



What's new from our RNA community

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Note From the Editor

by: Danielle Bilodeau, PhD candidate at CU Anschutz

As we approach the end of a tumultuous year, we are all encouraged to reflect on the challenges faced and overcome. For many of us this holiday season will be quite different to what we're used to. Events that used to involve being reunited with friends and family for celebrations and rituals will in many cases be held virtually; without the usual fanfare but with no less passion. The RNA Club wishes each of you a season that is above all physically, mentally and spiritually healthy, but also full of joy and hope for the new year.



We also want to take this time to wholeheartedly thank all of the volunteers who made RNA Club possible this year. We are extremely grateful to all the students and faculty who helped with the Undergrad Day event and all those who continue to participate in the seminar series. The RNA Club has been expanding its repertoire of events and there is a long list of students, post-docs, research associates, administrators and faculty who have come together to make these ideas a reality. We look forward to more RNA events in 2021 and wish you all a very happy new year.

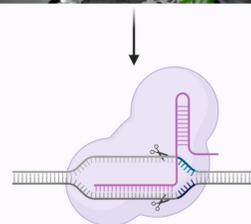
Today's edition focuses on the recent Nobel Prize in Chemistry awarded to Dr. Emmanuelle Charpentier and Dr. Jennifer Doudna. We explore Dr. Doudna's connections to Colorado, how ground-breaking discoveries aren't always recognized right away, and the impact of the first ever Nobel Prize in science awarded to an all-women team. We hope you enjoy this edition and thank you for making 2020 a very successful year for the Colorado RNA Club.

CRISPR's Long Journey: From a Yogurt Company to Nobel Prize 2020

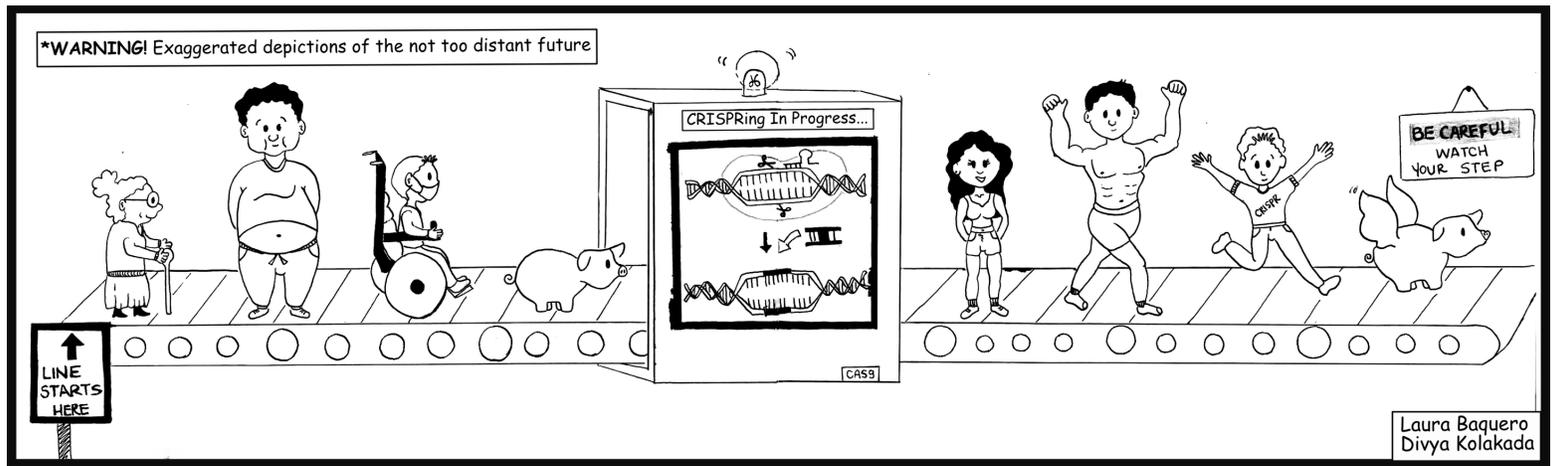
by: Ankita Arora, PhD, Postdoctoral Fellow at CU Anschutz

