

## Facilities and Other Resources

### Information specific to the AREA program

#### 1. Evidence of the educational mentoring to undergraduate students by the PI during the past five years:

The PI firmly believes in the paramount importance of research mentoring for undergraduate students majoring in chemistry and pharmaceutical science. This hands-on laboratory experience not only ignites their passion for learning but also equips them with invaluable skills that will greatly benefit their future careers in the realms of chemistry and drug development, whether in manufacturing or research institutions. The PI has always dedicated his efforts to mentoring and nurturing the talents of undergraduate students, with a significant number of them being females hailing from diverse backgrounds. This mentorship has been extended through various channels, including the Summer Research Program, Independent Study (CHM379), Advanced chemistry lab (CHM479), and Senior Research (CHM489). Additionally, the PI has made substantial contributions to undergraduate education by designing and implementing the Medicinal Chemistry and Pharmacology laboratory course (CHM443). This course provides undergraduates with even more hands-on training opportunities, further enriching their educational experience. By securing the funding proposed in this application, the PI will be able to sustain and enhance their commitment to undergraduate education, with a specific focus on students from diverse backgrounds.

#### **Great achievements of the undergraduates under the PI's supervision in the past five years:**

<b>Dano, Raina (current undergraduate in the PI's lab)</b> She received Ohio Space Grant scholarship (2020) College Valedictorian (2021)	<b>Cody Orahoske</b> (former undergraduate and then a graduate student, graduated with PhD in May 2023 from the PI's lab, first generation college grad and PhD in family) He received American Association of Clinical Chemistry (AACC) student travel award 2020
<b>Shannon Urmetz</b> Lily Ng summer undergraduate res award (2021)	<b>Melanie Erickson</b> Lily Ng summer undergraduate res award (2021)
<b>Aidyn S Johnson</b> Lily Ng summer undergraduate res award (2022)	<b>Lucas C Devole</b> Lily Ng summer undergraduate res award (2022) Ohio Space Grant scholarship (2022)

Student name	Summer	Research publication with undergraduate listed as co-author
<b>Cody M Orahoske</b> (graduated with PhD from the PIs lab)	2017	Zhao A, Zheng Q, <u>Orahoske CM</u> , Idippily ND, <u>Ashcraft MM</u> , <u>Quamine A</u> , Su B. <i>Bioorg Med Chem Lett</i> . 2018 Feb 15;28(4):727-731.
<b>Myah S Marbury</b>	2017	Orahoske CM, Afrin M, Li Y, Hanna J, <u>Marbury M</u> , Li B, Su B*. Identification of Prazosin as a Potential Flagellum Attachment Zone 1(FAZ1) Inhibitor for the Treatment of Human African Trypanosomiasis. <i>ACS Infect Dis</i> . 2022 Aug 12;8(8):1711-1726.
<b>Abboud Sabbagh</b>	2018	Zhao A, Li Y, Orahoske CM, Schnur B, <u>Sabbagh A</u> , Zhang W, Li B, Su B. <i>Bioorg Med Chem</i> . 2019 Apr 15;27(8):1517-1528.
<b>Jovana Hana</b>	2019	Li Y, Orahoske CM, Geldenhuys WJ, Bhattarai A, <u>Sabbagh A</u> , Bobba V, Salem FM, Zhang W, Shukla GC, Lathia JD, Wang B, Su B*. Small-Molecule HSP27 Inhibitor Abolishes Androgen Receptors in Glioblastoma. <i>J Med Chem</i> . 2021 Feb 11;64(3):1570-1583.
<b>Raina Dano</b> (Grad student at Cleveland Clinic)	2021	Li Y, Orahoske CM, <u>Dano R</u> , Zhang W, Li B, Su B*. Pharmacokinetic study of an anti-trypanosome agent with different formulations and administration routes in mice by HPLC-MS/MS. <i>Biomed Chromatogr</i> . 2021 Oct;35(10):e5169.
<b>Shannon Urmetz</b> (Grad student at CSU)	2021	Li Y, <u>Dano R</u> , <u>Li C</u> , Zhang W, Lathia JD, Wang B, Su B*. Pharmacokinetic and brain distribution study of an anti-glioblastoma agent in mice by HPLC-MS/MS. <i>Biomed Chromatogr</i> . 2022 Jan 3;;e5310.

