






AN INSPIRATION PRESENTATION

Novel & Exciting SciEd Activities
Rana C. Morris, PhD





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How can I get my kids to learn?



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How & why do kids learn? *They PLAY because it is fun!*



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How & why do kids learn? *They PLAY because it is fun!*



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How can I get my kids to learn *beyond purely play?*

Math is hard!

I can't find the right Pokemon card fast enough!

Provide an incentive!
Show a real solution!



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The beginning of my curriculum development journey....

MnM Math

Pokémon Card Database Structure

Provide an incentive! Show a real solution!



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3 Key Criteria for "directed" learning

1. Must connect to the **real world**. (*obvious relevancy*)
2. Must involve **active learning & discovery**. (*physical development of skills to reinforce cognitive acquisitions*)
3. Must involve **story-telling**. (*question development, understanding & interpretation of data, and communication*)

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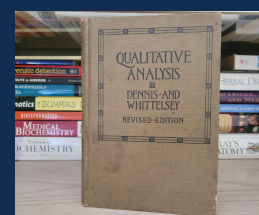
Why college science can be boring



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Organic Chemistry Qualitative Analysis Lab



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“Identify an unknown”



I tried to get students excited about General/Inorganic Chemistry

Burn something!






The next phase of my curriculum development journey....

Analytical Chemistry Lab

Forensic Crime Investigations









And the next phase of my curriculum development journey....

Molecular Biology & Biochemistry Labs

The BEER Lab



Zymergonics: Molecular Biology, Biochemistry, Bioinformatics and Beer!
 Mark S. Elliott¹ & Rana C. Morris^{1,2}
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²NCBI/MLM/NIH & IMC, Bethesda, MD

Semester I: Yeast Cellular Biology and Molecular Genetics
Yeast Culturing & Growth
 Goals: Phenotypic analysis of growth for two strains of yeast under varying environmental conditions.
 Project Description: Assessing the growth rates for different strains of *Saccharomyces cerevisiae* (S. cerevisiae) under varying environmental conditions (carbon source, nitrogen levels and temperature).
 Methods Explored: Preparation of media and reagents. Sterile technique. Growth curve analysis and data visualization. Microscopy and plating. Growth curve analysis. Growth curve analysis. Growth curve analysis.
 Duration: 2 weeks

II. DNA Isolation/Characterization
 Goals: Isolation and characterization of DNA in different yeast strains.
 Project Description: Isolating chromosomal and plasmid DNA from two different yeast strains (S. cerevisiae & S. pastorianus).
 Methods Explored: Growth of yeast strains in liquid media. Isolation and characterization of DNA samples via UV absorbance measurements and gel electrophoresis. Restriction enzyme digests and ligation. Gel electrophoresis and DNA quantification.
 Duration: 4 weeks

III. RNA Isolation/Characterization
 Goals: Isolation of total RNA expression in yeast under different conditions.
 Project Description: Isolating RNA populations of yeast strains under varying environmental conditions (glucose, temperature and oxygen levels).
 Methods Explored: Growth of yeast strains in liquid media under varying environmental conditions. Isolation of total RNA samples using Trizol reagent. RNA quantification and gel electrophoresis. Northern blot analysis of specific genes.
 Duration: 3 weeks

IV. RNA Expression Analysis
 Goals: High-throughput transcript expression analysis of different yeast strains under varying environmental conditions.
 Project Description: High-throughput transcript expression analysis of different yeast strains under varying environmental conditions (glucose, temperature and oxygen levels).
 Methods Explored: Growth of yeast strains in liquid media under varying environmental conditions. Isolation of total RNA samples using Trizol reagent. RNA quantification and gel electrophoresis. Northern blot analysis of specific genes.
 Duration: 4 weeks

Semester II: The Biochemistry of Yeast Fermentation
Yeast Growth & Sampling
 Goals: Development of environmental samples for growth of differing yeast strains under physiological and controlled environmental conditions.
 Project Description: Development of media to allow samples to be grown under physiological and controlled environmental conditions. Development of environmental conditions for growth of differing yeast strains under physiological and controlled environmental conditions.
 Methods Explored: Sterile technique in culturing yeasts in solid and liquid media. Growth curve analysis. Microscopy and plating. Growth curve analysis. Growth curve analysis.
 Duration: 2 weeks

II. Protein Isolation/Characterization
 Goals: Isolation and characterization of proteins in different yeast strains.
 Project Description: Isolating and characterizing proteins from two different yeast strains (S. cerevisiae & S. pastorianus).
 Methods Explored: Growth of yeast strains in liquid media. Isolation and characterization of protein samples via SDS-PAGE and Western blotting.
 Duration: 3 weeks

