Hi-C interaction matrix correction using ICE in Rust

Bachelor thesis defense

Felix Karg

13. Juli 2019

University of Freiburg

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

Enhancer Promoter Interaction

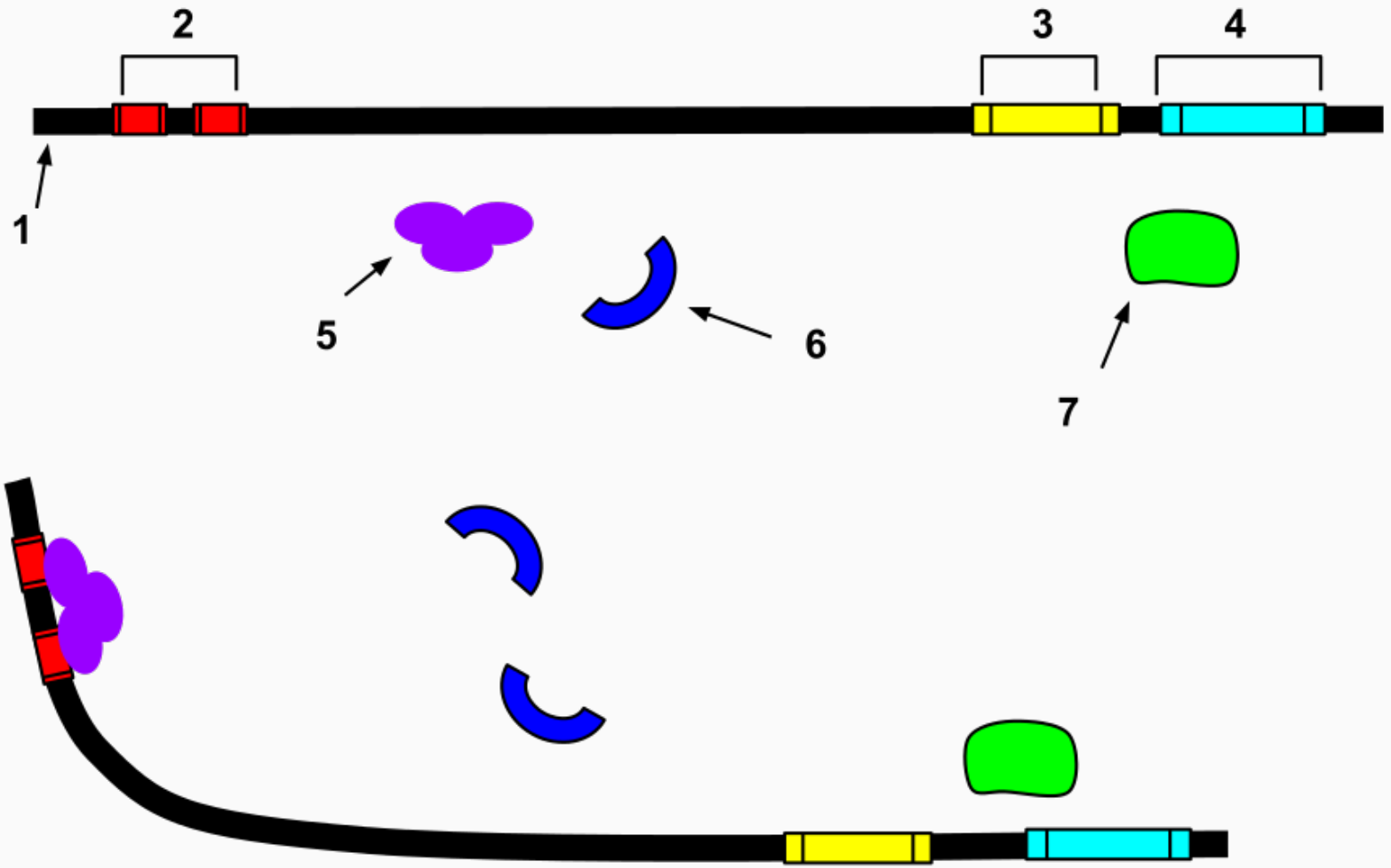

Image adapted from [1].

