DNA & Protein Synthesis

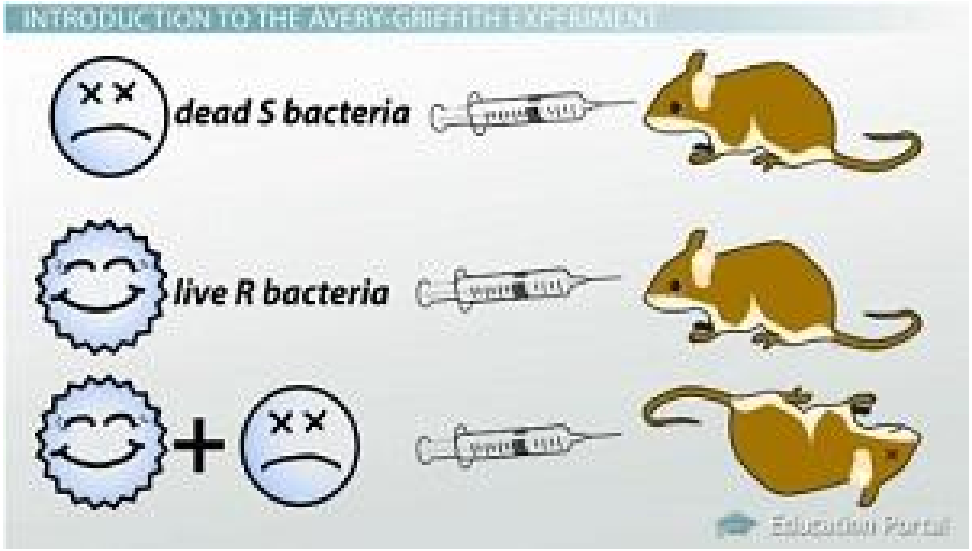
Unit 5!

Discovery of DNA (Deoxyribonucleic Acid): heredity material

A. Griffith and Avery
   a. Used bacteria that caused pneumonia and bacteria that did not cause pneumonia.
   b. Three experimental groups
      i. Group A: Mice injected with heat-killed pneumonia
      ii. Group B: Mice injected with heat-killed pneumonia and non-pneumonia bacteria.
      iii. Group C: mice injected with non-pneumonia bacteria
   c. Heat-killing destroys the cell body, rupturing the cell and allowing the DNA to leave the cell body.
   d. Results:
      i. Group A: lived
      ii. Group B: died

Conclusion

Conclusion- DNA is the genetic material. Once the cells “took up” the dangerous DNA, the DNA was expressed and turned the cells into pneumonia-causing bacteria. The DNA could now reproduce in the cell.



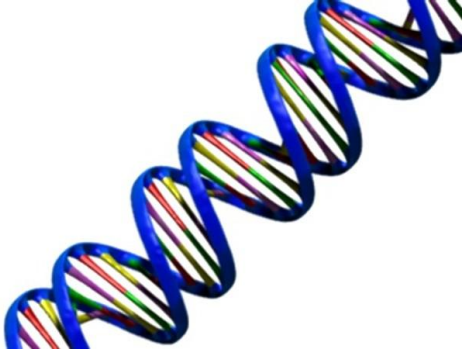
Rosiland Franklin and Maurice Wilkins

1. Franklin developed a technique, despite being forced to work in a basement lab with poor equipment, to take and develop x-rays. The first picture of DNA that was clear
2. Franklin began to work on interpreting the X-ray, taking notes as she worked.
3. Wilkins, her lab assistant, stole her notes and X-rays. He gave them to two competing scientist- Watson and Crick.

