



Σ I G M A



VOL. 5 Fall 2017

Welcome to the Research Club!



The Research Club is created to facilitate student research in a myriad of topics. Every Friday, we will either be listening to a guest speaker, doing experiments, learning lab techniques, or working on internship applications. It is one of the few clubs in Stuyvesant dedicated to developing student's interest in research and preparing student's for greater opportunities. One of its main goals is to revive Sigma, its magazine, in order for more members of the Stuyvesant community to have access to scientific material written by their peers. By encouraging its members to write articles, the club aims to hone the writing, presentational, and communication skills of future scientists.

Additionally, the club will expand and strive to compete in science competitions by forming members into teams based on their interests and levels of experience. The club hopes to motivate its members to actively engage in scientific discussions and earn valuable experience by receiving feedback to improve their scientific writing.

Take Advantage of this Edition

This edition features many of this year's graduating seniors' research reports, which were submitted to Regeneron and various other prestigious competitions.

The reports have been annotated and shortened by members the Research Club. We hope this can aid your understanding of the report.



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Special thanks for the support of Principal Contreras, the Biology Department, the Chemistry & Physics Department, Alumni Association, and the Student Union.

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The Effects Of The PARP Inhibitor Olaparib Of Lymphoblastoid Cell Lines With Heterozygous Pathogenic Mutant BRCA Pathway Proteins

By Samuel Ramos

Olaparib is a new chemotherapeutic on the market, which uses an effect known as synthetic lethality in order to kill tumor cells. Despite its benefits, the selective targeting of cancer cells by synthetic lethality that makes PARP inhibitors an effective cancer treatment may also lead to increased cell death in people who are genetically predisposed to breast and ovarian cancer, due to the removal of the base excision repair pathway and reliance on the damaged homologous repair pathway. In order to address whether or not a heterozygous pathogenic mutation in the BRCA repair pathway, common in the somatic cells of breast and ovarian cancer patients, would cause cell death, I focused my research on the effects of olaparib heterozygous BRCA pathway protein pathogenic mutants. My results have led me to the conclusion that these cells show significantly increased sensitivity to Olaparib compared to normal BRCA pathway protein cells in humans.

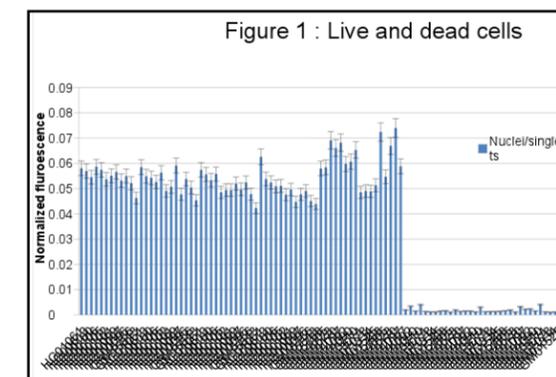


Figure 1: In this graph, it can be seen that much fewer viable cell nuclei were counted by the flow cytometer in the variant cells than in the control

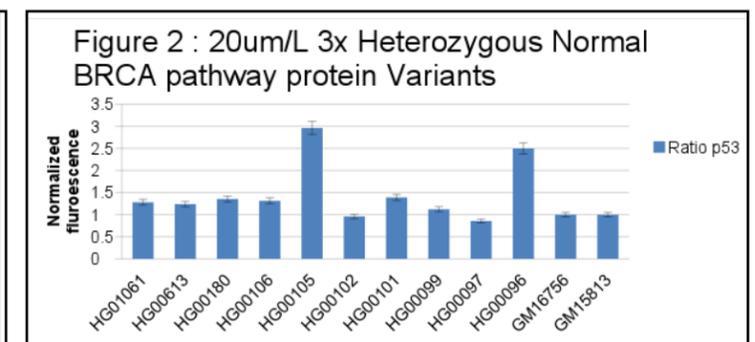


Figure 2: The healthy LCL cell lines used as the control were treated with 20 um/L 3x of mimetic agent combo and did not show increased localization of p53

AISE Survey Response

An anonymous email survey of Stuyvesant High School students was conducted in order to test possible applications of the Asch-Line Experiment in regards to subjective issues. Students were asked to respond to a variety of prompts indicating their self-reported agreement with a minimum wage hike and their motivation on the issue. Students were randomly assigned two versions of the survey. The one difference between those surveys was information indicating wide popular consensus between a minimum wage hike. The notion tested was whether evidence of a popular majority in support of a minimum wage hike would cause greater support of a minimum wage hike and a relative decline in the motivation of those opposed to a minimum wage hike. The evidence gathered regarding this notion ranged from inconclusive to dismissive of this notion.

