Our PLTW Experiences

BREVANNA STEPHEN, COURTNEE SIMPSON, IBRAHIMA SACKO, ISMAEL ITUARTE

STEM Innovation Academy of Orange
SCIENCE TECHNOLOGY ENGINEERING MATHEMATICS

Orange Public Schools

Overview

Throughout the PLTW coursework, we are learning how to:

- present
- collaborate with different individuals
- be a leader and take accountability
- be skeptical in order to gain the best possible results and answers from scientific experimentation

We have used:

- Math
- Modeling
- Diagrams and Drawings

in order to convey our data and express our information in a way that imitates the professionals.

Biomedical Science Courses

Principles of Biomedical Science (Participants: Freshman)
The fundamentals of the entire medical course are taught through following a crime scene investigation, involving the death of Anna Garcia

Human Body Systems (Participants: Sophomores w/Biomed Major)

We revisit the fundamentals that we have learned from PBS and apply them to the Human Body and its functions.

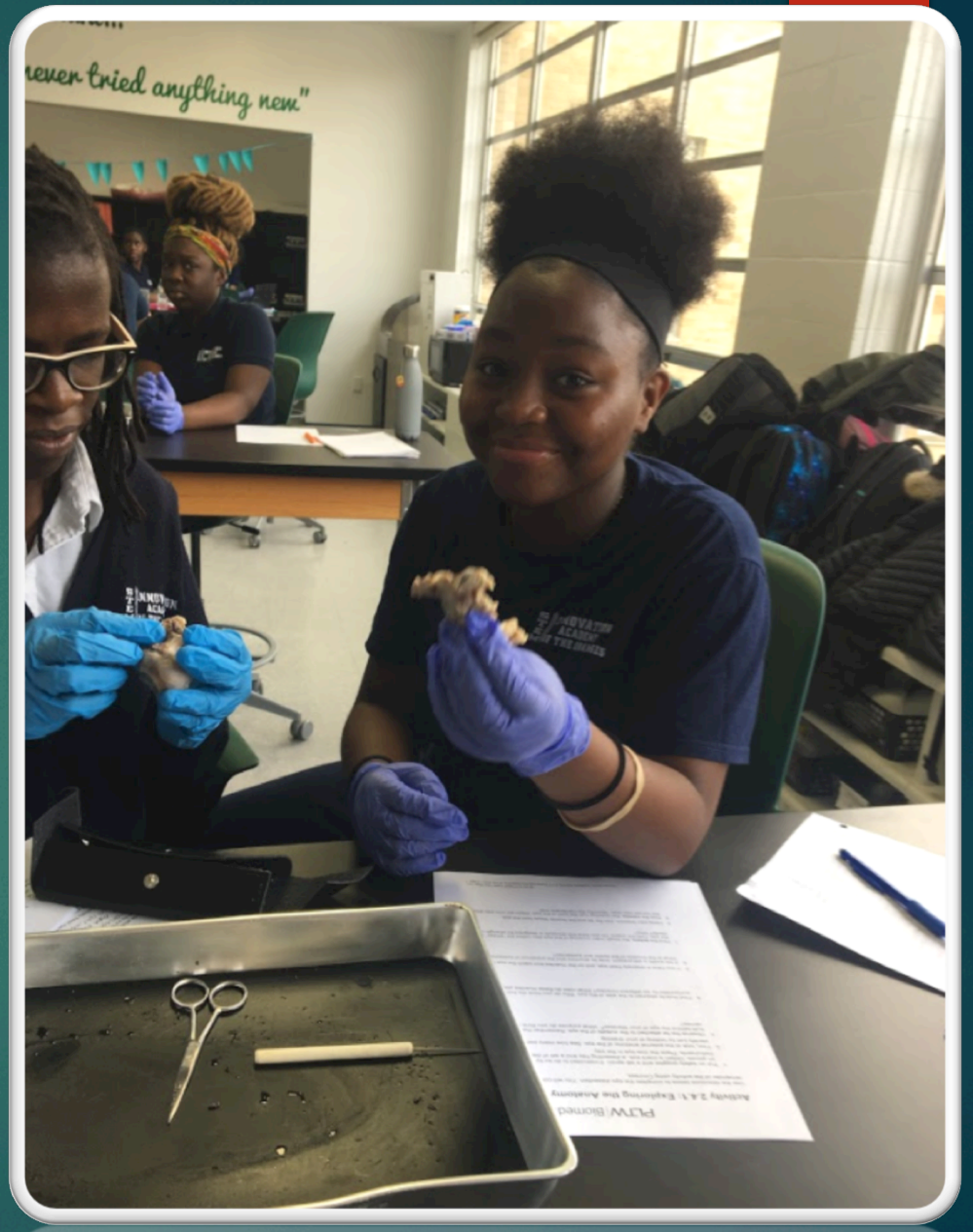
Medical Interventions (Participants: Juniors w/Biomed Major)

We have related problems that occur within the human body, with the ideas that were learned regarding the human body in the Human Body Systems course.

