Chapter Development Report

Biomedical Engineering Society at UCLA (University of California, Los Angeles)

2018-2019

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Executive Summary

UCLA's Biomedical Engineering Society (BMES) chapter was founded in 2003, and serves to bring together undergraduates, graduate students, professors, and alumni in the bioengineering field. UCLA BMES strives to ensure the success of any student interested in bioengineering. BMES activities and events are focused around six areas: academics, professional/career development, social, mentorship, community outreach, and technical projects. This year, we focused our efforts on extensive improvements to industry and professional development, community outreach, and technical projects. We debuted our first Biotech Career Fair at UCLA, and also expanded our school Science Days to include two more Title 1 schools. Also, we have more than tripled our technical projects capacity and have grown our technical projects to include three yearlong project teams and two student-led engineering courses. We are excited for this tremendous growth and are proud to present this work in the following Chapter Development Report.

Cover Letter

To the Student Chapter Award Committee Members,

In the 2018 - 2019 year, the UCLA chapter of the Biomedical Engineering Society made significant developments in the areas of industry and professional development, community outreach, and technical projects.

In January of this year, we debuted our first ever Biotech Career Fair as part of an effort to bring more bioengineering-centric job and internship opportunities to the UCLA engineering population. We recognized the lack of such opportunities in the annual UCLA Engineering and Technical Fair and collaborated intensively with student chapters of the American Institute of Chemical Engineers and the American Society of Mechanical Engineers to bring four prominent biotech companies to UCLA to recruit our engineering students.

We have also expanded the reach and capacity of our community outreach efforts. In the 2016 - 2017 academic year, we started our first school Science Day when we hosted 70 middle school students from Equitas Science Academy - a Title 1 school - for a day of interactive bioengineering activities, campus tours, and a graduate student panel. This year, we have expanded our school Science Days to accommodate two additional schools - Madison Middle School and Fairburn Elementary - and have begun a partnership with a high school youth leadership program, #LEAD.

Lastly, we have significantly grown our technical projects division into three yearlong project teams and two student-led engineering courses. When our technical projects division was first conceived in 2016, there was only one team of 20 students led by one project manager. Now, we have ten project managers teaching a combined total of 100 students. (For reference, one bioengineering graduating class size at UCLA is approximately 60 students).

For the coming 2019 - 2020 school year, we are shifting our focus to member retention of first year and transfer students and introducing more “first year”-specific events. We are also looking to continue the growth of our technical projects division and to introduce a bioengineering hack-a-thon in the near future. We are extremely proud of our growth this year and look forward to sharing our progress with you in our Chapter Development Report.

Sincerely,

Mandy Hung, Chapter President
hung.mandy.15@gmail.com

Dr. Daniel T. Kamei, Chapter Advisor
kamei@seas.ucla.edu

I. Administration Report

This year, there were 27 officers on the board of the UCLA chapter (including the executive board) and 10 committee members. There was an increase in the number of officers due to the continued expansion of the capacity and depth of our Technical Projects Division. There was also an increase in the number of committee members due to an increased effort in getting the underclassman population more deeply involved with the UCLA chapter.

Officers

President: Mandy Hung, hung.mandy.15@gmail.com

- ➢ The President is the executive administrative, presiding, and reporting officer. As chief executive, the President will supervise the chapter's affairs and activities, and he or she will be responsible for overall public relations (i.e. with other student groups, SOLE) and promotion of the chapter's activities. The President is also in charge of the Technical Projects Division. (Note: with the expansion of our technical projects program, we have added a new Executive Board position in the 2019-2020 year, Technical Projects Vice President, to preside over all technical projects affairs).

Internal Vice President: Max Zhu, mzhu2.4@gmail.com

- ➢ The Internal Vice President will serve as the chapter's chief officer in the absence of the President. His or her primary responsibility is encouraging relations between board members by planning officer retreats, and between BMES members and the Bioengineering Department through major club social events.

External Vice President: Cooper Tanquary, ctanq18@ucla.edu

- ➢ The External Vice President is responsible for heading sponsorship efforts via both the sponsorship package and sources of funding at UCLA. The External Vice President provides help and guidance for the officers, aids in function planning and execution, and is responsible for purchasing/tracking of BMES merchandise.

Management Tree

General Structure:

- ➢ Executive Board
  - ○ General Board
    - ■ Committee

Breakdown of Board Positions:

- ➢ President

- Secretary
- Historian
- Technical Projects Project Managers

➢ Internal Vice President
- Mentorship
- Social
- Publicity
  - Publicity Committee

➢ External Vice President
- Treasurer
  - Finance Committee
- Industry
  - Industry Committee
- Community Outreach
  - Community Outreach Committee

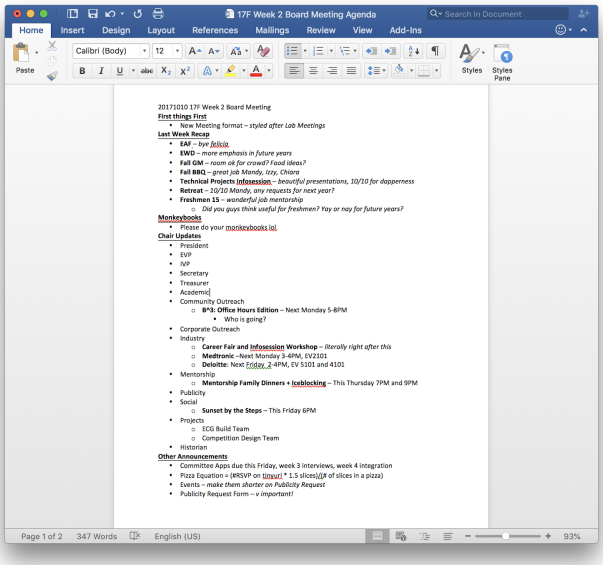
Membership

There are 277 undergraduate students in the UCLA Bioengineering department. Out of those students, 154 are active members of BMES at UCLA.

Executive and General Body Meetings

Executive Board Meetings:

➢ Once a week, led by executive board
➢ Intended for members of BMES general board and committee as a forum for planning and executing events
➢ Example meeting agenda:



General Body Meetings:

General body meetings are held during the first week of each quarter

- ➢ Fall General Meeting
  - Tuesday, 10/2/18 6 - 8 PM Attendance: 115
- ➢ Winter General Meeting
  - Tuesday, 1/8/19 6 - 8 PM Attendance: 80
- ➢ Spring General Meeting
  - Wednesday, 4/3/19 6 - 8 PM Attendance: 50

II. Treasury Report

Our chapter's finances operate through a school department account and a university bank account. The Treasurer and their Finance committee keep records of all transactions. Income sources include university funding, membership dues, and corporate donations. Our total expenditure for the year represents 87% of our total income. We intend to put this year's surplus towards expanding next year's Biotech Career Fair and our technical projects division.

