


Jeffrey Axelrod

Professor of Pathology

 NIH Biosketch available Online

 Curriculum Vitae available Online

CONTACT INFORMATION

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Bio

ACADEMIC APPOINTMENTS

- Professor, Pathology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Stanford Cancer Institute

HONORS AND AWARDS

- MERIT Award, NIH (2014)
- Election to Membership, American Association of University Pathologists (The Pluto Society) (2014)
- Election to Membership, Association of American Physicians (2011)
- Election to Membership, American Society for Clinical Investigation (2004)
- Cancer Research Fund of the Damon Runyon-Walter Winchell Foundation, Damon-Runyon Scholar Award - Connie and Bob Lurie Scholar (1999)
- Junior Faculty Scholars Award, Howard Hughes Medical Institute (1998)
- Paul E. Strandjord Young Investigator Award, Academy of Clinical Laboratory Physicians and Scientists (1994)
- Clinical Investigator Award, NIH (1993)

PROFESSIONAL EDUCATION

- M.D., Ph.D., Washington University Sch of Med , Medicine and Molecular Biology (1991)
- Sc.B., Brown University , Biochemistry (1981)

LINKS

- Axelrod Lab Homepage: <https://web.stanford.edu/group/axelrodlab/index.shtml>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

The overarching goal of the research in my lab is to understand how signal transduction pathways regulate morphogenesis - the emergence of spatial organization - during development. Development requires that cells differentiate to acquire the necessary complement of cell fates, and that they adopt the structure required to carry out their functions. In multicellular organisms, signal transduction is essential to these processes, yet while our understanding of how signals regulate gene expression is relatively advanced, our understanding of how signals direct the acquisition of specific shapes and forms is less advanced.

Our major project is to investigate a pathway that controls the polarity of epithelial cells within the plane of the epithelium. Epithelia delimit compartments of differing composition, and are necessarily specialized on their apical and basal surfaces. In addition, many epithelial cells are overtly polarized along an axis orthogonal to the apical-basal axis, in a direction defined by the organization of the tissue or organ [referred to as planar cell polarity (PCP)]. In effect, therefore, cells acquire a global “knowledge” of which way is which, much as a compass tells us direction on the earth’s surface. Some examples include the specialized hair cells of the mammalian cochlea, that display a spectacularly polarized organization of kinocilia and stereocilia on their apical surfaces, the dynamic ciliated cells of the tracheal and reproductive tract epithelia, and cells in the gastrulating vertebrate embryo that display polarized migration and intercalation behaviors. In each case, PCP is critical to the function of these cells and tissues, and errors in the signaling system controlling PCP lead to human diseases and developmental defects, including congenital deafness, neural tube closure defects and cardiac outflow tract anomalies. The primary goal of my work on PCP has been to elucidate, at molecular and cell biological levels, the nature of the signals that induce subcellular asymmetry, and how cells then respond to this molecular asymmetry to orient their cytoskeletons.

We employ two principal model systems in our work. Because of the availability of remarkably powerful genetic, molecular and cell biological tools, we use the fruitfly, *Drosophila melanogaster*, as our primary model for investigating the fundamental mechanisms of PCP signaling. Importantly, flies have proven to be a remarkably well-conserved model for the molecular mechanisms of signaling events that direct vertebrate development. More recently, we have taken advantage of our experience in studying these mechanisms to extend our work to vertebrates, using primarily the mouse. To date, our work on vertebrates, along with the work of others, indicates a substantial conservation, but also reveals numerous differences and variations deserving of further study.

Teaching

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Pablo Sanchez Bosch, Alex Weiner

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Cancer Biology (Phd Program)

Publications

PUBLICATIONS

- **Prickle isoforms determine handedness of helical morphogenesis.** *eLife*
Cho, B., Song, S., Axelrod, J. D.
2020; 9
- **Cyclin-dependent kinase control of motile ciliogenesis** *ELIFE*
Vladar, E. K., Stratton, M. B., Saal, M. L., Salazar-De Simone, G., Wang, X., Wolgemuth, D., Stearns, T., Axelrod, J. D.
2018; 7
- **Disruption of Core Planar Cell Polarity Signaling Regulates Renal Tubule Morphogenesis but Is Not Cystogenic** *CURRENT BIOLOGY*

