Name:s _____

Team #_____ **School**_____

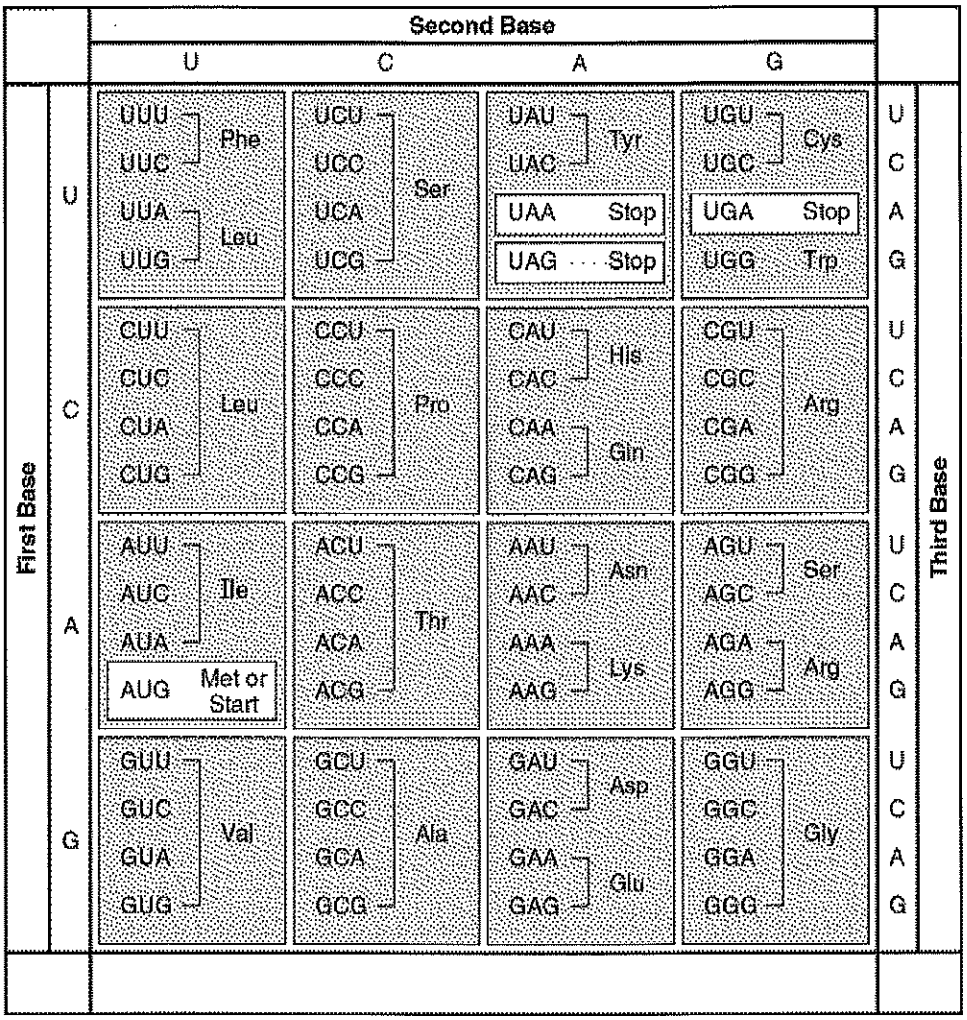
Whiting Science Olympiad Invitational 2013

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 1. What kind of chemical bond is found between paired bases of the DNA double helix?
   a. hydrogen
   b. covalent
   c. phosphate
   d. ionic
   e. sulfhydryl

____ 2. A pedigree CANNOT be used to
   a. determine whether an allele is dominant or recessive.
   b. determine whether a trait is inherited.
   c. show how a trait is passed from one generation to the next.
   d. none of the above

Use the table of condons below to answer the following questions.



