



Philip Beachy

The Ernest and Amelia Gallo Professor, Professor of Urology, of Developmental Biology and, by courtesy, of Chemical and Systems Biology

CONTACT INFORMATION

- **Administrative Contact**

Valerie Hyun-Hee Park - Administrative Associate 3

Email valpark@stanford.edu

Tel (650) 736-8530

Bio

ACADEMIC APPOINTMENTS

- Professor, Urology
- Professor, Developmental Biology
- Professor (By courtesy), Chemical and Systems Biology
- Member, Bio-X
- Member, Institute for Stem Cell Biology and Regenerative Medicine
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Stanford Cancer Institute
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Director, Siebel Investigator Program, Institute for Stem Cell Biology and Regenerative Medicine, (2016- present)

HONORS AND AWARDS

- Katharine Berkan Judd Award for Cancer Research, Sloan Kettering Institute (2016)
- Keio Medical Science Prize, Keio University, Japan (2011)
- March of Dimes Prize in Developmental Biology, March of Dimes Birth Defects Foundation (2008)
- Fellow, American Academy of Arts and Sciences (2003)
- Member, National Academy of Sciences (2002)
- National Academy of Sciences Award in Molecular Biology, National Academy of Sciences (1998)
- Outstanding Young Scientist Award, Maryland Academy of Sciences (1997)

PROFESSIONAL EDUCATION

- Ph.D., Stanford University , Biochemistry (1986)
- B.S., Goshen College, Goshen, Indiana , Natural Sciences (1979)

LINKS

- Beachy Lab: <https://pbeachy.stanford.edu/>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My lab studies the function of Hedgehog proteins and other extracellular signals in morphogenesis (pattern formation) and in injury repair and regeneration (pattern maintenance). We study how the distribution of such signals is regulated in tissues, how cells perceive and respond to distinct concentrations of signals, and how such signaling pathways arose in evolution. We also study the normal roles of such signals in stem-cell physiology and their abnormal roles in the formation and expansion of cancer stem cells.

Teaching

COURSES

2025-26

- Stem Cell Biology & Regenerative Medicine: STEMREM 201A (Aut)

2024-25

- Stem Cell Biology & Regenerative Medicine: STEMREM 201A (Aut)

2023-24

- Stem Cell Biology & Regenerative Medicine: STEMREM 201A (Aut)

2022-23

- Stem Cell Biology & Regenerative Medicine: STEMREM 201A (Aut)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Seungyeon LEE, Mallory Laboulaye, Ye Tian, Jingyu Zhao

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Cancer Biology (Phd Program)
- Developmental Biology (Phd Program)
- Stem Cell Biology and Regenerative Medicine (Phd Program)

Publications

PUBLICATIONS

- **Neuroendocrine cells orchestrate regeneration through Desert hedgehog signaling.** *Cell*
Kong, W., Lu, W. J., Dubey, M., Suryawanshi, R. K., Vijayakumar, S., Jeong, Y., Gombar, S., Diehn, M., Shin, K., Ott, M., Chien, Y. H., Sarin, K. Y., Desai, et al
2025
- **Cellular and molecular mechanisms of Hedgehog signalling.** *Nature reviews. Molecular cell biology*
Zhang, Y., Beachy, P. A.
2023
- **Dispatched uses Na⁺ flux to power release of lipid-modified Hedgehog.** *Nature*
Wang, Q., Asarnow, D. E., Ding, K., Mann, R. K., Hatakeyama, J., Zhang, Y., Ma, Y., Cheng, Y., Beachy, P. A.