Effects of SUMO-1 Gene Transfer on Cardiac Function in a Mouse

By Michael Zheng

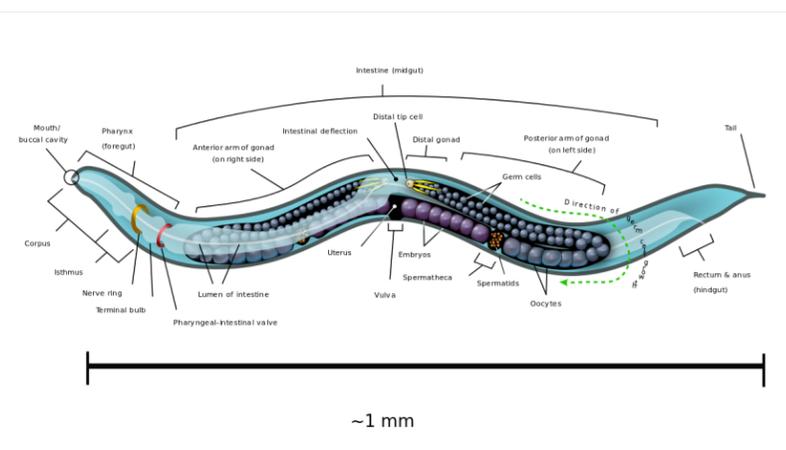
Congestive heart failure is an omnipresent feature of Duchenne Muscular Dystrophy (DMD); two key components of which are cardiac oxidative stress and decreased sarcoplasmic reticulum calcium adenosine triphosphatase (SERCA2a) activity and function. SUMO-1 gene transfer has been shown to both improve SERCA2a expression and function as well as prevent harmful changes caused by reactive oxygen species (ROS). In this article, we aim to determine the expression levels of SERCA2a and Nox4 in muscle dystrophic hearts with and without SUMO-1 gene transfer in animal models of DMD, *mdx* mice and *mdx:utrophin* double knockout (dKO) mice. Our results show that adeno-associated vector type 9 mediated SUMO-1 gene transfer via tail injection was effective in improving both increasing levels of SERCA2a and decreasing levels of Nox4, while improving fractional shortening, and thus cardiac contractility and function.

Inducing RNA Interference in *Caenorhabditis elegans* using Dpy-11 and Bli-1 transformed OP50

By Manjit Singh

Many problems arise from mutations. They cause disease, damage the body, and are extremely difficult to study in a lab setting. Mutations in a cell occur due to random chance, so when different mutagens, or agents that cause mutations, such as radiation and damaging toxic agents like nitrous oxide, is introduced to the cell, the mutation aimed for has only a small chance of actually occurring and the chance of it occurring without any other mutations is even smaller. This makes reproducing the effects of the mutation in a lab much harder.

My team and I worked to figure out a way to replicate the effects of certain mutations in *Caenorhabditis elegans*, or *C. elegans*. *C. elegans* is a very simple organism, yet its genome and processes closely resemble those of humans, especially in the neurological sense. For this reason, *C. elegans* are commonly used to determine how certain mutations affects certain processes. The process we used to simulate the effects of the mutations was RNA interference. RNA interference uses genes from certain bacteria to block out the effects of genes in the *C. elegans*. We used RNA interference to study how two genes, the Dpy-11 gene and the Bli-1 gene, affect the behavior and appearance of the *C. elegans*. Our results indicate that the Dpy-11 gene codes for the worms ability to move in a serpentine pattern as well as the width of the worm and the Bli-1 gene codes for



This diagram of a lateral cross section of a single *C. elegans*, with its different components highlights the similarities between human and *C. elegans* anatomy and physiology.

Characterization of N-Myc Downstream Targets

By **Benedict Ho**

A subtype of prostate cancer called neuroendocrine prostate cancer (NEPC) develops as a mechanism of treatment resistance. NEPC has been shown to be driven by overexpression and amplification of the oncogene MYCN (encoding N-Myc). This research aims to determine how N-Myc drives the NEPC phenotype by identifying downstream-regulated genes. By identifying downstream targets, a greater insight into how N-Myc reprograms prostate adenocarcinoma can be gained.

Two human models are used in this research. One is a castration-resistant human cell model, established from 22Rv1 cells that have been transfected with N-Myc. The other is a novel patient-derived NEPC cell line model with endogenous expression of N-Myc. Downstream targets of N-Myc were identified by both comparing syngeneic 22Rv1 cell lines and by knockdown of N-Myc in the organoid models. Collectively, my data establishes N-Myc as an upstream regulator of ten genes that previously were never associated with N-Myc in NEPC. These target genes include genes that may drive features of NEPC, like FYN and NCAM (implicated in metastasis), and genes involved in stem cells biology, like SOX11 and HOXB6.

