overhand knot at the AAA end of strand I to join it to its new complementary strand.

12. Replication of strand II begins with the action of DNA polymerase at the replication fork and works outward toward the TTT end. (This is the lagging strand of DNA.) Build the complementary DNA strand for strand II, proceeding from right to left; then tie the two strands together at the TTT end.
13. Now untie the overhand knots that join strands I and II at the 22nd base pair and at the right-hand end of the original double strand.
14. Continue the replication of strand I from left to right until you complete the new complementary strand. Tie another overhand knot to join strand I and its complement at the right-hand end of the molecule.
15. Continue the replication of strand II from the right-hand end to the left. When you reach the 22nd base pair, use another knot to join the two segments of the newly formed strand (the complement of strand II).
16. Tie another overhand knot in the right-hand end of strand II to join it to its new complementary strand.

Analysis

1. Compare the two new double-stranded molecules you have just completed. How are they similar to the original DNA molecule containing strands I and II? How are they different?
2. In your own words, describe a replication fork.
3. Describe the differences in the way strands I and II are replicated.
4. Describe how DNA replication makes it possible to produce two identical cells from one parent.

Investigation 8B ◆ Mitotic Cell Division

To study mitosis, you will examine groups of cells that have been preserved and then stained. Their nuclear structures are visible with the compound microscope. Some of the cells you will see are at very early stages of mitosis, some will be at later stages, and others may be in interphase—a term used for G1, S, and G2, collectively. From slides such as these, biologists have been able to trace the steps a cell goes through during mitotic division. It is very difficult to tell from slides just which stages come first and which come later. Keep this in mind as you try to reconstruct the process for yourself.

Materials (per team of 2)
compound microscope
modeling clay
prepared slide of animal embryo cells (*Ascaris* or whitefish)
prepared slide of onion root-tip cells

Procedure

1. Place the slide of root-tip cells on the microscope stage, and examine it under low power. Scan the entire section. Observe that cells far from the tip and cells right at the tip are not actively dividing. Locate the region of active mitosis between these two regions.
2. Change to the high-power objective. As you observe the cells, focus up and down slowly with the fine-adjustment knob to bring different structures into sharp focus. Find cells at various stages of mitosis. When the slide was prepared, the cells were killed at different stages of a continuous process. The cells can be compared to scrambled single frames of film. Figure out how you would piece the frames of the film together. Refer to Figure 8.11 for help. Make sketches from the slide of cells in interphase, prophase, metaphase, anaphase, and telophase as described in Section 8.6. Identify each by stage.
3. Examine a slide of developing *Ascaris*. Find a cell in which the chromosomes are long and threadlike. Try to count the number of individual chromosomes.
4. Find a cell in which the chromosomes are at the equator of the spindle. Compare the poles of this spindle with those of the spindles in the dividing plant cells you studied in steps 1 and 2.
5. Find a cell in which the chromosomes are separating and the cell is beginning to pinch together in the middle. Compare this method of cytoplasmic division with the method you observed in plants.

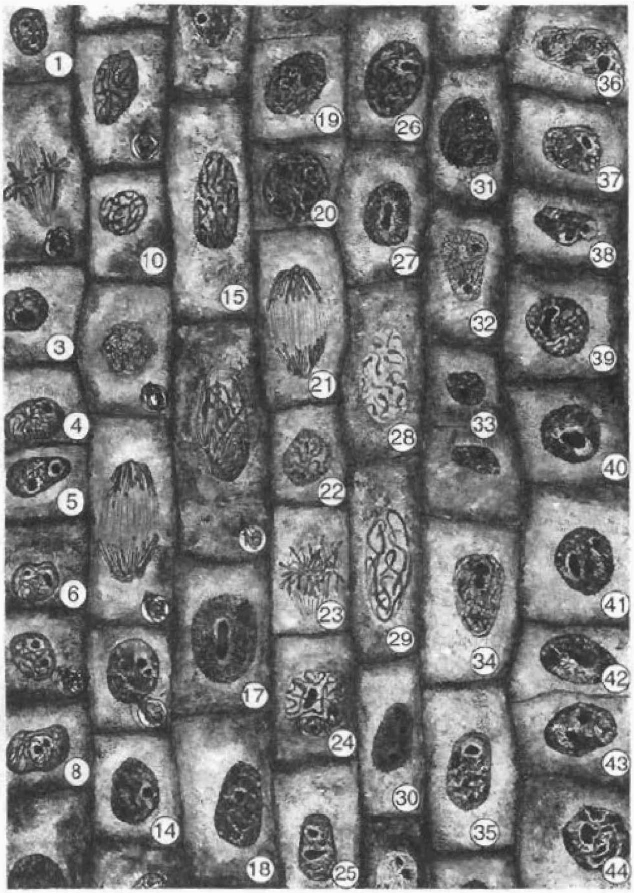

FIGURE 8B.1

Drawing of dividing cells in an onion root as seen through a compound microscope. Arrange cells 2, 7, 9, 11, 12, 13, 16, and 33 in the correct order, demonstrating stages in mitosis.

6. With clay and four large sketches of a plant cell, model each stage of mitosis, from prophase to telophase, for a plant cell with three pairs of chromosomes. Make each pair of chromosomes a different length or color.

Analysis

1. How is the process of mitosis in plant and animal cells similar?
2. How does mitosis in plant and animal cells differ?
3. Refer to Figure 8B.1, and study cells numbered 2, 7, 9, 11, 12, 13, 16, and 33. Rewrite the order of these cells to reflect the sequence of stages you would see if only one cell were undergoing mitosis
4. Compare the number and types of chromosomes in the two new nuclei of the clay model with the number and types from the original parent nucleus.
5. If mitosis occurs in a cell but cell division does not occur, what is the result?

Investigations for Chapter 9

Expressing Genetic Information

Investigation 9A ◆ Transcription

DNA is the molecule in which all of the genetic information for the cell is stored. The information is encoded as a triplet code in which each sequence of three nucleotide bases codes for a specific piece of information. The DNA is contained in the nucleus, but the cellular processes take place in the cytosol. How does the information from the DNA get into the cytosol where it can be used? This investigation will help you understand that process.

Materials (per team of 2)

pop-it beads: 40 black, 40 white, 32 green, 32 red, 20 pink

string

tags

Procedure

PART A DNA Transcription

You will build a double-stranded segment of DNA and a single-stranded segment of messenger RNA (mRNA) using colored pop-it beads and the following color code for the nucleotide bases:

black = adenine (A) white = thymine (T)

green = guanine (G) red = cytosine (C)

pink = uracil (U)

1. Construct DNA strand I, as you did in Investigation 8A, by linking the colored pop-it beads together to represent the following sequence of nucleotide bases:

   A A A G G T C T C C T C T A A T T G G T C T C C T T A G G T C T C C T T
2. Attach a tag labeled roman numeral *I* to the AAA end of strand I.