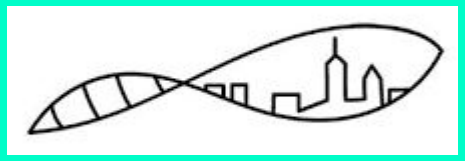
Transforming Cures with SENCER

Davida Smyth
Eugene Lang College of Liberal Arts

THE NEW SCHOOL LANG



SENCER
SCIENCE EDUCATION FOR NEW CIVIC ENGAGEMENTS AND RESPONSIBILITIES

A bit about Sencer...

We're 20 this year

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Science Education for New Civic Engagements and Responsibilities

=

SENCER, a comprehensive, national dissemination project, aims to improve undergraduate science education and foster civic engagement by teaching "to" basic science "through" complex, capacious, and unsolved public issues.

NATIONAL CENTER FOR
SCIENCE & CIVIC ENGAGEMENT
N C S C E

About | Resources and Initiatives | News | Meetings | Grants & Recognition

NATIONAL INSTITUTE FOR CIVIC ENGAGEMENT

Texas Woman's University Hold Fifth Annual SENCER Symposium

New SENCER ideals = Philosophy

- SENCER connects science and civic engagement by teaching “through” **complex**, and **unsolved public issues** “to” basic science.
- SENCER invites students to take **responsibility for their learning** and put the knowledge and methods of science to immediate use.
- SENCER reveals both **the power** and the limits of science in addressing the great challenges of our time.
- SENCER helps students make connections between local civic issues and national and global **“grand challenges.”**

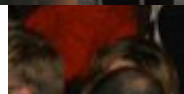
2001 SENCER Summer Institute



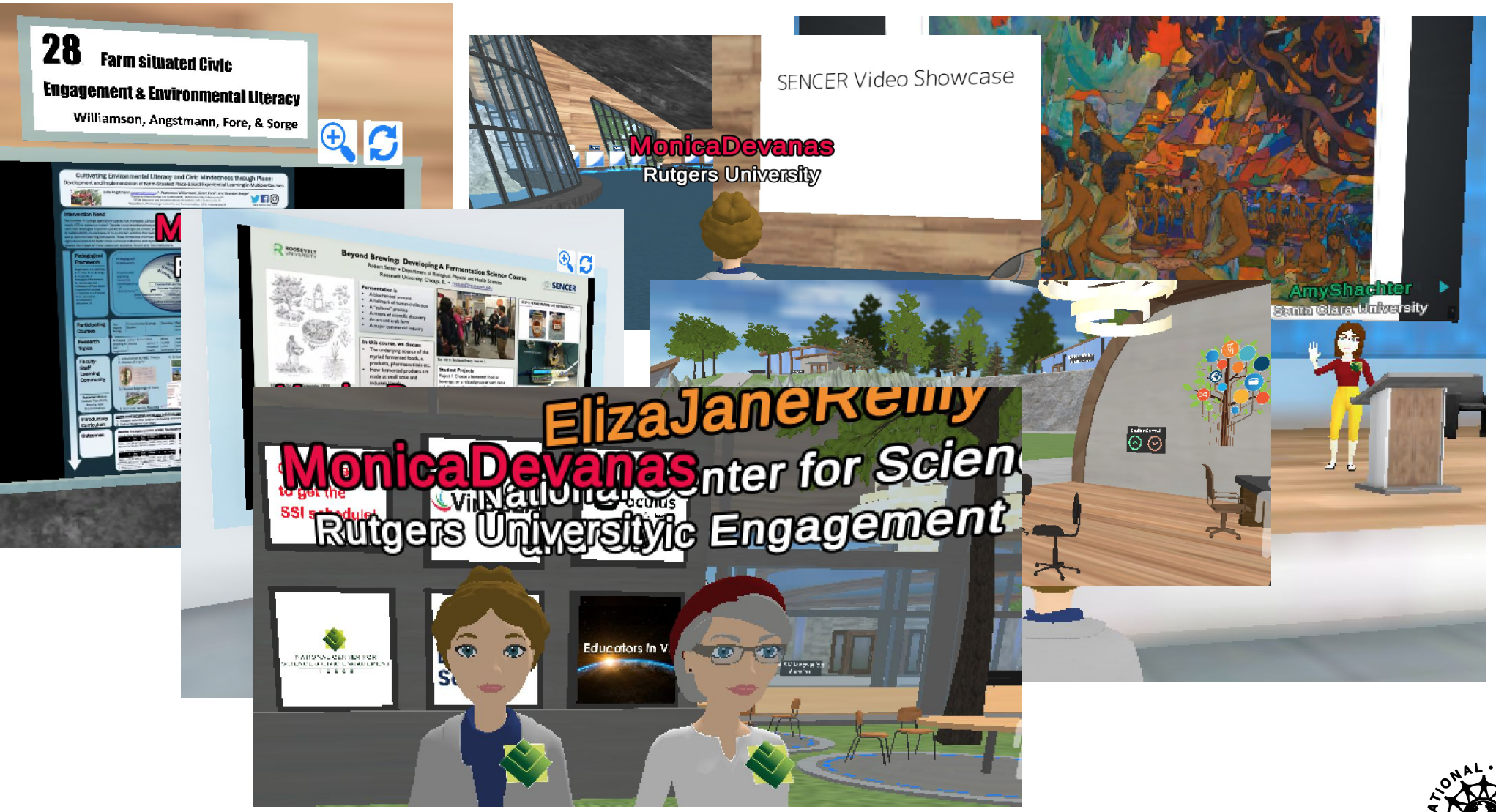






2020 SENCER Summer Institute



SENCER "Resources"