- Kunimoto, K., Bayly, R. D., Vladar, E. K., Vonderfecht, T., Gallagher, A., Axelrod, J. D.
2017; 27 (20): 3120+
- **Airway epithelial homeostasis and planar cell polarity signaling depend on multiciliated cell differentiation.** *JCI insight*
Vladar, E. K., Nayak, J. V., Milla, C. E., Axelrod, J. D.
2016; 1 (13)
 - **Clustering and negative feedback by endocytosis in planar cell polarity signaling is modulated by ubiquitinylation of prickle.** *PLoS genetics*
Cho, B., Pierre-Louis, G., Sagner, A., Eaton, S., Axelrod, J. D.
2015; 11 (5)
 - **Microtubules provide directional information for core PCP function** *ELIFE*
Matis, M., Russler-Germain, D. A., Hu, Q., Tomlin, C. J., Axelrod, J. D.
2014; 3
 - **Asymmetric homotypic interactions of the atypical cadherin Flamingo mediate intercellular polarity signaling** *CELL*
Chen, W., Antic, D., Matis, M., Logan, C. Y., Povelones, M., Anderson, G. A., Nusse, R., Axelrod, J. D.
2008; 133 (6): 1093-1105
 - **Endosomal Wnt signaling proteins control microtubule nucleation in dendrites.** *PLoS biology*
Weiner, A. T., Seebold, D. Y., Torres-Gutierrez, P. n., Folker, C. n., Swope, R. D., Kothe, G. O., Stoltz, J. G., Zalenski, M. K., Kozlowski, C. n., Barbera, D. J., Patel, M. A., Thyagarajan, P. n., Shorey, et al
2020; 18 (3): e3000647
 - **Planar cell polarity signaling in the development of left-right asymmetry.** *Current opinion in cell biology*
Axelrod, J. D.
2019; 62: 61–69
 - **VANGL2 regulates luminal epithelial organization and cell turnover in the mammary gland.** *Scientific reports*
Smith, P., Godde, N., Rubio, S., Tekeste, M., Vladar, E. K., Axelrod, J. D., Henderson, D. J., Milgrom-Hoffman, M., Humbert, P. O., Hinck, L.
2019; 9 (1): 7079
 - **ABNORMAL BASAL CELLS UNDERLIE EPITHELIAL DYSFUNCTION IN CYSTIC FIBROSIS**
Vladar, E. K., Milla, C., Axelrod, J. D.
WILEY.2018: 175
 - **FijiWingsPolarity: An open source toolkit for semi-automated detection of cell polarity** *FLY*
Dobens, L. L., Shipman, A., Axelrod, J. D.
2018; 12 (1): 23–33
 - **Wnt Signaling in Chronic Rhinosinusitis with Nasal Polyps.** *American journal of respiratory cell and molecular biology*
Böscke, R., Vladar, E. K., Könnecke, M., Hüsing, B., Linke, R., Pries, R., Reiling, N., Axelrod, J. D., Nayak, J. V., Wollenberg, B.
2017
 - **Prickle1 mutation causes planar cell polarity and directional cell migration defects associated with cardiac outflow tract anomalies and other structural birth defects** *BIOLOGY OPEN*
Gibbs, B. C., Damerla, R. R., Vladar, E. K., Chatterjee, B., Wan, Y., Liu, X., Cui, C., Gabriel, G. C., Zahid, M., Yagi, H., Szabo-Rogers, H. L., Suyama, K. L., Axelrod, et al
2016; 5 (3): 323-335
 - **Prickle isoforms control the direction of tissue polarity by microtubule independent and dependent mechanisms.** *Biology open*
Sharp, K. A., Axelrod, J. D.
2016; 5 (3): 229-236
 - **The Phenotypic Effects of Royal Jelly on Wild-Type D. melanogaster Are Strain-Specific.** *PloS one*
Morgan, S. L., Seggio, J. A., Nascimento, N. F., Huh, D. D., Hicks, J. A., Sharp, K. A., Axelrod, J. D., Wang, K. C.
2016; 11 (8)
 - **Observing planar cell polarity in multiciliated mouse airway epithelial cells.** *Methods in cell biology*
Vladar, E. K., Lee, Y. L., Stearns, T., Axelrod, J. D.
2015; 127: 37-54

