensor (TIRS) delivers land surface temperatures at higher spatial resolution of 30 m but at a lower frequency of 16 days. The downscaled LST data has spatial resolution of 30 m with a frequency of every 5 min. The downscaled estimates showed a reasonable agreement (-0.09 to 3.30 K) when they were validated against independent Landsat images. The results of this study could be applicable in any urban area in the world.

## MOTIVATION

- Available Satellite LST data are either a low spatial resolution and high temporal resolution or a high spatial resolution and low temporal resolution.
- Urban areas have a complex heterogeneous surface texture that can be lost in coarse resolution.

## STUDY AREA

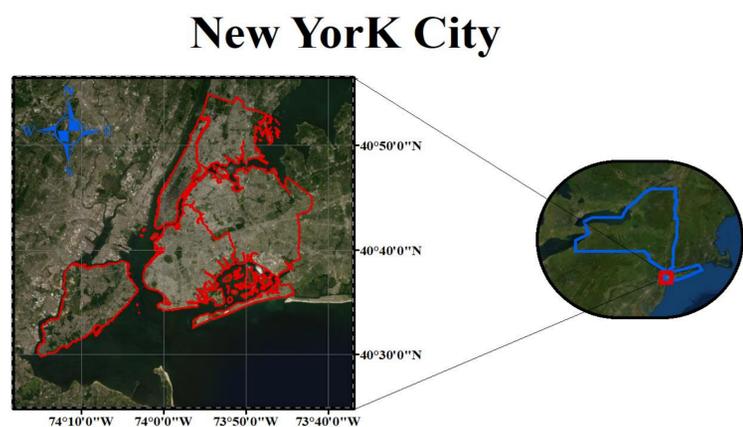


Figure 1. Study Area

## METHODOLOGY

- Dataset: daily land surface temperature over NYC from July 2017 to July 2020
- Obtain from Landsat 8 and GOES-R
- Time: 11:30pm EST
- Spatial resolution: 2 km to 30 m