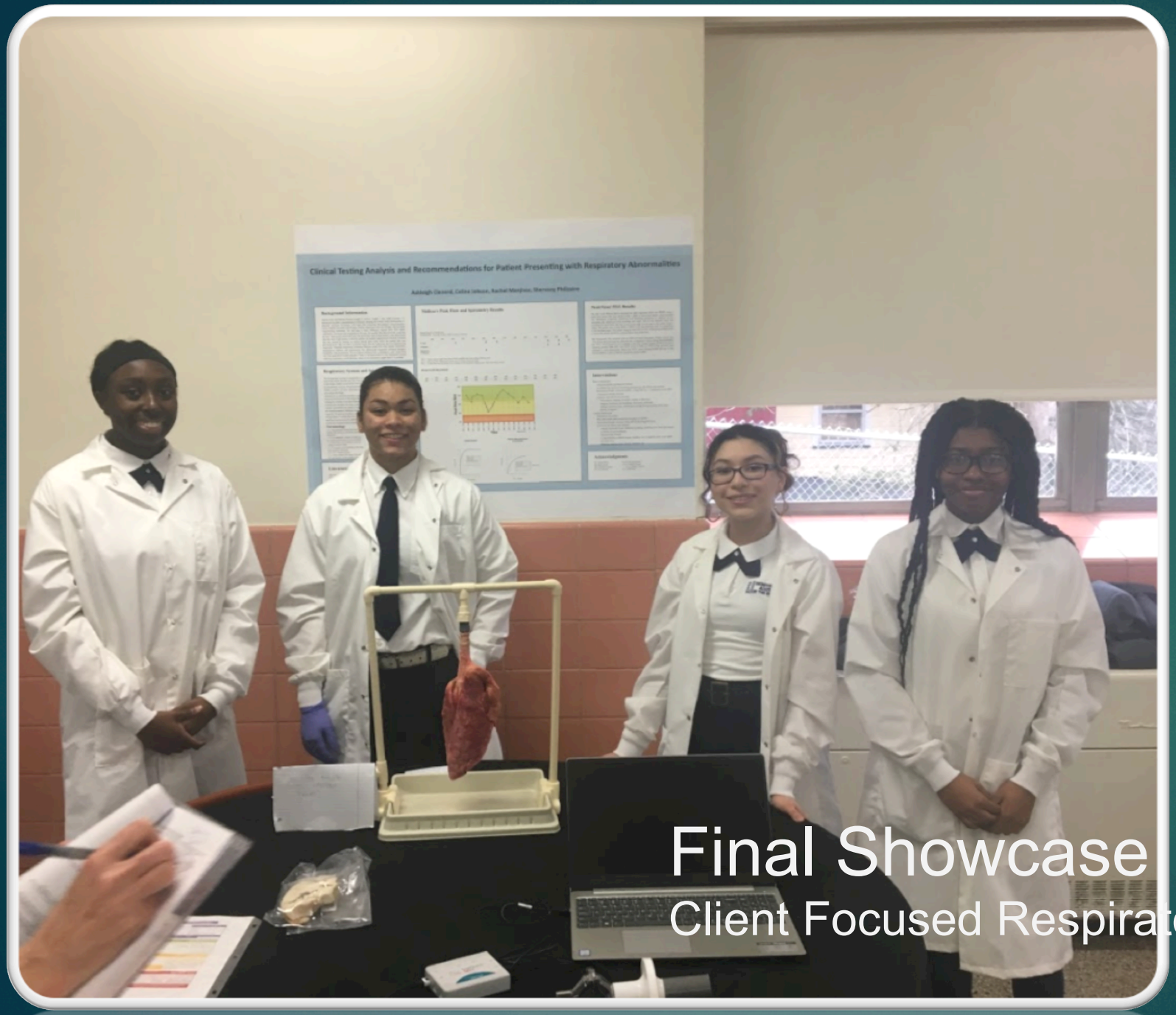
Anna Garcia

Crime scene investigation

"Calorimetry Lab"



"Sheep Brain Dissection"



Final Showcase

Client Focused Respiratory Investigation

Experiences

In engaging with the coursework from PLTW we have:

- Learned how the brain transmits signals to parts of our body and its reactions

- Gained an understanding of medical tools, terminology and practices: e.g. *Micropipettes, EKG's, Dissections, Po Bid*

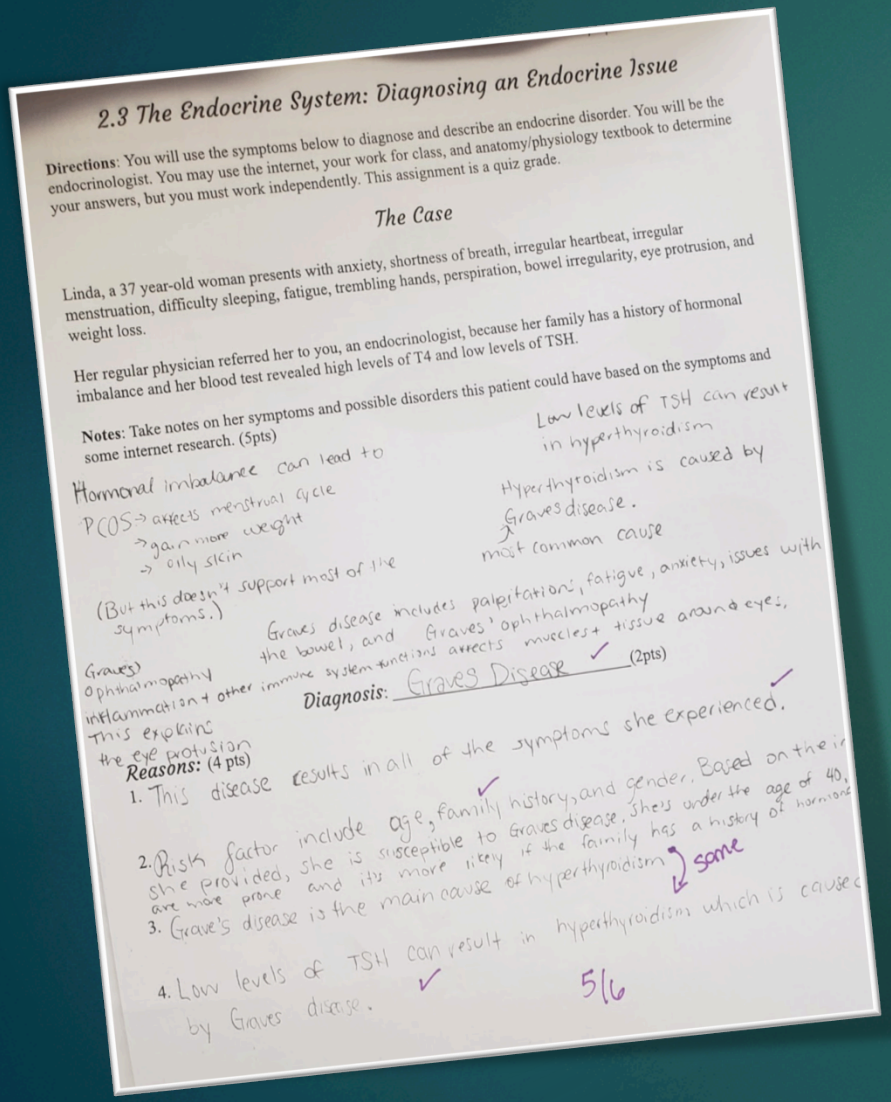
- Immersed ourselves in professional and medical settings; acting accordingly as Forensic Analysts, Surgeons and FBI Agents

Experiences

- We have written formal reports (e.g. being bone and criminal investigators)
- We have created medical presentations (e.g. Nutrition plans for specialized patients)
- We have conducted dissections on sheep hearts and cow eyes

Diagnostic Challenges

“Diagnosing a Thyroid Disorder”



2.3 The Endocrine System: Diagnosing an Endocrine Issue

Directions: You will use the symptoms below to diagnose and describe an endocrine disorder. You will be the endocrinologist. You may use the internet, your work for class, and anatomy/physiology textbook to determine your answers, but you must work independently. This assignment is a quiz grade.

The Case

Linda, a 37 year-old woman presents with anxiety, shortness of breath, irregular heartbeat, irregular menstruation, difficulty sleeping, fatigue, trembling hands, perspiration, bowel irregularity, eye protrusion, and weight loss.

Her regular physician referred her to you, an endocrinologist, because her family has a history of hormonal imbalance and her blood test revealed high levels of T4 and low levels of TSH.

Notes: Take notes on her symptoms and possible disorders this patient could have based on the symptoms and some internet research. (5pts)

Hormonal imbalance can lead to
PCOS → affects menstrual cycle
→ gain more weight
→ oily skin
(But this doesn't support most of the symptoms.)

