Bioscience Industry Fellowship Project

2015 Presentations

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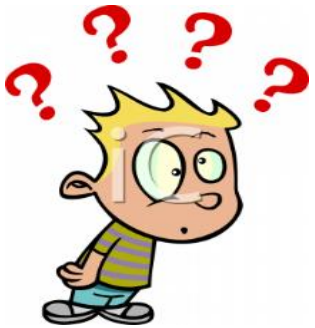


Biotechnology…. not as "Scary" as you thought!

Mabel Jackson
Adjunct Chemistry Instructor
Forsyth Technical Community College

Lisa Bratti
Adjunct Chemistry Instructor
Rowan Cabarrus Community College

Overview

- What is Biotechnology and where did it come from?
- How does Biotechnology help people?
- Why is Biotechnology important to our chemistry students?
- What is the Biopharmaceutical process?
- What is chromatography and what part does it play in biotechnology?
- How do we do gas chromatography?

What is Biotechnology

- According to the OECD definition, biotechnology is: “The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.”

- It is a technology that is based on biology, which uses living organisms to make innovative products that improve our lives. Our industry works in healthcare, agriculture and industry to meet life’s greatest needs in a carefully regulated way.

- The use of advances in life science to create products and services for our world.

- The exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc.

- At its simplest, biotechnology is technology based on biology - biotechnology harnesses cellular and bimolecular processes to develop technologies and products that help improve our lives and the health of our planet.

- **Sub-fields of biotechnology are:**

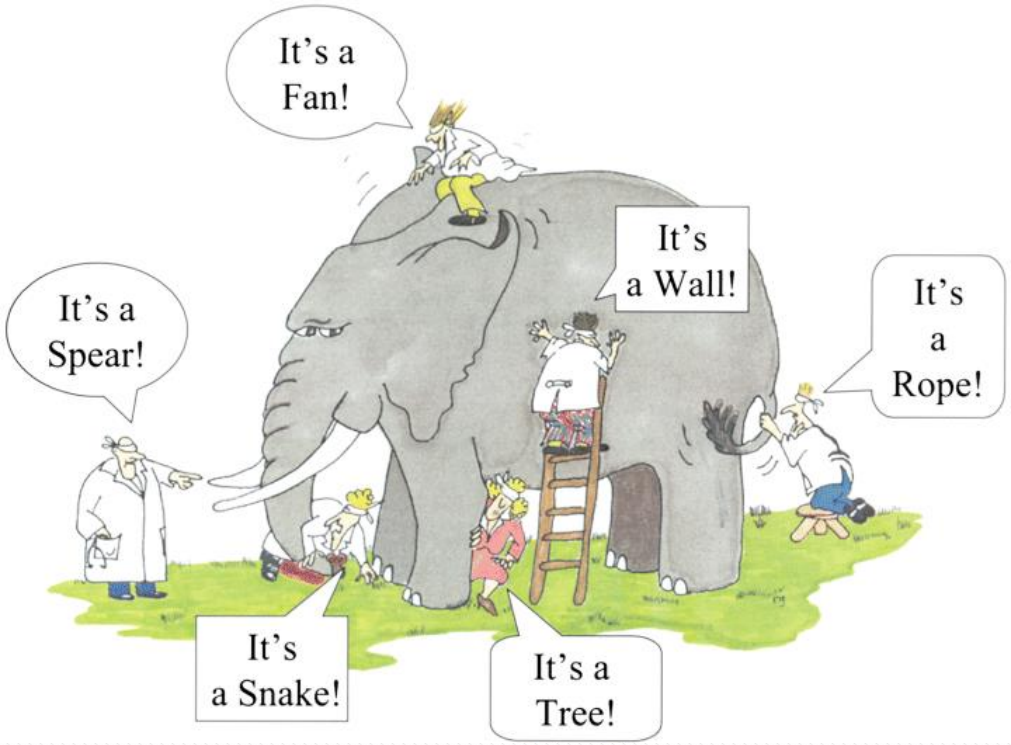
  Red biotechnology is biotechnology applied to medical processes.

  White/Grey biotechnology, is biotechnology applied to industrial processes.

  Green biotechnology is biotechnology applied to agricultural processes.

  The term blue biotechnology has also been used to describe the marine and aquatic applications.

Biotechnology Perspective



Dr. Beard-http://www.bartonchurch.org.uk/blog/2014-03-01-the-one-about-the-blind-men-and-an-elephant

Biotechnology – Not Just Today?

The Bible already provides numerous examples of biotechnology.

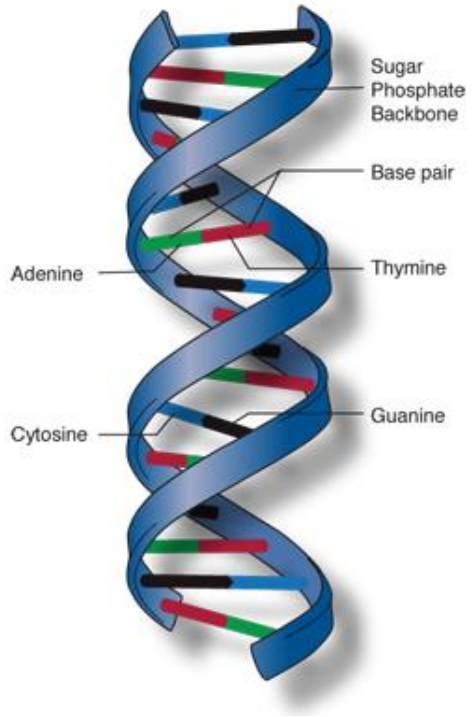
- It deals with the conversion of grapes to wine, of dough to bread and of milk to cheese.

- The oldest biotechnological processes are found in microbial fermentations, as born out by the Babylonian tablet dated circa 6000 B.C., explaining the preparation of beer.

- The Sumerians were able to brew as many as twenty types of beer in the third millennium B.C.

- In about 4000 B.C. leavened bread was produced with the aid of yeast.

Why is Biotechnology Important



The discovery of the structure of DNA by James Watson and Francis Crick in 1953 is one of the most famous scientific discoveries of all time.

Gene therapy – altering DNA within cells in an organism to treat or cure a disease – is one of the most promising areas of biotechnology research.

Another process, polymerase chain reaction (PCR), is also being used to more quickly and accurately identify the presence of infections such as AIDS and Lyme disease.

Biotechnology in agriculture has the ability to give biological protection from disease and pests thereby increasing the crop production to double or even higher than normal harvest.

Image courtesy of the National Human Genome Research Institute's Talking Glossary

The Companies

DavosPharma
EG GILERO
Pace Analytical
Medispect
LabCorp
Medtox (Labcorp)
Alte Biosciences
Biologics Consulting Group
BMG LABTECH
Certara
Chiesi USA (Chiesi)
CiVentiChem
Covis Pharmaceuticals
Ocean Therapeutics
Ockham
PMG Research
Trana Discovery
Acris Pharmaceuticals
Agile EndoSurgery
Algynomics
Annias Immunotherapeutics
Ascletis
Asklepios Biopharmaceutical
BioKier
Cardioxyl Therapeutics
Cempra Pharmaceuticals
Combs Lab
Effipharma
EpiCypher
Exodos Life Science Partners
G1 Therapeutics
Heat Biologics
NanoCor Therapeutics
NanoOncology
Pathfinder Pharmaceuticals
Pozen
Qualiber
Rho
Vascular Pharmaceuticals

American Health Research
AREVA Med
New Hope Clinical Research
PMG Research
Grifols
Novo Nordisk
cGMP Validation
Bioagilytix
AAIPharma
Adroit Pharma Development
Alpax Pharmaceuticals
AlphaVax
Aptiv Solutions
Argos Therapeutics
Avioq
Bayer
Becton Dickinson
Becton Dickinson
BHV Pharma
BioCryst Pharmaceuticals
BioMarck Pharmaceuticals
Biomedomics
bioMerieux

Cancer Advances (Cato Bioventures)
Cato Research
Celgene
Chaperone Therapeutics
Chimerix
Clearside Biomedical

Clinical Trials of North Carolina
Curl Bio
Cytex Therapeutics
Cytonet
Eboo Pharmaceuticals
EG GILERO
Eisai
Endacea
Entegrion
Envigen Pharmaceuticals
Eton Bioscience

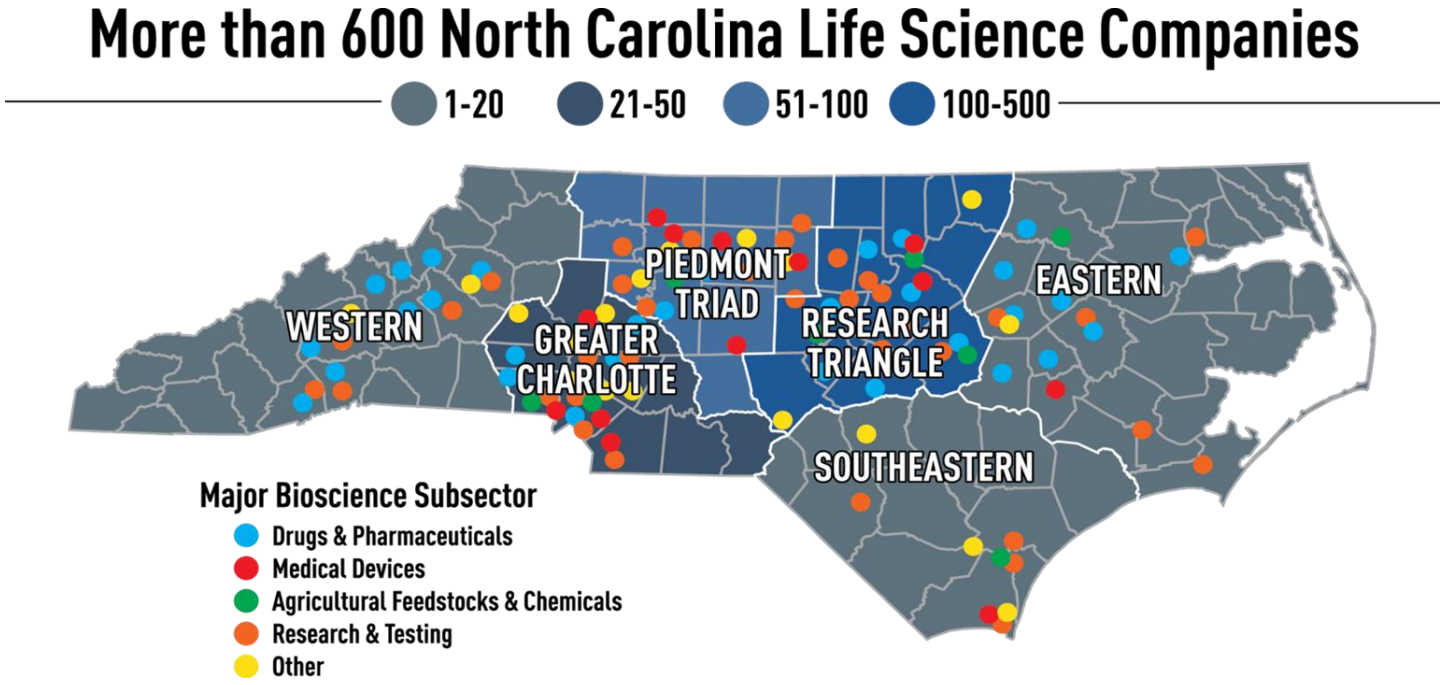
Expression Analysis (Quintiles)
Fennec Pharma
Health Decisions
Innocrin Pharmaceuticals
Intrexon
KBI Biopharma
LabCorp
Labcorp Clinical Trials
Liquidia Technologies
Malin
Merck
Metabolon
Neusentis (Pfizer)
Novan Therapeutics
Ocera Therapeutics
Parion Sciences
Patheon
Pearl Therapeutics (AstraZeneca)
Pique Therapeutics
ProPharma Group
Qualyst
Sandoz (Novartis)
Scioderm
Scynexis
Seachaid Pharmaceuticals
Syngenta
Synthon
T3D Therapeutics
Thrombotargets
Vascular Biosciences
Viamet Pharmaceuticals
Zenalux Biomedical
Zinfandel Pharmaceuticals
Zoetis
Maynard Engineering & Consulting
Novozymes
Elanco (Lilly)
Merz Pharmaceuticals
Piedmont Pharmaceuticals
DSM Pharmaceutical Products

Fervent Pharmaceuticals
Metrics Contract Services (Mayne Pharma)
PMG Research
High Point Clinical Trials Center (TransTech Pharma)
Patheon
TransTech Pharma
WIL Research
Biocytics
Pace Analytical
Ei
Labcorp Clinical Trials
Exela
Greer Laboratories
G&W Laboratories
Baxter
Aerial BioPharma
Aerie Pharmaceuticals
Array Biopharma
Asymchem
Catalent
Envisia Therapeutics
Fujifilm Diosynth
Furiex Pharmaceuticals (Forest Pharmaceuticals)
Gentris
Humacyte
Liquidia Technologies
Novella Clinical (Quintiles)
Oxygen Biotherapeutics
PPD
Regado Biosciences
Selexys
Sequenom
SOV Therapeutics
Triangle Insights Group
AbD Serotec (Bio-rad)
Agile Sciences
Arbor Pharmaceuticals
Arbovax

BioDelivery Sciences International
Charles River Laboratories

Covidien
DARA Biosciences
FLAG Therapeutics
INC Research
LipoScience
NanoVector
North Carolina Clinical Research
Pharmaceutical Calibrations & Instrumentation
PMG Research
PRA International
Salix Pharmaceuticals (Valeant)
Sprout Pharmaceuticals
Trinity Drug Partners
Wake Research Associates
Zoion Pharma
Grifols
Dignify Therapeutics
Aspir-tek
Alera Labs
Biogen
Cirrus Pharmaceuticals (Kemwell)
Cloud Pharmaceuticals
Cognosci
Enci Therapeutics
GlaxoSmithKline
KXT bio
MonomerChem Inc
NephroGenex
NovaTarg Therapeutics
Oncotide Pharmaceuticals
Precision Biosciences
QPS
Ridge Diagnostics
Spyrx
Triangle Research Labs (Gigacyte)
United Therapeutics
ViiV Healthcare
Vijaya Pharma
ZenBio
Patrin Pharma

Where are the opportunities/jobs in Biotechnology



Top 10 Careers In Biotechnology

Medical Scientists
Medical scientists specialize in researching and investigating biological systems in order to further understand and treat human diseases.

Biological Technicians
Biological technicians help biological and medical scientists carry out their research and experiments.

Medical and Clinical Lab Technologists & Technicians
Medical and clinical lab technologists and technicians work in either labs or health care facilities and perform tests studying blood, fluids, organs, tissue, and other substances.

Biochemists and Biophysicists
Biochemists and biophysicists design and perform various complex tests for their research. Their job includes studying proteins, DNA, RNA, and several other molecules.

Biomedical Engineers
Biomedical engineers use their knowledge of engineering to design and construct systems and products for medical usage. Some products include prostheses, and devices such as MRIs and CAT Scans.

Microbiologists
Microbiologists focus primarily on the classification and functions of microorganisms found in humans, plants, water, etc. They conduct complex research on these microscopic organisms to develop new drugs to combat diseases.

Epidemiologists
Epidemiologists compile data to try and understand the causes of diseases, improve public health issues, and prevent future problems. They analyze data and plan studies to find new statistics about diseases, and then report those findings to others in the medical and public health field.

R&D and Process Development Scientists
Research and development scientists are generally responsible for the manufacturing process that happens within a lab. They supervise lab technicians and lead the project team.

Regulatory QA/QC Biomanufacturing Specialists
Order is the priority for a regulatory QA/QC biomanufacturing specialist. They are responsible for supervising a project or job and guaranteeing that all criteria and requirements are met.

