

Timothy A. Whitehead
Curriculum Vitae

ADDRESS AND CONTACT DETAILS

E1B32 JS Carothers Biotechnology Building
3415 Colorado Ave
University of Colorado, Boulder, CO 80303
Phone (303) 735 2145
Email timothy.whitehead@colorado.edu
<https://www.colorado.edu/faculty/whitehead/research>

APPOINTMENTS

University of Colorado, Boulder, CO
Associate Professor, Department of Chemical and Biological Engineering
Jan 2019-current

Michigan State University, East Lansing, MI
Johansen Crosby Endowed Chair Associate Professor, Department of Chemical
Engineering and Materials Science, Department of Biosystems and Agricultural Engineering
July 2017-Dec 2018
Assistant Professor, Department of Chemical Engineering and Materials Science,
Department of Biosystems and Agricultural Engineering Aug 2011-Jun 2017

EDUCATION

University of Washington, Seattle, WA
Senior Fellow, Department of Biochemistry, Feb 2009-Aug 2011
Advisor: David Baker, PhD

University of California-Berkeley, Berkeley, CA
PhD in Chemical Engineering, May 2008
Thesis: Engineering proteins to build nanostructures
Thesis advisor: Douglas S. Clark, PhD

Vanderbilt University, Nashville, TN
BE in Chemical Engineering, magna cum laude, May 2001

PROFESSIONAL EXPERIENCE

University of Washington, Seattle, WA
Senior Fellow, Department of Biochemistry, Feb 2009-Aug 2011

University of California-Berkeley, Berkeley, CA
Senior Fellow, Department of Chemical Engineering, June 2008-Jan 2009

University of California-Berkeley, Berkeley, CA
Graduate Research Assistant, Department of Chemical Engineering, Aug 2002-May 2008

Arcadis G&M, Melville, NY
Environmental Engineer, Dec 2001-July 2002

- Designed plants for groundwater remediation

AWARDS

2017 College of Engineering Nominee, MSU Teacher/Scholar Award
2017 Johansen Crosby Endowed Chair, CHEMS MSU
2017 Young Scientist Keynote, PEGS Meeting
2015 Fellow, Global Academy MSU
2013 NSF CAREER
2007 NIH T32 pre-doctoral Biotechnology Training Fellowship

RESEARCH INTERESTS

Protein engineering, protein design, biomolecular recognition, renewable energy production, antibody and antibody mimics, antigen design, synthetic biology, biochemical engineering

COMPLETE PUBLICATION LIST (h-index 22; i-10 index 32; 2308 total citations – Google Scholar, Dec 05 2020)

52. Bailey B. Banach, Gabriele Cerutti, Ahmed S. Fahad, Chen-Hsiang Shen, Matheus Olivera de Souza, Phini Katsamba, Yaroslav Tsybovsky, Pengfei Wang, Manoj S. Nair, Yaoxing Huang, Irene M. Francino Urdániz, Paul J. Steiner, Matias Gutiérrez-González, Lihong Liu, Sheila N. Lopez Acevedo, Alexandra Nazzari, Jacy R. Wolfe, Yang Luo, Adam S. Olia, I-Ting Teng, Jian Yu, Tongqing Zhou, Eswar Reddem, Jude Bimela, Xiaoli Pan, Bharat Madan, Amy D. Laflin, Rajani Madan, Kwok-Yung Yuen, **Timothy A. Whitehead**, David D. Ho, Peter D. Kwong, Lawrence Shapiro & Brandon J. DeKosky, (2020) “Paired heavy and light chain signatures contribute to potent SARS-CoV-2 neutralization in IGHV3-53/3-66 public antibody responses”, *under review*

51. Kirby MB, **Whitehead TA***, (2020) “Facile Assembly of Combinatorial Mutagenesis Libraries using Nicking Mutagenesis”, *Methods in Molecular Biology*, *accepted*

50. Steiner PJ, Baumer ZT, Whitehead TA*, (2020) “A method for user-defined mutagenesis by integrating oligo pool synthesis technology with nicking mutagenesis”, *Bio-protocol* 10(15) e3697

49. Medina-Cucurella A[^], Gary F. Bammert, William Dunkle, Christopher Javens, Yaqi Zhu, Veronica T. Mutchler, Janet T. Teel, Caitlin A. Stein[^], Steve A. Dunham, **Whitehead TA***, (2020) “Feline Interleukin-31 shares overlapping epitopes with Oncostatin M receptor and IL-31RA”, *Biochemistry*, *in press* doi: 10.1021/acs.biochem.0c00176

48. Timothy A. Whitehead^{a,*}, Scott Banta^b, William E. Bentley^c, Michael J. Betenbaugh^d, Christina Chan^e, Douglas S. Clark^f, Corinne Hoesli^g, Michael C. Jewett^h, Beth Junkerⁱ, Mattheos Koffas^j, Rashmi Kshirsagar^k, Amanda Lewis^l, Chien-Ting Li^d, Costas Maranas^m, E. Terry Papoutsakisⁿ, Kris J. Prather^o, Steffen Schaffer^p, Laura Segatori^q, Ian Wheeldon^r, (2020) “The Importance and future of Biochemical Engineering”, *Biotechnology & Bioengineering*, *in press*

47. Faber MS[^], Van Leuven JT, **Whitehead TA**, Miller CR* “Saturation mutagenesis genome engineering of infective ΦX174 bacteriophage via unamplified oligo pools and golden gate assembly”, (2020) *ACS Synthetic Biology* *in press*
doi:10.1021/acssynbio.9b00411

46. Leman JK, Weitzner BD, Renfrew DP, Lewis SM, Moretti R, Watkins AM, Mulligan VK, Lyskov S, Adolf-Bryfogle J, Labonte JW, **Rosetta Commons Consortium**, et al (2020) “Better together: Elements of successful scientific software development in a distributed collaborative community”, *PLOS Computational Biology*, e1007507

