

Prediction of Regulatory Networks from Expression and Chromatin Data

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Overview

Time	Topic	Who
2:30 - 2:45	Introduction / gene regulation / transcription / chromatin	IC
2:45 - 3:00	Introduction ChIP-seq peak calling	MH
3:00 - 3:50	Practical peak calling	MH
4:15 - 4:30	Introduction Footprints	IC
4:30 - 4:45	Introduction Regulatory networks	MS
4:45 - 5:50	Practical Regulatory Networks	IG, MS & FS
5:50 - 6:00	Q & A session	all

Material - <https://github.com/SchulzLab/EpigenomicsTutorial-ISMB2017>

Team



Ivan Costa (IC)



Matthias Heinig (MH)



Marcel Schulz(MH)



Florian Schmidt (FS)

Introduction - Gene Regulation, Transcription and Chromatin

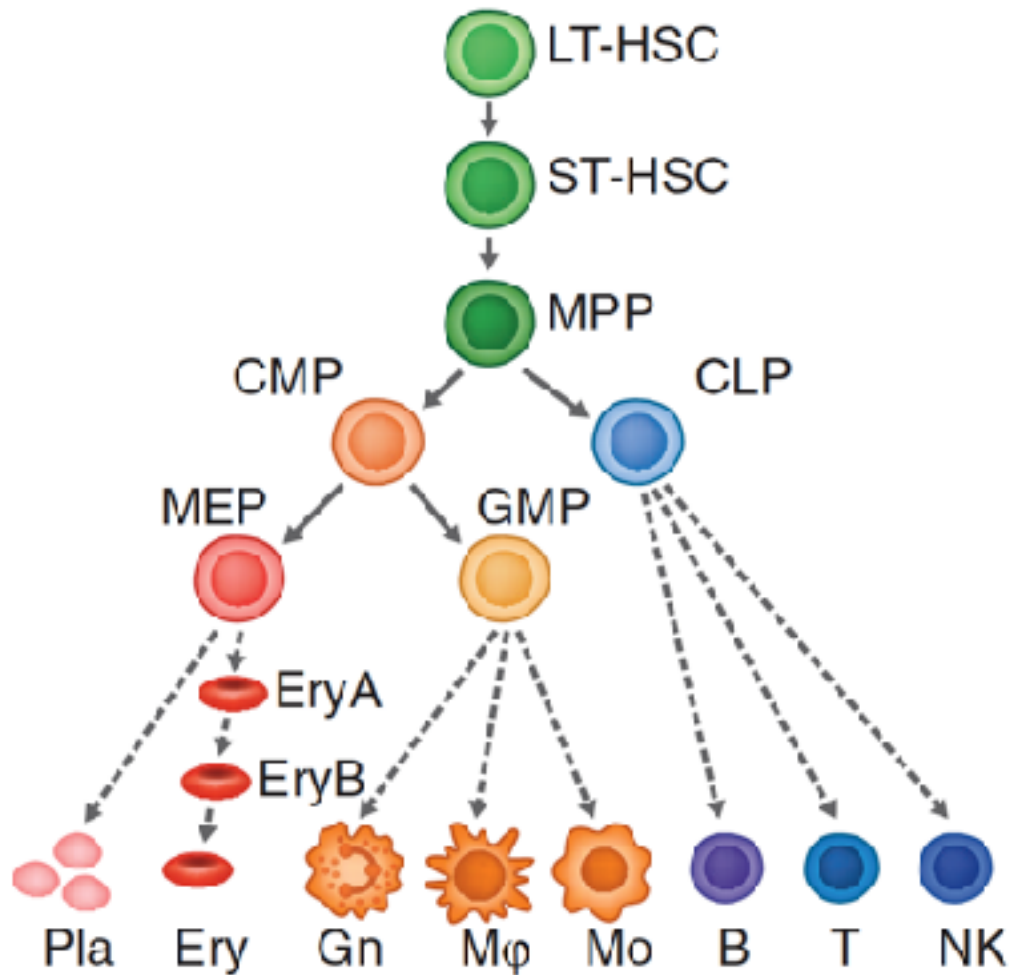
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Cell Differentiation & Gene Regulation

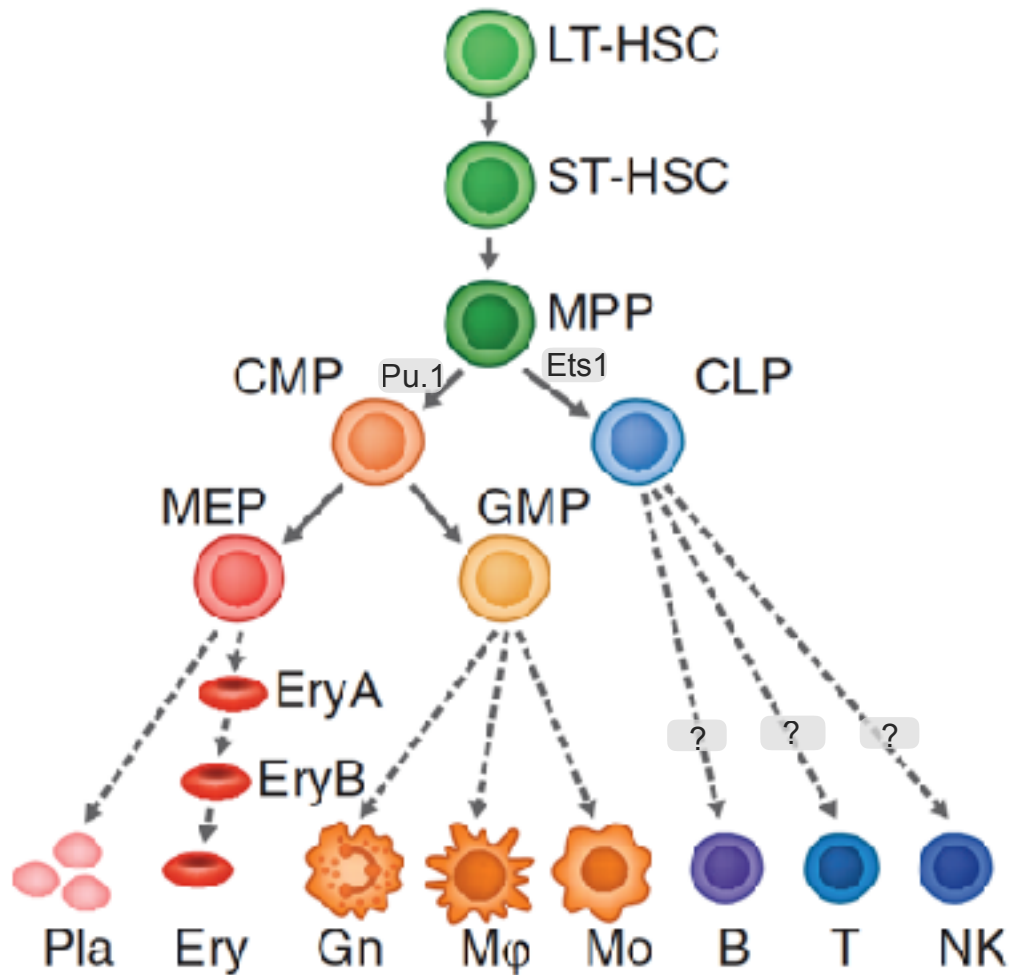
Hematopoiesis



Adapted from Lara-Astiaso, Science, 2015.