Model Courses

Pearls of Practice

Backgrounders

Informal STEM Learning Partnerships

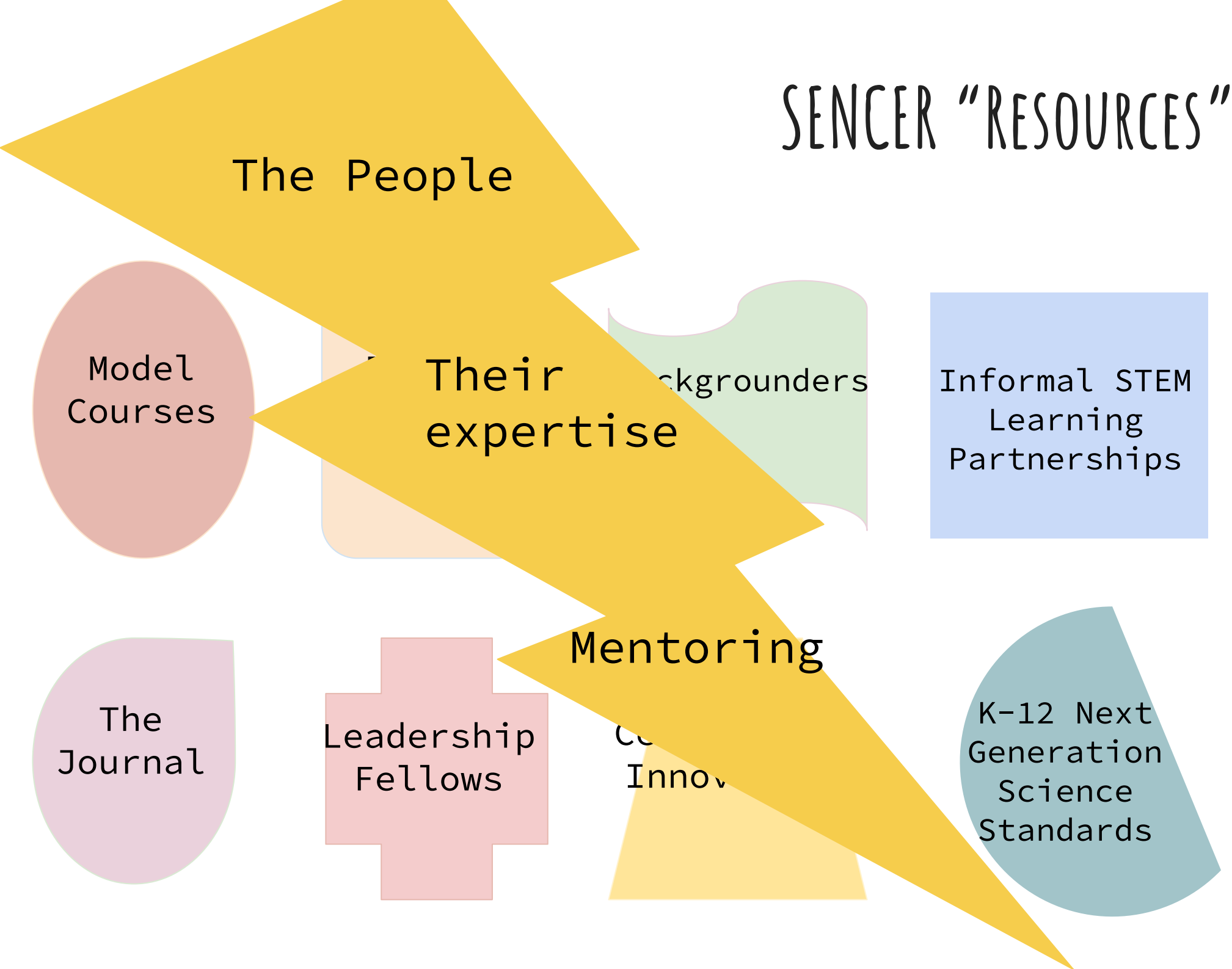
The Journal

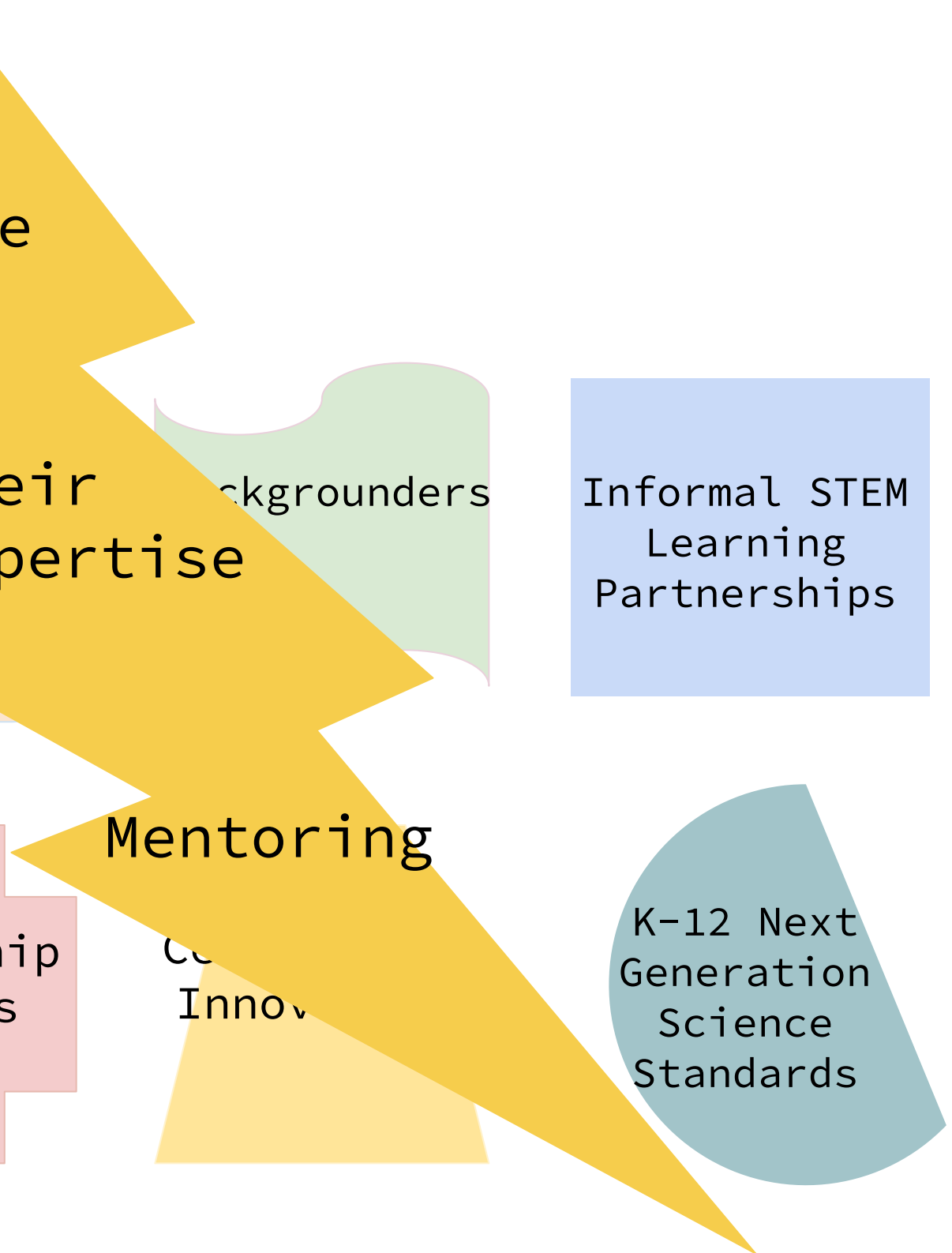
Leadership Fellows

SENCER Centers for Innovation

K-12 Next Generation Science Standards

SENCER "Resources"





SENCER outcomes

A Professional Community

Teacher-Scholars

Professional development - better teaching

Shedding light/ Solving local issues

Improve learning through real-world issues

SENCER, CURES AND ME

More impactful, Engaging, inclusive Teaching

Why Undergraduate Research and PBL?

1. Classroom-based Undergraduate Research Experiences (CUREs) and PBL have been shown to enhance the career development and readiness of students
2. They can substantially impact retention in STEM disciplines
3. CUREs and PBL are inclusive, exposing a greater number of students to high-impact experiences (Bangera and Brownell, 2014).
4. Projects can also be designed to generate meaningful data that can inform further student research projects as well as the research agenda of the faculty member

High-Impact Educational Practices: What They Are Who Has Access to Them and Why They Matter by George D. Kuh (AAC&U 2008)

What are They?

PBL as a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate an authentic, engaging, and complex question, problem, or challenge (Eberlein et al., 2008)

CURE course is one in which students are expected to engage in science research with the aim of producing novel results that are of interest to the scientific community (Corwin, Graham, and Dolan, 2015).

What are They?

PBL as a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate an authentic, engaging, and complex question, problem, or challenge (Eberlein et al., 2008)

CURE course is one in which students are expected to engage in science research with the aim of producing novel results that are of interest to the scientific community (Corwin, Graham, and Dolan, 2015).

We use an inclusive definition of undergraduate research (UGR) here as being an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline.

Iteration

Collaboration

Relevance

Discovery

Scientific Process

Auchincloss *et al*. 2014, Ballen *et al.* 2017

Scaffolded Experiences

Responsible for their own learning

Discovery

Local Issues/ Grand Challenges

Power and Limits of Science

Auchincloss *et al*. 2014, Ballen *et al.* 2017

Incubating the SENCER Ideals with Project-Based Learning and Undergraduate Research:

Perspectives from Two Liberal Arts Institutions

R. DREW SIEG
Truman State University

MADHAVAN NARAYANAN
Mercy College

JOSHUA SABATINI
Passaic County Community College

NANCY BEVERLY
Mercy College

GEETHA SURENDRAN
Mercy College

DAVIDA S. SMYTH
Eugene Lang College of Liberal Arts at the New School

Abstract

TABLE 1: Synergies Between the Efforts at Mercy and YHC

Project Characteristics	At Mercy (Majors and Non-Majors)	At YHC (Non-Majors)
Projects are authentic and tied to wicked and capacious problems or issues.	Projects are based around themes such as climate change, antibiotic resistance, and cancer.	Course is based around themes such as GMOs, epidemics, and antibiotic resistance.
Student voice and choice	Students pick the topic and/or design the experiment.	Students vote on three themes from a list of six options.
Students reflect on their work	We use pre- and post-SALGs and the URSSA. Rubrics are used to assess their fellow team members. They review their peers and give feedback.	We use the SALG, CLASS-BIO, and TOSLS as pre- and post-assessments.
There is time for critique and revision	We use shared lab books, lab meeting discussions, and peer review. The posters are reviewed before the printing and presentation.	Each theme's project involves at least one class period for peer review. Students also assign peer grades during group projects.
A challenging problem/question	Questions are capacious: How can we design a better sunscreen? Can we find antibiotic-resistant bacteria on the campus? What will happen when there are no more fish?	Problems relate to real-world questions: Do common foods contain GMOs? How widespread are antibiotic-resistant bacteria? Why do diseases spread?
Inquiry or research is sustained	Across the curriculum, projects can last from 2 to 15 weeks.	Each lab/lecture theme lasts 4 weeks.
Students present publically	Students present their work orally, in posters or as ePortfolios. In some cases, proposals/brochures are generated to effect change on campus. Students present posters either on campus or at local conferences.	Students generate distributable final projects, such as board games, campus flyers, and infographics.

Why do we need science at the New School?

View from a graduate TA :(

What about the New School?

THE NEW SCHOOL LANG

The school is known for fashion, theatre, music and social justice. But few know about the science program ….

Teeny program

~ 25 students

~ 30 minors

Room to grow!

About Interdisciplinary Science….

Student's don't declare a major until their sophomore year

Students have to take one class that fulfills the scientific perspective - not all students take a science class - No GenEd!

Seminar based curriculum

They don't "like" science.

It's not "for them".

They can't "do science"

The Freshmen

Getting started with SENCER

FYS: TOILETS CHANGED THE WORLD

FALL 2019

TAUGHT BY: DAVIDA SMYTH

SECTION: AA

CRN: 5919

Credits: 4

FIRST YEAR SEMINAR: HOW THE TOILET CHANGED THE WORLD: In this project-based seminar, we focus on the development of the toilet and its impact on sanitation and public health from the earliest biblical accounts to the present day and beyond. Class discussions will draw on news articles, blogs, and selections from scientific papers, and labs will contribute to the instructor's microbiological research investigating the impact of human activity on New York water bodies and ecosystems. We will approach access to toilets as a social justice issue both as a public health threat as well as a threat to public safety, particularly that of women. Students will learn about how toilet design and use differs across our globe according to cultural, economic, and political differences. Lastly, students will learn about current developments in improving sanitation and toilet access and how intrepid and creative individuals are developing ways to make money from poop. Assignments will include weekly reflective blogs, laboratory activities, and a collaborative project to design and market concept toilets that are aesthetically pleasing, affordable for low-income communities, and minimize their impact on planetary health. At the end of the course we will assess how this course has affected your perception of how toilets have impacted humans from the perspectives of public health, social justice, aesthetics and design.

- Students get assigned
- Not major specific
- Writing intensive
- Peer mentoring as well

Breadth and Diversity of Learning less depth

How do I assess?

- SALG - Pre and post
- Portfolios - reflect throughout
- Discussion boards - throughout
- Assignments - throughout
- Quizzes - not exams, mid and end of semester
- Projects with a rubric and presentation at the end

Class is designed to reflect the diversity of the learners. It’s interdisciplinary!

