

Bioscience Industry Fellowship Project

2014 Presentations



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BIOSCIENCES INDUSTRY FELLOWSHIP PROGRAM

JUNE 2-27, 2014

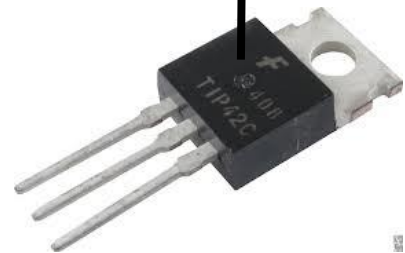
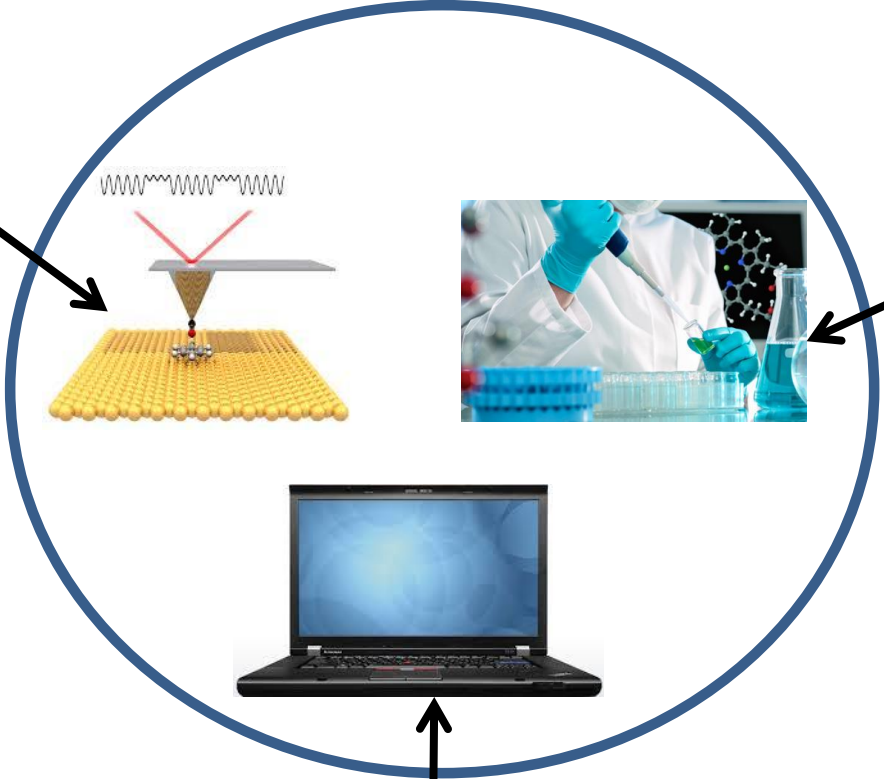
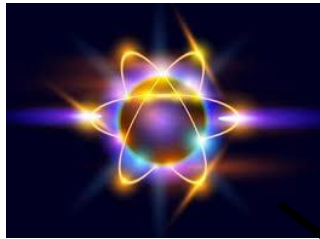
Example of Course Development for STEM Community College Instructors

(Based on BIFP Experience)

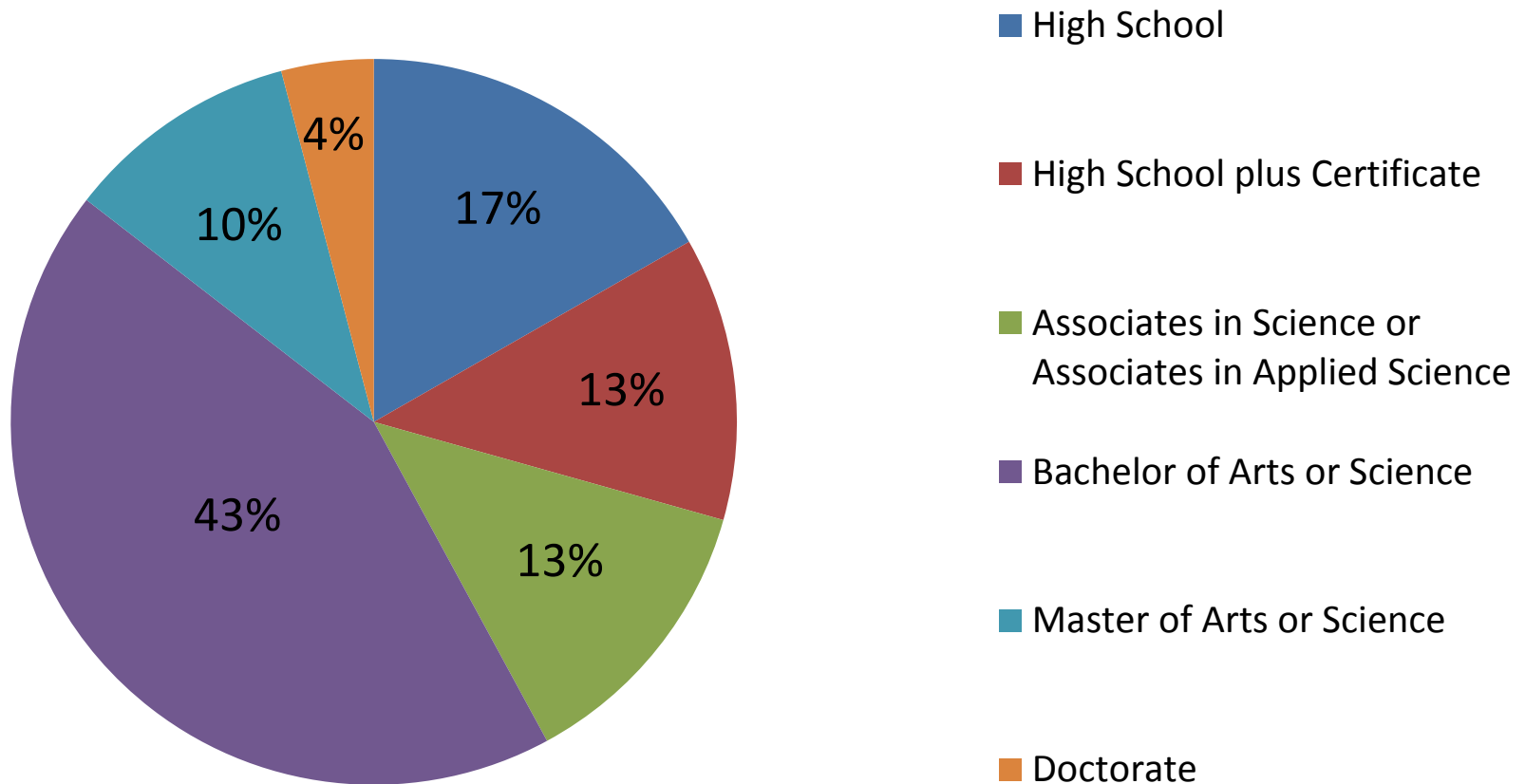
Heather King
Developmental Math Instructor
Forsyth Technical Community College, NC
hking@forsythtech.edu

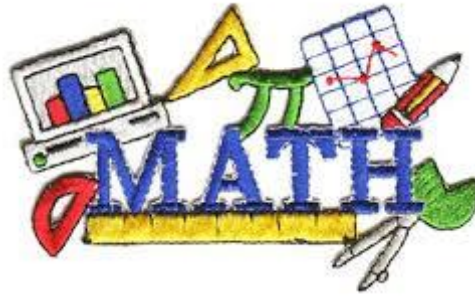
Igor Kreydin
STEAM Instructor
Roxbury Community College, MA
ikreydin@rcc.mass.edu

Modern Industry



2012 Educational Profile for Biotechnology Employees in NC





In every math class you will hear ...

Why do I need to know this?

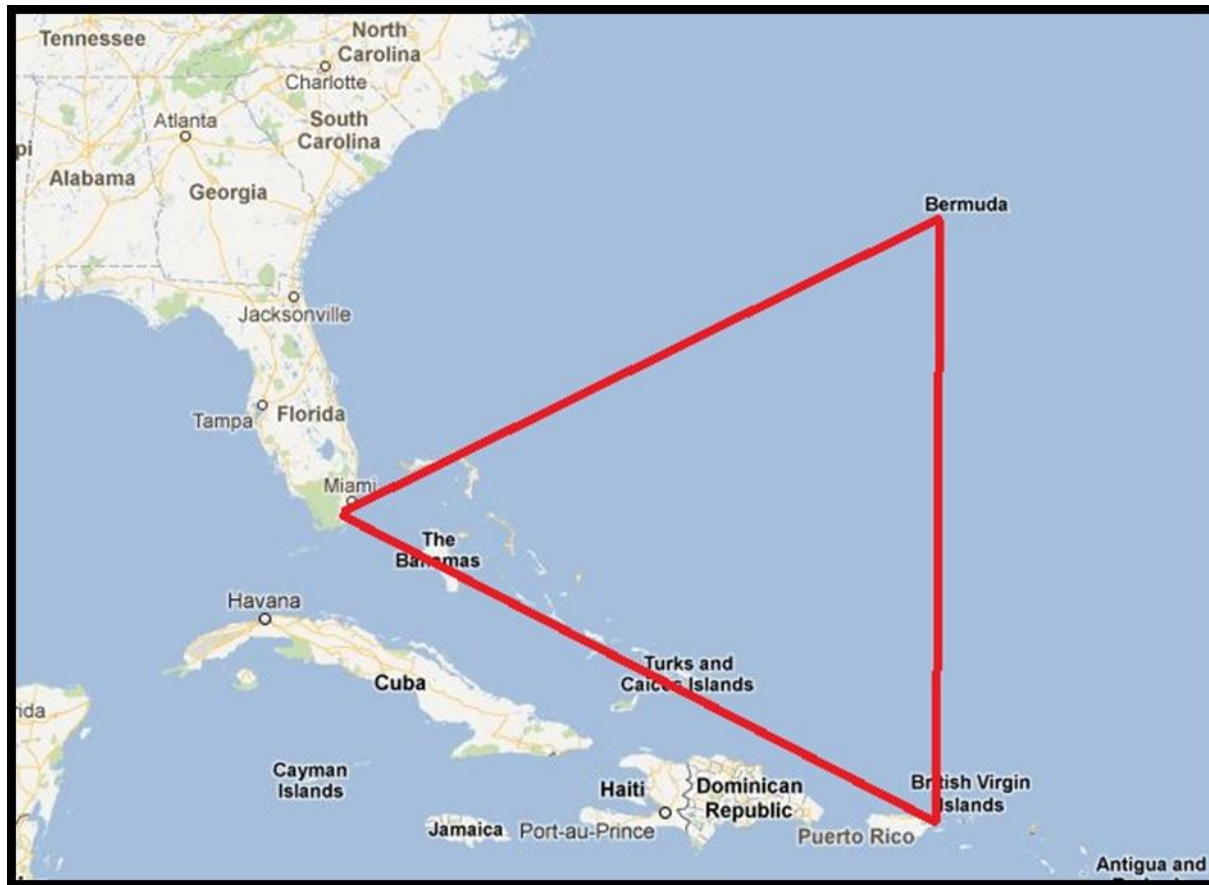
When will I ever use this?



In every science class you will hear ...

