Unit Test: Genetics and Heredity

Read each question. Circle the letter of the correct answer.

1. Which is not a factor that could increase the rate of mutations in a cell?

A. exposure to a chemical carcinogen

B. infection with a virus, such as HPV

C. exposure of the cell to UV radiation

D. environmental pressure to adapt for survival

2. A scientist is using a karyotype to investigate a mutation in an organism. Which type of mutation would a karyotype best help to discover?

A. point mutation

B. frameshift mutation

C. nondisjunction mutation

D. gene duplication mutation

3. Robert and his wife are ready to start a family, but they are concerned about having a child inherit a disease. This disease is an autosomal recessive disorder that requires both parents to contribute a recessive allele in order for the child to express the disorder. If both Robert and his wife are heterozygous for this trait, what is the probability that one of their children will have the disease?

A. 25%

B. 50%

C. 75%

D. 100%

4. Which description supports the claim that mutations in gametes could cause an increase in genetic diversity in a population?

A. A deletion during meiosis results in a new version of an allele.

B. A drug creates a mutation in a liver cell. The mutated cell multiplies.

C. UV rays create thymine dimers that negatively affect a skin cell's function.

D. A brain cell has a missense mutation that allows it to function more effectively.

5. A scientist examines a human cell with 23 chromosomes and hypothesizes that this cell is the product of meiosis. Which of these would provide further evidence that the cell is the product of meiosis?

A. The chromosomes in the cell consist of only autosomes.

B. The chromosomes in the cell lack a homologous pair in the same cell.

C. The chromosomes in the cell are contained within a nuclear membrane.

D. The chromosomes in the cell were not replicated before the cell divided.

6. Which of these best explains the role of recombination in increasing genetic diversity?

A. Recombination allows fertilization to occur after meiosis.

B. Recombination causes the number of chromosomes in sex cells to change.

C. Recombination causes alleles of genes to be switched between homologous chromosomes.

D. Recombination causes the order of the bases of DNA sequences on chromosomes to become reversed.

7. A scientist wants to perform an analysis on a segment of DNA. Which of these would a PCR most help the scientist to do?

A. Determine where on the chromosome the segment is located.

B. Determine the shape of the proteins that the chromosome codes for.

C. Cause the proteins that the DNA segment codes for to be expressed.

D. Make billions of copies of the DNA segment in a short amount of time.

8. Scientists have developed a genetically modified salmon that can mature to full size in half of the time of the wild salmon. The scientists take great care to ensure that the salmon are not accidentally released into the wild. Which of these would be the primary concern regarding the environmental impact of releasing genetically engineered salmon into the wild?

A. The genetically engineered salmon could introduce modified genes into wild salmon populations.

B. The genetically engineered salmon would consume more food on average than would wild salmon.

C. The genetically engineered salmon would not grow as well in the wild as they do in inland facilities.

D. The genetically engineered salmon may not be able to reproduce as well in the wild as wild populations do.

Read each question. Follow the instructions to answer the questions.

9. After being exposed to radioactivity, a strand of DNA with the sequence ATTATCTGC has been changed to ATTCGCATCTGC.

Write the letter of the correct term in each blank to complete the paragraph.

As a result of being exposed to radioactivity, a(n) _____ mutation has occurred. This caused a change to the _____ sequence in the organism's genome and can potentially lead to an alteration of the _____ sequence in an expressed protein.

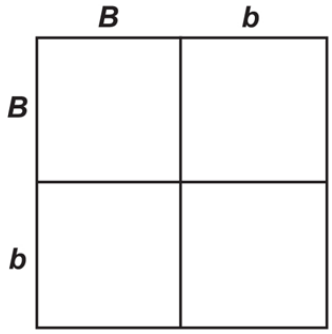
A. deletion	**C.** amino acid
B. insertion	**D.** nucleic acid

10. The three main errors that result in chromosomal mutation are gene duplication, nondisjunction, and translocation. Write the letter of the type of error that likely caused each mutation next to the description of the mutation. Some letters may be used more than once.

A karyotype shows that an individual has three copies of chromosome 21.	
Genetic testing shows a person has a section of chromosome 15 located on chromosome 2.	
Scientists inserting a genetic mutation into mice find one of the mice has two non-mutated copies of the gene as well as the mutated copy they inserted.	
A plant is found to be tetraploid, meaning that instead of homologous pairs it contains homologous quadruplets for each chromosome number.	

