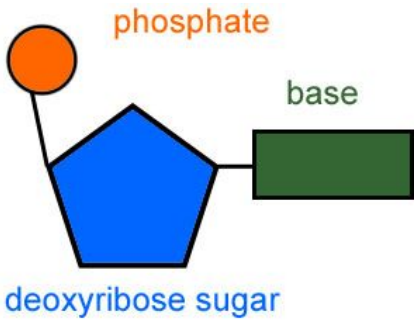
Name: _____ Period: ____ Date: _____

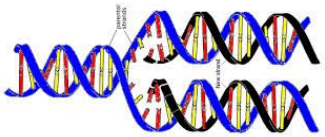
MCAS Review 3: Genetics!

DNA: *Stores genetic information*

- DNA is ALWAYS kept in the **nucleus**!!!!!!!!!!! It NEVER leaves.
- **Double-helix** = twisted ladder discovered by Watson and Crick!
- Made up of **nucleotides** together in chains
  - **5-carbon Sugar** = Deoxyribose (in DNA) or Ribose (in RNA)
  - **Nitrogenous base** = Adenine, Cytosine, Guanine, Thymine, or Uracil (A, C, G, T, U)
  - **Phosphate group**
- Base-pairing rules
  - Adenine pairs with Thymine (A—T)
  - Cytosine pairs with Guanine (C—G)



DNA Replication: *Making copies of DNA*



- Happens in **NUCLEUS**
- Carried out by enzyme DNA polymerase
- DNA helix unzips and new bases are brought in using base-pairing rules

Transcription: *DNA → RNA*

- Happens in **NUCLEUS**
- Uses DNA code to make a strand of mRNA
- REMEMBER: in RNA, the base Uracil replaces Thymine!
  - (A—U)
  - (C—G)

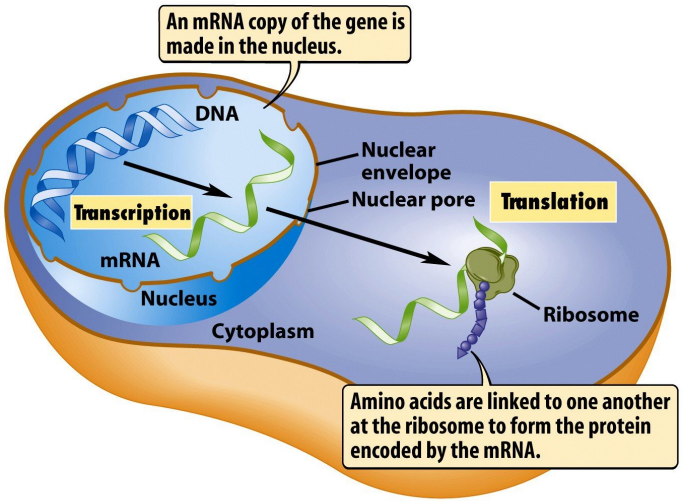


Figure 13-2 Discover Biology 3/e
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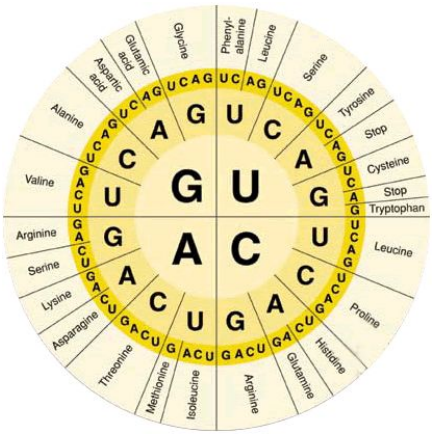
DNA: T C A A C A T G

RNA: A G U U G U A C

Translation: *RNA → Protein*

- Happens in **RIBOSOMES**
- Uses **mRNA** code to bring in **amino acids** to make **proteins**
  - Codon = 3 base sequence



RNA sequence: UCG - CAC - GGU

Amino Acid sequence : Serine-Histidine-Glycine

**AUG= start codon

Mutations

- Mutations are **mistakes in the DNA or RNA sequence**
- Lead to a **change in the protein made**
    - If a mutation causes no change it is called a silent mutation
- A mutation in a gamete (**sex cell**) results in the mutation existing in EVERY cell of the child
- ***Deletions*** (take one base away), ***insertions*** (add one base), and ***substitutions*** (switch base)