Bioproduction Operators
A bioproduction operator is hands-on in the biotech industry in a different way. Bioproduction operators are responsible for the manufacturing, packaging, and shipping of products produced.

Biotechnology Program at Forsyth Tech

A program that focuses on the application of the biological sciences, biochemistry, and genetics to the preparation of new and enhanced agricultural, environmental, clinical, and industrial products, including the commercial exploitation of microbes, plants, and animals. Potential course work includes instruction in general biology, general and organic chemistry, physics, biochemistry, molecular biology, immunology, microbiology, genetics, and cellular biology.

Fall Semester					
BIO 111	General Biology I **NEW VERSION 2014**	3	3	0	4
CHM 131	Introduction to Chemistry **REVISED REQUISITE**	3	0	0	3
CHM 131A	Introduction to Chemistry Lab **REVISED REQUISITE**	0	3	0	1
ENG 111	Writing and Inquiry **NEW VERSION 2014**	3	0	0	3
		9	6	0	11
Spring Semester					
BIO 112	General Biology II **NEW VERSION 2014**	3	3	0	4
CHM 132	Organic and Biochemistry	3	3	0	4
CIS 110	Introduction to Computers **REVISED REQUISITE**	2	2	0	3
		8	8	0	11
Fall Semester					
BTC 181	Basic Lab Techniques **NEW VERSION 2014**	3	3	0	4
BIO 250	Genetics	3	3	0	4
___ ___	Natural Science/Mathematics Elective	*	*	*	3
		6	6	0	11
Spring Semester					
BIO 275	Microbiology	3	3	0	4
BTC 150	Bioethics **NEW VERSION 2014**	3	0	0	3
MAT 152	Statistical Methods I **NEW 2014**				

Key Aspects of the Forsyth Tech Biotechnology Program

- The Biotechnology curriculum, which has emerged from molecular biology and chemical engineering, is designed to meet the increasing demands for skilled laboratory technicians in various fields of biological and chemical technology.

- Course work emphasizes biology, chemistry, mathematics, and technical communications. The curriculum objectives are designed to prepare graduates to serve in three distinct capacities: research assistant to a biologist or chemist, laboratory technician/instrumentation technician, and quality control/quality assurance technician.

- Graduates should be qualified for employment in various areas of industry and government, including research and development, manufacturing, sales, and customer service.

Forsyth Tech Career in Biotechnology

With an increasing demand of 10-15% annually within the Piedmont Triad, the employment opportunities for biotechnology graduates are numerous.

The primary use of biotechnology in North Carolina is in the production of pharmaceuticals, research and diagnostics.

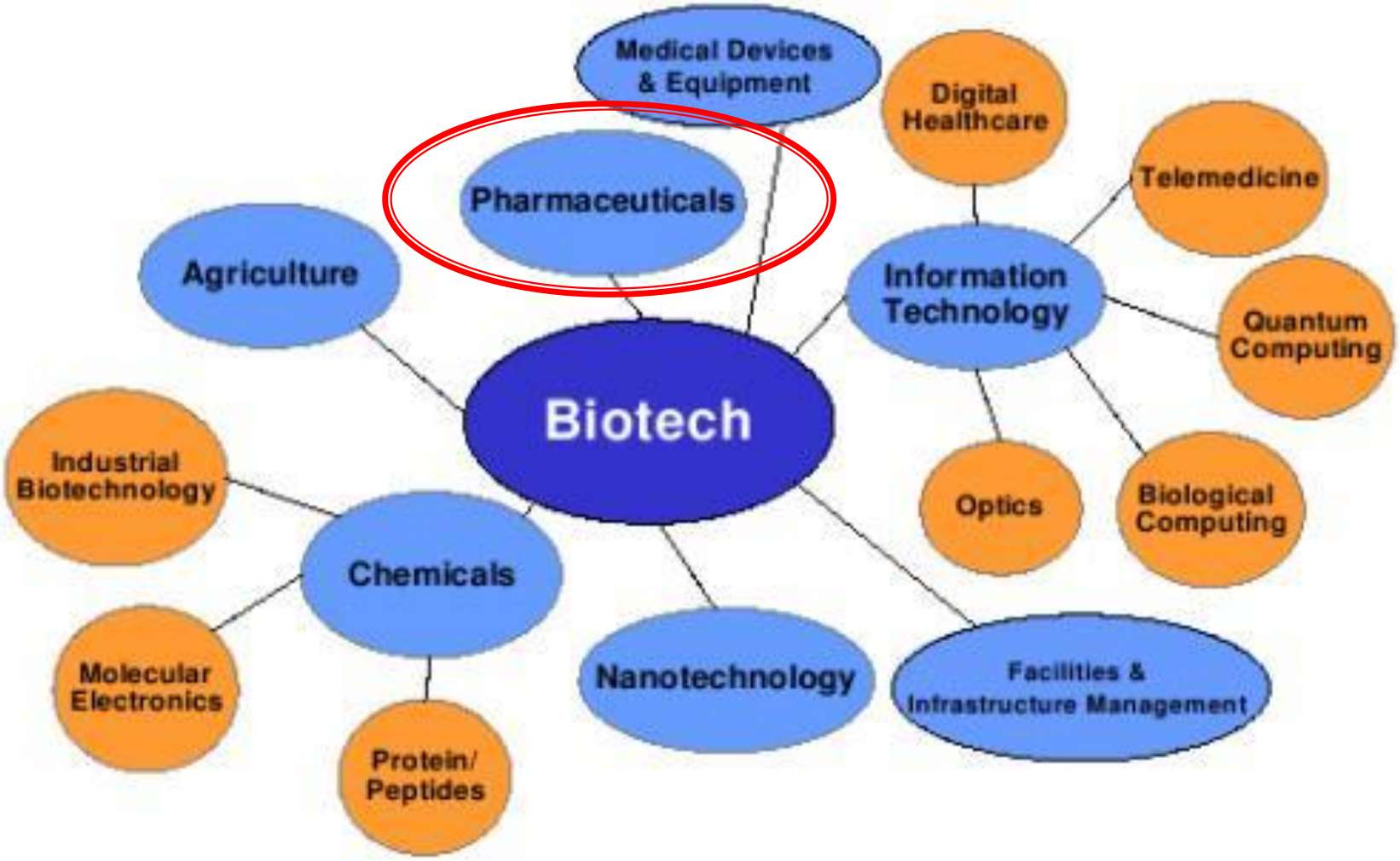
Forsyth Tech's biotechnology program prepares individuals to become the highly skilled technicians needed to support the growing medical, life science, and pharmaceutical research and development efforts in this area.

Career Opportunities for Forsyth Tech Biotechnology Graduates

Research Assistant
Research Associate (graduates with further experience)
Research Technician
Scientist Assistant and Associate (graduates with further experience)
Laboratory Assistant
Laboratory Technician
Quality Control Technician
Bioprocess Technician

The Biotechnology program is supported by the high-growth industry initiatives of the Employment and Training Administration, U.S. Department of Labor.

The Biotechnology Industry



US Pharmaceutical Industry

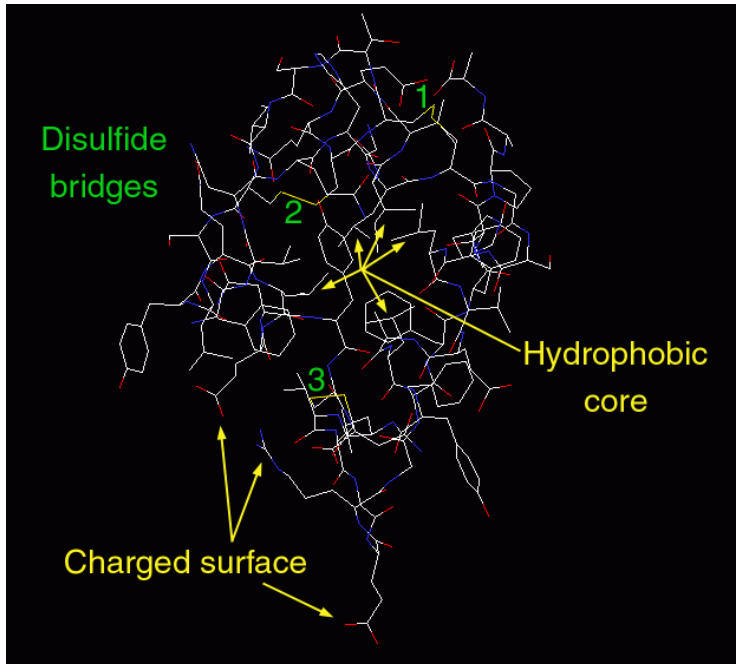
- 10 million known compounds
- 1,543 pharmaceutical compound have been approved by the FDA as of 2013
- 3400 compounds currently being studied
- 810,000 jobs
- Largest world market
- Overall economic impact $789 billion
- Americans spent $307 billion on pharmaceuticals

2010- Phrma.org and http://www.raps.org/Regulatory-Focus/News/2014/10/03/20488/How-Many-Drugs-has-FDA-Approved-in-its-Entire-History-New-Paper-Explains/

Biotechnology: Why do we need it?

http://www.flanderstoday.eu/innovation/vib-researchers-simplify-production-biotech-drugs

Biopharmaceutical Process: Insulin



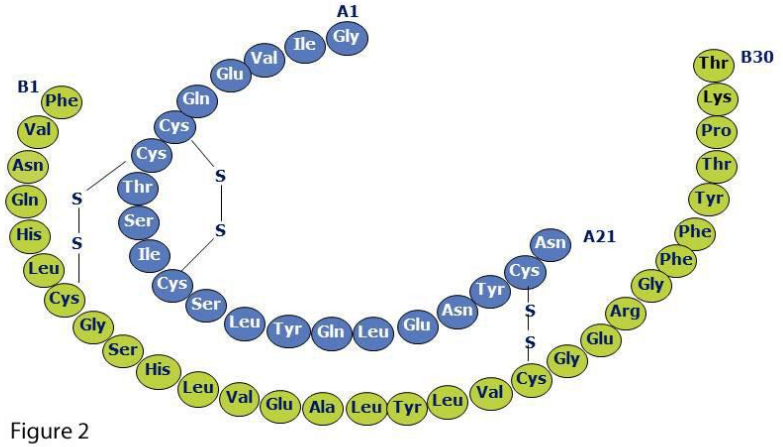


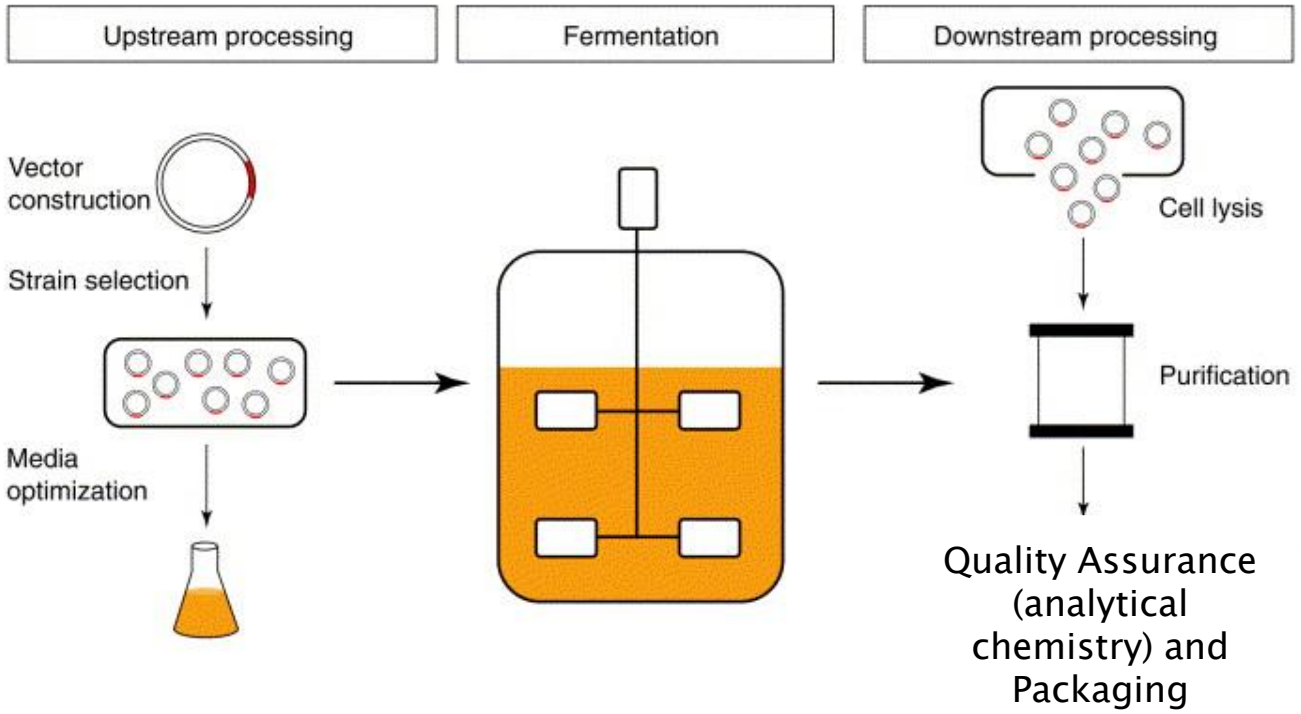
Figure 2

http://www.rcsb.org/pdb/101/motm.do?momID=14

http://www.med.uni-giessen.de/itr/history/inshist.html

http://www.fefchemicals.com/biopharm/scientific-information/articles/the-insulin-peptide-family/

Biopharmaceutical Process

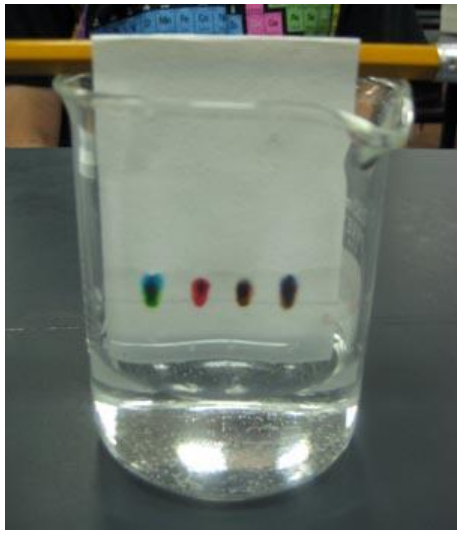


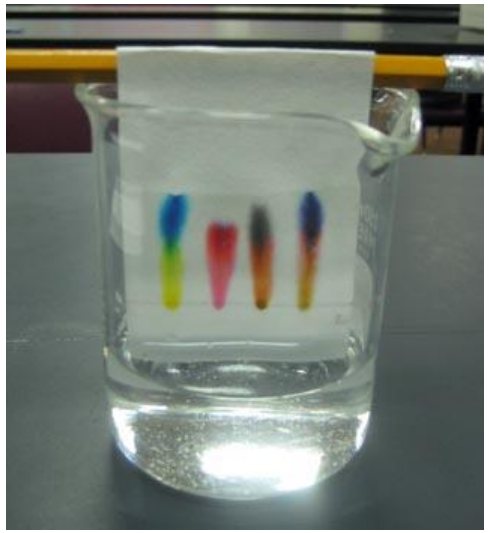
http://www.sciencedirect.com/science/article/pii/S016777990001475X

