

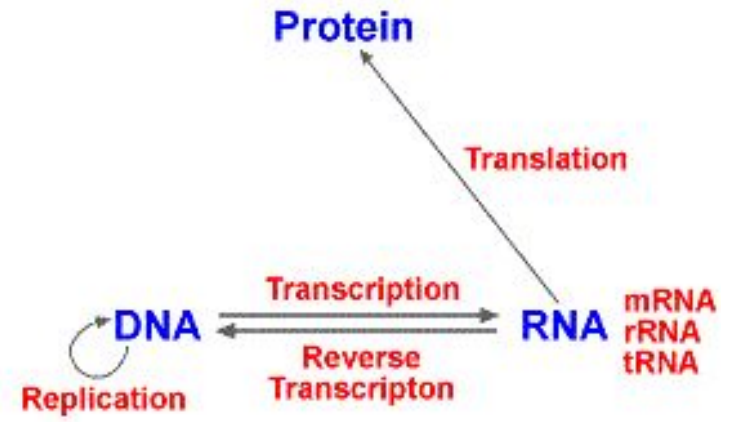
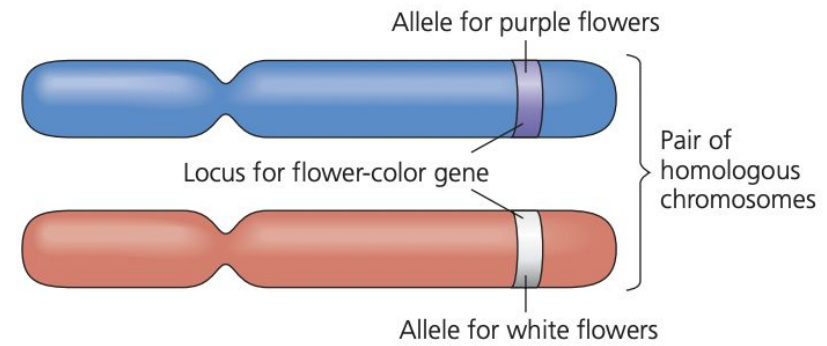
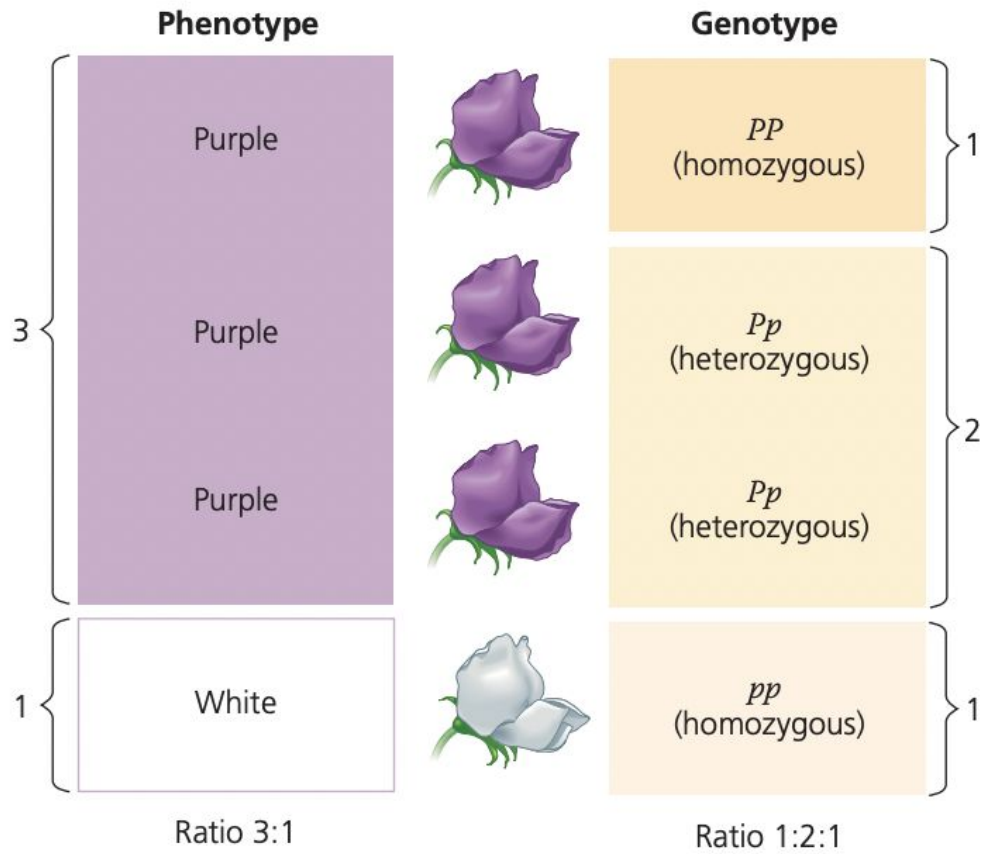