Low levels of TSH can result in hyperthyroidism
Hyperthyroidism is caused by Graves disease.
most common cause

Graves disease includes palpitation, fatigue, anxiety, issues with the bowel, and Graves' ophthalmopathy
Graves ophthalmopathy
inflammation + other immune system functions affects muscles + tissue around eyes.
This explains the eye protusion

Diagnosis: Graves Disease (2pts)

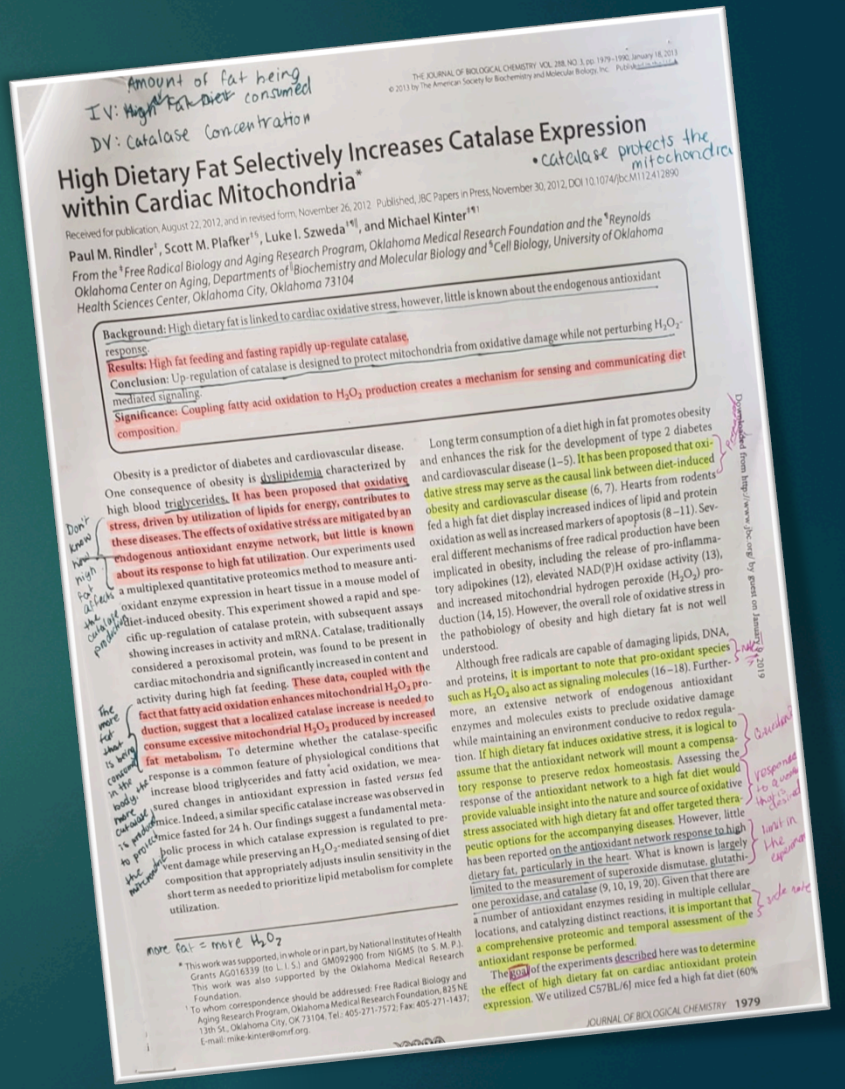
Reasons: (4 pts)

1. This disease results in all of the symptoms she experienced.
2. Risk factor include age, family history, and gender. Based on the info she provided, she is susceptible to Graves disease, she's under the age of 40, are more prone and its more likely if the family has a history of hormone
3. Grave's disease is the main cause of hyperthyroidism → some
4. Low levels of TSH can result in hyperthyroidism which is caused by Graves disease.

5/6

“Human Body Model”

“Primary Journal Article”



Amount of fat being consumed
IV: High fat diet
DV: Catalase concentration

High Dietary Fat Selectively Increases Catalase Expression within Cardiac Mitochondria*

• catalase protects the mitochondria

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Paul M. Rindler[‡], **Scott M. Plafker**[‡§], **Luke I. Szweda**[‡¶], **and Michael Kinter**[‡¶]
From the [‡]Free Radical Biology and Aging Research Program, Oklahoma Medical Research Foundation and the [¶]Reynolds Oklahoma Center on Aging, Departments of [§]Biochemistry and Molecular Biology and [¶]Cell Biology, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma 73104

Background: High dietary fat is linked to cardiac oxidative stress, however, little is known about the endogenous antioxidant response.
Results: High fat feeding and fasting rapidly up-regulate catalase.
Conclusion: Up-regulation of catalase is designed to protect mitochondria from oxidative damage while not perturbing H_2O_2-mediated signaling.
Significance: Coupling fatty acid oxidation to H_2O_2 production creates a mechanism for sensing and communicating diet composition.

Obesity is a predictor of diabetes and cardiovascular disease. One consequence of obesity is dyslipidemia characterized by high blood triglycerides. It has been proposed that oxidative stress, driven by utilization of lipids for energy, contributes to these diseases. The effects of oxidative stress are mitigated by an endogenous antioxidant enzyme network, but little is known about its response to high fat utilization. Our experiments used a multiplexed quantitative proteomics method to measure antioxidant enzyme expression in heart tissue in a mouse model of diet-induced obesity. This experiment showed a rapid and specific up-regulation of catalase protein, with subsequent assays showing increases in activity and mRNA. Catalase, traditionally considered a peroxisomal protein, was found to be present in cardiac mitochondria and significantly increased in content and activity during high fat feeding. These data, coupled with the fact that fatty acid oxidation enhances mitochondrial H_2O_2 production, suggest that a localized catalase increase is needed to consume excessive mitochondrial H_2O_2 produced by increased fat metabolism. To determine whether the catalase-specific response is a common feature of physiological conditions that increase blood triglycerides and fatty acid oxidation, we measured changes in antioxidant expression in fasted *versus* fed mice. Indeed, a similar specific catalase increase was observed in mice fasted for 24 h. Our findings suggest a fundamental metabolic process in which catalase expression is regulated to prevent damage while preserving an H_2O_2-mediated sensing of diet composition that appropriately adjusts insulin sensitivity in the short term as needed to prioritize lipid metabolism for complete utilization.

Long term consumption of a diet high in fat promotes obesity and enhances the risk for the development of type 2 diabetes and cardiovascular disease (1–5). It has been proposed that oxidative stress may serve as the causal link between diet-induced obesity and cardiovascular disease (6, 7). Hearts from rodents fed a high fat diet display increased indices of lipid and protein oxidation as well as increased markers of apoptosis (8–11). Several different mechanisms of free radical production have been implicated in obesity, including the release of pro-inflammatory adipokines (12), elevated NAD(P)H oxidase activity (13), and increased mitochondrial hydrogen peroxide (H_2O_2) production (14, 15). However, the overall role of oxidative stress in the pathobiology of obesity and high dietary fat is not well understood.

Although free radicals are capable of damaging lipids, DNA, and proteins, it is important to note that pro-oxidant species such as H_2O_2 also act as signaling molecules (16–18). Furthermore, an extensive network of endogenous antioxidant enzymes and molecules exists to preclude oxidative damage while maintaining an environment conducive to redox regulation. If high dietary fat induces oxidative stress, it is logical to assume that the antioxidant network will mount a compensatory response to preserve redox homeostasis. Assessing the response of the antioxidant network to a high fat diet would provide valuable insight into the nature and source of oxidative stress associated with high dietary fat and offer targeted therapeutic options for the accompanying diseases. However, little has been reported on the antioxidant network response to high dietary fat, particularly in the heart. What is known is largely limited to the measurement of superoxide dismutase, glutathione peroxidase, and catalase (9, 10, 19, 20). Given that there are a number of antioxidant enzymes residing in multiple cellular locations, and catalyzing distinct reactions, it is important that a comprehensive proteomic and temporal assessment of the antioxidant response be performed.

