

# Haylie R. Helms

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## Education

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- 2021 – Present **PhD Candidate, Biomedical Engineering**, Oregon Health and Science University  
International Alliance for Cancer Early Detection (ACED) Pre-Doctoral Scholar and Achievement Rewards for College Scientists (ARCS) Scholar  
Dissertation: Bioprinting the Tumor Microenvironment with Subcellular Resolution to Investigate Spatiotemporal Dynamics of Breast Cancer Initiation and Progression  
Advisor: Luiz E. Bertassoni, DDS PhD  
Dissertation Advisory Committee: Summer L. Gibbs, PhD, Michelle (Shelley) C. Barton, PhD, and Ellen M. Langer, PhD.
- 2017 – 2019 **MS, Modern Human Anatomy**, University of Colorado – Anschutz Medical Campus  
Capstone Project: Generation of Cardiac Organoids Using Cardiomyocytes, Endothelial Cells, Epicardial Cells, and Cardiac Fibroblasts Derived from Human Induced Pluripotent Stem Cells  
Advisor: Jeffrey G. Jacot, PhD  
Exam Committee: John H. Caldwell, PhD and Louis S. Stodieck, PhD
- 2013 – 2017 **BA, Biology, Society and Environment**, University of Minnesota – Twin Cities  
Minor: History of Science, Technology, and Medicine  
Community Engagement Scholar  
Capstone Project: Recellularization of Decellularized Lung Matrix Using Definitive Endoderm Cells Derived from Human Induced Pluripotent Stem Cells  
Advisor: Angela Panoskaltis-Mortari, PhD

## Research Experience

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- 2021 – Present **Graduate Researcher**, Bertassoni Lab/Knight Cancer Precision Biofabrication Hub, Department of Biomedical Engineering, Oregon Health and Science University
- Developed a novel biofabrication method to single-cell bioprint heterogeneous tissues matching native cellular organization at subcellular resolution
  - Investigating cellular spatial dynamics on tumor evolution within the ductal carcinoma in situ tumor microenvironment using single-cell bioprinting
- 2019 – 2021 **Researcher 5 - Manager of the 3D Bioprinting Core Facility & Mortari Lab**  
Department of Pediatrics, University of Minnesota – Twin Cities
- Developed a 3D bioprinted tumor model to study the effects of altered metabolic pathways on tumor growth
  - Created a novel method for 3D bioprinting arteriovenous grafts
  - Investigated the use of an intrapulmonary aerosol generating device to regenerate damaged segments of the airways by delivering new, healthy cells
  - Examined the role of extracellular matrix composition and mechanical properties in cell differentiation of bioprinted constructs
- 2018 – 2019 **Graduate Researcher**, Jacot Lab, Department of Bioengineering  
University of Colorado – Anschutz Medical Campus
- Developed a protocol to generate and characterize cardiac organoids from a single human induced pluripotent stem cell source
  - Developed digital heart models that were 3D printed and imported into virtual reality for cardiac vasculature and coronary artery disease education
  - Data acquisition, mill maintenance, segmentation, and 3D anatomical model generation for the Visible Human Project. Work featured in National Geographic

- 2015 – 2017 **Undergraduate Researcher**, Mortari Lab, Department of Pediatrics  
University of Minnesota – Twin Cities
- Studied the effects of ex vivo lung perfusion and ventilation on the inflammatory cascade of transplanted lungs using TransMedics “OCS™ LUNG”. This work contributed to the device receiving FDA approval
  - Decellularized mouse lungs and recellularized with human induced pluripotent stem cell derived definitive endoderm cells
- 2015 – 2017 **Research Assistant**, Department of Surgery  
University of Minnesota – Twin Cities
- Investigated factors from the Intensive Care Unit which may be particularly stressful leading to mental illness following lung transplantation.
  - Worked with and among the hospital and clinic staff to administer surveys to lung transplant patients
  - Database entry of patients' ICU stay using Epic electronic medical records
- 2013 – 2015 **Research Assistant**, TrialNet, Department of Pediatrics  
University of Minnesota – Twin Cities
- Provided clinic and administrative support during clinical trials aimed at prevention, delaying onset, and treatment of type 1 diabetes
  - Met with patients and their families at the University of Minnesota Pediatric Specialty Care Clinic for clinical trial recruitment
  - Assisted during clinical trials by doing blood draws, processing samples, maintaining visit reports, and biobank management