Watson & Crick

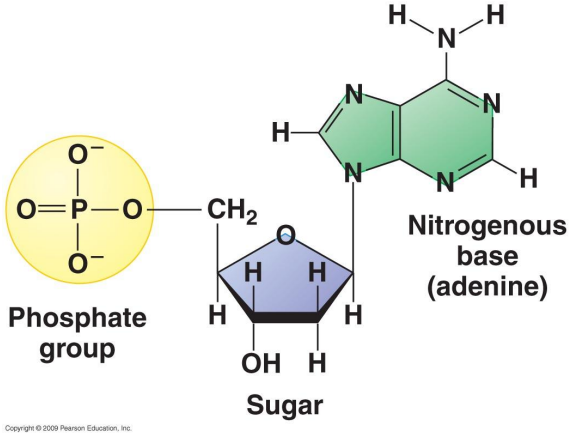
1. Using Franklin's notes and the X-ray,, Watson and Crick developed a model of the DNA structure.
2. Watson and Crick were awarded the Nobel Prize for their work, submitting it mere days ahead of Rosiland Franklin. They did not acknowledge her contribution. Later, Wilkins was also awarded the Nobel Prize, but Franklin had died and could not receive the award.

DNA Structure



1. Shape
    a. Double helix- like two spiral staircases wound together.
2. Unwound, the DNA molecule resembles a ladder
    a. The sides- phosphates and sugars that alternate.
    b. The rungs- nitrogen bases that are linked together and to the sugar.

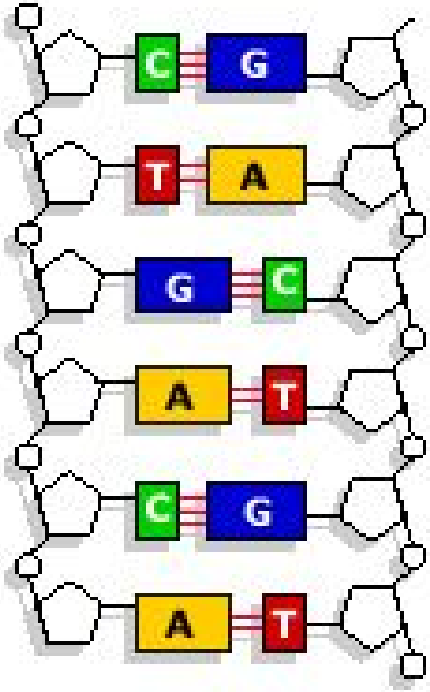
Monomer of DNA



1. Called a nucleotide.
2. The three parts:
   a. 5 carbon sugar- deoxyribose
   b. phosphate group- gives DNA a negative charge.
   c. One of the four nitrogen bases:
      1. Thymine (T)
      2. Adenine (A)
      3. Guanine (G)
      4. Cytosine (C)

Nitrogen base pairing

1. Purine pairs with a pyrimidine.
    a. Purine: 2- 5 carbon sugar ring: A & G
    b. Pyrimidine: 1- 5 carbon sugar ring: T & C.
2. A pairs with T to make a rung on the ladder.
3. G pairs with C to make a rung on the ladder.
    a. The bases are held together by weak hydrogen bonds.



DNA to chromosomes

1. Three monomer= codon (ex: A-T-G, C-C-T, etc.)
2. Many codons make a gene.
3. Many genes make DNA molecule.
4. Many DNA molecules + protein make a chromosome.

