Stanford

Tim Stearns

Professor of Biology

Curriculum Vitae available Online

CONTACT INFORMATION

- **Alternate Contact**

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Bio

BIO

Tim Stearns is an Emeritus Professor who, as of Sept. 2022, is Professor and Head of Laboratory at Rockefeller University and Dean of the David Rockefeller Graduate School. He previously held the Frank Lee and Carol Hall Professorship in the Department of Biology at Stanford and was Senior Associate Vice Provost of Research. He also held appointments in the Department of Genetics in Stanford Medical School, the Stanford Cancer Institute, and Bio-X, and was a Faculty Fellow in Chem-H, and an affiliated faculty member of the Center for International Security and Cooperation. Stearns is a member of JASON, a group that advises the government on matters of science, technology and national security and has also been an advisor to the National Academies of Science, President's Council of Advisors on Science and Technology, and the Defense Science Board. Stearns received a B.S. from Cornell University, a Ph.D. from MIT, and did a postdoctoral fellowship at the University of California, San Francisco. His research concerns the mechanism and regulation of cell division, the organization of signaling pathways within cells, and cell biology of fungal pathogens. Stearns was named an HHMI Professor in 2002, for his work in science education, and has taught international laboratory workshops in South Africa, Chile, Ghana, and Tanzania. He was chair of the NCSD Study Section at NIH, and served on the editorial boards of several journals.

ACADEMIC APPOINTMENTS

- Professor, Biology
- Member, Bio-X

ADMINISTRATIVE APPOINTMENTS

- Senior Associate Vice Provost of Research, VPDoR, (2020-2022)
- Chair, Dept. of Biology, (2014-2020)

LINKS

- Stearns Lab Home Page: http://stearnslab.stanford.edu

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

The central question behind our work is how the centrosome and primary cilium control cell function and influence development, and how defects in these structures cause a remarkable range of human disease, ranging from cancer, polycystic kidney disease, and obesity, to neurocognitive defects including mental retardation, schizophrenia, and dyslexia.

The centrosome consists of a pair of centrioles and pericentriolar material and organizes the cytoplasmic microtubules of most animal cells. Most importantly, the mother centriole (the older of the two in the pair) nucleates the formation of a primary cilium in most cells in the body. First seen by cell biologists in the 1950's, the primary cilium was ignored for many years until a combination of human and model organism genetics revealed that it is a critical sensory organelle with functions in many important processes. Defects in primary cilium structure and function cause a set of human conditions, called ciliopathies, that share a set of phenotypes that reflect the importance of the cilium in signaling pathways.

There are three main projects in the lab:

1) Ciliary biogenesis and function. In addition to the microtubules making up the interphase array and the mitotic spindle, many animal cells make a specialized microtubule structure, the primary cilium. This is a single, non-motile cilium that is able to act as a transducer of mechanical and chemical signals - sort of a cellular antenna. The microtubules of the ciliary axoneme grow directly from a centriole at their base, this centriole is often called a basal body. Some epithelial cells in the trachea, oviduct and brain produce hundreds of motile cilia on their surface, each with a centriole at their base. We are studying both the primary cilium and multi-ciliated cells for clues into ciliary structure and function, and centriole formation.

2) Cell cycle control of centrosome duplication. We have shown that duplication of the centrosome, the microtubule organizing center of animal cells, is dependent on the cell cycle kinase cdk2, and on cell cycle-specific proteolysis. We are working to determine the molecular mechanisms of centrosome duplication and to understand how centrosome duplication is controlled so that it happens once and only once per cell cycle. Cancer cells often have aberrant centrosome numbers, and we are investigating the relationship between aberrant centrosome number and the genome instability that is common in cancer cells.

3) Microtubule nucleation and organization. Microtubules are polymers of tubulin, which is a heterodimer of alpha-tubulin and beta-tubulin. We have identified a remarkable complex of proteins associated with a third type of tubulin, gamma-tubulin. Gamma-tubulin and its associated proteins are localized to the centrosome and are critical for initiation, or nucleation, of microtubule assembly. The gamma-tubulin complex (gammaTuRC) is a very large, ring-shaped complex and contains at least 6 proteins in addition to gamma-tubulin. We are determining the role of gamma-tubulin and its associated proteins in microtubule nucleation and organization.