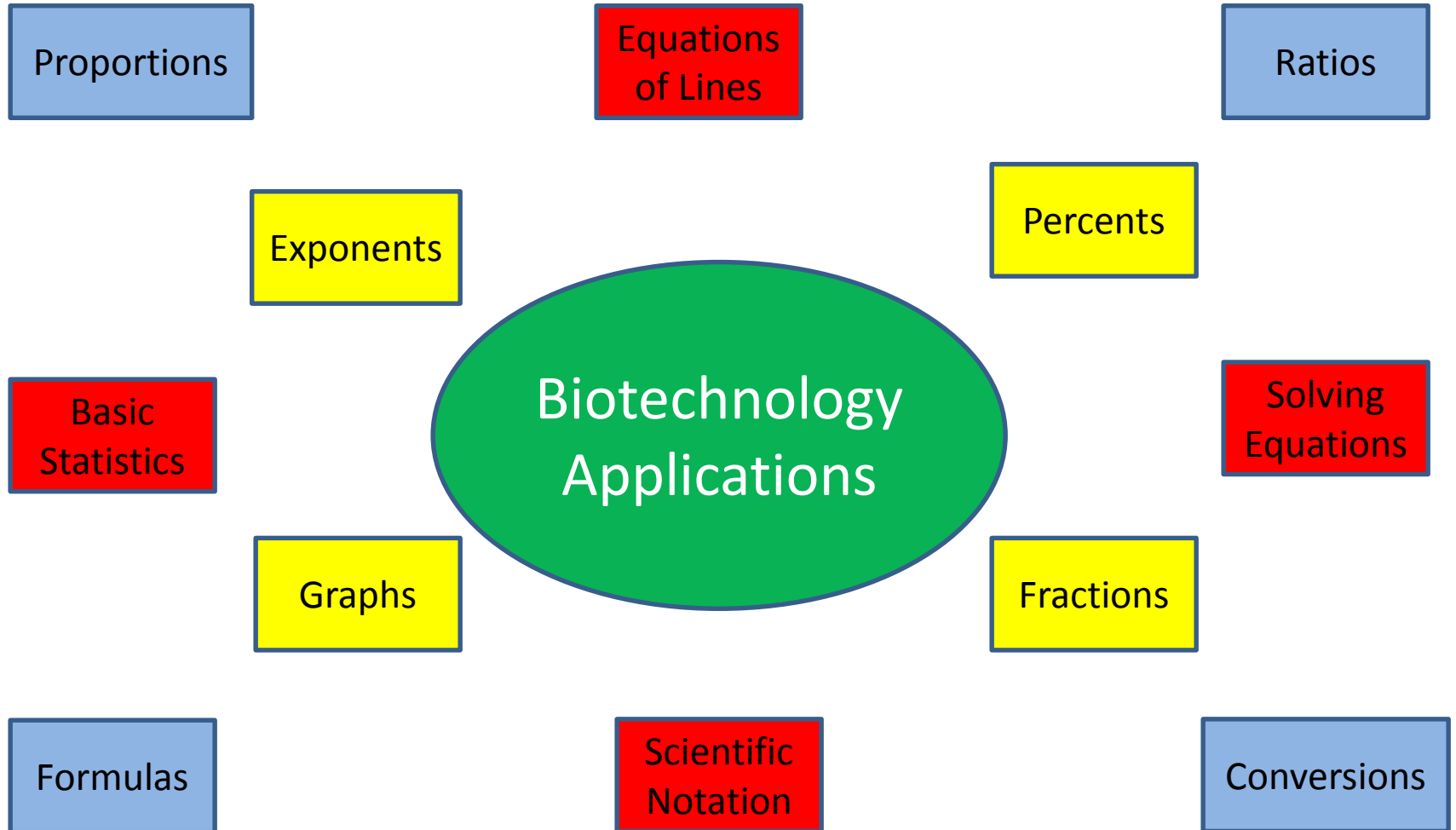
Did I learn how to do this in my math class?

Don't Let Your Students Get Stuck Here.



Make Math Relevant!

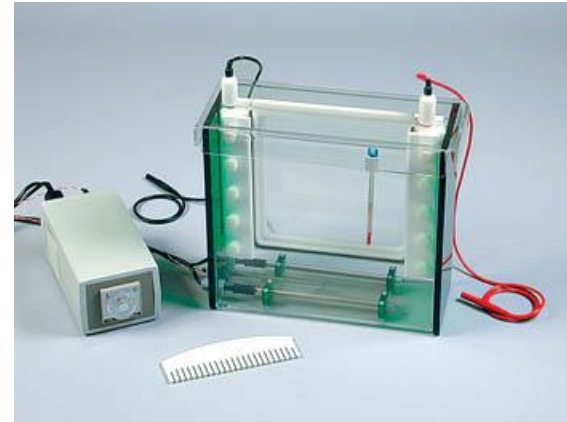
Basic Mathematical Concepts



Expressions, Linear Equations & Inequalities

Dilutions of Solutions

Forsyth Technical Community College



Suppose you have a stock TGS electrophoresis buffer solution that is used in a protein profiler investigation of fish. The stock is 10 times more concentrated than the desired buffer. How would you prepare 400 mL at the correct concentration?

Concentration & Volume Formula

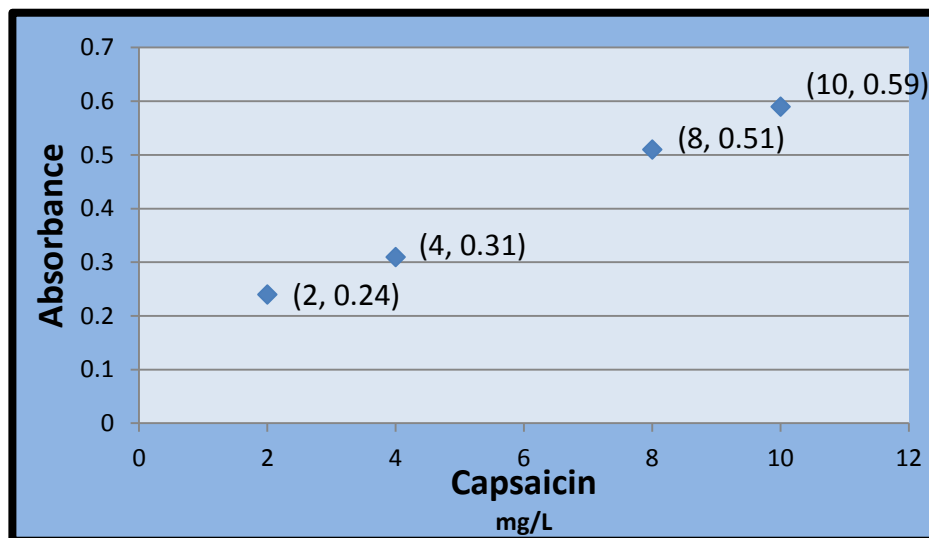
$$C_1V_1 = C_2V_2$$



Linear Equations in Two Variables

Standard Curves & Unknown Concentrations

Rowan Cabarrus Community College



- Use two data points to determine the equation for the line of best fit.

Slope-Intercept Form of a Line

$$y = mx + b$$

- Use your equation to predict the amount of capsaicin present when the absorbance is 0.55.

Polynomials & Quadratic Applications

Conversions, Scientific Notation & Exponents

Alamance Community College & Biogen Idec



Suppose a bioreactor holds 2000 L of broth. There are about 2×10^9 bacteria in each mL of the broth. About how many bacteria are present in the entire bioreactor?

Convert 2000 L to mL

Set Up a Proportion

$$\frac{2 \times 10^9 \text{ bacteria}}{1 \text{ mL}} = \frac{x \text{ bacteria}}{2 \times 10^6 \text{ mL}}$$



Rational Expressions & Equations

Stoke's Law: Solid/Liquid Separation

BioNetwork Capstone Center



The settling velocity, V_g , is jointly proportional to the square of the diameter, D , and the difference in the densities of the solid, ρ_s , and the liquid, ρ_l , and inversely proportional to the viscosity, μ . For the constant of proportionality, use gravitational acceleration, g , divided by 18.

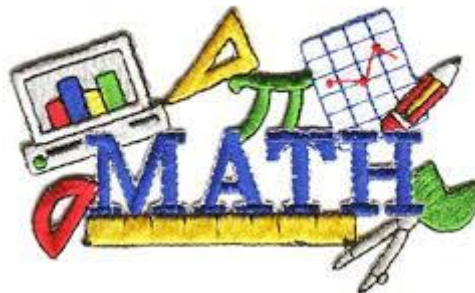
- Choose the correct equation.

A. $V_g = \frac{D^2(\rho_s - \rho_l)}{\mu} \times \frac{g}{18}$

B. $V_g = \frac{\mu}{D^2(\rho_s - \rho_l)} \times \frac{g}{18}$

- What happens to the settling velocity when the viscosity increases?

As the viscosity increases, the settling velocity decreases.



In every math class you will hear ...

Do I have to show my work?



“If you didn’t document it, you didn’t do it.”

Conclusion

- The Bioindustry is a high tech industry with a huge workforce market for high school and community college graduates.
- Workshops and fellowships, like BIFP, are excellent ways to educate high school teachers, community college instructors and the community.
- Developmental math students need the opportunity to connect math and science by solving relevant application problems.

EZEKIEL BARNES

U.S. Air Force Veteran and Student at Forsyth
Tech in Winston-Salem, NC

JULIE ELLIS

Professor of Biology at Kaskaskia College in
Centralia, IL

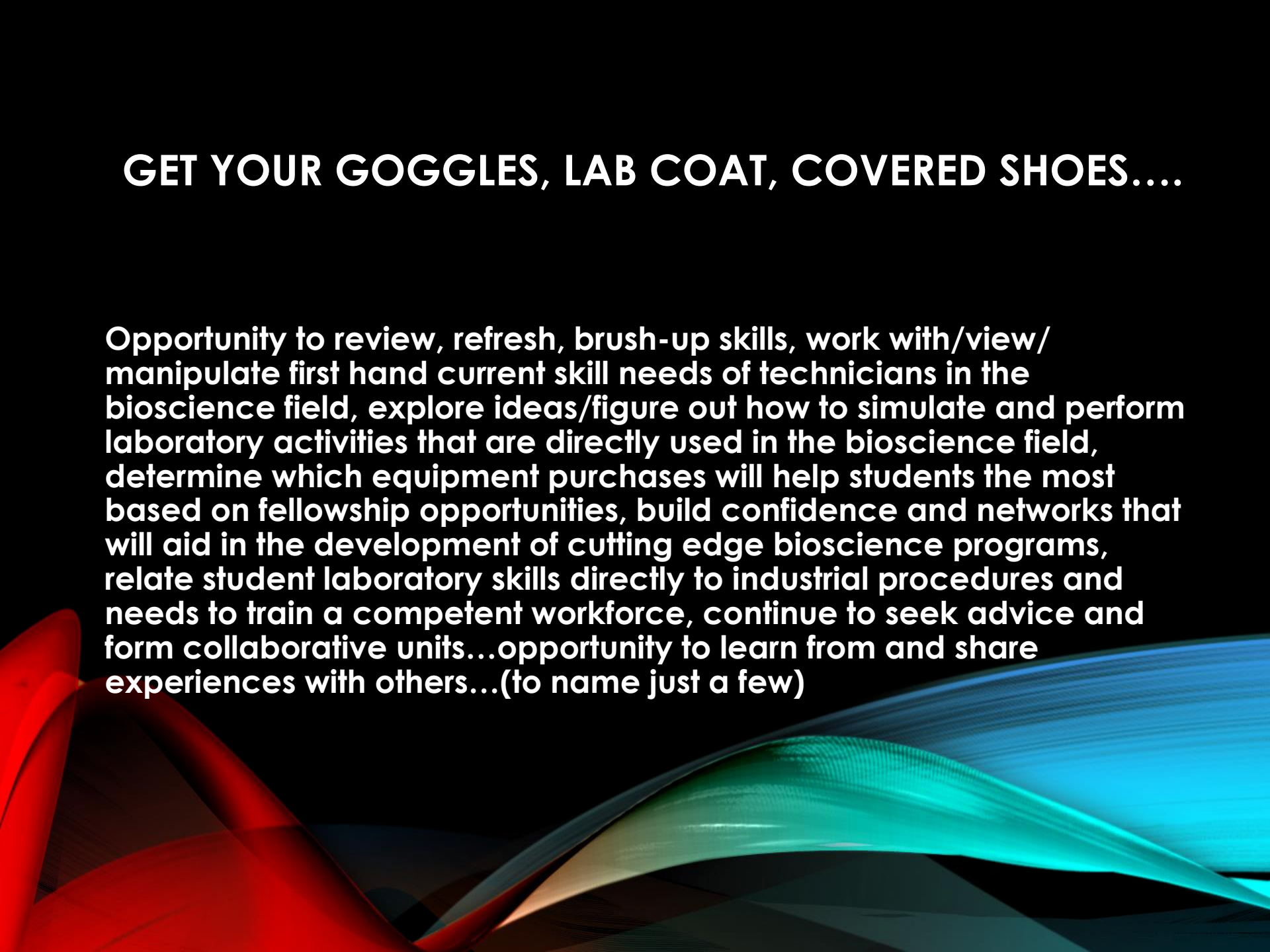




What does “Boot Camp” mean?

GET YOUR GOGGLES, LAB COAT, COVERED SHOES....

Opportunity to review, refresh, brush-up skills, work with/view/manipulate first hand current skill needs of technicians in the bioscience field, explore ideas/figure out how to simulate and perform laboratory activities that are directly used in the bioscience field, determine which equipment purchases will help students the most based on fellowship opportunities, build confidence and networks that will aid in the development of cutting edge bioscience programs, relate student laboratory skills directly to industrial procedures and needs to train a competent workforce, continue to seek advice and form collaborative units...opportunity to learn from and share experiences with others...(to name just a few)

The background of the slide features abstract, flowing shapes in shades of red and blue. The red shapes are on the left side, and the blue shapes are on the right side, creating a dynamic, wave-like pattern.