___ 3. A possible sequence of nucleotides in the template strand of DNA that would code for the polypeptide sequence phe-leu-ile-val would be
   a. 3' AAC-GAC-GUC-AUA 5'.
   b. 3' AAA-GAA-TAA-CAA 5'.
   c. 5' AUG-CTG-CAG-TAT 3'.
   d. 3' AAA-AAT-ATA-ACA 5'.
   e. 5' TTG-CTA-CAG-TAG 3'.

___ 4. A lac repressor turns off the lac genes by binding to
   a. the lac genes.
   b. the operator.
   c. tRNA.
   d. the promoter.

___ 5. Which of the following statements is true?
   a. An expressed gene is turned off.
   b. RNA polymerase regulates gene expression.
   c. A promoter determines whether a gene is expressed.
   d. Proteins that bind to regulatory sites on DNA determine whether a gene is expressed.

____ 6. Two characters that appear in a 9:3:3:1 ratio in the F2 generation should have which of the following properties?
   a. Each of the characters is controlled by a single gene.
   b. The genes controlling the characters obey the law of independent assortment.
   c. Each of the genes controlling the characters has two alleles.
   d. Only A and C are correct.
   e. A, B, and C are correct.

____ 7. Gene therapy
   a. is a widely accepted procedure.
   b. cannot be used to correct genetic disorders.
   c. involves replacement of a defective allele in sex cells.
   d. had apparent success in treating disorders involving bone marrow cells.
   e. has proven to be beneficial to HIV patients.

____ 8. What does Figure 13-1 show?

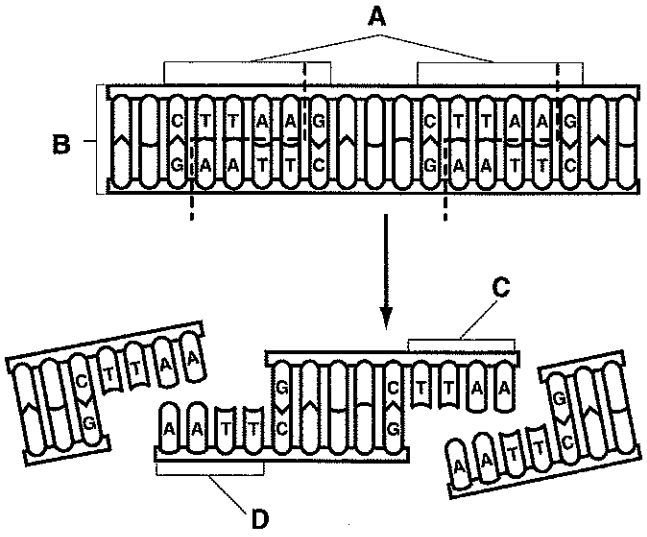


Figure 13–1

   a. polymerase chain reaction
   b. gel electrophoresis
   c. DNA sequencing
   d. a restriction enzyme cutting different sequences of DNA

____ 9. What is the most logical sequence of steps for splicing foreign DNA into a plasmid and inserting the plasmid into a bacterium?

I. Transform bacteria with recombinant DNA molecule.
II. Cut the plasmid DNA using restriction enzymes.
III. Extract plasmid DNA from bacterial cells.
IV. Hydrogen-bond the plasmid DNA to nonplasmid DNA fragments.
V. Use ligase to seal plasmid DNA to nonplasmid DNA.

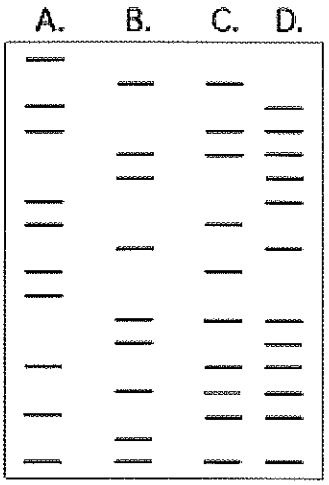
a. I, II, IV, III, V
b. IV, V, I, II, III
c. III, II, IV, V, I
d. III, IV, V, I, II
e. II, III, V, IV, I

____ 10. During transcription, an RNA molecule is formed
a. that is double-stranded.
b. inside the nucleus.
c. that is complementary to both strands of DNA.
d. that is complementary to neither strand of DNA.