Chromatography

Stationary phase

Mobile phase

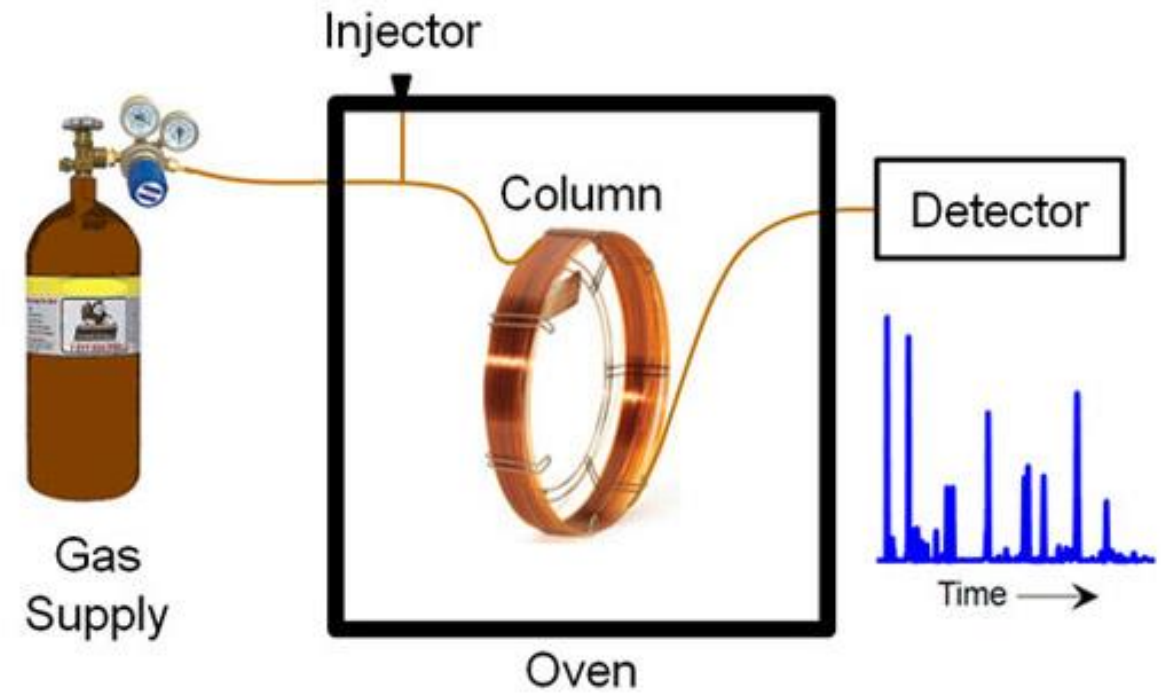




Shape
Molecular Mass
Charge
Polarity
Solubility
pH

http://archive.wastatelaser.org/_support/toolkits/stc/PofM/lesson17.asp

Gas Chromatography

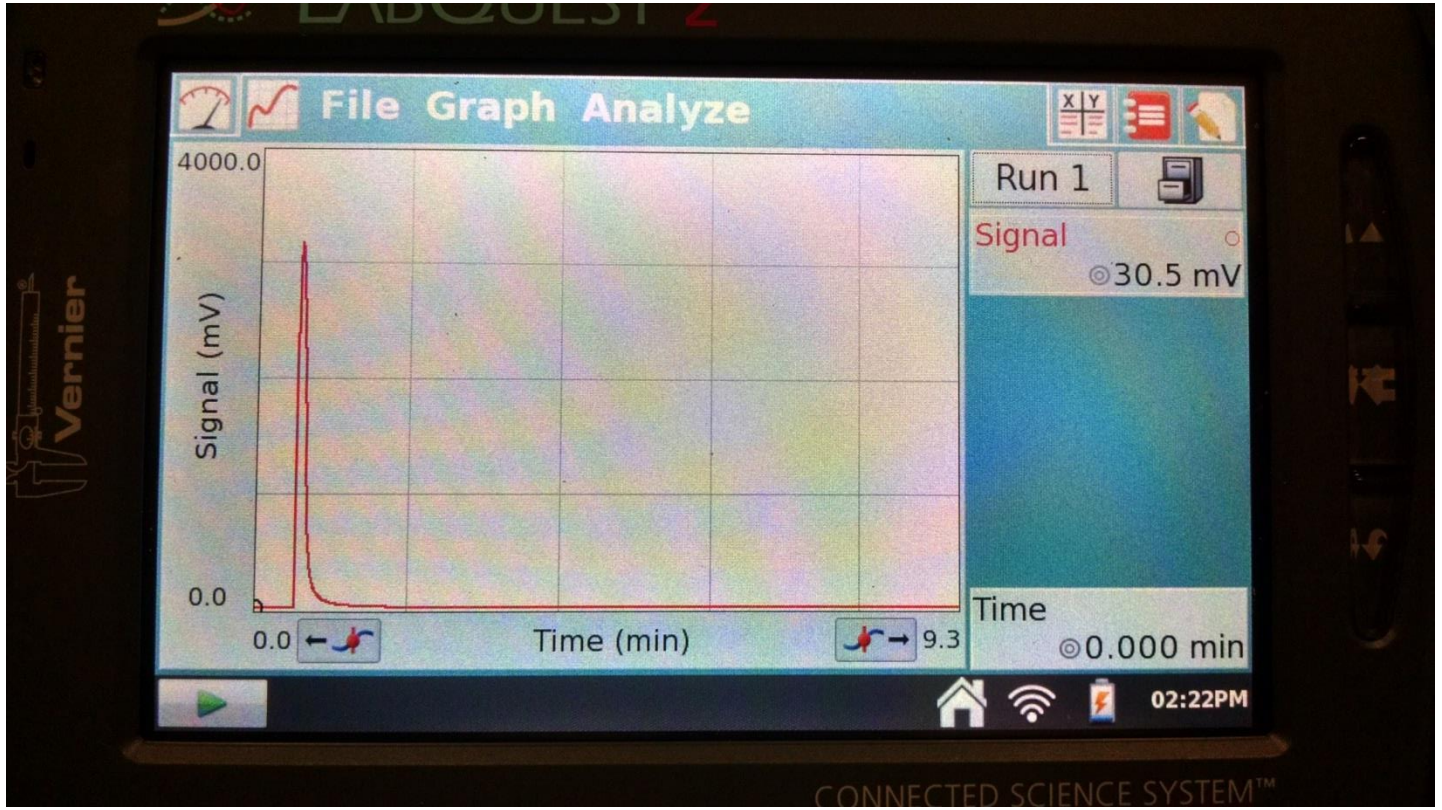


http://shop.educatec.ch/images/gc-mini_unit1.jpg

Using GC to Determine the Purity of a Production Sample

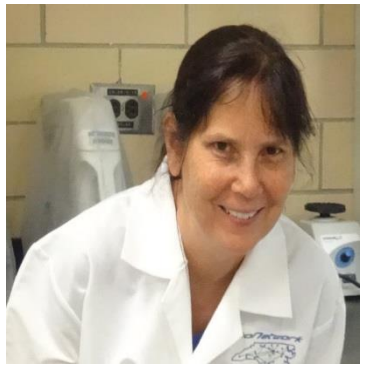
1. Please hand-in your certificated from the GC tutorial homework.
2. Please obtain a GC Batch Procedure.
3. Demo of Cleaning and Injection
4. Carry out procedure.

Chromatography Data Analysis



Questions


Golden LEAF Biomanufacturing
Training and Education Center



National Science Foundation
WHERE DISCOVERIES BEGIN

Rowan Cabarrus Community College

Forsyth Technical Community Collec

Wake Forest University

BioGen

Piedmont
Pharmaceuticals

BIOTECHNOLOGY: USING SCIENCE TO IMPROVE AND SUSTAIN LIFE

Shania Dalton and Ingrid Burke

June 26, 2015

What is Biotechnology?

DEFINITIONS

In 1917, Karl Ereky defined it as " all lines of work by which products are produced from raw materials with the aid of living things."

Presently, http://www.merriam-webster.com/dictionary/biotechnology describes it as the manipulation (as through genetic engineering) of living organisms or their components to produce useful usually commercial products (as pest resistant crops, new bacterial strains, or novel pharmaceuticals); *also* : any of various applications of biological science used in such manipulation

BIOTECHNOLOGY PRINCIPLES

Build the Knowledge

Apply It

Foster It

Share It

Transfer it to transform the world!

Building personal knowledge, love, and respect of biotechnology through the people, hands on experiences, and education from birth onward.

PEOPLE WHO USE BIOTECH

Growers

Individuals with prosthesis

Ranchers

Chefs

Insulin dependent individuals

Aquaponic and Hydroponic Gardeners

Diabetics

Nonprofessionals (tinkerers)

Zoologist/Veterinarians

Entomologists

Astronauts

Military

Pet owners

BUILD THE KNOWLEDGE

Introducing healthy habits

Introducing cooking as chemistry

Encouraging questions about environment

Family history

Traditional ***ceviche*** consists of raw seafood tossed with an acidic marinade such as citrus juice or vinegar that "cooks" the fish.

Build the language...

Build the skills..

Build to the next step...

Gardening

Charting

Practicing good hand washing skills

Taking care of pets

Using a medication tracking log

Foster It…
starting at the beginning can bring about the sky as no longer being the limit.

Build the language...

Build the skills..

Build to the next step...

Pre-K through Elementary School

Allowing and encouraging “Why” questions

Have youths feed and water plants and animals

Family members do presentations about their jobs in biotechnology

Basic experiments with plants, insects, chemical processes

Begin teaching reading comprehension and writing skills in all subjects, creative and critical thinking skill by the way of games and other media.

Begin an experience portfolio (i.e. feeding and watering charts)

Middle School

Facility tours (JSNN, B.R.I.T.E)

More advanced experiments with plants, insects, chemical processes

Learn more about biotechnology throughout history from migration to domestication of animals and purposeful crop growing and clothing manufacturing

Increase interactive learning of science and math concepts and language

Expanding effective reading and writing skills in all subjects

Expand experience portfolio with individual and group work (i.e. documentation of experiments, school projects, and community service)

INTRODUCTION TO BIOTECHNOLOGY AND MANUFACTURING IN HIGH SCHOOLS

WHAT IS BIOTECHNOLOGY?

- Courtney Harrington PhD. – Forsyth Technology Community College

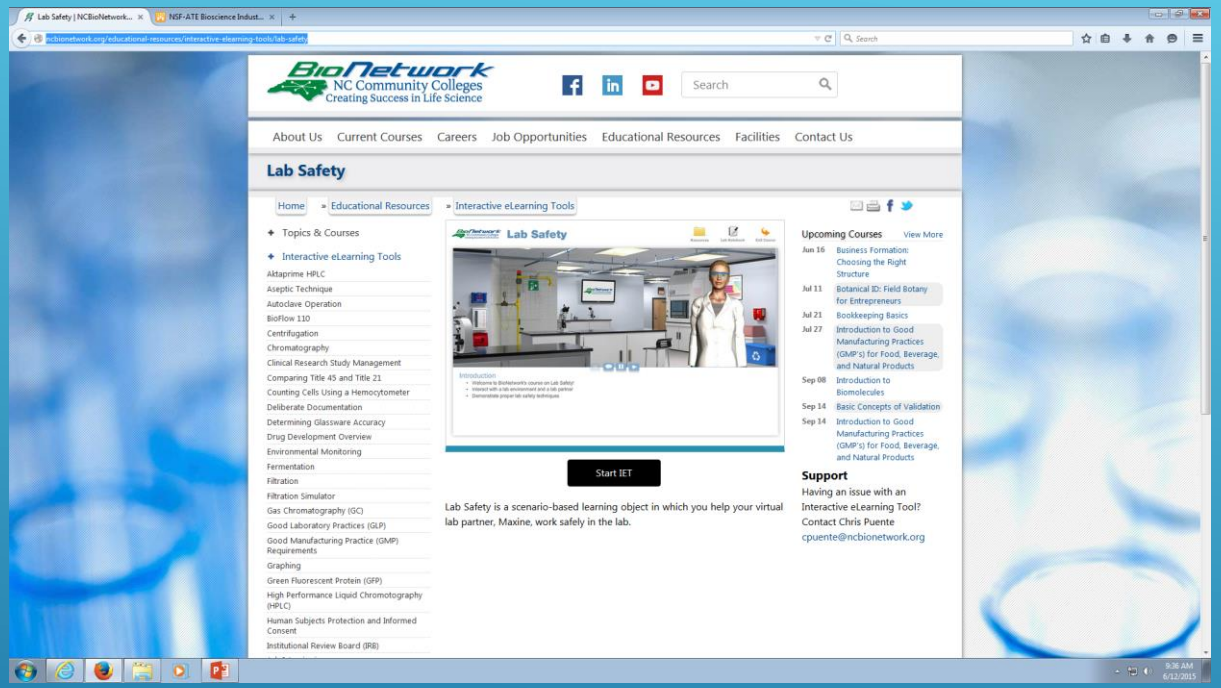
- What is Biotechnology

- Ideas for Student Posters
  - Research and Development
  - Biopharmaceuticals
  - Pharmaceuticals
  - Biosimilar
  - Bioprocessing
  - Biomanufacturing
  - Upstream vs. Downstream Processing
  - Drugs vs. Biologics
  - Herbals
  - Instruments and Tools of the Trade
  - Animal Health
  - Quality Control
  - Quality Assurance
  - Biotechnology Testing Equipment

keepcalm-o-matic.co.uk

BIOTECHNOLOGY AND MANUFACTURING POSTER SESSION

ncbionetwork.org



- BioNetwork – a host of virtual interactive activities.
- North Carolina BioNetwork

VIRTUAL INTERACTIVE ACTIVITIES

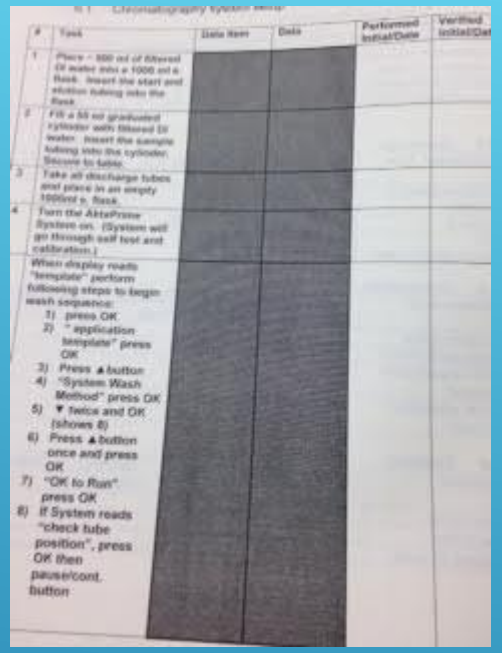
- **Purpose:**
  - **What did they do wrong?**
  - **Outcome of their mistakes?**
  - **Importance of Sterility in Laboratories**
  - **Zombie College**
  - **Aseptic Techniques LAB**
  - **Glo-Germ activity**

  - **http://blog.nelsonjameson.com/wp-content/uploads/2013/03/glowgerm-300x63.jpg**

GOWNING GONE WRONG

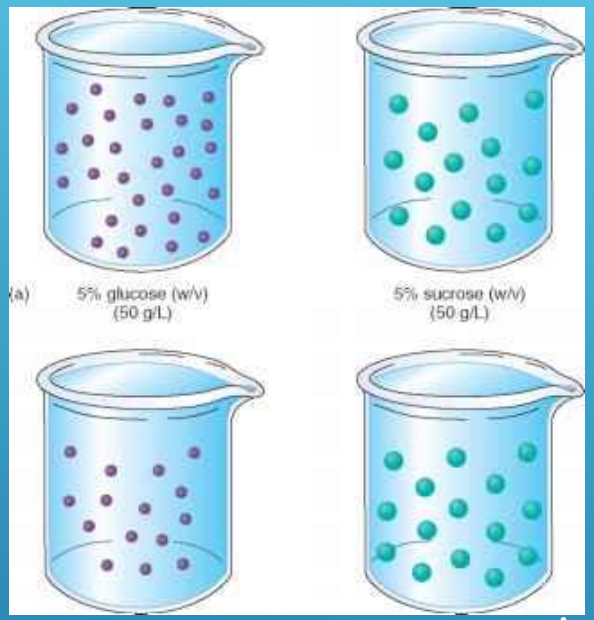
(THE IMPORTANCE OF ASEPTIC TECHNIQUE)

