Forensic Science
Bell-Ringer

- A women attending her mother's funeral notices a man. The women was very interested in the man, but did not get his name or number before he left the funeral. The women goes home and kills her sister.
- Why?

- This is question asked to Serial Killers…only a Serial Killer can get it correct!

Ok, let's look at Molecular Genetics

DNA and Forensic Science

DNA

- AKA- Deoxyribonucleic acid
- The hereditary blueprint of the cell
- ALL living things have this stuff
- Why?
- We need to have events that take place with precisely coordinated effort
- DNA is contained in the chromosomes which is found in the nucleus

- DNA- 2 strands wrapped around each other to form a ling, twisted, ladder- A double Helix
- 1956- Watson and Crick
- How do we squeeze all this DNA into a cell?
- Fold it over, and over, and over, and over, and over……..

So, how is DNA put together?

- Made of repeated subunits of nucleotides
- Phosphate
- Sugar- a 5 Carbon one- Deoxyribose
- Nitrogenous Base - 4 of them
- Adenine
- Guanine
- Cytosine
- Thymine

- Remember- nucleotides are held together by a phosphodiester bond
- Hey, wait, who the heck is ester?
- Okay, DNA is like a ladder
- The sides are the sugar, phosphate groups, the rungs are the nitrogenous bases
- Okay, now we need order, so we have bases pairing
- A=T and
- C≡G
- Okay, remember they are held in place by hydrogen bonds- the lines represent the number involved

- The 2 strands are complementary
- They run in opposite directions
- They have a 3’ end and a 5’ end
- The 5’ end always has a phosphate group and the 3’ end has an hydroxyl group
- The 5’ is always opposite the 3’- so they are anti- parallel
- Does this make any sense?
- If not, look at the picture…….

Ok, so why is DNA important?

- DNA's role is to direct the manufacture of proteins
- DNA does not do this directly, it uses RNA as an intermediate
- SO……
- DNA ⟶ RNA ⟶ Proteins

- This is known as the **CENTRAL DOGMA of MOLECULAR BIOLOGY**
- Let's peek at DNA replication

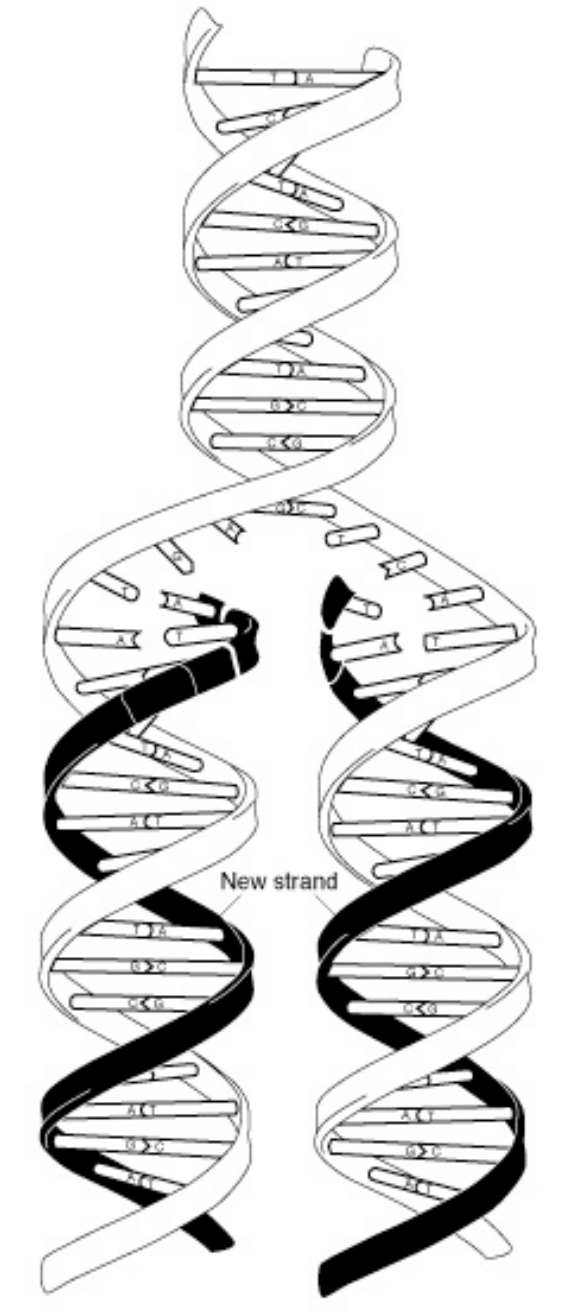
- Ok, we said that DNA is twisted over onto itself. So, what must it do first?
- Unwind
- How can it do this?
- Break the H bonds
- The enzymes name is DNA helicase
- It now assumes a shaped called a replication fork
- So, each strand now serves as a template for a new strand
- DNA polymerase- enzyme that adds the nucleotides along the naked DNA strand

