CURRICULUM VITAE

Murphy G. Brasuel

The Colorado College
Department of Chemistry
14 E. Cache la Poudre
Colorado Springs, CO 80903

Dept. phone: (719)-227-8256

E-mail: mbrasuel@ColoradoCollege.edu

Education

2002-2003 Postdoctoral, Toxicology, University of Michigan, Ann Arbor, MI
- Advisor: Professor Martin Philbert

1996-2002 Ph.D. Analytical Chemistry, University of Michigan, Ann Arbor, MI
- Thesis title: "Liquid Polymer Nanosensors for Intracellular Applications: Fibers and PEBBLEs".
- Advisor: Professor Raoul Kopelman

1992-1996 BA Chemistry, The Colorado College, Colorado Springs, CO

Teaching Experience and Laboratory Management Experience

2017-Present *Department of Chemistry and Biochemistry, Colorado College, Colorado Springs CO*
Associate Professor

2016-2017 *Department of Chemistry and Biochemistry, Colorado College, Colorado Springs CO*
Associate Professor and Chair.

2015-2016 *Department of Chemistry and Biochemistry, Colorado College, Colorado Springs CO*
Associate Professor and Co-Chair.

2011-2015 *Department of Chemistry and Biochemistry, Colorado College, Colorado Springs CO*
Associate Professor and Chair.

2004-2011 *Department of Chemistry and Biochemistry, Colorado College, Colorado Springs CO*
Assistant Professor

2003-2004 *Department of Chemistry, Colorado College, Colorado Springs CO*
Visiting Assistant Professor of Chemistry

1997-1998 *Introductory Chemistry Laboratory administrative teaching assistant, University of Michigan, Ann Arbor, MI*
- Under N. Kerner at the University of Michigan helped run the general chemistry laboratories and redesigned labs to fit replacement of single wavelength spectrometers with scanning wavelength spectrometers.

1996 *General Chemistry Teaching Assistant University of Michigan, Ann Arbor, MI*
- Served as a GSI (Graduate Student Instructor) for both general chemistry lecture courses and for the general chemistry laboratory.

1999-2000 *Laboratory Hazardous Waste and Safety Manager, University of Michigan, Ann Arbor, MI*

- Trained new graduate students on laboratory instrumentation and served as resource for the handling of laboratory waste and safety. Prepared the lab for and served as liaison during OSHA inspections.

Pedagogy Workshops

2004 PEW Consortium Workshop, Integrating Nanoscience and Nanotechnology into Physical Science and Mathematics Curricular, Lawrence University.

2007 POGIL (Process Oriented Guided Inquiry Learning) Implementation Workshop, Colorado College

2007 cCWCS (Center for Workshops in the Chemical Sciences) Forensic Science Workshop, Williams College.

2014 cCWCS (Center for Workshops in the Chemical Sciences) Advanced Chemistry and Art Workshop, Villanova University.

Research Experience

(July 2002 – October 2003) *University of Michigan, Ann Arbor, MI*
Postdoctoral research directed by Prof. M. Philbert on the application of nano-technology to the study of toxicology in single cells and live animals.

(May 1997-June 2002) *University of Michigan, Ann Arbor, MI*
Research directed by Prof. R. Kopelman on the development of submicron fluorescence-based sensors (600nm-bead diameter) for the purpose of non-invasive analyte monitoring inside single viable cells. Ion exchange and ion coextraction techniques were used to develop highly selective sensors for Na^+, K^+, and Cl-. Gene-gun and liposomal techniques were developed for the delivery of these spherical sensors to the cytoplasm of viable C6 glioma cells. Confocal and fluorescent imaging were used to monitor intracellular ion activities during cell perturbation.

(summer 1995) *University of New Mexico, Albuquerque, NM*
Project directed by Prof. C. Enke. Set up of Finnigan 4000-quadrupole mass spectrometer for undergraduate research laboratory. Also gained introductory knowledge on sector, time of flight and triple quadrupole mass spectrometers as well as experience with ion traps.

(summer 1994) *The Colorado College, Colorado Springs, CO*
Project directed by Prof. R. Bertrand and H. Drossman on the development of a "dip-stick" indicator test for caffeine. The project centered on the optimization of a sandwich ELISA (enzyme-linked immunosorbent assay) technique for caffeine with the goal of miniaturizing the optimized technique into a colorimetric indicator test.

College Service and Leadership

Directorship

2023-present Bridge Scholars Program Director

Standing committees

2019-2022 Chair Natural Science Executive Committee (NSEC)
2018-2019 Natural Science Executive Committee (NSEC) Committee on Instruction Rep
2015-2016 Natural Science Executive Committee (NSEC) Committee on Instruction Rep

2007-2011 Dean's Advisory Committee
2006-2007 Member of Minority Concerns committee
2005-2006 Member of The Colorado College Children's Center committee

Ad hoc and other committees
Spring 2023 Affirmative Action Advisory Group
2022-2023 Project 2024 Subcommittee on Time (Managing Resources and Observing Limits)
2021-2023 Colorado College Faculty Handbook Review Task Force Committee
2020-2022 Secretary-treasurer of the Colorado College Chapter of the American Association of University Professors (AAUP)
Spring 2020 Building CC Traditions Block Project Committee
Spring 2019 Advising Task Force
2007-2014 Sigma Xi local chapter treasurer

Search committees (outside department)
Fall 2022 Cognate Organismal Biology search
Fall 2022 Cognate targeted senior hire in mathematics and Computer Science
Spring 2020 Colorado College President search
Fall 2018 Cognate Physics search, Internal Dean of the Faculty search
Fall 2014 Cognate Department of Human Biology and Kinesiology (HBK) search
Summer 2006 Women's Concerns Representative D-I Programs Equipment Manager Search Minority Concerns Representative Head Coach of M/W Swimming and Diving and Director of Aquatics Search

Search committees (tenure track inside department)
Fall 2007 Tenure Track Biochemist Search
Fall 2011 Chair Tenure Track Organic Chemist Search
Fall 2012 Chair Tenure Track Inorganic Search
Fall 2013 Chair Tenure Track Bioorganic Chemist Search
Fall 2013 Chair Tenure Track Inorganic Chemist Search
Fall 2015 Tenure Track Bioorganic Chemist Search
Fall 2016 Tenure Track Organic Chemist Search
Fall 2016 Chair Tenure Track Analytical Chemist Search
Fall 2018 Renewable Term Lecturer Search
Fall 2019 Tenure Track Inorganic Chemist/Biochemist Search
Fall 2020 Renewable Term Lecturer Search