- A different way of reading a lab report
- Helps prepare students for the manufacturing industry
- Importance of recording data



BATCH PRODUCTION RECORDS

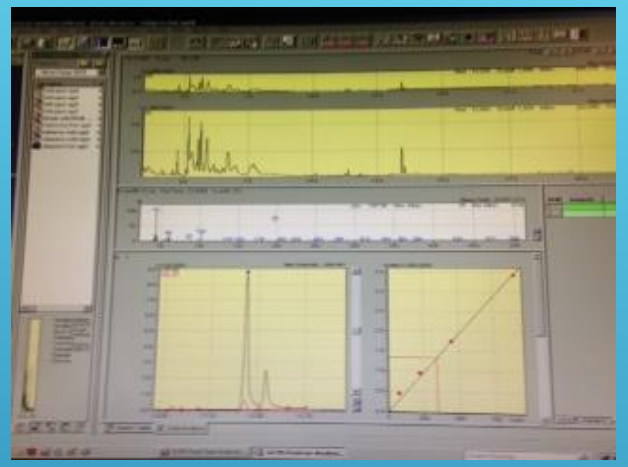
SKILLS AND ACTIVITIES FOR THE HIGH SCHOOL CLASSROOM

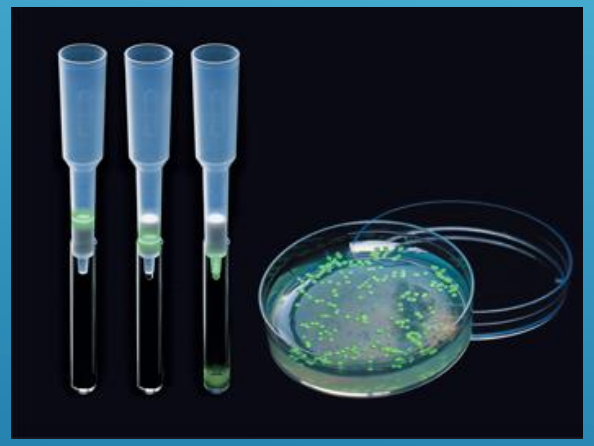


rrnursingschool.biz

- A necessity for students as they go off to college or work in the biotechnology field.
- Biotechnology – Ellyn Daugherty, MST- Making Solutions of Differing Mass - LAB

SOLUTIONS AND DILUTIONS – AN IMPORTANT CONCEPT





biorad.com

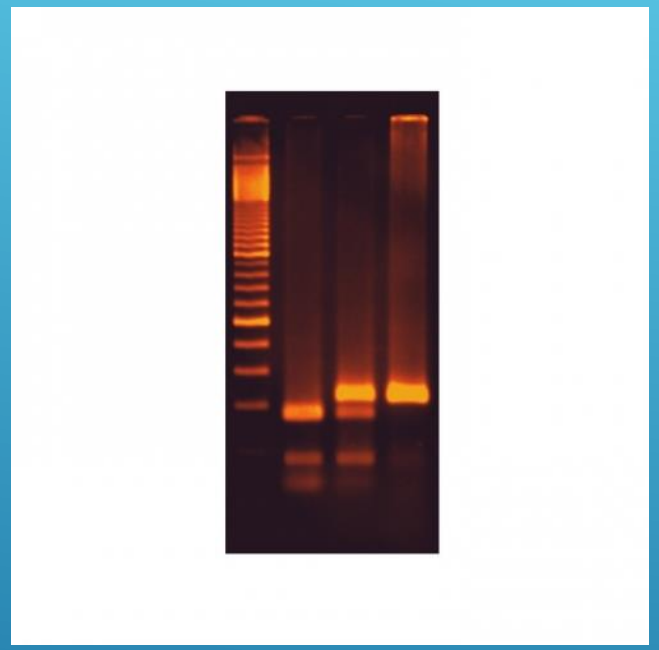
GAS AND LIQUID CHROMATOGRAPHY

- Ideas:
- Capsaicin in Peppers – Gas Chromatography
- Green Fluorescent Protein (GFP)- Liquid Chromatography
- High School Level- Hydrophobic Interaction Column Chromatography (HIC)

SPECTROPHOTOMETRY

- Use of colors to measure absorbance
- Ex. Anthocyanin Activity

PTC – Gel Electrophoresis



edvotek.com

High School Option – Alu PV92

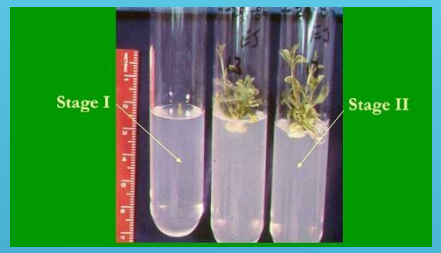
- Uses an intron instead of an exon
- Important because of students being minors

biorad.com

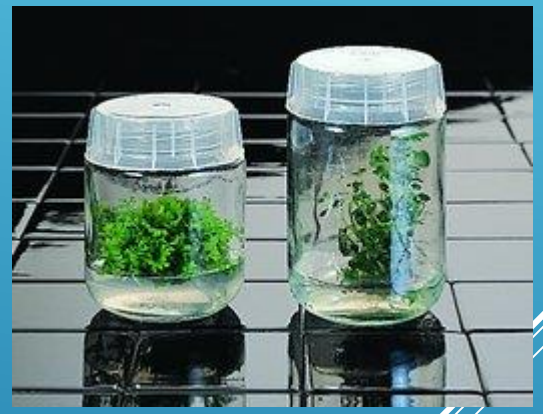
POLYMERASE CHAIN REACTION (PCR)

PLANT VS. ANIMAL TISSUE CULTURE

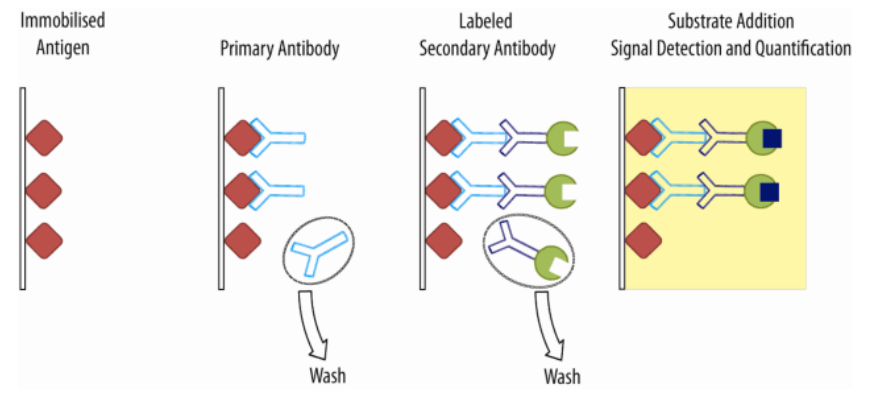
- Plant Tissue Culture Virtual Lab
- Plant Tissue Culture Lab
- Easier to do in an high school



apsnet.org



sigmaaldrich.com



rockland-inc.com

- Understanding how Color Assays Work
- Ex: ELISA Activity

ALLERGEN UNIT

ANIMAL HEALTH

- Design a way to dissolve chitin(a substance found in the exoskeleton of parasites)
- Must be a biodegradable material and safe for the environment
- Use mushrooms instead of animals since they also have chitin

greenvillemosquitosquad.com

- What is regenerative medicine?
- How does it work?
- Understanding Regenerative Medicine
- Idea from Wake Forest School of Medicine

REGENERATIVE MEDICINE

OTHER IDEAS

CLINICAL TRIALS– DESIGN AN ADVERTISEMENT

- Students will design a poster to advertise for people to sign up for a study for clinical trials

http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0CAcQjRw&url=http%3A%2F%2Fwww.jli.edu.in%2Fblog%2Fadvertising-in-clinical-trials%2F&ei=RF6JVdGDLcHBggTNj4TADw&bvm=bv.96339352,d.cWc&psig=AFQjCNEXv_ZRId5JfaLg72Cg6VFyVlsqLQ&ust=1435152248588971

nnin.org

NANOTECHNOLOGY

- What is Nanotechnology?
- Students Explore a Problem of Interest and Presentation
- Ex: Lighter Sports Equipment, adhesives, etc

FINAL EXAM!

- At the end of the semester students will design their own case study about a disorder
- Incorporate aspects of what they have learned in course by studying the disorder
- Activities they would use to explore the disorder
- Must have data from one activity that they actually did to simulate what would happen
- **Presentation Day!**

Share It

Can we take this further?

- Community projects
- Creating sustainability at home, in schools, in the community and across the world.
- Internships
- College and job fairs
- Sharing community experiences
- Entrepreneurships
- From science to facts

BIOTECHNOLOGY

Transfer it to others…

to transform the world!

HOW DO I TRANSFER IT?

Use all the skills learned to seek a career…

Further your education…

Become an entrepreneur …

Work on improving your community...

Advocate for advancement of science for sustainability…

...the possibilities are endless.

TIPS FOR SUCCESS…

Market Yourself Successfully

Communication and Teamwork

Continue to Learn

Reading and Writing Skills

Being Inquisitive

Taking Initiative

Passion

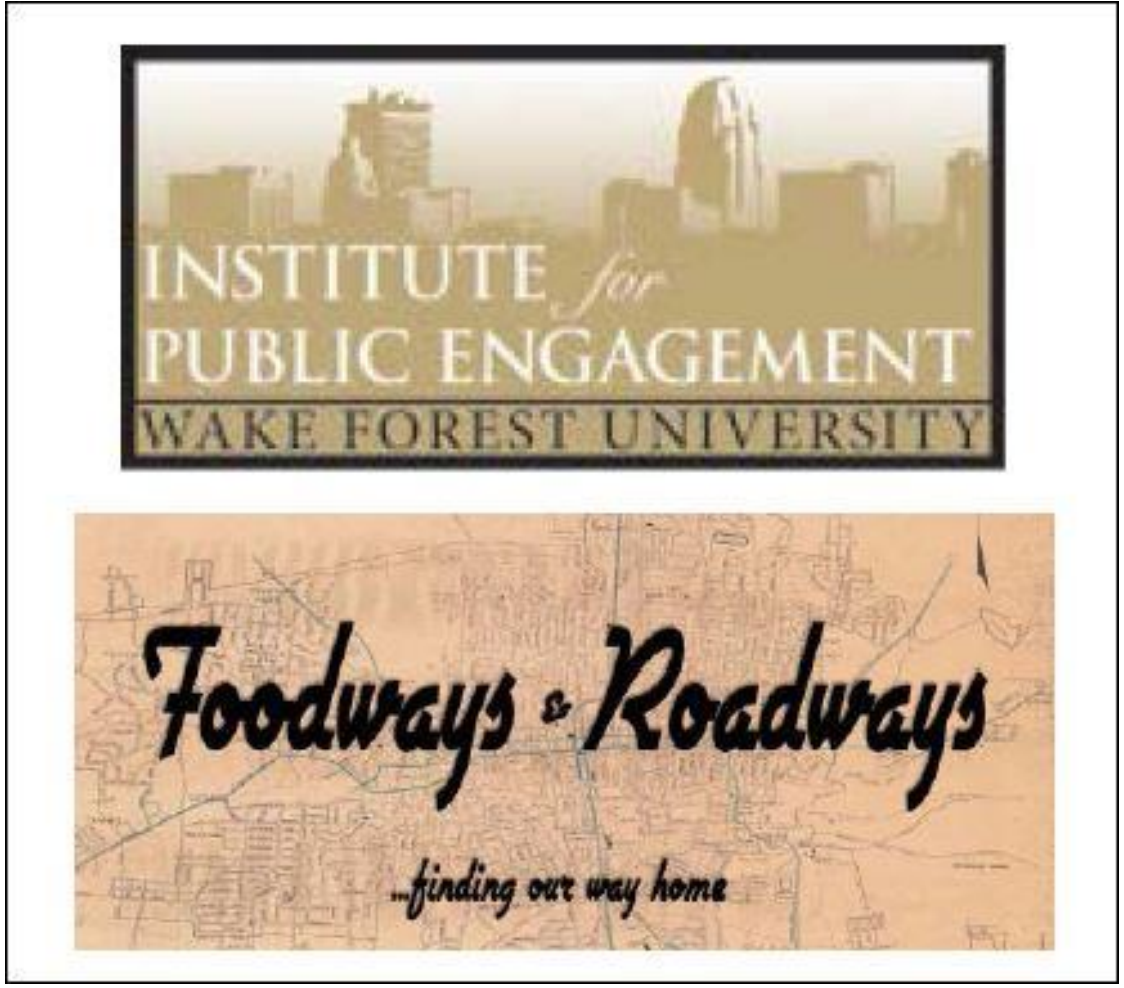
Flexibility

Customer Service Skills

Know Your Value**s**

WE WOULD LIKE TO THANK EVERYONE FOR THE OPPORTUNITIES, EXPERIENCES AND HOSPITALITY AS WE LEARNED THE PRINCIPLES OF BIOTECHNOLOGY!

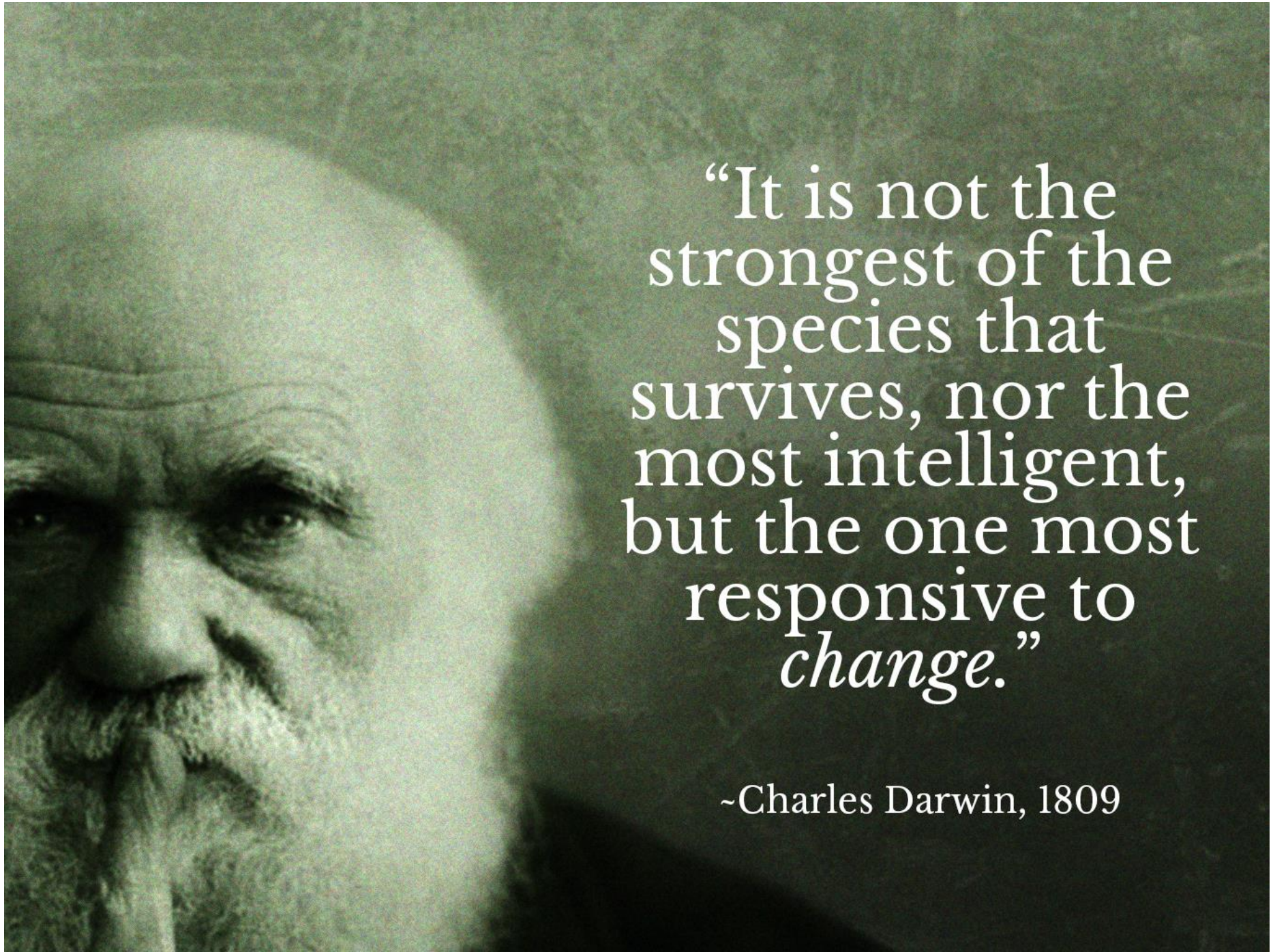

HYDROPONICS
BIOTECHNOLOGY
IN YOUR BACKYARD
FOR
A SUSTAINABLE FUTURE



"…Savoca said some solutions to help ***create more self-sustaining food systems*** include ***community gardens***, ***urban farming***, revitalizing public markets and veggie cars …"

http://www.journalnow.com/news/local/project-examines-changes-in-food-systems-in-african-american-communities/article_02a01886-3798-11e3-aba0-001a4bcf6878.html

http://www.camelcitydispatch.com/foodways-roadways-screening-panel-discussion-and-reception/


“It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to *change*.”
~Charles Darwin, 1809

Respond to change…

WHAT DO WE NEED?