Cell Differentiation & Gene Regulation

Hematopoiesis

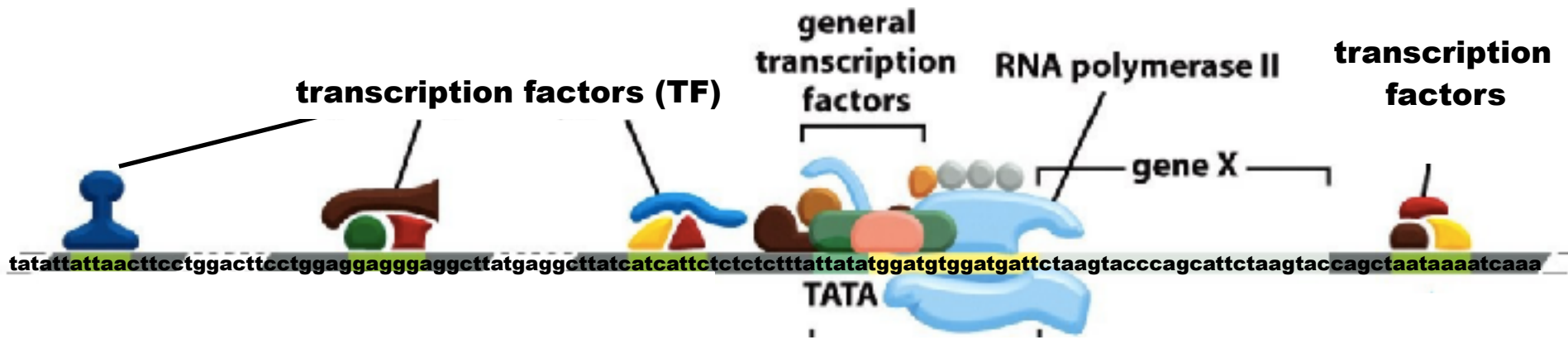


plasticity

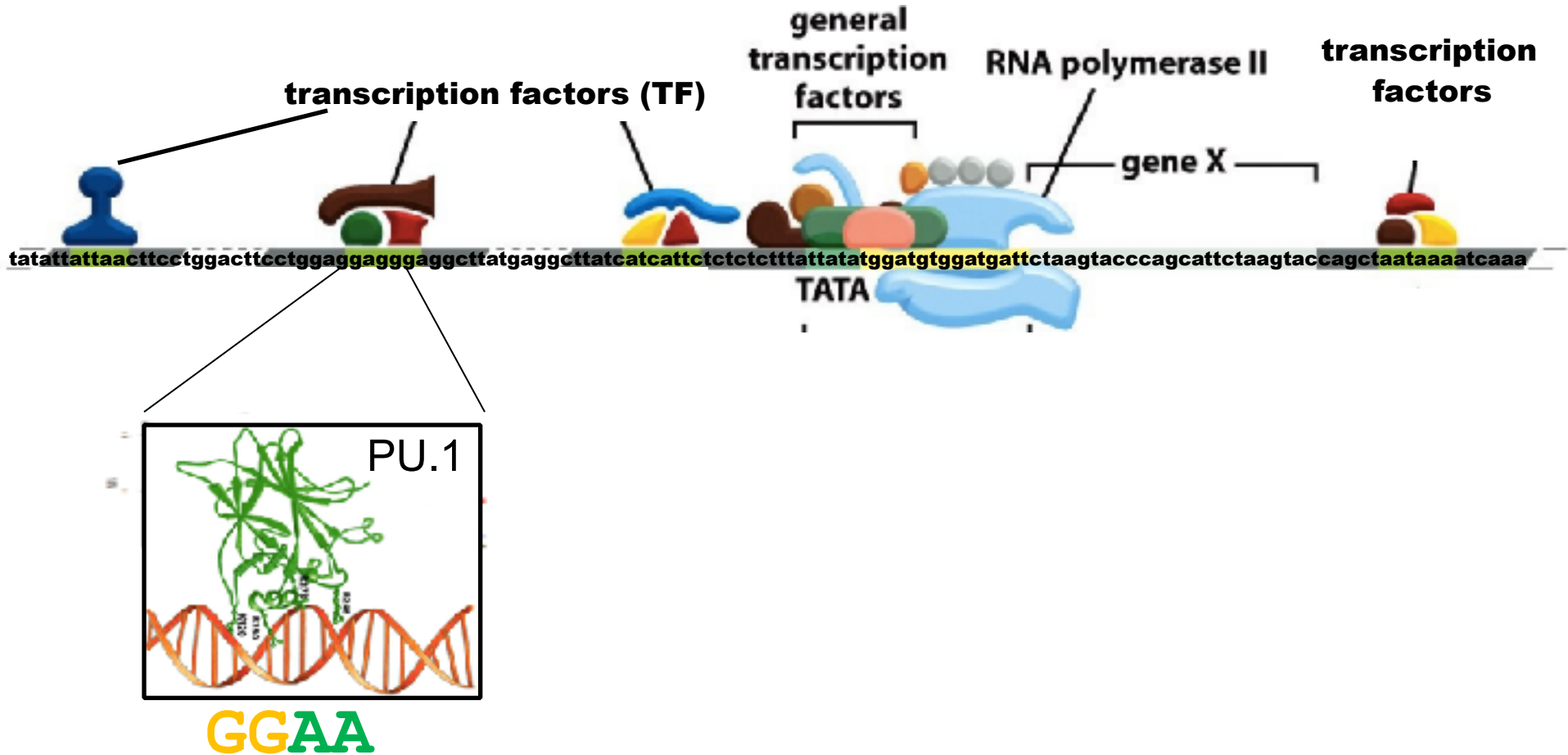
cell memory

Adapted from Lara-Astiaso, Science, 2015.

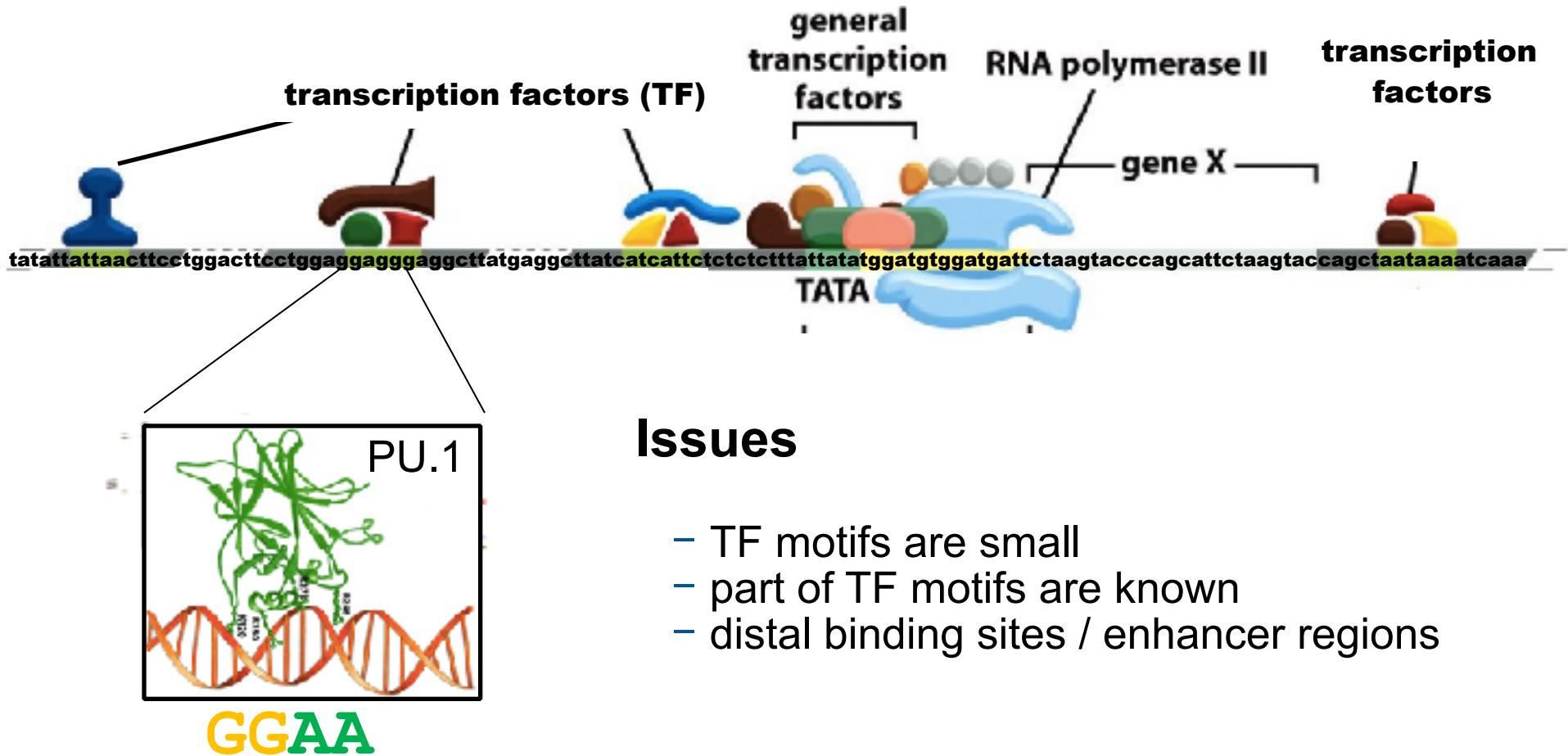
Regulatory Control – Protein-DNA interaction



Regulatory Control – Protein-DNA interaction



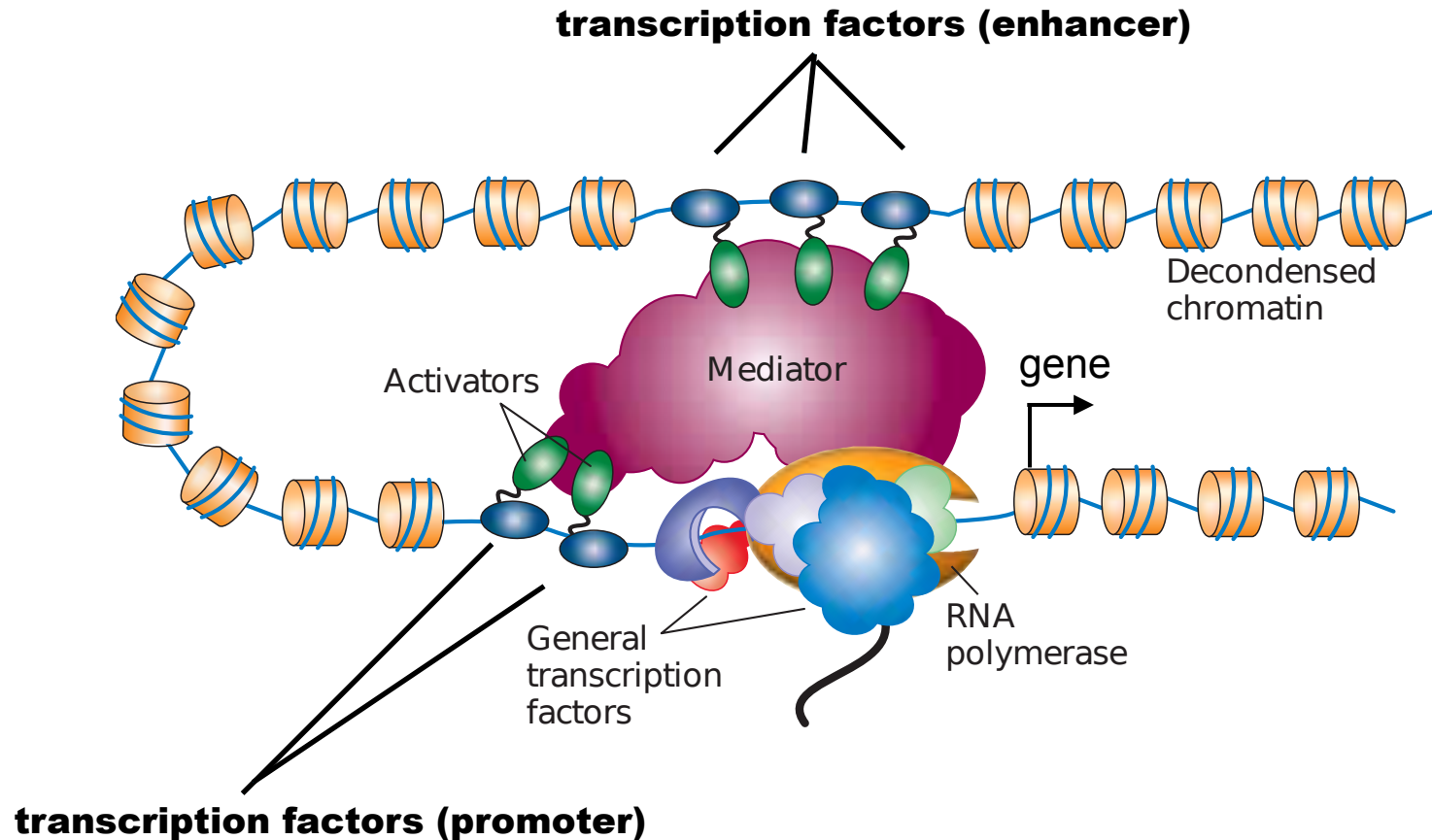
Regulatory Control – Protein-DNA interaction