The CRISPR gene editing technology has revolutionized biology - with applications ranging from customizing disease relevant animal models to curing genetic disorders to agrotechnology. However, little attention has been paid to the history behind the discovery that led to the first Nobel prize shared by two women scientists. The long arduous journey started with the discovery of a strange microbial repeat sequence, its recognition as an adaptive immune system, and finally the biological characterization paving the way for its repurposing as a genome engineering tool.

In the late 2000s Philippe Horvath, a recent PhD graduate, joined Rhodia Food, a manufacturer of bacterial starter cultures to set up the company's first molecular biology lab. One of his projects was to circumvent frequent phage infections that destroyed the *Streptococcus thermophilus* cultures used to make dairy products, especially yogurt and cheese. Fast forward a few years later, his team discovered a clear correlation between the spacer sequences in the genome of *Streptococcus* and phage resistance. Further selection experiments revealed that the resistant strains had acquired phage-derived sequences at their CRISPR loci. Eureka!, they had observed acquired immunity through CRISPR in action.



This seminal discovery sparked the interest of a Lithuanian biochemist studying bacterial (cont. p2)



by: Divya Kolakada, PhD candidate, and Laura Baquero, Professional Research Assistant at CU Anschutz

restriction enzymes, Virginijus Šikšnys. He started to investigate if he could reconstitute the system *in vitro* in a different microbe that is routinely used as a laboratory workhouse, *E. coli*. Thus, the necessary and sufficient components of the CRISPR-Cas9 immune system—the Cas9 nuclease, crRNA, and tracrRNA were known. Lastly, Šikšnys' group demonstrated that the CRISPR-Cas9 system can be programmed to cut a target DNA site of their choosing *in vitro*. But wait, doesn't that sound similar to the groundbreaking paper by the Nobel laureates Jennifer Doudna and Emmanuele Charpentier? It does, because it is.

Here's what happened next: Šikšnys and his team were the first to submit their paper to Cell. Six days later, the journal rejected the paper without review. They edited the manuscript and sent it to the Proceedings of the National Academy of Sciences, which published it online in September 2012. Meanwhile, Doudna and Charpentier submitted their paper two months later to Science, which fast-tracked it for publication, thus giving them the lead. Šikšnys and his team were effectively scooped and thus far have received much less attention and their contribution has been largely overlooked. However, in 2018 Virginijus Šikšnys together with Doudna and Charpentier received the prestigious Kavli Prize in Nanoscience - giving recognition where it was due.

The two stories bring to light two important lessons. The first and foremost is that breakthroughs more often than not come from unlikely origins. The early contributors to CRISPR research were not on a quest to edit the human genome, but rather were fueled by curiosity to improve the economics of yogurt

production. Secondly, many like Šikšnys, who do their pioneering work in less mainstream institutes, face additional hardships and witness their seminal discoveries rejected by leading journals. This calls for a more inclusive science culture and training on how to overcome biases by journals, editors and reviewers.

CRISPR's Jennifer Doudna Has Roots in Colorado

by: Giulia Corbet, PhD candidate at CU Boulder

Dr. Jennifer Doudna and Dr. Emmanuelle Charpentier recently made history with their win of the Nobel Prize in Chemistry for their work on CRISPR. Dr. Doudna has long been a pioneer in the field of RNA biology, and has strong roots in the Colorado RNA community.

Doudna, who is a Professor at the University of California, Berkeley and a Howard Hughes Medical Institute Investigator, obtained her Ph.D. at Harvard Medical School. Following graduate school, she moved to Boulder and joined Dr. Tom Cech's lab as a postdoctoral associate in 1991. During her time in the Cech lab, Doudna worked to uncover the structure and function of the *Tetrahymena* ribozyme, a catalytic RNA molecule discovered by Cech's lab.

