

**NC STATE**  
UNIVERSITY

Genetics and  
Genomics Academy

SECOND ANNUAL RETREAT

GENETICS &  
GENOMICS  
ACADEMY

# 2023 ANNUAL RETREAT EVENT SCHEDULE

## Morning: In-person and Online

### Welcome & Updates - Duke Energy Hall

- 08:30 am Coffee and light breakfast. Poster and vendor set up.
- 09:00 am Opening remarks by Dr. Fred Gould, GGA Director
- Updates from the GGA Executive Committee to include...
- Annual Report for the GGA
  - Interface with the PDU
  - GG Scholars Program—overview and new student introductions
  - New faculty and new graduate student introductions
  - Seminar series
  - Discussion of the day's events

### Science Talks: Session 1

- 09:30 am Christa Baker, Department of Biological Sciences
- 09:40 am Kerim Eroglu, Molecular and Structural Biochemistry
- 09:50 am Ryan Sartor, Department of Biochemistry and Bio & Ag Engineering
- 10:00 am Sharonda LeBlanc, Department of Physics
- 10:10 am GGA Paper of the Year Winner (1 of 2): Echo Pan, Functional Genomics PhD Candidate in Dr. Rodolphe Barrangou's Lab, Department of Food Bioprocessing and Nutrition Sciences. *Paper Title: Genomic epigenetic landscapes drive CRISPR-based genome editing in Bifidobacterium*

### Coffee Break, Posters & Vendors

Please take a coffee break and visit the posters and vendors around the room. Retreat will reconvene at 11:00 am.

### Science Talks: Session 2

- 11:00 am Carter Clinton, Department of Biological Sciences
- 11:10 am Santosh Mishra, Department of Molecular Biomedical Sciences
- 11:20 am Terri Long, Department of Plant & Microbial Biology
- 11:30 am Qingshan Wei, Department of Chemical & Biomolecular Engineering
- 11:40 am GGA Paper of the Year Winner (2 of 2): Amarish K. Yadav, Postdoctoral Research Scholar in Dr. Max Scott's Lab, Department of Entomology and Plant Pathology. *Paper Title: CRISPR/Cas9-based split homing gene drive targeting doublesex for population suppression of the global fruit pest Drosophila*

# 2023 ANNUAL RETREAT EVENT SCHEDULE

## Afternoon: In-Person Only

### Lunch Break, Posters & Vendors, GGA Contests

12:00 pm Please break for provided lunch and visit posters as well as the vendor tables. There will be extra time following the lunch hour, from 1:00 to 1:45, to continue to visit and vote on your top 3 posters, awards to follow.

01:45 pm GGA Contest Winners Announced

### Afternoon Retreat Events

**GGA Brainstorming Session:** *Moderated by Leigh Shamblin, Director of Leadership and Professor of Practice, Department of Management, Innovation & Entrepreneurship*

02:00 pm Introduction to the brainstorming session and the GGA goals, needs, and session layout

Breakout sessions formed around the following topics...

- *Undergraduate G&G education for all*
- *Outreach and engagement*
- *Enhancing GGS and other graduate education opportunities*
- *Genetics and genomics interdisciplinary research opportunities/collaborations*

Goals: Identifying strategic and operational activities for the coming year, and identifying people and resources needed to support identified activities

In the remaining time, there will be a discussion on community building

### Closing remarks and Happy Hour - Duke Energy Hall ABCD

05:00 pm Closing remarks by Dr. Fred Gould followed by a Happy Hour, with light fare and beverages.

**Thank you for joining us, we look forward to seeing you next year!**



# GENETICS & GENOMICS ACADEMY

*"THERE'S ALWAYS A PLACE AT THE EDGE OF  
OUR KNOWLEDGE, WHERE WHAT'S BEYOND  
IS UNIMAGINABLE, AND THAT EDGE, OF  
COURSE, MOVES."*

*- DR. L.M. LEDERMAN 1998*

Welcome to the Genetics and Genomics Academy (GGA)! Today, concepts and technologies in genetics and genomics are evolving rapidly, continually transforming our understanding of biology. This brings great scientific opportunities and great social responsibility. The GGA embraces both.

