

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

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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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

- Gates Center for Regenerative Medicine (Member)
- University of Colorado Cancer Center (Member)
- International Society for Stem Cell Research (member)
- University of Colorado Medical Scientist Training Program (Member)
- Wisconsin Stem Cell Round-table (founder)

Publications (28 total peer reviewed publications; * denotes equal contribution)

- (1) **Brumbaugh, J.**, Di Stefano, B., Hochedlinger, K. Reprogramming: identifying the mechanisms that safeguard cell identity. *Development*. 146(23), 2019. PMID:31659274
- (2) **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
- (3) 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
- (4) 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
- (5) 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
- (6) 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
- (7) **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
- (8) 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
- (9) 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
- (10) 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
- (11) 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
- (12) 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., Tasmir, 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
- (13) 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

Publications (continued)

- (14) 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
- (15) 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 α and Regulates Differentiation of ES Cells along the FLK1+ Lineage. **Mol Cell Proteomics**. 13(3), 2014. PMID:24390425
- (16) **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
- (17) **Brumbaugh, J.**, Hochedlinger, K. Removing reprogramming roadblocks: Mbd3 depletion allows deterministic iPSC generation. **Cell Stem Cell**. 13(4), 2013. PMID:24094318
- (18) 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
- (19) 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
- (20) **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
- (21) **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
- (22) 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 iPS cells. **Nature Methods**. 8(10), 2011. PMID:21983960
- (23) 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
- (24) Laketa, V., Zerbakhsh, 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
- (25) **Brumbaugh, J.**, Phanstiel, D. & Coon, J.J. Unraveling the histone's potential: a proteomics perspective. **Epigenetics**. 3(5), 2008. PMID:18849650
- (26) 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
- (27) **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
- (28) **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:

2020-2021	MCDB 4650: Developmental Biology
2020	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	Responsible Conduct of Research (Guest Instructor "Scientists in Society")
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

Teaching and Mentorship (continued)

Teaching experience (continued):

- 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:

- 2019-present | Ph.D. thesis advisor to Alison Swearingen
- 2016-2017 | Research mentor to Shona Robinson (M.S. student), currently an Associate Scientist in Genome Engineering Technologies at Oxford Genetics Ltd.

Undergraduate student mentorship:

- 2019-present | Research mentor to Meghan Skalicky (undergraduate)
- 2019-present | Research mentor to Emir Bajric (undergraduate)
- 2019-2020 | Research mentor to Emily Czarnik (undergraduate)
- 2014-2016 | Research mentor to Ryan Legraw (undergraduate/technician), currently in a Ph.D. program at Arizona State University
- 2012-2014 | Research mentor to Daniel Kramer (undergraduate/technician), currently in a Ph.D. program at the University of California, Berkeley

Peer Review Service

Editing:

- 2020-2021 | Guest Associate Editor for Frontiers in Cell and Developmental Biology

Manuscript Review:

- 2020-2021 | The FEBS Journal
- 2019-2020 | Zygote
- 2019-2020 | Reproductive Biomedicine Online
- 2019 | Scientific Reports
- 2016-2018 | Proteomics
- 2017 | Stem Cell Reports

Review Committee for meetings:

- 2020-2021 | International Society for Stem Cell Research Annual Meeting-Abstract reviewer

Outreach

- 2020 | Led a discussion on stem cells at Rock Canyon High School (Highlands Ranch, CO)
- 2020 | Featured Interview: The PULSE newsletter from the International Society for Stem Cell Research (ISSCR)
- 2020 | Featured interview: Immortal: An oral history of stem cell discovery; Morgridge Institute for Research
- 2019 | Guest on "Buffs Talk Science" podcast
- 2019 | Science Fair Judge for Corden Pharma Colorado Regional Science Fair

Select Research Presentations

- 2020 | Invited Talk: International Society for Stem Cell Research (ISSCR) Annual Meeting (Boston, MA; converted to a virtual format due to COVID19)
- 2019 | Invited Talk: Stem Cell and Organoids Research Exchange (Boulder, CO)
- 2019 | Invited Talk: Molecular, Cellular, and Developmental Biology Retreat (Vail, CO)
- 2019 | Invited Talk: Molecular, Cellular, and Developmental Biology Graduate Student Symposium (Boulder, CO)
- 2018 | Invited Talk: Massachusetts General Hospital Molecular Biology Symposium (Falmouth, MA)
- 2014 | Poster/Flash Talk: International Society for Stem Cell Research (ISSCR) Annual Meeting (Vancouver, Canada)
- 2009 | Invited Talk: International Society for Stem Cell Research (ISSCR) Annual Meeting (Barcelona, Spain)
- 2008 | Invited Talk: HUPO World Conference (Amsterdam, Netherlands)

Select Research Presentations (continued)

Trainee Presentations:

- 2019 | Alison Swearingen, Poster: Molecular, Cellular, and Developmental Biology Retreat (Vail, CO)
- 2019 | Sarah Tronnes, Poster: Molecular, Cellular, and Developmental Biology Retreat (Vail, CO)
- 2019 | Sarah Tronnes, Poster: University of California, Berkeley Dillon Lab Retreat (Berkeley, CA)
- 2019 | Alison Swearingen, Invited Talk: Stem Cell and Organoids Research Exchange (Boulder, CO)

Professional Development

- 2019-present | I have attended 36 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.