

How many bases?

DNA

4 bases

Pairing:

G - C
A - T

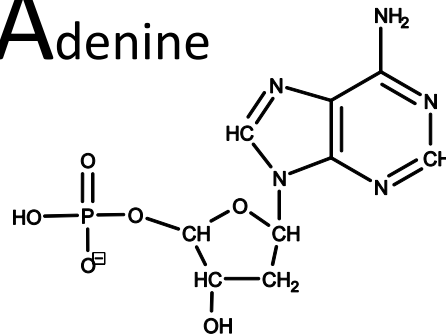
Mutation rate:

$$10^{-10} \text{ errors/}_{(\text{rep} * \text{base})}$$

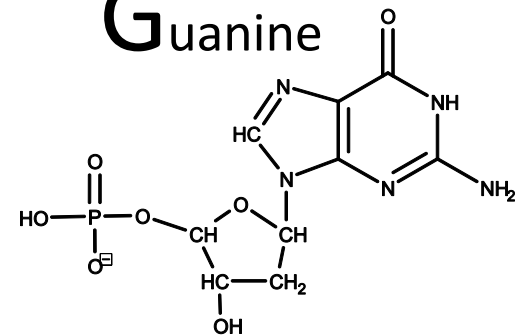


Nucleotides

Adenine

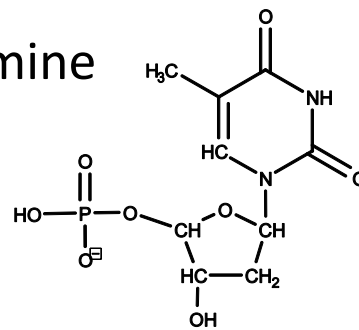


Guanine

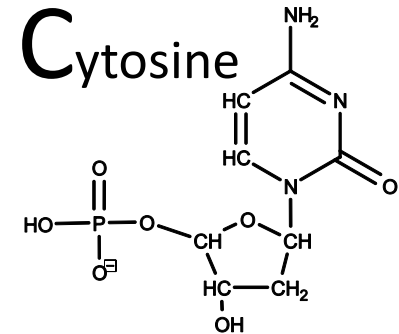


Purines

Thymine



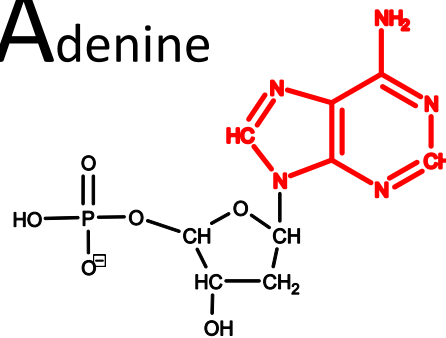
Cytosine



Pyrimidines

