

Robert C. Shields, Ph.D.

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RESEARCH INTERESTS

Oral microbiology; microbial genetics; functional genomics; biofilms

EDUCATION

- 2010-2014 **Ph.D.** in Microbiology, Newcastle University, Institute for Cell and Molecular Biosciences
Advisor: Dr. Nicholas S. Jakubovics
Thesis: Extracellular DNA in Head and Neck Biofilms
- 2006-2009 **B.S.** in Marine Biology, Newcastle University, School of Natural and Environmental Sciences
Advisors: Prof. Peter J. W. Olive and Dr. Jane Delany

PROFESSIONAL EXPERIENCE

- 2021-Current Assistant Professor, Department of Biological Sciences, Arkansas State University
2017-2021 Research Assistant Professor, Department of Oral Biology, University of Florida
2014-2017 Postdoctoral Research Associate, Department of Oral Biology, University of Florida

FELLOWSHIPS, HONORS & AWARDS

- 2022 ASM-SCB Charles C. Randall Lectureship Award
2020 Colgate Award for Research Excellence
2013 Recipient (Team), BioNOW Best Biomedical Project of the Year
2012 Society for General Microbiology Research Visit Award
2011-2014 Recipient, Centre for Oral Health Research Ph.D. Fellowship

LIST OF PUBLICATIONS

[Google Scholar](#)

[As of 1/20/2023] Total citations: **689**, *h*-index: **15**, i10-index (# of publications with ≥ 10 citations): **17**
[†] indicates a student advisee

1. Rostami N, **Shields RC**, Serrage H, Lawler C, Brittan J, Yassin S, Ahmed H, Treumann A, Thompson P, Waldron K, Nobbs A, & Jakubovics N (2022) **Interspecies competition in oral biofilms mediated by *Streptococcus gordonii* extracellular deoxyribonuclease SsnA**. *NPJ Biofilms and Microbiomes*. 8(1):96 [PubMed](#)
2. [†]King S, [†]Quick A, [†]King K, Walker AR, & **Shields RC** (2022) **Activation of TnSmu1, an integrative and conjugative element, by an ImmR-like transcriptional regulator in *Streptococcus mutans***. *Microbiology*. 168(10) [PubMed](#)

3. Walker AR & **Shields RC** (2022) **Investigating CRISPR spacer targets and their impact on genomic diversification of *Streptococcus mutans***. *Frontiers in Genetics*. 13:997341 [PubMed](#)
4. Walker AR, **Shields RC** (2022) **Identification and Analysis of Essential Genes in *Streptococcus mutans* with Transposon sequencing**. *Methods in Molecular Biology; Essential Genes and Genomes* 237-258 [PubMed](#)
5. **Shields RC**, Walker AR, Maricic N, Chakraborty B, Underhill SAM, Burne RA (2020) **Repurposing the *Streptococcus mutans* CRISPR-Cas9 system to understand essential gene function**. *PLoS Pathogens*. 16(3):e1008344. [PubMed](#)
6. **Shields RC**, Kim JN, Ahn SJ, Burne RA (2020) **Peptides encoded in the *Streptococcus mutans* rcrRPQ operon are essential for thermotolerance**. *Microbiology*. 166(3):306-317. [PubMed](#)
7. Underhill SAM, **Shields RC**, Burne RA, & Hagen SJ (2019) **Carbohydrate and PepO control bimodality in competence development by *Streptococcus mutans***. *Molecular Microbiology*. 112(5):1388-1402. [PubMed](#)
8. **Shields RC**, Kaspar JR, Underhill SAM, Lee K, & Burne RA (2019) **Fluorescence tools adapted for monitoring the behaviors of *Streptococcus* species**. *Applied and Environmental Microbiology*. 85(15):e00620-19. [PubMed](#)
9. **Shields RC** & Jensen PA (2019) **The bare necessities: uncovering essential and condition-critical genes with transposon sequencing**. *Molecular Oral Microbiology*. 34(2): 39-50. [PubMed](#)
10. Underhill SAM, **Shields RC**, Kaspar JR, Haider M, Burne RA, & Hagen SJ (2018) **Intracellular signaling by the comRS system in *Streptococcus mutans* genetic competence**. *mSphere*. 3(5):e00444-18. [PubMed](#)
11. Kaspar JR, **Shields RC**, & Burne RA (2018) **Competence inhibition by the XrpA peptide encoded within the comX gene of *Streptococcus mutans***. *Molecular Microbiology*. 109(3):345-364. [PubMed](#)
 - Received a recommendation by Faculty of 1000
12. **Shields RC**, Zeng L, Culp DJ, & Burne RA (2018) **Genomewide identification of essential genes and fitness determinants of *Streptococcus mutans* UA159**. *mSphere*. 3(1):e00031-18. [PubMed](#)
13. **Shields RC**, O'Brien G, Maricic N, [†]Kesterson AE, [†]Grace M, Hagen SJ, & Burne RA (2018) **Genome-wide screens reveal new gene products that influence genetic competence in *Streptococcus mutans***. *Journal of Bacteriology*. 200(2):e00508-17. [PubMed](#)
 - Selected to be a Spotlight Article by a JB Editor
14. Kaspar JR, Underhill SAM, **Shields RC**, Reyes A, Rosenzweig S, Hagen SJ, & Burne RA (2017) **Intercellular communication via the comX-inducing peptide (XIP) of *Streptococcus mutans***. *Journal of Bacteriology*. 199(21):e00404-17. [PubMed](#)
 - Selected to be a Spotlight Article by a JB Editor
 - Work featured on cover: *J. Bacteriol.* 2017, Volume 199, Issue 24.

