

# Nicole E. Friend

(760) 574-5733

nicole.friend-1@colorado.edu

www.linkedin.com/in/nicole-friend

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## Education

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### Postdoctoral Associate

University of Colorado, Boulder

Start: Sept. 2023

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### Doctor of Philosophy, Biomedical Engineering

University of Michigan, Ann Arbor

Start: Sept. 2017

Completed: Aug. 2023

### Master of Science in Engineering, Biomedical Engineering

University of Michigan, Ann Arbor

Start: Sept. 2017

Completed: April 2019

### Bachelor of Science, Bioengineering: BioSystems

University of California, San Diego

Start: Sept. 2013

Completed: June 2017

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## Peer Reviewed Journal Publications

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Margolis, E. A., Choi, L. S., **Friend, N. E.**, & Putnam, A. J. (2024) Engineering primitive multiscale chimeric vasculature by combining human microvessels with explanted murine vessels. *Sci Rep*, 14(1), 4036.

Hobson, E. C., Li, W., **Friend, N. E.**, Putnam, A. J., Stegmann, J. P., & Deng, C. X. (2023). Crossover of surface waves and the capillary-viscous-elastic transition in soft biomaterials detected by resonant acoustic rheometry. *Biomaterials*, 122282.

**Friend, N. E.**, Beamish, J. A., Margolis, E. A., Schott, N. G., Stegmann, J. P., & Putnam, A. J. (2023). Pre-cultured, cell-encapsulating fibrin microbeads for the vascularization of ischemic tissues. *J Biomed Mater Res A*, 1-13.

Margolis, E. A., **Friend, N. E.**, Rolle, M. W., Alsberg, E., & Putnam, A. J. (2023) Manufacturing the multiscale vascular hierarchy: Progress towards solving tissue engineering's grand challenge. *Trends Biotechnol*, 41(11), 1400-1416.

**Friend, N. E.\***, McCoy, A. J.\*, Stegmann, J. P., & Putnam, A. J. (2023). A combination of matrix stiffness and degradability dictate microvascular network assembly and remodeling in cell-laden poly (ethylene glycol) hydrogels. *Biomaterials*, 295, 122050.

Ky, A., McCoy, A. J., Flesher, C. G. **Friend, N. E.**, Li, J., Akinleye, K., Patsalis, C., Lumeng, C. N., Putnam, A. J., & O'Rourke, R. W. (2023). Matrix density regulates adipocyte phenotype. *Adipocyte*, 12 (1), 2268261.

Schott, N. G.\*, **Friend, N. E.\***, & Stegmann, J. P. (2020). Coupling osteogenesis and vasculogenesis in engineered orthopedic tissues. *Tiss Eng Part B Rev*, 27(3), 199-214.

**Friend, N. E.\***, Rioja, A. Y.\*, Kong, Y. P., Beamish, J. A., Hong, X., Habif, J. C., Bezenah, J. B., Deng, C. X., Stegmann, J. P., & Putnam, A. J. (2020). Injectable pre-cultured tissue modules catalyze the formation of extensive functional microvasculature in vivo. *Sci Rep*, 10(1), 1-16.

Bezenah, J. R., Rioja, A. Y., Juliar, B., **Friend, N.**, & Putnam, A. J. (2019). Assessing the ability of human endothelial cells derived from induced-pluripotent stem cells to form functional microvasculature in vivo. *Biotechnol Bioeng*, 116(2), 415-426

\* Co-first authors

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## Peer Reviewed Conference Publications

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**Friend, N. E.\***, Woodcock, C. S. E.\*, & Huang-Saad, A. (2021). Low-barrier strategies to increase student-centered learning. Paper presented at 2021 ASEE Annual Conference & Exposition held virtually. <https://peer.asee.org/low-barrier-strategies-to-increase-student-centered-learning>

Woodcock, C. S. E.\*, **Friend, N. E.\***, & Huang-Saad, A. (2019). Exploratory examination of an interdisciplinary engineering field: Tissue engineering and regenerative medicine. Paper presented at 2019 ASEE Annual Conference & Exposition, Tampa, Florida. <https://peer.asee.org/32801>

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## Posters and Presentations

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**Friend, N. E.**, Stegmann, J. P., & Putnam, A. J. Cell-encapsulating PEG microbeads support prevascularization in vitro and angiogenic sprouting in vivo. Poster Presentation. Society for Biomaterials 2023 Annual Meeting & Exposition in San Diego, California.