The Correlation Between Antibiotic Exposure and Obesity: The Implications of PPAR-gamma gene Differences in Mice Exposed to and not Exposed to Antibiotics

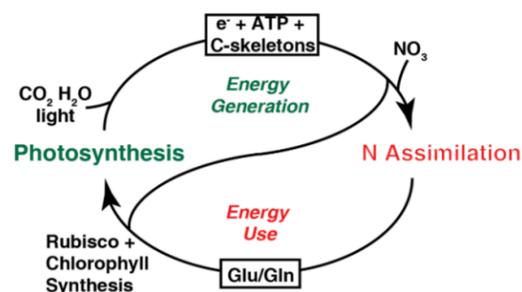
By **Kazi Maisha**

A linkage between antibiotic exposure and obesity has been observed in previous experiments and situations. In the Blaser Lab, the actual mechanism that allows for this correlation is being observed with a subtherapeutic antibiotic treatment experiment. Mice are being exposed to antibiotics and put on a high fat diet to track their weight gain journey. This is being compared against mice not on antibiotics but on the same diet. There is known exhibited difference in the fat cell gene expression typically found in brown fat between control and STAT groups [Can Include Paper from Dr. Mueller if Available Yet]. Therefore, transcription factors or these cells are being isolated and studied to track its significance in obesity related to antibiotic exposure. PPAR gamma, also known as peroxisome proliferator-activated receptor gamma, is the specific transcription factor being focused on due to its high frequency in brown fat cells in mice. Its frequency in fat cells of STAT mice as compared to that in control mice will indicate its relevance in this antibiotic-exposure chain.

Quantifying the impact of nitrogen use on photosynthetic rates by live imaging

By Jenny Gao

The increasing agricultural demands due to the growing population has led to increasing uses of nitrogen fertilizer. It is essential to obtain a better understanding of how plants respond to levels of nitrogen supply in order to reduce the detrimental impacts of nitrogen on the environment. Nitrogen assimilation is an energy-demanding process which is reliant on the energy generated during photosynthesis. The objective of this project is to gain insight into the link between energy demand for nitrogen assimilation and energy production by photosynthesis by examining the effect of light intensity and nitrogen dose on traits such as biomass. Computer scripts were developed to estimate chlorophyll content from leaf color and biomass from leaf area. In addition, photosynthetic parameters were measured on live plants using pulse-amplitude modulated fluorometry. These approaches should advance plant sciences because, as opposed to common procedures, the ones developed here are noninvasive and allow continuous measurements. Results showed that color can estimate chlorophyll concentration and should be further explored. Finally, my results showed a link between photosynthesis and nitrogen use, as biomass is dependent on nitrogen supply for plants grown in high light, but not low light. It was concluded that there is an interaction between nitrogen and light on photosynthesis and biomass.



(Research facility, 2017)

Figure 1: This ying/yang model shows that nitrogen assimilation is linked to photosynthesis in the energy cycle.

A More Efficient Algorithm For Appending Data

By James Ko

This paper introduces growth arrays, array-like data structures that are designed for appending elements. When the number of items is not known beforehand but is expected to be large, growth arrays perform better than dynamic arrays by a constant factor. They support all operations dynamic arrays do, such as random access, iteration, and insertion or deletion at an index. For operations other than appending, however, they perform the same as or slightly worse than dynamic arrays. Growth arrays have the potential to make a major impact on the field of computer science. If dynamic arrays are replaced with growth arrays across various programming languages and frameworks, it is likely that many programs will see significant performance boosts. Also, other array-based data structures such as circular queues and stacks stand to benefit from the efficiency improvements of growth arrays.

