Stanford



Elizabeth Sattely

Associate Professor of Chemical Engineering

Bio

BIO

Plants have an extraordinary capacity to harvest atmospheric CO2 and sunlight for the production of energy-rich biopolymers, clinically used drugs, and other biologically active small molecules. The metabolic pathways that produce these compounds are key to developing sustainable biofuel feedstocks, protecting crops from pathogens, and discovering new natural-product based therapeutics for human disease. These applications motivate us to find new ways to elucidate and engineer plant metabolism. We use a multidisciplinary approach combining chemistry, enzymology, genetics, and metabolomics to tackle problems that include new methods for delignification of lignocellulosic biomass and the engineering of plant antibiotic biosynthesis.

ACADEMIC APPOINTMENTS

- Associate Professor, Chemical Engineering
- Member, Bio-X
- Faculty Fellow, Sarafan ChEM-H

HONORS AND AWARDS

- Allan P. Colburn Award, AIChe (2019)
- HHMI Investigator, Howard Hughes Medical Institute (2018)
- Young Faculty Award, DARPA (2018)
- Chan Zuckerberg Biohub Investigator, Chan Zuckerberg Biohub (2017)
- Marion Milligan Mason Award for Women in the Chemical Sciences, AAAS (2016)
- Simons Faculty Scholar Award, Howard Hughes Medical Institute (2016)
- Early Career Award, DOE (2015)
- Faculty Scholar Award, Hellman Fellows Fund (2013)
- New Innovator Award, NIH (2013)
- Gabilan Fellow, Stanford University (2011)
- Terman Fellow, Stanford University (2011)
- Pathway to Independence Award, NIH (2010)
- Postdoctoral Fellowship, Damon Runyon Cancer Research Foundation (2008)
- Division of Organic Chemistry Graduate Fellowship, ACS (2003)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Steering committee for SynBio satellite meeting, American Society of Plant Biology Annual Conference (2018 - 2018)
- Advisory Committee, Joint Institute for Metrology in Biology (2016 - present)
- Synthetic Biology Advisory Board Member, DOE JGI (2016 - present)
- Editorial Board Member, Cell Chemical Biology (2015 - present)
- Genomes to Natural Products Network (GNPN) Member, NIH (2015 - present)
- American Institute of Chemical Engineers (AICHE) Member, AIChe (2013 - present)
- Fellow, Stanford ChEM-H Institute (2013 - present)
- Faculty advisor, SMASH (Summer Math and Science Honors Academy) (2011 - 2011)

PROFESSIONAL EDUCATION

- PhD, Boston College (2007)

LINKS

- Sattely Research Group Website: https://www.sattelylab.org/

Teaching

COURSES

2026-27

- Foundational Biology for Engineers: CHEMENG 55, ENGR 55 (Aut)
- The Future of Food: Defining Challenges to Reinvent Food Systems: CHEMENG 455 (Spr)

2025-26

- Foundational Biology for Engineers: CHEMENG 55, ENGR 55 (Aut)
- The Future of Food: Defining Challenges to Reinvent Food Systems: CHEMENG 455 (Spr)

2024-25

- Foundational Biology for Engineers: CHEMENG 55, ENGR 55 (Aut)
- The Future of Food: Defining Challenges to Reinvent Food Systems: CHEMENG 455 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Jenna Ahn, Yalikunjiang Aizezi, Signe Dahlberg-Wright, Izzi Gengaro

Postdoctoral Faculty Sponsor

Catherine Liou, Jenna Manske, Sarah Niehs

Doctoral Dissertation Advisor (AC)

Matthew Brockley, Casey Chan, Clista Galecki, Ryan Kong, Tara Lowensohn, Caleb Olaso, Arryn Owens, Anna Pons, Anish Somani, Chloe Wick

Doctoral Dissertation Co-Advisor (AC)

Bailey Daymo, Matthew Proefke

Publications

PUBLICATIONS

- **Cephalotaxinone enzymes reveal a whole plant model for homoharringtonine biosynthesis.** *Nature chemical biology*
  Dho, Y., Smith, K., Sattely, E. S.
  2026

- **A single-cell screening platform accelerates functional genetics in plants.** *Nature biotechnology*
  Lowensohn, T. N., Cody, W. B., Tsai, C., Vlahos, A. E., Call, C. C., Gao, X. J., Sattely, E. S.
  2026

