1. DNA, and in some cases RNA, is the primary source of heritable information. Genetic information is stored in and passed to subsequent generations through DNA molecules and, in some cases, RNA molecules.

A. Identify the building blocks of DNA and label the parts in the diagram
   - building block - nucleotide

B. Identify the number of DNA strands found in a DNA molecule and Explain the orientation of the DNA strands
   - 2 DNA strands hydrogen bonded together. The 2 strands are antiparallel

C. Identify and label the following parts in a DNA molecule: nitrogenous bases, hydrogen bonds, sugar phosphate, nucleotide

D. Explain the importance of the hydrogen bonds in the DNA molecule
hold the two antiparallel strands together

E. Explain what is meant by the 5’ and 3’ ends of the nucleotide

the numbers refer to the carbon that is in that position. the 5’ end is the 5th carbon which has a phosphate attached and the 3’ end is the 3rd carbon in the structure which has a OH (hydroxyl group) attached

F. Identify and label the 5’ and 3’ ends in the following DNA molecule

![DNA molecule diagram]

G. Explain the importance of the 5’ and 3’ end in a DNA molecule

- the orientation of the 3’ and 5’ end determine which direction DNA and RNA polymerase will lay down nucleotides.
- DNA replication- DNA polymerase synthesizes the new strand in the 5’ – 3’ direction (so it reads the template strand 3’-5’)
- transcription- RNA polymerase also must synthesize the new RNA strand in the 5’ to 3’ direction (so it reads the DNA template strand 3’ to 5’)

2. DNA, and sometimes RNA, exhibits specific nucleotide base pairing that is conserved through evolution

A. DESCRIBE a purine and IDENTIFY the purines in DNA

Describe- Purines are nucleotides with double ringed nitrogenous bases.
identify- A and G are purines
B. DESCRIBE a pyrimidine and IDENTIFY the pyrimidines in DNA/RNA
- describe- pyrimidines are nucleotides with single ring bases
- identify- T and C are pyrimidines

C. Label the purines and pyrimidines in the following DNA molecule

D. Identify the base pairing rule AND EXPLAIN the base pairing rule
- A pairs with T and C pairs with G
- explain- a purine must pair with a pyrimidine so it is the correct width. A must pair with T because it is the correct width and correct number of hydrogen bonds holding them together (both require 2 hydrogen bonds)
- G and C must pair together for the correct width (purine to pyrimidine) and the correct number of hydrogen bonds (both need 3)

E. PREDICT the percentage of A if the DNA has 30% C AND JUSTIFY

\[
\begin{align*}
\text{C - 30} & \quad 100 \\
\text{G - 30} & \quad 60 \\
\frac{60}{140} & = 20
\end{align*}
\]
- justify- since C and G pair the percentage of each must be equal to each other. Since A and T pair the percentage of each must be equal to each other. the total percentage for all must add to 100%

3. Prokaryotic and Eukaryotes contain chromosomes
   A. Identify the number of chromosomes (as single or multiple) that exist in prokaryotes and eukaryotes and Describe their shape (circular or linear)
      - Prokaryote- 1 double helix chromosome that is circular
      - eukaryotes- multiple double helix chromosomes that are linear

   B. IDENTIFY the components of a eukaryote chromosome and DESCRIBE the arrangement of the components in the chromosome
      - contains multiple histones (a group of 8 proteins) with DNA wrapped around each histone. the combination of histone and DNA is called a nucleosome.
      - histones that are tightly packed together is heterochromatin
      - histones that are separated (loosely packed) is euchromatin

   C. DESCRIBE heterochromatin and euchromatin and EXPLAIN the importance of each type of folding
      - heterochromatin is tightly packeded so gene expression does not occur in heterochromatin
      - euchromatin is loosely packed so gene expression can occur

   D. Label the heterochromatin and euchromatin regions in the following diagram

4. DNA replication ensures continuity of hereditary information
A. Identify the phase in which DNA replication takes place and EXPLAIN the importance of DNA replication
   - DNA replication occurs during the “S” phase of interphase prior to mitosis and meiosis. This ensures that there is the correct amount of DNA in the daughter cells after cell division.