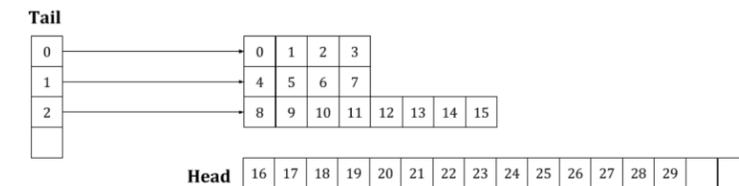


Figure 1: Appending 30 items to a growth array with $c_0 = 4$, $g = 2$

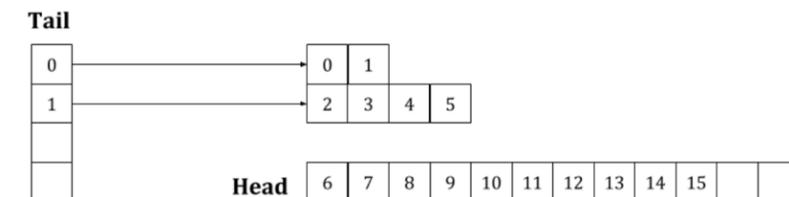


Figure 2: Appending 16 items to a growth array with $c_0 = 2$, $g = 3$

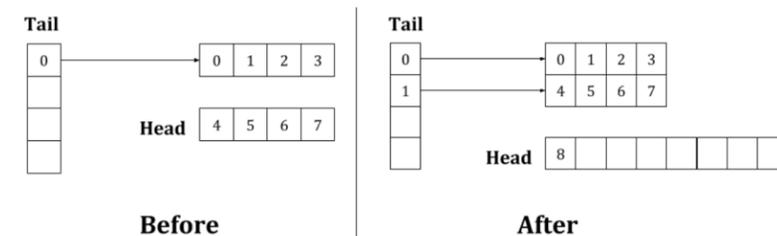
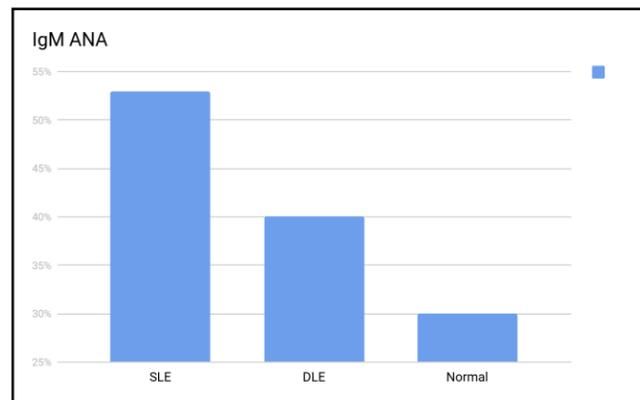


Figure 3: Appending 1 item to a growth array with $c_0 = 4$, $g = 2$. Initial size: 8

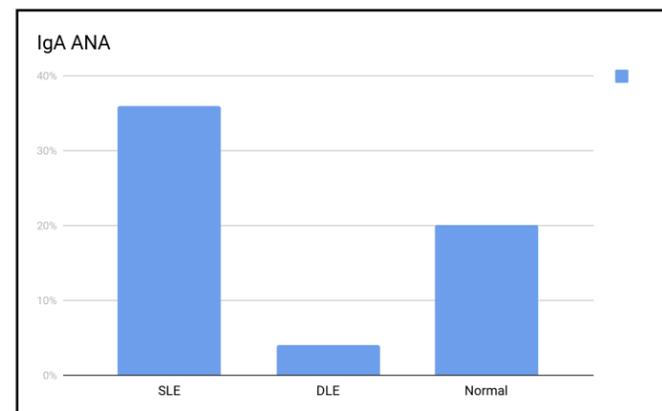
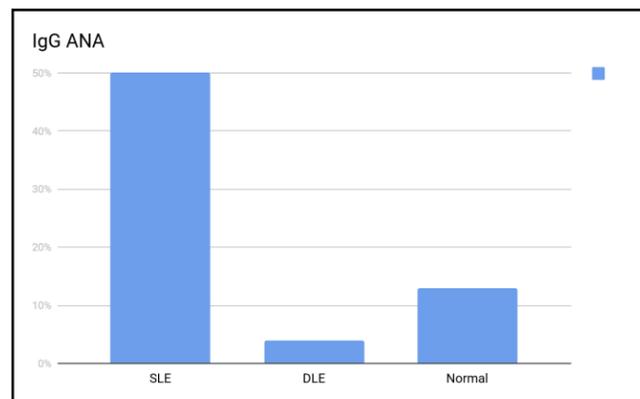
Immunoglobulin Antinuclear Antibodies Correlation With SLE and DLE

By Razeen Adit

Systemic Lupus Erythematosus (SLE) is an autoimmune disease that affects 1.5 million Americans. In people with SLE, the bodies own immune cells attack itself. Discoid lupus erythematosus (DLE) is an autoimmune disease similar to SLE that only affects the skin. Higher levels of Immunoglobulin antinuclear antibodies (ANAs) were found in people with SLE than DLE. We took samples from people with SLE, DLE, and people with no autoimmune history. We tested for different ANAs through using enzyme-linked immunosorbent assays (ELISAs) along with immunofluorescence (IF). Both methods showed higher levels of ANAs in SLE patients compared to DLE patients.



Previous studies have concluded that SLE has higher levels of Immunoglobulin G (IgG) than DLE. Our research, tested to see if a correlation exists with IgM and IgA just as it exists with IgG. Positive IgG was seen in 50% SLE, 4% DLE and 13% Normal. IgM antinuclear antibodies were present in 53% SLE, 40% DLE and 30% Normal. IgA antinuclear antibodies were present in 36% SLE, 4% DLE, and 20% normal.



Increasing Usability of Web-Based Decision Support System for Women with High Risk of Breast Cancer

