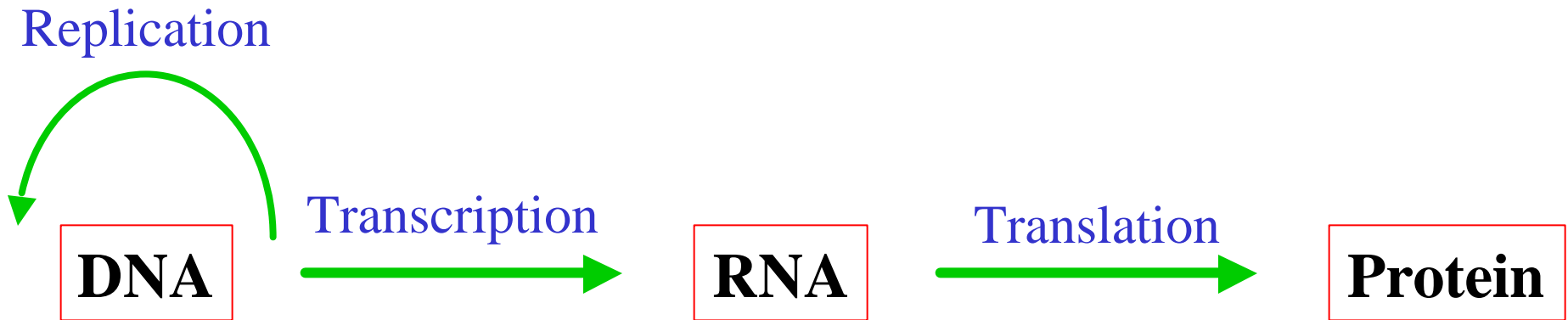


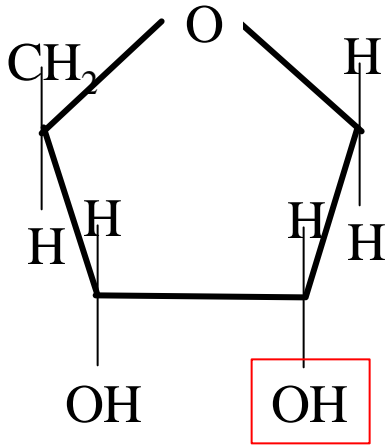
Central Dogma



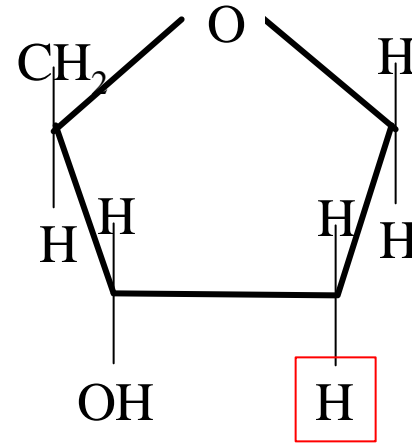
RNA = ribonucleic acid

→ Each step provides the cell/organism a point of control