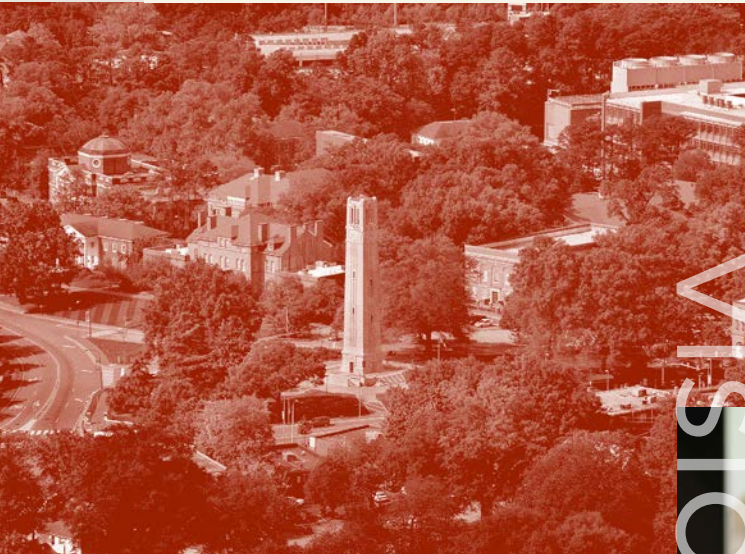
- THE GGA EXECUTIVE COMMITTEE

## VISION

The Genetics and Genomics Academy promotes and supports collaborations across all research, training, and outreach activities at NC State University to forge a more interdisciplinary understanding of the genetic and genomic underpinnings of life on earth to sustain biodiversity and improve societal equity and wellbeing.

## MISSION

To develop and use genetics and genomics knowledge to enhance the wellbeing of societies and ecosystems



VISION

# BUILDING ON A GREAT LEGACY

Genetics has been at the core of NC State's basic and applied biological research since the 1940s. Pioneering luminaries in the field such as Barbara McClintock and Richard Lewontin have passed through our doors. Eleven NC State faculty members working in genetics have been elected to the National Academy of Sciences. This did not happen by chance. A series of university administrators have seen progress in basic and applied genetics as essential to our mission as a land grant university.

