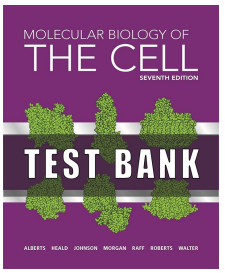
Molecular Biology of the Cell 7th Edition Alberts Test Bank

MOLECULAR BIOLOGY OF THE CELL, SEVENTH EDITION
CHAPTER 1: CELLS AND GENOMES



1. Scientists discover more than ten thousand new species of living organisms every year. What is shared between all of these organisms?
   A. They are made of cells, whose nuclei enclose their DNA.
   B. They obtain their energy from sunlight.
   C. They produce and use adenosine triphosphate (ATP).
   D. Their genome contains at least 1000 genes.
   E. All of the above.

2. All cells …
   A. have membrane transport proteins.
   B. synthesize proteins on the ribosome.
   C. replicate their genome by DNA polymerization.
   D. transcribe their genetic information by RNA polymerization.
   E. All of the above.

3. Imagine a segment of DNA (within a gene) encoding a certain amount of information in its nucleotide sequence. When this segment is fully transcribed into mRNA and then translated into protein, in general, …
   A. the protein sequence would carry more information compared to the DNA and mRNA sequences, because its alphabet has 20 letters.
   B. the protein sequence would carry less information compared to the DNA and mRNA sequences, because several codons can correspond to one amino acid.
   C. the amount of information in the mRNA sequence is lower, because the mRNA has been transcribed using only one of the DNA strands as the template.
   D. the amount of information in the mRNA sequence is higher, because several mRNA molecules can be transcribed from one DNA molecule.

4. Which of the following processes that happens inside a cell DOES NOT normally require consumption of free energy by the cell?
   A. Replication of the genetic material

B. Import of nutrients from the environment
C. Diffusion of small molecules within the cell
D. Regulation of gene expression
E. Synthesis of enzymes that catalyze cellular reactions

5. Which of the following would you NOT expect to find in a bacterial cell?
A. Swimming using flagella
B. Having a cell wall around the plasma membrane
C. ATP production in mitochondria
D. Protein production on the ribosome
E. Sexual exchange of DNA with other bacteria

6. To trace family relationships between distantly related organisms such as humans, algae, bacteria, and archaea, one should compare their genomes in regions …
A. that evolve rapidly.
B. that have a higher mutation rate.
C. that code for proteins.
D. where mutations are hardly tolerated.
E. where most mutations are selectively neutral.

7. Laboratory strains of the model organism *Escherichia coli* that are resistant to antibiotics are very often used in research laboratories as well as in the biotechnology industry. If cultures of such bacteria were allowed to contaminate the environment uncontrollably, it is possible that at some point, pathogenic bacteria such as *Neisseria meningitidis* (which causes meningitis and can cause death, especially in children) could acquire the same antibiotic-resistance gene, causing a meningitis outbreak that is difficult to treat. In this scenario, which of the following mechanisms is a more likely source of the antibiotic-resistance gene in *N. meningitidis*?
A. Random new gene generation
B. Intragenic mutation
C. Gene duplication
D. DNA segment shuffling
E. Horizontal gene transfer

8. A virus …
A. is a type of cell.
B. has genetic material made of proteins.

C. can only infect a single host species.
D. can act as a vector for gene transfer.
E. cannot persist in its host for more than one cell generation.

9. Which of the following does NOT typically involve horizontal gene transfer?
A. Sexual reproduction in humans
B. Bacteriophage infection of bacteria
C. The evolutionary history of the eukaryotic cell
D. The accidental duplication of a small region of a bacterial chromosome followed by cell division
E. Introduction of plasmids into bacteria in a laboratory

10. Gene duplication can give rise to homologous genes that are part of gene families. For example, there are six actin genes in the genome of most mammalian species. In humans, the *ACTB* gene, which encodes a cytoskeletal actin, is expressed ubiquitously, while *ACTC1* is expressed mainly in cardiac cells. Although bacteria lack the eukaryotic cytoskeletal organization, the bacterial *MreB* gene bears recognizable sequence similarity to mammalian actin genes and codes for a protein that is similar to actin in structure and function. Which of the following statements is true about these genes?
A. *ACTB* is homologous to *ACTC1* but not to *MreB.*
B. *ACTB* is orthologous to *ACTC1* but not to *MreB.*
C. *ACTB* is paralogous to *ACTC1* but not to *MreB.*
D. *MreB* is orthologous to *ACTB* but not to *ACTC1*.
E. *ACTB* is paralogous to both *ACTC1* and *MreB.*

11. Out of nearly 5000 protein-coding gene families, there is a set of nearly 300 conserved gene families that are found in species from all domains of life. When one looks at the general functions assigned to these gene families, it is found that …
A. the majority of them function in cell-to-cell signaling.
B. the majority of them are poorly characterized.
C. more than one-third of them are involved in translation or amino acid transport and metabolism.
D. more than one-half of the shared families are involved in DNA replication and transcription.
E. Nearly all of them are involved in energy production and carbohydrate metabolism.

