Chapter of the Year Competition Report

University of Maryland, College Park

05/30/2020

Section A: Programs and Projects

Part I: Design projects

For the past couple years, our chapter's focus has been on developing an adaptable braking system for wheelchairs. The inspiration came from a collaboration with the Engineering World Health chapter at Makerere University in Uganda. Their needs assessment documented a huge gap in wheelchair accessibility due to the poor quality of those that were donated. It also indicated that individuals who did have access to wheelchairs experienced a significant amount of injuries each year, most notably due to the lack of an appropriate braking system.

Over the last year, we have advanced our initial design concept into an almost complete prototype (Appendix A). The basic mechanism of operation is incredibly similar to braking on a bike. This was done to promote the sustainability of the braking system. Bikes are widely used in the community, and simulating the mechanism of a bike brake not only enables more comfort and familiarity, but also allows any future troubleshooting or repairs necessary to be done by members of the community. The user will have access to a compressible handle wherever is most comfortable for them (since this piece will also be adaptable). And compression of the handle would then, like in a typical bike brake, contract the cables linked to the brake, and cause the arms of the brake to close in on the wheel.

This year's work centered on optimization and problem-solving as new design issues came to the surface. The first goal was to optimize the dimensions of our 3D printed parts to fit securely with the wheelchair and the remaining brake components. This took quite an amount of time due to both unexpected complications in assembly that we readdressed with each new

revision of our printed parts and delays in the ordering and printing process. While the steel yoke and tie end rod clamp were printed of PLA plastic in our current prototype, the final material would ideally be steel to minimize wear in use and wear due to changing climate conditions over time.

Second, our starting design had envisioned semi-metallic brake pads within the bike brake housing. However, after several discussions our team realized that the sustainability and ease of repair was best with the use of typical bike brakes. Since bikes are a very common mode of transportation in developing countries, these materials are not only more financially feasible but also more available in general.

Finally, we noticed a weight imbalance in our original design. The added weight of the bike brake caused the entire braking system to lean forward at an angle. This imbalance would significantly reduce the design's efficacy among other complications. To provide a "counterbalance", the steel yoke was modified such that it had two connection points to the tie end rod clamp. This provided more strength and stability to hold the brake up in a position most optimal for braking (perpendicular to the wheel).

Overall, this year's developments solved some major design problems and finalized our printed part dimensions. Had the term not been cut short due to the unfortunate current circumstances, our team would have manufactured the aforementioned parts in metal, completed the testing phase, addressed any setbacks, and proceeded to ship two basic prototypes for testing to Makerere University. (Taken from our design proposal submission 2020).

Part II: Kit builds:

Since our chapter had already utilized 2 of the 3 EWH kits in the past, this year we wanted to investigate some different options before coming back to the kits. As a result our leadership team began looking into different possibilities within the field of prosthetics. In the fall we met with a visiting lecturer at UMD, Dr. Eric Bubar, to discuss potential prosthetic workshops.

Our first workshop was aimed to be an assembly session. Dr. Bubar had been working on a prosthetic hand model for easy use and assembly in developing countries and wanted to test the time it took to put it together (Appendix B). Our leadership team spent time in the fall putting the prosthetic hand together ourselves before assessing how we could develop this into a workshop. We ultimately decided that it was a bit too difficult to implement on a larger scale for our members.

Our second workshop was aimed to be an instructional one that demonstrated how to go from an initial scan of a hand to a prosthetic model. It was planned for March 26th but unfortunately our university closed down before then (Appendix C). If in the fall we are able to

return to campus, we will host the workshop in person. If not, then we will probably hold it in a webinar format instead.

Part III: Equipment repaired:

After having quite a bit of difficulty in sourcing broken medical devices over the past several years, this year we wanted to try moving along different lines. In the fall, as mentioned above, we met with Dr. Eric Bubar to discuss potentially moving the repair team toward prosthetics projects. He offered to guide us along the development of a modular prosthetic hand device. And we planned, after having the aforementioned prosthetics workshops, to shift our repair team toward this project. Again, due to the pandemic we were unable to commit this shift.

Another area we were investigating for the repair team was suggested by our faculty advisor, Dr. Angela Jones. After conveying our difficulties in sourcing she advised us to contact the NIH Warehouse and see if they would be willing to provide us with medical devices for repair.