- Now this is weird, DNA polymerase can ONLY add nucleotides to the growing strand- it "needs" permission to do this
- RNA primer adds the first nucleotide which kicks this thing into motion
- 2 strands are created. Remember?
- One is made ***continuously***- this is called the ***Leading strand***
- One is made ***bit, by bit***- this is the ***lagging strand***- these 'bits' are called
- ***Okazaki Fragments***

- But why Mr. Wardisiani, is it not made in one clean sweep like the other one?
- Well children, normally nucleotides are added in the 5' to 3' direction
- But, when we unzip, we have both directions- DNA polymerase ***DOES NOT WORK*** in this backward direction. So, we add in clumps
- DNA ligase will 'glue' them together later so we have 2 nice, continuous strands

- So……..
- We get 2 strands- 1/2 old, 1/2 new
- This is called the ***Semi- conservation*** model of DNA replication
- YOU need to know
- ***DNA Helicase*****- HELICASE HACKS**
- ***DNA Polymerase*****- POLYMERASE PASTES**
- ***DNA Ligase*****- LIGASE LINKS**
- Let's move on to RNA

- DNA, which stays in the nucleus, gives a message to RNA, hence the name, mRNA
- This takes the message out into the cytoplasm, where our story will go next…..
- **RNA-**
- single stranded (DNA- DS)
- ribose sugar (DNA- deoxyribose)
- uracil replaces thymine (A=T, C≡G)


New strand

Bell-Ringer

- **Forensic Science**
- What is the difference between the 3′ and 5′ ends of a DNA Molecule?
- What are the 4 Nitrogen Base Pairs in DNA? In RNA?

3 types of RNA

- mRNA- messenger RNA-copies information from one strand of DNA and takes the message out
- rRNA- ribosomal RNA- made in nucleolus- makes up the ribosmes
- tRNA- transfer RNA- shuttles amino acids around the cell

- Simple enough, now let's move on
- DNA tRNA cytoplasm
- Alrighty then…….
- tRNA goes out to a ribosome (rRNA) and starts the process
- ***Transcription- takes place in the nucleus***
- ***Copies the information from the DNA***
- First step- unwind the DNA, untwist it
- A ***Promoter*** starts the process

- The strand that is used is called the Sense strand, the other is the antisense strand
- This time we use RNA polymerase
- Just like DNA replication, we get a new strand, but, it needs to be processed before we can use it.
- It has a bunch of stuff that we do not need
- The areas we want are called *EXONS*
- The areas we ***DO NOT*** want are *INTRONS*