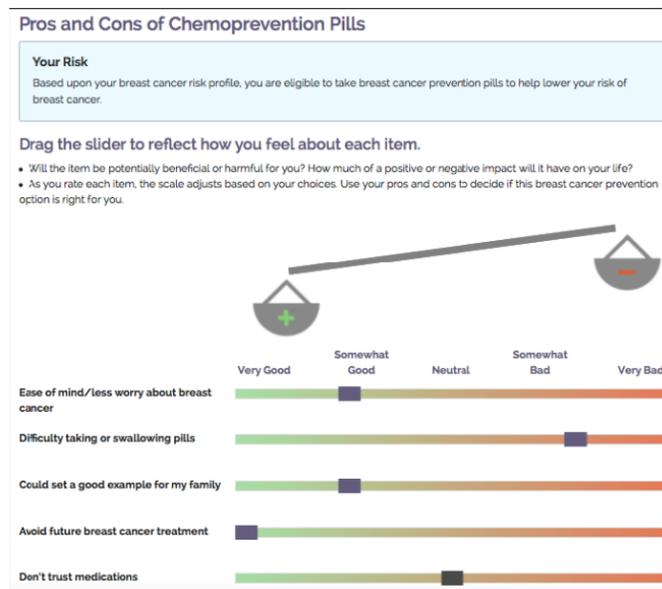
By Shayan Huda Chowdhury

Chemoprevention with antiestrogens such as tamoxifen and raloxifene could decrease the incidence of invasive breast cancer among women with high-risk of breast cancer by a staggering 30-70%, similar to the risk reduction of heart diseases. And yet, the adoption of such treatment is abysmally low, to the tune of 5%, with a major reason being lack of awareness among the target beneficiaries of the benefits of chemoprevention, lack of routine breast cancer assessment and lack of knowledge about chemoprevention leading to concerns about its side effects, due to it being associated with those of chemotherapy. The research team has developed RealRisks, a web-based tool to facilitate informed decision-making about send help chemoprevention.

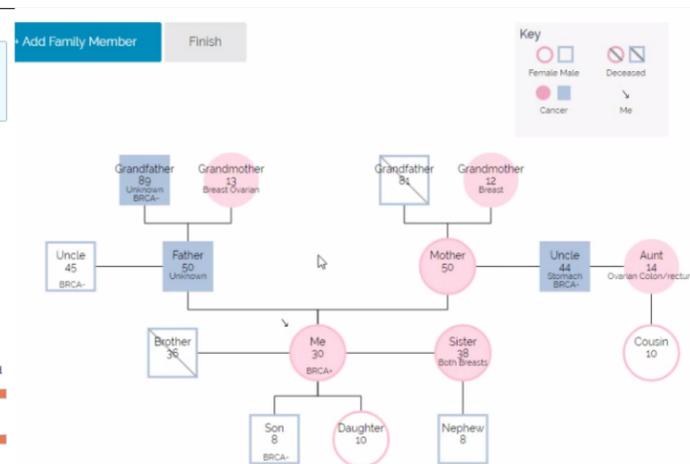
The purpose of this project is to understand usability issues of RealRisks among patients of different ethnic, economic and educational background, age, IT literacy, and English proficiency. My hypothesis is that such factors will significantly affect the subject's ability to use RealRisks and thus influence adoption of chemoprevention. Analysis of user behavior using surveys, usability recordings, etc. may make improvements in the content, ease of use and navigability of the tool and thus lead to increased adoption. Video tutorial may be used to make RealRisks more user-friendly and allow patients to have a platform for learning at their own pace.

The findings of the study indicate that over 85% of participants thought RealRisks was useful, easy to use and increased their knowledge about breast cancer and understanding of breast cancer risk factors. However, based on difference in usability score from English-speaking and Spanish-speaking subjects, usability improvements would need to be made to accommodate both language speaking populations.

Based on our findings, we concluded that the various methods we implemented in RealRisks such as the “clicking games” and “preference elicitation” activities were immensely effective in improving the perception of user-friendliness. Furthermore, for user groups with strong family ties, e.g. the Hispanic population, the action plan generated from RealRisks was able to be targeted for not only the patients but families. In conclusion, the study underscores importance of usability testing in creating culturally relevant and targeted PtDAs designed for diverse populations with varying health literacy and acculturation. The implications of this study may be applicable to other PtDAs for generating awareness about screening for other forms of cancer and even other diseases thereby reducing load on providers and thus healthcare costs.



Preference Elicitation Scales to Help Reveal The Importance of Various Factors to the Subject



Using the Gail Model to Help Build Appropriate Family Tree to Assess Risk from First-Degree Relative

The Effects of Autologous Plasma Concentration and Volume of Culturing Medium on the Metabolic Activity of Human Umbilical Cord Stem Cells

By Qixuan Weng

Umbilical cord stem cells are of continued interest as they explode in the medical field with more research concluding on their abilities to better treat or cure various diseases. However, effective preservation and expansion of the stem cells remains a challenge, yet is essential to a large-scale application. Traditional methods of cell expansion, culturing in fetal bovine serum (FBS), have unsatisfactory cell yields; however, human cord blood-derived plasma (hCBP) may be an effective alternative. The effects of autologous hCBP in the culturing medium of cord stem cells were studied by comparing their metabolic performances in their respective media using spectrophotometry. The results depict high absorbances for media with 5% hCBP, but lower absorbances with higher concentrations of hCBP--that is 10% hCBP. As expected, the 5% FBS medium did not show promising results compared to hCBP. However, 40 μ L of test medium yielded lower metabolic performance relative to 200 μ L, most likely due to significant evaporation rates that cause MTT's cytotoxic nature to manifest. To reinforce the current conclusion, hCBP concentration with smaller average increments with different volumes can be studied to get more precise answers. In addition, repetition should become significant in future experiments to ensure effective precision of prospective data.