The goal of the experiments described here was to determine the effect of high dietary fat on cardiac antioxidant protein expression. We utilized C57BL/6J mice fed a high fat diet (60%

more fat = more H_2O_2

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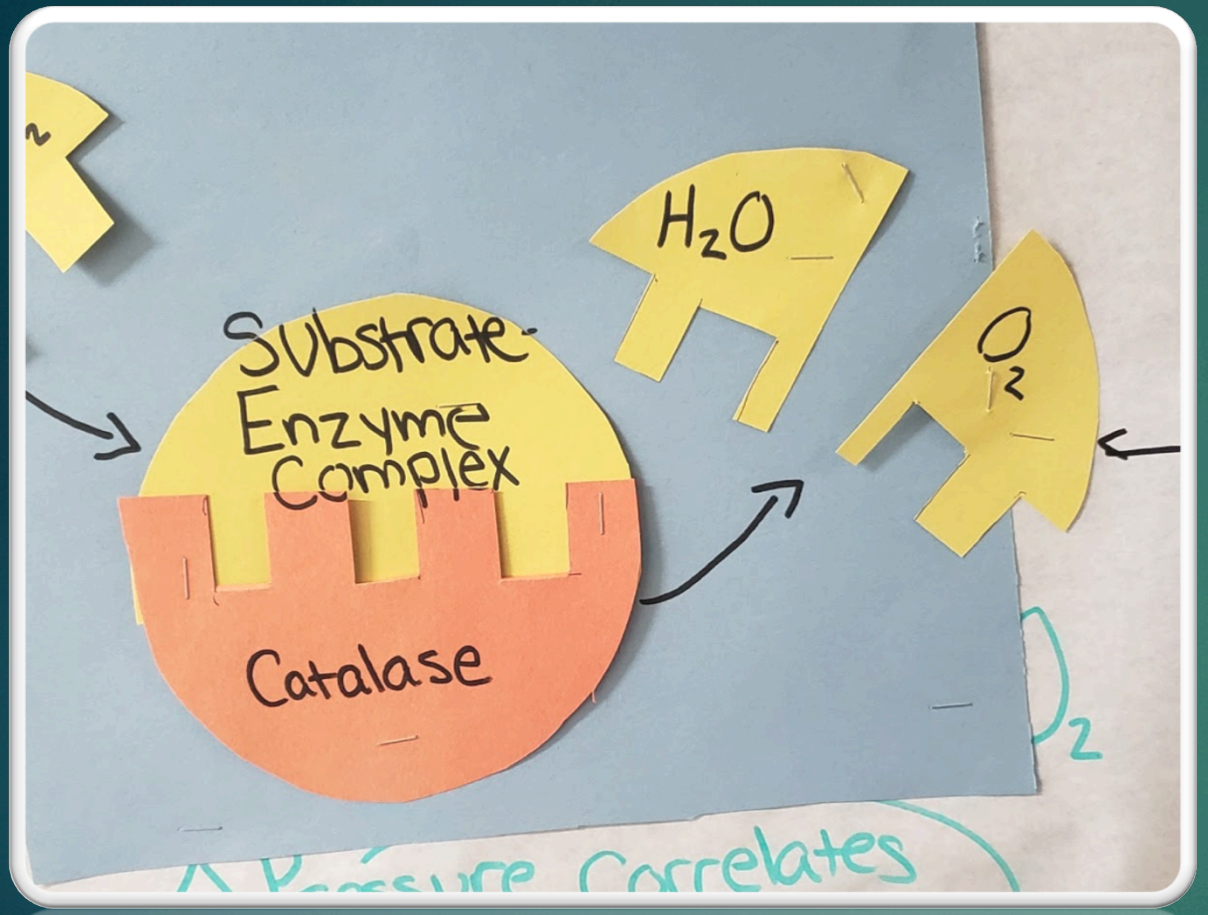
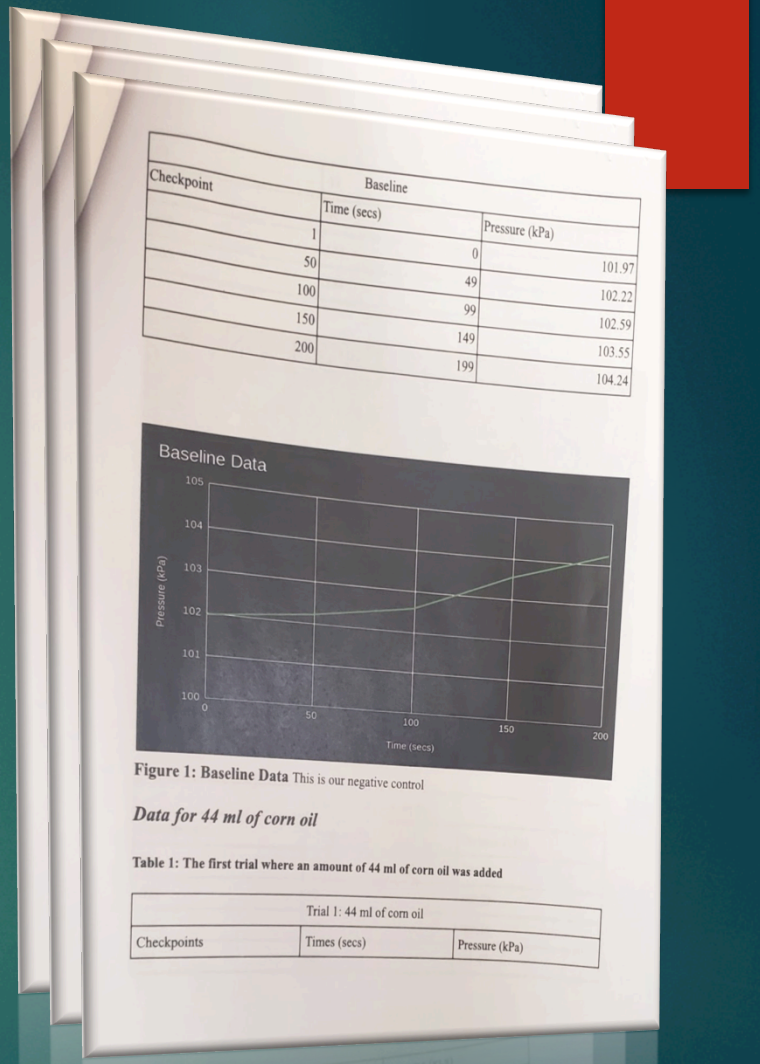
' To whom correspondence should be addressed: Free Radical Biology and Aging Research Program, Oklahoma Medical Research Foundation, 825 NE 13th St., Oklahoma City, OK 73104. Tel.: 405-271-7572; Fax: 405-271-1437; E-mail: mike-kinter@omrf.org.