- **Coordinating cell polarity: heading in the right direction?** *DEVELOPMENT*
Axelrod, J. D., Bergmann, D. C.
2014; 141 (17): 3298-3302
- **prickle modulates microtubule polarity and axonal transport to ameliorate seizures in flies.** *Proceedings of the National Academy of Sciences of the United States of America*
Ehaideb, S. N., Iyengar, A., Ueda, A., Iacobucci, G. J., Cranston, C., Bassuk, A. G., Gubb, D., Axelrod, J. D., Gunawardena, S., Wu, C., Manak, J. R.
2014; 111 (30): 11187-11192
- **Prickle/spiny-legs isoforms control the polarity of the apical microtubule network in planar cell polarity.** *Development*
Olofsson, J., Sharp, K. A., Matis, M., Cho, B., Axelrod, J. D.
2014; 141 (14): 2866-2874
- **Methods for studying planar cell polarity** *METHODS*
Olofsson, J., Axelrod, J. D.
2014; 68 (1): 97-104
- **Coordinating cell polarity: heading in the right direction?** *Development (Cambridge, England)*
Axelrod, J. D., Bergmann, D. C.
2014; 141 (17): 3298-3302
- **Myb promotes centriole amplification and later steps of the multiciliogenesis program** *DEVELOPMENT*
Tan, F. E., Vldar, E. K., Ma, L., Fuentealba, L. C., Hoh, R., Espinoza, F. H., Axelrod, J. D., Alvarez-Buylla, A., Stearns, T., Kintner, C., Krasnow, M. A.
2013; 140 (20): 4277-4286
- **Regulation of PCP by the Fat signaling pathway** *GENES & DEVELOPMENT*
Matis, M., Axelrod, J. D.
2013; 27 (20): 2207-2220
- **Myb promotes centriole amplification and later steps of the multiciliogenesis program.** *Development*
Tan, F. E., Vldar, E. K., Ma, L., Fuentealba, L. C., Hoh, R., Espinoza, F. H., Axelrod, J. D., Alvarez-Buylla, A., Stearns, T., Kintner, C., Krasnow, M. A.
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- **Absolute requirement of cholesterol binding for Hedgehog gradient formation in Drosophila.** *Biology open*
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2013; 2 (6): 596-604
- **Microtubules Enable the Planar Cell Polarity of Airway Cilia** *CURRENT BIOLOGY*
Vldar, E. K., Bayly, R. D., Sangoram, A. M., Scott, M. P., Axelrod, J. D.
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- **Remodeling a Tissue: Subtraction Adds Insight** *SCIENCE SIGNALING*
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Abate, A., Vincent, S., Dobbe, R., Silletti, A., Master, N., Axelrod, J. D., Tomlin, C. J.
2012; 9 (6): 1607-1620
- **Planar Polarized Protrusions Break the Symmetry of EGFR Signaling during Drosophila Bract Cell Fate Induction** *DEVELOPMENTAL CELL*
Peng, Y., Han, C., Axelrod, J. D.
2012; 23 (3): 507-518
- **A universal analysis tool for the detection of asymmetric signal distribution in microscopic images** *DEVELOPMENTAL DYNAMICS*
Matis, M., Axelrod, J. D., Galic, M.
2012; 241 (8): 1301-1309
- **Nuclear localization of Prickle2 is required to establish cell polarity during early mouse embryogenesis** *DEVELOPMENTAL BIOLOGY*
Tao, H., Inoue, K., Kiyonari, H., Bassuk, A. G., Axelrod, J. D., Sasaki, H., Aizawa, S., Ueno, N.

