

The genetic material must show variation. Which of the following is NOT an example of genetic variation?

- New mutations can occur during meiosis.
- A)**  Different species have different numbers of chromosomes.
- B)**  Different individuals within a species have different phenotypes.
- C)**  Individuals of different species may have similar phenotypes.
- D)**

2 Why might heat-killed bacteria be useful as a vaccine?

- It can cause a lethal infection.
- A)**  Heat degradation of proteins changes their shape.
- B)**  Molecules from the cell surface are still intact and can provoke an immune response.
- C)**  DNA molecules can transform other strains of bacteria.
- D)**

3 What is the key difference between 'rough' and 'smooth' *S. pneumoniae*?

- Rough bacteria can evade the immune system of a mouse.
- A)**  Rough bacteria have more genes than smooth bacteria.
- B)**  Smooth bacteria have more genes than rough bacteria.
- C)**  Smooth bacteria are able to synthesize a polysaccharide capsule.
- D)**

4 What occurred in the transformation observed by Griffith?

- A rough strain underwent mutation to convert it to a smooth strain.
- A)**  A smooth strain underwent mutation to convert it to a rough strain.
- B)**  A rough strain passed genetic information to a smooth strain.
- C)**  A smooth strain passed genetic information to a rough strain.
- D)**

5 Why was the DNase treatment used by Avery, MacLeod, and McCarty an important step?

- This allowed them to isolate pure DNA samples.
- A)**  This allowed them to isolate pure protein samples.
- B)**  This allowed them to demonstrate that removing the DNA prevents transformation.
- C)**  This allowed them to demonstrate that mixing rough cells with DNA prevents transformation.
- D)**

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**6** Which of the following statements about Griffith's type IIR strain of bacteria is incorrect?

- It cannot make a polysaccharide capsule.
- A)**  It must be competent to pick up DNA from the environment.
- B)**  It contains a mutation in a gene that would allow synthesis of a type III capsule.
- C)**  All of these are correct statements.
- D)**

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**7** What key characteristic of T2 bacteriophage allowed Hershey and Chase to use it in their studies of the genetic material?

- Its genes encode proteins that assemble to produce the viral coat.
- A)**  It injects its genetic material into a bacterial cell.
- B)**  It can undergo either the lytic or lysogenic life cycle.
- C)**  It enters the bacterial cell to cause infection.
- D)**

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**8** Which of the following is a key component of a DNA nucleotide?

- Nitrogenous base.
- A)**  Deoxyribose sugar.
- B)**  Phosphate group.
- C)**  All of these.
- D)**  None of these.
- E)**

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**9** What is the difference between purines and pyrimidines?

- Purines are found in RNA while pyrimidines are found in DNA.
- A)**
- Pyrimidines are found in RNA while purines are found in DNA.
- B)**
- Purines contain a double ring backbone, while pyrimidines contain a single ring backbone.
- C)**
- Pyrimidines contain a double ring backbone while purines contain a single ring backbone.
- D)**

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**10** What type of bond connects nucleotides?

- Phosphodiester.
- A)**
- Hydrogen.
- B)**
- Ionic.
- C)**
- A and B.
- D)**
- None of these.
- E)**

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**11** Which of the following statements about the structure of DNA is incorrect?

- One complete turn requires 3.4nm and 10 base pairs.
- A)**
- The backbones of each strand run in opposite directions relative to each other.
- B)**
- Each pair of nucleotides is held together by three hydrogen bonds.
- C)**
- The width of the molecule is a constant 2nm.
- D)**

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**12** Which of the following is a line of evidence that indicates triplex DNA may exist in vivo?

- Triplex DNA can be synthesized in the lab.
  - A)**
  - Triplex DNA follows certain base pairing rules.
  - B)**
  - Triplex DNA is recognized by certain proteins present in cells.
  - C)**
  - A and B.
  - D)**
  - None of these.
  - E)**
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**13**

What functional role is the three dimensional structure of DNA likely to accomplish?

- Very long molecules of DNA can be packed into a small space.
- A)**  Information within DNA is made available to drive cellular functions.
- B)**  Information within DNA is modified from generation to generation.
- C)**  All of these.
- D)**  None of these.
- E)**

**14**

In studying a virus, you find the following proportions of nitrogenous bases present: adenine 23%, guanine 31%, cytosine 23%, unexpected base 17%. What statement(s) can you make about this virus?

- It probably uses RNA as its genetic material.
- A)**  The genetic material of this virus is probably single stranded.
- B)**  Base pairing rules in this virus probably include adenine:cytosine.
- C)**  A and B.
- D)**  None of the above.
- E)**

**15**

Which statement is false?

- RNA and DNA are both composed of nucleotides joined by phosphodiester bonds.
- A)**  RNA and DNA both have secondary and tertiary structure.
- B)**  RNA is always single stranded while DNA is always double stranded.
- C)**  A and B are both false.
- D)**  None of these (A, B and C are all true statements).
- E)**

**16**

The advent of molecular genetics has greatly improved our ability to perform research in other areas of genetics.