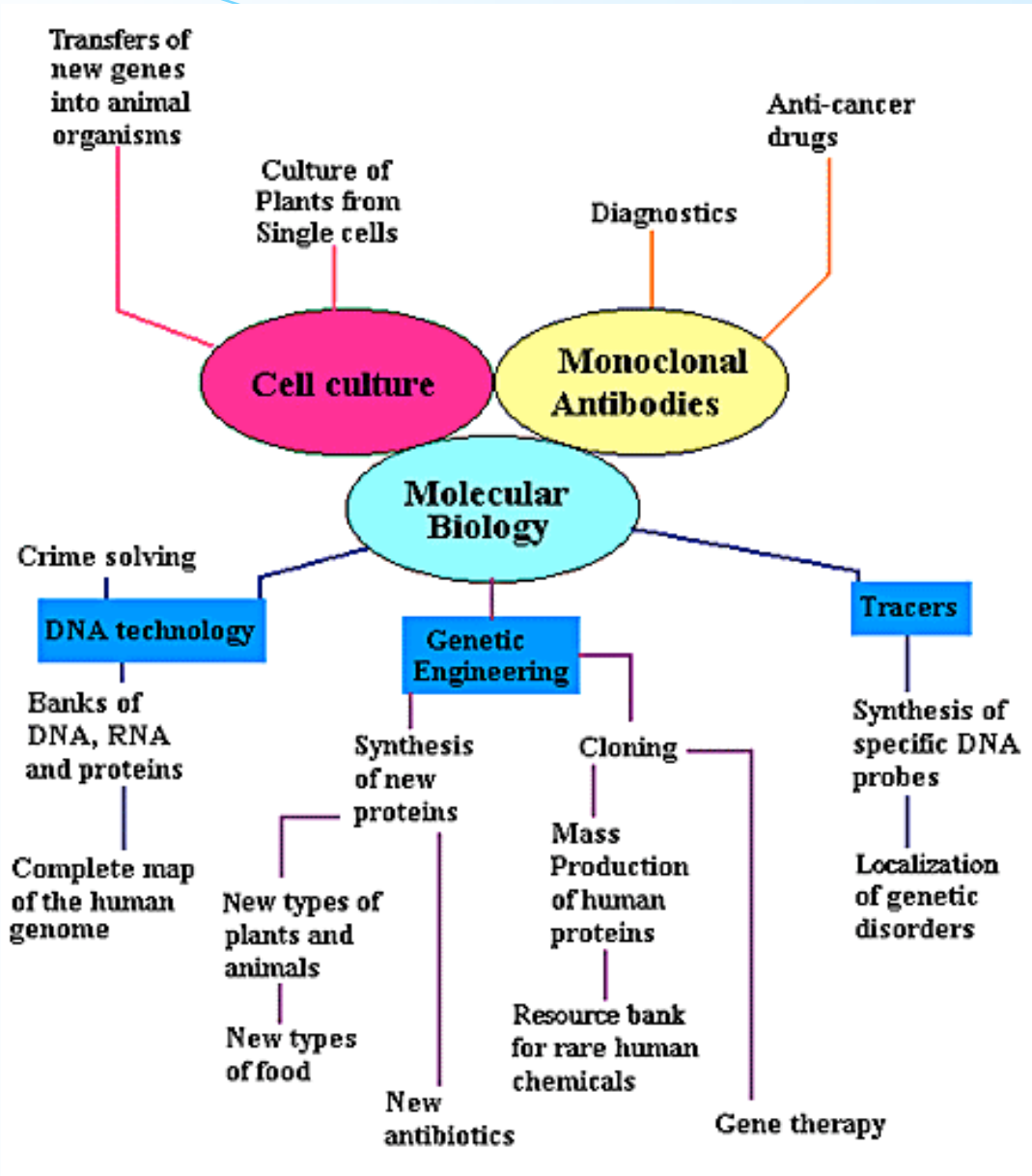
- So, the introns go, the exons stay
- A poly A tail (AAAAAAAAAAAAAAA) is added to the tail, and a 5' cap is added to the front
- Once it leaves, it is now ready to be Translated- this occurs in the cytoplasm at the ribosome
- *The mRNA carries the message in the form of* ***codons- or groups of three***

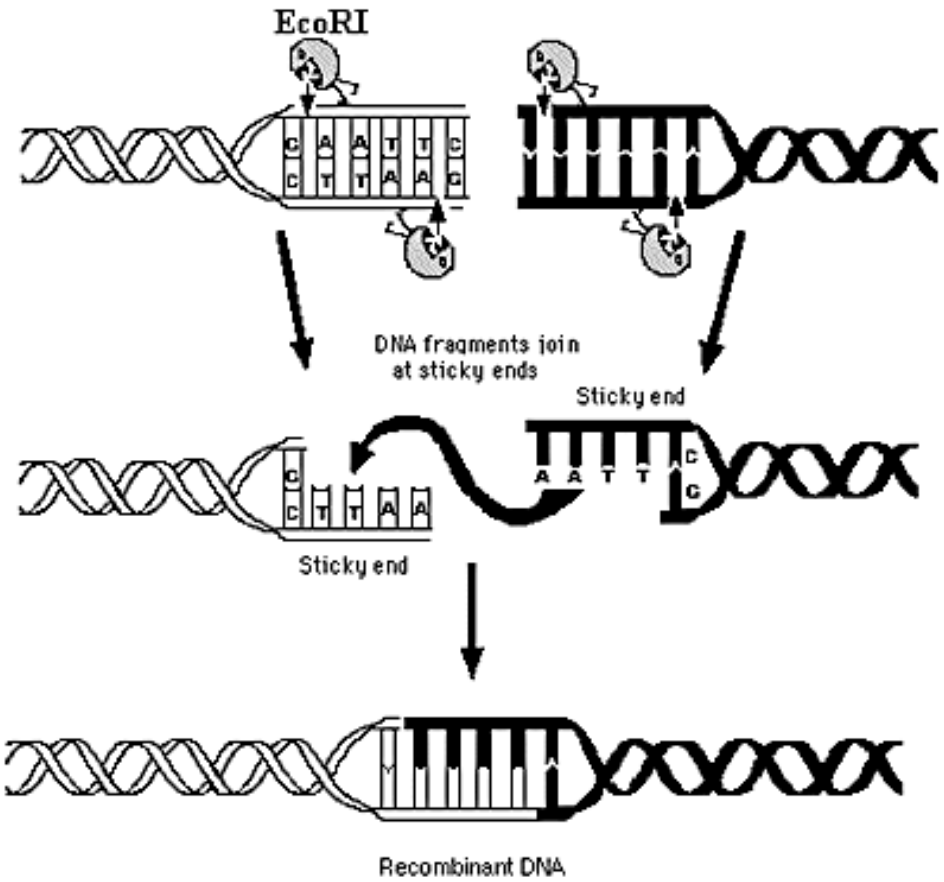
- The mRNA waits at the ribosome for the tRNA to bring in the correct anti-codon that corresponds to the codon
- They are brought in, the aa are joined by peptide bonds, the tRNA move out naked to pick up some one else
- Our chain grows into a polypeptide
- Finally, we reach a STOP codon and it does just that- everything stops