Bionetwork, Food, Beverages And Dietary Suppl.

High Point, Clinical Trials

FOOD AND WATER

BioNetwork
NC Community Colleges
Creating Success in Life Science

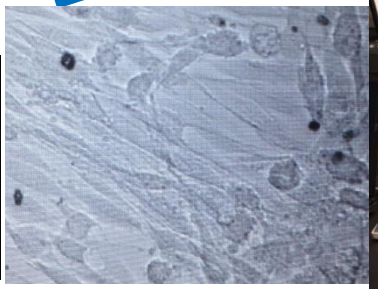
Cook Medical

HEALTH

ENERGY

B.R.I.T.E

Alamance Com. Col.



Capstone, NCSU

Biotechnology:

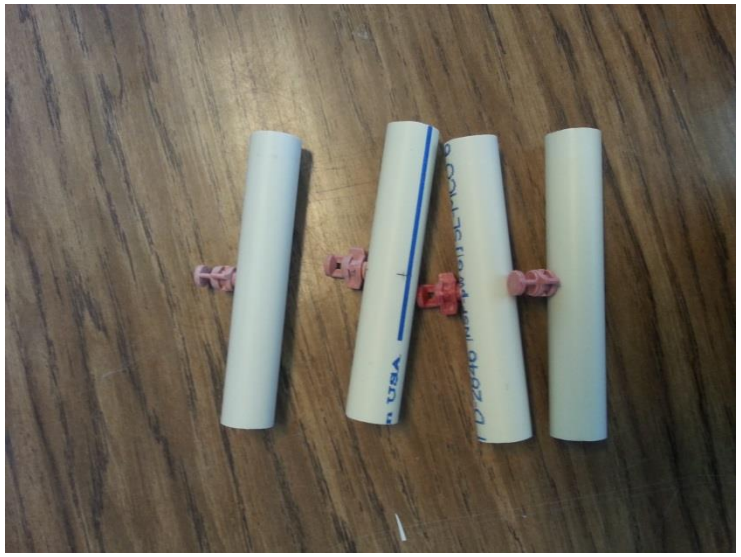
Demystify the scary factor

Hands-on learning

Ownership of school project

Sustainability for the community

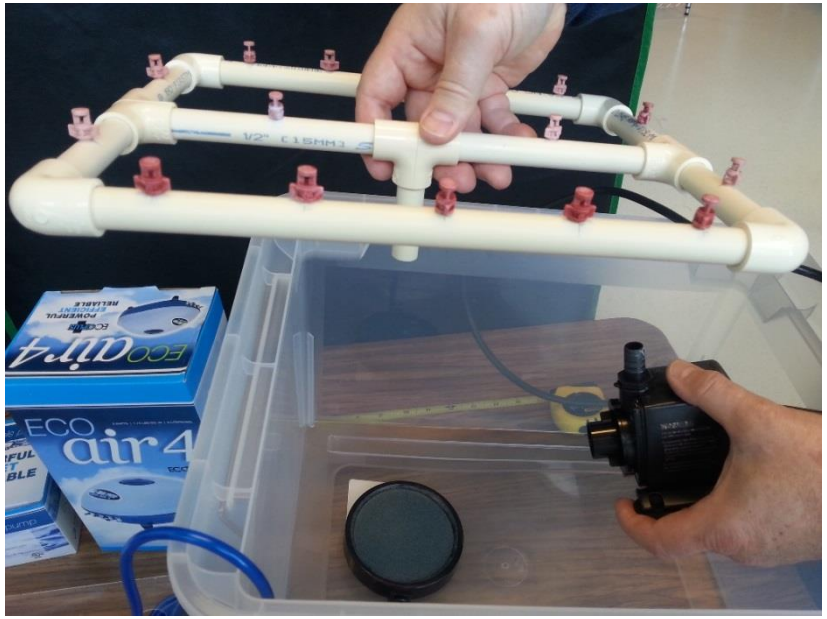
D. Herr, Ph.D.
Professor and Nanoscience Department Chair



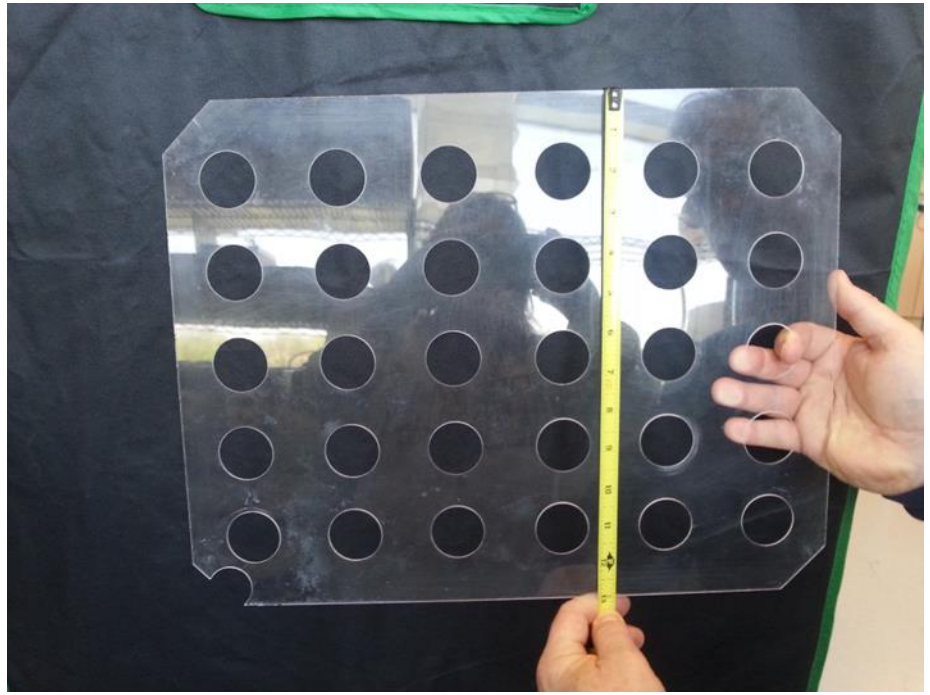
Various sizes of PVC pipe and spray nozzles

PVC pipe connectors

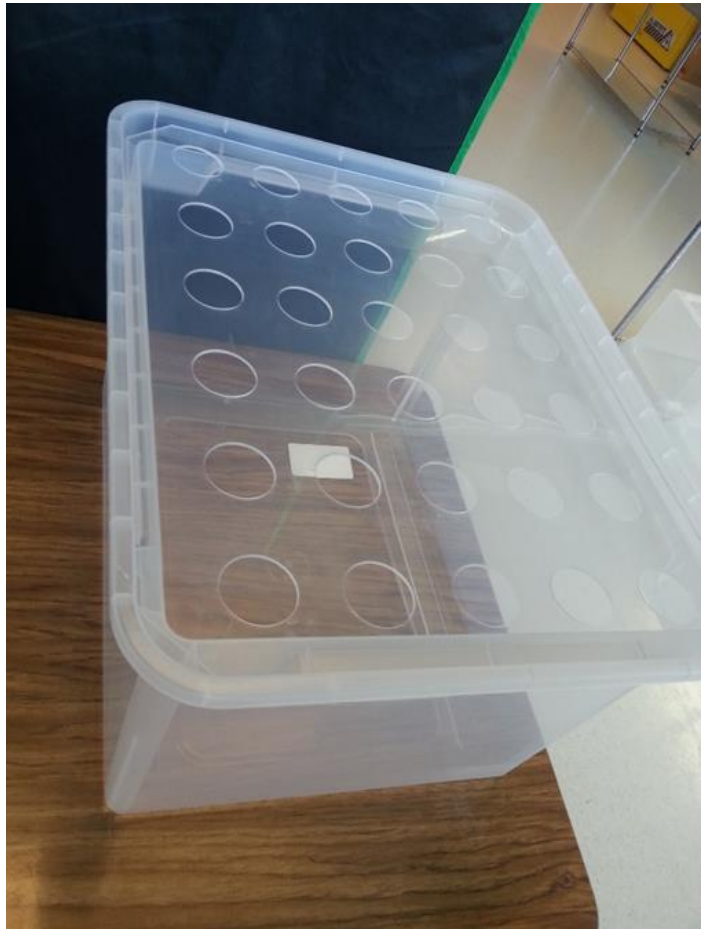
Submersible water pump, air stones and tubing, timers for lights



The water pump is attached to the water circulation system



Plexiglass with cut holes to hold the starter plugs and cut to fit in the top of the hydroponic system box



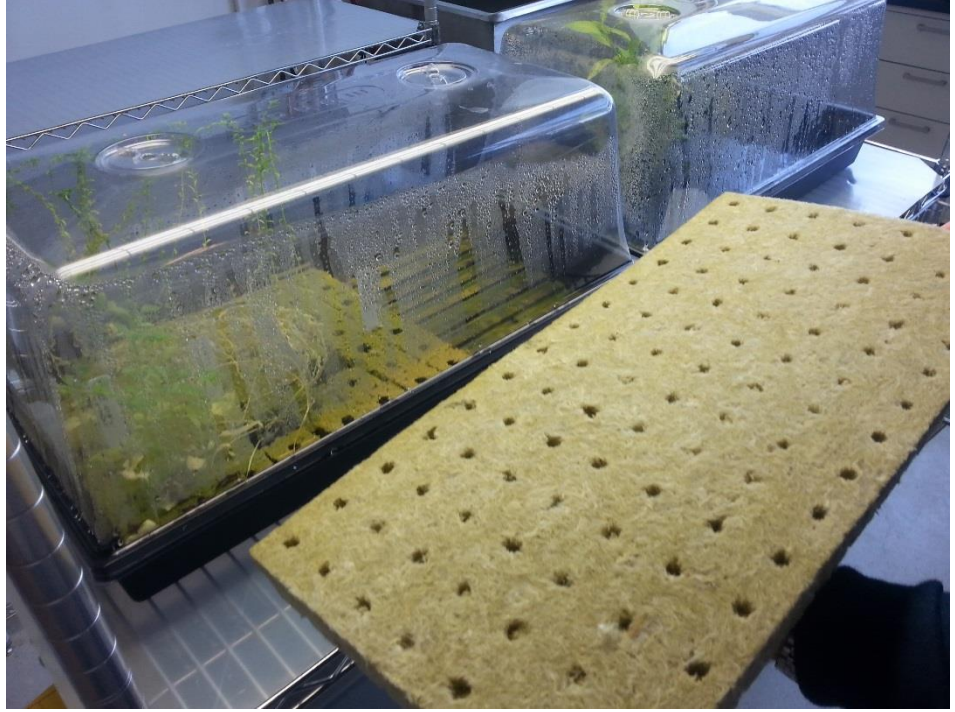
Hydroponics nutrient solutions

JSNN

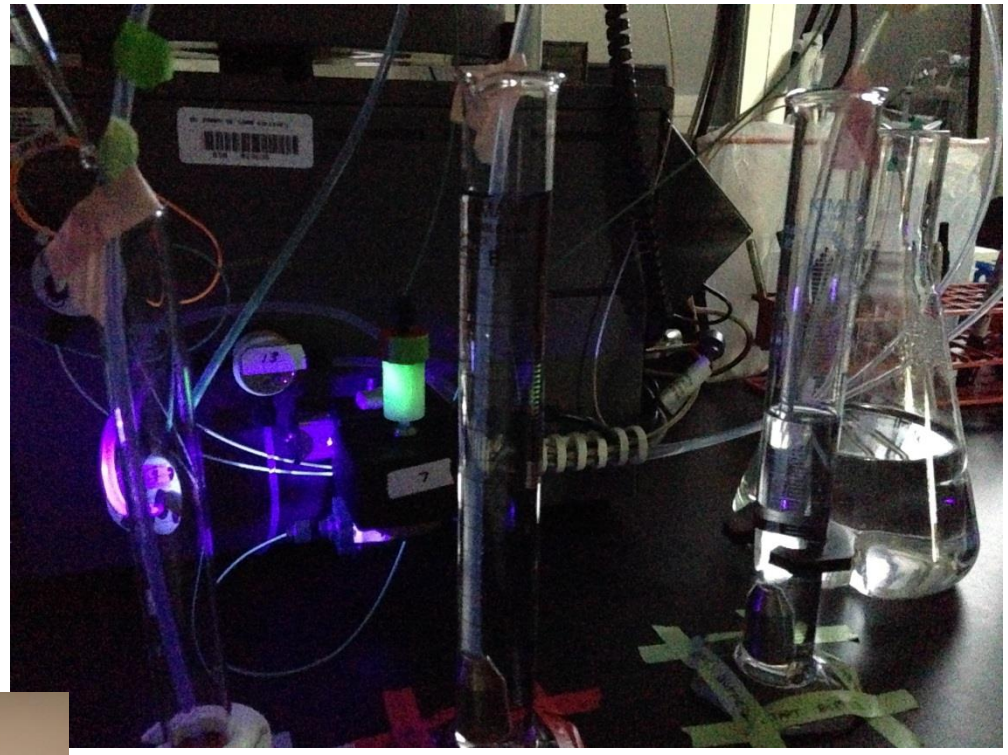
Joint School for Nanosciences and Nanoengineering

