Empowering Black Scientists in STEM: Early Success of the Black Biomechanists Association

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Abstract—Black individuals are underrepresented in science, technology, engineering, and mathematics (STEM) fields. In 2016, Black students earned 9% of science and 4% of engineering bachelor’s degrees compared to a total of 56% of science and engineering bachelor’s degrees earned by White students. Even with similar entering rates, Black students leave STEM majors at 1.4 times the rate of White students. These data reflect the manifestation of diversity, equity, and inclusion (DEI) barriers faced by Black students and scientists to successfully navigate higher education and pursue careers in STEM fields. There remains a critical need to develop better ways to recruit, retain, train, and graduate Black students in STEM, especially within predominantly White institutions. Biomechanics is a growing interdisciplinary and translational STEM field where DEI barriers persist. Thus, the Black Biomechanists Association (BBA) was founded in 2020 with intentions to reduce these barriers and give much needed support to Black students and biomechanists in STEM spaces. The organization’s mission is to uplift and enrich Black biomechanists in their academic and professional careers. Our objectives to achieve this mission provide a supportive environment and resources to address the challenges, needs, and interests of Black biomechanists, as well as aid in the biomechanics community’s efforts to achieve DEI. In two short years, BBA has developed a needs-based mentoring program, hosted professional development and culturally-competent mentoring workshops, and produced communications to educate the biomechanics community and broader audience on culturally-relevant topics that impact Black biomechanists. The purpose of this article is to share the work and impact of BBA to date.

Keywords—Biomechanics, Education, Diversity, Inclusion, Black professionals.

INTRODUCTION

The term “underrepresented” refers to the representation of a group in a specific area being smaller than the group’s representation in the general population. In science, technology, engineering, and mathematics (STEM) fields in the United States (US), Black individuals are heavily underrepresented. Black individuals currently make up roughly 13% of the US population. However, in 2016, Black students only earned 9% of science and 4% of engineering bachelor’s degrees, compared to a total of 56% by White students. Part of this underrepresentation problem lies in the fact that Black students are more likely to leave STEM majors than White students. Even with similar entering rates, Black students switch out of STEM majors at a rate of 40% compared to 29% by White students. In addition, only 39.8% of Black students complete a 4-year degree within 6 years compared to 64.3% of White students. Sadly, within STEM majors, 26% of Black students leave institutions without graduating compared to 13% of White students.

These data directly reflect the manifestation of diversity, equity, and inclusion (DEI) barriers faced by Black students and scientists to successfully navigate higher education and pursue careers in STEM fields, particularly in predominately White institutions (PWIs). Lack of retention in academia is easily seen through the decreasing percentages of Black students
at higher educational levels; a deficit that directly carries over into career stages. Among graduate students enrolled in science and engineering programs, only 11% are Black students.6 Beyond just STEM fields, only 5.4% of Black students earn doctorate degrees and more than a dozen graduate fields lack even one Black doctoral recipient.4 At bachelor-degree-granting schools, only 5.2% of tenured faculty are Black individuals.3 Historically Black Colleges and Universities (HBCUs) have played an incredible role in reducing DEI barriers, not only in recruiting, retaining, and graduating Black students, but also in preparing Black students for success in science and engineering doctoral programs. In 2016, 15% of Black students who earned a bachelor’s degree in the US did so from an HBCU. Additionally, these HBCU graduates made up 25% of Black graduates who went on to earn a doctorate degree from a science and engineering program between 2013 and 2017.6 While HBCUs make tremendous strides towards diversifying higher education, it is evident that there is still a critical need to develop better ways to recruit, retain, train, and graduate Black students in STEM within PWIs.

