

# Justin Brumbaugh, Ph.D.

Assistant Professor & Boettcher Investigator  
Molecular, Cellular, and Developmental Biology



University of Colorado

## Academic Positions

2019-present Assistant Professor  
University of Colorado  
Molecular, Cellular, and Developmental Biology  
University of Colorado Cancer Center  
Gates Center for Regenerative Medicine

## Education & Training

2012-2018 NIH/NRSA (F32) Kirschstein Postdoctoral Fellow  
Harvard Medical School/Mass. General Hospital  
Advisor: Konrad Hochedlinger

2011 NIH Biotechnology Training Program Intern  
Max Planck Institute for Biochemistry  
Advisor: Matthias Mann

2006-2011 Ph.D. in Biochemistry  
University of Wisconsin-Madison  
Advisors: Joshua Coon & James Thomson

2004-2006 Fulbright Scholar  
European Molecular Biology Lab (EMBL)  
Advisor: Carsten Schultz

2000-2004 B.S. in Biochemistry (Honors), Minor in Chemistry  
Penn State University  
Undergraduate thesis advisor: Sarah Ades



## Industry Experience

2012 Research Scientist  
Cellular Dynamics International  
Genome Modification Division


## Awards & Honors

2022 ISSCR Lawrence Goldstein Science Policy Fellow  
2020 Boettcher Investigator (Webb-Waring Biomedical Research Award)  
2019 ISSCR Next Generation Leader  
2014-2017 NIH/NRSA (F32) Kirschstein Postdoctoral Fellowship  
2014 Tosteson & Fund for Medical Discovery Post-doctoral Fellowship  
2010 Baxter Innovation Award  
2009-2011 NIH Biotechnology Training Grant  
2006-2009 NSF Graduate Research Fellowship  
2004-2005 Fulbright Scholar  
2004 Wedler Undergraduate Thesis Award  
2003 Pfizer Undergraduate Research Scholarship  
2003 Arthur Glenn Undergraduate Research Scholarship  
2000-2004 Schreyer Honors Scholar

## Contact

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 @Brumbaugh\_JB

## Research

My lab develops novel and innovative tools to manipulate cell fate. Our research leverages unique aspects of stem cell biology and induced reprogramming to uncover mechanistic determinants of development and homeostasis. We apply these systems in both murine and human models with the ultimate goal of driving basic science and regenerative medicine.

## Areas of Expertise

- Pluripotency
- Chromatin modification
- Cell fate change
- Proteomics
- Stem Cell Biology
- Regenerative medicine

## Professional Activities and Memberships

- International Society for Stem Cell Research (ISSCR)
- ISSCR Policy Committee
- Gates Center for Regenerative Medicine
- CU Cancer Center
- CU Medical Scientist Training Program
- University of Colorado Signaling and Cellular Regulation Training Program