Cech lab member Anne Gooding, who worked closely with Doudna, shares a fun anecdote from Doudna's time in Boulder. "[Doudna] was elected (cont. p3)



the spokesperson from the lab to let one of the other postdocs know that he needed to get a professional haircut before going on job interviews. He [had] cut his own hair, and it was quite obvious. She was diplomatic and gentle, yet had the authority, which is why the lab 'elected' her for this special job."

In a recent piece for the Daily Camera, Cech described Doudna as the type to choose a problem that others would find too difficult and use her creativity and perseverance to solve it. These traits are only some of the strengths that led Doudna to become a titan in the field of RNA structural biology. Furthermore, as

Cech wrote in his recent "Cech It Out" blog, Doudna did not need CRISPR to be famous in scientific circles. She was elected to the National Academy of Sciences on the basis of her RNA and RNA-protein structural biology work, all before CRISPR.

Following her postdoc in the Cech lab, Doudna went on to start her own lab at Yale, followed by her move to UC Berkeley. Despite leaving Colorado, Doudna has left a lasting impact on its RNA community. She has mentored several RNA biologists who went on to start their own labs in Colorado, including Dr. Robert Batey (CU Boulder) and Dr. Jeffrey Kieft (CU Anschutz).

Breaking Another Glass Ceiling: First All-Female Team to Win a Nobel Prize in Science

by: Charlotte Cialek, PhD candidate at Colorado State University

Last month, the Nobel Prize in Chemistry was awarded to Emmanuelle Charpentier and Jennifer Doudna. Undoubtedly, this prize was well-justified. Only 8 years ago, Doudna and Charpentier's [seminal research article](#) suggested using the CRISPR-Cas system for directed genome editing. The system's simplicity, adaptability, and robustness revolutionized the medical and biological research fields.

Charpentier and Doudna's Prize was especially poignant for women: this was the first time that a Nobel Prize in science was awarded to an all-female team.

For scientists, the Nobel Prize is a monumental recognition of their scientific achievement. Yet, shockingly few women scientists are Nobel Laureates. Since 1901, women have been awarded only 4% of the Nobel Prizes in the sciences (categories of Chemistry, Physiology/Medicine, and Physics). However, this trend is starting to change. For instance, nearly half of the female Nobel Prize winners have been awarded since 2000.

The newest female Nobel laureates in Chemistry, Drs. Charpentier and Doudna, want to continue this forward momentum:

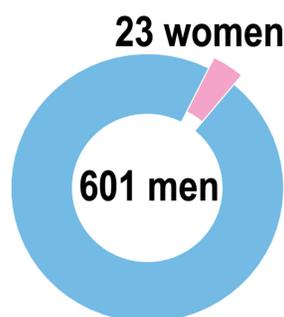
"My wish is to show [young women] that women in science can also have an impact through the research

that they are performing," Dr. Charpentier said to the [press](#).

Dr. Doudna is optimistic for the future of gender equity in science: "I think for many women there's a feeling that no matter what they do their work will never be recognized as it might be if they were a man," she said to the press. "I'd like to see that change, of course, and I think this is a step in the right direction."

How do women scientists feel about the glass ceiling broken by Drs. Doudna and Charpentier? What do they think this means for gender diversity in STEM?

We reached out to women scientists in our community to collect their reactions to this historical event. Some are early in their scientific careers, while others have a long list of scientific achievements. Here's what they think:



Nobel Prizes awarded to men versus women in Chemistry, Physiology/ Medicine, and Physics between 1901 and 2020

"Yes! More please! Inclusivity in science is so important to our ability to respond to and solve the world's greatest challenges." Candace Mathiason, PhD, Professor at CSU Fort Collins and Women in Science Network leader

"Seeing that Dr. Charpentier and Dr. Doudna had been awarded the Nobel prize for CRISPR (cont. p4)

so soon after its invention would have been inspiring no matter who they were. The fact that they are among far too few female recipients of the honor made the news extra delightful.” Tina Marriott Larson, President and COO of [Recursion](#)