# **Genetics Part II: Electric Boogaloo**

Shorna Alam - Splash 2022

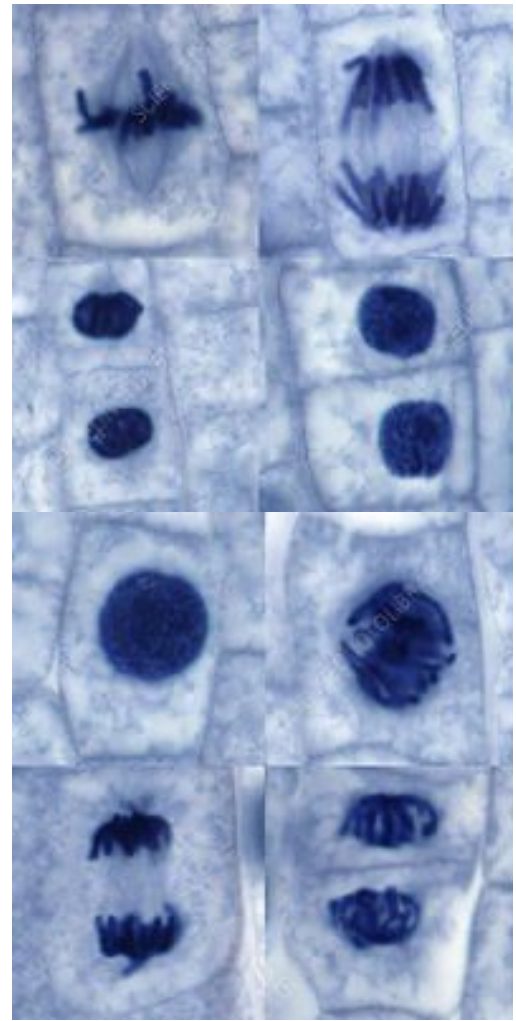


***Review: Mendelian  
Genetics and the  
Central Dogma***





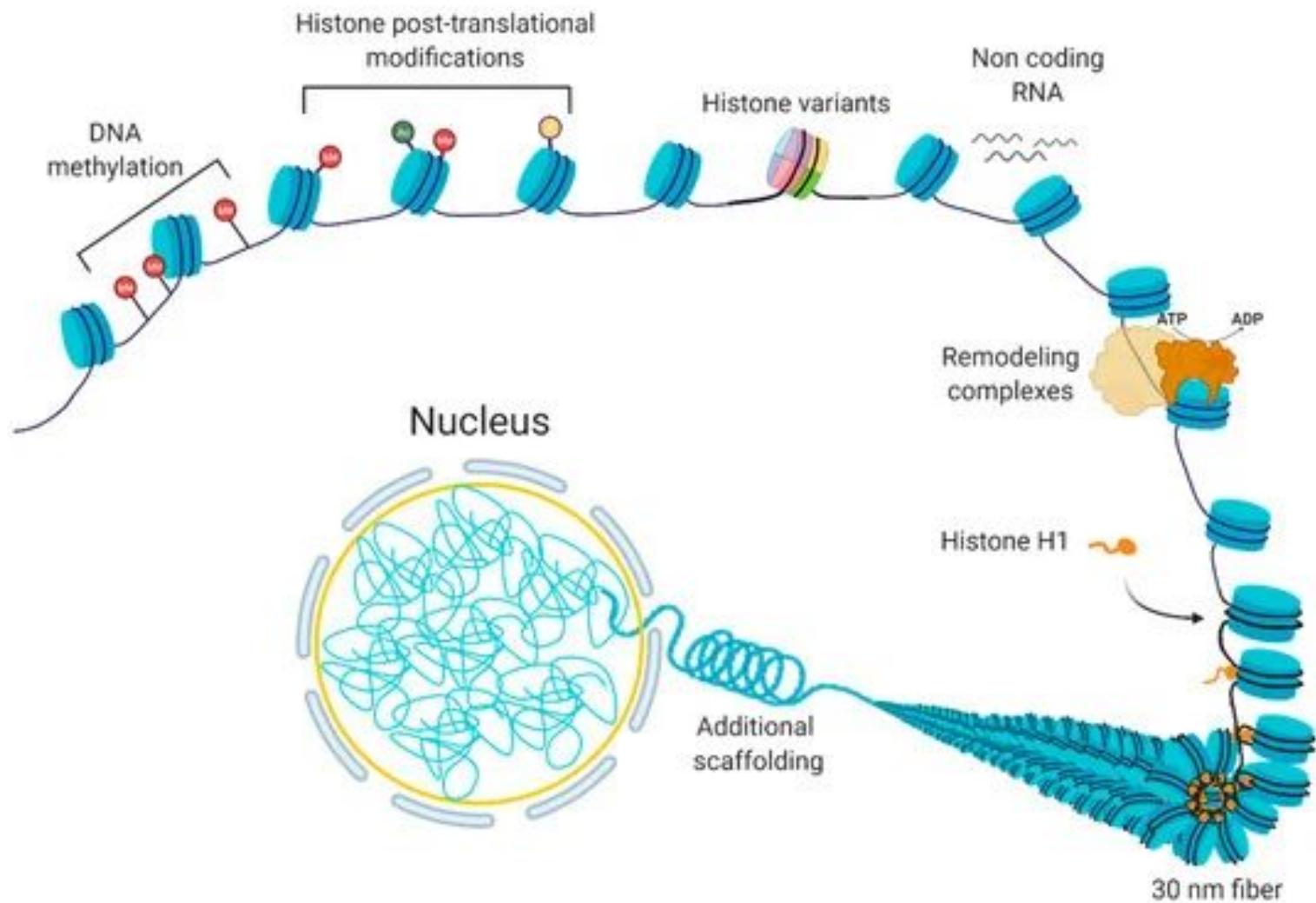
***Epigenetics (and related  
Gene Regulation  
Mechanisms)***