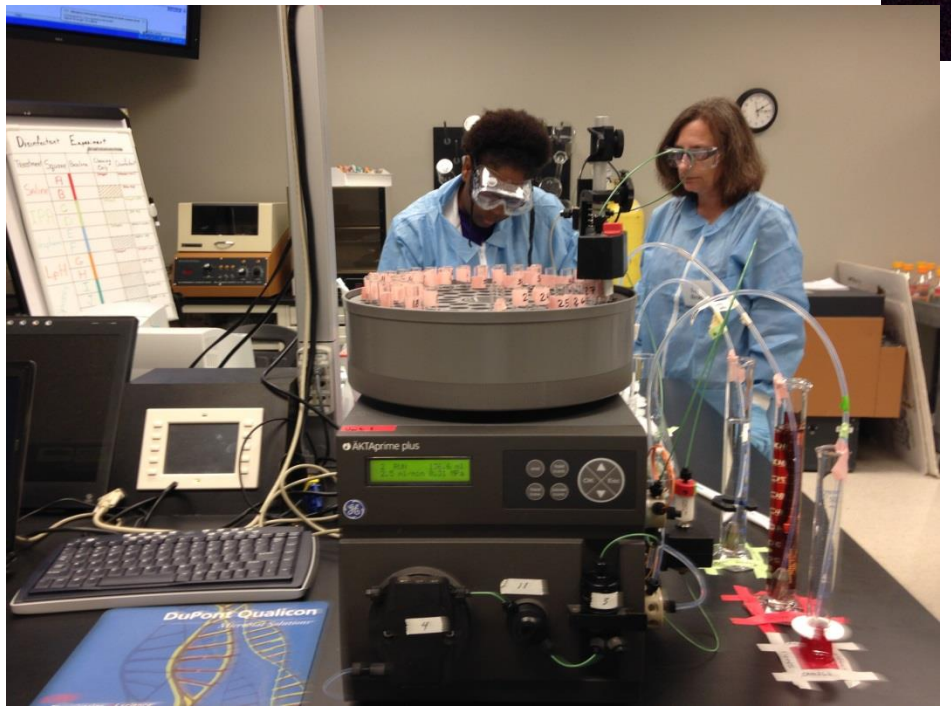
Instead of starter plugs, we can use starter mats

Growth: nutrients
Photosynthesis



chromatography

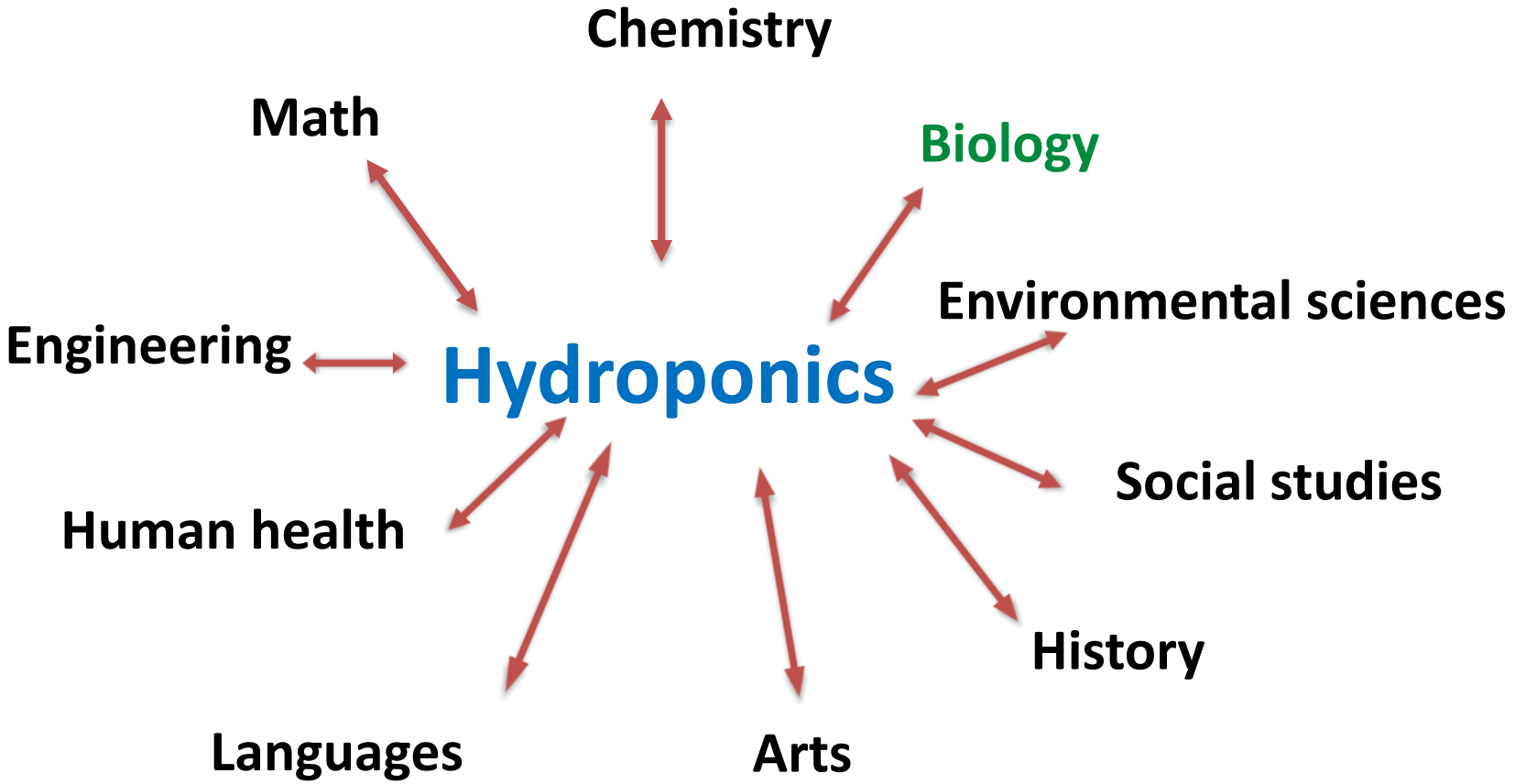




HPLC analysis

Biotechnology in the classroom …

- Hands on learning
- Ownership
- Intercurricular



Biotechnology in the classroom …

Hands on learning
Ownership
Inter-curricular

Biology:

Skills:

- Experimental design and research
- Documenting and labeling
- Pipetting, weighing, calculating concentrations, dilutions
- Analytical tools

Themes:

- Nutrition
- Plant growth
- Photosynthesis
- Sustainability

… and in your backyard

Hydroponics and Learning

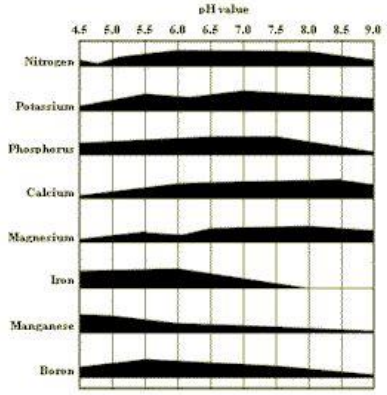
pH levels in hydroponics systems

pH Values For Different Hydroponic Crops

(*From Hydroponic Food Production* by Howard M. Resh Woodbridge Press, 1987)

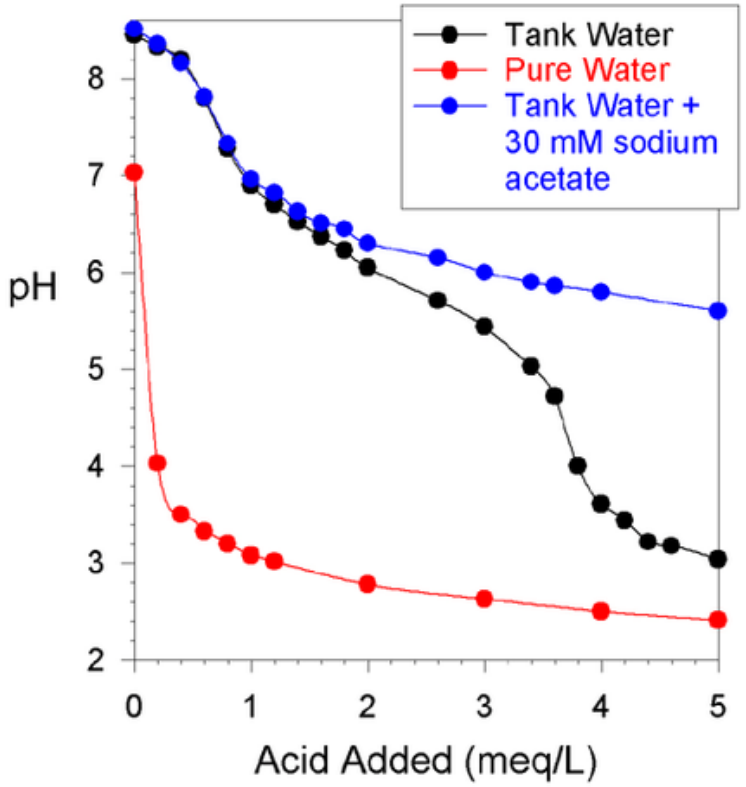
Plant	pH Range
Beans	6.0-6.5
Broccoli	6.0-6.5
Cabbage	6.5-7.5
Cantaloupe	6.5-6.8
Carrots	5.8-6.4
Chives	6.0-6.5
Cucumbers	5.8-6.0
Garlic	6.0-6.5
Lettuce	6.0-6.5
Onions	6.5-7.0
Peas	6.0-6.8
Pineapple	5.0-5.5
Pumpkin	5.0-6.5
Radish	6.0-7.0
Strawberries	5.5-6.5
Tomatoes	5.5-6.5

Availability Of Nutrients Available At Different pH Levels



NOTE:
This chart is for soiless (hydroponic) gardening only and does not apply to organic or dirt gardening.

http://www.advancednutrients.com/breakthrough/



Collect Data from tests and experiments on pH levels of the tank water:

Graph results.

Make comparisons.

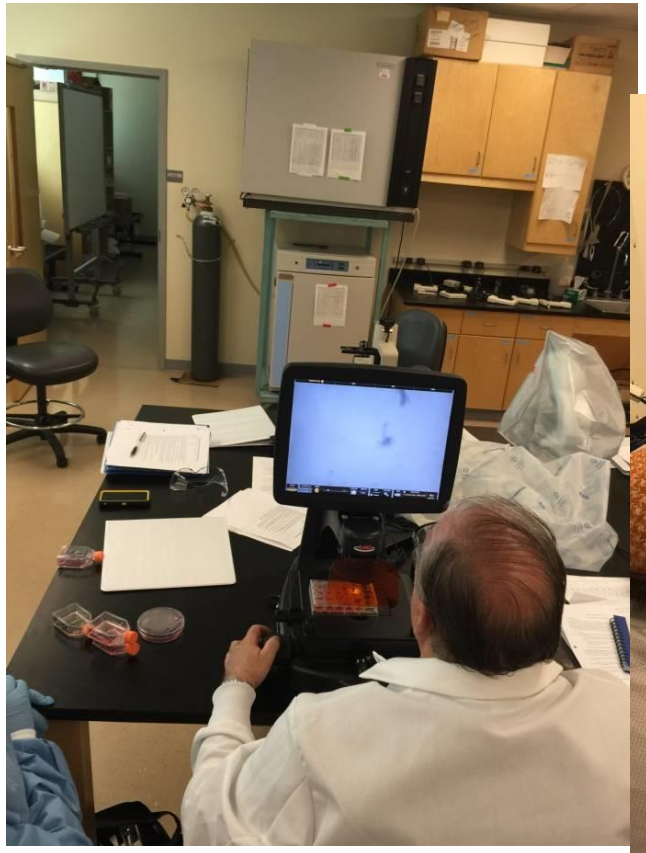
Model the pH level as a function of the buffer.

$$pH = pK_a + log\frac{[base]}{[acid]}$$

Inferences: chemical nature of alkalinity

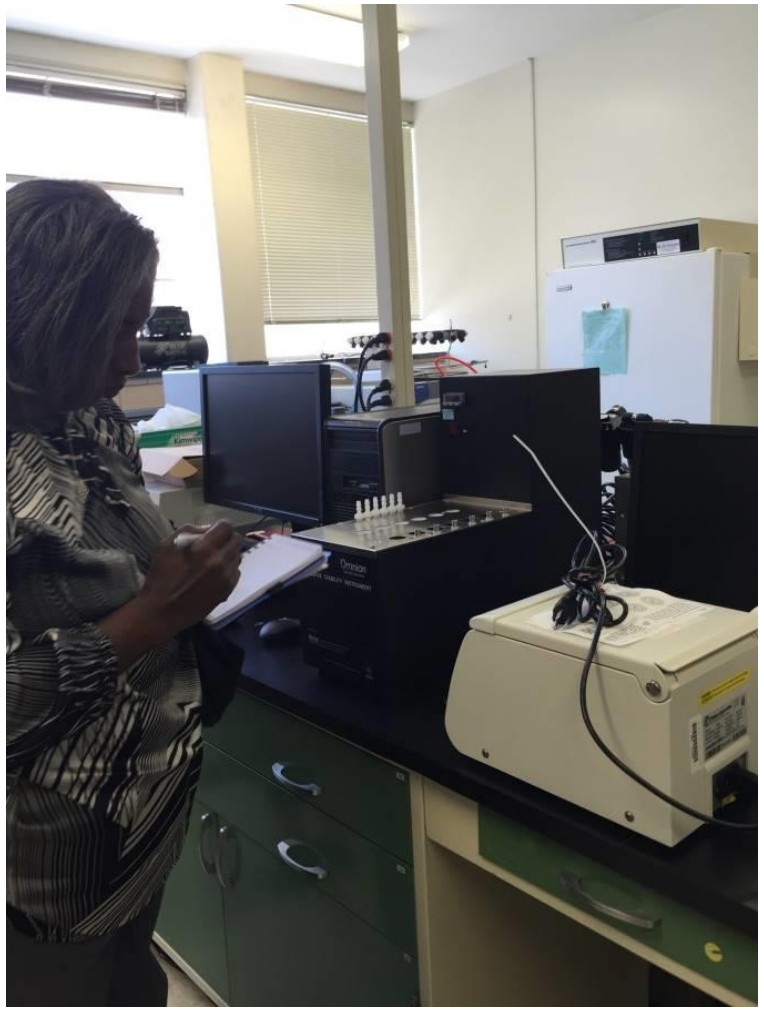
http://www.advancedaquarist.com/2002/2/chemistry#section-0

Predicted Increase in Biotech Jobs



Research to Quality Control

Preparing Students for Careers in Biotechnology
Using Cross Curricular Activities



DF = Dilution factor described above

10^3 = factor for conversion from g to mg

ε = (26 900 L x mol^{-1} x cm^{-1}) Molar absorptivity of cyd-3-glu (molar extinction coefficient)

	Sample ID	Dilution Factor (DF)	pH = 1.0 (KCl) 520nm pH 1	pH = 1.0 (KCl) 700nm pH 1	pH = 4.5 (sodium acetate) 520nm pH 4.5	pH = 4.5 (sodium acetate) 700nm pH 4.5	A 1.227	Anthocyanin content (mg/L)
2	~~A~~ Cabbage		1.363 A	Ø.ØØ9A	0.174 ~~0.181~~	0.047 0.046	~~0.004~~ .003	204.38
3	~~B~~ 100% juice		Ø.176 A	Ø.ØØØA	0.044 1.044	0.004 0.000	~~0.000~~ .116	19.37
4	~~C~~ pom		Ø.765 A	Ø.ØØ1A	0.142 ~~1.121~~	0.007 1.007	~~0.356~~ .629	105.04
5	~~D~~ wine		Ø.788A	Ø.ØØ7A	0.253 ~~1.216~~	0.012 1.000	~~0.473~~ .341	90.34

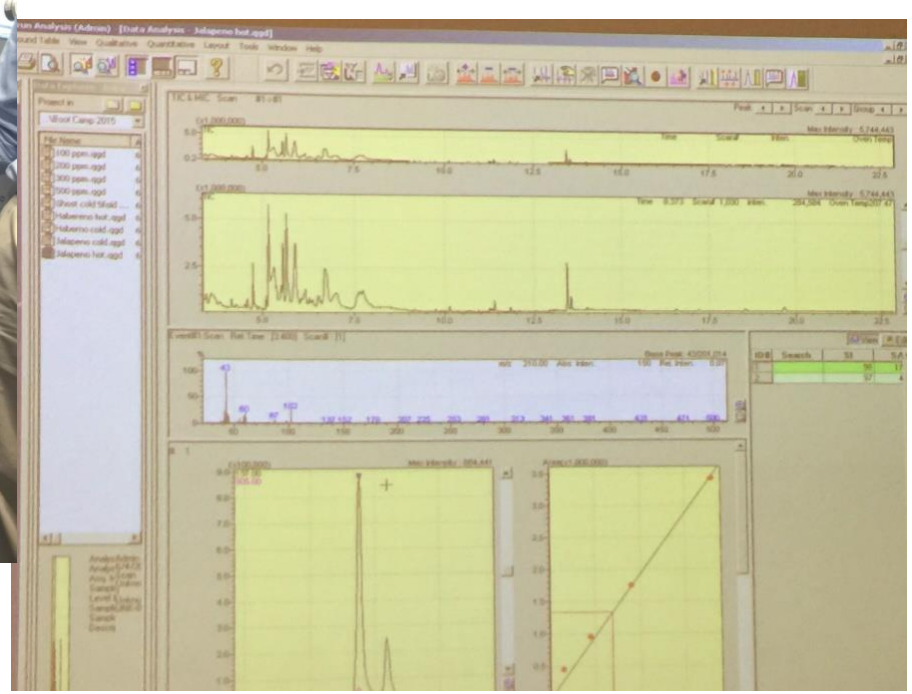
Observations and conclusions:

Which sample had the highest total anthocyanin content? Is this what you expected?