Scholarship Committees
2019-2023 Goldwater* Scholarship Program Faculty Representative
2004-2017 Goldwater Scholarship Program Faculty Representative
**Since the establishment of the Goldwater Scholarship in 1986 Colorado College has had a total of 26 scholarship recipients and honorable mentions. I have been directly involved with %92 of the CC awardees.*

Science Education and Communication
2005-2013 Colorado College Representative on the CSURF committee (Colorado Springs Undergraduate Research Forum), responsible for an annual research forum where students from The Air Force Academy, Colorado College, and the University of Colorado at Colorado Springs present work in all disciplines

Honors
2023 Verner Z. Reed Professorship in Natural Sciences
2012 Bob Pizzi Outstanding Faculty Advisor of the Year Memorial Award
2005-2007 John D. and Catherine T. MacArthur Assistant Professorship, Colorado College

1998-2002 Rackham Merit Fellowship (University of Michigan)
1997-1998 GAANN (Graduate Assistance in Areas of National Need) Teaching Fellowship
1996 LULAC (The League of United Latin American Citizens) National Scholarship Fund
1992-1996 Barnes Chemistry Scholarship

Professional Affiliations
American Chemical Society (ACS), Sigma Xi, The Scientific Research Society (an honor society; election to membership is based on proven research ability), American Association of University Professors (AAUP)

Publications
Brasuel, M. G., Bowman, A. C., Blanchett, C. J. K., and Bower, N. W., "Minimally Invasive Sequential Analyses of Questioned Paintings: Six Experiments in Art Authentication," Journal of Forensic Science Education, Accepted, October, 2023,

Bower, N. W., Brasuel, M., Fahrenkrug, E., and Cooney M. D., "Insights into Geographic and Temporal Variation in Fatty Acid Composition of Croton Nuts Using ATR-FTIR," International Journal of Analytical Chemistry, vol. 2018, Article ID 4739759, 8 pages, 2018. https://doi.org/10.1155/2018/4739759.

Wise, W., and Brasuel, M., "The current state of engineered nanomaterials in consumer goods and waste streams: the need to develop nanoproperty-quantifiable sensors for monitoring engineered nanomaterials," Nanotechnology, Science and Applications, 2011, **4**, 73-86.

Brasuel, M., McCarter, A. D., and Bower, N., "Forensic Art Analysis Using Novel Reflectance Spectroscopy and Pyrolysis Gas Chromatography – Mass Spectrometry Instrumentation," The Chemical Educator, 2009, **14**, 150-154.

Moding, E., Hellyer, J., Rank, K., Lostroh, P., and Brasuel, M., "Characterization of PEBBLEs as a Tool for Real-Time Measurement of *Dictyostelium discoideum* Endosomal pH," Journal of Sensors, 2009, vol. 2009, Article ID 235158.

Xu, H., Buck, S. M., Kopelman, R., Philbert, M. A., Brasuel, M., Ross, B. D., and Rehemtulla, A., "Photoexcitation-Based Nano-Explorers: Chemical Analysis inside Live Cells and Photodynamic Therapy," Israel Journal of Chemistry, 2004, **44**, 317-337.

Behrend, C. J., Anker, J. N., McNaughton, B. H., Brasuel, M., Philbert, M. A., and Kopelman, R., "Metal-Capped Brownian and Magnetically Modulated Optical Nanoprobes (MOONs): Micromechanics in Chemical and Biological Microenvironments," Journal of Physical Chemistry B, 2004, **108** (29), 10408 - 10414.

Buck, S. M., Lee Koo, Y. E., Park, E., Xu, H., Philbert, M. A., Brasuel, M. and Kopelman, R., "Optochemical nanosensor PEBBLEs: photonic explorers for bioanalysis with biologically localized embedding," Current Opinion in Chemical Biology 2004, **8**, 540–546.

Buck, S.M., Xu, H., Brasuel, M., Philbert, M. A., and Kopelman, R., Nanoscale probes encapsulated by biologically localized embedding (PEBBLEs) for ion sensing and imaging in live cells, Talanta 2004, **63**, 41–59

Lee Koo, Y. E., Cao, Y., Kopelman, R., Man Koo, S., Brasuel, M., and Philbert, M. A., "Real-Time Measurements of Dissolved Oxygen Inside Live Cells by Organically Modified Silicate Fluorescent Nanosensors," Analytical Chemistry 2004, **76**, 2498-2505.

Brasuel, M., Kopelman, R., Miller, T.J., and Philbert, M.A., "Liquid polymer nano-PEBBLEs for Cl^- analysis and biological applications", The Analyst, 2003, **128**, 1262-1267

Park, J. E., Brasuel, M., Behrend, C., Philbert, M. A., and Kopelman, R., "Ratiometric Optical PEBBLE Nanosensors for Real-Time Magnesium Ion Concentrations Inside Viable Cells," Analytical Chemistry 2003, **75**, 3784-3791.

Monson, E., Brasuel, M., Philbert, M. A., and Kopelman, R., Chapter 59, PEBBLE Nanosensors for In Vitro Bioanalysis, In "Biomedical Photonics Handbook," Vo-Dinh, T., Ed., March 2003, CRC press.

Brasuel, M., Kopelman R., Philbert, M. A., et. al., "Production, Characteristics and Applications of Fluorescent PEBBLE Nano-Sensors: Potassium, Oxygen, Calcium and pH Imaging Inside Live Cells," Review, in Sensors and Materials, Barker, S., Ed., (M.Y.U. KK, Tokyo, Japan) 2002, 14, 309-338

Brasuel, M., Kopelman R., Kasman I., Miller T.J., and Philbert M.A., "Ion Concentrations in Live Cells From Highly Selective Ion Correlation Fluorescent Nano-Sensors for Sodium," Proceedings of IEEE sensors, 2002.

Brasuel, M., Kopelman R., et. al. (2002). Chapter 16, Pebble Nanosensors for Real Time Intracellular Chemical Imaging, In "Optical Biosensors: Present and Future," Ligler, F., S., and Taitt, C., A., June 2002, Elsevier.