____ 11. 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. *XcXc* and *XCY*
b. *XCXC* and *XcY*
c. *XCXc* and *XCY*
d. *XCXC* and *XCY*
e. *XcXc* and *XcY*

____ 12. When during the cell cycle is a cell's DNA replicated?
a. M phase
b. G2 phase
c. S phase
d. G1 phase

Use the figure below to answer the following questions. The DNA profiles below represent four different individuals.



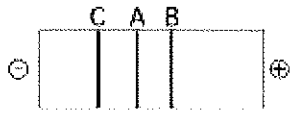
____ 13. Which of the following statements is most likely *true?*
a. D is the child of B and C.
b. D is the child of A and B.
c. D is the child of A and C.
d. B is the child of A and C.
e. A is the child of C and D.

____ 14. Gene regulation in eukaryotes
a. allows for cell specialization.
b. usually involves operons.
c. includes the action of DNA polymerase.
d. is simpler than in prokaryotes.

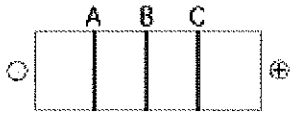
____ 15. Which enzyme catalyzes the elongation of a DNA strand in the 5' → 3' direction?
a. DNA ligase
b. topoisomerase
c. DNA polymerase
d. primase
e. helicase

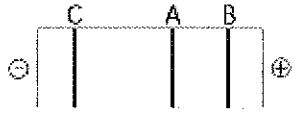
____ 16. One possible result of chromosomal breakage is for a fragment to join a nonhomologous chromosome. This is called a (an)
a. translocation.
b. disjunction.
c. duplication.
d. inversion.
e. deletion.

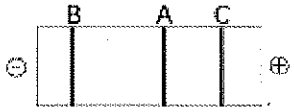
____ 17. The segment of DNA shown in the figure below has restriction sites I and II, which create restriction fragments A, B, and C. Which of the gels produced by electrophoresis shown below best represents the separation and identity of these fragments?

a.


b.


c.


d.


e.


____ 18. SRY is
a. a gene present on the Y chromosome that triggers male development.
b. an autosomal gene that is required for the expression of genes on the X chromosome.
c. required for development, and males or females lacking the gene do not survive past early childhood.
d. a gene present on the X chromosome that triggers female development.
e. an autosomal gene that is required for the expression of genes on the Y chromosome.

____ 19. What is the difference between a monohybrid cross and a dihybrid cross?
a. A monohybrid cross involves organisms that are heterozygous for a single character, whereas a dihybrid cross involves organisms that are heterozygous for two characters.
b. A monohybrid cross produces a single progeny, whereas a dihybrid cross produces two progeny.
c. A monohybrid cross results in a 9:3:3:1 ratio whereas a dihybrid cross gives a 3:1 ratio.
d. A monohybrid cross involves a single parent, whereas a dihybrid cross involves two parents.
e. A monohybrid cross is performed only once, whereas a dihybrid cross is performed twice.

____ 20. Which of the following statements about mitochondria is *false*?
a. Because mitochondria are present in the cytoplasm, mitochondrial diseases are transmitted maternally.
b. Mitochondria contain circular DNA molecules that code for proteins and RNAs.
c. Like nuclear genes, mitochondrial genes usually follow Mendelian patterns of inheritance.
d. Because of the role of the mitochondria in producing cellular energy, mitochondrial diseases often affect the muscles and nervous system.
e. Many mitochondrial genes encode proteins that play roles in the electron transport chain and ATP synthesis.

____ 21. Which of the following happens at the conclusion of meiosis I?
a. The chromosome number is conserved.
b. Sister chromatids are separated.
c. Homologous chromosomes are separated.
d. Four daughter cells are formed.
e. The sperm cells elongate to form a head and a tail end.

