

# Stanford

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## Greg Barsh

Professor of Genetics and of Pediatrics, Emeritus

### CONTACT INFORMATION

- **Alternate Contact**

Kathy Shaw - Administrative Assistant

**Email** katyshaw@cmgm.stanford.edu

**Tel** 723 5035

### Bio

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#### ACADEMIC APPOINTMENTS

- Professor Emeritus-Hourly, Genetics
- Member, Bio-X

#### PROFESSIONAL EDUCATION

- MD, University of Washington , Medicine (1984)
- BS, University of California, Irvine , Biology (1977)
- PhD, University of Washington , Genetics of Human Disease (1984)

### Research & Scholarship

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#### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Color variation is one of the most readily apparent differences among closely related animals, and has been studied extensively as a model for Mendelian genetics over the last 100 years. Our laboratory is interested in the mechanisms that give rise to eye, hair, and skin coloration, both as a tool for studying gene action and interaction, and because many signaling pathways used by the pigmentary system play important roles in human development and disease.

All mammals use the same genetic toolbox, and several mouse coat color mutations have human counterparts such as oculocutaneous albinism or Chediak-Higashi syndrome. Applying the genetics of mouse hair color as a model, however, is relevant not only to rare inborn errors but also to common diseases including diabetes and obesity, neurodegeneration, and skin cancer. Production of normal hair and skin color depends on a series of processes--cell migration, stem cell renewal, paracrine regulation of cell physiology--used in many different contexts throughout the body; pigmentation phenotypes are especially well-suited for studying these processes because mutations are efficiently recognized, subtle effects on gene expression are easily detected, and the cell types and tissues involved are amenable to experimental manipulation.

Our original interest in mouse coat color genetics stems from mutations that cause a back-and-forth switch between pigment granules characteristic of red hair, to those characteristic of black, brown, or blond hair. Studies of these pigment type-switching mutations have identified one set of pathways important for body weight regulation, and another set of pathways implicated in neurodegeneration. Several current projects in the laboratory are directed at specific aspects of these pathways.

## Teaching

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### GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Genetics (Phd Program)

## Publications

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### PUBLICATIONS

- **High frequency of an otherwise rare phenotype in a small and isolated tiger population.** *Proceedings of the National Academy of Sciences of the United States of America*  
Sagar, V., Kaelin, C. B., Natesh, M., Reddy, P. A., Mohapatra, R. K., Chhattani, H., Thatte, P., Vaidyanathan, S., Biswas, S., Bhatt, S., Paul, S., Jhala, Y. V., Verma, et al  
2021; 118 (39)
- **Dog colour patterns explained by modular promoters of ancient canid origin.** *Nature ecology & evolution*  
Bannasch, D. L., Kaelin, C. B., Letko, A., Loechel, R., Hug, P., Jagannathan, V., Henkel, J., Roosje, P., Hytonen, M. K., Lohi, H., Arumilli, M., DoGA consortium, Minor, K. M., et al  
2021
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- **Population structure, inbreeding and stripe pattern abnormalities in plains zebras.** *Molecular ecology*  
Larison, B., Kaelin, C. B., Harrigan, R., Henegar, C., I Rubenstein, D., Kamath, P., Aschenborn, O., Smith, T. B., Barsh, G. S.  
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- **Digital gene expression for non-model organisms** *GENOME RESEARCH*  
Hong, L. Z., Li, J., Schmidt-Kuentzel, A., Warren, W. C., Barsh, G. S.  
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- **Ribosomal mutations cause p53-mediated dark skin and pleiotropic effects** *NATURE GENETICS*  
McGowan, K. A., Li, J. Z., Park, C. Y., Beaudry, V., Tabor, H. K., Sabnis, A. J., Zhang, W., Fuchs, H., de Angelis, M. H., Myers, R. M., Attardi, L. D., Barsh, G. S.  
2008; 40 (8): 963-970
- **A -defensin mutation causes black coat color in domestic dogs.** *Science*  
Candille, S. I., Kaelin, C. B., Cattanaach, B. M., Yu, B., Thompson, D. A., Nix, M. A., Kerns, J. A., Schmutz, S. M., Millhauser, G. L., Barsh, G. S.  
2007; 318 (5855): 1418-1423
- **Linkage and segregation analysis of black and brindle coat color in domestic dogs** *GENETICS*  
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- **A healthy tan?** *New England journal of medicine*  
Barsh, G., Attardi, L. D.  
2007; 356 (21): 2208-2210
- **Effects of hypothalamic neurodegeneration on energy balance** *PLOS BIOLOGY*  
Xu, A. W., Kaelin, C. B., Morton, G. J., Ogimoto, K., Stanhope, K., Graham, J., Baskin, D. G., Havel, P., Schwartz, M. W., Barsh, G. S.  
2005; 3 (12): 2168-2176
- **PI3K integrates the action of insulin and leptin on hypothalamic neurons** *JOURNAL OF CLINICAL INVESTIGATION*  
Xu, A. W., Kaelin, C. B., Takeda, K., Akira, S., Schwartz, M. W., Barsh, G. S.