45. Steiner PJ[^], Bedewitz MA[^], Medina-Cucurella A[^], Cutler S, **Whitehead TA***, (2019) “A yeast surface display platform for plant hormone receptors: towards directed evolution of new biosensors”, *AICHE J*, *in press*

*Invited contribution to special issue honoring Nobel laureate Frances Arnold

44. Faber MS[^], Wrenbeck EE[^], Azouz L[&], Steiner PJ[^], **Whitehead TA***, (2019) “Impact of initial protein stability on local fitness landscapes”, *Molecular Biology Evolution*, *in press* <https://www.biorxiv.org/content/10.1101/590398v1>

43. Medina-Cucurella A[^], Steiner PJ[^], Faber MS[^], Beltran J, Borelli A[^], Kirby M[^], Cutler S, **Whitehead TA***, (2019) “User-defined single pot mutagenesis using unamplified oligo pools”, *Protein Engineering Design & Selection*, 32(1): 41-45

42. Wrenbeck EE[^], Bedewitz MA, Klesmith JR[^], Noshin S[&], Barry CS, **Whitehead TA*** (2019) “An automated data-driven pipeline for improving heterologous enzyme expression” *ACS Synthetic Biology* 8(3):474-481

41. Faber MS[^], **Whitehead TA*** (2019) “Data-driven engineering of protein therapeutics”, *Current Opinion in Biotechnology* 60:104-110

40. Medina-Cucurella A[^], Zhu Y, Bowen SJ, Bergeron LM, **Whitehead TA*** (2018) “Pro region engineering of nerve growth factor by deep mutational scanning enables a yeast platform for conformational epitope mapping of anti-NGF monoclonal antibodies”, *Biotechnology & Bioengineering*, 115:1925-1937 DOI: 10.1002/bit.26706

39. Acquaye-Seedah E, Reczek E, Russell H, Sandman SO[&], Collins JH[&], Stein CA[^], DiVenere A, **Whitehead TA**, Maynard JA (2018) “Plasmablast derived monoclonal antibody response to pertussis toxin after adult acellular pertussis booster immunization”,

Infection & Immunity, 86:6 e00004-18 DOI: 10.1128/IAI.00004-18

38. Medina-Cucurella A[^], **Whitehead TA*** (2018) “Characterizing Protein-Protein Interactions Using Deep Sequencing Coupled to Yeast Surface Display”, *Methods in Molecular Biology in Protein Complex Assembly*, 101-121

37. **Whitehead TA***, (2017) “A peptide mimic of an antibody” *Science*, 358:450-451

36. **Whitehead T***, Cutler S, Wheeldon I, (2017) “Plant Metabolic Engineering for Chemicals, Fuels, and Precursors”, *Chemical Engineering Progress SBE Supplement (invited)*

35. Wrenbeck EE[^], Azouz LR[&], **Whitehead TA*** (2017), “Single-mutation fitness landscapes for an enzyme on multiple substrates reveal specificity is globally encoded”, *Nature Communications* 8:15695

34. **Whitehead TA***, Bandi CK, Berger M, Park J, Chundawat S* (2017) “Negatively supercharging cellulases render them lignin-resistant”, *ACS Sustainable Chemistry & Engineering* 5:6247-6252 doi:10.1021/acssuschemeng.7b01202

- Cover of ACS Sustainable Chemistry & Engineering

33. Wang X, Stapleton JA[^], Klesmith JR[^], Hewlett E, **Whitehead TA**, Maynard J (2017) “Fine epitope mapping of two antibodies neutralizing the *Bordetella* adenylate cyclase toxin”, *Biochemistry* 56:1324-1336 doi: 10.1021/acs.biochem.6b01163

32. Klesmith JR[^], Bacik JP, Wrenbeck EE[^], Michalczyk R, **Whitehead TA*** (2017) “Trade-offs between enzyme fitness and solubility illuminated by deep mutational scanning”, *PNAS* 114:2265-2270 doi: 10.1073/pnas.1614437114

31. Wrenbeck EE[^], Faber M[^], **Whitehead TA*** (2017) “Deep sequencing methods for protein engineering and design”, *Current Opinion in Structural Biology* 45:36-44

30. Haarmeyer C[^], Smith MD[&], Chundawat S, Sammond D, **Whitehead TA***, (2017) “Insights into cellulase-lignin non-specific binding revealed by computational redesign of the surface of green fluorescent protein”, *Biotechnology & Bioengineering* 114:740-750 doi:10.1002/bit.26201

29. Kowalsky CA[^], **Whitehead TA***, (2016) “Determination of binding affinity upon mutation for type I dockerin-cohesin complexes from *Clostridium thermocellum* and *Clostridium cellulolyticum* using deep sequencing”, *Proteins* 84(12): 1914-1928 doi:10.1002/prot.25175

28. Wrenbeck EE[^], Klesmith JR[^], Adeniran A, Stapleton JA[^], Tyo KJ, **Whitehead TA***, (2016) “Plasmid-based single-pot saturation mutagenesis”, *Nature Methods* 13(11): 928-930 doi:10.1038/nmeth.4029

- Documentation at Nature Protocols Exchange (doi:10.1038/protex.2016.061)