Brasuel, M., Kopelman R., et. al. "Fluorescent Nanosensors for Intracellular Chemical Analysis: Decyl Methacrylate Liquid Polymer Matrix and Ion Exchange Based Potassium PEBBLE Sensors With Real Time Application to Viable Rat C6 Glioma Cells," Analytical Chemistry 2001, **73**, 2221-2228.

Miller, M., Brasuel, M., Kopelman, R., et. al. "Optochemical Nanosensors for Intracellular Chemical Measurement," SPIE (Int. Soc. Opt. Eng.) Proc. 1999, 3540, 198-205.

Clark, H., Brasuel, M., Kopelman R., et. al. "Subcellular Optochemical Nanobiosensors: Probes Encapsulated by Biologically Localized Embedding (PEBBLEs)," Sensors and Actuators B 1998, **51**, 12-16.

Regional and National Meeting Presentations

ACS Central Regional Meeting,

- 2000, Poster presentation, "Liquid Polymer Nano-Optodes for Biological Applications."

ACS National Meeting

- 2007, Poster Presentation, "Coumarin 343 PEBBLEs Selectively Monitor Intracellular Magnesium Ion Concentrations Inside *Dictyostelium discoideum*," Everett J. Moding*, and Murphy Brasuel.
- 2007, Poster Presentation, "Size Optimization of Estrogen Imprinted Polymers in Non-fluorinated Solvents," Benjamin L Custer*, and Murphy Brasuel.
- 2007, Poster Presentation, "Dictyostelium discoideum: A Platform for the Screening of Intracellular Nanosensor Performance," Kevin M. Rank*, and Murphy Brasuel.
- 2008, Poster Presentation, "Application of PEBBLEs as a novel tool for pH and calcium measurement in *Dictyostelium discoideum*," Jessica A Hellyer*, Everett Moding*, and Murphy G. Brasuel.
- 2010, Poster Presentation, "Exploration Into an Optical Sensor for Capsaicinoids," Marie Trujillo* and Murphy Brasuel
- 2011, Poster Presentation, "PEBBLEs as a tool for monitoring intracellular ion flux in *Dictyostelium discoideum* during bacteria/ cell host/guest interaction," Leah Chibwe*, Henok Yemam*, and Murphy Brasuel
- 2011 Poster Presentation, "Characterization of sulfur substitution on crown ether ion selectivity," Frederick T Chen*, Murphy Brasuel, and Brandon English
- 2011 Talk, "Forensic chemistry, archeological chemistry, and art chemistry: Frameworks for innovative analytical chemistry instruction at multiple levels," Murphy G. Brasuel and Nathan Bower

- 2014 Poster Presentation, “Fabrication and characterization of Cu_2ZnSnS (CZTS) using microwave assisted one-pot synthesis and varying pH,” Paul Todd*, Hannah Kim*, and Murphy Brasuel
- 2014 Poster Presentation, “Quantification of *Salmonella* disruption of normal proton channel function in *Dictyostelium discoideum.”* Taylor Kelson* and Murphy Brasuel
- 2022 Poster Presentation, “Analysis of volatiles and nectar from flowers of *Pleurothallis* subgenus *Ancipitia* to determine if *P. Crocodiliceps* group species are pollinated by deception.” Anusha Vajrala*, Isobel Hensley*, Murphy Brasuel, and Mark Wilson
- 2022 Poster Presentation, “Phytochemical characterization of ninety-two Rosinweed (*Silphium integrifolium*) Genotypes: GC-MS profiles and their chemometric analysis.” Ayush Chitrakar*, Yiren Zhang*, Blaze Johnson, Ebony Murrell, Edy Chérémond, and Murphy Brasuel

Denotes undergraduate researcher

ANACHEM/SAS Symposium,

- 1997, Poster presentation, “Robust Miniaturized Potassium Selective Optical Sensors for Extracellular use.”

Biennial Conference on Chemical Education (BCCE),

- 2008, Oral presentation, “Comparison of Art-Chem & Forensic Science for Fostering Critical Thinking in Chemistry,” Nate Bower and Murphy Brasuel.
- 2010, Oral presentation, “Forensic Art Analysis: A Way to Teach Analytical Chemistry Skills at Multiple Levels,” Murphy Brasuel and Nate Bower.

Federation of Analytical Chemistry and Spectroscopy Societies (FACSS),

- 1998, Oral presentation, “Potential-Sensitive Optodes for Optically Recording Transmembrane Voltage and Analyte Activity.”
- 1999, Oral presentation, “Liquid Polymer Nano-Optodes for Measurement of Analytes Poorly Detected by Fluorescent Free Dye.”
- 2000,Oral presentation, Ion Concentration in Live Cells From Highly Selective Ion Correlation Fluorescent Nano-Sensors.”
- 2008, Invited Oral presentation, The application of nano-sensors to the real-time monitoring of endosomal ion fluctuation in *Dictyostelium discoideum* during cAMP stimulation; Murphy Brasuel[1], Phoebe Lostroh[2], Jessica Hellyer[1], Everett Moding[1]; 1Colorado College Department of Chemistry, 2Colorado College Department of Biology

Institute of Electrical and Electronics Engineers (IEEE) Sensors,

- 2002, Invited talk, “Ion Concentrations in Live Cells From Highly Selective Ion Correlation Fluorescent Nano-Sensors for Sodium.”

The Midstates Consortium for Math and Science Undergraduate Research Symposia,

- 2005, Poster Presentation, “Optimization of the Synthesis of CdTe Quantum Dots in Non-Coordinating Solvent,” Joseph Forrester*****, Murphy Brasuel, Nate Bower.
- 2005, Poster Presentation, “*Dictyostelium Discoideum* as a Robust Platform for Intracellular Nanosensor Characterization,” Kevin Rank*****, Murphy Brasuel, and Phoebe Lostroh.
- 2007, Poster Presentation, “Application of PEBBLEs as a Novel Tool for Calcium Measurement in *Dictyostelium discoideum*,” Jessica Hellyer*, Everett Moding*, Kevin Rank*, Phoebe Lostroh, and Murphy Brasuel.
- 2007, Poster Presentation, “Statistical Optimization of a Single-Pot Synthesis of CdTe/CdS Core-Shell Quantum Dots,” Laura Sherman* and Murphy Brasuel.
- 2009, Poster Presentation, “pH Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction,” Mengyi Cao*, Leah Chibwe*, Margaux Miller*, Phoebe Lostroh, and Murphy Brasuel.
- 2010, Poster Presentation, “Optical Spectroscopic Quantification of Capsaicinoid Content in Chili Peppers,” Bryce Ingram* and Murphy Brasuel