2021

- **Hedgehog pathway activation through nanobody-mediated conformational blockade of the Patched sterol conduit.** *Proceedings of the National Academy of Sciences of the United States of America*
Zhang, Y., Lu, W., Bulkley, D. P., Liang, J., Ralko, A., Han, S., Roberts, K. J., Li, A., Cho, W., Cheng, Y., Manglik, A., Beachy, P. A.
2020
- **Smoothed stimulation by membrane sterols drives Hedgehog pathway activity.** *Nature*
Deshpande, I., Liang, J., Hedeem, D., Roberts, K. J., Zhang, Y., Ha, B., Latorraca, N. R., Faust, B., Dror, R. O., Beachy, P. A., Myers, B. R., Manglik, A.
2019
- **Structural Basis for Cholesterol Transport-like Activity of the Hedgehog Receptor Patched.** *Cell*
Zhang, Y., Bulkley, D. P., Xin, Y., Roberts, K. J., Asarnow, D. E., Sharma, A., Myers, B. R., Cho, W., Cheng, Y., Beachy, P. A.
2018
- **Cilia-Associated Oxysterols Activate Smoothed.** *Molecular cell*
Raleigh, D. R., Sever, N., Choksi, P. K., Sigg, M. A., Hines, K. M., Thompson, B. M., Elnatan, D., Jaishankar, P., Bisignano, P., Garcia-Gonzalo, F. R., Krup, A. L., Eberl, M., Byrne, et al
2018; 72 (2): 316
- **Neuronal delivery of Hedgehog directs spatial patterning of taste organ regeneration.** *Proceedings of the National Academy of Sciences of the United States of America*
Lu, W. J., Mann, R. K., Nguyen, A. n., Bi, T. n., Silverstein, M. n., Tang, J. Y., Chen, X. n., Beachy, P. A.
2018; 115 (2): E200–E209
- **Single-cell transcriptomics of 20 mouse organs creates a Tabula Muris.** *Nature*
2018; 562 (7727): 367–72
- **Hedgehog mediated degradation of Ihog adhesion proteins modulates cell segregation in Drosophila wing imaginal discs** *NATURE COMMUNICATIONS*
Hsia, E. Y. C., Zhang, Y., Tran, H., Lim, A., Chou, Y., Lan, G., Beachy, P. A., Zheng, X.
2017; 8: 1275
- **Stromal Gli2 activity coordinates a niche signaling program for mammary epithelial stem cells** *SCIENCE*
Zhao, C., Cai, S., Shin, K., Lim, A., Kalisky, T., Lu, W., Clarke, M. F., Beachy, P. A.
2017; 356 (6335): 284–?
- **The Stromal Niche for Epithelial Stem Cells: A Template for Regeneration and a Brake on Malignancy.** *Cancer cell*
Roberts, K. J., Kershner, A. M., Beachy, P. A.
2017; 32 (4): 404–10
- **Rapid, direct activity assays for Smoothed reveal Hedgehog pathway regulation by membrane cholesterol and extracellular sodium.** *Proceedings of the National Academy of Sciences of the United States of America*
Myers, B. R., Neahring, L. n., Zhang, Y. n., Roberts, K. J., Beachy, P. A.
2017; 114 (52): E11141–E11150
- **Control of inflammation by stromal Hedgehog pathway activation restrains colitis.** *Proceedings of the National Academy of Sciences of the United States of America*
Lee, J. J., Rothenberg, M. E., Seeley, E. S., Zimdahl, B., Kawano, S., Lu, W., Shin, K., Sakata-Kato, T., Chen, J. K., Diehn, M., Clarke, M. F., Beachy, P. A.
2016
- **Hedgehog Signaling Restrains Bladder Cancer Progression by Eliciting Stromal Production of Urothelial Differentiation Factors** *CANCER CELL*
Shin, K., Lim, A., Zhao, C., Sahoo, D., Pan, Y., Spiekerkoetter, E., Liao, J. C., Beachy, P. A.
2014; 26 (4): 521-533
- **Stromal response to Hedgehog signaling restrains pancreatic cancer progression.** *Proceedings of the National Academy of Sciences of the United States of America*
Lee, J. J., Perera, R. M., Wang, H., Wu, D., Liu, X. S., Han, S., Fitamant, J., Jones, P. D., Ghanta, K. S., Kawano, S., Nagle, J. M., Deshpande, V., Boucher, et al