- True
- A)**  False
- B)**

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**17**

The genetic material must be able to contain an infinite amount of information.

- True  
**A)**  
 False  
**B)**

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**18**

Avery, MacLeod, and McCarty were able to demonstrate that their biochemical extracts were perfectly pure.

- True  
**A)**  
 False  
**B)**

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**19**

Hershey and Chase demonstrated that DNA is the genetic material for eukaryotic organisms.

- True  
**A)**  
 False  
**B)**

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**20**

T2 bacteriophage rely on the lytic life cycle to generate an ongoing infection.

- True  
**A)**  
 False  
**B)**

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**21**

DNA is the genetic material for all organisms.

- True  
**A)**  
 False  
**B)**

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**22**

A nucleoside consists of a nitrogenous base, a sugar, and up to three phosphate groups.

- True  
**A)**  
 False  
**B)**

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**23**

Deoxycytidine refers to the nucleoside which includes the base cytosine and deoxyribose sugar.

- True  
**A)**  
 False

**B)**

**24**

Hydrogen bonding is the primary chemical bond holding a strand of DNA together.

True

**A)**

False

**B)**

**25**

Rosalind Franklin was given proper recognition for her critical role in the discovery of the structure of DNA.

True

**A)**

False

**B)**

**26**

The backbones of the two DNA strands in a double helix run in opposite directions (one 5'-3' left to right, the other 5'-3' right to left).

True

**A)**

False

**B)**

**27**

B DNA is the only biologically relevant form of DNA.

True

**A)**

False

**B)**

**28**

Eukaryotic DNA is packaged around proteins to form compact loops.

True

**A)**

False

**B)**

**29**

RNA molecules follow the same base pairing rules as DNA.

True

**A)**

False

**B)**

30. The percentage composition of a nucleic acid found in a bacteriophage is

32.3% Adenine

28.7% Thymine

23.6% Cytosine

15.4% Guanine

The molecule is most likely

- a) Double-stranded DNA
- b) Mitochondrial DNA
- c) Messenger RNA
- d) Double-stranded RNA
- e) Single-stranded DNA

31. DNA replication

- a) Is the first step of protein synthesis
- b) Occurs in the G<sub>2</sub> phase of the cell cycle
- c) May be conservative or semi-conservative at different points in an organism's life cycle
- d) Helps to ensure genetic information is passed to future generations
- e) Is only semi-conservative in eukaryotes, not prokaryotes

32. Which of the following statements concerning Griffith's work with *Streptococcus pneumoniae* is incorrect?

- a) Injected heat-killed S-form bacteria allowed mice to survive
- b) Injected heat-killed S-form bacteria together with live R-form bacteria killed mice
- c) Injected S-form bacteria killed mice
- d) Injected R-form bacteria killed mice
- e) The S-form bacteria are enveloped with a capsule of polysaccharide

33. In what order do the following molecules become involved in DNA replication in *E. Coli*?

- i) Single-stranded binding proteins
  - ii) DNA polymerase III
  - iii) Primase
  - iv) Helicase
- a) iv, i, iii, ii    b) iv, iii, i, ii    c) i,iii, iv, ii    d) iii, ii, iv, i    e) ii, iii, iv, i

34. Complementary base pairing is the result of

- a) Hydrogen bonding
- b) The fact that complementary bases fit together physically**
- c) Covalent bonding
- d) Ionic bonding
- e) The fact that strands of DNA are unwound around each other in a double helix

35. If a free phosphate is found at the 5' end of a DNA strand, what is found at the other end of the same strand?

- a) A hydroxyl group on the 5' carbon of a deoxyribose sugar.

- b) A hydroxyl group on the 3' carbon of a deoxyribose sugar.
  - c) A phosphate group on the 5' carbon of a deoxyribose sugar.
  - d) A phosphate group on the 3' carbon of a deoxyribose sugar.
  - e) A base attached to the 3' carbon of a deoxyribose sugar.
36. DNA acts as a template for transcription. Which of the following statements regarding the DNA of a gene being expressed is true?
- a) After unwinding, both of the DNA strands are used as template for the same gene.
  - b) After unwinding, only one of the DNA strands is used as a template.
  - c) The two strands only act as a template when paired.
  - d) In prokaryotes, the binding of RNA polymerase to unwound DNA occurs randomly on either one of the two strands.
  - e) The strand with the higher Guanine-Cytosine content acts as the template.
37. When a mixture of DNA fragments undergo gel electrophoresis
- a) Smaller fragments move slower and further on the gel relative to larger fragments.
  - b) Larger fragments move slower and further on the gel relative to smaller fragments.
  - c) Smaller fragments move faster, but not as far on the gel relative to larger fragments.
  - d) Larger fragments move slower and not as far on the gel relative to smaller fragments.
  - e) Smaller fragments show up more easily on the gel.
38. Which of the following is **NOT** true about t-RNA molecules?
- a) They possess a 3' acceptor stem used in binding amino acids.
  - b) It is single-stranded RNA.
  - c) They are the main component of ribosomes. (ribosomes made of rRNA)
  - d) Individually, they may be able to bind to more than one codon;
  - e) They possess an anticodon that is complementary to the mRNA codon.
39. The number of nitrogenous bases codes by 9 amino acids would be
- a) **27**
  - b) 9
  - c) 3
  - d) 18
  - e) Too little information provided
40. In Huntington's disease, CAG repeats occur more frequently than in people without the disease. The results in many more additional amino acids of the same type added in the polypeptide. The addition of these CAG repeats (due to mutation over time) would be best described as
- a) Base-pair substitutions
  - b) Insertions
  - c) Frameshift mutations
  - d) Deletions
  - e) Silent mutations