- Now, proteins have different shapes
- Primary- linear
- Secondary- coil, zigzag pattern
- Tertiary- folding
- Quaternary- joining of 2 or more

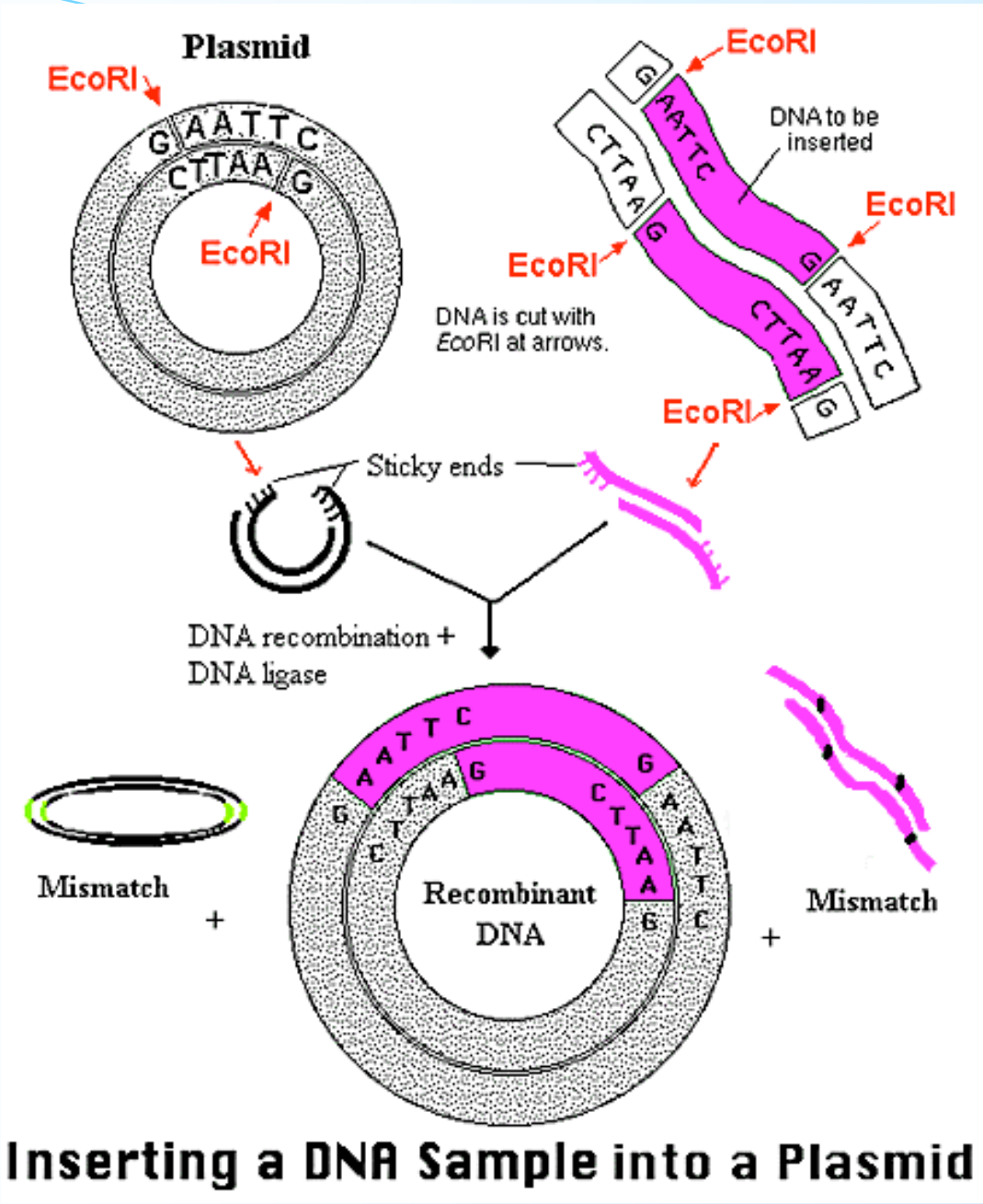
Mutations

- Mutations are changes in the DNA code
- Most are caught in the proof reading, some are not
- MOST are lethal, some are not
- Point
- Base substitution
- Insertions
- Deletions
- Translocation
- Inversions
- Duplication
- Why do they occur?
- Its random