2014; 111 (30): E3091-100

- **Identification of recurrent SMO and BRAF mutations in ameloblastomas.** *Nature genetics*
Sweeney, R. T., McClary, A. C., Myers, B. R., Biscocho, J., Neahring, L., Kwei, K. A., Qu, K., Gong, X., Ng, T., Jones, C. D., Varma, S., Odegaard, J. I., Sugiyama, et al
2014; 46 (7): 722-725
- **Cellular origin of bladder neoplasia and tissue dynamics of its progression to invasive carcinoma.** *Nature cell biology*
Shin, K., Lim, A., Odegaard, J. I., Honeycutt, J. D., Kawano, S., Hsieh, M. H., Beachy, P. A.
2014; 16 (5): 469-478
- **Simultaneous measurement of smoothened entry into and exit from the primary cilium.** *PLoS one*
Kim, J., Hsia, E. Y., Kim, J., Sever, N., Beachy, P. A., Zheng, X.
2014; 9 (8)
- **Hedgehog pathway modulation by multiple lipid binding sites on the smoothened effector of signal response.** *Developmental cell*
Myers, B. R., Sever, N., Chong, Y. C., Kim, J., Belani, J. D., Rychnovsky, S., Bazan, J. F., Beachy, P. A.
2013; 26 (4): 346-357
- **Scube/You activity mediates release of dually lipid-modified Hedgehog signal in soluble form** *GENES & DEVELOPMENT*
Creanga, A., Glenn, T. D., Mann, R. K., Saunders, A. M., Talbot, W. S., Beachy, P. A.
2012; 26 (12): 1312-1325
- **Structure of the protein core of the glypican Dally-like and localization of a region important for hedgehog signaling** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Kim, M., Saunders, A. M., Hamaoka, B. Y., Beachy, P. A., Leahy, D. J.
2011; 108 (32): 13112-13117
- **Hedgehog/Wnt feedback supports regenerative proliferation of epithelial stem cells in bladder** *NATURE*
Shin, K., Lee, J., Guo, N., Kim, J., Lim, A., Qu, L., Mysorekar, I. U., Beachy, P. A.
2011; 472 (7341): 110-U145
- **Hedgehog-responsive candidate cell of origin for diffuse intrinsic pontine glioma** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Monje, M., Mitra, S. S., Freret, M. E., Raveh, T. B., Kim, J., Masek, M., Attema, J. L., Li, G., Haddix, T., Edwards, M. S., Fisher, P. G., Weissman, I. L., Rowitch, et al
2011; 108 (11): 4453-4458
- **Interactions between Hedgehog proteins and their binding partners come into view** *GENES & DEVELOPMENT*
Beachy, P. A., Hymowitz, S. G., Lazarus, R. A., Leahy, D. J., Siebold, C.
2010; 24 (18): 2001-2012
- **Arsenic antagonizes the Hedgehog pathway by preventing ciliary accumulation and reducing stability of the Gli2 transcriptional effector** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Kim, J., Lee, J. J., Kim, J., Gardner, D., Beachy, P. A.
2010; 107 (30): 13432-13437
- **Itraconazole, a Commonly Used Antifungal that Inhibits Hedgehog Pathway Activity and Cancer Growth** *CANCER CELL*
Kim, J., Tang, J. Y., Gong, R., Kim, J., Lee, J. J., Clemons, K. V., Chong, C. R., Chang, K. S., Fereshteh, M., Gardner, D., Reya, T., Liu, J. O., Epstein, et al
2010; 17 (4): 388-399
- **Dally-like core protein and its mammalian homologues mediate stimulatory and inhibitory effects on Hedgehog signal response** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Williams, E. H., Pappano, W. N., Saunders, A. M., Kim, M., Leahy, D. J., Beachy, P. A.
2010; 107 (13): 5869-5874
- **Genetic and biochemical definition of the Hedgehog receptor** *GENES & DEVELOPMENT*
Zheng, X., Mann, R. K., Sever, N., Beachy, P. A.
2010; 24 (1): 57-71

