

Unit 2

Genetic Continuity

Are You Ready? (pages 80–81)

1. 1—cell wall

The cell wall protects and supports plant cells.

- 2—mitochondrion

Mitochondria are the site of cellular respiration, a process that supplies energy to the cell.

- 3—cell membrane

The cell membrane forms the outer boundary of the cell and regulates the movement of materials in and out of the cell.

- 4—nucleus

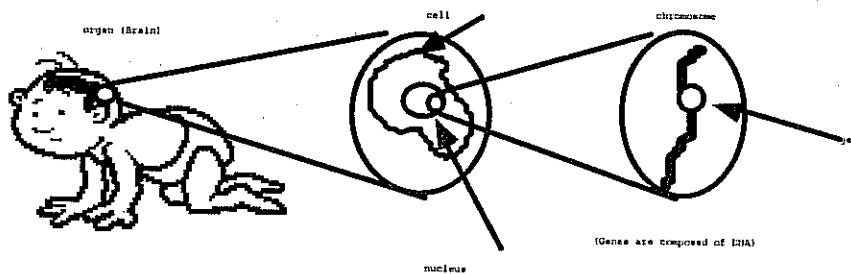
The nucleus is the control centre for the cell.

- 5—chromosome

Chromosomes contain the genetic material of the cell.

2. (a) The correct order is: organism, organ, tissue, cell, nucleus, chromosome, gene, DNA molecule.

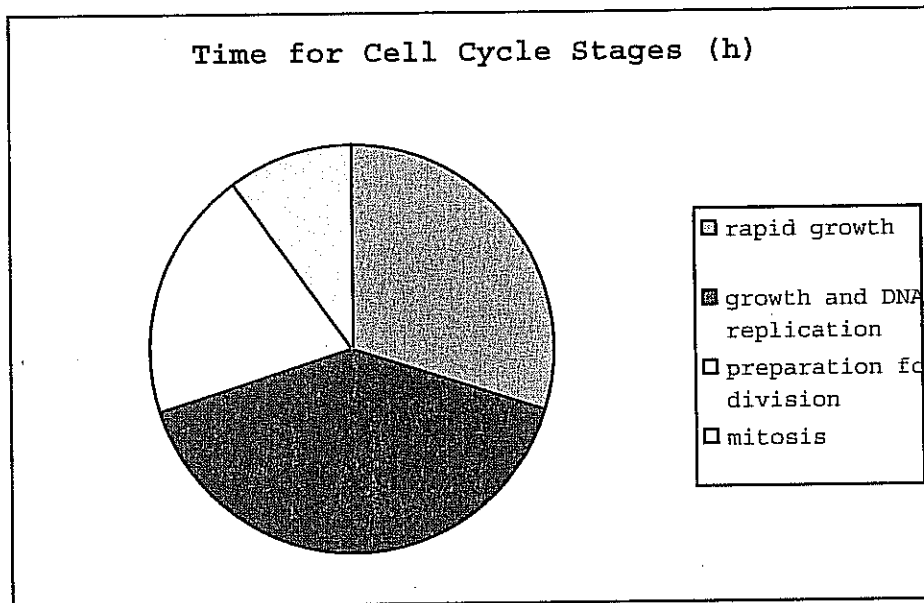
- (b)



- (c)

3. One would expect to find 46 chromosomes a skin cell and a fertilized egg cell (Figures 3 and 6); one would expect to find 23 chromosomes in a sperm cell and an unfertilized egg cell (Figures 4 and 5).
4. (a) Hereditary traits that are determined by genes include: blood type, hair colour and number of digits or limbs.
 (b) Hereditary traits that are influenced by the environment include: weight, hair length and muscle size.
5. (a) Some advantages of reproduction by fission are that it is faster, only one parent is needed, and the offspring are the same as the parent.
 (b) An advantage of reproduction by the union of sex cells is that new traits are possible. Each sex cell will have a different combination of genes. The union of two different sex cells provides variation, which allows for greater adaptability to the environment, and thus, greater survival.
6. Each cell needs the correct amount of DNA to function properly. Both too little and too much DNA interferes with normal cell activities.

7.



