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InnovATEBIO ATE Project Talk: Expanding Hands-On Biotechnology and Biomanufacturing Experiences to Grow the Workforce

Due# 2300800

Grant duration: October 2023 - September 2026

April 18, 2025

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Eduardo Ayala, PhD, El Camino College, Participant

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Why This Project Matters

- Biotech & biomanufacturing jobs are growing: it's not just lab skills that matter
- Industry needs *teams* that can:
  - Work across departments
  - Follow procedures
  - Meet deadlines
- Our students need exposure to this *real-world workflow*

Students at Skyline College doing a BioSCOPE project

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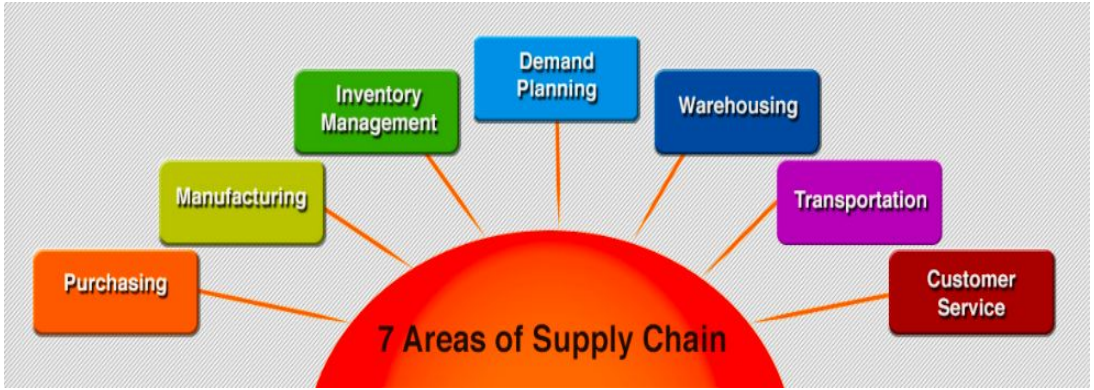
The Gap We Noticed

- Traditional biotech education focuses heavily on *technical skills*
- But industry also needs:
  - Operations knowledge
  - Communication across roles
  - Project and quality management
- That's where our project comes in



Supply Chain spectrum

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Our Ultimate Project Goal

- Provide students with experience in how a biotech operation really works:
  - From raw materials to final product, including:
    - Roles
    - Documentation
    - Teamwork + communication
    - Troubleshooting
- How?
  - **Faculty professional development**

Instructors at Cerritos College aliquoting chelex

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Meet BioSCOPE

Bioscience ***S***upply ***C***hain ***O***perations ***P***rojects for ***E***ducation: framework for teaching biotech workflows, including:

- Materials management
- Production planning
- Quality Control
- Documentation and SOPs
- Team-based production

Students *doing* - Galileo HS

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Think Like a Company

Students don’t just do a lab - they run a mini biotech operation:

- Take on roles
  - Production team (Manufacturing Techs)
  - Managers (Safety, Inventory, Quality)
  - Student Coordinator (Project Manager)
- Follow SOPs/Batch Records
- Track production
- Troubleshoot and communicate as a team

Skyline College verifying batch records

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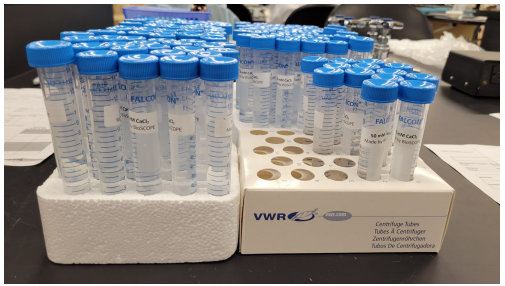
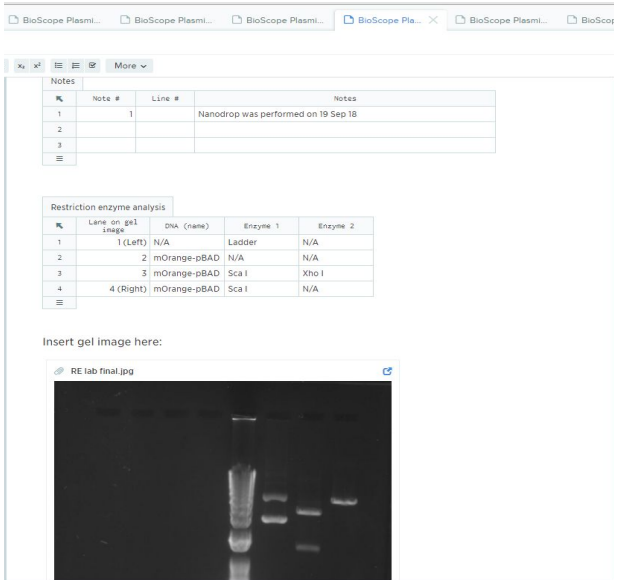
What it Looks Like (Example)

