BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Douglas N. Robinson	Professor of Cell Biology, Pharmacology and Molecular Sciences, and Chemical and Biomolecular Engineering
eRA COMMONS USER NAME drobin15	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
Purdue University, West Lafayette, IN	B.S.	1991	Genetic Biology
Yale University, New Haven, CT	Ph.D.	1997	Genetics
Stanford University, Stanford, CA		1997-2001	Biochemistry

A. Personal Statement

My research goals are to understand how cells interface biochemistry and mechanics to perform dynamic cell shape change during processes such as cell division, cell motility, and cellular morphogenesis. I am also interested in how cells sense and respond to mechanical inputs, which help direct their behavior. This process of mechanosensing is fundamental to a broad array of healthy physiology, such as hearing, blood pressure regulation, bone remodeling, durotaxis, and stem-cell decisions. We have found that cell division (cytokinesis) naturally encompasses all of these cell behaviors with the added value that cytokinesis is of fundamental medical importance as a source of novel anti-cancer drug targets. The social amoeba *Dictyostelium discoideum* has been our principle model of choice because it undergoes cytokinesis and cell motility in a manner that is highly analogous to mammalian cells and is highly tractable for genetic through engineering approaches. In our research, we employ a broad range of conceptually distinct approaches, ranging from genetics, biochemistry and advanced quantitative microscopy to engineering and computational biology. To accomplish this, I have recruited a diverse group of researchers in my lab whose expertise span these disciplines. My own training was in developmental genetics with Lynn Cooley at Yale and biochemistry with Jim Spudich at Stanford. We also collaborate closely with computational biologist Pablo Iglesias at JHU Electrical and Computer Engineering. In addition, we are working with Ron Rock at University of Chicago to apply single molecule methods to study the force-dependent assembly and function of proteins involved in cytokinesis and cellular mechanosensing.

My lab has also branched out considerably to apply our conceptual approaches to a diversity of other cell shape change and cellular mechanosensing processes through collaboration with several investigators. For example, with Janice Evans (JHU School of Public Health), we are examining the mechanics and shape changes of mammalian oocyte maturation and meiotic cell division. We have been working with Mike Overholtzer (Sloan Kettering) on entosis, the process by which one cell engulfs another and which is common in many tumors. We are also working with Elizabeth Chen (JHU MBG) to examine the biochemical basis of the cell mechanics that guide and control of myoblast fusion during muscle development. Finally, we are working with Robert Anders (JHU Pathology) to study the mechanics of liver and pancreatic cancer progression and Ramana Sidhaye to study the molecular mechanical basis for chronic obstructive pulmonary disease.

B. Positions and Honors

Positions and Employment

1988-1991 Undergraduate Honors Research, Purdue University, West Lafayette, IN
1991-1997 Graduate Student, Yale University School of Medicine, New Haven, CT
1997-2001 Postdoctoral Fellow, Stanford University School of Medicine, Stanford, CA
2001- Primary Appointment: Dept. of Cell Biology, Johns Hopkins School of Medicine, Baltimore, MD
Secondary Appointments: Dept. of Pharmacology and Molecular Sciences, Dept. of Chemical and Biomolecular Engineering, Whiting School of Engineering

Training Programs: Biochemistry, Cell and Molecular Biology (BCMB), Anti-Cancer Drug Development Program (ACDD), and NanoBioMed (NBMed)

Other Experience and Professional Memberships

1995- American Society for Cell Biology
2003- Biophysical Society
2009- Editorial Board Member, *Biophysical Journal*
2010- Editorial Board Member, *Current Biology*
2011- Editorial Board Member, *Cytoskeleton*

Outreach

2009- Founding organizer and director of the Johns Hopkins *Summer Academic Research Experience* (SARE) program for disadvantaged Baltimore youth. To date, 100% college matriculation rate with 40% pursuing a STEM major; Kabacoff C, Srivastava V, **Robinson DN***. A Summer Academic Research Experience for Disadvantaged Youth. *CBE Life Sci. Educ.* 2013; 12: 410-418.