- **A PIVOT towards single-cell functional genetic screening in plants** *NATURE BIOTECHNOLOGY*
  Lowensohn, T. N., Sattely, E. S.
  2026

- **Chemistry and Biology of Taxol Biosynthesis**
  Sattely, E.
  ELSEVIER.2026

- **FoTO1 orchestrates Taxol biosynthesis through catalytic and non-catalytic mechanisms.** *bioRxiv : the preprint server for biology*
  Wick, C., Somani, A., Liu, J. C., Karunadasa, S. S., Xu, S. L., Fordyce, P. M., McClune, C. J., Sattely, E. S.
  2026

- **Identification and characterization of dietary antigens in oral tolerance.** *Science immunology*
  Blum, J. E., Kong, R., Schulman, E. A., Chen, F. M., Upadhyay, R., Romero-Meza, G., Littman, D. R., Fischbach, M. A., Nagashima, K., Sattely, E. S.
  2026; 11 (117): eaeb4684

- **Gut microbiota gate host exposure to cholinesterase inhibitors from dietary Solanums.** *bioRxiv : the preprint server for biology*
  Liou, C. S., Louwies, T., Iakiviak, M., Rajniak, J., Murugkar, P. P., Higginbottom, S. K., Weakley, A., Meng, X., Htet, P., Cabrera, A. V., Jasper, M., Dimas, A., Schulman, et al
  2025

- **Discovery of homoharringtonine pathway enzymes reveals a whole plant model for coordinated biosynthesis.** *bioRxiv : the preprint server for biology*
  Dho, Y., Smith, K., Sattely, E. S.
  2025

- **Discovery of FoTO1 and Taxol genes enables biosynthesis of baccatin III.** *Nature*
  McClune, C. J., Liu, J. C., Wick, C., De La Peña, R., Lange, B. M., Fordyce, P. M., Sattely, E. S.
  2025

- **Multiplexed perturbation of yew reveals cryptic proteins that enable a total biosynthesis of baccatin III and Taxol precursors.** *bioRxiv : the preprint server for biology*
  McClune, C. J., Liu, J. C., Wick, C., De La Peña, R., Lange, B. M., Fordyce, P. M., Sattely, E. S.
  2024

- **Plants Utilize a Protection/Deprotection Strategy in Limonoid Biosynthesis: A "Missing Link" Carboxylesterase Boosts Yields and Provides Insights into Furan Formation.** *Journal of the American Chemical Society*
  Hodgson, H., Stephenson, M. J., Kikuchi, S., Martin, L. B., Liu, J. C., Casson, R., Rejzek, M., Sattely, E. S., Osbourn, A.
  2024

- **Transcriptome analysis reveals role of transcription factor WRKY70 in early N-hydroxy-pipecolic acid signaling.** *Plant physiology*
  Foret, J., Kim, J. G., Sattely, E. S., Mudgett, M. B.
  2024

- **A developmental gradient reveals biosynthetic pathways to eukaryotic toxins in monocot geophytes.** *Cell*
  Mehta, N., Meng, Y., Zare, R., Kamenetsky-Goldstein, R., Sattely, E.
  2024