- Flexible projects-student led or customer led
- Students produce a batch of plasmid DNA
- One team handles prep, another QC
- Everyone follows documentation and reports up
- Goal: deliver a high-quality product - *together*



Packing and labeling $CaCl_2$ aliquots



QC of plasmids by restriction digest

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Skills Beyond the Bench

This project builds:

- Professional skills: accountability, teamwork, communication
- Operational understanding: what happens before and after the pipetting
- Project flow: deadlines, documentation, chain of custody

Watch out for the auditor! Galileo HS

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Faculty Toolkit - BioSCOPE 101

We created BioSCOPE 101 to make it easy for faculty to teach operations - **industry vetted templates**:

- Standard Operating Procedures (SOP templates)
- Batch records
- Team roles and job descriptions
- Skills matrices
- Suggested project timelines

Templates are available on Canvas. No Canvas account? You can sign up - it's free!
https://www.instructure.com/try-canvas

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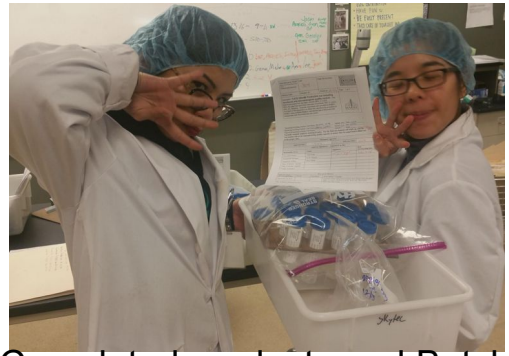
How Students Respond

Early feedback shows students:

- Feel more confident working in teams
- Understand how companies actually function
- See more clearly how their work fits into the big picture
- More than just technical skills

Students making buffers



Completed products and Batch Records. Ready to deliver!

Team meeting at Galileo HS

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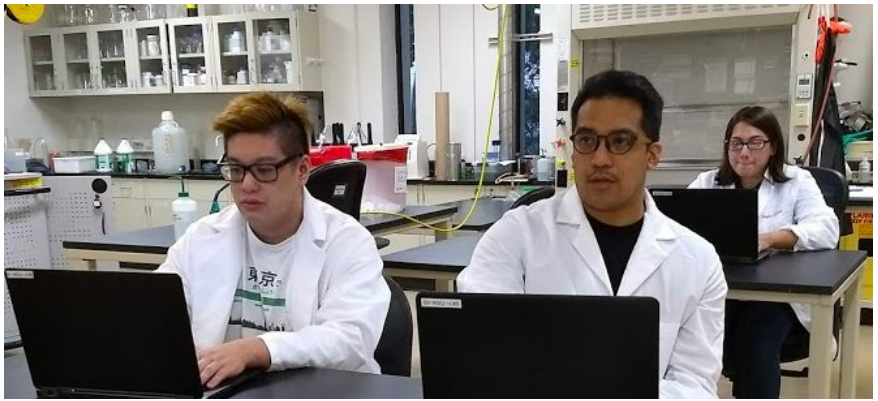
Not Just for Biotech Majors

These skills are essential across STEM careers:

- Project coordination
- Documented processes
- Accountability

Great for any student going into lab work, manufacturing, or healthcare



Very serious QA department checking the intro class's documents

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What this Project is NOT

- It's not just another wet lab
- It's not only for advanced students
- ***It is*** about getting students to work like an industry team
    - Even in high school or intro college courses

Students at Galileo HS making plates for a Middle School lesson

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Faculty Support

We provide:

- PD workshops
- Curriculum
- Editable templates
- Ongoing implementation support

