BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Nelson, Celeste M

eRA COMMONS USER NAME (credential, e.g., agency login): CMNELSON

POSITION TITLE: Wilke Family Professor in Bioengineering, Professor of Chemical and Biological Eng'g

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Massachusetts Institute of Technology, Cambridge, MA	S.B.	06/1998	Biology
Massachusetts Institute of Technology, Cambridge, MA	S.B.	06/1998	Chemical Engineering
Johns Hopkins University School of Medicine, Baltimore, MD	Ph.D.	10/2003	Biomedical Engineering
Lawrence Berkeley National Laboratory, Berkeley, CA		08/2007	Mammary Gland Biology
Woods Hole Marine Biological Laboratory, Woods Hole, MA		07/2007	Embryology

A. Personal Statement

At the departments of Chemical & Biological Engineering and Molecular Biology at Princeton University, I have built and directed a multidisciplinary research team that combines microscale tissue engineering, molecular cell biology, and finite element method-based approaches to investigate the mechanical control mechanisms underlying development and cancer progression. As a PI on several past and present competitive grants, my directing, collaborating with, and mentoring other researchers has been fruitful, leading to more than 150 peer-reviewed publications. I have a passion for teaching and mentoring, and many of my previous trainees are now highly successful young leaders in tenure-track or tenured positions.

Recent and ongoing projects that I would like to highlight include:

U01 CA214292
Tien & Nelson (MPI)
4/1/17-3/31/23
Engineered invasive human breast tumors with integrated capillaries and lymphatics

R01 HD099030
Nelson (PI)
8/15/19-6/30/24
Mechanical forces and the regulation of airway progenitor cells

NSF CBET-2134935
Nelson (PI)
12/1/21-11/30/25
RECODE: Using light and mechanics to monitor and control the differentiation of lung alveolar organoids

R01 HL164861
Nelson (PI)
1/1/22 – 12/31/25
Interplay between mechanical forces and retinoic acid in lung development

DP1 HD111539
Nelson (PI)
9/16/2022 – 8/31/2027
Mechanical clocks during fetal development

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2020-	Wilke Family Professor in Bioengineering
2020	Pomeroy and Betty Perry Smith Professor
2016-	Professor, Chemical & Biological Engineering
2014-2017	Director of Graduate Studies, Chemical & Biological Engineering
2012-2016	Associate Professor, Chemical & Biological Engineering
2008-	Associated Faculty, Molecular Biology
	Member, Cancer Institute of New Jersey (CINJ)
2007-2012	Assistant Professor, Chemical & Biological Engineering

Honors

2022	NIH Director's Pioneer Award
2022	Van C. Mow Lectureship, Columbia University
2022	Princeton Engineering Commendation for Outstanding Teaching
2021	Council on Science and Technology (CST) Community of Practice Fellow
2021	Biodiversity Grand Challenge Award, High Meadows Environmental Institute
2020	Princeton Engineering Commendation for Outstanding Teaching
2019	Mid-Career Award from the Biomedical Engineering Society (BMES)
2018-2019	Princeton Engineering Commendation for Outstanding Teaching
2017-2018	Blavatnik National Award Finalist for Young Scientists in Life Sciences
2016	HHMI Faculty Scholar
2016	President's Award for Distinguished Teaching (Princeton University)
2016	American Institute of Medical & Biological Engineering (AIMBE) College of Fellows
2014	Thiele Lectureship, University of Notre Dame
2014	Princeton School of Engineering and Applied Science (SEAS) Distinguished Teacher Award
2013	E. Llewellyn-Thomas Distinguished Lecture, University of Toronto
2012	Camille Dreyfus Teacher-Scholar Award
2011	Allan P. Colburn Award, American Institute of Chemical Engineers (AIChE)
2010	MIT Technology Review TR35 (Young Innovators under 35)
2010	Alfred P. Sloan Fellowship in Molecular Biology
2009-2010	Princeton Engineering Commendation for Outstanding Teaching
2009	E. Lawrence Keyes, Jr./Emerson Electric Co. Faculty Advancement Award
2008	David & Lucile Packard Foundation Fellowship
2007	Burroughs Wellcome Fund Career Award at the Scientific Interface
2007	LBNL Outstanding Performance Award
2004-2007	DOD Breast Cancer Research Program Postdoctoral Fellowship
2004	Ruth L. Kirschstein NRSA Postdoctoral Fellowship (declined)
1999-2003	Whitaker Foundation Graduate Fellowship
1999	National Science Foundation Graduate Fellowship (declined)
1998	Elected to Phi Beta Kappa
1997	Elected to Tau Beta Pi National Engineering Honor Society
1997-1998	Cunningham Memorial Fellowship
1997-1999	Amoco Foundation Fellowship
1997-2000	Biotechnology Process Engineering Center Research Fellowship