Due to the pandemic, we were unable to do both of these things but we plan to do them as soon as we head back to campus.

Part IV: STEM activities:

Our first service event in the fall was with the Adventures in Science organization, which brings elementary and middle school students to the University of Maryland every Saturday for various science and engineering activities. We went through a lesson on biomedical devices and more specifically focused on prosthetics. The ten students were asked to form groups and work on building a prosthetic hand out of craft materials capable of picking up a tennis ball, a toy lion, and a roll of tape. Our eight volunteers walked around asking for justifications behind their ideas and introducing relevant engineering concepts. After the mini-competition, we ended the session showing the students videos of advanced prosthetic hand designs and answering various career-oriented questions (Appendix D).

Our second service event in the fall was with The Choice Program. This program engages underprivileged high school students with science and engineering lessons throughout the year. About twenty students came to our campus in mid-November where we spent the evening working through various coding activities on the Arduino software. Students were given the chance to work with Arduino circuit boards as well and learned to combine the circuity with the code to light a lightbulb, make a motor spin, and much more (Appendix E). We had six volunteers for this event.

Our first service event in the spring was with the Women in Engineering organization in their Engineers' Night Out program. About 30 elementary and middle school students joined us for a night of building simple pneumatic devices. The students learned about the impact of

pressure as a force and how that applies to biological systems and biomedical devices (Appendix F) along with six volunteers. The session was also followed by a question-answer session on various careers in engineering. For this event, we collaborated with the Biomedical Engineering Society. The students were split into two groups and rotated between our activity and that of BMES.

We had originally planned to host a booth at our university's Maryland Day with various engineering activities for visiting students and kids of all ages. This was also canceled due to the pandemic (Appendix G).

The students and organizers both seemed to really enjoy the activities planned for the events above. And all the activities were made possible by a great leadership team and dedicated chapter members who volunteered their time.

Part V: Future activities

Clearly, a great deal of things were unable to happen since the semester was cut short. However we are looking forward to our eventual return to campus to restart all our projects. For our innovation team, we plan to get into the testing phase that we put together in the fall and manufacture our CAD parts in metal for more accurate testing. We plan to hold our prosthetics workshops and get started with the aforementioned modular prosthetic hand project. We hope to get in contact with the NIH Warehouse to potentially source some broken medical devices. And we plan to continue to host service events and guest speakers.

After hosting online elections, we elected a new board and also developed two new positions on our leadership team - Workshops Chair and CAD Chair. Our workshops chair will be in charge of kit days as well as repair-oriented workshops to give our members a chance to acquire new technical skills. Our CAD chair will be responsible for holding CAD nights with introductory CAD lessons and assist the innovation team with CAD parts as well.

And should our fall semester be moved online, we will meet as a leadership team and decide how to move forward and continue to engage our members.

Section B: Organizational Structure

Part I: Chapter Structure and Statistics:

The board for the EWH chapter at UMD consists of 7 members, and responsibilities are divided among board members. On the executive team, there are 2 Co-Presidents who are responsible for oversight of all the leadership, coordinating the relationship between board and general members, organizing meetings, and maintaining our relationship with the EWH chapter at Makerere University in Uganda. There is also a treasurer who is responsible for fiscal management, applying for and obtaining funding from the university, organizing fundraisers, and managing the chapter bank account. On the leadership team, there is an Innovation Chair who is responsible for the innovation team that is focused on preparing for the annual design competition proposal. The Innovation Chair coordinates the design timeline and schedule, testing, and leads the team in building the prototype. The Events Coordinator organizes guest speaker events and service/outreach events; they are also responsible for coordinating the team of volunteers for service events. The Kit Chair is responsible for holding workshops and kit days. As detailed previously, while we had prepared to hold a workshop on the development of the prosthetic model, we were unable to hold the event due to the campus closure. The Promotions Consultant designs the event fliers (Appendix H) and advertises and promotes events through emails and our social media, including our Facebook page (www.facebook.com/ewhumd) and our Instagram page (www.instagram.com/ewhumd). Regarding administrative support, we also worked with university faculty to book rooms for our meetings and events.