Enhancer Promoter Interaction

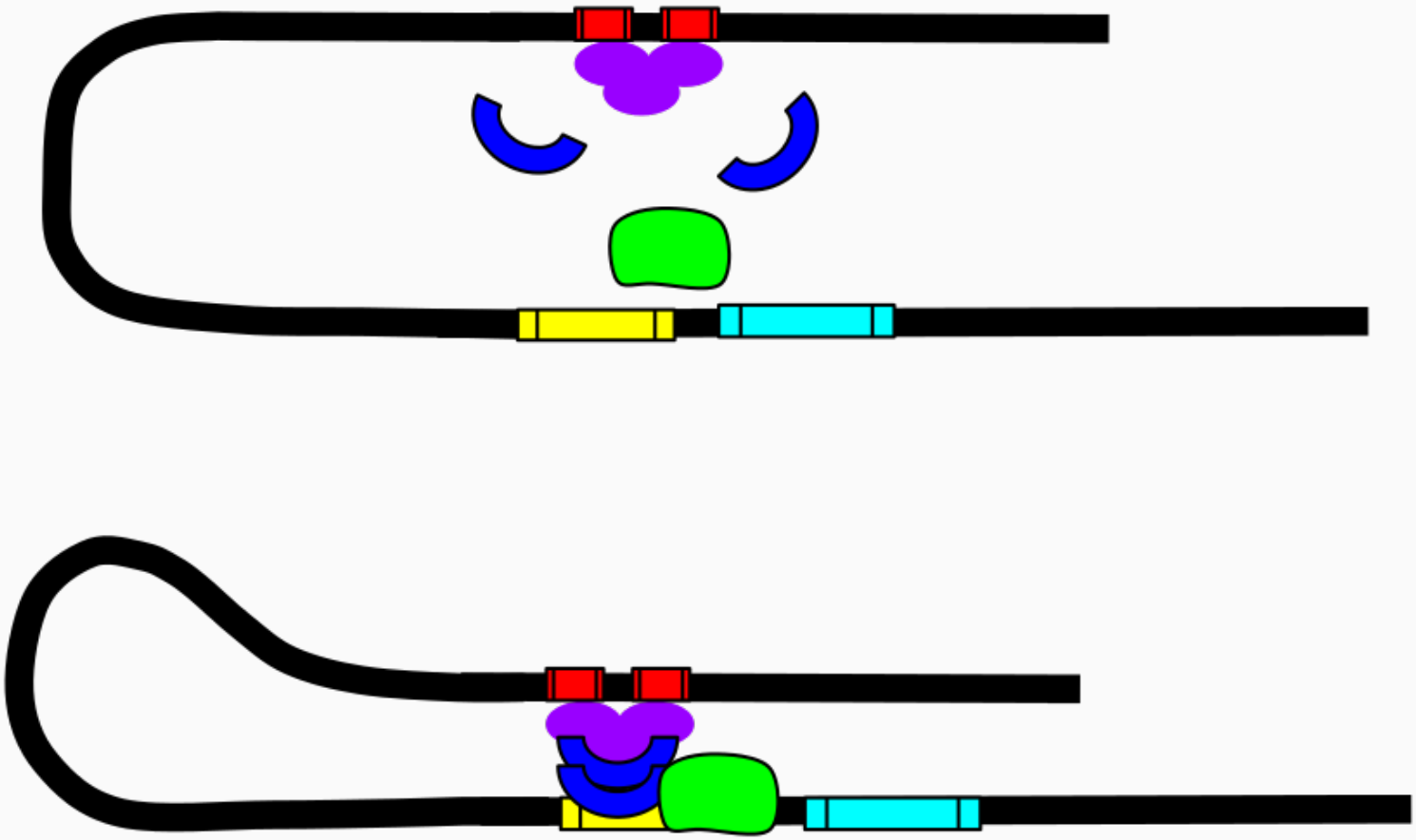

Image adapted from [1].