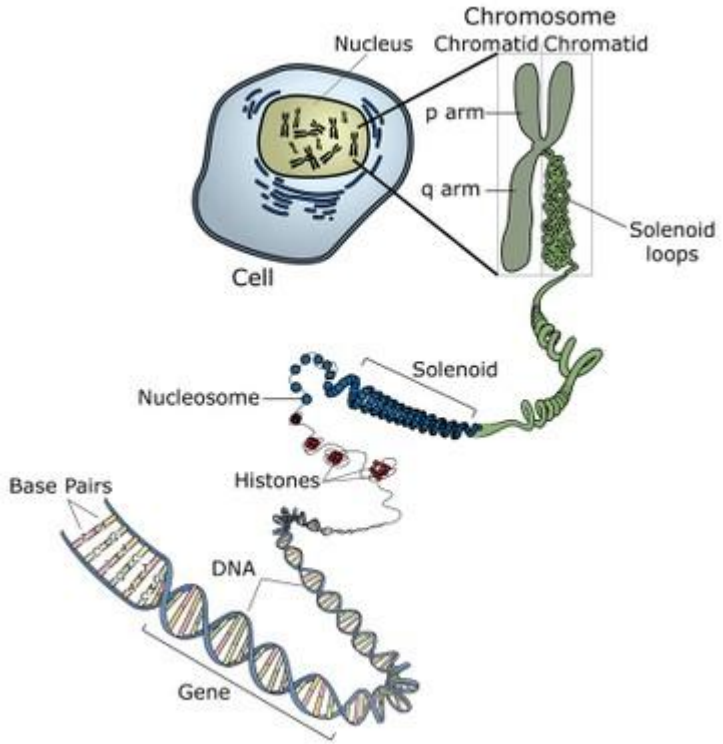


Image adapted from: National Human Genome Research Institute.