27. Klesmith JR[^], Thorwall S[&], **Whitehead TA*** (2016) “Interpreting deep mutational scanning data resulting from plate-based selections”, *bioRxiv* 087072
26. Stapleton JA[^], Kim J, Hamilton JP, Wu M, Irber LC, Maddamsetti R, Briney B, Newton L, Burton DR, Brown CT, Chan C, Buell CR, **Whitehead TA*** (2016) “Haplotype-phased synthetic long reads from short-read sequencing”, *PLoS ONE* 11(1):e0147229
25. Khare S^{*}, **Whitehead TA*** (2015), “Introduction to RosettaCON Special Collection”, *PLoS ONE* 10(12):e0144326
24. Klesmith JR[^], **Whitehead TA*** (2015), “High-throughput evaluation of synthetic metabolic pathways”, *Technology* 4(01):9-14
23. Klesmith JR[^], Bacik JP, Michalczyk R, **Whitehead TA*** (2015) “High-resolution sequence function mapping of a levoglucosan utilization pathway in *E. coli*”, *ACS Synthetic Biology* 4 (11), 1235-1243 DOI: 10.1021/acssynbio.5b00131
- Selected for ‘Introducing our Authors’ feature highlight.
22. Bacik JP, Klesmith JR[^], **Whitehead TA**, Jarboe LR, Unkefer CJ, Mark BL, Michalczyk R (2015) “Structural insights into bioconversion of the biomass pyrolysis product levoglucosan”, *Journal of Biological Chemistry* 290 (44), 26638-26648
21. Kowalsky CA[^], Faber M[^], Nath A, Dann H[&], Kelly VW[&], Liu L, Shanker P, Wagner EK, Maynard J, Chan C, **Whitehead TA*** (2015) “Rapid fine conformational epitope mapping using comprehensive mutagenesis and deep sequencing”, *Journal of Biological Chemistry* 290 (44), 26457-26470 doi:10.1074/jbc.M115.676635
- Top 5 accessed article for J. Biol. Chem., Oct. 2015.
20. Stapleton JA[^], **Whitehead TA**, Nanda V (2015) “Computational redesign of the lipid-facing surface of the outer membrane protein OmpA”, *PNAS* 112(31):9632-9637
19. Kowalsky CA[^], Klesmith JR[^], Stapleton JA[^], Kelly VW[&], Reichkitzer N[&], **Whitehead TA*** (2015) “High-resolution sequence-function mapping of full proteins”, *PLoS ONE*, 10(3): e0118193. doi:10.1371/journal.pone.0118193
18. Tomek KJ[&], Saldarriaga CRC[&], Velasquez FPC, Liu T, Hodge DB, **Whitehead TA***, (2015) “Removal and upgrading of lignocellulosic fermentation inhibitors by in situ biocatalysis and liquid-liquid extraction”, *Biotechnology & Bioengineering*, 112(3):627-632.
<http://onlinelibrary.wiley.com/doi/10.1002/bit.25473/abstract>
- Selected for B&B video highlight.
17. Gao D, Haarmeyer C[^], Balan V, **Whitehead TA**, Dale BE, Chundawat SPS (2014) “Lignin triggers irreversible cellulase loss during pretreated lignocellulosic biomass saccharification”, *Biotechnology for Biofuels*, 7:175

16. Bienick MS[&], Young KW[&], Klesmith JR[^], Detwiler EE[^], Tomek KJ[&], **Whitehead TA***, (2014) “The interrelationship between promoter strength, gene expression, and growth rate”, *PLoS ONE*, DOI: 10.1371/journal.pone.0109105
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0109105>

15. **Whitehead TA***, Baker D, Fleishman SJ* (2013) “Computational design of novel protein binders and experimental affinity maturation”, *Methods Enzymology*, 523:1-19. doi: 10.1016/B978-0-12-394292-0.00001-1.

14. **Whitehead TA+**, Chevalier A⁺, Song Y et al. (2012) “Optimization of affinity, specificity, and function of designed Influenza inhibitors using deep sequencing”, *Nature Biotechnology* 30(6):543-8. doi: 10.1038/nbt.2214

+ **authors contributed equally**

- Cover of Nature Biotechnology; Featured in numerous popular press articles and radio interviews, including NPR.

13. Fleishman SJ, **Whitehead TA**, Strauch EM et al. (2011) “Community-wide assessment of protein-interface modeling suggests improvements to design methodology”, *J Mol Biol* 414(2):289

12. Fleishman SJ, Corn JE, Strauch EM, **Whitehead TA**, Karanicolas J, Baker D (2011) “Hotspot-centric *de novo* design of protein binders”, *J Mol Biol* 413(5):1047

11. Fleishman SJ⁺, **Whitehead TA+**, Ekiert D⁺, Dreyfus C, Corn JE, Strauch EM, Wilson IA, Baker D (2011) “Computational design of proteins targeting the conserved stem region of Influenza hemagglutinin”, *Science* 332(6031):816-21

+ **authors contributed equally**

- Featured in numerous popular press articles and radio interviews, including NPR.

10. Fleishman SJ, Corn JE, Strauch EM, **Whitehead TA**, Andre I, Thompson J, Havranek JJ, Das R, Bradley P, Baker D (2010), “Rosetta in CAPRI rounds 13-19” *Proteins* 78(15):3212

9. **Whitehead TA**, Bergeron LM, Clark DS (2009), “Tying up the loose ends: circular permutation decreases the proteolytic susceptibility of recombinant proteins” *Protein Eng Des Sel* 22 (10):607-13

8. Slocik JM, Kim SN, **Whitehead TA**, Clark DS, Naik RR (2009), “Biotemplated metal nanowires using hyperthermophilic protein filaments”, *Small* 5 (18):2038-42

7. Bruns N, Pustelny K, Bergeron LM, **Whitehead TA**, Clark DS (2009), “Mechanical nanosensor based on FRET within a thermosome: damage-reporting polymeric materials”, *Angew Chem Int Ed Engl* 48 (31):5666-9

- Inside cover of Angew Chem Int Ed Engl; feature story in Chemistry World: <http://www.rsc.org/chemistryworld/News/2009/May/05050901.asp>