## Research Funding

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- 2023-2024 **Co-PI** with Luiz Bertassoni, DDS PhD. *Single Cell Bioprinting for the Systematic Assessment of Spatial Dynamics on Tumor Evolution*. “Full Project” awarded by the Cancer Early Detection Advanced Research (CEDAR) Center, Oregon Health and Science University.
- 2023-2024 **Co-PI** with Ashley Anderson, MD/PhD Student. *RUNX1 Effects on Neoplastic-Immune Hybrid Cell Migration and Tumor Microenvironment Cell-Cell Communication Using Single Cell Bioprinting*. Pilot Grant awarded by Knight Cancer Institute Scientific Operations, Oregon Health and Science University.
- 2023-2024 **Co-PI** with Eric Cramer, MD/PhD Student and Ashley Anderson, MD/PhD Student. *Combining Bioprinting and Agent-Based Modeling for Simulating Biological Systems*. Quantitative and Systems Biology Award, Oregon Health and Science University.
- 2023-2024 Team Member\*. PI Luiz Bertassoni, DDS PhD. *Development and Validation of a Single-Cell Bioprinting Platform for Fabrication of Complex Tissues and Tumor Models*. “Full Project” awarded by the Cancer Early Detection Advanced Research (CEDAR) Center, Oregon Health and Science University. \*Grant adapted from my qualifying exam

## Training Grants, Fellowships, and Scholarships

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- 2022-2026 International Alliance for Cancer Early Detection (ACED) Pre-Doctoral Scholar. Full Tuition and Stipend Coverage for 4 years
- 2021-2022 NIH/NIDCR T90DE030859, Portland Oral Health Research Training Program. Full Tuition and Stipend Coverage for 3 years. Terminated early for cancer scholarship
- 2021-2024 Achievement Awards for College Scientists (ARCS) Scholar, Oregon Chapter. Room and Board supplement for 3 years
- 2021-2022 Douglas Strain Fellowship, OHSU Department of Biomedical Engineering. Full Tuition and Stipend Coverage for 1 year

2016-2017	Waller Scholarship, University of Minnesota Twin Cities
2015-2016	Harrington Scholarship, University of Minnesota Twin Cities
2015	Cancer Research, Education, and Training Experience (CREATE) Internship, Masonic Cancer Center, University of Minnesota Twin Cities
2014-2015	Charles & Myrtle Stroud Scholarship, University of Minnesota Twin Cities

## Awards and Honors

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2024	Excellence in Research Award Finalist. OHSU All-Hill Student Council.
2023	Best Poster, Oregon Bioengineering Symposium. <i>Bioprinting the Tumor Microenvironment with Single-Cell Resolution to Model the Spatial Dynamics of Tumor Evolution in Breast Cancer.</i>
2023	Featured in Oregon Public Broadcasting's <i>All Science. No Fiction.</i> Series
2022	Best PhD Student Poster Presentation, OHSU School of Dentistry Research Day. <i>Single Cell Bioprinted Cell Circuits for the Systematic Assessment of Cell-Cell Communication in the Early Tumor Microenvironment.</i>
2022	Best Poster Presentation, Department of Biomedical Engineering Research Retreat. <i>Development of a Single-Cell Bioprinting Platform for the Systematic Assessment of Cell-Cell Communication Effects in the Early Tumor Microenvironment.</i>
2022	Best Graduate Poster Presentation, Oregon Bioengineering Symposium. <i>Development of a Single-Cell Bioprinting Platform for Systematic Assessment of Cell-Cell Communication.</i>
2019	Visible Human Project featured in National Geographic's <i>The Future of Medicine</i> Special Issue
2019	Second Place Poster Presentation in the Engineering, Technology, and Math Division at the Research and Creative Arts Symposium, University of Colorado Denver
2017	Community Engagement Scholar Distinction, University of Minnesota Twin Cities
2017	College of Liberal Arts Exceptional Student, University of Minnesota Twin Cities
2016	College of Liberal Arts Exceptional Student, University of Minnesota Twin Cities
2016	College of Liberal Arts Fall Deans List, University of Minnesota Twin Cities
2015	College of Liberal Arts Exceptional Student, University of Minnesota Twin Cities
2013	Valedictorian, Kerkhoven-Murdock-Sunburg High School