Inheritance

- There are two types of alleles: **dominant** (B) and **recessive** (b)
    - If you have the dominant allele, you will show it!
- During ***meiosis***, genes will mix and move around on their own before they are pulled apart. This leads to **variety** in how things look and, ***combined with crossing over, is why you look different from your siblings!***

Homozygous	Same alleles! (BB, bb, AA, aa, dd)
Heterozygous	One of each allele (Bb, Aa, Dd) - Dominant phenotype will show!
Genotype	What your **genes** are *(bb, Bb, Tt, etc.)*
Phenotype	What the organism **looks like** *(blue eyes, brown hair, tall, Type O blood, etc.)*
Incomplete dominance	Heterozygote shows ***blended(mixed)*** phenotype - Red (RR) + white (WW) = **pink** (RW)
Codominance	Heterozygote shows ***both*** phenotypes - Red (RR) + white (WW) = **red/white stripes** (RW)
Sex-linked traits	Genes found on **sex chromosomes** (X or Y) - Male: $X^?Y$ Female: $X^?X^?$
Polygenic Inheritance	Traits that are **controlled by several genes** - Example: skin color in humans is a blend of approximately six different genes
Multiple Alleles	Gene with **more than two alleles** - Example: There are three alleles for blood type (I^A, I^B, i)

Practice Questions

_____1. Which type of cell must contain a mutation in order for the mutation to be passed from a woman to her offspring?

a. Blood cell
b. Brain cell
b. Egg cell
d. Skin cell

_____2. In tomato plants, the tall vine allele (**T**) is dominant to the short vine allele (**t**). Two tomato plants are crossed. Among the offspring plants grown from seed, 45% have tall vines and 55% have short vines. What are the **most likely** genotypes of the parent plants?

a. **TT** and **tt**
c. **Tt** and **tt**
b. **Tt** and **TT**
d. **tt** and **tt**

____3. Garden pea plants can have yellow seeds or green seeds. In a pea plant that is heterozygous for seed color, the allele for yellow seeds masks the effects of the allele for green seeds. Which of the following terms best describes the allele for yellow seeds?

a. Codominant b. Dominant c. Recessive d. Sex-linked

_____4. Which of the following processes produces the nucleotide sequence UUA from the sequence AAT?

a. Meiosis
c. Respiration
b. Replication
d. Transcription

_____5. In pea plants, the allele for smooth seeds (**R**) is dominant to the allele for wrinkled seeds (**r**). Two parent plants are crossed. Almost half of the offspring have smooth seeds, while the rest of the offspring have wrinkled seeds.
Which of the following identifies the **most likely** genotypes of the two parent plants?

a. **RR** and **Rr**
c. **Rr** and **rr**
b. **RR** and **rr**
d. **Rr** and **Rr**

_____6. An inherited metabolic disorder called phenylketonuria (PKU) can result in serious problems in infancy. The chance that two parents who are heterozygous will have a child with PKU is 25%. Which of the following terms **best** applies to the inheritance pattern for PKU?

a. Codominant b. Dominant c. Recessive d. Sex-linked

_____7. In a eukaryotic cell, which of the following processes directly involves DNA?

a. Translation
c. Active transport of ions
b. Cellular Respiration
d. Replication of chromosomes

_____8. In a molecule of double-stranded DNA, the amount of adenine is always equal to the amount of___

a. Cytosine
c. Thymine
b. Guanine
d. Uracil

_____9. In fruit flies, the gene for eye color is located on the X chromosome, and the red eye allele **(R)** is dominant to the white eye allele **(r)**. A female fly with genotype $\mathbf{X^RX^r}$ is mated with a male fly with genotype $\mathbf{X^rY}$. Which of the following best describes the expected outcome of the cross?

a. The chance of an offspring having red eyes is 75%.

b. The chance of an offspring having white eyes is 50%.

c. The chance that a male offspring will have white eyes is 0%.

d. The chance that a female offspring will have red eyes is 100%.