## Comstock & Robinson

Estimation of Dominance Variance



## Gertrude Cox

Textbook: Experimental Designs

## Barbara McClintock

Visiting Professor

## Stanley Stephens

Polyploid Evolution



## Major Goodman

Maize Genetic Diversity

## Charles "Sam" Levings

Cytoplasmic Sterility



Genetics PhD  
Program Authorized

Richard Lewontin  
1954-58

1950

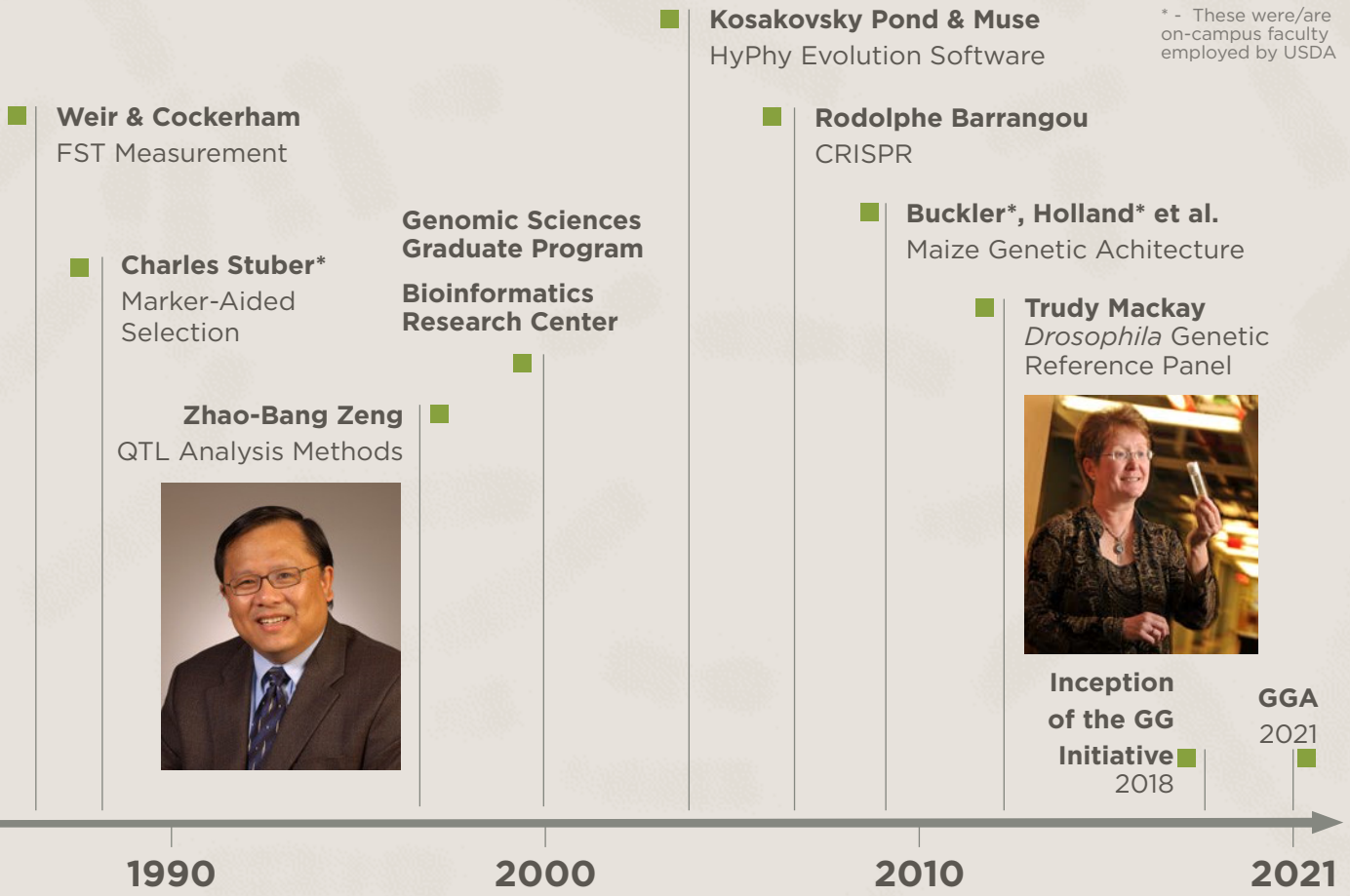
1960

1970

1980

Historic collaborations between our statisticians and plant breeders produced methods for enhancing crop yields that were adopted globally. Our theoreticians partnered with taxonomists and molecular biologists to understand the evolution of biodiversity. We blended the fields of biochemistry and classical genetics as part of the revolution culminating in the human genome project. Our faculty discovered interactions between the environment and our epigenomes that impact health. NC State continues to move genetics out of the laboratory and into the field to improve sustainability of agriculture, human health, and global biodiversity.

WE ARE POISED TO BUILD ON THIS GREAT LEGACY OF COLLABORATION AND INNOVATION AS WE PUSH THE FRONTIERS OF GENETICS AND GENOMICS FORWARD.



\* - These were/are on-campus faculty employed by USDA

## GENETICS & GENOMICS ACADEMY

Genetics and genomics are central to all life sciences and can no longer be seen as isolated specialties or programs. The GGA recognizes this, and its goal is to leverage NC State's rich legacy in genetics to connect and invigorate our other unique strengths in the life sciences, and ultimately drive excellence in transdisciplinary research and training. The reach of the GGA is from the basic to the applied, from molecules to ecosystems, from the traditional to the cutting-edge, integrating all of these areas to maximize impact on fundamental knowledge and positive societal outcomes.

*"OUR STRENGTH IS IN OUR MEMBERSHIP. DEDICATION, COLLABORATION AND ENGAGEMENT OF OUR FACULTY, STAFF AND TRAINEES, REPRESENTING NUMEROUS DEPARTMENTS ACROSS CAMPUS, DRIVES THE SUCCESS OF THE GGA."*

*- JEFF YODER,  
PROFESSOR OF INNATE  
IMMUNOLOGY*







COMMUNITY



## GGA COMMUNITY

### A DIVERSE, ENGAGED COMMUNITY

The GGA brings together faculty and trainees from across the university engaged in outstanding research and teaching, and provides a strong platform and novel connections for interdisciplinary interactions. The GGA is home to the Genetics and Genomics Scholars (GG Scholars) program, one of NC State's first umbrella PhD training programs. The GGA hosts Research Interest Groups (RIGs), GGA-member-driven communities centered on fundamental and emerging research areas. The GGA serves as a hub for the sharing of scientific discovery through an annual retreat, a world-class seminar series, and extensive public education and outreach efforts. Together, GGA activities allow NC State to produce excellence in transdisciplinary research, recruit the best young scientists, and enhance our reputation as a leading research university.