BIOTECHNOLOGY

UMBRELLA
CORPORATION



OUR BUSINESS
IS LIFE ITSELF

 **Stella**
Type your password

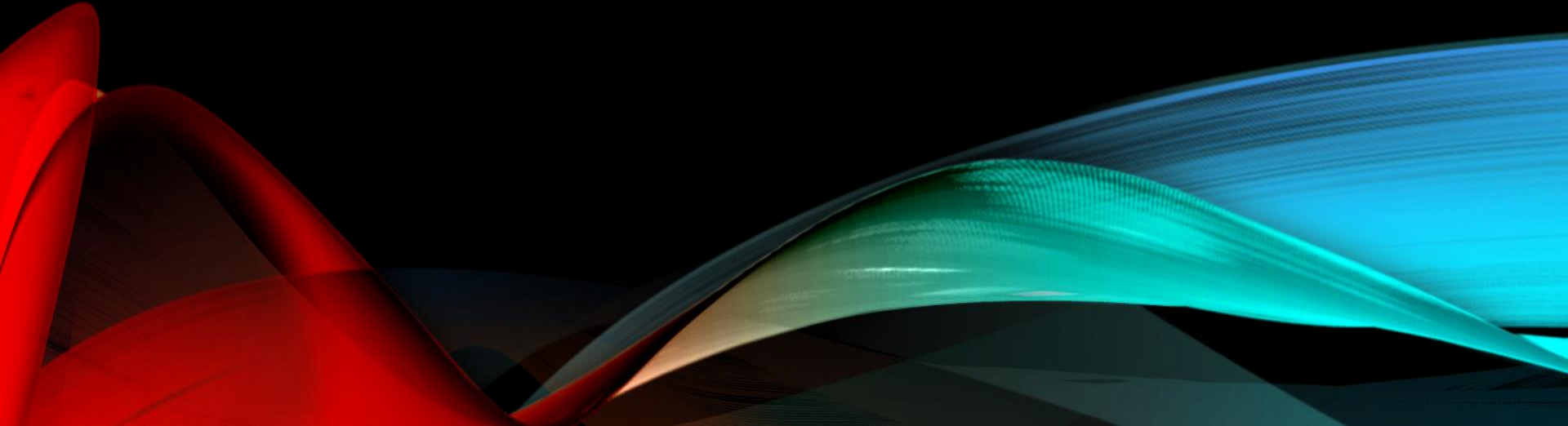
 Shut down the computer before leaving the lab

Property of Umbrella
Corporation

<http://grungestyle.deviantart.com/art/Umbrella-Corporation-v1-0-0-59508857>

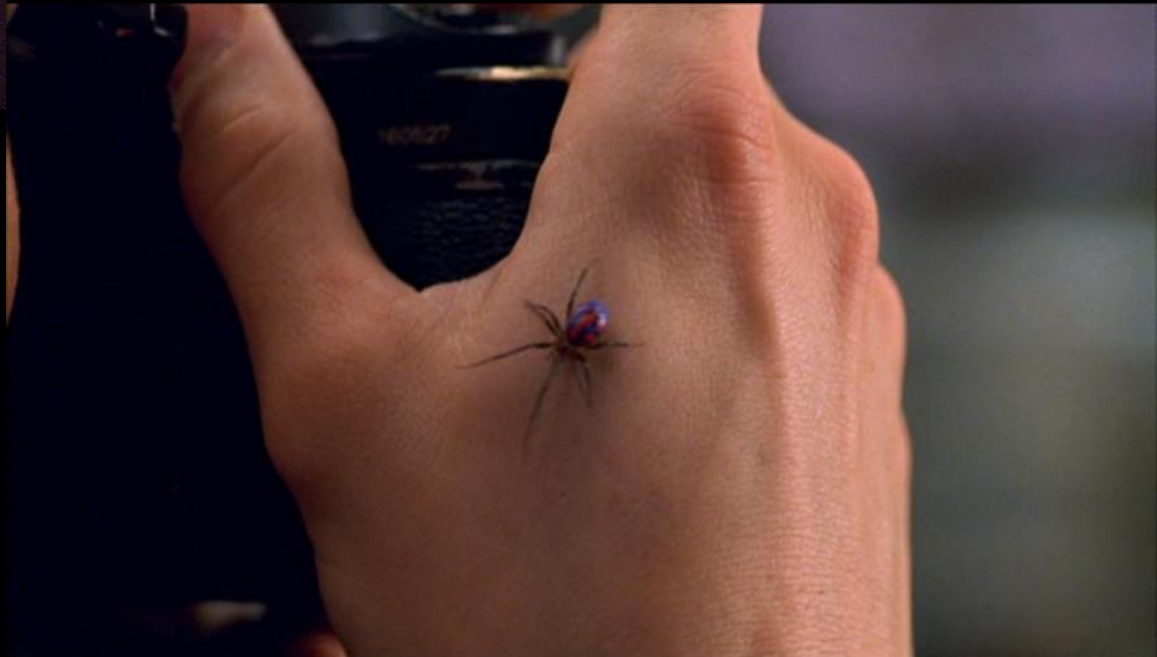
UMBRELLA CORPORATION

The Umbrella Corporation was a giant conglomerate which operated ruthlessly as a major international player in a number of markets; including pharmaceuticals and medical equipment along with top-secret operations utilizing genetic engineering and biological weaponry.





<http://www.herogohome.com/2013/07/01/super-movie-monday-spider-man-2002/>



BIOTECHNOLOGY DEFINED

Biotechnology:

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



HOW DOES BIOTECH BENEFIT US?

MEDICINE

- Designing organisms to produce antibiotics
- Creating medicines that are more effective and have fewer side effects
- Conducting gene therapy, genetic testing and DNA fingerprinting
- Using microorganisms to produce vaccines and hormones; insulin is produced this way
- Creating new vaccines by genetically altering food, which could revolutionize medicine in Third World countries
- Modifying microorganisms to produce products such as vaccines and insulin

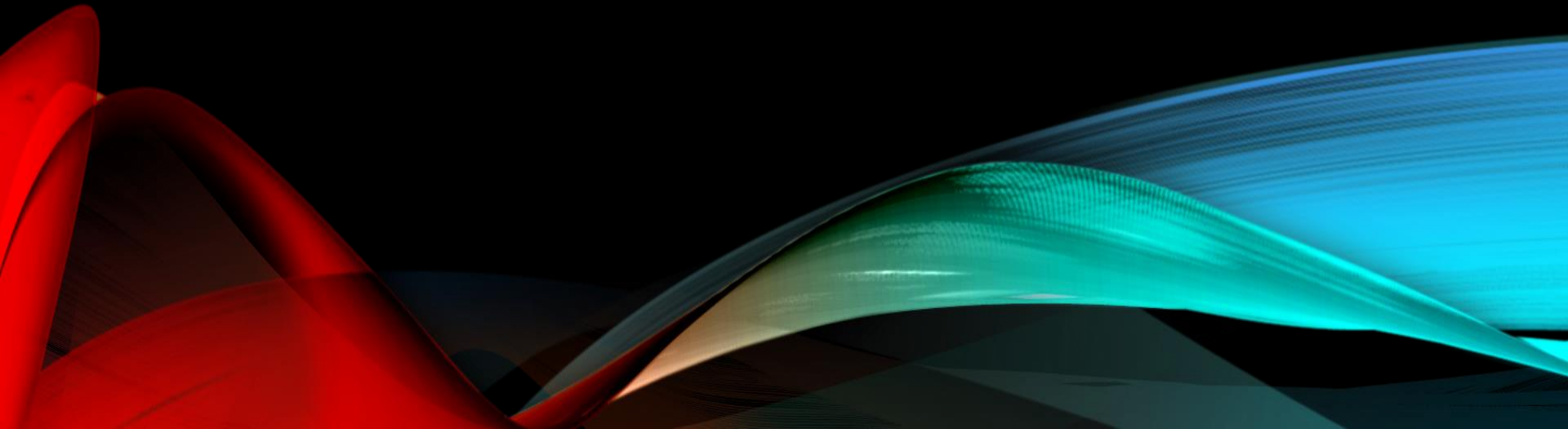
Agriculture

- Improving crop yield
- Controlling weeds and animal pests
- Making crops tolerant to environmental stresses such as drought, temperature extremes and salt
- Increasing nutritional qualities of food crops
- Reducing dependence on fertilizers and pesticides
- Creating pasture plants that are more digestible for livestock
- Protecting animals against parasites
- Genetically modifying crops to be disease-resistant or alter the timing of fruit production

