

## LA-UR-20-28744

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Title: Science on Tap 2020

Author(s): Sanbonmatsu, Karissa Yoshiko

Intended for: Web

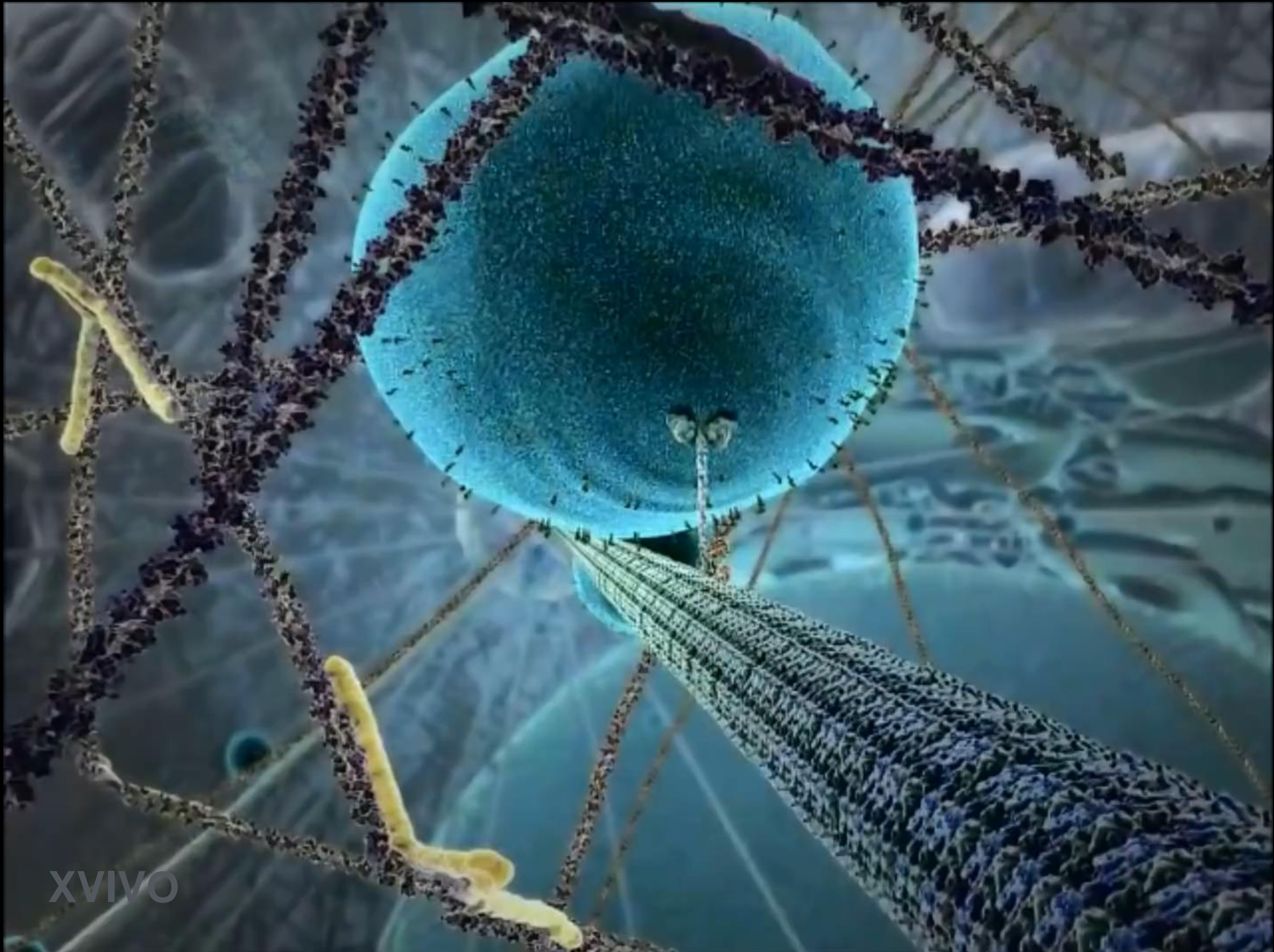
  

Issued: 2020-10-29

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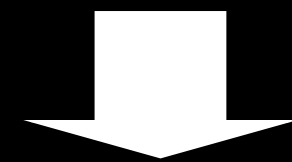
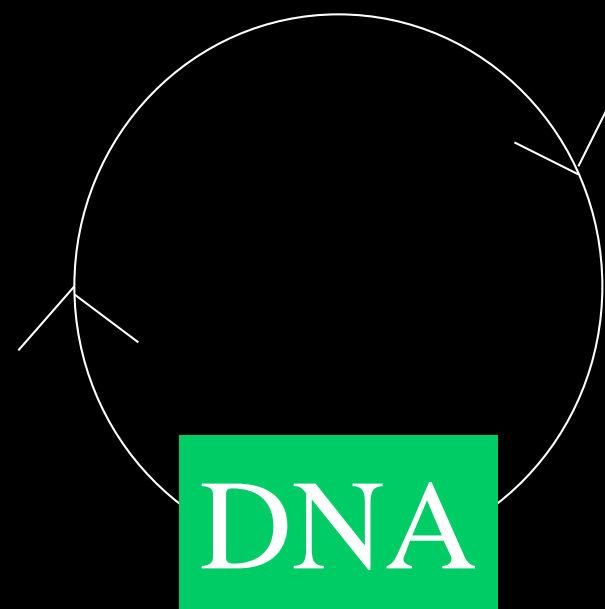
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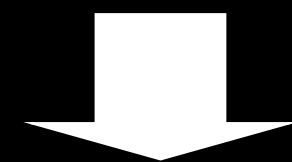
# Central Dogma of Biology