15. Geraldeli S, Soares EF, Alvarez AJ, Tanaz F, **Shields RC**, Sinhoreti, MAC, & Nascimento, MM (2017) **A new arginine-based dental adhesive system: formulation, mechanical and anti-caries properties.** *Journal of Dentistry.* 63:72-80. [PubMed](#)
16. Rostami N, **Shields RC**, Yassin SA, Hawkins AR, Bowen L, Luo TL, Rickard AH, Holliday R, Preshaw PM, Jakubovics, NS (2017) **A critical role for extracellular DNA in dental plaque formation.** *Journal of Dental Research.* 96(2):208-216. [PubMed](#)
17. **Shields RC**, & Burne RA (2016) **Growth of *Streptococcus mutans* in biofilms alters peptide signalling at the sub-population level.** *Frontiers in Microbiology.* 7:1075. [PubMed](#)
18. Son M, **Shields RC**, Ahn SJ, Burne RA, & Hagen SJ (2015) **Bidirectional signalling in the competence regulatory pathway of *Streptococcus mutans*.** *FEMS Microbiology Letters.* 362(19). [PubMed](#)
19. **Shields RC**, & Burne RA (2015) **Conserved and divergent functions of RcrRPQ in *Streptococcus gordonii* and *Streptococcus mutans*.** *FEMS Microbiology Letters.* 362(16). [PubMed](#)
20. Ramakrishnan, Y, **Shields, RC**, Elbadawey, MR, & Wilson, JR (2015) **Biofilms in chronic rhinosinusitis: what is new and where next?** *The Journal of Laryngology and Otology.* 129(8):744-751. [PubMed](#)
21. Jakubovics NS, **Shields RC**, Rajarajan N, & Burgess JG (2013) **Life after death: the critical role of extracellular DNA in microbial biofilms.** *Letters in Applied Microbiology.* 57(6):467-475. [PubMed](#)
22. **Shields RC**, Mokhtar N, Ford M, Hall MJ, Burgess JG, ElBadawey MR, & Jakubovics NS (2013) **Efficacy of a marine bacterial nuclease against biofilm forming microorganisms isolated from chronic rhinosinusitis.** *PLOS ONE.* 8(2):e55339. [PubMed](#)
23. Shakir A, Elbadawey MR, **Shields RC**, Jakubovics NS, & Burgess JG (2012) **Removal of biofilms from tracheoesophageal speech valves using a novel marine microbial deoxyribonuclease.** *Otolaryngology and Head and Neck Surgery.* 147(3):509-514. [PubMed](#)

In submission:

Shields RC, [†]Chan V, Kaspar JR, Walker AR, Velsko IM, Richards VP, & Burne RA. MreCD of *Streptococcus mutans* determine cell shape, biofilm architecture and interspecies competition. *Journal of Bacteriology*