## Publications (34 total peer reviewed publications; \*equal contribution;†corresponding author )

- (1) Serdyukova, K., Swearingen, A.R., Coradin, M., Nevo, M., Tran, H., Bajric, E., **Brumbaugh, J.**† Leveraging dominant-negative histone H3 K-to-M mutations to study chromatin during differentiation and development. *Development*. 150(21), 2023. PMID: 37846748
- (2) **Brumbaugh, J.**†, Aguado, B.A., Lysaght, T., Goldstein, L.S.B. Human fetal tissue is critical for biomedical research. *Stem Cell Reports*. 2023. PMID: 37977142
- (3) Scott, A.K., Casas, E., Schneider, S.E., Swearingen, A.R., Van Den Elzen, C.L., Seelbinder, B., Barthold, J.E., Kugel, J.F., Stern, J.L., Foster, K.J., Emery, N.C., **Brumbaugh, J.**, Neu, C.P. Mechanical memory stored through epigenetic remodeling reduces cell therapeutic potential. *Biophysical Journal*. 122(8), 2023. PMID: 36871159
- (4) Witkowski, M.T., Lee, S., Wang, E., Lee, A.K., Talbot, A., Ma, C., Tsopoulidis, N., **Brumbaugh, J.**, Zhao, Y., Roberts, K.G., Hogg, S.J., Nomikou, S., Ghebrechristos, Y.E., Thandapani, P., Mullighan, C.G., Hochedlinger, K., Chen, W., Abdel-Wahab, O., Eyquem, J., Aifantis, I. NUDT21 limits CD19 levels through alternative mRNA polyadenylation in B cell acute lymphoblastic leukemia. *Nature Immunology*. 23(10), 2022. PMID: 36138187
- (5) Seelbinder, B., Ghosh, S., Schneider, S.E., Scott, A., Berman, A.G., Goergen, C.J., Margulies, K.B., Bedi, K., Casas, E., Swearingen, A.R., **Brumbaugh, J.**, Calve, S., Neu, C.P. Nuclear Deformation Guides Chromatin Reorganization in Cardiac Development and Disease. *Nature Biomedical Engineering*. 5(12), 2021. PMID: 34857921.
- (6) **Brumbaugh, J.**\*†, Di Stefano, B.\* , Sardina, J.L.\* , Chromatin Regulation in Cell Fate Decisions. *Frontiers in Cell and Developmental Biology*. 9, 2021. PMID: 34540846
- (7) **Brumbaugh, J.**, Di Stefano, B., Hochedlinger, K. Reprogramming: identifying the mechanisms that safeguard cell identity. *Development*. 146(23), 2019. PMID:31659274
- (8) **Brumbaugh, J.**\* , Soo Kim, I.\* , Ji, F., Huebner, A.J., Di Stefano, B., Schwarz, B.A., Charlton, J., Coffey, A., Choi, J., Walsh, R.M., Schindler, J.W., Anselmo, A., Meissner, A., Sadreyev, R.I., Bernstein, B., Hock, H.\* , Hochedlinger, K.\* Inducible histone K-to-M mutations are dynamic tools to probe the physiological role of site-specific histone methylation in vitro and in vivo. *Nature Cell Biology*. 21(11), 2019. PMID:31659274
- (9) Di Stefano, B., Luo, E.C., Haggerty, C., Aigner, S., Charlton, J., **Brumbaugh, J.**, Ji, F., Rabano Jiménez, I., Clowers, K.J., Huebner, A.J., Clement, K., Lipchina, I., de Kort, M.A.C., Anselmo, A., Pulice, J., Gerli, M.F.M., Gu, H., Gygi, S.P., Sadreyev, R.I., Meissner, A., Yeo, G.W., Hochedlinger, K. The RNA Helicase DDX6 Controls Cellular Plasticity by Modulating P-Body Homeostasis. *Cell Stem Cell*. 25(5), 2019. PMID:31588046
- (10) Schiebinger, G., Shu, J., Tabaka, M., Cleary, B., Subramanian, V., Solomon, A., Gould, J., Liu, S., Lin, S., Berube, P., Lee, L., Chen, J., **Brumbaugh, J.**, Rigollet, P., Hochedlinger, K., Jaenisch, R., Regev, A., Lander, E.S. Optimal-Transport Analysis of Single-Cell Gene Expression Identifies Developmental Trajectories in Reprogramming. *Cell*. 176(4), 2019. PMID:30712874
- (11) Sardina, J.L., Collombet, S., Tian, T.V., Gómez, A., Di Stefano, B., Berenguer, C., **Brumbaugh, J.**, Stadhouders, R., Segura-Morales, C., Gut, M., Gut, I.G., Heath, S., Aranda, S., Di Croce, L., Hochedlinger, K., Thieffry, D., Graf, T. Transcription Factors Drive Tet2-Mediated Enhancer Demethylation to Reprogram Cell Fate. *Cell Stem Cell*. 23(5), 2018. PMID:30220521
- (12) Di Stefano, B., Ueda, M., Sabri, S., **Brumbaugh, J.**, Huebner, A.J., Sahakyan, A., Clement, K., Clowers, K.J., Erickson, A.R., Shioda, K., Gygi, S.P., Gu, H., Shioda, T., Meissner, A., Takashima, Y., Plath, K., Hochedlinger, K. Reduced MEK inhibition preserves genomic stability in naive human embryonic stem cells. *Nature Methods*. 15(9), 2018. PMID:30127506
- (13) **Brumbaugh, J.**\* , Di Stefano, B.\* , Wang, X., Borkent, M., Forouzmand, E., Clowers, K.J., Schwarz, B.A., Kalocsay, M., Elledge, S., Gygi, S.P., Hu, G., Yongsheng, Y., Hochedlinger, K. Nudt21 controls cell fate by connecting alternative polyadenylation to chromatin signaling. *Cell*. 172(1-2), 2018. PMID:29249356
- (14) Choi, J., Huebner, A.J., Clement, K., Walsh, R.M., Savol, A., Lin, K., Gu, H., Di Stefano, B., **Brumbaugh, J.**, Kim, S., Sharif, J., Rose, C.M., Mohammad, A., Odajima, J., Charron, J., Shioda, T., Gnirke, A., Gygi, S.P., Koseki, H., Sadreyev, R., Xiao, A., Meissner, A., Hochedlinger, K. Prolonged Mek1/2 suppression impairs the developmental potential of embryonic stem cells. *Nature*. 548(7666), 2017. PMID:28746311