Our chapter has 76 members on the University of Maryland TerpLink roster. The Innovation Team met weekly and had an average attendance of about 10-15 people. Our guest speaker events were held on October 24, 2019, November 12, 2019, and February 27, 2020. Each had an average attendance of about 20 people. Our service events were held on November 2, 2019, November 20, 2019, and February 21, 2020. Events and meetings planned during and after March 2020 were cancelled due to the pandemic.

Section II: Fundraising Approaches

Approach	**Amount**
Student Government Association (SGA)	$660
Do Good Mini Grant	$400
Total	**$1060**

Through the university SGA we applied for and obtained funds for chapter dues and fees for the design competition. We also applied for a Mini Grant through the Do Good Institute which is aimed to support student-run proposals with a goal of creating a positive social impact. This funding is intended to be used for shipment and building of the braking system.

Section III: Other chapter activities

Throughout the year we have held several guest speaker, service, professional development, and social events. Our first guest speaker was Ms. Katie Geary who is a UMD alumna who currently works at the FDA developing medical devices with a focus on shoulder replacements for individuals with injuries and arthritic complications. We also had Mr. Kevin Aroom who spoke about Project CURE, a nonprofit that processes and ships donated medical equipment to developing countries around the world. Our final guest speaker before campus closed was Mr. Danyal Malik who spoke about Walk With Me Prosthetics, a non-profit startup that aims to provide low-cost lower limb prosthetics to amputees in developing countries. We also planned to have an instructional workshop on prosthetic development led by Dr. Eric Bubar. However, this was cancelled due to the pandemic.

Additionally, we had several service/outreach events in which we worked with students from local communities to introduce them to the field of bioengineering and carried out hands-on activities. We worked with the Adventures in Science Program, students from the Choice program, and participated in an "Engineers Night Out" with the Women in Engineering Outreach program. Each of these events are detailed in Section A. We had planned to participate in Maryland Day, a university-wide community outreach event (Appendix G). However, the event was cancelled due to COVID-19.

In addition to service and guest speaker events, we also had a professional development event in which we collaborated with other bioengineering organizations on campus to hold a bioengineering career panel. Finally, we had a social event with the leadership team at the beginning of the semester where we had a leadership dinner.

Section C: EWH Chapter Feedback

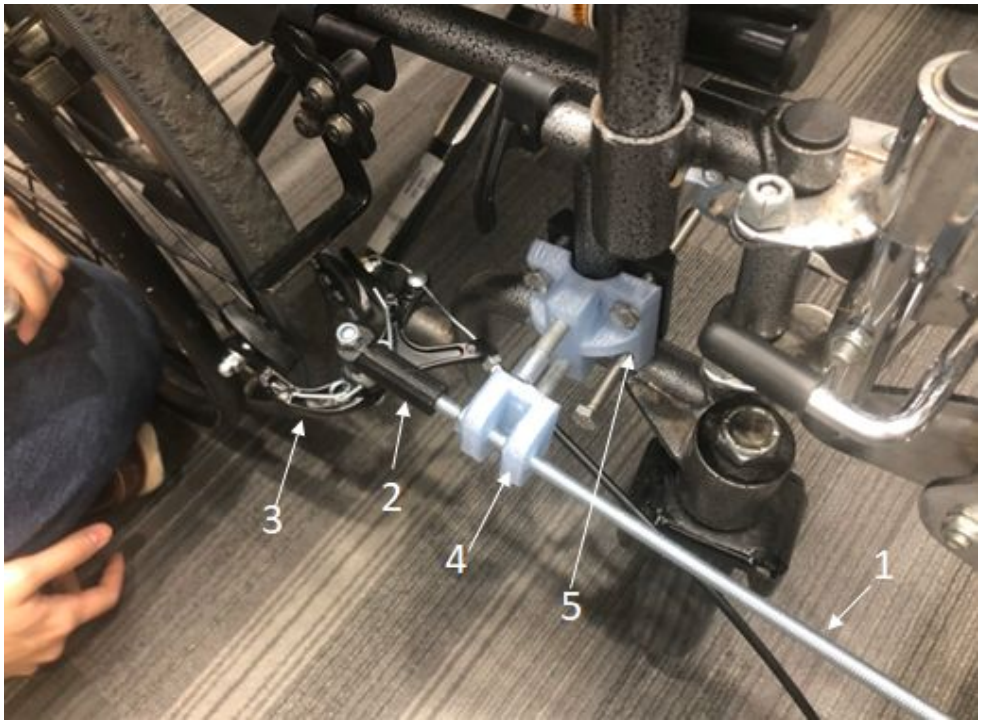
Our chapter has been really interested in giving members a chance to be a part of the EWH Summer Institute. After gauging interest, it seemed like the cost was a concern for many of them. As a result, we investigated different avenues to go down to make this more feasible - including developing a study abroad program associated with our university or developing a lab course at UMD to teach the hands-on repair skills acquired in the Summer Institute.