41. Which of the following enzymes would be considered an exonuclease, an enzyme with the ability to remove incorrectly matched nucleotides?
- a) DNA helicase
  - b) Peptidyl transferase
  - c) DNA ligase
  - d) RNA polymerase
  - e) DNA polymerase
42. The main idea behind PCR is
- a) the cloning of one's entire DNA sequence to create genetically similar organisms
  - b) the combination of two different organism's DNA
  - c) the amplification of a specific region of the DNA for further study
  - d) the extraction of DNA from a cell
  - e) to genetically sequence an organism's DNA
43. Denaturation, annealing, and elongation (extending) are the three phases of a PCR cycle. The annealing phase involves:
- a) Adding nucleotides so that *Taq* polymerase can add them to a growing strand
  - b) Heating the DNA to high temperatures in order to separate the original helix
  - c) Adding complementary primers to help locate the target sequence to be copied
  - d) Sticking DNA of different chromosomes together so that the entire genome can be copied
44. A radioisotope used to label proteins differentially from nucleic acids is (a)  $^{32}\text{P}$  (b)  $^{14}\text{C}$  (c)  $^{35}\text{S}$  (d)  $^{15}\text{N}$
45. Which of the following single strands would be part of a palindrome in double-stranded DNA? (a) GAATTC (b) ATGATG (c) CTAATC (d) CCCTTT (e) none of the above
46. Which of the following is an enzyme used to form a phosphodiester bond in a nick between a 3' end of one DNA chain and a 5' end of another? (a) DNA polymerase (b) restriction endonuclease (c) DNA ligase (d) S1 nuclease (e) phosphodiesterase
47. Bacterial cells are rendered more permeable to uptake of plasmids by treatment with (a) heat (b) calcium chloride (c) alkali (d) a blender (e) ultrasound

48. The melting temperature of a DNA molecule is determined by using (a) electrophoresis (b) change in electrical conductivity (c) column chromatography (d) density-gradient ultracentrifugation (e) change in optical density
49. Which of the following is a desirable characteristic for a cloning plasmid? (a) a site at which replication can be initiated (b) one or more unique restriction endonuclease sites (c) one or more antibiotic-resistance or drug resistance genes (d) a highly active promoter (e) all of the above
50. The classical 1957 experiment of Meselson and Stahl was concerned with (a) mode of DNA replication (b) polymerase chain reaction (c) in vitro production of recombinant DNA molecules (d) synthesis of hybrid proteins (e) transduction via lambda phage
51. Many of the genes in lambda phage are clustered according to similarity of function. Which of these gene clusters could most likely be deleted and replaced with foreign DNA, making the recombinant phage a useful cloning vector? (a) nucleases to destroy host DNA (b) head capsomeres (c) phage-specific RNA polymerase (d) establishment and maintenance of lysogeny (e) tail proteins
52. Eukaryotic genes may not function properly when cloned into bacteria because of (a) inability to excise introns (b) destruction by native endonucleases (c) failure of promoter to be recognized by bacterial RNA polymerase (d) different ribosome binding sites (e) all of the above
53. The DNA fingerprinting process involves (a) chain terminators (b) degenerate oligonucleotides (c) VNTR loci (d) RFLPs (e) cDNA

### **Vocabulary Questions**

For each of the following definitions, give the appropriate term and spell it correctly. Terms are single words unless indicated otherwise.

1. A technique that separates molecules according to their net charge in an electric field, usually on solid or semisolid support media such as paper or agarose.
2. Separation of complementary chains of a DNA molecule, usually by heating.
3. Reassociation of complementary single-stranded regions of DNA with DNA, or DNA with RNA.
4. Exposure of a photographic film to DNA labeled with a radioactive isotope.
5. Symmetrical sequences of nucleotide base pairs in double-stranded DNA that read the same on each strand from 5' to 3'.

6. Bacterial enzymes that break phosphodiester bonds in DNA at specific base sequences. (Two words.)
7. The random collection of a sufficiently large sample of cloned fragments of the DNA of an organism to ensure that all of that organism's DNA is represented in the collection. (Two words.)
8. An enzyme used to add deoxyribonucleotides to the 3' ends of DNA chains without a template. (Two or three words.)
9. An *in vitro* technique for copying the complementary strands of a target DNA sequence simultaneously for a series of cycles until the desired amount is obtained. (Three words.)
10. The name of the product produced by reverse transcriptase enzyme from an mRNA template. (One or two words.)