## Publications (continued)

- (15) Choi, J., Clement, K., Huebner, A.J., Webster, J., Rose, C.M., **Brumbaugh, J.**, Walsh, R.M., Lee, S., Savol, A., Etchegaray, J.P., Gu, H., Boyle, P., Elling, U., Mostoslavsky, R., Sadreyev, R., Park, P.J., Gygi, S.P., Meissner, A., Hochedlinger, K. DUSP9 modulates DNA hypomethylation in female mouse pluripotent stem cells. *Cell Stem Cell*. 20(5), 2017. PMID:28366588
- (16) Liu, L.L., **Brumbaugh, J.**, Bar-Nur, O., Smith, Z., Stadtfeld, M., Meissner, A., Hochedlinger, K., Michor, F. Probabilistic Modeling of Reprogramming to Induced Pluripotent Stem Cells. *Cell Reports*. 17(12), 2016. PMID:28009305
- (17) Borkent, M., Bennett, B.D., Lackford, B., Bar-Nur, O., **Brumbaugh, J.**, Wang, L., Du, Y., Fargo, D.C., Apostolou, E., Cheloufi, S., Maherali, N., Elledge, S.J., Hu, G., Hochedlinger, K. A Serial shRNA Screen for Roadblocks to Reprogramming Identifies the Protein Modifier SUMO2. *Stem Cell Reports*. 6(5), 2016. PMID:26947976
- (18) Cheloufi, S., Elling, U., Hopfgartner, B., Jung, Y.L., Murn, J., Ninova, M., Hubmann, M., Badeaux, A.I., Ang, C.E., Tenen, D., Wesche, D.J., Abazova, N., Hogue, M., Tasdemir, N., **Brumbaugh, J.**, Rathert, P., Jude, J., Ferrari, F., Blanco, A., Fellner, M., Wenzel, D., Zinner, M., Vidal, S.E., Bell, O., Stadtfeld, M., Chang, H.Y., Almouzni, G., Lowe, S.W., Rinn, J., Wernig, M., Aravin, A., Shi, Y., Park, P.J., Penninger, J.M., Zuber, J., Hochedlinger, K. The histone chaperone CAF-1 safeguards somatic cell identity. *Nature*. 528(7581), 2015. PMID:26659182
- (19) Bar-Nur, O., Verheul, C., Sommer, A.G., **Brumbaugh, J.**, Schwarz, B.A., Lipchina, I., Huebner, A.J., Mostoslavsky, G., Hochedlinger, K. Lineage conversion induced by pluripotency factors involves transient passage through an iPSC cell stage. *Nature Biotechnology*. 33(7), 2015. PMID:26098450
- (20) Bar-Nur, O.\* , **Brumbaugh, J.\***, Verheul, C., Apostolou, E., Pruteanu-Malinici, I., Walsh, R.M., Ramaswamy, S., Hochedlinger, K. Small molecules facilitate rapid and synchronous iPSC generation. *Nature Methods*. 11(11), 2014. PMID:25262205
- (21) Honarpour, N., Rose, C.M., **Brumbaugh, J.**, Anderson, J., Graham, R.L.J., Sweredoski, M.J., Hess, S., Coon, J.J., Deshaies, R.J. F-box Protein FBXL16 Binds PP2A-B55 $\alpha$  and Regulates Differentiation of ES Cells along the FLK1+ Lineage. *Mol Cell Proteomics*. 13(3), 2014. PMID:24390425
- (22) **Brumbaugh, J.\***, Russell, J.D.\* , Yu, P., Westphall, M.S., Coon, J.J., Thomson, J.A. NANOG is multiply phosphorylated and directly modified by ERK2 and CDK1 in vitro. *Stem Cell Reports*. 2(1), 2014. PMID:24678451
- (23) **Brumbaugh, J.**, Hochedlinger, K. Removing reprogramming roadblocks: Mbd3 depletion allows deterministic iPSC generation. *Cell Stem Cell*. 13(4), 2013. PMID:24094318
- (24) Van Etten, J., Schagat, T.L., Hrit, J., Weidmann, C., **Brumbaugh, J.**, Coon, J.J. & Goldstrohm, A.C. Human Pumilio proteins recruit multiple deadenylases to efficiently repress messenger RNAs. *J Biol Chem*. 287(43), 2012. PMID:22955276
- (25) Bailey, D.J., Rose, C.M., McAlister, G.C., **Brumbaugh, J.**, Yu, P., Wenger, C.D., Westphall, M.S., Thomson, J.A. & Coon, J.J. Instant spectral assignment for advanced decision tree-driven mass spectrometry. *PNAS*. 109(22), 2012. PMID:22586074
- (26) **Brumbaugh, J.**, Hou, Z., Russell, J.D., Howden, S.E., Yu, P., Ledvina, A.R., Coon, J.J. & Thomson, J.A. Phosphorylation regulates human OCT4. *PNAS*. 109(19), 2012. PMID:22474382
- (27) **Brumbaugh, J.**, Rose, C.M., Phanstiel, D.H., Thomson, J.A. & Coon, J.J. Proteomics and pluripotency. *Crit Rev Biochem Mol Biol*. 46(6), 2011. PMID:21999516
- (28) Phanstiel, D.H.\* , **Brumbaugh, J.\***, Wenger, C.D., Tian, S., Probasco, M.D., Bailey, D.J., Swaney, D.L., Tervo, M.A., Bolin, J.M., Ruotti, V., Stewart, R., Thomson, J.A. & Coon, J.J. Proteomic and phosphoproteomic comparison of human ES and iPSC cells. *Nature Methods*. 8(10), 2011. PMID:21983960
- (29) McAlister, G.C., Phanstiel, D.H., **Brumbaugh, J.**, Westphall, M.S. & Coon, J.J. Higher-energy collision-activated dissociation without a dedicated collision cell. *Mol Cell Proteomics*. 10(5), 2011. PMID:21393638
- (30) Laketa, V., Zarbakhsh, S., Morbier, E., Subramanian, D., Dinkel, C., **Brumbaugh, J.**, Zimmermann, P., Pepperkok, R. & Schultz, C. Membrane-permeant phosphoinositide derivatives as modulators of growth factor signaling and neurite outgrowth. *Chem Biol*. 16(11), 2009. PMID:19942142
- (31) **Brumbaugh, J.**, Phanstiel, D. & Coon, J.J. Unraveling the histone's potential: a proteomics perspective. *Epigenetics*. 3(5), 2008. PMID:18849650