5449	“If you work at a waste-processing facility you would be paid due to the existence and constant flow of poop into the facility.”
6376	“You can make money off of people using your restrooms.”
27730	“Selling poop for creating fertilizer for plants.”
49032	“charge people to use the bathroom. Selling fertilizer”
51949	“It seems like most plumbing and chemicals companies make money off of it also in not human waste, any farms with natural fertilizer. ”
53558	“Compost toilets can be useful for farmers. Feces can be used to enrich soil. So the more enriched the soil is, the more productivity a farm has, thus more money is being profited.”
56031	“not adequate to answer this question. ”
56370	“Producing goods or services such as toilets or plumbing ”
58945	“You can become a plumber. ”
64053	“As I said before poop is a good fertilizer! People can and are already capitalizing on the fertilizer industry.”
73229	“You can make money from "poop" buy donating it for research.”
77740	“The waste produced by humans can be used as compost to fertilize crops. In order to achieve that, the waste has to be fermented within certain containers.”
98131	“Diaper companies, plumbing, toilet technology such as heated seats”

What do you expect to know by the end of the class?

“I expect that I will understand the history of toilets and sanitation as well as the social justice aspects of toilets. I would like to learn more about how to get involved in making sure people get good access to toilets and sanitation.”

“I would like to learn more about research skills”

“By the end of this class I would like to be informed on how toilets really do contribute to the world as well as the history behind them. I would also like to learn how we as a class can make a difference to the people who are less fortunate and do not have access to toilets. ”

What do you expect to know by the end of the class?

“I expect [illegible] and sanitation [illegible] ts. I would like [illegible] ing sure people get [illegible]

“I would l[illegible]

“By the en[illegible] how toilets re[illegible] history behind them. I would also like to learn how we as a class can make a difference to the people who are less fortunate and do not have access to toilets. ”

“I would like to know why it is so heavily based on science, and what we gain from taking this course. ”

Field Trips

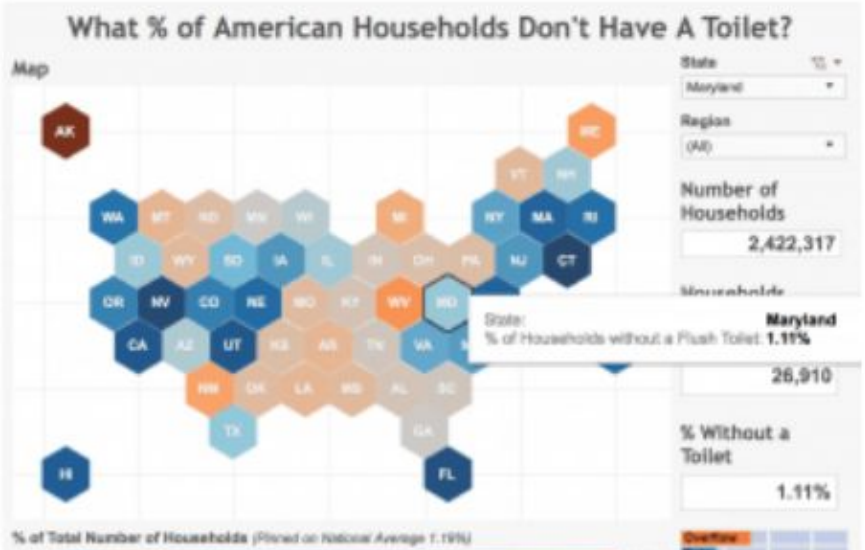
Davida Smyth @ProfSmyth · Oct 11, 2018

Who needs to visit a water treatment plant when you've one beneath you! OMG the New School University Center is ridiculously amazing ! Team **toilets** getting to grips with 'poop purée' and reverse osmosis systems @EugeneLang @TheNewSchool @SENCERnet @tnssciencelabs

Toilets Change the World: Ind 11

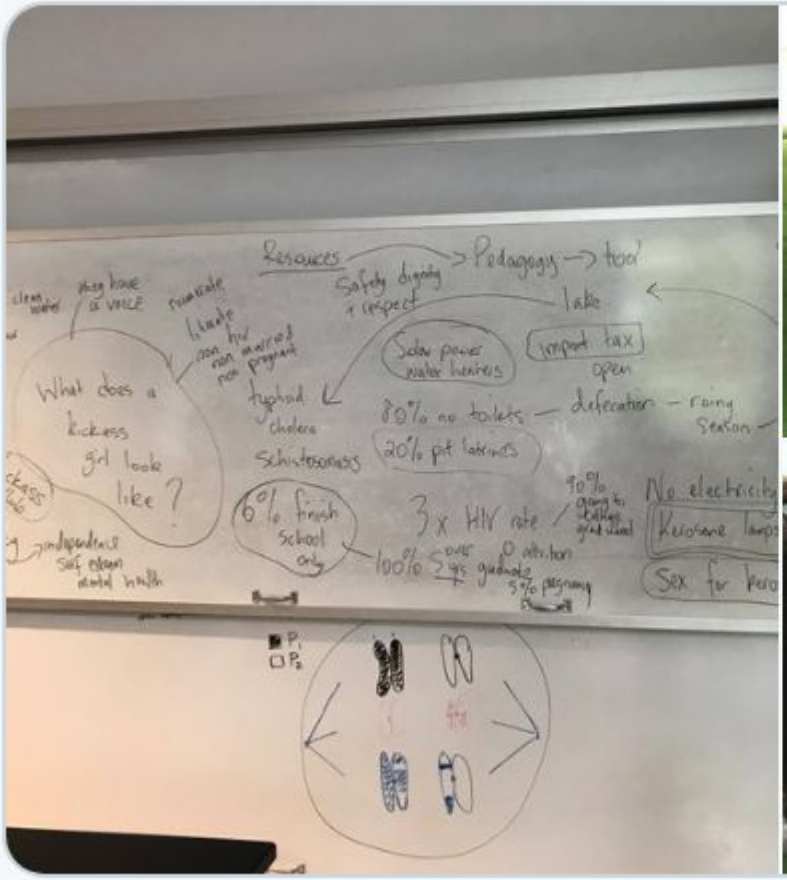
Posted on November 4, 2018 / Under Toilets Change the World / With 3 Comments

This week in class we analyzed data organized by Overflow Solutions Data, about the percentage of Americans without a flushing toilet. I looked at Maryland and the District of Columbia, where I live back home. I was surprised to find that 1.11% of Marylanders who own a home, don't have access to the flush toilet system in their home. It's very shocking to think that people in my state don't have access to something as simple as a toilet. Also, I do know that Maryland isn't a state in bad shape, in terms of money, because Maryland is full of many affluent and powerful people because of our proximity to Washington D.C. I also checked the District of Columbia's data and found that about 2,137 out of the 306,184 homeowners in D.C. don't have a toilet. Both Maryland and D.C. have enough money and powerful people to solve this issue of toilet access, however, even in 2014, this is still an issue.



Davida Smyth @ProfSmyth · Oct 2, 2018

‘Every time you see something good in our village there’s a **WISER** girl’ ...learning what a kick-ass girl looks like from Dr. Sherryl Broverman @girlsendpoverty from @WISERGirls_Intl @SENCERnet @EugeneLang @TheNewSchool @DukeU



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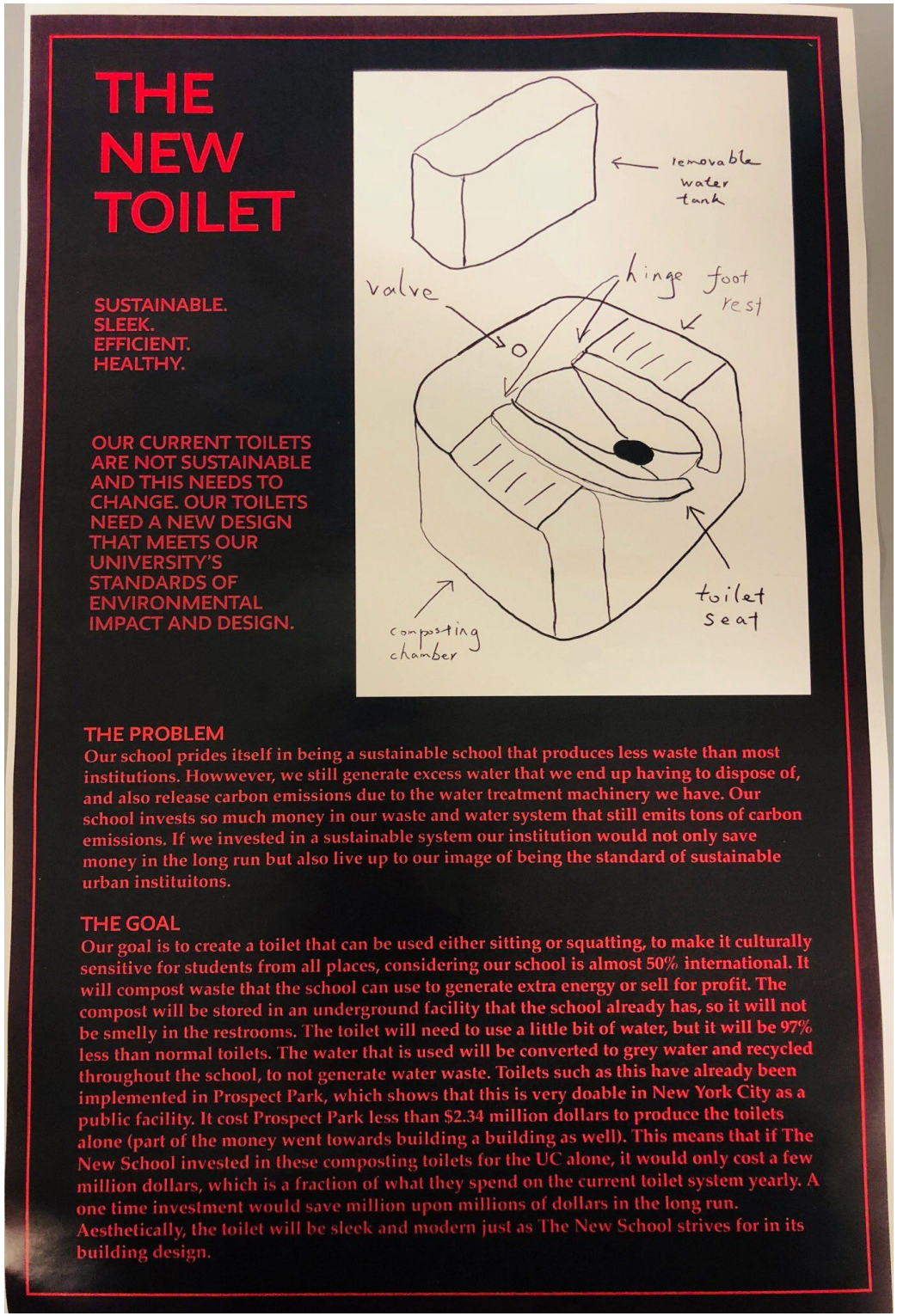