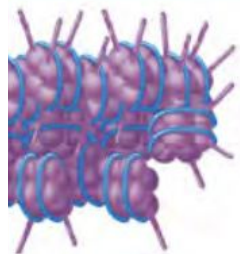


***Why did children born during the Great Dutch Famine have consistently higher levels of schizophrenia and obesity?***

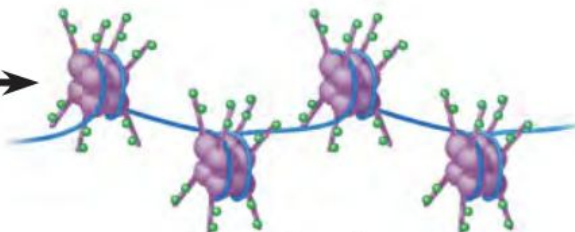


~1-2 kb

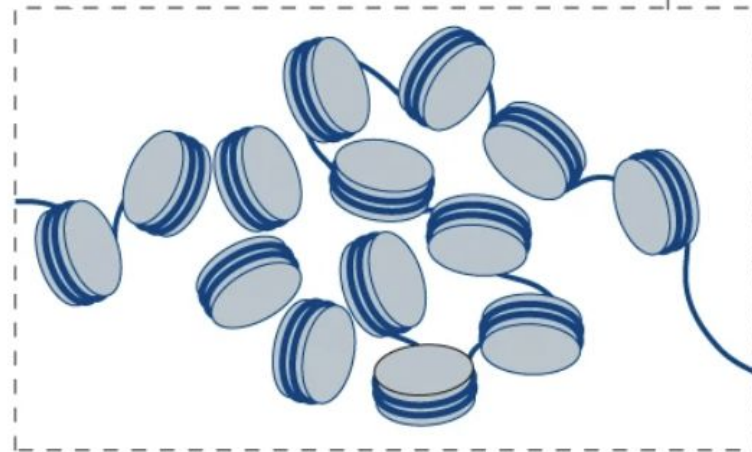
Nucleosome clutches



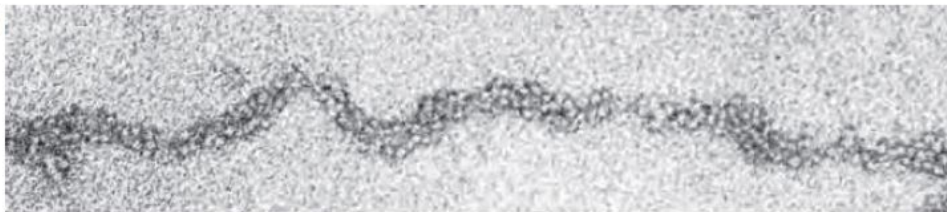
Unacetylated histones



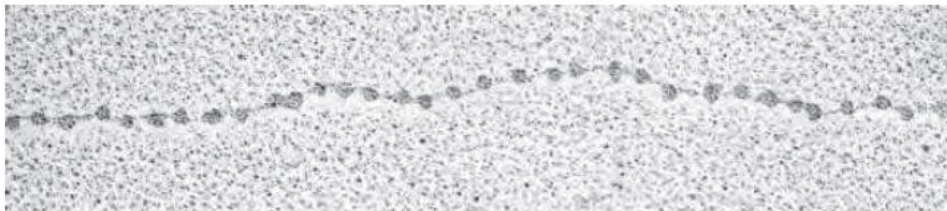
Acetylated histones



(A)



(B)

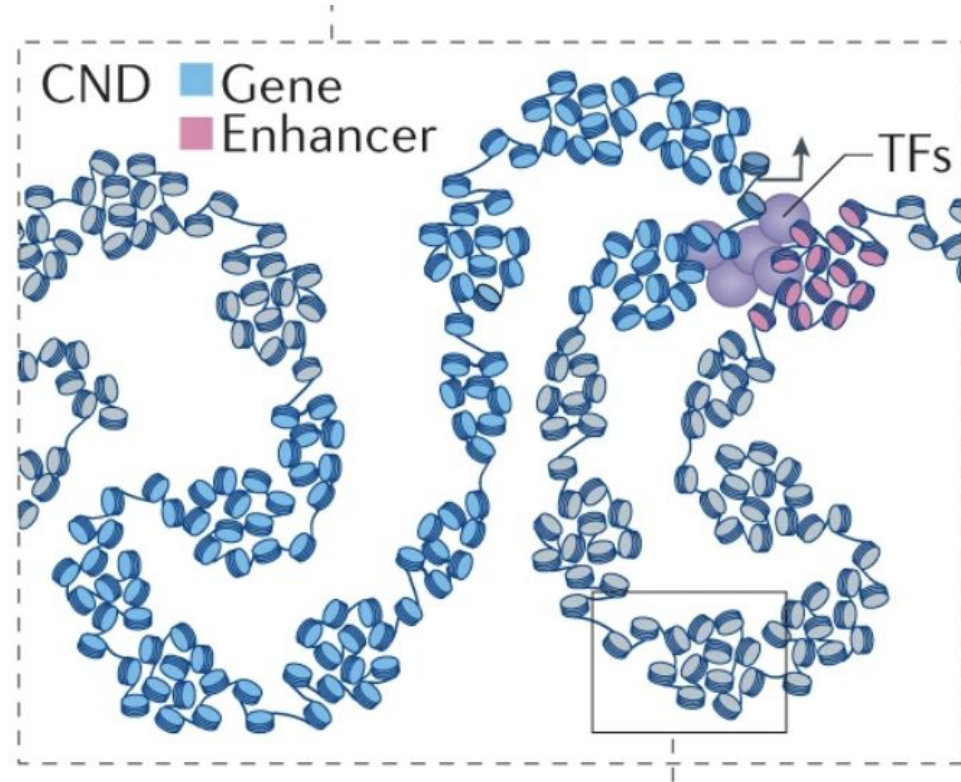
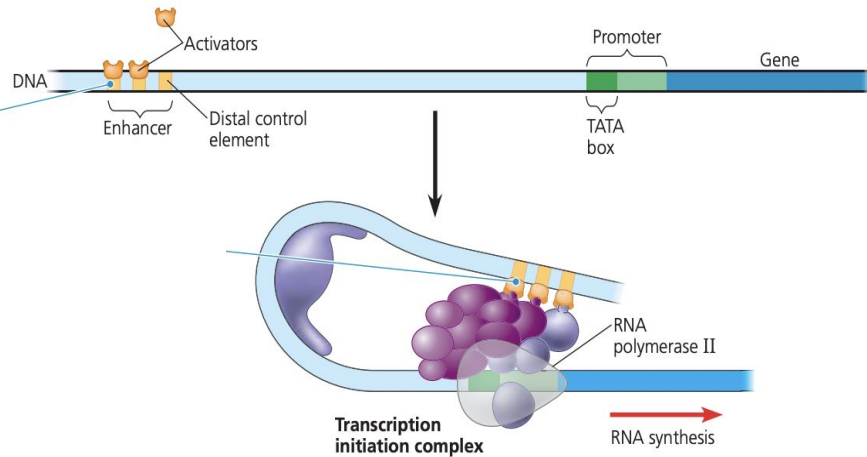


50 nm



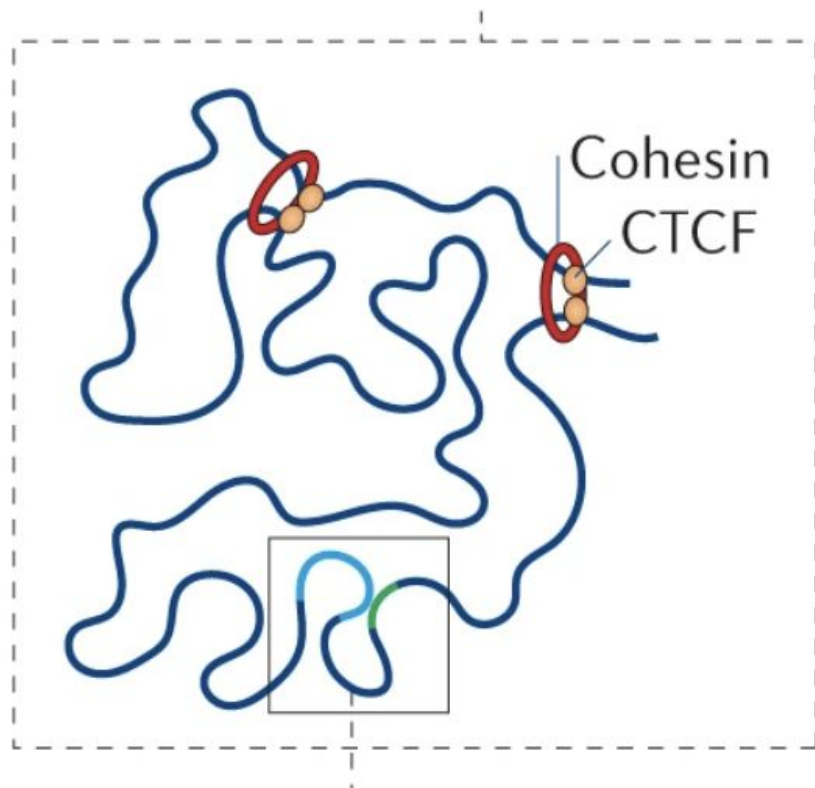
10–100 kb

- Chromatin nanodomains
- Functional loops (E–P contacts)