<b>Melanie Erickson</b>	2021	Li Y, Orahoske CM, <u>Urmetz SM</u> , Zhang W, Huang Y, Gan C, Su B*. Identification of estrogen receptor down-regulators for endocrine resistant breast cancer. <i>J Steroid Biochem Mol Biol.</i> 2022 Aug 4;224:106162.
<b>Aidyn S Johnson</b> (Grad student at CSU)	2022 2023	Yaxin Li, Cody Orahoske, Fatma Salem, <u>Aidyn Johnson</u> , <u>Christia Tannous</u> , <u>Lucas Devole</u> , Wenjing Zhang, Justin D. Lathia, Bingcheng Wang, and Bin Su*. Lead Optimization of Androgen Receptor-HSP27 Disrupting Agents in Glioblastoma, <i>J. Med. Chem.</i> 2023, 66, 8, 5567–5583
<b>Lucas C Devole</b> (Grad student at CSU)	2022 2023	
<b>Christia Tannous</b>	2022	
<b>Kyle Santoro</b>	2023	

Over the past five years, a cohort of dedicated students has been enrolled in Independent Study (CHM379), Advanced Chemistry Lab (CHM479), and Senior Research (CHM489) within the laboratory of our Principal Investigator (PI). These students have committed 5-6 hours each week to collaborative work with the PI and our esteemed graduate students on various research projects. In these unique courses, students receive personalized mentorship in critical areas such as experimental design, data collection, and data interpretation, setting them apart from traditional laboratory courses. Depending on their individual interests, the PI tailors their experience by introducing them to a diverse range of research techniques, spanning from organic synthesis and analytical methodologies to cancer cell biology and western blotting assays. Moreover, the PI actively reaches out to local industry partners to explore internship opportunities for our students. This proactive approach greatly benefits those who aspire to secure employment upon graduation, as it equips them with valuable real-world experience and connections in their chosen field.

Student name	Time	CHM course	Credit hours
Ismaili, Enri	Spring 2017	CHM489	4
Walden, Amanda	Spring 2017	CHM489	3
Ismaili, Enri	Spring 2017	CHM489	3
Orahoske, Cody	Summer 2017	CHM379	4
Orahoske, Cody	Fall 2017	CHM379	3
Marbury, Myah	Fall 2017	CHM379	4
Gadowski, Elizabeth	Fall 2017	CHM489	4
Myers, Hope	Fall 2017	CHM489	3
Thompson, Jocelyn	Fall 2017	CHM379	3
Kingery, Drew	Spring 2018	CHM489	4
Meek, Connor	Spring 2018	CHM379	2
Thompson, Jocelyn	Spring 2018	CHM379	3
Kowalik, Marek	Summer 2018	CHM379	3
Michaels, Jamie	Summer 2018	CHM489	4
Quade, James	Summer 2018	CHM489	3
Sabbagh, Abboud	Fall 2018	CHM489	3
Florjancic, Maranda	Fall 2018	CHM489	4
Quade, James	Fall 2018	CHM379	2
Frey, Megan	Fall 2018	CHM379	3
Lewis, Carrie	Fall 2018	CHM379	3
Davis, Brian	Spring 2019	CHM379	4
Price, Paul	Spring 2019	CHM379	3
Worthley, Morgan	Spring 2019	CHM379	2
Hassouneh, Lila	Spring 2019	CHM489	3