Teaching

COURSES

2022-23

- Genetics and Developmental Biology Training Camp: DBIO 200, GENE 200 (Aut)

2021-22

- Genetics and Developmental Biology Training Camp: DBIO 200, GENE 200 (Aut)
- Introduction to Laboratory Research in Cell and Molecular Biology: BIO 45 (Aut, Win)

2020-21

- Genetics and Developmental Biology Training Camp: DBIO 200, GENE 200 (Aut)

- Introduction to Laboratory Research in Cell and Molecular Biology: BIO 45 (Aut, Win)
- Sustainability and Civilization: BIO 35, HISTORY 35, POLISCI 35 (Sum)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Alex Long

Postdoctoral Research Mentor

Richa Sharma

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biology (School of Humanities and Sciences) (Phd Program)
- Cancer Biology (Phd Program)
- Genetics (Phd Program)

Publications

PUBLICATIONS

- **MAP9/MAPH-9 supports axonemal microtubule doublets and modulates motor movement.** *Developmental cell*
  Tran, M. V., Khuntsariya, D., Fetter, R. D., Ferguson, J. W., Wang, J. T., Long, A. F., Cote, L. E., Wellard, S. R., Vazquez-Martinez, N., Sallee, M. D., Genova, M., Magiera, M. M., Eskinazi, et al
  2023
- **Calcineurin associates with centrosomes and regulates cilia length maintenance.** *Journal of cell science*
  Tsekitsidou, E., Wong, C. J., Ulengin-Talkish, I., Barth, A. I., Stearns, T., Gingras, A. C., Wang, J. T., Cyert, M. S.
  2023
- **Single-molecule imaging in the primary cilium.** *Methods in cell biology*
  Weiss, L. E., Love, J. F., Yoon, J., Comerci, C. J., Milenkovic, L., Kanie, T., Jackson, P. K., Stearns, T., Gustavsson, A.
  2023; 176: 59-83
- **Post-mitotic centriole disengagement and maturation leads to centrosome amplification in polyploid trophoblast giant cells.** *Molecular biology of the cell*
  Buss, G., Stratton, M. B., Milenkovic, L., Stearns, T.
  2022: mbcE22050182
- **Long-range migration of centrioles to the apical surface of the olfactory epithelium.** *eLife*
  Ching, K., Wang, J. T., Stearns, T.
  2022; 11
- **Investigate the origins of COVID-19.** *Science (New York, N.Y.)*
  Bloom, J. D., Chan, Y. A., Baric, R. S., Bjorkman, P. J., Cobey, S., Deverman, B. E., Fisman, D. N., Gupta, R., Iwasaki, A., Lipsitch, M., Medzhitov, R., Neher, R. A., Nielsen, et al
  2021; 372 (6543): 694
- **Hedgehog signaling and the primary cilium: implications for spatial and temporal constraints on signaling.** *Development (Cambridge, England)*
  Ho, E. K., Stearns, T.
  2021; 148 (9)
- **A not-so-simple twist of fate.** *Developmental cell*
  Long, A. F., Stearns, T.
  2021; 56 (4): 402–4
- **Assaying Cell Cycle Progression via Flow Cytometry in CRISPR/Cas9-Treated Cells.** *Methods in molecular biology (Clifton, N.J.)*
  Geisinger, J. M., Stearns, T.
  2021; 2329: 195-204

- **The nucleus serves as the pacemaker for the cell cycle.** *eLife*
  Afanzar, O., Buss, G. K., Stearns, T., Ferrell, J. E.
  2020; 9

- **Cilium Axoneme Internalization and Degradation in Chytrid Fungi.** *Cytoskeleton (Hoboken, N.J.)*
  Venard, C. M., Vasudevan, K. K., Stearns, T.
  2020

- **Systematic Discovery of Short Linear Motifs Decodes Calcineurin Phosphatase Signaling.** *Molecular cell*
  Wigington, C. P., Roy, J. n., Damle, N. P., Yadav, V. K., Blikstad, C. n., Resch, E. n., Wong, C. J., Mackay, D. R., Wang, J. T., Krystkowiak, I. n., Bradburn, D. A., Tsekitsidou, E. n., Hong, et al
  2020

- **CRISPR/Cas9 treatment causes extended TP53-dependent cell cycle arrest in human cells.** *Nucleic acids research*
  Geisinger, J. M., Stearns, T. n.
  2020

- **Centrioles are amplified in cycling progenitors of olfactory sensory neurons.** *PLoS biology*
  Ching, K. n., Stearns, T. n.
  2020; 18 (9): e3000852

- **Transient Primary Cilia Mediate Robust Hedgehog Pathway-Dependent Cell Cycle Control.** *Current biology : CB*
  Ho, E. K., Tsai, A. E., Stearns, T. n.
  2020

- **Growth disadvantage associated with centrosome amplification drives population-level centriole number homeostasis.** *Molecular biology of the cell*
  Sala, R. n., Farrell, K. C., Stearns, T. n.
  2020: mbcE19040195

