

Stanford



Aaron F. Straight

Professor of Biochemistry and, by courtesy, of Chemical and Systems Biology

CONTACT INFORMATION

• Administrative Contact

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Bio

ACADEMIC APPOINTMENTS

- Professor, Biochemistry
- Professor (By courtesy), Chemical and Systems Biology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Stanford Cancer Institute
- Faculty Fellow, Stanford ChEM-H
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Chairperson, Department of Biochemistry, (2019- present)
- Senator, Stanford University Faculty Senate, (2019-2020)
- Chairperson, Committee on Graduate Admissions and Policy, (2017-2018)

HONORS AND AWARDS

- Mayent-Rothschild Institute Curie Award, Institute Curie (2019)
- Stanford Faculty Excellence in Teaching Award, Stanford Medical School (2014)
- American Cancer Society Research Scholar, American Cancer Society (2011-2014)
- Gordon Family Scholar of the Damon Runyon Foundation, Damon Runyon Cancer Research Foundation (2005-2007)
- Damon Runyon Postdoctoral Fellow, Damon Runyon Cancer Research Foundation (1998-2001)
- Dartmouth College Senior Fellow, Dartmouth College (1989)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- External Scientific Advisor, 4D Nucleome Project - NIH Common Fund (2015 - 2020)
- Fellowship Award Committee, Damon Runyon Cancer Research Foundation (2018 - present)

- Scientific Advisory Board, LifeTime Initiative (2018 - present)

PROFESSIONAL EDUCATION

- BA, Dartmouth College , Biology (1989)
- Ph.D., University of California at San Francisco , Biochemistry (1998)
- Post-Doctoral Fellow, Harvard Medical School , Cell Biology (2003)

LINKS

- Straight Lab: <http://straightlab.stanford.edu>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Our goal is to understand how chromosomes are faithfully transmitted during cell division and how chromosomes are structured and organized in the nucleus. Many cellular processes act on the chromosome to specialize different chromosomal domains for unique functions in the biology of cells. One of the best examples of a specialized chromatin domain is the eukaryotic centromere and kinetochore that forms at a single site on each human chromosome and ensures the proper segregation of the genome during each cell division cycle. The laboratory studies the genetic and epigenetic mechanisms that control the formation of human centromeres and kinetochores. Cells use a variety of different mechanisms to change the function of chromosomes. We have also focused on understanding how RNAs that associate with chromosomes regulate the reorganization of chromatin into silent heterochromatic domains. Our recent efforts have been directed at understanding how long range interactions between chromosomes are used to organize the genome within the nucleus and to control gene expression and chromosome dynamics. We use a combination of digital microscopy to extract quantitative information about the dynamics of chromosomes in living cells, biochemical reconstitution to assemble chromatin and chromosomes in vitro, and genetics to manipulate the chromosome segregation process in order to study how chromosome-distribution systems function in eukaryotes.

Teaching

COURSES

2020-21

- Currents in Biochemistry: BIOC 257 (Aut)

2017-18

- Biochemistry Bootcamp: BIOC 202 (Aut)
- Developing an Original Research Proposal: BIOC 360 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Ray Futia, Elisabeth Meyer, Edmundo Vides

Postdoctoral Faculty Sponsor

Pragya Sidhwani, Kousik Sundararajan, Linda Yen

Doctoral Dissertation Advisor (AC)

Julio Flores Servin, Kelsey Fryer, Owen Smith

Doctoral (Program)

Julio Flores Servin

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biochemistry (Phd Program)
- Chemical and Systems Biology (Phd Program)