6. **Whitehead TA**, Je E, Clark DS (2009), “Rational shape engineering of the filamentous protein gamma prefoldin through incremental gene truncation”, *Biopolymers* 91 (6):496-503
5. Bergeron LM, Gomez L, **Whitehead TA**, Clark DS (2009), “Self-renaturing enzymes: design of an enzyme-chaperone chimera as a new approach to enzyme stabilization”, *Biotechnol Bioeng* 102 (5):1316-22
 - Spotlight article in *Biotechnol Bioeng*.
4. **Whitehead TA**, Meadows AL, Clark DS (2008), “Controlling the self-assembly of a filamentous hyperthermophilic chaperone by an engineered capping protein”, *Small* 4 (7):956-60
3. **Whitehead TA**, Boonyaratanakornkit BB, Hoellrigl V, Clark DS (2007), “A filamentous molecular chaperone of the prefoldin family from the deep-sea hyperthermophile *Methanocaldococcus jannaschii*”, *Protein Science* 16 (4): 626-634
2. Boonyaratanakornkit BB, Simpson AJ, **Whitehead TA**, Fraser CM, El-Sayed NMA, Clark DS (2005), “Transcriptional profiling of the hyperthermophilic methanarchaeon *Methanococcus jannaschii* in response to lethal heat and non-lethal cold shock”, *Environmental Microbiology* 7 (6): 789-797
1. Laksanalamai P, **Whitehead TA**, Robb FT (2004), “Minimal protein-folding systems in hyperthermophilic archaea”, *Nature Reviews Microbiology* 2 (4): 315-324

PATENTS

7. Kirby M, Baumer Z, Bedewitz M, Petersen B, Steiner PJ, **Whitehead TA (2020)** “Stabilizing Mutants of Prefusion Sars-Cov-2 (Covid-19) Spike Protein And Improved Yeast Surface Display Engineering Platform For The Same”, **US Patent App. No. 63/026,316**
6. Wrenbeck EE, Klesmith JR, Stapleton JA, **Whitehead TA (2016)** “Plasmid-based single-pot saturation mutagenesis”, US Patent Application Number 62/380,717; “Methods for generating single- or multi-site mutagenesis” **(2019)** US Patent App. 16/115,029
5. Stapleton JA, **Whitehead T (2015)** “Methods for assembling and reading nucleic acid sequences from mixed populations”, US Patent Application number 14947988; **(2019)** US Patent App. 10/233,490; **(2019)** US Patent App. 16/253,898
4. Baker D, Fleishman SJ, **Whitehead TA (2016)** “Polypeptides for treating and/or limiting influenza infection”, US Patent 9,388,217
3. Baker D, Fleishman SJ, **Whitehead TA (2015)** “Polypeptides for treating and/or limiting influenza infection”, US Patent 9,181,300

2. Baker D, Fleishman SJ, **Whitehead TA (2014)** “Polypeptides for treating and/or limiting influenza infection”, US Patent 8,765,686

1. **Whitehead TA, Clark DS (2014)** “Heterologous Expression of Extremophile Heat Shock Proteins and Chaperones in Microorganisms to Increase Tolerance to Toxic Compounds”, US Patent 8,685,729

PROPOSALS

Funded, active projects (\$ my contribution)

07/2014- 06/2024	Co-PI (lead PI Rob Last) (initial with renewal) NIH Plant Biotechnology for Health and Sustainability T-32 Training Grant		\$812, 412
01/2019- 12/2023	PI The influence of evolutionary landscapes on protective antibody development	NIH NIAID R01	\$2,796,000
07/2019- 06/2021	co-Lead PI Engineering long ssDNA donors for genome editing applications	NIH NIGMS R21	\$220,000
10/2018- 03/2023	co-PI (PI D. Nusinow, Danforth Center) Advanced plant sensing technologies	DARPA APT	\$1,117,000
08/2020- 08/2022	PI EAGER: Dynamic control of metabolism using redesigned proteins	NSF CBET	\$220,000

Completed projects

06/2013- 05/2019	Lead PI CAREER: Programming Proteins by Deep Sequencing and Design	NSF	\$416,970
06/2015- 08/2018	Lead PI Research Experience for Undergraduates Supplemental Funding	NSF	\$38,683
05/2016- 12/2017	Lead PI Fine conformational epitope mapping to observe epitope walking	Zoetis	\$110,000
09/2016- 12/2016	Lead PI Paratope affinity maturation for antibodies	Zoetis	\$31,000
06/2016- 05/2017	Lead PI MSU iGEM Synthetic Biology Team	NSF-Beacon	\$12,000
01/2016- 12/2016	Lead PI Development of an optimized fermentative pathway from levoglucosan to isobutanol	USDA	\$35,518
12/2015- 06/2017	Lead PI Deep sequencing of designed operons reveals Pareto optimal growth-associated metabolic pathways	MSU-DFI	\$50,000
8/2012-	Lead PI w/ Co-PI S. Chundawat	NSF	\$299,800

12/2016	Solving a Sticky Problem: Understanding Enzyme Binding to Lignocellulosic Biomass During Biofuel Production		
4/2013-7/2015	Co-Lead PI w/ Co-Lead PI K. Chan Deep Sequencing to Screen Functional Antibody Epitopes	NIH	\$356,732
11/2014-7/2015	Lead PI De Novo Genome Assembly of Polyploids Using a Method for Assembling and Reading Large Contiguous DNA Sequences	M-TRAC	\$48,000
1/2014-11/2014	Lead PI Method for assembling and reading large contiguous DNA sequences from mixed populations	MIIIE	\$69,820
6/2013-8/2014	Lead PI Engineering Nanobody Specificity to Outer Membrane Proteins	JHU-APL	\$58,567
8/2012-7/2014	Lead PI Computational Design of Beta-barrel Membrane Proteins	NIH	\$104,368

INVITED PRESENTATIONS

33. **Whitehead TA** (2019) “Chemogenetic control of organisms using redesigned proteins” Colorado State University Chemical Engineering Colloquium, Fort Collins, CO

32. **Whitehead TA** (2019) “Chemogenetic control of organisms using redesigned proteins” American Institute of Chemical Engineers National Meeting, Orlando, FL

31. **Whitehead TA** (2019) “An automated data-driven pipeline for improving heterologous enzyme expression” Society for Industrial Microbiology and Biotechnology, Washington, D.C.