A. gene duplication
B. nondisjunction
C. translocation

11. In rats, the allele for having a black coat (*B*) is dominant to the allele for having a brown coat (*b*). Two rats that are heterozygous for coat color have offspring. Fill out the Punnett square to show the possible genotypes of the offspring. Write the letter of the correct answer in each of the squares.



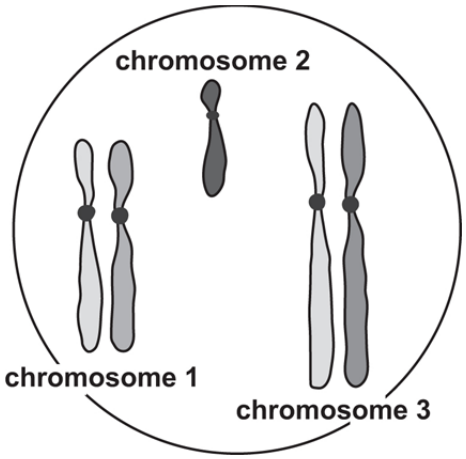
A. *BB** **B.** *Bb** **C.** *bb*

12. For each situation, write the letter of the technique that would be most helpful.

A doctor wants to know if a patient has an inherited disorder.	
A scientist needs many copies of a gene to conduct an experiment.	
A genetic engineer wants to replace a defective copy of a gene with a functional copy in a chromosome.	
A medical researcher needs many copies of a protein to be produced to use in a medical treatment.	

A. DNA editing using CRISPR
B. DNA replication using PCR
C. DNA analysis through genetic testing
D. DNA insertion into bacteria as a plasmid

13. While karyotyping a set of cells, a scientist finds a cell as shown with an aneuploid (one that is neither haploid nor diploid) set of chromosomes, as shown in the diagram.



He discards this cell because it is likely unviable. Explain how the scientist reached this conclusion. Write one letter in each blank to correctly complete the sentences.

A diploid cell would have **1.** _____ of each chromosome and a haploid cell would have **2.** _____ of each chromosome. The cell pictured is neither diploid nor haploid because there is only one copy of **3.** _____ while there are two copies of **4.** _____. This cell would likely not be viable because it would express less protein from genes located on **5.** _____. The loss in protein expression would be detrimental to cell survival.

1.	**2.**	**3.**	**4.**	**5.**
A. one copy	**E.** one copy	**I.** chromosome 1	**M.** chromosome 1	**Q.** chromosome 1
B. two copies	**F.** two copies	**J.** chromosome 2	**N.** chromosome 2	**R.** chromosome 2
C. three copies	**G.** three copies	**K.** chromosomes 1 and 2	**O.** chromosomes 1 and 2	**S.** chromosome 3
D. four copies	**H.** four copies	**L.** chromosomes 1 and 3	**P.** chromosomes 1 and 3	

14. Myosin II is a motor protein that is produced mainly in muscle cells. It is produced only in these cells because its expression is tightly regulated. Circle the letters of the words that describe genetic material that contains information about the amino acid sequence of the myosin protein.

A. exon regions in the myosin gene

B. intron regions in the myosin gene

C. mRNA message for the myosin gene

D. the promoter region of the myosin gene

E. RNA polymerase, which binds to the myosin gene

15. A researcher crossed two purebred shrubs of the same species. One produces a fruit with a thin skin, and one produces a fruit with a thick skin. All of the plants resulting from the cross produce fruits with thick skins. Enter one letter in each blank to correctly complete the sentences.

Thin skin is 1. _____ thick skin in this plant. If the plants resulting from the cross were crossed with each other, 2. _____ of their offspring would be expected to produce fruits with a thick skin.

1.	**2.**
A. dominant to	**D.** none
B. recessive to	**E.** 1/4
C. codominant to	**F.** 1/2
	G. 3/4
	H. all

16. A scientist is gathering information to support the argument that traits are influenced by interactions between genes and the environment. Classify each piece of evidence as "Supports" or "Does not support" in supporting her argument. Write the letter of each piece of evidence in the correct box.