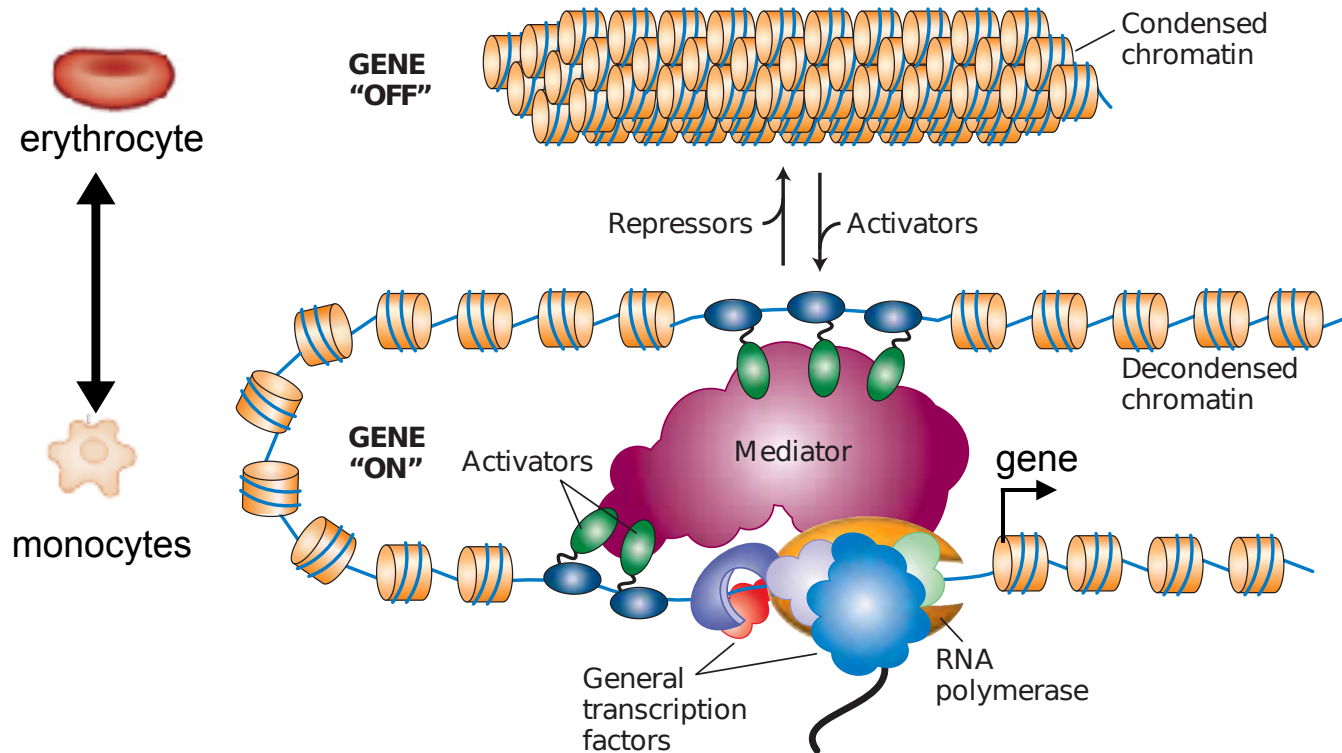
Issues

- TF motifs are small
- part of TF motifs are known
- distal binding sites / enhancer regions