B. Identify the direction DNA polymerase reads the template strand AND EXPLAIN why the template strand is read in that direction
   - DNA polymerase reads the template strand 3’ to 5’ and synthesizes the new strand 5’ to 3’. (it must lay down the new nucleotides by adding them to the exposed 3’ end).

C. Identify the direction in which DNA is synthesized
   - The new strand is synthesized 5’ to 3’.

D. Draw in what the leading strand and lagging strand would look like as they are being made

E. Identify and Label which template strand would form the continuous leading strand and which strand would be the discontinuous lagging strand

F. Explain why the leading strand is referred to as the continuous strand
   - It is made towards the replication fork as the helicase separates the DNA strands. The leading strand does not have any breaks in the strand.

G. Explain why the lagging strand is referred to as the discontinuous strand
   - Made away from the replication fork. Must be made in fragments (okazaki fragments) as the replication fork unwinds DNA polymerase adds new nucleotides away from the fork. The fragments then need to be covalently bonded to make it a continuous complete strand.

H. Describe what a replication bubble is and label the replication bubbles in the diagram below
   - The replication bubble is where the helicase has separates the DNA strands from each other. The replication bubble contains 2 replication forks.
I. For each of the circles below, DETERMINE if the end is 5'' or 3’ and label them in the diagram.
(each circle needs to be labeled as either 3’ or 5’)

J. Identify and label the leading and lagging stands in the DNA replication diagram above.

K. EXPLAIN why a newly synthesized DNA strand is made from both continuous and discontinuous DNA synthesis.
   - DNA replication is semi conservative. since there are two template strands from the original DNA, the one template strand is read towards the replication fork and is made continuously while the other template strand is made away from the replication fork and made discontinuously.
5. Describe the mechanisms by which genetic information is copied for transmission between generations.

A. Identify and label the following structures in the diagram below: topoisomerase, single stranded binding proteins, DNA polymerase (both of them), okazaki fragments, DNA ligase, helicase, 3', 5', continuous strand, discontinuous strand, primase

B. Explain the purpose for each of the enzymes involved in DNA replication
   - helicase - unwind and separate the hydrogen bonds
   - topoisomerase - on the other side of the replication fork, as helicase unwinds the DNA strands, topoisomerase will prevent supercoiling (over winding) of the DNA strands upstream of the replication fork
   - Primase - adds RNA nucleotides forming the primer
   - DNA polymerase - synthesizes the new DNA strands on both the continuous and discontinuous strands
C. Describe the process of DNA replication
- 1. Helicase unwinds and separates the DNA strands breaking the hydrogen bonds
- 2. Topoisomerase prevents supercoiling on the other side of the replication fork
- 3. Primase adds RNA nucleotides forming the primer on both continuous and discontinuous strands
- 4. DNA polymerase adds nucleotides on both leading/lagging strands synthesizing them in the 5’ to 3’ direction
- 5. DNA ligase covalently bonds the okazaki fragments
- 6. Proofreading of the synthesized strands

D. Explain what is meant by the phrase “DNA replication is a semiconservative process”
- Replication is a semiconservative process—that is, one strand of DNA serves as the template for a new strand of complementary DNA.

E. Predict what would happen if a ligase inhibitor was present AND JUSTIFY your prediction
- The discontinuous strand would stay as fragments but because ligase would not be able to covalently connect the okazaki fragments

F. Predict what would happen if a topoisomerase inhibitor was present AND JUSTIFY your prediction
- DNA replication would stop since supercoiling would occur preventing DNA helicase from being able to unwind the DNA strands. If topoisomerase inhibitor is present, topoisomerase would not be able to prevent the overtwisting of the DNA strand
1. The sequence of the RNA bases, together with the structure of the RNA molecule, determines RNA function
   A. Describe the overall structure of RNA
      - single stranded nucleic acid made of nucleotides. Nucleotides made of phosphate, ribose sugar, nitrogenous bases. (A-U, C-G)

