

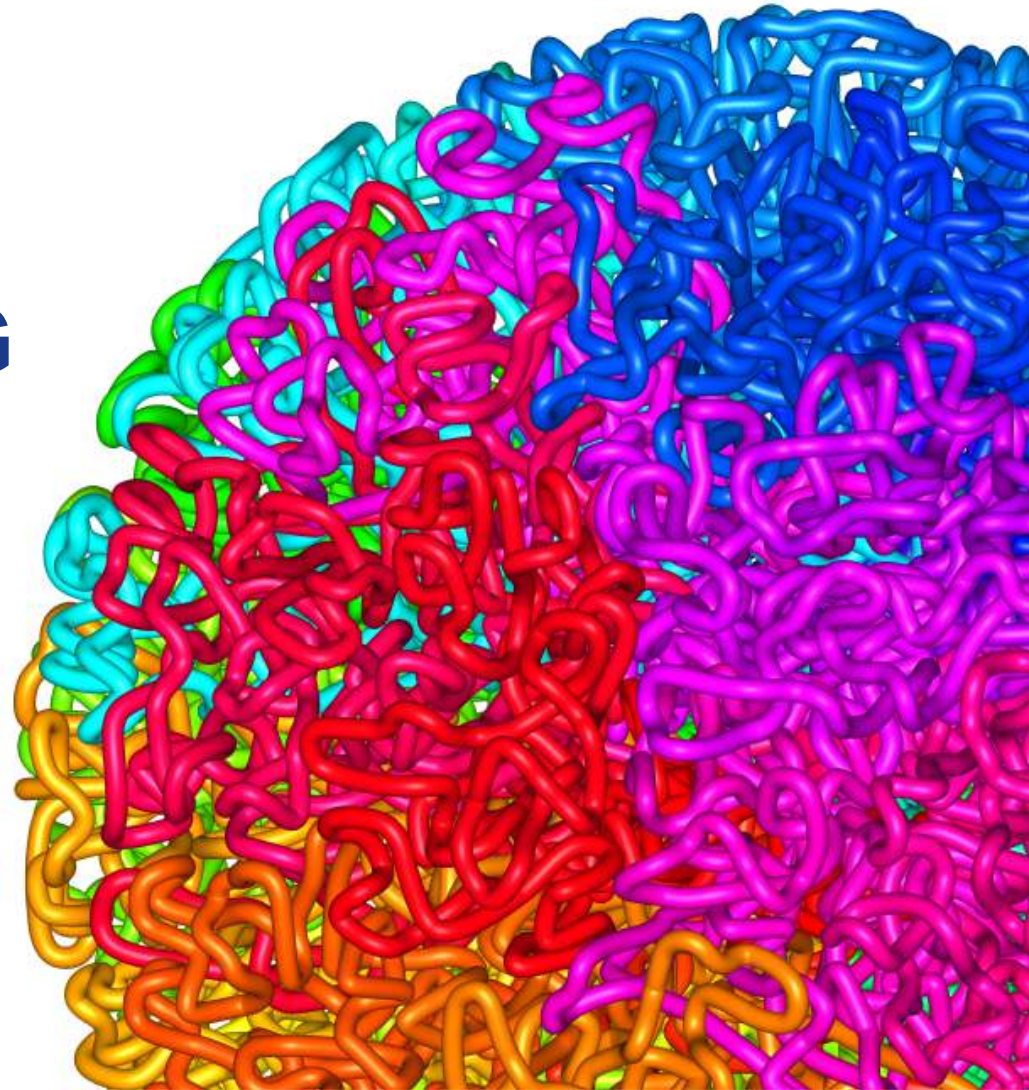
# READING & WRITING GENOMES IN 3D

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Erez Lieberman Aiden  
Director, The Center for Genome Architecture