Honors

1991 Phi Beta Kappa, Purdue University Chapter
1997-2000 Damon Runyon-Walter Winchell Cancer Research Fund Postdoctoral Fellow
2000 Leukemia Research Foundation, Postdoctoral Award (declined)
2000-2004 Burroughs Wellcome Fund Career Award in the Biomedical Sciences
2003-2006 Arnold and Mabel Beckman Foundation Young Investigator Award
2007-2011 American Cancer Society Research Scholar Award
2011 Biophysical Society Annual Meeting Symposium Chair and Speaker

C. Selected peer-reviewed publications (from >53 total publications; *(co-)corresponding author)

1. Girard KD, Chaney C, Delannoy M, Kuo SC, **Robinson DN.*** 2004. Dynacortin contributes to cortical viscoelasticity and helps determine the shape changes of cytokinesis. *EMBO J.* 23: 1536-1546. PMCID: PMC391072
2. Zhang W, **Robinson DN.*** 2005. Balance of actively generated contractile and resistive forces controls cytokinesis dynamics. *Proc. Natl. Acad. Sci*. 102: 7186-7191. PMCID: PMC1129136
3. Girard KD, Kuo SC, **Robinson DN.*** 2006. Dictyostelium myosin-II mechanochemistry promotes active behavior of the cortex on long time-scales. *Proc. Natl. Acad. Sci. USA* 103: 2103-2108. PMCID: PMC1413706
4. Effler JC, Kee Y-S, Berk JM, Tran MN, Iglesias PA, **Robinson DN.*** 2006. Mitosis-specific mechanosensing and contractile protein redistribution control cell shape. *Curr. Biol.* 16: 1962-1967. PMCID: PMC2474462
5. Kabacoff C, Xiong Y, Musib R, Reichl EM, Kim J, Iglesias PA, **Robinson DN.*** 2007. Dynacortin facilitates polarization of chemotaxing cells. *BMC Biol.* 5: 53. PMCID: PMC2231340
6. Reichl EM, Ren Y, Morphew MK, Delannoy M, Effler JC, Girard KD, Divi S, Iglesias PA, Kuo SC, **Robinson DN.*** 2008. Interactions between myosin and actin crosslinkers control cytokinesis contractility dynamics and mechanics. *Curr. Biol.* 18: 471-480. (Cover article) PMCID: PMC2361134
7. Yang L, Effler JC, Kutscher BL, Sullivan SP, **Robinson DN**, Iglesias PA. Modeling cellular deformations using the level set formalism. BMC Systems Biology 2008; 2:68. PMCID: PMC2535594
8. Ren Y, Effler JC, Norstrom M, Luo T, Firtel RA, Iglesias PA, Rock RS, **Robinson DN.*** Mechanosensing through cooperative interactions between the motor myosin-II and the actin crosslinker cortexillin-I. *Curr. Biol.* 2009; 19(17): 1421-1428. PMCID: PMC2763054
9. Xiong Y, Kabacoff C, Franca-Koh J, Devreotes PN, **Robinson DN**, Iglesias PA. Automated characterization of cell shape changes during amoeboid motility. *BMC Systems Biology* 2010; 4:33. PMCID: PMC2864235
10. Larson SM, Lee HJ, Hung P-h, Matthews LM, **Robinson DN***, Evans JP.* Cortical mechanics and meiosis II completion in mammalian oocytes are mediated by myosin-II and ezrin-radixin-moesin (ERM) proteins. *Mol. Biol. Cell* 2010; 21: 3182-3192. (*co-corresponding authors) PMCID: PMC2877640

11. Zhou Q, Kee Y-S, Poirier CC, Jelinek C, Osborne J, Divi S, Surcel A, Tran ME, Eggert US, Müller-Taubenberger A, Iglesias PA, Cotter RJ, **Robinson DN.*** 14-3-3 coordinates microtubules, Rac, and myosin II to control cell mechanics and cytokinesis. *Curr. Biol.* 2010; 20: 1881-1889. PMCID: PMC2975807
12. Luo T, Mohan K, Srivastava V, Ren Y, Iglesias PA, **Robinson DN.*** Understanding the cooperative interactions between myosin II and actin crosslinkers mediated by actin filaments during mechanosensation. *Biophys. J.* 2012; 102(2): 238-247. PMCID: PMC3260782
13. Kee YS, Ren Y, Dorfman D, Iijima M, Firtel RA, Iglesias PA, **Robinson DN.*** A mechanosensory system governs myosin II accumulation in dividing cells. *Mol. Biol. Cell* 2012; 23(8): 1510-1523. PMCID: PMC3327329
14. Poirier CC, Ng WP, **Robinson DN,** Iglesias PA. Deconvolution of the cellular force-generating subsystems that govern cytokinesis furrow ingression. *PLoS Comp. Biol*. 2012; 8(4): e1002467. PMCID: PMC3343096
15. West-Foyle H, **Robinson DN.*** Cytokinesis Mechanics and Mechanosensing. *Cytoskeleton* 2012; 69(10): 700-709. PMCID: PMC3477504
16. Dickinson D, **Robinson DN**, Nelson WJ, Weis WI. α-catenin and IQGAP regulate myosin localization to control epithelial tube morphogenesis in *Dictyostelium. Dev. Cell* 2012; 23: 533-546. PMCID: PMC3443284
17. Kryzak CA, Moraine MM, Kyle DD, Lee HJ, **Robinson DN**, Evans JP. Prophase I mouse oocytes are deficient in the ability to respond to fertilization by decreasing membrane receptivity to sperm and establishing a membrane block to polyspermy. *Biol. Reprod.* 2013; 89: 44, 1-13. PMID: 23863404
18. Luo T, Mohan K, Iglesias PA, **Robinson DN.*** Molecular mechanisms of cellular mechanosensing. *Nat. Mater.* 2013; 12: 1064-1071. PMCID: PMC3838893
19. Luo T, Srivastava V, Ren Y, **Robinson DN.*** Mimicking the mechanical properties of the cell cortex by the self-assembly of an actin cortex in vesicles. *App. Phys. Lett.* 2014; 104: 153701-1-5. PMCID: PMC4000382