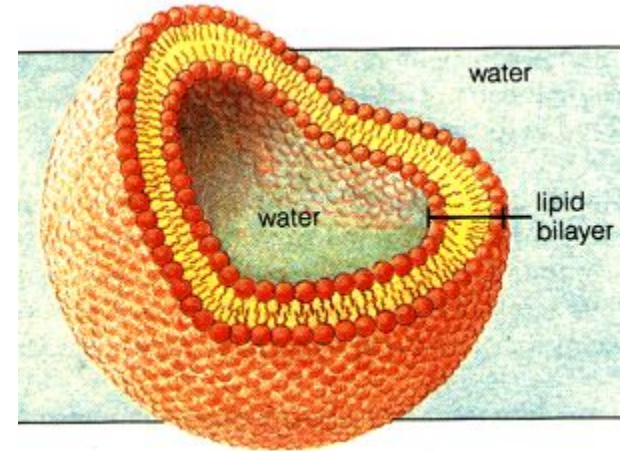
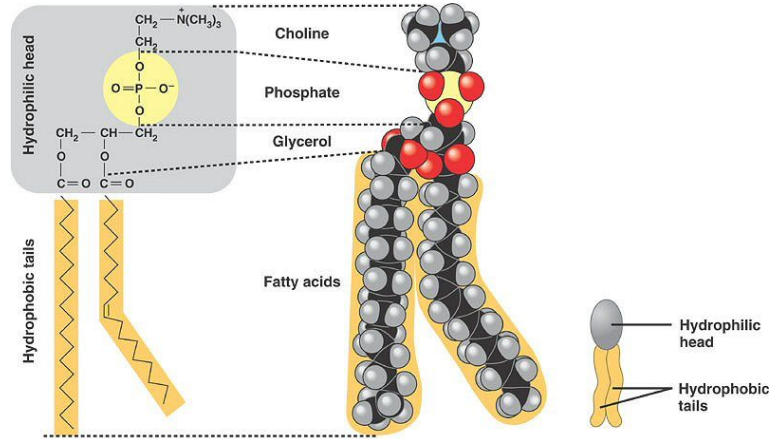
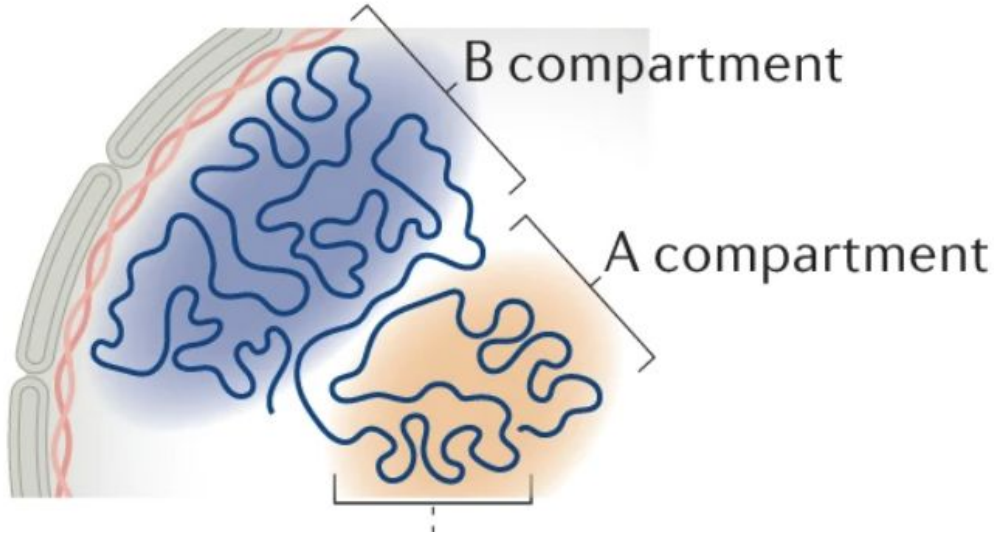
100 kb to few megabases