Financial Summary

	Income	Expenditure	Net
Executive	$2,241.62	$670.58	$1,571.04
Community Outreach	$9,793.54	$9,793.54	$0.00
Industry	$5,554.20	$0.00	$5,554.20
Mentorship	$840.53	$1,512.00	-$671.47
Social	$5,337.35	$8,304.37	-$2,967.02
Build Team	$1,224.79	$1,224.79	$0.00
Cell Team	$1,477.24	$1,477.24	$0.00
Design Team	$419.18	$419.18	$0.00
TOTAL	$26,888.45	$23,401.70	$3,486.75

Balance Sheet

Event	Committee	Income	Expenditure	Net
Company Info Session (x5)	Industry	$400.00		$400.00
Biotech Career Fair	Industry	$1,000.00		$1,000.00
Holiday Party	Social		$938.37	-$938.37
BE Ball	Social		$200.00	-$200.00
End of Year Banquet	Social	$4,365.00	$6,400.00	-$2,035.00

Science Vendor Expo	Industry	$4,154.20		$4,154.20
Fall BBQ	Social	$259.35		$259.35
KBBQ Social	Social	$713.00	$716.00	-$3.00
Game Night	Social		$50.00	-$50.00
Broom Ball	Mentorship	$330.00	$300.00	$30.00
Freshman 15	Mentorship		$12.00	-$12.00
Fall General Meeting	Executive		$377.50	-$377.50
Winter General Meeting	Executive		$169.40	-$169.40
Spring General Meeting	Executive		$123.68	-$123.68
Koala T Fundraiser	Executive	$48.47		$48.47
Sip Fundraiser	Executive	$67.50		$67.50
CPK Fundraiser	Executive	$69.42		$69.42
Boba Banh Mi Fundraiser	Mentorship	$510.53		$510.53
Finals Care Package Fundraiser	Executive	$57.23		$57.23
Membership Dues	Executive	$1,510.00		$1,510.00
T-Shirt sales	Executive	$489.00		$489.00
Community Outreach	Community Outreach	$9,793.54	$7,823.89	$1,969.65
Build Team	Build Team	$1,224.79	$1,224.79	$0.00
Design Team	Design Team	$419.18	$419.18	$0.00
Mentorship Discretionary Fund	Mentorship		$1,200.00	-$1,200.00
Cell Team	Cell Team	$1,477.24	$1,477.24	$0.00
General Supplies	Community Outreach		$1,969.65	-$1,969.65

III. Chapter Activities

1. Industry and Professional Development Activities

Every quarter, BMES at UCLA hosts several information sessions with various biotech and medical device companies that come to recruit UCLA engineering students for jobs and internship opportunities. Many of these events are jointly held with the UCLA chapters of AIChE, ASME, and ISPE so that these opportunities can reach even more students. This year marks the debut of our first ever Biotech Career Fair, the first biotech-centric career fair of its kind at UCLA.

Event	Date and Time	Description	Attendance
Tech Trends with Deloitte	Friday, 10/5/18 2 - 4 PM	Explore new innovations in technology and technology consulting with Deloitte professionals.	51
Neural Analytics Infosession	Tuesday, 10/16/18 6 - 8 PM	Learn more about open positions at Neural Analytics for brain health management.	24
Amgen Infosession	Tuesday, 10/23/18 6 - 8 PM	Network with Amgen recruiters for internship opportunities in research and analytics.	24
BiVACOR Infosession	Tuesday, 11/13/18 6 - 8 PM	Participate in recruitment for engineering internships in the artificial heart company.	30
KGI Infosession	Tuesday, 11/13/18 6 - 8 PM	Learn more about the various graduate school pathways available in bioprocessing.	23
Azzur Infosession	Thursday, 11/15/18 6 - 8 PM	Representatives from Azzur present on careers in consulting for life sciences companies as well as recruit for internships.	15
Edwards Lifesciences Tour	Wednesday, 11/28/18 2 - 5 PM	Visit the Irvine campus to tour the site and learn about careers with Edwards Lifesciences.	8

Berkeley MEng Infosession	Thursday, 11/29/18 12 - 1 PM	Interact with admissions representatives of the Masters program at UC Berkeley and learn more about various options for pursuing a postgraduate degree	20
Biotech Career Fair	Friday, 1/25/19 11 AM - 3 PM	Host a biotech-centric career fair in which students can network with different biotechnology-focused companies for internship recruitment opportunities. Companies include BiVACOR, Nantworks, Masimo, and ZS Associates.	170
Boston Scientific Infosession	Tuesday, 2/5/19 6 - 8 PM	Learn more about the Boston Scientific program and recruit for company internships and jobs.	32
Science Vendor Expo	Thursday, 4/18/19 11 AM - 3 PM	Host biotechnology companies on campus to market laboratory and research products to various labs and research associates	210

Biotech Career Fair

The UCLA chapter's Biotech Career Fair began out of a need for a career fair that is bioengineering-centric for students who plan on pursuing an industry career in bioengineering. Our experience in the past three years of attending the annual UCLA Engineering and Technical Fair was that biotech companies were rarely present - we would count it very fortuitous if two biotech companies showed up. Compared to other engineering majors who had tens of other companies to choose from, attending the UCLA Technical Fair as a bioengineering major was usually not fruitful. Thus, we decided to host our own career fair with prominent biotech companies to facilitate obtaining industry opportunities in bioengineering.

We initiated collaborations with student chapters of the American Institute of Chemical Engineers and the American Society of Mechanical Engineers to secure a venue, obtain campus funding, recruit biotech companies, and advertise our career fair to the UCLA student population. On January 25th, 2019, our first ever Biotech Career Fair debuted in the Ackerman

Grand Ballroom, which is the same venue that hosts UCLA's Engineering and Technical Fair. We had four prominent biotech companies - BiVACOR, Nantworks, Masimo, and ZS Associates - and over 150 engineering students in attendance. Feedback from the companies who attended was very positive, and we are looking to expand our Biotech Career Fair to have even more companies in the following year.

2. Social Activities

We aim to have many social events every quarter to encourage bonding and networking within the bioengineering department. Our larger events allow students to interact with graduate students and faculty on a more casual level, and our smaller events allow students to bond with each other in a fun and friendly setting.

Event	Date and Time	Description	Attendance
Board Retreat	Saturday - Sunday 10/6/18 - 10/7/18	Provide time for leadership activities and team bonding of board members	35
Fall Barbecue	Tuesday, 10/16/18 5 - 8 PM	Gather to play games, eat food, and get to know new students at the start of the school year	100
KBBQ Social	Friday, 11/2/18 7 - 9 PM	Venture to Koreatown to enjoy delicious food and converse with fellow members	31
Holiday Party	Monday, 11/26/18 6 - 9 PM	Gather at the end of Fall to celebrate a successful quarter, eat food, and continue to build community	80
BE Ball	Friday, 2/8/19 6 - 9 PM	Dress up, dance and celebrate friendship through a prom-like event	75
Game Night	Friday, 3/1/19 7 - 9 PM	Destress after midterms by playing board games and video games with fellow members	20
Broomball	Friday, 5/10/19 9 - 11 PM	Enjoy friendly competition and community building through a	40

		team sport event called broomball (essentially hockey with normal shoes)	

3. Inter-Chapter Activities

This year we had our first inter-chapter collaboration with USC's ASBME chapter. It was a very fun and rewarding event and we hope that this marks the start of continued collaboration between our two chapters.