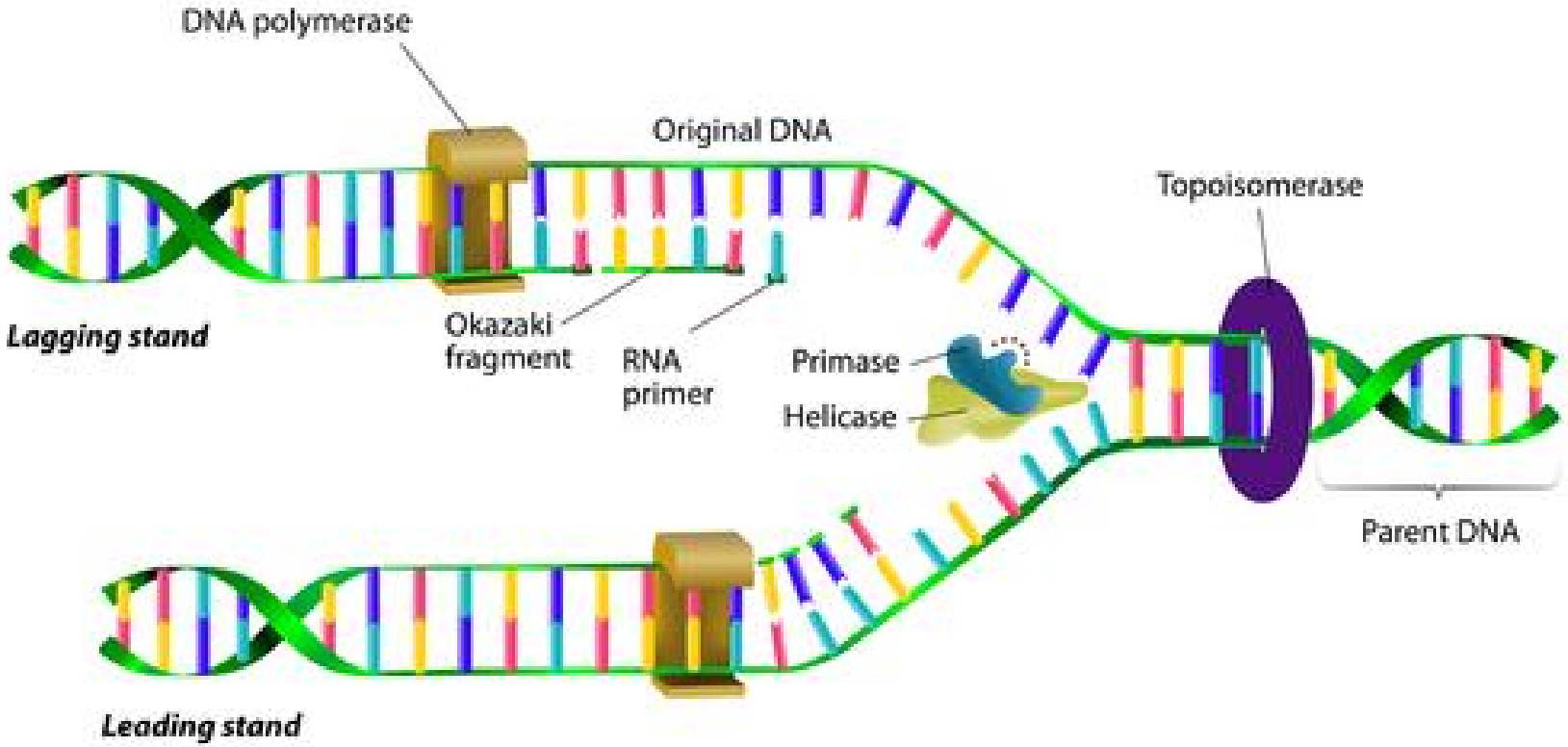
DNA Replication

1. DNA is needed in each cell to “control” the cell.
2. When a cell divides, it passes on an exact copy of the DNA to function correctly.
1. DNA makes a copy of itself during interphase in a cell’s life cycle.

Steps

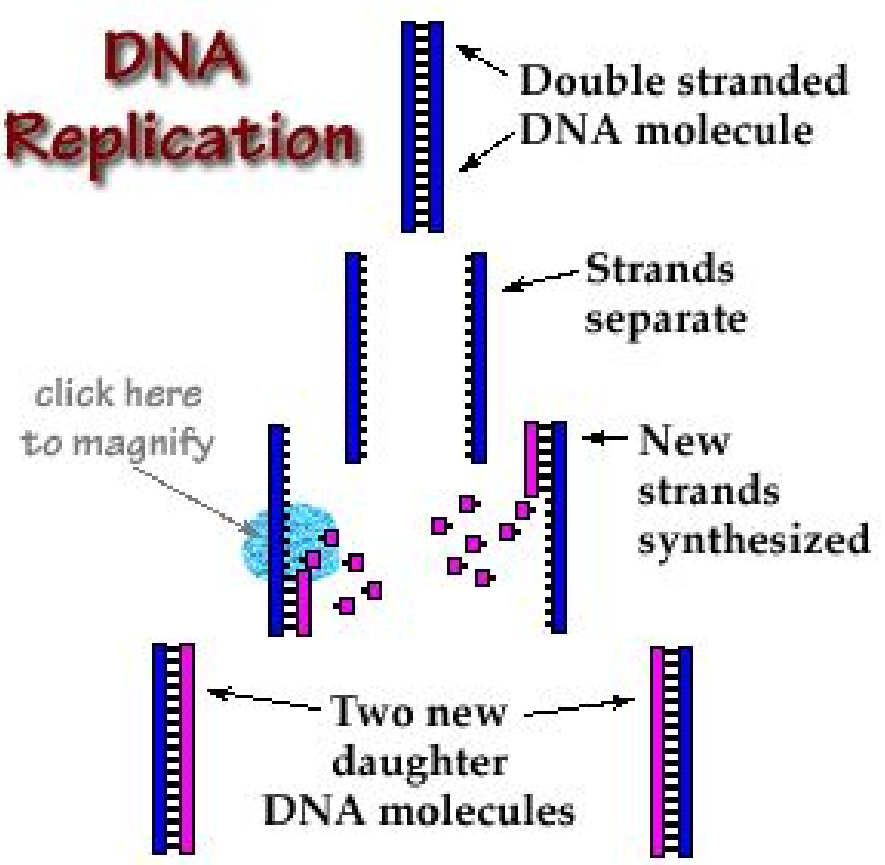
1. Hydrogen bonds break between bases (Helicase)
2. DNA splits down the middle (Helicase)
3. Newly unpaired nucleotides pair with extra nucleotides in the nucleus by base-pairing (enzyme that helps this is called DNA polymerase.)
4. Enzymes polymerase links the new nucleotides together to form a new strand, complementary strand, to the old side of DNA.
5. 2 new strands of DNA (1 new and 1 original side), both identical to the original, are complete.
6. Enzymes- proofread the DNA for errors.