Baylor College of Medicine  
Rice University

Senior Investigator,  
Center for Theoretical Biological Physics

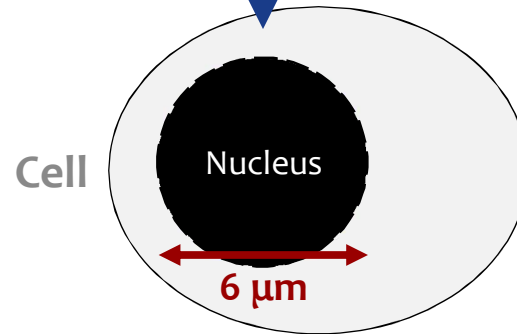


# THE HUMAN GENOME IS LONG!

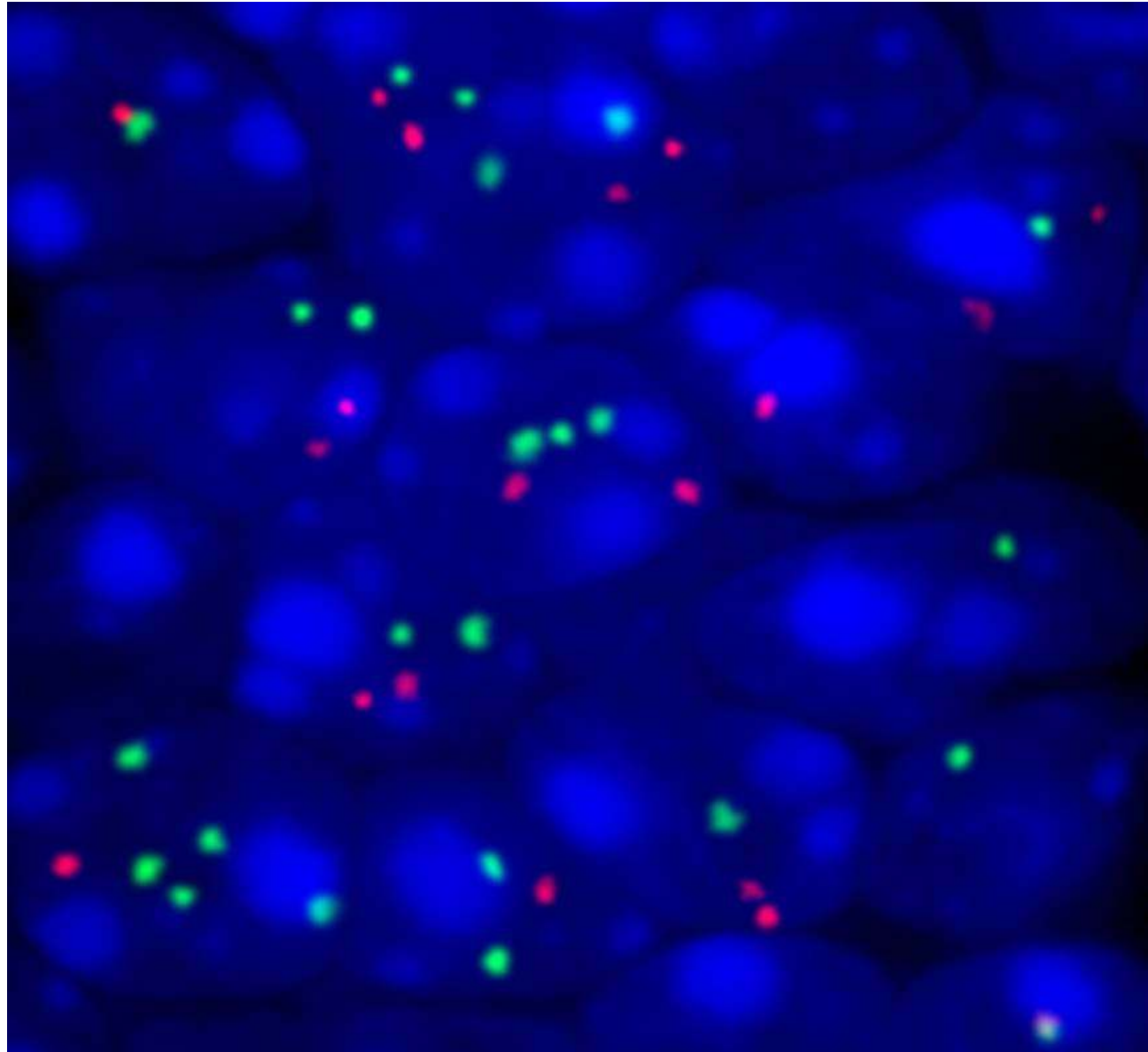
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← **3 BILLION Letters** →  
**2 METERS**

...CGTTTACGAAAATCGCAAAACTTTTCGATACCCATAGGCTACTGATCATACGACCGTTTACGAAAATCGAAACCTTCCGATCTAGGCTAC...



MICROSCOPY &  
FLUORESCENT IN  
SITU HYBRIDIZATION  
**FISH**





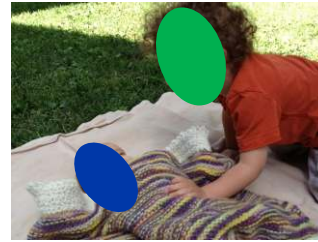
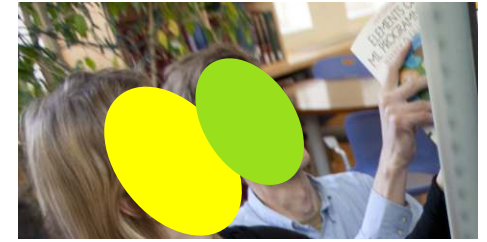
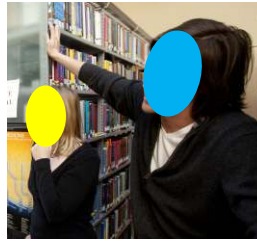
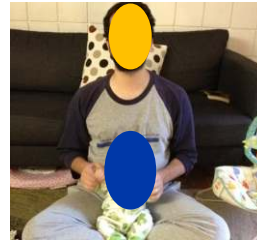
# **CONTACT MAPPING**

The Facebook Analogy

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# FACEBOOK

## CONTACT MAP

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Faces



Number of times in the same picture



# FACEBOOK

## CONTACT MAP

---

Faces



Number of times in the same picture



# Hi-C

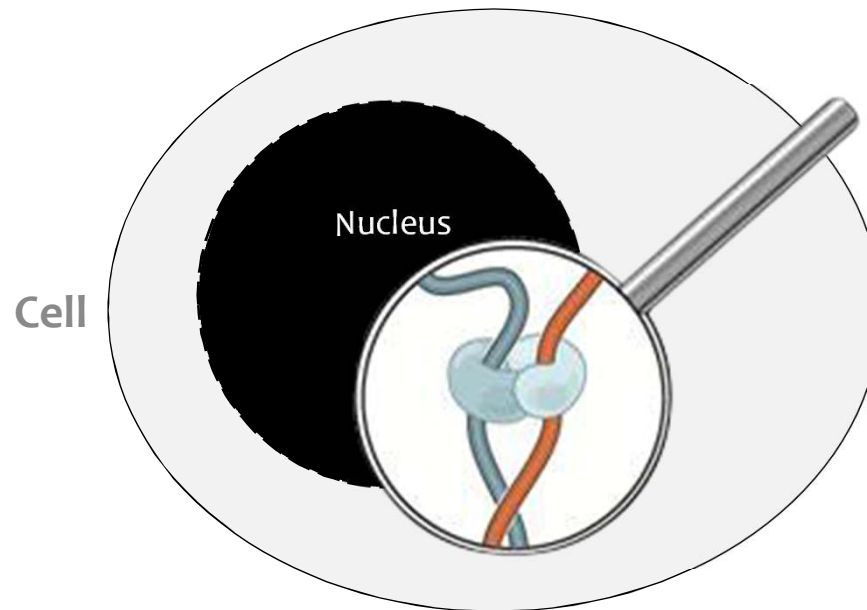
## The Development Process

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# Hi-C PROTOCOL

(ALGORITHM DESCRIBING AN EXPERIMENT)