Event	Date and Time	Description	Attendance
UCLA x USC Beach Volleyball	Saturday, 3/6/2019 11 AM - 3 PM	Commute to Venice Beach to play volleyball and form friendships with USC's ASBME	10

4. Outreach Activities

This year, we mentored middle and high school students on their projects for the Los Angeles County Science Fair as part of our school science fair program. In addition, we hosted students from two different Title I schools and a youth leadership program for three interactive days of tours, immersive bioengineering-centered activities, and a graduate student panel at UCLA.

Event	Date and Time	Description	Attendance
Beverly Vista Science Fair	Tuesday, 1/22/19 6 - 8 PM	Counsel high school students competing in annual science fair	15
Madison Science Day	Wednesday, 2/6/19 10 AM - 2 PM	Host Title I middle school on campus for tour and bioengineering-centric activities	137
Kid's Day	Tuesday, 4/9/19 8 AM - 12 PM	Collaborate with ESUC to host hands-on demonstration for elementary students	120
#LEAD Visit	Thursday, 4/25/19	Host the #LEAD youth	90

	10 AM - 1 PM	leadership program on campus for tour and student panel	
Fairburn Science Day	Wednesday, 2/29/19 10 AM - 2 PM	Host a Title I elementary school for immersive bioengineering activities and campus tour	60

School Science Days

In 2016, we brought 70 middle school students from Equitas Science Academy - a Title 1 school in which 92% of students are on free or reduced lunch and 84% are English learners - to UCLA for a day of interactive bioengineering activities, campus tours, and a graduate student panel. This outreach event, Equitas Science Day, marked the start of our school Science Day series. The following year (2017), we hosted 90 students from Equitas again and were able to obtain enough campus funding to cover a majority of the school's travel expenses. This year, we have expanded our school Science Days to accommodate two additional Title 1 schools, Madison Middle School and Fairburn Elementary. With great effort on behalf of our community outreach and finance committees, we able to completely cover the expenses for both Madison Science Day and Fairburn Science Day. We have received much positive feedback from the schools and it was extremely rewarding to be able to bring these students to UCLA and teach them about bioengineering. Educational and charitable outreach has always been a cause that is dear to our hearts, and we will always strive to increase the reach and quality of our efforts.

Partnership with #LEAD

This year, we began a partnership with the #LEAD youth leadership program. #LEAD is a program that prepares high school students from Tulare County for leadership by giving them the opportunity to engage with local professionals, participate in service learning community projects and visit college campuses. In April we hosted 80 high school students and 10 chaperones from #LEAD at UCLA. Students participated in presentations about applying to college and about bioengineering, a meet and greet with bioengineering undergrad and grad students, and a tour of the UCLA campus. The presentations and activities were received extremely well by both the students and chaperones, and we were told by the organizers of the program that the students had very rewarding experiences interacting with the UCLA bioengineering students. This partnership is one of our first efforts in serving high school communities, as our previous outreach endeavors were mostly for elementary and middle school students. We hope to continue this partnership with #LEAD in the following years and also expand our efforts in serving high school populations.

5. Mentoring Activities

Mentorship has always been a crucial part of BMES at UCLA. Our tight-knit mentorship family system breaks down the club into smaller families to allow members to bond more and provide more one-on-one mentoring to underclassmen. We also put on a variety of academic advising events such as medical and graduate school panels as well as class planning dinners.

Event	Date and Time	Description	Attendance
Freshman 15	Tuesday, 10/9/18 6 - 8 PM	Give 15 pieces of advice to first years regarding self-care, academics, and student life	40
Medical School Infosession	Tuesday, 10/30/18 6 - 8 PM	A panel of faculty, med school students, and students currently applying to medical school offer advice and answer questions	15
Class Planning Dinner	Wednesday, 10/31/18 6 - 8 PM	Help underclassmen plan classes by attending dinner at a dining hall on the Hill	35
Mentorship House Cup Games	Saturday, 12/1/18 2 - 4 PM	A friendly competition among mentorship families through activities and games to win points towards a grand ‘house cup’ prize	35
Study Table	Wednesday, 3/6/19 5 - 8 PM	Study for upper division classes with transfer students and other upperclassmen	38
Research Mixer	Thursday, 3/7/19 6 - 8 PM	Provide a space for undergraduates to network with graduate students and secure positions in labs	45
Graduate School Infosession	Thursday, 5/23/19 6 - 8 PM	A panel of faculty, graduate students, and seniors who have already applied to grad school offer advice and answer questions	18

6. Other Initiatives and Activities

In addition to general body meetings in which members network and learn about upcoming events, the UCLA chapter also conducts fundraisers in the local community to raise money for our various programs. All proceeds go directly back to the students and to the department.

Event	Date and Time	Description	Attendance
Engineering Welcome Day	Wednesday, 9/26/18 10 AM - 1 PM	Collaborate with the School of Engineering to welcome incoming freshmen engineering students	150+
Fall General Meeting	Tuesday, 10/2/18 6 PM - 8 PM	Provide overview of events for Fall Quarter and network with general members	115
Technical Projects Infosession	Thursday, 10/4/18 6 PM - 8 PM	Introduce the technical project teams for the year and release applications	75
Koala T Fundraiser	Thursday, 12/6/18 11:30 AM - 9 PM	Fundraise for BMES at Koala T restaurant	30
Winter General Meeting	Tuesday, 1/8/19 6 - 8 PM	Provide overview of events for Winter Quarter and network with general members	80
Sip Fundraiser	Thursday, 3/7/19 12 PM - 10 PM	Fundraise for BMES at Sip Matcha tea shop	47
Spring General Meeting	Wednesday, 4/3/19 6 - 8 PM	Provide overview of events for Spring Quarter and network with general members	50
CPK Fundraiser	Thursday, 4/4/19 11 AM - 9:30 PM	Fundraise for BMES at California Pizza Kitchen restaurant	15
Boba x Banh Mi Fundraiser	Tuesday, 4/30/19 11 AM - 2 PM	Fundraise for BMES by selling milk tea and banh mi on campus	200+
Cake Pops Fundraiser	Thursday, 5/2/19 8 AM - 2 PM	Fundraise to donate profits to Relay for Life by selling	80+

		homemade cake pops on campus	

Technical Projects Division

We observed that most bioengineering majors usually had plenty of experience working in research labs, but lacked relevant engineering skills when applying for internships and jobs. Additionally, most students did not get hands-on experience building a medical device until their 4th year Capstone design project. Thus, we began our technical projects division to provide students with opportunities to learn more technical skills and gain hands-on experience.

The Electrocardiogram (ECG) Build Team started in 2016 with 20 students and was led by one project manager. It was a year-long beginner project where 1st and 2nd year students learn basic coding, circuits, and Arduino skills through building an Arduino-based ECG in smaller teams. The following year (2017), with support from our department, we were able to increase membership to 30 students.