- **Discovery and characterization of dietary antigens in oral tolerance.** *bioRxiv : the preprint server for biology*
  Blum, J. E., Kong, R., Schulman, E. A., Chen, F. M., Upadhyay, R., Romero-Meza, G., Littman, D. R., Fischbach, M. A., Nagashima, K., Sattely, E. S.
  2024
- **Reconstitution of early paclitaxel biosynthetic network.** *Nature communications*
  Liu, J. C., De La Peña, R., Tocol, C., Sattely, E. S.
  2024; 15 (1): 1419
- **Plant carbonic anhydrase-like enzymes in neuroactive alkaloid biosynthesis.** *Nature*
  Nett, R. S., Dho, Y., Tsai, C., Passow, D., Martinez Grundman, J., Low, Y. Y., Sattely, E. S.
  2023
- **Reconstitution of Early Paclitaxel Biosynthetic Network.** *bioRxiv : the preprint server for biology*
  Chun-Ting Liu, J., De La Pena, R., Tocol, C., Sattely, E. S.
  2023
- **Mapping the T cell repertoire to a complex gut bacterial community.** *Nature*
  Nagashima, K., Zhao, A., Atabakhsh, K., Bae, M., Blum, J. E., Weakley, A., Jain, S., Meng, X., Cheng, A. G., Wang, M., Higginbottom, S., Dimas, A., Murugkar, et al
  2023
- **Multiplicity of the Agrobacterium Infection of Nicotiana benthamiana for Transient DNA Delivery** *ACS SYNTHETIC BIOLOGY*
  Carlson, E. D., Rajniak, J., Sattely, E. S.
  2023: 2329-2338
- **A developmental gradient reveals biosynthetic pathways to eukaryotic toxins in monocot geophytes.** *bioRxiv : the preprint server for biology*
  Mehta, N., Meng, Y., Zare, R., Kamenetsky-Goldstein, R., Sattely, E.
  2023
- **Complex scaffold remodeling in plant triterpene biosynthesis.** *Science (New York, N.Y.)*
  De La Pena, R., Hodgson, H., Liu, J. C., Stephenson, M. J., Martin, A. C., Owen, C., Harkess, A., Leebens-Mack, J., Jimenez, L. E., Osbourn, A., Sattely, E. S.
  2023; 379 (6630): 361-368
- **Alleviating Cell Lysate-Induced Inhibition to Enable RT-PCR from Single Cells in Picoliter-Volume Double Emulsion Droplets.** *Analytical chemistry*
  Khariton, M., McClune, C. J., Brower, K. K., Klemm, S., Sattely, E. S., Fordyce, P. M., Wang, B.
  2023
- **Author Correction: Modular, programmable RNA sensing using ADAR editing in living cells.** *Nature biotechnology*
  Kaseniit, K. E., Katz, N., Kolber, N. S., Call, C. C., Wengier, D. L., Cody, W. B., Sattely, E. S., Gao, X. J.
  2022
- **Modular, programmable RNA sensing using ADAR editing in living cells.** *Nature biotechnology*
  Kaseniit, K. E., Katz, N., Kolber, N. S., Call, C. C., Wengier, D. L., Cody, W. B., Sattely, E. S., Gao, X. J.
  2022
- **Transcriptional Reactivation of Lignin Biosynthesis for the Heterologous Production of Etoposide Aglycone in Nicotiana benthamiana.** *ACS synthetic biology*
  Kim, S. S., Wengier, D. L., Ragland, C. J., Sattely, E. S.
  2022
- **A plant host, Nicotiana benthamiana, enables the production and study of fungal lignin-degrading enzymes.** *Communications biology*
  Khlystov, N. A., Yoshikuni, Y., Deutsch, S., Sattely, E. S.
  2021; 4 (1): 1027
- **A metabolic regulon reveals early and late acting enzymes in neuroactive Lycopodium alkaloid biosynthesis.** *Proceedings of the National Academy of Sciences of the United States of America*
  Nett, R. S., Dho, Y., Low, Y., Sattely, E. S.
  2021; 118 (24)