## Publications

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1. **Helms HR**, Oyama KA, Ware JP, Ibsen SD, Bertassoni LE. Multiplex Single-Cell Bioprinting for Engineering of Heterogeneous Tissue Constructs with Subcellular Spatial Resolution. *bioRxiv*. 2024. DOI: 10.1101/2024.02.01.578499 (under review, *Advanced Materials*)
2. Visalakshan RM, Lowrey MK, Sousa MGC, **Helms HR**, Samiea A, Schutt CE, Moreau JM, Bertassoni LE. Opportunities and Challenges to Engineer 3D Models of Tumor-Adaptive Immune Interactions. *Front. Immunol.* 2023. DOI: 10.3389/fimmu.2023.1162905
3. Galliger Z, Vogt CD, **Helms HR**, Panoskaltsis-Mortari A. Extracellular Matrix Microparticles Improve GelMA Bioink Resolution for 3D Bioprinting at Ambient Temperature. *Macromo. Mater. Eng.* 2022. DOI: 10.1002/mame.202200196
4. Tan YH\*, **Helms HR\***, Nakayama KH. Decellularization Strategies for Regenerating Cardiac and Skeletal Muscle Tissues. *Front Bioeng Biotechnol.* 2022. DOI: 10.3389/fbioe.2022.831300  
\*Co-first authors
5. Spratt JR, Mattison LM, Iaizzo PA, Brown RZ, **Helms H**, Iles T, Howard BT, Panoskaltsis-Mortari A, Loor G. An Experimental Study of the Recovery of Injured Porcine Lungs with Prolonged Normothermic Cellular Ex Vivo Lung Perfusion Following Donation after Circulatory Death. *Transplant Int.* 2017. DOI: 10.1111/tri.12981

6. Spratt JR, Loor G, Mattison L, Meyer C, Ehrhardt M, **Helms H**, Panoskaltsis-Mortari A. In Vitro Analysis of RBC-Mediated Lung Injury in Prolonged Ex Vivo Lung Perfusion. *J. Heart Lung Transplantation*. 2017. DOI: 10.1016/j.healun.2017.01.1507
7. Loor G, Howard BT, Spratt JR, Mattison LM, Panoskaltsis-Mortari A, Iles TL, Meyer CM, **Helms HR**, Price A, Iaizzo PA. Prolonged EVLP using OCS Lung: Cellular and Acellular Perfusates. *Transplantation*. 2017. DOI: 10.1097/TP.0000000000001616
8. **Helms H**. The Sphygmomanometer and its Impact on Clinical Practice. *Recommended Dose. Bulletin of the History of Medicine*. 2016.