Chromatin

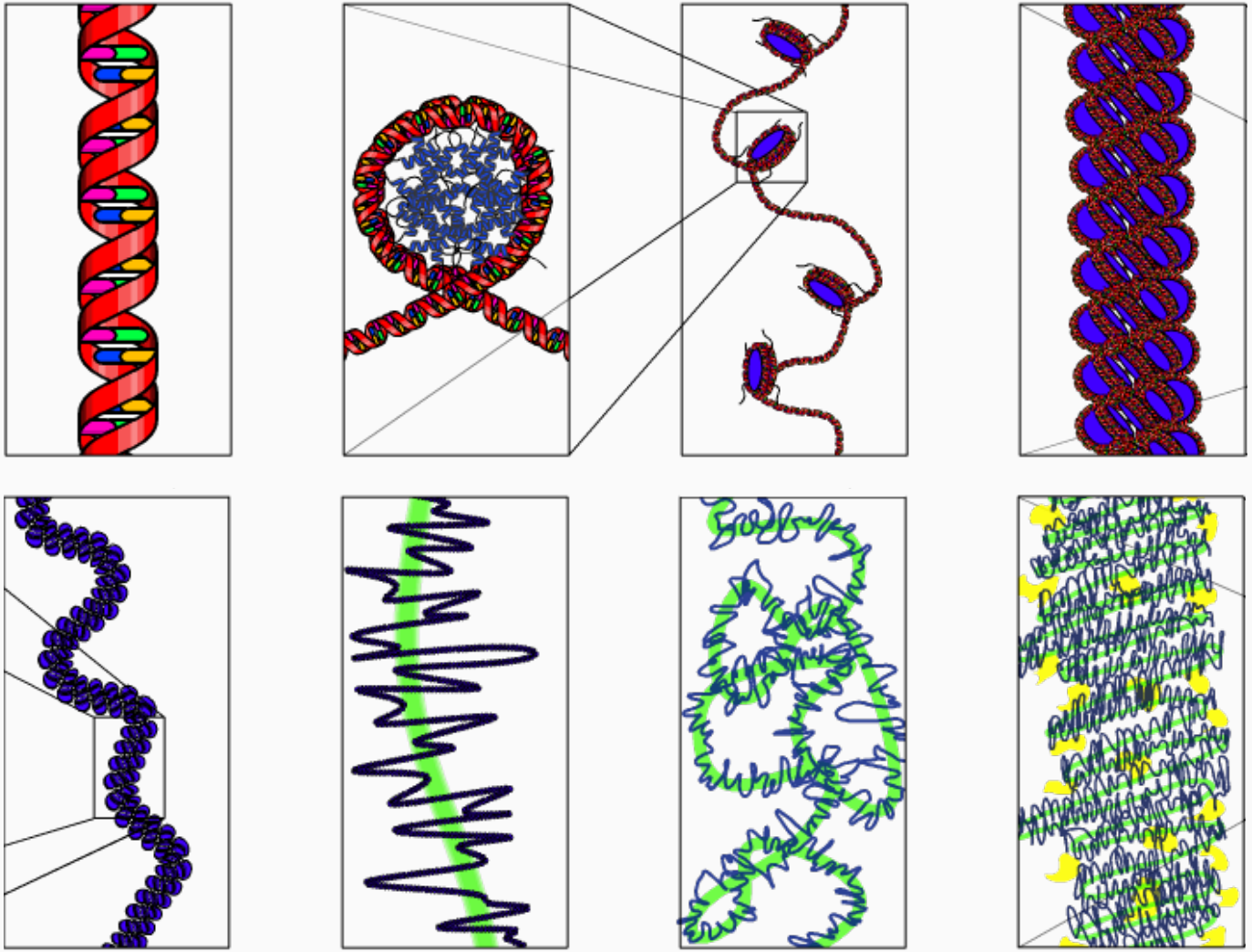

Image adapted from [2].

