11. Metaphase chromosomes can be identified by size, shape, banding patterns, or hybridization to fluorescent probes (chromosome painting). Chromosome paint-ing is a technique for visualizing chromosomes using fluoresecent probes. In this method, DNA probes labeled with specific fluorescent tags are hybridized to metaphase chromosomes. After unbound probes are washed off, the chromo-somes are visualized with fluorescence microscopy. Each chromosome then fluoresces with a different combination of fluorescent tags. Then a computer analyzes the tags and assigns a false color image. This way each chromosome can be identified by its false-color image and size.

12. Polytene chromosomes are present in larval salivary glands of the fruit fly *Drosophila melanogaster*, and are also present in cells in other dipteran insects andin plants. These enlarged interphase chromosomes, which can be observed with a light microscope, form as a result of multiple rounds of DNA replication (poly-tenization) without chromosome separation or cell division. Polytene chromo- somes consist of multiple gene copies, which when transcribed provide the cells with an abundance of mRNA encoding proteins required for larval growth and development.

13. Replication origins are the points at which DNA synthesis is initiated. The centromere is the region to which the mitotic spindle attaches. The telomeres arespecialized structures located at the ends of linear chromosomes. (a) The chro- mosome would not be capable of being duplicated during S phase. (b) The chro-mosome could be replicated, but it may not be segregated evenly to the two daughter cells. The centromere is responsible for proper segregation of the duplicated chromosomes; without it the chromosomes will be distributed to the daughter cells by chance.

14. Because DNA polymerase is unable to initiate synthesis of a nucleotide strand, RNA primers must first be introduced to synthesize both leading and lagging strands. Eventually, the RNA region is degraded and DNA polymerase fills in the missing nucleotides. In the case of the lagging strand, DNA polymerase willfill in this gap using an upstream Okazaki fragment. At the very ends of the chromosome, there is no upstream Okazaki fragment, and thus it is not possibleto replace the RNA nucleotides with DNA. Thus the chromosome shortens aftereach round of replication, this being known as the end replication problem. While telomeres do not halt this problem, they ensure that the lost DNA is non-coding DNA. Rather than lose protein or RNA encoding DNA, the genome instead loses non-coding telomere DNA.