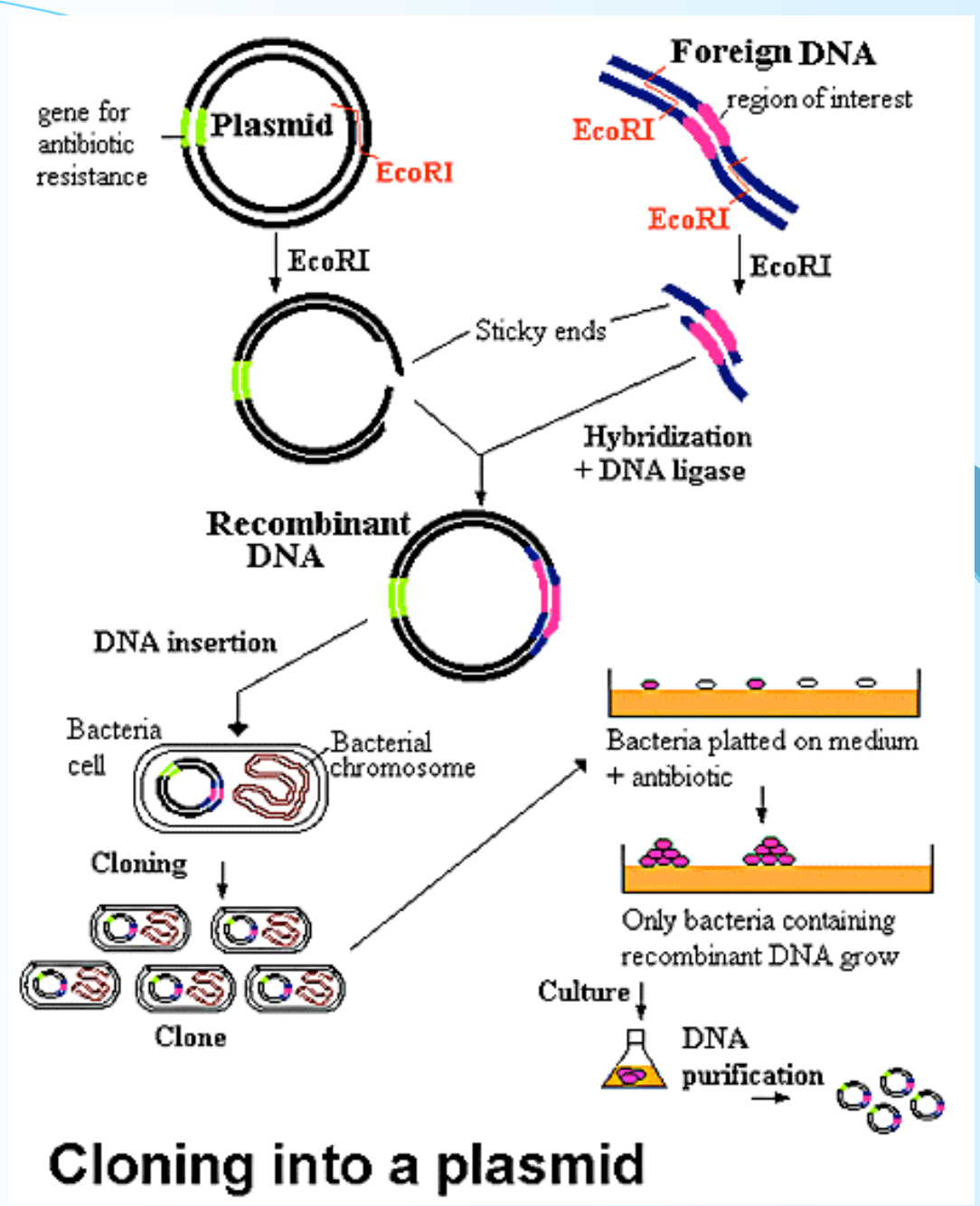

Transfers of new genes into animal organisms
Culture of Plants from Single cells
Diagnostics
Anti-cancer drugs
Cell culture
Monoclonal Antibodies
Molecular Biology
Crime solving
DNA technology
Genetic Engineering
Tracers
Banks of DNA, RNA and proteins
Synthesis of new proteins
Cloning
Synthesis of specific DNA probes
Complete map of the human genome
New types of plants and animals
Mass Production of human proteins
Localization of genetic disorders
New types of food
Resource bank for rare human chemicals
New antibiotics
Gene therapy