Biomechanics, the study of the structure, function, and motion of biological systems,4 is a growing interdisciplinary and translational STEM field. However, even as a relatively young STEM field, DEI barriers exist and persist in biomechanics. Most biomechanics degree programs are only offered at PWIs, with the few Black faculty and students in this particular discipline spread out amongst institutions. This scattered representation that can occur at PWIs within the field of biomechanics presents Black faculty and students with common DEI barriers of difficulties being a token minority and/or lack of belonging at their institutions. Important DEI improvements at the institutional level are in development, but the implementation process is slow. The longstanding needs of Black scholars and scientists must be met now. Thus, the Black Biomechanists Association (BBA) was founded in October 2020 with intentions to reduce DEI barriers and provide much needed resources and support to Black students and biomechanists in STEM spaces. The purpose of this article is to share the work and impact of BBA to date.

ESTABLISHMENT

The BBA co-founders are Kayla Seymore, PhD student at the University of Delaware, Erica Bell, PhD, postdoctoral fellow at the Mayo Clinic, and Matt McCullough, PhD, administrator at North Carolina A&T University. Ms. Seymore and Dr. Bell met while working in the same lab as the sole Black graduate students in biomechanics at their institution. Dr. Bell and Dr. McCullough were introduced by Dr. Bell’s PhD advisor. It was the hope that Dr. McCullough would not only be on Dr. Bell’s dissertation committee, but would also provide additional mentorship as a senior Black faculty working in the biomedical engineering and biomechanics fields. Attending scientific conferences since 2014, all three founders witnessed the lack of visibility of Black biomechanists. In an attempt to rectify this issue, Dr. Bell and Dr. McCullough hosted an informal meet up with other Black biomechanists at the American Society of Biomechanics (ASB) annual meeting in 2015, but only managed to meet with two other Black attendees.

From 2015 on, Dr. Bell and Dr. McCullough actively tried to establish a network (professional and social) to make Black biomechanists more visible with the intent to bring Black biomechanists together as a community. Although affiliation groups within established biomechanics and engineering organizations were considered, bylaw restrictions for affiliation groups did not align with the founders’ goals and vision for support of Black scientists. In the Spring 2020 aftermath of tensions around injustice against Black communities in the US and globally, the co-founders saw many non-Black people awaken to the political, economic, and social injustices Black people face every day. They found themselves reaching out and confiding in one another about the public atrocities still plaguing the Black community. The more conversations were had, the more the co-founders realized that other Black scientists in the community might need this type of support, now more than ever. While many professional organizations released statements on systemic racism and pledged to take actions towards anti-racism, they knew this simply could not be done without critical involvement of minority voices. Thus, Ms. Seymore, Dr. Bell, and Dr. McCullough decided to host an official meeting for Black biomechanists.

The initial meetings of BBA were prior to our official founding and took place during two separate Affinity Group sessions at the 44th annual ASB meeting in August 2020. The purpose of these two meetings was to provide a safe space for open dialogue to establish the needs of members, discuss objectives for the group, and gain feedback on how to better relay issues and developments that affect the Black biomechanics community back to the ASB Diversity Committee. Some of the key takeaways raised by attendees are summarized in Table 1. These takeaways, which helped in the development of the organization’s objectives, are reflective of the needs of those Black biomechanists in attendance and further evidence an underlying lack of support that contributes to the aforementioned DEI barriers.
MISSION AND OBJECTIVES

The mission of the Black Biomechanists Association is to uplift and enrich Black biomechanists in their academic and professional careers. To succeed in this mission, three main objectives have been established: (1) to provide a supportive environment to discuss the challenges, needs, and interests of Black biomechanists; (2) to provide resources that encourage visibility, increase engagement, and empower Black biomechanists; and (3) to aid in the biomechanics community’s efforts to achieve DEI. To take actionable steps towards each of these objectives and target some of the biggest DEI barriers faced by Black biomechanists, five subcommittees within the organization were formed; each with their own leadership, supporting team among organization members, and specific goals (Table 2).