- **Primary cilium loss in mammalian cells occurs predominantly by whole-cilium shedding.** *PLoS biology*
  Mirvis, M., Siemers, K. A., Nelson, W. J., Stearns, T. P.
  2019; 17 (7): e3000381

- **Regulation of cilia abundance in multiciliated cells** *ELIFE*
  Nanjundappa, R., Kong, D., Shim, K., Stearns, T., Brody, S. L., Loncarek, J., Mahjoub, M. R.
  2019; 8

- **Motional dynamics of single Patched1 molecules in cilia are controlled by Hedgehog and cholesterol** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Weiss, L. E., Milenkovic, L., Yoon, J., Stearns, T., Moerner, W. E.
  2019; 116 (12): 5550-5557

- **Pocket similarity identifies selective estrogen receptor modulators as microtubule modulators at the taxane site** *NATURE COMMUNICATIONS*
  Lo, Y., Cormier, O., Liu, T., Nettles, K. W., Katzenellenbogen, J. A., Stearns, T., Altman, R. B.
  2019; 10

- **Motional dynamics of single Patched1 molecules in cilia are controlled by Hedgehog and cholesterol.** *Proceedings of the National Academy of Sciences of the United States of America*
  Weiss, L. E., Milenkovic, L., Yoon, J., Stearns, T., Moerner, W. E.
  2019

- **Revealing Nanoscale Morphology of the Primary Cilium Using Super-Resolution Fluorescence Microscopy** *BIOPHYSICAL JOURNAL*
  Yoon, J., Comerci, C. J., Weiss, L. E., Milenkovic, L., Stearns, T., Moernert, W. E.
  2019; 116 (2): 319-329

- **Regulation of cilia abundance in multiciliated cells.** *eLife*
  Nanjundappa, R. n., Kong, D. n., Shim, K. n., Stearns, T. n., Brody, S. L., Loncarek, J. n., Mahjoub, M. R.
  2019; 8

- **Pocket similarity identifies selective estrogen receptor modulators as microtubule modulators at the taxane site.** *Nature communications*

Lo, Y. C., Cormier, O. n., Liu, T. n., Nettles, K. W., Katzenellenbogen, J. A., Stearns, T. n., Altman, R. B.
2019; 10 (1): 1033

- **Revealing Nanoscale Morphology of the Primary Cilium Using Super-Resolution Fluorescence Microscopy.** *Biophysical journal*
  Yoon, J., Comerci, C. J., Weiss, L. E., Milenkovic, L., Stearns, T., Moerner, W. E.
  2018
- **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
- **Cilium structure, assembly, and disassembly regulated by the cytoskeleton.** *The Biochemical journal*
  Mirvis, M., Stearns, T., James Nelson, W.
  2018; 475 (14): 2329–53
- **Cilium structure, assembly, and disassembly regulated by the cytoskeleton** *BIOCHEMICAL JOURNAL*
  Mirvis, M., Stearns, T., Nelson, W.
  2018; 475: 2329-2353
- **Quantifying Nanoscale Morphological Features of the Primary Cilium Membrane using Super-Resolution Fluorescence Microscopy**
  Yoon, J., Weiss, L., Milenkovic, L., Stearns, T., Moerner, W. E.
  CELL PRESS.2018: 268A
- **The ABCs of Centriole Architecture: The Form and Function of Triplet Microtubules.** *Cold Spring Harbor symposia on quantitative biology*
  Wang, J. T., Stearns, T. n.
  2018
- **Mitosis sans Mitosis: The Mitotic Oscillator in Differentiation** *DEVELOPMENTAL CELL*
  Stratton, M., Stearns, T.
  2017; 43 (4): 385–86
- **Centriole triplet microtubules are required for stable centriole formation and inheritance in human cell** *ELIFE*
  Wang, J. T., Kong, D., Hoerner, C. R., Loncarek, J., Stearns, T.
  2017; 6
- **Using Yeast to Determine the Functional Consequences of Mutations in the Human p53 Tumor Suppressor Gene: An Introductory Course-Based Undergraduate Research Experience in Molecular and Cell Biology** *BIOCHEMISTRY AND MOLECULAR BIOLOGY EDUCATION*
  Hekmat-Scafe, D. S., Brownell, S. E., Seawell, P. C., Malladi, S., Imam, J. F., Singla, V., Bradon, N., Cyert, M. S., Stearns, T.
  2017; 45 (2): 161-178
- **Centriole triplet microtubules are required for stable centriole formation and inheritance in human cells.** *eLife*
  Wang, J. T., Kong, D. n., Hoerner, C. R., Loncarek, J. n., Stearns, T. n.
  2017; 6
- **The ABCs of Centriole Architecture: The Form and Function of Triplet Microtubules**
  Wang, J. T., Stearns, T., Stewart, D., Stillman, B.
  COLD SPRING HARBOR LABORATORY PRESS.2017: 145-155
- **A Conversation with Tim Stearns**
  Witkowski, J., Stearns, T., Stewart, D., Stillman, B.
  COLD SPRING HARBOR LABORATORY PRESS.2017: 409-412
- **Sperm Centrosomes: Kiss Your Asterless Goodbye, for Fertility's Sake.** *Current biology*
  Schatten, G., Stearns, T.
  2015; 25 (24): R1178-81
- **MDM1 is a microtubule-binding protein that negatively regulates centriole duplication.** *Molecular biology of the cell*
  Van de Mark, D., Kong, D., Loncarek, J., Stearns, T.
  2015; 26 (21): 3788-3802