Publications

PUBLICATIONS

- **Mapping Transcriptome-Wide and Genome-Wide RNA-DNA Contacts with Chromatin-Associated RNA Sequencing (ChAR-seq).** *Methods in molecular biology (Clifton, N.J.)*
Limouse, C., Jukam, D., Smith, O. K., Fryer, K. A., Straight, A. F.
2020; 2161: 115–42
- **Chromatin-Associated RNA Sequencing (ChAR-seq).** *Current protocols in molecular biology*
Jukam, D., Limouse, C., Smith, O. K., Risca, V. I., Bell, J. C., Straight, A. F.
2019: e87
- **CDK phosphorylation of *Xenopus laevis* M18BP1 promotes its metaphase centromere localization.** *The EMBO journal*
French, B. T., Straight, A. F.
2019
- **Chromatin-associated RNA sequencing (ChAR-seq) maps genome-wide RNA-to-DNA contacts** *ELIFE*
Bell, J. C., Jukam, D., Teran, N. A., Risca, V. I., Smith, O. K., Johnson, W. L., Skotheim, J. M., Greenleaf, W., Straight, A. F.
2018; 7
- **Measurement of Mesoscale Conformational Dynamics of Freely Diffusing Molecules with Tracking FCS** *BIOPHYSICAL JOURNAL*
Limouse, C., Bell, J. C., Fuller, C. J., Straight, A. F., Mabuchi, H.
2018; 114 (7): 1539–50
- **Constitutive centromere-associated network contacts confer differential stability on CENP-A nucleosomes in vitro and in the cell** *MOLECULAR BIOLOGY OF THE CELL*
Cao, S., Zhou, K., Zhang, Z., Luger, K., Straight, A. F.
2018; 29 (6): 751–62
- **Centromere and Kinetochore Assembly in *Xenopus laevis* Egg Extract.** *Cold Spring Harbor protocols*
Flores Servin, J. C., Straight, A. F.
2018
- **RNA-mediated regulation of heterochromatin** *CURRENT OPINION IN CELL BIOLOGY*
Johnson, W. L., Straight, A. F.
2017; 46: 102–9
- **Form and function of topologically associating genomic domains in budding yeast** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Eser, U., Chandler-Brown, D., Ay, F., Straight, A. F., Duang, Z., Noble, W. S., Skotheim, J. M.
2017; 114 (15): E3061-E3070
- **Variable chromatin structure revealed by in situ spatially correlated DNA cleavage mapping.** *Nature*
Risca, V. I., Denny, S. K., Straight, A. F., Greenleaf, W. J.
2017; 541 (7636): 237-241
- **Editorial overview: The cell nucleus: New discoveries on nuclear structure, dynamics and function.** *Current opinion in cell biology*
Foisner, R., Straight, A. F.
2017; 46: iv-vi
- **The Power of *Xenopus* Egg Extract for Reconstitution of Centromere and Kinetochore Function.** *Progress in molecular and subcellular biology*
French, B. T., Straight, A. F.
2017; 56: 59–84