Project

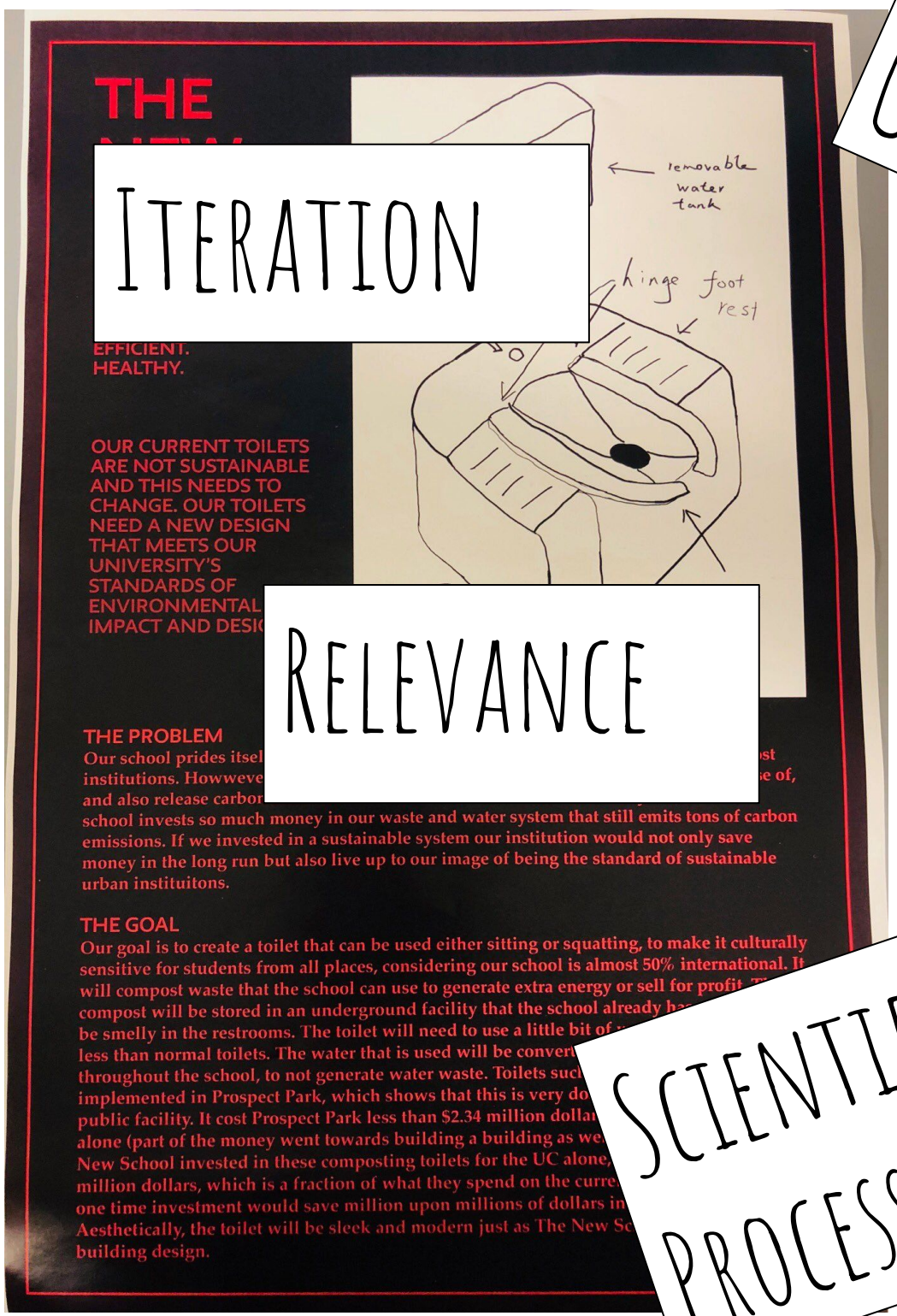
Team based semester long

Google docs

Final paper - rubric

Presentation - rubric

Invited guests



Iteration

Relevance

Collaboration

Project

Team based semester long

Google

Final p

Discovery

Presentation - rubric

ited guests

Scientific Process

Money from poop?

Response	Question
2223	“Waste can be made into compost or to produce biogas, which can be sold for money. ”
16945	“Poop can be the raw material for compost. Also, it can produce biogas if we place it in a biodigester.”
22246	“you can make money from poop by producing methane gas and compost material”
29615	“Mainly by using bio-digesters to create clean energy. ”
37630	“By turning it into energy you can use, or fertilizer.”
65334	“Through composting waste or using a toilet as a biogas system to power electricity, gas for cooking, etc”
79591	“You can install a biodigester and use the poop in it which will produce methane gas that can be burned and used as a source of power. The gas can be sold for money”

At the Introductory Level

MICROBIAL ECOLOGIES

FALL 2019

TAUGHT BY: DAVIDA SMYTH

SECTION: A

CRN: 7662

Credits: 4

In this course we will investigate the role that human activity can play in the ecological and evolutionary processes that generate, maintain, and perturb biodiversity in urban and rural, biotic and abiotic environments. Students will be introduced to contemporary ecology practices including computer-based simulations, statistics and modeling, as well as modern microbiological molecular and sequencing approaches. Ecosystem structure and processes in a variety of habitats, including soils, oceans, and the human gut as well as ethical considerations of sustainability, bioremediation and environmental justice will be reviewed to provide the foundational knowledge for an authentic four-week research project investigating the microbiome of the urban environment. Concepts will be reinforced with in-class assignments, case studies and discussions and learning evaluated by quizzes, laboratory write-ups, team projects, discussions of the primary literature, and in-class exams. This course satisfies the Foundation requirement for the Interdisciplinary Science major or minor. This course also satisfies the laboratory requirement for the Environmental Studies major, and the "subject by subject" course requirement for Journalism + Design Major. The course can also serve as a prerequisite for LSCI 3055 Microbiome of Urban Spaces research course.

- A major course
- More science focused
- Planetary health
- Has a CURE - tiny earth

Breadth and Diversity of Learning less depth

How do I assess?

- SALG - Pre and post
- Portfolios Project - with prompts
- Creative work - based on the portfolio
- Discussion boards - throughout
- Assignments - throughout
- Take home and in class exams, mid and end of semester

Class is designed to reflect the diversity of the learners. It’s interdisciplinary!

Can Bacteria Catch a Virus

Response	Question
1668	“true”
8561	“No”
15163	“Unsure”
17110	“Yes, but only certain types that attack bacteria. ”
21192	“Maybe? I am not sure what would happen if it did. Maybe certain ones would be fine and able to keep passing the virus on. ”
31394	“yes, some viruses can attach themselves to bacteria just as they attach themselves to human cells/host cell. ”
34742	“true”
44995	“I think so”
58834	“False”
80284	“No”
81517	“Yes”
82834	“I'm not sure. I think they can be overpowered, say by antibodies, but i'm not sure if they can be "turned" per se.”
85187	“Not all bacteria is bad, but all viruses are. ”
88562	“Viruses implant themselves into bacteria. ”
93009	“I'm unsure but I think so.”
99366	“Yes?”

Getting Friendly with Bacteria

- My cell wall structure/Gram stain reaction
- My type of respiration
- My type of metabolism
- Where do I normally live/do I sometimes go on holidays (from a lake into someone's intestine)
- Am I a pathogen? If not, am I useful for something?
- Do I have virulence factors? Am I antibiotic resistant?
- Who are my family members (My Genus) - Make friends with them on digication
- Who are my friends (In my classification tree) - Make friends with them on digication
- Do I have any pretty pictures of me/diagrams/movies
- Am I famous/in the news/notorious?

Deinococcus radiodurans

Here are some of my favorite Radioactive Spots around the world:

In 2011, I visited Japan after the 9.91 magnitude earthquake. This earthquake caused a powerful tsunami which shut down crucial parts of the Fukushima Daini Nuclear Power Plant causing disaster for the people of Japan and people who relied on the country's exports. (McFadden) For me, it was a great vacation spot where I got to receive large amounts of radioactive waste. Although I feel terrible for the people living in Japan at that time who were effected, I missed the previous nuclear power plant accident which happen around the world which I visited from there. I did help the community near Fukushima by acting as a form of bioremediation. I was able to help clean up the massive amounts of nuclear waste faster than humans. Nuclear waste lingers so I tend to come back to Japan as often as possible to get my fix. Little did the workers know that I was here to help out too!

Hanoi, Toru. The New York Times. Japan Indicts 3 Former Executives Over Fukushima Disaster. 29 February 2016. https://www.nytimes.com/2016/03/01/world/asia/japan-indicts-3-former-executives-over-fukushima-nuclear-disaster.html

Kondo Rubric

Does it spark joy?

PUBLIC PROGRAMS AND EVENTS

Marvelous Microbes

Eugene Lang College Building

GENERAL PUBLIC

Exhibition: February 17 - 28, 2020

Reception: Friday February 21, 2020 - 5:30 to 7:30pm

Marvelous Microbes the Exhibit will be held from the 17th to the 28th of February featuring the creative works of the Spring and Fall sections of Microbial Ecologies. The exhibit is a celebration of all things microbial, from art and comics to songs and plush toys. Each creative work was designed by a student as part of an assignment called "Getting Friendly with Bacteria" and has an associated barcode that links to a website, designed by the student, to feature the microbes. Come learn about all the marvelous microbes, their amazing capabilities, and their roles in Earth's Ecosystems!