Spatial Structure

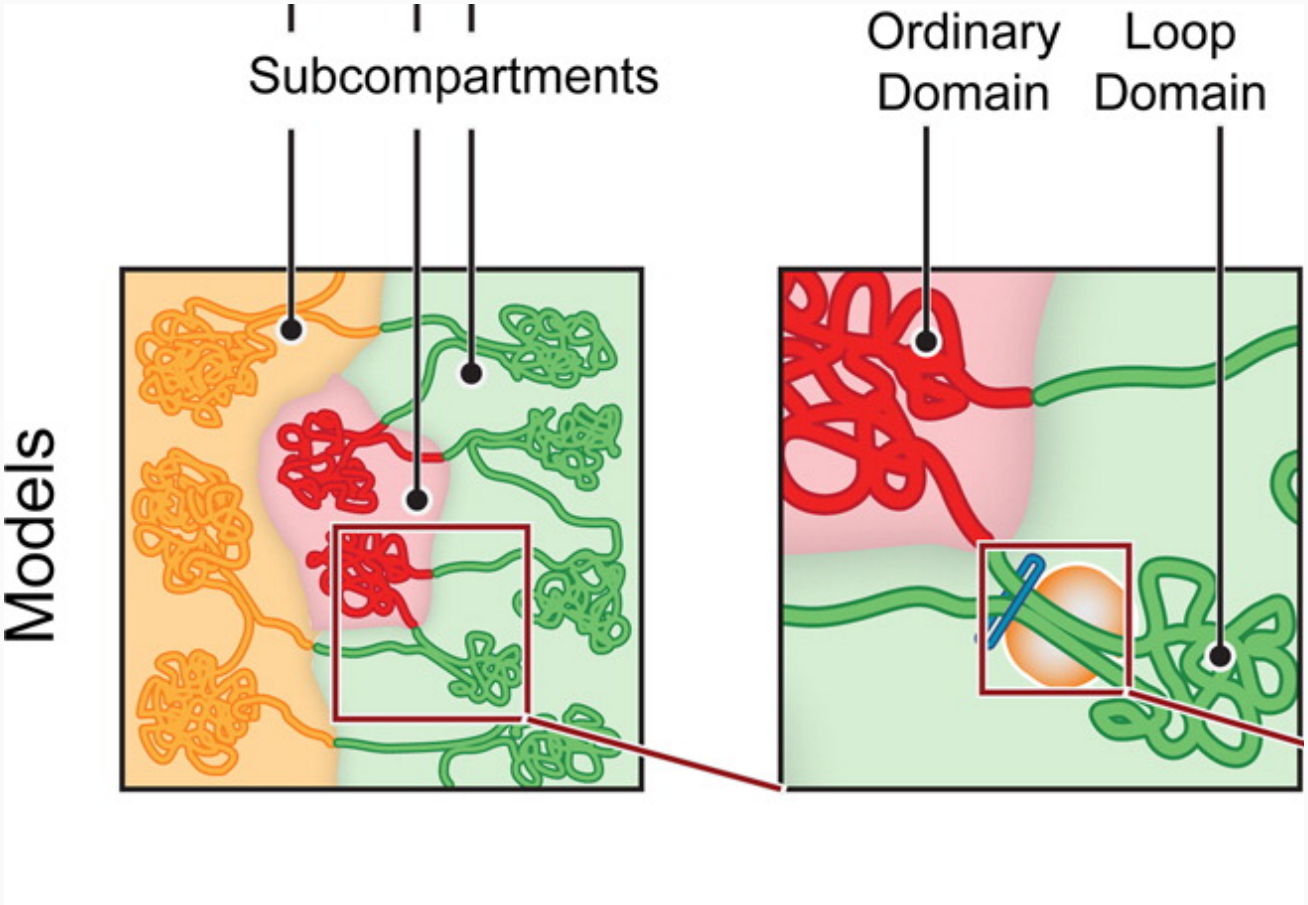

Image adapted from [3].

Enhancers may act on genes from other chromosomes [4]!

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

High-Throughput 3C (Hi-C)