   B. Describe the differences between DNA and RNA
      - DNA double stranded, RNA single stranded
      - DNA contains the pyrimidine T while RNA contains U
      - DNA contains the sugar deoxyribose while RNA contains the sugar ribose

   C. Explain the role for each of the following types of RNA
      - mRNA
         - mRNA molecules carry information from DNA to the ribosome.
            - tRNA
               - tRNA molecules bind specific amino acids and have anti-codon sequences that base pair with the mRNA. tRNA is recruited to the ribosome during translation to generate the primary peptide sequence based on the mRNA sequence.

      - rRNA
         - rRNA molecules are functional building blocks of ribosomes.
2. Genetic information flows from a sequence of nucleotides in DNA to a sequence of bases in an mRNA molecule to a sequence of amino acids in a protein.

A. Explain what is meant by the phrase “Central Dogma”

   The flow of genetic information flows from DNA into proteins by the process of transcription and translation.

B. Describe how the phenotype of an organism is determined by its genotype.

   The combination of genes in an organism determines the physical appearance (phenotype) of the organism.

C. Identify the location where transcription takes place and identify what is produced as a result of transcription.

   - Transcription occurs in the nucleus and produces mRNA.

D. Identify the enzyme used in transcription and explain its role in transcription.

   - RNA polymerase is the enzyme used in transcription which synthesizes the new RNA strand by using the DNA template to produce the RNA strand.

E. Describe the process of transcription.

   RNA polymerases use a single template strand of DNA to direct the inclusion of bases in the newly formed RNA molecule. RNA polymerase attaches to the promoter region on the DNA strand, adds RNA nucleotides to the new strand, and stops adding nucleotides when it gets to the termination sequence.

F. Identify the direction in which RNA polymerase synthesizes mRNA molecules and explain why the RNA polymerase must synthesize mRNA in this direction.

   The enzyme RNA polymerase synthesizes mRNA molecules in the 5’ to 3’ direction by reading the template DNA strand in the 3’ to 5’ direction.
G. Draw a circle around the noncoding strand and EXPLAIN why it is the noncoding strand.

- the noncoding strand is the template/nonsense strand bc it is complementary to the RNA. It does not contain the code for the protein.

The DNA strand acting as the template strand is also referred to as the noncoding strand, minus strand, or antisense strand.

H. Draw a circle around the coding strand and EXPLAIN why it is the coding strand.

- the coding strand is the sense strand bc it is the code for the amino acid sequence which will determine the protein produced.

I. Explain how the selection of which DNA strand will serve as the template.

Selection of which DNA strand serves as the template strand depends on the gene being transcribed. The transcription factors will attach to the DNA strand that will be transcribed and translated.

J. Identify the mRNA strand that would be produced from the following DNA strand:

```
ATGATCTCGTAA
AUGAUCU
TACCTAGAGCATT
```

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

3. In eukaryotic cells the mRNA transcript undergoes a series of enzyme-regulated modifications.

A. Identify the location where RNA processing occurs.
   - inside the nucleus

B. Describe what occurs to the pre-mRNA to process it into a mature mRNA.
Addition of a poly-A tail, Addition of a GTP cap, Excision of introns and splicing and retention of exons.

C. Explain the importance for RNA processing

- the introns are noncoding segments so must be removed. If not removed the wrong amino acids would be in the protein and produce the wrong shape protein. the poly a tail is added so enzymes do not degrade it while moving through cytosol. the GTP cap helps attach to ribosome.

D. EXPLAIN how the same pre m-RNA strand can result in different mature mRNA strands

excision (removal) of introns and splicing and of exons can generate different versions of the resulting mRNA molecule; this is known as alternative splicing.