<b>Dano, Raina</b>	Fall 2019	CHM379	3
<b>Hawk, Adam</b>	Fall 2019	CHM489	3
<b>Solovyova, Kseniya</b>	Fall 2019	CHM379	4
<b>Churley, Christopher</b>	Fall 2019	CHM379	4
<b>Alabsi, Sarah</b>	Fall 2019	CHM379	2
<b>Dano, Raina</b>	Spring 2020	CHM379	3
<b>Krylow, Jeremy</b>	Spring 2020	CHM379	3
<b>Milosavljevic, Marko</b>	Spring 2020	CHM379	4
<b>Solovyova, Kseniya</b>	Spring 2020	CHM489	4
<b>Imre, David</b>	Spring 2021	CHM379	1
<b>Savaliya, Mudra Rajenkumar</b>	Spring 2021	CHM479	5
<b>Dano, Raina</b>	Spring 2021	CHM489	3
<b>Krylow, Jeremy</b>	Spring 2021	CHM489	3
<b>Solovyova, Kseniya</b>	Spring 2021	CHM489	4
<b>Ekhomeri, Amjad</b>	Fall 2021	CHM379	3
<b>Erickson, Melanie</b>	Fall 2021	CHM489	3
<b>Kongai, Tracy</b>	Fall 2021	CHM489	5
<b>Urmetz, Shannon</b>	Fall 2021	CHM489	5
<b>Devole, Lucas</b>	Spring 2022	CHM379	1
<b>Ekhomeri, Amjad</b>	Spring 2022	CHM379	3
<b>Klatka, Hope</b>	Spring 2022	CHM479/489	4/4
<b>Teske, Jessica</b>	Spring 2022	CHM489	3
<b>Urmetz, Shannon</b>	Spring 2022	CHM489	4
<b>Devole, Lucas</b>	Fall 2022	CHM379	2
<b>Johnson, Aidyn</b>	Fall 2022	CHM379	3
<b>Tannous, Christia</b>	Fall 2022	CHM379	2
<b>Devole, Lucas</b>	Spring 2023	CHM379/479	1/3
<b>Hammer, Matigan</b>	Spring 2023	CHM379	1
<b>Wilt, Blake</b>	Spring 2023	CHM379	1
<b>Johnson, Aidyn</b>	Spring 2023	CHM479/489	3/1
<b>Santoro, Kyle</b>	Summer 2023	CHM479	6
<b>Allen, Seth</b>	Fall 2023	CHM379	2
<b>Greene, Mckenna</b>	Fall 2023	CHM379	3
<b>Ighneim, Sabreena</b>	Fall 2023	CHM379	3

## 2. Impact of an AREA Award on Investigator's Research Program:

Dr. Bin Su, an accomplished medicinal chemist specializing in cancer research, has played a pivotal role since joining CSU. Under his leadership, a team of CSU investigators, well-versed in medicinal and combinatorial chemistry, has fostered collaborative relationships with numerous biologists and computational chemists in the Greater Cleveland area. Dr. Su's contributions extend to partnering with distinguished researchers at Case Western Reserve University (CWRU) and the Cleveland Clinic, such as Dr. Justin Lathia, Drs. Khalid Sossey-Alaoui, Bingcheng Wang, Monica Montano, and David Danielpour from CWRU's cancer center. Together, they have successfully optimized lead compounds for drug development, resulting in multiple joint publications and grant submissions stemming from these fruitful collaborations. Noteworthy accomplishments include the 2012 Scott Hamilton CARES award, which funded the joint efforts of Dr. Su and Dr. Fredic Reu to develop non-nucleoside DNA methyltransferase inhibitors for hematological malignancies. Although not funded, Drs. Montano

and Danielpour's submission of a Department of Defense prostate cancer Idea Grant received positive feedback. Further highlighting Dr. Su's impact, a successful RO1 grant submission in August 2015 with Dr. Bingcheng Wang culminated in funding in April 2016, aimed at developing a novel glioma treatment. Currently, Dr. Khalid Sossey-Alaoui and Dr. Su are supported by an R01 grant, focusing on YB1 in triple-negative breast cancer. These collaborations underscore Dr. Su's active engagement within the local research community. His expertise in medicinal chemistry and pharmacokinetics is invaluable to biologists working on various diseases in Northeast Ohio. Continued extramural funding, exemplified by the AREA award, is essential for Dr. Su to sustain his groundbreaking research. With this support, he can continue to offer his drug discovery proficiency to fellow investigators in the region and create mentoring opportunities for undergraduate students.

a). The funds will allow more interaction of the PI as a medicinal chemist to interact with other biologists in the local research community and create an interdisciplinary research environment for the students in biomedical sciences.