OBSTACLES AND ADVANCEMENTS

Initial establishment as an organization was the biggest obstacle BBA faced. The idea for BBA originated in 2015, yet it was not officially founded until October 2020. The founders built BBA from the ground up with no initial professional society/industry partnerships, social presence, or funding. Without funding and personnel, it is difficult to grow an organization. Organizing within an already established scientific society would have been ideal, but there seemed to be no place for BBA to readily integrate and still provide necessary services tailored to Black scholars. With overwhelming interest and support at the 2020 meetings, the founders of BBA were finally able to press forward in establishing the organization. Currently, all individuals who actively execute BBA subcommittee initiatives are volunteers, contributing their skills and shared passion for implementing effective DEI initiatives. However, this means that the time and work put into BBA is in addition to primary responsibilities of work, school, family, etc.

The COVID-19 pandemic has negatively impacted productivity and the ability to connect in a lot of ways within academic and research STEM fields. Yet, the transition to virtual/online formats for academic and research settings during the COVID-19 pandemic also presented a unique opportunity for BBA to thrive. In 2020, a diverse group of individuals from various disciplines, career stages, global locations, and skill sets volunteered to support BBA’s mission. This galvanized group development is in stark contrast to traditional scientific societies, and resulted in a unique situation for BBA, where the mission and work of the organization is completely founded on the needs of Black biomechanists. Additionally, BBA founders are all

| TABLE 1. Key takeaways from initial BBA meetings brought forth by Black biomechanists. |
|-----------------------------------------------|
| **ASB 2020 Meeting Takeaways**                  |
| Identifying and combatting Anti-Blackness in STEM |
| Increasing Black representation in study participation, as well as for persons with disabilities |
| Provide needs-based mentoring to facilitate engagement and retention of Black, Indigenous, and People of Color (BIPOC) students/scientists within the field of biomechanics |
| Provide award/funding opportunities to support member conference attendance (often a barrier for conference attendance/participation) |
| Provide platforms and spaces for interaction as well as visibility Events throughout the year outside of ASB (social, outreach, and professional development) |
| Representation across ASB leadership to help address systemic barriers and relay needs/interests of the BIPOC community within ASB and broadly to the biomechanics field |
| Create outreach opportunities for ASB that go to Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI), and Tribal Universities to discuss biomechanics |

| TABLE 2. Brief description of BBA subcommittees and respective goals. |
|------------------------|-----------------|
| **Subcommittee**       | **Primary Goal** |
| Program Planning       | To deliver programming relevant to the academic and professional success of Black biomechanists by hosting signature social, educational, and industry-partnered events |
| Mentoring              | To provide Black biomechanists with mentoring at all academic and professional career stages through development of a needs-based mentoring program |
| Communications         | To educate the biomechanics community and broader audience on culturally-relevant topics that impact Black biomechanists, and communicate pertinent biomechanics events, resources, and advancement opportunities |
| Fundraising            | To garner and manage funding to provide programming, outreach events, scholarships, and research funds for Black biomechanists |
| Outreach               | To establish educational and interactive outreach programs to engage, recruit, and support future Black biomechanists |
currently at different stages in their academic/professional careers, and thus offer unique perspectives and input on the needs of fellow Black scholars and scientists as the organization continues to expand.

Funding is often a barrier for membership and participation in events for Black biomechanists. Membership and all of our programming is free, making our events and resources highly accessible. Since its founding in October 2020, BBA has gained 218 members of various genders, ethnicities, and academic/career stages (Figures 1, 2). Due to the interdisciplinary nature of biomechanics and its position as a translational STEM field, our members also work and study in a wide range of disciplines (Figure 2).

**IMPACT AND ACCOMPLISHMENTS**

BBA developed its mission statement and objectives to target and reduce DEI barriers and give much needed support to Black students and biomechanists. In alignment with the BBA mission, five subcommittees were created (Table 2), each with distinctive goals, to target some of the biggest DEI barriers faced by Black biomechanists. Each committee directly addresses at least one of the organization’s objectives and, at times, collaborates with multiple subcommittees. These efforts have produced great programming and progress towards BBA’s objectives in less than 2 years.

**Program Planning**

The Program Planning Subcommittee plans both internal and external events with the overall goal of delivering programming relevant to the academic and professional success of Black biomechanists. Internal events are for BBA members which feature professional development programming tailored to BBA member needs. These needs-based events are held every other month providing on-going learning opportunities, in preference to the typical one-off programming during professional conferences. External events are for members and the broad biome-
The mechanics community. These events are typically integrated into professional conference programming and can cover a variety of social, educational, and industry-driven topics.