- 2018, Poster Presentation, “Nutritional Analysis of Croton Nuts to Determine Suitability for Animal Feed,” Israel Ashiagbor* and Murphy Brasuel
- 2019, Poster Presentation, “Optimization of red-emitting carbon quantum dot sensors for measuring H^+ and Mg^{2+} in *Dictyostelium discoideum,”* Rosa Mallorson* and Murphy Brasuel
- 2020, Poster Presentation, “Extraction and Analysis of Volatiles from Flowers of the Orchid Genus *Pleurothallis*,” Isobel (Izzy) Hensley*, Murphy Brasuel and Mark Wilson
- 2022 Poster Presentation, “Phytochemical characterization of ninety-two Rosinweed (*Silphium integrifolium*) Genotypes.” Yiren Zhang*, Ayush Chitrakar*, Blaze Johnson, Alex Griffin, Ebony Murrell, and Murphy Brasuel

***Denotes undergraduate researcher*

Pittsburgh Conference (Pittcon),

- 1998, Poster presentation, “Preparation and characterization of Fiberless Nano-Optodes.”
- 1999, Oral presentation, “Novel Matrix for Liquid Polymer Optochemical PEBBLE Sensors.”
- 2000,Two oral presentations, “Ionophore based Nanosensors for use inside Living Cells,” and “Cloaked Nano-Optodes for Biological Applications.”
- 2001, Oral presentation, “Continued Development of the PEBBLE Nano-Sensor: Fabrication, Characterization and Application of Fluorescent Anionic Nano-Sensors.” Poster presentation, “Fabrication, Characterization and Application of Cationic Fluorescent PEBBLE Nano-Sensors.”
- 2002, Oral presentation, “Intracellular Applications of Anion Sensing liquid Polymer PEBBLE optodes.”
- 2003, Oral presentation, “Monitoring Anions in Single Living Cells in Real Time Utilizing Highly Selective Submicron Nano-Optodes.”
- 2008, Poster presentation, “Statistical Optimization of a Single-Pot Synthesis of CdTe/CdS Core Shell Quantum Dots,” Laura Sherman*, and Murphy Brasuel.
- 2010, Poster presentation, “Synthetic Optimization and Characterization of Type I and Type II Core/Shell Cadmium Chalcogenide Quantum Dots for Use in Polymer/Quantum Dot Photovoltaic Energy Production,” Spencer Williams* and Murphy Brasuel.
- 2017, Poster presentation, “Advancements Toward Fabrication of a Modified Carbon Quantum Dot as a Biocompatible Real-Time pH Sensor,” Alexander P. Flugel* and Murphy Brasuel.

***Denotes undergraduate researcher*

Sigma Xi, The Scientific Research Society, Pikes Peak Chapter

- 2004, Invited speaker, "Nano-Optical Sensors from 'Inner Space' to Mountaintop"
- 2009, Invited speaker, “The Qualitative and Quantitative Determination of the Pungency of Chili”

Innovations in the Scholarship of Teaching and Learning at Liberal Arts Colleges, Wabash, 2009.

- 2009, Poster presentation, “Student-Reported Learning Gains and the Use of Writing Portfolios as a Bridge Between General Chemistry and Forensic Science,” Nathan W. Bower and Murphy Brasuel.

Funding at Colorado College

Internal Funded Grants

- Summer 2005, Faculty-Student Collaborative Research Grant, “*Dictyostelium discoideum* as a Robust Platform for Methods Development for the Study of Ion-Flux with Nano-Scale Sensors.” Student: Kevin Rank
- Summer 2006, Faculty-Student Collaborative Research Grant, “Polymer Imprinting for the Selective Batch Extraction and Quantification of Steroids and Steroidal Compounds from Wastewater Streams.” Student: Benjamin L. Custer
- Summer 2007, Faculty-Student Collaborative Research Grant, “The Application of Novel Nano-Sensors to the Quantification of cAMP Induced Calcium and Magnesium Flux in *Dictyostelium Discoideum*.” Student: Jessica A Hellyer

- Summer 2009, Faculty-Student Collaborative Research Grant, “Fabrication, and Characterization of Na^+ Nano-Sensors for Real Time Monitoring of Viral Manipulation of Eukaryotic Cell Function.” Student: Henok Yemam
- Summer 2010, Faculty-Student Collaborative Research Grant, “Exploration of Analytical Methods for Probing the Toxicity of Nanomaterials.” Student: Kelsey Wise
- Summer 2014, Faculty Opportunity Grant, Literature research for review article for Methods and Applications in Fluorescence. Wet lab work on the fabrication and characterization of carbon q-dot based sensors. Student: Swetha Charles
- Summer 2016, Faculty-Student Collaborative Research Grant, “*Impact of pathogens on the function of proton channels in D. discoideum.*” Student: Alexander Flugel
- Summer 2018, Faculty-Student Collaborative Research Grant, “*Nutritional evaluation of Croton nut protein through LC/MS/MS,*” Student: Israel Ashiagbor
- Summer 2019, Faculty-Student Collaborative Research Grant split between two students, “*Optimization of a quinoxaline colorimetric assay for the quantification diacetyls in beers,”* Student: Aaron Cronin, “*Optimization and Characterization of Carbon Quantum Dots for Application in Mg^{2+} Sensors for Biological Applications*,” Student: Rosa Mallorson
- Summer 2020, Faculty-Student Collaborative Research Grant, “*GC-MS Analysis of Floral Volatiles in the Orchid Genus Pleurothallis,”* Student: Isobel (Izzy) Hensley
- Summer 2021, Julia E. and Kenneth G. Bower Family Award in Chemistry and Biochemistry, “Phytochemical characterization of ninety-two Rosinweed (*Silphium integrifolium*) Genotypes: GC-MS profiles and their chemometric analysis.” Student: Yiren (Elaine) Zhang
- Summer 2021, Faculty-Student Collaborative Research Grant, “Application of Carbon Quantum Dot Constructs for Fluorescent Monitoring of Environmental and Biological Cation Flux.” Student: Fernando Marco Gomez
- Summer 2023, Faculty-Student Collaborative Research Grant, “Isolation and Characterization of Insecticidal Phytochemicals from *Silphium* Leaves.” Student: Simone Zhang
- Summer 2023, Julia E. and Kenneth G. Bower Family Award in Chemistry and Biochemistry, “Analysis of Volatiles from Flowers of *Pleurothallis* Subgenus *Ancipitia (Orchidaceae)*” Student: Ashlyn C Walker