III. ADH1 Purification/Kinetics
 Goals: Isolation and kinetic analysis of ADH1 enzyme and substrate.
 Project Description: Isolating and characterizing ADH1 enzyme from yeast strains under varying environmental conditions.
 Methods Explored: Growth of yeast strains in liquid media under varying environmental conditions. Isolation and purification of ADH1 enzyme. Kinetic analysis of ADH1 enzyme activity.
 Duration: 3 weeks

IV. Metabolite Analysis
 Goals: Analysis of metabolite concentrations and implications on yeast growth under varying environmental conditions.
 Project Description: Analysis of metabolite concentrations and implications on yeast growth under varying environmental conditions (glucose, temperature and oxygen levels).
 Methods Explored: Growth of yeast strains in liquid media under varying environmental conditions. Isolation and purification of metabolite samples. Metabolite analysis via HPLC and GC-MS.
 Duration: 3 weeks

So how did this end up?



My journey continued... NCBI FieldGuide Examples



On All-Hallow's Eve

- Protein-protein sequence & structure comparison
 - Vampire Bat Plasminogen Activator
 - Human Tissue Plasminogen Activator

At Mississippi State University

- Southern blot primer for Channel Catfish Virus

At the University of Michigan Medical School

- PCR primers for Huntingtin microsatellite triplet expansion

My journey continued... NCBI @ETSU

"Can you set up a homework assignment for my Genetics Lab students?"

- Write a news article about the gene with relevancy for a lay person
- Describe the gene – tell us all about it
- Find the sequences for: gene, transcript, protein
- Find and annotate the 3D structure
- Create a website to show the class & your family!

Which gene should I pick?


How about one for your disease?



Other Cool Ideas I've Seen: Communicating Science

This web page was produced as an assignment for an undergraduate course at Davidson College.

Jenny Hoekstra's Genomics Page



<http://members.aol.com/jyhoekstra-wjpy>

Assignment #1: [My Favorite Gene](#)
 Assignment #2: [My Favorite Yeast Gene](#)
 Assignment #3: [My Favorite Yeast Gene Expression](#)
 Assignment #4: [My Favorite Yeast Protein](#)

For more information, visit the [Genomics Home Page](#) or the [Davidson College Home Page](#).
 Questions or comments? E-mail me: "jhoekstra" at "davidson.edu".

Had enough Genomics for today? Check out Davidson [Women's Swimming](#) website.

BLOOM SYNDROME AND YOU: UNDERSTANDING THE DISEASE



Signs & Symptoms

Scientific Background

FACTS ABOUT CF

- Genetic disease: people are born with cystic fibrosis.
- Life expectancy is based on how long and severe the disease is for each individual.
- In 2009, the median survival age of patients was in the mid 30's.
- The median age keeps going up with new treatments being found all the time.
- People can live a normal life as long as they get good food, take their medication and follow the doctor's advice carefully.

SYMPTOMS

- There are many symptoms that have some of the most common and serious:
- Sticky mucus builds up in the lungs which makes it difficult to breathe.
- Most people also build up the mucus over time. When this happens the body has a hard time absorbing things and the person cannot regulate the body's blood sugar.
- Salty tasting skin.
- Poor health and growth despite a normal food intake.
- Frequent, watery and obstructive stools.
- Lung infections.

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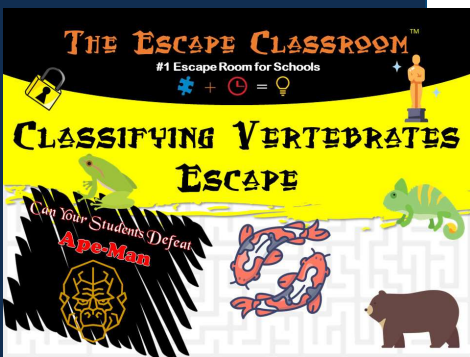
Other Cool Ideas I've seen: Advanced Playing!

THE ESCAPE CLASSROOM™

#1 Escape Room for Schools

CLASSIFYING VERTEBRATES ESCAPE

Can Your Students Defeat Ape-Man?