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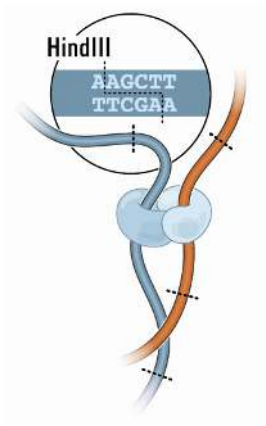


Erez Lieberman-Aiden, Nynke van Berkum  
et al. Science 2009

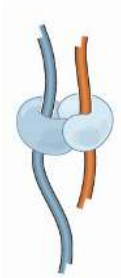
# Hi-C PROTOCOL

(RECIPE FOR AN EXPERIMENT)

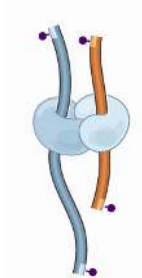
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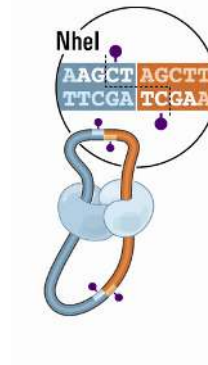
**Crosslink  
DNA**



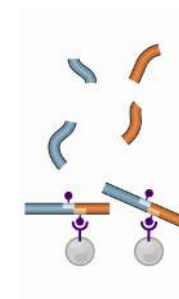
**Cut with  
Restriction  
Enzyme**



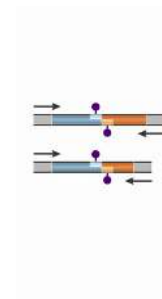
**Fill Ends and  
Mark with  
Biotin**



**Ligate**



**Purify and  
Shear DNA;  
Pull Down  
with Biotin**



**Sequence  
Using Paired-  
Ends**

*w/ Nynke van Berkum, Louise Williams, Andi Gnirke, Chad Nusbaum, Job Dekker, Eric Lander*