Faculty planning their production during PD

CAST Intro to Accessibility Webinar Recording

CAST Intro to Universal Design for Learning Webinar Recording

Quality manager verifying production

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Featured Implementation of a BioSCOPE Project
Dr. Eduardo Ayala

El Camino College BioSCOPE Implementation: ECC Onizuka Day Biotechnology Experience

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Onizuka Day 2025 Project

- Project
  - Event: Onizuka Space Science Day 2025
  - Made “biotech kits,” solutions for paper chromatography and agarose electrophoresis of candy dyes
  - Will validate the equipment, supplies and products
  - Biotech students volunteered in two shifts on Saturday March 15. 8am-2:30 pm

Brilliant Biotechnology

Eduardo Ayala – Professor, Biology (ECC)

Biotechnology is an exciting field with implications for every aspect of our lives! In this session, students will apply biotechnology techniques, including pipetting, extractions, chromatography and electrophoresis, to the analysis of dyes from candies. Additionally, students will observe the migration of DNA by agarose gel electrophoresis. Join us to learn more about how biotechnology shapes our world!

Participants must be in 6th grade or older.

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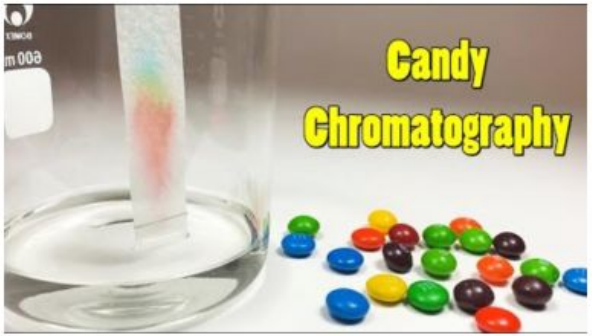
Onizuka Day Activities

- Paper Chromatography
  - https://www.youtube.com/watch?v=GDROkh1zlr8&t=258s
  - 1. Candy Chromatography: What Makes Those Colors? (Science Buddies)
  - https://www.sciencebuddies.org/science-fair-projects/project-ideas

- Agarose Gel Electrophoresis
  - Candy Dye
  - DNA
- 3. Overview: Food Dye Electrophoresis (BABEC)
- https://www.youtube.com/watch?v=WOfkuU0yAU0&list=PLMXaiiFprsiPuOmwMkAVdb9MdTq3F_0iJ



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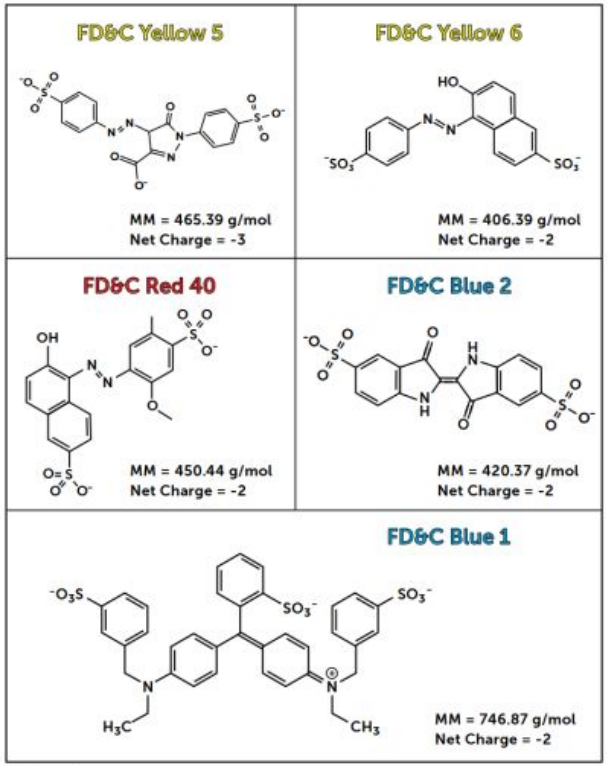
Dyes in Skittles



MM = molar mass

Candy Color Electrophoresis MiniLab
https://theminione.com/wp-content/uploads/2019/04/M3009-Candy-Color-Electrophoresis-StudentsGuide-041019-WEB-EMAIL.pdf

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Activity: Candy Extraction and Chromatography Apparatus Set Up