- Topologically associating domains
- Chromatin loops



Up to 100s of megabases

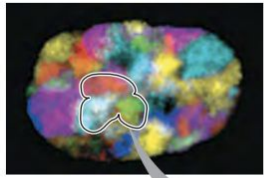
- Compartments
- Hubs



## Size

Entire chromosomes

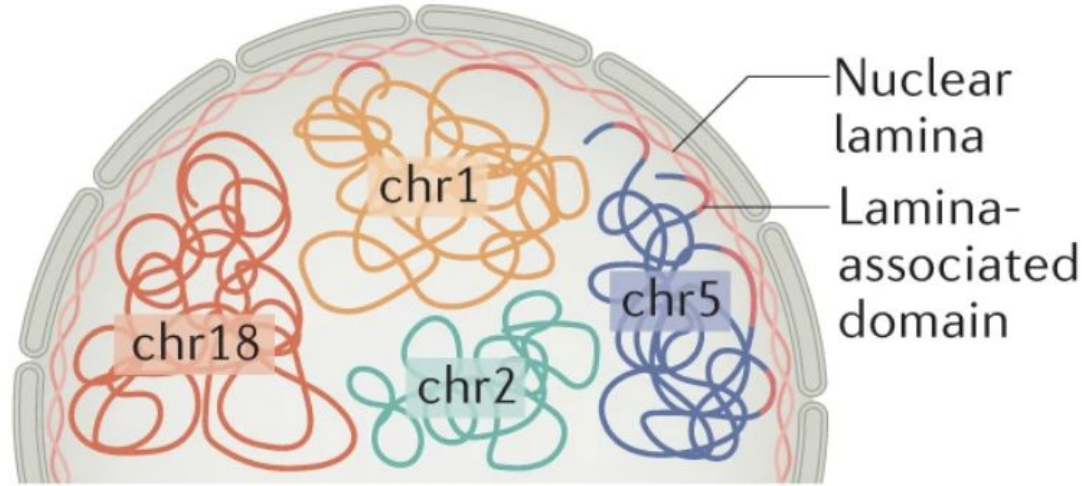
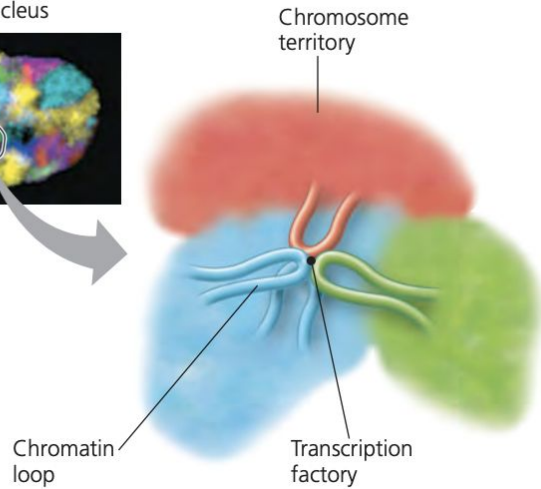
Chromosomes in the interphase nucleus



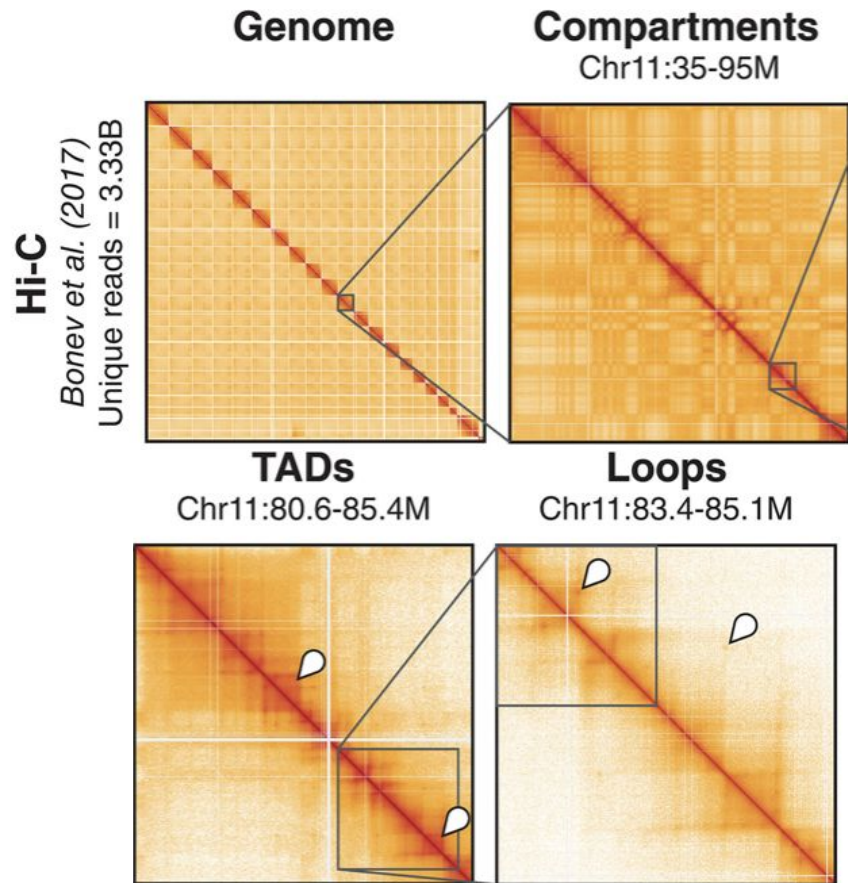
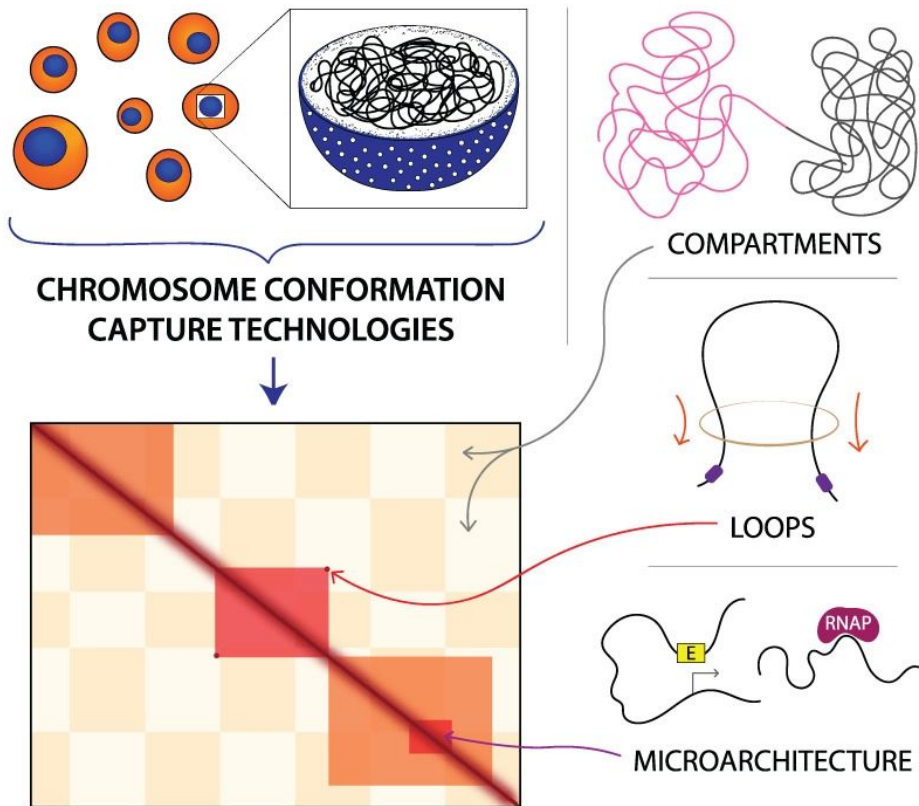
10  $\mu\text{m}$