# Hi-C

GENERATES GENOME-  
WIDE CONTACT MAPS

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Genome



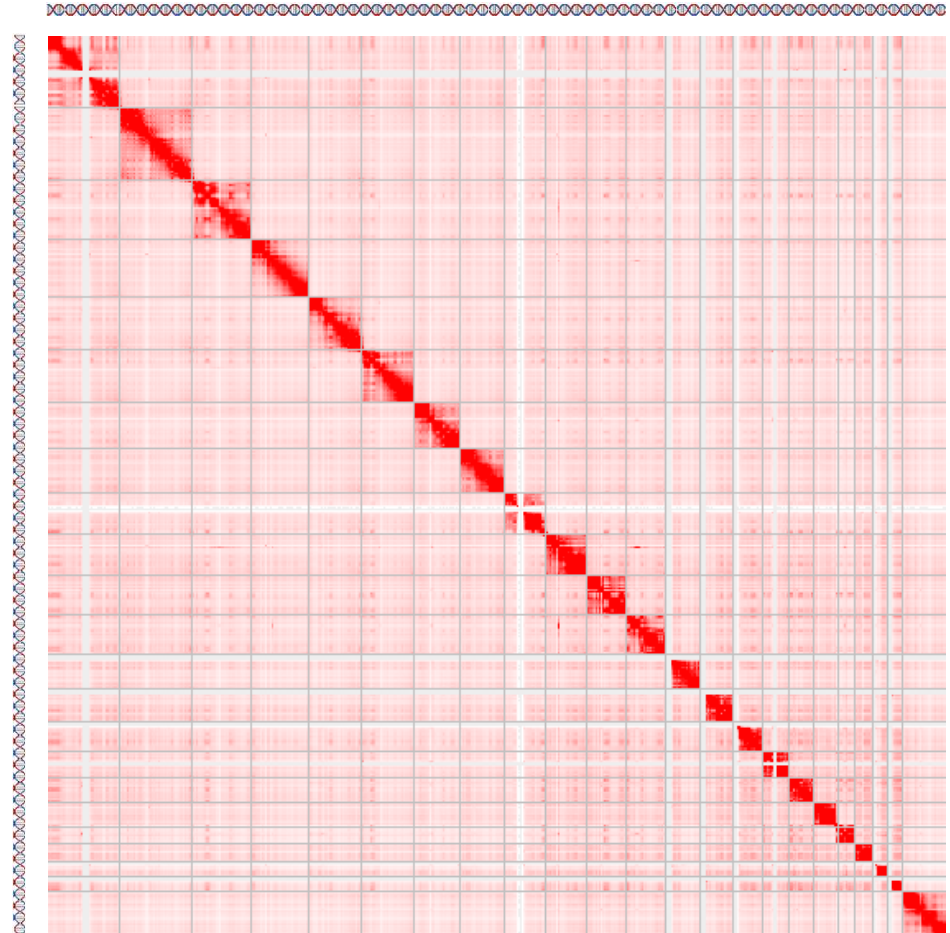
Chromosome

# Hi-C

GENERATES GENOME-  
WIDE CONTACT MAPS

---

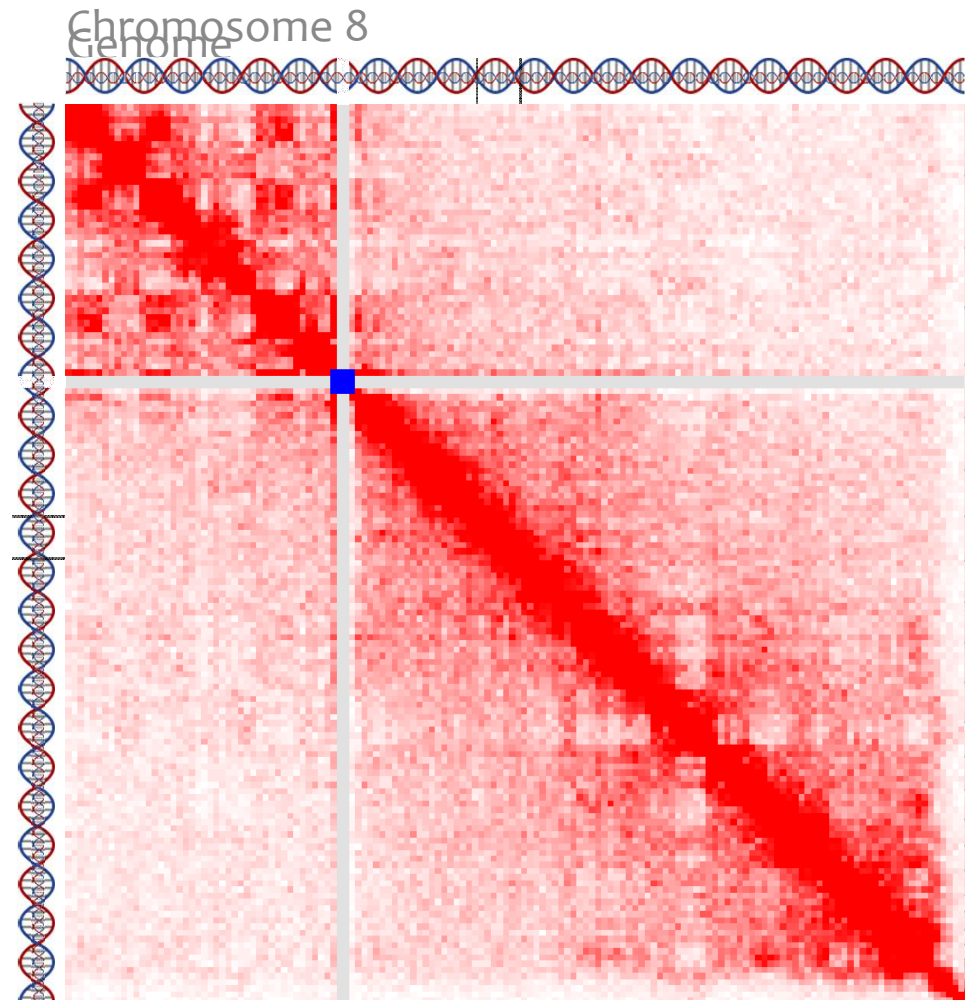
Genome



# Hi-C

GENERATES GENOME-  
WIDE CONTACT MAPS

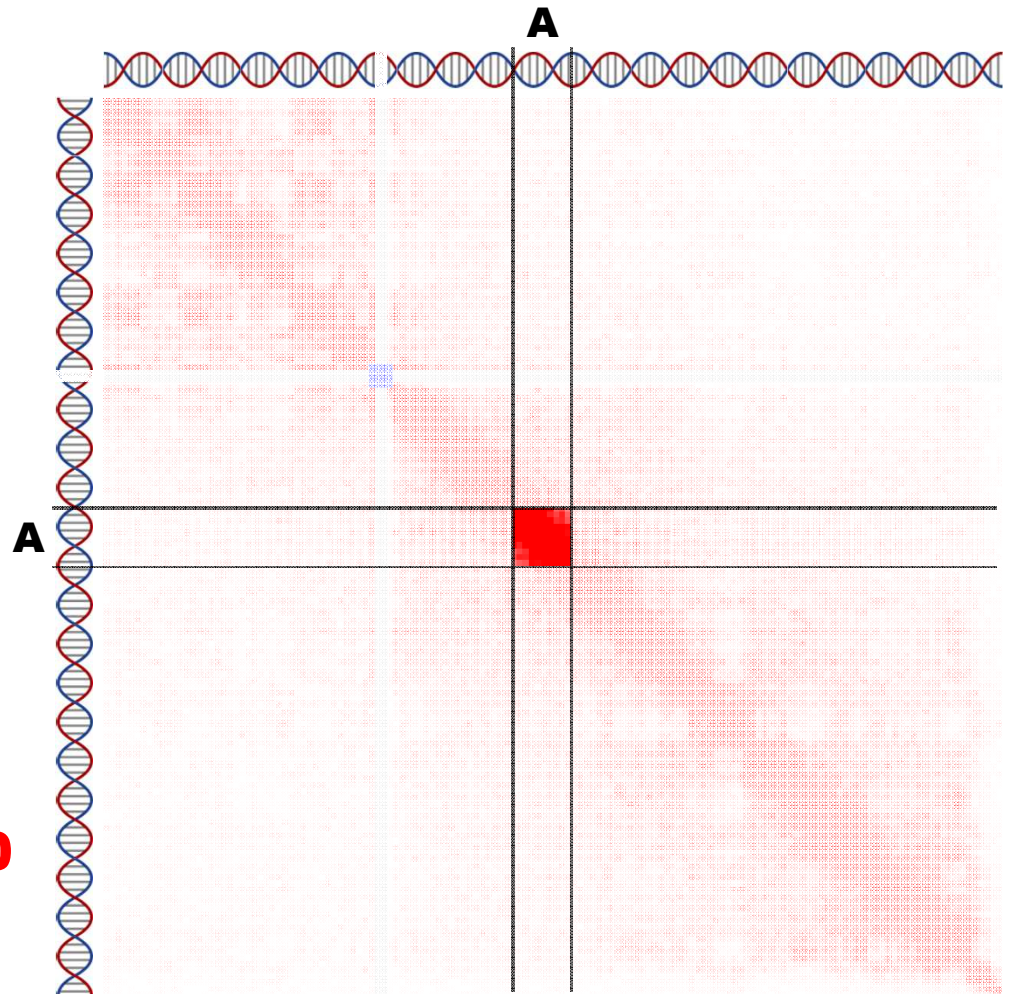
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# Hi-C