A Little Love Goes a Long Way: Family Cohesion and Suicidal Ideation in NYC Adolescents

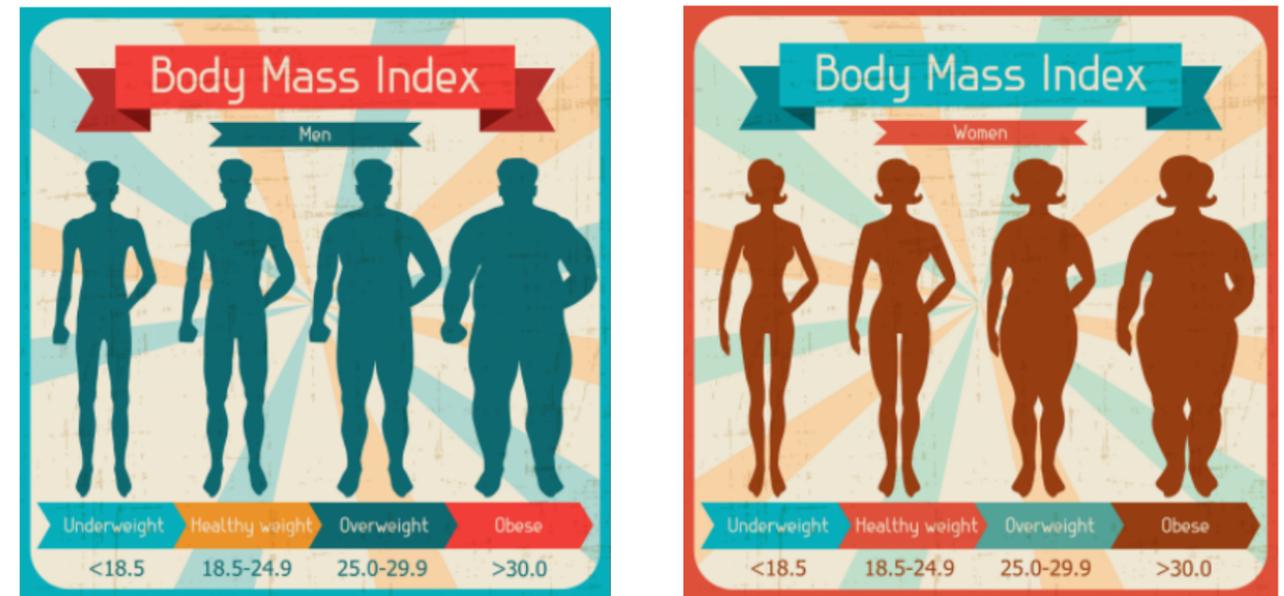
By Charlotte Ruhl

This research study investigates the relationship between family cohesion and suicidal ideation in New York City adolescents ages 12-19. Participants (n=55) were given a series of questionnaires that measured both variables. The moderating effect of sexual orientation was also observed. The Family Assessment Device (FAD) was used to measure family cohesion, while the Suicidal Ideation Questionnaire (SIQ) was used to measure suicidal ideation (SI). Results demonstrate a moderately negative relationship between family cohesion and suicide ideation, as illustrated by the Pearson's product-moment correlation coefficient. The hierarchical linear regression analysis demonstrated that the demographic variables were not statistically significant in the family cohesion and suicidal ideation interaction. A two-way ANOVA moderation analysis did not reveal a statistically significant moderating role of sexual orientation. Although this study had limitations, such as a small sample size, the cross sectional approach, and restricted geographic region, it offers new insights regarding the contributing role family cohesion plays in adolescent suicidal ideation. Future research on family cohesion should account for cultural values, acculturation and enculturation, and should also distinguish among the levels of severity of suicidal ideation, ranging from passive thoughts to active plans. Overall, this study emphasizes the importance of suicide awareness and familial unity.

Unveiling the Significance of Factors Involving Body Mass Index (BMI) in Early Teens (Ages 13-17)

By Dell Zheng

This study to presents a model with the purpose to analyze what factors affect students and determines each student's Body Mass Index (BMI). This study utilizes a Multivariate Linear Regression F Test, along with the corresponding T tests for each individual variable. The Multivariate Linear Regression F Test was conducted using the Analysis ToolPack from Microsoft Excel. With a significance level or alpha of 0.05, only 1 of the variables end up being statistically significant, as well as the model as a whole.