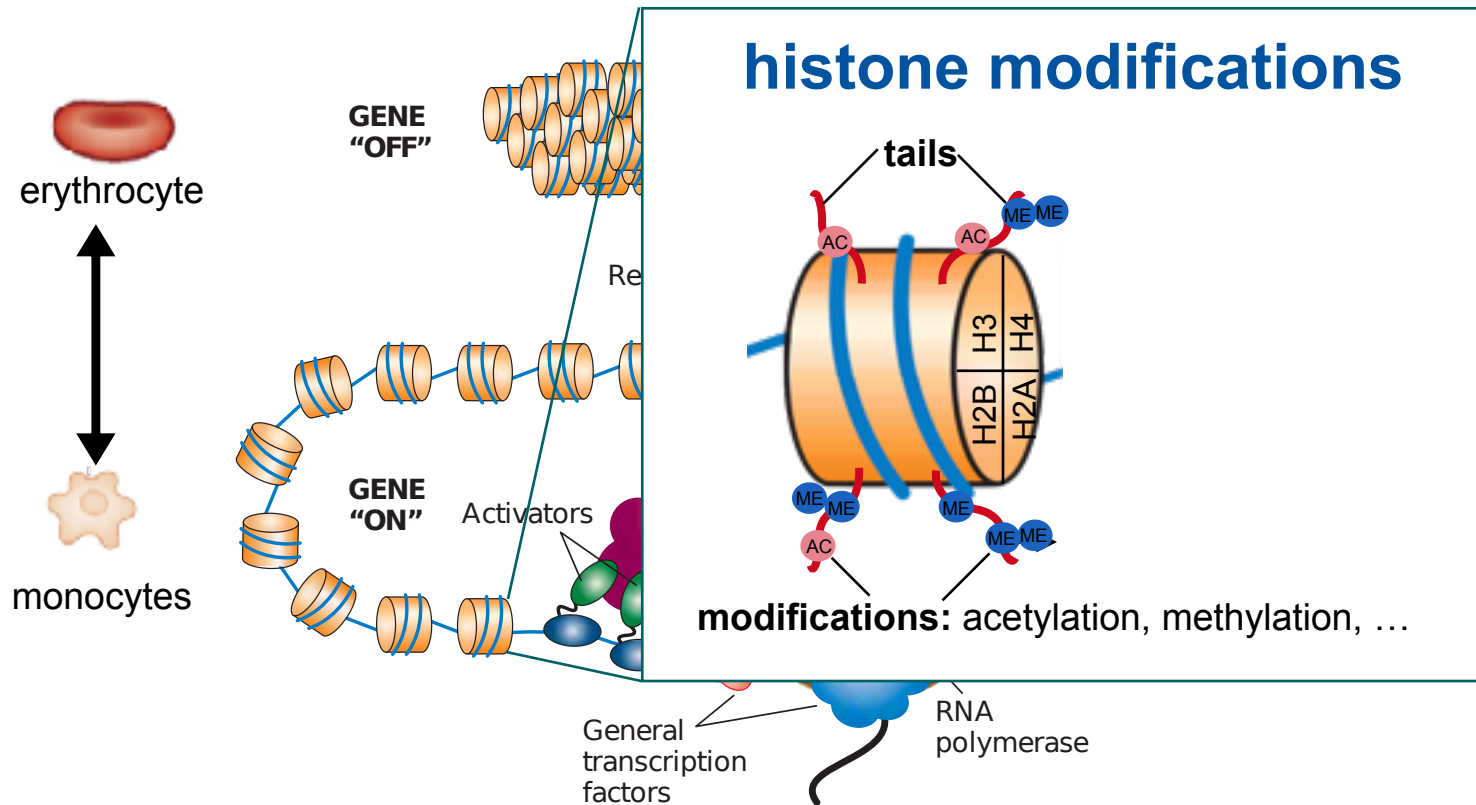
Chromatin and Gene Regulation



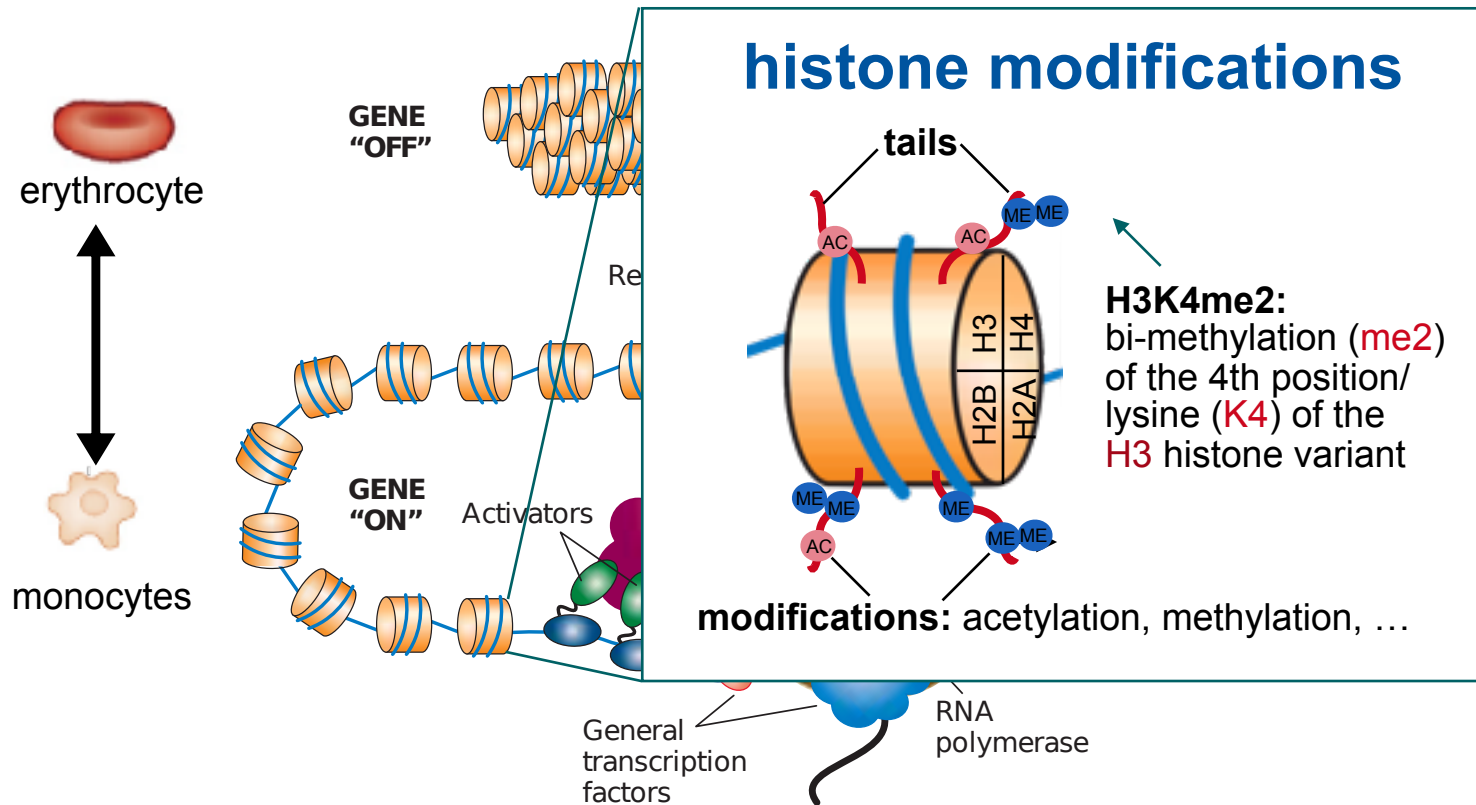
Chromatin and Cell Memory/Plasticity



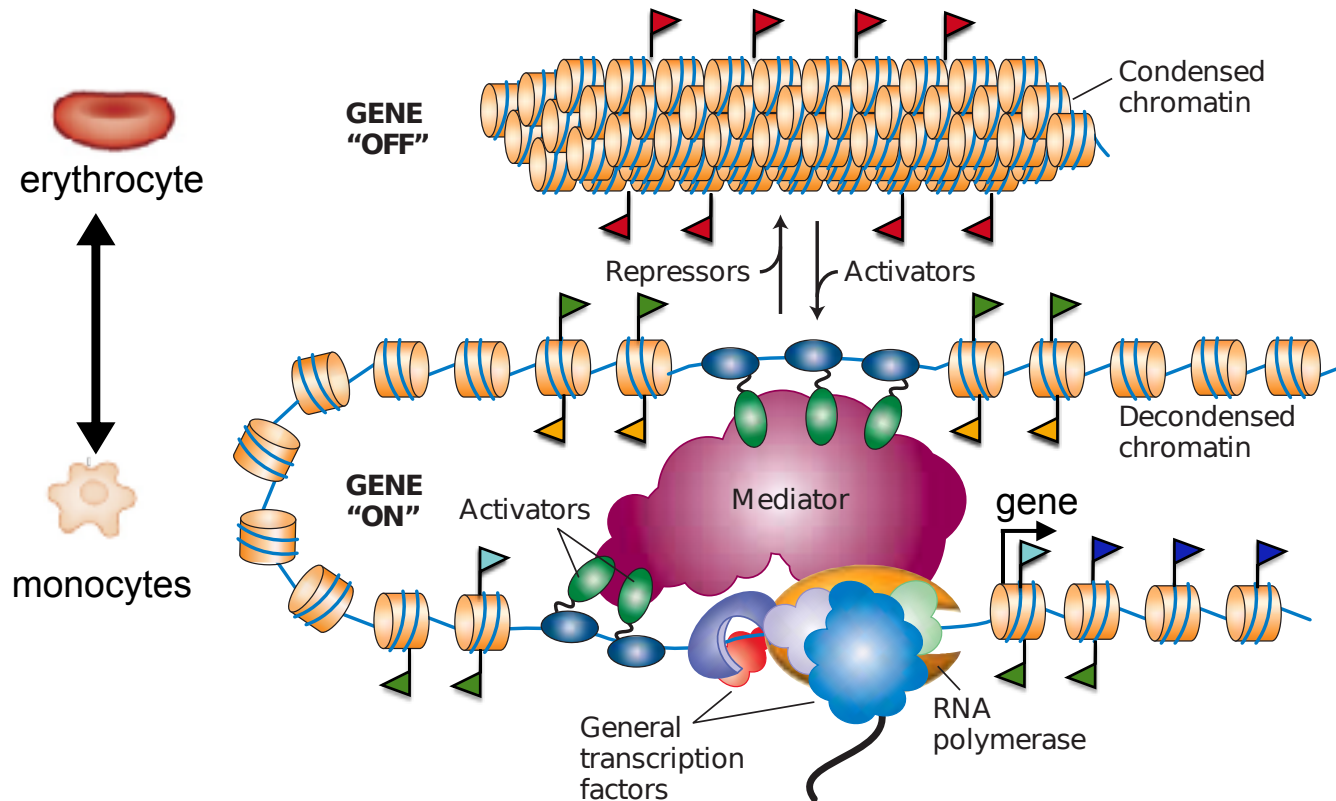
Chromatin and Histones



Chromatin and Histones



Chromatin and Cell Memory/Plasticity



Histone Code

Transcription

H3K79me2, H3K36me3

Active Regions

H3K27ac, H3K9ac

Active Promoters

H3K4me3

Active Enhancers

H3K4me1

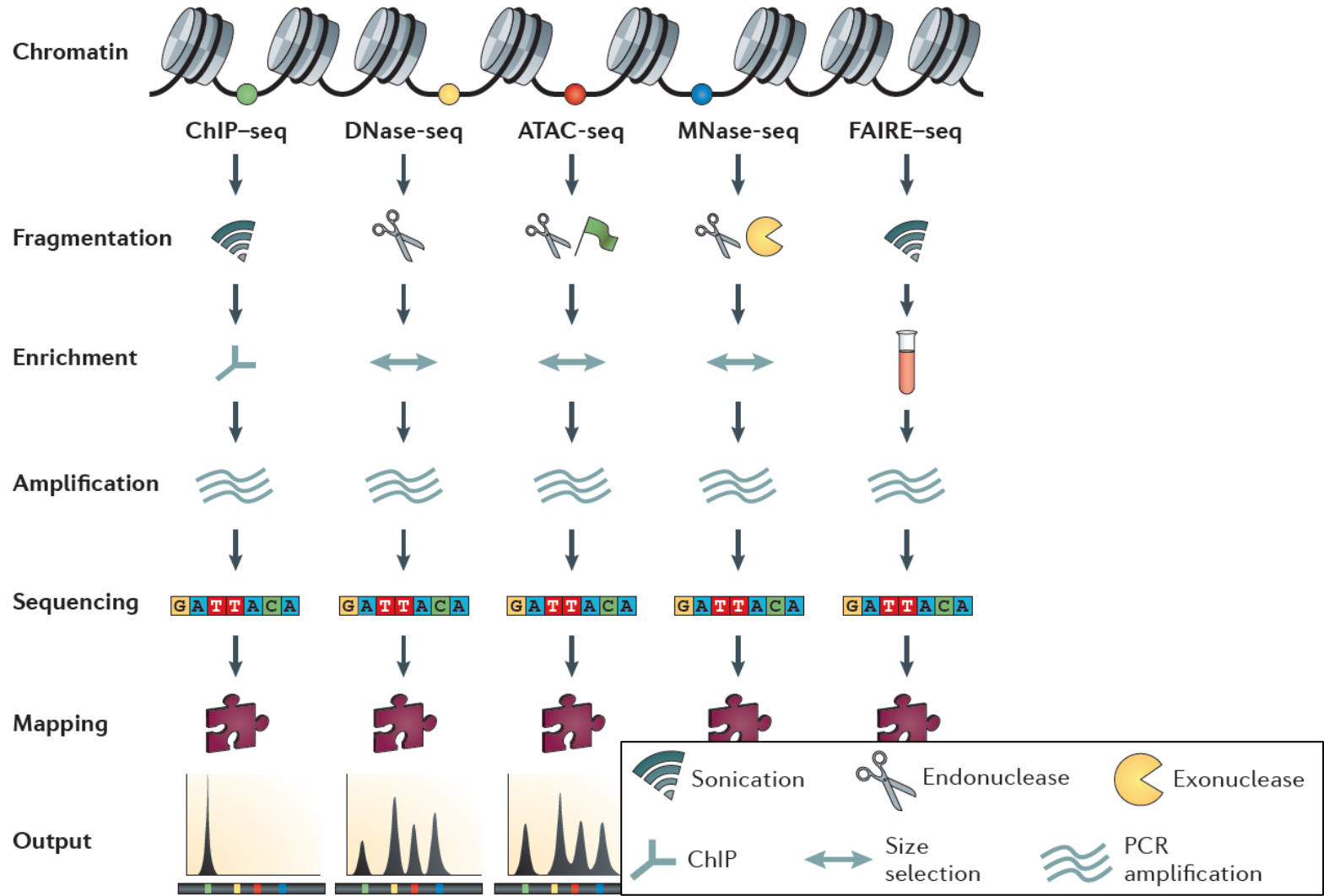
Repressed Prom.

