

REVIEW 5: GENETICS

1. Chromosomes:

- a. Humans have _____ chromosomes, or _____ homologous pairs.
 - **Homologous:** _____
- b. **Chromosome pairs** carry genes for the same traits.
 - Most organisms have two copies of the gene for each trait — 1 from each parent, 1 on each member of the homologous pair.
- c. **Sex chromosomes** — in humans, females are _____ and males are _____.
 - The Y chromosome is much _____ than the X, so it is missing many genes. This means many genes on the X chromosome do not have a “partner”.
- d. **Common mistake:** “Humans have 23 chromosomes (or 46 pairs of chromosomes, or some other incorrect number).”

These numbers are often confused. You must memorize them correctly.

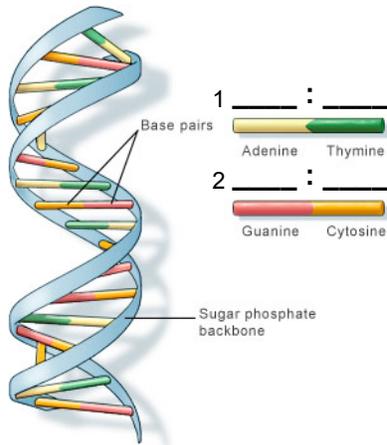
2. Chromosomes and Genes

- a. Each chromosome has hundreds or thousands of genes.
- b. Each gene codes for a particular **protein**.
 - **Common mistake:** “Genes/DNA are made from protein.”

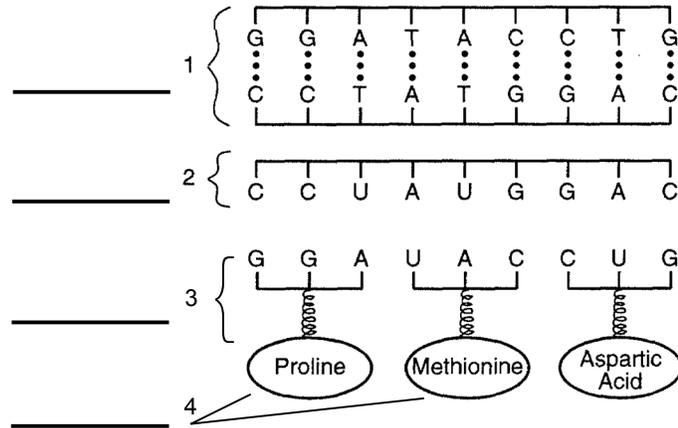
Genes carry the instructions to make protein. The genes themselves are made from nucleic acids.
- c. While genes determine our traits, the environment can affect the expression of genes.

3. DNA

- a. DNA is the chemical that makes up your genes and chromosomes.
 - **Analogy:** If your genes and chromosomes are the “instruction manual” for your body, DNA would be the paper it is printed on.
 - **Analogy:** All the DNA in the nucleus of one of your cells — all 46 of your chromosomes together — make a book. Each individual chromosomes is a chapter in that book. Each gene is a paragraph in a single chapter.
- b. The shape of a DNA molecule is a _____, which resembles a twisted ladder.
- c. The shape of DNA allows it to _____, or copy, itself almost exactly.
- d. DNA is made of 4 bases: _____, _____, _____, _____
 - **Pairing of bases:** _____ : _____, and _____ : _____
 - in RNA the base pairs are _____ : _____ and _____ : _____



DNA DOUBLE HELIX



PROTEIN SYNTHESIS (READING DNA)

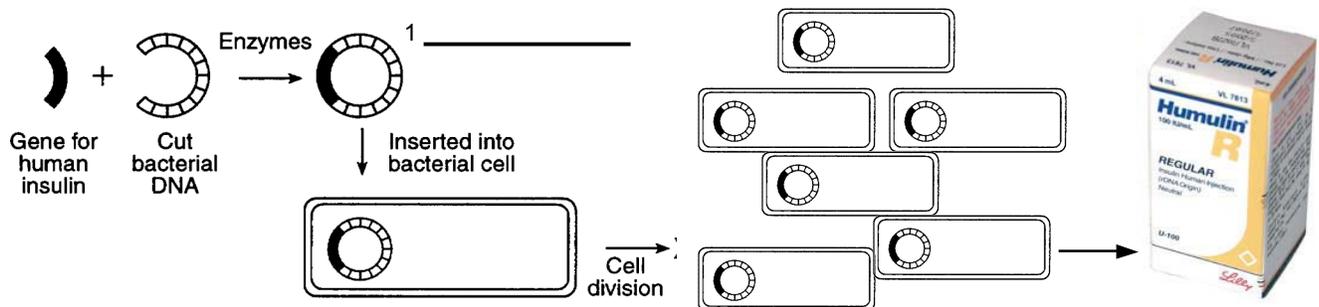
4. **Protein Synthesis:** This is how genes control your body:

- a. A **codon** is a sequence of _____ **bases** in DNA.
 - Each codon represents a specific **amino acid**.
 - The DNA with its codons remains protected in the _____.
 - Proteins are built in the _____ by the _____.
 - _____ carries a copy of the genetic code from the DNA to the ribosomes.
 - As the ribosome reads the genetic code on the mRNA, _____ brings the correct amino acid to the ribosome. The ribosome then bonds the amino acids together.
 - So ribosomes read the genetic code and assemble the amino acids in the same order that they are listed in the DNA codons.
 - The amino acids are bonded together to make a _____.
 - The order of the amino acids — which is determined by the DNA sequence — then determines the _____ of the protein.
 - The shape of a protein determines its _____.
 - Therefore: The sequence of bases in DNA will determine the _____ of all the proteins in the body.
 - These proteins — coded for by DNA — build and run the body.

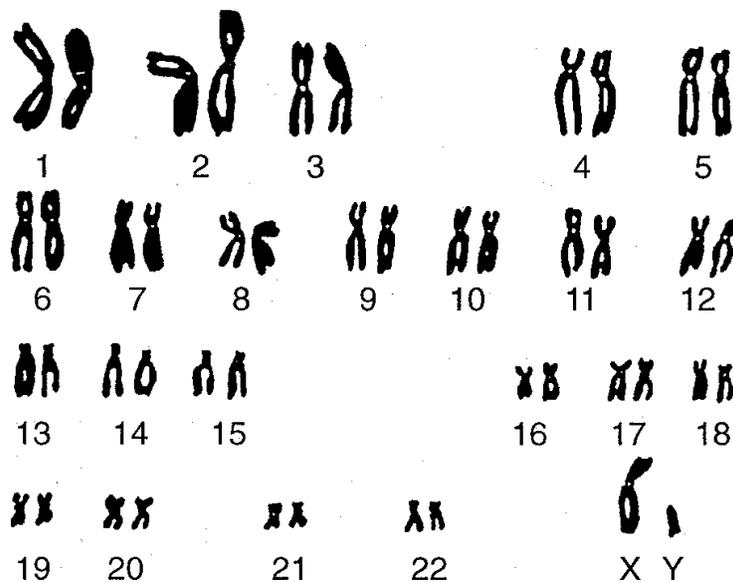
The order of DNA _____ in your genes determines the order of _____ in your proteins, which determines the protein's _____ and _____.

Therefore, how your body functions depends on the order of the bases in your genes!

5. Mutations: _____
- Can only be passed on if they occur in reproductive cells (sperm or egg).
 - Gene mutations** may cause a change in a gene which can change the _____ of the _____ produced from that gene. This will have an effect on the way the protein works (if it still works at all).
 - Gene mutations are caused when DNA bases are in some way changed.
 - Mutagenic agent: _____
 - Common **mutagenic agents** include: _____
 - Chromosome mutations** are usually caused when a person inherits too many or too few chromosomes.
 - Chromosome mutations affect many genes at once. Most are lethal.
 - Down's Syndrome:** Non lethal mutation, caused by inheritance of an extra copy of chromosome 21.
6. Genetic Technology:
- Selective breeding:** _____
 - Example: breeding plants (food crops, like corn, wheat) and animals (livestock, like cows) for agriculture or breeding animals as pets (likes, dogs, cats, birds)
 - Genetic engineering:** _____
 - _____ are used to cut and paste the DNA segments.
 - Organism that receives the new gene will begin to make the _____ coded for by that gene.
 - The new protein will be _____ as the one produced by the original organism.
 - _____ are often used because they are simple and reproduce quickly.
 - The two examples of gene engineering you MUST know:
 - Bacteria have been engineered to make _____ for diabetics.
 - Bacteria have been engineered to make _____ hormone.
 - In both cases the engineered hormones are safe to use because they are identical to normal human hormones.



