C. Nathan Hancock

Associate Professor
Department of Biology and Geology
University of South Carolina Aiken

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Education

1999-2005 **Ph.D. Biochemistry, University of Missouri - Columbia**
Advisor: Dr. Bruce McClure
Thesis: "S-RNase proteins: Functional studies of the 120kDa glycoprotein and S-RNase oligomerization"
Accomplishments: Showed the 120 kD protein is required for self-incompatibility, identified S-RNase oligomers, and cloned cDNAs from multiple *Nicotiana* species
Development: Coordinated an undergraduate research project, learned protein purification (chromatography), peptide antibody design, immunoblot, binding assays, analytical ultracentrifugation, and plant transformation

1993-1999 **B.S. Plant Sciences, University of Arizona**
Senior Research Advisor: Dr. Gary Thompson
Magna Cum Laude (3.744 GPA), Honors, Plant Science Outstanding Senior

Employment

2011- current Associate Professor
University of South Carolina Aiken, Department of Biology and Geology
Researching the transposition mechanisms for the *mPing* transposable element and developing plant gene discovery tools.
Teaching Biological Science I, Principles of Biochemistry, Plant Physiology, and Applied Biotechnology.

2008 – 2011 Post-doctoral Researcher
University of Georgia, Center for Applied Genetic Technology
Advisor: Dr. Wayne Parrott
Accomplishments: Produced stable soybean transformants, characterized transposon activity, analyzed transposon insertion sites in the soybean genome, and phenotyped transgenic plants in the field
Development: Learned additional plant transformation techniques, Prepared NSF grant application and reports and trained and directed technicians and undergraduate students

2005-2008 Post-doctoral Researcher
University of Georgia, Department of Plant Biology
Advisor: Dr. Susan Wessler
Accomplishments: Optimized the *mPing* yeast transposition assay, characterized transpose proteins by electrophoretic mobility shift, immunoprecipitation, and yeast two-hybrid assays, and identified a nuclear export signal that regulates transposase activity
Development: Designed and taught a research-based laboratory class and coordinated an undergraduate research project

Awards

2019-current - Washington Savannah River Company Endowed Chair
2017 - USC Breakthrough Star
2017 - USCA Scholarly Activity Award

Publications

Liu P, Panda K, Edwards SA, Swanson R, Yi H, Pandesha P, Hung YH, Klaas G, Ye X, Collins MV, Renken KN, Gilbertson LA, Veena V, Hancock CN, Slotkin RK**. Transposase-assisted target-site integration for efficient plant genome engineering** Nature. 2024, 1-8.

Hancock CN, Germany T, Redd P, Timmons J, Lipford J, Burns S, Cervantes-Perez SA, Libault M, Shen W, An YQ, Kanizay L. **Identification and characterization of a temperature sensitive chlorotic soybean mutant.** bioRxiv. (preprint, under review at Plant Direct).

Dhingra A, Shinde S, D'Agostino L, Devkar V, Shinde H, Rajurkar AB, Sonah H, Vuong TD, Siebecker MG, Jiao Y, Hancock CN, Nguyen HT, Deshmukh R, Patil GB. **Identification of novel germplasm and genetic loci for enhancing mineral element uptake in soybean.** Environmental and Experimental Botany. 2024, 219:105643.

Mudunkothge JS, Hancock CN, Krezek BA: **The GUS Reporter System in Flower Development Studies.** In Flower Development: Methods and Protocols. 2023, pp. 351-363. New York, NY: Springer US

Redd PS, Payero L, Gilbert D, Page CA, King R, McAssey E, Bodie D, Diaz S, Hancock CN: **Transposase expression, element abundance, element size, and DNA repair determine the mobility and heritability of *PIF/Pong/Harbinger* transposable elements.** Frontiers in Cell and Developmental Biology 2023, 11: 1184046.

Renken K, Mendoza SM, Diaz S, Slotkin RK, Hancock CN: **Pol V produced RNA facilitates transposable element excision site repair in Arabidopsis.** microPublication Biology 2023, 10.17912/micropub.biology.000793

Redd PS, Diaz S, Weidner D, Benjamin J, Hancock CN: **Mobility of *mPing* and its associated elements is regulated by both internal and terminal sequences.** Mobile DNA 2023, 14: 1 https://doi.org/10.1186/s13100-023-00289-3.

Herbert A, Hancock CN, Cox B, Schnabel G, Moreno D, Carvalho R, Jones J, Paret ML, Geng X, Wang H: **Oxytetracycline and streptomycin resistance genes in *Xanthomonas arboricola* pv. pruni, the causal agent of bacterial spot in peach.** Frontiers in Microbiology 2022, 13:821808.

