

Review Sheet Chromosomal Basis of Inheritance

Lester BIOL 150

General things to do to prepare for the exam:

- study the PowerPoints
- write out the answers to the learning objectives found with each PowerPoint
- listen to my lecture recordings

Chapter 15

Describe the chromosome theory of inheritance.

What are linked genes?

How does crossing over affect linkage?

What is a chromosome map and what does it tell you?

What is the maximum value for the frequency of recombination?

Compare and contrast the XY, ZW, XO, TSD systems for sex determination.

Explain the effect on males and females with an X-linked dominant gene; an X-linked recessive gene.

Describe the symptoms of Duchenne muscular dystrophy and its mode of inheritance. Are males and females equally affected? Explain.

Describe the symptoms of hemophilia. Are males and females equally affected? Explain.

What are Barr bodies? Do they form in males or females? Is it always the same X chromosome that is affected? Are there any consequences to males? Females?

Define aneuploidy and polyploidy. What are the possible consequences of each condition? It is the same for plants and animals? Explain.

What is trisomy? Monosomy?

Describe what happens during nondisjunction of chromosomes. What are possible consequences to the organism?

Describe chromosomal duplication, inversion, deletion, and translocation. What are possible consequences to the organism?

What causes Down syndrome? Klinefelter's syndrome? Trisomy X? Turner's syndrome?

Certain cancers are caused by what type of chromosomal abnormality?

Describe how Prader-Willi syndrome and Angelman syndrome can result from the same chromosomal abnormality.

Describe genetic imprinting. Look up epigenetics and relate it to genetic imprinting.

Describe Fragile-X syndrome.

How are mitochondria and mitochondrial genes inherited?

What kinds of disorders typically result from mitochondrial DNA mutations?

Sample Test Questions

Why are males more often affected by sex-linked traits than females?

- A) Male hormones such as testosterone often alter the effects of mutations on the X chromosome.
- B) Female hormones such as estrogen often compensate for the effects of mutations on the X chromosome.
- C) X chromosomes in males generally have more mutations than X chromosomes in females.
- D) Males are hemizygous for the X chromosome.

The SRY gene is best described as _____.

- A) a gene present on the X chromosome that triggers female development
- B) an autosomal gene that is required for the expression of genes on the Y chromosome
- C) a gene present on the Y chromosome that triggers male development
- D) an autosomal gene that is required for the expression of genes on the X chromosome

Red-green color blindness is a sex-linked recessive trait in humans. Two people with normal color vision have a color-blind son. What are the genotypes of the parents?

- A) X^nX^n and X^nY
- B) $XNXN$ and XnY
- C) $XNXN$ and XNY
- D) $XNXn$ and XNY

In humans, clear gender differentiation occurs not at fertilization, but after the second month of gestation.

Which of the following statements describes the first event of this differentiation?

- A) formation of testosterone in male embryos
- B) formation of estrogens in female embryos
- C) activation of SRY in male embryos and masculinization of the gonads
- D) activation of SRY in females and feminization of the gonads

Duchenne muscular dystrophy is a serious condition caused by a recessive allele of a gene on the human X chromosome. The patients have muscles that weaken over time because they have absent or decreased dystrophin, a muscle protein. They rarely live past their 20s. How likely is it for a woman to have this condition?

- A) Women can never have this condition.
- B) One-fourth of the daughters of an affected man would have this condition.
- C) One-half of the daughters of an affected father and a carrier mother could have this condition.
- D) Only if a woman is XXX could she have this condition.

All female mammals have one active X chromosome per cell instead of two. What causes this to happen?

- A) activation of the XIST gene on the X chromosome that will become the Barr body
- B) activation of the BARR gene on one X chromosome, which then becomes inactive
- C) inactivation of the XIST gene on the X chromosome derived from the male parent
- D) attachment of methyl (-CH₃) groups to the X chromosome that will remain active

A man who is a dwarf with achondroplasia and normal vision marries a color-blind woman of normal height. The man's father was six feet tall, and both the woman's parents were of average height. Dwarfism caused by achondroplasia is autosomal dominant, and red-green color blindness is X-linked recessive. How many of their daughters might be expected to be color-blind with achondroplasia?

- A) none
- B) half
- C) one out of four
- D) three out of four

A recessive allele on the X chromosome is responsible for red-green color blindness in humans. A woman with normal vision whose father is color blind marries a color-blind male. What is the probability that this couple's first son will be color blind?

- A) $1/4$ B) $1/2$ C) $2/3$ D) $3/4$

Use the following information to answer the question.

Sex	Phenotype	Number
male	wild	123
male	yellow	116
female	wild	240

In a *Drosophila* experiment, a cross was made between homozygous wild-type females and yellow-bodied males. All of the resulting F₁s were phenotypically wild type. However, adult flies of the F₂ generation (resulting from matings of the F₁s) had the characteristics shown in the figure. How is the mutant allele for yellow body inherited?

- A) It is recessive. B) It is codominant. C) It is dominant. D) It is incompletely dominant.

Which of the following statements regarding gene linkage is correct?

- A) The closer two genes are on a chromosome, the lower the probability that a crossover will occur between them.
B) The observed frequency of recombination of two genes that are far apart from each other has a maximum value of 100%.
C) All of the traits that Mendel studied—seed color, pod shape, flower color, and others—are due to genes linked on the same chromosome.
D) Linked genes are found on different chromosomes.

What does a recombination frequency of 50% indicate?

- A) The two genes are likely to be located on different chromosomes.
B) All of the offspring have combinations of traits that match one of the two parents.
C) The genes are located on sex chromosomes. D) Abnormal meiosis has occurred.

One possible result of chromosomal breakage is for a fragment to join a nonhomologous chromosome. What is this type of chromosomal alteration called?

- A) deletion B) inversion C) translocation D) duplication

Of the following human aneuploidies, which is the one that generally has the most severe impact on the health of the individual?

- A) 47, trisomy 21 B) 47, XXY C) 47, XXX D) 45, X

A woman is found to have 47 chromosomes, including three X chromosomes. Which of the following statements describes her expected phenotype?

- A) a female with masculine characteristics such as facial hair B) an apparent male who is sterile
C) healthy female of slightly above-average height D) a sterile female

Which of the following is an example of monosomy in humans?

- A) Turner syndrome B) Klinefelter syndrome C) Down syndrome D) trisomy X

Mitochondrial DNA is primarily involved in coding for proteins needed for protein complexes of the electron transport chain and ATP synthase. Therefore, mutations in mitochondrial genes would most affect which of the following processes?

- A) DNA synthesis in cells of the immune system B) the movement of oxygen into erythrocytes
C) generation of ATP in muscle cells D) the storage of urine in the urinary bladder