Supports	**Does not support**

A. Certain chemicals can alter the DNA of cells.

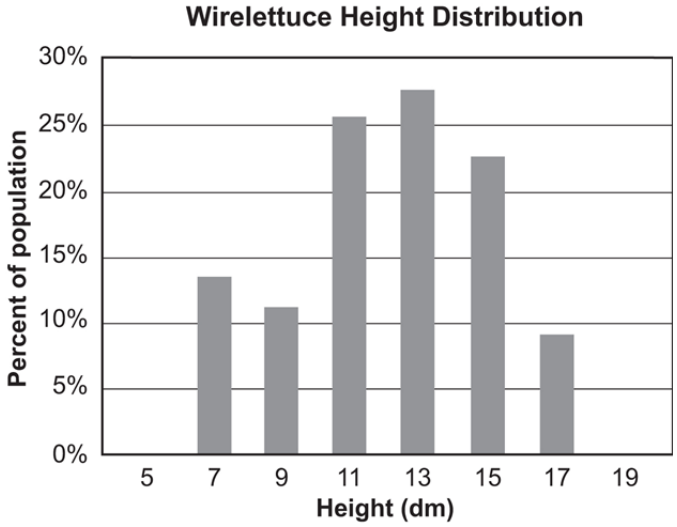
B. Mutations in body cells will not be passed on to offspring.

C. Individuals can be carriers for traits without actually expressing the trait.

D. Dominant genes can "mask" recessive genes so that only the dominant phenotype is shown.

E. UV radiation can cause thymine "dimers," where neighboring thymines disconnect from their adenines and bond together instead.

17. Wirelettuce is a flowering plant native to the western United States. A scientist plants many seeds of *Stephanomeria exigua* from the same parent plants. She observes the height of the offspring as shown.



Which are reasonable explanations for the differences in height of the offspring? Circle the letter of all the correct responses.

A. The offspring were planted in different light conditions.

B. The offspring were grown in different soil containing different chemicals.

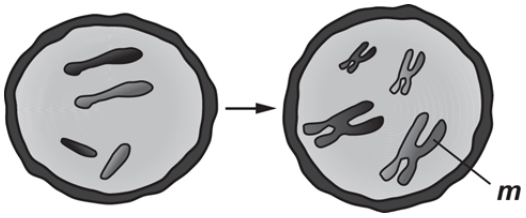
C. Their parents were both homozygous for all genes affecting plant height.

D. The offspring inherited different forms of genes for height from each parent.

E. A mutation in a gene regulating height occurred in the somatic cells of the parents.

Read each statement. Write your answer on the lines.

18. After replication, one sister chromatid of a chromosome pair is mutated at the locus marked *m* as shown.



If *m* is in a coding region, describe one possible effect of this mutation on the offspring.

Explain how this model can be used to show whether the mutation will affect the daughter cells produced by mitosis.

19. Many doctors are starting to use genetic testing to screen for disease-causing mutations in healthy patients.

Explain what genetic testing is.

Identify a risk that can occur with widespread use of genetic testing.

Propose a safeguard that regulators can put in place to mitigate that risk.

20. Humans have cloned bacteria and plants for hundreds of years, but cloning animals is a relatively recent technological advance.

Describe the processes of cloning bacteria and plants.

Explain why the cloning of animals is so much more difficult than the cloning of bacteria and plants.

21. As a result of his experiments, Mendel described the basic rule of genetic inheritance, called the *law of segregation.*

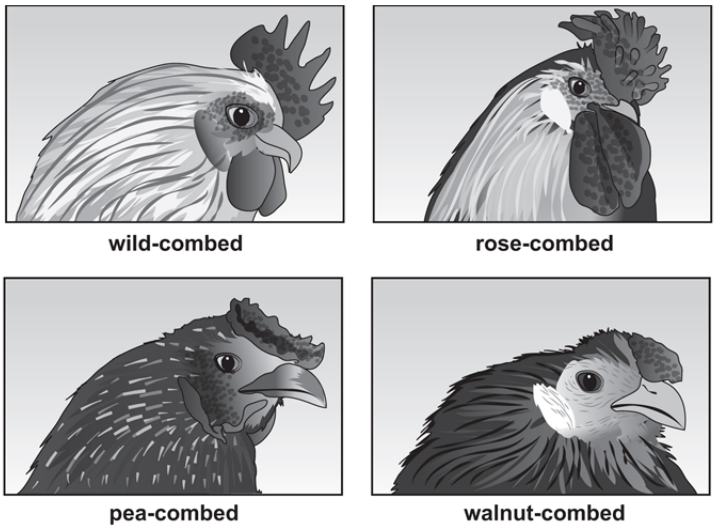
Identify what Mendel's law of segregation states about the process of meiosis.