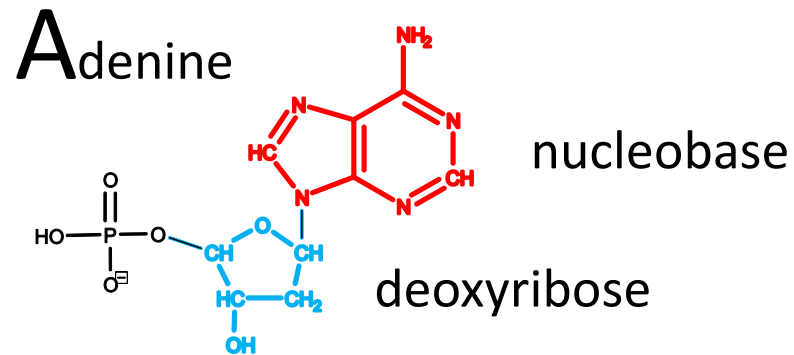
Nucleotides

A adenine

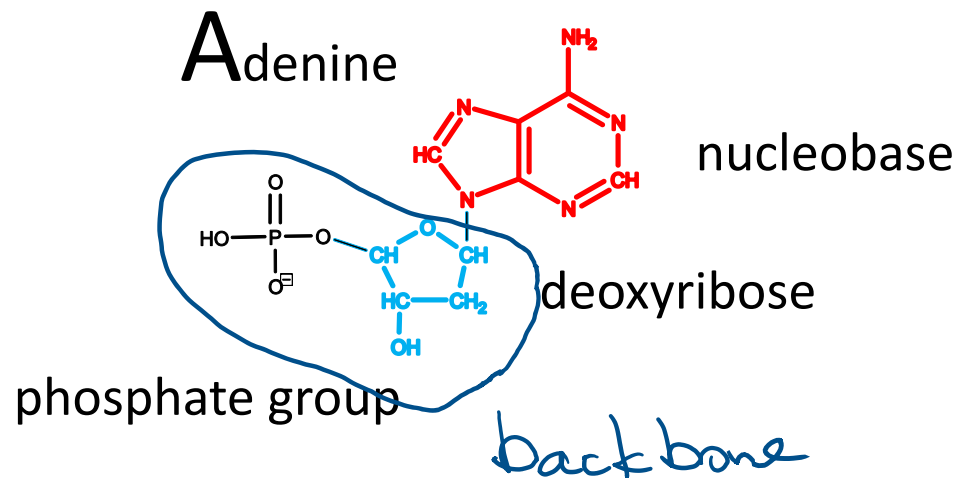


nucleobase

Nucleotides



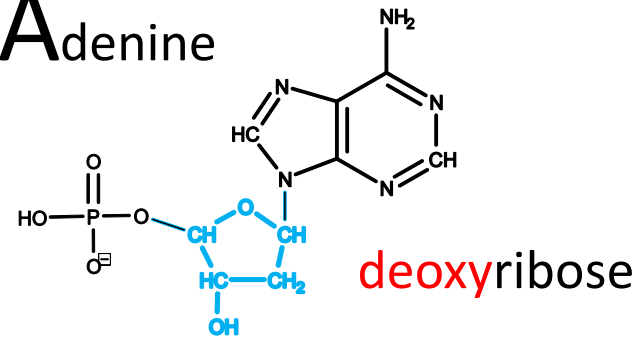
Nucleotides



Nucleotides

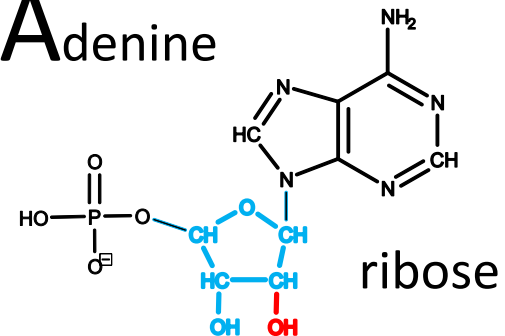
Adenine

DNA



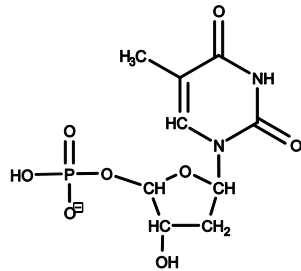
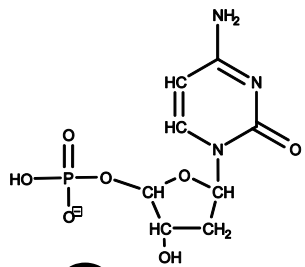
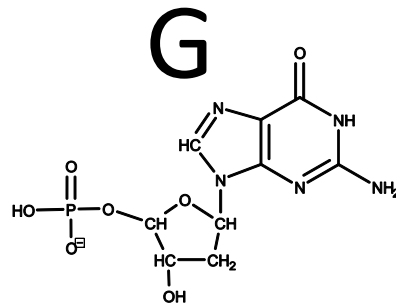
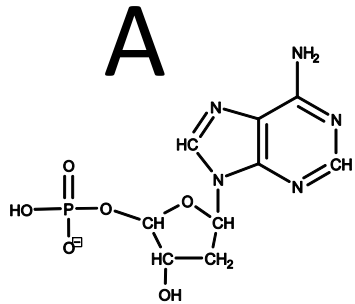
Adenine