## Publications (continued)

- (32) Phanstiel, D., **Brumbaugh, J.**, Berggren, W.T., Conard, K., Feng, X., Levenstein, M.E., McAlister, G.C., Thomson, J.A. & Coon, J.J. Mass spectrometry identifies and quantifies 74 unique histone H4 isoforms in differentiating human ES cells. *PNAS*. 105(11), 2008. PMID:18326628
- (33) **Brumbaugh, J.**, Schleifenbaum, A., Stier, G., Sattler, M. & Schultz, C. Single- and dual-parameter FRET kinase probes based on pleckstrin. *Nature Protocols*. 1(2), 2006. PMID:17406341
- (34) **Brumbaugh, J.**, Schleifenbaum, A., Gasch, A., Sattler, M. & Schultz, C. A dual parameter FRET probe for measuring PKC and PKA activity in living cells. *J Am Chem Soc*. 128(1), 2006. PMID:16390103

## Teaching and Mentorship

### Teaching experience:

2020-2023	MCDB 4650: Developmental Biology
2020-2023	MCDB 5230: Graduate Core (Taught 4 classes on chromatin regulation & RNA processing)
2020	BCHM 5801: Advanced Topics in Signaling Transduction and Cellular Regulation (Taught two classes on chromatin regulation)
2020-2023	Responsible Conduct of Research (Guest Instructor “Scientists in Society” & “Mentorship”)
2019	Guest lecturer-MCDB 4650: Developmental Biology
2019	Guest lecturer-MCDB 3135: Molecular Biology
2012	Guest lecturer-BIOCHEM 703: Methods in Biochemistry
2011	Counselor-Wisconsin Summer Science Camp
2007	Guest lecturer-CHEM 329: Fundamentals of Analytical Chemistry
2006-2007	Teaching Assistant-BIOCHEM 507: General Biochemistry
2004	Teaching Assistant-KINES 004: Principles of Fly Tying and Fly Fishing for Trout
2003-2004	Teaching Assistant-BMB 401: General Biochemistry

### Graduate student mentorship:

2023	Pauline Reimer (M.S. student)
2023-present	Erin O’Connor (PhD student)
2021-present	Mika Nevo (PhD student)
2019-present	Alison Swearingen (PhD student; 2022 Gordon Stone Graduate Scholarship)
2016-2017	Shona Robinson (M.S. student), currently Senior Associate Scientist at ElevateBio

### Postdoctoral trainee mentorship:

2023-present	Deirdre Logsdon
2021-2023	Mariel Coradin, currently Scientist at Corgenix Medical Corporation
2021-2023	Eduard Casas, currently Bioinformatics Scientist at Watchmaker Genomics
2020-2022	Steven Guard, currently Senior Scientist at Strategic Analysis Inc.

