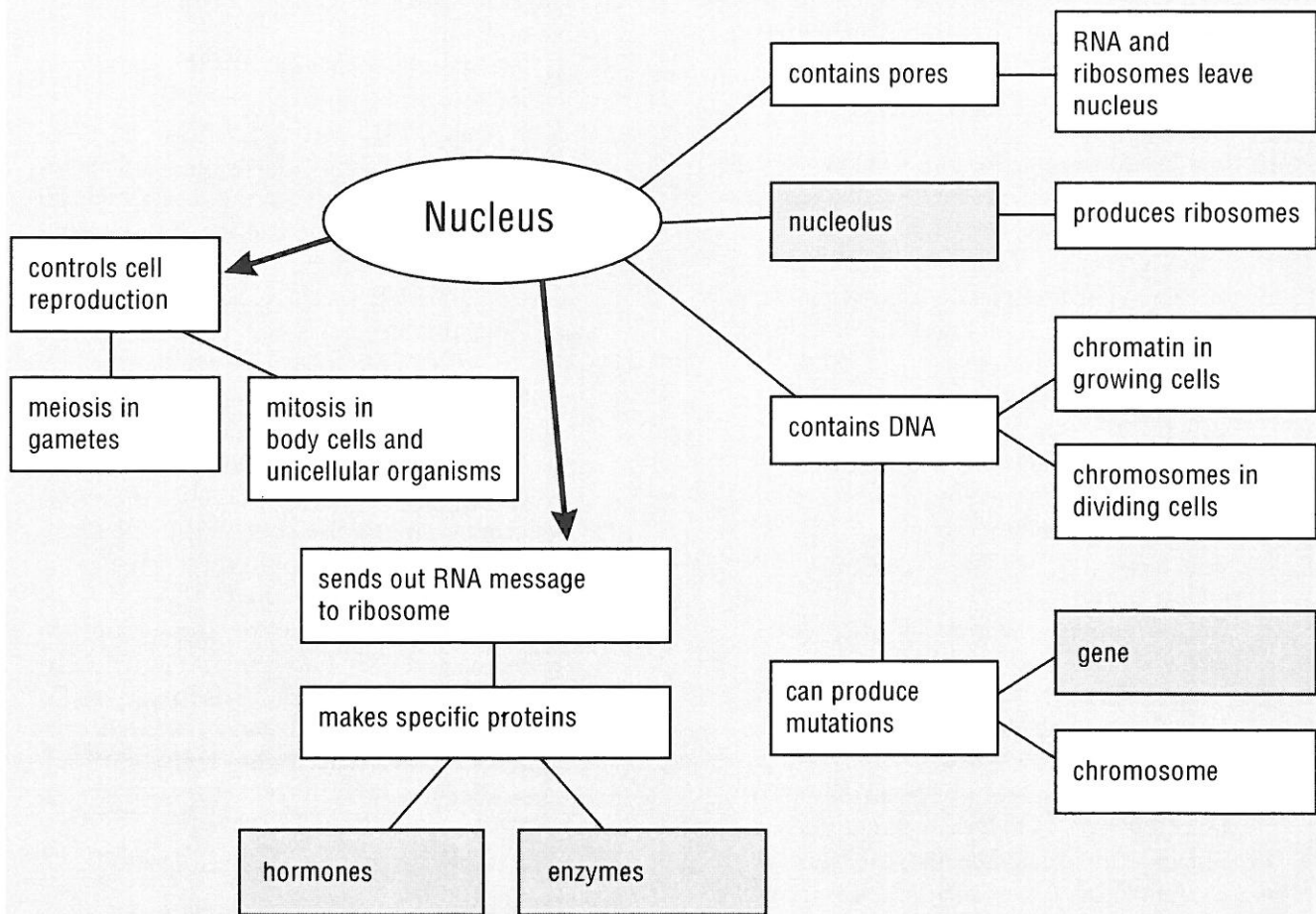


**UNIT 2 REVIEW ANSWERS, p. 238–241**
**Visualizing Key Ideas**

1.