RNA vs. DNA



Ribose



Deoxyribose

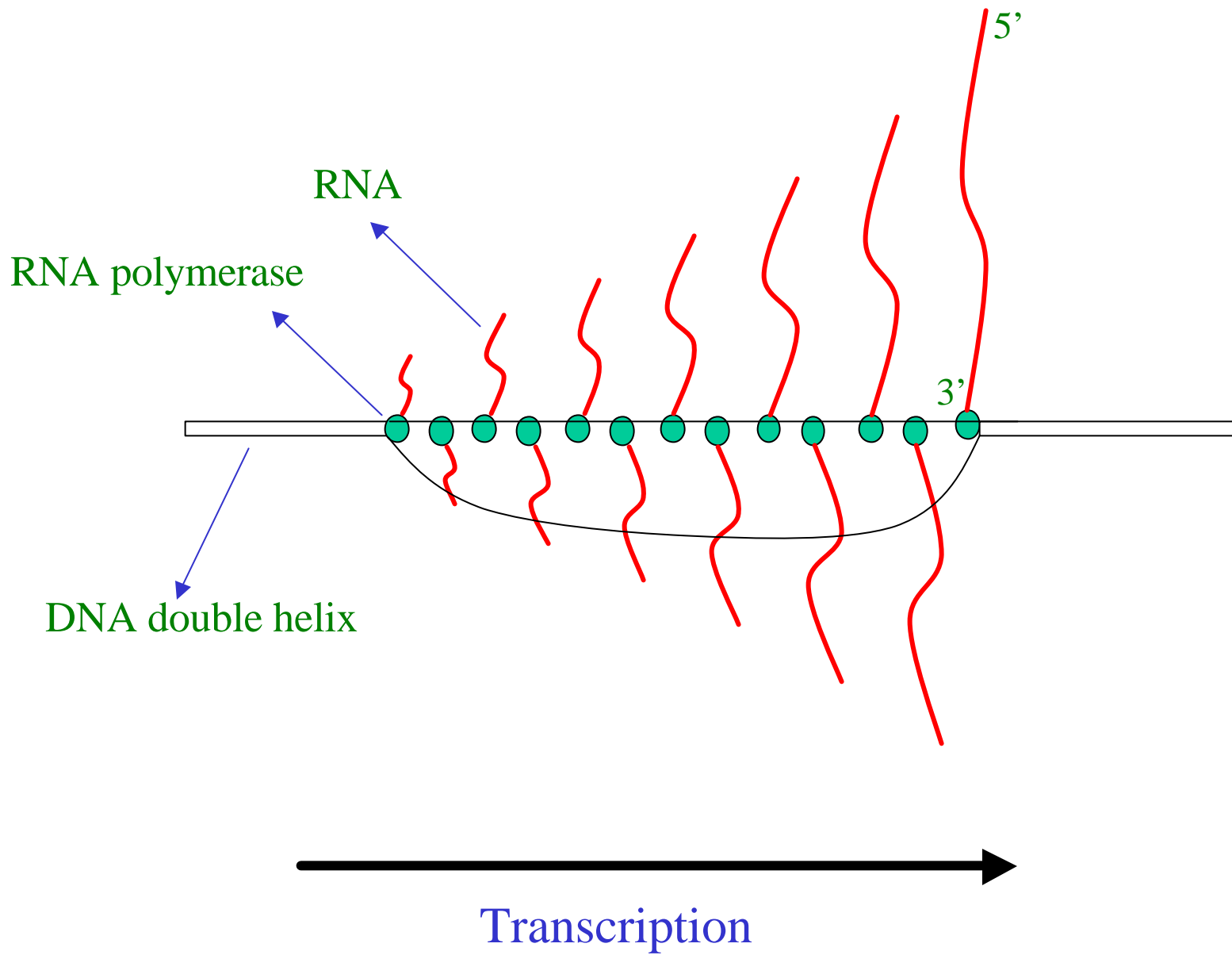
- i. Ribose in place of Deoxyribose
- ii. U in place of T
- iii. Single-stranded instead of double-stranded