RNA

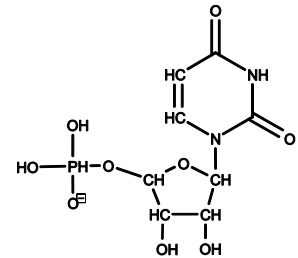
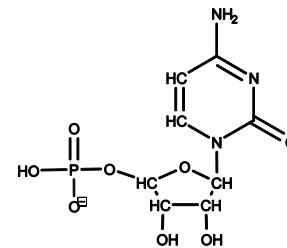
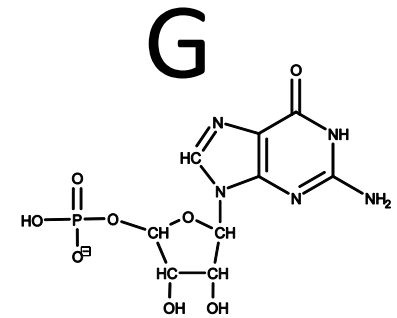
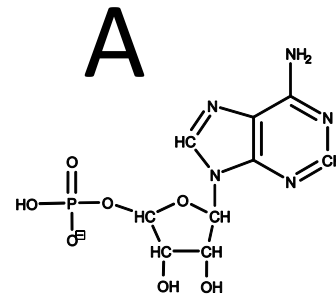