Getting Here

About Public Programs

Subscribe to our mailing list

Livestream Channel

YouTube Channel

Davida Smyth @ProfSmyth · Apr 11

Team **Tiny Earth** at the New School wound down today with a flash poster session! Fun was had and we discussed what we'd do next if we had unlimited funding :) @TinyEarthNet @TheNewSchool @EugeneLang @NewSchoolTEDC @SfAMtweets @ASMicrobiology

Tiny Earth

studentsourcing antibiotic discovery

ProfSmyth · Apr

at the New School wou… flash poster

had and we discussed what …

:) @TinyEarthNet @TheNewSchool…

@NewSchoolTEDC @SfAMtweets @ASMicrobiology

ITERATION

COLLABORATION

RELEVANCE

DISCOVERY

SCIENTIFIC PROCESS

Undergrad Research

CURES, SURES and Independent Research

An Authentic Course-Based Research Experience in Antibiotic Resistance and Microbial Genomics

DAVIDA S. SMYTH
Mercy College

Abstract

We have designed and implemented a novel microbiology elective course "Microbiology of Urban Spaces" to provide students with a transformative education in microbial ecology and genomics. It champions the values of general education while making sure students are well equipped for their future careers. Infusing my personal research into the course allowed me the time and resources needed to advance my own research, while allowing the students to tackle an authentic and real-world problem that they can be passionate about. Several students who own ideas and questions. These students have taken the first steps towards developing the mindset and confidence in themselves that will enable them to succeed in their future scientific endeavors. Though still in its infancy, this course shows great promise to promote SENCER ideals at Mercy College and beyond.

Introduction

A Capacious and Civic Issue

Bacteria residing in the environment can act as reservoirs

Assessing Learning

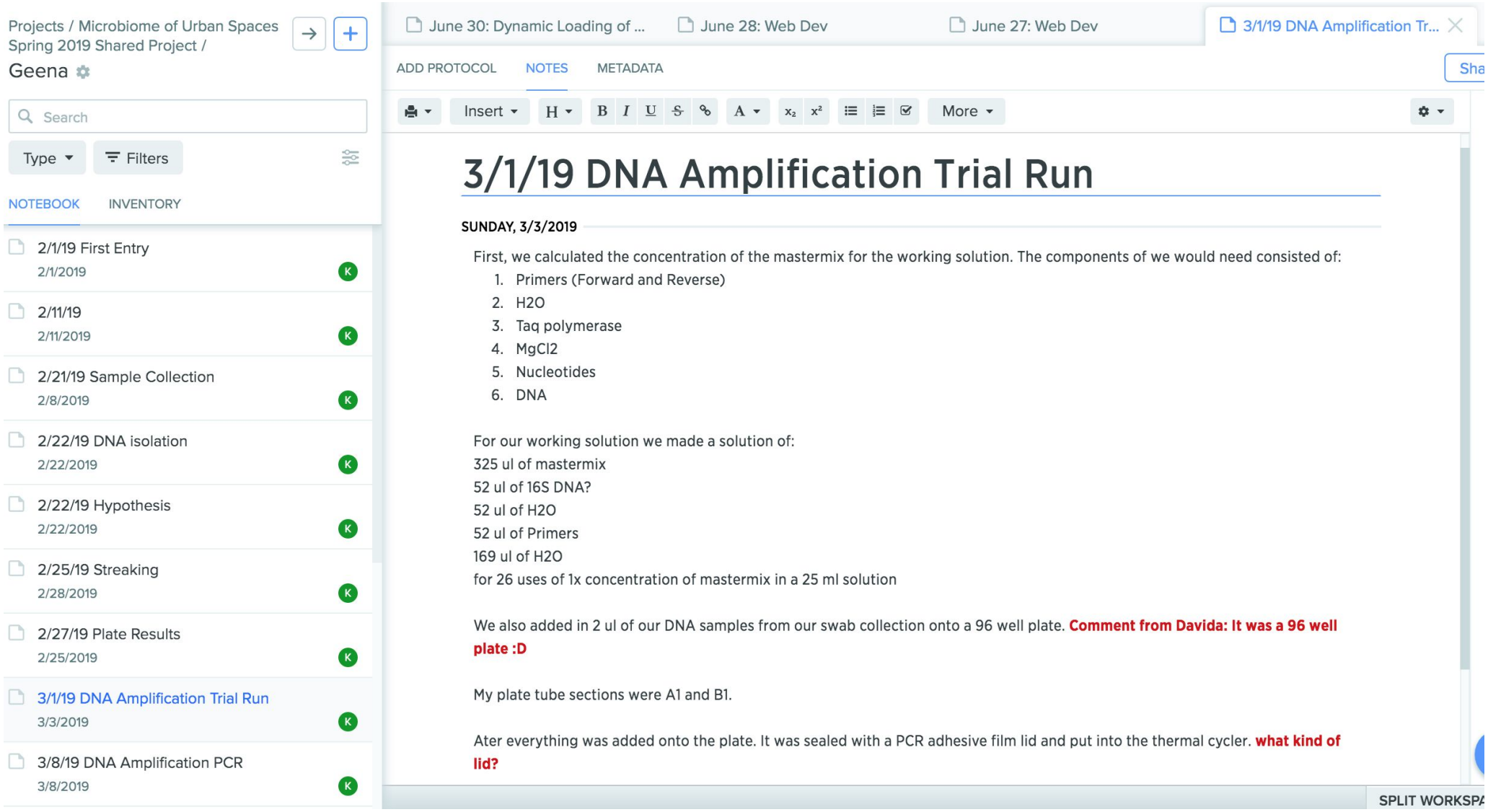
Before the experience
  a. SALG and Concept Inventories
  b. Quizzes - useful for safety training etc

During the experience
  b. Electronic Lab Book
  c. Weekly meetings - depends on the size of the class
  d. Mid-semester evaluation

After the experience
  b. SALG and Concept Inventories
  c. Final Papers - Rubric
  d. Posters - Rubric
  e. Presentations - Rubric
  f. Final Evaluation

Pre - SALG

Response	Question
14421	"Procedures during experiments, and forming a better hypothesis."
23176	"the intricacies of Microbiomes in NYC"
28396	"How bacteria exist in the urban environment, and how that impacts humans that live share that environment."
33720	"how microbiomes function in urban spaces"
34758	"more microbiology concepts"
50911	"More regarding the process of analyzing data as well as what specific aspects of lab simulations have to be present to make bigger picture conclusions."
61581	"How to design an experiment, conduct appropriate lab protocol"
61829	"I want to be able to conduct research on my own or be confident in designing research. "
66072	"Understand more about sequencing DNA and identifying the contents of a microbiome."


Projects / Microbiome of Urban Spaces
Spring 2019 Shared Project /
Geena
Search
Type
Filters
NOTEBOOK
INVENTORY
2/1/19 First Entry
2/1/2019
2/11/19
2/11/2019
2/21/19 Sample Collection
2/8/2019
2/22/19 DNA isolation
2/22/2019
2/22/19 Hypothesis
2/22/2019
2/25/19 Streaking
2/28/2019
2/27/19 Plate Results
2/25/2019
3/1/19 DNA Amplification Trial Run
3/3/2019
3/8/19 DNA Amplification PCR
3/8/2019
June 30: Dynamic Loading of ...
June 28: Web Dev
June 27: Web Dev
3/1/19 DNA Amplification Tr...
ADD PROTOCOL
NOTES
METADATA
Insert
More
3/1/19 DNA Amplification Trial Run
SUNDAY, 3/3/2019
First, we calculated the concentration of the mastermix for the working solution. The components of we would need consisted of:
1. Primers (Forward and Reverse)
2. H2O
3. Taq polymerase
4. MgCl2
5. Nucleotides
6. DNA
For our working solution we made a solution of:
325 ul of mastermix
52 ul of 16S DNA?
52 ul of H2O
52 ul of Primers
169 ul of H2O
for 26 uses of 1x concentration of mastermix in a 25 ml solution
We also added in 2 ul of our DNA samples from our swab collection onto a 96 well plate. Comment from Davida: It was a 96 well plate :D
My plate tube sections were A1 and B1.
Ater everything was added onto the plate. It was sealed with a PCR adhesive film lid and put into the thermal cycler. what kind of lid?
SPLIT WORKSPA

BENCHLING

Hold the door!

An examination of the bacteria on the elevator buttons in the residence halls.

Molly Metz
Mentor: Davida Smyth, PhD
Department of Natural Sciences and Mathematics,
The New School, New York, NY 10011

Abstract

The presence of antibiotic resistant bacteria is becoming a larger and larger issue which forces us to examine our day-to-day practices and cleaning patterns, especially in the built environment. This purpose of this research study is to examine what bacteria lives on the surfaces of elevators in a commonly used elevator in a residence hall at The New School. Using two separate processes to examine what bacteria are present on the surface of these buttons, and specifically if there's a presence of methicillin-resistant Staphylococcus. The results from this first round of testing indicate that the colonies isolated from the selective plates had a presence of living *Staphyloccocus Haemolyticus* as well as *Bacillus licheniformis*. The DNA swabbing method showed a prevalence of Pseudomonas as well as Azotobacter, Bacterioides, Serratia, and Alistipes on the elevator buttons.

Background

Staphylococcus is group of about 30 different bacteria which are commonly found in nature and the built environment. Staph can live on different fomites, in the air, and is frequently found in peoples nasal cavities. Though some forms of Staph are resistant to antimicrobials, such as MRSA or Methicillin Resistant *Staphylococcus aureus*. MRSA is resistant to most drugs making it a growing problem in the built environment, especially people who are immunocompromised. MRSA has the mecA gene which produces a protein that binds to penicillin and methicillin and inactivates it. Cases of MRSA were originally only found in hospitals but have continued to spread beyond hospital walls and treatment options are limited as it's resistant to previously used antibiotics. The Stuyvesant Park Residence Hall is home to over 640 New School students with just two small elevators that can fit about eight people each. As previous studies in hospitals have shown, highly trafficked elevator buttons may be home to antibiotic-resistant Staphylococcus.