12. Which of the following is true regarding *Escherichia coli*?

A. Most of our understanding about mitosis comes from studies on this model organism.
B. It is a rod-shaped bacterium that can only grow in the gut of humans and other vertebrates.
C. Two strains of *E. coli* can differ by up to 0.1% in their genomes.
D. *E. coli* strain K-12 encodes about 4300 proteins.
E. The *E. coli* (strain K-12) genome is about 430 million nucleotide pairs long.

13. Which of the following is NOT true regarding the tree of life?

A. Most bacteria and archaea have 1000 to 6000 genes in their genomes.
B. Eukaryotes are more similar to archaea than to bacteria with respect to the proteins that act on their DNA.
C. Most bacteria and archaea have genome sizes between one and ten million nucleotide pairs, whereas eukaryotic genomes can be millions of times larger.
D. Archaeal species were thought to belong to the eukaryotic world before sequence analysis placed them in a separate domain of life.
E. Photosynthetic bacteria are thought to be the ancestors of the eukaryotic chloroplasts.

14. A mutation in the *cdc28* gene in the budding yeast *Saccharomyces cerevisiae* causes cell-cycle arrest, giving rise to unbudded cells that look like "dumbbells." Treatment of wild-type cells with nocodazole, a drug that destabilizes some cytoskeletal polymers, leads to a similar phenotype. Based only on these observations, which statement is true regarding *cdc28*?

A. c*dc28* codes for a master regulatory kinase that phosphorylates other proteins.
B. Nocodazole binds to the protein coded by the *cdc28* gene.
C. The product of the *cdc28* gene is responsible for resistance to nocodazole.
D. The product of the *cdc28* gene is involved in cell cycle regulation.
E. The product of *cdc28* destabilizes the same cytoskeletal polymers that nocodazole also destabilizes.

15. Which of the following structures is exclusively found in eukaryotic cells?

A. Plasma membrane
B. Cell wall
C. Chromosome
D. Ribosome
E. Lysosome

16. Mitochondria and chloroplasts are thought to have evolved from free-living aerobic bacteria that were engulfed by an ancestral anaerobic cell and established a mutually beneficial (symbiotic) relationship with it. Which of the following statements is NOT true about these organelles?

A. They are similar in size to small bacteria.
B. They have their own circular genomic DNA.
C. They have their own ribosomes.
D. They have their own transfer RNAs.
E. They are found in all eukaryotes.

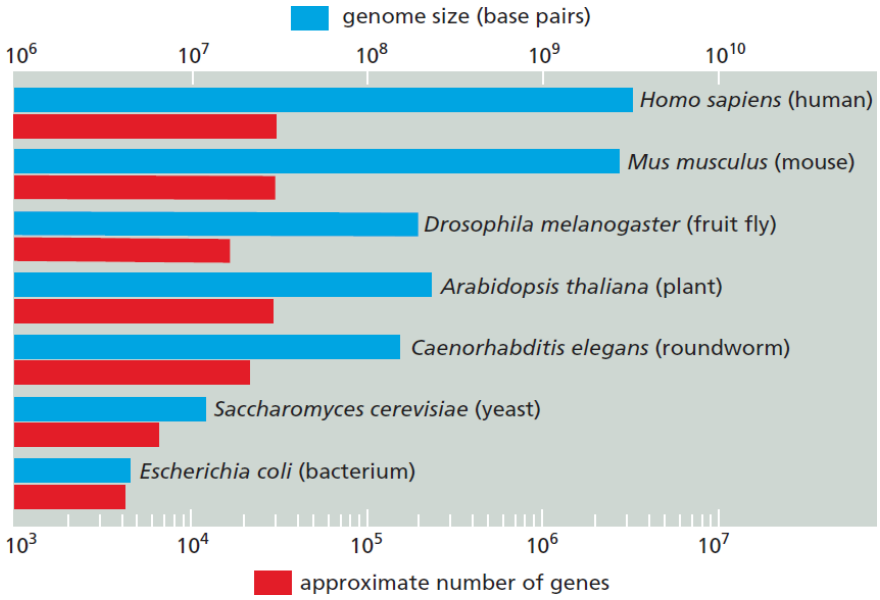
17. In terms of cellular lifestyle, different kingdoms of life can be likened to *hunters*, *farmers*, and *scavengers*. Which of the following is true in this scheme?

A. The ancestral eukaryotic cell was a *farmer*, but it turned into a *hunter* once it acquired mitochondria.
B. Plant cells are considered *scavengers*, because their cell wall does not allow them to move.
C. Most protozoa are *hunters*, whereas animal cells are *farmers*.
D. The ancestral eukaryotic cell was a *hunter*, but upon acquiring chloroplasts it made the transition into *farming*.
E. Fungi are *scavengers* without mitochondria.