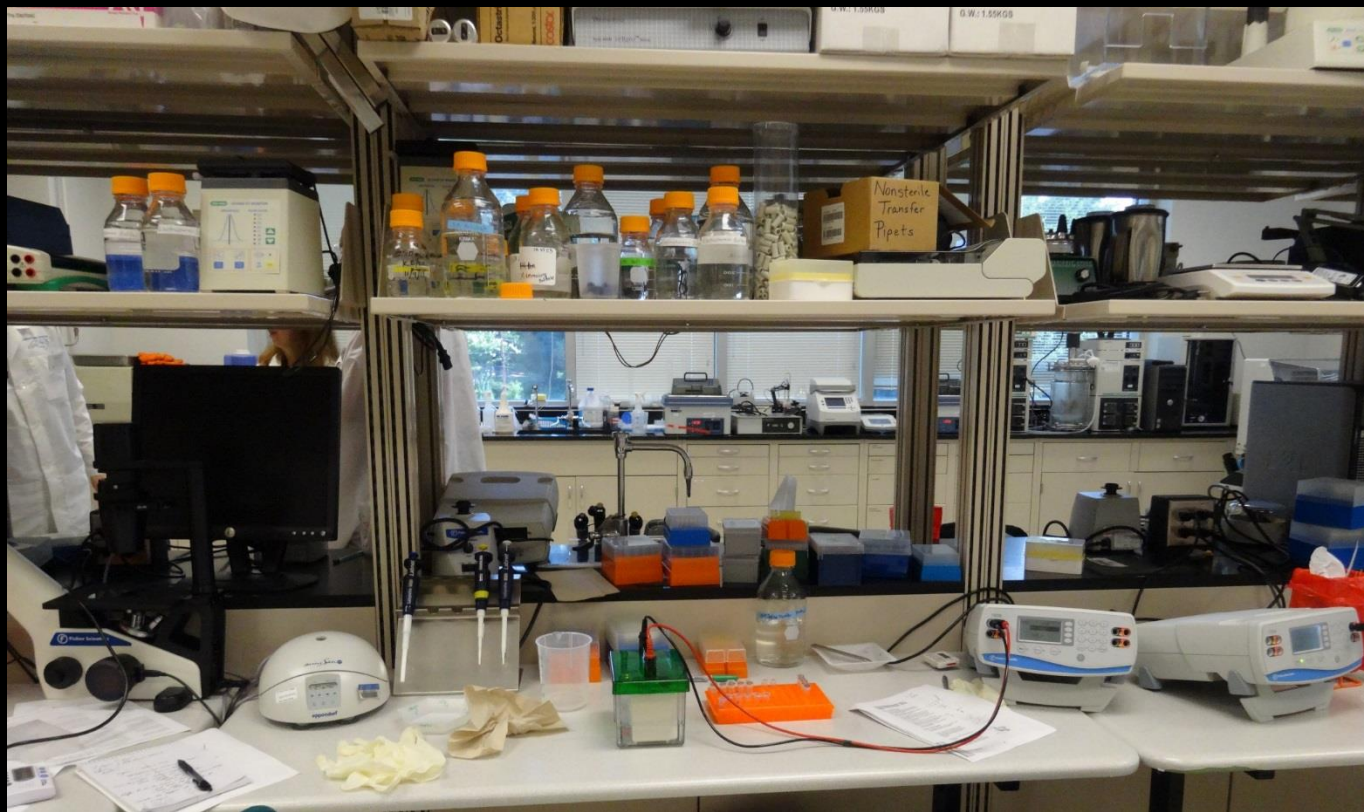
Industry

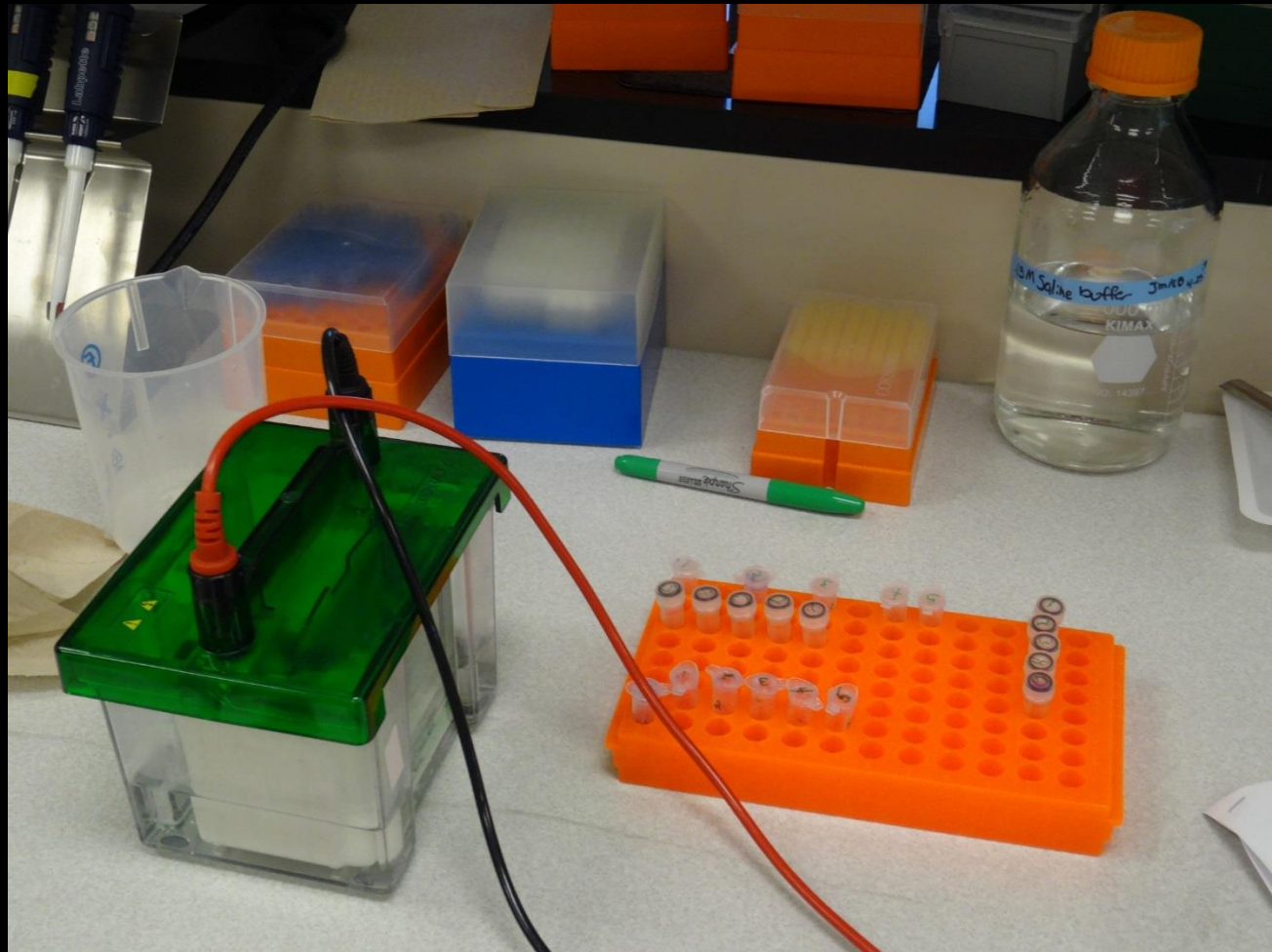
- Developing biocatalysts, such as enzymes, to synthesize chemicals, thereby reducing the environmental impact of industrial processes in chemical manufacturing
- Developing plant alternatives for fuel and manufacturing to reduce dependence on finite energy and material sources

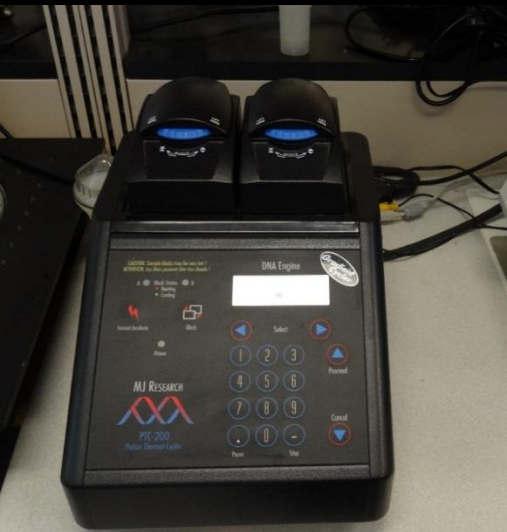
WE LEARN BEST FROM FIRST HAND EXPERIENCES...



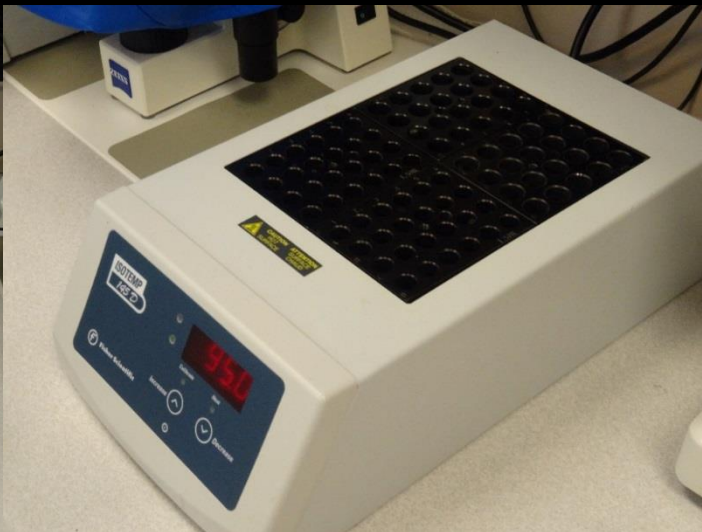




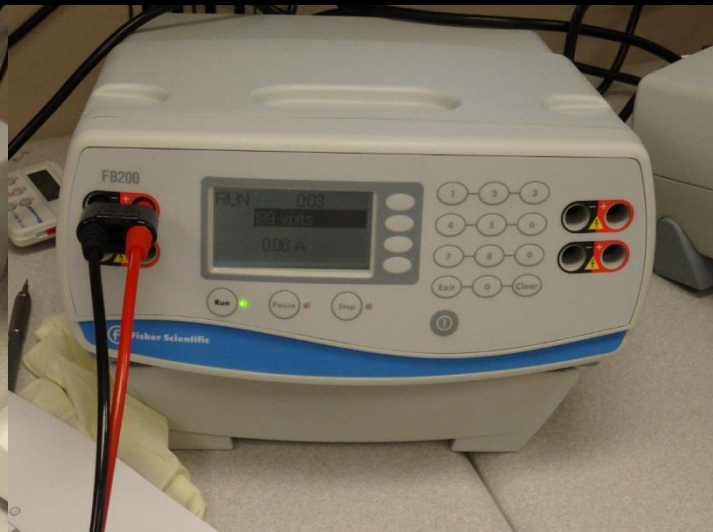




A



B

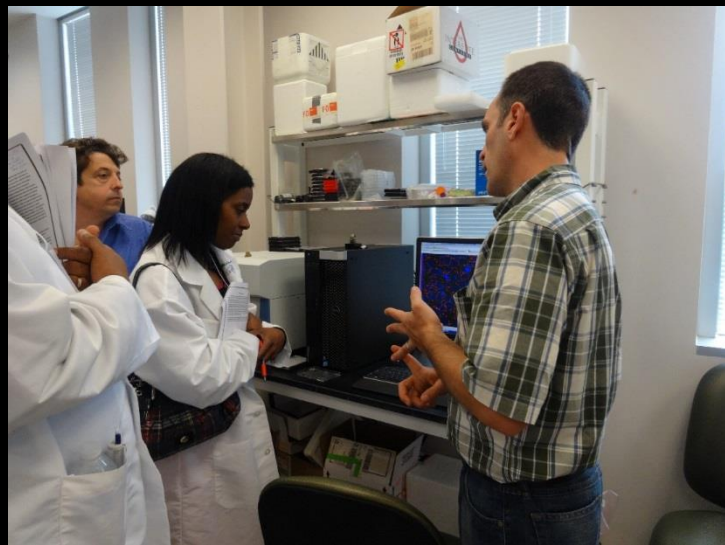
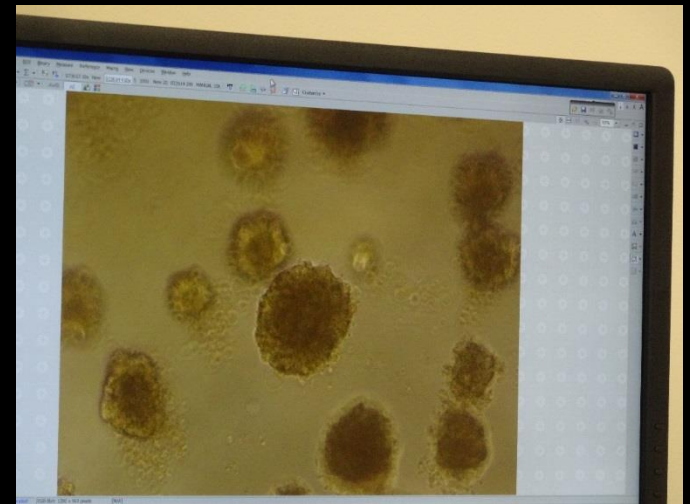
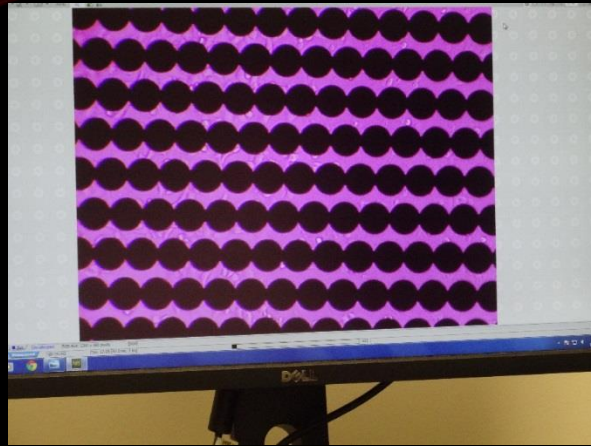


C



**Dr. Rob
Onyenwoke**

**Biomanufacturing Research
Institute and Technology**







Capsaicin; HPLC, GC-MS



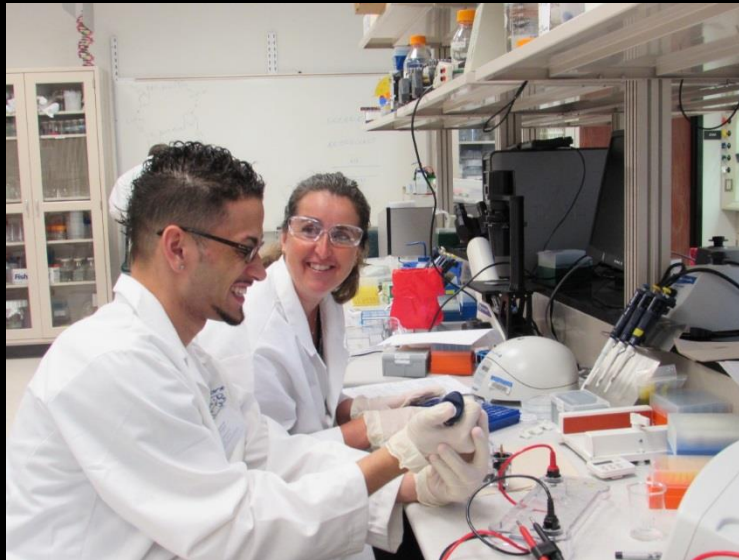




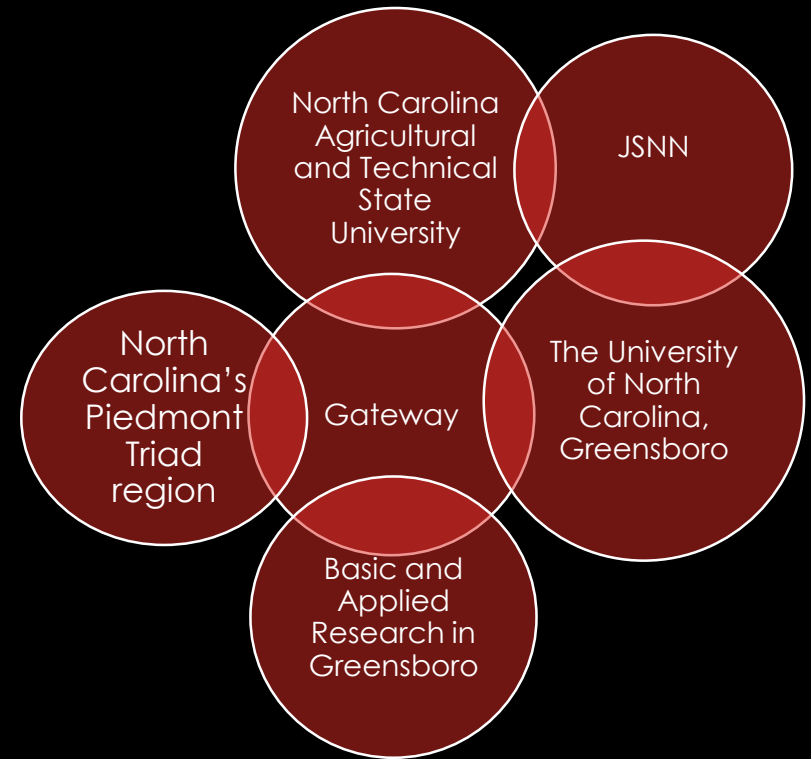
William Woodruff,
Department Head,
Biotechnology SE Region