____ 22. The human X and Y chromosomes are
a. both present in every somatic cell of males and females alike.
b. of approximately equal size.
c. almost entirely homologous, despite their different names.
d. called "sex chromosomes" because they determine an individual's sex.
e. all of the above

____ 23. Which of the following is *not* a part of the eukaryotic transcription initiation complex?
a. RNA polymerase
b. snRNP
c. promoter
d. transcription factors
e. TATA box

____ 24. Which of the following techniques do scientists use to make many copies of a gene?
a. polymerase chain reaction
b. gel electrophoresis
c. transformation
d. cloning

____ 25. What is shown in Figure 11-1?

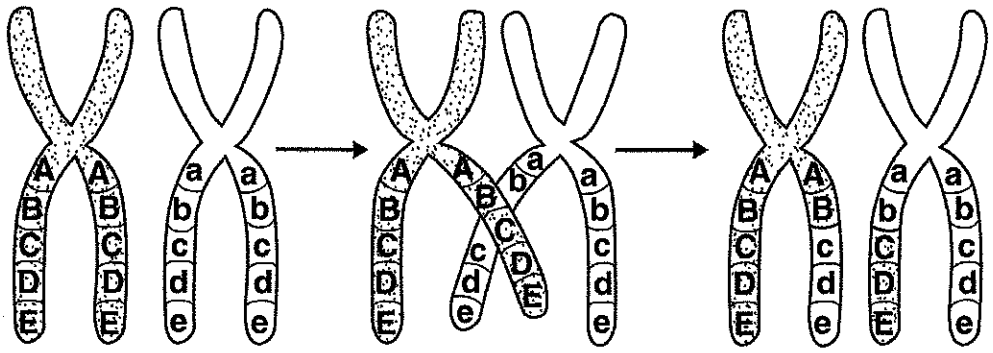


Figure 11–1

a. anaphase I of meiosis
b. crossing-over
c. independent assortment
d. incomplete dominance

____ 26. Colorblindness is more common in males than in females because
a. males who are colorblind have two copies of the allele for colorblindness.
b. fathers pass the allele for colorblindness to their sons only.
c. the allele for colorblindness is recessive and located on the X chromosome.
d. the allele for colorblindness is located on the Y chromosome.

____ 27. A cross between homozygous purple-flowered and homozygous white-flowered pea plants results in offspring with purple flowers. This demonstrates
a. the mistakes made by Mendel.
b. the blending model of genetics.
c. dominance.
d. true-breeding.
e. a dihybrid cross.

____ 28. Bacteria containing recombinant plasmids are often identified by which process?
a. using radioactive tracers to locate the plasmids
b. removing the DNA of all cells in a culture to see which cells have plasmids
c. examining the cells with an electron microscope
d. exposing the bacteria to an antibiotic that kills cells lacking the plasmid
e. producing antibodies specific for each bacterium containing a recombinant plasmid

____ 29. After telophase I of meiosis, the chromosomal makeup of each daughter cell is
a. haploid, and the chromosomes are composed of two chromatids.
b. tetraploid, and the chromosomes are composed of two chromatids.
c. haploid, and the chromosomes are composed of a single chromatid.
d. diploid, and the chromosomes are composed of a single chromatid.
e. diploid, and the chromosomes are composed of two chromatids.

____ 30. The DNA double helix has a uniform diameter because ____, which have two rings, always pair with ____, which have one ring.
a. deoxyribose sugars; ribose sugars
b. purines; pyrimidines
c. nucleotides; nucleoside triphosphates
d. ribose sugars; deoxyribose sugars
e. pyrimidines; purines

____ 31. Which of the following best describes the complete sequence of steps occurring during *every* cycle of PCR?
1. The primers hybridize to the target DNA.
2. The mixture is heated to a high temperature to denature the double stranded target DNA.
3. Fresh DNA polymerase is added.
4. DNA polymerase extends the primers to make a copy of the target DNA.
a. 2, 3, 4
b. 2, 1, 4
c. 3, 4, 1, 2
d. 3, 4, 2
e. 1, 3, 2, 4

____ 32. Which of the following is the term for a human cell that contains 22 pairs of autosomes and two X chromosomes?
a. an unfertilized egg cell
b. a sperm cell
c. a male somatic cell
d. a female somatic cell
e. both A and D

____ 33. A cross of a white hen with a black rooster produces erminette-color offspring. This type of inheritance is known as

a. polygenic inheritance.
b. multiple alleles.
c. codominance.
d. incomplete dominance.