References

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Acknowledgements

Thanks to Davida Smyth, Marcus Banks, Katayoun Chamany for their work, funds, and support on this research study.

Discussion

The results from these two tests show that there are a lot of different types of bacteria that live on the surface of the elevator buttons even though they are cleaned daily with a metal polish cleaner according to the maintenance staff at the residence hall. It would be interesting to continue to examine what bacteria is on these surfaces throughout the course of the academic year: before students move in, days after move in, and incrementally throughout their stay. In addition, looking at the different residence halls to see if these types of bacteria are equally distributed amongst the four residence halls each with a slightly different demographic and population of students. The plates we used were only selective for Staphylococcus, in the future using plates that are specific for other bacteria such as Pseudomonas would be intersting to look at. This is just one small step into learning more about the microbiome of the built environment and how our practices influence what's living around us.

Results

The two processes for collecting and identifying the DNA present on the elevator buttons of the New School's Stuyvesant Park Residence Hall show that there was no Methicillin resistant *Staphylococcus aureus* living or dead on the buttons. The tests did show that there were colonies of *Staphyloccocus Haemolyticus* as well as *Bacillus licheniformis*. The swabbing showed that there was DNA from Pseudomonas, Azotobacter, Serratia, Bacteroides and Alistipes though it was not living on the surface of the buttons.

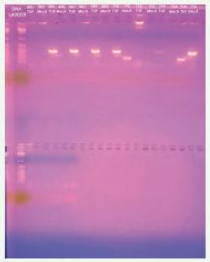

Figure 5

Lobby outside up button

36% Pseudomonas

11% Azotobacter

4% Serratia

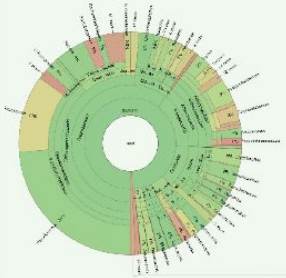

Figure 4

Lobby inside button

14% Pseudomonas

11% Bacteroides

6% Alistipes

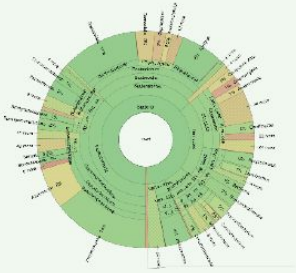

Figure 3

Hypotheses

Using swabs and selective plates for antibiotic resistant Staphylococcus on the surface of the buttons on the inside and outside of the residence hall elevator I expect to find the presence of antibiotic resistant Staphylococcus and other bacteria. I also expect to find a higher concentration of bacteria on the buttons on the lobby, basement and upper level floors which are frequented the most often.

Methods

This study used two different methods to identify the living and dead bacteria on the surfaces of the elevator buttons in a New School residence hall. Below are illustrations of the processes detailed below.

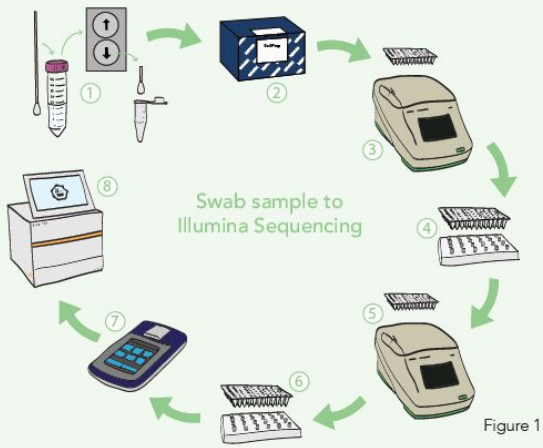

Figure 1

Process #1: 1) Swabs dipped in a solution of NaCl and Tween were swabbed for 10 seconds on the buttons and stored in a 2ml eppendorf. 2) Using a Qiagen DNeasy PowerSoil prep kit the DNA was removed from the swab. 3) Amplicon PCR with primers to select 16S. 4) PCR clean up using magnets. 5) PCR to add Illumina barcodes to the amplified 16S DNA. 6) PCR clean up using magnets. 7) Quantification of DNA using a Qubit spectrophotometer. 8) DNA is pooled with other students sampled and placed into the Illumina iSeq.

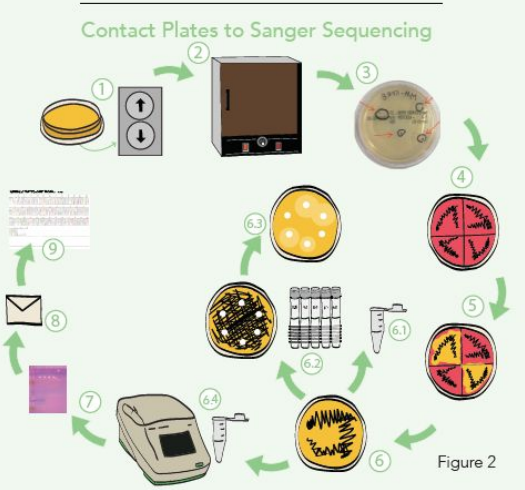

Figure 2

Process #2: 1) Antibiotic resistant Staphylococcus selective plates were placed on the surface of the elevator buttons for 10 secs. 2) Plates were incubated at 35°C for 48hrs. 3) Identify growth on the plates. 4) Colonies were selected and swabbed onto Mannitol plates. 5) Mannitol plates were incubated to test whether the colonies were fermenters or non-fermenters. 6) Colonies from Mannitol plates were swabbed onto TSA plates. 6.1) Colonies were stored in -80°C freezer. 6.2) Samples were diluted to a 0.5 MacFarland standard and plated onto Meuller-Hinton agar plates and placed with antibiotic discs. 6.3) Plates were incubated and the zones were measured. 6.4) Colonies were boil prepped and *tuf* and *mecA* primers were added in PCR. 7) Samples were run on a gel to test for bands with the mecA and TUF genes. 8) Samples wit bands for TUF and mecA were sent to Sanger for sequencing. 9) Results of Sanger sequencing.

THE NEW SCHOOL

HOW YOU FEEL RESEARCH IN GENERAL MIGHT BE ABLE TO SOLVE REAL WORLD PROBLEMS ...

Response	Question
14421	"As a lot of people base their decisions on trends, practicality, and ease of use, there can often be problems with the products we use everyday. Because of this my research could possibly help people realise the flaws in the design of the products they use, as some of these flaws can turn out to be life threatening."
23176	"Research is our biggest hope for solving real world problems. It always has been. "
33720	"There are increased reports of infectious disease and research can be done to minimize those reports whether it is through medicine, the SDG, etc..."
34758	"emphasis science communicate for overall efficient scientific literacy on research based on the proposed interventions to prevent the spread of pathogenic microbes "
41702	"Develop new methods/procedures for cleaning areas and preparing prepackaged food "
44080	"."
66072	"Particularly, this research can inform design practices, cleaning practices, and more which have an impact on the spread of infectious diseases and the general health of populations."
91784	"Getting a basic understanding of microbiology allows students to connect to other disciplines."

SENCERized Research?

New SENCER ideals = Philosophy

- SENCER connects science and civic engagement by teaching “through” **complex**, and **unsolved public issues** “to” basic science.
- SENCER invites students to take **responsibility for their learning** and put the knowledge and methods of science to immediate use.
- SENCER reveals both **the power** and the limits of science in addressing the great challenges of our time.
- SENCER helps students make connections between local civic issues and national and global **“grand challenges.”**

FRIDAY - CPHM90

ISOLATING RESISTANT STAPHYLOCOCCUS FROM HAND DRYERS IN AN URBAN COLLEGE

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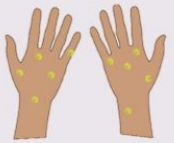
[1] Natural Sciences, Mercy College, Dobbs Ferry, NY and [2] Eugene Lang College of Liberal Arts at The New School



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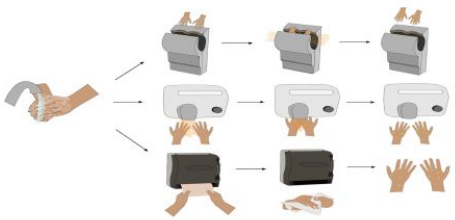
Abstract

Much emphasis is being placed on hand washing as a preventive measure to avoid spreading bacteria. However, recent studies have implied that methods used to dry your hands can contribute to bacterial spread. This is alarming due to the presence of antibiotic resistant bacteria in the environment such as MRSA. We examined three different types of devices people commonly use to dry their hands. Drying option A, was a hand towel dispenser. Drying option B, was a vertical air dryer that dries the front and back of each hand simultaneously as they are drawn slowly out of the machine. Drying option C, was a downward pointing dryer. We hypothesized that Drying Option B would be the best reservoir for resistant Staphylococci due to it's design. Using HardyChrom contact agar plates, selective for Staphylococci, our initial study indicated that Drying option B overall had higher colony numbers of Staphylococcal bacteria (We repeated this experiment twice). On the first round, we found that the average number of bacterial colonies per site identified on drying option B (13.6 colonies per sampling site) were higher than option A (11 per site) or C (7 colonies colonies per site). Similar results were found one week later (A had 4.5 per site, B had 13.6 per site and C had 2 per site). In order to determine if campuses might be playing a role in this and whether or not cleaning could reduce the bacterial burden, we expanded our survey to include all three campuses of our college and we collected samples both before and after we after we cleaned the dryer sampling surfaces using clinical grade antimicrobial soap (commonly used at our institution). We took samples at time 0, 20 mins after cleaning and 7 days later. Though not all campuses had examples of all three dryer types, similar trends were observed where we could find them. The vertical dryers (Option B) had the greatest numbers of colonies at time point zero, cleaning reduced bacterial burden but it recovered to pre-cleaning numbers 7 days later. Dryer options A and C were found at all three campuses and exhibited similarly low numbers of bacteria before and after cleaning. Our work though preliminary demonstrates that the type of dryer used could serve as an important reservoir for resistant bacteria in the college environment and that the cleaning strategy may not be effective in reducing the problem. We are currently typing the bacteria isolated to determine their genetic relatedness and survival capabilities and characteristics.