DNA replication



Semi Conservative

each new DNA molecule has one side from the original and one side that is new

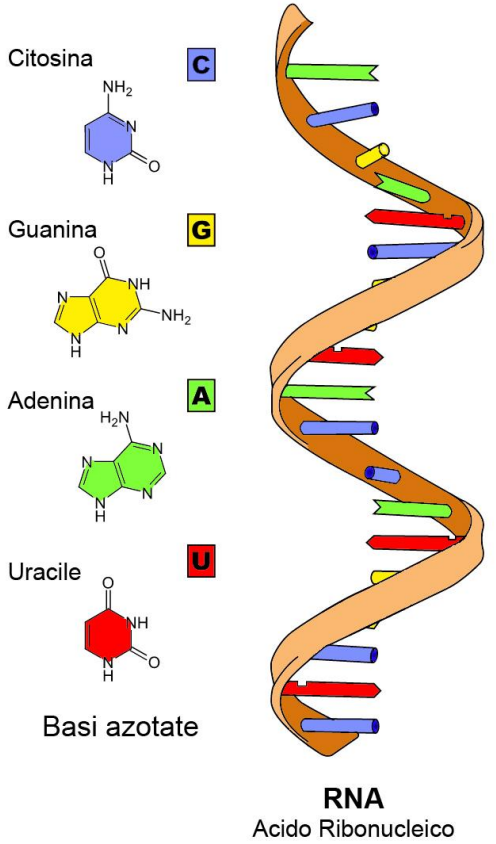


DNA mutations- when replication goes wrong.

1. Point mutations- a single base pair is changed (A-T becomes G-C in a strand)
    a. Ex: THE DOG BIT THE CA**T**
        THE DOG BIT THE CA**R**
2. Frameshift mutation- a single base pair is added or deleted from the strand, causing the amino acid code to change dramatically.
    a. Ex: THE DOG BIT THE CAT
        THE DOB ITT HEC AT

RNA- the second nucleic acid

1. Ribonucleic acid
2. Used in protein synthesis
3. Single stranded in structure
    a. 4 based pairs:
        i. A- adenine
        ii. U- uracil (replaces the thymine of DNA)
        iii. C- cytosine
        iv. G- guanine
    b. Ribose sugar
    c. Phosphate