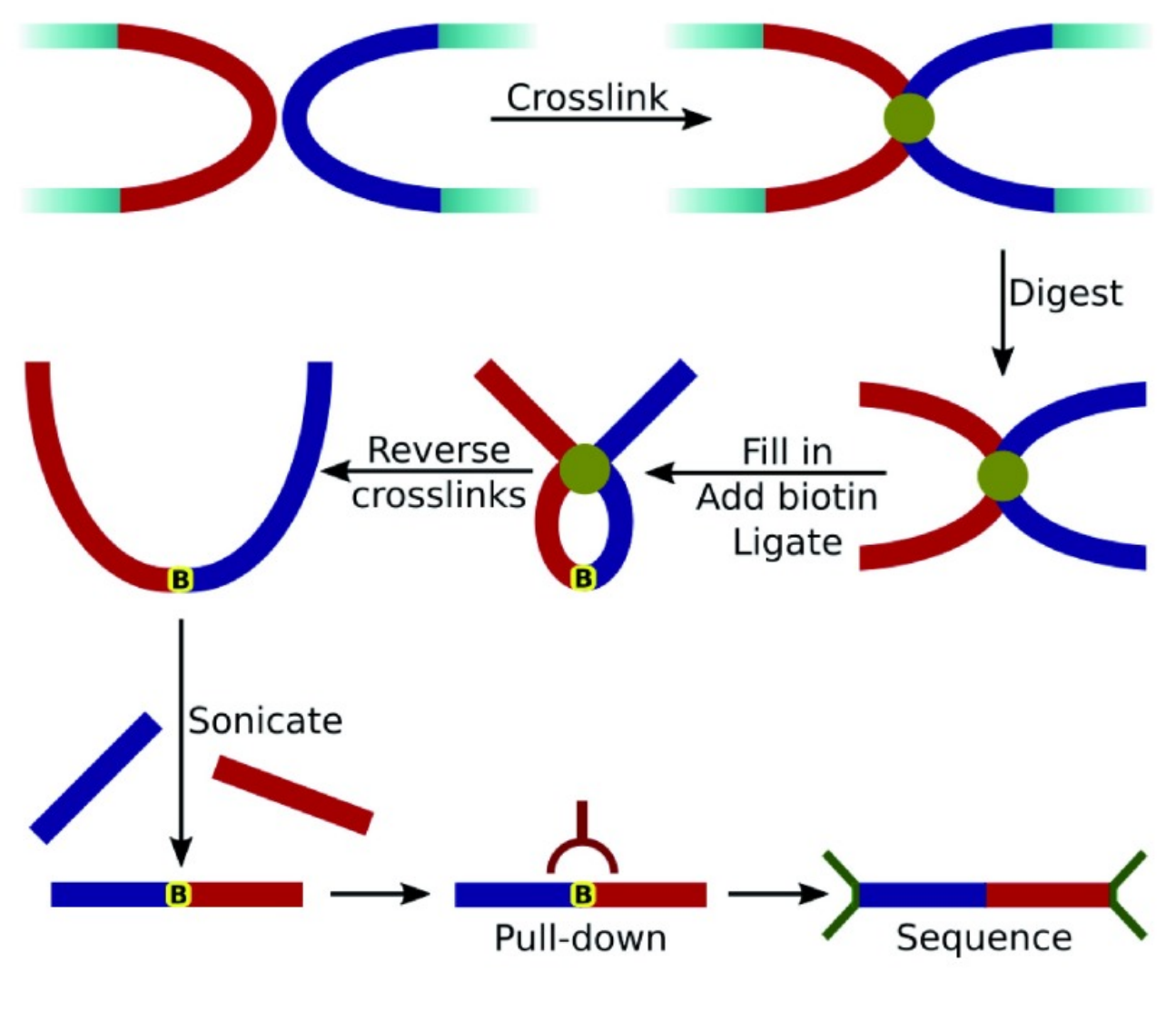

Image adapted from [5].