McCoy, A. J., **Friend, N. E.**, Zhang, I. W., & Putnam, A. J. Cell-mediated matrix stiffening accompanies vascular morphogenesis in both natural and synthetic hydrogels. Poster Presentation. Society for Biomaterials 2023 Annual Meeting & Exposition in San Diego, California.

Zhang, I. W., **Friend, N. E.**, Margolis, E. A., & Putnam, A. J. Cell-laden bead bath to support extrusion bioprinting of vascularized constructs. Rapid Fire Oral & Poster Presentation. Society for Biomaterials 2023 Annual Meeting & Exposition in San Diego, California.

Margolis, E. A., Choi, L. S., **Friend, N. E.**, & Putnam, A. J. Engineering hierarchical vascular chimeras by combining human microvessels with explanted murine vessels. Poster Presentation. TERMIS AM 2022 Annual Conference & Exposition in Toronto, Canada.

**Friend, N. E.**, Stegemann, J. P., & Putnam, A. J. Development of modular, cell-laden PEG microbeads for vascularization. Poster Presentation. Glenn V. Edmonson Lecture and 2022 Biomedical Engineering Symposium in Ann Arbor, Michigan.

**Friend, N. E.**, Stegemann, J. P., & Putnam, A. J. Development of modular, cell-laden PEG microbeads for vascularization. Rapid Fire Oral & Poster Presentation. Society for Biomaterials 2022 Annual Meeting & Exposition in Baltimore, Maryland.

Davidson, C. D., Kamen, J. L., Matera, D. L., **Friend, N. E.**, Putnam, A. J., Baker, B. M. Synthetic matrix fibers support 3D endothelial cell network assembly in fibrin hydrogels. Oral Presentation. Society for Biomaterials 2022 Annual Meeting & Exposition in Baltimore, Maryland.

Margolis, E. A., Choi, L. S., **Friend, N. E.**, & Putnam, A. J. Engineering hierarchical vascular chimeras by combining human microvessels with explanted murine vessels. Oral Presentation. Society for Biomaterials 2022 Annual Meeting & Exposition in Baltimore, Maryland.

Davidson, C. D., Kamen, J. L., Matera, D. L., **Friend, N. E.**, Putnam, A. J., & Baker, B. M. Synthetic matrix fibers support 3D endothelial cell network assembly in fibrin hydrogels. Poster Presentation. Biomedical Engineering Society 2021 Annual Meeting & Exposition in Orlando, Florida.

**Friend, N. E.**, Stegemann, J. P., & Putnam, A. J. Vascularization of degradable PEGNB hydrogels via coculture of endothelial and stromal cells. Oral Presentation. Society for Biomaterials 2021 Annual Meeting & Exposition held virtually.

**Friend, N. E.**, Beamish, J. A., Stegemann, J. P., & Putnam, A. J. Evaluating pre-vascularized microtissues in a mouse model of hindlimb ischemia. Poster Presentation. Society for Biomaterials 2019 Annual Meeting & Exposition in Seattle, Washington.

**Friend, N. E.**, Woodcock, C. S. E., Stegemann, J. P., & Huang-Saad, A. Y. An exploration of faculty perceptions of tissue engineering and regenerative medicine to inform biomedical engineering curriculum development. Poster Presentation. Society for Biomaterials 2019 Annual Meeting & Exposition in Seattle, Washington.

**Friend, N. E.**, Ungerleider, J. L., & Christman, K. L. Myoblast response to tissue specific extracellular matrix environments. Poster Presentation. Biomedical Engineering Society 2016 Annual Meeting & Exposition in Minneapolis, Minnesota.

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### Research Experience

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<b>Postdoctoral Associate</b>   <i>Dr. Kristi Anseth   Univ. of Colorado</i> Performing primary research focused on the delivery of vasculogenic and immunomodulatory extracellular vesicles within granular hydrogels for the regeneration of vascularized bone tissue.	<b>Sept. 2023 – Present</b>
<b>Graduate Student Researcher</b>   <i>Drs. Andrew Putnam &amp; Jan Stegemann   Univ. of Michigan</i> Performed research for my thesis focused on creating cell-encapsulating, vascularized microbeads using natural and synthetic materials for the therapeutic vascularization of ischemic tissues.	<b>Sept. 2017 – July 2023</b>
<b>Graduate Student Researcher (EER)</b>   <i>Dr. Aileen Huang-Saad   Univ. of Michigan</i> Performed engineering education research focused on broadly defining the field of biomedical engineering, with an emphasis on tissue engineering and regenerative medicine, to inform curriculum development and student career prospects.	<b>Sept. 2017 – July 2021</b>