- **Engineering post-translational regulation of glutamine synthetase for controllable ammonia production in the plant-symbiont A. brasilense.** *Applied and environmental microbiology*
  Schnabel, T., Sattely, E.
  2021
- **Integrated project-based learning (IPBL) implementation for first year chemical engineering student: DIY hydraulic jack project** *EDUCATION FOR CHEMICAL ENGINEERS*
  Burkholder, E., Hwang, L., Sattely, E., Holmes, N.
  2021; 35: 69-80
- **Dirigent Proteins Guide Asymmetric Heterocoupling for the Synthesis of Complex Natural Product Analogues.** *Journal of the American Chemical Society*
  Kim, S. S., Sattely, E. S.
  2021
- **Arabidopsis UGT76B1 glycosylates N-hydroxy-pipecolic acid and inactivates systemic acquired resistance in tomato.** *The Plant cell*
  Holmes, E. C., Chen, Y. C., Mudgett, M. B., Sattely, E. S.
  2021; 33 (3): 750–65
- **Total Biosynthesis of the Tubulin-Binding Alkaloid Colchicine.** *Journal of the American Chemical Society*
  Nett, R. S., Sattely, E. S.
  2021
- **Improved Stability of Engineered Ammonia Production in the Plant-Symbiont Azospirillum brasilense.** *ACS synthetic biology*
  Schnabel, T., Sattely, E.
  2021
- **Rerouting plant terpene biosynthesis enables momilactone pathway elucidation.** *Nature chemical biology*
  De La Pena, R., Sattely, E. S.
  2020
- **Engineering Plant Synthetic Pathways for the Biosynthesis of Novel Antifungals.** *ACS central science*
  Calgaro-Kozina, A., Vuu, K. M., Keasling, J. D., Loque, D., Sattely, E. S., Shih, P. M.
  2020; 6 (8): 1394–1400
- **Discovery and engineering of colchicine alkaloid biosynthesis.** *Nature*
  Nett, R. S., Lau, W., Sattely, E. S.
  2020
- **A Metabolic Pathway for Activation of Dietary Glucosinolates by a Human Gut Symbiont.** *Cell*
  Liou, C. S., Sirk, S. J., Diaz, C. A., Klein, A. P., Fischer, C. R., Higginbottom, S. K., Erez, A., Donia, M. S., Sonnenburg, J. L., Sattely, E. S.
  2020; 180 (4): 717
- **Root-Secreted Coumarins and the Microbiota Interact to Improve Iron Nutrition in Arabidopsis.** *Cell host & microbe*
  Harbort, C. J., Hashimoto, M. n., Inoue, H. n., Niu, Y. n., Guan, R. n., Rombolà, A. D., Kopriva, S. n., Voges, M. J., Sattely, E. S., Garrido-Oter, R. n., Schulze-Lefert, P. n.
  2020
- **A Pathogen-Responsive Gene Cluster for Highly Modified Fatty Acids in Tomato.** *Cell*
  Jeon, J. E., Kim, J. G., Fischer, C. R., Mehta, N. n., Dufour-Schroif, C. n., Wemmer, K. n., Mudgett, M. B., Sattely, E. n.
  2020; 180 (1): 176–87.e19
- **Total Biosynthesis for Milligram-Scale Production of Etoposide Intermediates in a Plant Chassis** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Schultz, B. J., Kim, S., Lau, W., Sattely, E. S.
  2019; 141 (49): 19231–35
- **An engineered pathway for N-hydroxy-pipecolic acid synthesis enhances systemic acquired resistance in tomato.** *Science signaling*
  Holmes, E. C., Chen, Y., Sattely, E. S., Mudgett, M. B.
  2019; 12 (604)

- **The alkynes we eat: Where do they come from and how do we identify them?**
  Fischer, C., Jeon, J., Smith, K., Sattely, E.
  AMER CHEMICAL SOC.2019

- **Developing Plant Synthetic Biology Tools for Complex Metabolic Engineering.**
  Shih, P. M., Calgaro-Kozina, A., Khanh Vuu, Keasling, J. D., Loque, D., Sattely, E. S.
  SPRINGER.2019: S2

- **Identification of key enzymes responsible for protolimonoid biosynthesis in plants: Opening the door to azadirachtin production.** *Proceedings of the National Academy of Sciences of the United States of America*
  Hodgson, H. n., De La Peña, R. n., Stephenson, M. J., Thimmappa, R. n., Vincent, J. L., Sattely, E. S., Osbourn, A. n.
  2019

- **Plant-derived coumarins shape the composition of an Arabidopsis synthetic root microbiome.** *Proceedings of the National Academy of Sciences of the United States of America*
  Voges, M. J., Bai, Y. n., Schulze-Lefert, P. n., Sattely, E. S.
  2019

- **D2O Labeling to Measure Active Biosynthesis of Natural Products in Medicinal Plants.** *AIChE journal. American Institute of Chemical Engineers*
  Nett, R. S., Guan, X., Smith, K., Faust, A. M., Sattely, E. S., Fischer, C. R.
  2018; 64 (12): 4319-4330

- **N-hydroxy-pipecolic acid is a mobile metabolite that induces systemic disease resistance in Arabidopsis** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Chen, Y., Holmes, E. C., Rajniak, J., Kim, J., Tang, S., Fischer, C. R., Mudgett, M., Sattely, E. S.
  2018; 115 (21): E4920–E4929