H3K27me3

Repressed Regions

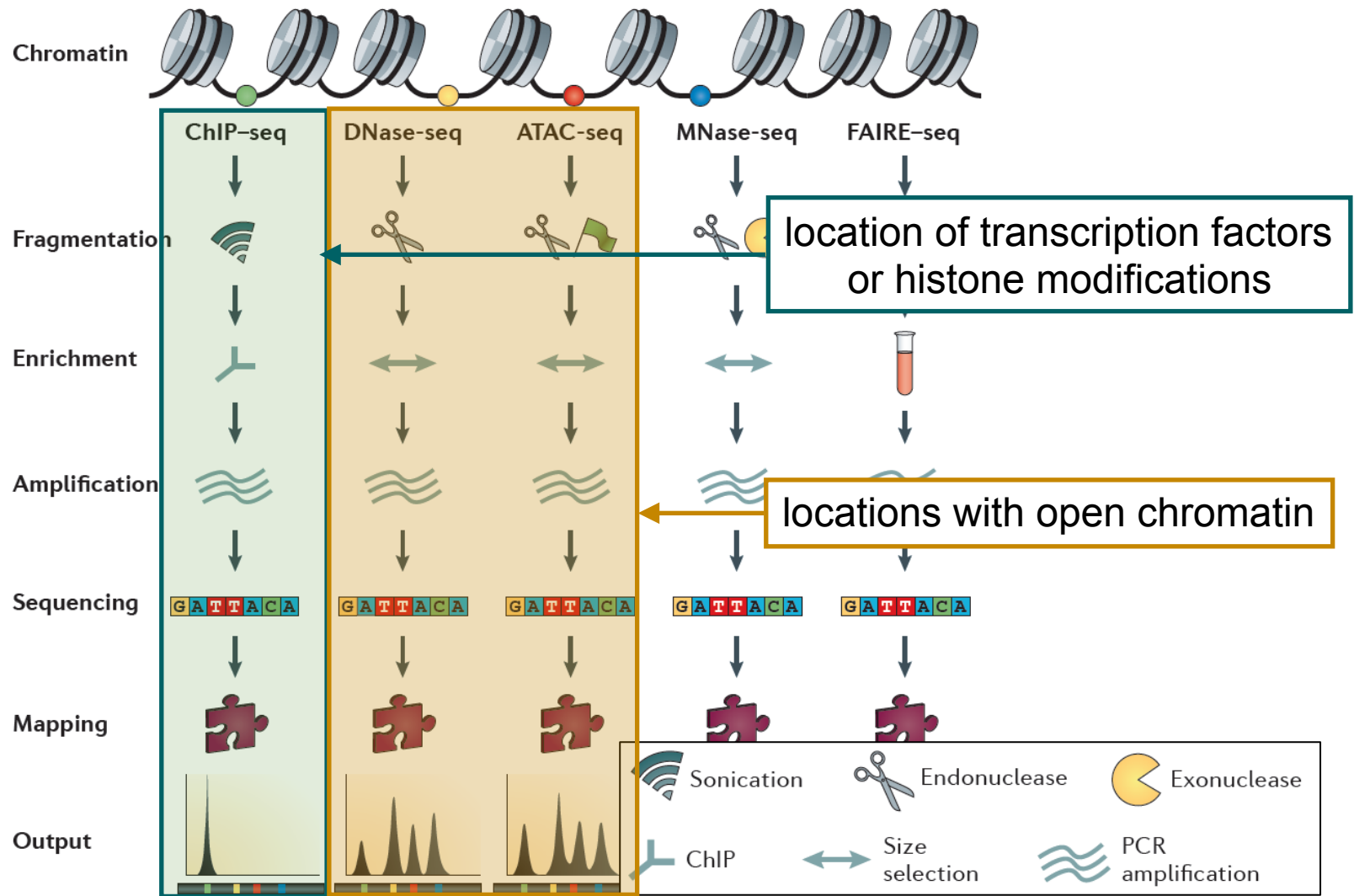
H3K9me3

NGS and Chromatin



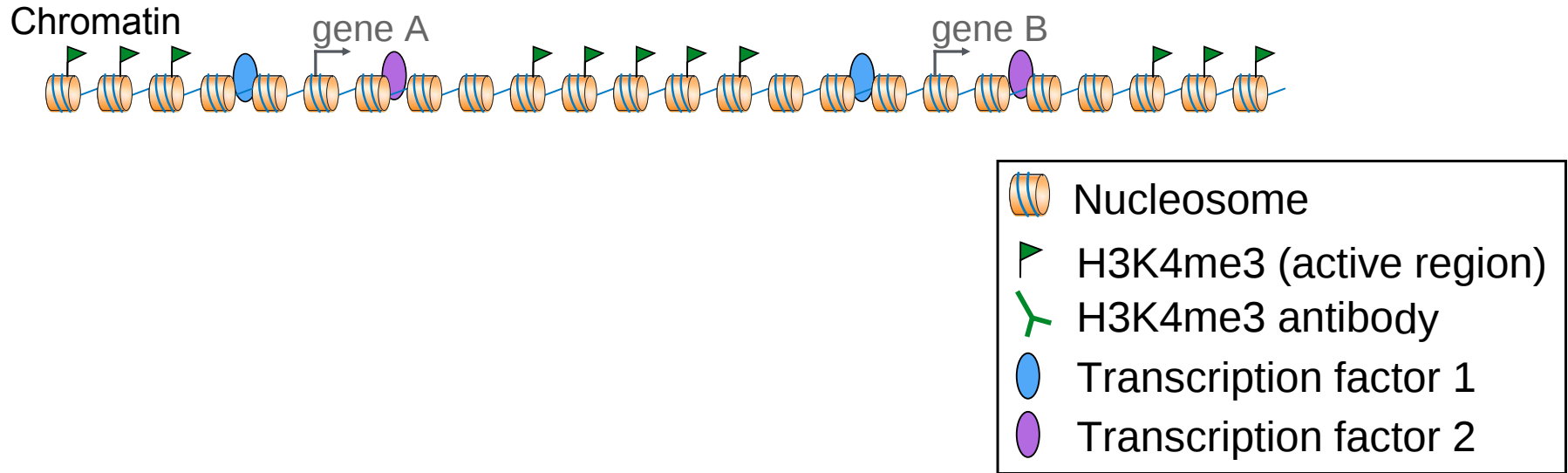
Source: Meyer, C.A. and Liu X.S. (2014). *Nature Reviews Genetics*.

NGS and Chromatin

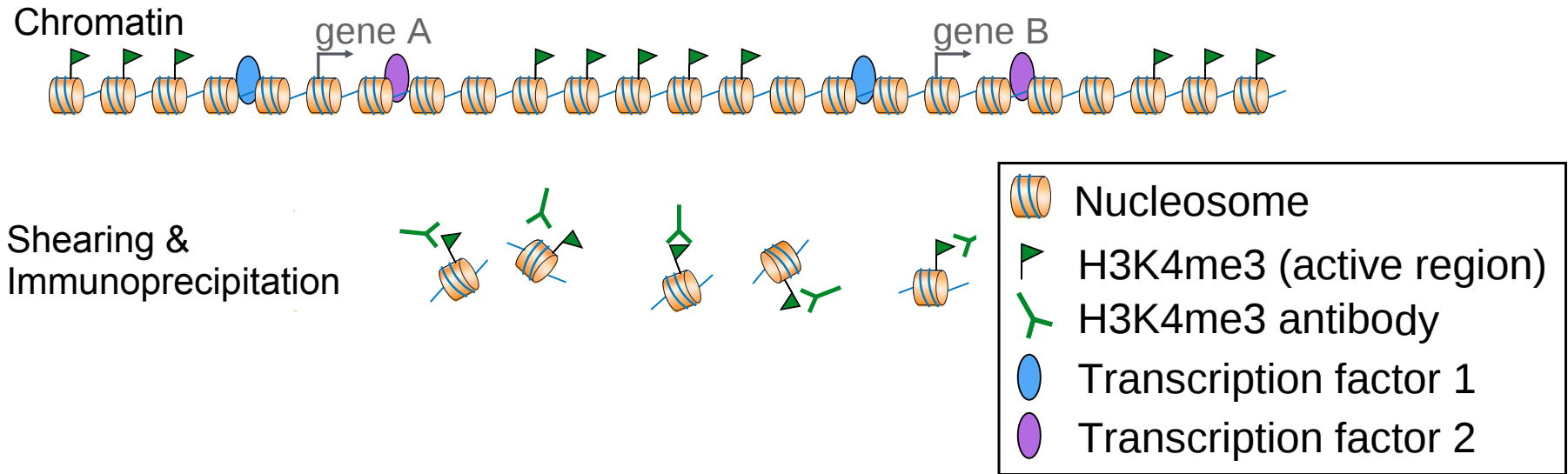


Source: Meyer, C.A. and Liu X.S. (2014). *Nature Reviews Genetics*.

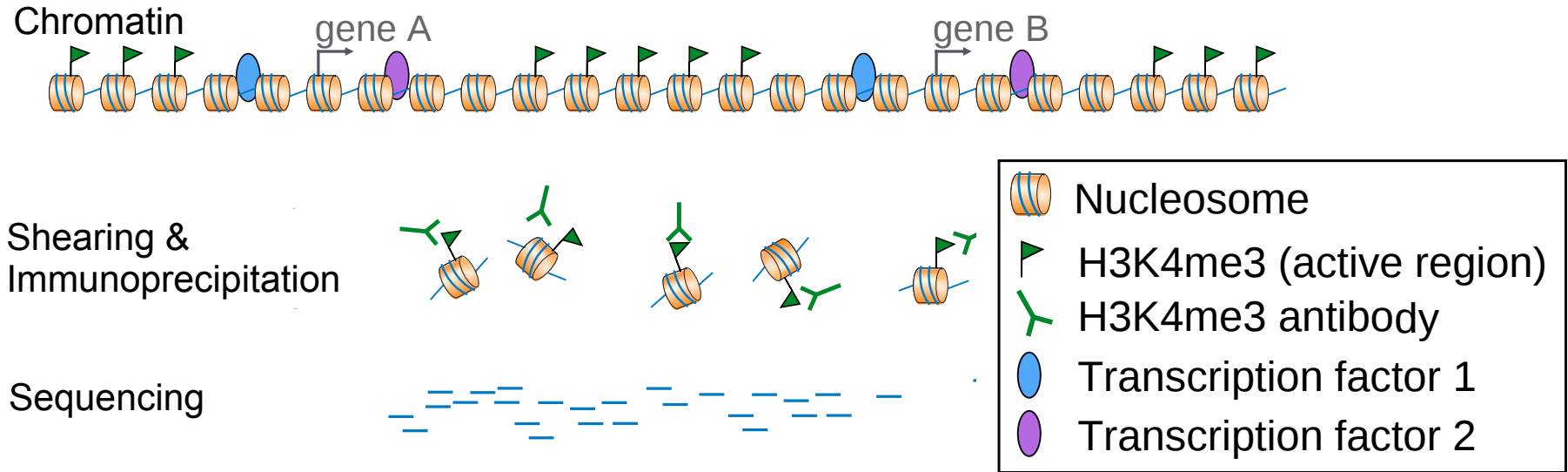
DNA - Protein interactions with ChIP-Seq