8. (a) $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

(b) $\frac{1}{2}$

Chapter 3

Cell Division

Reflect on Your Learning (page 82)

1. Cell specialization brings greater efficiency for individual cell functions.
Multicellular organisms consist of specialized cells that are highly adept at performing their particular tasks.
2. (a) Some advantages of asexual reproduction are that there is no need to find a mate, reproduction is rapid, and the offspring are the same as the parent.
(b) An advantage of sexual reproduction is that it allows for diversity resulting from the combination of genes.
3. (a) 22
(b) 11
(c) 22

Try This Activity (page 83)

- (a) Glycerin was used to slow the movement of the daphnia.
- (b) An ice cube was used to slow the movement of the daphnia.
- (d) Movement and heart rate are slower at lower temperature.
- (e) If a brood pouch is present, it will be seen as a sac filled with small globes.
- (f) Daphnia are multicellular. There are different specialized structures visible.

Try This Activity (page 85)

- (a) The large cube is made of eight small cubes. The total surface area of the large cube would be half the total surface area of eight individual small cubes.
- (b) The smaller cells would have a larger total surface area.
- (c) The ratio of cell surface area to cell volume would be greater for smaller cells than for larger cells.
- (d) These cells need a maximum surface area to quickly allow nutrients to diffuse in and wastes to diffuse out.

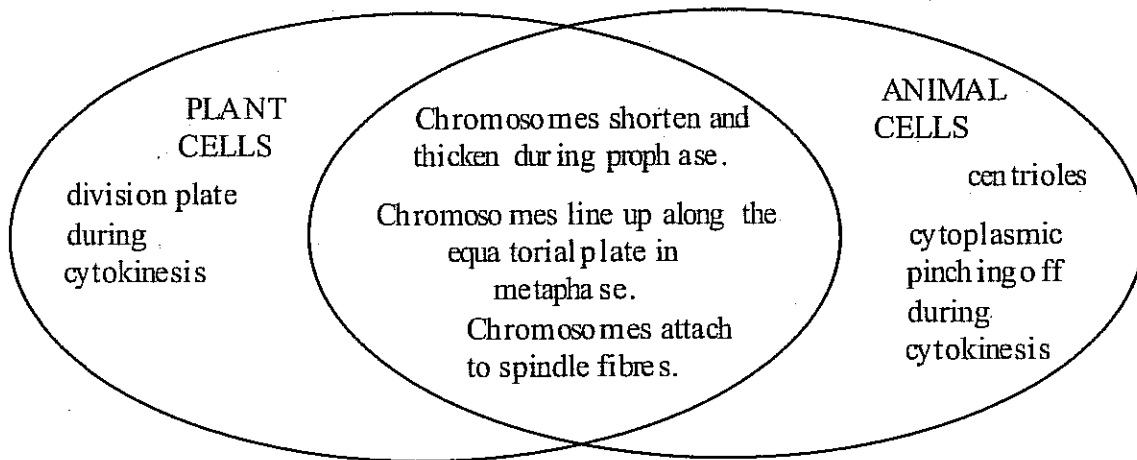
3.2 Practice (page 90)

1. Prophase—chromosomes condense, becoming shorter and thicker; centrioles move to opposite poles of the cell; spindle fibres attach to the centromeres of the chromosomes; the nuclear membrane starts to dissolve.
Metaphase—chromosomes line up at the equatorial plate; the nuclear membrane completely dissolves.
Anaphase—centromeres divide and the resulting chromosomes (formerly chromatids) move to opposite poles of the spindle; an identical set of chromosomes moves to each pole.
Telophase—chromosomes lengthen again; the spindle fibres dissolve; nuclear membrane forms around the chromosomes
2. Each of the daughter cells would contain 10 chromosomes.
3. The genetic material must replicate. The chromosomes must once again become double-stranded.

4. Answers will vary with dictionaries. Some common definitions given are pro: prior to; meta: occurring later than; ana: upward, backward, again; telo: end.
 5. Daughter cells are identical to each other and to the parent cell.
 6. Spindle fibres are microtubules that align and direct chromosomes during cell division.
 7. Cytokinesis produces two distinct and separate cells. If cytokinesis did not occur, mitosis would result in a single cell with two nuclei.
 8. When a cell reaches its maximum size, it can divide or die. Cell division permits the survival of the organism or tissue.
 9. Under both circumstances dead cells could not be replaced and the organism would die. death would result.
 10. Both sister chromatids for one of the chromosomes moved to the same pole. Each sister chromatid duplicated its genetic information and became a separate, double-stranded chromosome.
- (b) One cell would have too much genetic information, the other cell too little. Chemical directions carried in the chromosomes are necessary for the proper functioning of a cell, and thus a cell that had too little genetic information would likely not survive. A cell with too much genetic information would also experience difficulties.