After talking with EWH and our study abroad program, the final details are summed up in Appendix I. Since this still doesn't improve affordability a great deal, we were wondering if EWH would be willing to make their Summer Institute teaching manuals more accessible so that we could host our own workshops for members.

We acknowledge that this may not be possible, but wanted to put it out there for thought regardless. Thank you!

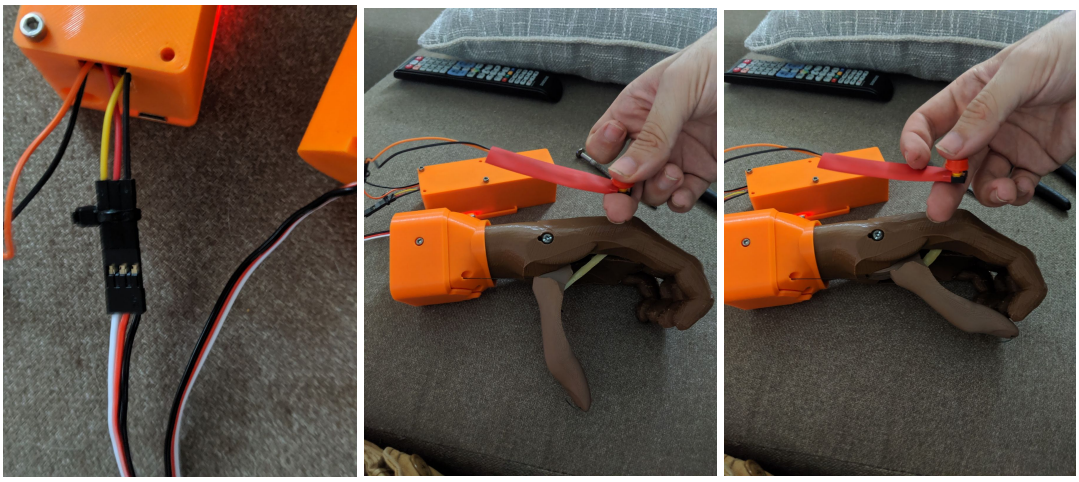
Section D: Appendix - Photos, Tables, Schematics and additional material

Appendix A



The adaptable braking system's base structure is a 12 inch steel threaded rod (1). The front end of the rod is attached to an internally threaded rod end piece (2). This piece allows for the attachment of the bike brake (3) that then sits in front of the wheel. A steel yoke (4) also sits on the threaded rod and is positioned, using hex nuts, according to the frame-wheel distance of each individual wheelchair. And finally, the steel yoke is held to the wheelchair using a tie end rod clamp (5) that can be fixed onto any bar of the frame. The steel yoke provides a great deal of adjustability to the design by accommodating two different variations in wheelchair dimensions - the distance between the wheelchair frame and the wheel and the distance between the wheel and the brake's attachment to the wheelchair frame. (Taken from our design proposal submission 2020).