### Undergraduate student mentorship:

2023-present	Daniel Martins (Uplift student through STEM Routes)
2023-present	Lynae Smith
2022-2023	Valarie Finck
2022-2023	Nova Jones (Uplift student through STEM Routes)
2022-2023	Sanjana Potlapelly (awarded an Undergraduate Research Opportunities Scholarship)
2021-2022	Huong Tran (graduated magna cum laude with an honors thesis)
2019-2023	Emir Bajric (awarded an Undergraduate Research Opportunities Scholarship)
2019-2021	Meghan Skalicky (graduated summa cum laude with an honors thesis)
2019-2020	Emily Czarnik
2014-2016	Ryan Legraw
2012-2014	Daniel Kramer

### Thesis committees:

2019-present	I have served on 27 thesis committees across multiple departments (Molecular, Cellular, and Developmental Biology; Biochemistry; Mechanical Engineering; Materials Science and Engineering)
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## Diversity, Equity, and Inclusion

- 2023-2024 Organizer for a concurrent track session on Equity, Diversity, and Inclusion for the ISSCR annual meeting
- 2022-present Faculty mentor: Uplift Program (providing research opportunities to underserved students)
- 2022-present Scientists of Color participant (planning science outreach to underserved high schools)
- 2022 Faculty Diversity Action Plan Recruitment Committee
- 2022 Certificate in Multicultural Mentoring (CU Office for Diversity, Equity, and Inclusion)

## Science Policy

- 2023 Representative for the International Society for Stem Cell Research Congressional Advocacy day (Meet with congressional staff regarding fetal tissue research and science funding)
- 2022-present International Society for Stem Cell Research Policy Committee

## Select Research Presentations

- 2023 Invited Talk: Epicypher Annual Meeting: Frontiers in Epigenetics (Cancun, Mexico)
- 2023 Invited Talk: Washington University Developmental Biology Seminar Series (St. Louis, MO)
- 2023 Invited Talk: UNC Genetics and Molecular Biology/Bioinformatics Seminar Series (Chapel Hill, NC)
- 2023 Invited Talk: University of British Columbia Epigenetics Seminar Series (Vancouver, Canada)
- 2022 Invited Talk: ISSCR NextGen Leaders Symposium (Sinzig, Germany)
- 2022 Invited Talk: Biomolecular Chemistry Centennial Symposium (Madison, WI)
- 2022 Invited Talk: Gates Center for Regenerative Medicine, CU Anschutz (Denver, CO; Virtual)
- 2021 Invited Talk: University of Texas Medical Branch (Galveston, TX; Virtual)
- 2021 Invited Talk: Illinois Institute of Technology (Chicago, IL; Virtual)
- 2020 Invited Talk: ISSCR Annual Meeting (Boston, MA; virtual format due to COVID19)
- 2019 Invited Talk: Stem Cell and Organoids Research Exchange (Boulder, CO)
- 2019 Invited Talk: MCDB Retreat (Vail, CO)
- 2019 Invited Talk: MCDB Graduate Student Symposium (Boulder, CO)
- 2018 Invited Talk: Massachusetts General Hospital Molecular Biology Symposium (Falmouth, MA)
- 2014 Poster/Flash Talk: ISSCR Annual Meeting (Vancouver, Canada)
- 2009 Invited Talk: ISSCR Annual Meeting (Barcelona, Spain)
- 2008 Invited Talk: HUPO World Conference (Amsterdam, Netherlands)

### *Trainee Presentations:*

- 2023 Alison Swearingen, Invited Talk: ISSCR Annual Meeting (Boston, CO)
- 2023 Mika Nevo, Invited Talk: Colorado RNA Club (Denver, CO)
- 2022 Alison Swearingen, Invited Talk: CO Genome Regulation Summer Symposium (Denver, CO)
- 2021 Steven Guard, Invited Talk: CU Senescence Supergroup (Boulder, CO)
- 2019 Sarah Tronnes, Poster: University of California, Berkeley Dillon Lab Retreat (Berkeley, CA)

## Professional Development

- 2019-present I have attended 39 workshops offered through the University of Colorado Research Development Office and Faculty Teaching Excellence Program. The topic of these workshops ranged from student mental health to active teaching approaches and increasing diversity, equity and inclusion. I've also sought out professional development opportunities to expand my experience with DEI, including the Coursera Anti-racism course and received a certificate in multicultural mentoring from the University of Colorado Center for Faculty Development & Advancement and the Office of Diversity, Equity & Inclusion, in collaboration with the International Mentoring Association (IMA).