Plemmons AN, Askins AR, Mendoza SM, Hancock CN: **A transposon-based activation tag system for functional genomics in cereals: Detection of *mPing*-based activation tag mobilization in wheat.** In: Bilichak A., Laurie J.D. (eds) Accelerated Breeding of Cereal Crops 2022. Springer Protocols Handbooks. Humana, New York, NY. https://doi.org/10.1007/978-1-0716-1526-3_9 .

Nguyen CX, Dohnalkova A, Hancock CN, Kirk KR, Stacey G, and Stacey MG: **Critical role for uricase and xanthine dehydrogenase in soybean nitrogen fixation and nodule development.** The Plant Genome 2021, : e20171.

Johnson A, Mcassey E, Diaz S, Reagin J, Redd PS, Parrilla DR, Nguyen H, Stec A, McDaniel LA, Clemente TE, Stupar RM, Parrott WA, Hancock CN: **Development of *mPing*-based activation tags for crop insertional mutagenesis**. *Plant Direct* 2021, 5 (1): e00300.

Mackey AS, Redd PS, DeLaurier A, Hancock CN: **Codon optimized *Tol2* transposase results in increased transient expression of a crystallin-GFP transgene in zebrafish**. *microPublication Biology* 2020, 10.17912/micropub.biology.000268.

Moulton K, Diaz S, Strother A, Hancock CN: **A partial T-DNA insertion near *KNAT1* results in lobed *Arabidopsis thaliana* leaves**. *microPublication Biology* 2020, 10.17912/micropub.biology.000253.

Christos N. Velanis, Pumi Perera, Bennett Thomson, Erica de Leau, Shih Chieh Liang, Ben Hartwig, Alex Förderer, Harry Thornton, Pedro Arede, Jiawen Chen, Kimberly M. Webb, Serin Gümüs, Geert De Jaeger, Clinton A. Page, C. Nathan Hancock, Christos Spanos, Juri Rappsilber, Philipp Voigt, Franziska Turck, Frank Wellmer, Justin Goodrich: **The domesticated transposase *ALP2* mediates formation of a novel Polycomb protein complex by direct interaction with MSI1, a core subunit of Polycomb Repressive Complex 2 (PRC2)**. *PLOs Genetics* 2020, 16.5: e1008681.

Chen J, Lu L, Benjamin J, Diaz SS, Hancock CN, Stajich JE, Wessler SR: **Tracking the origin of two genetic components associated with transposable element bursts in domesticated rice**. *Nature Communications* 2019, **10**(1), 641.

Strother AE, Diaz SS, Baker ME, Hancock CN: **Targeted insertion of the *mPing* transposable element**. *Journal of the South Carolina Academy of Science* 2018, **16** (1): 48-52.

Payero L, Outten G, Burckhalter CE, Hancock, CN: **Alteration of the *Ping* and *Pong* ORF1 proteins allows for hyperactive transposition of *mPing*.** *Journal of the South Carolina Academy of Science* 2016, **14** (2):1-6.

Gilbert DM, Bridges MC, Strother AE, Burckhalter CE, Burnette JM, Hancock CN: **Precise repair of *mPing* excision sites is facilitated by target site duplication derived microhomology.** *Mobile DNA* 2015, **6**:15.

Kanizay L, Jacobs T, Hancock CN: **A transgenic, visual screenable marker for soybean seeds.** *Transgenic Research* 2015, **25(2)**:187-193.

Cui Y, Barampuram S, Stacey MG, Hancock CN, Findley S, Mathieu M, Zhang Z, Parrott WA, Stacey G: ***Tnt1* retrotransposon mutagenesis: A tool for soybean functional genomics**. *Plant Physiology* 2013, **161**:36-47.

Hancock CN, Zhang F, Floyd K, Richardson AO, LaFayette P, Tucker D, Wessler SR, Parrott WA: **The rice MITE *mPing* is an effective insertional mutagen in soybean (*Glycine max*).** *Plant Physiology* 2011, **157**:552–562.

Hancock CN, Zhang F, Wessler SR: **Transposition of the *Tourist*-MITE *mPing* in yeast: an assay that retains key features of catalysis by the Class 2 *PIF/Harbinger* superfamily.** *Mobile DNA* 2010, **1**:5.

Naito K, Zhang F, Tsukiyama T, Saito H, Hancock CN, Richardson AO, Okumoto Y, Tanisaka T, Wessler SR: **Unexpected consequences of a sudden and massive transposon amplification on rice gene expression.** *Nature* 2009, **461:**1130-1134.

Yang GJ, Holligan-Nagel D, Feschotte C, Hancock CN, Wessler SR: **Tuned for transposition: molecular determinants underlying the hyperactivity of a *Stowaway* MITE.** *Science* 2009, **325:**1391-1394.