External Funded Grants

- 2009 3 year, $60,000 Merck/AAAS Undergraduate Science Research grant Nate Bower, professor of chemistry; Marc Snyder, associate professor of biology; Murphy Brasuel, assistant professor of chemistry; Margaret Daugherty, assistant professor of chemistry; Phoebe Lostroh, assistant professor of biology; and Nancy Huang, assistant professor of biology
- 2014, $204,047 National Science Foundation Major Research Instrumentation (NSF-MRI) Award Acquisition of High Performance Liquid Chromatography Tandem Mass Spectrometry Instrument to Support Research and Undergraduate Education in Southern Colorado

Undergraduate Research Students

- In my career at Colorado College, I have mentored ≈ 100 student research projects. A full list of students appears in Appendix 1.

Articles Reviewed for:

The Chemical Educator
ACS Nano Letters
NSF grant applications
Recent Patents on Engineering
Applied Physics A
Journal of Environmental Sciences

Appendix
Undergraduate Research Students

2005 Joseph D. Forrester (Research block, part time summer research) “Optimization of the Synthesis of CdTe Quantum Dots in Non-Coordinating Solvent” (2005 Poster, PEW Midstates Science and Mathematics Consortium Undergraduate Research Symposia).

Alden J. Parker ’07 (10 weeks summer research) Use of imprinted polymer for the separation of Capsaicin from Dihydrocapsaicin by HPLC (Results used to develop lab “Imprinted Polymer as a HPLC Stationary Phase for the Identification and Separation of Cholesterol from Archeological Samples”).

Kevin M. Rank ’07 (10 weeks summer research) “Dictyostelium discoideum as a Robust Platform for Intracellular Nanosensor Characterizations” (2005 Poster, PEW Midstates Science and Mathematics Consortium Undergraduate Research Symposia).

2006 Frank L. Bauer ’06 (Research Block) “A Study of Reaction Rates (Kinetics): The Photodecomposition of Fluorescein by TiO_2” (Developed as a lab for second semester general chemistry students).

Benjamin L. Custer ’06 (10 weeks summer research) “The Optimization of Spherical Imprinted Polymer Using Non-Flourinated Solvents” (Poster presentation 2007 ACS National Meeting).

Everett J. Moding ’08 (10 weeks summer research BARNES) Fabrication of Calcium selective nano-sensors for the measurement of Calcium in *Dictyostelium discoideum* during cell aggregation (Poster presentation 2007 ACS National Meeting).

Toan P. Nguyen ’07 (Part time summer research) Comparison of Atomic Absorption (AA) and complexometric titrations for the verification of Ca^{2+} and Mg^{2+} concentrations in buffers for the study of divalent ion stabilization of RNA folding.

Kevin M. Rank ’07 (Research Block) Development of Calcium nano-sensors using matrix co-localized Quantum Dots as a fluorescent reference peak (Poster presentation 2007 ACS National Meeting).

2007 Blake Schnebly ’07 (Independent Writing Block) “Ion-Selective Bulk Optodes for the Determination of Cations in Aqueous Samples, Fabrication and Characterization of an Optode for the Undergraduate Curriculum” (Submitted to The Chemical Educator, currently in preparation for re-submission).

Alexis D. McCarter ’08 (Research Block) “Reflectance Spectral Analysis of Palette Mixtures in Paintings, Currencies, and their Forgeries” (Article published 2009).

Kristen Houser (Research Block) “Determination of capsaicin and dihydrocapsaicin in peppers using molecularly imprinted polymers”

Melissa H. Weinrobe ’08 (Research Block) “Quantification of 17β-estradiol from wastewater effluent using molecularly imprinted polymer” (Senior Seminar).

Everett J. Moding ’08 (Research Block) “Fabrication of pH selective nano-sensors for the measurement of Calcium in Dictyostelium discoideum during cell aggregation” (Data combined with Jessica’s for presentation at the Spring 2008 National ACS meeting, published in 2009 Journal of Sensors).

Jessica Hellyer ’09 (10 week faculty/student collaborative research) “Application of PEBBLEs as a novel tool for pH and calcium measurement in Dictyostelium discoideum” (Poster at 2007 PEW

Midstates Science and Mathematics Consortium Undergraduate Research Symposia, Abstract accepted for presentation at the spring 2008 National ACS meeting).

Laura D. Sherman ’08 (10 week faculty/student collaborative research BARNES) “Statistical Optimization of a Single-Pot Synthesis of CdTe/CdS Core-Shell Quantum Dots” (Poster at 2007 PEW Midstates Science and Mathematics Consortium Undergraduate Research Symposia, Abstract accepted for presentation at the spring 2008 Pittsburg Conference).

2008 Alexis D. McCarter ’08 (Research Block 8, 2008, co-directed with Bower) “Offline Pyr-GC-MS (Pyrolysis Gas Chromatography-Mass Spectroscopy) for the Identification of Paint Binding Media in Oil and Acrylic Paint” (Article published 2009).

Katrina Koc’09 (10 week faculty/student collaborative research BARNES) “Fabrication of Sol-Gel sensors for Ion Measurement During RNA/DNA Cation Mediated Folding” (Research continued Block 5, 2009).