GRANT SUPPORT

Active Grants

2023-2025	PI (50%) Functional Characterization of Gram-positive Hypothetical Genes Arkansas INBRE, Research Development Grant Total Direct Costs: \$225,000
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- 2022-2023 Co-PI
Acquisition of a nanoindenter for materials science and biomaterials research
National Science Federation, MRI
Total Direct Costs: \$586,231
- 2021-2023 PI (25%)
Exploring Integrative Conjugative Elements in the Biology and Ecology of
Streptococcus mutans
National Institute of Dental and Craniofacial Research, 7R03DE029882-02
Total Direct Costs: \$200,000
- 2021-2024 Co-I (5%)
Assessing the impact of Agr quorum sensing on *Staphylococcus aureus*
physiology in the space flight environment
National Aeronautics and Space Administration
Total Direct Costs: \$749,576

Pending Grants

- 2022-2024 Co-I (5%)
Defining the mechanistic link between bacterial NO synthase and aminoglycoside
tolerance
National Institute of Allergy and Infectious Diseases
- 2022-2024 PI (25%)
Engineering essential gene targeting therapeutics against *Streptococcus mutans*
National Institute of Dental and Craniofacial Research
Review: 40 (Impact Score)

Completed Grants

- 2018-2021 Co-I (5%)
Probing the effect of stimulated microgravity on the pathogenic potential of
cariogenic *Streptococcus mutans*
National Aeronautics and Space Administration
Total Direct Costs: \$300,000
- 2020-2021 PI (10%)
Development of new anti-caries therapeutics using a CRISPR interference
platform
Colgate Palmolive, Colgate Award for Research Excellence
Total Direct Costs: \$30,000

TEACHING EXPERIENCE

Department of Biological Sciences, Arkansas State University, AR

2021-Current: Course director and instructor of senior-level Microbiology course (BIO4104) – designed and taught 23 lectures, developed a course-based undergraduate research experience (CURE) which participates in the TinyEarth curriculum (<https://tinyearth.wisc.edu/>) to facilitate student sourcing of soil antibiotics.

MENTORING/ADVISING

Arkansas State University

Name	Position	Period
Shawn King	Undergraduate	2021-2021
Bryant Reed	Undergraduate	2021-2022
Kalee King	Undergraduate	2021-2021
Parker Meeks	Undergraduate	2021-2022
Jakson St.Pierre	Undergraduate	2021-2022
Allison Quick	Undergraduate	2022-2022
Makenzie Rone	Undergraduate	2022-2022
Courtney Dover	Undergraduate	2022-Current
Seth Woods	Undergraduate	2022-Current
Erin Pruitt	Undergraduate	2022-Current
Beatrice Rono	PhD Candidate	2022-Current

University of Florida

Name	Position	Period
Megan Grace	Undergraduate	2015-2016
Justin Norell	Research Technician	2016
Greg O'Brien	PhD Candidate	2016-2018
Alexandria Kesterson	PhD Candidate	2016
Natalie Maricic	Postdoctoral Fellow	2016-2020
Sabarathnam Balu	Postdoctoral Fellow	2017-2021
Victor Chan	Summer Dental Research Student	2017
Antony Sperduto	Undergraduate	2018-2020
Alejandro Walker	Postdoctoral Fellow	2018-2021
Luis Fernando	Undergraduate	2019-2020

SERVICE AND COMMITTEES

ARKANSAS STATE UNIVERSITY**Honors Senior Thesis Committees**

2021-present Thesis Committee Member (NYIT@ASState) – Beau Belcher (Troy Camarata's group)

2022-present Thesis Committee Member – Hannah Seats (Maureen Dolan's group)

Ph.D. Dissertation Committees

2022-present Thesis Committee Member – Natalie Haydt (Lorin Neuman-Lee's group)

Departmental Committees

Safety Committee (2021-Current)

Other Service Commitments

Pre-Dental Student Association Advisor

Professional Development Activities

Nov. 10, 2021: BioDiversity Committee – Safe Zone Training

UNIVERSITY OF FLORIDA

Ph.D. Dissertation Committees

2019-2021 Thesis Committee Member (IFAS) – Ke Aira Davis (Kelly Rice's group)

SERVICE AND COMMITTEES – EXTERNAL

Grant Review Panels

NIAID, Drug Discovery and Mechanisms of Antimicrobial Resistance (March 2022; Early Career Reviewer Program)

Editorial Board

MicrobiologyOpen-Associate Editor (2021-2023)

Journal of Oral Microbiology-Editorial Board Member (2022-Current)