b). The funds will allow for the training of additional undergraduate students in the PI's laboratory, completing portions of the research described in the present proposal. The goal is to have two to three undergraduates each semester (including summer), working on short or long-term projects, depending on their goals and availability. CSU is an affordable and often only opportunity for some student population to pursue higher education. It is important that our students have the opportunity to work with the same caliber of research-active faculty as those students who are in a position to attend more elite institutions. The PI is committed to this concept, and chose CSU as his workplace based upon this principle. Extramural support will allow him to continue a rigorous research program so that our undergraduate students are exposed to and obtain true research experience.

c). Undergraduate students work closely with the graduate students in the laboratory under the PI's direct supervision. These funds will provide strong research support for graduate students, who will take on two to three undergraduate students per semester so as to expand the number of undergraduates working in the lab. There are currently two graduate students are involved in the PI's project. In addition to their own research, they will play an important role in the undergraduate student research training.

### 3. A profile of the students of the applicant institute:

Cleveland State University (CSU) is a dynamic, urban institution that caters to a diverse student body of approximately 16,500 individuals, consisting of 11,000 undergraduates and 5,500 graduate students. Of this population, nearly 30% identify as members of racial minority groups, with African American students making up roughly 18%. In 2022, the College of Arts and Sciences (CAS) enrolled 3,512 students. The Department of Chemistry at CAS is responsible for providing chemistry courses to the entire university, offering both a B.S. in Chemistry and a B.S. in Pharmaceutical Science for undergraduate students. Graduates of our chemistry program have successfully landed positions in companies and laboratories such as Lubrizol Corporation, Sherwin Williams, NASA Glenn Research Center, BASF Corporation, Dow Chemical, as well as leading pharmaceutical companies such as Merck, Pfizer, Eli Lilly, Procter & Gamble, and Johnson & Johnson. Others have been accepted into top graduate programs in chemistry, or professional schools in medicine, law, and optometry at renowned universities such as Case Western Reserve University, Cleveland Clinic, and Ohio State University. Several of our students have even pursued careers in education and are now playing critical roles in teaching the next generation of scientists. With our new project, we are committed to attracting more female and minority students to STEM majors and providing them with the necessary tools and resources to succeed. We believe that by doing so, we can offer more opportunities to the next generation of scientists, who will undoubtedly make significant contributions to society.

One pivotal objective of this proposal is to expand hands-on training opportunities for our undergraduate students, with a particular emphasis on encouraging participation among women and those from racial minority backgrounds who are pursuing studies in the fields of chemistry and biomedicine. Through this initiative, we anticipate attracting a more diverse representation of female and minority students in STEM majors, thereby affording them greater access to research opportunities. This endeavor aligns with our commitment to nurturing the next generation of scientists who will play pivotal roles in shaping the future of science and innovation.

### 4. Research and Educational Environment at CSU:

CSU is ideally located in one of the top biomedical and health care cities in the US: Cleveland is identified as the nation's new healthcare innovation destination: [http://www.bioenterprise.com/images/company\\_assets/512F1C7F-0D64-4A5E-9D91-785DC064755F/2010VentureCapitalReport\\_b23b.PDF](http://www.bioenterprise.com/images/company_assets/512F1C7F-0D64-4A5E-9D91-785DC064755F/2010VentureCapitalReport_b23b.PDF).

CSU's aggressive research agenda is mirrored in the fact that 32% of the 17,500 students at the University are enrolled in graduate programs. In partnership with the Cleveland Clinic, the College of Arts and Sciences (CAS) offers 3 outstanding PhD programs –Regulatory Biology (Department of Biological, Geological and Environmental Sciences), Clinical-Bioanalytical Chemistry (Department of Chemistry), Adult Development and Aging (School of Health Sciences). Besides graduate program, CSU has a well-supported Honors program, serving the educational needs of academically talented undergraduate students, and providing them with a strong grounding in research.