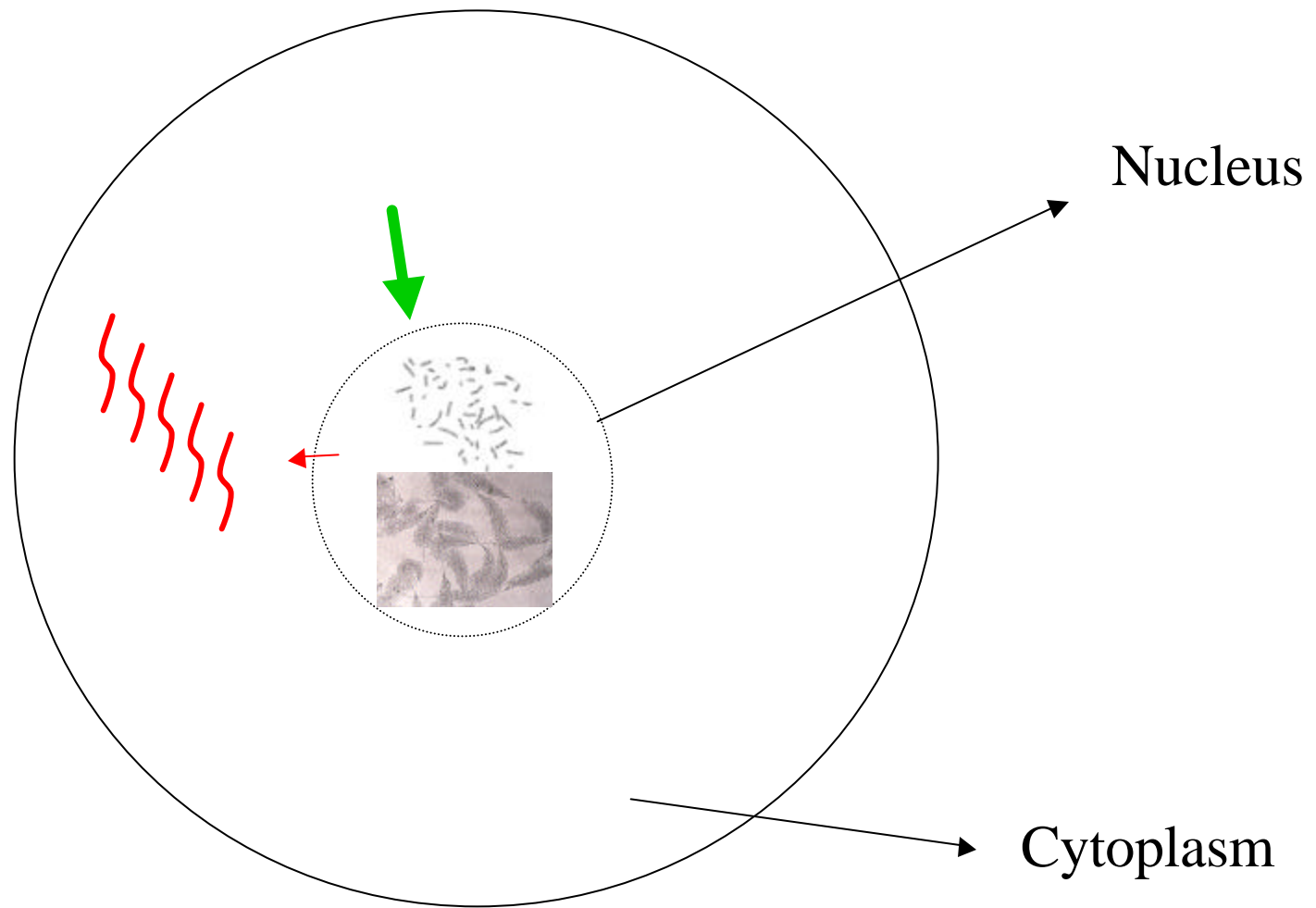
A T
G C
C G
T A
T A
A T
C G
C G
T A
G C
A T
A T

DNA

A
G
C
U
U
A
C
C
C
U
G
A
A

RNA





Nucleus

Cytoplasm

Cell

Each step provides the cell/organism a point of control

How do you convert DNA to protein???

- Proteins are made from amino acids (20 of them)
- DNA or RNA are made of nucleotides (4 of them)
- ✓ If you use 1 nucleotide for amino acid you get only $4^1=4$ combinations
A, G, C, U
- ✓ If you use 2 nucleotide combinations you get only $4^2=16$ amino acids
AA, AG, AC, AU, UU, UA, UG, UC, GG, GA, GC, GU,
CC, CA, CU, CG
- ✓ If you use 3 nucleotide combinations you get $4^3=64$ possibilities

The Genetic Code

Second nucleotide

First nucleotide

	U	C	A	G	
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

Third nucleotide

How do you convert DNA to protein???

- Proteins are made from amino acids (20 of them)
- DNA or RNA are made of nucleotides (4 of them)
- Three nucleotide combination represent a code providing $4^3=64$ possibilities
- Several codons can be used for a single amino acid providing a **wobble** (i.e. allowing for a slight sloppiness in the translation process)