1995-1998 Edward Abdun-Nur Memorial Fellowship

C. Contributions to Science

1. Engineered models of tumor development and progression. In collaboration with Joe Tien and Derek Radisky, my group has led efforts to use engineered tumor models to study the effects of mechanical forces and gene expression changes on the behavior of breast cancer cells. We have found definitive roles for interstitial fluid pressure (IFP) in tumor cell invasion. We have also uncovered positional effects of the microenvironment that regulate tumor cell phenotype irrespective of genotype.
    a. Piotrowski-Daspit AS, Tien J, Nelson CM. Interstitial fluid pressure regulates collective invasion in engineered human breast tumors via Snail, vimentin, and E-cadherin. Integr. Biol., 8: 319-331 (2016). PMC4792648
    b. Boghaert E, Radisky DC, Nelson CM. Lattice-based model of ductal carcinoma in situ suggests rules for breast cancer progression to an invasive state. PLOS Comp. Biol., 10: e1003997 (2014). PMC4256017
    c. Boghaert E, Gleghorn JP, Lee K, Gjorevski N, Radisky DC, Nelson CM. Host epithelial geometry regulates breast cancer cell invasiveness. Proc. Natl. Acad. Sci. USA, 109: 19362-19367 (2012). PMC3511712
    d. Tien J, Truslow JG, Nelson CM. Modulation of invasive phenotype by interstitial pressure-driven convection in aggregates of human breast cancer cell. PLOS ONE, 7: e45191 (2012). PMC3445465

2. Mechanical forces and epithelial-mesenchymal transition (EMT). My group has worked to define the role of physical forces in tissue dysmorphogenesis, as is observed during tumor metastasis, and has specifically uncovered the role of tissue stiffness and intercellular contractility in regulating EMT. We have found that mechanical stresses regulate EMT both by altering the nuclear localization of MRTF-A, as well as by altering the membrane localization of Rac1b, and that these signaling pathways also induce multinucleation and genomic instability through abscission failure.
    a. Simi AK, Anlas AA, Stallings-Mann M, Zhang S, Hsia T, Cichon M, Radisky DC, Nelson CM. A soft microenvironment protects from failure of midbody abscission and multinucleation downstream of the EMT-promoting transcription factor Snail. Cancer Res., 78: 2277-2289 (2018). PMC5932229
    b. Lee K, Chen QK, Lui C, Cichon MA, Radisky DC, Nelson CM. Matrix compliance regulates Rac1b membrane localization, NADPH oxidase assembly, and epithelial-mesenchymal transition. Mol. Biol. Cell, 23: 4097-4108 (2012). PMC4058048
    c. Gomez EW, Chen QK, Gjorevski N, Nelson CM. Tissue geometry patterns epithelial-mesenchymal transition via intercellular mechanotransduction. J. Cell. Biochem., 110: 44-51 (2010). PMC3155296
    d. Radisky DC, Levy DD, Littlepage LE, Liu H, Nelson CM, Fata JE, Leake D, Godden EL, Albertson DG, Nieto MA, Werb Z, Bissell MJ. Rac1b and reactive oxygen species mediate MMP3-induced EMT and genomic instability, Nature, 436: 123-127 (2005). PMC2784913