4. Translation involves energy and many sequential steps, including initiation, elongation, and termination.
A. IDENTIFY the location where translation takes place and IDENTIFY the molecule produced at the end of translation

- translation occurs at the ribosome and produces a polypeptide

B. Explain the role of mRNA in protein synthesis, DETERMINE the number of nucleotides that make up a codon AND DRAW a circle around each codon

- mRNA contains the code from DNA which will be used to produce the amino acid sequence.
- 3 nucleotides make up 1 codon

C. EXPLAIN the role of tRNA in protein synthesis and IDENTIFY and label both the anticodon and amino acid on the tRNA

- carry over the amino acids to the growing polypeptide chain

D. Describe the overall structure of ribosomes AND EXPLAIN what ribosomes are made up of

- ribosomes are made of rRNA and proteins. site of protein synthesis. allows mRNA codon to pair with tRNA anticodon and formation of peptide bonds between amino acids
E. DESCRIBE what is occurring at each step in translation to produce a polypeptide

1. Initiation - assembling all the RNA's involved in protein synthesis at the codon start sequence
   - small ribosomal subunit attaches to mRNA at start codon sequence
   - tRNA carries the correct amino acid over based on the codon
   - large ribosomal subunit attaches

2. Elongation - growth of polypeptide chain
   - tRNA continues to bring the corresponding amino acid over to the growing polypeptide chain
   - amino acids peptide bonded together
   - process continues along the mRNA until a stop codon is reached

3. Termination - polypeptide is done being assembled
   - separation of the types of RNA from the polypeptide chain
   - result is a polypeptide in its primary structure which will then go on to fold into secondary, tertiary, quaternary structure based on the amino acids present
F. Determine the polypeptide that would be produced based on the following mRNA strand

\[
\text{mRNA: AUGGGCUCCAUC}
\]

met-ala-ser-ile

G. Explain why the analysis of DNA to compare individuals results in a greater estimate of genetic variability than does analysis of amino acid sequences
- different DNA sequences can code for the same amino acid
5. Nearly all living organisms use the same genetic code, which is evidence for the common ancestry of all living organisms.
   A. Describe the similarities of protein synthesis in Prokaryotes and Eukaryotes
      - transcription occurs using DNA as the template, and RNA polymerase as the enzyme
      - translation occurs at the ribosomes using the 3 types of RNA's resulting in a polypeptide

   B. EXPLAIN how transcription and translation varies between prokaryotes and Eukaryotes
      - eukaryotes have RNA processing after transcription while prokaryotes do not have RNA processing

   C. Explain why transcription and translation can happen at the same time in Prokaryotes but not Eukaryotes
      transcription occurs in eukaryotes inside the nucleus and must do RNA processing before moving out of the nucleus to the ribosomes.
      prokaryotes do not have to do RNA processing and transcription occurs in the cytosol where the ribosomes are located

6. Genetic information in retroviruses is a special case and has an alternate flow of information
   A. Identify the genetic contents of a retrovirus
      - retroviruses have RNA as their genetics content

   B. Viruses, just like prokaryotes and Eukaryotes use their genetic content to produce proteins.
      Describe the processes retroviruses must go through to produce a protein
      retroviruses must first make a DNA strand before protein synthesis can occur.
      RNA → DNA → RNA → protein

   C. Explain why the central dogma does not apply to retroviruses
      retroviruses start with RNA not DNA for their genetic content

   D. EXPLAIN why During the infection cycle for a typical retrovirus, such as HIV, which uses RNA as genetic material, the genetic variation in the resulting population of new virus particles is very high
- because retroviruses produce DNA from RNA during reverse transcription, there is no proofreading so errors are introduced into the DNA strand and not corrected

Name__________________________________________________	Unit 6 regulation of gene expression & cell specialization

1. In prokaryotes, groups of genes called operons are transcribed in a single mRNA molecule. The lac operon is an example of an inducible system

A. Explain the importance of the regulatory gene in the prokaryote and IDENTIFY the molecule that is produced from the regulatory gene
   - produces a protein called the repressor protein that controls protein synthesis.