Additionally, after the success of our first technical project team, we decided to open up a more advanced team. The Competition Design Team was started in 2017 with 8 members. This intermediate –advanced team was set up to submit a different original project to national bioengineering competitions every year, depending on the team's area of focus. The team elected to work on developing a brace sensor to aid in musculoskeletal recovery, and submitted their project to the NIH DEBUT competition.

This year, we have restructured our technical projects division to have three yearlong project teams and two student-taught engineering courses. As of September of 2018, our technical projects division is led by ten project managers and consists of 100 students from all engineering disciplines. (For reference, the average bioengineering graduating class at UCLA is about 60 people). The breakdown of students in this year's technical projects is below:

- ➢ Yearlong project teams
    - Pulse Oximeter Build Team: 26
    - Design Team: 21
    - Introduction to Cell Research Team: 11
- ➢ Student-taught engineering courses
    - Electrocardiogram: 22
    - Introduction to 3D Pharming: 20

This year's project teams and classes are a restructuring of our previous Build and Competition Design Teams. We have adapted the ECG Build Team into the ECG student-taught engineering course. We also have expanded our Competition Design Team into a Design Team program consisting of five separate design teams, each pursuing a bioengineering-related build project. Examples of current Design Team projects include a 3D-printed pill dispenser and an automated cell washer. The Pulse Oximeter Build Team is a yearlong project similar to the ECG Build Team in which students learn how to build and customize a pulse oximeter from scratch. Our third yearlong team is the Intro to Cell Research Team, in which students are taught a rigorous curriculum of cell research techniques with the end goal of placement into a research lab. Lastly, our second student-taught engineering course is Intro to 3D Pharming, in which we instruct students in the basics of designing and 3D printing pills for drug encapsulation to use in personalized medicine.

IV. Future Directions

For the upcoming school year, immediate goals include increasing the breadth of events we host through encouraging more cross-board collaborations (i.e. between Mentorship and Community Outreach) as well as increasing retention of first years and transfers by providing events and spaces for these students to find a home within our organization. In terms of cross-board collaboration, planning and execution of events can be made more thorough and unique if multiple officers can work as a team to put on events and utilize each of their specialties. We also recognize the highly unique and at times difficult experience that transfers have upon entering UCLA. In order to target these students and ensure that they feel welcome in our organization, we would like to have more "First-Year" specific events at the start of the quarter that would be inclusive of freshmen and transfers alike.

A longer term goal is to offer more opportunities for engagement in the scope of our Technical Projects. An event we would like to see happen in the next year or two would be a bioengineering version of a Hack-a-Thon. The premise of the event is that teams of 4 or 5 are given a goal for a medical device and are then given 30 hours to brainstorm, design, CAD and print a device under the given parameters and then present their work. Since we have had such an enormous interest from our members in technical projects, this could provide BMES members, as well as any student in the engineering school or otherwise who is interested in medical devices, a chance to compete in a collaborative, yet competitive, environment. We could collaborate with the UCLA Makerspace for CAD classes, 3D printing workshops, and Arduino workshops during the event. We can utilize our industry sponsorship packet to secure funding for supplies and food for the event, as well as industry mentors who design the prompt for the build, provide advice for teams and judge the event. The EVP will secure sponsors and funding, the new Technical Projects VP will partner with the UCLA Makerspace for coordination of workshops and use of equipment, and the President will work with the department to establish the event and contact other engineering clubs.

V. Application for the Outstanding Outreach Award

Appendices for Program 1 were also submitted as supplementary files.

Table of Contents

Program 1: Science Day Series

Program Description

In previous years, we hosted an annual science day for 70-90 sixth graders from Equitas Science Academy #2, a Title I school located in an underserved area in downtown Los Angeles where 92% of students are on free/reduced lunch and 84% are English learners. During these events, we would incorporate both undergraduate and graduate students to conduct various hands-on science activities, coupled with a campus tour. We are proud to host this event to hopefully instill a passion for STEM-related concepts and to encourage the option of seeking higher education, especially for demographics typically underrepresented in engineering. This year, we aimed to expand to working with more community partners. In doing so, we hosted 2 science days with new community partners: one event with 90 eighth grade students from Madison Middle School, a Title I middle school where 94% of students are on free/reduced lunch, and another with Fairburn Elementary School, a local elementary school of the Los Angeles Unified School District. With help from our campus advisor, we were able to secure funding to cover the costs of transportation, supplies, and lunch for our visiting attendees, which was a major accomplishment for us and the partnered schools.

Goals

To expose young students to STEM-related concepts and foster a correlation between scientific concepts and everyday life. We recruited a diverse group of graduate and undergraduate students to help volunteer at these events, in hopes that young students will be encouraged to seek higher education or areas in STEM by seeing people who mirror their own experiences and backgrounds.

Target Audience

Elementary and Middle School students from underrepresented backgrounds

Chapter Participation

We had around 40-50 undergraduate and graduate students at both events. We partnered with the Campus Tours staff from the Admissions Office of UCLA to help give campus tours and the UCLA Planetarium to schedule showings of the solar system.

Methods

We got in contact with Madison Middle through a chapter member that had a relative working at the school. With Fairburn Elementary, they reached out to our chapter indicating that they would be interested in hosting us to conduct hands-on activities at their school.

Since our previous years of hosting Equitas Science Day were successful, we decided to set up a similar program for both schools. We applied for funding through various campus organizations, including Student Organizations, Leadership, and Engagement (SOLE) and Undergraduate Student Association Council (USAC) to help cover the costs of transportation, supplies, and lunch. We were especially adamant securing funding for lunch with students of Madison Middle, since such a high population of the student body are on free/reduced lunch. Since funding applications take a couple of weeks or months to get processed, we often had to apply for funding the quarter before the event took place.

After applying and securing funding, we booked school buses for the students and placed Subway catering orders for boxed lunches. Additionally, we went out to by supplies for the planned activities and scheduled the Planetarium showings.

Next, we reached out to chapter members to help volunteer at the different activities. We aimed to recruit enough volunteers to have around 5-7 members in each activity rotation. To facilitate this, we split both Madison Middle and Fairburn Elementary students into 3 groups. Madison Middle comprised of 3 groups of 30, while Fairburn Elementary comprised of 3 groups of 20. For Madison, these groups were then placed on a rotational schedule of 45-minute activities, which included a Planetarium Showing, Strawberry DNA Extraction, and a Campus Tour. Likewise, with Fairburn, the kids were placed a similar rotational schedule with an Edible DNA activity, an Edible Boba Gel activity, and a Campus Tour.

Then, we outreached to the Bioengineering Graduate Association (BGA) to recruit graduate students who are interested helping out with our activities/interested in designing an activity for students to interact with. The Edible Boba Gel activity this year was staffed and designed by the bioengineering graduate students, which the students enjoyed a lot since they were able to observe the immediate encapsulation of the alginate gel.

Lastly, we booked the rooms for all the events to take place in.

Future of Program

For next year, we would love to further increase the amount of students we can host from each school, as well as finding other Title I community partners. We will continue to apply to funding to cover the costs of food, transportation, and supplies to encourage more students to come out without financial burden.