Explain the role of meiosis in genetic variation.

Directions: Read the passage, then answer the questions that follow.

Raising Chickens

A family is raising chickens. They desire to increase certain desirable characteristics while eliminating the less-desirable traits. One of the traits that is important to this family is the type of comb that the male birds express. The comb is a fleshy projection on the top of the heads of male chickens. Four different comb types are possible: wild-combed, rose-combed, pea-combed, and walnut-combed, as shown in the image.



In order to inherit a wild comb, the male needs to be homozygous recessive for both traits (*rrpp*). If it inherits at least one dominant *R* it will be rose-combed (*Rrpp* or *RRpp*) and if it receives at least one dominant *P* it will be pea-combed (*rrPp* or *rrPP*). Finally, if the male chicken receives at least one *R* and one *P* it will be walnut-combed.

22. If this family would like to breed a wild-combed chicken with a walnut-combed chicken that are both homozygous for the traits, what is the probability that the result would be an offspring with wild combs? Circle the letter of the correct answer.

A. 0%

B. 25%

C. 50%

D. 100%

23. Feather color is a highly prized trait in chickens. One of the loci that controls feather color has two alleles, black (*B*) and blue (*b*). A chicken that has two black alleles (*B/B*) is black, and a chicken that has two blue alleles is blue (*b/b*). However, a chicken that inherits one of each trait (*B/b*) is an intermediate of the two. If two intermediate-colored chickens together produced 100 chicks, how many would you expect to be black? Circle the letter of the correct answer.

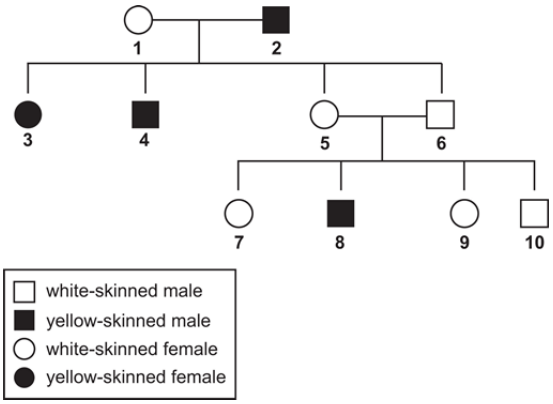
A. 25

B. 50

C. 75

D. 100

24. Yellow skin in chickens is a trait that is desirable. Yellow skin color in chickens is determined by a recessive allele (*w*), while the white allele (*W*) is dominant. The pedigree shown is a representative of the individuals in the Brown family's flock with the squares representing the males and the circles representing the females.



Write an X in the correct cell in the table to show the genotype for each individual listed. Write an X in the column labeled "*WW or Ww*" if a determination between these two genotypes cannot be made.

	WW	***Ww***	***ww***	***WW* or *Ww***
A. individual 1				
B. individual 5				
C. individual 8				
D. individual 9				

25. One trait that the family wished to produce was barred feathers, which causes the feathers to look like they have a striped pattern. The allele for barred feathers is dominant and it is located on the sex chromosome, so the trait is considered to be sex linked. Chickens are a bit different from humans in that the male carries two of the same chromosomes to determine gender (*ZZ*), and the female carries one of each type of sex chromosome (*ZW*). Therefore, males carry two alleles for this trait and females carry only one. This family has a male chicken that is not barred Z^bZ^b) and a female that is barred (Z^BW).Write your answer on the lines.

Predict the percent chance that a female and male chick produced from this mating would be barred. Explain how you came to this conclusion.

If an environmental factor was discovered that caused more female chicks to be produced than male chicks, how would this change the percentage of barred chickens in the family's flock?