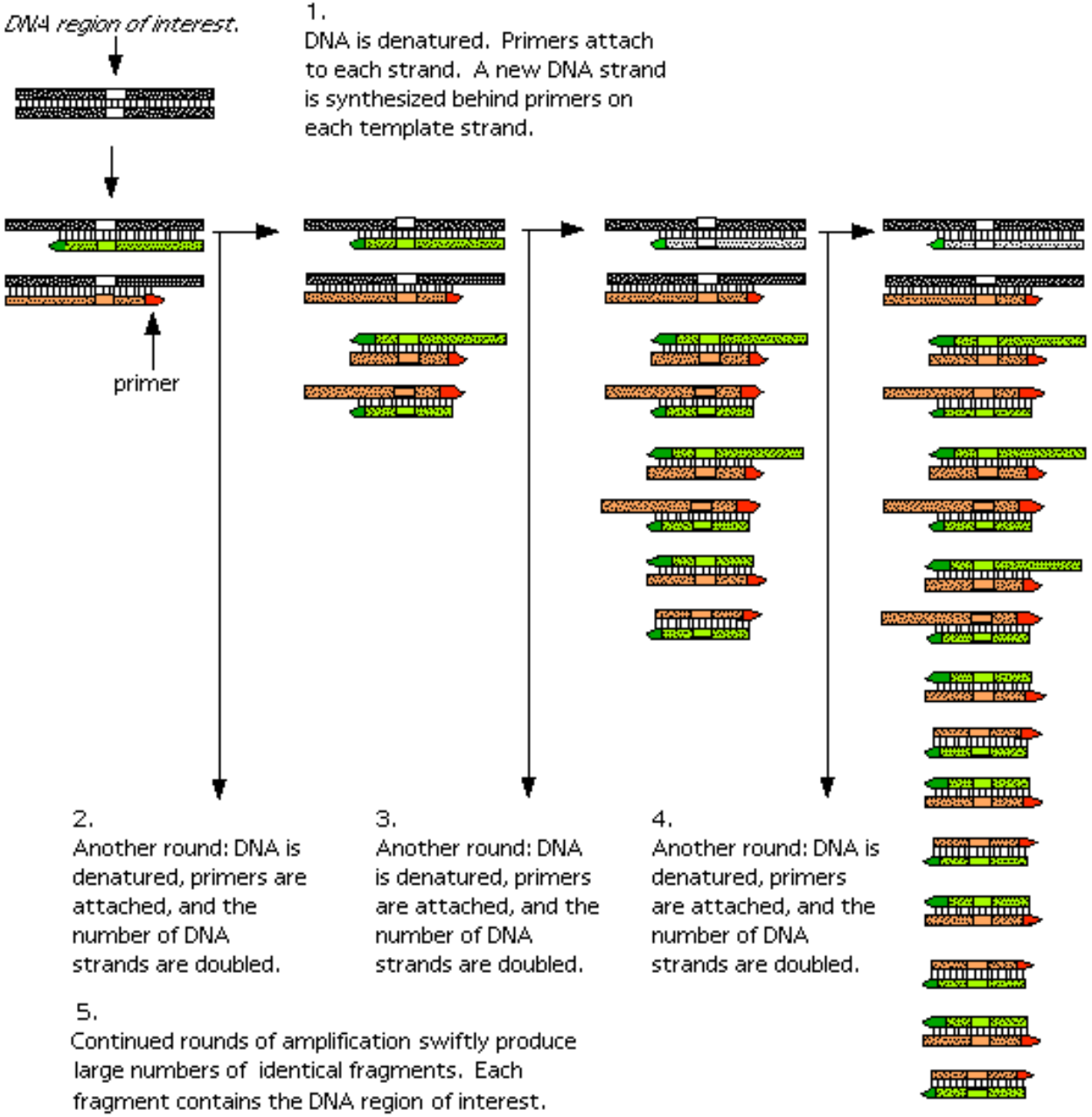
Restriction Enzyme Action of EcoRI



Inserting a DNA Sample into a Plasmid


gene for antibiotic resistance
Plasmid
EcoRI
EcoRI
Foreign DNA
region of interest
EcoRI
EcoRI
EcoRI
Sticky ends
Hybridization + DNA ligase
Recombinant DNA
DNA insertion
Bacteria cell
Bacterial chromosome
Cloning