**DNA polymerase**



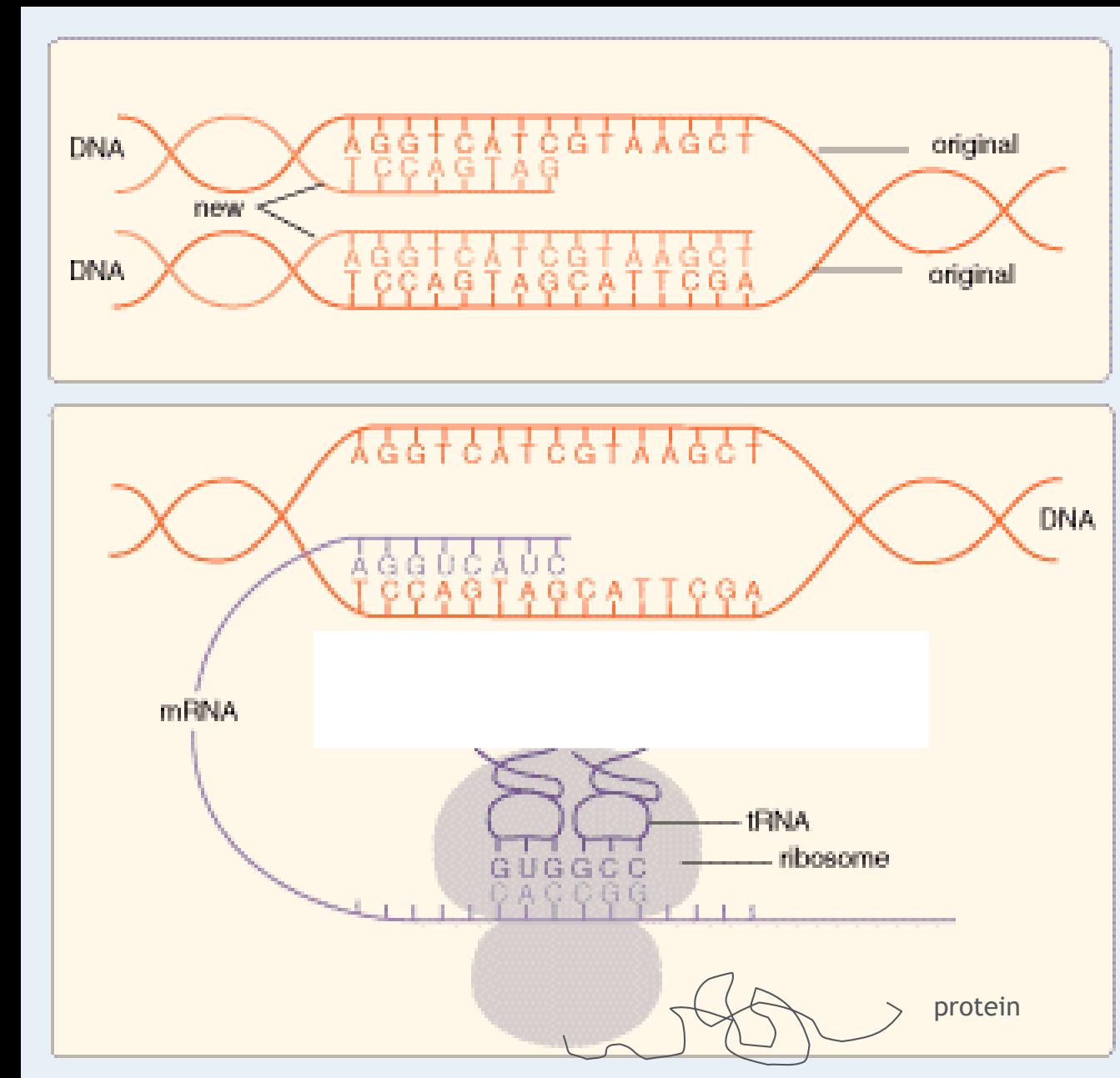
**RNA polymerase**

**RNA**



**RIBOSOME**

**PROTEIN**

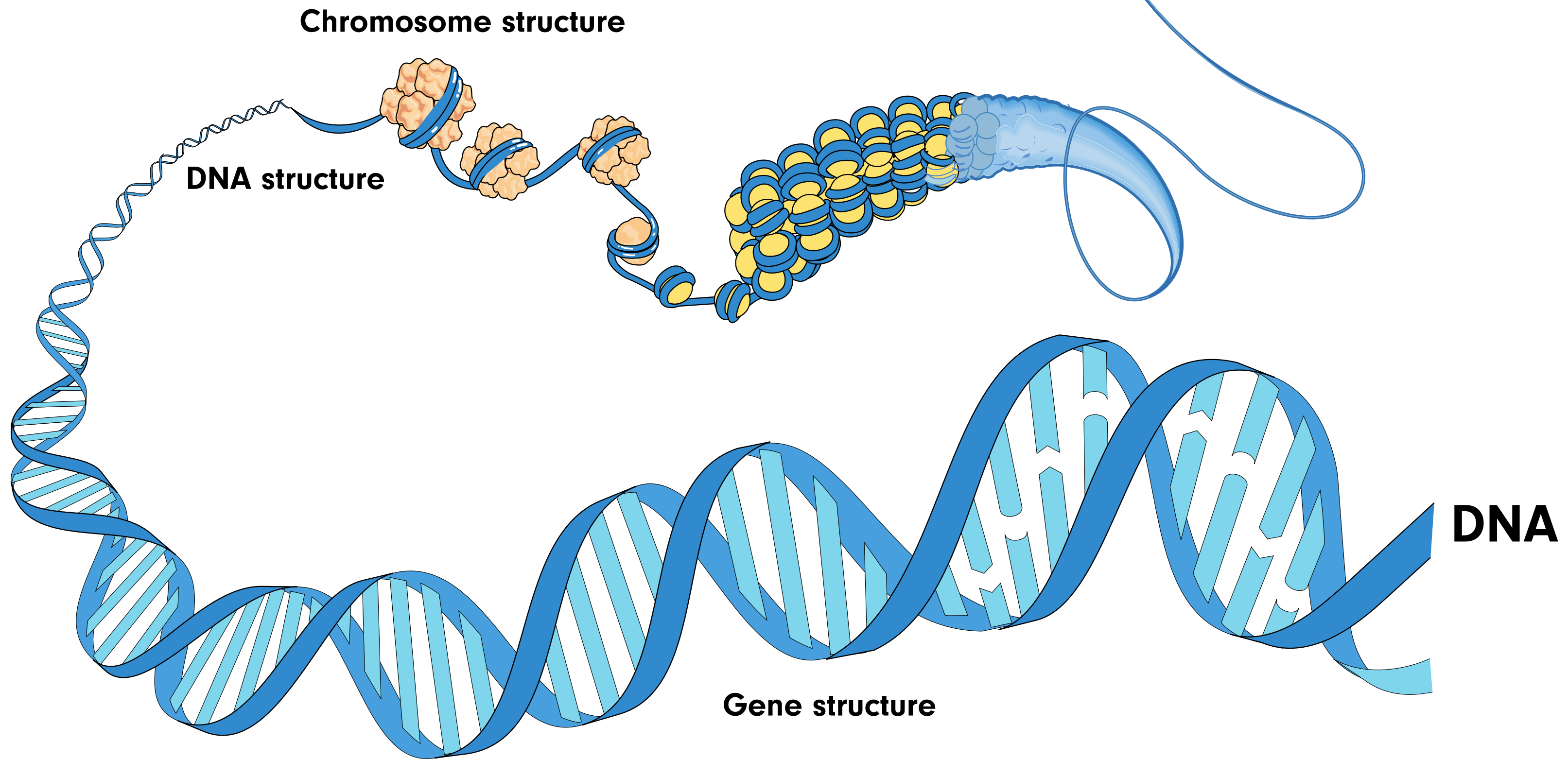
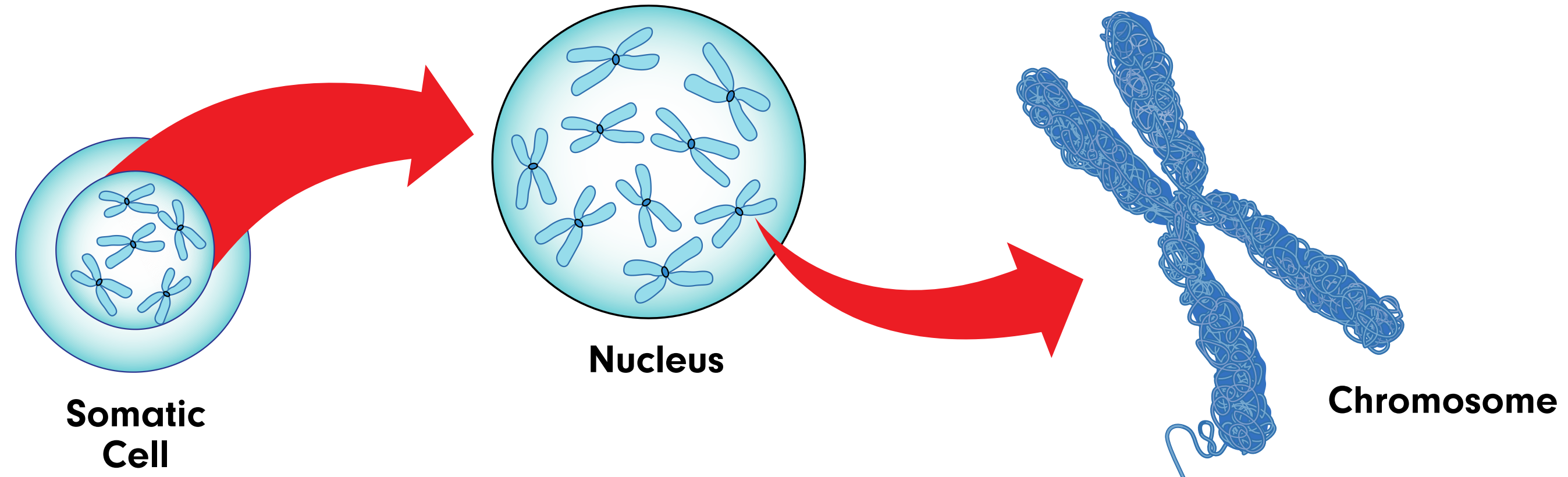


DNA replication

RNA production  
(transcription)