- **The Power of *Xenopus* Egg Extract for Reconstitution of Centromere and Kinetochores Function** *Centromeres and Kinetochores*
French, B. T., Straight, A. F.
edited by Black, B. E.
Springer.2017: 59–84
- ***Xenopus laevis* M18BP1 Directly Binds Existing CENP-A Nucleosomes to Promote Centromeric Chromatin Assembly.** *Developmental cell*
French, B. T., Westhorpe, F. G., Limouse, C., Straight, A. F.
2017; 42 (2): 190–99.e10
- **RNA-dependent stabilization of SUV39H1 at constitutive heterochromatin.** *eLife*
Johnson, W. L., Yewdell, W. T., Bell, J. C., McNulty, S. M., Duda, Z., O'Neill, R. J., Sullivan, B. A., Straight, A. F.
2017; 6
- **Acetylation of histone H4 lysine 5 and 12 is required for CENP-A deposition into centromeres.** *Nature communications*
Shang, W., Hori, T., Westhorpe, F. G., Godek, K. M., Toyoda, A., Misu, S., Monma, N., Ikeo, K., Carroll, C. W., Takami, Y., Fujiyama, A., Kimura, H., Straight, et al
2016; 7: 13465-?
- **MIS12/MIND Control at the Kinetochores.** *Cell*
Ladurner, R., Straight, A. F.
2016; 167 (4): 889-891
- **In Vitro Kinetochores Assembly.** *Methods in molecular biology (Clifton, N.J.)*
Miell, M. D., Straight, A. F.
2016; 1413: 111-133
- **A cell-free CENP-A assembly system defines the chromatin requirements for centromere maintenance** *JOURNAL OF CELL BIOLOGY*
Westhorpe, F. G., Fuller, C. J., Straight, A. F.
2015; 209 (6): 789-801
- **Histone titration against the genome sets the DNA-to-cytoplasm threshold for the *Xenopus* midblastula transition.** *Proceedings of the National Academy of Sciences of the United States of America*
Amodeo, A. A., Jukam, D., Straight, A. F., Skotheim, J. M.
2015; 112 (10): E1086-95
- **Regulating the timing of CENP-A nucleosome assembly by phosphorylation.** *Developmental cell*
Miell, M. D., Straight, A. F.
2015; 32 (1): 1-2
- **The centromere: epigenetic control of chromosome segregation during mitosis.** *Cold Spring Harbor perspectives in biology*
Westhorpe, F. G., Straight, A. F.
2015; 7 (1)
- **The centromere: epigenetic control of chromosome segregation during mitosis.** *Cold Spring Harbor perspectives in biology*
Westhorpe, F. G., Straight, A. F.
2014; 7 (1)
- **Recurrent point mutations in the kinetochores gene KNSTRN in cutaneous squamous cell carcinoma** *NATURE GENETICS*
Lee, C. S., Bhaduri, A., Mah, A., Johnson, W. L., Ungewickell, A., Aros, C. J., Nguyen, C. B., Rios, E. J., Siprashvili, Z., Straight, A., Kim, J., Aasi, S. Z., Khavari, et al
2014; 46 (10): 1060-1062
- **Recurrent point mutations in the kinetochores gene KNSTRN in cutaneous squamous cell carcinoma.** *Nature genetics*
Lee, C. S., Bhaduri, A., Mah, A., Johnson, W. L., Ungewickell, A., Aros, C. J., Nguyen, C. B., Rios, E. J., Siprashvili, Z., Straight, A., Kim, J., Aasi, S. Z., Khavari, et al
2014; 46 (10): 1060-1062
- **Reply to "CENP-A octamers do not confer a reduction in nucleosome height by AFM".** *Nature structural & molecular biology*
Miell, M. D., Straight, A. F., Allshire, R. C.
2014; 21 (1): 5-8