Clone
Bacteria platted on medium + antibiotic
Only bacteria containing recombinant DNA grow
Culture
DNA purification
Cloning into a plasmid

POLYMERASE CHAIN REACTION



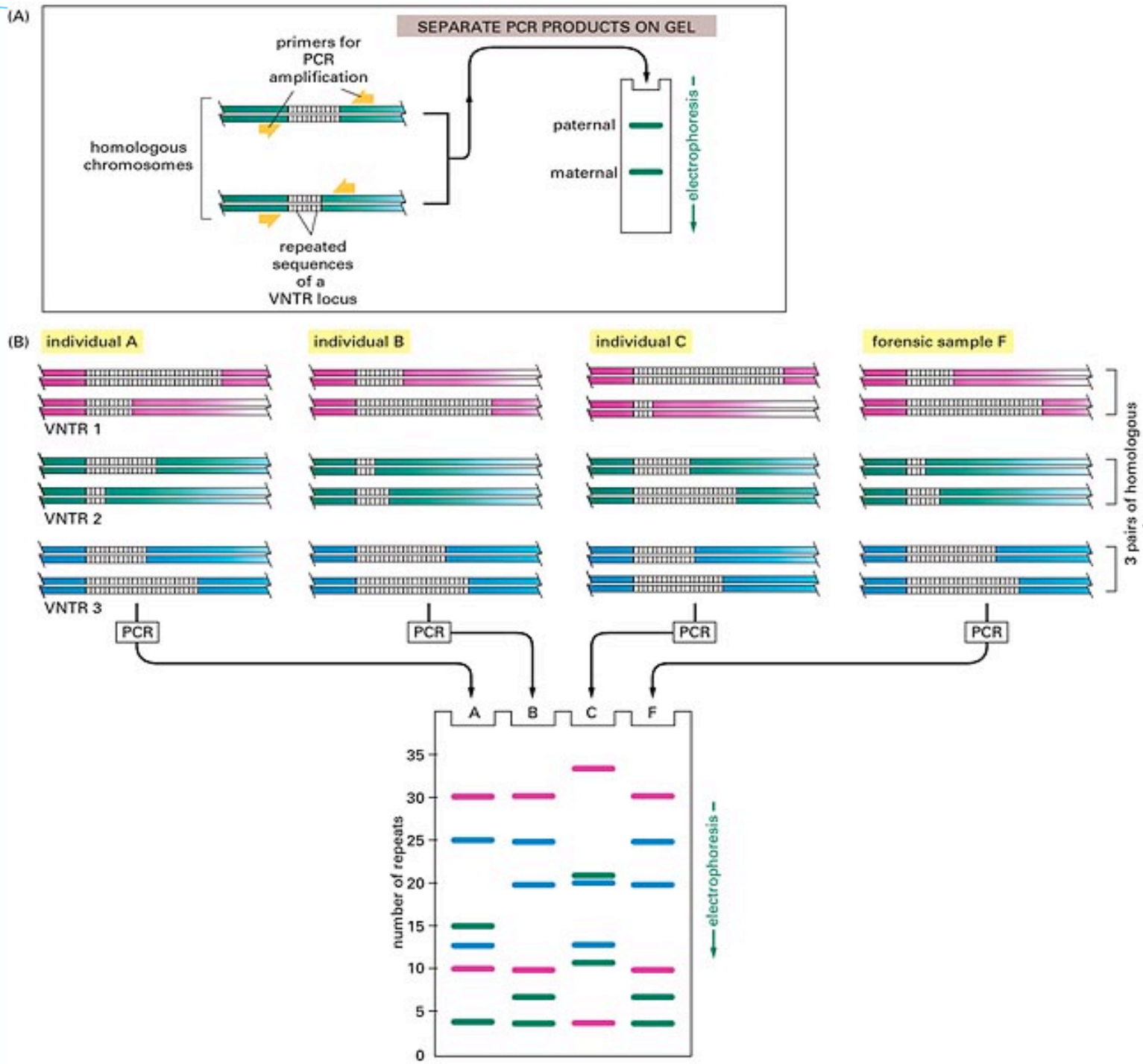
1.
DNA is denatured. Primers attach to each strand. A new DNA strand is synthesized behind primers on each template strand.