## Organization level

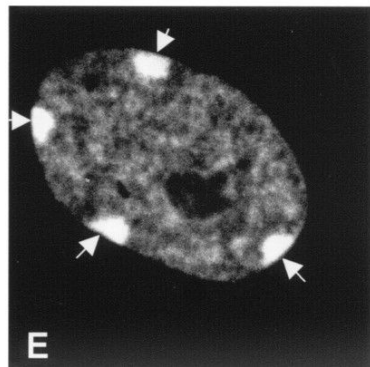
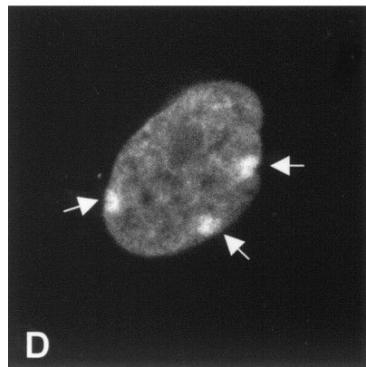
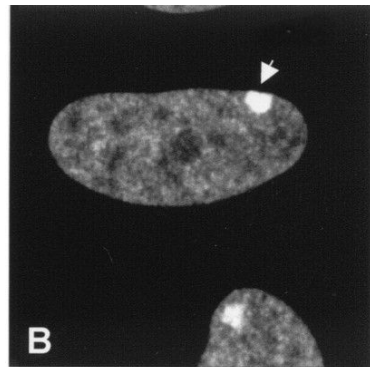
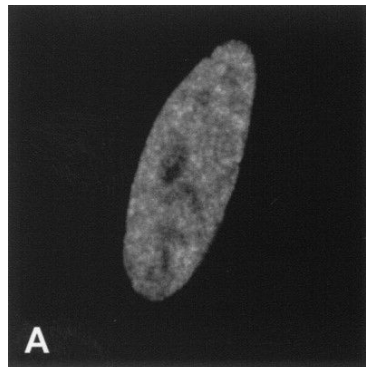
Chromosome territories









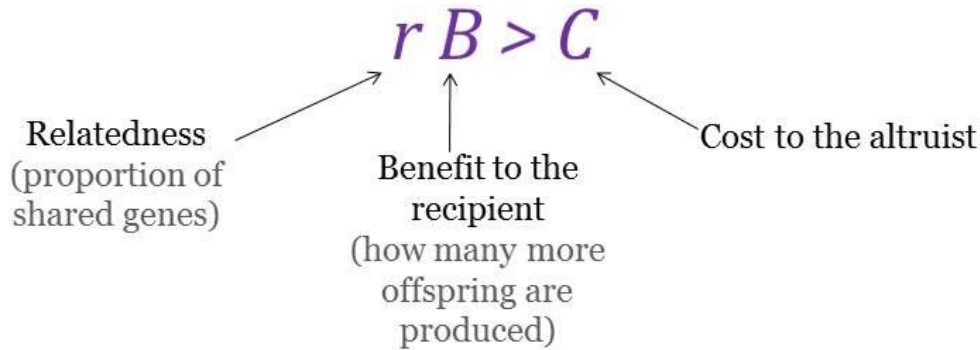










***Sex Determination &  
Ethology***

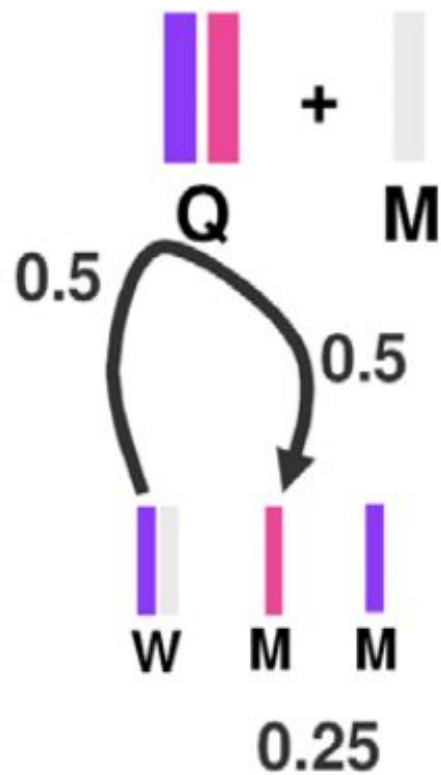
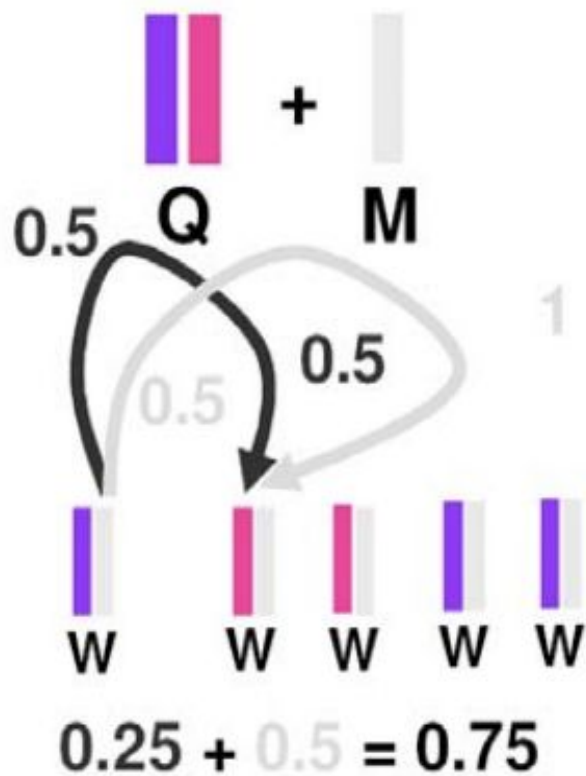
## Hamilton's rule

Altruism is favored by natural selection when:



“I would gladly lay down my life for two brothers or eight cousins”