“It looks like we have made some discovery here”



JOINT SCHOOL OF NANOSCIENCE AND NANOENGINEERING





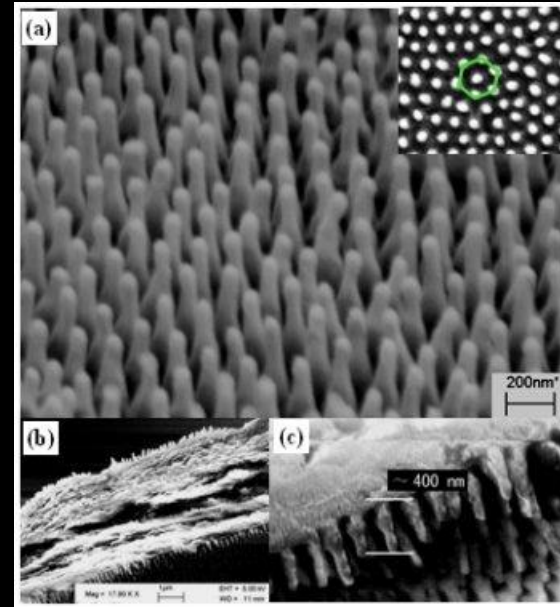
Dr. Daniel Herr



Dr. Mehrad Tajkarimi

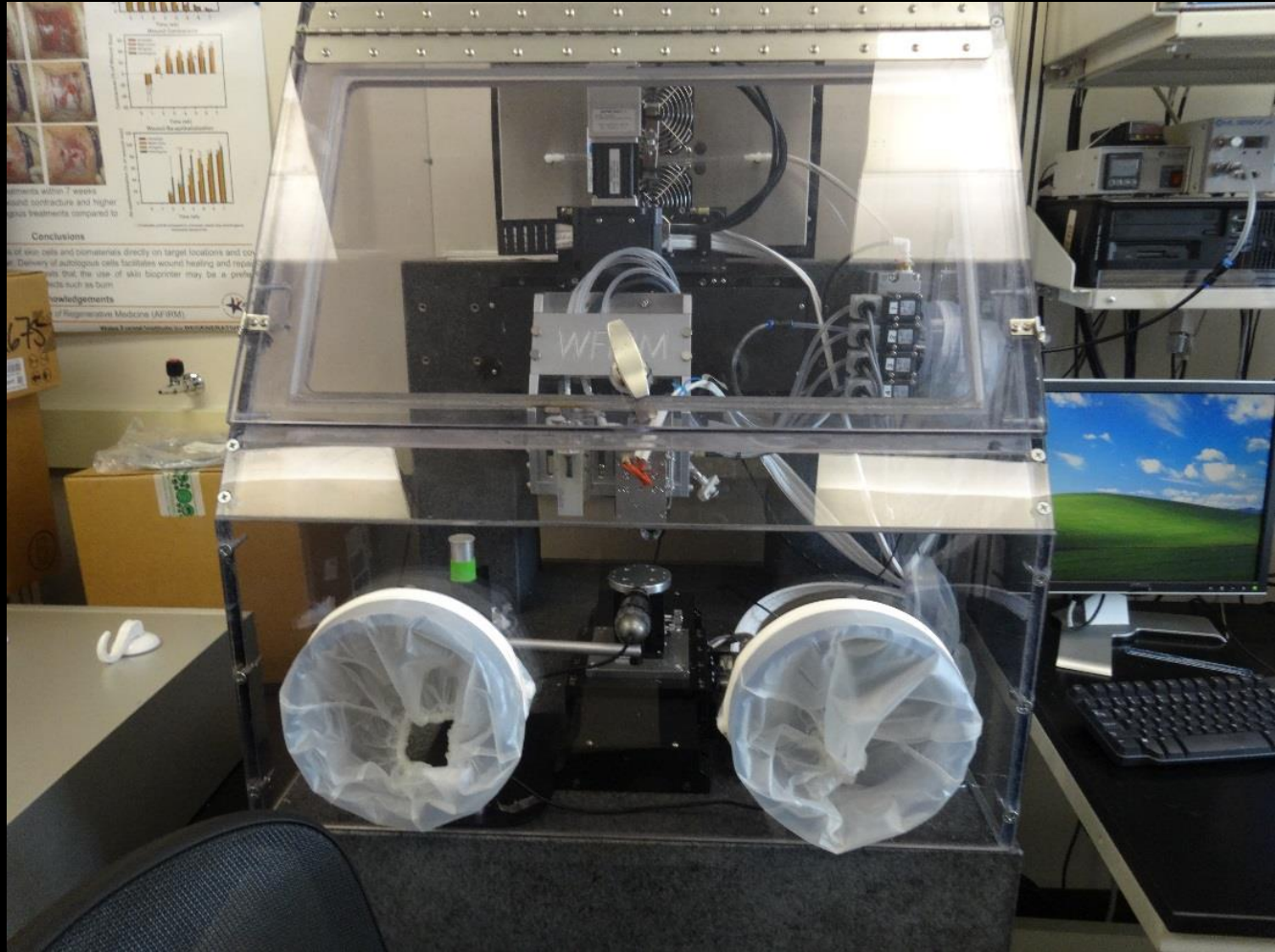


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<http://images.iop.org/objects/ntw/news/7/3/2/070302-1.jpg>

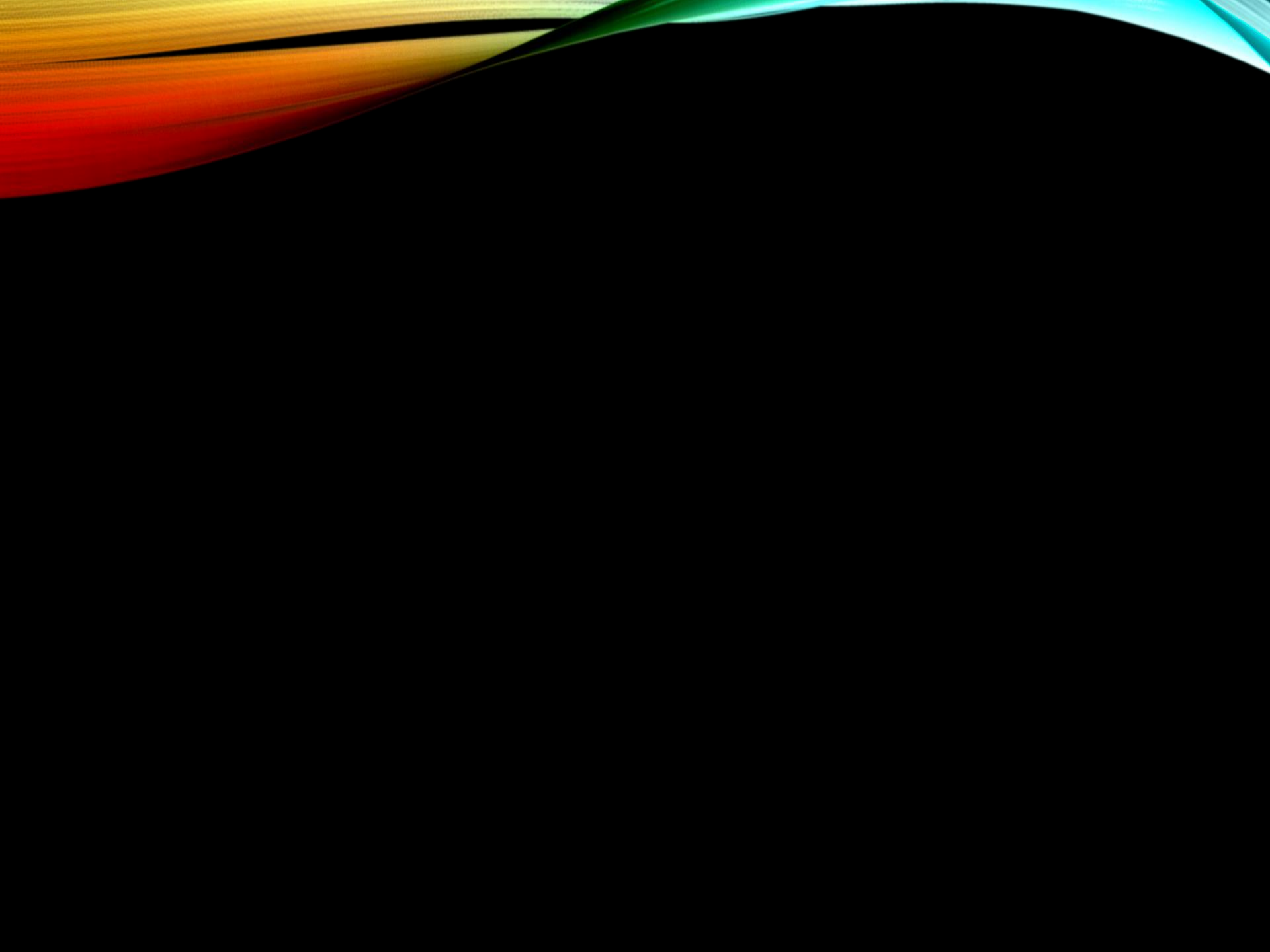




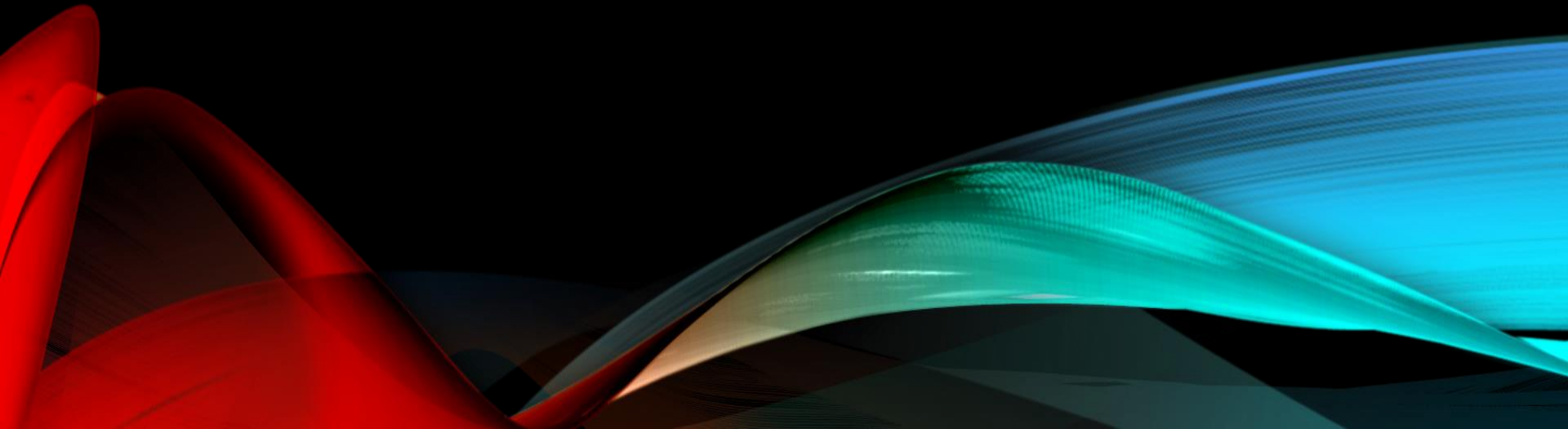


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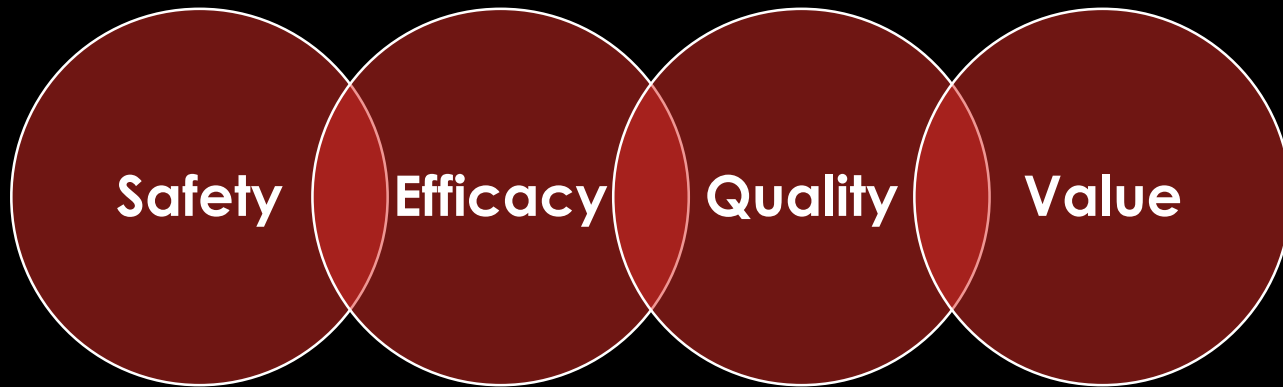