“I had mixed feelings. Happy that these amazing women were fully recognized, but sad that it’s 2020 and this is still a rare and noteworthy event.” Carol Wilusz, PhD, Professor and Graduate Program Director at CSU Fort Collins

“I am delighted...but dismayed that it's 2020 and there are still so few women STEM Nobelists. More astoundingly, there are still no Black STEM Nobelists of any gender.” Anna Lily Hodshire, PhD, Research Scientist at CSU Fort Collins

“I am happy that they got the recognition they deserved and reminded that many deserving women in history were not afforded the same courtesy. Diversity in science only makes it better. This win is reflective of a long overdue acceptance and appreciation of that fact.” Hazheen Shirneki, PhD, Postdoc at St. Jude Children’s Research Hospital

“Seeing two women share this accomplishment, I can see the tide turning for generations to come.” Callie Slaughter, undergraduate student at CSU Fort Collins

“For over a decade at the start of my career I was the only female in my department. Now there are more of us. More female teams will succeed behind the ground breakers.” Jennifer Hoeting, PhD, Professor at CSU Fort Collins and Women in Natural Science leader

“I’m hopeful for our next generation of scientists, but as a society we still have a lot of work to do.” Amber Baldwin, Research Scientist, and Lauren Thompson, Graduate Student at CU Anschutz on behalf of [CU Anschutz Women in STEM \(WiSTEM\)](#)

“My concerns are that the COVID pandemic and its increased burden on adult caretakers currently threatens the advances we have won for women’s equity in STEM fields.” Erin Nishimura, PhD, Professor at CSU Fort Collins, BMB IDEA committee founder, member of CNS Diversity, Equity and Inclusion committee and the CMB diversity initiative team.

RNA Club’s First Undergrad Day a Resounding Success

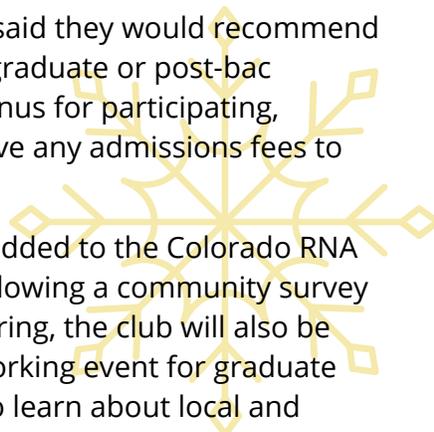
by: Danielle Bilodeau, PhD candidate at CU Anschutz

On October 20th, volunteers with the Colorado RNA Club hosted an Undergrad Day that brought together around 40 undergraduate students from across the country to learn about RNA research in Colorado and the graduate school experience. The University of Colorado’s Boulder, Anschutz and Colorado Springs campuses were represented alongside Colorado State University, Denver University and Metropolitan State University.

Members of the admissions committee and graduate students were available to address questions from the attendees about a typical day in graduate school, how to pick a program, and tips on preparing a good application. Organizers Dr. Tim Stasevich and Dr. Marisa Ruehle were both very pleased with the event and turnout, especially given the limitations of an online format.

Holding an online forum did also have unique advantages, as many of the participants indicated in a follow-up survey that they would not have been able to attend an in-person event. Feedback from the participants was very positive and all those who responded to the survey said they would recommend the event to other undergraduate or post-bac students. As an added bonus for participating, attendees are able to waive any admissions fees to CU Anschutz.

The Undergrad Day was added to the Colorado RNA Club’s roster of events following a community survey sent out last year. This spring, the club will also be hosting an Industry networking event for graduate students and post-docs to learn about local and national companies. Stay tuned for more information on this event in 2021!



For announcements of recent RNA-relevant publications, job openings, events or awards from your lab, e-mail us at ColoradoRNAClub@gmail.com

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