Refer to the result below to answer the following questions.

A tall plant is crossed with a short plant, and the progeny are all intermediate in size between the two parental plants.

____ 34. This could be an example of

a. incomplete dominance.
b. polygenic inheritance.
c. complete dominance.
d. A and B
e. B and C

____ 35. The polymerase chain reaction is important because it allows us to

a. incorporate genes into viruses.
b. make many copies of a targeted segment of DNA.
c. insert eukaryotic genes into prokaryotic plasmids.
d. make DNA from RNA transcripts.
e. insert regulatory sequences into eukaryotic genes.

____ 36. When during the cell cycle are chromosomes visible?

a. only during the G1 phase
b. only during the M phase
c. only when they are being replicated
d. only during interphase

For the following questions, match the key event of meiosis with the stages listed below.

I.	prophase I	V.	prophase II
II.	metaphase I	VI.	metaphase II
III.	anaphase I	VII.	anaphase II
IV.	telophase I	VIII.	telophase II

____ 37. Centromeres of sister chromatids uncouple and chromatids separate.

a. II
b. VII
c. IV
d. III
e. V

____ 38. A human individual is phenotypically female, but her interphase somatic nuclei do not show the presence of Barr bodies. Which of the following statements concerning her is probably *true?*

a. She has two Y chromosomes.
b. She has Turner syndrome.
c. She has Klinefelter syndrome.
d. She has the normal number of sex chromosomes.
e. She has an extra X chromosome.

____ 39. Cytosine makes up 38% of the nucleotides in a sample of DNA from an organism. Approximately, what percentage of the nucleotides in this sample will be thymine?
a. 12
b. 31
c. 38
d. 24
e. It cannot be determined from the information provided.

____ 40. Black fur in mice *(B)* is dominant to brown fur *(b)* Short tails *(T)* are dominant to long tails *(t)*. What fraction of the progeny of the cross BbTt × BBtt will have black fur and long tails?
a. 1/2
b. 1/16
c. 3/8
d. 3/16
e. 9/16

____ 41. What is the role of the spindle during mitosis?
a. It duplicates the DNA.
b. It breaks down the nuclear membrane.
c. It helps separate the chromosomes.
d. It divides the cell in half.

____ 42. If a chromosome lacks certain genes, what has most likely occurred?
a. an inversion
b. disjunction
c. a deletion
d. a nonduplication
e. a translocation

____ 43. Which of the following best describes the addition of nucleotides to a growing DNA chain?
a. A nucleoside monophosphate is added to the 3' end of the DNA.
b. A nucleoside diphosphate is added to the 5' end of the DNA, releasing a molecule of phosphate.
c. A nucleoside diphosphate is added to the 3' end of the DNA, releasing a molecule of phosphate.
d. A nucleoside triphosphate is added to the 3' end of the DNA, releasing a molecule of pyrophosphate.
e. A nucleoside triphosphate is added to the 5' end of the DNA, releasing a molecule of pyrophosphate.

____ 44. A recombinant plasmid gets inside a bacterial cell by
a. transformation.
b. hybridization.
c. radiation.
d. recombination.