**Using Key Terms**

2. Answers will vary. Check for the correct relationships in students' sentences. Accept all reasonable answers. Some sample connections are given below.

- Genes that code for proteins are located on the DNA.
- Mutagens can cause a harmful negative mutation that may possibly be treated with gene therapy to replace the mutated gene.
- Single celled eukaryotes such as amoebas reproduce asexually through the process of binary fission and mitosis, while multicellular organisms such as sponges reproduce asexually through the process of budding and mitosis.
- If mutations occur in the checkpoint proteins in the cell cycle that involve DNA replication, cancer may result.

- Following fertilization, which is the union of the male and female gamete, millions of mitotic divisions will occur in embryonic development.
- Stem cells, which are cells that have not undergone differentiation, are used in therapeutic cloning to replace diseased cells.

**Checking Concepts**
**Chapter 4**

- The sides of the DNA ladder consist of sugars and phosphates. The steps of the ladder are made of paired A-T, G-C bases.
- Chromatin is the substance that contains DNA and associated proteins.
- A chromosome is a very compact X-shaped strand of chromatin and contains one DNA molecule.

6. The function of the nuclear membrane is to protect the contents of the nucleus.
7. Genes are important to the functioning of a cell because they contain the information to code for proteins that carry out the activities of the cell necessary for the cell's survival.
8. Answers will vary. Accept answers that reflect the following main ideas.
  - (a) The DNA message for a specific protein is copied into a small molecule called ribonucleic acid or RNA.
  - (b) The RNA message is copied from the DNA and delivered to the ribosome.
  - (c) The Golgi body repackages the protein for transport out of the cell.
  - (d) A vesicle forms off the end of the Golgi body to carry the protein to the cell membrane. Or: A vesicle forms off the end of the endoplasmic reticulum and carries the protein to the Golgi body.
  - (e) RNA leaves the nucleus through the nuclear pore.
  - (f) The ribosome is the location where proteins are made in the cell.
  - (g) Proteins that are made for export out of the cell enter the channels of the endoplasmic reticulum.
  - (h) Proteins that are being transported out of the cell leave through the cell membrane.
9. Three factors that could change the cell's genetic information are radiation (X rays, ultraviolet rays), chemicals, and viruses.
10. Three different effects of mutations are that the mutation could have a positive, negative, or neutral effect on the survival of the individual.

### Chapter 5

11. Body cells must be able to reproduce for growth and to replace worn-out cells.
12. (a) Interphase is important for cell reproduction because it prepares the cell for division by duplicating all the organelles as well as the DNA.
  - (b) Mitosis is important for cell reproduction because the nuclear material gets equally divided between the two forming cells.
  - (c) Cytokinesis is important for cell reproduction to separate the two nuclei and cell contents into two separate cells.
13. Cell reproduction is controlled by checkpoint proteins that ensure that the cell is ready to move forward into the next stage of the cell cycle.

14. The nucleolus is always visible in interphase as this is when the cell is busy performing its functions and requires proteins to be made.
15. The sister chromatids move to opposite poles in anaphase.
16. (a) There are no centrioles for the spindle fibres to attach to in plants.
  - (b) In plant cells, a cell plate forms between the two cells. The cell wall and cell membrane are made from there. In animal cells, there is no cell plate and the cell membrane pinches apart.
17. Humans assist plant reproduction through cutting and grafting.
18. The benefits of plant grafting are that growers can reproduce plants that cannot grow roots from cuttings; the stem can be attached to a plant with a strong root system so that it can grow flowers or fruit much quicker than from seeds; and you can also control the size of the plant by grafting stems onto dwarf trees which makes it easier to obtain the fruit.
19. Current uses of reproductive cloning include producing a genetic duplicate of a previously existing organism with desirable qualities. For example, cows that produce a lot of milk are cloned. Reproductive cloning is also used for tissue matches.