- **Biosynthesis of redox-active metabolites in response to iron deficiency in plants** *NATURE CHEMICAL BIOLOGY*
  Rajniak, J., Giehl, R. F. H., Chang, E., Murgia, I., von Wiren, N., Sattely, E. S.
  2018; 14 (5): 442-+

- **A lignin-epoxy resin derived from biomass as an alternative to formaldehyde-based wood adhesives** *GREEN CHEMISTRY*
  Li, R., Gutierrez, J., Chung, Y., Frank, C. W., Billington, S. L., Sattely, E. S.
  2018; 20 (7): 1459–66

- **HEx: A heterologous expression platform for the discovery of fungal natural products** *SCIENCE ADVANCES*
  Harvey, C. J. B., Tang, M., Schlecht, U., Horecka, J., Fischer, C. R., Lin, H., Li, J., Naughton, B., Cherry, J., Miranda, M., Li, Y., Chu, A. M., Hennessy, et al
  2018; 4 (4): eaar5459

- **Biosynthesis of cabbage phytoalexins from indole glucosinolate.** *Proceedings of the National Academy of Sciences of the United States of America*
  Klein, A. P., Sattely, E. S.
  2017; 114 (8): 1910-1915

- **Metabolism of the xenobiotic compound benzotriazole in Arabidopsis plants**
  LeFevre, G., Lipsky, A., Mueller, C., Sattely, E., Luthy, R.
  AMER CHEMICAL SOC.2016

- **Plant Assimilation Kinetics and Metabolism of 2-Mercaptobenzothiazole Tire Rubber Vulcanizers by Arabidopsis** *ENVIRONMENTAL SCIENCE & TECHNOLOGY*
  Lefevre, G. H., Portmann, A. C., Muller, C. E., Sattely, E. S., Luthy, R. G.
  2016; 50 (13): 6762-6771

- **Competing mechanisms for perfluoroalkyl acid accumulation in plants revealed using an Arabidopsis model system.** *Environmental toxicology and chemistry*
  Müller, C. E., Lefevre, G. H., Timofte, A. E., Hussain, F. A., Sattely, E. S., Luthy, R. G.
  2016; 35 (5): 1138-1147

- **Discovery of benzotriazole and novel plant metabolites in Arabidopsis and food crops**

LeFevre, G., Lipsky, A., Sattely, E., Higgins, C., Hyland, K., Luthy, R.
AMER CHEMICAL SOC.2016

- **Discovery and engineering of plant chemistry for plant and human health**
  Sattely, E.
  AMER CHEMICAL SOC.2016
- **Two cytochromes P450 catalyze S-heterocyclizations in cabbage phytoalexin biosynthesis.** *Nature chemical biology*
  Klein, A. P., Sattely, E. S.
  2015; 11 (11): 837-839
- **A new cyanogenic metabolite in Arabidopsis required for inducible pathogen defence.** *Nature*
  Rajniak, J., Barco, B., Clay, N. K., Sattely, E. S.
  2015; 525 (7569): 376-379
- **Rapid Phytotransformation of Benzotriazole Generates Synthetic Tryptophan and Auxin Analogs in Arabidopsis.** *Environmental science & technology*
  Lefevre, G. H., Müller, C. E., Li, R. J., Luthy, R. G., Sattely, E. S.
  2015; 49 (18): 10959-10968
- **Six enzymes from mayapple that complete the biosynthetic pathway to the etoposide aglycone.** *Science*
  Lau, W., Sattely, E. S.
  2015; 349 (6253): 1224-1228
- **Key applications of plant metabolic engineering.** *PLoS biology*
  Lau, W., Fischbach, M. A., Osbourn, A., Sattely, E. S.
  2014; 12 (6)
- **The chemical logic of plant natural product biosynthesis.** *Current opinion in plant biology*
  Anarat-Cappillino, G., Sattely, E. S.
  2014; 19: 51-58
- **Minimum set of cytochromes p450 for reconstituting the biosynthesis of camalexin, a major Arabidopsis antibiotic.** *Angewandte Chemie (International ed. in English)*
  Klein, A. P., Anarat-Cappillino, G., Sattely, E. S.
  2013; 52 (51): 13625-13628
- **A Renewable Lignin-Lactide Copolymer and Application in Biobased Composites** *ACS SUSTAINABLE CHEMISTRY & ENGINEERING*
  Chung, Y., Olsson, J. V., Li, R. J., Frank, C. W., Waymouth, R. M., Billington, S. L., Sattely, E. S.
  2013; 1 (10): 1231-1238
- **Graft-polymerization of poly(lactic acid) onto lignin with application to biobased composites**
  Chung, Y., Olsson, J. V., Li, R., Billington, S., Frank, C. W., Waymouth, R. M., Sattely, E.
  AMER CHEMICAL SOC.2013
- **Identification and characterization of key enzymes and multi-enzyme complexes in plant secondary metabolism**
  Anarat-Cappillino, G., Sattely, E. S.
  AMER CHEMICAL SOC.2013
- **Three Cytochromes P450 are Sufficient to Reconstitute the Biosynthesis of Camalexin, a Major Arabidopsis Antibiotic** *Angew. Chem. Int. Ed.*
  Klein, A., P., Anarat-Cappillino, G., Sattely, E., S.
  2013; 52: 13625-13628
- **Design and Stereoselective Preparation of a New Class of Chiral Olefin Metathesis Catalysts and Application to Enantioselective Synthesis of Quebrachamine: Catalyst Development Inspired by Natural Product Synthesis** *J. Am. Chem. Soc.*
  Sattely, E., S., Meek, S., J., Malcolmson, S., J., Schrock, R., R., Hoveyda, A., H.
  2009; 131: 943- 953
- **Three Siderophores from One Assembly Line Enzyme** *J. Am. Chem. Soc.*
  Wuest, W., M., Sattely, E., S., Walsh, C., T.