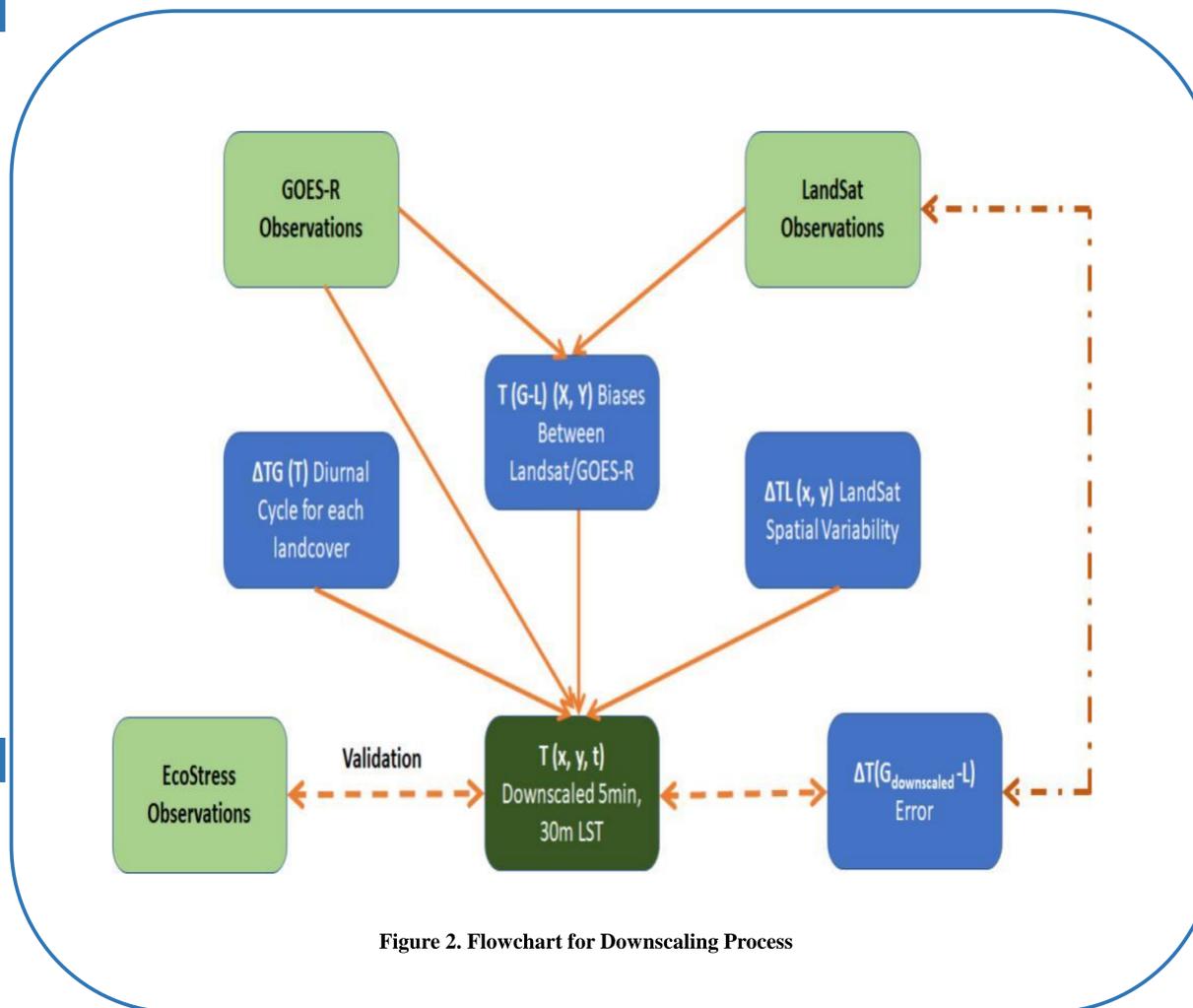


Figure 2. Flowchart for Downscaling Process

## RESULTS

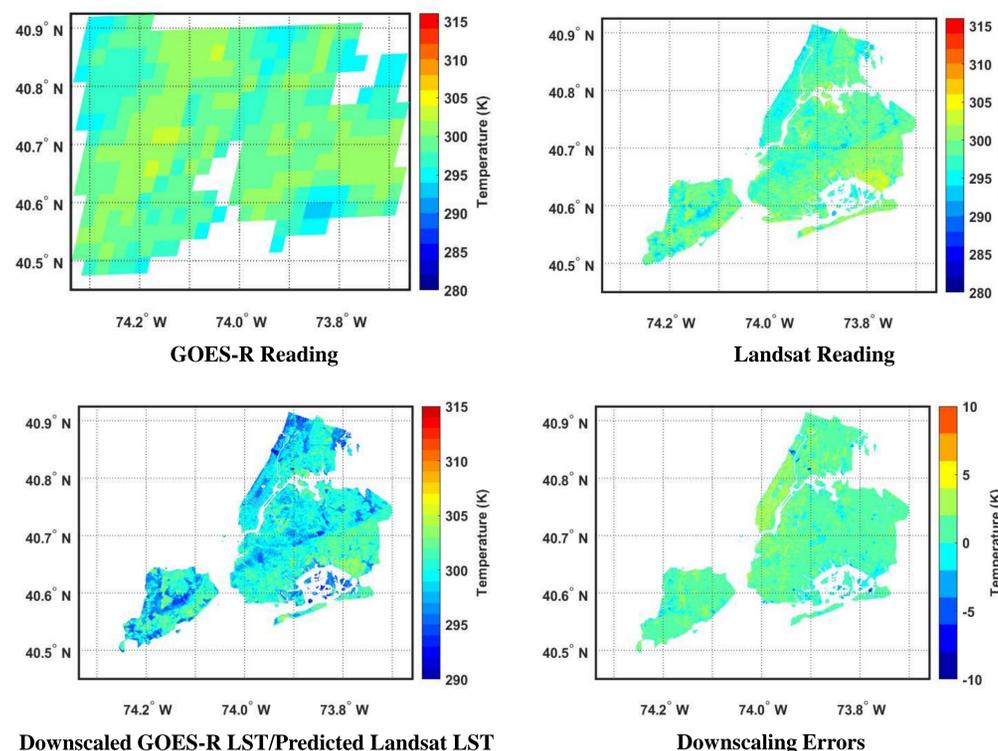


Figure 3. Downscaling GOES-R: October 2017

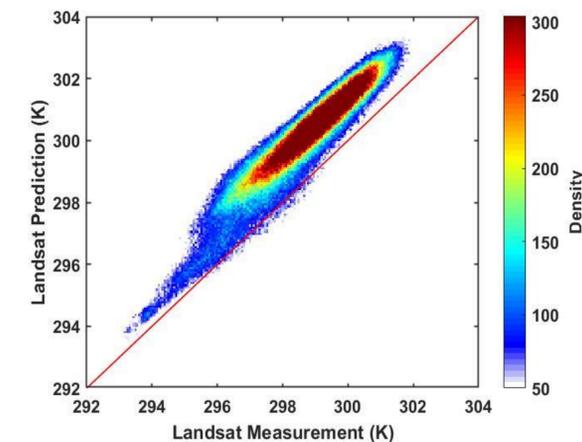


Figure 4. Measurement versus prediction scatter plot

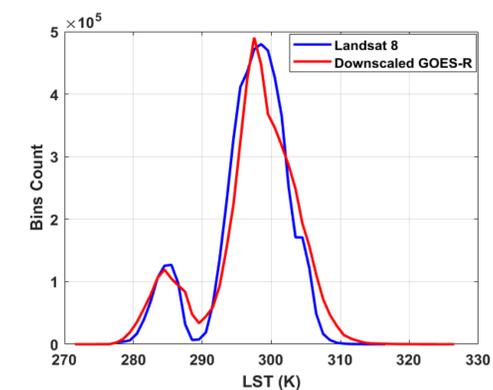


Figure 5. Distribution of Temperature for GOES-R and Landsat Readings

## CONCLUSION AND NEXT STEPS:

The differences between the Landsat LST measurements and predicted LSTs were between -0.09 to 3.30 K. The RMSE is less than 1.7 K. 60 – 80% of the variation are explained by the model. ECOSTRESS data and ground-based measurements from infrared cameras and drones will be used to validate the model.

## ACKNOWLEDGEMENT:

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## REFERENCE:

- Bechtel et al., 2012, Downscaling Land Surface Temperature in Urban Area: A Case Study for Hamburg, Germany.
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# Search for Naturally Occurring Fe (II) vs Fe (III) Roles in Model Carbohydrate Matrix by Forcing Trans-metalation in Mammography



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**ABSTRACT:** We have been working to test possible bio metal displacement (particularly iron) from their native bioenvironment by external agents. We used Gadolinium and iodinated radiological contrast media that are known to be environmental toxins and displace metals affecting aquatic species. Using soft mammography X-rays at a low kVp we collected x-ray absorption Fuji and Golden apples with contrast. Time series data for several days on these model carbohydrate samples have been recorded and are being analyzed not only to test the metal displacement theory, but also to image the distribution of radiological contrast. Additionally, the