## Conference Proceedings

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1. **Helms HR**, Davies AE, Duhon R, Moreau JM, Langer EM, Bertassoni LE. *Single Cell Bioprinted Cell Circuits for the Systematic Assessment of Cell-Cell Communication in the Early Tumor Microenvironment*. American Association for Cancer Research Annual Meeting. Orlando, FL. April 14-19, 2023.
2. Alfonzo D, Tucker A, Rothweiler P, Galliger Z, **Helms H**, Erdman A, Panoskaltsis-Mortari A. *The Process Implementation of Micro Manufactured SLA Printed Nasopharyngeal Swabs*. Design of Medical Devices Conference 2021. Minneapolis, MN. April 14, 2021.
3. Akinnola I, Meyers CM, **Helms H**, Panoskaltsis-Mortari A. *Evaluation of iPSC-derived Hemangioblasts in Regeneration of Pulmonary Endothelium*. American Thoracic Society 2019 Grover Conference on Pulmonary Vasculature in Development, Injury and Repair. Sedalia, CO. September 4, 2020. \*Cancelled due to COVID-19.
4. Galliger Z, **Helms HR**, Zhang B, Diaz Gutierrez I, Andrade R, Panoskaltsis-Mortari, A. *Rabbit Tracheal Model for 3D Bioprinted Pediatric Tracheal Grafts for Critical Length Reconstruction*. Association for Clinical and Translational Science. Washington, D.C. April 14, 2020. \*Cancelled due to COVID-19.
5. **Helms HR**, Jarrell DK, Jacot JG. *Generation of Cardiac Organoids Using Cardiomyocytes, Endothelial Cells, Epicardial Cells, and Cardiac Fibroblasts Derived from Human Induced Pluripotent Stem Cells*. American Association for Anatomy Annual Meeting at Experimental Biology 2019. Orlando, FL. April 9, 2019.
6. Spratt JR, Loor G, Mattison LM, Meyer C, Ehrhardt M, **Helms H**, Panoskaltsis-Mortari A. *In Vitro Analysis of RBC-Mediated Lung Injury in Prolonged Ex Vivo Lung Perfusion*. International Society for Heart and Lung Transplantation 37th Annual Meeting & Scientific Sessions. San Diego, CA. April 6, 2017.
7. Spratt JR, Mattison LM, Iaizzo PA, Panoskaltsis-Mortari A, Iles TL, Meyer CM, **Helms H**, Price A, Payne WD, Loor G. *Uncontrolled DCD with Prolonged Ex Vivo Lung Perfusion (EVLP): a Feasible Model for Donor Lung Recovery and Allocation*. Minnesota Surgical Society 2016 Spring Meeting. Minneapolis, MN. May 6, 2016.

## Oral Presentations

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1. **Helms HR**, Oyama KA, Davies AE, Langer EM, Bertassoni LE. *Building Tumor Models with Single Cell Spatial Resolution Using Microfluidic Bioprinting*. Department of Biomedical Engineering Seminar Series, Oregon Health and Science University. Portland, OR. December 1, 2023.
2. **Helms HR**, Oyama KA, Davies AE, Langer EM, Bertassoni LE. *Building Tumor Models with Single Cell Spatial Resolution Using Microfluidic Bioprinting*. The 5<sup>th</sup> Annual Australian Bioprinting Workshop for Tissue Engineering and Regenerative Medicine. Sydney, Australia. November 20, 2023.
3. **Helms HR**, Oyama KA, Davies AE, Moreau JM, Langer EM, Bertassoni LE. *Building Tissues with Single Cell Spatial Resolution Using Microfluidic Bioprinting*. Oregon Bioengineering Symposium. Eugene, OR. November 3, 2023.
4. **Helms HR**, Oyama KA, Davies AE, Moreau JM, Langer EM, Bertassoni LE. *Building Tissues with Single Cell Spatial Resolution Using Microfluidic Bioprinting*. Biomedical Engineering Department Seminar Series, Oregon Health and Science University. Portland, OR. August 11, 2023.