2009 Leah Chibwe ’11 (10 weeks of summer research funded by Merck/AAAS grant) “pH Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction” (Poster to be presented at 2009 PEW Midstates Science and Mathematics Consortium Undergraduate Research Symposia)

Mengyi Cao ’11 (10 weeks of summer research funded by Merck/AAAS grant) “pH Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction” (Poster to be presented at 2009 PEW Midstates Science and Mathematics Consortium Undergraduate Research Symposia, work continued block 2, 2009)

Henok A. Yemam ’12 (10 week faculty/student collaborative research) “Fabrication, and Characterization of Na+ Nano-Sensors for Real Time Monitoring of Viral Manipulation of Eukaryotic Cell Function.” (shifted to the development of Mg^{2+} sensors for the same purpose)

Spencer T. Williams ’10 (10 weeks summer research) “Synthetic Optimization and Characterization of Type I and Type II Core/Shell Cadmium Chalcogenide Quantum Dots for Use in Polymer/Quantum Dot Photovoltaic Energy Production.” (Abstract accepted for 2010 Pittsburg conference)

Marie D. Trujillo ’10 (Research Block 1, 2009) “Design and Characterization of an Optical Sensor for Capsaicin.” (Data presented at Senior Seminar, abstract accepted for Spring 2010 National ACS meeting)

2010 Leah Chibwe ’11 (10 weeks of summer research funded by Merck/AAAS grant) “Magnesium Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction” (poster presentation given at the Spring 2011 ACS national meeting)

Henok A. Yemam ’12 (10 weeks of summer research funded by Merck/AAAS grant) “Magnesium Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction” (poster presentation given at the Spring 2011 ACS national meeting)

Jonathan E. Dorsey ’12 (10 weeks summer research) “Development of Rapid Optical and Electrochemical Methods for the Quantification of Capsaicin in Fresh and Dry Peppers”

Bryce M. Ingram ’12 (6 weeks summer research) “Development of Rapid Optical and Electrochemical Methods for the Quantification of Capsaicin in Fresh and Dry Peppers”

Kelsey Wise ’12 (10 week faculty/student collaborative research) “Review of Analytical Methods for Probing the Toxicity of Nanomaterials”

Frederick T Chen ’11 (3 blocks of research 2010-11 school year) Organic synthesis of ionophores for analytical applications co-supervised by Brandon English (visiting organic chemist) (poster presentation given at Spring 2011 National ACS meeting)

2011 Henok A. Yemam ’12 (10 weeks of summer research funded by Belan Fund) Continued work on “Magnesium Selective PEBBLE Nano-Sensors for the Exploration of the Mechanisms of Bacteria/Eukaryotic Cell Interaction” (poster presentation given at the 2012 Pittsburg Conference)

Travis (Justine) Garoutte ’12 (1 block of research 2011-12 school year) Medical Forensics and development of labs for a forensic science course.

James Park ’12 (1 block of research 2011-12 school year) Fabrication and application of graphene to electrochemistry. (Data presented as senior seminar, poster presentation at 2012 CSURF)

2012 Jordan DeGayner ’12 (1 block of research 2011-12 school year) Optimization and utilization of Mg^{2+} PEBBLEs for real time magnesium measurements. (Poster presentation at 2012 CSURF)

Christopher C Dickinson ’12 (1 block of research 2011-12 school year) Optimization and utilization of Mg^{2+} PEBBLEs for real time magnesium measurements. (Data presented as senior seminar, poster presentation at 2012 CSURF)

Paul Todd ’13 (1 block of research 2011-12 school year). Fabrication and characterization of carbon based quantum dots.

Rachel K Wilson ’12 (1 block of research 2011-12 school year) Optimization and utilization of Mg^{2+} PEBBLEs for real time magnesium measurements. (Data presented as senior seminar, poster presentation at 2012 CSURF).

Kyle Buckwalder ‘13 (0.5 block of research 2011-12 school year, 10 weeks summer research, 0.5 block research 2012-13 school year) Optimization and utilization of Mg^{2+} PEBBLEs for real time magnesium measurements. (Data presented as senior seminar, poster presentation at 2012 CSURF, 2013 CSURF).

Nicholas Koch ’13 (1 block of research 2011-12 school year, 10 week summer research) Development and optimization of a field portable method for capsaicinoid quantification. (Data presented as senior seminar, poster presentation at 2012 CSURF).

Merritt Logan ’13 (1 block of research 2011-12 school year, 10 weeks summer research) Optimization of oxygen independent polymerization of polyacrylamide (block research). PEBBLE Nanosensors for the Measurement of Intracellular Magnesium Ion Concentration in Vivo (Summer, Data presented as senior seminar, poster presentation at 2013 CSURF).

Jimin Kim ’14 (10 weeks summer research) Use of pH Sensitive Nanosensors to measure proton influx/efflux in Wild Type and *Salmonella*-infected *D. discoideum.*

Taylor Kelson ’14 (10 weeks summer research) Use of pH Sensitive Nanosensors to measure proton influx/efflux in Wild Type and *Salmonella*-infected *D. discoideum.*

Kaleb Roush ’14 (10 weeks summer research, 1 block of research 2012-2013 school year) Use of PEBBLEs to Determine the Effect of *Salmonella* Infection on Calcium Signaling in *Dictyostelium Discoideum*.

Reed Hillmar ’13 (10 weeks summer research) Determination of a Reliable and Selective Detection Method for Titanium Dioxide and Quantification in Wastewater Effluent (Used for EV capstone paper, accepted as senior seminar when major changed from EV-chem to chemistry)

2013 Nikki Steinsiek ’13 (1 block or research 2012-2013 school year) PEBBLE Nanosensors for the Measurement of Intracellular Calcium Ion Concentration in Vivo (Data presented as senior seminar)

Natalie Nicholls ’13 (1 block or research 2012-2013 school year) Optimization and utilization of Mg^{2+} PEBBLEs for real time magnesium measurements in healthy and infected *D. discoideum*.

Taylor Kelson ’14 (1 block of research spring 2012-2013 school year, 1 block of research fall 2013-14 school year) Optimization of PEBBLE functionalization and delivery protocols, Review of polymer matrices and sensing components for pH sensing optical nano-sensors. (poster presentation given at Spring 2014 National ACS meeting)

Will Bowers ’13 (1 block of research 2012-2013 school year) EM (Electron Microscopy) determination of intracellular nanosensor localization.

Charles Curtis ’13 (1 block of research 2012-2013 school year) EM (Electron Microscopy) determination of intracellular nanosensor localization.

Qua Nguyen ’13 (1 block of research 2012-2013 school year) EM (Electron Microscopy) determination of intracellular nanosensor localization.

Kang-Min Kim ’15 (1 block of research 2012-2013 school year) Current field methods of THC quantification in persons suspected of impaired driving. Compare and contrast of methods used for drug testing when there is zero tolerance and methods that may useful in Colorado and Washington to determine impairment.