Oral Diseases-Reviewing Editor (2017-Current)

Ad hoc journal reviewer (57 reviews in total; [Publons Record](#)):

Access Microbiology, Archives of Oral Biology, Biofouling, Environmental International, Frontiers in Genetics, Genomics, Journal of Dental Research, Journal of Oral Microbiology, Journal of Visualized Experiments, Microbiology, Molecular Biology Reports, Molecular Oral Microbiology, Molecular Microbiology, Nature Communications, Oral Diseases, PeerJ, PLoS ONE, PLoS Pathogens, Scientific Reports, Science Signaling

REGIONAL, NATIONAL AND INTERNATIONAL PRESENTATIONS

2023

2023, March Invited speaker; American Association for Dental, Oral, and Craniofacial Research Annual Meeting

2022

2022, Oct Invited speaker; ASM-SCB Annual Meeting

2022, May Invited speaker; Colgate Clinical Research Innovation Day

2022, March Invited speaker; Arkansas Bioinformatics Consortium

2021

2021, Feb Invited speaker; at Arkansas State University.

2020

2020, Aug Systematic investigation of essential genes in *Streptococcus mutans* via repurposing of the endogenous CRISPR-Cas9 system. GMS6193 Oral Biology Research Conference; University of Florida, USA.

2020, June Invited speaker; at University of Nebraska.

2019

2019, July **Shields RC**, Walker AR, & Burne RA. Systematic investigation by CRISPRi of essential genes in *Streptococcus mutans* via repurposing of the endogenous CRISPR-Cas9 system. 20th International Conference on Bacilli and Gram-Positive Bacteria; Washington DC, USA.

2019, June Maricic N, **Shields RC**, & Burne RA. Loss of DivIB uncouples peptide signalling pathways in *Streptococcus mutans*. ASM Microbe 2019; San Francisco, USA.

2018

- 2018, Oct Kaspar JR, Lee K, **Shields RC**, & Burne RA. Development of tools for the analysis of dual-species biofilms between health- and disease-associated Streptococci of the oral microbiome. 8th ASM Conference on Biofilms; Washington DC, USA.
- 2018, June Rostami N, **Shields RC**, Lawler C, Nobbs A, & Jakubovics NS. Impact of deoxyribonucleases on the structure of oral biofilms. IADR; London, UK.
- 2018, March Chan V, **Shields RC**, & Burne RA. Investigating the role of MreCD in cell elongation and stress survival in *Streptococcus mutans*. AADR; Fort Lauderdale, USA.
- 2018, Jan The bare necessities – general and environment-specific essential genes of *Streptococcus mutans*. GMS6193 Oral Biology Research Conference; University of Florida, USA.
- 2017**
- 2017, Nov Divide and conquer: investigating cell division in *Streptococcus mutans*. Oral Biology Retreat; University of Florida, USA.
- 2017, Oct Kaspar JR, **Shields RC**, & Burne RA. Inhibition of genetic competence in *Streptococcus mutans* by the novel regulator XrpA. ASM Conference on Cell-Cell Communication in Bacteria; Athens, USA.
- 2017, June Maricic N, **Shields, RC**, & Burne, RA. Genome-wide screens identify novel regulators that integrate stress tolerance and genetic competence in *Streptococcus mutans*. ASM General Meeting; New Orleans, USA.
- 2017, March **Shields, RC**, Kesterson, AE, Grace, M, & Burne, RA. Novel genes required for genetic competence in *Streptococcus mutans* revealed by transposon mutagenesis. IADR/AADR/CADR General Session and Exhibition; San Francisco, USA.
- 2017, Jan Gone Fishin': Techniques for Discovering New Biology in *Streptococcus mutans*. GMS6193 Oral Biology Research Conference; University of Florida, USA.
- 2016**
- 2016, Aug **Shields, RC**, Kim, JN, Ahn, S-J, & Burne, RA. The essential role of the gene products and peptide effectors of the *rcrRPQ* operon in tolerance of cell envelope stress. ASM Conference on Streptococcal Genetics; Washington DC, USA.
- 2016, Aug **Shields, RC**, & Burne, RA. Growth of *Streptococcus mutans* biofilms alters peptide signalling at the sub-population level. ASM Conference on Streptococcal Genetics; Washington DC, USA.
- 2016, Aug Kaspar, JR, **Shields, RC**, Ahn, S-J, Burne, RA. Insights into the functions and regulation of the *comX* regulatory peptide, XrpA, of *Streptococcus mutans*. ASM Conference on Streptococcal Genetics; Washington DC, USA.
- 2016, March Growth of *Streptococcus mutans* in biofilms alters peptide signaling at the sub-population level. Spring Synergy; University of Florida, USA.
- 2015**
- 2015, Oct Contrasting temporal and sub-population responses of *S. mutans* biofilms to a peptide signal. GMS6193 Oral Biology Research Conference; University of Florida, USA.
- 2015, May **Shields, RC**, & Burne, RA. RcrR influences stress tolerance but not genetic competence in *Streptococcus gordonii*. ASM General Meeting; New Orleans, USA.
- 2015, March RcrR influences stress tolerance but not genetic competence in *Streptococcus gordonii*. Spring Synergy; University of Florida, USA.
- 2014**
- 2014, Aug Extracellular DNA in biofilm matrices. GMS6193 Oral Biology Research Conference; University of Florida, USA.