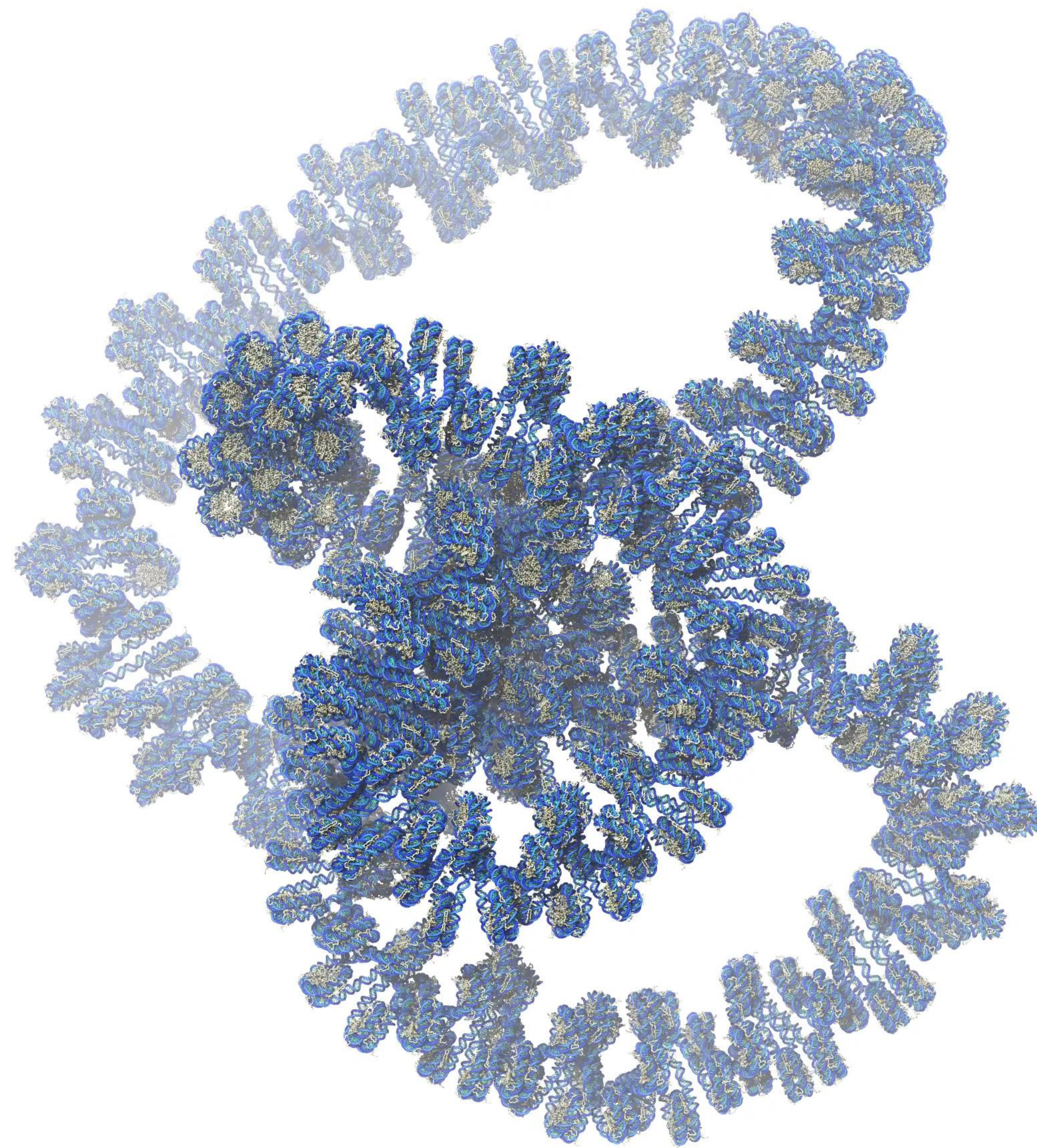
Protein production  
(translation)

# Chromosome structure





Los Alamos National Laboratory TRINITY SUPERCOMPUTER

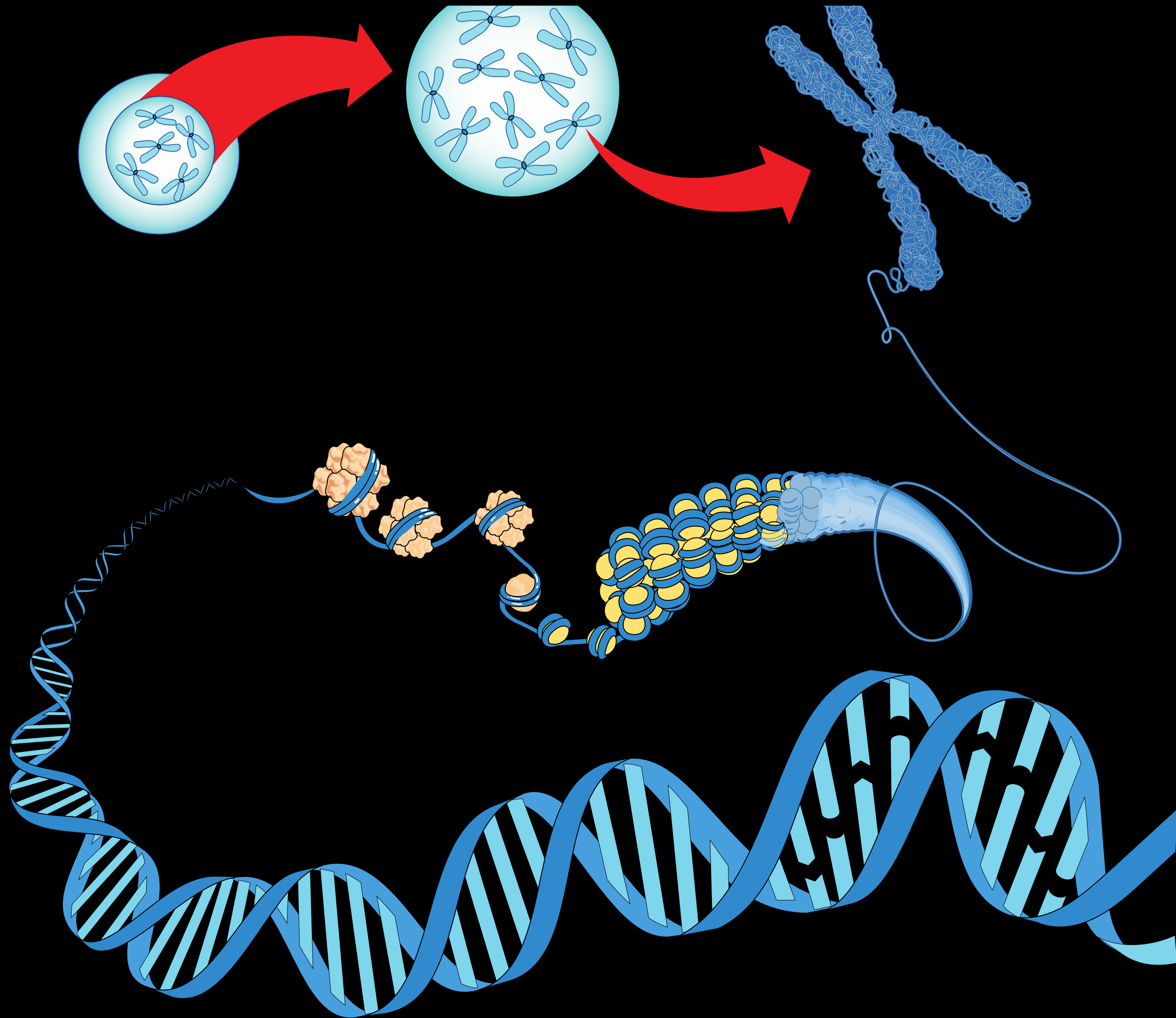


LANL  
NYU  
RIKEN  
CRAY  
INTEL

Sanbonmatsu Lab  
(J. Comp. Chem. 2019)