RNA

A. The monomer unit is a sugar, phosphate, and a base pair (A-U, G-C).

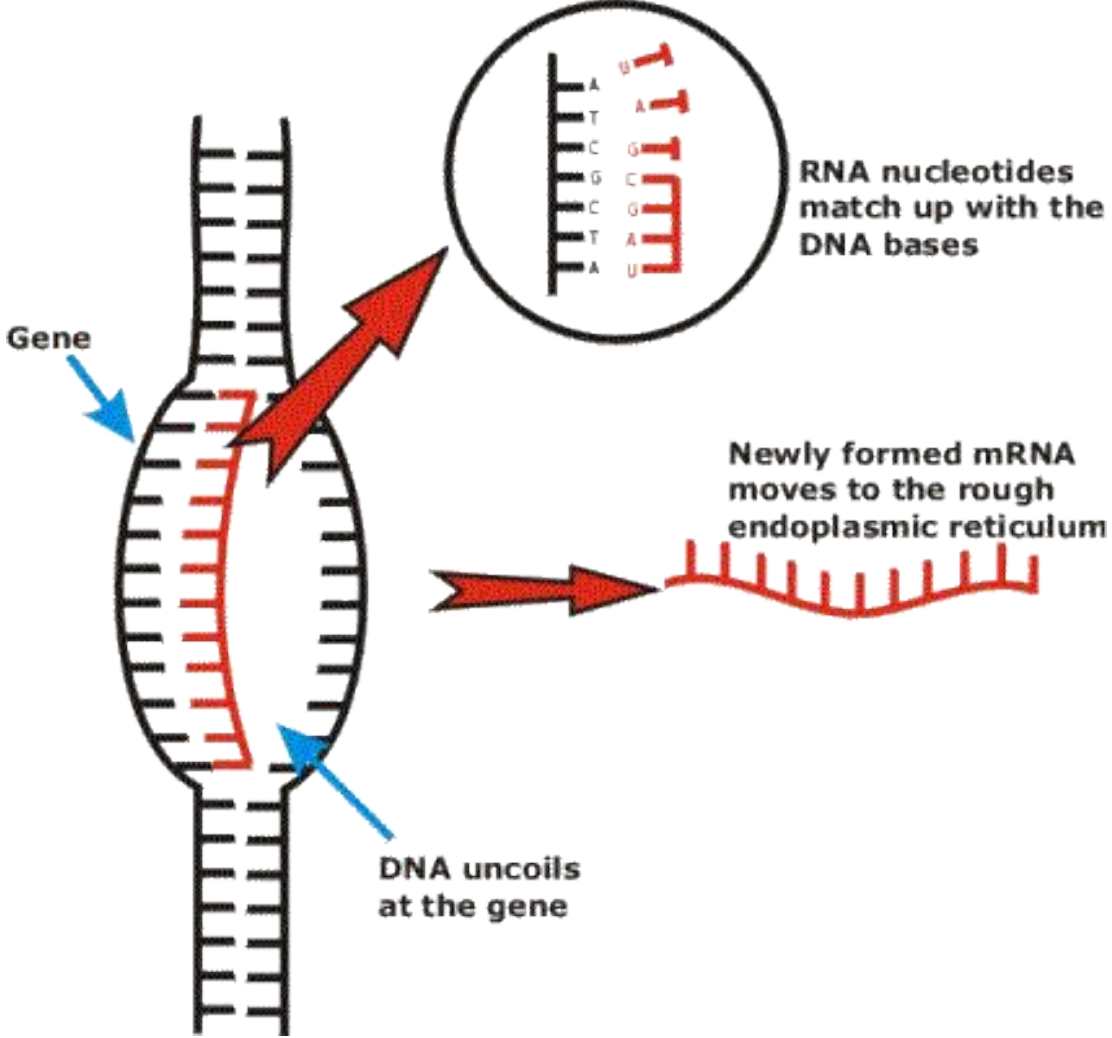
B. Three kinds of RNA

1. mRNA (messenger RNA)- travels from the nucleus to the cytoplasm (ribosomes)
2. tRNA (transfer RNA)- in the cytoplasm only, brings amino acids to the ribosomes.
3. rRNA (ribosomal RNA)- RNA that makes up the ribosomes that produce the proteins.