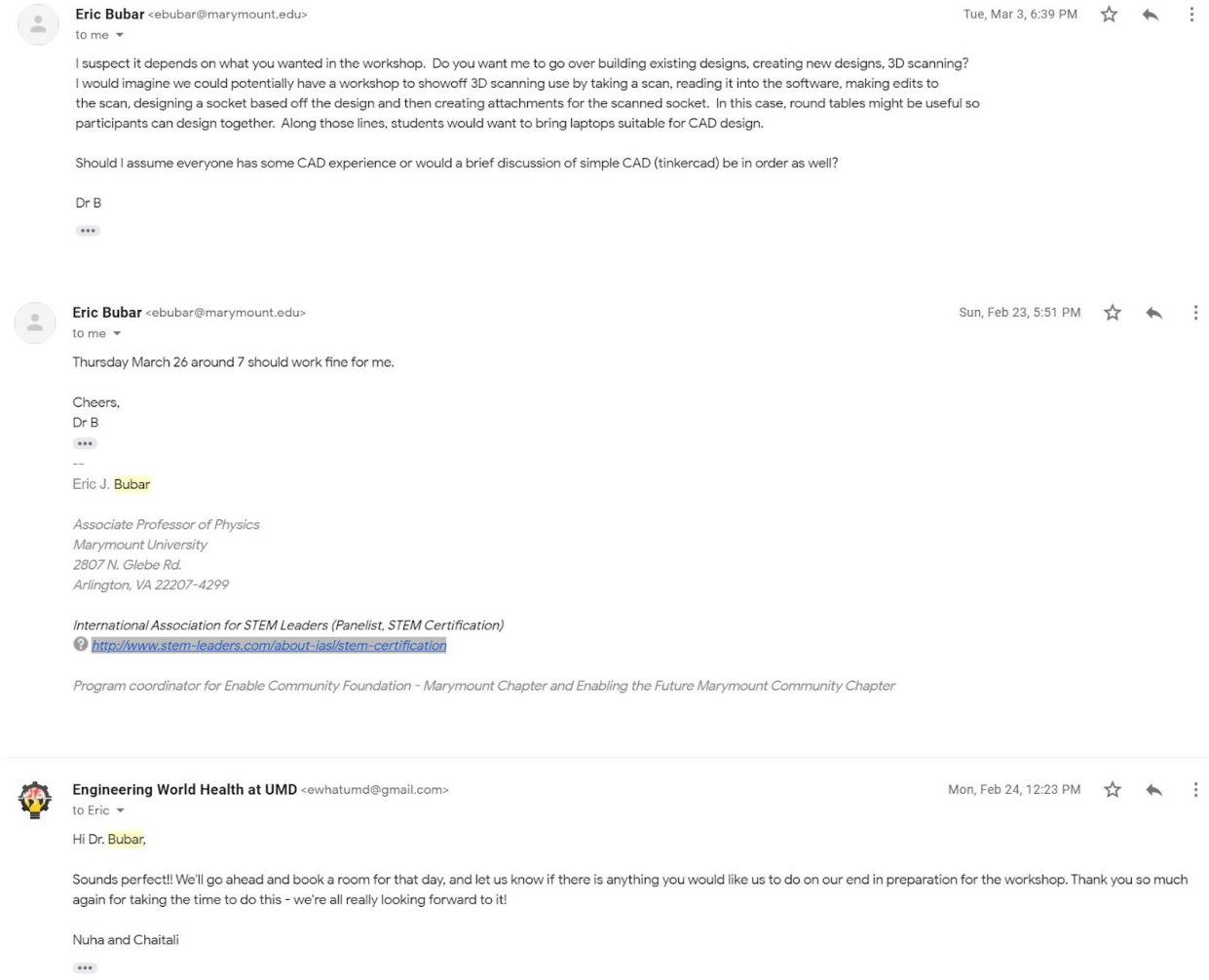
Appendix B



Unfortunately, the device we built is still on campus and we are all at home so we were unable to provide a picture of the device we built. However, just for the idea here are some images of what the device looks like post-building. These images are taken from Dr. Bubar's manual cited below.

Bubar, E. (n.d.). Wrist Mech. https://docs.google.com/document/d/15Qi8354YAS5EJnBqJcT2HUBNaXwBZ5ymHQfw0T9-NeE/edit.

Appendix C



Eric Bubar <ebubar@marymount.edu> Tue, Mar 3, 6:39 PM
to me

I suspect it depends on what you wanted in the workshop. Do you want me to go over building existing designs, creating new designs, 3D scanning? I would imagine we could potentially have a workshop to showoff 3D scanning use by taking a scan, reading it into the software, making edits to the scan, designing a socket based off the design and then creating attachments for the scanned socket. In this case, round tables might be useful so participants can design together. Along those lines, students would want to bring laptops suitable for CAD design.

Should I assume everyone has some CAD experience or would a brief discussion of simple CAD (tinkercad) be in order as well?

Dr B

Eric Bubar <ebubar@marymount.edu> Sun, Feb 23, 5:51 PM
to me

Thursday March 26 around 7 should work fine for me.