We are looking into expanding into a new science fair program with Madison Middle School where we will conduct on-site visits at Madison to mentor students on their own science fair idea. We aim to cover all costs of their experiments and to host them at UCLA for a

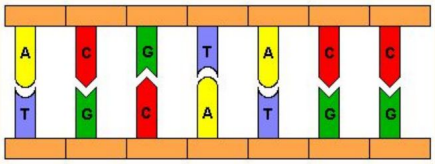
mini-symposium at the end of the year for students to share the culmination of their efforts. If the event is successful, we may help cover the costs of submitting their projects to the Los Angeles County Science and Engineering Fair the following school year. This year we had already looked into and planned for a similar year-long program to take place with a local high school, but due to eventual lack of communication from our partner, we were unable to continue this. However, we will use our previous plans from this planned program to scale down for a middle school application for the next school year.

Appendix A: Edible DNA Presentation (for Third Grade Students)

DNA Molecule

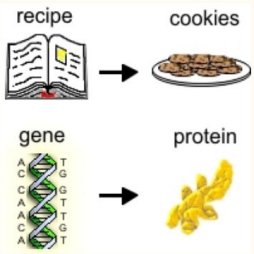
UCLA Biomedical Engineering Society

What is DNA?



What is DNA?

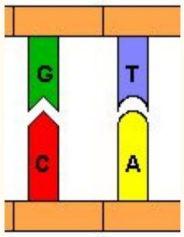
RECIPE for all living things



Base Pairing

A's and T's pair together

C's and G's pair together



DNA is a Molecule

Base Pairing Activity

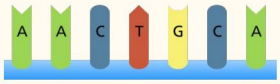
With your group, try to come up with the complementary sequence for the following pattern

A - Pink

T - Green

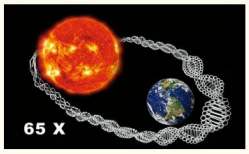
C - Orange

G - Yellow

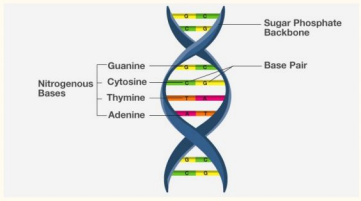


Interesting Fact

If you unraveled all the DNA molecules in your body and placed them end to end, it would stretch to the Sun and back 65 times.



DNA Structure



Edible DNA- Make Your Molecule

Connect toothpicks to licorice.

Try to fit as many as you can **without breaking** the licorice

Try to make it helical

A - Pink

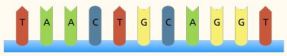
T - Green

C - Orange

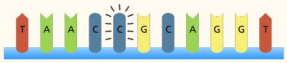
G - Yellow

Mutations

Original sequence



Point mutation



Strawberry DNA Extraction

Objectives:

(1) Understand basics of DNA structure and function (Central Dogma of Biology: DNA => RNA => Protein)
(2) Introduce students to basic lab techniques (substrate/solvent, extraction)
(3) Connect DNA technology to current exciting research areas/technologies in bioengineering

Icebreaker:

* Both mentors and mentees answer the questions. Be Creative! * (more questions at the end!)

(1) Names
(2) Where are you from/places you both have lived (especially for BE students)
(3) What is your favorite school subject and why?
(4) What are your favorite hobbies/sports/activities?

Materials (per student)

Material	Amount
plastic ziploc bag	1
strawberries	2
dish detergent	10 mL (2 tsp)
salt	1.2 g (1/4 tsp)
water	90 mL
plastic cups	2
coffee filter	1
90% rubbing alcohol (ethanol or isopropyl)	5 mL
stirrer	1

Procedure:

Note: Guided concepts/observations are in blue and special notes/warnings are in red)

(1) Remove all leaves off of strawberry
(2) Seal strawberry in a plastic bag and mash it completely

-breaks open cells, releases DNA

-strawberries contain pectinase (breaks down cell walls)

(3) In plastic cup: mix detergent, salt, water
-this is your DNA extraction solution
(4) Pour the extraction solution into the bag with your strawberry
-detergent dissolves phospholipid bilayers of the cells/organelles

-salt breaks up protein chains (histones) binding the nucleic acids
-Na^+ neutralizes negatively charged DNA, prevents binding to positively charge histone
- water serves as a medium for reaction to occur in
(5) Reseal the bag and continue mashing for another minute
- *avoid making too many bubbles*
(6) Place coffee filter in new plastic cup
(7) Pour the strawberry + extraction solution mixture into the filter slowly in small increments
- *physically filters out the excess strawberry cells/tissue (caught in the filter)*
- *filtrate contains DNA and extraction solution*
(8) Remove filter paper and pour ICE COLD rubbing alcohol into the strawberry mix
- *pour along the walls of the cup*
- *do not mix or stir!*
- *DNA is insoluble in ethanol (because ethanol is less polar, while DNA is negative)*
- *DNA will precipitate out of the ethanol (clump together)*
- *the colder the ethanol, the less soluble DNA will be => we will extract DNA!*
(9) Observe DNA layer form between strawberry extract and ethanol layers
-What does it look like? It will be white and cloudy
(10) Pick up the DNA using the stirrer
-play with it

- DON'T EAT IT or any part of the strawberries!!! (Emphasize safety in science)

Ideas for things to talk about with mentees:

- **During experiment:**
  - ✔ When you eat your food, do you normally think about what it is made of? Why is this important for your health?
  - ✔ Everything is comprised of atoms => we are made of atoms. How is that constructed? Atoms => Molecules => Amino Acids => Polypeptide backbone => α-helices/ β-sheets => Tertiary Structure => Quaternary Structure => Protein => Cells => Tissue => Organs => People
  - ✔ Why is it important that we can extract DNA? (or other materials) => allows us to analyze one thing (experimentally control) => research genetic material (discuss applications)
- **For fun:**
  - ✔ What is your favorite sport?
  - ✔ What is your favorite food?
  - ✔ What do you (as a BE) do as an engineer in your classes/labs?
  - ✔ What is your favorite type of science? (Emphasize how they all connect) ✔ What are you working on in your science/math classes now?

- ✔ What are you interested in doing when you grow up?
- ✔ What are you planning on doing in high school to prepare for what you want to do in college/career? (seems serious, but I was asked this in 8th grade and it always stuck with me)
- ✔ The healthcare industry is one of the largest in the U.S. now. There are many ways to get involved: nursing, doctor/med, bioengineer, managerial, pharmacist, researcher, biologist, hospital, physical trainer, biochemist, insurance, etc.