Introduction/ Hypotheses



We wanted to determine what bacteria might be found on the surfaces of different types of handdryers in our campus. This led to several hypotheses.

Hypothesis 1: Hand dryers are reservoirs for presumptive antibiotic resistant Staphylococcal (ARS) bacteria

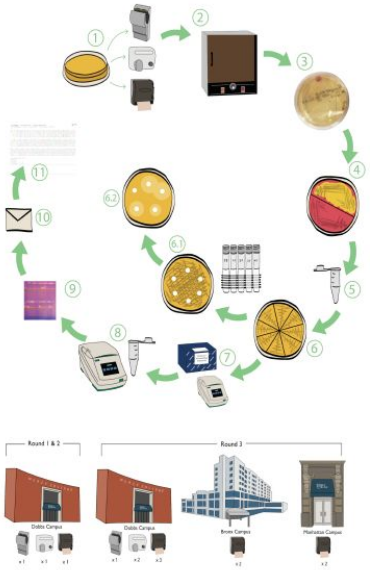
Hypothesis 2: Cleaning the handdryers will remove the presence of presumptive antibiotic resistant Staphylococcal (ARS) bacteria

Hypothesis 3: Hand dryer devices aerosolise presumptive antibiotic resistant Staphylococcal (ARS) bacteria

Acknowledgments

We would like to thank our professor, Dr. Davida Smyth who mentored and guided us throughout this experiment. We would also like to thank Mercy College and Eugene Lang College at the New School College for offering their assistance with running our experiments. Furthermore, we would like to thank lab assistants Molly Metz and Natalie Vegas for their help with this project. We are grateful for the continued support of the department, faculty, library personnel and administrative support staff at Mercy College and Eugene Lang College at the New School College. Lastly, we are grateful to ASM for giving us the opportunity and honor to present our findings at ASM 2019.

Methods



Process 1 Using Hardy-Chrom contact agar plates, selective for presumptive antibiotic resistant Staphylococcus bacteria (ARS), we took 10 samples of different hand drying mechanisms (Drying option A, was a hand towel dispensers. Drying option B, was a vertical air dryer that dries the front and back of each hand simultaneously as they are drawn slowly out of the machine. Drying option C, was a downward pointing dryer). Plates were Incubated at 37°C and up to 16 colonies were isolated from each plate

Process 2 16 strains were isolated and purified by streaking for single colonies using Mannitol Salt Plates. Growth and fermentation pattern was recorded. Purified strains were stored at -80°C..

Process 3 Stocked purified strains were streaked onto TSA, incubated at 37°C for a minimum of 2 days. DNA was isolated using the Ultra Clean DNA isolation kit. PCR was conducted using isolated DNA or a boil prep and gel to reveal the presence of tuf (for species), *mecA* (methicillin resistance) and *qacAB* (quaternary ammonium compound resistance). In addition, antibiograms were generated for each strain using Mueller-Hinton agar and a 0.5 McFarland Standard.

Process 4 PCRs for those strains that were positive for *tuf* and *mecA*, *tuf* and *qacAB* and tuf, *mecA* and *qacAB* were sent for sequencing.

Results of plating

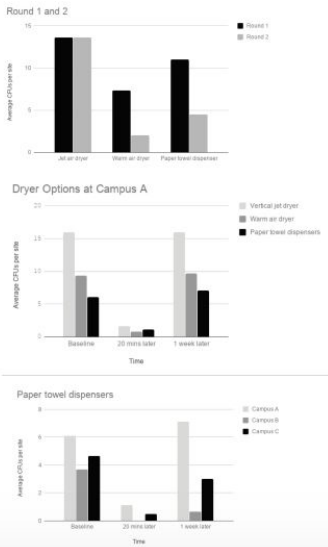


Chart 1 reveals that vertical air jet dryers, had the greatest bacterial load (Option B). We found that the average number of bacterial colonies per site identified on drying option B (13.6 colonies per sampling site) were higher than option A (11 per site) or C (7 colonies colonies per site). We reproduced the experiment one week later (A had 4.5 per site, B had 13.6 per site and C had 2 per site) and found similar results. Thus we proved hypothesis 1 to be true.

In round 3, we included a cleaning step using the cleaning agent employed by our facilities personnel as well as expanding our study to include all three of our campuses. Only campus A had all three drying options. The second chart reveals drying option B had the greatest numbers of bacteria and that despite cleaning, these numbers returned to baseline one week later.

In the third chart we studied paper towel dispensers at all three campuses. Campus A had the greatest bacterial burden of all three campuses. Again cleaning reduced the numbers but they increased one week later. Hypothesis 2 was thus not proven.

Sequencing Results

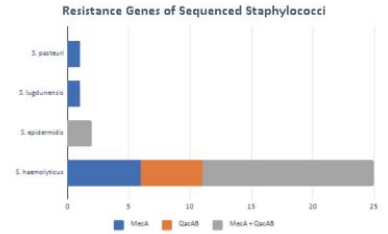
Table 1. Sequencing results for Round 1

Preliminary Findings for Round 1					
	Number Sequenced (Total isolated)	*S. haemolyticus*	*S. epidermidis*	*S. lugdunensis*	*S. pasteuri*
Dryer Option A	9(20)	6	2	0	1
Dryer Option B	6(20)	6	0	0	0
Dryer Option C	4(20)	3	0	1	0

Table 2. Sequencing results for Round 2

Preliminary Findings for Round 2					
	Number Sequenced (Total isolated)	*S. haemolyticus*	*S. epidermidis*	*S. lugdunensis*	*S. pasteuri*
Dryer Option A	4(10)	4	0	0	0
Dryer Option B	4(10)	4	0	0	0
Dryer Option C	2(10)	2	0	0	0

Chart 4. Presence of resistance genes in Staphylococci



Discussion

Our study has provided further evidence that hand dryers and vertical jet hand dryers in particular are reservoirs for bacteria, in our case, antibiotic resistant Staphylococci. We note that we have several key experiments left to complete, the sequencing of all bacteria we isolated and determining if they are clonally related. Nevertheless, our findings of such high numbers of bacteria and our results with the cleaning pose many new questions for further study. We intend to use Box fingerprinting to determine the genetic relatedness of the Staphylococci we isolated, and potentially multi-locus sequence typing for the *Staphylococcus hemolyticus* strains that we isolated. We have found *Staphylococcus hemolyticus* at several sites at our campus, implying that these bacteria are the most common Staphylococci in our environment. Our data gathered from our dispersal and aerosolization experiments are currently being analysed. The reasons for finding these species and not others remain to be elucidated but may be influenced by methicillin or QacAB resistance.

Citations

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Do antimicrobial paints do what they say they do on the tin?

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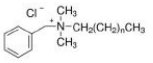
[1] Natural Sciences, Mercy College, Dobbs Ferry, NY and [2] Eugene Lang College of Liberal Arts at The New School



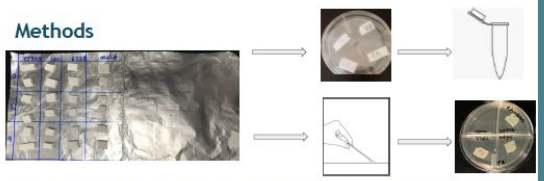
ABSTRACT

The rise of superbugs that are resistant to antibiotics have led to the development of products marketed to consumers as being antimicrobial. We are concerned that such products could lead to emergence of further resistance strategies among organisms that could spread to human pathogens and further exacerbate the problem of resistance. One of the items impregnated with antimicrobial agents being marketed to consumers is wall paint. Several different strategies have been utilized from changing the structure of the paint to adding chemicals to the paint directly. We've performed experiments on two antimicrobial paints, Paint A, Paint B, and Paint C, a non-antimicrobial paint used on our college's walls. Paint A is marketed as antimicrobial, and contains a chemical known to be a potential cause of cancer. Paint B, has been designed to have a honeycomb structure that may or may not allow microbes to flourish.

BACKGROUND

The use of antimicrobial agents has been beneficial when combating infection, but, their widespread use contributes to the increase and emergence of novel resistant microbes in virtually all environmental niches [1]. Products such as coolers, paints, textiles are a few examples of items that are being coated with antimicrobial properties to avoid consumers from getting sick. Consumers' attitude towards hygiene and active lifestyle has created a rapidly increasing market for antimicrobial textiles [2]. Triclosan is an antimicrobial agent used so ubiquitously that 75% of the U.S.A population is likely exposed to this compound via consumer goods and personal care products [3]. Benzalkonium Chloride (BAC) is a newer antimicrobial compound that has been replacing triclosan for some time now. Although this newer replacement was thought to be a safer alternative, studies show that its not. A recent study done by Virinchipuram, etc. (2018), investigated the toxic effects of three antimicrobial agents. Among the three, BAC was tested on nematode *C. elegans* and zebrafish (Danio rerio) [4]. Results showed that BAC was the most toxic among the three, with acute lethal toxicity occurring at environmentally relevant concentrations [4]. There is much controversy surrounding the increased use of antibacterial substances in a wide range of consumer products and the possibility that, as with antibiotics, indiscriminate use of biocides might contribute to the overall pattern of susceptibility in the general environment and in the clinic [5].