5. **Helms HR** and Bertassoni LE. *Single Cell Bioprinted Cell Circuits for the Systematic Assessment of Cell-Cell Communication in the Early Tumor Microenvironment*. Oregon Health and Science University Research Week. Portland, OR. May 3, 2023.
6. **Helms HR**, Tahayeri A, Bertassoni LE. *Precision Biofabrication: Microfluidic Single Cell Bioprinting*. Oregon Health and Science University Research Week. Portland, OR. May 3, 2022.
7. **Helms HR**, Tahayeri A, Sousa M, Bertassoni LE. *Precision Biofabrication: Microfluidic Single Cell Bioprinting*. Oregon Health and Science University School of Dentistry Research Day. Portland, OR. March 3, 2022.
8. **Helms HR**. *Bioprinting and Regenerative Medicine Research at the University of Minnesota's Bioprinting Core Facility*. Invited Speaker. Sacred Heart Lions Club Monthly Meeting. Sacred Heart, MN. March 1, 2021.
9. **Helms HR**, Jarrell DK, Jacot JG. *Generation of Cardiac Organoids Using Induced Pluripotent Stem Cells, 3D Culture, and Simulated Microgravity*. Modern Human Anatomy Seminar Series, University of Colorado Anschutz Medical Campus. Aurora, CO. December 6, 2018.

## Poster Presentations

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1. **Helms HR**, Oyama KA, Davies AE, Moreau JM, Langer EM, Bertassoni LE. *Building Tissues with Single Cell Spatial Resolution Using Microfluidic Bioprinting*. Oregon Bioengineering Symposium. Eugene, OR. November 3, 2023.
2. **Helms HR**, Oyama KA, Davies AE, Moreau JM, Langer EM, Bertassoni LE. *Bioprinting the Tumor Microenvironment with Single-Cell Resolution to Model the Spatial Dynamics of Tumor Evolution in Breast Cancer*. Early Detection of Cancer Conference 2023. London, UK. October 10, 2023.
3. **Helms HR**, Oyama KA, Tahayeri A, Singh NK, Mishra A, Davies AE, Moreau JM, Langer EM, Bertassoni LE. *Bioprinting the Tumor Microenvironment with Single-Cell Resolution to Model the Spatial Dynamics of Tumor Evolution in Breast Cancer*. National Cancer Institute Patient-Derived Models of Cancer and Cancer Tissue Engineering Collective Joint Annual Meeting. Portland, OR. August 31, 2023.
4. **Helms HR**, Davies AE, Duhon R, Moreau JM, Langer EM, Bertassoni LE. *Single Cell Bioprinting: a Novel Tool for the Systematic Assessment of Single Cell Spatial Dynamics*. Spatial Biology USA 2023, Oxford Global. Boston, MA. June 8, 2023.
5. **Helms HR**, Davies AE, Duhon R, Moreau JM, Langer EM, Bertassoni LE. *Single Cell Bioprinting: a Novel Tool for the Systematic Assessment of Single Cell Spatial Dynamics on Tumor Evolution*. Single-Cell Spatial Analysis of Cancer Mini-Symposium. Portland, OR. May 15, 2023.
6. **Helms HR**, Davies AE, Duhon R, Moreau JM, Langer EM, Bertassoni LE. *Single Cell Bioprinted Cell Circuits for the Systematic Assessment of Cell-Cell Communication in the Early Tumor Microenvironment*. American Association for Cancer Research Annual Meeting. Orlando, FL. April 17, 2023.
7. **Helms HR**, Davies AE, Duhon R, Moreau JM, Langer EM, Bertassoni LE. *Single Cell Bioprinted Cell Circuits for the Systematic Assessment of Cell-Cell Communication in the Early Tumor Microenvironment*. School of Dentistry Research Day. Portland, OR. March 2, 2023.
8. **Helms HR** and Bertassoni LE. *Development of a Single-Cell Bioprinting Platform for the Systematic Assessment of Cell-Cell Communication Effects in the Early Tumor Microenvironment*. Oregon Health and Science University Department of Biomedical Engineering Research Retreat. Portland, OR. December 12, 2022.
9. **Helms HR** and Bertassoni LE. *Development of a Single-Cell Bioprinting Platform for the Systematic Assessment of Cell-Cell Communication Effects in the Early Tumor Microenvironment*. Knight to Knight Biofabrication Retreat, University of Oregon Knight Campus and Oregon Health and Science University Knight Cancer Institute. Portland, OR. November 18, 2022.
10. **Helms HR** and Bertassoni LE. *Development of a Single-Cell Bioprinting Platform for the Systematic Assessment of Cell-Cell Communication Effects in the Early Tumor Microenvironment*. Cancer Early Detection Conference. Portland, OR. October 18-20, 2022.
11. **Helms HR** and Bertassoni LE. *Development of a Single-Cell Bioprinting Platform for Systematic Assessment of Cell-Cell Communication*. Oregon Bioengineering Symposium 2022. Corvallis, OR. October 6, 2022.