"Substrate and Enzyme Model"



Checkpoint	Baseline	
	Time (secs)	Pressure (kPa)
1	0	101.97
50	49	102.22
100	99	102.59
150	149	103.55
200	199	104.24

Figure 1: Baseline Data This is our negative control

Data for 44 ml of corn oil

Table 1: The first trial where an amount of 44 ml of corn oil was added

Trial 1: 44 ml of corn oil		
Checkpoints	Times (secs)	Pressure (kPa)

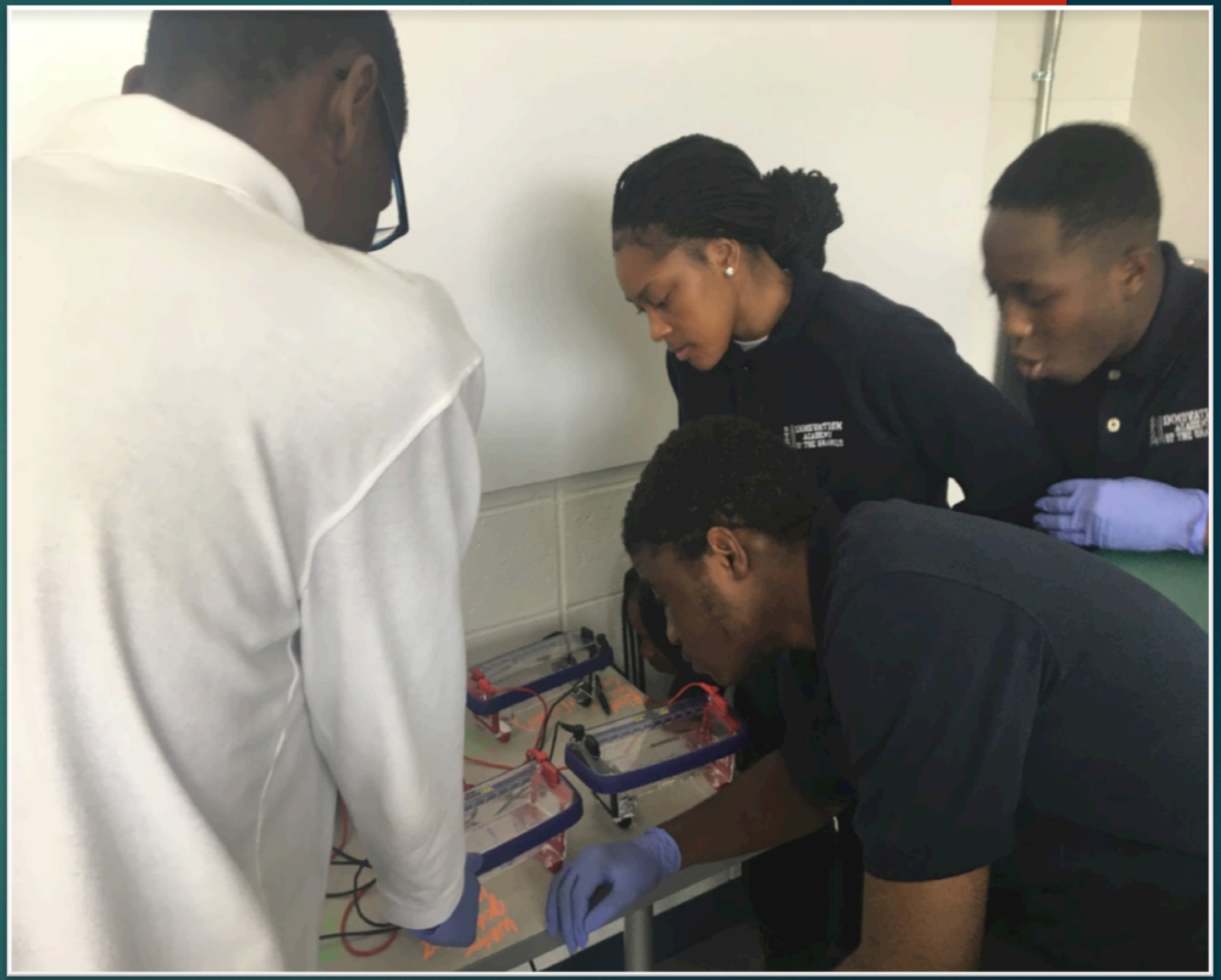
"Student Data Collection"