30. **Whitehead TA** (2019) “Using Deep Sequencing Datasets to Tailor Specificity” PEGS, Boston, MA

29. **Whitehead TA** (2018) “Programming enzymes by deep sequencing and design” University of Minnesota Biotechnology Colloquium, Minneapolis, MN

28. **Faber MS, Whitehead TA** (2018) “Investigating the Fundamental Constraints on Enzyme Evolution Using Massively Parallel Sequence-Function Analysis”. Annual international meeting of the American Society of Agricultural and Biological Engineers, Detroit, MI

27. **Whitehead TA** (2018) “Programming enzymes by deep sequencing and design” University of Indiana, Bloomington Chemistry Colloquium, Bloomington, IN

26. **Whitehead TA** (2018) “Programming antibodies and antigens using deep

sequencing-enabled protein engineering” Eli Lilly Genomics Seminar, La Jolla, CA

25. Whitehead TA (2018) “Programming biomolecules by deep sequencing and design” Wayne State University Chemical Engineering and Materials Science Colloquium, Detroit, MI

24. Whitehead TA (2018) “Programming biomolecules by deep sequencing and design” Colorado University-Boulder Chemical and Biomolecular Engineering Departmental Colloquium, Boulder, CO

23. Whitehead TA (2018) “Programming antibodies and antigens using deep sequencing-enabled protein engineering” Michigan State University Pharmacology and Toxicology Departmental Seminar, East Lansing, MI

22. Whitehead TA (2017) “Programming antibodies and antigens using deep sequencing-enabled protein engineering” Antibody Engineering & Therapeutics, San Diego, CA

21. Whitehead TA (2017) “Programming proteins by deep sequencing and design” Michigan State University Institute for Quantitative Health and Science, East Lansing, MI

20. Whitehead TA (2017) “Programming proteins by deep sequencing and design” Penn State University Chemical Engineering Colloquium, State College, PA

19. Whitehead TA (2017) “Programming proteins by deep sequencing and design” Columbia University Chemical Engineering Colloquium, New York, New York

18. Whitehead TA (2017) “Programming proteins by deep sequencing and design” University of Edinburgh Institute of Genetics & Molecular Medicine, Edinburgh, UK

17. Whitehead TA (2017) “Programming proteins by deep sequencing and design” Young Scientist Keynote, PEGS, Boston, MA

16. Whitehead TA (2017) “Elucidating constraints on biomolecular engineering” Johns Hopkins University Chemical and Biological Engineering Colloquium, Baltimore, MD

15. Whitehead TA (2017) “Programming proteins by deep sequencing and design” Univ. Puerto Rico at Cayey RISE program on computational chemistry, Cayey, PR

14. Whitehead TA (2017) “Programming proteins by deep sequencing and design” UC Riverside Chemical Engineering Colloquium, Riverside, CA

13. Whitehead TA (2016) “Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing” Cancer Immunology Havana, Cuba

12. **Whitehead TA** (2016) “Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing” PEGS, Boston, MA
11. **Whitehead TA** (2016) “High-throughput conformational epitope mapping for antibody discovery” MSU Innovation Celebration, East Lansing, MI
10. Kowalsky CA, **Whitehead TA** (2016) “Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing” PepTalk, San Diego, CA
9. **Whitehead TA** (2015) “High throughput conformational epitope mapping to guide design of structure-based vaccines” Biochemical and Molecular Engineering Conference XIX, Puerto Vallarta, Mexico
8. **Whitehead TA** (2015) “Going deep with biomolecular engineering and design” CHEMS annual research forum, East Lansing, MI
7. **Whitehead TA** (2012), “Constructing protein-protein binders by deep sequencing and design”, Defense Threat Reduction Agency, Workshop on “A systems approach to cell-based sensing”, Scottsdale, AZ
6. **Whitehead TA** (2012), “Constructing protein therapeutics by deep sequencing and design”, NSF BEACON Center, Michigan State University
5. **Whitehead TA** (2011), “Leave no amino acid unturned: computational design and exploitation of fitness landscapes leads to broadly neutralizing flu anti-virals”, 2011 RosettaCON, Leavenworth, WA
4. **Whitehead TA** (2010), “Design, validation, and improvement of functional proteins”, Michigan State University Department of Chemical Engineering and Materials Science, East Lansing, MI
3. **Whitehead TA** (2010), “Self-assembling Protein Ovaloids: a New Dimension in Protein Design”, Annual meeting of the American Chemical Society, San Francisco, CA, Nanobiotechnology session
2. **Whitehead TA** (2008), “Engineering extremophilic chaperones for biofuels production and nanobiotechnology”, Rice University Department of Chemical Engineering, Houston, TX
1. **Whitehead TA** [*presenter*], Clark DS (2007), “Engineering hyperthermophilic chaperones for biocatalysis and nanobiotechnology”, Annual meeting of the Society for Industrial Microbiology, Denver, CO

OTHER PRESENTATIONS

Whitehead TA (2020) “Mutations favoring the ‘up’ prefusion conformation of SARS-

CoV-2 Spike” Virtual COVID-19 Rosetta Conference

Whitehead TA (2019) “Data-driven engineering of useful proteins” Biochemical and Molecular Engineering XXI, Mont Tremblant, Quebec, Canada

Whitehead TA (2019) “User-defined chemical genetic systems in plants” American Chemical Society Annual Meeting BIOT division, Orlando, FL

Whitehead TA (2018) “Automating the Engineering of Improved Enzymes for Biomanufacturing” American Institute of Chemical Engineers National Meeting, Pittsburgh, PA

Whitehead TA, Wrenbeck EE (2017) “Nicking Mutagenesis” Annual Meeting of the American Chemical Society BIOT Division, San Francisco, CA

Whitehead TA (2017) “Improving Synthetic Metabolic Pathway Yields and Productivities Using a Hybrid Computational/Experimental Approach to Increase Enzyme Solubility” International Conference on Biomolecular Engineering San Diego, CA