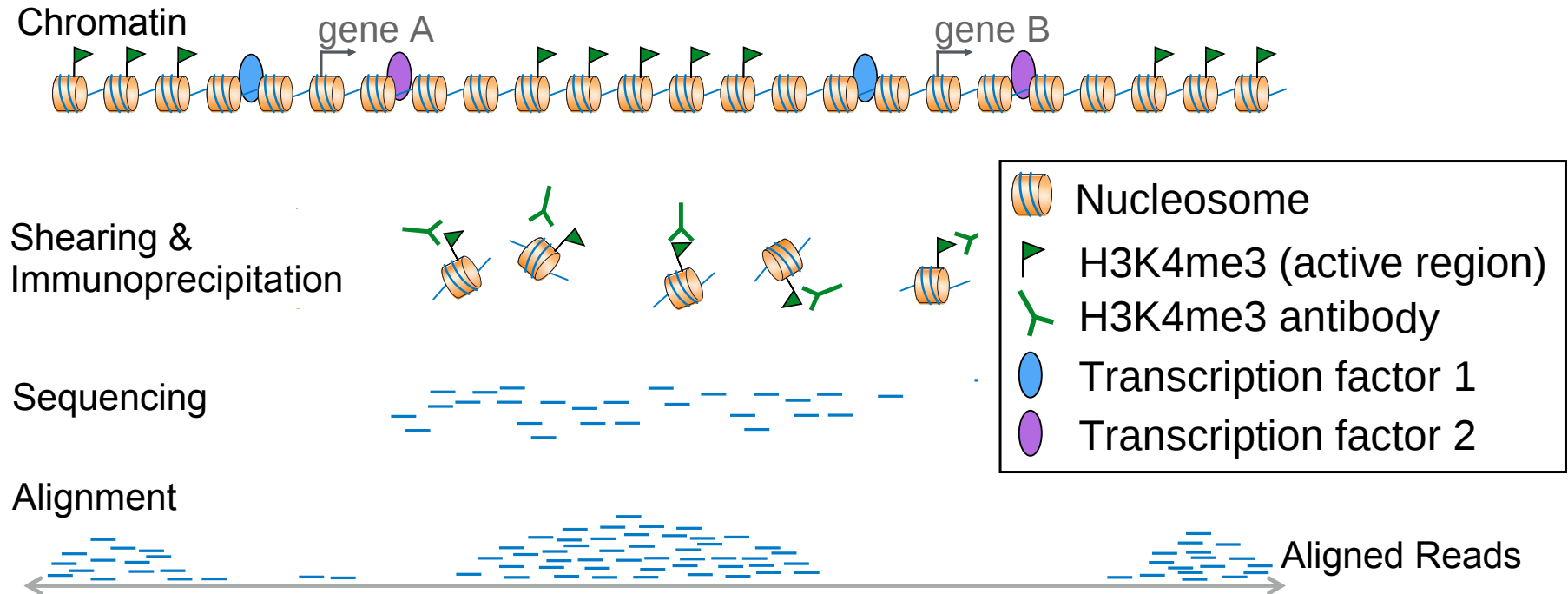
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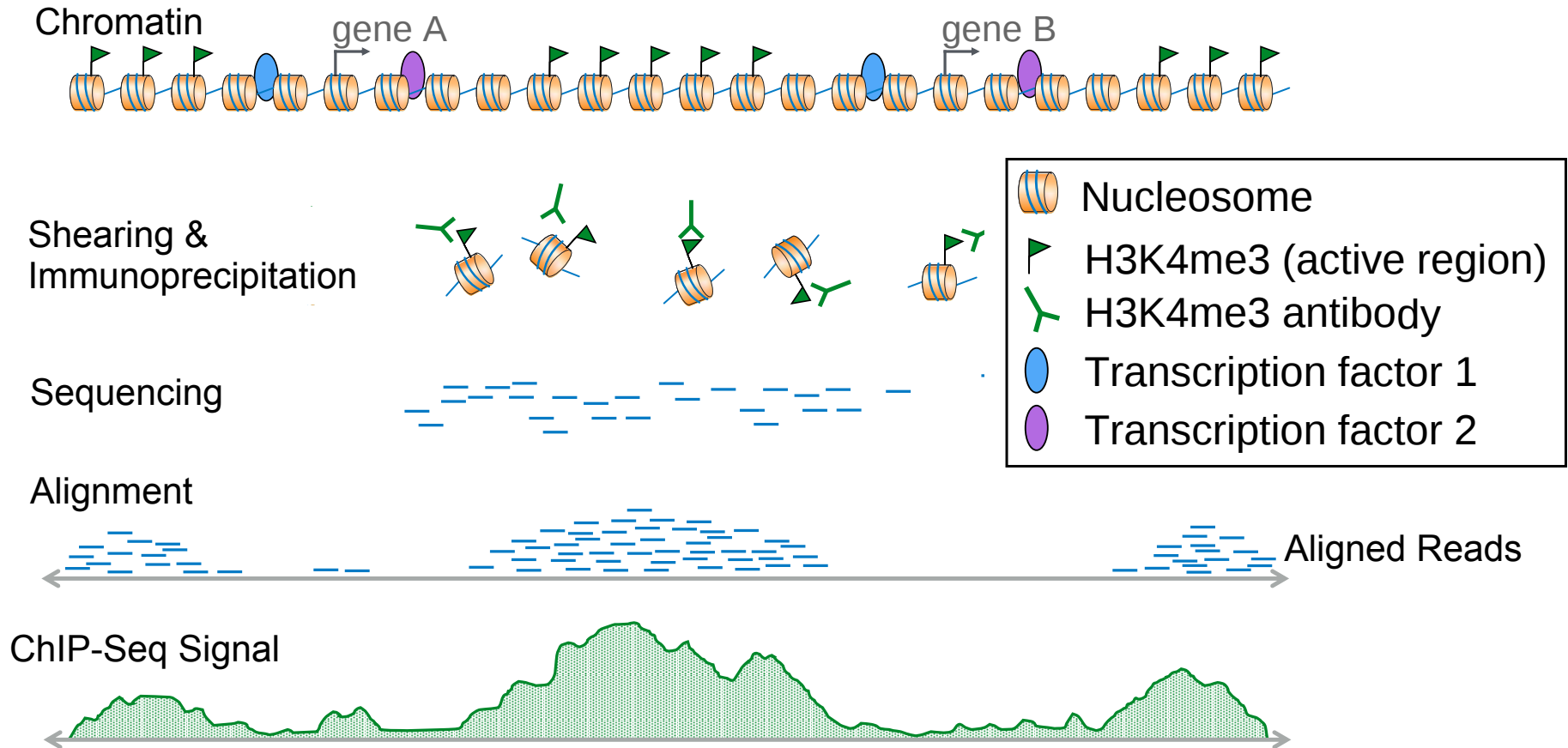
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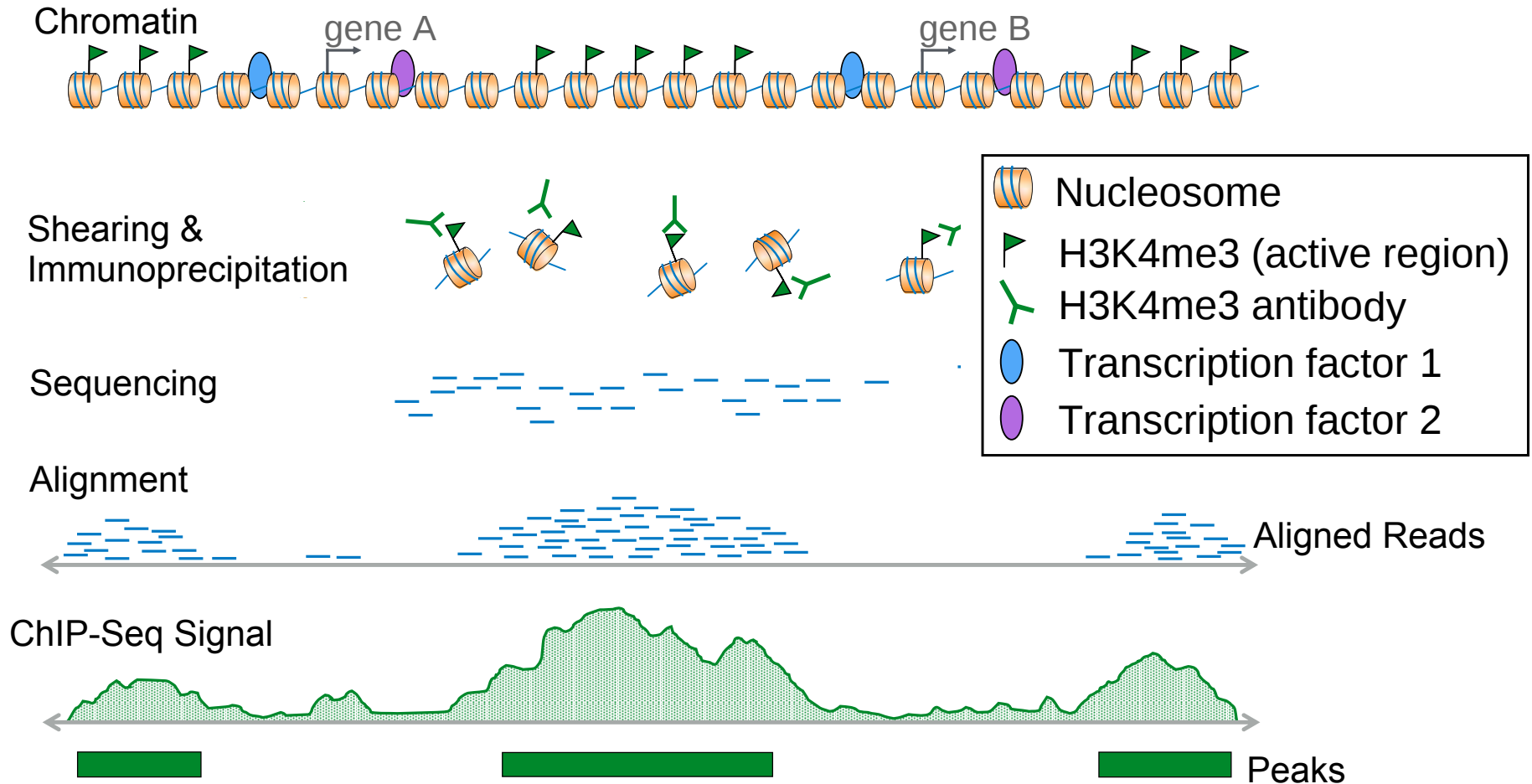
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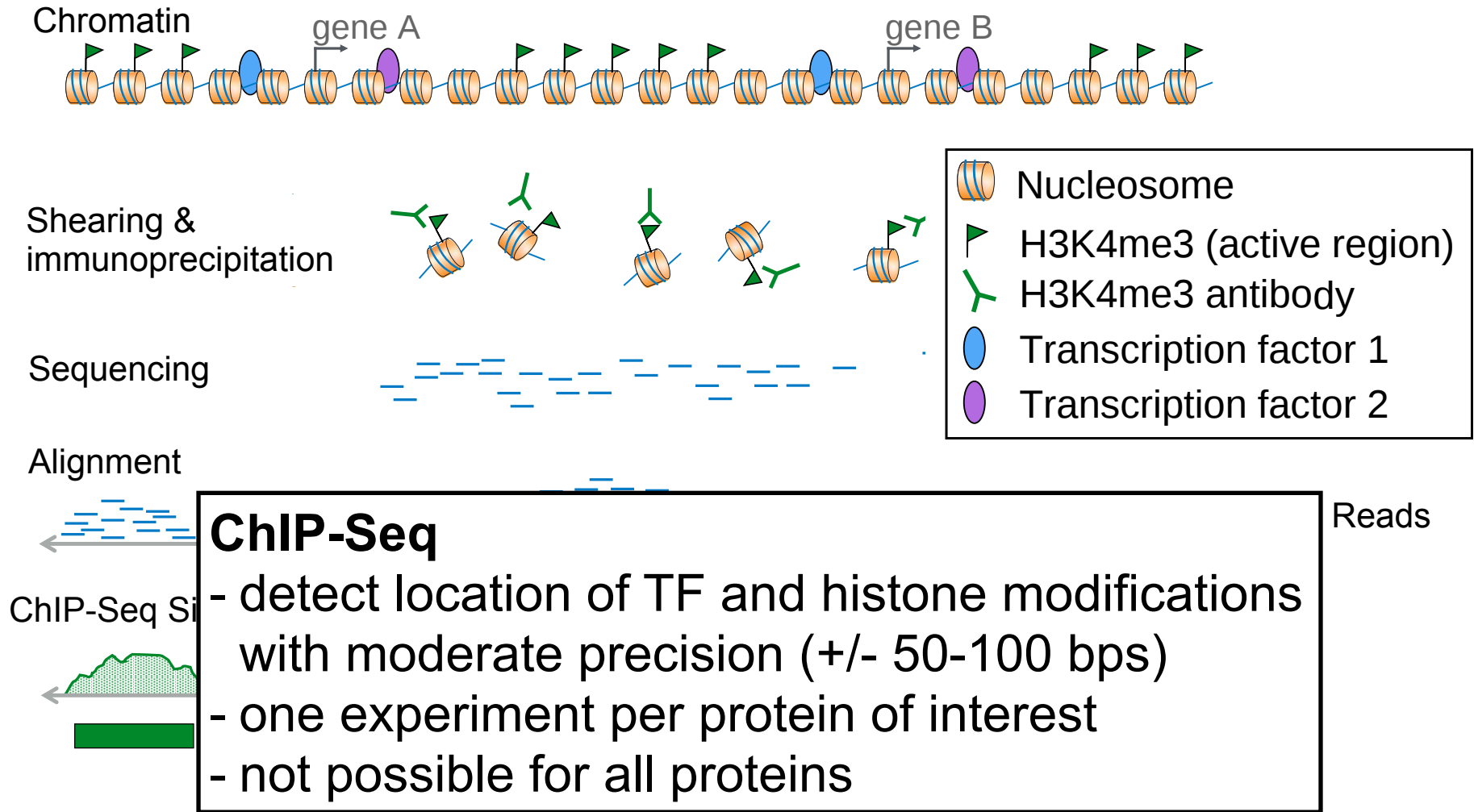
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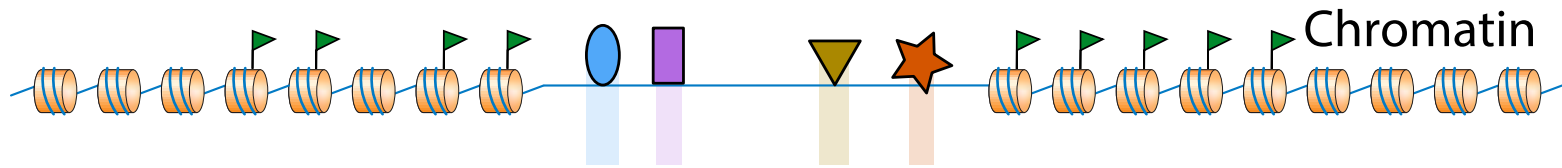
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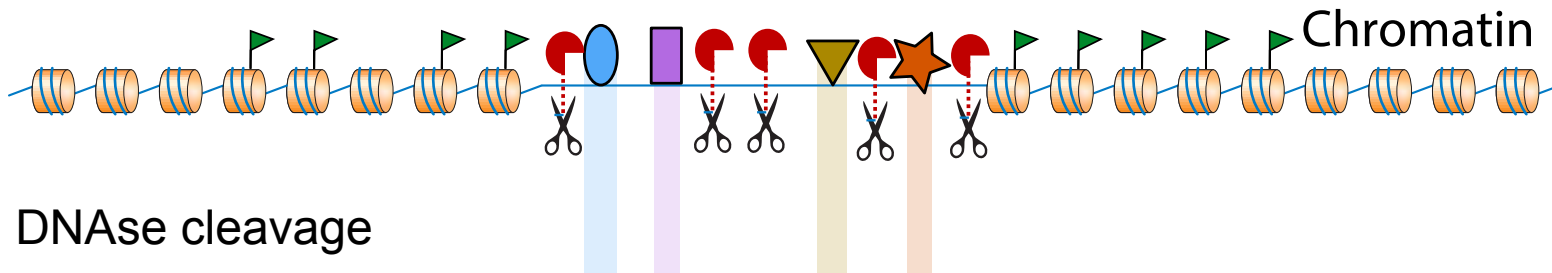