- **Swapping CENP-A at the centromere.** *Nature cell biology*
French, B. T., Straight, A. F.
2013; 15 (9): 1028-1030
- **CENP-A confers a reduction in height on octameric nucleosomes.** *Nature structural & molecular biology*
Miell, M. D., Fuller, C. J., Guse, A., Barysz, H. M., Downes, A., Owen-Hughes, T., Rappsilber, J., Straight, A. F., Allshire, R. C.
2013; 20 (6): 763-765
- **Functions of the centromere and kinetochore in chromosome segregation.** *Current opinion in cell biology*
Westhorpe, F. G., Straight, A. F.
2013; 25 (3): 334-340
- **A conserved mechanism for centromeric nucleosome recognition by centromere protein CENP-C.** *Science*
Kato, H., Jiang, J., Zhou, B., Rozendaal, M., Feng, H., Ghirlando, R., Xiao, T. S., Straight, A. F., Bai, Y.
2013; 340 (6136): 1110-1113
- **Esperanto for histones: CENP-A, not CenH3, is the centromeric histone H3 variant** *CHROMOSOME RESEARCH*
Earnshaw, W. C., Allshire, R. C., Black, B. E., Bloom, K., Brinkley, B. R., BROWN, W., Cheeseman, I. M., Choo, K. H., Copenhaver, G. P., DeLuca, J. G., Desai, A., Diekmann, S., Erhardt, et al
2013; 21 (2): 101-106
- **Fluorescent protein applications in microscopy.** *Methods in cell biology*
Johnson, W. L., Straight, A. F.
2013; 114: 99-123
- **A cell-free system for functional centromere and kinetochore assembly** *NATURE PROTOCOLS*
Guse, A., Fuller, C. J., Straight, A. F.
2012; 7 (10): 1847-1869
- **Imaging nanometre-scale structure in cells using in situ aberration correction** *JOURNAL OF MICROSCOPY*
Fuller, C. J., Straight, A. F.
2012; 248 (1): 90-101
- **The Split Personality of CENP-A Nucleosomes** *CELL*
Westhorpe, F. G., Straight, A. F.
2012; 150 (2): 245-247
- **Dynamics of CENP-N kinetochore binding during the cell cycle** *JOURNAL OF CELL SCIENCE*
Hellwig, D., Emmerth, S., Ulbricht, T., Doering, V., Hoischen, C., Martin, R., Samora, C. P., McAinsh, A. D., Carroll, C. W., Straight, A. F., Meraldi, P., Diekmann, S.
2011; 124 (22): 3871-3883
- **CENP-C recruits M18BP1 to centromeres to promote CENP-A chromatin assembly** *JOURNAL OF CELL BIOLOGY*
Moree, B., Meyer, C. B., Fuller, C. J., Straight, A. F.
2011; 194 (6): 855-871
- **In vitro centromere and kinetochore assembly on defined chromatin templates** *NATURE*
Guse, A., Carroll, C. W., Moree, B., Fuller, C. J., Straight, A. F.
2011; 477 (7364): 354-U136
- **Single-molecule fluorescence experiments with real-time feedback: Tracking-FCS, tracking-FRET and tracking diffusometry** *242nd National Meeting of the American-Chemical-Society (ACS)*
Limouse, C., Fuller, C., Zhang, K., Straight, A., Mabuchi, H.
AMER CHEMICAL SOC.2011
- **Single molecule dynamics of chromatin fibers** *Annual Meeting of the American-Society-for-Cell-Biology (ASCB)*
Limouse, C., Fuller, C., Straight, A., Mabuchi, H.
AMER SOC CELL BIOLOGY.2011
- **Local Geometry and Elasticity in Compact Chromatin Structure** *BIOPHYSICAL JOURNAL*