D. Research Support

Ongoing Research Support

1. 5R01 GM086704-04 (Iglesias, P/Robinson, D – MPI) 4/1/10-1/31/14
   National Institutes of Health / NIGMS No Cost Extension to 1/31/15
   Computational Models of Cell Division

The goals of this project are to develop a computational framework around the level set formalism for simulating whole-cell, cell shape changes during cytokinesis and for cross-comparison to develop a model of the actin cytoskeleton using a discrete-network representation of interacting filaments with which to investigate cell morphological changes during cytokinesis.

2. 2R01 GM066817-10A1 1/1/2014-12/31/17
   National Institutes of Health / NIGMS
   The Biochemical Basis for the Mechanics of Cytokinesis
   Role: PI

The goals of this project are to determine how cells use biomolecules to generate the necessary physical properties that promote the cell shape changes of cytokinesis. Two key pathways to be studied include an equatorial feedback control system that includes IQGAP proteins, cortexillin I and myosin II, and a global cortical pathway that includes a Rac-family small GTPase, 14-3-3 and myosin II. A combination of proteins dynamics, biochemical reconstitutions, genetic interaction analysis, and proteomics approaches will be pursued.

3. 1R03 HD074773-01A1 (Evans, J/Robinson, D - MPI) 7/1/14-6/30/15
   National Institutes of Health / NICHD
   Signaling Pathways that Mediate Oocyte Cortical Mechanics

The goals of this proposal are to determine what regulatory pathways control mouse oocyte mechanics. Preliminary data implicates several gene products and the goal here is to demonstrate that these genes may be disrupted or deleted for future research to be proposed in an R01 application.

4. Sol Goldman Pancreatic Cancer Research Center (Robinson, D/Anders, R - MPI) 1/1/14-12/31/14
   Johns Hopkins School of Medicine
   Cell genetics mechanics landscape in pancreatic cancer

The goals of this proposal are to map the mechanical genetic landscape of pancreatic cancer cell-lines and to correlate the cell mechanical changes associated with down-stream activated RAS inhibitor treatment and novel cell mechanics modulators.

5. 1R01 GM109863-01 (Robinson, D/Rock, R – MPI) 7/1/14-3/31/18
   National Institutes of Health / NIGMS
   Force-sensitive macromolecular cytoskeletal assembly

The objective of this proposal is to combine single molecule biophysics with cell biophysics to determine how myosin II assembly is directed by mechanical stress and how different alpha-actinin isoforms achieve mechanosensitivity. Specifically, we will learn how mechanical stress promotes myosin II bipolar thick filament assembly and disassembly. Further, MHCKC serves as a model system for studying how mechanical stress indirectly affects the activity of regulatory enzymes. Using alpha-actinin isoforms as model proteins, we will determine how isoform specific kinetic features of crosslinking proteins can tune force-sensitive responses, which can lead to formation and patterning of distinct structures during cell morphogenesis.

Completed Research Support (last three years)

1. RSG CCG-114122 Robinson (PI) 7/1/07–6/30/12
   American Cancer Society
   Investigation into the mechanical feedback regulation of cytokinesis
   Role: PI

2. Robinson, D / Gagnon, Z - MPI 7/1/11-6/30/12
   JHU Engineering in Oncology Center at the INBT
   Development of a Stress-Delivery Platform to Probe Cellular Mechanosensing