> 90% of genome does not code for proteins



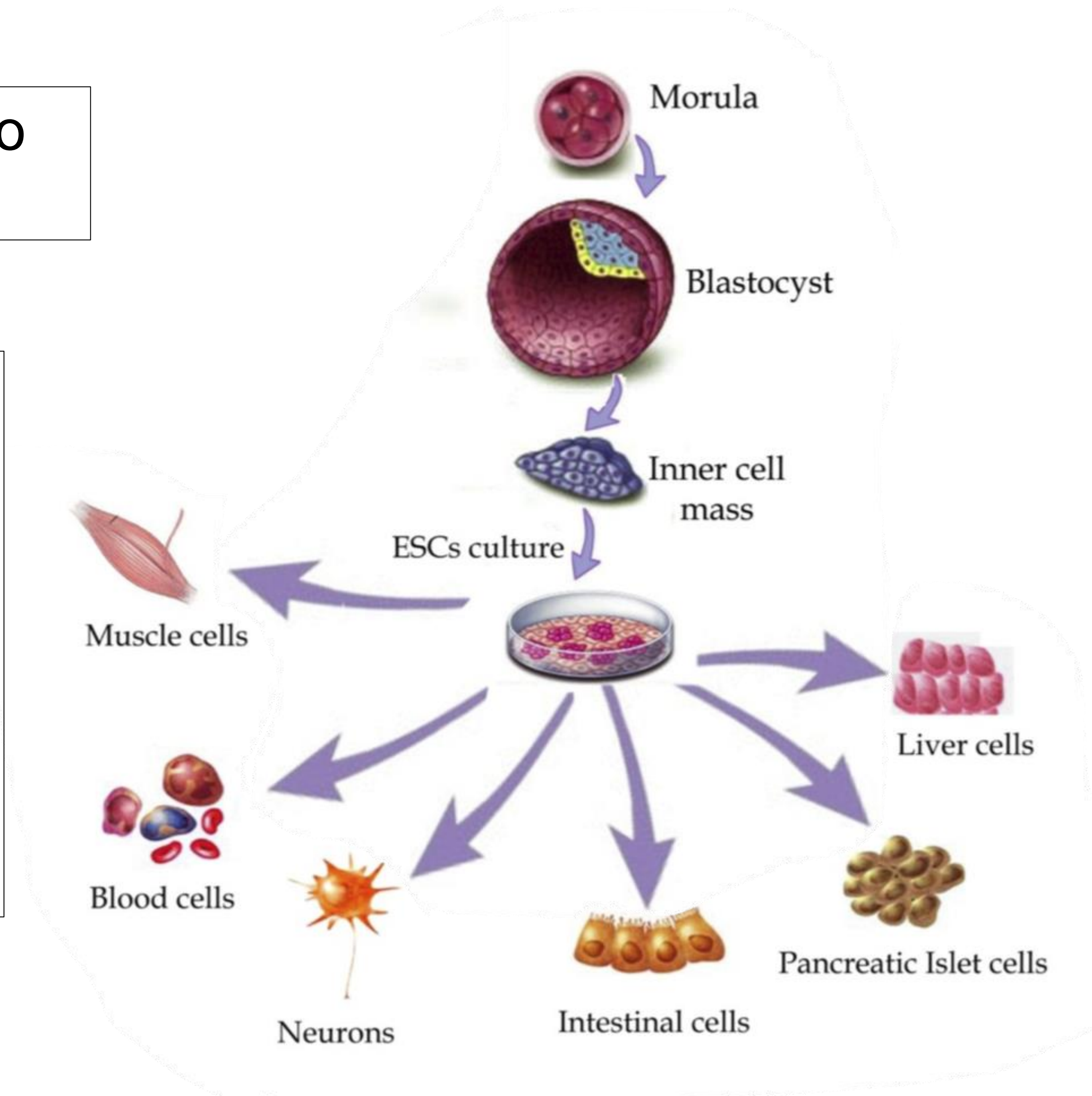
# All cells in your body have nearly identical DNA sequences

Question: how can cells be so different from each other?

Answer:

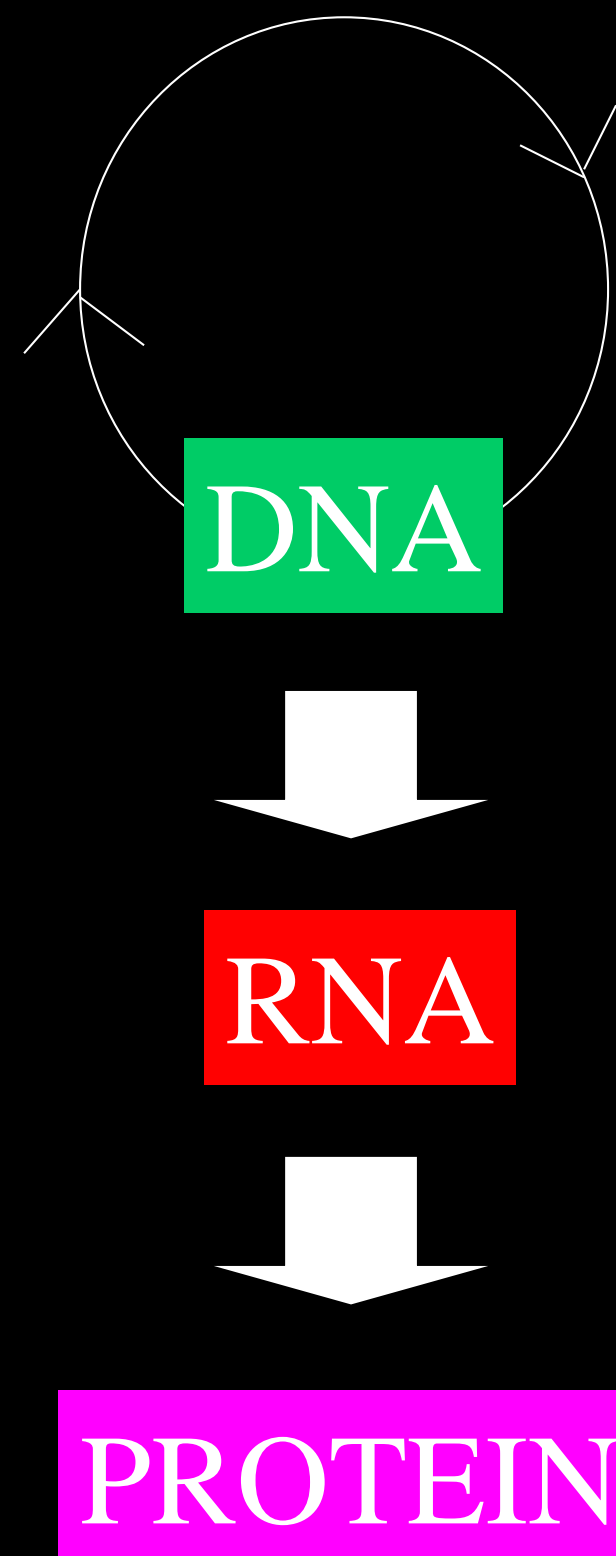
Genes are turned on and off differently during embryo development.

The shape of the chromosome controls this.