B. Describe how this regulatory gene is involved in the operons
   - the regulatory gene will be transcribed and translated into the regulatory repressor protein which is capable on binding to the operator region and stopping protein synthesis

C. Identify the structures that make up a lac operon
   - promoter region, operator region, structural genes (which will be transcribed and translated into proteins)

D. Explain the purpose of the operator region
E. Explain the importance of the promoter region
- location for RNA polymerase to bind to

F. Describe how the repressor protein regulates gene expression in prokaryotes
- if protein synthesis is not needed for the genes, the repressor protein, if it has the correct shape, can bind to operator region preventing RNA polymerase from functioning so transcription cannot occur preventing protein synthesis from occurring

G. The Lac operon is an inducible operon. Explain what is means to be an inducible operon.
- if the operon is inducible, that means it can be induced or turned on. so in its normal state it is turned off

H. Explain how gene expression can occur in an inducible operon and EXPLAIN how lactose is involved in the inducible operon
- in an inducible operon, since it is normally turned off, the repressor is bound to the operator region preventing RNA polymerase from doing transcription.
- when lactose is present, allolactose (isomer of lactose) binds to the repressor changing the shape of the repressor. the shape change causes the repressor to stop binding to the operator region. RNA polymerase is then able to do transcription

1. Epigenetic changes can affect gene expression through reversible modifications of DNA or histones.

A. Explain epigenetics
- epigenetics is the change to gene expression without changing the genetic code. (it can allow gene expression to occur or stop gene expression)

B. Describe how the methyl group causes changes in the chromosome
- when the methyl tag is present, it causes the chromatin to tightly pack into heterochromatin preventing gene expression from happening
- when the methyl tag is removed, chromatin is loosely packed into euchromatin so gene expression can occur
C. Explain the impact these epigenetic changes have on gene expression
- it controls whether gene expression can occur. In some cases, methyl tags are removed from genes that should not be expressed which can negatively impact the organism like producing cancerous cells

2. The phenotype of a cell or organism is determined by the combination of genes that are expressed and the levels at which they are expressed

A. Since each cell contains all the genes of the organism, EXPLAIN how cells can express different phenotypes
- different cells express different genes resulting in the production of different proteins

B. Promoter regions on DNA are involved with gene expression. Identify the location of promoters and EXPLAIN their involvement with gene expression
- promoter regions are upstream (not part of) from the region where transcription occurs. The promoter region can activate or turn off gene expression

C. Describe the involvement of transcription factors in the expression of genes
- transcription factors bind to the promoter region activating or inactivating transcription. If transcription factors are activating transcription, it signals RNA polymerase to attach and begin transcription of that gene

D. Explain how signal transduction is involved in phenotypic expression
- the environmental signal (ligand) causes signal transduction which produces a response to activate the transcription factors. (the transcription factors are inactive so no gene expression can occur until signal transduction activates the transcription factors)

4. In eukaryotes, groups of genes may be influenced by the same transcription factors to coordinate expression.
A. DESCRIBE how the same transcription factor can regulate/active gene expression of multiple genes

The same transcription factor can bind to multiple different promoter regions activating different genes. This coordinates their production at the same time coordinating activity in the body. (the transcription factor can also at the same time bind to different promoters causing gene expression to stop... this is not pictured in the diagram to the right)

B. Predict what would happen to gene expression if a chemical was bound to the transcription factors. JUSTIFY your prediction

transcription would not happen since the transcription factors would be unable to bind to the promoter region. RNA polymerase would not attach so transcription would not happen and no protein would be made

Name_________________________________________________

Unit 6 Mutations and Biotechnology review

1. Disruptions in genes and gene products cause new phenotypes.
   A. Identify environmental factors that increase the mutation rate in an organism, and discuss their effect on the genome of the organism.
B. Identify the process that would produce errors in the DNA sequence and EXPLAIN why the errors in the DNA could have an impact on the phenotype

- errors can occur in DNA replication or DNA proofreading which could result in the wrong amino acid in the polypeptide sequence. changing in the polypeptide would change the secondary/tertiary/tertiary folding resulting in a different phenotype