heterogeneity of this process could help understand the mechanism of metal displacement and we feel the standard deviation values in image pixels could be valuable. An extension of this work currently underway is the effect of heat shock and comparing the contrast diffusion pattern to simulate the effects of global warming enhancing metal toxicity on biological tissues including mammals.

**BACKGROUND:** This project involves the displacement of bio metals from their native bioenvironment in biological tissues such as aquatic species and mammals using a small number of radiological contrast media. Apples are fruits that retain mainly 85% water, and the rest is composed of carbohydrates and minerals. Data analysis of any metal displacement or distribution of the contrast using mammography x-rays and its collected x-ray absorption may be observed to test metal displacement theory. Time series analysis of affected protein layers due to “toxic” interaction with Gadolinium and Iodine moieties in naturally occurring proteins in apples are observed in low energy x-rays created by mammography. Both groups of hot and cold materials may offer new insights in metal displacement and its toxic effect on biological tissue of aquatic species and mammals.

**DATA TAKING:** To analyze the fuji apples we targeted the region-of-interest (ROI) on the surrounding spots made pre-contrast and post-contrast. The ROI size varied depending on which fruit/vegetable we were currently experimenting on. However, the ROI was maintained at a small and constant shape. The ROI for the surrounding air space of the fruit/vegetable was kept the same using either a 64 size ROI or 120 size ROI. Subtracting the spot exposure detection values from the full exposure in the nearby air space gives us the absorption at the spot.