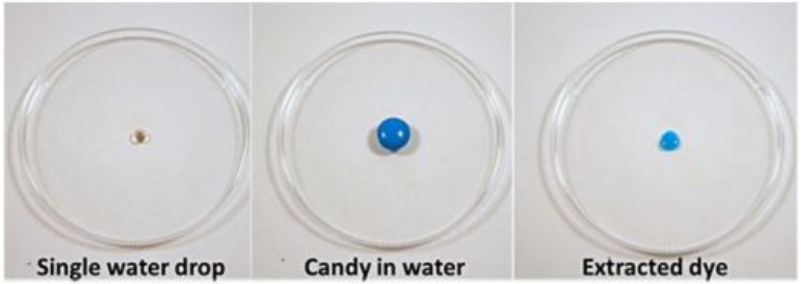

Image Credit: Sandra Slutz, Science Buddies / Science Buddies

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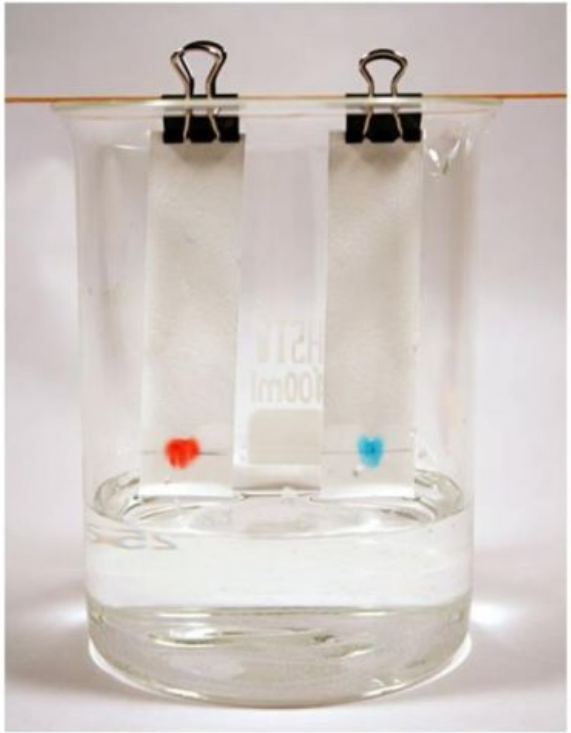
Activity: Running and Analyzing Paper Chromatography



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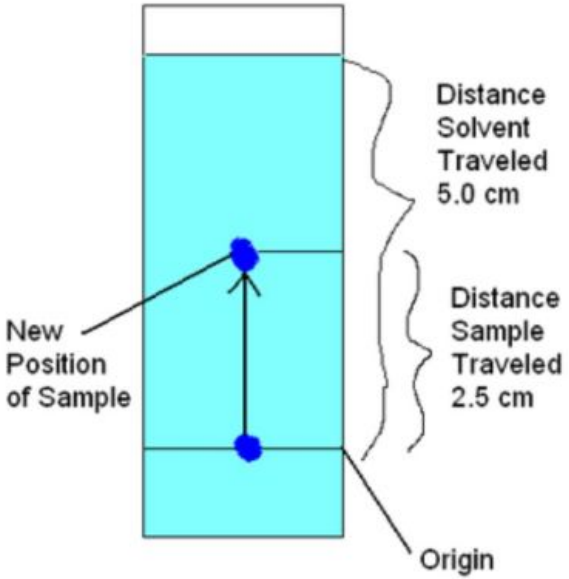

https://www.sciencebuddies.org/science-fair-projects/project-ideas

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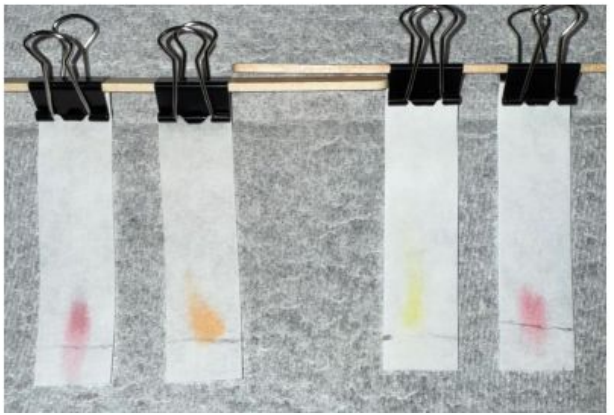
Candy Dye Paper Chromatography



