

## Introduction to Genetics

1) Genetics is the study of \_\_\_\_\_.

- A) inheritance and variation
- B) mutation and recession
- C) transcription and translation
- D) diploid and haploid
- E) replication and recombination

2) What is meant by the term *genetic code*?

3) What is meant by *complementarity* in terms of the structure of DNA?

## Mendelian genetics

1) A recessive allele in tigers causes the white tiger. If two normally pigmented tigers are mated and produce a white offspring, what percentage of their remaining offspring would be expected to have normal pigmentation?

- A) 25%
- B) 50%
- C) about 66%
- D) 75%
- E) about 90%

2) Tightly curled or wooly hair is caused by a dominant gene in humans. If a heterozygous curly-haired person marries a person with straight hair, what percentage of their offspring would be expected to have straight hair?

- A) 25%
- B) 50%
- C) 75%
- D) 100%
- E) It is impossible to predict the outcome.

3) Which types of phenotypic ratios are likely to occur in crosses when dealing with a single gene pair for which all the genotypic combinations are of equal viability?

- A) 9:3:3:1, 27:9:9:9:3:3:3:1
- B) 1:2:1, 3:1
- C) 1:4:6:4:1, 1:1:1:1
- D) 12:3:1, 9:7
- E) 2:3, 1:2

4) Which types of phenotypic ratios are likely to occur in crosses when dealing with two gene pairs for which all the genotypic combinations are of equal viability?

- A) 9:3:3:1
- B) 1:2:1, 3:1
- C) 6:6:2
- D) 12:2:2
- E) 2:3, 1:2

5) The Chi-square test involves a statistical comparison between measured (observed) and predicted (expected) values. One generally determines degrees of freedom as \_\_\_\_\_.

- A) the number of categories being compared
- B) one less than the number of classes being compared
- C) one more than the number of classes being compared
- D) ten minus the sum of the two categories
- E) the sum of the two categories

6) According to Mendel's model, because of the \_\_\_\_\_ of chromosomes during meiosis, all possible combinations of gametes will be formed in equal frequency.

7) In peas, gray seed color is dominant to white. For the purposes of this question, assume that Mendel crossed plants with gray seeds with each other and the following progeny were produced: 320 gray and 80 white.

- a) What is the most probable genotype of each parent?
- a) What genotypic and phenotypic ratios are expected in the progeny of such a cross?

8) Albinism, lack of pigmentation in humans, results from an autosomal recessive gene (*a*). Two parents with normal pigmentation have an albino child.

- a) What is the probability that their next child will be albino?
- b) What is the probability that their next child will be an albino girl?
- c) What is the probability that their next three children will be albino?

9) *Dentinogenesis imperfecta* is a rare, autosomal, dominantly inherited disease of the teeth that occurs in about one in 8000 people (Witkop 1957). The teeth are somewhat brown in color, and the crowns wear down rapidly. Assume that a male with *dentinogenesis imperfecta* and no family history of the disease marries a woman with normal teeth. What is the probability that

- a) their first child will have *dentinogenesis imperfecta*?
- b) their first two children will have *dentinogenesis imperfecta*?
- c) their first child will be a girl with *dentinogenesis imperfecta*?

10) What conditions are likely to apply if the progeny from the cross  $AaBb \times AaBb$  appear in the 9:3:3:1 ratio?

11) Assuming independent assortment, what proportion of the offspring of the cross  $AaBbCcDd \times AabbCCdd$  will have the *aabbccdd* genotype?

12) How many different kinds of gametes can be produced by an individual with the genotype AABbCCddEeFf?

13) Assume that a cross is made between a heterozygous tall pea plant and a homozygous short pea plant. Fifty offspring are produced in the following frequency:

30 = tall

20 = short

- What frequency of tall and short plants is expected?
- To test the goodness of fit between the observed and expected values, provide the needed statement of the null hypothesis.
- Compute a Chi-square value associated with the appropriate test of significance.
- How many degrees of freedom are associated with this test of significance?

14) In studies of human genetics, usually a single individual brings the condition to the attention of a scientist or physician. When pedigrees are developed to illustrate transmission of the trait, what term does one use to refer to this individual?

## Extensions of Mendelian Genetics

1) A mutation in a gene often results in a reduction of the product of that gene. The term for this type of mutation is \_\_\_\_\_.

- codominance
- incomplete dominance
- gain of function
- multiple allelism
- loss of function or null (in the case of complete loss)

2) Typically, when one wishes to represent a human gene, the symbol used is \_\_\_\_\_.

- in italics
- in all lowercase letters
- in all uppercase letters
- in bold print
- underlined

3) With incomplete dominance, a likely ratio resulting from a monohybrid cross would be \_\_\_\_\_.

- 3:3
- 1:2:2:4
- 1:2:1
- 9:3:3:1
- 3:1

4) A situation in which there are more than two alternative forms of a given gene would be called \_\_\_\_\_.