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- Koslover, E. F., Fuller, C. J., Straight, A. F., Spakowitz, A. J.
2010; 99 (12): 3941-3950
- **Dual recognition of CENP-A nucleosomes is required for centromere assembly** *JOURNAL OF CELL BIOLOGY*
Carroll, C. W., Milks, K. J., Straight, A. F.
2010; 189 (7): 1143-1155
 - **RB's original CIN?** *GENES & DEVELOPMENT*
Sage, J., Straight, A. F.
2010; 24 (13): 1329-1333
 - **Image analysis benchmarking methods for high-content screen design** *JOURNAL OF MICROSCOPY-OXFORD*
Fuller, C. J., Straight, A. F.
2010; 238 (2): 145-161
 - **Dissection of CENP-C-directed Centromere and Kinetochore Assembly** *MOLECULAR BIOLOGY OF THE CELL*
Milks, K. J., Moree, B., Straight, A. F.
2009; 20 (19): 4246-4255
 - **Centromere assembly requires the direct recognition of CENP-A nucleosomes by CENP-N** *NATURE CELL BIOLOGY*
Carroll, C. W., Silva, M. C., Godek, K. M., Jansen, L. E., Straight, A. F.
2009; 11 (7): 896-U297
 - **Genome-wide analysis reveals a cell cycle-dependent mechanism controlling centromere propagation** *JOURNAL OF CELL BIOLOGY*
Erhardt, S., Mellone, B. G., Betts, C. M., Zhang, W., Karpen, G. H., Straight, A. F.
2008; 183 (5): 805-818
 - **Polo-Like Kinase Controls Vertebrate Spindle Elongation and Cytokinesis** *PLOS ONE*
Brennan, I. M., Peters, U., Kapoor, T. M., Straight, A. F.
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 - **Centromeric chromatin gets loaded** *JOURNAL OF CELL BIOLOGY*
Carroll, C. W., Straight, A. F.
2007; 176 (6): 735-736
 - **Fluorescent protein applications in microscopy** *DIGITAL MICROSCOPY, 3RD EDITION*
Straight, A. F.
2007; 81: 93-?
 - **Centromere formation: from epigenetics to self-assembly** *TRENDS IN CELL BIOLOGY*
Carroll, C. W., Straight, A. F.
2006; 16 (2): 70-78
 - **Absolute stereochemical assignment and fluorescence tuning of the small molecule tool, (-)-blebbistatin** *EUROPEAN JOURNAL OF ORGANIC CHEMISTRY*
Lucas-Lopez, C., Patterson, S., Blum, T., Straight, A. F., TOOTH, J., Slawin, A. M., Mitchison, T. J., Sellers, J. R., Westwood, N. J.
2005: 1736-1740
 - **Blebbistatin, a myosin II inhibitor, is photoinactivated by blue light** *BIOCHEMISTRY*
Sakamoto, T., Limouze, J., Combs, C. A., Straight, A. F., Sellers, J. R.
2005; 44 (2): 584-588
 - **Anillin binds nonmuscle myosin II and regulates the contractile ring** *MOLECULAR BIOLOGY OF THE CELL*
Straight, A. F., Field, C. M., Mitchison, T. J.
2005; 16 (1): 193-201
 - **Kinetic mechanism of blebbistatin inhibition of nonmuscle myosin IIB** *BIOCHEMISTRY*
Ramamurthy, B., Yengo, C. M., Straight, A. F., Mitchison, T. J., Sweeney, H. L.
2004; 43 (46): 14832-14839
 - **Specificity of blebbistatin, an inhibitor of myosin II** *JOURNAL OF MUSCLE RESEARCH AND CELL MOTILITY*
Limouze, J., Straight, A. F., Mitchison, T., Sellers, J. E.
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2004; 25 (4-5): 337-341

- **Determining the position of the cell division plane** *NATURE*
Canman, J. C., Cameron, L. A., Maddox, P. S., Straight, A., Tirnauer, J. S., Mitchison, T. J., Fang, G. W., Kapoor, T. M., Salmon, E. D.
2003; 424 (6952): 1074-1078
- **Direct observation of microtubule dynamics at kinetochores in *Xenopus* extract spindles: implications for spindle mechanics** *JOURNAL OF CELL BIOLOGY*
Maddox, P., Straight, A., Coughlin, P., Mitchison, T. J., Salmon, E. D.
2003; 162 (3): 377-382
- **Divergent signals and cytoskeletal assemblies regulate self-organizing polarity in neutrophils** *CELL*
Xu, J. S., Wang, F., Van Keymeulen, A., Herzmark, P., Straight, A., Kelly, K., Takuwa, Y., Sugimoto, N., Mitchison, T., Bourne, H. R.
2003; 114 (2): 201-214
- **Dissecting temporal and spatial control of cytokinesis with a myosin II inhibitor** *SCIENCE*
Straight, A. F., Cheung, A., Limouze, J., Chen, I., Westwood, N. J., Sellers, J. R., Mitchison, T. J.
2003; 299 (5613): 1743-1747
- **Self- and actin-templated assembly of mammalian septins** *DEVELOPMENTAL CELL*
Kinoshita, M., Field, C. M., Coughlin, M. L., Straight, A. F., Mitchison, T. J.
2002; 3 (6): 791-802
- **Anaphase onset does not require the microtubule-dependent depletion of kinetochore and centromere-binding proteins** *JOURNAL OF CELL SCIENCE*
Canman, J. C., Sharma, N., Straight, A., Shannon, K. B., Fang, G. W., Salmon, E. D.
2002; 115 (19): 3787-3795
- **A small-molecule inhibitor of skeletal muscle myosin II** *NATURE CELL BIOLOGY*
Cheung, A., Dantzig, J. A., Hollingworth, S., Baylor, S. M., Goldman, Y. E., Mitchison, T. J., Straight, A. F.
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2000; 10 (20): R760-R770
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Straight, A. F., Shou, W. Y., Dowd, G. J., Turck, C. W., Deshaies, R. J., Johnson, A. D., Moazed, D.
1999; 97 (2): 245-256
- **Time-lapse microscopy reveals unique roles for kinesins during anaphase in budding yeast** *JOURNAL OF CELL BIOLOGY*
Straight, A. F., Sedat, J. W., Murray, A. W.
1998; 143 (3): 687-694
- **Dynamics of centromeres during metaphase-anaphase transition in fission yeast: Dis1 is implicated in force balance in metaphase bipolar spindle** *MOLECULAR BIOLOGY OF THE CELL*
Nabeshima, K., Nakagawa, T., Straight, A. F., Murray, A., Chikashige, Y., Yamashita, Y. M., Hiraoka, Y., Yanagida, M.
1998; 9 (11): 3211-3225
- **In vivo visualization of chromosomes using lac operator-repressor binding** *TRENDS IN CELL BIOLOGY*
Belmont, A. S., Straight, A. F.
1998; 8 (3): 121-124
- **Interphase chromosomes undergo constrained diffusional motion in living cells** *CURRENT BIOLOGY*
Marshall, W. F., Straight, A., Marko, J. F., Swedlow, J., Dernburg, A., Belmont, A., Murray, A. W., Agard, D. A., Sedat, J. W.
1997; 7 (12): 930-939
- **Cell cycle: Checkpoint proteins and kinetochores** *CURRENT BIOLOGY*
Straight, A. F.
1997; 7 (10): R613-R616
- **Chromosome and low copy plasmid segregation in E-coli: Visual evidence for distinct mechanisms** *CELL*