_____10. During DNA replication, the wrong nucleotide was inserted in the DNA sequence. Which of the following terms describes this situation?

a. Mutation

b. Regentation

c. Transcription

d. Translation

_____11. A partial Punnett square is shown below.

AA	AA
Aa	Aa

Which of the following statements describes the parental genotypes that would result in this Punnett square?

a. Both parents are heterozygous.
b. Both parents are homozygous dominant.
c. One parent is homozygous recessive and the other parent is heterozygous.
d. One parent is homozygous dominant and the other parent is heterozygous.

____12. According to Mendel's law of segregation, which of the following statements describes what happens to the alleles of a gene pair?

a. The alleles are moved to different chromosomes.
b. The alleles are mutated in the process of mitosis
c. The alleles are separated during fertilization.
d. The alleles are separated during gamete formation.

_____13. Which of the following features of DNA is **most important** in determining the phenotype of an organism?

a. the direction of the helical twist

b. the number of deoxyribose sugars

c. the sequence of nitrogenous bases

d. the strength of the hydrogen bonds

_____14. A portion of one strand of a DNA molecule has the sequence shown below.

ACCTGAAGG

Assuming there are no mutations in this portion of the DNA, what is the corresponding sequence on the complementary DNA strand?

a. ACCTGAAGG
c. TGGACTTCC
b. GTTCAGGAA
d. UGGACUUCC

_____15. Which of the following statements best describes a DNA molecule?

a. It is a double helix.
c. It is composed of amino acids.
b. It contains the sugar ribose.
d. It contains the nitrogenous base uracil.

_____16. Fireflies produce light inside their bodies. The enzyme luciferase is involved in the reaction that produces the light. Scientists have isolated the luciferase gene.
A scientist inserts the luciferase gene into the DNA of cells from another organism. If these cells produce light, the scientist knows that which of the following occurred?

a. The luciferase gene mutated inside the cells.
b. The luciferase gene was transcribed and translated.
c. The luciferase gene destroyed the original genes of the cells.
d. The luciferase gene moved from the nucleus to the endoplasmic reticulum.

_____17**.** Individuals with one form of lactose intolerance do not produce the enzyme lactase because the gene coding for the production of lactase is shut off in their cells. This means that which of the following processes does **not** occur for the gene?

a. hydrogenation
c. replication
b. mutation
d. transcription

____18. In humans, one form of night blindness is an inherited condition that affects far more males than females. Males with one copy of the allele for this form of night blindness will have the condition, but females must have two copies of the allele to have the condition.

Which of the following best describes the allele that codes for this form of night blindness?

a. recessive on the X chromosome
c. dominant on the Y chromosome
b. polygenic on the X chromosome
d. codominant on the Y chromosome

____19. In tigers, the allele for orange fur is dominant to the allele for white fur. If two heterozygous tigers mate and produce offspring, what is the probability of an individual offspring having white fur?

a. 0
c. ½
b. ¼
d. 1

20. Corn kernels can be high in starch (starchy) or high in sugar (sweet). The allele for starchy kernels (**H**) is dominant to the allele for sweet kernels (**h**).

Each kernel on an ear of corn represents an individual offspring. A particular ear of corn has 92 starchy kernels and 88 sweet kernels.

a. What are the **most likely** genotypes of the parent corn plants that produced this particular ear of corn?

b. Explain how you determined the genotypes of the parent corn plants in part (a). Draw a Punnett square for the cross to support your answer.

c. Identify the genotypes for two corn plants that, when crossed, will produce plants with 100% starchy kernels.

21. A certain genetic disorder is caused by a single base mutation in the DNA of a certain gene. The mutation changes the amino acid glutamate (Glu) to aspartate (Asp).

a. Identify the type of macromolecule (carbohydrate, lipid, nucleic acid, protein) that changes when Glu changes to Asp. Explain your answer.

Val-Ser-Ala-Arg-Asp

The sample of DNA below is being analyzed to determine if a patient has the genetic disorder.

3' CAA-TCG-CGG-TCT-CTT 5'

b. Determine the mRNA sequence from the patient's DNA sequence.
c. Using the information in the codon table below, determine the amino acid sequence that is coded for by the mRNA sequence you determined in part (b)
d. Determine whether the patient has the genetic disorder. Explain your answer.

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