- **Gli2 trafficking links Hedgehog-dependent activation of Smoothened in the primary cilium to transcriptional activation in the nucleus** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Kim, J., Kato, M., Beachy, P. A.
2009; 106 (51): 21666-21671
- **The mode of Hedgehog binding to Ihog homologues is not conserved across different phyla** *NATURE*
McLellan, J. S., Zheng, X., Hauk, G., Ghirlando, R., Beachy, P. A., Leahy, D. J.
2008; 455 (7215): 979-U62
- **Oxysterols pathway in are novel activators of the hedgehog pluripotent mesenchymal cells** *JOURNAL OF BIOLOGICAL CHEMISTRY*
Dwyer, J. R., Sever, N., Carlson, M., Nelson, S. F., Beachy, P. A., Parhami, F.
2007; 282 (12): 8959-8968
- **Structure of a heparin-dependent complex of hedgehog and Ihog** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
McLellan, J. S., Yao, S., Zheng, X., Geisbrecht, B. V., Ghirlando, R., Beachy, P. A., Leahy, D. J.
2006; 103 (46): 17208-17213
- **Prevalence of off-target effects in Drosophila RNA interference screens** *NATURE*
Ma, Y., Creanga, A., Lum, L., Beachy, P. A.
2006; 443 (7109): 359-363
- **A genomewide screen for components of the RNAi pathway in Drosophila cultured cells** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Dorner, S., Lum, L., Kim, M., Paro, R., Beachy, P. A., Green, R.
2006; 103 (32): 11880-11885
- **The ihog cell-surface proteins bind hedgehog and mediate pathway activation** *CELL*
Yao, S. Q., Lum, L., Beachy, P.
2006; 125 (2): 343-357
- **Defective cerebellar response to mitogenic Hedgehog signaling in Down's syndrome mice** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Roper, R. J., Baxter, L. L., Saran, N. G., Klinedinst, D. K., Beachy, P. A., Reeves, R. H.
2006; 103 (5): 1452-1456
- **Molecular mechanisms of Sonic hedgehog mutant effects in holoprosencephaly** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Maity, T., Fuse, N., Beachy, P. A.
2005; 102 (47): 17026-17031
- **Extensive phosphorylation of Smoothened in Hedgehog pathway activation** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Zhang, C., Williams, E. H., Guo, Y., Lum, L., Beachy, P. A.
2004; 101 (52): 17900-17907
- **Tissue repair and stem cell renewal in carcinogenesis** *NATURE*
Beachy, P. A., Karhadkar, S. S., Berman, D. M.
2004; 432 (7015): 324-331
- **Mending and malignancy** *NATURE*
Beachy, P. A., Karhadkar, S. S., Berman, D. M.
2004; 431 (7007): 402-402
- **The Hedgehog response network: Sensors, switches, and routers** *SCIENCE*
Lum, L., Beachy, P. A.
2004; 304 (5678): 1755-1759
- **Novel lipid modifications of secreted protein signals** *ANNUAL REVIEW OF BIOCHEMISTRY*
Mann, R. K., Beachy, P. A.

2004; 73: 891-923

- **Hedgehog signal transduction via smoothed association with a cytoplasmic complex scaffolded by the atypical kinesin, Costal-2** *MOLECULAR CELL*
Lum, L., Zhang, C., Oh, S., Mann, R. K., von Kessler, D. P., Taipale, J., Weis-Garcia, F., Gong, R. Y., Wang, B. L., Beachy, P. A.
2003; 12 (5): 1261-1274
- **A defective response to Hedgehog signaling in disorders of cholesterol biosynthesis** *NATURE GENETICS*
Cooper, M. K., Wassif, C. A., Krakowiak, P. A., Taipale, J., Gong, R. Y., Kelley, R. I., Porter, F. D., Beachy, P. A.
2003; 33 (4): 508-513
- **Identification of Hedgehog pathway components by RNAi in Drosophila cultured cells** *SCIENCE*
Lum, L., Yao, S. Q., Mozer, B., Rovescalli, A., Von Kessler, D., Nirenberg, M., Beachy, P. A.
2003; 299 (5615): 2039-2045
- **Hedgehog signalling within airway epithelial progenitors and in small-cell lung cancer** *NATURE*
Watkins, D. N., Berman, D. M., Burkholder, S. G., Wang, B. L., Beachy, P. A., BAYLIN, S. B.
2003; 422 (6929): 313-317
- **Inhibition of Hedgehog signaling by direct binding of cyclopamine to Smoothed** *GENES & DEVELOPMENT*
Chen, J. K., Taipale, J., Cooper, M. K., Beachy, P. A.
2002; 16 (21): 2743-2748
- **Small molecule modulation of Smoothed activity** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Chen, J. K., Taipale, J., Young, K. E., Maiti, T., Beachy, P. A.
2002; 99 (22): 14071-14076
- **Hedgehog-mediated patterning of the mammalian embryo requires transporter-like function of dispatched** *CELL*
Ma, Y., Erkner, A., Gong, R. Y., Yao, S. Q., Taipale, J., Basler, K., Beachy, P. A.
2002; 111 (1): 63-75
- **Medulloblastoma growth inhibition by Hedgehog pathway blockade** *SCIENCE*
Berman, D. M., Karhadkar, S. S., Hallahan, A. R., Pritchard, J. I., Eberhart, C. G., Watkins, D. N., Chen, J. K., Cooper, M. K., Taipale, J., Olson, J. M., Beachy, P. A.
2002; 297 (5586): 1559-1561
- **Patched acts catalytically to suppress the activity of Smoothed** *NATURE*
Taipale, J., Cooper, M. K., Maiti, T., Beachy, P. A.
2002; 418 (6900): 892-897
- **Skinny Hedgehog, an acyltransferase required for palmitoylation and activity of the Hedgehog signal** *SCIENCE*
Chamoun, Z., Mann, R. K., Nellen, D., von Kessler, D. P., Bellotto, M., Beachy, P. A., Basler, K.
2001; 293 (5537): 2080-2084
- **The Hedgehog and Wnt signaling pathways in cancer** *NATURE*
Taipale, J., Beachy, P. A.
2001; 411 (6835): 349-354
- **Cholesterol modification of proteins** *BIOCHIMICA ET BIOPHYSICA ACTA-MOLECULAR AND CELL BIOLOGY OF LIPIDS*
Mann, R. K., Beachy, P. A.
2000; 1529 (1-3): 188-202
- **Effects of oncogenic mutations in Smoothed and Patched can be reversed by cyclopamine** *NATURE*
Taipale, J., Chen, J. K., Cooper, M. K., Wang, B. L., Mann, R. K., Milenkovic, L., Scott, M. P., Beachy, P. A.
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- **Hedgehog-regulated processing of Gli3 produces an anterior/posterior repressor gradient in the developing vertebrate limb** *CELL*
Wang, B. L., Fallon, J. F., Beachy, P. A.
2000; 100 (4): 423-434