BBA has hosted multiple events throughout 2020–2022 (Figure 3) relevant to the academic and professional success of Black biomechanists, many addressing the most frequent requests of attendees at the initial meetings. One 2021 event was a seminar presentation about microaggressions given by BBA Founders, raising awareness by defining microaggressions and describing how they impact Black students and professionals. This event helped to identify and provide publicly-available resources to combat Anti-Blackness in STEM spaces (Table 2). Programs with the largest attendance were focused on mentoring: the importance of mentoring, the potential impact of mentoring on career paths, and expanding mentoring networks. One of our proudest accomplishments was hosting a workshop at the 45th annual ASB meeting on ‘How to be a Culturally-Competent Mentor’. Programming for this workshop spanned career stages and offered attendees the opportunity to not only learn from experienced Black educators in higher education, but also engage in discussions about perceived mentoring barriers and actionable steps towards becoming more culturally-competent mentors.

**Mentoring**

The Mentoring Subcommittee was developed specifically to provide needs-based mentoring to better facilitate engagement and retention of Black students and scientists within the field of biomechanics. Many attendees at the initial meetings agreed that there was a gap in current mentoring structures. For instance, there are many career stages between a graduate student and a tenured faculty member, yet this is typically the mentor pairing trainees are offered. Traditional mentoring models in academia follow a dyadic hierarchical model, which presents as a one-on-one pairing of a senior mentor with a junior mentee based in technical training. While mentee needs are unlikely to be met by a single mentor, affinity-based mentoring groups have been successful in supporting underrepresented individuals in STEM. BBA members have expressed an interest in a mentoring program that provides support beyond technical training from mentors with experiences more immediate to their own. Additionally, members expressed a desire to interact with mentors on a more prolonged basis, as opposed to the single mentoring experience that is typically offered at professional conferences.

Through the work of this subcommittee, BBA has developed and launched its own needs-based mentoring program serving all academic and professional career stages. Participating mentees and mentors completed a custom survey to better align the needs of mentees with the abilities of mentors. This survey included technical, professional development, and social needs, to provide more meaningful pairings. The initial mentoring program launch garnered 28 mentors and 16 mentees, resulting in 16 matches. One non-traditional feature of this program was that mentees could also serve as mentors, resembling more of a mentoring triad than a traditional mentoring dyad. For example, a doctoral student could mentor a master’s or undergraduate student and be mentored by someone at the
early or senior career level. BBA believes this “layered” approach to mentoring, that incorporates non-traditional mentoring model methods along with supporting a variety of mentorship needs, will better serve BBA members in their academic and professional careers.

The Mentoring Subcommittee is currently gathering data about these initial matches to qualitatively and/or quantitatively assess the matching process developed for this program. However, verbal and written mentee feedback about the program have already shown to be promising. This subcommittee also partners with the Program Planning Subcommittee to plan and host mentoring-related events, many of which took place throughout the past year. These events are tailored to both mentees and mentors so that members are gaining mentorship experiences while also improving their mentoring skills.

**Communications**

The Communications Subcommittee was created to educate the biomechanics community and broader audience on culturally-relevant topics that impact Black biomechanists. This is accomplished through several endeavors, including a monthly newsletter and various social media platforms. The monthly newsletter (Table 3, Figure 4), provided freely online, is currently the biggest initiative of the Communications Subcommittee, which features a special academic or culturally-relevant topic, announcements about upcoming events or funding opportunities, and member highlights to increase visibility of Black biomechanists. The content produced by this committee focuses on demystifying “hidden curriculum” (i.e., unspoken keys to academic success) for Black students, bringing awareness to DEI barriers Black students and biomechanists face in academia, and providing resources to reduce DEI barriers. Some of the topics addressed this year included: funding (one of the biggest barriers), grant writing (to help reduce the funding barrier), and the importance of allies.