- **Zeta-Tubulin Is a Member of a Conserved Tubulin Module and Is a Component of the Centriolar Basal Foot in Multiciliated Cells** *CURRENT BIOLOGY*
  Turk, E., Wills, A. A., Kwon, T., Sedzinski, J., Wallingford, J. B., Stearns, T.
  2015; 25 (16): 2177-2183
- **A High-Enrollment Course-Based Undergraduate Research Experience Improves Student Conceptions of Scientific Thinking and Ability to Interpret Data** *CBE-LIFE SCIENCES EDUCATION*
  Brownell, S. E., Hekmat-Scafe, D. S., Singla, V., Seawell, P. C., Imam, J. F., Eddy, S. L., Stearns, T., Cyert, M. S.
  2015; 14 (2)
- **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
- **Cell biology. Centrioles, in absentia.** *Science (New York, N.Y.)*
  Stearns, T. n.
  2015; 348 (6239): 1091–92
- **Probing mammalian centrosome structure using BioID proximity-dependent biotinylation** *CENTROSOME & CENTRIOLE*
  Firat-Karalar, E. N., Stearns, T.
  2015; 129: 153-170
- **Cby1 promotes Ahi1 recruitment to a ring-shaped domain at the centriole-cilium interface and facilitates proper cilium formation and function** *MOLECULAR BIOLOGY OF THE CELL*
  Lee, Y. L., Sante, J., Comerci, C. J., Cyge, B., Menezes, L. F., Li, F., Germino, G. G., Moerner, W. E., Takemaru, K., Stearns, T.
  2014; 25 (19): 2919-2933
- **Cby1 promotes Ahi1 recruitment to a ring-shaped domain at the centriole-cilium interface and facilitates proper cilium formation and function.** *Molecular biology of the cell*
  Lee, Y. L., Santé, J., Comerci, C. J., Cyge, B., Menezes, L. F., Li, F., Germino, G. G., Moerner, W. E., Takemaru, K., Stearns, T.
  2014; 25 (19): 2919-2933
- **Proteomic analysis of mammalian sperm cells identifies new components of the centrosome** *JOURNAL OF CELL SCIENCE*
  Firat-Karalar, E. N., Sante, J., Elliott, S., Stearns, T.
  2014; 127 (19): 4128-4133
- **The centriole duplication cycle** *PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES*
  Firat-Karalar, E. N., Stearns, T.
  2014; 369 (1650)
- **Proximity Interactions among Centrosome Components Identify Regulators of Centriole Duplication** *CURRENT BIOLOGY*
  Firat-Karalar, E. N., Rauniyar, N., Yates, J. R., Stearns, T.
  2014; 24 (6): 664-670
- **Centrosome-kinase fusions promote oncogenic signaling and disrupt centrosome function in myeloproliferative neoplasms.** *PloS one*
  Lee, J. Y., Hong, W., Majeti, R., Stearns, T.
  2014; 9 (3)
- **Journey to the center of the centrosome.** *Developmental cell*
  Stearns, T. n.
  2014; 28 (6): 603–4
- **Centrosome-kinase fusions promote oncogenic signaling and disrupt centrosome function in myeloproliferative neoplasms.** *PloS one*
  Lee, J. Y., Hong, W., Majeti, R., Stearns, T.
  2014; 9 (3)
- **Myb promotes centriole amplification and later steps of the multiciliogenesis program** *DEVELOPMENT*
  Tan, F. E., Vladar, 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
- **Autophagy promotes primary ciliogenesis by removing OFD1 from centriolar satellites** *NATURE*