- **Sonic hedgehog protein signals not as a hydrolytic enzyme but as an apparent ligand for Patched** *National Academy of Sciences Colloquium on Proteolytic Processing and Physiological Regulation*
Fuse, N., Maiti, T., Wang, B. L., Porter, J. A., Hall, T. M., Leahy, D. J., Beachy, P. A.
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- **Nuclear trafficking of cubitus interruptus in the transcriptional regulation of hedgehog target gene expression** *CELL*
Chen, C. H., von Kessler, D. P., Park, W. J., Beachy, P. A.
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- **Teratogen-mediated inhibition of target tissue response to Shh signaling** *SCIENCE*
Cooper, M. K., Porter, J. A., Young, K. E., Beachy, P. A.
1998; 280 (5369): 1603-1607
- **Crystal structure of a hedgehog autoprocessing domain: Homology between hedgehog and self-splicing proteins** *CELL*
Hall, T. M., Porter, J. A., Young, K. E., Koonin, E. V., Beachy, P. A., Leahy, D. J.
1997; 91 (1): 85-97
- **Multiple roles of cholesterol in hedgehog protein biogenesis and signaling** *Cold Spring Harbor Symposium on Quantitative Biology - Pattern Formation During Development*
Beachy, P. A., Cooper, M. K., Young, K. E., von Kessler, D. P., Park, W. J., Hall, T. M., Leahy, D. J., Porter, J. A.
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- **Cholesterol modification of hedgehog signaling proteins in animal development** *SCIENCE*
Porter, J. A., Young, K. E., Beachy, P. A.
1996; 274 (5285): 255-259
- **Cyclopia and defective axial patterning in mice lacking Sonic hedgehog gene function** *NATURE*
Chiang, C., Ying, L. T., Lee, E., Young, K. E., Corden, J. L., Westphal, H., Beachy, P. A.
1996; 383 (6599): 407-413
- **Hedgehog patterning activity: Role of a lipophilic modification mediated by the carboxy-terminal autoprocessing domain** *CELL*
Porter, J. A., Ekker, S. C., Park, W. J., VONKESSLER, D. P., Young, K. E., Chen, C. H., Ma, Y., Woods, A. S., Cotter, R. J., Koonin, E. V., Beachy, P. A.
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- **A POTENTIAL CATALYTIC SITE REVEALED BY THE 1.7-ANGSTROM CRYSTAL-STRUCTURE OF THE AMINO-TERMINAL SIGNALING DOMAIN OF SONIC HEDGEHOG** *NATURE*
Hall, T. M., Porter, J. A., Beachy, P. A., Leahy, D. J.
1995; 378 (6553): 212-216
- **CONTROL OF DROSOPHILA TRACHEAL BRANCHING BY THE NOVEL HOMEODOMAIN GENE UNPLUGGED, A REGULATORY TARGET FOR GENES OF THE BITHORAX COMPLEX** *DEVELOPMENT*
CHANG, C., Young, K. E., Beachy, P. A.
1995; 121 (11): 3901-3912
- **PATTERNING ACTIVITIES OF VERTEBRATE HEDGEHOG PROTEINS IN THE DEVELOPING EYE AND BRAIN** *CURRENT BIOLOGY*
Ekker, S. C., Ungar, A. R., Greenstein, P., VONKESSLER, D. P., Porter, J. A., MOON, R. T., Beachy, P. A.
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- **PATTERNING OF THE NEURAL ECTODERM OF XENOPUS-LAEVIS BY THE AMINO-TERMINAL PRODUCT OF HEDGEHOG AUTOPROTEOLYTIC CLEAVAGE** *DEVELOPMENT*
Lai, C. J., Ekker, S. C., Beachy, P. A., MOON, R. T.
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- **DISTINCT EXPRESSION AND SHARED ACTIVITIES OF MEMBERS OF THE HEDGEHOG GENE FAMILY OF XENOPUS-LAEVIS** *DEVELOPMENT*
Ekker, S. C., McGrew, L. L., Lai, C. J., Lee, J. J., VONKESSLER, D. P., MOON, R. T., Beachy, P. A.
1995; 121 (8): 2337-2347
- **INDUCTION OF MIDBRAIN DOPAMINERGIC-NEURONS BY SONIC HEDGEHOG** *NEURON*
Hynes, M., Porter, J. A., Chiang, C., Chang, D., TESSIERLAVIGNE, M., Beachy, P. A., Rosenthal, A.