Haarmeyer C, Smith M, Chundawat SPS, Sammond DW, **Whitehead TA** (2016) “Using Protein Design to Evaluate the Relationship Between Protein Surface Potential and Protein-Lignin Binding for the Engineering of Low Lignin Binding Cellulases” Annual Meeting of AIChE San Francisco, CA

Wrenbeck EE, Azouz LA, **Whitehead TA** (2016) “Fitness Landscapes for an Enzyme on Multiple Substrates” Annual Meeting of AIChE San Francisco, CA

Whitehead TA (2016) “Enzyme Redesign is Unsurprisingly Difficult” RosettaCON Leavenworth, WA

Whitehead TA (2016) “Deep Sequencing Methods for Protein Engineering and Design” Protein Society, Baltimore, MD

Whitehead TA (2016) “Deep Sequencing Methods for Protein Engineering and Design” Protein Engineering Canada Ottawa, Canada

Whitehead TA (2016) “High-throughput conformational epitope mapping by deep sequencing for antibody discovery” Annual Meeting American Chemical Society BIOT Division, San Diego, CA

Klesmith JR, **Whitehead TA** (2016) “Deep sequencing-guided assessment and computational design of synthetic metabolic pathways” Annual Meeting American Chemical Society BIOT Division, San Diego, CA

Whitehead TA (2016) “High-Throughput Conformational Epitope Mapping to Guide Design of Structure-Based Vaccines” AIChE Midwest Regional Conference, Chicago, IL

Whitehead TA, Stapleton JA (2014), “Long read DNA sequencing technology”, MichBio Annual Conference, Detroit, MI

Stapleton JA, **Whitehead TA** (2014), “Identifying rare combinations of mutations in HIV patients to predict drug resistance”, MSU Board of Trustees, East Lansing, MI

Kowalsky CA, Klesmith JR, Faber M, **Whitehead TA** (2014), “Going Deep with Biomolecular Engineering and Design”, AIChE National Meeting, Atlanta, GA

Kowalsky CA, **Whitehead TA** (2014), “Sequence Function Mapping of Full-Length Protein Sequences”, AIChE National Meeting, Atlanta, GA

Klesmith JR, **Whitehead TA** (2014), “Optimizing physical properties of enzymes using deep mutational scanning”, RosettaCON, Leavenworth, WA

Kowalsky CA, **Whitehead TA** (2014), “High-resolution sequence-function mapping of full proteins”, MSU Engineering Graduate Research Symposium, Lansing MI

- Won graduate student poster award

Haarmeyer C, Chundawat SP, **Whitehead T** (2014), “Correlating surface properties to nonspecific binding: GFP as a tag in lignocellulosic biofuel production”, CHEMS Department Research Forum, Lansing, MI

Haarmeyer C, Chundawat SP, **Whitehead T** (2014), “Correlating surface properties to nonspecific binding: GFP as a tag in lignocellulosic biofuel production”, RosettaCON, Leavenworth, WA

Kowalsky CA, Klesmith JR, **Whitehead TA** (2014), “High Resolution Sequence Function Mapping of Proteins”, MSU Engineering Research Symposium, East Lansing, MI

Whitehead TA (2014), “Optimizing pathway flux by simultaneous protein and promoter engineering”, Annual meeting of the American Chemical Society, Dallas, TX, BIOT section

Whitehead TA (2013), “Biochemical production of high-value products from pyrolyzed biomass by design of catabolic pathway”, National Meeting of the American Institute of Chemical Engineers, San Francisco, CA

Whitehead TA (2013), “Constructing functioning proteins by deep sequencing and design”, 2nd Annual Symposium on Plant Biotechnology for Health and Sustainability, Michigan State University

Kowalsky CA, Klesmith JR, **Whitehead TA** (2013), “High Resolution Sequence Function Mapping of Proteins”, MSU CHEMS Research Forum, East Lansing, MI

Kowalsky CA, Klesmith JR, **Whitehead TA** (2013), “High Resolution Sequence

Function Mapping of Proteins”, RosettaCON, Leavenworth, WA

Kowalsky CA, Klesmith JR, **Whitehead TA** (2013), “High Resolution Sequence Function Mapping of Proteins”, UM-MSU Blue-Green Seminar, Ann Arbor, MI

Whitehead TA (2012), “Constructing protein therapeutics by deep sequencing and design”, Inaugural Symposium on Plant Biotechnology for Health and Sustainability, Michigan State University

Whitehead TA (2012), “Leave no amino acid unturned: de novo design, directed evolution, and fitness landscape exploitation leads to potential Influenza therapeutics”, Annual meeting of the American Chemical Society, San Diego, CA, BIOT section

Whitehead, TA (2011) “Deep mutational scanning as a new tool for protein sequence/function relationships”, National Meeting of the American Institute of Chemical Engineers, Minneapolis, MN

Whitehead, TA (2011) “Computational design of proteins targeting the conserved stem region of influenza hemagglutinin”, National Meeting of the American Institute of Chemical Engineers, Minneapolis, MN

Whitehead TA (2011), “Computational design of proteins targeting the conserved stem region of Influenza hemagglutinin”, The 7th Annual PEGS Conference, Boston, MA

Whitehead TA [poster] (2007), “Engineering molecular chaperones to build controllable structures at the nanoscale”, Annual meeting of the American Institute of Chemical Engineers, Salt Lake City, UT

Chase SD, **Whitehead TA** [presenter], Blanch HW, Clark DS (2007), “Upregulation of a hyperthermophilic chaperone increases the solvent tolerance of *Escherichia coli*”, Annual meeting of the American Institute of Chemical Engineers, Salt Lake City, UT

Whitehead TA [presenter], Clark DS (2007), “Protein engineering of extremophilic chaperones for molecular self-assembly”, Annual meeting of the American Chemical Society, Boston, MA

Whitehead TA [presenter], Clark DS (2006) “Tunable functionalized filament scaffolds from an engineered hyperthermophilic protein”, Annual meeting of the American Chemical Society, San Francisco, CA