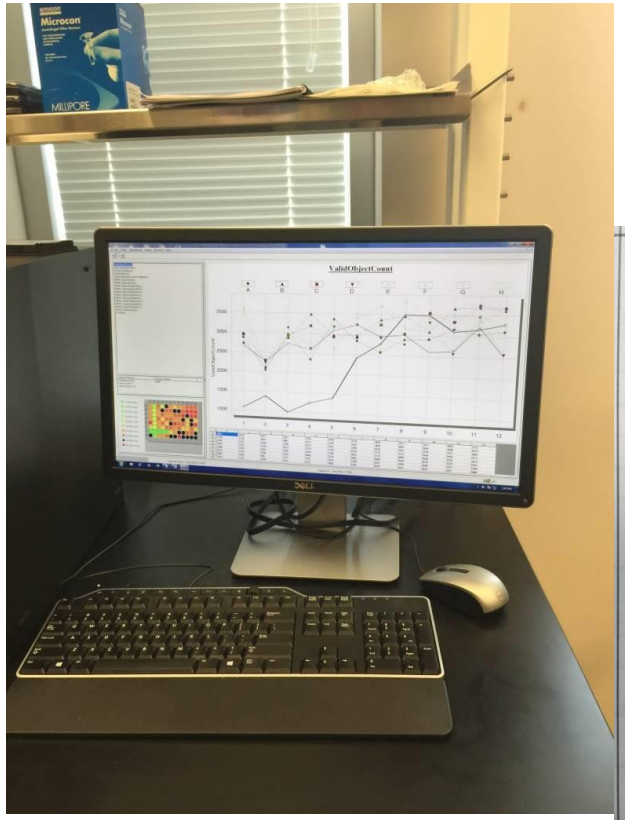
$$Anth\left(\frac{mg}{L}\right) = \frac{A \cdot MW \cdot DF \cdot 10^3}{\varepsilon \cdot 1}$$

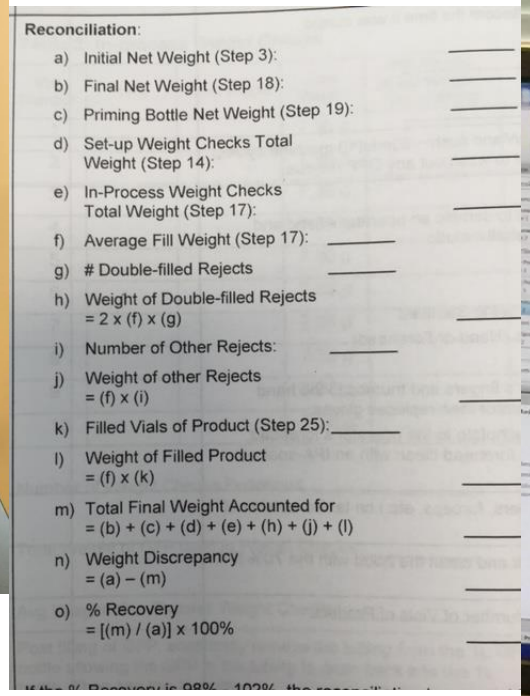
Extensions

$$\frac{m}{e} = \frac{H^2 r}{2V}$$



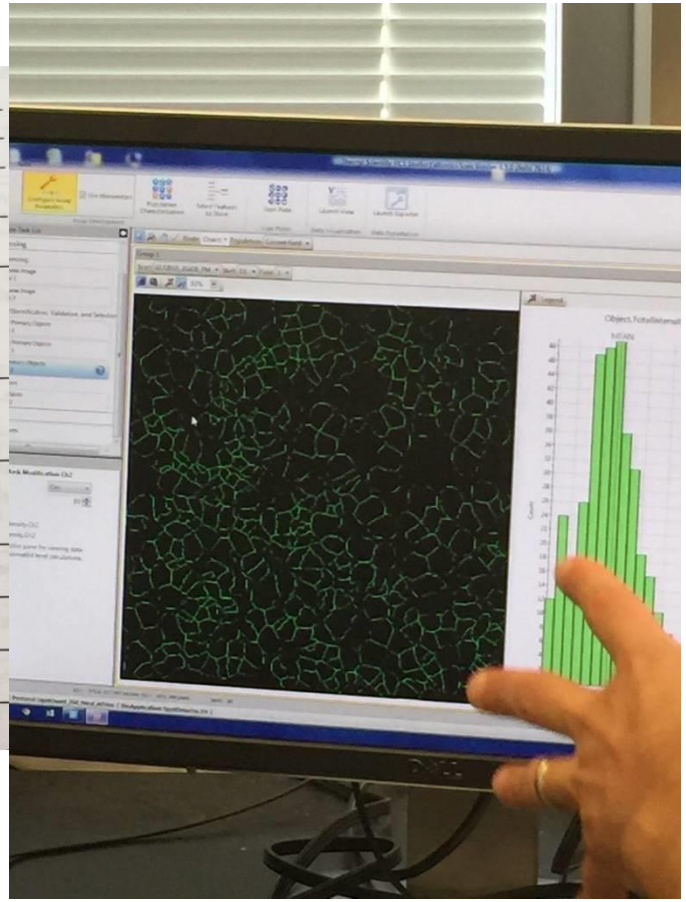
It’s not Math-magic!





Reconciliation:

a) Initial Net Weight (Step 3): _____
b) Final Net Weight (Step 18): _____
c) Priming Bottle Net Weight (Step 19): _____
d) Set-up Weight Checks Total Weight (Step 14): _____
e) In-Process Weight Checks Total Weight (Step 17): _____
f) Average Fill Weight (Step 17): _____
g) # Double-filled Rejects _____
h) Weight of Double-filled Rejects = 2 x (f) x (g) _____
i) Number of Other Rejects: _____
j) Weight of other Rejects = (f) x (i) _____
k) Filled Vials of Product (Step 25): _____
l) Weight of Filled Product = (f) x (k) _____
m) Total Final Weight Accounted for = (b) + (c) + (d) + (e) + (h) + (j) + (l) _____
n) Weight Discrepancy = (a) – (m) _____
o) % Recovery = [(m) / (a)] x 100% _____



Using Science to Understand the Math

Math helps to better understand the Science.

Bionetwork Goals Married with Academic Goals:

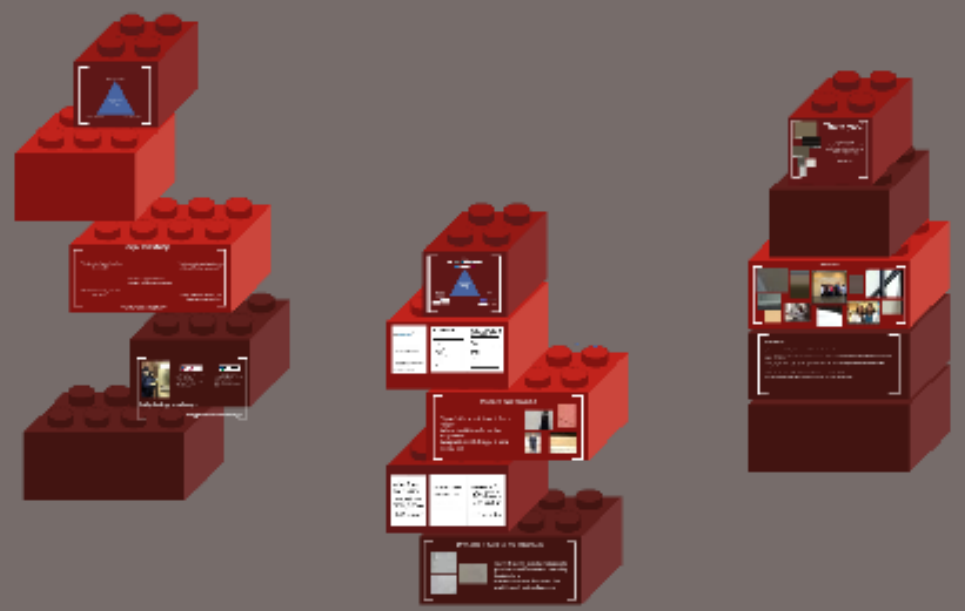
Biotech goals across curriculum

- Relating it to students' experience
- Relevance to their futures
- Involving students in educating the community
- Inspiring other educators
- Utilizing available resources
- Biotechnology should be a priority
- Planned field trips involving visits to Biotech sites including colleges, research institutions, and manufacturing facilities
- Writing about findings and conclusions

Benefits include very specific skills development

- Estimating and measuring
- Concept of very large and very small
- Transforming formulae
- Modelling with functions and graphs
- Analyzing real data
- Dynamic geometric applications
- Using CAS
- Using Excel
- Communicating results clearly

Bionetworking: Collaboration



Creating Bridges

Bioscience Industry Fellowship 2015

Gretchen Ingvason, MWCC, MA
Frances Turner, HCC, MD

HOWARD COMMUNITY COLLEGE

"You can get there from here."

- Located in Columbia, MD
- Over 14,000 credit students[1]
- 15% graduation rate, 16.4% transfer rate (2010)[1]
- 69 biotechnology firms in Howard County[2]
- ~65.5 diagnostics, testing, R&D[3]
- ~24.7% manufacturing[3]

Mount Wachusett Community College

"Build your future"

- Located in Gardner, Devens, Leominster, MA
- 6500 credit students (2014)[4]
- 15% graduation rate; 15% transfer rate (2014)[4]
- "Massachusetts Supercluster"[5]
- 550 biotechnology and pharmaceutical companies(2011)[5]
- 57,642 biopharma employees (2013)[5]

Bridge biology to industry...

Bridge industry to biology...

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Bridge in

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ndustry...

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Major Take Aways…

"Feeding, fueling and healing the world..."

"Putting students' education first with world class equipment."

"There are opportunities in research at the technician level."

"Biomanufacturing jobs are out there."

"Thro

s are

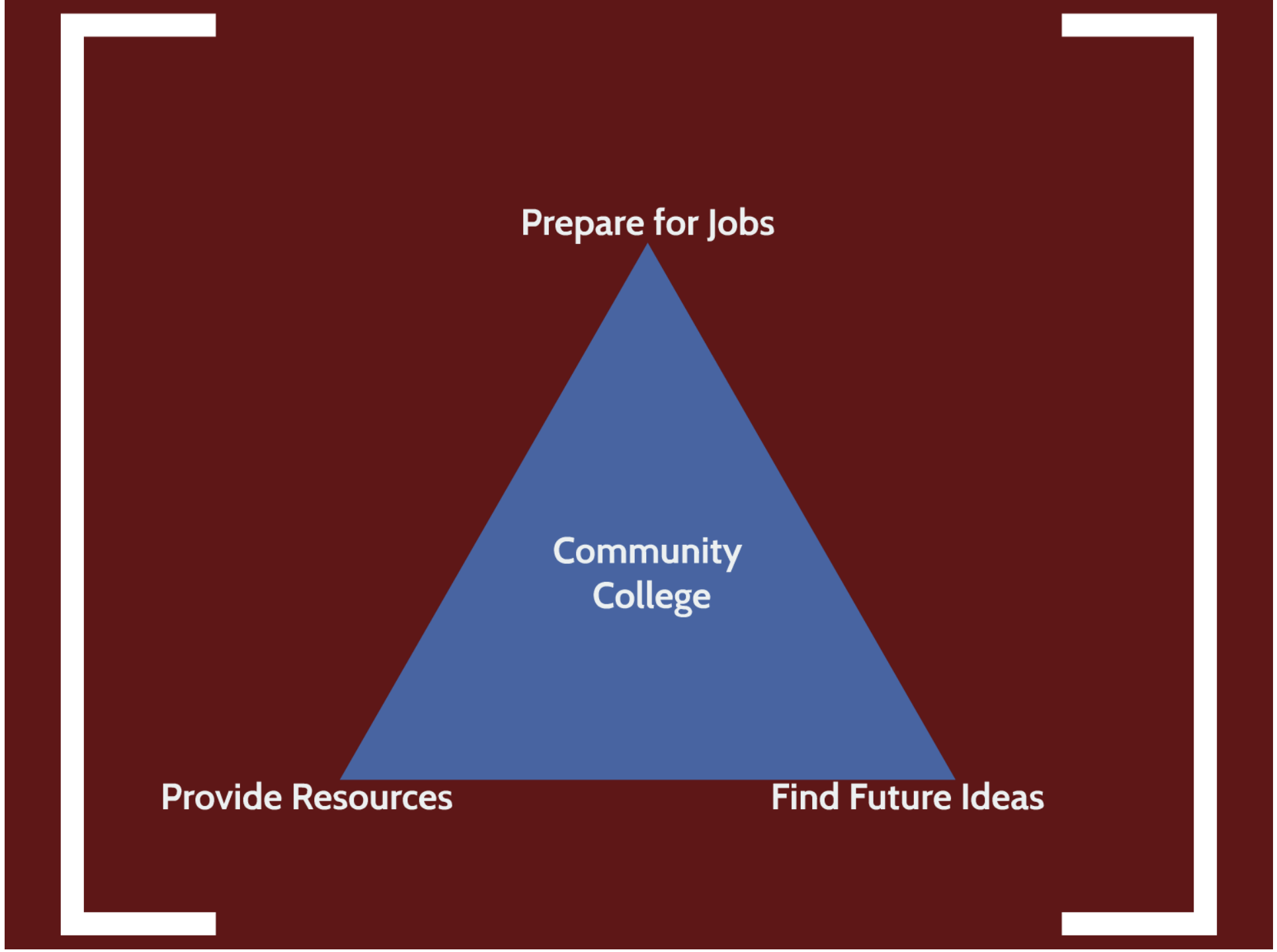
"Through hands on experience, students learn about the biotechnology industry."

n

level."

"Quality matters. People's lives depend on your product."