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- **LIMB-PATTERNING ACTIVITY AND RESTRICTED POSTERIOR LOCALIZATION OF THE AMINO-TERMINAL PRODUCT OF SONIC HEDGEHOG CLEAVAGE** *CURRENT BIOLOGY*
LOPEZMARTINEZ, A., Chang, D. T., Chiang, C., Porter, J. A., Ros, M. A., Simandl, B. K., Beachy, P. A., Fallon, J. F.
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- **FLOOR PLATE AND MOTOR-NEURON INDUCTION BY DIFFERENT CONCENTRATIONS OF THE AMINO-TERMINAL CLEAVAGE PRODUCT OF SONIC HEDGEHOG AUTOPROTEOLYSIS** *CELL*
Roelink, H., Porter, J. A., Chiang, C., Tanabe, Y., Chang, D. T., Beachy, P. A., Jessell, T. M.
1995; 81 (3): 445-455
- **LONG-RANGE SCLEROTOME INDUCTION BY SONIC HEDGEHOG - DIRECT ROLE OF THE AMINO-TERMINAL CLEAVAGE PRODUCT AND MODULATION BY THE CYCLIC-AMP SIGNALING PATHWAY** *CELL*
Fan, C. M., Porter, J. A., Chiang, C., Chang, D. T., Beachy, P. A., TESSIERLAVIGNE, M.
1995; 81 (3): 457-465
- **THE PRODUCT OF HEDGEHOG AUTOPROTEOLYTIC CLEAVAGE ACTIVE IN LOCAL AND LONG-RANGE SIGNALING** *NATURE*
Porter, J. A., VONKESSLER, D. P., Ekker, S. C., Young, K. E., Lee, J. J., Moses, K., Beachy, P. A.
1995; 374 (6520): 363-366
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Sun, B., Hursh, D. A., Jackson, D., Beachy, P. A.
1995; 14 (3): 520-535
- **AUTOPROTEOLYSIS IN HEDGEHOG PROTEIN BIOGENESIS** *SCIENCE*
Lee, J. J., Ekker, S. C., VONKESSLER, D. P., Porter, J. A., Sun, B. I., Beachy, P. A.
1994; 266 (5190): 1528-1537
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Chiang, C., Patel, N. H., Young, K. E., Beachy, P. A.
1994; 120 (12): 3581-3593
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Chang, D. T., Lopez, A., VONKESSLER, D. P., Chiang, C., Simandl, B. K., Zhao, R. B., Seldin, M. F., Fallon, J. F., Beachy, P. A.
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- **EXPRESSION OF A NOVEL TOLL-LIKE GENE SPANS THE PARASEGMENT BOUNDARY AND CONTRIBUTES TO HEDGEHOG FUNCTION IN THE ADULT EYE OF DROSOPHILA** *MECHANISMS OF DEVELOPMENT*
Chiang, C., Beachy, P. A.
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Ekker, S. C., Jackson, D. G., VONKESSLER, D. P., Sun, B. I., Young, K. E., Beachy, P. A.
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Ma, C. Y., Zhou, Y., Beachy, P. A., Moses, K.
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