<b>Undergraduate Researcher   Dr. Karen Christman   UC San Diego</b> Continued and expanded research from summer REU project to include additional cell types and extracellular matrix environments. Designed and optimized protocol for the decellularization and hydrogel fabrication of liver extracellular matrix.	<b>Sept. 2016 – June 2017</b>
<b>Bioengineering NSF-REU Summer Program   Dr. Karen Christman   UC San Diego</b> Designed and implemented an independent research project to determine the response of myoblasts to tissue-specific decellularized extracellular matrix environments.	<b>June 2016 – Sept. 2016</b>
<b>Undergraduate Researcher   Dr. Robert Sah   UC San Diego</b> Continued and expanded research from Genentech summer research program project to include comparison of lubrication properties between healthy and osteoarthritic synovial fluid samples.	<b>Aug. 2015 – June 2016</b>
<b>Genentech Summer Research Program   Dr. Robert Sah   UC San Diego</b> Performed friction and protein analysis to determine effect of selective digestion on human synovial fluid's lubricating properties.	<b>June 2015 – Aug. 2015</b>
<b>Faculty Mentor Program   Drs. Gary Vilke &amp; Edward Castillo   UC San Diego</b> Conducted clinical research analyzing the trends common among psychiatric medication adherence and emergency room utilization.	<b>Jan. 2015 – June 2015</b>
<hr/> <b>Teaching Experience</b> <hr/>	
<b>Graduate Student Instructor – BIOMEDE 474: Introduction to Tissue Engineering   Univ. of Michigan</b> Assisted with the laboratory component of the course which aimed to teach undergraduates foundational knowledge and basic hands-on skills in tissue engineering microvasculature.	<b>Aug. 2022 – Dec. 2022</b>
<b>Graduate Student Teaching Apprentice – Engineering the Cellular Microenvironment: An Introduction to Tissue Engineering Module   Univ. of Michigan</b> Designed and implemented a graduate student lead 4-week course which aimed to teach undergraduates foundational knowledge and basic hands-on skills in tissue engineering.	<b>Jan. 2019 – Mar. 2019</b>
<b>Teaching Assistant   UC San Diego</b> Worked closely with various professors to conduct UC San Diego's Introduction to Bioengineering course. Assisted underclassman students with project development and lead weekly group discussion sections.	<b>Jan. 2017 – Mar. 2017</b>
<hr/> <b>Scholarships and Funding</b> <hr/>	
<b>University of Michigan Rackham Research Exchange Travel Grant</b> Awarded to diverse doctoral students to increase their advancement into the most competitive research and teaching careers through funded visits to participating universities.	<b>Jan. 2020</b>
<b>University of Michigan Rackham Professional Development Grant</b> Awarded to doctoral students to offset the cost of participating in professional development opportunities.	<b>May 2019</b>
<b>University of Michigan Rackham Conference Travel Grant</b> Awarded to graduate students to offset the cost of traveling to conferences to present research.	<b>Feb. 2019, 2022, 2023</b>
<b>University of Michigan Tissue Eng. and Regeneration (TEAM) T32 Training Grant</b> An interdisciplinary research-intensive training program for individuals who wish to pursue careers with a focus in the area of tissue engineering and regenerative medicine – 2 years of funding.	<b>July 2018</b>
<b>University of Michigan Rackham Graduate Merit Fellowship</b> A fellowship awarded to graduate students who have demonstrated a sustained commitment to diversity in the academic, professional, or civic realm and come from an educational, cultural or geographic background that is underrepresented – 2.5 years of funding.	<b>Feb. 2017</b>