2013

- 2013, Nov **Shields, RC**, Hall, MJ, Burgess, JG, & Jakubovics, NS. An acid-sensitive deoxyribonuclease from the oral commensal *Streptococcus gordonii*. Society for Applied Microbiology Postgraduate and Early Career Scientists Research Conference; London, UK.
- 2013, Oct Oral biofilms contain extracellular DNA and are dispersed by DNaseI. Centre for Oral Health Research Afternoon. **Best oral presentation award*
- 2013, Sep **Shields, RC**, Hall, MJ, El-Badawey, MR, Burgess, JG, & Jakubovics, NS. Removal of oral biofilms by a marine microbial deoxyribonuclease. Eurobiofilms; Ghent, Belgium.
- 2013, March From seaweed to sinuses – extracellular DNA in biofilms. Institute of Cell and Molecular Biosciences Postgraduate Symposium; Newcastle University, UK.

2012

- 2012, Aug **Shields, RC**, Hall, MJ, Burgess, JG, & Jakubovics NS. Extracellular nuclease of *Streptococcus gordonii* disperses *Streptococcus mutans*. Society for General Microbiology Autumn Conference; Warwick, UK.
- 2012, Feb **Shields, RC**, Hall, MJ, Burgess, JG, & Jakubovics, NS. Extracellular DNA in biofilms associated with chronic rhinosinusitis. Oral Microbiology and Immunology Group Postgraduate Symposium; Newcastle, UK.

2011

- 2011, Nov Shakir, A, **Shields, RC**, Jakubovics, NS, Burgess, JG, & El-Badawey, MR. Chronic rhinosinusitis: microbial aetiology and treatment with a novel bacterial nuclease. British Rhinological Society Annual Society Meeting; Edinburgh, UK.
- 2011, Sep **Shields, RC**, Jakubovics, NS, & Burgess, JG. Reducing dental plaque formation with a novel bacterial nuclease. British Society of Oral and Dental Research; Sheffield, UK.
- 2011, Sep Shakir, A, Burgess, JG, Jakubovics, NS, **Shields, RC**, & El-Badawey, MR. Toward the treatment of paranasal sinus biofilms using a novel nuclease. American Academy of Otolaryngology – Head and Neck Surgery Annual Meeting; San Francisco, USA.
- 2011, Sep Shakir, A, Burgess, JG, Jakubovics, NS, **Shields, RC**, & El-Badawey, MR. AntiBiofilm molecules on trachea-esophageal speaking valves. American Academy of Otolaryngology – Head and Neck Surgery Annual Meeting; San Francisco, USA.
- 2011, Sep The importance of extracellular DNA to biofilms. Institute of Cell and Molecular Biosciences Postgraduate Symposium; Newcastle University, UK.
- 2011, Feb Novel bacterial nucleases – assessing their therapeutic use in chronic rhinosinusitis, larynx valve prosthesis biofouling, and dental plaque removal. School of Marine Science and Technology Postgraduate Symposium; Newcastle University, UK. **Best oral presentation award*

PROFESSIONAL SOCIETY MEMBERSHIPS

2012-2014	Society for Applied Microbiology
2012-2014	Society for General Microbiology
2013-present	Oral Microbiology and Immunology Group UK
2014-present	American Society of Microbiology
2017-present	International Association of Dental Research