Whitehead TA [presenter], Clark DS (2005), “Exploring sequence space of a new biological nanowire”, Annual meeting of the American Institute of Chemical Engineers, Cincinnati, OH

Whitehead TA [presenter], Clark DS (2005), “Discovery of a filamentous chaperone from a hyperthermophile”, Annual meeting of the American Institute of Chemical Engineers, Cincinnati, OH

Whitehead TA, Hollrigl V, Bergeron LM, Clark DS [poster] (2004), “Characterization of chaperones from *Methanococcus jannaschii* for biotechnology applications”, International Extremophiles Conference, Cambridge, Maryland

TEACHING

<u>Graduate Courses</u>	<u>Date</u>	<u>Students</u>	<u>SIRS (4.0)</u>
CHEN5150 Biomolecular Kinetics, Transport, and Thermodynamics.	FS2020	14	
CHEN5150 Biomolecular Kinetics, Transport, and Thermodynamics.	FS2019	7	
CHE882 Advanced Biochemical Engineering	SS2018	9	
CHE 883 Multidisciplinary Bioprocess Engineering	SS2017	8	
CHE 882 Advanced Biochemical Engineering	SS2016	6	N/A
CHE 891 Selected Topics – Synthetic Biology	SS2015	7	4.00

<u>Undergraduate Courses</u>	<u>Date</u>	<u>Students</u>	<u>SIRS (4.0)</u>
CHEN2120 Material and Energy Balances	SS2020	35	
CHE201 Material and Energy Balances	FS2018	59	
CHE 481 Biochemical Engineering Laboratory	FS2017	62	
CHE 481 Biochemical Engineering Laboratory	FS2016	47	3.17
CHE 201 Material and Energy Balances	SS2016	40	3.57
CHE 481 Biochemical Engineering Laboratory	FS2015	42	2.76
CHE 481 Biochemical Engineering Laboratory	FS2014	42	3.48
CHE 201 Material and Energy Balances	FS2013	62	3.49
CHE 201 Material and Energy Balances	FS2013	52	3.76
CHE 201 Material and Energy Balances	FS2012	53	3.69
CHE 201 Material and Energy Balances	FS2012	46	3.72
CHE 201 Material and Energy Balances	SS2012	45	3.50

Courses Developed

CHE 891: Selected Topics – Synthetic Biology. This course presented an overview of the field of synthetic biology. Lectures were used to establish synthetic biology as a discipline separate from engineering and discovery biology. Key enabling technologies were described with recourse to primary literature, and applications utilizing synthetic biology were covered. There were two seminar-style lectures per week, with one class period per week involving a journal club.

CHEN5150 - Biomolecular Kinetics, Transport, and Thermodynamics. Required for the Biological Engineering PhD. This course covers aspects of kinetics, transport, and thermodynamics as they relate to interactions between biomolecules and cells. These core subjects will be introduced within concepts common to cell biology, protein/genetic engineering, and signaling, among others.

ADVISING

Postdoctoral

Matilda Newton 2019-
Matt Bedewitz 2019-
PJ Steiner 2018-
Jim Stapleton 2012-2015

Current Position

Research Professor, University of Oregon

Ph.D. Students

Emily Rhodes 2020-
Mia Keyser 2020-
Zoe Davis 2020-
Irene Francino Urdaniz 2019-
Alison Leonard 2020-
Brian Petersen 2019-
Zach Baumer 2019-
Monica Kirby 2018-
Angelica Medina 2015-2019
Matthew Faber 2014-2019
Emily Wrenbeck 2013-2017
Justin Klesmith 2012-2016
Caitlin Kowalsky 2011-2016

Current Position

Scientist, GigaGen
Scientist, Xencor
Scientist, Ginkgo Bioworks
Scientist, Zoetis
Senior Scientist, Adimab

Masters Students

Carolyn Haarmeyer 2012-2016
MaryAnn Laboe 2016-2018

Current Position

PhD candidate, Michigan State

Undergraduates

Tyndall Rounsefell 2020-
Justin Nwafor 2019
Sophia Ullmer 2019-
Cyrus Haas 2019-
Emma Aouille 2019
Sarah Caldwell 2017-2018
Noelia Barvo 2017-2018
Raisa Noshin 2017
Justin Hosten 2017
Andrew Dsouza 2016-2017
Ethan Maurer 2016-2018
Jennifer Theland 2016
Sara Sandman 2015
Laura Raef Azouz 2015-2017
Brooke Gunderson 2014-2015
Sarah Thorwall 2014-2016
Matthew Smith 2014-2016
Rachel Schuldt 2013
Manuel Henry 2013

Current Position

Undergraduate, Connecticut College

Undergraduate, CU-Boulder
Undergraduate, MSU
Undergraduate, MSU
Undergraduate, UVA
Undergraduate, UMBC
Undergraduate, MSU
Undergraduate, MSU
Undergraduate, Royal Institute Sweden
Unknown
Grad Student, Univ. Texas
Proctor & Gamble
Grad Student, UC Riverside
Grad Student, Univ Michigan
Undergraduate, MSU
Undergraduate, MSU

Hailey Dann	2013-2016	GM, Minneapolis, MN
Vince Kelly	2013-2016	Grad Student, UIUC
Nolan Reichkitstizer	2012-2015	Kellogg, Battle Creek, MI
Emily Ward	2012-2013	Undergraduate, MSU
Austin Kennedy	2012-2013	Schlumberger
Steven Rausch	2012-2014	Dow Corning
Carlos Castillo	US2012	National University Colombia
Kyle Tomek	2012-2014	Grad Student, NC State
Matthew Bienick	2012-2014	Grad Student, U Arizona
Alex Smith	2011-2012	Eli Lilly
Alison Menzias	2011-2012	Undergraduate, MSU

High School Students

Rebecca Wang	US2015
Katherine Erdman	US2014
Katherine Young	US2013
Lani Hack	US2012