At the university level, CSU faculty members are offered many incentives and opportunities to develop their research programs. Our Office of Sponsored Programs of Research (OSPR) offers a considerable variety of research support to CSU faculty and students. This includes a portfolio of internal funding opportunities, including a **Dissertation Research Award** (up to \$5,000), **Faculty Scholarship Initiative** (\$5,000), **Faculty Research Development** (up to \$25,000); **Graduate Faculty Travel Award Program**, as well as **Reduced Teaching Research Facilitation Program**, the latter providing faculty with protected time from teaching and service, in order to devote time to writing research grants and focus on funded research projects. OSPR has a Technology Transfer Office, which assists researchers to establish university-industry collaborations, to evaluate commercial potential of intellectual property (IP), and to take necessary steps to commercialize university-derived innovation, through protection of IP and subsequent licensing activities.

Gene Regulation in Health and Disease (GRHD) is a research program founded in 2008 at CSU and consists of a group of 15 extramurally-funded investigators from three COSHP departments– Department of Biological, Geological and Environmental Sciences (BGES); Department of Chemistry, Department of Physics. The center provides a platform for faculty member focusing on disease related research to exchange research ideas and obtain suggestions and advice. Based upon both quantity and quality of research publications, for which a GRHD member is corresponding author, GHRD is highly ranked among Molecular Genetics Centers in the country. An external Advisory Committee (Drs. Paul DiCorleto Ph.D. Staff, Institute Chairman, Lerner Research Institute, Cleveland Clinic, **Richard W. Hanson, Ph.D.** Leonard & Jean Skeggs Professor of Biochemistry, Case Western Reserve University School of Medicine, **Roy L. Silverstein, M.D.** John and Linda Mellows Professor and Chair, Department of Medicine, Medical College of Wisconsin, **George R. Stark, Ph.D.** Distinguished Scientist, Cleveland Clinic, Member of the U.S. National Academy of Science and Institute of Medicine and Fellow of the Royal Society of London) further supports the goals of GRHD. Members of our External Advisory Committee participate in GRHD monthly research presentations on a regular basis and give advice to the GRHD members. GRHD also receives financial support from COSHP in terms of funds equivalent to 25% of indirect costs. As the member of GRHD, the investigator Dr. Bin Su receives support from the center.

In terms of undergraduate education, the Department of Chemistry has offered BS of chemistry for many years. There are three tracks of the chemistry major including, American Chemical Society Certified B.S. Degree, B.S. Degree with Pre-Professional Training, and B.S. Degree with Teaching Licensure. These different tracks provide flexibility to students with different career plans. In 2009, Ohio Board of Regents has approved the Bachelor of Science in Pharmaceutical Science (BSPS) at Department of Chemistry at CSU. The new program further concentrates the department's research interest in biomedical sciences. Currently, there are **38** students involved in the BSPS program, and the enrollment of students in the program has increased significantly over the past several years. These students are interested about drug discovery and are looking for opportunities to strengthen their knowledge and skills in pharmaceutical sciences.

An active drug discovery laboratory will be a very good complement to the current research activities of the department. It will significantly strength the department's biomedical research power. The potential R15 support would enhance the research environment of CSU, and greatly benefit the educational programs and provide drug discovery research opportunities to the graduate and undergraduate students.

##### 5. Institutional support for the proposed research project:

CSU provides additional support for research active and extramurally funded faculty as follows:

*Teaching release time:* At the college level, CAS provides protected research time for our faculty who supervise Ph.D. students. The Program provides faculty who supervise Ph.D. students with 4-8 credit hours release time from teaching per academic year (AY), thus reducing teaching load by 1-2 courses.

*Travel stipends:* A competitive internal program exists to provide funds for travel to scientific meetings to present recent results for both faculty and students.

*Undergraduate student summer stipends:* The provost office provides summer grant for undergraduate students who have active research with faculty members. The grant can be used for part of the student summer salary and research related expending.

## **Facilities, Biohazards, and Office**

### 1. laboratories:

Dr. Su has been allocated 1,000 sq. ft. of dedicated laboratory space on the third floor of the Science Research Building. The space is divided into two sections, with 500 sq. ft. designated for Organic Chemistry and the other 500 sq. ft. assigned for Biochemistry research. The Organic Chemistry laboratory includes 4 rows of six-meter benches, 5 fume hoods, and 12 sinks. The lab is already equipped with essential instruments such as hotplate stirrers, oven, rotavapor, vacuum pump, glassware, analytical balance, UV detectors, and ultrasonic washer. The Biochemistry laboratory is also well equipped, with a Class II A/B3 Biosafety Cabinet, two Inverted Trinocular Microscopes with imagines taking function, a CO<sub>2</sub> incubator, a water-bath, several balances, three centrifuges, a Molecular device ID3-STD plate reader.