18. Comparing the genomes of present-day mitochondria or chloroplasts with the genomes of their corresponding bacteria reveals that these organelles do not have many of the genes that are essential for their function. For instance, they lack the many genes that are required for DNA replication. What has happened to these genes?

A. They have been lost during evolution, since the organelles no longer rely on DNA replication.
B. The required genes are kept in the nucleus, but many have evolved by gene transfer from the organelle.
C. These genes have undergone mutations and have changed beyond recognition, but are still present in the organelle.
D. The organelles do not replicate their DNA; they import new DNA from the nucleus.
E. The required genes are on plasmids that are separate from the organelle’s genome.

19. Based on the variation of genome size and gene number in the organisms presented in the following graph, which organism has the highest number of genes per unit length of their genome? (Note the logarithmic scale.)



A. H. sapiens
B. M. musculus
C. A. thaliana
D. C. elegans
E. E. coli

20. Which of the following groups of living organisms has the highest variation in haploid genome size?

A. Mammals
B. Fish
C. Fungi
D. Protozoa
E. Prokaryotes

21. All cells in a multicellular organism have normally developed from a single cell and share the same genome, but can nevertheless be wildly different in their shape and function. What in the eukaryotic genome is responsible for this cell-type diversity?

A. The genes that encode transcription regulatory proteins
B. The regulatory sequences that control the expression of genes

C. The genes that code for molecules involved in receiving cellular signals
D. The genes that code for molecules involved in sending cellular signals to other cells
E. All of the above

22. *Didinium nasutum* is a single-celled eukaryote that can hunt and feed on other living cells. It has an elaborate anatomy with beating cilia, a "mouth opening," an "anal aperture," and a set of contractile bundles; it can also shoot "darts" to paralyze its prey. What group of living cells does *D. nasutum* represent?

A. Protozoa
B. Yeasts
C. Algae
D. Animals
E. It can belong to any of the above

23. It is a model organism used to study various cell processes such as regulation of the eukaryotic cell cycle. Mutants are available for every gene in its exceptionally small genome. It can live indefinitely in either a haploid or a diploid state. Which of the following describes this organism?

A. It can reproduce only asexually.
B. It is a fungus.
C. It lacks a cell wall.
D. Its cell cycle is typically much slower than that of human cells.
E. All of the above

24. It is a model organism used to study various eukaryotic cell and developmental processes such as cell division and cell death. Its hermaphrodite adult is composed of exactly 959 somatic (non-germ) cells, the lineage of each of which has been worked out with great precision. It is approximately 1 mm long. Which of the following describes this organism?

A. It is a vertebrate.
B. It is a plant pathogen that destroys many crops.
C. Its genome codes for a few thousand genes.
D. It can fly.
E. It can be frozen indefinitely in a state of suspended animation.

25. It is a model organism used to study various cell and developmental processes such as the growth of developing body parts in the right place and with the correct shape. It develops from a

fertilized egg to an adult in a little over a week, and has been a favorite of geneticists for almost a century. Some of its cells have giant chromosomes whose banding patterns have been extremely helpful in classical genetic studies. Which of the following describes this organism?

A. It is a vertebrate.
B. Its genome is only 10 million nucleotide pairs long.
C. There are many more duplicate genes in this organism compared to humans.
D. Although useful for genetic studies, the molecular mechanisms governing its development are irrelevant to human development.
E. It normally only reproduces sexually.

26. This model organism is particularly well suited for studying developmental processes in higher animals. It develops from a fertilized egg to an adult in only two to three months, and its body is transparent for the first two weeks, making it easy to observe cell behavior during development. Which of the following describes this organism?

A. It is a vertebrate.
B. It is well suited for genetic analysis.
C. Its early stages of development occur outside of the mother's body.
D. Its genome size is almost half that of humans.
E. All of the above.

27. Judged by the average number of nucleotide-pair differences per 1000 nucleotide pairs, which of the following pairs show the highest difference?

A. The genomes of *S. cerevisiae* and *M. musculus*
B. The genomes of two different *E. coli* strains
C. The ribosomal RNA genes from human and *E. coli*
D. The transfer RNA genes in a human and *M. musculus*
E. The genomes of two humans

28. Indicate if each of the following descriptions matches RNA (R) or DNA (D). Your answer would be a five-letter string composed of letters R and D only, e.g. RDDRR.

( ) It is mainly found as a long, double-stranded molecule.
( ) It contains the sugar ribose.
( ) It normally contains the bases thymine, cytosine, adenine, and guanine.
( ) It can normally adopt distinctive folded shapes.
( ) It can be used as the template for protein synthesis.