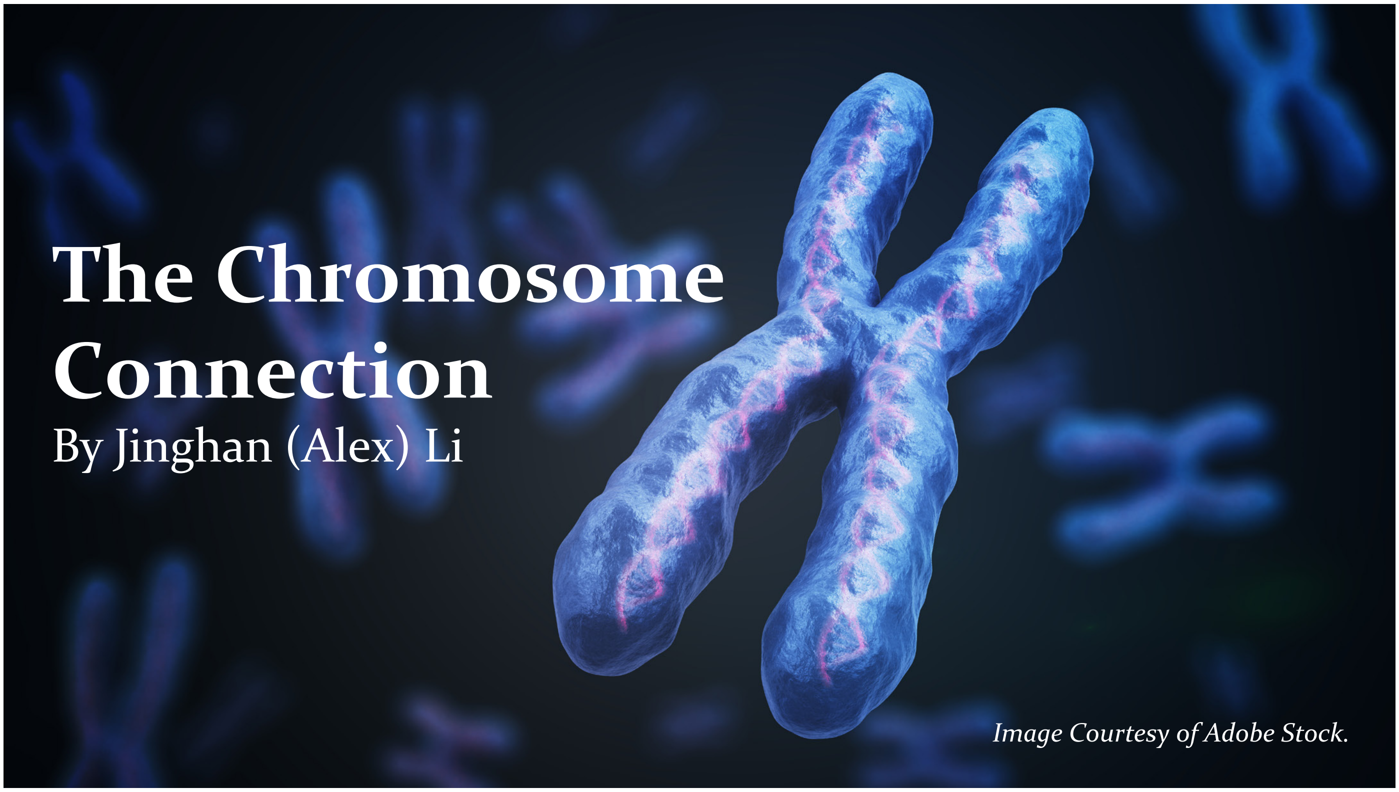

The Chromosome Connection

By Jinghan (Alex) Li

Image Courtesy of Adobe Stock.

In a quiet square outside the Institute of Cytology and Genetics in Novosibirsk, Russia, stands a children's book-styled bronze mouse cloaked in a scholar's robe, knitting the double-strand of DNA with its paws. This is the Monument to the Laboratory Mouse, commemorating their contribution to the development of therapeutics.

But it's not the mouse alone. In the shadows of the mouse's public adoration, there is a counterpart that causes the average person to frown when hearing its name.

Fruit flies, scientifically known as Drosophila melanogaster, are one of the most important model organisms, species that share similarities with the more complex lifeforms and allow for biological studies in a less complex and more convenient system. Research using fruit flies has laid the foundation for much of modern biology, including inheritance, development, mutations, and gene interactions.[1]

Figure 1. *Monument to the Laboratory Mouse. Courtesy of Wikimedia Commons.*

Dr. Jeff Sekelsky, a Professor of Biology and Genetics at the University of North Carolina at Chapel Hill, has spent more than 20 years at UNC using Drosophila to unravel the mysteries of cell division and DNA damage and repair.