DNA

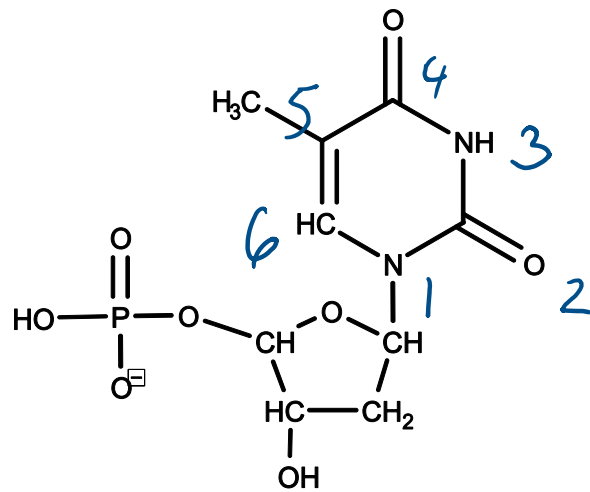
RNA



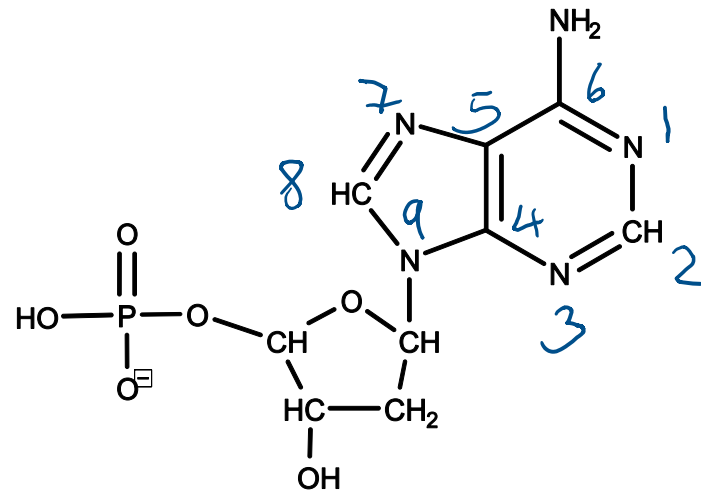
Thymine
5-methyluracil



Uracil

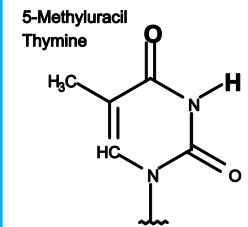
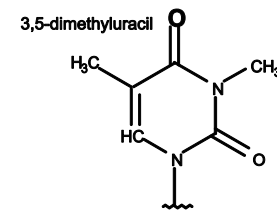
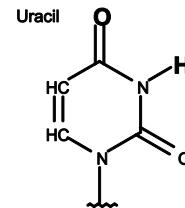
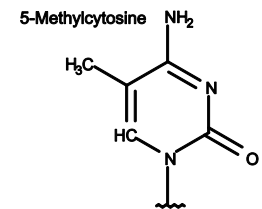
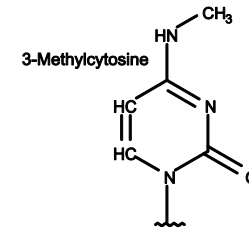
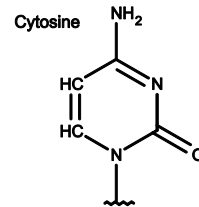
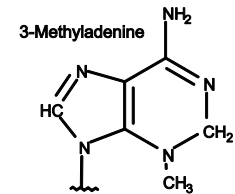
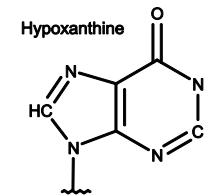
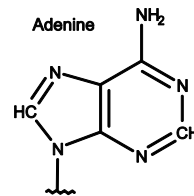
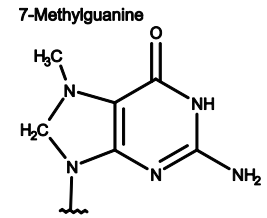
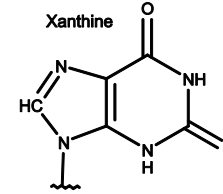
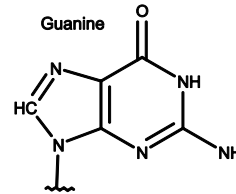