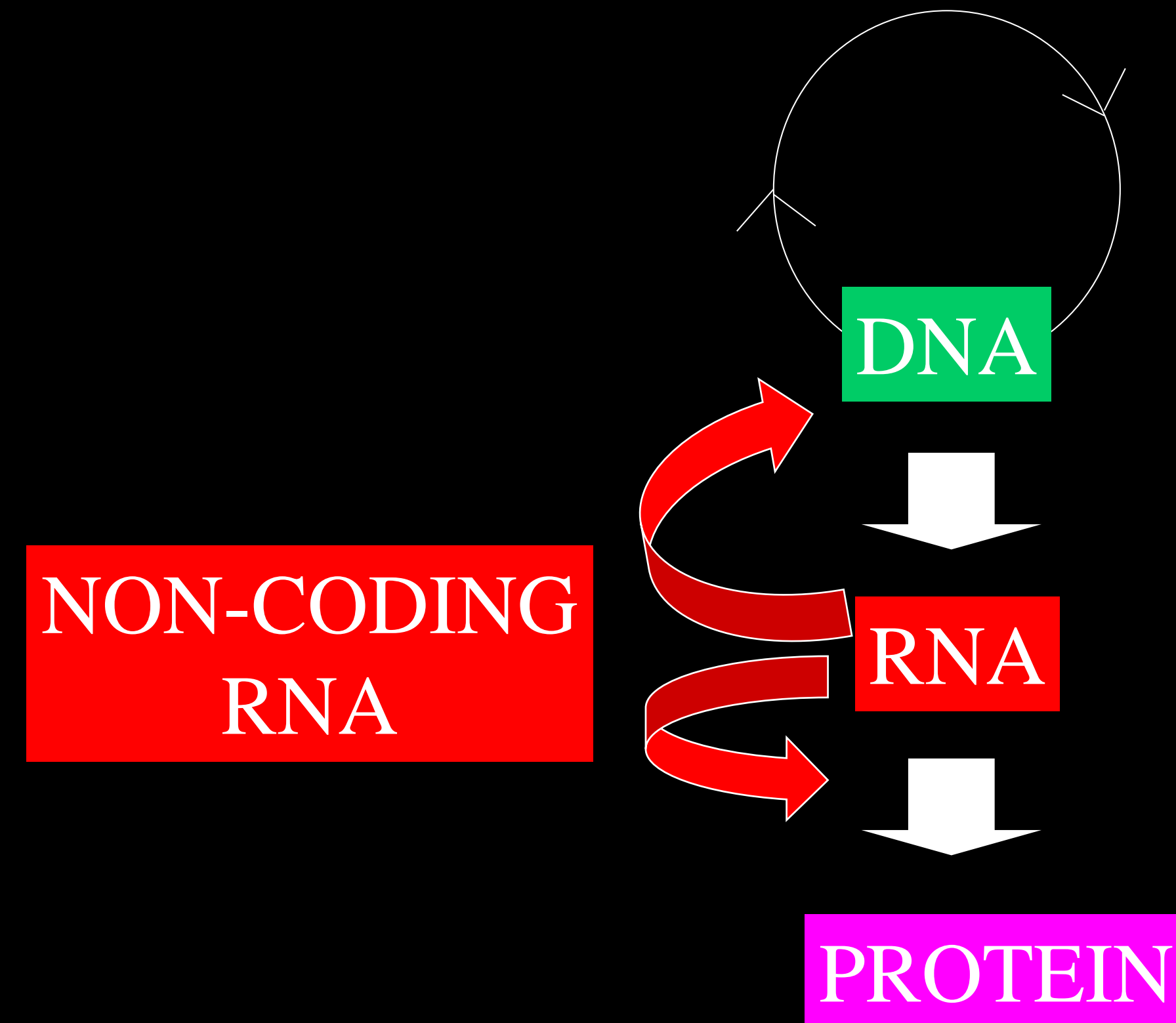


- > 90% of genome encodes RNA that does not code for protein ('non-coding RNA', 'dark matter of genome')

Old data

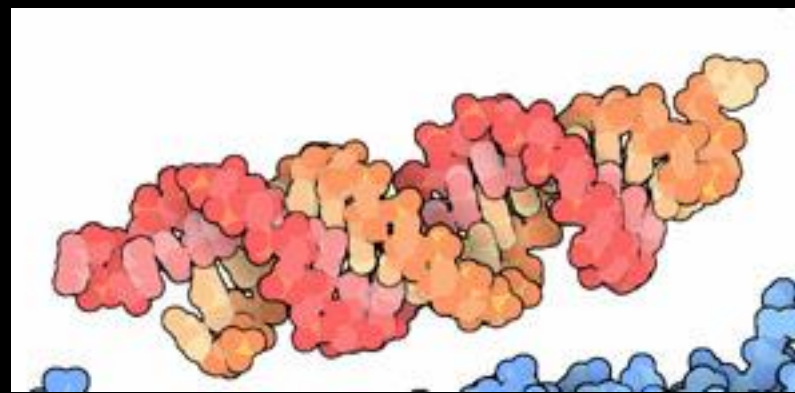
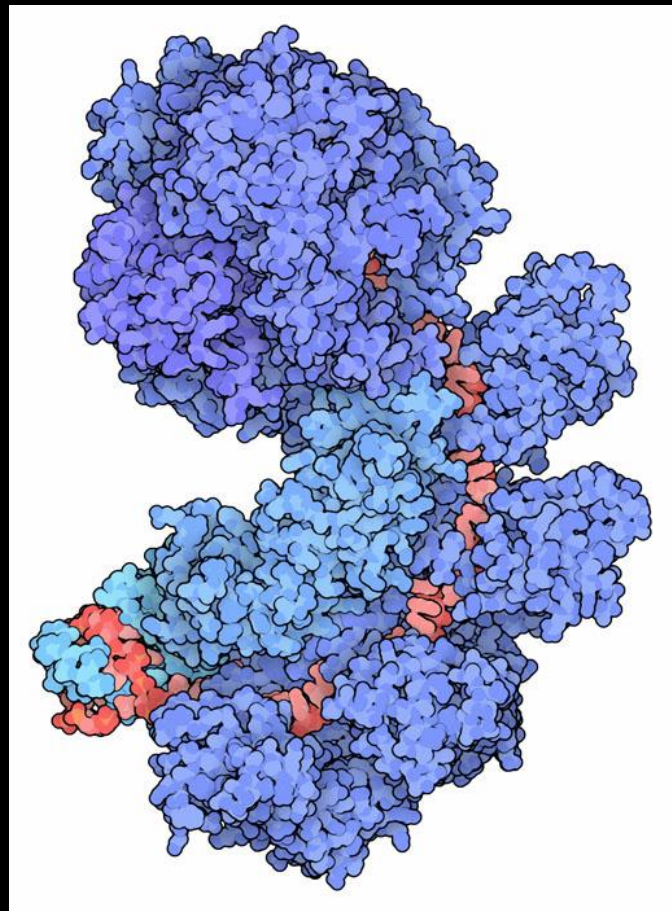


New data



# Non-coding RNA

## Short non-coding RNA



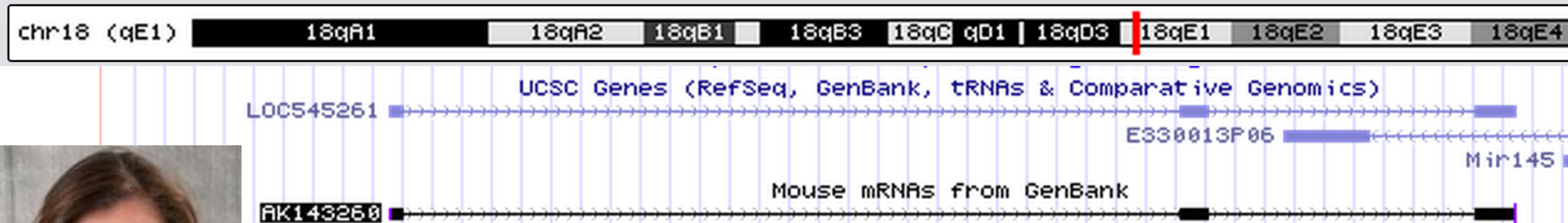
## Long non-coding RNA

?