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Stubbs, J. L., Vladar, E. K., Axelrod, J. D., Kintner, C.
2012; 14 (2): 140-147
- **Asymmetric Protein Localization in Planar Cell Polarity: Mechanisms, Puzzles, and Challenges** *PLANAR CELL POLARITY DURING DEVELOPMENT*
Peng, Y., Axelrod, J. D.
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- **Modeling the control of planar cell polarity** *WILEY INTERDISCIPLINARY REVIEWS-SYSTEMS BIOLOGY AND MEDICINE*
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- **Pointing in the right direction: new developments in the field of planar cell polarity** *NATURE REVIEWS GENETICS*
Bayly, R., Axelrod, J. D.
2011; 12 (6): 385-391
- **Versatile spectral methods for point set matching** *PATTERN RECOGNITION LETTERS*
Silletti, A., Abate, A., Axelrod, J. D., Tomlin, C. J.
2011; 32 (5): 731-739
- **Mutations in Prickle Orthologs Cause Seizures in Flies, Mice, and Humans** *AMERICAN JOURNAL OF HUMAN GENETICS*
Tao, H., Manak, J. R., Sowers, L., Mei, X., Kiyonari, H., Abe, T., Dandaleh, N. S., Yang, T., Wu, S., Chen, S., Fox, M. H., Gurnett, C., Montine, et al
2011; 88 (2): 138-149
- **STED Super-resolution Microscopy in Drosophila Tissue and in Mammalian Cells.** *Proceedings of SPIE--the International Society for Optical Engineering*
Lau, L., Lee, Y. L., Matis, M., Axelrod, J., Stearns, T., Moerner, W. E.
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- **STED Super-resolution Microscopy in Drosophila Tissue and in Mammalian Cells** *Conference on Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications III*
Lau, L., Lee, Y. L., Matis, M., Axelrod, J., Stearns, T., Moerner, W. E.
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- **Delivering the Lateral Inhibition Punchline: It's All About the Timing** *SCIENCE SIGNALING*
Axelrod, J. D.
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- **Planar Cell Polarity Enables Posterior Localization of Nodal Cilia and Left-Right Axis Determination during Mouse and Xenopus Embryogenesis** *PLOS ONE*
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- **Studies of epithelial PCP.** *Seminars in cell & developmental biology*
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- **Progress and challenges in understanding planar cell polarity signaling** *SEMINARS IN CELL & DEVELOPMENTAL BIOLOGY*
Axelrod, J. D.
2009; 20 (8): 964-971
- **Planar Cell Polarity Signaling: The Developing Cell's Compass** *COLD SPRING HARBOR PERSPECTIVES IN BIOLOGY*
Vladar, E. K., Antic, D., Axelrod, J. D.
2009; 1 (3)
- **Bone morphogenetic protein 2 induces pulmonary angiogenesis via Wnt-beta-catenin and Wnt-RhoA-Rac1 pathways** *JOURNAL OF CELL BIOLOGY*
Perez, V. A., Alastalo, T., Wu, J. C., Axelrod, J. D., Cooke, J. P., Amieva, M., Rabinovitch, M.
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Ma, D., Amonlirdviman, K., Raffard, R. L., Abate, A., Tomlin, C. J., Axelrod, J. D.
2008; 105 (48): 18800-18805
- **A Homozygous Mutation in Human PRICKLE1 Causes an Autosomal-Recessive Progressive Myoclonus Epilepsy-Ataxia Syndrome** *AMERICAN JOURNAL OF HUMAN GENETICS*
Bassuk, A. G., Wallace, R. H., Buhr, A., Buller, A. R., Afawi, Z., Shimojo, M., Miyata, S., Chen, S., Gonzalez-Alegre, P., Griesbach, H. L., Wu, S., Nashelsky, M., Vladar, et al
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- **Dishevelled links basal body docking and orientation in ciliated epithelial cells** *TRENDS IN CELL BIOLOGY*
Vladar, E. K., Axelrod, J. D.
2008; 18 (11): 517-520
- **Bad hair days for mouse PCP mutants** *NATURE CELL BIOLOGY*
Axelrod, J. D.
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Vincent, S., Perrimon, N., Axelrod, J. D.
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- **Basal bodies, kinocilia and planar cell polarity** *NATURE GENETICS*
Axelrod, J. D.
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- **An adjoint-based parameter identification algorithm applied to planar cell polarity signaling** *IEEE TRANSACTIONS ON AUTOMATIC CONTROL*
Raffard, R. L., Amonlirdviman, K., Axelrod, J. D., Tomlin, C. J.
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Raffard, R. L., Amonlirdviman, K., Axelrod, J. D., Tomlin, C. J.
2008: 109-121
- **Biology by numbers: mathematical modelling in developmental biology** *NATURE REVIEWS GENETICS*
Tomlin, C. J., Axelrod, J. D.
2007; 8 (5): 331-340
- **Asymmetric distribution of Prickle-like 2 reveals an early underlying polarization of vestibular sensory epithelia in the inner ear** *JOURNAL OF NEUROSCIENCE*
Deans, M. R., Antic, D., Suyama, K., Scott, M. P., Axelrod, J. D., Goodrich, L. V.
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Guan, J., Li, H., Rogulja, A., Axelrod, J. D., Cadigan, K. M.
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Axelrod, J. D.
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- **A WNTer wonderland in Snowbird** *DEVELOPMENT*
He, X., Axelrod, J. D.
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- **Automatic parameter identification via the adjoint method, with application to understanding planar cell polarity** *45th IEEE Conference on Decision and Control*
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