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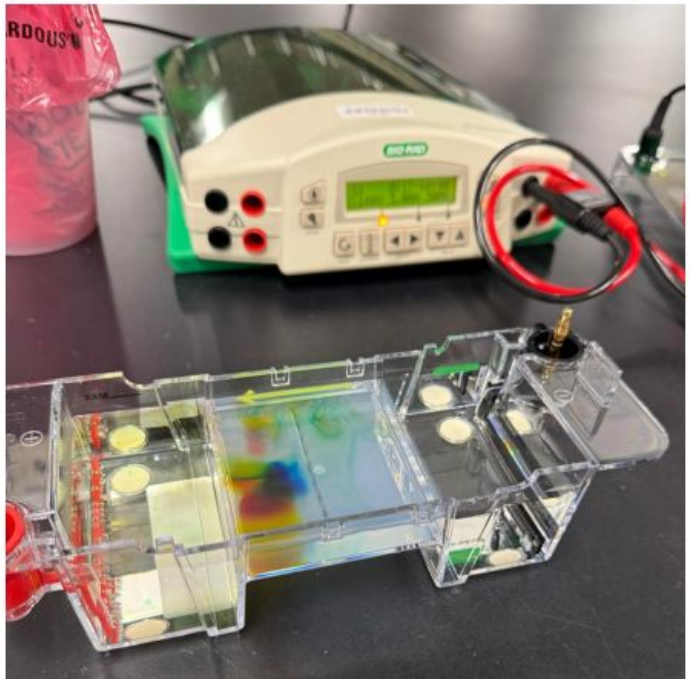
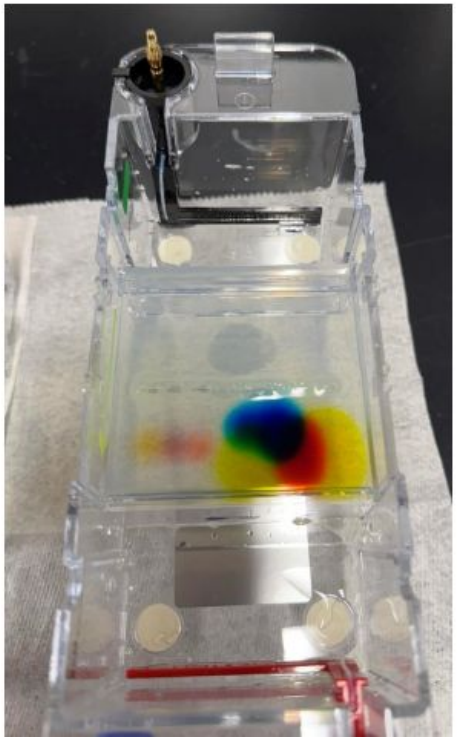
Candy Dye Gel Electrophoresis





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Overview

Pre-Onizuka Day Activities

- Faculty Brainstorm and Input from Dean
- Supply Chain Lecture and Planning Sessions with Students
  - In-class
- Preparing Kits
  - In-class
- Piloting and Troubleshooting with Students
  - In-class

Day of and Post-Onizuka Day Activities

- Implementation during Onizuka Day
  - Biotech mentors
  - Hands-on activity
  - Student-led presentations
  - Rolling with things that didn't go as planned
- Debrief (In-class)
  - What worked
  - What didn't
  - Overview of BIOSCOPE
  - Making BIOSCOPE survey available

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Onizuka Day Planning

- Customers
- Product
- Staffing
- Deadlines
- Branding and Marketing
- Materials and Equipment

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Onizuka Day Planning: Customers

- Audience
  - Students: 6th grade and up
- Number of participants per session
  - 16-20 per session. 32-40 total
- Feedback (continuous improvement)

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Onizuka Day Planning: Product

- Biotech Experience
  - Kits
    - Candy dye extractions
    - Candy dye paper chromatography
  - Gel Electrophoresis
    - Candy dye
    - DNA
- Creating an experience, they will take home
  - Hands-on
  - Meaningful and Impactful
- Lab Safety Considerations

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Onizuka Day Planning: Lab Safety Considerations

Challenges

- Age of participants
- Risk of eating in the lab
- O-chem lab houses dangerous chemicals
- Potential allergies to candy
- Boiling agarose
- Parents may be concerned about candy dyes
  - Red 40 for example
- Attire (shorts, sandals, etc.)