2009; 131: 5056-5057

- **Enzymatic Tailoring of Ornithine in the Biosynthesis of the Rhizobium Cyclic Trihydroxamate Siderophore Vicibactin** *J. Am. Chem. Soc.*
  Heemstra Jr., J., R., Walsh, C., T., Sattely, E., S.
  2009; 131: 15317-15329
- **A Latent Oxazoline Electrophile for N-O-C Bond Formation in Pseudomonine Biosynthesis** *J. Am. Chem. Soc.*
  Sattely, E., S., Walsh, C., T.
  2008; 130: 12282-12284
- **Total Biosynthesis: in vitro Reconstitution of Polyketide and Nonribosomal Peptide Pathways** *Nat. Prod. Rep.*
  Sattely, E., S., Fischbach, M., A., Walsh, C., T.
  2008; 25: 757-793
- **Highly Efficient Molybdenum-Based Catalysts for Enantioselective Alkene Metathesis** *Nature*
  Malcolmson, S., J., Meek, S., J., Sattely, E., S., Schrock, R., R., Hoveyda, A., H.
  2008; 456: 933-937
- **Enantioselective Synthesis of Cyclic Amines and Amides through Mo-Catalyzed Asymmetric Ring-Closing Metathesis** *J. Am. Chem. Soc.*
  Sattely, E., S., Cortez, G., A., Moebius, D., C., Schrock, R., R., Hoveyda, A., H.
  2005; 127: 8526-8533
- **Efficient Catalytic Enantioselective Synthesis of Unsaturated Amines: Preparation of Small- and Medium- Ring Cyclic Amines through Mo-Catalyzed Asymmetric Ring-Closing Metathesis in the Absence of Solvent** *J. Am. Chem. Soc.*
  Dolman, S., J., Sattely, E., S., Hoveyda, A., H., Schrock, R., R.
  2002; 124: 6991-6997
- **Catalytic Asymmetric Ring-Opening Metathesis/Cross Metathesis (AROM/CM) Reactions. Mechanism and Application to Enantioselective Synthesis of Functionalized Cyclopentanes** *J. Am. Chem. Soc.*
  La, D., S., Sattely, E., S., Ford, J., G., Schrock, R., R., Hoveyda, A., H.
  2001; 123: 7767-7778
- **Tandem Catalytic Asymmetric Ring-Opening Metathesis/Cross Metathesis** *J. Am. Chem. Soc.*
  La, D., S., Ford, J., G., Sattely, E., S., Bonitatebus, P., J., Schrock, R., R., Hoveyda, A., H.
  1999; 121: 11603-11604