***BIOSCIENCE/BIOTECHNOLOGY IS A FIELD OF STUDY
THAT CONTINUES TO IMPROVE PEOPLE'S LIVES!***

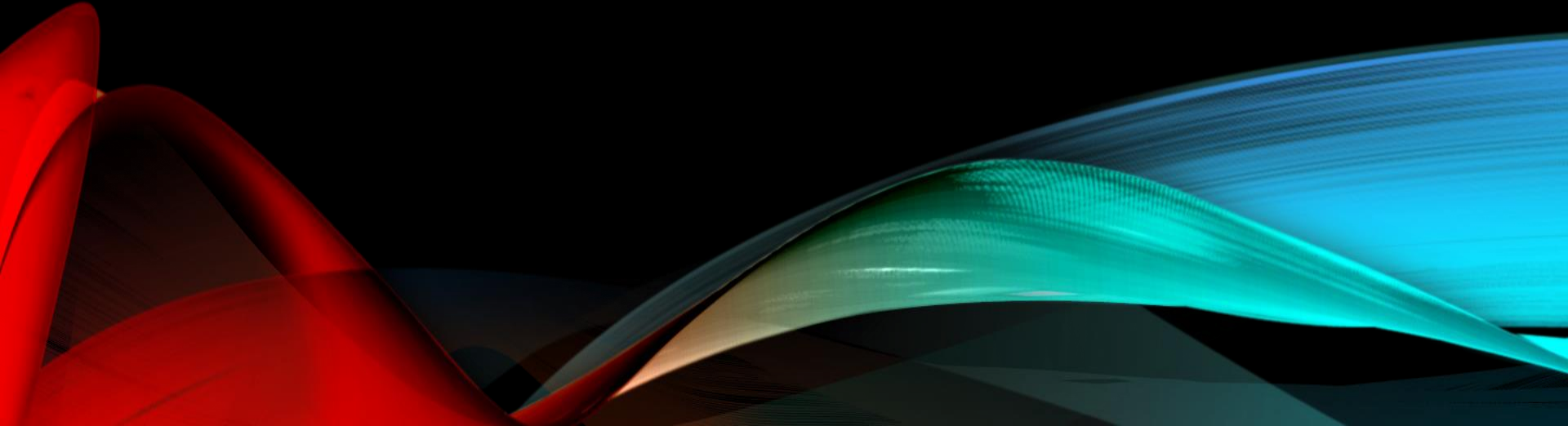


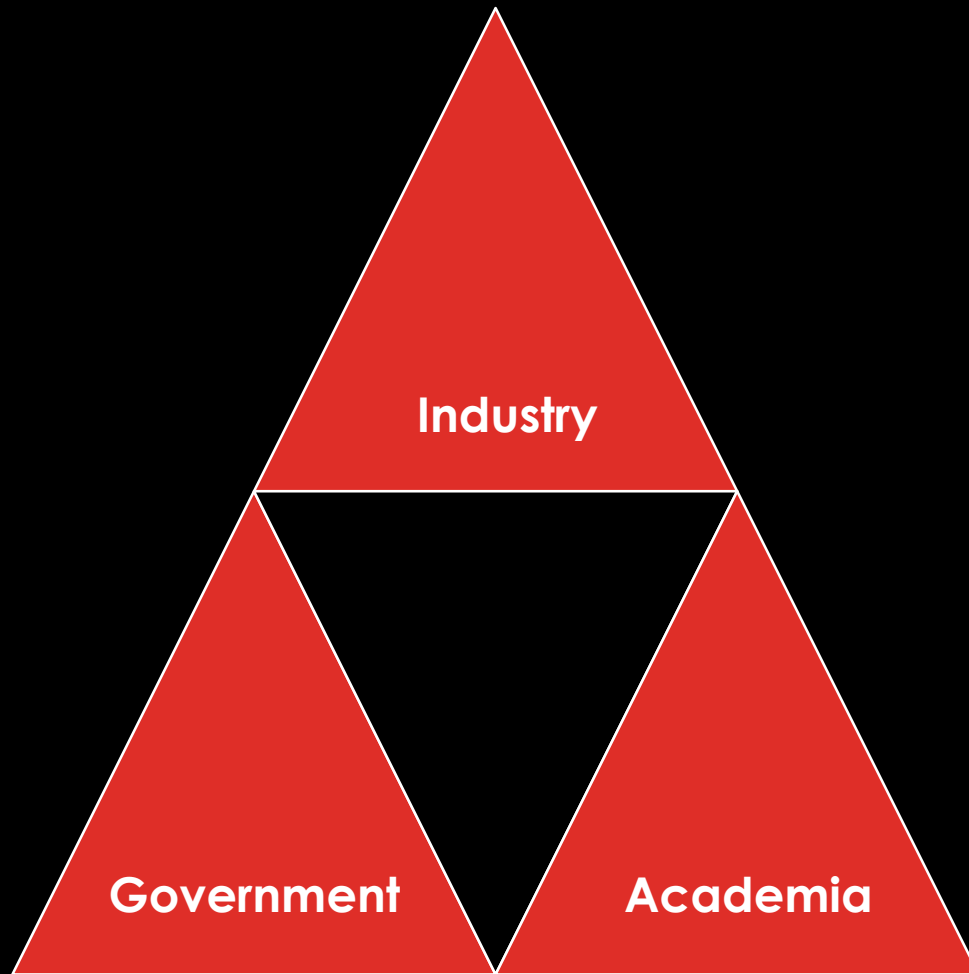
INDUSTRY VIEWPOINT




TARGACEPT

COLLABORATION AND NETWORKS





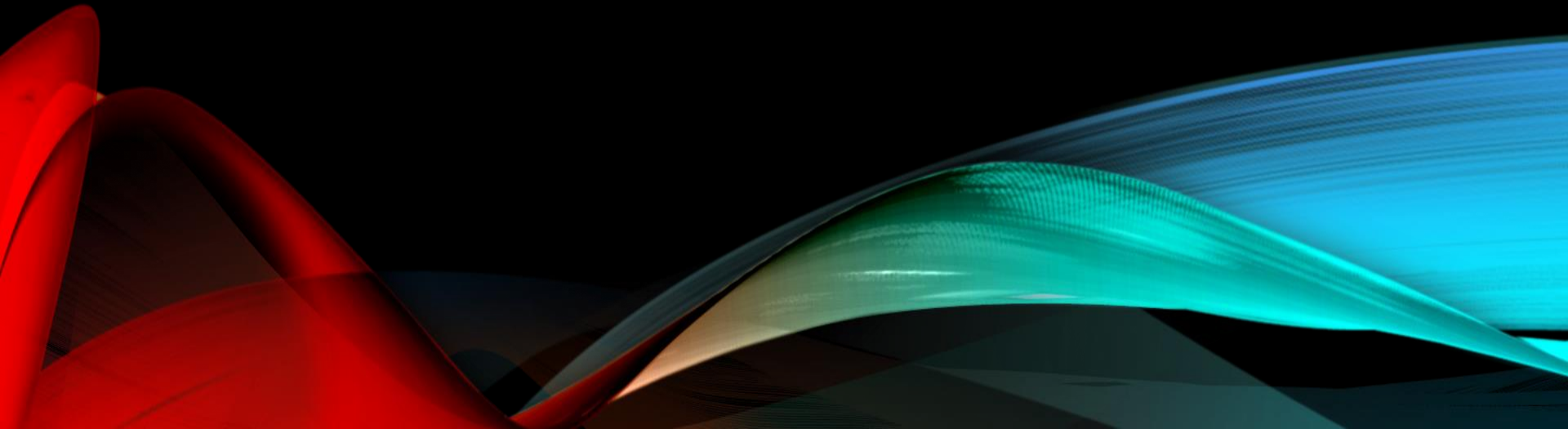


**People will continue to
make the Bioscience
Model Work for New
Discoveries to Help
All Mankind!**

**Zeke and Julie,
I am going to
get some geko
tape and I will
meet you at
the top! 😊**



WHAT ARE YOUR QUESTIONS?

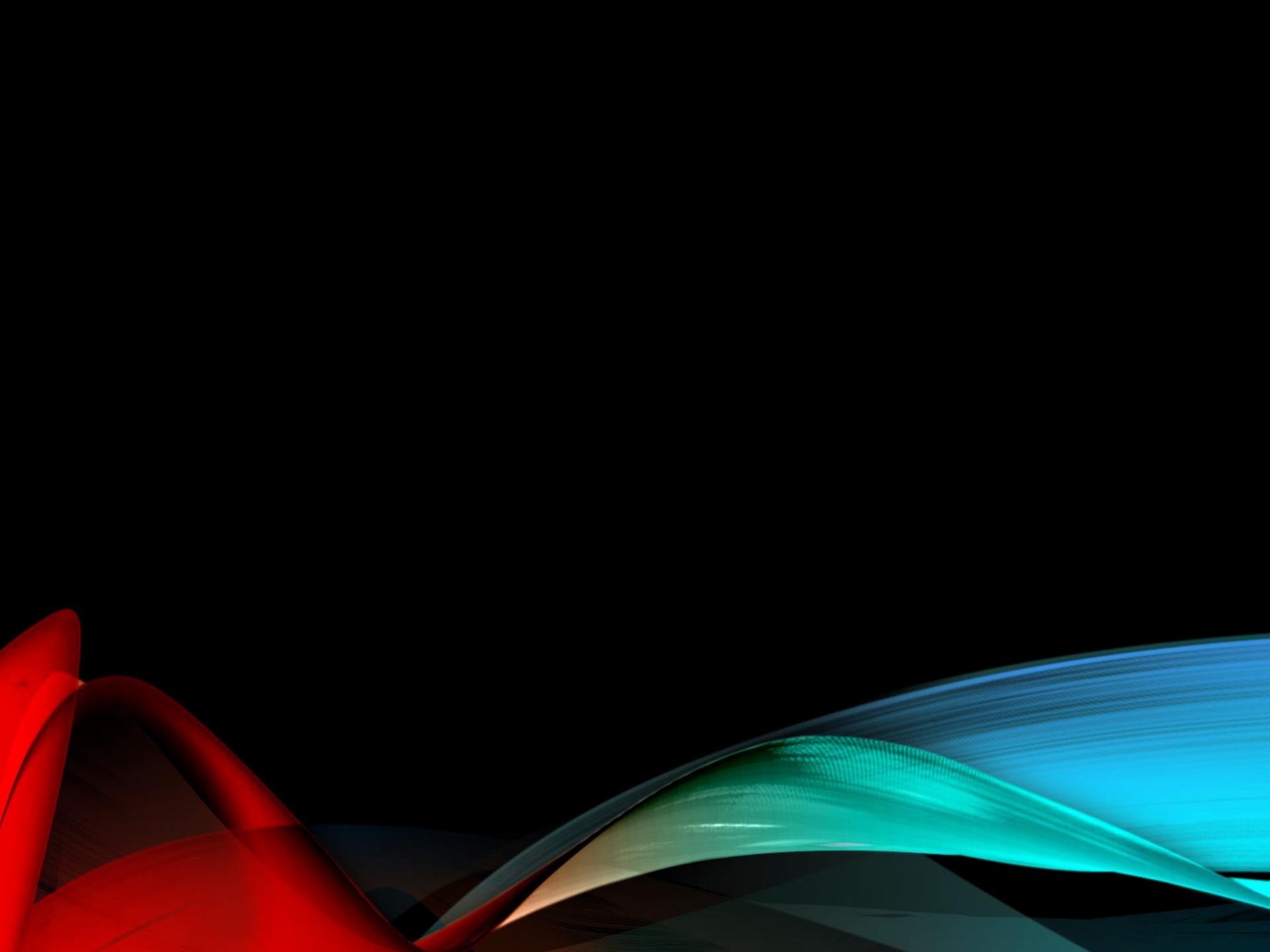




Thank You!

Thanks to each of you for all of your time, efforts, and the funds put into this Fellows program. We learned a lot in just one month that prepares us for our futures in Biotech. We also want to give a huge thank you to all of the companies and school's for inviting us in and taking us through tours of facilities and machinery. We are very grateful and honored to be selected and a part of this program. Thank you again to Russ Read, Micah Welch, and others for an unforgettable and applicable learning experience that we will share with others.