# Mouse Braveheart



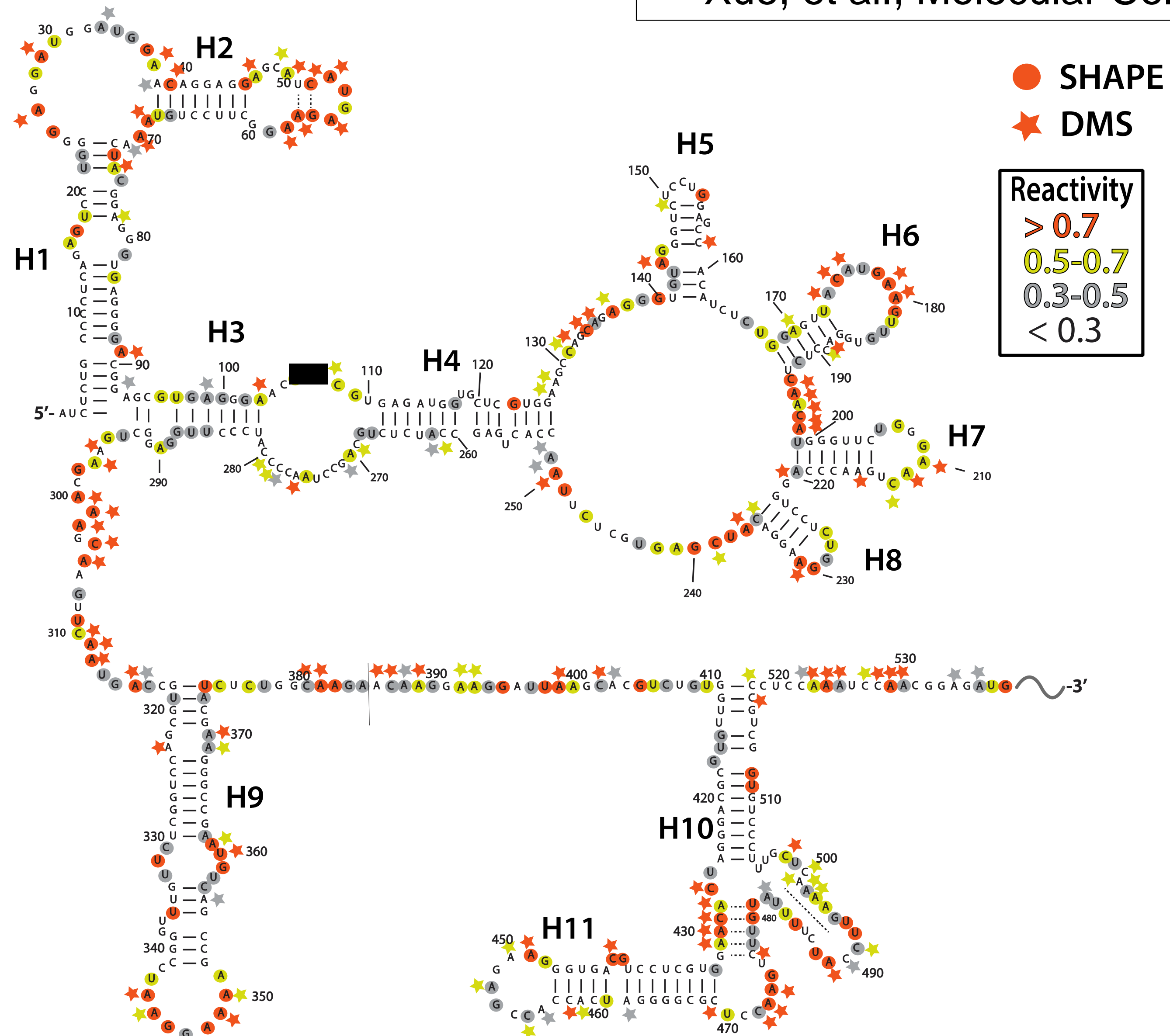
- *Mus musculus*, Klattenhoff, *et al.*, Cell 2013
  - ~540 nts
  - Required for cardiovascular lineage commitment in mouse development



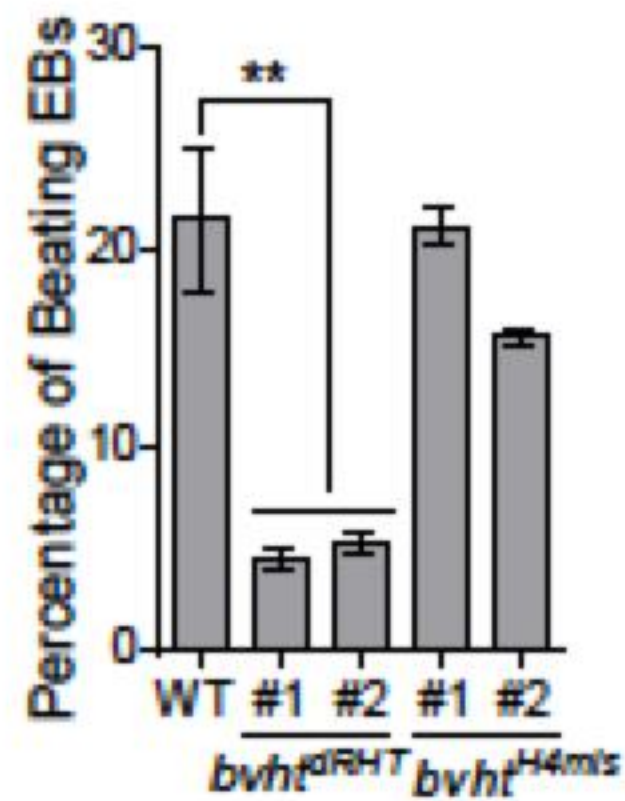
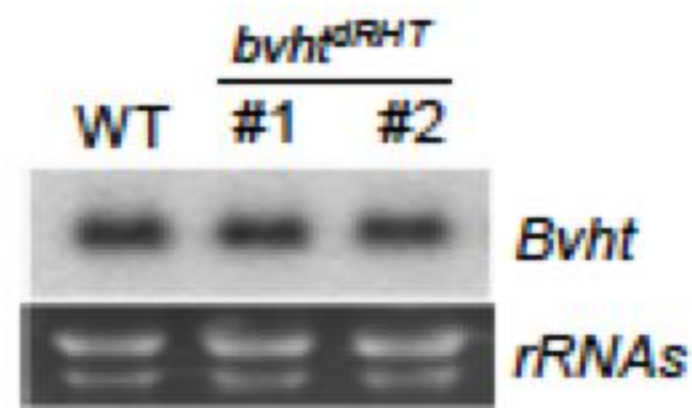
Collab with Laurie Boyer (MIT) and Trushar Patel (Lethbridge, CA)

# Braveheart 2D RNA structure determined in wetlab

Xue, et al., Molecular Cell (2016)