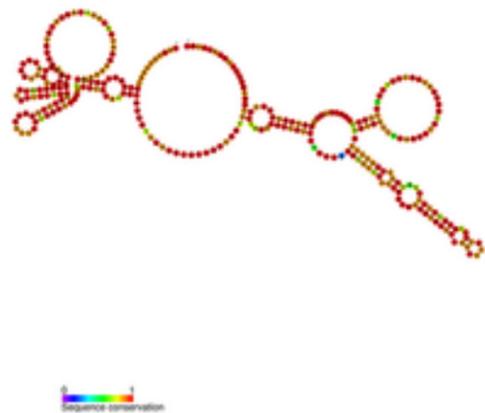


Two diagrams illustrating Body Mass Index ranges and the corresponding weight classifications (such as underweight and obese) for people within those ranges. Classifications based on BMI are different for men and women, so separate charts are needed.

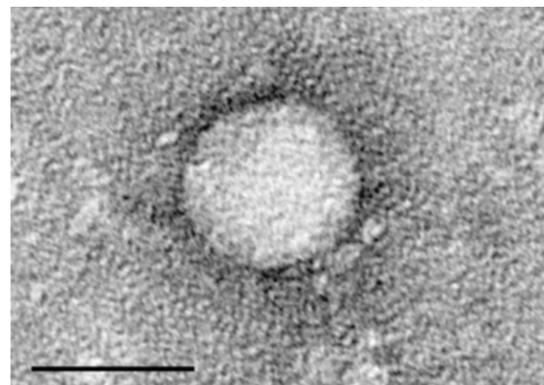
Homology Between Viral and Human Proteins

By Sean Vaysburd

Identifying homology between human and viral proteins is important because protein matches may provide insights for understanding viral diseases. The human immune system might be ignoring viruses with DNA homologous to that of human immune system cells, believing the viruses to be part of the immune system. This paper summarizes results of research on human-vs-viral homology for human proteins from the NCBI database and viral proteins from the ViPR and PaVE databases. Highly significant homology between human proteins and viral proteins was discovered. The homology was mainly with viruses of the poxviridae and herpesviridae families. Homology was also discovered with viral proteins and proteins of multiple model organisms. A notable result was homology with the protein ubiquitin on both viral and model organisms, which offers an area of future research.



The predicted structure of the retroviral 3'UTR stability element of the Rous sarcoma virus, the first described oncovirus (cancer causing virus).



An image taken through an electron microscope of a Hepatitis C virus, another famous oncovirus.

HUMOR



If a king farts...
is it called a noble gas?

What do you call an acid
with an attitude?
A-mean-oh acid.

I just electrocuted myself.

How shocking. How do you currently feel?

I'm kind of amped.

Watt I can't hear you.

I said it hertz a lot.

studyable

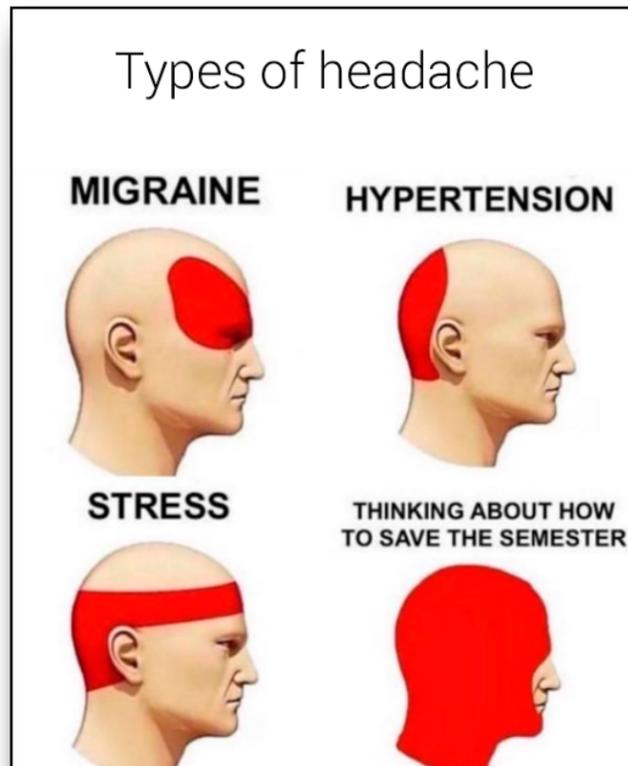
Did you know? Type O Blood was actually meant to be Type Zero blood, due to the lack of glycoproteins in the red blood cells. It was misread and is now called Type "O" blood. I guess you could call it a **typo**.