Methods



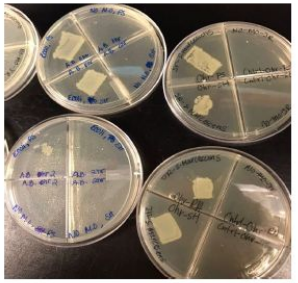
Standard tester boards for paint were used and cut into small sections of roughly 1 cm^2. The painted boards were painted three times with each paint to ensure even coverage, and were UV sterilized for 20 mins on both sides. Tester organisms were suspended in saline to a McFarland standard of 1. A 10 µL drop of the saline solution was transferred to the painted boards and the paint boards examined at different time intervals (0 hrs, 2 hrs, 4 hrs, 8 hrs and 24 hrs). A blank sterilized paint board was used as a control. At specific timepoints, the boards were either placed on agar plates for 30 seconds and incubated at 37°C overnight or swabbed, and the swabs deposited in eppendorfs for counts. We observed the plates for growth after 24 hrs.

Paint A (PS) was an antibacterial paint which contained benzalkonium chloride described as killing >99.9% of microbes within 2 hrs of exposure.
Paint B (RA) was an antimicrobial paint which has a designed structure that impedes fungal growth. It's ability to kill bacteria was unknown.
Paint C (SH) was used as a control because it's used at our school and is a non-antimicrobial paint, i.e. it does not have any specific antimicrobial activity.

RESULTS

A.

Microorganism	Paint A 0Hrs	Paint B 0Hrs	Paint C 0Hrs	Paint A 2 Hrs	Paint B 2 Hrs	Paint C 2Hrs
Bacillus subtilis	0	N/A	+	0	N/A	++
Escherichia coli	+	N/A	+	0	N/A	-
Enterococcus faecalis	+	N/A	+	-	N/A	+
Proteus vulgaris	N/A	+	+	N/A	0	-
Pseudomonas aeruginosa	N/A	+	+	N/A	-	-
Serratia marcescens	N/A	+	+	N/A	-	-
Serratia marcescens	+	N/A	+	0	N/A	-
Staphylococcus aureus	N/A	+	+	N/A	-	-
Staphylococcus epidermidis	0	N/A	+	0	N/A	++
Staphylococcus saprophyticus	N/A	+	+	N/A	++	++



Preliminary results were obtained from an undergraduate research class "The Microbiome of Urban Spaces" that used environmental strains. Figure A represents the preliminary results of the second trial of the experiment. The results of the growth in the ten microorganism are represented. Each student used a different organism and tested either Paint A or Paint B against Paint C.

B.

0 Hrs	Paint A	Paint B	Paint C
NoMo	0	0	0
25923	0	++	++
7206	0	++	++
6734	0	++	++
Mu50	++	++	++
LAC	+	++	++
6538	-	++	++

- 0 : No growth
- + : Growth
- (-) : Less Growth
- (++) More Growth
- NiA : Not tested

C.

24 Hrs	Paint A	Paint B	Paint C
NoMo	0	0	0
25923	0	++	+
7206	0	++	-
6734	0	+	-
Mu50	0	-	+
LAC	0	-	+
6538	0	-	+

Further testing used different strains, with 25923 the control strain for this experiment. RN7206 and RN6734 are *agr* - and *agr* + *S. aureus* respectively. The accessory gene regulator (agr) of *S. aureus* is a global regulator of the staphylococcal virulon, which controls secreted virulence factors and surface proteins [6]. Mu50 (an hospital associated Methicillin Resistant *Staphylococcus aureus* strain, MRSA), LAC (a community MRSA), and 6538 (Quaternary Ammonium Compound resistant *S. aureus*) are clinically relevant and resistant *S. aureus*. Figure B and C are showing the results at 0 hrs and 24 hrs. NOMO stands for no microorganism.

D.

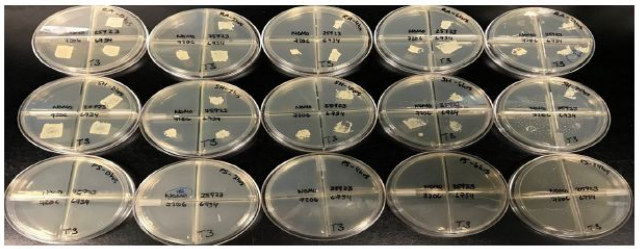


Figure D shows the third trial of this experiment, starting at 0 hrs, 2 hrs, 4 hrs, 6 hrs, and 24hrs looking at Strain 25923, 6734, 7206. The subtle changes can be visualized on the agar plates, Paint A there was no obvious growth seen on the plates. For Paint C a significant decrease in growth was observed at 24 hrs. This led us to question what occured between 0 hrs and 24 hrs that resulted in a decrease in growth of the organisms.

Benzalkonium chloride is hazardous to the aquatic environment, acutely toxic (oral, dermal and inhalation) and corrosive to metal and skin. It also causes serious eye damage. The fine print eludes to the other potential hazards....

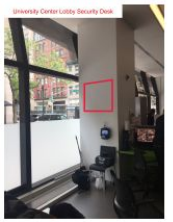
ATTENTION: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

CURRENT and FUTURE WORK

At the New School, we've begun month-long pilots of our three paints in the field. For this work, we painted sections of paint board, two sections for each type of paint, sterilized them with UV and fixed them to the walls using command strips.

We will let them stay on the walls for 1 month after which we shall remove the boards. One of each will be swabbed for bacterial DNA and subjected to 16S *rRNA* amplicon sequencing and the other will be sampled using contact agar plates.

High Traffic Areas



Medium Traffic Areas

Low Traffic Areas

Three examples of the boards *in situ* are shown.

Colonies isolated from the boards will have their DNA isolated and subjected to PCR for the 16S *rRNA* gene to identify the sequences. Amplicon sequencing will be performed on the iSeq in the Smyth Lab. We anticipate that we will be able to isolate environmental organisms that are resistant to the paint. Sequencing will reveal all the organisms living and dead that were on the paint.

ACKNOWLEDGMENTS

We would like to acknowledge the hard work and diligence of all the microbiology students at Mercy College and the faculty in the Natural Science Department. We would like to thank Molly Metz and Janelly Eralte for their support and hard work they put into making this possible. We would also like to thank the McNair department for their funding and guidance.

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Journal of Student Research

Volume 8, Issue 2, pp 1-4

Research Article

Hitchhikers in Honey: An investigation of the inhibitory mechanisms of bacteria found in honey

Emma Letcher[a] and Davida S. Smyth[a]

Honey has a stable physiochemical composition that contributes to its long shelf life and has been noted as an antimicrobial substance for centuries. Although it is common knowledge that honey affords some antimicrobial properties, the specific mechanisms behind this remain elusive. This paper hypothesizes that the microorganisms in certain raw honeys contribute towards their antimicrobial properties. In our study, we analyzed several raw and processed honey samples to determine their microbial constituents. The antimicrobial potential of the isolated microbes was tested using several clinically relevant bacteria including *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Pseudomonas aeruginosa*. Of the tested honeys, Manuka (New Zealand) and Wildflower honey (Tennessee, USA) contained microorganisms exhibiting antimicrobial activity. All the isolated colonies grew on MacConkey and Mannitol agar and generated bands for the 16S rRNA gene implying that they were bacteria. This paper concludes that bacteria isolated from honey could be a new area of research within the topic of antimicrobial honey samples.

Keywords: honeybee; antimicrobial; microbes; beneficial; raw honey; gram positive bacteria

Certain strains of bacteria are developing new ways to resist antibiotics. This presents great challenges to healthcare providers and patients alike as it increases the length of stay in hospitals, requires more intensive care, and is more costly [1]. To combat these "super bugs", more research around traditional antibiotics is needed. Honey from *Apis mellifera* (*A. mellifera*), commonly known as the Western Honeybee has and their capacity to inhibit the growth of several clinically relevant strains of bacteria.

Methods and Materials

Collection

A variety of raw and processed honey bottles were purchased over a period of three weeks from various regions of the United States. Filtered honey (H3) was purchased from a

SENCERIZED RESEARCH COMING FROM CURES

- Honey hitchhikers
- Antimicrobial Paint
- Acidification and soil microbes
- Floods and drought and soil microbes
- Airpods and bacteria
- Handdryers and bacteria
- Modeling the University Center

Two graduates wrote IRBs for the first time and three wrote a NYC parks permit - Other types of learning!

How many Students engaged in UGR with me?

1. ~40 students engaged in Tiny Earth
    a. Majority had not done research before
2. 20 students in Microbiome of Urban Spaces
    a. Majority had not done research before
3. 10 New School students in SURE/REU (2019)
    a. 1 student has published a paper
    b. 6 student posters at conferences (MACUB, ASM)
4. 2 Mercy Students returned as volunteers
    a. 2 posters at ASM Microbe 2019
    b. 1 talk at ASM Microbe 2019
5. 4 Highschool students in collaboration with UBRP
    a. Won best poster at URBP symposium

=> Already UGR is starting at the New School!

What outcomes Am I Seeing?

- Technical skills
- Stats / analysis
- Science literacy
- Content mastery
- Civic value / outreach
- Project ownership
- Creativity
- Communication

What outcomes am I seeking?

- Technical skills
- Stats / analysis
- Science literacy
- Content mastery
- Civi[illegible]ch
- Proj[illegible]
- Crea[illegible]
- Communication

What outcomes am I se

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- Science literacy
- Content mastery
- Civic value / outreach
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Scaffolded Experiences

Responsible for their own learning

Discovery

Local Issues/ Grand Challenges

Power and Limits of Science

QUBES
The Power of Biology × Math × Community

Acknowledgments

- Amazing students who shared assignments and participated in the courses and research
- Maverick colleagues in the Natural Sciences at Mercy College and the New School
- Team SENCER, especially Monica Devanas, Eliza Jane Reilly, Jay LaBov, Kathy Browne
- REMNet team, Tiny Earth

THE NEW SCHOOL LANG

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SCIENCE EDUCATION FOR NEW CIVIC ENGAGEMENTS AND RESPONSIBILITIES