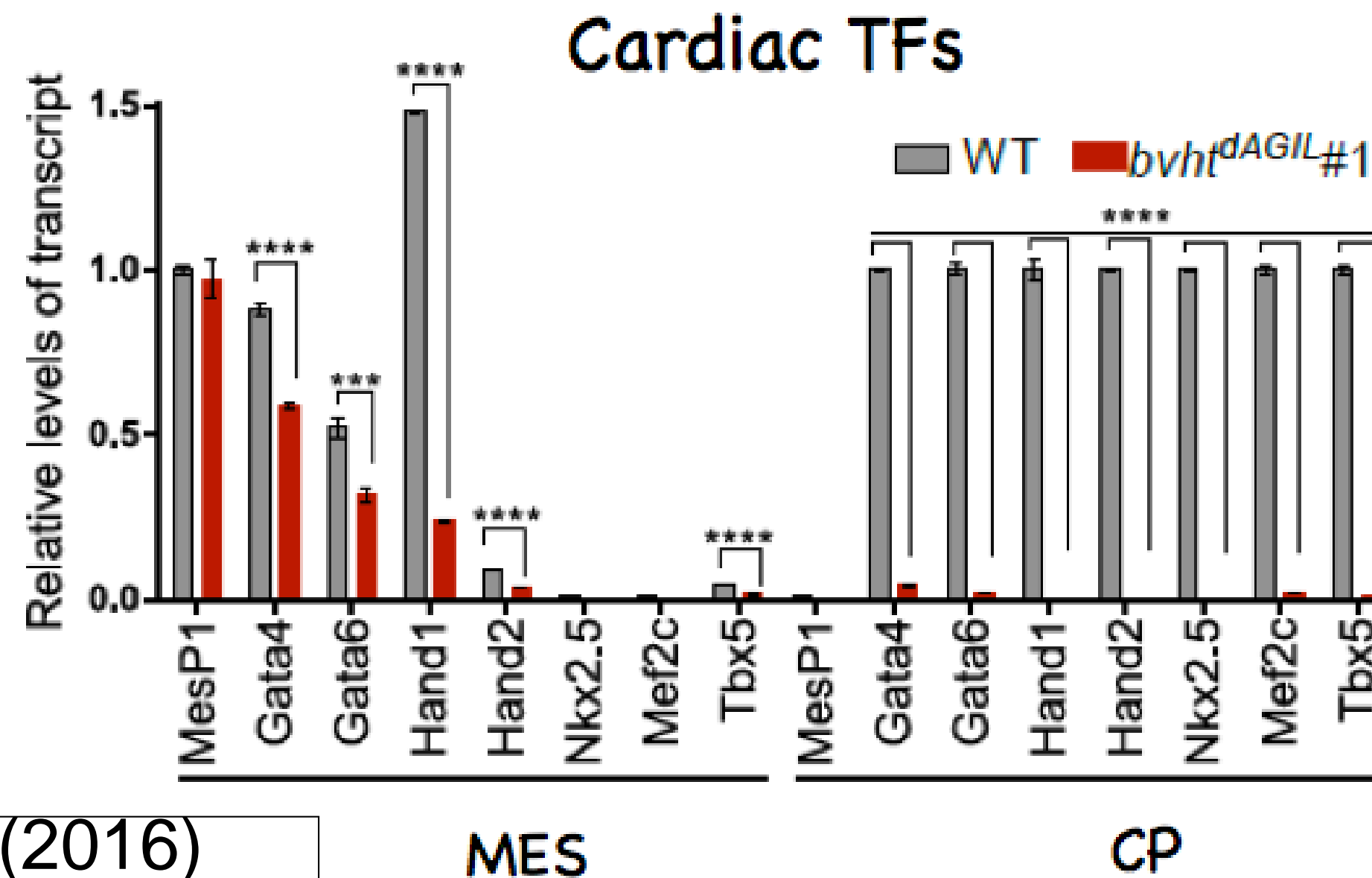
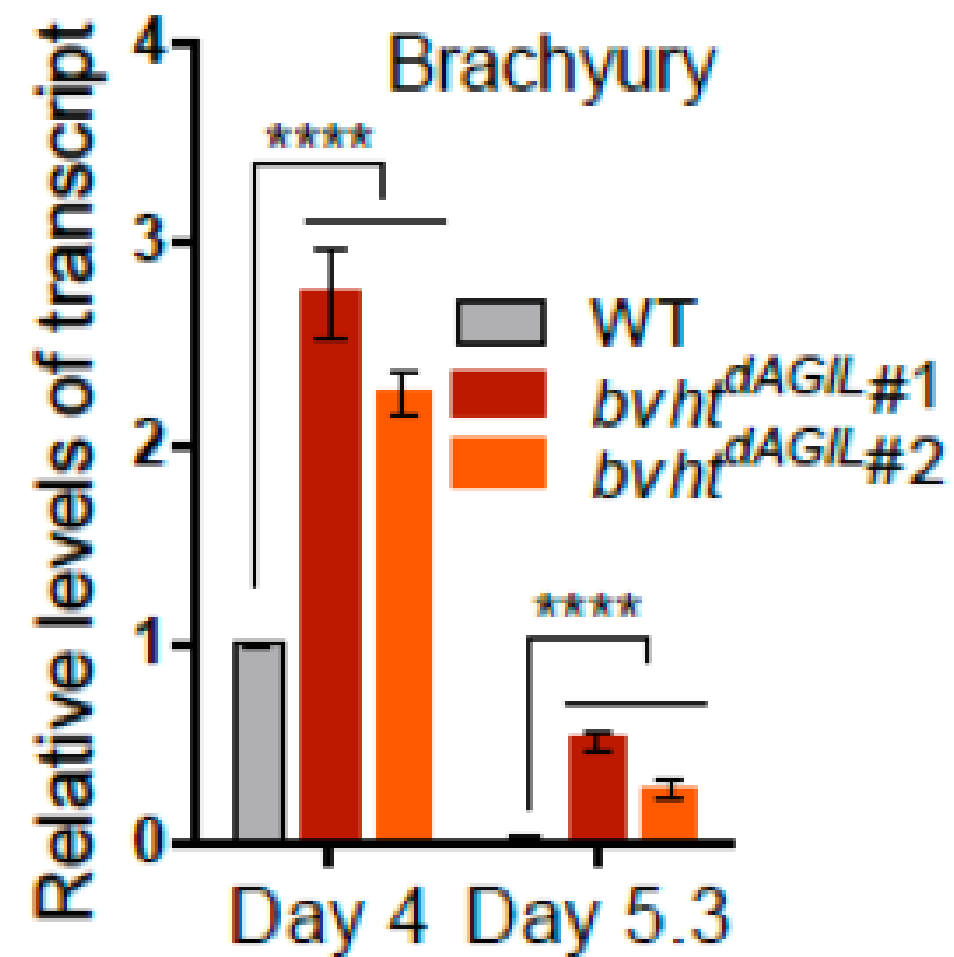
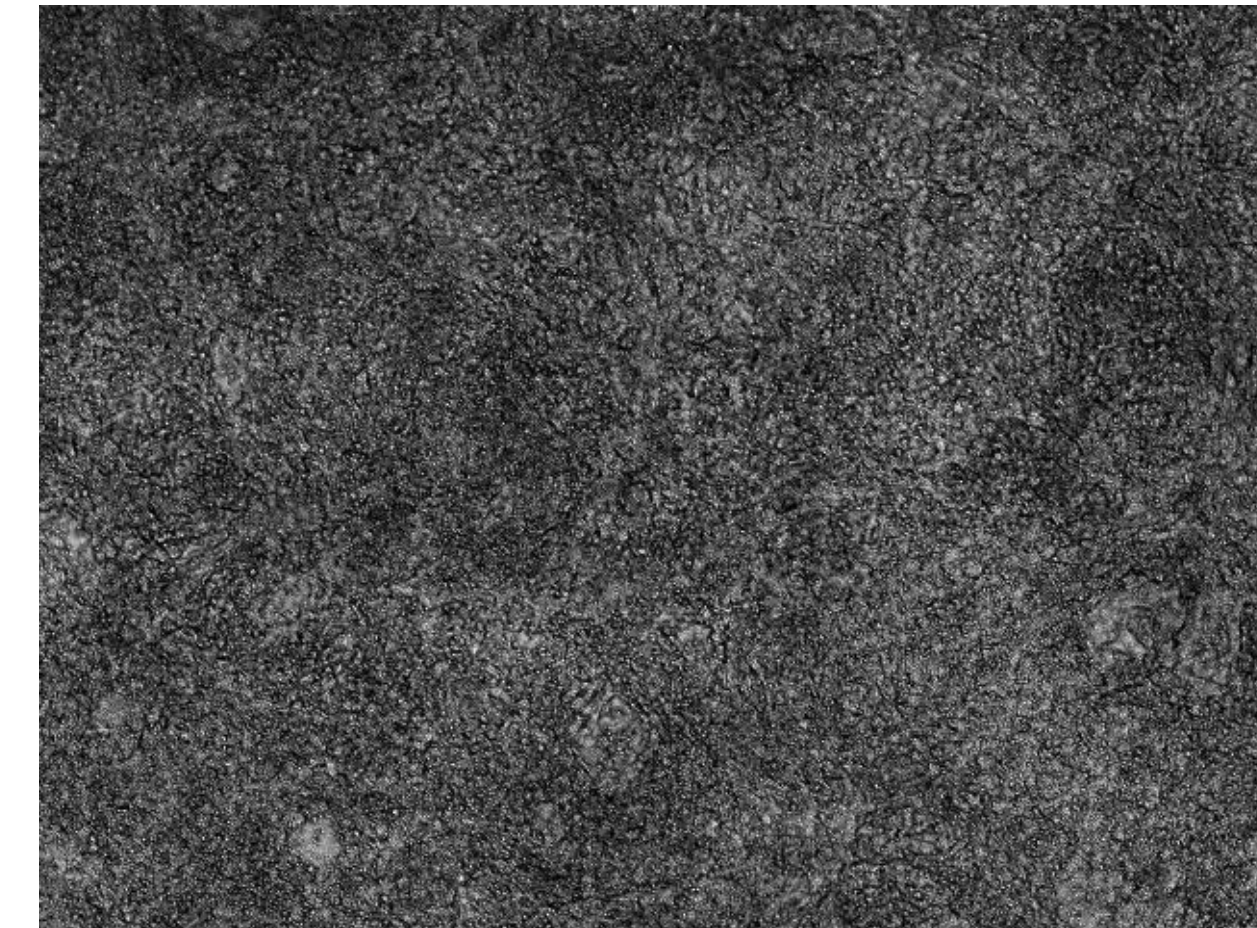
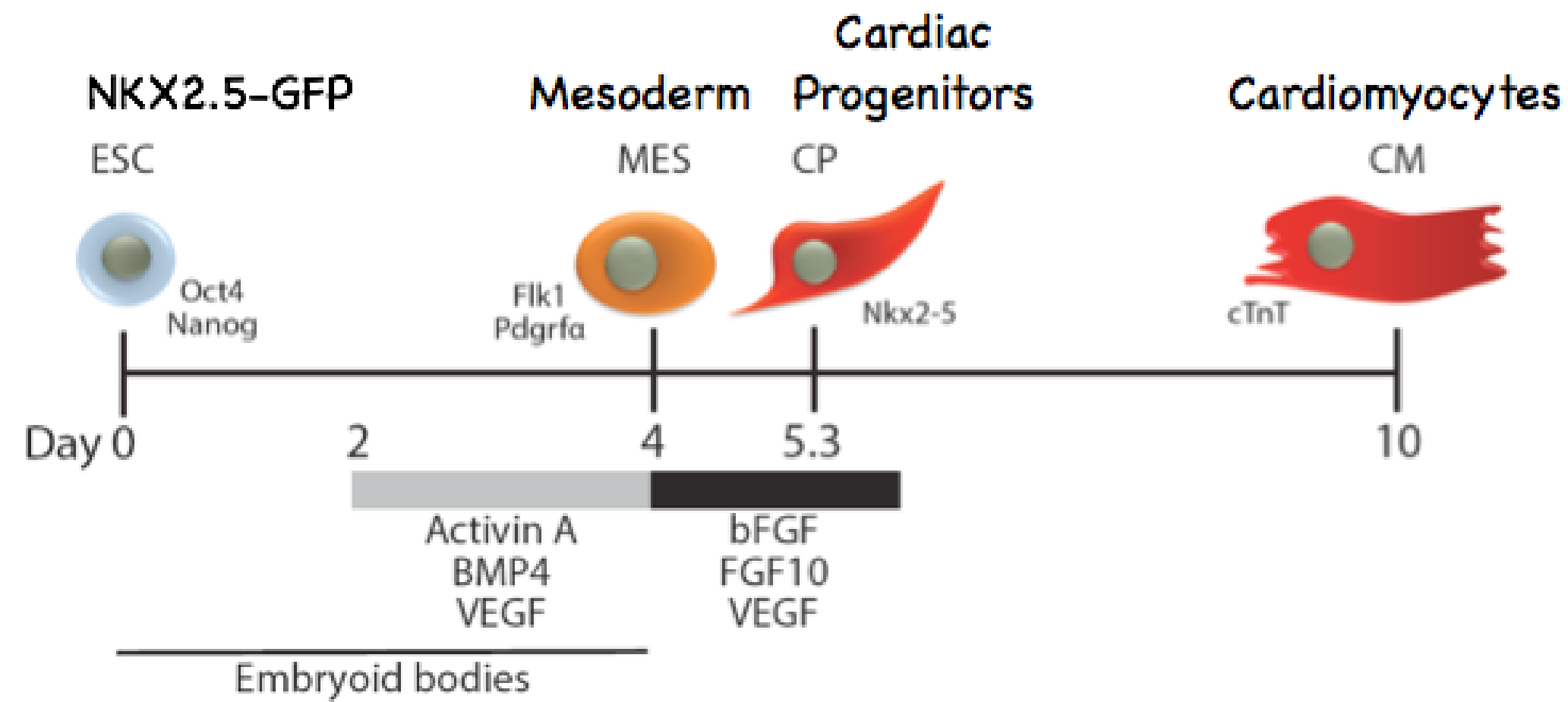