<b>Society for Biomaterials 2017 Cato T. Laurencin Travel Fellowship</b> A travel fellowship awarded to underrepresented minorities providing the resources to attend the annual meeting of the Society for Biomaterials.	Jan. 2017
<b>National Action Council for Minorities in Engineering (NACME) Scholarship</b> A scholarship awarded to talented underrepresented undergraduate minority engineering students.	Jan. 2016
<b>Genetech Summer Research Scholarship</b> A scholarship award to students with an interest in life sciences and biotechnology fields.	June 2015
<b>Awards and Honors</b>	
<b>Glenn V. Edmonson Scholarship</b> Awarded to students who are excelling in the BME graduate program, within the classroom, as a researcher, and/or through service and leadership.	Apr. 2022
<b>Society for Biomaterials 2019 Student Travel Achievement Recognition (STAR) Award</b> A travel fellowship awarded to students whose abstracts made an outstanding contribution to the 2019 Society for Biomaterials Annual Meeting in Seattle, Washington. Awarded for the abstract titled " <i>An Exploration of Faculty Perceptions of Tissue Engineering and Regenerative Medicine to Inform Biomedical Engineering Curriculum Development.</i> "	Apr. 2019
<b>UC San Diego Provost Honors</b> Awarded to students who receive above a 3.5 GPA for the quarter's coursework.	FA 2014, WI 2015, FA 2015, WI 2016, SP 2016
<b>Outreach</b>	
<b>Cientifico Latino Graduate Student Mentorship Initiative (CL GSMI)</b> Mentor senior undergraduates from underrepresented backgrounds through the process of applying for graduate school, including reviewing and providing feedback on application material and conducting mock interviews.	Sept. 2020 – Present
<b>BME Graduate Application Assistance Program (BME GAAP)</b> Mentor prospective graduate school applicants from non-traditional paths or historically disadvantaged backgrounds by reviewing application materials throughout the process of applying to BME PhD programs.	Sept. 2022 – Aug. 2023
<b>University of Michigan Science Education &amp; Engagement for Kids (UM-SEEK)</b> Helped 3 <sup>rd</sup> - 5 <sup>th</sup> grade students develop science competency at Estabrook Elementary School in Ypsilanti, Michigan through implementation of curriculum and hands-on activities to prepare them for the state-mandated M-STEP Exam.	Oct. 2019 – Feb. 2020
<b>University of Michigan Discover Engineering</b> Helped with annual Discover Engineering event by leading lab tours to introduce middle school students to various types of tissue engineering research.	July 2018 – July 2019
<b>UCSD Jacobs Undergraduate Mentor Program (JUMP)</b> <i>Upperclassman Mentor</i> – Mentored underclassman students majoring in bioengineering throughout the year.	Oct. 2015 – June 2017
<b>UCSD Society of Women Engineers (SWE)</b> <i>Envision Planning Committee Member</i> – Responsible for planning the logistics behind UCSD SWE Chapter's largest outreach event for high school girls. <i>Peer Engineering Program Committee Member and Peer Mentor</i> – Responsible for helping plan and implement a new outreach program at UC San Diego to mentor high school students in carrying out engineering design projects.	Oct. 2013 – June 2017
<b>Organizations and Memberships</b>	
<b>Society for Biomaterials (SFB)</b>	April 2017 – Present
<b>California Louis Stokes Alliance for Minority Participation (LSAMP/CAMP) Science Program</b>	June 2015 – June 2017

**Society of Women Engineers (SWE)**

**Oct. 2013 – June 2017**

**Association for Women in Science (AWIS)**

**Oct. 2015 – Oct. 2016**

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**Work Experience**

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**Orientation Leader** | *UC San Diego Sixth College*

Welcomed students to UC San Diego and Sixth College by helping them adjust to their new surroundings. As a returning/senior orientation leader I helped train new orientation leaders.

**Apr. – Sept. 2014, 2015,  
2016**

**Research Associate** | *UC San Diego Thornton Hospital*

Interacted with patients in the emergency department to enroll patients in studies used for current and future clinical research (160+ hours).

**Jan. 2015 – June 2015**

**Lab and Research Assistant** | *UC San Diego Bioengineering Department*

Assisted Dr. Robert Sah's Cartilage Tissue Engineering Lab through general lab maintenance and helped researchers with various projects/experiments/research.

**July 2014 – June 2015**

**College Ambassador** | *UC San Diego Sixth College*

Planned events for Sixth College during Welcome Week and throughout the academic year.

**May 2014 – June 2015**

**Fiscal Assistant** | *UC San Diego Mechanical and Aerospace Engineering Department*

Worked alongside members of the MAE Fiscal Department to keep record of financial transactions as well as assist faculty and staff in organizing and maintaining records.

**June 2014 – Oct. 2014**