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- **Remembrance of cilia past.** *Cell*
  Hoerner, C., Stearns, T.
  2013; 155 (2): 271-273
- **Myb promotes centriole amplification and later steps of the multiciliogenesis program.** *Development*
  Tan, F. E., Vladar, 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
- **FOP Is a Centriolar Satellite Protein Involved in Ciliogenesis** *PLOS ONE*
  Lee, J. Y., Stearns, T.
  2013; 8 (3)
- **The Rilp-like proteins Rilpl1 and Rilpl2 regulate ciliary membrane content.** *Molecular biology of the cell*
  Schaub, J. R., Stearns, T.
  2013; 24 (4): 453-464
- **Cell architecture: putting the building blocks together** *CURRENT OPINION IN CELL BIOLOGY*
  Akhmanova, A., Stearns, T.
  2013; 25 (1): 3-5
- **Transcriptional Program of Ciliated Epithelial Cells Reveals New Cilium and Centrosome Components and Links to Human Disease** *PLOS ONE*
  Hoh, R. A., Stowe, T. R., Turk, E., Stearns, T.
  2012; 7 (12)
- **Supernumerary Centrosomes Nucleate Extra Cilia and Compromise Primary Cilium Signaling** *CURRENT BIOLOGY*
  Mahjoub, M. R., Stearns, T.
  2012; 22 (17): 1628-1634
- **The centriolar satellite proteins Cep72 and Cep290 interact and are required for recruitment of BBS proteins to the cilium** *MOLECULAR BIOLOGY OF THE CELL*
  Stowe, T. R., Wilkinson, C. J., Iqbal, A., Stearns, T.
  2012; 23 (17): 3322-3335
- **STED Microscopy with Optimized Labeling Density Reveals 9-Fold Arrangement of a Centriole Protein** *BIOPHYSICAL JOURNAL*
  Lau, L., Lee, Y. L., Sahl, S. J., Stearns, T., Moerner, W. E.
  2012; 102 (12): 2926-2935
- **Mechanosensing by the Primary Cilium: Deletion of Kif3A Reduces Bone Formation Due to Loading** *PLOS ONE*
  Temiyasathit, S., Tang, W. J., Leucht, P., Anderson, C. T., Monica, S. D., Castillo, A. B., Helms, J. A., Stearns, T., Jacobs, C. R.
  2012; 7 (3)
- **A crucial requirement for Hedgehog signaling in small cell lung cancer** *NATURE MEDICINE*
  Park, K., Martelotto, L. G., Peifer, M., Sos, M. L., Karnezis, A. N., Mahjoub, M. R., Bernard, K., Conklin, J. F., Szczepny, A., Yuan, J., Guo, R., Ospina, B., Falzon, et al
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- **Curcumin Inhibits Growth of Saccharomyces cerevisiae through Iron Chelation** *EUKARYOTIC CELL*
  Minear, S., O'Donnell, A. F., Ballew, A., Giaever, G., Nislow, C., Stearns, T., Cyert, M. S.
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- **The centrosome cycle: Centriole biogenesis, duplication and inherent asymmetries** *NATURE CELL BIOLOGY*
  Nigg, E. A., Stearns, T.
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  Lau, L., Lee, Y. L., Matis, M., Axelrod, J., Stearns, T., Moerner, W. E.
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- **Cep152 interacts with Plk4 and is required for centriole duplication** *JOURNAL OF CELL BIOLOGY*
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- **Cep120 is asymmetrically localized to the daughter centriole and is essential for centriole assembly** *JOURNAL OF CELL BIOLOGY*
  Mahjoub, M. R., Xie, Z., Stearns, T.
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- **The life cycle of centrioles.** *Cold Spring Harbor symposia on quantitative biology*
  Hatch, E., Stearns, T.
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- **STEM CELLS A fateful age gap** *NATURE*
  Stearns, T.
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- **Centriole Age Underlies Asynchronous Primary Cilium Growth in Mammalian Cells** *CURRENT BIOLOGY*
  Anderson, C. T., Stearns, T.
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- **Polo Kinase and Separase Regulate the Mitotic Licensing of Centriole Duplication in Human Cells** *DEVELOPMENTAL CELL*
  Tsou, M. B., Wang, W., George, K. A., Uryu, K., Stearns, T., Jallepalli, P. V.
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  Haren, L., Stearns, T., Luders, J.
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- **Exploring the pole: an EMBO conference on centrosomes and spindle pole bodies** *NATURE CELL BIOLOGY*
  Jaspersen, S. L., Stearns, T.
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- **Primary cilia: Cellular sensors for the skeleton** *37th International Sun Valley Workshop on Skeletal Tissue Biology*
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- **Primary cilia: Mechanosensory organelles in bone cells.** *28th Annual Meeting of the American-Society-for-Bone-and-Mineral-Research*
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