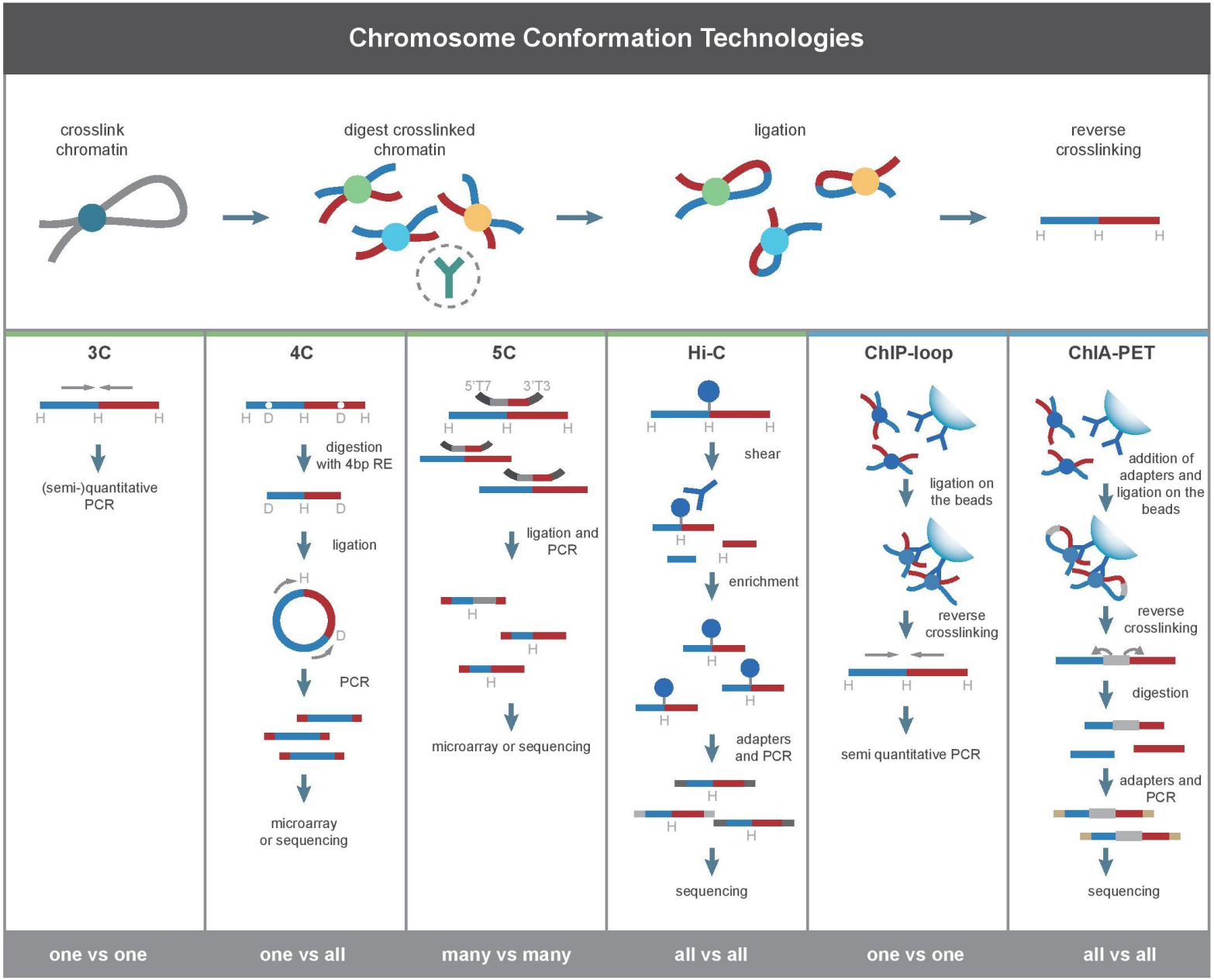
Chromosome Conformation Technologies
crosslink chromatin
digest crosslinked chromatin
ligation
reverse crosslinking
H H H
3C
(semi-)quantitative PCR
4C
H D H D H
digestion with 4bp RE
D H D
ligation
H
D
PCR
microarray or sequencing
5C
5'T7 3'T3
ligation and PCR
microarray or sequencing
Hi-C
shear
enrichment
adapters and PCR
sequencing
ChIP-loop
ligation on the beads
reverse crosslinking
semi quantitative PCR
ChIA-PET
addition of adapters and ligation on the beads
reverse crosslinking
digestion
adapters and PCR
sequencing
one vs one
one vs all
many vs many
all vs all
one vs one
all vs all

Image from [6].

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

Content

TODO: FIND NAME

Hi-C

ICE

Results

Sources

Sources i

- J. Cheff, "Enhancer nucleotide sequence." `https://commons.wikimedia.org/wiki/File:Enhancer_Nucleotide_Sequence.svg`, 2015. **Licensed under CC BY-SA 4.0; Image has been cropped; accessed 2019-07-12.**
- R. Wheeler, "Chromatin structures." `https://commons.wikimedia.org/wiki/File:Chromatin_Structures.png`, 2005. **Licensed under CC BY-SA 3.0; Image has been cropped; accessed 2019-06-26.**

Sources ii

- S. S. Rao, M. H. Huntley, N. C. Durand, E. K. Stamenova, I. D. Bochkov, J. T. Robinson, A. L. Sanborn, I. Machol, A. D. Omer, E. S. Lander, *et al.*, "A 3d map of the human genome at kilobase resolution reveals principles of chromatin looping," *Cell*, vol. 159, no. 7, pp. 1665–1680, 2014.
- C. G. Spilianakis, M. D. Lalioti, T. Town, G. R. Lee, and R. A. Flavell, "Interchromosomal associations between alternatively expressed loci," *Nature*, vol. 435, no. 7042, p. 637, 2005.

Sources iii

- S. Wingett, P. Ewels, M. Furlan-Magaril, T. Nagano, S. Schoenfelder, P. Fraser, and S. Andrews, "Hicup: pipeline for mapping and processing hi-c data," *F1000Research*, vol. 4, 2015.
- G. Li, L. Cai, H. Chang, P. Hong, Q. Zhou, E. V. Kulakova, N. A. Kolchanov, and Y. Ruan, "Chromatin interaction analysis with paired-end tag (chia-pet) sequencing technology and application," *BMC Genomics*, vol. 15, p. S11, Dec 2014.