3. Engineered tissue models of mammary morphogenesis. My group has created tissue engineering approaches to build 3D mammary epithelial tissues that can be used to study the physical forces and biochemical signaling that drives branching morphogenesis. We have shown that branches emerge at specific sites because of gradients of autocrine inhibitory morphogens and mechanical stresses, and have identified the gene expression changes that drive branching from these regions.
    a. Gjorevski N, Piotrowski AS, Varner VD, Nelson CM. Dynamic tensile forces drive collective migration through three-dimensional extracellular matrices. Sci. Rep., 5: 11458 (2015). PMC4792648
    b. Lee K, Gjorevski N, Boghaert E, Radisky DC, Nelson CM. Snail1, Snail2, and E47 promote mammary epithelial branching morphogenesis. EMBO J., 30: 2662-2674 (2011). PMC4911209
    c. Gjorevski N, Nelson CM. Endogenous patterns of mechanical stress are required for branching morphogenesis. Integr. Biol., 2: 424-434 (2010). PMC3074564
    d. Nelson CM, VanDuijn MM, Inman JL, Fletcher DA, Bissell MJ. Tissue geometry determines sites of mammary branching morphogenesis in organotypic cultures. Science, 314: 298-300 (2006). PMC3003460

4. Mechanical forces and stem cell differentiation. My group has led efforts to uncover the relative roles of mechanical forces in regulating stem and progenitor cell phenotype. Our efforts have unveiled the critical roles of cell shape and mechanics in the fates of mesenchymal stem cells, mammary progenitor cells, and breast cancer-like stem cells.
    a. Han S, Pang MF, Nelson CM. Substratum stiffness tunes proliferation downstream of Wnt3a in part by regulating integrin-linked kinase and frizzled-1, J. Cell Sci., 131: jcs210476 (2018). PMC5963841
    b. Pang MF, Siedlik MJ, Han S, Stallings-Mann M, Radisky DC, Nelson CM. Tissue stiffness and hypoxia modulate the integrin-linked kinase ILK to control breast cancer stem-like cells. Cancer Res., 76: 1-11 (2016). PMC5026611
    c. Lui C, Lee K, Nelson CM. Matrix compliance and RhoA direct the differentiation of mammary progenitor cells. Biomech. Modeling Mechanobiol., 11: 1241-1249 (2012). PMC3339284
    d. McBeath R, Pirone DM, Nelson CM, Bhadriraju K, Chen CS. Cell shape, cytoskeletal tension, and RhoA regulate stem cell lineage commitment. Dev. Cell, 6: 483-495 (2004).

5. Role of physical forces in morphogenesis of the lung. Since 2012, my group has been studying the effects of mechanical forces on airway development using birds, mammals, and reptiles as model systems. We have uncovered several surprising roles for physical forces in airway morphogenesis, including the need for apical constriction during branching in the avian lung and a previously unrecognized role for airway smooth muscle during bifurcation events in the mammalian lung. Our results suggest that airway complexity is highly regulated by mechanical forces and cannot be explained solely by genetic controls.
    a. Goodwin K., Jaslove J.M., Tao H., Zhu M., Hopyan S., Nelson C.M. Patterning the embryonic pulmonary mesenchyme, *iScience,* 25: 103838 (2022). PMC8889149
    b. Kim HY, Pang MF, Varner VD, Kojima L, Miller E, Radisky DC, Nelson CM. Localized smooth muscle differentiation is essential for bifurcation during branching morphogenesis of the mammalian lung. Dev. Cell, 34: 719-726 (2015). PMC4589145
    c. Varner VD, Gleghorn JP, Miller E, Radisky DC, Nelson CM. Mechanically patterning the embryonic airway epithelium. Proc. Natl. Acad. Sci. USA, 112: 9230-9235 (2015). PMC4522767
    d. Kim HY, Varner VD, Nelson CM. Apical constriction initiates new bud formation during monopodial branching of the embryonic chicken lung. Development, 140: 3146-3155 (2013). PMC3931740

Link to My NCBI publications:
https://www.ncbi.nlm.nih.gov/myncbi/celeste.nelson.1/bibliography/public/