Protein Synthesis- the process of making protein; happens in 2 stages

Transcription: (DNA to RNA) to copy

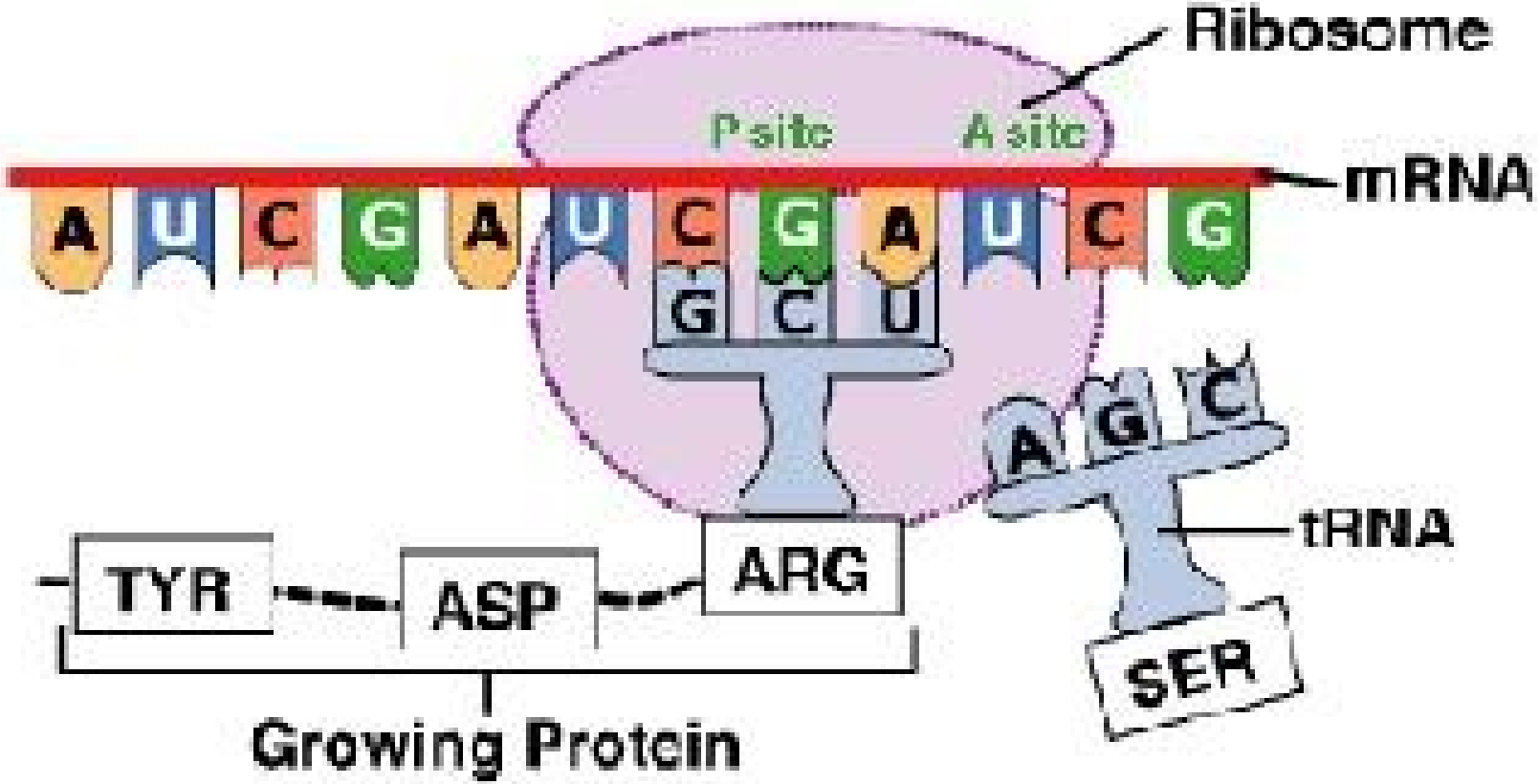
1. DNA bases can be read like musical notes or letters in a sentence by the cell. But the DNA cannot leave the nucleus to go the ribosomes where the proteins are made.
2. RNA is used to copy, send, and read the DNA's orders about how to make a protein.
3. mRNA (messenger RNA) copies the DNA when the DNA unzips one section- this section is called a gene. (1gene=1protein). mRNA base pairs with one side of the DNA.
4. mRNA uses Uracil instead of Thymine.
5. mRNA leaves the nucleus through a pore.
6. The DNA re-zips the gene.