12. **Helms HR**, Spitzer VM. *Visualization of Coronary Artery Disease Using 3D Printed Models*. Modern Human Anatomy 3D Printing Group Spring Meeting 2019. Aurora, CO. May 14, 2019.
13. **Helms HR**, Spitzer VM. *A Shocking Presentation of Coronary Artery Disease: An Inside Look from the Susan Potter Dataset*. Exhibit Presentation. Research and Creative Arts Symposium. Denver, CO. April 26, 2019.
14. **Helms HR**, Jarrell DK, Jacot JG. *Generation of Cardiac Organoids Using Cardiomyocytes, Endothelial Cells, Epicardial Cells, and Cardiac Fibroblasts Derived from Human Induced Pluripotent Stem Cells*. Modern Human Anatomy Capstone Project Symposium. Aurora, CO. April 22, 2019.
15. **Helms HR**, Jarrell DK, Jacot JG. *Generation of Cardiac Organoids Using Cardiomyocytes, Endothelial Cells, Epicardial Cells, and Cardiac Fibroblasts Derived from Human Induced Pluripotent Stem Cells*. Regenerative Medicine, Stem Cells, Wound Healing and Bioengineering Poster Session. American Association for Anatomy Annual Meeting at Experimental Biology 2019. Orlando, FL. April 9, 2019.
16. **Helms H**, Meyer CM, Panoskaltis-Mortari A. *Recellularization of Decellularized Lung Matrix Using Definitive Endoderm Cells Derived from Induced Pluripotent Stem Cells*. University of Minnesota - Twin Cities Undergraduate Research Symposium. Minneapolis, MN. April 20, 2017.

## Teaching Experience

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Fall 2020	<b>Lab Instructor</b> , BMEn 5361: 3D Bioprinting University of Minnesota – Twin Cities
Fall 2019	<b>Lab Instructor</b> , BMEn 5361: 3D Bioprinting University of Minnesota – Twin Cities
Fall 2018	<b>Teaching Assistant</b> , Medical School Human Body Block University of Colorado – Anschutz Medical Campus

## Professional Experience

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2018 – 2019	<b>Anatomical Segmentation and 3D Modeling Specialist</b> Touch of Life Technologies, Aurora, CO
2018 – 2019	<b>Medical Scribe</b> University of Colorado Emergency Department, Aurora, CO
2018	<b>Anatomy Tutor</b> , School of Medicine University of Colorado – Anschutz Medical Campus

## Mentorship, Leadership, and Service Activities

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2024	Volunteer, NOVA Program - Cub Scouts Pack 254, Introduction to Tissue Engineering Lab Tours, OHSU
2023	Volunteer, Eureka! STEM Magnet Program for 8-12 grade youth, Meet a Biomedical Scientist Day, Hosted by Woman in Science PDX x BMES, OHSU
2023	Mentor, Undergraduate Student, CDCB/KCI Summer Internship, OHSU
2023	Mentor, Partnership for Scientific Inquiry, OHSU
2023	Interviewer, Biomedical Engineering PhD Program Admissions, OHSU
2022 – 2023	Treasurer, Biomedical Engineering Society (BMES) Executive Board, OHSU Chapter
2022 – 2023	Liaison, Biomedical Engineering graduate program liaison for OHSU's Graduate Student Organization (GSO)
2022	Mentor, High School Student Summer Intern, OHSU
2019 – 2021	Mentor, Masters Students and Undergraduate Researchers, University of Minnesota
2019	Interviewer, Modern Human Anatomy MS Program Admissions, CU Anschutz.
2018 – 2019	GED Instructor, Denver Rescue Mission, Denver, CO