Activity 3.3.1 (pages 91–93)

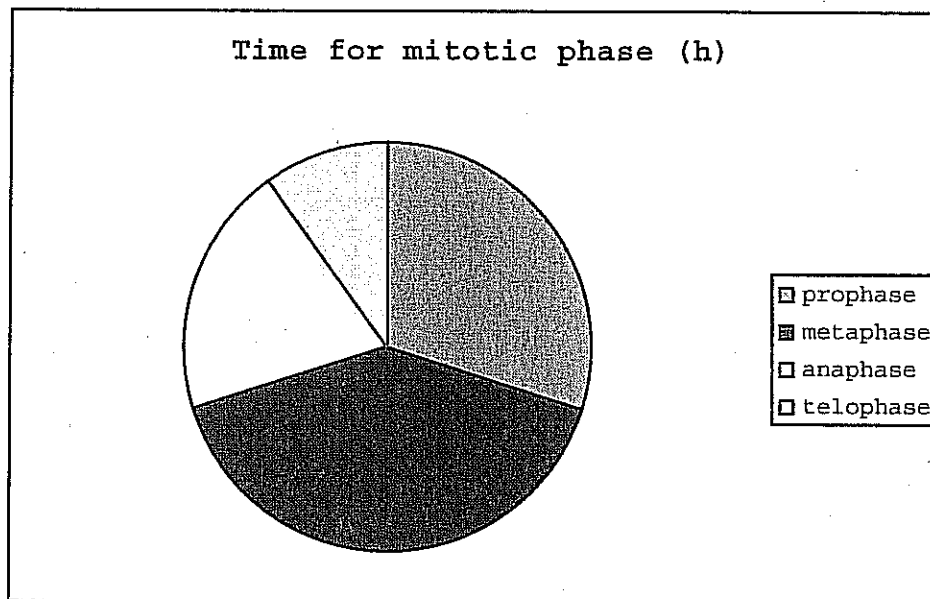
- (a) The cells of the meristematic area are smaller and closer together than the mature root cells.
- (b) These are areas of rapid growth, so there will be many cells undergoing mitosis.
- (c) The tissues were killed to make the microscope slide.
- (d)



- (e) Answers will vary. Expect at least 80% of the cells to be in interphase for plants and an even greater percentage for whitefish embryo cells.
- (f) Answers will vary.
- (g) Answers will vary.
- (h) Answers will vary.
- (i) Answers will vary. Use this formula:

$$\text{Time in each phase} = \frac{\# \text{ of cells in each phase} \times \# \text{ of hours for one cycle}}{\text{total number of cells}}$$

(i)



Sections 3.1–3.3 Questions (page 94)

1. A "cell clock" regulates the number of cell divisions available to cells.
2. Skin cells and cells from the digestive tract are continuously sloughed off and must be replaced. Red blood cells only live 120 days. If they were not replaced, the body would be unable to secure adequate amounts of oxygen to survive. Muscle cells are not easily damaged or sloughed off, so they do not require frequent replacement.
3. (a) The 36 h cell is dividing at a slower rate. A smaller portion of the cell cycle is taken up by cell division.
(b) The 24 h cell cycle represents the cell of an embryo. The cell division phase is longer and the cell cycle is shorter. This means that more cells would be produced more rapidly, which should be true of an embryo.
4. The cells would divide too quickly to specialize into different tissues. Without specialized tissues, plant cells cannot be provided with adequate levels of nutrients to support growth. Eventually the plant dies.
5. No, older people do not have older blood cells. Red blood cells live about 120 days and must be replaced by cell division.
6. A single defect caused by a X-ray may kill a single adult cell. The effect may not even be expressed in that particular cell. Reproductive cells have the blueprint for the embryo. Once reproductive cells combine to form a zygote, they divide many times. This would mean that the genetic defect would be found and expressed in many cells.
7. Immature cells undergo cell division more easily than highly specialized cells, such as nerve cells. By getting nerve cells to divide, scientists could regenerate nerves in the brain and spinal column. This would have great benefits for people who have had brain or spinal cord injuries (paraplegics and quadriplegics).