Appendix C: UCLA South Campus Tour (both Science Days)

South Campus Tours Script

Pick up: MS Breezeway
Start Tour: Bruin Plaza
End Tour: EV 3rd Floor Entrance

Introduction (Bruin Plaza) ● Welcome to campus ● Introduce yourself (name, major, hometown, campus involvement, preferred pronouns--optional) ● Remind guests that no recording is allowed during tour ● Allow for visitors to introduce themselves (name, what they want to be when they grow up) ● Ask guests to let you know if you're about to run into something while walking backward ● Provide a general sense of the tour (including that it will last about 45 minutes), remind them to ask questions at any time, etc.	Ice breaker questions (some guides ask for two responses): ● Favorite soup ● Favorite netflix show ● If you're a sandwich, what type of sandwich would you be? ● New favorite song
Bruin Walk ● Main walkway of campus ● Divides UCLA ○ One half is residence → "The Hill" and apartments ○ One half is academics ● Clubs recruit students, solicitors give out free movie passes, activists try to get students to sign petitions, and various other who hope for a moment of students' time ● Best way to make a big school feel small	● Mention BMES!
Janss Steps ● Is the original 87-step entrance to the university. ● The base of Janss Steps was once a popular spot for public speeches. Dr. Martin Luther King Jr. spoke to an audience of 4,500 students, faculty and staff here in 1965 and	

stated that "If democracy is to live, segregation must die."	
Royce Quad ● has been in many movies including: Legally Blonde, Old School, Nutty Professor, First Daughter, Bring it On Again, and Angels and Demons. ● It has also starred in television shows such as Modern Family, How I Met Your Mother, Buffy the Vampire Slayer, Heroes, and the remake of 90210.	● These next four buildings comprise the original quad and oldest four buildings at UCLA. The land for ● UCLA's current site in Westwood was purchased in 1925, construction on the campus began in 1927, and the four buildings were completed in 1929 in time for the Westwood campus to be opened to classes on ● Sept. 23, with 5,500 students enrolled. ← INSERT ANECDOTE ● Stuff that you have seen performed or presented in Royce
Royce Hall (1928) ● is the "landmark" of UCLA and was named for Josiah Royce ● Royce is modeled after the San Ambrogio church in Milan, Italy. ● Royce auditorium (has 1800 seats) is currently home to UCLA Center for the Art of Performance ○ UCLA "CAP" promotes an aesthetic of fusion and diversity—in which concert hall divas, world-class chamber orchestras and hip-hop dancers share the season—and sometimes the stage—with post-modern dancers, world music superstars, contemporary storytellers, and rock 'n' roll mavericks. **Royce Hall Architecture Story** ● Royce Hall was modeled after the San Ambrogio church in Milan, Italy ● Built by a very religious man who believed that nothing was perfect except for God himself ● As a result, built 52 imperfections into Royce Hall on purpose ● One year, an architecture professor brought his class out to Royce Quad for their final exam, and asked them to identify all 52	● Past guests include: Eleanor Roosevelt, Frank Sinatra, Louis Armstrong, the Gershwin brothers, Ella Fitzgerald, Duke Ellington, The New York Philharmonic ● Past speakers include Elie Wiesel, Robin Williams, Whoopi Goldberg, Oprah Winfrey, and Morgan Freeman. ● For the Royce Architecture Story, we actually don't know which one is taller, but we do know that one IS taller!

imperfections over the course of the 3 hour exam period ● The class worked together and managed to identify 51 imperfections, but could not find the last one no matter how hard they tried ● The professor told them the last imperfection, which is that 1 of the 2 towers is one brick layer higher than the other. ● At this point, have groups guess which tower is taller by dividing them on either side of you	
Powell Library (1928) ● is also known as the College Library. ● College Library has a collection of over 200,000 books. ● Powell Library was the first building constructed on the Westwood campus and is the main library ● Powell is open 24 hours a day Monday-Thursday throughout the quarter. ● Its ceiling was renovated at a cost of $6 million and is built in the Spanish Renaissance architectural style.	● Ask kids to guess how many books are in Powell ● Fahrenheit 451 by Ray Bradbury was written in the basement of Powell using a rented typewriter over the course of nine days for only $9.80
Moore Hall (1930) Also houses Moore 100 ○ Largest lecture hall ○ 442 seats (October 2018)	● Ask kids to guess how many seats are in Moore 100
Transition to South Campus Explain the quarter system ● Semester systems are super long (15-16 weeks) vs. 10 weeks (yay) ● Pros: O Breaks = breaks: no homework or preparation for exams O Explore more academically than you would be able to at a semester school (a lot easier to take a risk with classes - less commitment) -- also really great for	Potential joke when passing the vending machines: “These are also on the quarter system!”

undeclared people who don't know what they want to take -- can double major/minor and explore ● Distinguish North Campus and South Campus but emphasize all one campus O Divided for convenience	
First internet connection story ● The very first "internet" (formerly ARPANET) connection was sent from UCLA to the Stanford Research Institute on Oct 29, 1969 ○ UCLA built a supercomputer in the basement of Boelter Hall, and SRI built a supercomputer up in Palo Alto - they decided to send the first message from computer to computer via the ARPANET ■ Sent from room 3420 in Boelter Hall (the same furniture and coding is still in the room!) ○ The message was intended to be "LOGIN," but only one letter could be sent at a time ■ UCLA sent the "L" to SRI, then SRI sent the "O" to UCLA... UCLA then sent the "G" to SRI, but Stanford's computer crashed! ● UCLA was the first to invent the internet, Stanford was the first to crash the internet	
Henry Samueli School of Engineering and Applied Science (a part of Boelter Hall) - In the Henry Samueli School of Engineering and Applied Science there are 10 majors to choose from (excluding Undeclared): ● Aerospace ● Bioengineering ● Chemical ● Civil	● Plug why you chose Bioengineering

● Computer Engineering ● Computer Science ● Computer Science and Engineering ● Electrical ● Materials ● Mechanical	
Transition to Inverted Fountain ● Most popular major for incoming freshmen is Undeclared (most students change major 2-3 times during college career); personal experiences ● Business Economics is the most popular major for incoming transfer students (then it's political science, psychology and sociology) ● **Most popular UCLA majors as or 2017-2018:** ○ 1. Biology ○ 2. Political Science ○ 3. Psychology ○ 4. Business Economics	● Ask about their favorite class in school, tie it into a major
Inverted Fountain (stop) ● Built in 1968, 12-foot wide and five-foot deep crater in the center ● The Inverted Fountain was designed functionally: the surrounding buildings form a wind tunnel, so if the water were to flow up and out like a normal fountain, water would spray everywhere ● Tradition of "Bruintism" ○ During summer orientation before their first year, new students come to the fountain to be "Bruintized" ○ Students will lie flat on their stomachs on the brick, put their left hand in the water, and raise their right hand up. They will then recite an oath in which they swear to uphold the "True Bruin Values" (honor, dignity, respect, "bleeding blue and gold" for the rest of their days, etc). ○ Once they take their hands out of the water,	● Insert anecdote about Bruintism/Inverted Fountain ● Seniors jumping into fountain to celebrate

they cannot touch the water again until they take their last final as a UCLA senior ○ If they touch the water before this, they are cursed to stay an extra quarter at UCLA ○ Fun way to commemorate the academic and extracurricular accomplishments of our UCLA students - a tradition you (the prospective students) can hopefully be a part of one day!	