GENERATES GENOME-  
WIDE CONTACT MAPS

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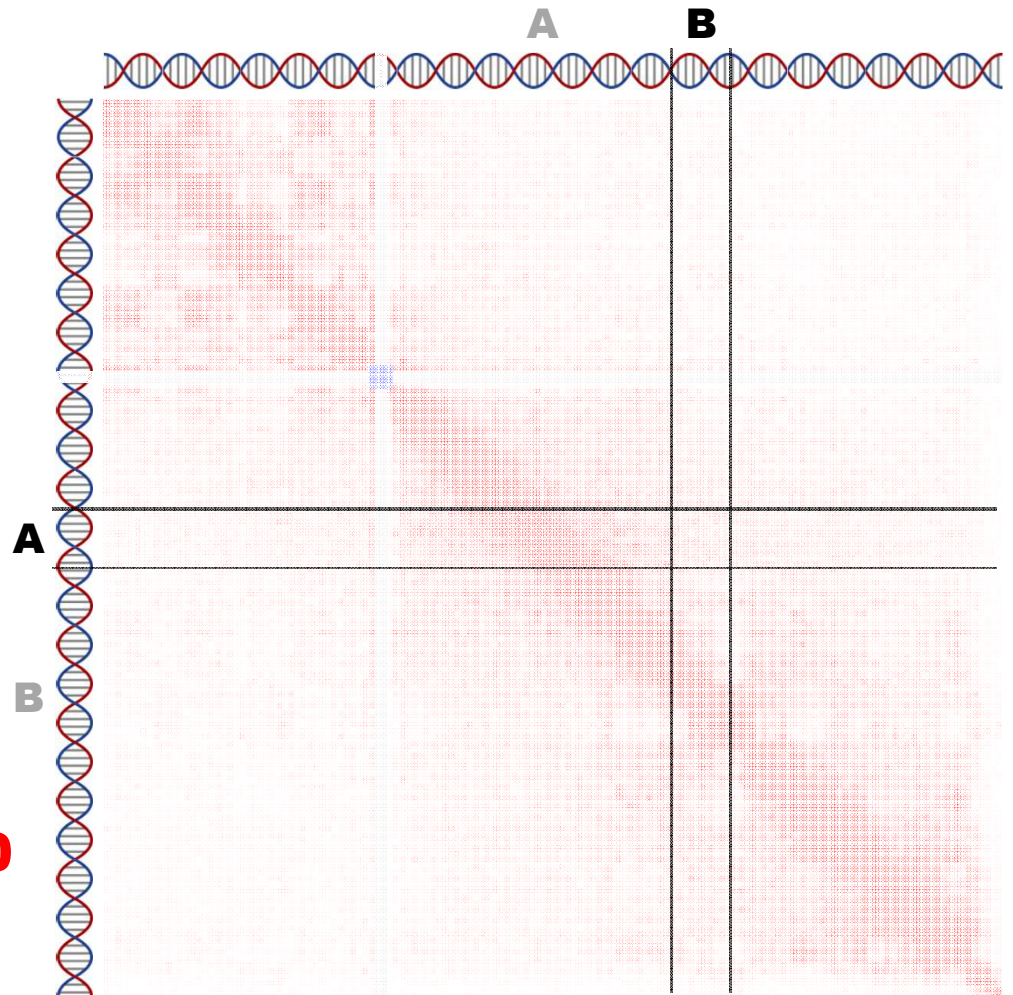
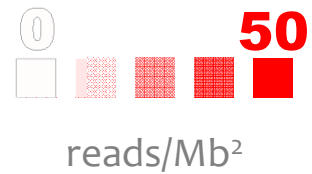