psychoxctive

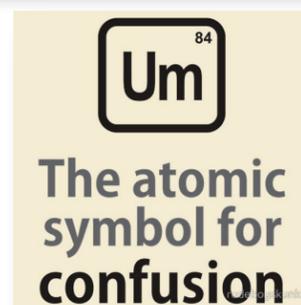
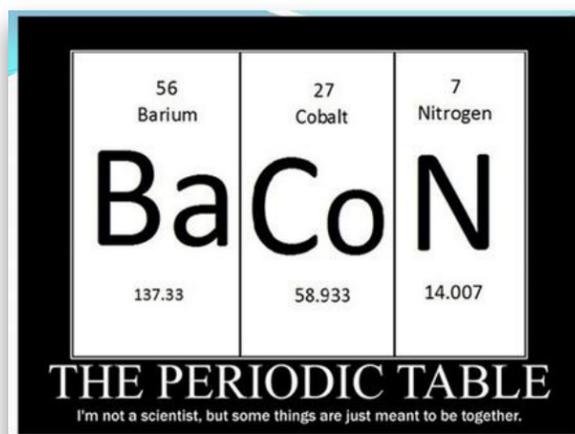
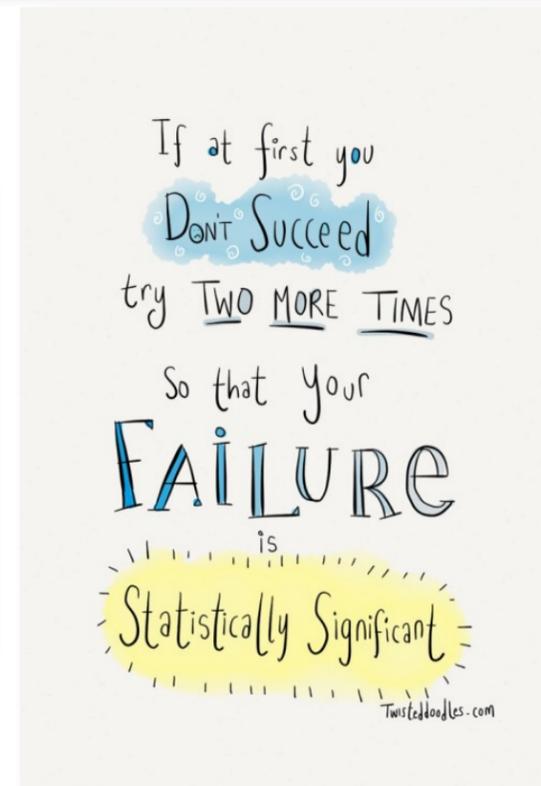
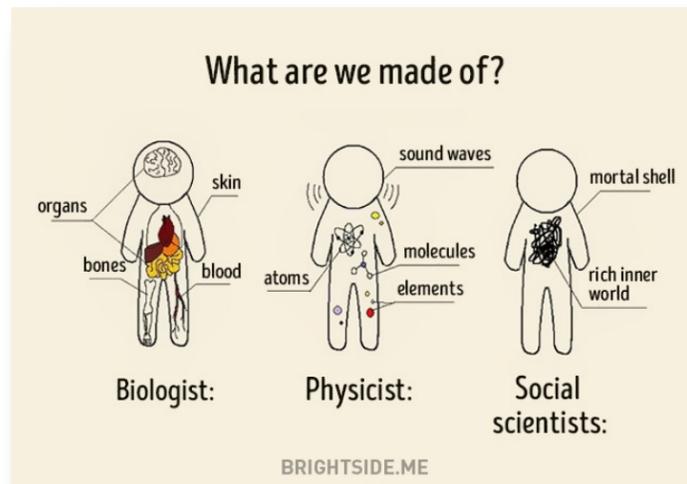
I showed this to my bio professor and she cried

Quelle: studyable #lol #science

276,621 Anmerku...



Me: What do I say to her??
 Friend: Bro, just be spontaneous, girls love that.
 Me: okay
 Me:



Student Opportunities

1. The Human Oncology and Pathogenesis Program (HOPP) Summer Student Program at MSKCC

A program in oncology during which students will have a chance to take part in independent research projects under the direct mentorship and guidance of a HOPP principal investigator (PI). Visit <https://www.mskcc.org/education-training/high-school-college/hopp-summer-student> for more information about the program. Applications are due February 8, 2018.

2. Cold Spring Harbor Laboratories SURP Program

A 10-week program over the summer that is designed to create as authentic a research experience for high school students as possible.

3. Rockefeller Center NYCSEF Program

A 6-week program that is sponsored by CUNY, whose goal is to introduce the research experience to high school students.

4. Group Summer Scholars Research Program (GSSRP) at the New Jersey Center for Science, Technology & Mathematics at Kean University

The GSSRP is a 6-week, hands-on research experience aimed at attracting and developing talented students who are interested in pursuing an education in a STEM field. Students learn how to conduct basic and applied research during this program and develop a true appreciation of the scientific research process while contributing first hand to the acquisition of new scientific knowledge. To apply, visit: www.kean.edu/summer-scholar. Applications are due March 30, 2018.

5. Applied Research Innovations in Science and Engineering (ARISE) program

This program is for academically strong, current 10th and 11th grade New York City students with a demonstrated interest in science, technology, engineering and math (STEM). Visit <http://engineering.nyu.edu/k12stem/arise/> for more information and to apply. Applications are due March 1, 2018.

2018

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