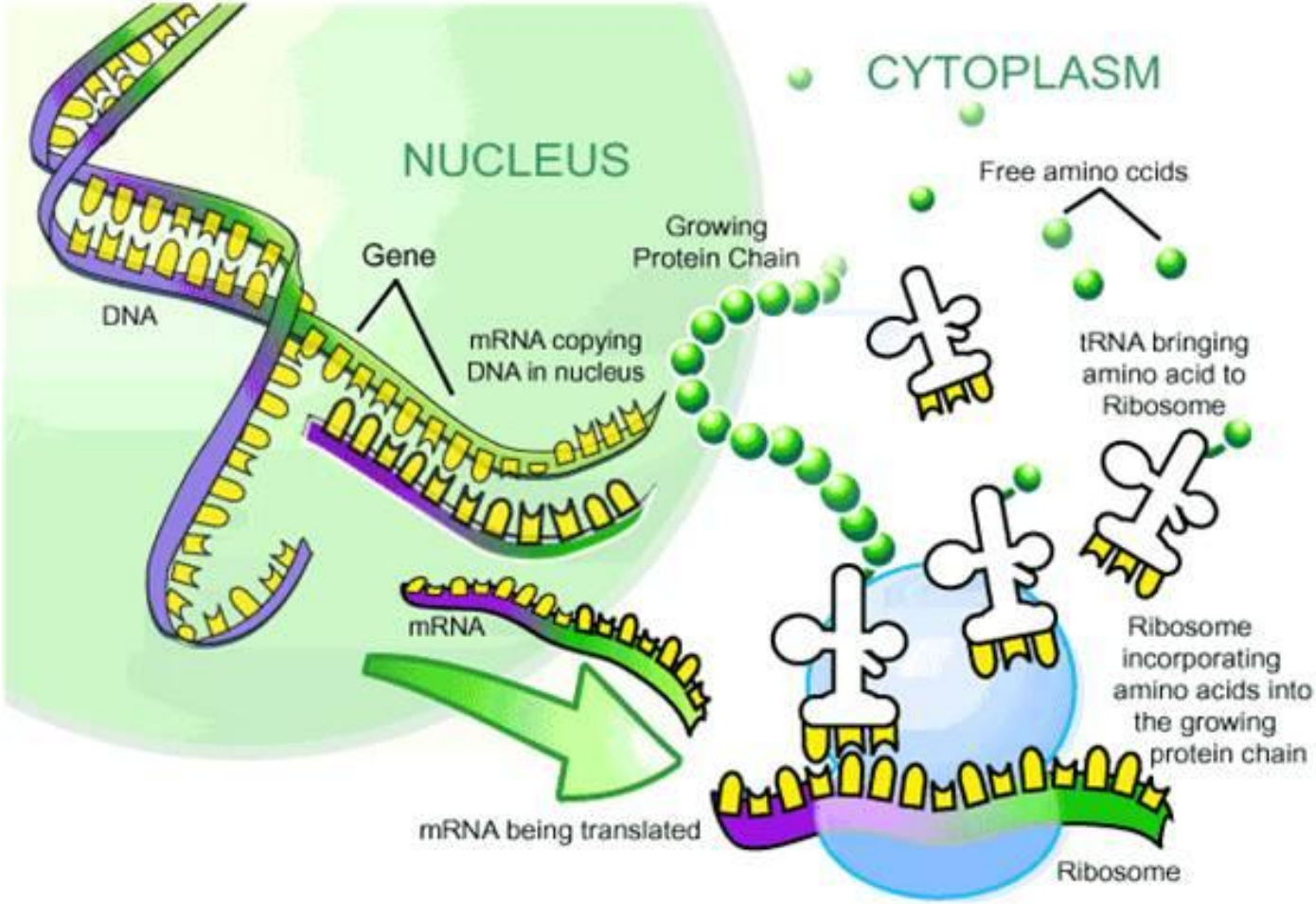

RNA nucleotides match up with the DNA bases
Gene
Newly formed mRNA moves to the rough endoplasmic reticulum
DNA uncoils at the gene

Protein Synthesis- the process of making protein; happens in 2 stages

Translation (mRNA to protein) to decode.

1. rRNA (ribosomal RNA) makes a ribosome in the cytoplasm.
2. mRNA joins with the ribosome (1 codon at a time)
3. tRNA brings one amino acid and must find a codon it can pair with using its anti-codon (three bases at the bottom of tRNA)
4. The ribosome allows the tRNA and mRNA to pair, and the amino acid is removed from each tRNA to make a string of amino acids.
5. When the tRNA that pairs with the STOP codon on mRNA passes through the ribosome, the amino acid chain- now a protein- is released.


Ribosome
P site
A site
mRNA
A U C G A U C G A U C G
G C U
A G C
tRNA
SER
TYR
ASP
ARG
Growing Protein


CYTOPLASM
NUCLEUS
Free amino ccids
Growing
Protein Chain
Gene
DNA
mRNA copying
DNA in nucleus
tRNA bringing
amino acid to
Ribosome
mRNA
Ribosome
incorporating
amino acids into
the growing
protein chain
mRNA being translated
Ribosome