Dr. Jeff Sekelsky

The DNA in our cells is constantly exposed to damage: ultraviolet (UV) radiation from sunlight, X-rays, cigarette smoke, and other environmental factors. Over the three billion years of evolution, life has learned to remedy them through a variety of DNA repair pathways that are shared, i.e., conserved, across many species, including between fruit flies and us. For example, we both perform nucleotide excision repair (NER), which specifically repairs the type of damage caused by UV light and various harmful chemicals. Without this repair pathway, as in the case for patients with a rare genetic disease called Xeroderma Pigmentosum, minor damage on the DNA that would otherwise be easily repaired by NER would accumulate. This results in extreme sensitivity to sunlight, cigarette smoke, and gas exhaust that can cause skin pigmentation, blistering, and cancer development.[2]

Another equally important repair mechanism is homologous recombination. This pathway uses an undamaged, identical or nearly identical DNA sequence as a template to accurately repair an extended length of damaged DNA. Meanwhile, the matching of DNA sequences also allows the cell to match and line up the chromosomes, which are structures formed by condensed DNA strands.[1] This process, termed crossing-over, allows the cells to properly segregate during the production of reproductive cells in sexual

Figure 2. *The Fly Room. Courtesy of Dr. Jeff Sekelsky*

reproduction, also known as meiosis. Interestingly, crossing-over in meiosis is initiated by the same type of DNA damage that is repaired through homologous recombination in other cells.[1]

When asked what drew him to this field, Dr. Sekelsky smiled. "I liked the history, all the works people have done, and the meaningful findings by excellent people. There are also lots of feelings of communities, within and between labs at UNC and between all Drosophila scientists." Though often underrated, the spirit of support and mutual benefit among Drosophila researchers has provided Dr. Sekelsky with a strong foundation for exploring his central question: How does recombination work, and why and how crossing-over is highly restricted to happen only during meiosis?

Drosophila is an excellent way to study these questions. There are genes in fruit flies that each contribute to different phenotypes, observable traits, such as eye color, the tail, and presence of hair on the back, by themselves. When those genes are lined up, recombination can exchange the genes on the two chromosomes of the cells, which can cause different combinations of phenotypes in the offspring. Combined with its rapid life cycle of approximately 10 days from egg to adult, Drosophila allows scientists to observe the changes of a complex organism across generations in just a few weeks.[1]

The observation takes place in what Dr. Sekelsky calls the "fly room". People would observe flies by the microscope, organize the rack full of flies, or brush instruments by the sink. With the researchers, the flies also sit quietly on a pad that infuses carbon dioxide which gently anesthetizes the flies.

During my talk with Dr. Sekelsky, I was invited to the fly room, sat down like one of the lab members, and looked at the flies under the microscope. Under the microscope, the fruit flies turned into a book filled with history and knowledge. The lab members showed me that one had red eyes, while the eyes of others were pale; some had black abdomens, while others did not. I saw some seemingly different wing structures and was then told that they have the same wings. The difference I saw was a natural variation.

It is a place full of peace and passion that one first seeing it would not immediately call a workplace. It is a group bonded by collaboration and support, driven by childlike curiosity in persistence and pursuit of deep answers. It is anchored by a commitment of academic excellence and rigor and empowered by the resources and connections across the scientific community.

The group led by Dr. Sekelsky is proud of their genuine love toward their work in chromosomes and drosophila. Wearing fruit fly costumes for Halloween, having a wing-wide-open fly cartoon above the door frame as a welcome, fruit fly documentaries everywhere on the desk… Their passion also extends beyond the warm niche of the lab. To acknowledge the unique structure of chromosomes in certain Drosophila cells, where hundreds of smaller chromosomes fuse into a superstructure known as the polytene chromosome, members of the Sekelsky lab collaboratively built a large-scale model using laboratory test tubes. This structure, which has helped scientists visualize the regulation of chromosomes, became both a teaching tool and a piece of art. The model was exhibited at the Ackland Art Museum, where it drew in curious visitors from outside the sciences. Today, it hangs beneath the ceiling of the Sekelsky lab, casting a unique scientific romance in a hub of curiosity and support.

Figure 3. *The Polytene Art Exhibited at Auckland. Image Courtesy of Dr. Jeff Sekelsky*

The fruit fly weaved the foundation of modern biology. Drosophila researchers, including those led by Dr. Sekelsky, have similarly woven a supportive network, built on collaboration, passion, and shared curiosity, for the peers, students, and the academic community. When asked what he loves most about Drosophila as a model organism, Dr. Sekelsky answered without hesitation: "It's the history, the people, and the community." Ever since Dr. Sekelsky's mentor sparked his interest in this field as an undergraduate student, the community, as well as the pure and relentless pursuit of knowledge, have been a lasting source of inspiration and purpose.

References

1. Interview with Jeff Sekelsky, Ph.D. 10/3/2025.
2. Black, J.O. Xeroderma Pigmentosum. *Head Neck Pathol.* **2016**, 10 (2), 139–144.