2.
Another round: DNA is denatured, primers are attached, and the number of DNA strands are doubled.

3.
Another round: DNA is denatured, primers are attached, and the number of DNA strands are doubled.

4.
Another round: DNA is denatured, primers are attached, and the number of DNA strands are doubled.

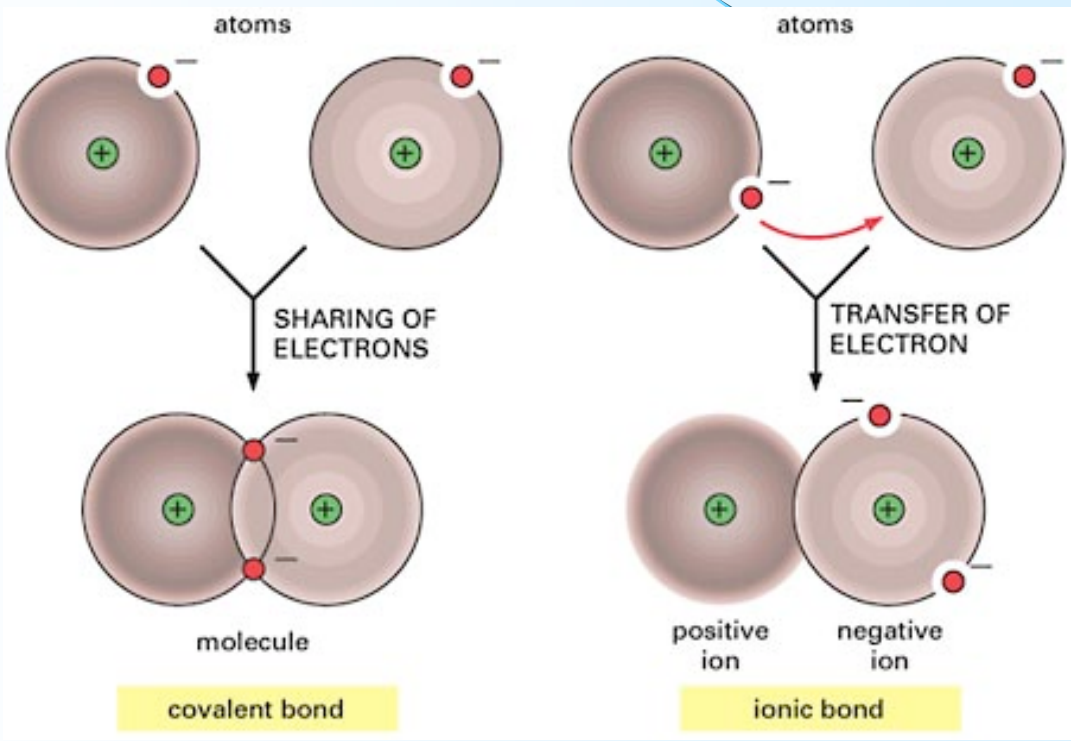
5.
Continued rounds of amplification swiftly produce large numbers of identical fragments. Each fragment contains the DNA region of interest.


(A)
SEPARATE PCR PRODUCTS ON GEL
primers for PCR amplification
homologous chromosomes
repeated sequences of a VNTR locus
paternal
maternal
electrophoresis
(B)
individual A
individual B
individual C
forensic sample F
VNTR 1
VNTR 2
VNTR 3
3 pairs of homologous chromosomes
PCR
A
B
C
F
number of repeats
35
30
25
20
15
10
5
0
electrophoresis

Quiz Time

1. What organelle is associated with protein synthesis?
2. What is the correct sequence of gene expression?
3. What does RNA have that DNA does not?
4. If the mRNA is uac, what is the anti-codon?
5. What is cut out of RNA before it is translated?

6. What is the name of the non continuous DNA strand that is made?
7. What is the function of DNA polymerase?
8. DNA ligase?
9. DNA helicase?
10. What is the name of the structure that forms ribosomes?


atoms
SHARING OF ELECTRONS
molecule
covalent bond
atoms
TRANSFER OF ELECTRON
positive ion
negative ion
ionic bond