Yang GJ, Zhang F, Hancock CN, Wessler SR: **Transposition of the rice miniature inverted repeat transposable element *mPing* in *Arabidopsis thaliana*.** *Proceedings of the National Academy of Sciences of the United States of America* 2007, **104:**10962-10967.

Goldraij A, Kondo K, Lee CB, Hancock CN, Sivaguru M, Vazquez-Santana S, Kim S, Phillips TE, Cruz-Garcia F, McClure B: **Compartmentalization of S-RNase and HT-B degradation in self-incompatible *Nicotiana*.** *Nature* 2006, **439:**805-810.

Hancock CN, Kent L, McClure BA: **The stylar 120 kDa glycoprotein is required for S-specific pollen rejection in *Nicotiana*.** *Plant Journal* 2005, **43:**716-723.

Cruz-Garcia F, Hancock CN, Kim D, McClure B: **Stylar glycoproteins bind to S-RNase in vitro.** *Plant Journal* 2005, **42:**295-304.

Cruz-Garcia F, Hancock CN, McClure B: **S-RNase complexes and pollen rejection.** *Journal of Experimental Botany* 2003, **54:**123-130.

Hancock CN, Kondo K, Beecher B, McClure B: **The S-locus and unilateral incompatibility** *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences* 2003, **358:**1133-1140.

Hancock CN, McClure B: **S-RNase-based self-incompatibility.** *Recent Research Developments in Plant Molecular Biology* (Pandalai SG ed.), vol. 1. Trivandrum, India: Research Signpost; 2003.

Funded Research

USCA Fundraising Campaign (2023) $6,000
Assembly and annotation of the *Sabal palmetto* genome

RISE, USC Internal (2023) $6,000
Preparation and publication of a manuscript describing a soybean Yellow Leaf mutant

NSF Plant Genome Research Program, Research Opportunity Award (2023-2024) $50,034
Targeted Integration of User-Defined DNA in Plants

United Soybean Board, Co-PI (2022) $18,725
Characterization of seed protein quality in re-balanced soybean lines

ASPIRE III, USC Internal (2021) $10,075
Expanding the microscopy imaging capacity to advance research activities at USC Aiken

Corteva Open Innovation Grant: Genome Editing for Crop Improvement (2021) Materials
Optimizing soybean productivity by modifying *GmCRY2*

SC Soybean Board (2021-2022) $7,132
Strategies for rescue of nitrogen deficient soybeans

South Carolina INBRE (NIH), Co-PI (2020-2025) $498,289
Expansion of Biomedical Research at the University of South Carolina Aiken

SC Soybean Board (2020) $3,500
Strategies for identification and rescue of poorly nodulated soybeans

SC INBRE Bioinformatics Pilot Project (2019-2021) $10,000
Genomic analysis of an RNA silencing mutant

SC Soybean Board (2019) $10,000
Strategies for identification and rescue of poorly nodulated soybeans

SC Soybean Board (2018) $5,000
High-throughput image analysis for soybean nutrient deficiency and in-season yield estimate prediction

NSF Genetic Mechanisms (2017 - 2023) $695,696
CAREER: Mechanisms that regulate activity of the plant DNA transposable element, *mPing*

NSF Plant Genome Research Program, Co-PI (2016 - 2019) $364,464
A resource for functional genomics to support soybean genetics and breeding

South Carolina INBRE (NIH), Co-PI (2016-2020) $99,418
Expansion of Biomedical Research at the University of South Carolina Aiken

NSF Plant Genome Research Program, Subaward (2015) $79,305
A genetic resource for gene discovery in soybean

ASPIRE III, USC Internal (2015) $100,000
Request for funds for a fluorescent confocal laser scanning microscope to advance research activities at USC Aiken

ASPIRE III, USC Internal (2015) $31,062
Purchase of a CFX96 Touch Real-Time PCR Detection System

NSF Plant Genome Research Program, Research Opportunity Award (2014) $38,000
A genetic resource for gene discovery in soybean

ASPIRE I, USC Internal (2014-2015) $15,000
Developing a *Phaseolus acutifolius* mutagenesis resource for discovery of drought related genes

RISE, USC Internal (2013-2014) $5,000
Development of *mPing*-based transposon tagging plasmids for tomato and wheat transformation

ASPIRE III, USC Internal (2012-2015) $100,000
The promotion of transgenic and controlled-environment greenhouse research at USC Aiken

Selected Presentations

Southern Section ASPB Meeting (2024) **Precision genome engineering with the *mPing* transposable element**, Dauphin Island, AL.

Plant Biology Department Seminar, University of Georgia (2023), **Harnessing the *mPing* transposable element for gene discovery and precision genome engineering**, Athens, GA.