# Hi-C

GENERATES GENOME-  
WIDE CONTACT MAPS

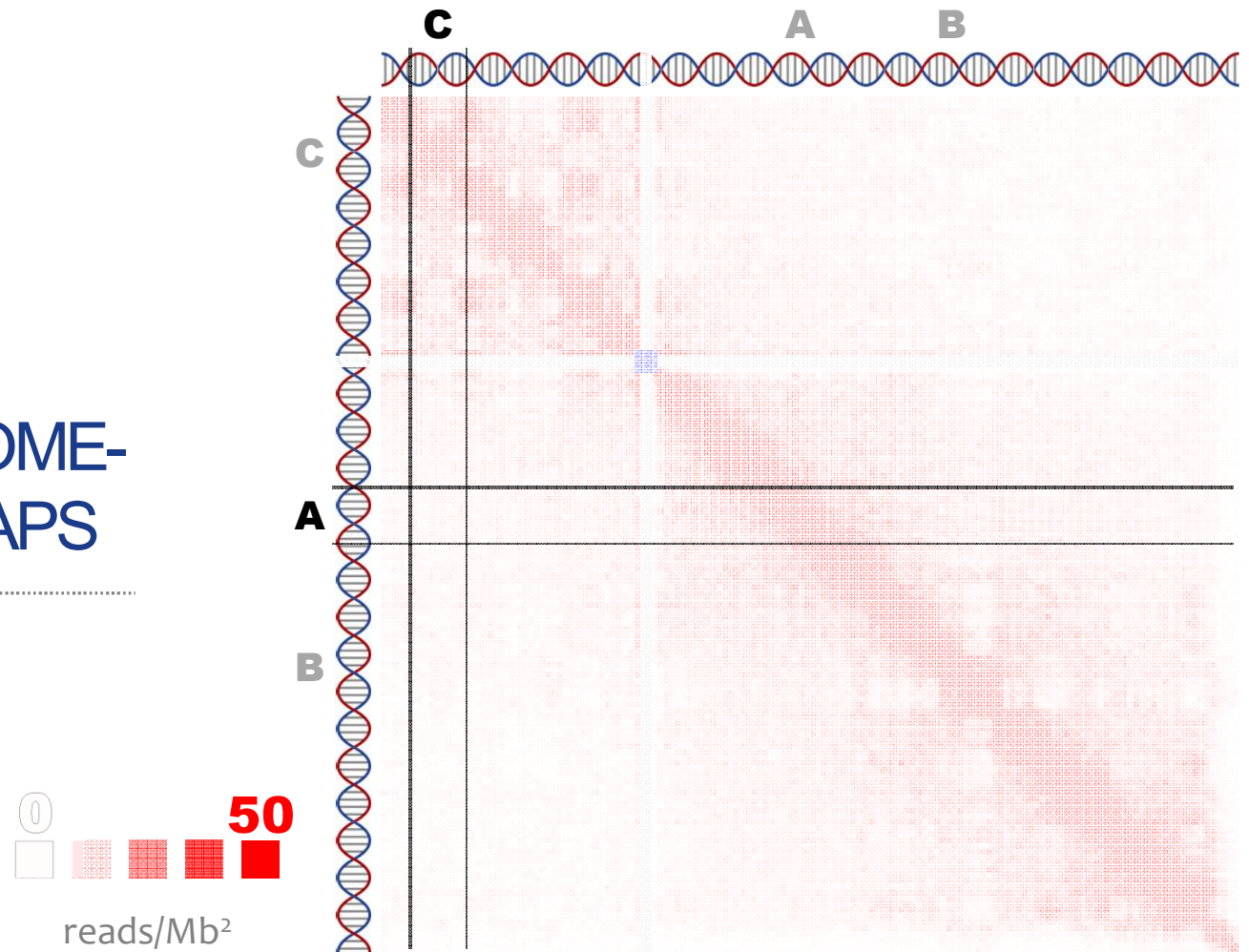
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# Hi-C

GENERATES GENOME-WIDE CONTACT MAPS

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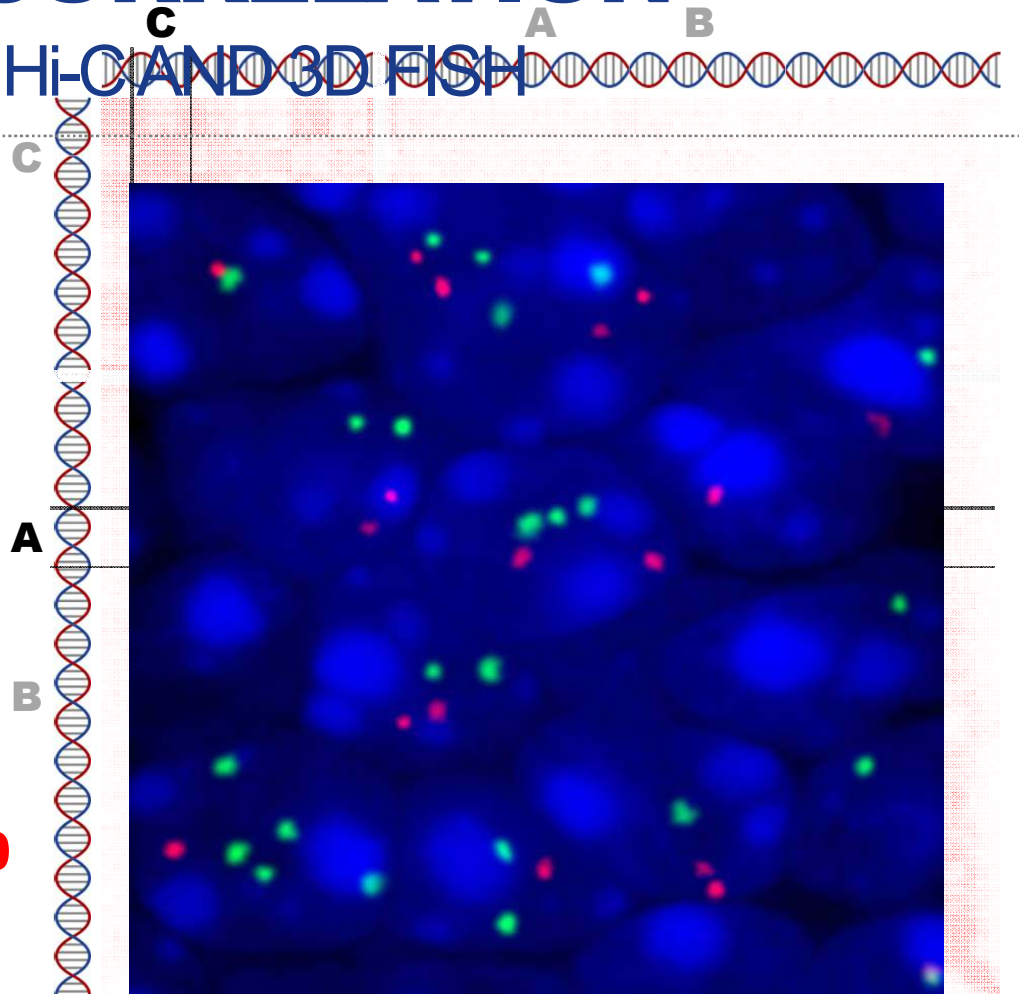