C. Identify the type of mutation in each the following DNA sequences and EXPLAIN the impact the mutation would have on the phenotype

<table>
<thead>
<tr>
<th>Original DNA strand</th>
<th>Second Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAG TGC AAA CCG C GT A AC ATT A U C AAG U U U G GC G CA U U G U AA ile lys phe gly ala leu stop</td>
<td>UUC phe</td>
</tr>
<tr>
<td>TAG TGC AAA CCG C GT A AC ATT A U C AAG U U U G GC G CA U U G U AA ile lys phe gly ala leu stop</td>
<td>UU stop</td>
</tr>
<tr>
<td>TAG UAC AAA CCG C GT A AC ATT A U C AAG U U U G GC G CA U U G U AA ile lys phe gly ala leu stop</td>
<td>U GA G</td>
</tr>
</tbody>
</table>

- point mutation that produces no change in amino acid sequence so no change in phenotype

- point mutation that produces a nonsense mutation with a premature stop codon. this would proteins a protein that is shorter than the original changing phenotype
A U C A G U U G G C G C A U U G U  
- frameshift mutation because there was a deletion of a nucleotide. All amino acids after that point will be different resulting in the protein folding differently so the phenotype would be different

D. PREDICT the impact a mutation to the gene coding for the repair enzyme would have on the cell AND JUSTIFY your prediction
- multiple errors would be present in the DNA that as synthesized during interphase. a mutation to the repair enzyme would not correct mutations which would produce proteins with the incorrect amino acid sequence and incorrect folding

E. HIV infects cells that contain a CCR5 protein on surface of the plasma membrane. Some individuals have a mutation in the CCR5 gene resulting in a smaller protein that remains on the inside. If a person with the gene mutation was exposed to HIV, PREDICT the impact the exposure would have on these individuals. JUSTIFY your prediction
- predict- these individuals would be immune to HIV
- justify- since the CCR5 protein is not on the outside of the cell, HIV would not have the protein to bind to. If HIV cannot bind, it cannot infect the cells making the individual immune to HIV. (in this case, the mutation produced a positive change in phenotype)

F. Sickle cell anemia is caused by a point mutation that results in the red blood having an altered shape. PREDICT the impact this mutation would have on an individual AND JUSTIFY your prediction.
- predict- individuals would not be able to transport oxygen
- justify- if the protein has an altered shape, oxygen cannot bind so the cells will not get enough oxygen for cellular respiration

G. Explain why some DNA mutations are harmful while other DNA mutations are beneficial
- the phenotypes that result from the mutation will be harmful or beneficial depending on the environment the organism is exposed to

2. Errors in mitosis or meiosis can result in changes in phenotype
A. Explain what non disjunction is
- the failure of the chromosomes or sister chromatids to separate in anaphase

B. Describe the impact non disjunction has on individuals
- the resulting daughter cells will have either too many to too few chromosomes
Changes in chromosome number often result in human disorders with developmental limitations, including Down syndrome/Trisomy 21 and Turner syndrome.

C. DESCRIBE how nondisjunction happens in MEIOSIS I and EXPLAIN how it impacts the chromosome number in the gametes

- during anaphase I homologous chromosomes failed to separate resulting in all gametes having the incorrect chromosome number. two gametes will have an extra chromosome and two gametes will have a missing chromosome. the incorrect chromosome number will produce changes in the phenotype

D. DESCRIBE how nondisjunction happens in MEIOSIS II and EXPLAIN how it impacts the chromosome number in the gametes

- in anaphase II sister chromatids failed to separate. the result would be two gametes having the correct chromosome number and the other two would be incorrect. one gamete would have an extra chromosome and one would be missing a chromosome.

3. Changes in genotype may affect phenotypes that are subject to natural selection. Genetic changes that enhance survival and reproduction can be selected for by environmental conditions
   A. DRAW a plasmid and DESCRIBE its structure.