____ 45. What is the function of DNA polymerase?
a. to seal together the broken ends of DNA strands
b. to rejoin the two DNA strands (one new and one old) after replication
c. to unwind the DNA helix during replication
d. to degrade damaged DNA molecules
e. to add nucleotides to the end of a growing DNA strand

____ 46. Two true-breeding stocks of pea plants are crossed. One parent has red, axial flowers and the other has white, terminal flowers; all F_1 individuals have red, axial flowers. If 1,000 F_2 offspring resulted from the cross, approximately how many of them would you expect to have red, terminal flowers? (Assume independent assortment).
   a. 65
   b. 565
   c. 250
   d. 190
   e. 750

____ 47. When crossing a homozygous recessive with a heterozygote, what is the chance of getting an offspring with the homozygous recessive phenotype?
   a. 50%
   b. 25%
   c. 75%
   d. 0%
   e. 100%

____ 48. Two plants are crossed, resulting in offspring with a 3:1 ratio for a particular trait. This suggests
   a. that the parents were both heterozygous.
   b. that a blending of traits has occurred.
   c. that the parents were true-breeding for contrasting traits.
   d. that each offspring has the same alleles.
   e. incomplete dominance.

____ 49. RNA polymerase and DNA polymerase differ in that
   a. RNA polymerase is much more accurate than DNA polymerase.
   b. RNA polymerase can initiate RNA synthesis, but DNA polymerase requires a primer to initiate DNA synthesis.
   c. RNA polymerase binds to single-stranded DNA, and DNA polymerase binds to double-stranded DNA.
   d. RNA polymerase uses RNA as a template, and DNA polymerase uses a DNA template.
   e. RNA polymerase does not need to separate the two strands of DNA in order to synthesize an RNA copy, whereas DNA polymerase must unwind the double helix before it can replicate the DNA.

____ 50. A woman has six sons. The chance that her next child will be a daughter is
   a. 1/2.
   b. 5/6.
   c. 0.
   d. 1/6.
   e. 1.

____ 51. Which of the following genotypes result in the same phenotype?
   a. IBIB and IAIB
   b. IBIB and IBi
   c. IBi and ii
   d. IAIA and IAIB

Use the following information to answer the questions below.

A woman who has blood type A, has a daughter who is type O positive and a son who is type B negative. Rh positive is a simple dominant trait over Rh negative.

____ 52. Which of the following is the probable genotype for the mother?
a. I^Airr
b. I^AI^ARr
c. I^AiRr
d. I^AI^ARR
e. I^AiRR

____ 53. Which of the following is a nucleotide found in DNA?
a. deoxyribose + phosphate group + cytosine
b. ribose + phosphate group + uracil
c. ribose + phosphate group + thymine
d. deoxyribose + phosphate group + uracil

____ 54. Which of the following is (are) true for alleles?
a. They can be identical or different for any given gene in a somatic cell.
b. They can be dominant or recessive.
c. They can represent alternative forms of a gene.
d. Only A and B are correct.
e. A, B, and C are correct.

Other

USING SCIENCE SKILLS
The pedigree shows the inheritance of free earlobes and attached earlobes in five generations of a family. Attached earlobes are caused by a recessive allele *(f)*.

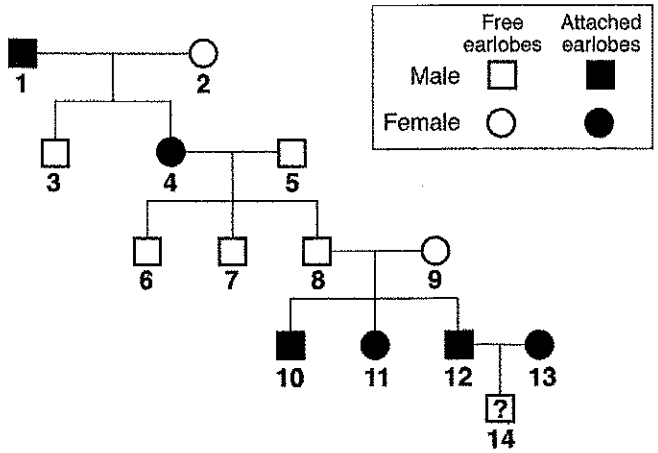


Figure 14–2

55. **Predicting** Predict the genotype and phenotype of individual 14 in Figure 14–2.