Resolution

- Lab safety training for participants
- Signage
- Proper PPE (googles and gloves)
- ASK if participants have allergies
- Waivers
- Accident reporting SOP
- "Baby-proofing" the lab
- First aid kit
- Biotech team will sanitize googles with 70% EtOH

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Onizuka Day Planning: Staffing

- Number of team members
  - Preparation of materials
  - Staffing the event
    - Confirmed volunteers
      - 10 students session A
      - 6 students session B
- Appropriate experience dictates activities
  - Participants
    - Candy dye extractions
    - Candy dye paper chromatography
  - Biotech Team
    - Gel electrophoresis
    - Handling of lab reagents and chemicals
    - Lab lectures

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Onizuka Day Planning: Deadlines

- Tuesday, 3/11
  - Candy chromatography kits are assembled
    - Materials delayed
  - Lab lecture assignments
- Thursday, 3/13
  - Pilot experiments
  - Rough draft of lab lectures
  - Walkthrough of roles and activities for the event
- Saturday, 3/15
  - The big day!
    - Gels poured and stations set up

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Onizuka Day Planning: Branding and Marketing

ECC's Marketing and Communication

- Dedicated Website
- Outreach to local schools and community organizations

ECC Biotech Team

- Biotech Logo Stickers
- Business cards
- Fliers
- Word of mouth

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Onizuka Day Planning: Materials and Equipment

- Budget
  - Approximately $130
- Ordering lead times and deadlines
- Refrigeration and climate control
- Logging of received supplies

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Onizuka Day Planning: Materials and Equipment

Ordered supplies

- Logo stickers
  - Ordered by Ying-Tsu Loh at BABEC (collaborator of ECC's Biotech Program)!

In-house supplies

- Rulers
- Beakers
- Gel electrophoresis apparatus and power supply

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Biotech “Kits”and Student Designed Logo

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Onizuka Day Lab Lecture Assignments

Session A

- Biotechnology Introduction
  - Professor Ayala
- Lab safety
  - Erick
- Dyes
  - Alejandra
- Paper Chromatography
  - Juliana
- Gel Electrophoresis
  - Sara
- Cell and DNA
  - Yovany

Session B

- Biotechnology Introduction
  - Professor Ayala
- Lab safety
  - Briana
- Dyes
  - Paola
- Paper Chromatography
  - Yovany
- Gel Electrophoresis
  - Sheida
- Cell and DNA
  - Harrison

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Biotech “Kits”

Work Instruction and Batch Record Document – Onizuka Day Biotechnology Kit

Manufacture Location: **Batch #:**

Purpose: To provide kits for Onizuka Day Biotechnology Session Participants.

Scope: The scope of this document is for use by biotechnology instructors and students to assemble biotechnology kits.

Materials:

- 40 Resealable Plastic Bags (6 5/8 in. x 5 7/8 in)
- 40 Original Skittles Fun Size Packs
- 40 Chromatography Paper Strips (6" x 0.75")
- 40 Mini Weigh Boats
- 80 Wooden Coffee Mixers
- 80 Plastic Pasteur Pipettes (3 mL)
- 80 Golf Pencils
- 120 Assorted Science Stickers
- 80 Small Binder Clips
- 40 Petri Dishes

Equipment and Supplies:

- Gloves

Method to produce Biotech Kits

Step	Technician Initial/Date	Verifier Initial/Date
1. Clean and sterilize lab surface with 70% EtOH.		
2. Gather all the materials and equipment needed.		
3. Don a pair of gloves.		
4. Retrieve a plastic baggie and affix a label. Place the items below with the appropriate quantity.		
5. One Skittles fun pack.		
6. Fold a piece of chromatography paper in half lengthwise and cut in half. Place both pieces of paper in the baggie.		
7. Two mini weigh boats.		
8. Two wooden mixers.		
9. Two plastic Pasteur pipettes.		
10. Two golf pencils.		
11. Two binder clips.		
12. 1 Petri dish.		
13. Three science stickers. Technician choice.		
14. Seal baggie by engaging the zip lock mechanism.		
15. Proceed with Kit QC in the following section.		

