

CHAPTER 9

HOW GENES AND GENOMES EVOLVE

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Generating Genetic Variation

- 9-1** Which of the following statements is *false*?
- (a) A mutation that arises in a mother's somatic cell often causes a disease in her daughter.
 - (b) All mutations in an asexually reproducing single-celled organism are passed on to progeny.
 - (c) In an evolutionary sense, somatic cells exist only to help propagate germ-line cells.
 - (d) A mutation is passed on to offspring only if it is present in the germ line.
- 9-2** Your friend works in a lab that is studying why a particular mutant strain of *Drosophila* grows an eye on its wing. Your friend discovers that this mutant strain of *Drosophila* is expressing a transcription factor incorrectly. In the mutant *Drosophila*, this transcription factor, which is normally expressed in the primordial eye tissue, is now misexpressed in the wing primordial wing tissue, thus turning on transcription of the set of genes required to produce an eye in the wing primordial tissue. If this hypothesis is true, which of the following types of genetic change would most likely lead to this situation?
- (a) a mutation within the transcription factor gene that leads to a premature stop codon after the third amino acid
 - (b) a mutation within the transcription factor gene that leads to a substitution of a positively charged amino acid for a negatively charged amino acid
 - (c) a mutation within an upstream enhancer of the gene
 - (d) a mutation in the TATA box of the gene
- 9-3** Match the type of phenotypic change below with the type of genetic change most likely to cause it. Each type of genetic change may be used more than once, or may not be used at all.

Phenotypic changes:

1. A protein normally localized in the nucleus is now localized in the cytoplasm. _____
2. A protein acquires a DNA binding domain. _____
3. Tandem copies of a gene are found in the genome. _____
4. A copy of a bacterial gene is now found integrated on a human chromosome. _____
5. A protein becomes much more unstable. _____

6. A protein normally expressed only in the liver is now expressed in blood cells. _____

Types of genetic change:

- A. mutation within a gene
- B. gene duplication
- C. mutation in a regulatory region
- D. exon shuffling
- E. horizontal gene transfer

- 9-4 For each of the following sentences, fill in the blanks with the best word or phrase in the list below. Not all words or phrases will be used; use each word or phrase only once.

Sexual reproduction in a multicellular organism involves specialized reproductive cells, called _____s, which come together to form a _____ that will divide to produce both reproductive and _____ cells. A point mutation in the DNA is considered a _____ mutation if it changes a nucleotide that leads to no phenotypic consequence; a point mutation is considered _____ if it changes a nucleotide within a gene and causes the protein to be non-functional.

common	somatic
gamete	neutral
homologous	intron
deleterious	cellulose
unequal	zygote

- 9-5 Transposable elements litter the genomes of primates, and a few of them are still capable of moving to new regions of the genome. If a transposable element jumped into an important gene in one of your cells when you were a baby and caused a disease, is it likely that your child would also have the disease? Explain.
- 9-6 What is the most likely explanation of why the overall mutation rates in bacteria and in humans are roughly similar?
- (a) Cell division needs to be fast.
 - (b) Most mutations are silent.
 - (c) There is a narrow range of mutation rates that offers an optimal balance between keeping the genome stable and generating sufficient diversity in a population.
 - (d) It benefits a multicellular organism to have some variability among its cells.
- 9-7 For each statement below, indicate whether it is true or false and explain why.

- A. To meet a challenge or develop a new function, evolution essentially builds from first principles, designing from scratch, to find the best possible solution.
- B. Nearly every instance of DNA duplication leads to a new functional gene.
- C. A pseudogene is very similar to a functional gene but cannot be expressed because of mutations.
- D. Most genes in vertebrates are unique, and only a few genes are members of multigene families.
- E. Horizontal transfer is very rare and thus has had little influence on the genomes of bacteria.

9-8 Two individuals are represented in each choice in Figure Q9-8; individual 1 is one of the parents of individual 2. The asterisk seen in each choice indicates the occurrence of a single mutation during the cell division. Which of the choices in Figure Q9-8 will lead to a mutation in every cell of the individual in which the original mutation occurred?