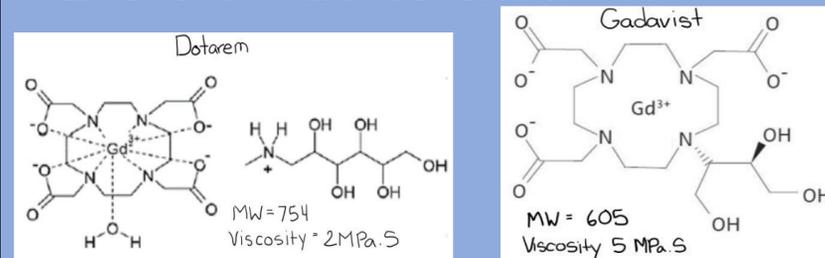
### CONCLUSION:

Based on the data obtained and observed. The trans metalation that was forced among the Fuji and Golden apples was greater increased during heat shock. This increase in trans metalation allowed for a greater absorption in x-rays because the fibers became harder. What is also observed is that gadolinium may also be more freely available when these structures are heated up, hence allowing Dotarem to absorb more than compared to Gadavist despite having the same atomic number.

**METHOD:** This project involves the displacement of bio metals (iron) using radiological contrast media and their effect on aquatic species. Technical parameters used from mammography x-rays were a low range of 20 kVp and 10 mAs. Imaging was repeated serially with identical set ups for several days. These technical parameters are important because at 20 kVp the effective x-ray beam is approximately 7 KeV, which can detect iron that gadolinium may attract through chelation mechanism. This technical parameter also enables Gadolinium and Iodine to appear bright on the image.

**SAMPLES:** Store brand Golden and Fuji apples were obtained; The effect of heat shock was included by placing one of two exact samples in a microwave and heating with intervals of 5 seconds (total of 30s) to obtain a hot and cold sample of each. The radiological contrast agents were Gadavist and Dotarem, and infusions were done by creating small holes on the inner outermost corners of the slices of apples and using a 23G needle to carefully add the radiological contrast media.

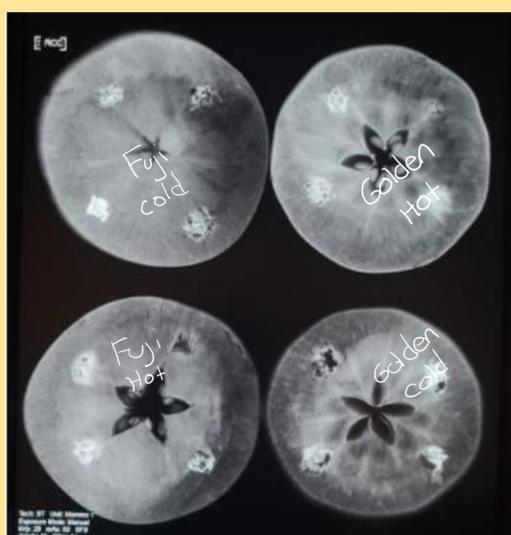
### MOLECULAR STRUCTURES OF RADIOLOGIC CONTRAST:



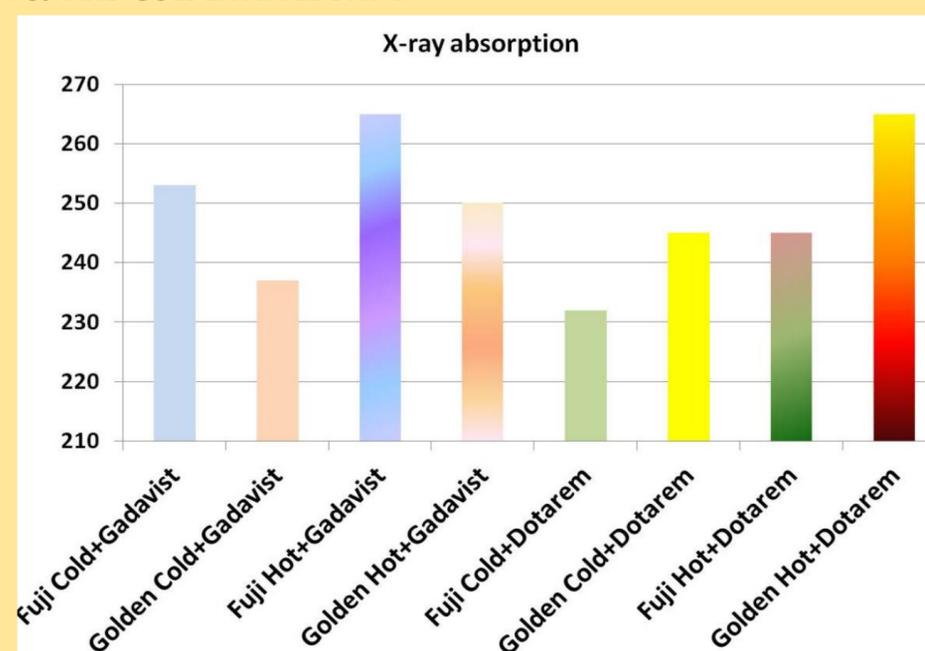
### ACKNOWLEDGEMENTS:

We would like to acknowledge valuable help from Jodi-Ann, also New York City College of Technology for access to mammography equipment for our undergraduate research students. This work was made possible with student stipends from City Tech to above student researchers under CRSP.

### HOT AND COLD FUJI AND GOLDEN APPLE:



### HOT AND COLD FUJI AND GOLDEN APPLE DATA:



### REFERENCES:

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- “Dotarem (Gadoterate Meglumine for Use with Magnetic Resonance Imaging): Uses, Dosage, Side Effects, Interactions, Warning.” *RxList*, [www.rxlist.com/dotarem-drug.htm](http://www.rxlist.com/dotarem-drug.htm). Accessed 23 Nov. 2021.



# From Pencil Sketch to Digital File

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## Introduction

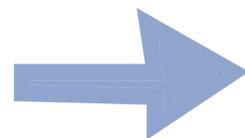
The effective way of capturing the attention of an audience in a book has changed significantly over the years. To reach a new audience some authors have chosen to write their books in the format of a "Graphic Novel". A Graphic Design novel is a piece of literature that is in the same format like a comic. Meanwhile, some believe that the term only refers to comics others believe that it is a separate medium, due to the difference in its production, publication processes. Unlike comics, a graphic novel has no restriction in genre but can be fictional, non-fictional, historical, and more.

## Research Purpose

The Purpose of this Project was to view the process of preparing pencil sketches for colorwork used in a Graphic Novel. This poster covers the first steps in creating a Graphic novel which consists of file preparation for book production; and the use of Adobe Creative Suite to translate sketches into digital files ready for color application.



Pencil Sketch Scan



## Methodology

- First, you must have the storyline.
  - You must research the topic covered in your graphic novel.
- Next create the sketches that complement the storyline.
  - Most writers do this step digitally but many others prefer doing this traditionally so that they can develop the sketches digitally later.
- Translate it into a digital file that is prepped for color application.
  - In Photoshop change the color profile to grayscale and adjust the Iso of the scans making the shadows and lines darker, meanwhile lessening the highlights to create a visible file.
  - After you must save these changes and put the edited scans into the format of a Graphic novel Page and save it as a lossy file. Now the file is ready for color application and line development.

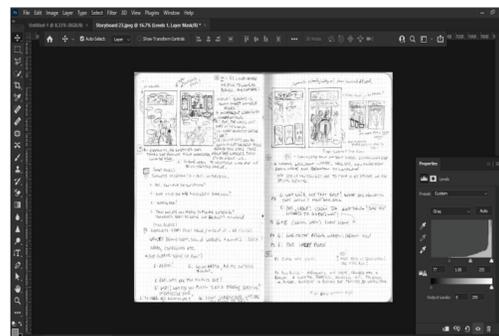
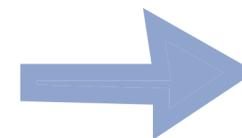


Image Levels adjusted in Photoshop



## Conclusion

Through this whole process of preparing the pencil sketches for color application and line development, I was able to view the the world of comics publishing from within. Not only that but I was able to see the role of a production assistant in the world of book development.

## References

By: Szép, Eszter. European Journal of American Culture. Mar2021, Vol. 40 Issue 1, p93-95. 3p. DOI: 10.1386/ejac\_00042\_5.



Final Scan edited and placed into Page Layout; prepared for Color application.