# GENETICS & GENOMICS SCHOLARS PROGRAM

THE GENETICS AND GENOMICS SCHOLARS PROGRAM PREPARES FUTURE SCIENTISTS FOR INTERDISCIPLINARY RESEARCH ACROSS THE LIFE SCIENCES.

The GG Scholars umbrella program trains students in 16 life sciences graduate programs across the university. Building on the philosophy that the exploration of genes and genomes informs all fields of biology, GG Scholars explore a variety of graduate programs at NC State University during their first year while expanding their training and research capabilities. GG Scholars engage in a one-year project-based curriculum that integrates foundational conceptual training in genetics and genome-scale techniques with big data analysis and professional development. For more details, please visit our website.

## Leadership

**Martha Burford Reiskind,**  
*Director of the GG Scholars program*  
Department of Biological Sciences,  
College of Sciences

**Rebecca Stojancic**  
*University Program Specialist*  
GGA and GG Scholars

**Webpage GGS:** [ggscholars.org](http://ggscholars.org)  
**Email GGS:** [gg\\_scholars@ncsu.edu](mailto:gg_scholars@ncsu.edu)



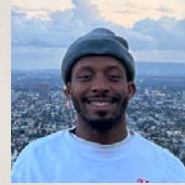
# GG SCHOLARS 2023 - 2024 FELLOWSHIP AWARDEES



**Erica Jones**  
*Crop Science*



**Ian Birchler de Allende**  
*Genetics*



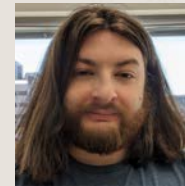
**Niaz Goodbee**  
*GG Scholar - First Year*



**Jordan Cummings**  
*Crop Science*



**Lucas Bauer**  
*Genetics*



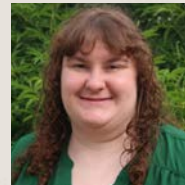
**Adam Breister**  
*Microbiology*



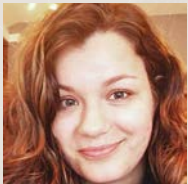
**Laide Rasaki**  
*Crop Science*



**Bobbie Walsmith**  
*Genetics*



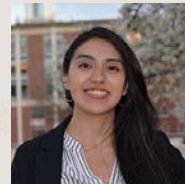
**Amanda Taylor**  
*Microbiology*



**Morgan Olmstead**  
*Entomology*



**Qiaochu Li**  
*Genetics*



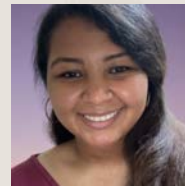
**Jennifer Tapia**  
*Plant Biology*



**Hannah Pil**  
*Genetics*



**Megan Welch**  
*GG Scholar - First Year*



**Kimberly Montalban**  
*Plant Pathology*

## 2023 PAPER OF THE YEAR WINNERS

### ECHO PAN (RODOLPHE BARRANOU'S LAB)

#### Paper Title: Genomic and epigenetic landscapes drive CRISPR-based genome editing in *Bifidobacterium*

**ABSTRACT:** *Bifidobacterium* is a commensal bacterial genus ubiquitous in the human gastrointestinal tract, which is associated with a range of health benefits. The advent of CRISPR-based genome editing technologies provides opportunities to investigate the genetics of important bacteria and transcend the lack of genetic tools in *bifidobacteria* to study the basis for their health-promoting attributes. Here, we repurpose the endogenous type I-G CRISPR-Cas system and adopt an exogenous CRISPR base editor for genome engineering in *B. animalis* subsp. *lactis*, demonstrating that both genomic and epigenetic contexts drive editing outcomes across strains. We reprogrammed the endogenous type I-G system to screen for naturally occurring large deletions up to 27 kb and to generate a 500-bp deletion in *tetW* to abolish tetracycline resistance. A CRISPR-cytosine base editor was optimized to install C•G-to-T•A amber mutations to resensitize multiple *B. lactis* strains to tetracycline. Remarkably, we uncovered epigenetic patterns that are distributed unevenly among *B. lactis* strains, despite their genomic homogeneity, that may contribute to editing efficiency variability. Insights were also expanded to *Bifidobacterium longum* subsp. *infantis* to emphasize the broad relevance of these findings. This study highlights the need to develop individualized CRISPR-based genome engineering approaches for distinct bacterial strains and opens avenues for engineering of next generation probiotics.