Stepping into the Shoes of a Specialist

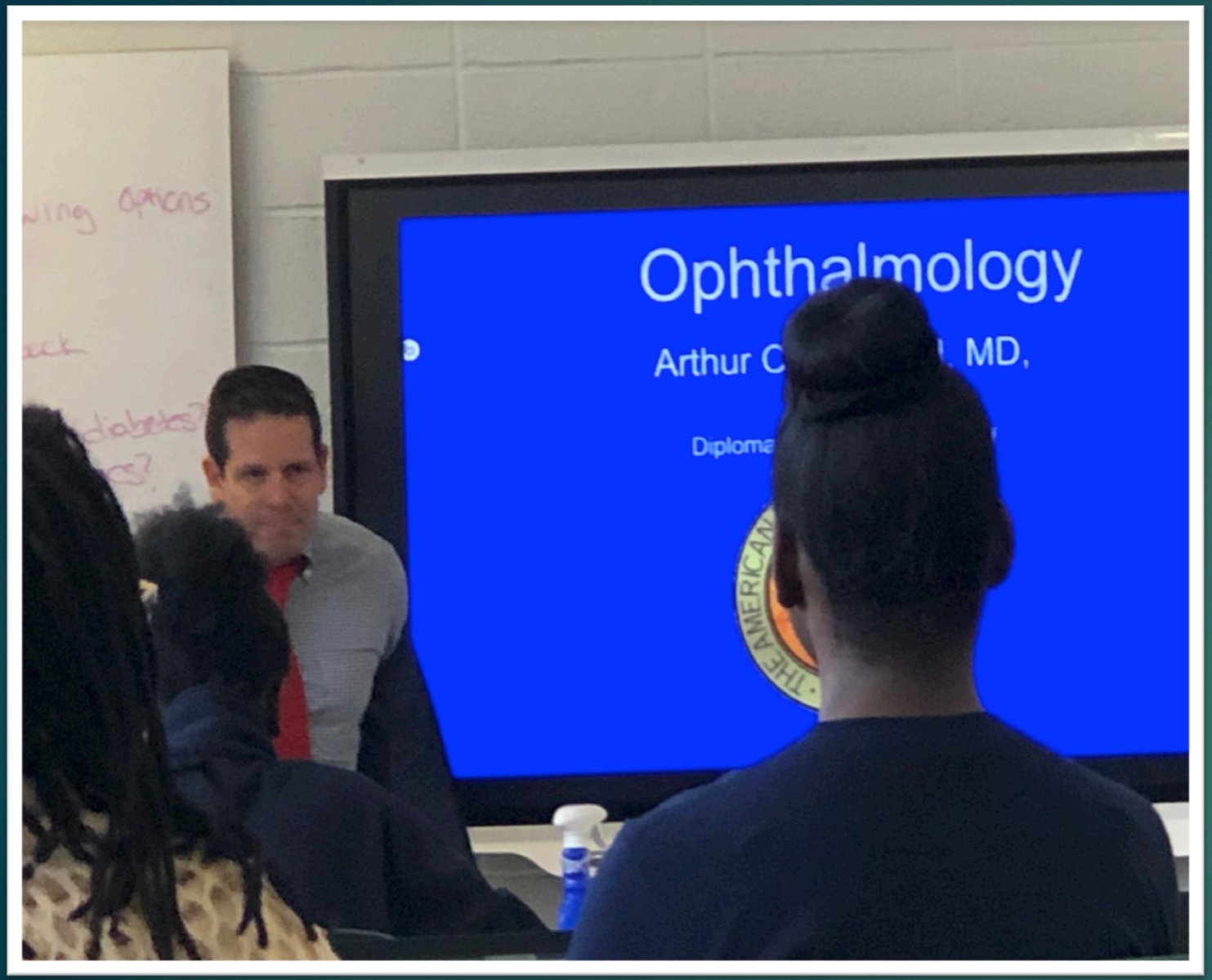
Presentations

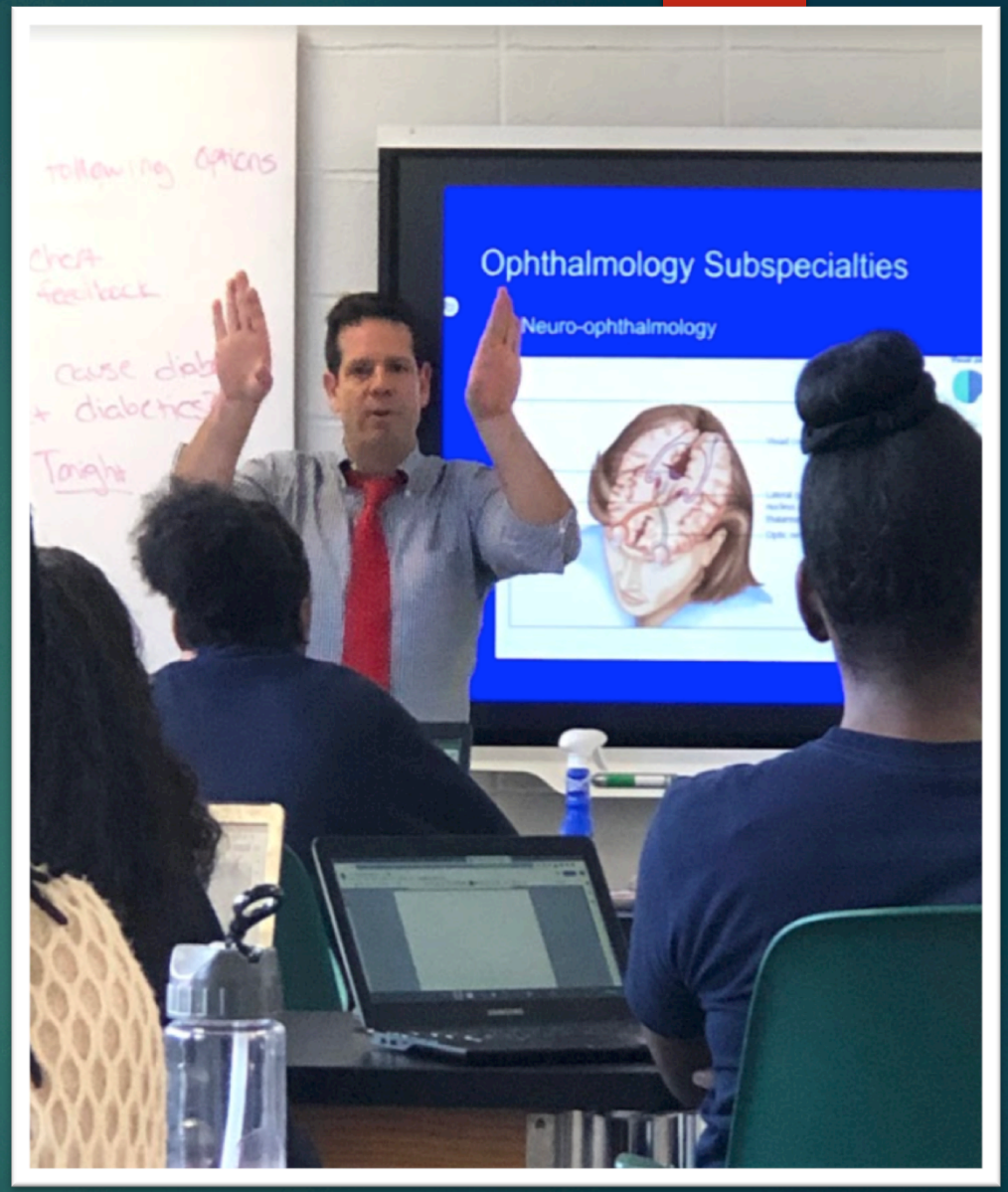
"Collaborating with Classmates to Culture Bacteria"

“3rd Degree Burns”



“Gel Electrophoresis”





Career Exploration

Opthamologist, Dr.Tutela; Dr. Shitihil- Physical Therapist

Dr.Shah- Internal Medicine

Skills Gained

- Verifying and Looking for Data
- Being Skeptical and Prone to ask more Questions
- Knowledge on how to use equipment and technology
- Quick and Effective Thinking

- I am able to understand technical details that can help me assess future health and body issues.
- My medical comprehension has improved as we have completed PBS, HBS and MI.
- PLTW has put me into a college-like environment with detailed and thorough classwork that has helped me and will help me in the future (college and careers)

Forensic Analyst: Formal Case Report
Teika Brown and Courtnee Simpson
Teacher: Ms. Henry
Class: Human Body Systems
Date: September 28,2018

Introduction

Bones are something that anthropologists use to determine who the remains belong to. In this case there was a body found in a park and the only bones recovered were the humerus, tibia, skull, and pelvis. The police called forensic anthropologists to see if they could use the bones to determine an identification for the bones. The forensic anthropologist job is to use the bones that were recovered from the scene to identify age, sex, gender and height. Forensic anthropologist will use global averages to determine the necessary characteristics they need to discover who the bones belong to.

Summary of Findings

Sex Determination

In order to tell the sex of the skeleton we measured the pelvis, sk

Based on those findings, we compared them to measurements set in place to tell whether the remains are male or female. After measuring the pelvis we came to the conclusion that the pelvis belonged to a female. Based on the results from the sub pubic angle, pubis body width and the pelvic cavity shape the measurements matched the indicators that tell whether the pelvis is female.

According to the measurements set in place, the sub pubic angle for
degrees) matched to the female subic angle (>90 degrees) that was set in pla
width for the pelvis found was around 40 mm which matched the standard fe
width (40mm) marker. But, when the greater sciatic notch of our bones (45 d
matched to the indicator it showed that the specific measurement matched the
notch of a male (<65 degrees). When we observed the shape of the pelvic cavi
was circular and wide, showing mainly coccyx which indicated that it was a fe

When measuring the skull, 2 out of 8 traits matched a male indicator an
matched female indicators. From observing the skull we noticed that the eye or
shape, the zygomatic process was not expressed beyond external auditory meatt
crest is smooth, the frontal bone was round/globular, the mandible of the skeleto
and v shaped, and the ramus of the mandible was slightly slanted. Despite the up
eye orbit being blunt and the external occipital protuberance being generally pres
majority of the qualitative data from the skeletal bones indicates the remains belo

the indicator of a male. The
retrieved was measured an
tibia from the tibia retrieve
qualitative and quantitativ
tibia belonged to a man. B
belonged to a female. It i
results. Based on our qua
a female. Although it is
made, we believe that th
the conclusion that the

After measuring the humerus found
average female. The transverse diameter of humeral head was 37mm and the average
range was from 37mm to 39mm. The vertical diameter of humeral head is 35mm the average
female diameter 42.7. The maximum length of the humerus is 310 mm and the epicondylar width
of the humerus is 55 mm. The average maximum for a average female was 305.9, and the
average epicondylar width was 56.8.

Race Determination

To find whether the bones found belonged to a European, Asian, or African we measured various features of the skull pertaining to the nasal region. We measurements of the nasal height(49.5mm) and the nasal index(0.45). In order to find the nasal height. When index, as well as

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measurements recov
European. Accordi
female.