### Chapter 6

20. The purpose of meiosis is to create variation among the individuals of a species and to halve the number of chromosomes so that when fertilization occurs, the diploid number for the species will be maintained.
21. (a) While mitosis and meiosis are both methods of reproduction, mitosis is asexual reproduction and meiosis is sexual reproduction. Mitosis produces very little genetic variation, whereas meiosis does create variation. In the process of mitosis, there is one cell division and diploid cells are produced. In meiosis, there are two cell divisions and haploid cells are produced.
  - (b) In meiosis I, homologous pairs of chromosomes move together to the equator and chromosomes separate. In meiosis II, single chromosomes line up at the equator and chromatids separate.
22. Two chromosomes can be identified as a pair of homologous chromosomes by their size and shape. They will have genes in the same location that cannot be identified by a karyotype.

23. Homologous chromosomes separate in anaphase I of meiosis I.
24. (a) The formation of an egg cell is different than the formation of a sperm cell because in a sperm cell there is an equal division of cytoplasm distributed among the four cells. In an egg cell, there is an unequal division of cytoplasm.  
(b) All four sperm cells that result are the same size and available for fertilization. One egg will be larger than the other eggs, and only the large egg is available for fertilization.
25. A gene mutation is a change in the base sequence of a single gene. This could include an insertion, deletion, or substitution. A chromosomal mutation occurs when large pieces of chromosomes (which include many genes) are moved, deleted, or added to other chromosomes. Entire chromosomes can be duplicated in a chromosomal mutation.
26. Down syndrome and Edwards syndrome are caused by chromosomal mutations.
27. (a) Animals aid plant reproduction through pollen transport by carrying the pollen to another plant of the same species so that the egg and sperm can unite for fertilization.  
(b) Animals aid plant reproduction through seed transport by carrying the seeds on their fur or by eating fruit and depositing undigested seeds to a new location.
31. A protein to be transported out of the cell will leave the cell in a vesicle through exocytosis.
32. A male cell will have one chromosome 23 or an X chromosome and a small piece of chromosome which is the Y chromosome. A female will have two copies of chromosome 23 or two X chromosomes.
33. The addition of an extra base in the DNA sequence will change the message because the message is read three bases at a time. This will cause a shift in the message being read so that everything after the insertion will be nonsense.
34. If a mutation occurs in a cell, the cell may no longer be able to perform its function since certain proteins will no longer be made by that cell.
35. (a) It is important that the DNA uncoils during DNA replication so that the steps of the ladder can break apart and form a template for the newly forming strand.  
(b) If there is a mistake in the sequence of bases in the newly formed strand, the gene message will be incorrect and the protein made may be incorrect.
36. Charts will vary, but should include the following information:  
Prophase: The chromosomes become visible and the spindle fibres appear and chromosomes attach.  
Metaphase: The chromosomes pull the X-shaped chromosomes into a single line at the equator.  
Anaphase: The spindle fibres contract and shorten and the chromatids are pulled to opposite poles of the cell.  
Telophase: The spindle fibres disappear and the nuclear membrane forms around each set of chromosomes.
37. (a) It is important that the cell does not divide when there are not enough nutrients because energy is required for cell division and many materials are needed to form new cell membranes and organelles. A lack of nutrients would mean that both the parent and daughter cell will have insufficient nutrients to survive.  
(b) If the DNA has not been replicated and mitosis occurs, each cell would end up with only half of the chromosomal material and the new cells would not be able to function.

### Understanding Key Ideas

28. A cell would not be able to function without a nucleolus because it is in the nucleolus that the ribosomes are made. Ribosomes are necessary for the production of proteins that control the cell's activities.
29. A protein would be made on ribosomes in the cytoplasm if the protein was to be used in the cell. Proteins made on ribosomes on the endoplasmic reticulum are sent to the Golgi body for transport out of the cell.
30. Each protein has a particular function. This function could be to act as a messenger or to help chemical reactions occur. The protein might be a structural protein. A cell in the digestive system may make enzymes to help break down the starch we eat into sugar. The presence of certain proteins in a developing embryo will also help a cell differentiate to become a certain cell type.