DNA - Protein interactions with DNase-Seq



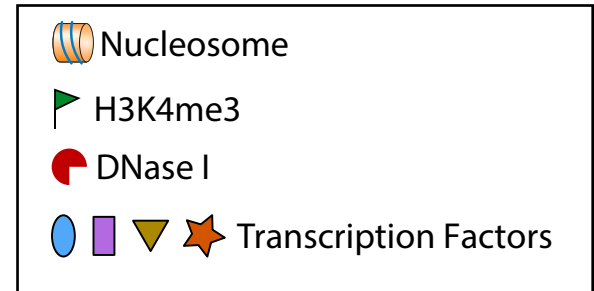
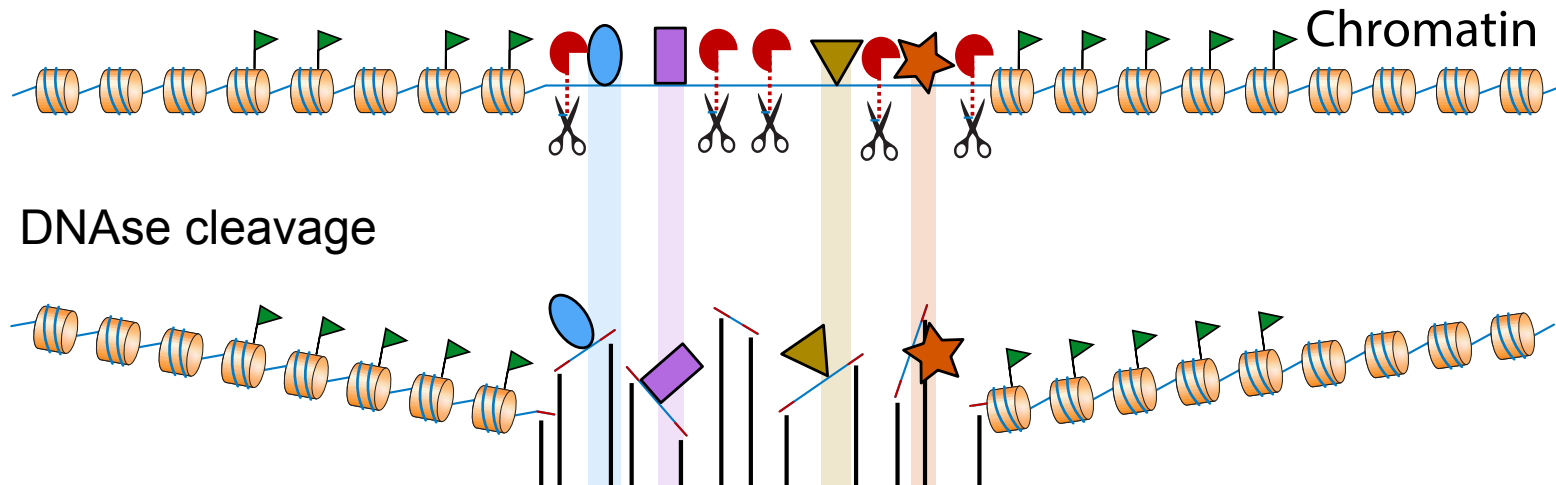
-  Nucleosome
-  H3K4me3
-  DNase I
-  Transcription Factors