Height Determination

To estimate the height of the skeleton remains we used the regression formula along with our recordings to determine the height of the skeleton. We started with measuring the maximum length of the tibia which was 34cm. We plugged in that number into the regression formula for a European female [2.90(MLT)+61.53] to determine her height. We used this equation due to scientists setting this equation into place for finding the height of a person using certain bones. After doing this we noted that the height was approximately 160.13 cm. Since everyone is not around that average we used the confidence interval which was 3.66 and added and subtracted the confidence interval from the height. After concluding the measurements of the tibia we converted the range that was in the centimeters to feet in inches which made out range 5 ft 1 in to 5 ft 4 in.

Next, we measured the maximum length of the humerus which was 28 cm. We plugged in that number to the regression formula for a European female [3.36(MLH)+57.97] to determine the height of the skeletons humerus. After plugging that in we noted that the height was

When the forensic anthropologists measured the maximum epiphyseal breadth of proximal tibia and the maximum epiphyseal breadth of distal tibia, both measurements matched the indicator of a male. The maximum epiphyseal breadth of proximal tibia from the tibia retrieved was measured and was 80.7 millimeters. The maximum epiphyseal breadth of distal tibia from the tibia retrieved was measured and was 54.3 millimeters. Although conducting both qualitative and quantitative assessments, when measuring the tibia the results indicated that the tibia belonged to a man. But, the measurement for the humerus indicated that the humerus belonged to a female. It is possible that we measured the tibia incorrectly which affected our results. Based on our qualitative data from the skull assessment indicates that the skull belongs to a female. Although it is not as accurate based on the observations we did and the comparisons made, we believe that the skull belongs to a female. Based on the skull and humerus, we came to the conclusion that the bones belong to a female.

After measuring the humerus found at the crime scene, our measurements matched the average female. The transverse diameter of humeral head was 37mm and the average female range was from 37mm to 39mm. The vertical diameter of humeral head is 35mm the average female diameter 42.7. The maximum length of the humerus is 310 mm and the epicondylar width of the humerus is 55 mm. The average maximum for a average female was 305.9, and the average epicondylar width was 56.8.

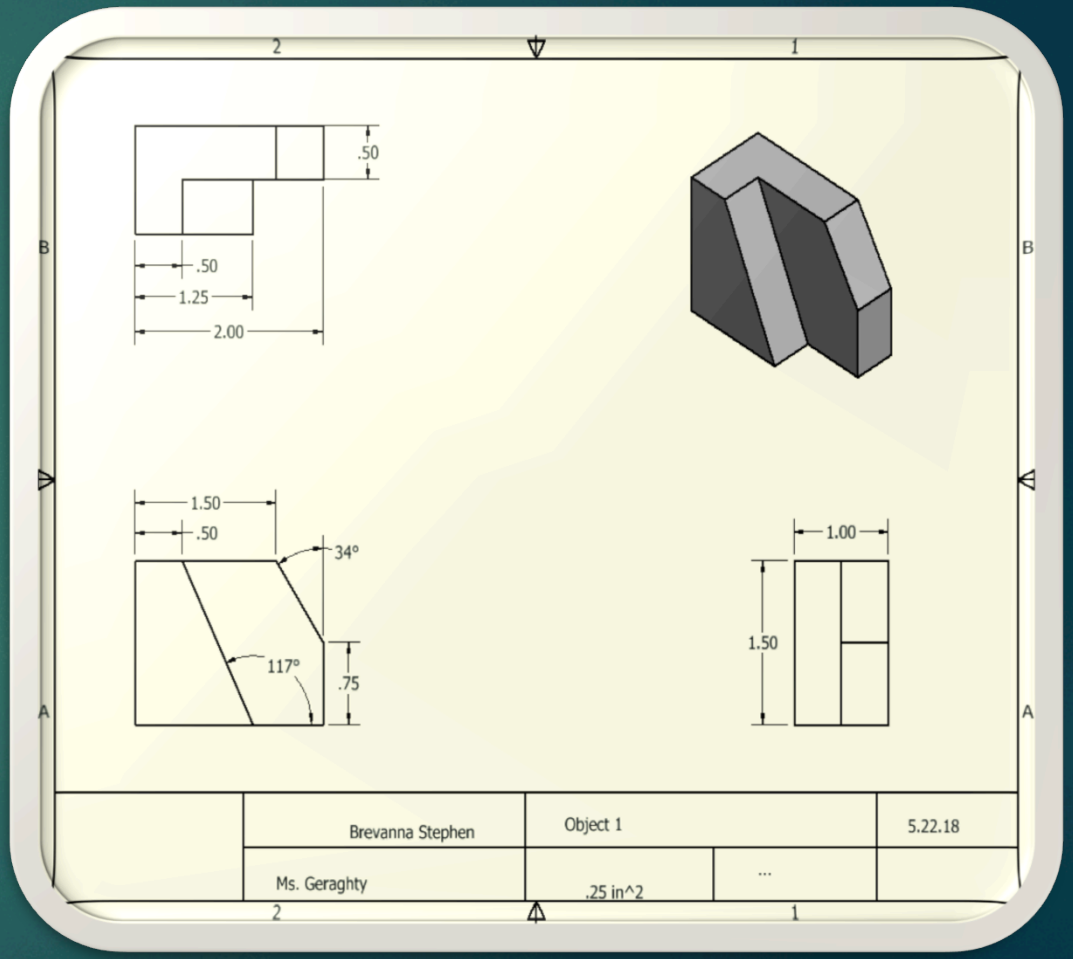
Race Determination

To find whether the bones found belonged to a European, Asian, or African we measured various features of the skull pertaining to the nasal region. We took the measurements of the nasal height(49.5mm) and the nasal width(22.4)mm to find the nasal index(0.45). In order to find the nasal index we divided the nasal width to the nasal height. When

Intro to Engineering

Structure

- Competency in basic Engineering skills such as documentation, the use of Computer Aided Design (CAD), and the design process
- Dipping our Toes into engineering
- Mathematics related to engineering
- Foreshadow of future courses
- Problem solving skills



Computer Integrated Manufacturing

Structure

- Application of basic skills learned in IED
- Basic projects using vex kits, CAD, and Robot C coding
- Knowledge about the manufacturing process
- How projects deal with the Manufacturing Process

Principles of Engineering

Structure

- Focuses on the different sub-divisions of engineering including electrical and civil engineering
- Application of basic skills to different projects related to each aspect of engineering
- Learned new information about each field of engineering to develop projects
- In turn these projects provided us with insight about what is available to us in the future
- Insight on future career choices