2018 – 2019	K-12 Tutor, Denver Rescue Mission, Denver, CO
2016 – 2017	Youth Coach, 13U Basketball and 13U Softball, Minneapolis Parks and Recreation
2016	Co-President, Global Medical and Dental Brigades, University of Minnesota
2015 – 2016	K-12 Tutor, Safe Place Homework Help, Minneapolis, MN
2014 – 2017	Volunteer, Medical Reserve Corps, University of Minnesota
2014 – 2016	Volunteer, Global Medical and Dental Brigades, University of Minnesota

## **Professional Membership**

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2023 – Present	American Association for Cancer Research (AACR)
2023 – Present	Biomedical Engineering Society (BMES)
2022 – Present	International Alliance for Cancer Early Detection (ACED)
2021 – 2024	International Society for Stem Cell Research (ISSCR)
2019	American Association of Anatomists (AAA)

## **Technical Skills**

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Human Cell Culture	A2780 (ovarian cancer), A549 (lung cancer), Adventitial fibroblasts (arterial), Aortic smooth muscle cells, Blood outgrowth endothelial cells, Breast cancer associated fibroblasts, Bronchial epithelial cells, CWR-r1 (prostate cancer), Dermal fibroblasts, DLD1 (colorectal cancer), Epidermal keratinocytes, Esophageal epithelial cells, Esophageal smooth muscle cells, H522 (lung cancer), HCT116 (colorectal cancer), Induced pluripotent stem cells, Lung fibroblasts, Macrophages, Mammary epithelial cells, Mammary fibroblasts, MCF7 (breast cancer), MCF10A (mammary epithelial), MDA-MB-231 (breast cancer), Myoepithelial cells, M4A4 (melanoma), MA148 (ovarian cancer), macrophages, microvascular endothelial cells, Mesenchymal stem/stromal cells from bone marrow, osteoblasts, OVCAR5 (ovarian cancer), PC3 (prostate cancer), SH-SY5Y (neuronal), SKOV-3 (ovarian cancer), THP-1 (monocytes), Umbilical vein endothelial cells (HUVEC), 239T (embryonic kidney)
Cell Differentiation	hiPSC derived: cardiac fibroblasts, cardiomyocytes, definitive endoderm cells, endothelial cells, and epicardial cells MSC-BM derived: adipocytes, chondrocytes, and osteoblasts THP-1 derived: macrophages
Primary Cell Isolation	Mouse: bone marrow-MSc and aortic endothelial cells
Molecular Biology	RNA extraction, cDNA synthesis, quantitative real-time PCR, cloning, bacterial culture, plasmid isolation and purification, gel electrophoresis, Sanger sequencing, transfection, transduction, flow cytometry
3D Printing/Bioprinting	Microfluidic Single-Cell, Extrusion, Stereolithography/Digital Light Processing, Two Photon
Tissue Engineering	Decellularization, recellularization, custom bioreactor development, GelMA synthesis, bioink cytocompatibility testing, cytotoxicity screening
Histology	Paraffin and fresh frozen sample preparation, microtome and cryostat sectioning, immunohistochemistry, immunofluorescence, bright field microscopy, fluorescent microscopy, confocal microscopy, live cell imaging
In Vivo Models	Mouse and porcine intramuscular injections, intravascular injections, sedation, euthanasia, dissection

Biomechanics	Mach-1 compression and tension testing
Modeling & Segmentation	Solidworks, Fusion 360, MAYA, CloudCompare, Slicer, Blender, SketchFab, VHD Segmentor
3D Animation	MAYA
Programming	R, MatLab, Arduino
Lab Management	Scheduling, billing, inventory, ordering, train and supervise student workers, waste management, equipment maintenance