- (c) It is important the cell does not divide if the DNA is damaged because this would be a mutation which could be carried to the next generation of cells.
38. (a) ii  
 (b) iv  
 (c) i  
 (d) i  
 (e) iii  
 (f) i  
 (g) ii  
 (h) ii  
 (i) ii
39. (a) Organisms appear to be similar in early stages of development because the same kinds of genes are read to make the same proteins.  
 (b) These early stage genes are no longer read and different proteins are being made in the later fish embryo and human embryo.
40. If cell reproduction is no longer controlled, a cell will continue to divide without going through the checkpoints. Cells could divide without sufficient nutrients or without DNA replication, or the cells would contain damaged DNA. The resulting cells may have abnormally large nuclei since the cells may have more than the diploid number of chromosomes if mitosis did not occur correctly. Cancer cells are cells that have lost the checkpoint controls.
41. Meiosis I produces genetic diversity through crossing over with exchange of genetic material and independent assortment, which sorts the homologous chromosomes into different cells. A huge number of possibilities are possible for just one gamete.
42. A mutation might be beneficial to the individual or may not produce an effect to harm the individual. An example of a beneficial mutation to humans is better night vision. An example of a neutral mutation for humans is a new hair colour.
43. Two differences between reproductive cloning and therapeutic cloning are that reproductive cloning produces an entirely new individual with desirable characteristics whereas therapeutic cloning produces only new cells or tissue with the purpose of correcting health problems.
44. A daughter horse egg or sperm cell will have 32 chromosomes.

45. Organizers may vary. Check for correct associations.
46. (a) In the first trimester, the brain and spinal cord are forming and organs are developing.  
 (b) The second trimester is the period of growth.  
 (c) The third trimester is the period of growth and preparation for birth. Rapid weight gain occurs due to the growth and accumulation of fat.
47. Artificial insemination is a technique to collect sperm and inject the sperm into the female. During in vitro fertilization, the sperm is not injected into the female. The sperm and egg are united in a petri dish.

### Thinking Critically

48. Methods scientists are using to gain further knowledge about the nucleus include different types of microscopy and nanoprobes.
49. DNA is protected from damage inside the nucleus by the nuclear membrane which allows only certain materials to pass in and out through the nuclear pores.
50. Mitosis produces a very small amount of variation through mutations, but meiosis produces variation with each meiotic division through crossing over and independent assortment as well as through mutations.
51. The cell drawn in metaphase I should have the four pairs of homologous chromosomes aligned at the equator. In metaphase II, there should be four single chromosomes at the equator.
52. You cannot identify a gene mutation in a karyotype because a gene mutation in the base sequence cannot be identified by examining chromosomes under the microscope. To identify a gene mutation, you would need to use other methods such as gel electrophoresis (DNA fingerprinting).
53. A mutation in your skin would not be inherited by your children. Only a mutation in your sex cells, the eggs, or sperm can be passed on to the next generation.
54. (a) If the checkpoint protein that checks for DNA replication fails and the DNA does not replicate, the daughter cells will not receive the correct number of chromosomes. If the cell divided, neither daughter cell would have the full DNA message as the DNA would have been divided between the cells.

- (b) The daughter cells would not be able to function properly as the message found on both genes of the homologous pair is necessary for a cell to function.
55. If the DNA is damaged, the cell will not pass the checkpoint proteins and therefore will be prevented from dividing further. No more tumour cells will grow, and the tumour cells that have been damaged with radiation will cease to function. (Mention that the radiation is highly localized so that only tumour cells, not normal cells, will be affected, as radiation of normal cells can cause them to become cancer cells.)
56. (a) A chemical that blocks the replication of DNA will stop cells from dividing further because, if DNA does not replicate, the cell will not proceed by the checkpoints and therefore will not continue through the cell cycle to divide.
- (b) If the spindle fibres are unable to form, the chromosomes will not be able to attach. The cell will not pass the checkpoint and therefore will be unable to proceed through the cell cycle to divide.
57. Answers will vary. Reasons why scientists should change plant genes include providing sufficient food to feed the world population. Someone might argue against changing the plant as you are creating a new species unnaturally and this might have an effect on the environment. For example, if an insect can no longer feed on the plant, it may die, and its predators may die.
58. Mutations introduce new genes that may benefit the organism if the conditions in the environment change. For example, if a virus appears in the population, some individuals might be resistant to the virus and survive to carry the resistance on to the next generation.
59. Gene therapy in theory should work if obstacles can be overcome, and some gene therapy has proven to be successful.
60. Accept all plausible answers. Students should be able to support their ideas. Asexual reproduction would produce large numbers in a planet that had no competition for space, but there does not seem to be much food on the planet. Asexual reproduction would only be possible if the organism is not complex and is without many tissue layers, like a sponge or hydra. Water is necessary for the egg and sperm to unite, but there is little water for sexual reproduction using external fertilization.