# STRONG CORRELATION

BETWEEN HI-C AND 3D FISH

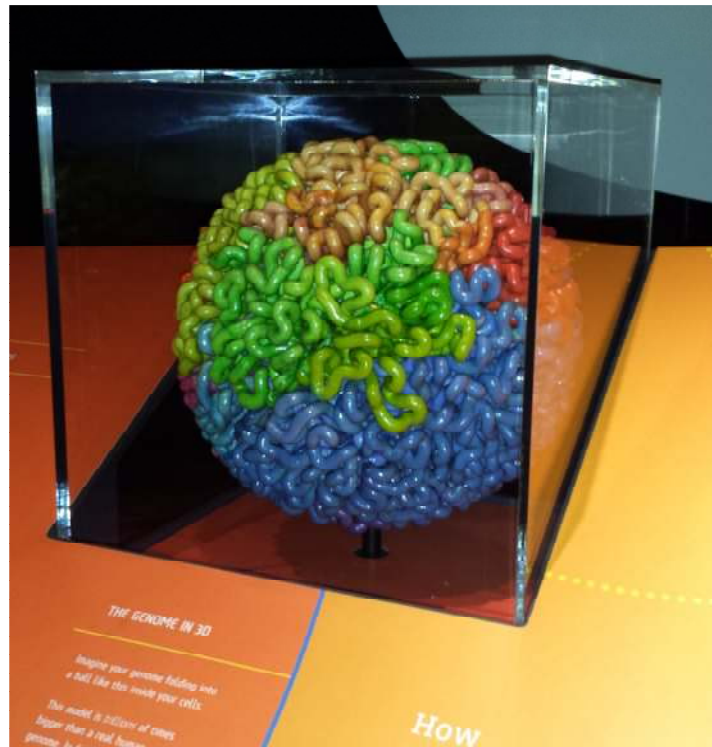
## Hi-C

GENERATES GENOME-WIDE CONTACT MAPS



# 3D SEQUENCING | 3D MODELS

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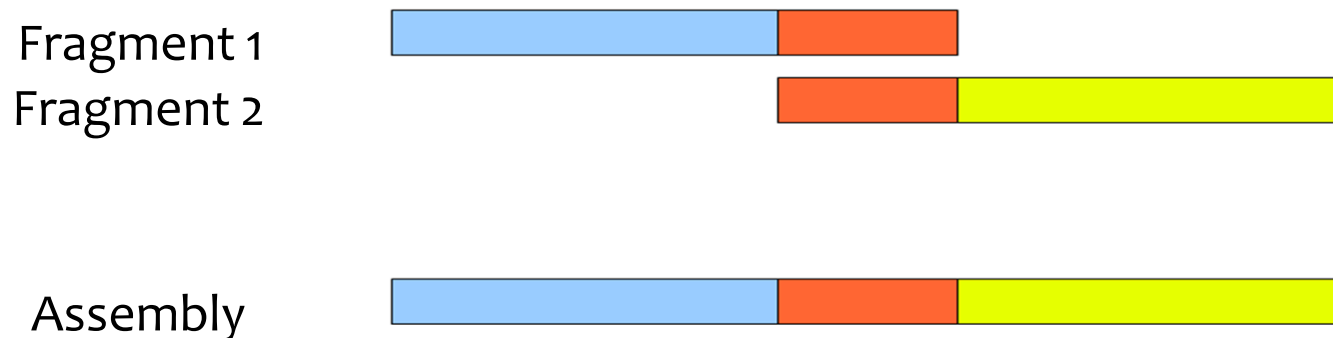