Cheers,
Dr B

--
Eric J. Bubar

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Arlington, VA 22207-4299

International Association for STEM Leaders (Panelist, STEM Certification)
http://www.stem-leaders.com/about-iasl/stem-certification

Program coordinator for Enable Community Foundation - Marymount Chapter and Enabling the Future Marymount Community Chapter

Engineering World Health at UMD <ewhatumd@gmail.com> Mon, Feb 24, 12:23 PM
to Eric

Hi Dr. Bubar,

Sounds perfect!! We'll go ahead and book a room for that day, and let us know if there is anything you would like us to do on our end in preparation for the workshop. Thank you so much again for taking the time to do this - we're all really looking forward to it!

Nuha and Chaitali

Email proceedings for our prosthetics development workshop with Dr. Bubar planned for March 26th, 2020.

Appendix D

Our chapter volunteering with Adventures in Science - working with elementary and middle school students on developing prosthetic hand models.

Appendix E

Our chapter volunteering with The Choice Program - building circuits and utilizing Arduino code to perform various functions.

Appendix F

Our chapter volunteering with the Women in Engineering program, building pneumatic devices with elementary and middle school students.

Appendix G

Good afternoon,

Thank you for participating in Maryland Day! I wanted to send you an update about T-shirt and lunch orders for the event. (I am sorry that I don't have an update about a location--I'm hoping I can send you some information about that shortly.)

T-shirt and lunch orders are due to the Office of Strategic Communications very soon. **I'm asking you to refer to this sheet to double-check your T-shirt and lunch orders by noon on Friday, February 21. Please make sure you are requesting only what you *need*, and update your requests as necessary.** Note that each *event* (each table) is limited to no more than a total of 10 lunches and a total of 10 T-shirts. If you originally requested more than 10 T-shirts or more than 10 lunches, please update your numbers accordingly. Furthermore, only full-day volunteers are eligible to request lunches.

You may absolutely request fewer than 10 T-shirts and 10 lunches for Maryland Day, and I encourage you to request only what you need. In previous years, we've had more than 50 unclaimed Maryland Day T-shirts after the event. Those T-shirts cost us, but, more importantly, we don't want to be wasteful! So, this is my plea to limit your T-shirt requests as much as possible.

I really appreciate your help. I'll be sending you updates as we get ready for Maryland Day on April 25.

Thank you,
Erin

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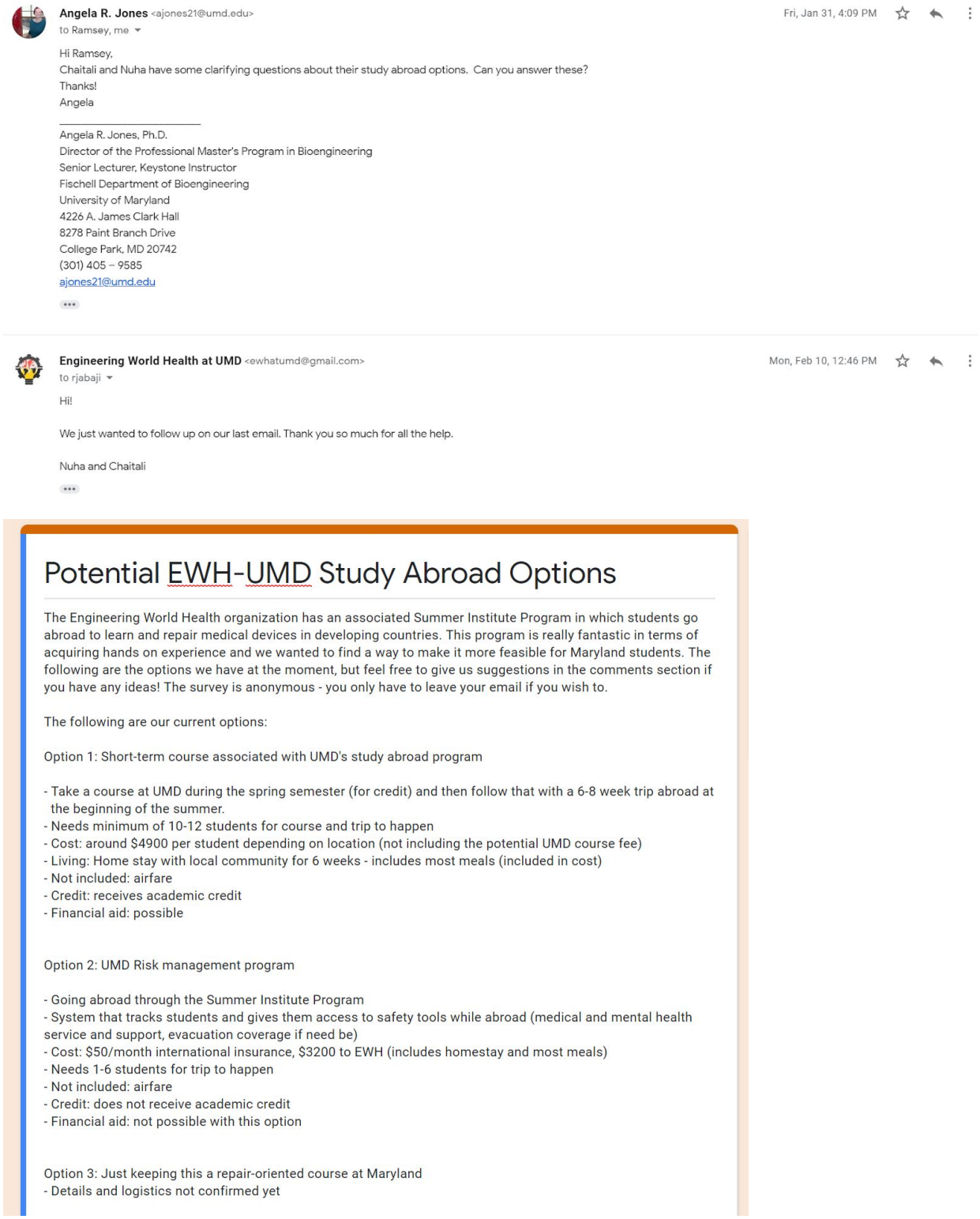
pronouns: she/her/hers