### AMARISH K. YADAV (MAX SCOTT'S LAB)

#### Paper Title: CRISPR/Cas9-based split homing gene drive targeting doublesex for population suppression of the global fruit pest *Drosophila suzukii*

**ABSTRACT:** Genetic-based methods offer environmentally friendly species-specific approaches for control of insect pests. One method, CRISPR homing gene drive that target genes essential for development, could provide very efficient and cost-effective control. While significant progress has been made in developing homing gene drives for mosquito disease vectors, little progress has been made with agricultural insect pests. Here, we report the development and evaluation of split homing drives that target the *doublesex* (*dsx*) gene in *Drosophila suzukii*, an invasive pest of soft-skinned fruits. The drive component, consisting of *dsx* single guide RNA and DsRed genes, was introduced into the female-specific exon of *dsx*, which is essential for function in females but not males. However, in most strains, hemizygous females were sterile and produced the male *dsx* transcript. With a modified homing drive that included an optimal splice acceptor site, hemizygous females from each of the four independent lines were fertile. High transmission rates of the DsRed gene (94 to 99%) were observed with a line that expressed Cas9 with two nuclear localization sequences from the *D. suzukii nanos* promoter. Mutant alleles of *dsx* with small in-frame deletions near the Cas9 cut site were not functional and thus would not provide resistance to drive. Finally, mathematical modeling showed that the strains could be used for suppression of lab cage populations of *D. suzukii* with repeated releases at relatively low release ratios (1:4). Our results indicate that the split CRISPR homing gene drive strains could potentially provide an effective means for control of *D. suzukii* populations.



## OUTREACH

### INSPIRING THE NEXT GENERATION OF SCIENTISTS

The broad GGA community of faculty, staff, postdoctoral researchers, and students strives to make their science accessible to the general public. We engage the community in varied and meaningful ways, including writing popular science books, developing online resources, training extension specialists, making K-12 classroom visits, running enriching afterschool programs, carrying out hands-on museum demos, giving illuminating science cafe talks, organizing citizen-science projects, offering teacher training workshops, leading summer science camps and providing diverse internships opportunities to students and teachers. Our goals are to make genetic and genomic sciences, from botany to biomedicine to evolution, accessible and exciting, involve the public in impactful research projects, and inspire the next generation of geneticists.

# 2023 ANNUAL REPORT

THE GENETICS AND GENOMICS ANNUAL REPORT PROVIDES INSIGHT INTO THE ACADEMY'S PROGRESS AND DELIVERY ON MEETING OUR FOUR COMMITMENTS AND FUTURE GOALS.

## BY THE NUMBERS

**450+** | Members    **28** | Departments    **200+** | Faculty

## WHAT IS NEXT FOR THE GGA?

This has been a year of growth for the Genetics and Genomics Academy. During the 2022-2023 year, we hosted our First Annual Retreat, hired two new staff members, hired a full-time undergraduate teaching faculty member, and hosted 24 faculty members as part of our Seminar Series, including a featured event with Sean B. Carroll with ~200 attendees and Krystal Tsosie and Latifa Jackson as part of the *Genes & Society: Decolonizing Human Genetic Research Workshop Series*. With your help, we would love to keep this momentum going! We've identified the following goals for the 2023-2024 year.

- Hire an excellent new executive director.
- Instantiate a GGS graduate minor.
- Develop and teach a set of 1-credit undergraduate courses.
- Work with the PDU to assist faculty in submitting at least 2 multi-investigator research proposals, 1 additional graduate training grant proposal, 1 proposal that would bring teachers from URM high schools to NC State for training, and 1 proposal to enable postbaccalaureate training of URM students at NC State.
- Move forward with goal of outreach to high school teachers.
- Develop new, active, research interest groups.
- Redesign GGA webpage that will include short videos that highlight faculty and student accomplishments and personal stories.
- Continue to find ways to integrate Research, Teaching and Engagement
- Maintain our commitment to DEI



SCAN FOR FULL REPORT

# 2023 T32 GRANT

## PROJECT NARRATIVE

To ensure that the recent increases in the power and sophistication of genetics and genomics research result in broad benefits to public health, researchers in genetics and genomics must be informed about the complex history of Genetics and actively engage with researchers in other disciplines as well as the public and policy makers. The Genetics, Genomics, and Societal Context T32 Training Program will provide PhD students with fundamental knowledge and research tools of genetics and genomics. The Program will integrate this technical training with courses and activities led by social scientists to prepare our T32 trainees to design their research and disseminate their knowledge effectively and appropriately for the benefit of society.