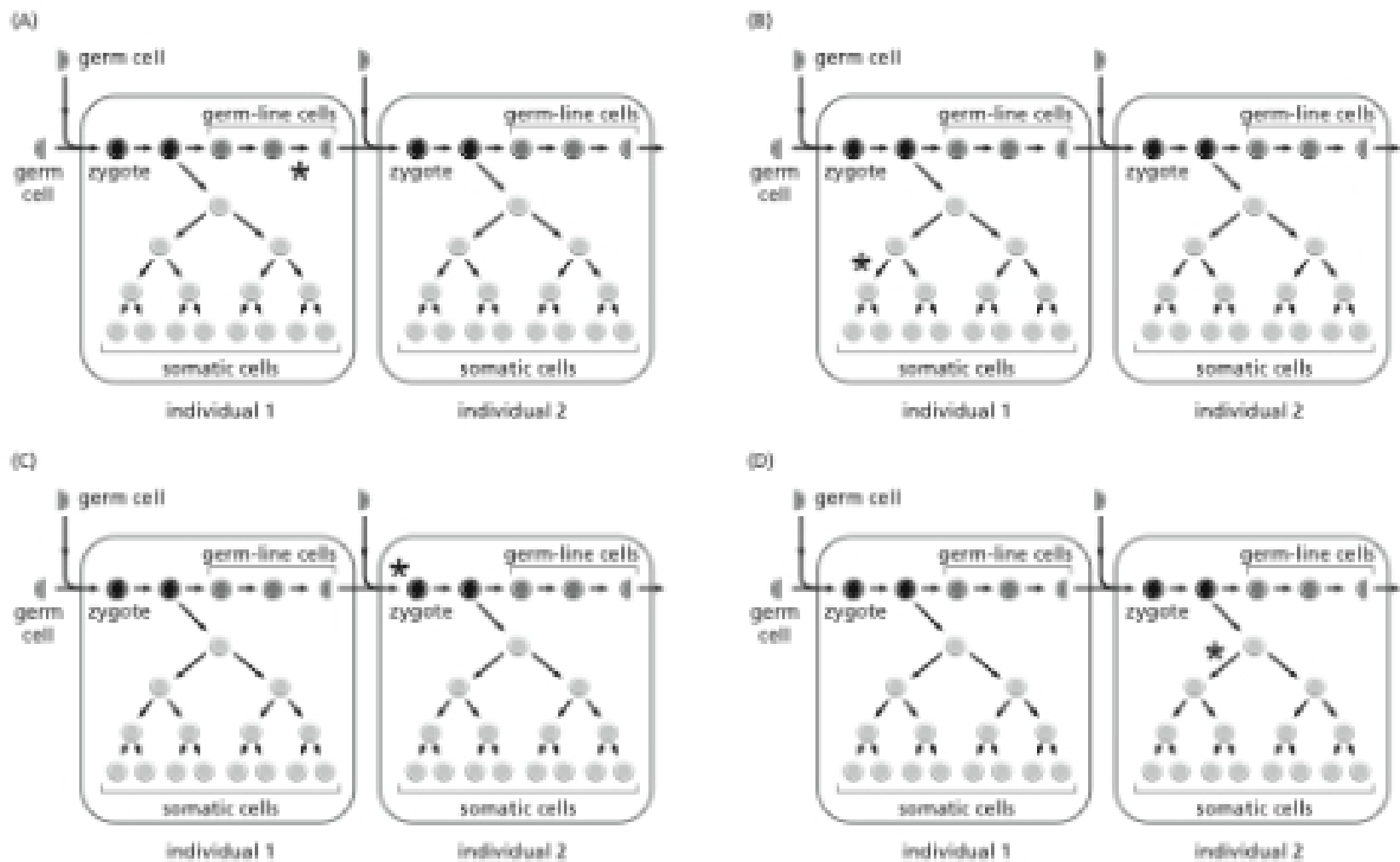


Figure Q9-8

9-9 Two individuals are represented in Figure Q9-9; individual 1 is one of the parents of individual 2. The asterisk indicates the occurrence of a single mutation.