Engineering Design and Development

Project-based Learning Experiences in Engineering

Skills Gained

The Ability to

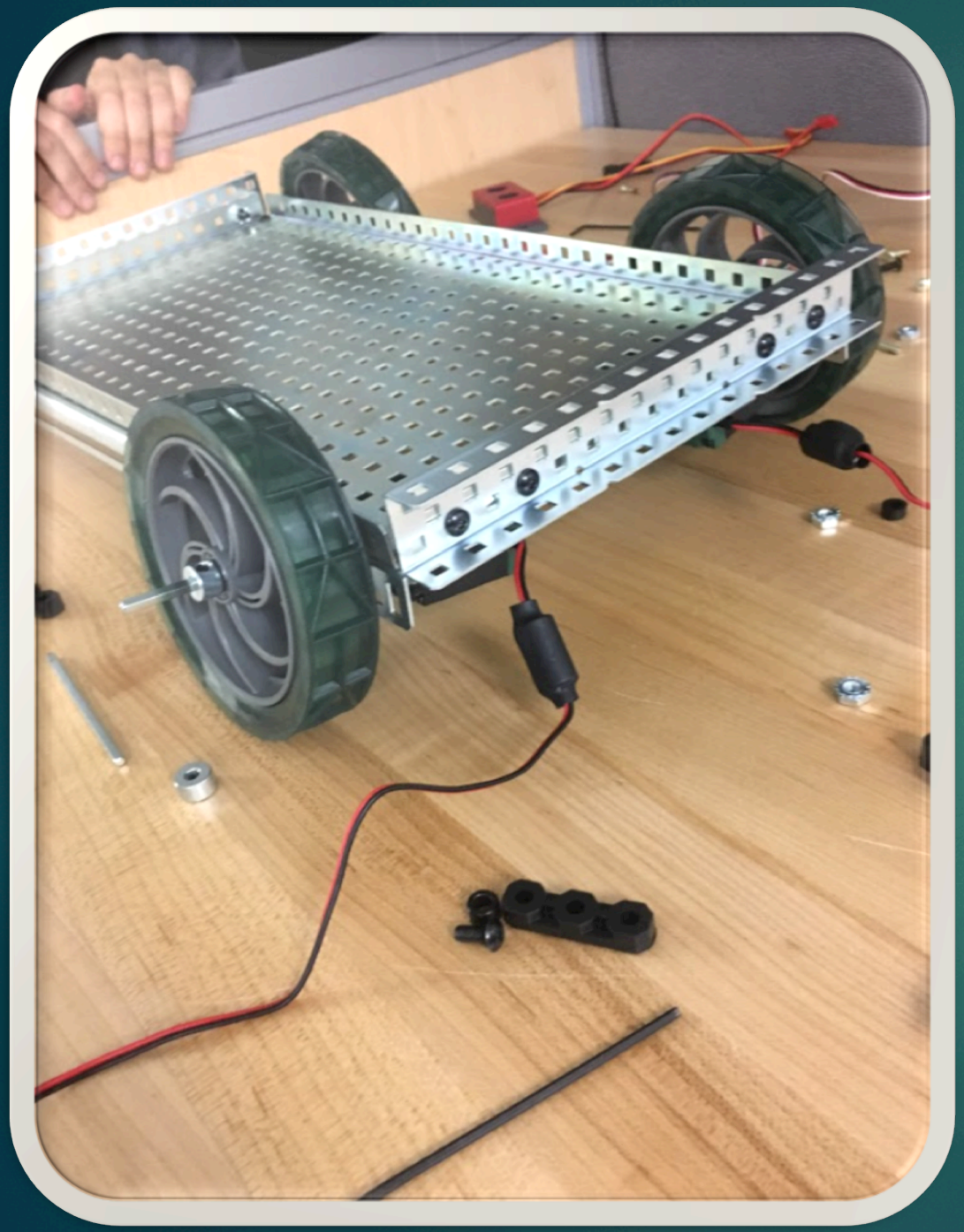
- Apply Solutions to Real-Life Situations
- Collaborate under time constraints
- Create multiple drafts to pick the one that best fits
- Present our projects comfortably in different environments

Automata Design Project

CAD Modeling

Drilling

Assembly

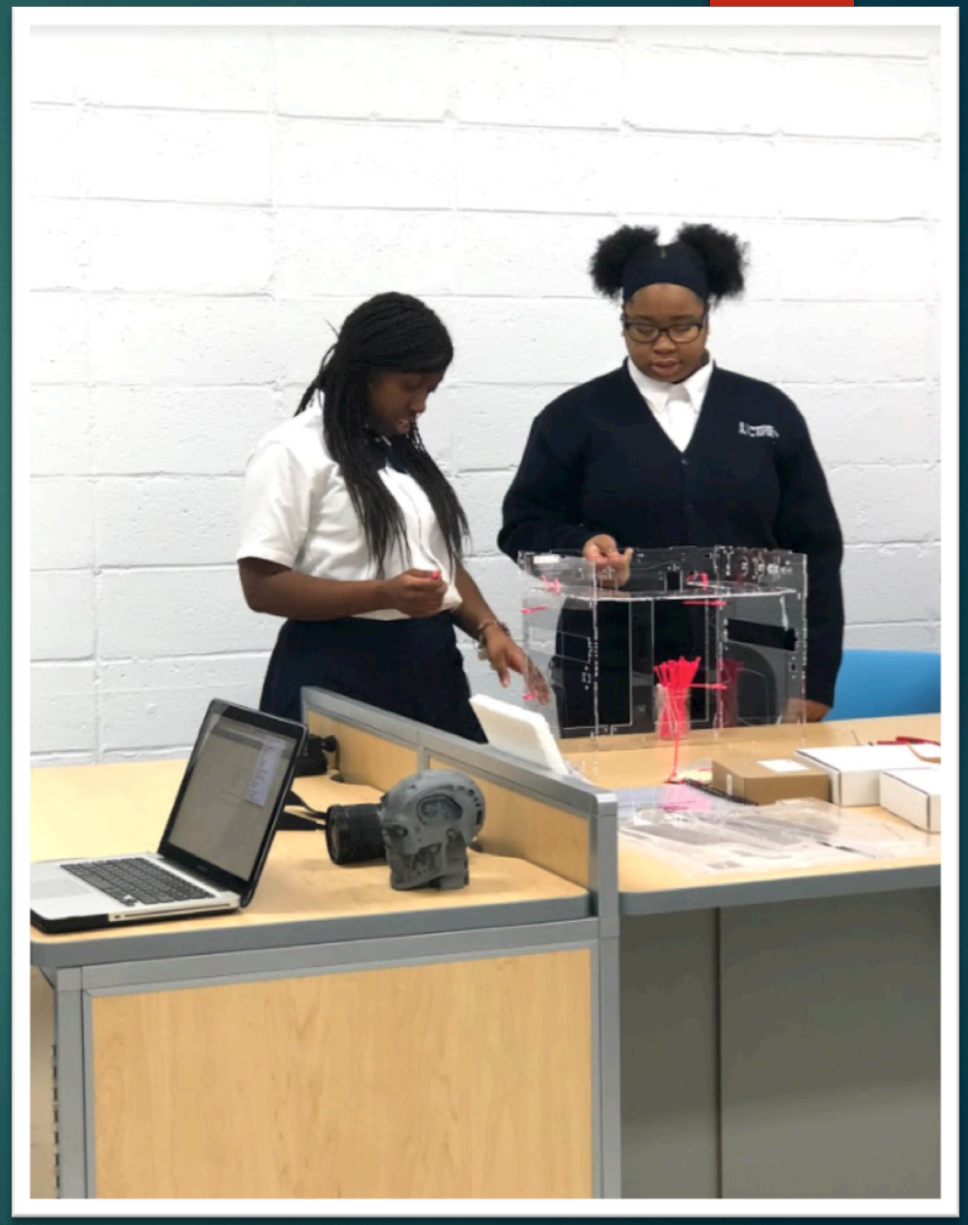


Automated Guided Vehicle (AGV)

- RobotC Coding
- VEX Cortex
- Light Sensor

PLTW Design Process experiences helped us to complete this project easily.

JellyBox: 3D Printers



Orange Public Schools

Thank you for listening

PROJECT LEAD THE WAY
PLTW