Miriam Huntley, Ashok Cutkosky, Adam Gardner, Jon Huntton

# 3D SEQUENCING | 1D ASSEMBLY

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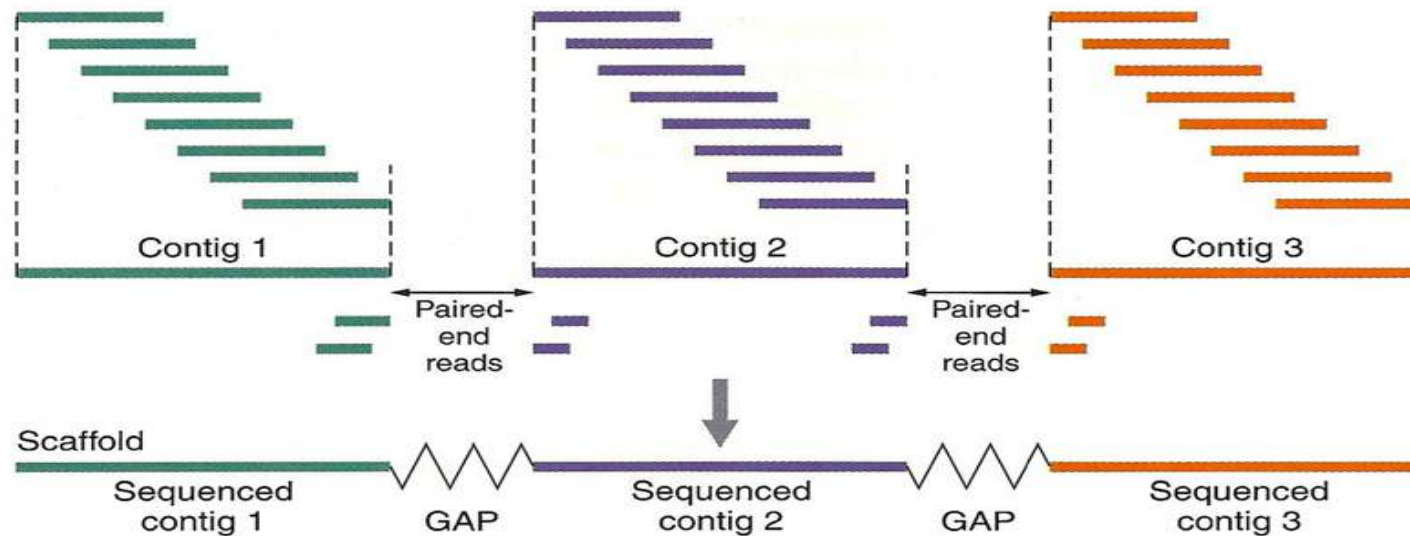
Genome assembly – Merging sequenced DNA fragments to form a complete genome



*Olga Dudchenko, Maxim Massenkoff, Neva Durand, David Jaffe, Neil Weisenfeld*

# 3D SEQUENCING | 1D ASSEMBLY

Genome assembly – Merging sequenced DNA fragments to form a complete genome



# 3D DATA GIVES GREAT ASSEMBLIES

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Reference

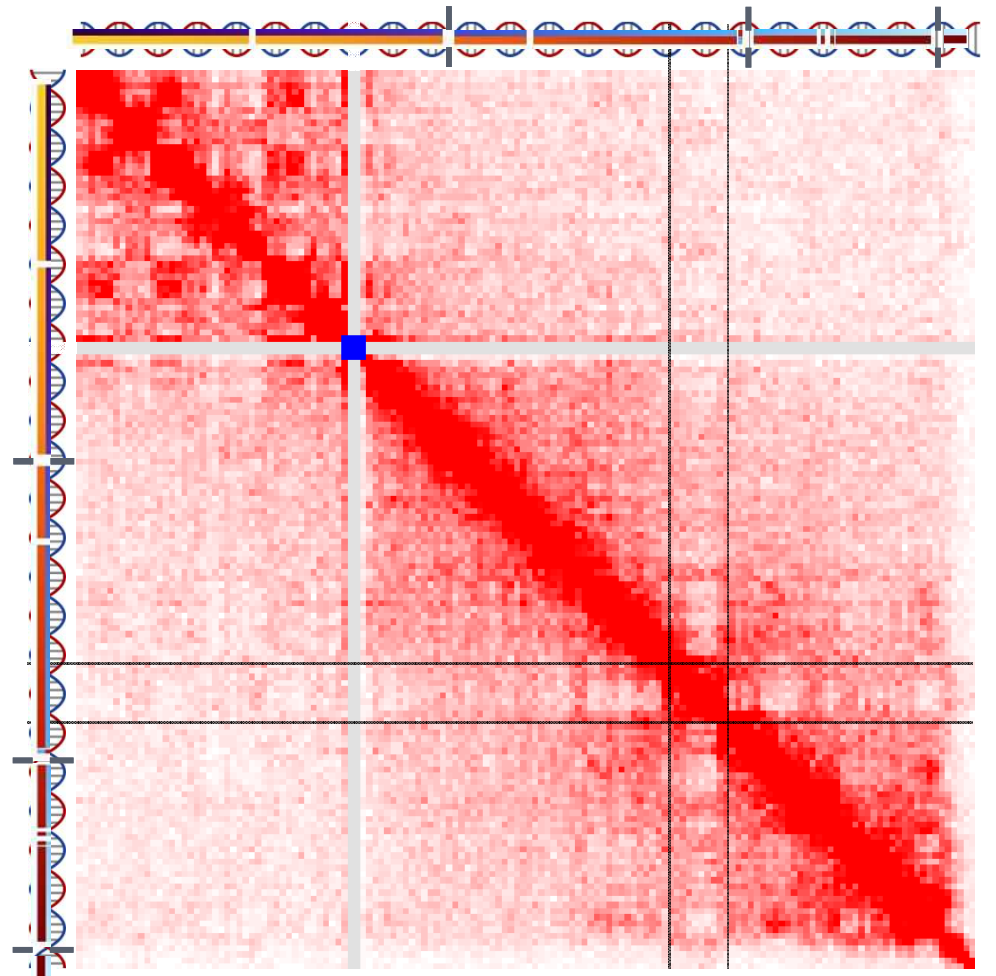


Assembly

# Reading

# Writing

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# GREETINGS FROM ANOTHER DIMENSION



## THE "C" TEAM

### Aiden Lab

Suhas Rao

Miriam Huntley

Neva Cherniavsky

Elena Stamenova

Adrian Sanborn

Arina Omer

Ivan Bochkov

Leon Furchtgott

Ashok Cutkosky

Najeeb Tarazi

Jian Li

### Broad

Louise Williams

Eric Lander

Andreas Gnirke

Chad Nusbaum

Jim Robinson

Bang Wong

### UMass Medical School

Nynke Van Berkum

Job Dekker