Program 2: Bioengineering Big Buddies (B^3)

Program Description

Our year-long community outreach program is called B^3 (“B-Cubed”), Bioengineering Big Buddies. This program involves visiting Beverly Vista Elementary and Hawthorne schools four times a quarter to conduct science projects with students. These science projects are aimed to introduce science concepts used in biotechnology through interactive, design-based experiments that encourage participants to think critically. Examples of these projects include Strawberry DNA extraction, Balloon Catheter modeling, Smartphone microscopes, Prosthetic Arm modeling, and Heart Valve modeling.

This year, the B^3 program has continued to expand within the Los Angeles Unified School District; BMES mentors were individually paired with students throughout the district participating in the Los Angeles County Science Fair. At Office Hour events, these middle and high school students met our mentors to improve their science fair presentation and learn more about the scientific method.

Goals

To inspire an interest in careers in science, math, engineering, and technology in traditionally underrepresented populations through hands-on activities to engage students.

Target Audience

Elementary, Middle, and High School Students from the Los Angeles Unified School District

Chapter Participation

About 10 volunteers attend each site visit, which take place 4 times per quarter for a total of 12 events per year.

About 15 volunteers attend Science Fair Office Hours, which was hosted twice this year.

Methods

Events are scheduled with our community partner during the summer for the Fall Quarter events, and then at the beginning of every quarter thereafter. Worksheets for both volunteers and participants are developed in accordance to the selected topic for each B^3 event. Time should be allowed for purchase of experiment materials and initial prototyping to ensure functionality of the project. Volunteers that sign up to attend each site visit are then debriefed on the chosen activity prior to departure for site, and an interactive powerpoint presentation is given to the students at the site before beginning the hands-on science activity. This presentation should include questions poised to the students to engage them and increase interest. Each site visit lasts

approximately one hour, with ten minutes allotted for an informative presentation about a science concept and its relevance to UCLA, forty-five minutes allotted for time to work on the project with the assistance of volunteers, and five minutes to reflect and reinforce the concepts taught with the students prior to dismissal.

For Office Hours sessions, volunteers are trained at a training session on the requirements of the Science Fair competition, including the grading scheme and expectations of the event. Volunteers review the steps of the Scientific Method and are given worksheets with constructive techniques to use with students to effectively guide students into designing their project with volunteers just telling students the solution to improving their project. On the day of the event, volunteers travel to the site are are seated in separate "offices," where students who have registered for the event are directed for fifteen minute appointments. One important aspect is to emphasize that parents should be separated from this meeting to focus on facilitating mentor-mentee discussion to ensure a valuable learning experience for the science fair participants.

Future of Program

We are hoping to expand this program next year to include high school participants. More specifically, we hope to foster a partnership with a Title I high school with an underdeveloped STEM program and provide events to expose students to advanced science concepts with hands-on demonstrations and opportunities to practice. We also hope to expand the Office Hours program into a more developed Science Fair program that will allow BMES volunteers to mentor students throughout the year as they prepare for submission to the science fair rather than only meeting once or twice to receive critical feedback.

Additionally, Community Outreach aims to collaborate with other divisions of BMES, specifically the Technical Projects division. The Technical Projects division of the club focuses on building cost-effective medical devices, including electrocardiograms and pulse oximeters. We hope to include Tech Days to the events list, during which members of the Technical Projects teams can visit site and show students the devices they have built and have in-house demonstrations of the heart rates that are measured and how it can be applied in a setting as simple as a classroom.

Smartphone Microscope Procedure

Objectives:

(1) Understand the basics of microscopy
(2) Learn common applications of microscopy
(3) Connect ideas in this activity to the real world and medicine

Materials (per 2 students)

Material	Amount
focus lens	1
7”x7” plywood board	1
3”x7” Plexiglas	1
7”x7” Plexiglas	1
wingnut	2
nut	9
washer	5
bolt	3
smartphone	1
bobby pin	1
tape	shared with table
specimen	varies

Procedure

(1) Insert bolts into the holes of the 7” x7” plywood board.
(2) Place one washer and nut on each of the bolts.
-The washer should be below the nut.
-The nuts should be twisted down the thread of the bolt.
(3) Place the wingnuts and a washer on each of the front two bolts.
-Place the wingnut about ⅓ to ½ down the thread of the bolt.
-The washer should be above the wingnut.
(4) Place the 3”x7” Plexiglas onto the two front bolts. Add a nut to all three bolts. Leave some space between the specimen stage and the nuts.
-The three nuts should be level, as the camera stage (7”x7” Plexiglas) will rest on these nuts.
(5) Place the lens into the center hole of the camera stage.
-Before embedding the lens, check which side will magnify objects. An easy way to do this is to place the lens against the camera of your phone and focus on an object.
-Ensure the students handle the lens very carefully. The lenses are easy to destroy, damage, and lose.
(6) Place the camera stage onto the bolts. Secure the stage by fastening the last three nuts onto the bolts.

-Before securing the camera stage, ensure that is is level. Adjust the nuts under the camera stage as necessary.

(7) Align the smartphone camera with the lens and place a specimen onto the specimen stage.

Ideas for things to talk about with mentees:

- **During experiment:**
  - Why do you think it is beneficial for us to be able to magnify small objects?
  - What are some applications for microscopes you can think of in science or medicine?
  - What kind of microscopes do you know (compound, confocal, scanning electron)? Do you know how they work?
- **For fun:**
  - What is your favorite sport?
  - What is your favorite food?
  - What do you (as a BE) do as an engineer in your classes/labs?
  - What is your favorite type of science? (Emphasize how they all connect)
  - What are you working on in your science/math classes now?
  - What are you interested in doing when you grow up?
  - What are you planning on doing in high school to prepare for what you want to do in college/career?
  - The healthcare industry is one of the largest in the U.S. now. There are many ways to get involved: nursing, doctor/med, bioengineer, managerial, pharmacist, researcher, biologist, hospital, physical trainer, biochemist, insurance, etc.

Appendix E: Biomechanical Prosthetic Procedure

Biomechanical Hand (via RIT—Rochester Institute of Technology)

Objectives:

(1) Understand how prosthetics can improve quality of life
(2) Have students solve an engineering problem (designing own prosthetic)
(3) Describe how the output from one part of the system can be the input to other parts

Vocabulary:

(1) Prosthesis (noun) or prosthetic (adjective)

Materials (per student)

Material	Amount
Small cardboard rectangles	9 (3 per finger)
Rubber Bands	3 bands, cut
Masking Tape	share w/ table
String	3 lengths
Large cardboard piece	1 piece
Plastic straws	12 (4 per finger)

Procedure:
Please note that smaller pieces of tape work better than bigger ones!