   - a plasmid is a double helix that is separate from the chromosome. It can contain gene sequences that benefit survival such as genes that code for the resistance of antibiotics there is a promoter region
B. DESCRIBE how transformation occurs in prokaryotes (bacteria) and EXPLAIN the positive impact it has on prokaryotes

- prokaryotes take in naked DNA (plasmid, or segment of DNA) from its surrounding environment and incorporate the DNA into its own DNA/plasmid
- explain- for prokaryotes, this allows from variation which could be a resistant gene allowing them to survive exposure to antibiotics

C. DESCRIBE the process of conjugation in prokaryotes and EXPLAIN the benefits to the prokaryotes

- describe- transfer of DNA from one prokaryote to another through a structure called a pili. when a plasmid with antibiotic resistance is passed to a prokaryote, the prokaryote now is resistant giving it a survival advantage

D. Describe how the process of transduction brings about genetic variation in prokaryotes

- a bacteriophage( virus that infects bacteria) transfers DNA from one bacteria to another bacteria as in infects the bacteria.

4. Genetic engineering techniques can be used to analyze and manipulate DNA and RNA
A. Explain the uses of gel electrophoresis
   - compare relationships of individuals or species
   - diagnose genetic disorders
   - evidence in crime scenes or paternity cases
B. Explain the purpose of restriction enzymes
   - looks for specific recognition sequences and cut DNA into fragments

C. Explain why the DNA fragments move through the gel
   - electricity pulls the DNA since DNA has a negative charge

D. Explain why DNA bands appear at different locations in the gel
   - fragments are different sizes, vary in number of nucleotides

E. Identify which fragments are able to move the furthest in the gel and EXPLAIN why they are able to move the furthest
   - smallest are able to move through the gel because they have the fewest nucleotides and easier to move through gel

F. Identify which type of fragments stay closest to the well
   - largest fragments because they have the most nucleotides so harder to move through gel

G. Explain why the banding pattern for each individual is different even though the same restriction enzyme is used
   - nucleotide sequence is different for each individual (except for identical twins)

H. Explain the benefit of using PCR
   - if you do not have enough DNA, PCR copies the DNA giving a large enough sample
5. In a transformation experiment, a sample of *E. coli* bacteria was mixed with a plasmid containing the gene for resistance to the antibiotic ampicillin (*amp*<sup>r</sup>). The following results were obtained

A. DESCRIBE how transformation occurred in some of the bacteria AND EXPLAIN how you would know if transformation occurred

- bacteria took in DNA from environment. if transformation occurred the bacteria would not die when exposed to the antibiotic

B. Describe the difference between wild type E. coli and *E. coli* and *amp*<sup>r</sup> plasmid.

- wild type *E. coli* did not contain the plasmid for resistance to ampicillin. *E. Coli* and *amp*<sup>r</sup> plasmid bacteria did transformation took in the plasmid from the environment and contain the gene for resistance

C. Explain why plates I and III have full growth of bacteria

- plates I and III had full growth because they were not exposed to the antibiotic. they were placed on a plate with nutrients. it did not matter is they had the resistant plasmid since they were not exposed to any antibiotic

D. Identify the negative control in the experiment and EXPLAIN why it is the negative control

- Plate II with wild type bacteria (bacteria without the plasmid) exposed to antibiotic. the negative control is the control in which “no response” is expected. if the antibiotic is efficient/effective, the bacteria without the plasmid should not survive. plate II showed that the antibiotic killed the bacteria without the plasmid so there was no growth (no response)

E. Describe the results on plate II and EXPLAIN the results
- plate II shows no bacterial growth. the wild type E. coli were exposed to the antibiotic but did not contain the resistant plasmid. the bacteria did not survive the exposure to the antibiotic so none of them survived to reproduce

F. Describe the results on plate IV and EXPLAIN the results
- Plate IV had colonies of bacteria growing. Not all the bacteria went through transformation and took in the amp\(^r\) plasmid (ampicillin resistant plasmid) so the plate was a combination of resistant and non resistant bacteria. when exposed to the antibiotic, the non resistant bacteria did not survive and reproduce while the resistant bacteria survived exposure and reproduced forming the colonies