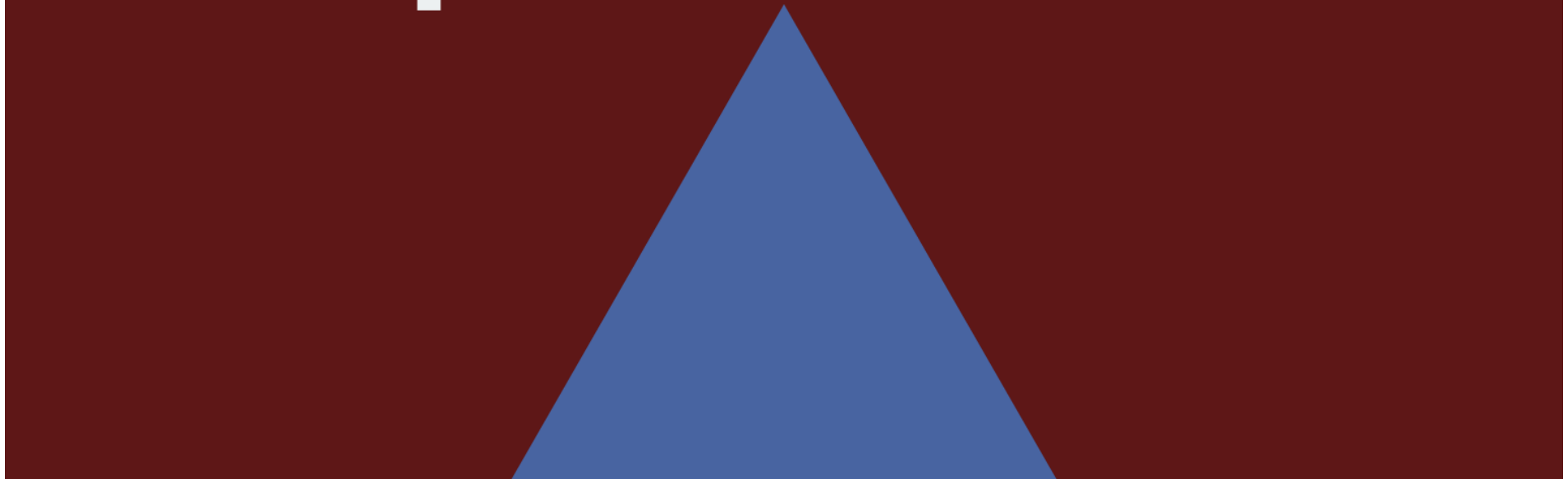
arn


Prepare for Jobs
Community College
Provide Resources
Find Future Ideas

Provide Resources

Find Future Ideas

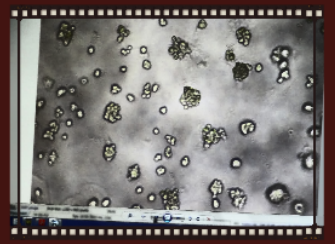
Prepare for Jobs



cluded

1. Which had the greater variability, the multiple samples or the multiple measurements? What are some potential reasons for the differences?
   - Consider the following - differences in equipment used, sample handling technique, machine set-up
2. Did you correctly predict the sample with the greater concentration? What are possible reasons for the different concentration?

Bringing it back to the classroom



- Learn biology-based processes to provide real-life context to quality instructions
- Create materials that stimulate quality work in the classroom

Name _____

Understanding Measurement Fundamentals

The measurement fundamentals discussed in class can be found in both a measurement technique and operational instruction. Two SOPs from the "Basics of Cell Culture – a Student Laboratory Manual", will be reviewed. When reviewing the individual documents, remember that the introductory chapters on equipment, contamination and laboratory practices may also be applicable.

#1 "Counting Cells Using a Hemocytometer" pages 26-29
#2 "Lab Exercise 5: Survival Assay-Sensitivity to UV Exposure" pages 38-42.

Use the space provided to complete the assignment, either handwritten or using Word®. Summarize your findings, providing examples with direct references to the document.

For each SOP identify:

- Methods - what characteristic will be measured, how are measurements taken
- Equipment specifications – comment on ability to measure within range necessary, ease of use, etc.
- Confidence (Uncertainty) Programs – accuracy vs precision, what are potential areas for errors (e.g. systemic, environmental, observational)
- Environmental Controls - temperature/humidity/light/time, are there potential effect on measurement tools or characteristic to be measured
- System – summarize what the system is (e.g. personnel, standards, devices)
- Capability – ability of system to measure characteristic, potential sources of error (e.g. bias, stability, repeatability)
- Standards Usage – are they used, traceability to NIST
- Data – how collected, consider format/resolution/suitability/confidentiality

Concepts to think about during review

- Identify each of the fundamentals as they appear in the protocols.
- Are there fundamentals missing? If yes, should they have been included – are they important or relevant to the task described?
- Are they areas within the methods for clarification or improvement?

Purpose

The laboratory exercise wil
looking at the difference be
the steps to collect and inte
and using the spectrophoto

Format

- Data collection will be re
  - Students will work individually.
  - The data will also
- The results will be depic appropriate.

Laboratory Exercise

Sample preparation and da
"Spectrophotometry Lab fo
products" created by AB Te
The buffer solutions will be

Each team will be assigned individual cuvettes for spec then be measured five time sample forms.

Name _____

LABORATORY EXERCISE
Measurement Variability

Purpose

The laboratory exercise will explore variability inherent in an analysis method, looking at the difference between repeatability and reproducibility. Additionally, the steps to collect and interpret colorimetric data, including sample preparation and using the spectrophotometer to collect data will be explored.

Format

- Data collection will be recorded using the check sheets provided
  - Students will work in teams of 2; however, each student will collect data individually.
  - The data will also be pooled as class.
- The results will be depicted using either histograms or scatter plots as appropriate.

Laboratory Exercise

Sample preparation and data collection will be conducted as described in "Spectrophotometry Lab for Quality Control of foods, beverages and natural products" created by AB Tech for the Bionetwork (ncbionetwork.org),
The buffer solutions will be provided and do not have to be prepared

Each team will be assigned 2 liquid samples for analysis and prepare their individual cuvettes for spectrophotometric analysis. The individual samples will then be measured five times at both wavelengths, in the order indicated on the sample forms.

Name _____

Background

This exercise is to be used by students for a basic understanding of measurement system analysis. When methods are developed for use in the QC laboratory, the precision and accuracy of the results need to be assessed. There are a variety of aspects that lead to variability when taking measurements: a) equipment, b) sample preparation, c) environmental conditions and d) analyst interaction. Measurement system analysis can sometimes also be referred to as gage R&R (repeatability and reproducibility).

- Repeatability is the closeness of measurements from the same instrument; the machines effect on the measurement. This refers to the equipment's inherent variation (e.g. drift, sensitivity).
- Reproducibility is the closeness of measurements under the same conditions; the human (environmental) effect on the measurement. This refers to the inherent variation attributed to how the method is conducted.

Pre-Lab Questions

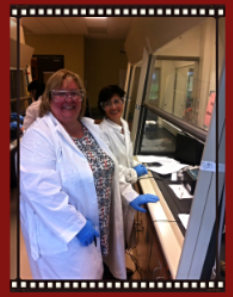
1. Describe the different types of errors that can occur based on the machine
2. Review the original method (pages) and the procedure on page 3. Describe potential areas of error that can be influenced by the operator and the laboratory environment.
3. Predict which of the two samples provided will have the greater concentration.

Post-Lab Questions

1. Which had the greater variability, the multiple samples or the multiple measurements? What are some potential reasons for the differences?
   - Consider the following - differences in equipment used, sample handling technique, machine set-up
2. Did you correctly predict the sample with the greater concentration? What are possible reasons for the different concentration?

Bringing it back to Lab 101

- "If you didn't write it down, it didn't happen"
- Include simulations for pre-lab assignments
- Incorporate small changes in basic biology labs



Name _____

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Name _____

Background

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Microscopic Observations Homework

Complete this assignment before next week's lab. This assignment is graded and will be collected at the start of the lab.

Visit this link: http://lsteam.org/iet/microscope/index.html

Answer the following questions briefly:

1. Every technician knows to clean his or her microscope before every use. Select the best product to use to clean the objective lenses of a microscope. Describe why this is your choice:
    a. Facial tissue
    b. Paper towel
    c. Lens wipes
2. Which power objective lens do you start with when first focusing on a specimen?
3. Which knob on the microscope is used to originally focus the specimen on a slide?
4. Which knob on the microscope is used to sharpen or fine tune the specimen on a slide?
5. Which knob on the microscope is used to center the specimen on a microscope?
6. Using the simulation, draw the letter "e" as viewed under the microscope. Describe how this view appears relative to the sample letter "e" on the slide.

lsteam.org/iet/microscope/index.html

Part I: Testing Different M
Below are the directions for the fo
WARNING: Some of the chemic

Test for glucose using Ben

1. Obtain 2 test tubes. With a glass marking pencil, label the test tubes 1 and 2 respectively. Write your initials on both test tubes.
2. Measure 5ml of water in the graduated cylinder provided and pour the water into test tube 1. Measure 5ml of water and 10 drops of sugar solution to test tube 2. Add 20 drops of Benedict solution to both test tubes.
3. Record the color of both test tubes.
4. Carefully place both test tubes upright in the hot water bath and let them heat for 1 minute. Watch the test tubes during this heating period.
5. Record any color changes you observe from both test tubes. Remove the test tubes from the water bath.
6. Carefully pour the liquid from both test tubes down the waste container provided. Throw the test tubes in the glass waste box.

Part I: Testing Different Macromolecules

Below are the directions for the food tests. Carry out each test as directed and record your results.
WARNING: Some of the chemicals used in these exercises can stain skin and/or clothing.

Test for glucose using Benedict's solution.

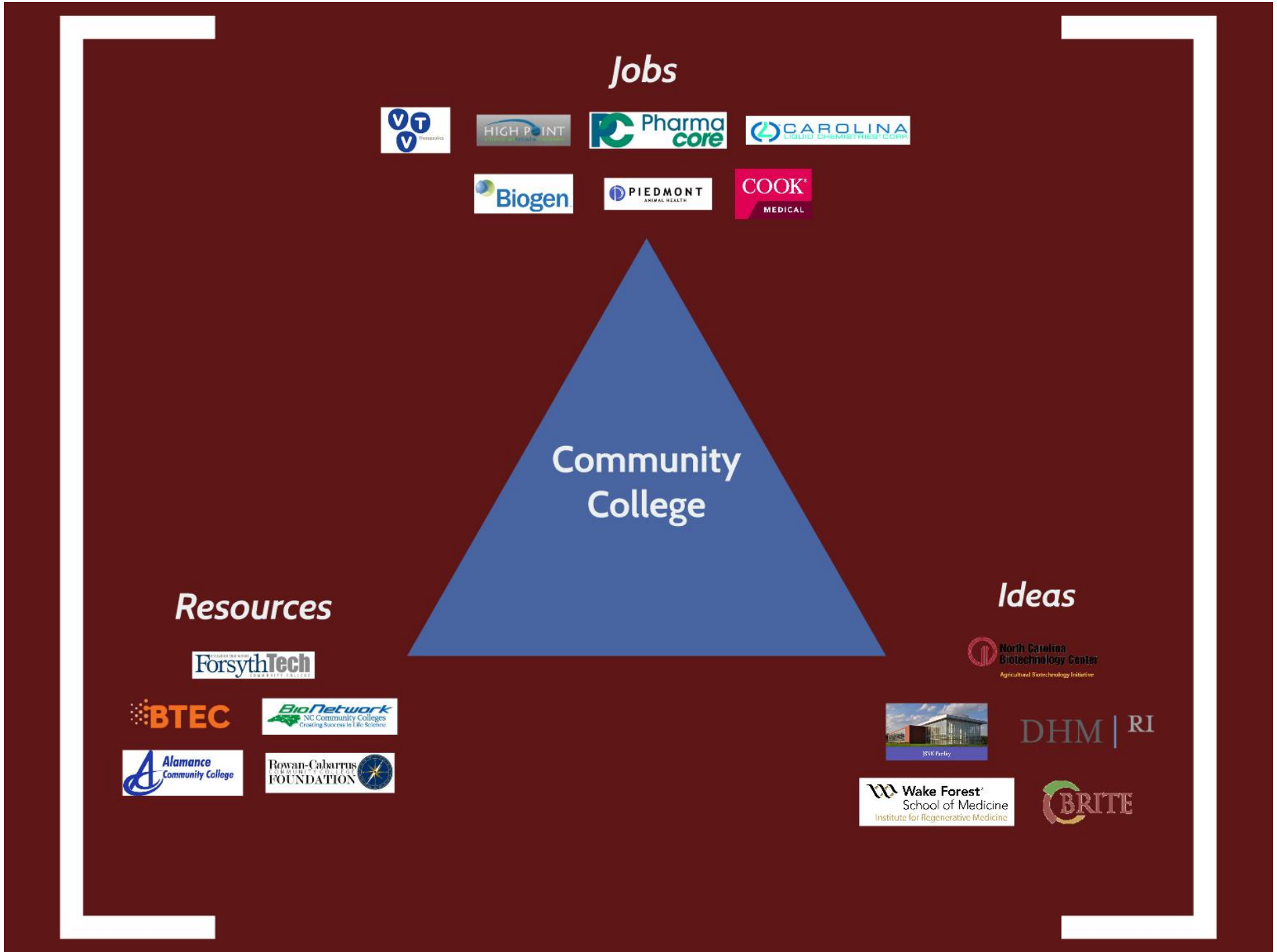
	Response/Results:	Operated by:	Verified by:
1. Obtain 2 test tubes. With a glass marking pencil, label the test tubes 1 and 2 respectively. Write your initials on both test tubes.			
2. Measure 5ml of water in the graduated cylinder provided and pour the water into test tube 1. Measure 5ml of water and 10 drops of sugar solution to test tube 2. Add 20 drops of Benedict solution to both test tubes.			
3. Record the color of both test tubes.	Test Tube 1: _____ Test Tube 2:_____		
4. Carefully place both test tubes upright in the hot water bath and let them heat for 1 minute. Watch the test tubes during this heating period.			
5. Record any color changes you observe from both test tubes. Remove the test tubes from the water bath.	Test Tube 1: _____ Test Tube 2:_____		
6. Carefully pour the liquid from both test tubes down the waste container provided. Throw the test tubes in the glass waste box.			

Part III: Testing for Lactaid

Lactaid contains the enzyme lactase that breaks down (hydrolizes/digests) lactose (a disaccharide) into the two monosaccharides glucose and galactose. Lactase is the enzyme that breaks down lactose (a disaccharide), releasing the two monosaccharides glucose and galactose. Individuals who are lactose intolerant do not produce sufficient quantities of lactase, and the undigested lactose causes an intestinal disturbance. By taking Lactaid (which contains lactase) with milk or dairy products, lactose intolerant individuals are able to take in lactose without adverse symptoms.

For this experiment, you will be provided two samples of milk. Both samples are unlabeled. Using a glucose strip, you will determine which test tube contains Lactaid and which one contains milk.

	Response/Results:	Operated by:	Verified by:
1. Write a hypothesis regarding the Lactaid sample you have obtained.			
2. Obtain two test tubes containing milk from your instructor. The tubes are labelled "A" and labelled "B".			
3. Obtain two glucose strips from your instructor.			
4. Dip one glucose strip into tube A. Carefully dry off any remaining droplets of milk on the strip and set it on the lab bench to dry. Record any change in color on the strip.	Record color change:		
5. Dip one glucose strip into tube B. Carefully dry off any remaining droplets of milk on the strip and set it on the lab bench to dry. Record any change in color on the strip.	Record color change:		
6. Based on your results, determine which test tube contains Lactaid and which test tube contains regular milk. Why?			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Mary Flournoy

"I've learned that
People will forget what you said.
People will forget what you did, but
People will never forget
How you made them feel."

~ Maya Angelou

Questions?










References:

(1) Howard Community College. Retrieved June 23, 2015, from http://howardcc.edu/





References:

(1) Howard Community College. Retrieved June 23, 2015, from http://howardcc.edu/

(2) Summary Biotechnology Jobs. (2014, January 8). Retrieved June 23, 2015, from http://www.bls.gov/ooh/life-physical-and-social-science/biological-technicians.h

(3) 2013 County Business Patterns - Biotechnology. (2013). Retrieved June 23, 2015, from http://www.mdp.state.md.us/msdc/CBP/BioTech_MD/2013/BioTech_Md13.shtml

(4) Mount Wachusett Community College. Retrieved June 23, 2015, from www.mwcc.edu

(5) Massachusetts Biotechnology Council. Retrieved June 23, 2015, from http://www.massbio.org/