2014 Hannah Kim ’14 (1 block of research 2013-2014 school year) Fabrication and Characterization of Cu_2ZnSnS_4 (CZTS) using Microwave assisted one-pot synthesis and varying pH (poster presentation given at Spring 2014 National ACS meeting)

Paul Todd ’13 (December) (1 block of research 2013-2014 school year) Fabrication and Characterization of Cu2ZnSnS4 (CZTS) using Microwave assisted one-pot synthesis and varying pH (poster presentation given at Spring 2014 National ACS meeting)

Brandon Ogilvie ’14 (1 block of research 2013-2014 school year) pH Sensitive Fluorescent Carbon Quantum Dots And Their Application In Living *Dictyostelium discoideum* Cells (data presented as senior seminar)

Kwi (Peter) H Choi ’14 (3 blocks of research 2013-2014 school year) Microwave Assisted Fabrication of Carbon Quantum Dot Based Ion Sensors (data presented as senior seminar and as a poster presentation at the 2014 CSURF)

Audra Sherman ’15 (1 block of research 2014-2015 school year) Fabrication and Characterization of Acrylamide PEBBLEs for the Quantification of Intracellular Magnesium Levels Using Fluorescently Labelled Carbon Q-dots

Gabrielle Hinton ’15 (2 blocks of research in the 2014-2015 school year) Fabrication and Characterization of a Sensor to Monitor the Intracellular Calcium Flux in *D. discoideum* (data presented as senior seminar)

Haley Schroeder ’16 (1 block of research 2014-2015 school year) Application of Fluorescently Labeled Carbon Quantum Dots to *D. discoideum* for the Quantification of Intracellular Magnesium Levels (data presented as poster presentation at 2015 CSURF)

Harrison Huang ’16 (1 block of research 2014-2015 school year) Quantification of Anthropogenic Nanomaterials in the Environment (continued project in Fall of 2015)

Swetha Charles ’14 (10 weeks summer research) Literature research for review article for *Methods and Applications in Fluorescence*. Wet lab work on the fabrication and characterization of carbon q-dot based sensors.

2015 Lucy Hartshorn ’15 (1 block of research 2014-2015 school year) Quantification of Exercise Induced Salivary Cortisol Production, collaboration with Professor Anthony Bull, HBK (data presented as senior seminar, as a poster presentation at the 2015 CSURF, and as part of poster at the 2015 Rocky Mountain Chapter—American College of Sports Medicine in the poster presentation “*CORTISOL ACCUMULATION IN RELATION TO BLOOD LACTATE FOLLOWING 1.5 MILE RUN IN HIGHER AND LOWER FIT ATHLETES*”)

Brian Heng ’17 (2 blocks of research) 2014-2015 school year: Carbon-Nanotubes From Recycled Plastic: Fabrication, Characterization, and Toxicology Comparison to Commercially Available Nanomaterials 2015-2016 school year: Quantification of Capsaicin: Absorptive Stripping Voltammetry using MWCNT and N-Vanillylnonanamide Fluorescent Imprinted Polymers

Harrison Huang ’16 (1 block of research 2015-2016 school year) Investigations in Chemistry: Environmental Impact of Nanomaterials (Data from 2014 and 2015 combined for senior seminar)

Yinzhou (Peter) Chen ’17 (1 block of research 2015-2016 school year) Application of Nanotechnology to Art: Synthesis of Fluorescent Carbon Q-Dots Pigment

2016 Emma Reznick ’16 (1 block of research 2015-2016 school year) A conductive, flexible filament for use in 3D printing sensors (data presented as senior seminar and as a poster presentation at the 2016 CSURF)

Noah van Ekdom ’16 (1 block of research 2015-2016 school year) Molecularly Imprinted Polymers for Capsaicinoid Detection

Hannah Quick ’17 (1 block of research 2015-2016 school year) Utilization of Fluorescently Labeled Carbon Quantum Dots to Monitor Magnesium Level in *Dictyostelium discoideum* (data presented as senior seminar and as a poster presentation at the 2016 CSURF)

Alexander Flugel ’17 (1 block of research 2015-2016 school year, 10 weeks summer research) Fluorescently Labeled Carbon Quantum Dots as Real-Time Nanosensors, Impact of pathogens on the function of proton channels in *D. discoideum* (data presented as senior seminar, as a poster presentation at the 2016 CSURF, poster presented at the Spring 2017 Pittsburg Conference)

2017 Sam Brown ’18 (1 block of research 2016-2017 school year) Exploratory Analysis of Linalool Bioconversion by Brewing Yeast in a Model Dry-Hop System

Eric L. Houghteling December ’18 (1 block of research 2016-2017 school year) The Individual and Synergistic Antioxidant benefits of Phenols Found in Beer and the Antioxidant Benefits of 7 Different Beers

Jacob Lewis ’18 (1 block of research 2016-2017 school year) Exploring a new colorimetric approach for testing concentration of *diacetyls* in beers: using a visible wavelength absorbing

quinoxaline derivative of *diacetyl* (data presented as senior seminar, as a poster presentation at the 2018 CSURF)

Anya Taylor ’18 (1 block of research 2016-2017 school year, continued work during at time permitted during 2017-2018 academic year) Determining Arsenic Concentrations in Local Water Samples Using Cloud Point Extraction (data presented as senior seminar)

Chencheng (Jacqueline) Xu December ’18 (1 block of research 2016-2017 school year) Fluorescently Labeled Carbon Quantum Dots for Determination of Magnesium Level through Conjugation with Coumarin 343 (data presented as senior seminar)

2018 Israel Ashiagbor ’20 (10 weeks summer research) Nutritional Analysis of Croton Nuts to Determine Suitability for Animal Feed (data presented at the 2018 Midstates Science and Mathematics Consortium Undergraduate Research Symposia)

Eric L. Houghteling December ’18 (2 blocks of research 2018-2019 school year) A Square Wave Voltammetry Method for the Characterization of Antioxidants in beer (data presented as senior seminar)

2019 Israel Ashiagbor ’20 (2 blocks research) Genetic Comparison of Croton Nuts Utilizing 2-D Gel Isoelectric Focusing/Electrophoresis (data combined with 2018 data presented as senior seminar)

Aaron Cronin ’20 (5 weeks summer research) Optimization of a quinoxaline colorimetric assay for the quantification diacetyls in beers (data presented as senior seminar)