- A) multiple alleles
- B) alternation of generations
- C) codominance
- D) incomplete dominance
- E) hemizyosity

5) What is the blood type of individuals who cannot add the terminal sugar to the H substance?

- A) O
- B) B
- C) A
- D) AB
- E) Bombay phenotype

6) What would be a typical phenotypic monohybrid ratio in which a lethal allele is involved?

- A) 2:1
- B) 9:3:3:1
- C) 6:2:3:1
- D) 13:5
- E) 3:1

7) What term is used to express the idea that several genes exert influence over the same characteristic?

- A) coextension
- B) co-adhesion
- C) terminal interaction
- D) gene interaction
- E) transformation

8) A condition in which one gene pair masks the expression of another gene pair is called \_\_\_\_\_.

- A) codominance
- B) epistasis
- C) dominance
- D) recessiveness
- E) additive alleles

9) Typical ratios resulting from epistatic interactions in dihybrid crosses would be \_\_\_\_\_.

- A) 9:3:3:1, 1:2:1
- B) 1:1:1:1, 1:4:6:4:1
- C) 9:3:4, 9:7
- D) 1:2:2:4:1:2:1:2:1, 1:2:1
- E) 3:1, 1:1

10) Because of the mechanism of sex determination, males of many species can be neither homozygous nor heterozygous. Such males are said to be \_\_\_\_\_.

- A) dominant
- B) hemizygous
- C) recessive
- D) complementary
- E) None of the answers listed are correct.

11) How many different alleles can a gene have?

12) Assume that a cross is made between two organisms that are both heterozygous for a gene that shows incomplete dominance. What phenotypic and genotypic ratios are expected in the offspring?

13) The trait of medium-sized leaves in iris is determined by the genetic condition  $PP'$ . Plants with large leaves are  $PP$ , whereas plants with small leaves are  $P'P'$ . A cross is made between two plants each with medium-sized leaves. If they produce 80 seedlings, what would be the expected phenotypes, and in what numbers would they be expected? What is the term for this allelic relationship?

14) In a mating between individuals with the genotypes  $IAi \times ii$ , what percentage of the offspring are expected to have the O blood type?

15) What is meant by the term *epistasis*? Distinguish between *epistasis* and *dominance*. Do not use examples in answering this question.

16) The following  $F_2$  results occur from a typical dihybrid cross:

purple:	$A\_B\_$	9/16
white:	$aaB\_$	3/16
white:	$A\_bb$	3/16
white:	$aabb$	1/16

If a double heterozygote ( $AaBb$ ) is crossed with a fully recessive organism ( $aabb$ ), what phenotypic ratio is expected in the offspring?

17) Many of the color varieties of summer squash are determined by several interacting loci:  $AA$  or  $Aa$  gives white,  $aaBB$  or  $aaBb$  gives yellow, and  $aabb$  produces green. Assume that two fully heterozygous plants are crossed. Give the phenotypes (with frequencies) of the offspring.

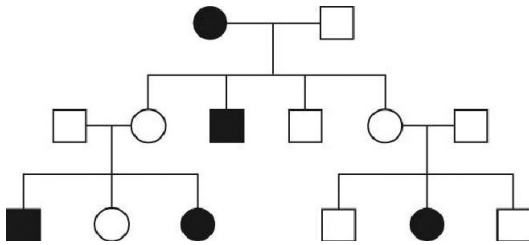
18) Name three modes of inheritance that are influenced by the sex of individuals.

19) The white-eye gene in *Drosophila* is recessive and sex-linked. Assume that a white-eyed female is mated to a wild-type male. What would be the phenotypes of the offspring?

20) Two forms of hemophilia are determined by genes on the X chromosome in humans. Assume that a phenotypically normal woman whose father had hemophilia is married to a normal man. What is the probability that their first son will have hemophilia?

21) If an X-linked disorder is lethal to the affected individual prior to the age at which one reaches reproductive maturation, the lethality will be expressed only in males. Why is this so?

22) The accompanying figure is a pedigree of a fairly common human hereditary trait in which the boxes represent males and the circles represent females. Shading symbolizes the abnormal phenotype.



Given that one gene pair is involved:

- Is the inheritance pattern X-linked or autosomal, recessive or dominant?
- Give the genotype of each individual in the pedigree. If more than one genotypic possibility exists, present all possible alternatives.

23) State a significant difference between X-linked and sex-influenced inheritance.

TRUE or FALSE?

24) "Gain of function" mutations are generally dominant since one copy in a diploid organism is sufficient to alter the normal phenotype.

25) A 9:7 ratio indicates incomplete dominance.

26) With both incomplete dominance and codominance, one expects heterozygous and homozygous classes to be phenotypically identical.

27) With multiple alleles, there can be more than two genetic alternatives for a given locus.

28) *Hemizyosity* is the term one uses to describe the state of a gene that has no allele on the opposing chromosome.

29) One result of X-linkage is a crisscross pattern of inheritance in which sons express recessive genes of their fathers and daughters express recessive genes of their mothers.