Southeast IDeA Conference (2023) **Using genome resequencing to identify the causative mutation underlying a chlorotic soybean phenotype**, Columbia, SC.

Biennial Molecular & Cellular Biology of the Soybean Conference (2023), **Harnessing the *mPing* transposable element for gene discovery and precision genome engineering**, Lincoln, NE.

Plant Biology (2023), **Developing transposon-based plant gene discovery and editing tools,** Savannah, GA.

Plant & Animal Genome Conference (2023), **Developing transposon-based plant gene discovery tools**, San Diego, CA.

Plant Biology (2022), **Why are there so many MITEs in my plant's genome?** Portland, OR.

Biennial Molecular & Cellular Biology of the Soybean Conference (2022), **Developing activation tagging resources for soybean gene discovery**, Virtual.

Southern Section ASBP Meeting (2022) **Developing Strategies for Nitrogen Deficiency Rescue in Soybean**, Birmingham, AL.

Brigham Young University Microbiology and Molecular Biology Department Seminar (2022) **Molecular Tools for Plant Gene Discovery**, Provo, UT.

Plant & Animal Genome Conference (2022), **The Chromatin Microenvironment Influences Miniature Inverted Repeat Transposable Element Activity**, Virtual.

Brigham Young University Microbiology and Molecular Biology Department Seminar (2020) **Identifying the regulatory mechanisms of a miniature transposable element**, Virtual.
National Big Data Health Science Conference (2020), **Leveraging Sequencing Technologies to Identify Genomic Alterations**, Columbia, SC.

ASPB Plant Biology Meeting (2019), **Self-regulation of the *Ping* and *mPing* Transposable Elements**, San Jose, CA.

Soybean Precision Genomics and Mutant Finder Day Workshop (2019), **Soybean Gene Discovery using the Transposable Element *mPing***, Lincoln, NE.

Georgia College Department of Biological and Environmental Sciences Seminar (2019), **Revealing the Mechanisms That Regulate the *mPing* Transposable Element from Rice,** Milledgeville, GA.

Plant & Animal Genome Conference (2018), **Replicative Transposition of the Miniature Inverted Repeat Transposable Element *mPing***, San Diego, CA.

Soybean Precision Genomics and Mutant Finder Day Workshop (2016), **Plant Gene Discovery by *mPing*-based Transposon Tagging**, Columbia, MO.

University of West Georgia Department of Biology Seminar (2015) **Plant Functional Genomics by Transposon Mutagenesis**, Carrollton, GA.

Soybean Precision Genomics and Mutant Finder Day Workshop (2015), **Plant Gene Discovery by *mPing*-based Transposon Tagging**, St. Paul, MN.

Southeast Developmental Biology Meeting (2015), **Plant Functional Genomics by Transposon Mutagenesis**, Clemson, SC.

Clemson University Department of Genetics and Biochemistry Seminar (2014), **Development of a Miniature Inverted Repeat Transposable Element-based Gene Discovery Tool**, Clemson, SC.

Department of Biology and Geology Seminar (2014), **Development of a Miniature Inverted Repeat Transposable Element-based Gene Discovery Tool**, University of South Carolina Aiken, SC.

American Society of Plant Biologists Southern Section Meeting (2014), **Plant Gene Discovery by *mPing*-based Transposon Tagging**, Lexington, KY.

Plant & Animal Genome Conference (2013), ***mPing*-based Transposon Tagging: Soybean Gene Discovery**, San Diego, CA.

Biennial Molecular & Cellular Biology of the Soybean Conference (2012), ***max* Mutation: *mPing*-based gene discovery**, Des Moines, IA.

Teaching Experience

Instructor	BIOL 121 **Biological Science**	2011-Current
	BIOL 325 **Plant Physiology**	2014-Current
	BIOL 412 **Applied Biotechnology**	2019-Current
	BIOL 490 **Senior Seminar**	2013-Current
	BIOL 541 **Principles of Biochemistry I**	2012-Current
	BIOL 542 **Principles of Biochemistry II**	2013-2017
	HONS 201 **Genetically Modified Organisms**	2013
	HONS 201 **World Food Problem**	2019

Co-Instructor
Fall 2008 (UGA)
PBIO 3250L - **The Dynamic Genome** (HHMI)
Designed and supervised in class yeast genetics experiments

Guest Lecturer
Spring 2007 (UGA)
PBIO 8100 - **Advanced Plant Genetics**
Guided students into the self-incompatibility literature

Substitute Lecturer
Spring 2002 (MU)
BCH 105 - **Biotechnology in Society**
Used in class exercises to engage students

Teaching Assistant
Fall 2001 (MU)
BCH 374 - **Molecular Biology Lab**
Taught basic laboratory techniques