DNA - Protein interactions with DNase-Seq

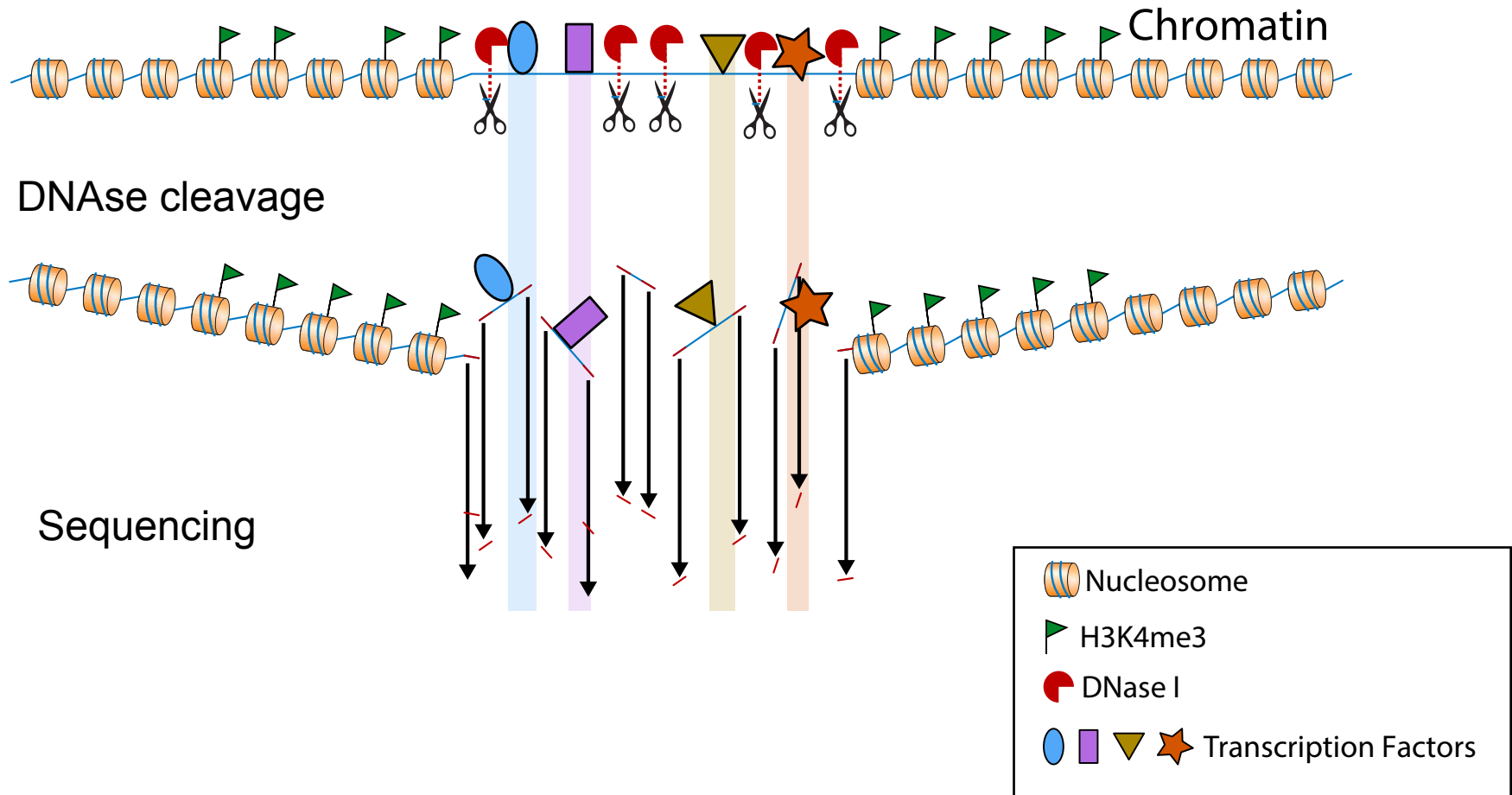


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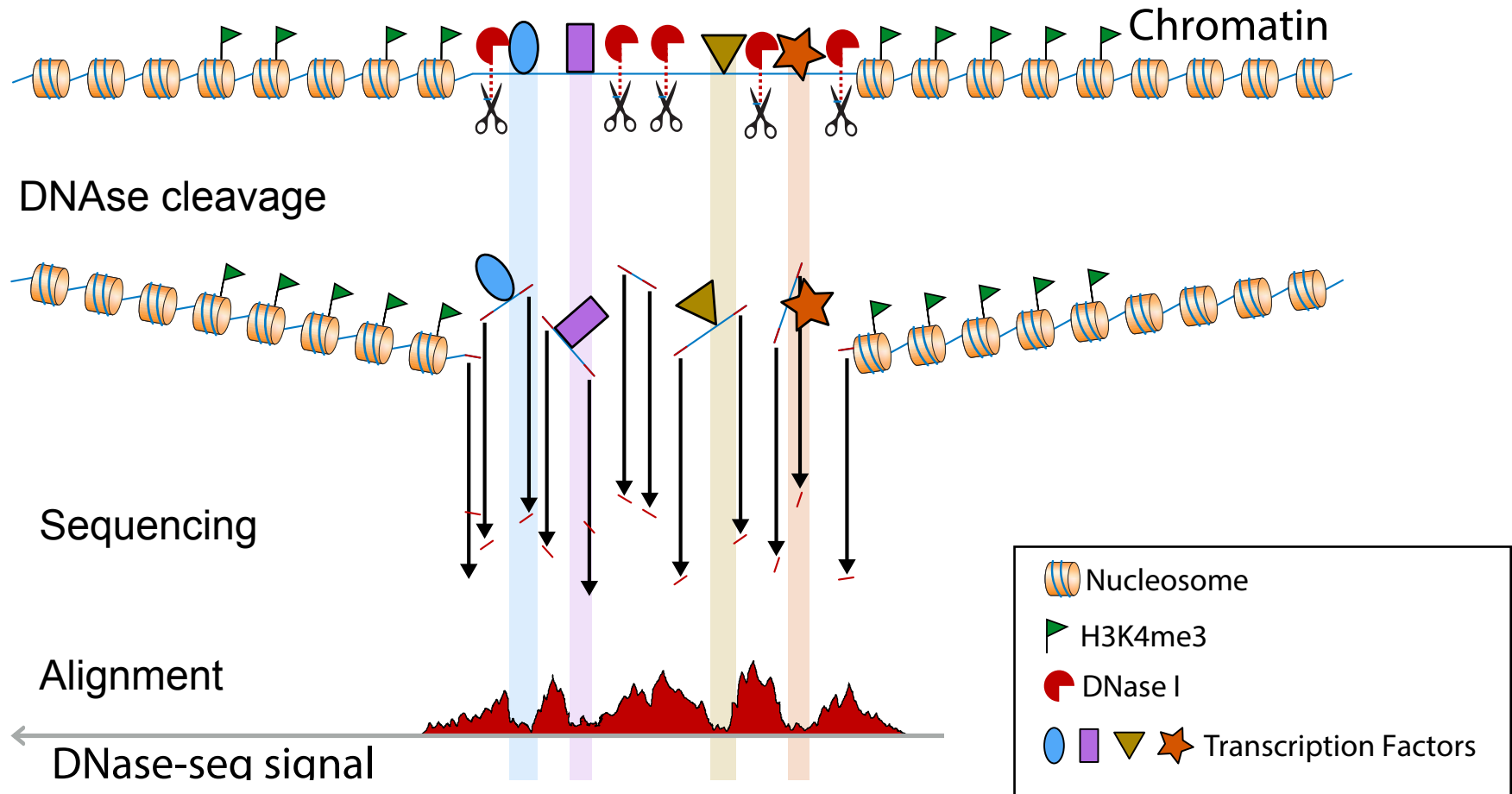
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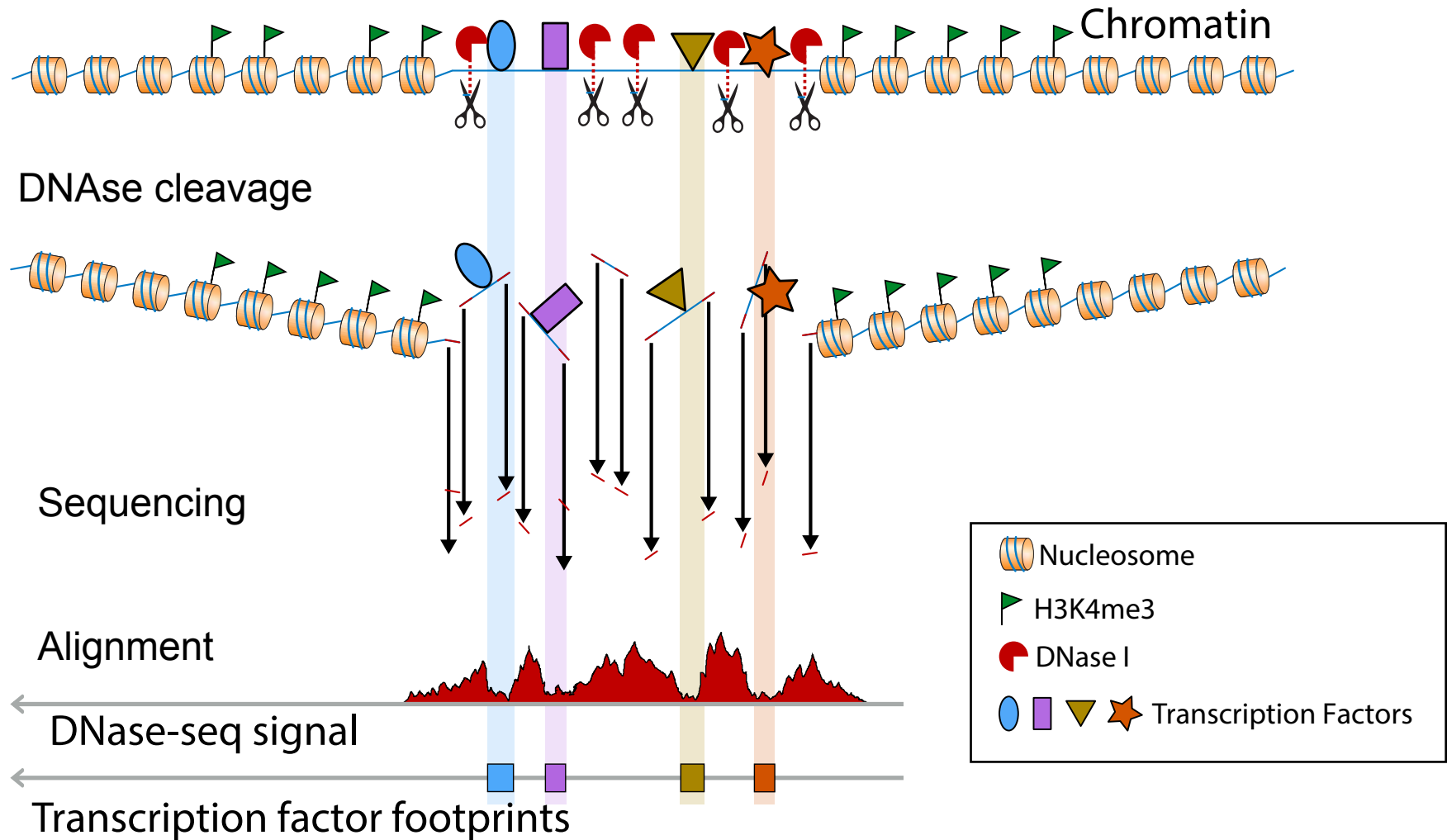
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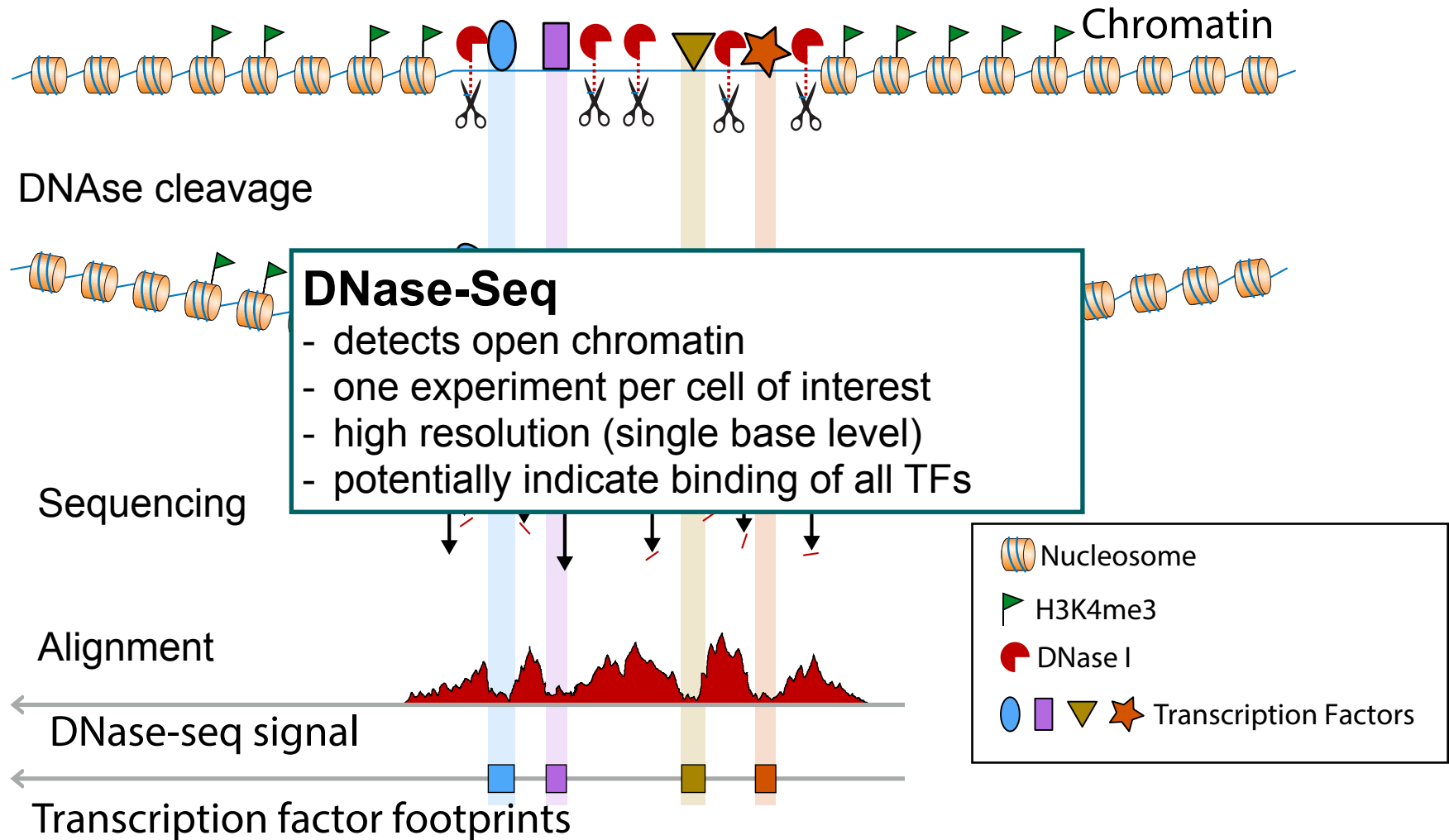
DNA - Protein interactions with DNase-Seq



DNA - Protein interactions with DNase-Seq



DNA - Protein interactions with DNase-Seq



Overview

Transcription factors

- main player of gene regulation/transcription

Chromatin/histones

- organization of chromatin conformation and controls cellular memory/plasticity

Histone modifications

- affect interaction of histones with DNA and other histones
- indicate regulatory status of genomic regions

Next generation sequencing

- TF binding and histone modifications (ChIP-seq)
- open chromatin regions (DNase- & ATAC-seq)

Next

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