Email proceedings for our planned booth at Maryland Day scheduled for April.

Appendix H

Fliers for our guest speakers, Ms. Katie Geary, Mr. Kevin Aroom, and Mr. Danyal Malik.

Appendix I



Angela R. Jones <ajones21@umd.edu> Fri, Jan 31, 4:09 PM
to Ramsey, me

Hi Ramsey,
Chaitali and Nuha have some clarifying questions about their study abroad options. Can you answer these?
Thanks!
Angela

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Director of the Professional Master's Program in Bioengineering
Senior Lecturer, Keystone Instructor
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ajones21@umd.edu

Engineering World Health at UMD <ewhatumd@gmail.com> Mon, Feb 10, 12:46 PM
to rjabaji

Hi!

We just wanted to follow up on our last email. Thank you so much for all the help.

Nuha and Chaitali

Potential EWH-UMD Study Abroad Options

The Engineering World Health organization has an associated Summer Institute Program in which students go abroad to learn and repair medical devices in developing countries. This program is really fantastic in terms of acquiring hands on experience and we wanted to find a way to make it more feasible for Maryland students. The following are the options we have at the moment, but feel free to give us suggestions in the comments section if you have any ideas! The survey is anonymous - you only have to leave your email if you wish to.

The following are our current options:

Option 1: Short-term course associated with UMD's study abroad program

- Take a course at UMD during the spring semester (for credit) and then follow that with a 6-8 week trip abroad at the beginning of the summer.
- Needs minimum of 10-12 students for course and trip to happen
- Cost: around $4900 per student depending on location (not including the potential UMD course fee)
- Living: Home stay with local community for 6 weeks - includes most meals (included in cost)
- Not included: airfare
- Credit: receives academic credit
- Financial aid: possible

Option 2: UMD Risk management program

- Going abroad through the Summer Institute Program
- System that tracks students and gives them access to safety tools while abroad (medical and mental health service and support, evacuation coverage if need be)
- Cost: $50/month international insurance, $3200 to EWH (includes homestay and most meals)
- Needs 1-6 students for trip to happen
- Not included: airfare
- Credit: does not receive academic credit
- Financial aid: not possible with this option

Option 3: Just keeping this a repair-oriented course at Maryland
- Details and logistics not confirmed yet

What we found in looking for different methods to pursue EWH's Summer Institute.