**TABLE 3. Newsletter issues on culturally-relevant topics or demystifying the “hidden curriculum”.**

| Date       | Topics                                      |
|------------|---------------------------------------------|
| 04/2021    | Deciding on Graduate School                 |
| 05/2021    | Representation in STEM Education            |
| 06/2021    | Racial Microaggressions                      |
| 08/2021    | How to Be a Culturally-Competent Mentor      |
| 09/2021    | Funding Opportunities                        |
| 10/2021    | Grant Writing Tips                          |
| 01/2022    | Goal Setting                                |
| 04/2022    | Industry Career Panel Recap                 |

BBA is not exclusively an organization of Black members; we recognize the importance of allyship to develop actionable and sustainable ways to combat and reduce DEI barriers. In addition to direct contributions, non-Black allies indirectly support the organization by increasing awareness of our endeavors to the broader biomechanics community. Thus, ‘The Ally Corner’ (Table 4, Figure 4) was created and launched in July 2021 as an extension of the monthly newsletter. This endeavor was created by allies within BBA with a mission to provide resources for allies to actively support and uplift Black biomechanists. ‘The Ally Corner’ will serve as a curated library of targeted resources to guide people who want to educate themselves and be effective allies in support of DEI initiatives within and beyond BBA. Topics presented in ‘The Ally Corner’ are included in Table 4. This initiative has already gained traction within the broader biomechanics community. BBA has received multiple notices of ‘The Ally Corner’ resources being presented and implemented in laboratory meetings to improve work environments.

In between BBA hosted events, much of our community engagement takes place on our social media platforms. Much of the content produced for these accounts include: member highlights to increase visibility; infographics to advertise internal/external events; dissemination of scholarly information; and dissemination of culturally-relevant information to increase awareness of DEI issues affecting Black scientists and students. Our Twitter account, @BlackBiomechs, was launched in August 2020 and currently has 1038 followers. To date, our Twitter posts have garnered 581,800 impressions, 2735 likes, and 1557 retweets. Our Instagram account, also launched in August 2020 and currently has 361 followers. To date, our Instagram stories and posts have reached a total of 1800 accounts and have had 1,364 interactions. These platforms have been invaluable in sharing information not only about the initiatives of the organization, but also about relevant topics that are important to and affect BBA members professionally, academically, and socially.

**Fundraising**

The Fundraising Subcommittee will be important as BBA continues to develop and establish collaborations with institutions, professional organizations, and industry partners. This committee seeks to garner and manage funding to provide programming, outreach events, scholarships, and research funds for Black biomechanists. Funding is one of the biggest barriers faced by Black biomechanists to progress and succeed in their careers, and this subcommittee seeks to reduce
the funding barrier and provide much needed financial support for Black biomechanists in a professional capacity. The main goal of this committee in 2021 was to prepare and file the paperwork necessary for BBA to become a 501(c)(3) certified and registered non-profit organization. As of March 2022, BBA is certified and registered at the state level and federal level as a 501(c)(3) non-profit organization. Filing for non-profit status was made possible by a generous donation of start-up funds from Novel Electronics Inc. (St. Paul, Minnesota), a company that sells research equipment and has members within ASB. This non-profit designation will allow us to apply for grants to implement our DEI initiatives and to receive tax-exempt donations from corporate/industry partners. The funds we garner will be used to better support Black biomechanists at all career stages by hosting events, establishing collaborations, and providing programs that will not only offer opportunities for professional development, but also financial support for career advancement.

Outreach

The Outreach Subcommittee was created to establish educational and interactive outreach programs to engage, recruit, and support future Black biomechanists at all career stages by hosting events, establishing collaborations, and providing programs that will not only offer opportunities for professional development, but also financial support for career advancement.