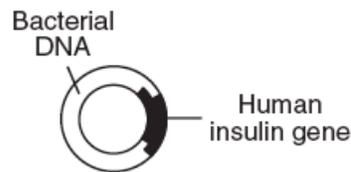
- c. New technologies (**karyotyping**, **DNA fingerprinting**) are making it easier to diagnose and treat genetic disease, though we cannot yet cure them.
- **Karyotype**: A photograph of an organism's chromosomes.
 - Can determine if a person has a chromosome disorder such as Down Syndrome.
 - **DNA fingerprinting**, or **gel electrophoresis**, creates banded patterns based on a person's DNA base sequence.
 - Each fingerprint is unique, so it can be used to identify people.
 - Fingerprints of relatives are similar to each other, so can be used to determine genetic relationships between two people, or even two groups of organisms.
- d. Genetic research has posed many **ethical** problems (ie right and wrong) that science alone cannot answer.
- Ethics: _____
-



A karyotype shows all 23 pairs of human chromosomes. Note the last pair identifies this as a male.

QUESTIONS

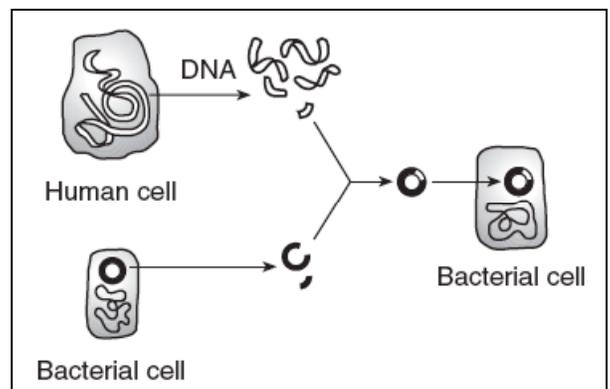
- Plants inherit genes that enable them to produce chlorophyll, but this pigment is not produced unless the plants are exposed to light. This is an example of how the environment can
 - cause mutations to occur
 - influence the expression of a genetic trait
 - result in the appearance of a new species
 - affect one plant species, but not another
- One variety of strawberry is resistant to a damaging fungus, but produces small fruit. Another strawberry variety produces large fruit, but is not resistant to the same fungus. The two desirable qualities may be combined in a new variety of strawberry plant by
 - cloning
 - asexual reproduction
 - direct harvesting
 - selective breeding
- A product of genetic engineering technology is represented below.



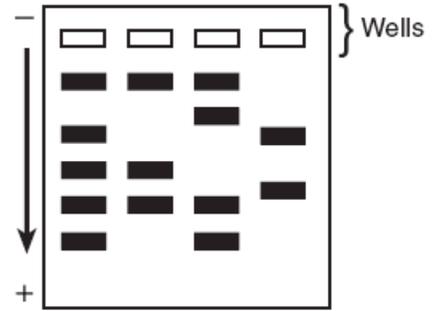
Which substance was needed to join the insulin gene to the bacterial DNA as shown?

- a specific carbohydrate
 - a specific enzyme
 - hormones
 - antibodies
- The diagram below represents a common laboratory technique in molecular genetics. One common use of this technology is the

- production of a human embryo to aid women who are unable to have children
- change of single-celled organisms to multi-cellular organisms
- introduction of a toxic substance to kill bacterial cells
- production of hormones or enzymes to replace missing human body chemicals



Question 5–6. The four wells represented in the diagram were each injected with fragments that were prepared from DNA samples using identical techniques.



5. This laboratory procedure is known as

- a. use of a dichotomous key
- b. gel electrophoresis
- c. cloning
- d. chromatography

6. The arrow represents the direction of the movement of the DNA fragments. What is responsible for the movement of the DNA in this process?

7. The four samples of DNA were taken from four different individuals. Explain how this is evident from the results shown in the diagram.

8. In DNA, a sequence of three bases is a code for the placement of a certain amino acid in a protein chain. The table to the right shows some amino acids with their abbreviations and DNA codes. Which amino acid chain would be produced by the DNA base sequence below?

| Amino Acid | Abbreviation | DNA Code |
|---------------|--------------|------------------------------|
| Phenylalanine | Phe | AAA, AAG |
| Tryptophan | Try | ACC |
| Serine | Ser | AGA, AGG, AGT, AGC, TCA, TCG |
| Valine | Val | CAA, CAG, CAT, CAC |
| Proline | Pro | GGA, GGG, GGT, GGC |
| Glutamine | Glu | GTT, GTC |
| Threonine | Thr | TGA, TGG, TGT, TGC |
| Asparagine | Asp | TTA, TTG |

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

- (1) Val — Glu — Phe — Asp — Thr — Asp
- (2) Val — Pro — Phe — Asp — Asp — Thr
- (3) Val — Glu — Phe — Asp — Asp — Thr
- (4) Val — Glu — Phe — Thr — Asp — Asp

9. Identify one environmental factor that could cause a base sequence in DNA to be changed to a different base sequence.