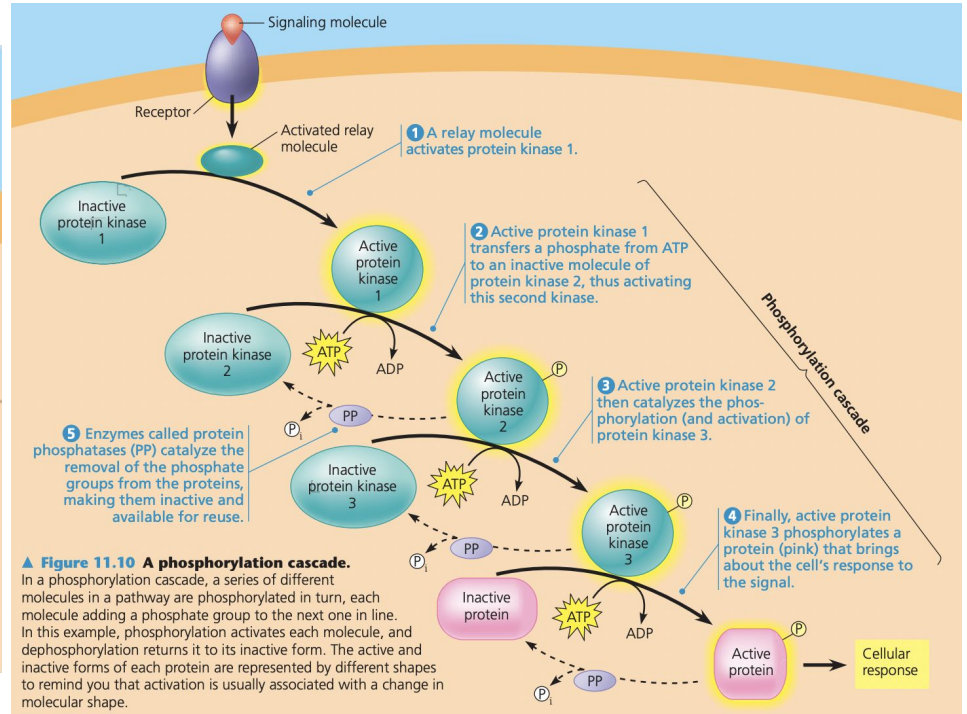
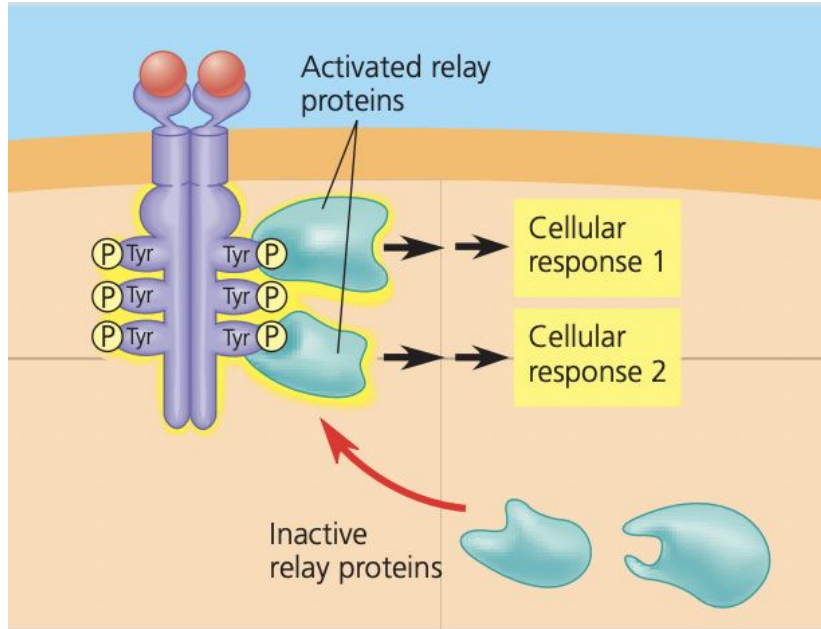
Type of adult bee	What they do	How many in a honey bee colony	How many in a bumble bee colony	What they look like in a honey bee colony	What they look like in a bumble bee colony
Queen	Lay eggs	1	1		
Worker	Take care of larvae, build and clean nest, forage	10,000-50,000	Less than 50 to over 400, depending on species		
Male	Leave nest to mate, then die	100-500	0-50, depending on species and season		