Gordon, G. S., Sitnikov, D., Webb, C. D., Teleman, A., Straight, A., Losick, R., Murray, A. W., Wright, A.
1997; 90 (6): 1113-1121

- **Mitosis in living budding yeast: Anaphase a but no metaphase plate** *SCIENCE*
Straight, A. F., Marshall, W. F., Sedat, J. W., Murray, A. W.
1997; 277 (5325): 574-578
- **Mitochondrial transmission during mating in *Saccharomyces cerevisiae* is determined by mitochondrial fusion and fission and the intramitochondrial segregation of mitochondrial DNA** *MOLECULAR BIOLOGY OF THE CELL*
Nunnari, J., Marshall, W. F., Straight, A., Murray, A., Sedat, J. W., Walter, P.
1997; 8 (7): 1233-1242
- **Bipolar localization of the replication origin regions of chromosomes in vegetative and sporulating cells of *B-subtilis*** *CELL*
Webb, C. D., Teleman, A., GORDON, S., Straight, A., Belmont, A., Lin, D. C., Grossman, A. D., Wright, A., Losick, R.
1997; 88 (5): 667-674
- **The spindle assembly checkpoint in budding yeast** *CELL CYCLE CONTROL*
Straight, A. F., Murray, A. W.
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- **GFP tagging of budding yeast chromosomes reveals that protein-protein interactions can mediate sister chromatid cohesion** *CURRENT BIOLOGY*
Straight, A. F., Belmont, A. S., Robinett, C. C., Murray, A. W.
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- **In vivo localization of DNA sequences and visualization of large-scale chromatin organization using lac operator/repressor recognition** *JOURNAL OF CELL BIOLOGY*
Robinett, C. C., Straight, A., Li, G., WILLHELM, C., Sudlow, G., Murray, A., Belmont, A. S.
1996; 135 (6): 1685-1700
- **Protein phosphatase 2A regulates MPF activity and sister chromatid cohesion in budding yeast** *CURRENT BIOLOGY*
Minshull, J., Straight, A., Rudner, A. D., Dernburg, A. F., Belmont, A., Murray, A. W.
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