E1. Polytene chromosomes can be viewed in greater detail under the microscope because they are much larger. This makes it much easier to detect very small changes in chromosome structure. They are produced from the sequential replication and alignment of chromosomes. As an example, suppose a toothpick has fine lines written on it. You would probably have trouble seeing the lines. However, if you took 1,000 toothpicks with the same lines and stacked them up in a parallel manner, the lines would be much easier to see. Similarly, small changes in chromosome structure are hard to see in a single chromosome but much easier to detect in a polytene chromosome.

E2. Colchicine interferes with the spindle apparatus and thereby causes nondisjunction. At high concentrations, it can cause complete nondisjunction and produce polyploid cells.

E3. You could begin with a normal diploid strain and first use anther culture. This would create a monoploid plant. This monoploid plant could then be treated on two successive occasions with colchicine to first produce a diploid plant and then a tetraploid plant. Since this tetraploid plant would be derived from a monoploid plant, it would be homozygous for all of its genes.

E4. The primary purpose is to generate strains that are homozygous for all of their genes. Since the pollen is haploid, it has only one copy of each gene. The strain can later be made diploid (and homozygous) by treatment with colchicine.

E5. Cell fusion techniques can be used to create hybrids between strains or different species that cannot readily interbreed. Any two types of cells can be made to fuse in the laboratory, even interspecies hybrids that could never interbreed naturally. In addition, the fusion of diploid cells instantly creates allotetraploids that are usually fertile.

E6. First, you would cross the two strains together. It is difficult to predict the phenotype of the offspring. Nevertheless, you would keep crossing offspring to each other and backcrossing them to the parental strains until you obtained a great-tasting tomato strain that was resistant to heat and the viral pathogen. You could then make this strain tetraploid by treatment with colchicine. If you crossed the tetraploid strain with your great-tasting diploid strain that was resistant to heat and the viral pathogen, you may get a triploid that had these characteristics. This triploid would probably be seedless.

E7. A G band is a dark band on a chromosome that has been stained with Giemsa. The pattern of G bands on chromosomes can be used to identify chromosomes, particularly ones of similar sizes. They also make it easier to detect changes in chromosome structure.

E8. A polytene chromosome is formed when a chromosome replicates many times, and the chromatids lie side by side as shown in Figure 8.21. The homologous chromosomes also lie side by side. Therefore, if there is a deletion, there will be a loop. The loop is the segment that is not deleted from one of the two homologues.

E9. The starting strain has three copies of the *bar* gene on both X chromosomes. An unequal crossover could produce chromosomes with one, two, four, or five copies, assuming that the X chromosomes are aligned over (at least) one *bar* gene. If mated to a male with three copies of the *bar* gene, the following combinations are possible:

X chromosome-1 *bar* copy + X chromosome-3 *bar* copies: *ultra-bar* heterozygote (45 facets)
X chromosome-2 *bar* copies + X chromosome-3 *bar* copies:
this fly would probably have fewer facets than the *ultra-bar* heterozygote but more facets than the *ultra-bar* homozygote, which would be somewhere between 45 and 25
X chromosome-4 *bar* copies + X chromosome-3 *bar* copies: fewer facets than the *ultra-bar* homozygote (less than 25)
X chromosome-5 *bar* copies + X chromosome-3 *bar* copies: fewer facets than the previous fly (much less than 25)

E10. The order, from most intense to least intense:

1 X chromosome-*bar*, 1 X chromosome-*ultra-bar*
1 X chromosome-*normal* and 1 X chromosome-*ultra-bar*
2 X chromosomes-*bar*
1 X chromosome-*normal* and 1 X chromosome-*bar*

It is interesting to note that the second and third genotypes of flies both have four copies of the gene. However, the fly having three copies on 1 X chromosome (1 X chromosome-*ultra-bar* and one copy on the other X chromosome) would produce more mRNA because of the position effect. That is why it has fewer facets (45) compared to a *bar* homozygote, which has 70 facets.

E11. You could cross the two species together to first create an allodiploid. The allodiploid could be treated with colchicine to make a segment of the plant an allotetraploid. As described in Figure 8.30, a cutting of the allotetraploid segment of the plant could be rooted to create a new allotetraploid plant. Alternatively, one could use cell fusion techniques as described in Figure 8.31. When you fuse two diploid cells together from two different species, you immediately create an allotetraploid.

E12. Since the plant giving the pollen is heterozygous for many genes, some of the pollen grains may be haploid for recessive alleles, which are nonbeneficial or even lethal. However, some pollen grains may inherit only the dominant (beneficial) alleles and grow quite well.