# CRISPR shows r-turn RNA motif essential for Braveheart function



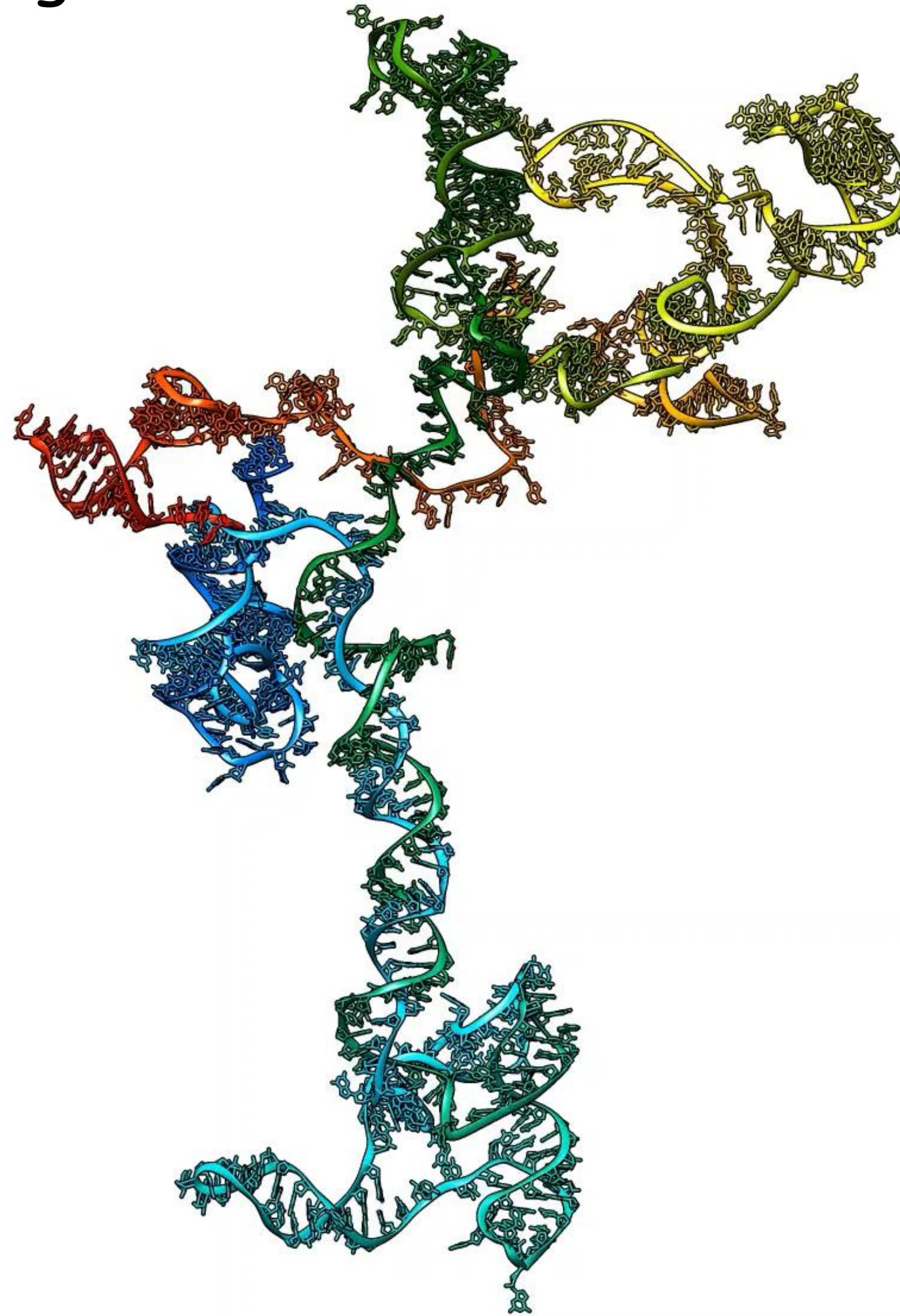
Xue, et al.,  
Molecular Cell  
(2016)

# Bvht structure is necessary for heart development in embryo



Xue, et al., Molecular Cell (2016)

# X-ray scattering reveals structured Braveheart RNA



# Comparison between our model and our experiment