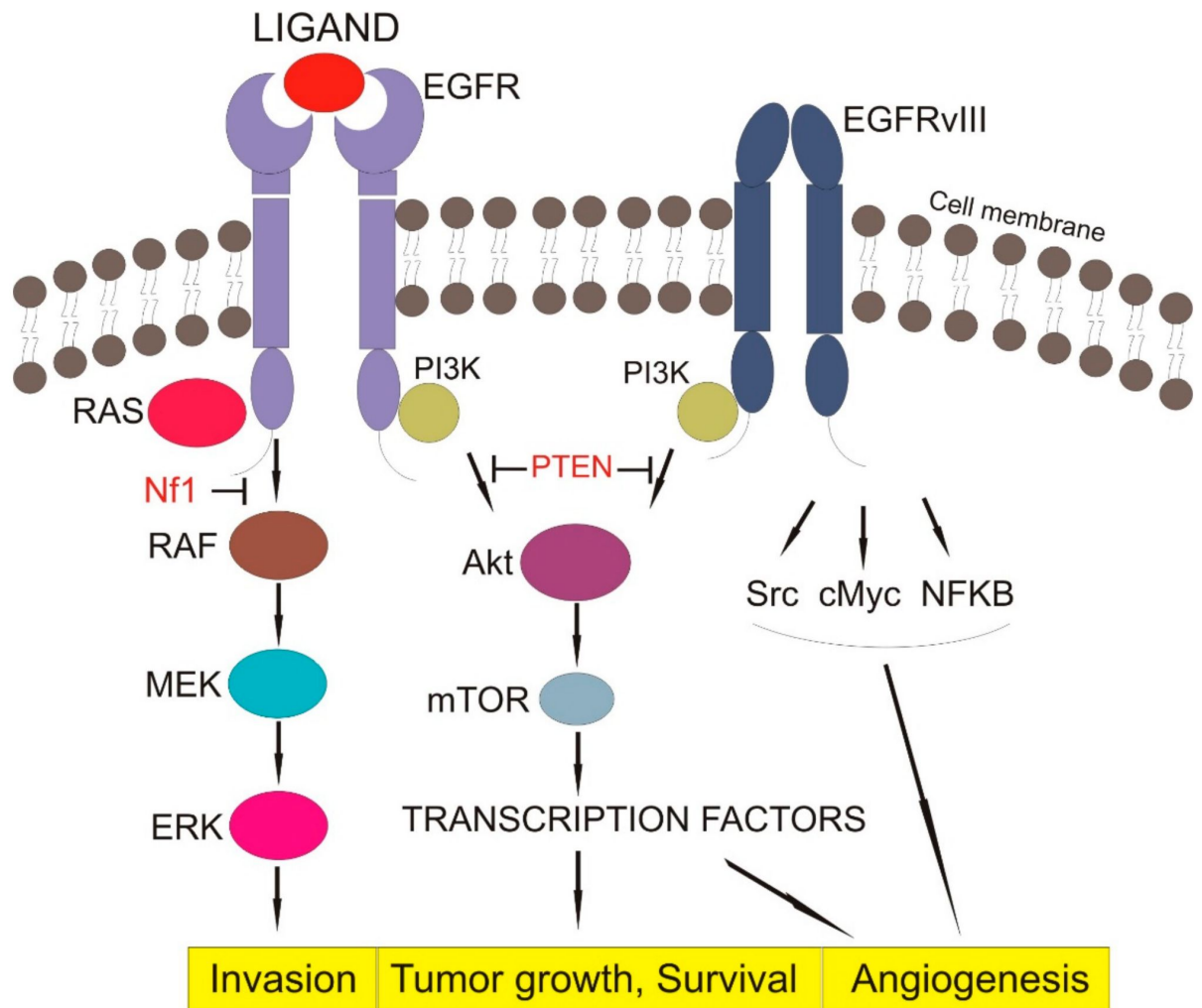






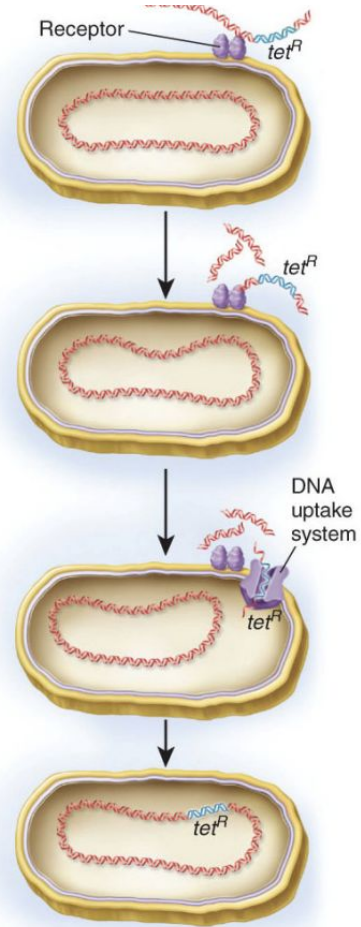
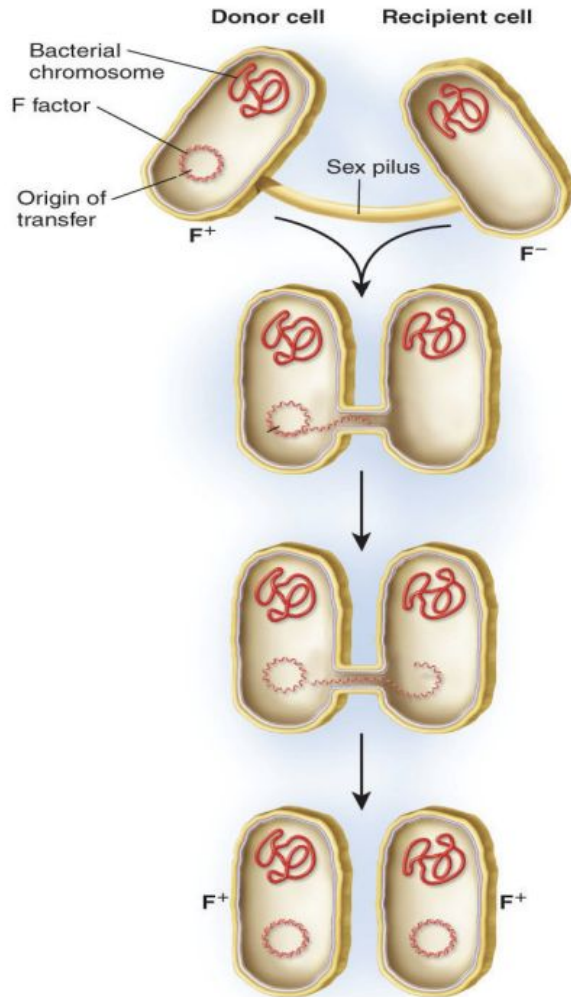
***Signaling Transduction  
Pathways as a means  
for TF regulation***







***Antibiotic Resistance  
and Horizontal Gene  
Transfer***



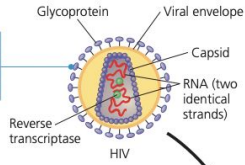
Transformed cell that is resistant to the antibiotic tetracycline





# ***Retroviruses***

1 The envelope glycoproteins enable the virus to bind to specific receptors on certain white blood cells.



**Figure 19.8 The replicative cycle of HIV, the retrovirus that causes AIDS.** Note in step 5 that DNA synthesized from the viral RNA genome is integrated as a provirus into the host cell chromosomal DNA, a characteristic unique to retroviruses. For simplicity, the cell-surface proteins that act as receptors for HIV are not shown. The photos on the left (artificially colored TEMs) show HIV entering and leaving a human white blood cell.

**MAKE CONNECTIONS** In Figure 7.11 (p. 130), you learned how HIV binds to cells. Describe what is known about this binding and how it was discovered.

2 The virus fuses with the cell's plasma membrane. The capsid proteins are removed, releasing the viral proteins and RNA.

3 Reverse transcriptase catalyzes the synthesis of a DNA strand complementary to the viral RNA.

4 Reverse transcriptase catalyzes the synthesis of a second DNA strand complementary to the first.

5 The double-stranded DNA is incorporated as a provirus into the cell's DNA.

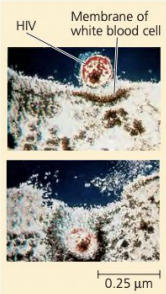
6 Proviral genes are transcribed into RNA molecules, which serve as genomes for the next viral generation and as mRNAs for translation into viral protein.

7 The viral proteins include capsid proteins and reverse transcriptase (made in the cytosol) and envelope glycoproteins (made in the ER).

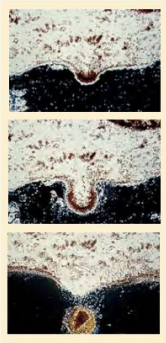
9 Capsids are assembled around viral genomes and reverse transcriptase molecules.

8 Vesicles transport the glycoproteins to the cell's plasma membrane.

10 New viruses bud off from the host cell.



HIV entering a cell



New HIV leaving a cell