There are temperature extremes which would harm the unprotected young. Water is not essential for sexual reproduction with internal fertilization and there is protection of the young. With changes on the planet as it evolves, sexual reproduction which introduces variation would be best so that more organisms would be able to survive and carry the genes to the next generation.

61. The diagrams should be similar to the meiosis diagrams in the text on pages 192 and 193.
- (a) The chromosomes should look similar (may be different colours or patterns).
- (b) Pieces of each chromosome should appear on the other chromosome.
- (c) The chromosomes should be sorted into four cells.
62. In a 48 h period, there would be  $2^{96}$  bacteria =  $7.9288 \times 10^{28}$ .
63. Accept all possible answers. The egg and sperm unite through fertilization to form a zygote. The zygote undergoes mitosis to form an embryo. Tissue layers begin to form, and a fetus develops.

### Pause and Reflect Answer

The main point is that asexual reproduction does not produce much variation, so if conditions change an organism that reproduces solely by this method may be quickly wiped out.

### UNIT 2 BLMS

- BLM 2-1, Unit 2 Summary
- BLM 2-2, Unit 2 Words to Know
- BLM 2-3, Parts of the Cell
- BLM 2-4, Functions of Cell Organelles
- BLM 2-5, Cell Organelles
- BLM 2-6, Modelling DNA
- BLM 2-7, Extracting DNA from Strawberries
- BLM 2-8, Making Predictions about Mutations
- BLM 2-9, Chapter 4 Quiz
- BLM 2-10, From One Cell to Many Cells
- BLM 2-11, Stages of the Cell Cycle
- BLM 2-12, The Cell Cycle
- BLM 2-13, Steps of Mitosis
- BLM 2-14, Cell Growth and Division
- BLM 2-15, The Cell Cycle and Cancer
- BLM 2-16, Factors that Affect Development of Cancer
- BLM 2-17, Observing the Cell Cycle in Plant Cells
- BLM 2-18, Examining Ideas about Cloning

- BLM 2-19, New Plants from Cuttings
- BLM 2-20, New Plants from Roots
- BLM 2-21, New Plants from Stems
- BLM 2-22, New Plants from Grafting
- BLM 2-23, Comparing Reproductive and Therapeutic Cloning
- BLM 2-24, Determining the Best Conditions for Yeast Reproduction
- BLM 2-25, Chapter 5 Quiz
- BLM 2-26, Using DNA to Solve Crimes
- BLM 2-27, How Variation Occurs in Meiosis
- BLM 2-28, Gametes
- BLM 2-29, Key Events in Meiosis
- BLM 2-30, Compare the Events of Meiosis and Mitosis
- BLM 2-31, Compare the Results of Mitosis and Meiosis
- BLM 2-32, Mitosis and Meiosis
- BLM 2-33, Gamete Summary
- BLM 2-34, Several Types of Chromosome Mutations
- BLM 2-35, Modelling How Variation Occurs in Meiosis
- BLM 2-36, Cell Reproduction
- BLM 2-37, Critical Periods of Embryonic and Fetal Development
- BLM 2-38, Chapter 6 Quiz
- BLM 2-39, Unit 2 Test
- BLM 2-40, Making a Decision for Genetown Stakeholder List
- BLM 2-41, Presentation Organizer
- BLM 2-42, Debate Procedures
- BLM 2-43, Unit 2 Review Concept Map
- BLM 2-44, BLM Answers