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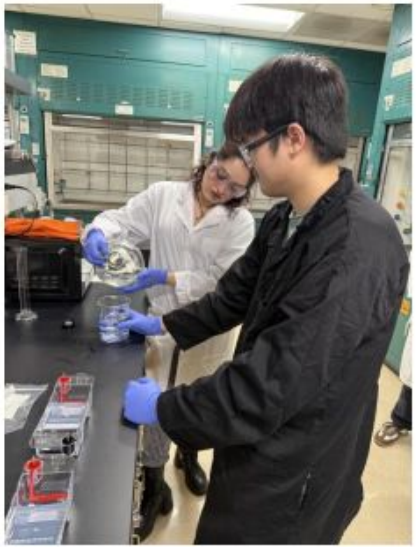
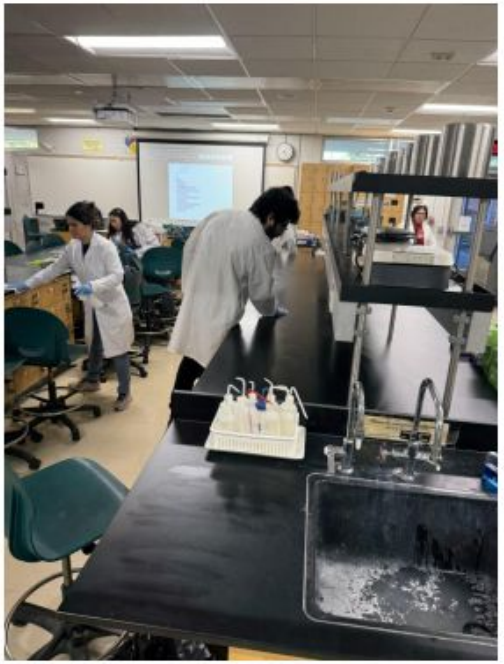
Preparing for Onizuka Day





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Onizuka Day!
Middle Schoolers are sitting.

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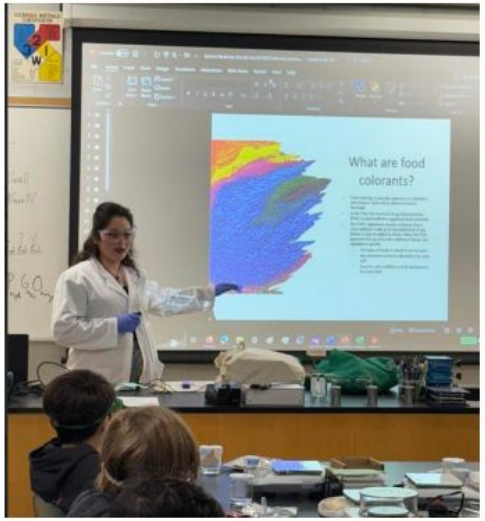
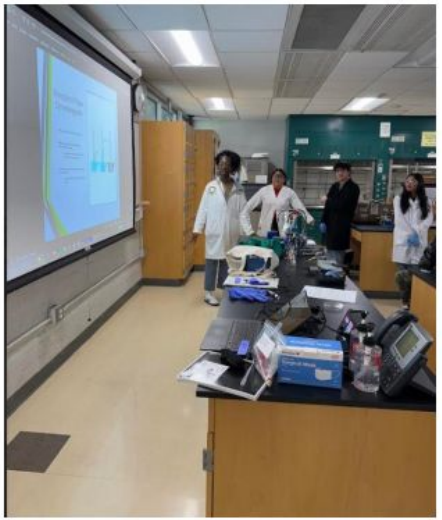
Onizuka Day! Presenting to Middle Schoolers!