2005; 115 (4): 951-958

- **Effects of G-protein mutations on skin color** *NATURE GENETICS*  
Van Raamsdonk, C. D., Fitch, K. R., Fuchs, H., de Angelis, M. H., Barsh, G. S.  
2004; 36 (9): 961-968
- **Dorsoventral patterning of the mouse coat by Tbx15.** *PLoS biology*  
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- **What controls variation in human skin color?** *PLoS biology*  
Barsh, G. S.  
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- **Spongiform degeneration in mahoganoid mutant mice** *SCIENCE*  
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- **Genetics of dark skin in mice** *GENES & DEVELOPMENT*  
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- **Genetic approaches to studying energy balance: Perception and integration** *NATURE REVIEWS GENETICS*  
Barsh, G. S., Schwartz, M. W.  
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- **A biochemical function for attractin in agouti-induced pigmentation and obesity** *NATURE GENETICS*  
He, L., Gunn, T. M., Bouley, D. M., Lu, X. Y., Watson, S. J., Schlossman, S. F., Duke-Cohan, J. S., Barsh, G. S.  
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- **Genetics of body-weight regulation** *NATURE*  
Barsh, G. S., Farooqi, I. S., O'Rahilly, S.  
2000; 404 (6778): 644-651
- **Melanocortin 1 receptor variation in the domestic dog** *MAMMALIAN GENOME*  
Newton, J. M., Wilkie, A. L., He, L., Jordan, S. A., Metallinos, D. L., Holmes, N. G., Jackson, I. J., Barsh, G. S.  
2000; 11 (1): 24-30
- **Antagonism of central melanocortin receptors in vitro and in vivo by Agouti-related protein** *SCIENCE*  
Ollmann, M. M., Wilson, B. D., Yang, Y. K., Kerns, J. A., Chen, Y. R., Gantz, I., Barsh, G. S.  
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- **Epigenetic models developed for plains zebras predict age in domestic horses and endangered equids.** *Communications biology*  
Larison, B., Pinho, G. M., Haghani, A., Zoller, J. A., Li, C. Z., Finno, C. J., Farrell, C., Kaelin, C. B., Barsh, G. S., Wooding, B., Robeck, T. R., Maddox, D., Pellegrini, et al  
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- **Recent evolutionary history of tigers highlights contrasting roles of genetic drift and selection.** *Molecular biology and evolution*  
Armstrong, E. E., Khan, A. n., Taylor, R. W., Gouy, A. n., Greenbaum, G. n., Thiéry, A. n., Kang, J. T., Redondo, S. A., Prost, S. n., Barsh, G. n., Kaelin, C. n., Phalke, S. n., Chugani, et al  
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- **Kingdom Come.** *PLoS genetics*  
Barsh, G. S., Copenhaver, G. P., Kohler, C., Qu, L.  
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- **Long live the king: chromosome-level assembly of the lion (Panthera leo) using linked-read, Hi-C, and long-read data.** *BMC biology*  
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- **Mixed methods.** *PLoS genetics*