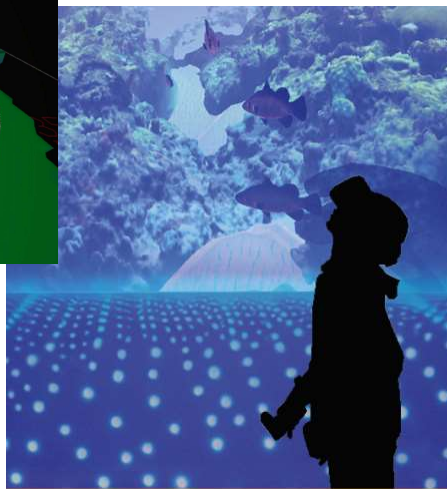
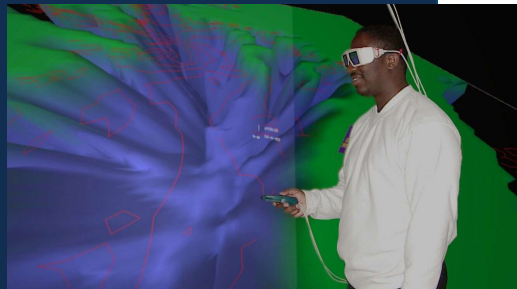





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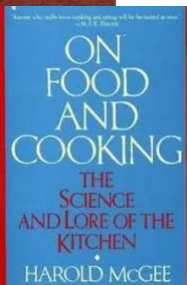
Other cool things I've seen: Experiencing science! *Early VR (CAVE) & now headsets*



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El Bulli & Jose Andres The Science of Food!



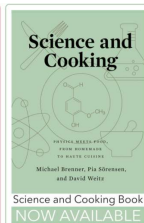
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Harvard John A. Paulson
School of Engineering
and Applied Sciences



2023 CHEF LECTURE
SERIES



Science and Cooking Book
NOW AVAILABLE



Food Fermentation:
The Science of Cooking
with Microbes
on HarvardX

New online course



Teacher Outreach

Science and Cooking
for Secondary
Teachers

Duke University

**Introduction, Math Review,
and Historical Context**

CHEM 130L, SS1 2020
SCIENCE OF COOKING

Patrick Charbonneau has taught this class for years, just never virtually.

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Did it make a difference?



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Infectious disease outbreak challenges



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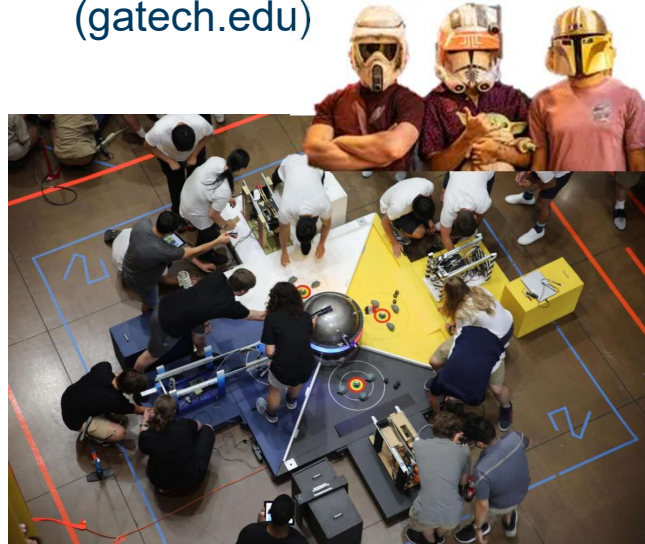
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Building toys & robots



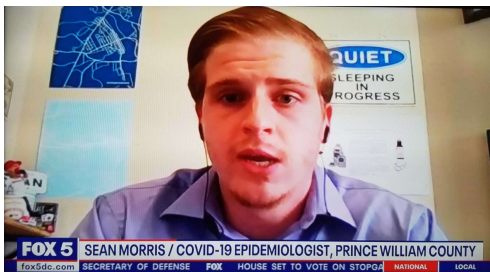
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ME 2110 Design Contest George W. Woodruff School of Mechanical Engineering (gatech.edu)



And did it make an impact?

Running the Prince William County, Manassas City & Park
COVID-19 Contact Tracing & Outbreak Investigations Unit



Now a police officer
in Fort Collins, CO



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How 5 Georgia Tech students helped Monday Night Brewing with a predicament

Variety 13-pack cases are major sellers but can lead to high labor costs for small craft breweries. These students built a device to help ease the expense.

By JERRY GRILLO - JUNE 14, 2017



An engineer & technical expert in
setting up fleets of school buses
across the country





Augusta University
Prof. Jessica Schwind
 Library Curriculum development core

Designed around an evolving disease outbreak on the Augusta campus – with weekly Newsbreak Videos to set the stage and realistic resources & processes to experience and learn research & investigation skills.

[Augusta University students to save the world, virtually – Jagwire](#)



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INTRO TO EPIDEMIOLOGY

FOLLOW THE RAPID PROGRESSION OF A DEADLY VIRUS