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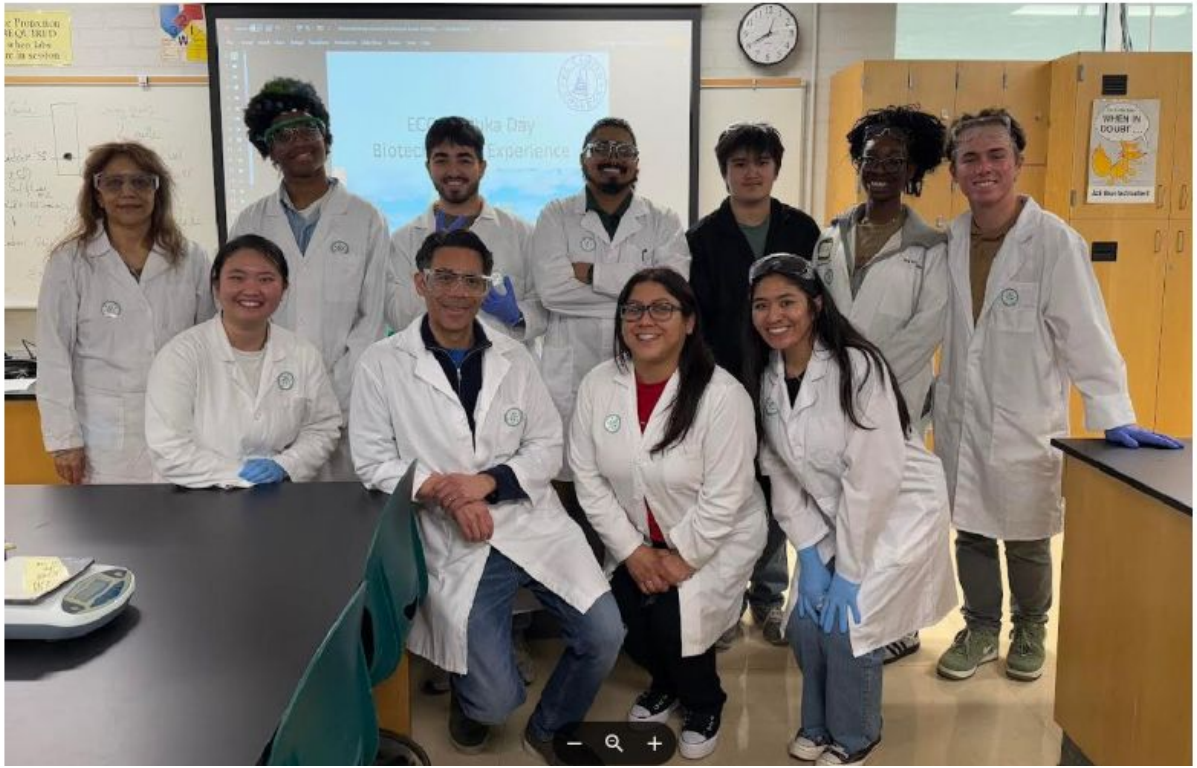
El Camino Community College Biotech Team!



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Onizuka Day Debrief: What did you learn from this experience?

- Creating an experience
- Teamwork
- Materials management
- Public speaking
- Marketing
- Communication
- Lab safety
- Making a product
- Equipment calibration
- Communicating with a customer
- Labeling
- Quality control
- Writing and following an SOP
- Anything not on this list?

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Onizuka Day Debrief

- What worked?
  - Student investment during the planning phase
  - Biotech Mentor Roles
  - Student led presentations and demonstrations
- Student Comments
  - Lab equipment demonstrations
  - Student presentations
  - Great recruiting opportunity for El Camino's Biotech program

- What improvements can we make to the Onizuka Biotech Experience for next year?
  - Timing: Ran out of time for DNA gel staining
  - Student lecture run through and PowerPoint formatting
  - Other workshops also had chromatography
- Student Suggestions
- Board next to Chem 153
  - Demo Kit (green writing)
  - Top off NaCl 10 mL more
  - Clothes pin (?) over binder clip
  - Min 4 slides per topic (?)
  - Take home everything but beakers, goggles & clips
  - Small words for the kids
  - Polaroid?

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Questions?

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Want to Try It?

We're looking for

- Faculty who want to learn and implement the system
- Courses where teamwork and process matter
- Feedback to improve the model

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How to Get Involved in a BioSCOPE Project

- InnovATEBIO Supply Chain Hub: https://hubs.innovatebio.org/supply-chain.html
- Reach out to the BioSCOPE Team:
  - Terri Quenzer - BioSCOPE events & registration info (tquenzer@miracosta.edu)
  - Ying-Tsu Loh - technical info (yingtsu@babec.org)
  - Emily Quach - technical info (equach@peralta.edu)

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Online Training Recordings

- Intro to Accessibility recording registration link & course materials: https://forms.gle/3sanpznighiyf7TX7
- Intro to UDL recording registration link & course materials: https://forms.gle/jgd4SCgBFq8QpvG8A
- BioSCOPE 101 recording registration link: https://forms.gle/gJUSyqFxdzxt72Hg7

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