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- **By what name shall I call thee?** *PLoS genetics*  
Barsh, G. S., Copenhaver, G. P.  
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  - **Making room for opinions.** *PLoS genetics*  
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  - **Evaluating the strength of genetic results: Risks and responsibilities.** *PLoS genetics*  
Barsh, G. S., Cooper, G. M., Copenhaver, G. P., Sirugo, G. n., Tang, H. n., Williams, S. M.  
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  - **-2019 PLOS Genetics Research Prize: Fruit fly school - language and dialects for communicating a threat.** *PLoS genetics*  
Barsh, G. S., Copenhaver, G. P., Prakash, E. S., Zarnescu, D. C.  
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  - **Periodic patterns in Rodentia: development and evolution.** *Experimental dermatology*  
Johnson, M. R., Barsh, G. S., Mallarino, R.  
2018
  - **Doubling down on forensic twin studies.** *PLoS genetics*  
Copenhaver, G. P., Weir, B., Rothstein, M., Tang, H., Williams, S. M., Barsh, G. S.  
2018; 14 (12): e1007831
  - **2018 PLOS Genetics Research Prize: Bundling, stabilizing, organizing-The orchestration of acentriolar spindle assembly by microtubule motor proteins** *PLOS GENETICS*  
Barsh, G. S., Bhalla, N., Cole, F., Copenhaver, G. P., Laceyfield, S., Libuda, D. E.  
2018; 14 (9): e1007649
  - **Skin color variation in Africa.** *Science (New York, N.Y.)*  
Tang, H., Barsh, G. S.  
2017; 358 (6365): 867-868
  - **Inference on the Genetic Basis of Eye and Skin Color in an Admixed Population via Bayesian Linear Mixed Models.** *Genetics*  
Lloyd-Jones, L. R., Robinson, M. R., Moser, G., Zeng, J., Beleza, S., Barsh, G. S., Tang, H., Visscher, P. M.  
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  - **Comparative tissue transcriptomics highlights dynamic differences among tissues but conserved metabolic transcript prioritization in preparation for arousal from torpor.** *Journal of comparative physiology. B, Biochemical, systemic, and environmental physiology*  
Bogren, L. K., Grabek, K. R., Barsh, G. S., Martin, S. L.  
2017
  - **Eliciting preferences on secondary findings: the Preferences Instrument for Genomic Secondary Results** *GENETICS IN MEDICINE*  
Brothers, K. B., East, K. M., Kelley, W. V., Wright, M. F., Westbrook, M. J., Rich, C. A., Bowling, K. M., Lose, E. J., Bebin, E. M., Simmons, S., Myers, J. A., Barsh, G., Myers, et al  
2017; 19 (3): 337-344

- **A Hox-Embedded Long Noncoding RNA: Is It All Hot Air?** *PLoS genetics*  
Selleri, L., Bartolomei, M. S., Bickmore, W. A., He, L., Stubbs, L., Reik, W., Barsh, G. S.  
2016; 12 (12): e1006485
- **Bringing PLOS Genetics Editors to Preprint Servers.** *PLoS genetics*  
Barsh, G. S., Bergman, C. M., Brown, C. D., Singh, N. D., Copenhaver, G. P.  
2016; 12 (12): e1006448
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- **Evolution: Sex, Diet and Red Ketocarotenoids.** *Current biology : CB*  
Barsh, G.  
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- **The Language of Genetics In the Interviews of Jane Gitschier.** *PLoS genetics*  
Barsh, G. S., Copenhaver, G. P.  
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- **Evolution: How the zebrafish got its stripes.** *eLife*  
McGowan, K. A., Barsh, G. S.  
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- **Regulatory mutations in TBX3 disrupt asymmetric hair pigmentation that underlies Dun camouflage color in horses** *NATURE GENETICS*  
Imsland, F., McGowan, K., Rubin, C., Henegar, C., Sundstrom, E., Berglund, J., Schwochow, D., Gustafson, U., Imsland, P., Lindblad-Toh, K., Lindgren, G., Mikko, S., Millon, et al  
2016; 48 (2): 152-158
- **PLOS Genetics Data Sharing Policy: In Pursuit of Functional Utility** *PLOS GENETICS*  
Barsh, G. S., Cooper, G. M., Copenhaver, G. P., Gibson, G., McCarthy, M. I., Tang, H., Williams, S. M.  
2015; 11 (12): e1005716
- **Electrostatic Similarity Analysis of Human beta-Defensin Binding in the Melanocortin System** *BIOPHYSICAL JOURNAL*  
Nix, M. A., Kaelin, C. B., Palomino, R., Miller, J. L., Barsh, G. S., Millhauser, G. L.  
2015; 109 (9): 1946-1958
- **A Decad(e) of Reasons to Contribute to a PLOS Community-Run Journal.** *PLoS genetics*  
Copenhaver, G. P., Barsh, G. S.  
2015; 11 (10): e1005557
- **Dominant Red Coat Color in Holstein Cattle Is Associated with a Missense Mutation in the Coatomer Protein Complex, Subunit Alpha (COPA) Gene** *PLOS ONE*  
Dorshorst, B., Henegar, C., Liao, X., Almen, M. S., Rubin, C., Ito, S., Wakamatsu, K., Stothard, P., Van Doormaal, B., Plastow, G., Barsh, G. S., Andersson, L.  
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- **Dominant Red Coat Color in Holstein Cattle Is Associated with a Missense Mutation in the Coatomer Protein Complex, Subunit Alpha (COPA) Gene.** *PloS one*  
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- **Recurrent Evolution of Melanism in South American Felids** *PLOS GENETICS*  
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- **Modeling 3D Facial Shape from DNA.** *PLoS genetics*  
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