FIGURE 4. Example issues of the monthly newsletter and ‘The Ally Corner’. These resources are freely accessible via the BBA Linktree at https://linktr.ee/blackbiomechs.

| Date  | Topics                        |
|-------|-------------------------------|
| 07/2021 | Allyship                      |
| 08/2021 | Cultural Competence          |
| 09/2021 | NIH Funding                  |
| 10/2021 | Outreach                     |
| 11/2021 | NIH Funding                  |
| 12/2021 | DEI in Action                |
| 01/2022 | How to Apologize             |
| 02/2022 | How to Support Your Black Colleagues and Mentees |
| 03/2022 | Microaggressions             |
| 04/2022 | DEI in Tenure and Promotion Decisions |

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Competent Mentor’ workshop, educational videos explaining the field of biomechanics, and impactful videos about what biomechanics means to BBA members. Many of our members have a similar backstory of having a love of sports/movement and an affinity for science growing up, but never knowing the field of biomechanics existed until late into or beyond their undergraduate training. BBA seeks to bridge this knowledge gap by educating students in biomechanics, what it can do, and the viable career options it has to offer. The visibility of Black biomechanists engaging in biomechanics prior to graduate school. BBA seeks to bridge this knowledge gap by educating students in biomechanics, what it can do, and the viable career options it has to offer. The visibility of Black biomechanists engaging and pursuing careers in this type of work provides a missing piece of STEM representation that could help with engagement and recruitment of future young Black biomechanists. This publicly accessible YouTube platform will allow us to highlight current Black biomechanists and their work, in addition to exposing youth (undergraduate, high school, middle school) to biomechanics at an earlier age in hopes of expanding the education pipeline and getting Black students involved in biomechanics prior to graduate school.

One of the best ways to get youth involved and interested in science is to create hands on, immersive experiences that combine science with fun activities relevant to the learner. For that reason, BBA partnered with National Biomechanics Day (NBD), a world-wide celebration of biomechanics in its many forms for high school students and teachers, in 2021 to provide five funding awards for NBD event hosts. This Black Biomechanists Outreach Through National Biomechanics Day Grant Program continued in 2022 with intentions to: (1) create NBD events that promote biomechanics in the Black community; (2) support Black students to run NBD events; and 3) provide awards for up to $1000 to support NBD event expenses and conference attendance to a 2022 biomechanics conference. Through this initiative in 2022, and the financial support provided by The Biomechanics Initiative, Inc., we were able to fund four Black graduate students to host NBD events at their institutions. Funding initiatives like these, that support the current Black biomechanists while also engaging with future Black biomechanists, are what BBA aspires to develop and provide for future members.

FUTURE DIRECTIONS

BBA has seen an explosion of growth and support in this first year and a half, and it is just the beginning. Each committee has its own goals for future directions, but collectively, BBA aspires to push DEI initiatives forward in the biomechanics community. It is evident, directly from the perspectives of Black biomechanists, that the need to feel fully supported in academic and professional careers are not currently being met for Black biomechanists. The DEI barriers Black biomechanists face in academia are noticeable and have existed for decades, yet not much has been done by individuals in positions of power to effectively reduce these barriers. Implementing needs-based initiatives is extremely important when developing programs to support Black biomechanists throughout their academic and professional careers. DEI initiatives must be intentional and consistent to reduce barriers and increase success of Black biomechanists now and in the future.

Thus, a major focus of BBA within the next 2 years will be to officially establish its own needs-based mentoring program, continued development of needs-based professional development programming, and implementation of youth outreach initiatives to expand the pipeline for Black students to progress into careers in biomechanics or related health science fields. Engaging and involving HBCUs, Hispanic-Serving Institutions, and Tribal Universities in our programming would further serve our diverse group of members and facilitate connections with other BIPOC individuals who may be interested in biomechanics and/or in search of support within the field of biomechanics. As the organization grows, having gained non-profit status, BBA will have an easier time with member recruitment, hosting events, and offering financial incentives to participate (e.g., members-only awards, scholarships, professional development opportunities) future forward. Additionally, BBA will continue to push for promotion and collaborations with more institutions, organizations, and companies to provide added resources, expanded professional networks, improved community engagement, and increased opportunities for the advancement of Black biomechanists.

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