(1) Lay three small pieces of cardboard next to each other (long way, connected like a finger)
(2) Tape the three pieces of cardboard together along the middle, and label this side "Inside"
-make sure the three pieces are connected side by side without gaps in between – this is the prosthetic finger
-the cardboard acts like the finger bones
(3) Turn the finger so that the "Inside" is facing down (so the tape is not showing). Then take a rubber band and line it up along the middle of the finger
-have the rubber band contact all 3 pieces, and have some of the rubber band hanging off one end
-this band acts similarly to how a finger muscle would work
(4) Tape the rubber band (NOT stretched) along the middle of each piece of cardboard piece. Leave one rubber band end hanging freely off the edge of the cardboard. BE SURE NOT TO PUT ANY TAPE OVER THE JOINTS ON THE RUBBER BAND SIDE. The rubber band should be taped on the middle of each small cardboard piece.
-be sure to tape the rubber band tightly, so it is unable to slip through the tape
(5) Test the effectiveness of rubber band – bend the finger away from the rubber band and make sure it bounces back to straight. If it doesn't, re-tape the rubber band, this time stretching it slightly before taping.
(6) Make 2 more fingers, following steps (1) – (5), if time permits
(7) Taking the inside edge of a finger (on the end where the rubber band is hanging off), tape the edge of the cardboard to the large piece of cardboard (the hand). Do this for all 3 fingers.
-the "inside" label should be facing the palm, and the rubber band should be on the back of the finger (the side facing the table/away from the palm)

(8) Turn the hand over and tape the loose end of the rubber band to the hand. Do this for all 3 fingers.

-make sure this connection is tight – mention the importance of detail and durability/effectiveness in engineering

(9) Tape an end of string onto the tip of each finger on the side opposite of the rubber band. MAKE SURE THAT THE TAPE IS AT THE VERY TOP OF THE FINGER AND IS ONLY TAPED DOWN WITH A SMALL PIECE OF TAPE.

-the string will eventually curl the finger forward and the rubber band should make it bounce back to straight

(10) Thread 4 pieces of straw onto each string, and position the first 3 in the middle of each finger section. Position the 4th straw on the palm.

-the string functions as the muscle pulling the finger forward

(11) Tape down all of the straws in the correct positions. Make sure the tape does not touch the string.

(12) Operate the hand by pulling on the strings!

-you should be pulling the string to bend the fingers toward the palm, and letting it go for the rubber band to pull them back to straight.

-play with it! Understand + appreciate how it works

-Mention why it's important to have good prosthetics that don't break (for the patient's sake and yours as well), and the importance of safety in science

Ideas for things to talk about with mentees:

- **During experiment:**
  - ✓ Why do you think prosthetics are so important in the medical field?
  - ✓ How is this prosthetic similar to a real hand? How is it different? What do you think it would be like having a biomechanical hand?
  - ✓ What are some limitations to this device? How could we improve it?
    - (Use more durable material, something tighter than a rubber band to make it stronger, etc.)
- **For fun:**
  - ✓ What is your favorite sport?
  - ✓ What is your favorite food?
  - ✓ What do you (as a BE) do as an engineer in your classes/labs?
  - ✓ What is your favorite type of science? (Emphasize how they all connect)
  - ✓ What are you working on in your science/math classes now?
  - ✓ What are you interested in doing when you grow up?
  - ✓ What are you planning on doing in high school to prepare for what you want to do in college/career? (seems serious, but I was asked this in 8th grade and it always stuck with me)
  - ✓ The healthcare industry is one of the largest in the U.S. now. There are many ways to get involved: nursing, doctor/med, bioengineer☺, managerial, pharmacist, researcher, biologist, hospital, physical trainer, biochemist, insurance, etc.

Artificial Heart Valve

Objectives:

(1) Understand how a heart valve and artificial heart valve function
(2) Understand principles of designing implantable devices
(3) Connect ideas in this activity to the real world and medicine

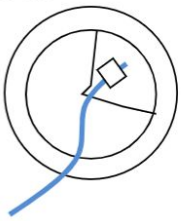
Materials (per student)

Material	Amount
plastic tube	1
balloon	2
pipe cleaners	2
rubber band	2
marble	1
plastic cup	2
heart valve template	1
string	3 pieces
tape	shared with table
scissors	shared with table

Procedure

Part 1: Modeling a normal heart valve

(1) Cut out the pieces from the template. For the flaps, fold along the dotted line.
-Need only three flaps (triangular shapes), one is extra.
(2) Tape the flaps to the ring.
-The flaps should overlap slightly.
-The valve we are modeling is the tricuspid valve, which has three flaps. We also have another valve, called the bicuspid valve, that has two flaps.
(3) Tape one end of a piece of string to the inside of the flap (the white side without the outline). Long tail of the string should be towards the tip of the flap.
-String acts as the tendons (aka heart strings) that control opening and closing of the valve.
tendons relaxed = valve open
tendons tensed (pull string) = valve closed



(4) Pull and release the strings to open and close the valve.

Part 2: Modeling a one-way artificial heart valve

(1) Cut off the neck (the narrowest part) of the balloon.
(2) Cut a hole approximately 1 cm in diameter in the bottom of the balloon.
-Best way to do this is to flatten the balloon, fold it in quarters, and cutting the tip off the end.
(3) Place the balloon in the plastic tube, pull the larger end of the balloon over the tubing.
(4) Cut one of the pipe cleaners into thirds. Fold each into a clamp and place over the balloon and tube.
-This serves to anchor the balloon down so that it doesn't collapse when water is

poured through.

(5) Place the marble into the balloon.

-This marble serves as the ball in the ball-and-cage model heart valve. It will block the flow in one direction.

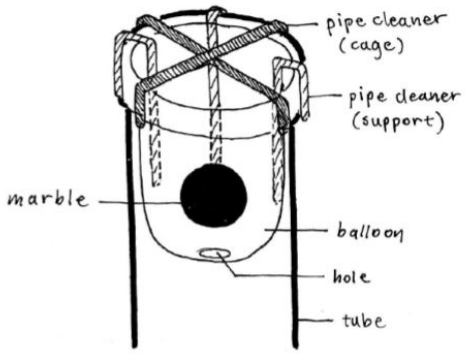
(8) Cut the second pipe cleaner in thirds. Fold each to form a grating over the end of the tube with the balloon.

-This serves as the cage in the ball-and-cage model heart valve, preventing the marble from falling out.

(9) Place rubber band around lip of tube on balloon end to secure everything in place.

(10) Pour water into the tube from the end with the balloon and observe what happens. Then pour water into the tube from the other end and observe what happens.

-Does water flow through the tube in both directions? Why or why not?
-Ideally, water should NOT flow when poured from the balloon end, but flow when poured from the free end.



Ideas for things to talk about with mentees:

- **During experiment:**
  - ✓ Do you think these materials are more like the mechanical or tissue valve replacements? Which material do you think is better for functioning in the human body?
  - ✓ Why do you think it is important for us to have valves between the chambers of the heart? Why is it important to have one-way flow in the heart?
  - ✓ Aside from heart valves, what other devices can be implanted in the body?
- **For fun:**
  - ✓ What is your favorite sport?
  - ✓ What is your favorite food?
  - ✓ What do you (as a BE) do as an engineer in your classes/labs?
  - ✓ What is your favorite type of science? (Emphasize how they all connect)
  - ✓ What are you working on in your science/math classes now?
  - ✓ What are you interested in doing when you grow up?
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