Rosa Mallorson ’20 (5 weeks summer research, 1 summer block research) Optimization and Characterization of Carbon Quantum Dots for Application in Mg^{2+} Sensors for Biological Applications (data presented as senior seminar, at 2019 Midstates Science and Mathematics Consortium Undergraduate Research Symposia, accepted for 2020 CSURF (cancelled due to COVID)

2020 Isobel (Izzy) Hensley ’21 (1 block research, 10 weeks summer research) GC-MS Analysis of Floral Volatiles in the Orchid Genus *Pleurothallis* (data presented as senior seminar and at 2020 Midstates Science and Mathematics Consortium Undergraduate Research Symposia)

Saket P. Mereddy ’22 (1 block research, 10 weeks summer research supported by Barnes Scholarship) Protein Quantification, Branch Chain Amino Acid Analysis, and Toxicological Evaluation on Croton Nuts to Determine Dietary and Medicinal Applicability

Jack D. Sedwick ’22 (1 block research) Exploring a New Spectroscopic Method for Quantification of Diacetyl Concentrations in Beer Utilizing Derivatization

Gregory M. Thompson ’22 (1 block research) Characterization and Modelling of Electron Transfer Rates in Carbon Quantum Dots

Fernando Gomez ’22 (10 weeks summer research supported by Alfred W. Alberts Summer Research Prize) Using Carbon Quantum Dots (CQDs) based fluorescence sensors to measure intracellular levels of Magnesium in *Dictyostelium Discoideum*

2021 Ayush Chitrakar ’22 (2 blocks research) Optimized Extraction and Initial Bioassay of Phytochemicals in *Silphium Integrifolium* (data presented as senior seminar, at the spring 2022 ACS National meeting and the 2022 Midstates Consortium for Math and Science Undergraduate Research Symposia)

Fernando Gomez ’22 (1 block research, 10 weeks summer research supported by Faculty-Student Collaborative Research Grant) Synthesis and Characterization of Carbon Quantum Dot (CQD)Based Nano sensors for Mg^{2+} (data presented as senior seminar)

Saket P. Mereddy ’22 (1 block research) Protein Quantification, Branch Chain Amino Acid Analysis, and Toxicological Evaluation of Croton Nuts to Determine Dietary Applicability (data presented as senior seminar)

Minh Pham ’23 (1 block research) Application of Carbon Quantum Dot Sensors for Enhanced Electrode Response: Cyclic Voltammetric Determination of Capsaicin

Jack D. Sedwick ’22 (1 block research) Optimization of a uHPLC Method for the Detection and Quantification of Diacetyl in Complex Beer Matrices (data presented as senior seminar)

Anusha Vajrala ’23 (10 weeks summer research supported by Barnes Scholarship) Analysis of volatiles and nectar from flowers of *Pleurothallis* subgenus *Ancipitia* to determine if *P. Crocodiliceps* group species are pollinated by deception (data presented at the spring 2022 ACS National meeting)

Greg Schmitt ’22 (1 block research) Analysis of a Nitrogen Rich Carbon Quantum Dot’s Electron Transfer Rate and Potential for Capsaicin Detection (data presented as senior seminar)

Bella Beattie ’22 (1 block research) Identification and Characterization of Toxic Protein Fractions in *Croton megalocarpus*

Yiren (Elaine) Zhang ’23 (1 block research, 10 weeks summer research supported the Julia E. and Kenneth G. Bower Family Award in Chemistry and Biochemistry) Phytochemical characterization of ninety-two Rosinweed (*Silphium integrifolium*) Genotypes: GC-MS profiles and their chemometric analysis. (data presented at the spring 2022 ACS National meeting and the 2022 Midstates Consortium for Math and Science Undergraduate Research Symposia)

Avery Newton ’22 (1 block research) Assay Development to Reliably Quantify Capsaicin Concentration in Chili Peppers (data presented as senior seminar)

2022 Judith Marquez ’22 (1 block research) Kinetic Assay used to Determine Concentrations of Capsaicinoids of Chili Powders (data presented as senior seminar)

Gregory M. Thompson ’22 (2 blocks research) Computational Analysis of Carbon Nanomaterials through Implementation of Density Functional Theory (DFT). Quantum Theory of Atoms in Molecules (QTAIM). Reduced Density Gradient (RDG) analysis. Simple Variational Quantum Monte Carlo (VMC) Diffusion Monte Carlo (DMC) (data presented as senior seminar)

Jared Mendiola ’22 (1 block research) Optimization of a Kinetic Assay for Quantification of Capsaicinoids in Chili Powders

2023 Nicole Chavarria ’23 (1 block research) Determination of the Physical Properties of the Purified Cannabinoids, Boiling Points and Heats of Vaporization (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Gabriel Katz ’25 (1 block research) Analysis of Volatiles from Flowers of *Pleurothallis* Subgenus *Ancipitia (Orchidaceae)* To Determine if the Phytochemicals Present are Consistent with Deceptive Pollination (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Ashlyn C Walker (1 block research, 10 weeks summer research supported by the Julia E. and Kenneth G. Bower Family Award in Chemistry and Biochemistry) Analysis of Volatiles from Flowers

of *Pleurothallis* Subgenus *Ancipitia (Orchidaceae)* To Determine if the Phytochemicals Present are Consistent with Deceptive Pollination (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Eli Turovsky ’24 (1 block research) Experimental Determination of the Boiling Point and Heat of Vaporization of Cannabinoids by Thermal Gravimetric Analysis (TGA) and Differential scanning calorimetry (DSC) (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Makenna C Wells ’25 (1 block research) Utilization of Microwave Synthesis Technology to Optimize the Fabrication and Isolation of Red-Emitting Carbon Quantum Dots (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Simeng (Simone) Zhang ’25 (1 block research, 10 weeks summer research supported by Faculty-Student Collaborative Research Grant) Optimization of Extraction Methods for the Qualitative Identification of Insecticidal Phytochemicals Found in Regionally Specific Phenotypes of *Silphium Integrifolium* (data presented at 2023 Colorado Springs Undergraduate Research Forum)

Shianne M Freeman ’25 (10 weeks summer research supported by Natural Science Divisional Research Funds) Optimization of Extraction Methods for the Qualitative Identification of Insecticidal Phytochemicals Found in Regionally Specific Phenotypes of *Silphium Integrifolium*