The department of Chemistry has several shared facilities, including a cold room and a dark room, which are available to all researchers. The Chemistry department also has a range of high-end equipment, such as the Beckman Coulter System Gold HPLC BioEssential 126/168 with autosampler, Varian 3900 gas chromatograph with Varian Saturn 2100 ion-trap mass spectrometer, Agilent 1100 series HPLC system with Bruker Daltonics esquire HCT ion-trap mass spectrometer, AB Sciex QTRAP 5500 LC-MS/MS system with Analyst and Lightsight software, AB Sciex QStar Elite LC-MS/MS system equipped with Nanospray II source, Beckman Coulter L400 plate reader, and Bruker 400MHz NMR.

### 2. Biohazards:

To safely handle biohazards in a research lab is critical, particularly for organic synthesis and infectious pathogens. The following steps will be taken to minimize potential accidents:

**Risk assessment and prevention:** The first step is to label biohazards in the lab and provide training and education to lab members on the hazards associated with them, as well as the proper procedures for handling and disposing of the materials.

**Personal protective equipment (PPE):** Proper PPE should be provided and used by all individuals who handle biohazardous materials. This may include gloves, gowns, masks, and eye protection.

**Containment:** Biohazardous materials should be stored and handled in appropriate containment devices, such as biological safety cabinets or autoclaves, and properly labeled.

**Disposal:** Biohazardous waste should be disposed of properly, in accordance with federal, state, and university regulations. This may involve autoclaving or chemical treatment, followed by disposal in designated biohazardous waste containers. In Su's organic chemistry laboratory, there is a hood specific designed for organic solvent waste in labeled containers, and every month the organic waste will be disposed of by environmental health and safety office of CSU.

**Emergency response:** In the event of a biohazard spill or exposure, we have established protocols for emergency response, including first aid and decontamination procedures.

**Regular inspections and monitoring:** Regular inspections and monitoring of biohazardous material handling areas should be conducted to ensure that all protocols and procedures are being followed and that any issues or concerns are addressed in a timely manner. The Environmental Health and Safety Office of CSU oversees the regulation and routinely checks labs to make sure protocols are in place.

### 3. Clinical:

Not applicable

### 4. Animal:

CSU has a centralized laboratory animal care and use program under the federal Animal Welfare Act (AWA) and Public Health Service (PHS) Policy for the Humane Care and Use of Laboratory Animals to the Institutional Laboratory Animal Care and Use Committee (ILACUC). The University program has Full Continued Accreditation by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC-I) and has a Public Health Services (PHS) assurance # A3554-01. This Institution has established an Institutional

Animal Care and Use Committee (IACUC), which is qualified through the experience and expertise of its members to oversee the Institution's animal program, facilities, and procedures. The IACUC consists of eight (8) members, and its membership meets the compositional requirements set forth in the PHS Policy at IV.A.3.b. A list of members is available through Office of Sponsored Program and Research (OSPR). The PI has a designated room in the facility and two active protocols for xenograft and pharmacokinetic study with mice.

5. Computers and software:

Dr. Su has a new hp core i5 vPRO desktop with two 22 inch hp monitors, another hp ELITEDESK with one 22 inch monitor, a Quad-Core Intel Xeon E5 Mac Pro, a 13-inch Intel Core i7 MacBook Pro, all installed with necessary professional software including Microsoft office, Chemdraw 22.2, GraphPad Prism9, Gpower3.1, Adobe Acrobat pro and Scifinder. There are two hp ELITEDESK with 22 inch monitors in the Lab. All the computers are connected to Xerox WorkCentre 5655 copier/printers in the department.

6. Office:

Dr. Su has a 120 sq. ft. office plus department secretarial support.