Thymine



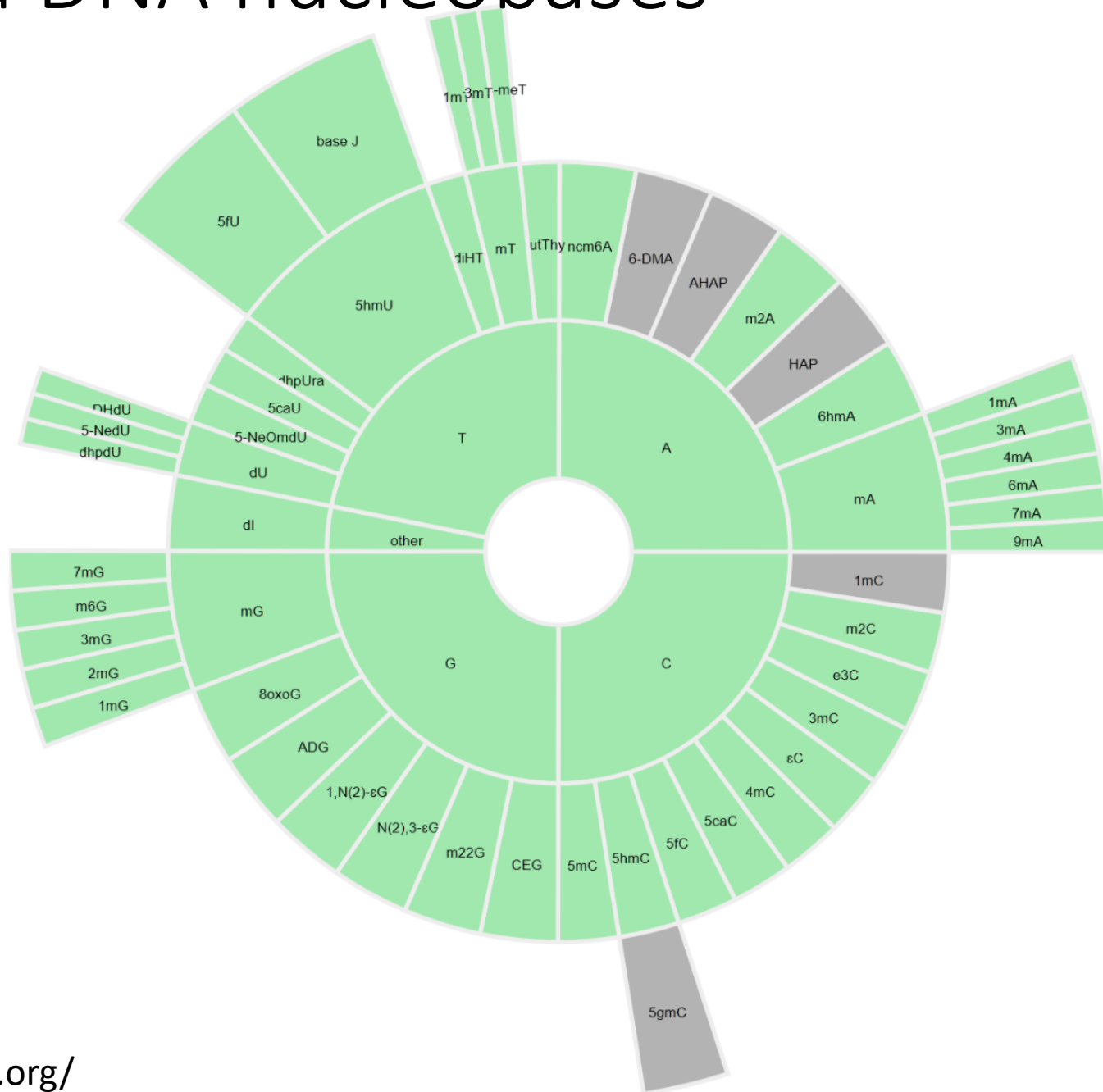
Adenine

Modified bases

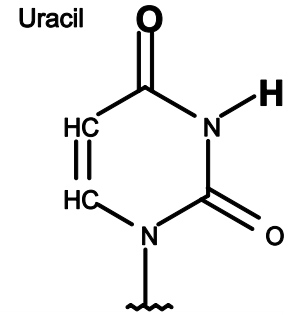


deamination

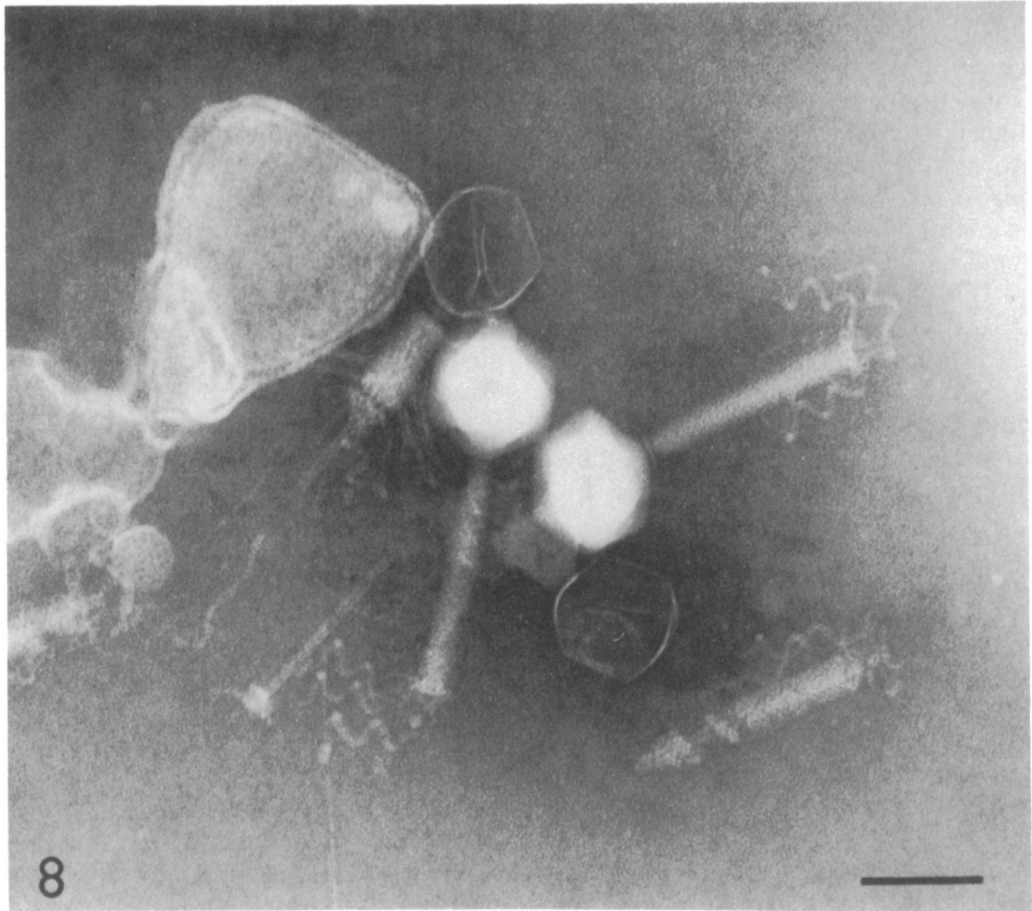
44 Modified DNA nucleobases



DNA of bacteriophage PBS1

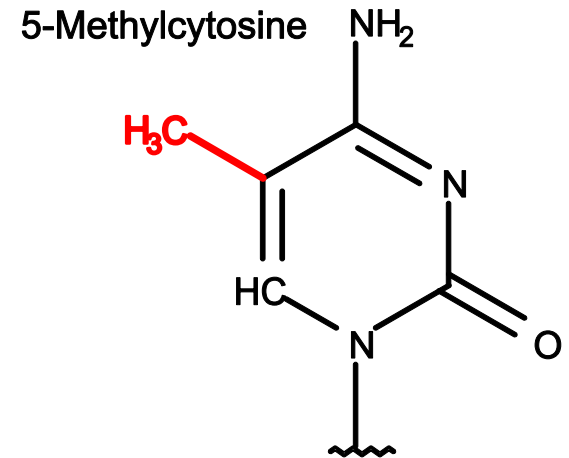


Phage of *Bacillus subtilis*

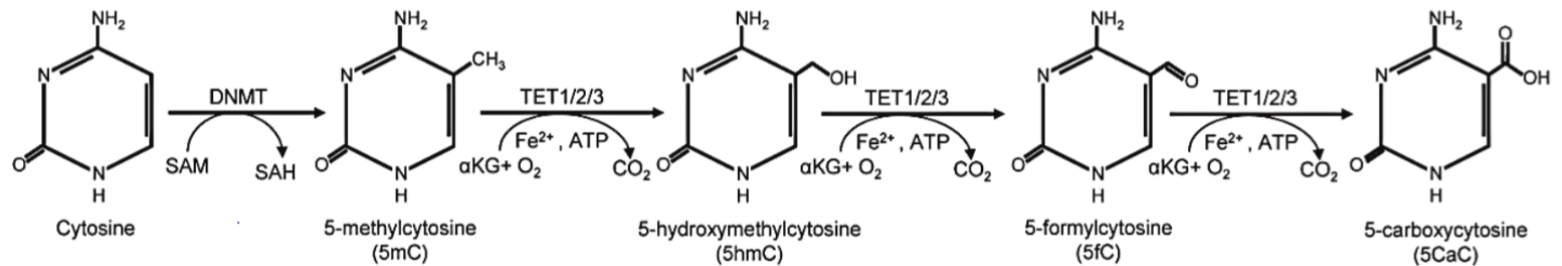
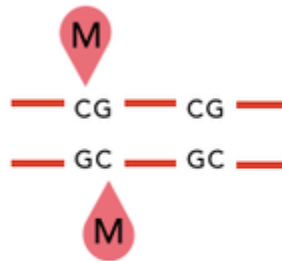


Micrograph of phage PBS1, $\times 130,000$, courtesy of F. A. Eiserling. Reference bar represents 100 nm.

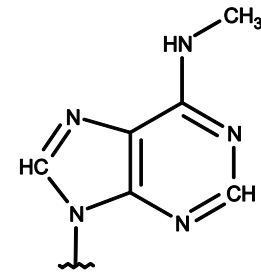
5-methylcytosine in DNA (5mC)



5-methylcytosine in DNA



6-Methyladenine (6mA)



GATC
CTAG

Dam methylase

Differentiating old from new strand

Modified RNA bases

Phylogenetic Distribution

The database currently (March 1, 2012) contains 109 modified ribonucleoside entries, distributed by RNA type and phylogenetic source as shown in the following table:

	Source		
	Archaea	(eu) Bacteria	Eukarya
tRNA	46	46	50
rRNA		1a	4a
SSU	12	9	21
LSU	8	15	14
5S	3		1
5.8S			5
mRNA			13
tmRNA			2
snRNA			11
chromosomal RNA			2
other small RNA			1

- 44 DNA mod
- 112 RNA mod
- Many survive replication
- Some are replicated themselves
- Functional: 5mC, 6mA, 5hmC, RNA &more

- Generated:
 - Enzyme activity
 - Damage
 - Misincorporation