DAVE YARLEY – BIONETWORK CAPSTONE
CENTER -


RICHARD GUALANDI – GOWNING, CLEAN
ROOM AND FILLING



ABTech



biogen idec



Human Insulin
Clotting Factors
Biomanufacturing
Gene Therapy
Regenerative Medicine

Agricultural Advances
Biofuels
Environment
Medical Devices



<http://gajitz.com>

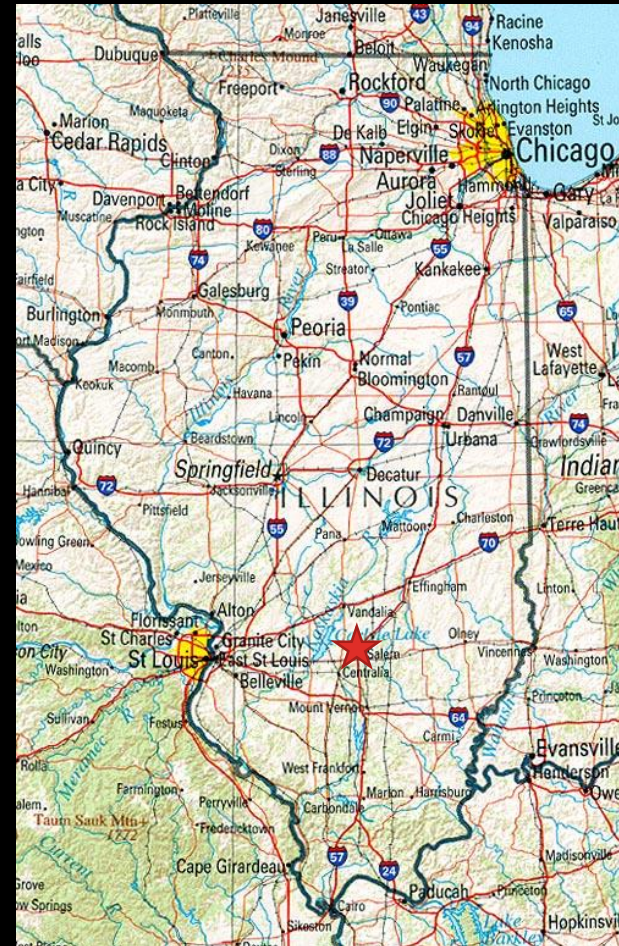


<http://tapiture.com>



<http://nsf.gov>

Where is Kaskaskia College?



RECRUITMENT PLAN FOR BIOSCIENCES

- ◆ Goal: to improve communication and recruitment to the biosciences by making the industry and its skills relatable and relevant to a broader audience
 - ◆ Recruitment Video
 - ◆ Social Media campaign
 - ◆ Print media

Social Media Campaign

Facebook

- ◆ Create a Biosciences page on Facebook to provide:
 - ◆ Career information
 - ◆ Education requirements
 - ◆ Professional development opportunities
 - ◆ Highlight advances and breakthroughs in the field
 - ◆ Share interviews with professionals in the discipline
- ◆ Will be linked to all other forms of social media

Social Media Campaign Target Audiences

- ◆ Facebook
 - ◆ Current professionals
- ◆ LinkedIn
 - ◆ Professionals who may transition from other disciplines
- ◆ Twitter and Instagram
 - ◆ Youngest generation, millennials
- ◆ YouTube
 - ◆ Reaches all people

Print Media

- ◆ Recruitment flyers
- ◆ Email
- ◆ Text messaging

Questions?



Bioscience Awareness: Using what we know to build for tomorrow's sustainability



Presenters
Savitha Pinnepalli, B.E., M.E., M.S. (River Parishes Community College)
Jude Okoyeh, Ph.D. (Forsyth Technical Community College)
NSF-ATE BIFP: Bioscience Industrial Fellowship Project



June 27, 2014



National Science Foundation
Division of Undergraduate Education (DUE)



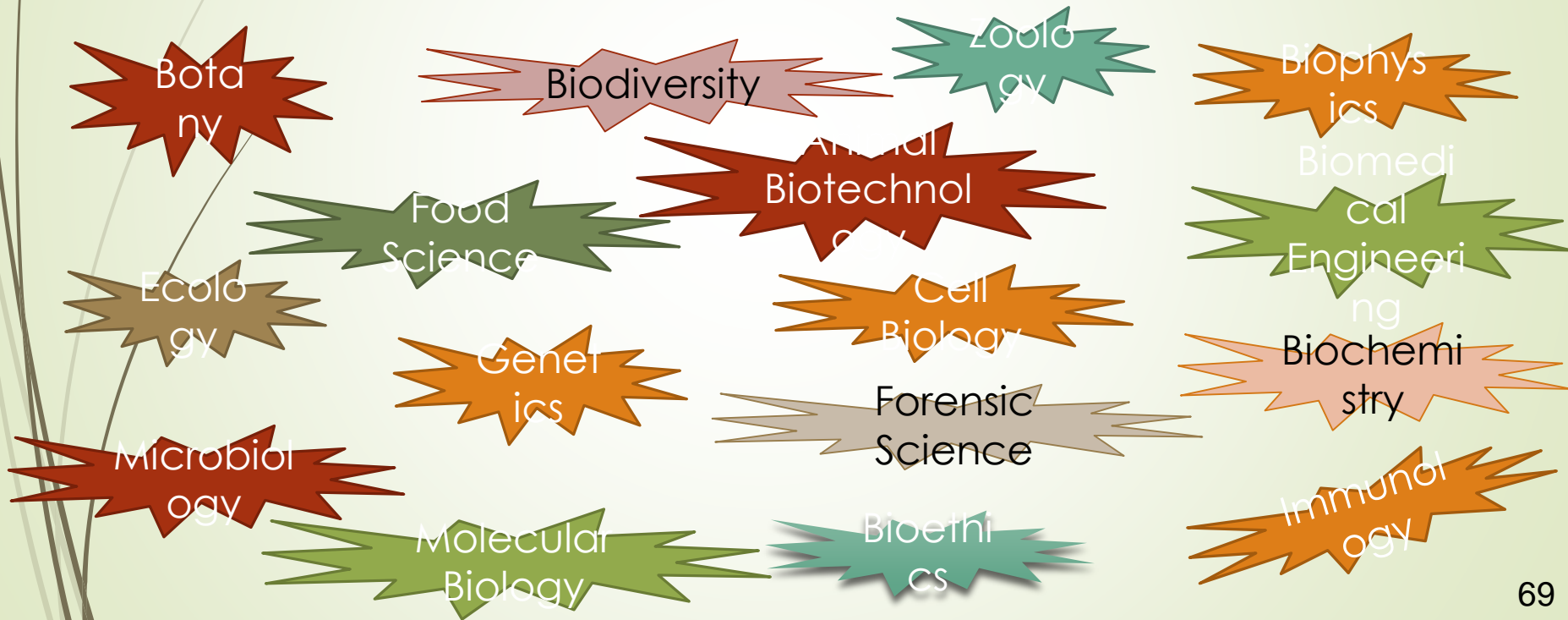
Objectives

- ▶ Bioscience and its disciplines.
- ▶ What is Biotechnology?
- ▶ Biotech Facts – Department of Labor
- ▶ Career Path for Biotech.
- ▶ Skills required for Biotechnicians.
- ▶ Current Biotech Resources.
- ▶ Implementation proposal for pilot outreach activities in Schools.
- ▶ Pre and Post Survey
- ▶ Biotechnology made easy using learning modules.
- ▶ Clone a mouse – Virtual lab training for students.
- ▶ Our Experiences in BIFP program.
- ▶ Industry visits
- ▶ Biotechnology Resources
- ▶ Bibliography
- ▶ Summary / Reflection

Bioscience and its disciplines

Bioscience results in creating products that cure diseases, ensure that we have safe and abundant food and water, and contribute to creating new fuels.

Disciplines of Bioscience include:



What is Biotechnology?

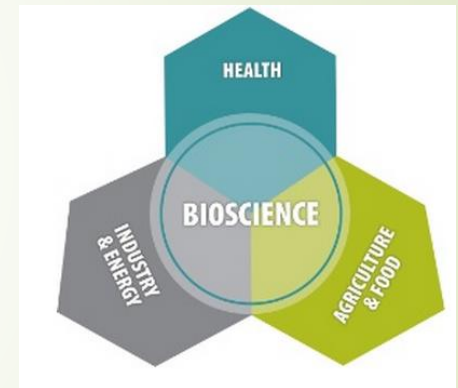
Biotechnology is the fusion of bioscience with technology to create and shape industries and products.

Biotechnology is a tool box that uses living things like cells and tiny molecules inside cells to make a product. Biotech uses cells and their processes to solve problems. Human understanding of how living organisms work has led to the concept of how we can put living organisms to work for us.

Biotechnology tools include working with:

- Cells
- Proteins
- Genes

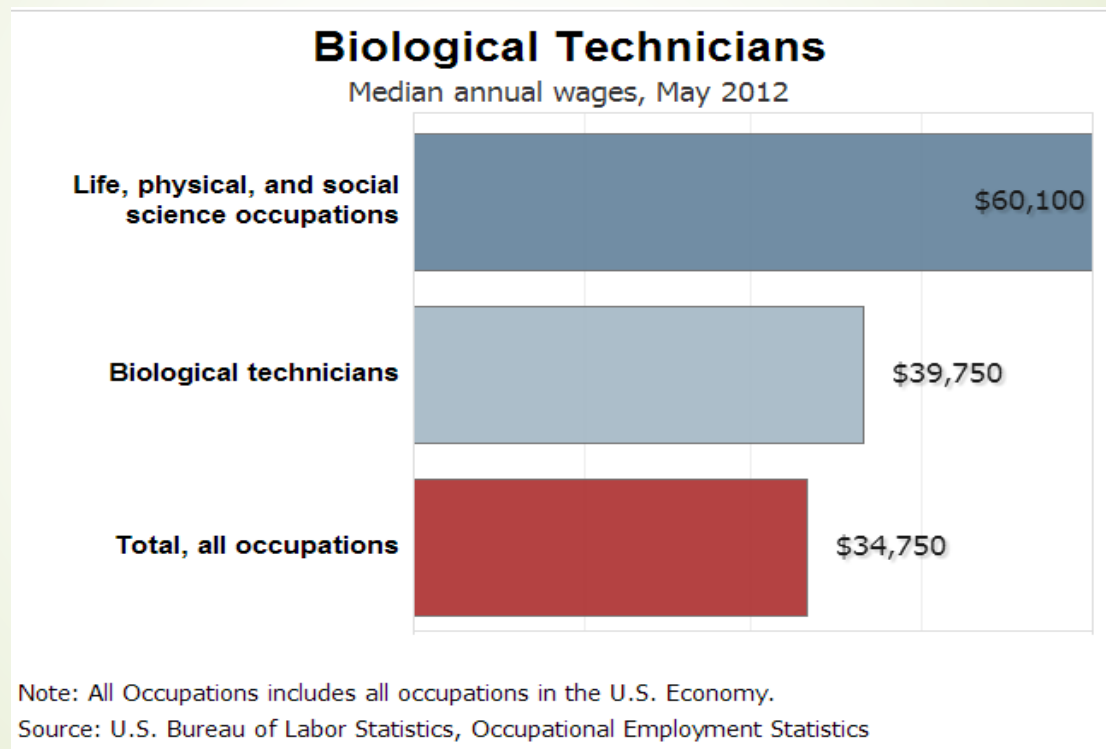
Some examples include selective breeding of plants and animals, yeast to make bread rise and produce wine.



Biotech Facts – Department of Labor

- **What Biological Technicians Do** Biological technicians help biological and medical scientists conduct laboratory tests and experiments.
- **Work Environment** Biological technicians typically work in laboratories.
- **How to Become a Biological Technician** Biological technicians typically need strong background in Sciences – biology, chemistry, math, physics, etc. or a closely related field. It is important for prospective biological technicians to gain laboratory experience while in school through internships.
- **Pay** The median annual wage nationwide for biological technicians was \$39,750 in May 2012 and varies by state.

Biotech Facts – Department of Labor



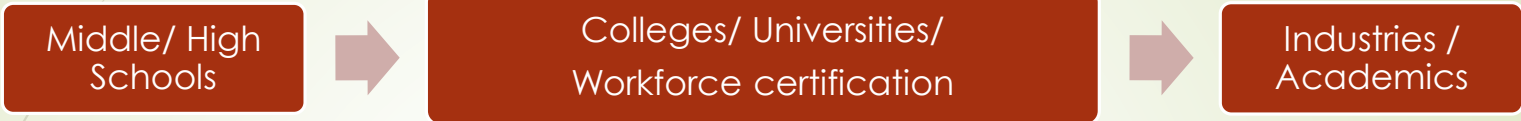
Biotech Facts – North Carolina

- Biotech Industry generates \$59 billion in economic activity statewide each year in North Carolina.
- Biotechnology employs more than 58,000 North Carolina residents
- 50% of biotech employees are at the technician level.
- Employment of biological technicians is projected to grow 10 percent from 2012 to 2022, about as fast as the average for all occupations. Continued growth in biotechnology and medical research is expected to increase demand for these workers.
- Drug development process involves high investment in R & D, clinical trials and is a high risk business. It involves Safety, efficacy, quality and value. However it is worthwhile for betterment of humanity.