# GENETICS & GENOMICS SEMINAR SERIES

Fall 2023 | Mondays @ 1:30pm | Stephens Room (3503 Thomas Hall) and ZOOM



AUG 21

## GGA Student Flash Talks

NC State University

Graduate students & Postdocs will give 3-minute talks as part of the GGA Summer Contests



AUG 28

## Gavin Conant, Ph.D.

NC State University

Associate Professor of Biological Sciences



SEP 4

## Labor Day

No seminar

Join us next week!



SEP 11

## Susan Lott, Ph.D.

University of California - Davis (ZOOM only)

Associate Professor, Dept. of Evolution and Ecology



SEP 18

## John Hogenesch, Ph.D.

Cincinnati Children's Hospital Medical Center

Professor of Pediatrics



SEP 25

## Brian M. Donovan, Ph.D.

BSCS Science Learning

Senior Research Scientist at BSCS Science Learning



OCT 2

## Eric Brooks, Ph.D.

NC State University

Assistant Professor of Quantitative Developmental Biology



OCT 9

## Fall Break

No seminar

Join us after break!



OCT 16

## Audrey Gasch, Ph.D.

University of Wisconsin - Madison

Professor of Genetics, Director of the UW-Madison Center for Genomic Science Innovation



OCT 23

## Patricia Wittkopp, Ph.D.

University of Michigan

Sally L. Allen Professor, Dept. of Food, Evolutionary Biology and Molecular, Cellular, and Developmental Biology



OCT 30

## Kate Buckley, Ph.D.

Auburn University

Assistant Professor



NOV 6

## Allissa Armstrong, Ph.D.

University of South Carolina

Assistant Professor of Biological Sciences



NOV 13

## Pavitra Muralidhar, Ph.D.

University of Chicago

Assistant Professor in Ecology & Evolution



NOV 20

## Carlos Giovanni Silva, Ph.D.

Brown University

Assistant Professor of Molecular Biology, Cell Biology & Biochemistry



NOV 27

## Len van Zyl, Ph.D.

ArrayXpress, RTP

CEO of ArrayXpress



DEC 4

## Jason Williams, Ph.D.

Cold Spring Harbor Laboratory, DNA Learning Center

Assistant Director, Diversity and Research Readiness, DNALC



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## ON-CAMPUS SUPPORTERS



### **Andy Baltzegar**

*Director, Genomic Sciences Lab*  
919.513.0738  
dabaltze@ncsu.edu

### **Kelly Sides**

*Asst Director, Plant Genotyping Facility*  
919.513.2012  
kafridey@ncsu.edu

**NC STATE**  
UNIVERSITY

**MicroFACS Facility**

**Ryan Paerl**  
rpaerl@ncsu.edu

**NC STATE**  
UNIVERSITY

**Cellular and Molecular  
Imaging Facility**

**Mariusz Zareba**  
mpzareba@ncsu.edu

**NC STATE**  
UNIVERSITY

**Proposal  
Development Unit**



### **Amanda Krentzel**

*Proposal Developer*  
aakrentz@ncsu.edu

“I work with GGA members on finding, developing, and improving their competitive research/education/outreach proposals. Please contact me to schedule a consultation or request services for proposal development support.”

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**PacBio - Niki Newell**

*Territory Account Manager*  
650.353.8827  
nnewell.pacb.com

**Illumina - Matt Sergent**

*Senior Territory Account Manager*  
619.672.5325  
msergent@illumina.com

**Mirxes - Jason Howard**

*Field Application Scientist*  
919.599.8616  
jasonhoward@mirxes.com

**Qiagen - Jeremy Vann Sanders**

*Senior Customer Solutions Manger - North Carolina*  
919.412.6833  
jeremy.sanders@qiagen.com