Current Position

High School, TX
High School, MD
Undergraduate, MIT
Undergraduate, UC Berkeley

Committee Member Ph.D. Students

Paul Sharpe, Eric Young, Bradley Paasch, Derek Fedeson, Kevin W Hall, Philip Angart, Daniel Lybrand, Qian Qin, Kanchan Chavan, Alshae Logan, Tom Aunins, Kristen Eller, Max Levy, Jacob Fenster, Nolan O'Connor

Committee Member Masters Students

Erica Earl

Highlights for Integrating Undergraduates in Research

- 2020- Faculty director, Univ. Colorado YSSRP program for undergraduate summer research (co-director 2019)
- Founder and faculty advisor of 1st MSU synthetic biology iGEM team. Won Bronze medal at 2016 iGEM world competition and have been invited to submit a research article on photochemostats to *Journal of Visualized Experiments*. Won Silver medal at 2017 iGEM.
- 9 undergraduates/high school students have been co-authors on submitted or published peer-reviewed journal articles.
- 3 undergraduates/high school students have been 1st authors on peer-reviewed journal articles.
- 6 former undergraduates currently enrolled in PhD programs.
- Laura Azouz (former student) was 2015 Goldwater nominee for MSU, won honorable mention in national competition, and won 1st place in Gulf Coast Undergraduate Research Symposium at Rice University (2016).

Peer Recognition of Graduate and Postdoctoral Students

- Alison Leonard won a NIH T32 Biophysics training grant fellowship.
- Jim Stapleton (postdoc) won an NIH F32 postdoctoral fellowship.

- Caitlin Kowalsky won best poster award at international conference PepTalk (San Diego, CA Jan 2016).
- Caitlin Kowalsky was 2016 Fitch Beach CHEMS nominee and won 3rd prize graduate student in the College of Engineering
- Justin Klesmith won a 2015 USDA NIFA predoctoral fellowship.
- Emily Wrenbeck and Angelica Medina both won NIH T32 Plant Biotechnology Training Fellowships.
- Emily Wrenbeck won 2017 Outstanding Graduate Student Award, MSU Dept. Chemical Engineering
- Matthew Faber won best poster award at Protein Engineering Canada (Ottawa, CA July 2016).
- Carolyn Haarmeyer won DOE graduate student fellowship (2015)
- Emily Wrenbeck won the *Biochemical Engineering Journal* poster award for the 2016 AIChE Food, Pharmaceutical, and Bioengineering Division (2016).
- Angelica Medina won best poster award at *MSU-UM Blue Green Seminar* (2017) and is University representative for HHMI Gilliam fellowship.

SERVICE

External Service.

- Associate Editor, *Protein Engineering Design & Selection* (Oxford University Press) 2020-
- Rosetta Commons Executive Committee (2016-present). Membership chair.
- Panelist on future of Biochemical Engineering, Biochemical and Molecular Engineering XXI Mont Tremblant, Quebec, CA (2019)
- NIH CMIA Study Section (Feb 2019; June 2019)
- NIH Innovative Immunology Study Section (June 2020; Nov 2020)
- Panel reviewer for National Science Foundation CBET Division (2013-present; 7 times)
- Panel reviewer for National Science Foundation EPSCoR (2017, 2018)
- Panel reviewer for National Institutes of Health Special Emphasis Panel on Zika Complications (2016)
- Ad hoc reviewer for Israeli Science Foundation (2014-current), Rosetta Licensing Funds (2015-current), National Science Foundation MCB Division (2017), Netherlands VENI program (2019), Poland NSF (2019), and Department of Defense (2016-current), European Research Council (2020)
- Reviewer for dozens of journals (*Science, eLife, PNAS, Nature Biotechnology, Biotechnology & Bioengineering, Genome Biology, Bioresource Technology, PROTEINS, PEDS, ChemBioChem, Scientific Reports, Current Opinion Biotechnology, PLOS Pathogens, Oncotarget*)
- Session chair, AIChE (2013-2015,2017), ACS BIOT Division (2015-present)

Conference organization.

- Lead organizer, Keystone conference on “**Computational Design and Modeling of Biomolecules**” 2022. Solicited, developed, organized, and was awarded first Keystone conference on Protein Design.
- Co-organizer, *2014 RosettaCON* Leavenworth WA. International conference with 200 attendees from over a dozen countries.
- Co-organizer of 1st, 2nd, and 5th annual *Symposium of Plant Biotechnology for Health and Sustainability*, East Lansing, MI (2012, 2013, 2016)
- Organizing committee, Biochemical and Molecular Engineering XXI (2019)

University Service.

- *Univ Colorado Dept Chem & Biological Eng Research Strategic Committee.*
- *Univ Colorado Dept Chem & Biological Eng Undergraduate Committee (2020-)*
- *Faculty advisor, alternative protein project student club (2020-)*
- *Faculty director, Univ. Colorado YSSRP program for undergraduate summer research (2020- ; co-director 2019)*
- *Univ Colorado Dept Chem & Biological Eng Faculty Committee (2019-2020)*
- *Univ Colorado Biological Engineering Graduate Committee (2019-)*
- *Univ Colorado BME committee (2019-2020)*
- *MSU Engineering Research Advisory Panel (2013-2017)*
- *MSU NIH T32 Training Grant Executive Committee (2014-2018)*
- *MSU Review Panel Member, Institutionally Limited Dec 2014*
- *MSU Faculty Adviser, OXE Chemical Engineering Undergraduate Society (2012-2017)*
- *Faculty Volunteer, High School Engineering Institute (2012-present)*
- *Faculty Volunteer, Engineering Connect (2012-2018)*
- *Faculty founder and co-advisor, MSU iGEM Synthetic Biology team (2016-2018)*
- *MSU Strategic Partnership Grant Review Panel Member (2017-2018)*
- *Member, MSU Departmental Graduate Studies Committee (2017-2018)*