Biotech Facts – North Carolina

- Average entry level salary is \$55,000 (BS degree) – Biogen idec
- Biotechnology is a global industry that requires life long learning.
- BRITE graduation and Placement rate 90%
- Current average number of biotech graduates per year in Forsyth Tech Community College, Rowan-Cabarrus Community College and Alamance Community College is around 18 - 20 students per year. At NC state university, there were 163 students (B.S), 21(M.S.) and 4 in Ph.D. program and 118 students graduated between 2008-2013.
- There is a dire need for trained biotechnicians.
- Student survey in Tengion company indicated that Biotech awareness is not common in High Schools. Hence our proposal is to start consistent biotech awareness at different school levels to generate curiosity and interest among students early in their career decision phase. These future biotechnicians can invent products for fighting diseases, feeding the world and saving our environment.

Career Path for Biotech



Research and Development	Manufacturing and Production	Quality Control and Assurance	Clinical Research	Sales and Technical support
Lab Technician, Research Assistant, Bioinformatics Analyst, Research Scientist, Forensic Scientist, Engineer	Environmental Technician, Manufacturing technician, Maintenance and Instrumentation Technician, Product Development Engineer, Process Technician	Quality Control Technician, Documentation Coordinator, Quality Control Analyst, Validation Specialist	Documentation Associate, Clinical Research Associate, Biostatistician, Regulatory Affairs Associate	Sales Associate, Facilities technician, Corporate Scientific Professionals

Skills required for Biotechnicians

- ▶ **Analytical skills.** Biological technicians need to be able to conduct scientific experiments and analyses with accuracy and precision.
- ▶ **Communication skills.** Biological technicians must be able to understand and follow the instructions of their managing scientists. They also need to be able to clearly communicate their processes and findings in written reports.
- ▶ **Critical-thinking skills.** Biological technicians draw conclusions from experimental results through sound reasoning and judgment.
- ▶ **Observational skills.** Biological technicians must constantly monitor their experiments. They need to keep a complete, accurate record of their work, such as the conditions under which the experiment was carried out, the procedures they followed, and the results they obtained.
- ▶ **Technical skills.** Biological technicians must be able to set up and operate sophisticated equipment and instruments. They also may need to adjust equipment to ensure that experiments are conducted properly.
- ▶ **Soft skills:** Strong work ethic, positive attitude, good communication skills, time management abilities, problem-solving skills, acting as a team player, self-confidence, ability to accept and learn from criticism, flexibility/adaptability, working well under pressure



Current Biotech Resources

- Academics – Universities, Community Colleges, Schools offer distance learning, short courses and degree programs.
- Research Institutes
- Industries – pharmaceutical, medical, food/agricultural or chemical manufacturers.
- Government agencies
- Other biotech affiliates like Triad growth partners (TGP) in North Carolina.




Implementation proposal for pilot outreach activities

Implementation (Middle/High Schools):

- ▶ Choose four model schools – 2 Early College/STEM Schools; 2 rural schools
- ▶ Biotechnology introductory visits to chosen schools.
- ▶ Administer pre-survey about biotechnology awareness
- ▶ Bi-monthly Biotechnology Lab and Equipment Demonstrations.
- ▶ End of session/semester survey – Faculty and Staff.
- ▶ Outreach / Summer Programs
- ▶ Virtual Labs

Colleges/Universities:

- ▶ Seminars/Workshops/Posters – academic, industries
- ▶ Involve Faculty & Staff
- ▶ Encourage students' attendance.
- ▶ Pre and post awareness surveys.



Biotech awareness through outreach activities in Schools

- After school training programs for juniors and seniors
- Summer Programs
 - Field trips to industries
 - Summer camps/ workshops
 - Track participants
- Advising college/ career technical education pathways
- Dual enrollment – tuition and fees are waived for high school students taking college courses for example- ACC NC.
- Students get a Head start on college by taking relevant College transfer courses
- Certifications- provide entry level job skills

Pre and Post Survey

Biotech awareness - presurvey

Biotech Awareness - presurvey

Please Identify yourself

- Student
- Parent
- Teacher
- Others

Name of your school (if applicable)

Enter your age?

Are you aware of Biotechnology field?

- Yes
- No

A biotechnologist can be a

- Lab Technician
- Scientist
- Researcher
- All of the above

Do you know anyone who works in the Biotech industry?

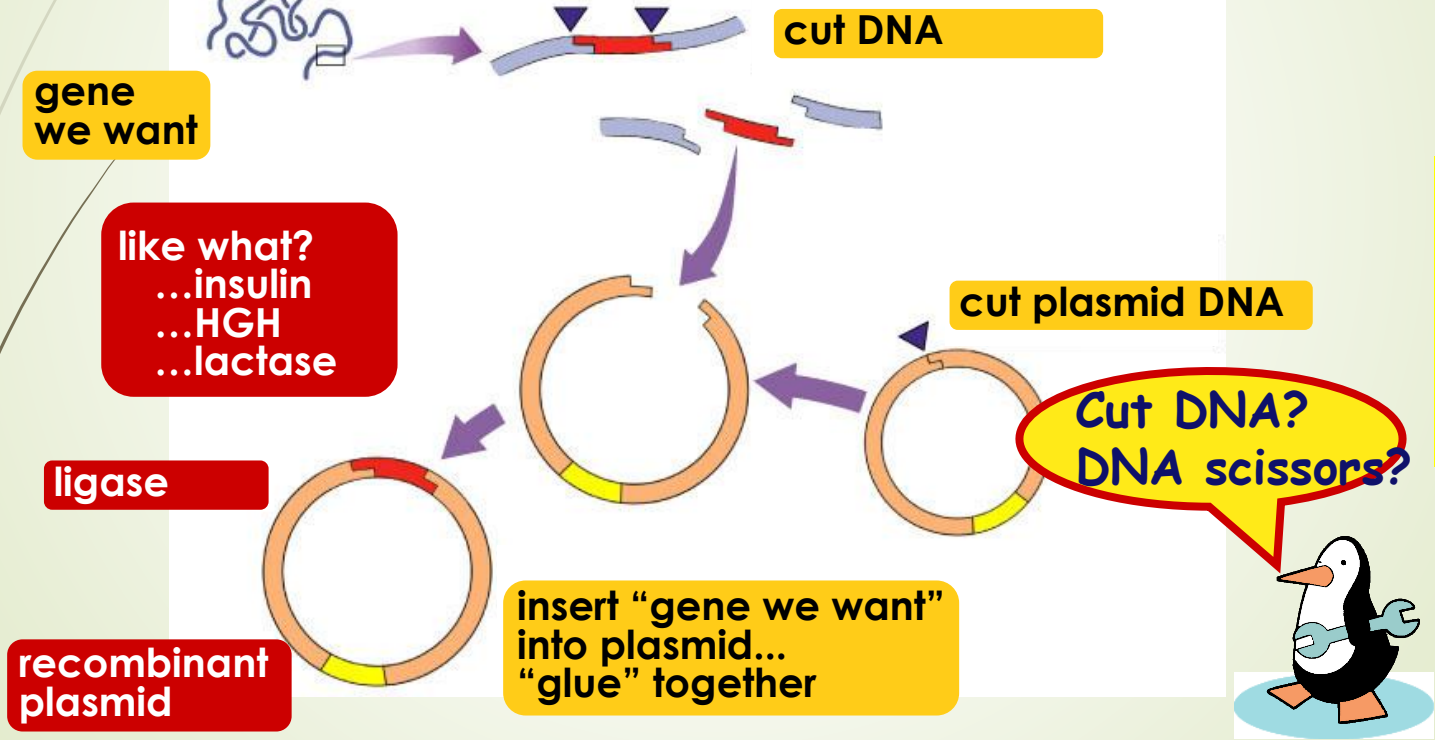
- Yes
- No

Would you like to pursue a career in Biotechnology field?

- Yes
- No

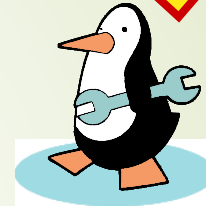
Biotechnology made easy using learning modules

- Plasmids used to insert new genes into bacteria



Manufacturing Protein

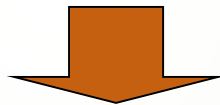
How can bacteria read human DNA?



- Gene produces protein in different organism or different individual

human insulin gene in bacteria

TAACGAATTCACGAATGGTTACATCGCCGAATTCACGATC
CATTGCTTAAGATGCTTACCAATGTAGCGGCTTAAGATGCTAGC



“new” protein from ~~organism~~ insulin from bacteria



bacteria

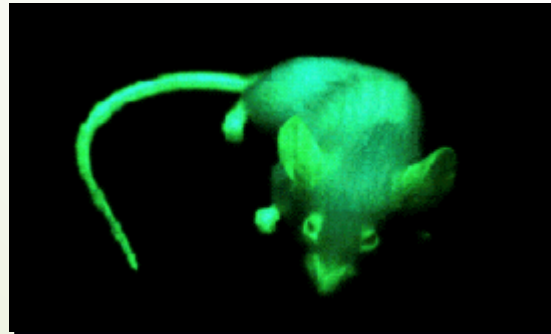


human insulin

Exciting students in STEM discipline Green with envy??



Jelly fish "GFP"



Transformed vertebrates

Exciting students in STEM discipline by providing resources, organizing talks, industry field trips and hands

Clone a mouse – Virtual lab training for students

<http://learn.genetics.utah.edu/content/cloning/clickandclone/>

Click and Clone



Virtual Labs

- Are cost effective.
- Enhance learning interest



Experience in BIFP program - Savitha Pinnepalli

As a BIFP fellow, I was given a quick refresher seminar on the concepts that would be involved in conducting the lab experiments in Forsyth Technical Community College, Rowan-Cabarrus community college, Asheville-Buncombe Technical Community and Alamance Community College. We conducted several experiments following the lab protocols, recorded and analyzed our results with the instructor. Some of the experiments were DNA restriction analysis, HPLC – High Performance Liquid chromatography (heat value of hot sauces and chillies) and GC-MS Gas Chromatography-Mass Spectroscopy. We were exposed to Biomanufacturing processes and instruments used in this field from drug discovery to development and launching of the product. We were provided hands on experience in the NC BioNetwork Capstone center in gowning, Biomanufacturing process of green fluorescent protein (GFP) and received certification. We visited industries like Tengion, Targacept, Biogen Idec, Patheon, transtech pharma, Wake Forest Institute for Regenerative Medicine (WFIRM), Joint school of Nano Engineering, David H. Murdock Research Institute, BRITE and research parks to name a few. In summary there is a need of high volume of trained biotechnicians and partnering of colleges and industries to engage more students in sciences is very critical. I have enjoyed working with the BIFP fellows and administrative staff. I would like to thank the PI Russ Read for his vision and Mission of promoting Biotechnology and providing excellent transportation, accommodation and hospitality.



Experience in BIFP program - *Jude Okoyeh*

The BIFP Fellowship has indeed enabled me to have a better insight into the amazing advancements that has been made, through the use of Biotechnology/Bioscience, in improving the quality of lives of people. The commitment and dedication of people from all strata of professional inclination are very encouraging and a challenge to most of us. The future looks even brighter and more promising in what can be accomplished in this field - WFU Regenerative Medicine, David Murdock Res. Institute, Nanotechnology, other big and small biotech industries and their affiliates. The question that is before us is: "How do we all ensure that our future generations can competently improve on the breakthroughs of today in order to meet and sustain the challenges of tomorrow in this exciting field of biotechnology?" I intend to disseminate the experiences and information I have gained through this program to the Students, Faculty and Staff at FTCC and beyond.

Finally, a big THANK YOU to the Organizers of BIFP; the NSF; the hosting schools, industries/institutes and my BIFP Colleagues. It has been a wonderful experience for the past four weeks.

Summary

- ▶ Biotech industry is growing at a rapid pace. There is a gap in the demand and supply of trained biotechnologists.
- ▶ There is a lack of biotech awareness in high school students, parents and community.
- ▶ Extensive and consistent outreach and awareness programs are required to bridge this gap.
- ▶ Track students interested in biotechnology and educate them on resources, degree programs and jobs available in the field.



Industries, Universities and Community College visits and hands on Lab experiments: BIFP Experience



BIFP hands on Lab Experiments



Industry visits





Biotechnology Resources



- ▶ <http://biotechworkforce.org/> National Center for the Biotechnology Workforce
- ▶ <http://www.ncbionetwork.org/index.cfm>
- ▶ <http://www.ncbiotech.org/biotech-basics>
- ▶ http://web.ornl.gov/sci/techresources/Human_Genome/index.shtml
- ▶ http://www.sciencedaily.com/news/plants_animals/biotechnology/
- ▶ <http://www.bio.org/>
- ▶ <http://learn.genetics.utah.edu/content/labs/extraction/>
- ▶ <http://nobelprize.org/educational/chemistry/pcr/game/index.html>
- ▶ http://glencoe.mcgraw-hill.com/sites/dl/free/0078757134/383937/BL_22.html
- ▶ <http://learn.genetics.utah.edu/content/tech/cloning/clickandclone/>

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