

- E1. A. G₂ phase (it could not complete prophase)
 B. Metaphase (it could not enter anaphase)
 C. Telophase (it could not divide into two daughter cells)
 D. G₂ phase (it could not enter prophase)
- E2. Perhaps the most convincing observation was that all of the white-eyed flies of the F₂ generation were males; not a single white-eyed female was observed. This suggests a link between sex determination and the inheritance of this trait. Since sex determination in fruit flies is determined by the number of X chromosomes, this suggests a relationship between the inheritance of the X chromosome and the inheritance of this trait.
- E3. Actually, his data are consistent with this hypothesis. To rule out a Y-linked allele, he could have crossed an F₁ female with a wild-type male rather than an F₁ male. The same results would be obtained. Since the wild-type male would not have a white allele, this would rule out Y-linkage.
- E4. The basic strategy is to set up a pair of reciprocal crosses. The phenotype of sons is usually the easiest way to discern the two patterns. If it is Y linked, the trait will only be passed from father to son. If it is X linked, the trait will be passed from mother to son.
- E5. To be a white-eyed female, a fly must inherit two X chromosomes and both must carry the white-eye allele. This could occur only if both X chromosomes in the female stayed together and the male gamete contained a Y chromosome. The white-eyed females would be XXY. To produce a red-eyed male, a female gamete lacking any sex chromosomes could unite with a normal male gamete carrying the X^{W+}. This would produce an X0, red-eyed male.
- E6. The 3:1 sex ratio occurs because the female produces 50% gametes that are XX (and must produce female offspring) and 50% that are X (and produce half male and half female offspring). The original female had one X chromosome carrying the red allele and two other X chromosomes carrying the eosin allele. Set up a Punnett square assuming that this female produces the following six types of gametes: X^{W+}X^{W-e}, X^{W+}X^{W-e}, X^{W-e}X^{W-e}, X^{W+}, X^{W-e}, X^{W-e}. The male of this cross is X^WY.

		Male gametes	
		♂ X ^W	Y
♀	X ^{W+} X ^{W-e}	X ^{W+} X ^{W-e} X ^W Red, female	X ^{W+} X ^{W-e} Y Red, female
	X ^{W+} X ^{W-e}	X ^{W+} X ^{W-e} X ^W Red, female	X ^{W+} X ^{W-e} Y Red, female
	X ^{W-e} X ^{W-e}	X ^{W-e} X ^{W-e} X ^W Eosin female	X ^{W-e} X ^{W-e} Y Eosin female
	X ^{W+}	X ^{W+} X ^W Red, female	X ^{W+} Y Red, male
	X ^{W-e}	X ^{W-e} X ^W Light-eosin female	X ^{W-e} Y Light-eosin male
	X ^{W-e}	X ^{W-e} X ^W Light-eosin female	X ^{W-e} Y Light-eosin male

- E7. During interphase, the chromosomes are longer, thinner, and much harder to see. In metaphase, they are highly condensed, which makes them thicker and shorter.
- E8. If we use the data from the F_1 mating (i.e., F_2 results), there were 3,470 red-eyed flies. We would expect a 3:1 ratio between red- and white-eyed flies. Therefore, assuming that all red-eyed offspring survived, there should have been about 1,157 (i.e., $3,470/3$) white-eyed flies. However, there were only 782. If we divide 782 by 1,157, we get a value of 0.676, or 67.6% have survived.
- E9. In general, you cannot distinguish between autosomal and pseudoautosomal inheritance from a pedigree analysis. Mothers and fathers have an equal probability of passing the alleles to sons and daughters. However, if an offspring had a chromosomal abnormality, you might be able to tell. For example, in a family tree involving the *Mic2* allele, an offspring that was X0 would have less of the gene product and an offspring that was XXX or XYY or XXY would have extra amounts of the gene products. This may lead you to suspect that the gene is located on the sex chromosomes.
- E10. You could karyotype other members of the family and see if affected members always carry the abnormal chromosome.
- E11. You need to make crosses to understand the pattern of inheritance of traits (determined by genes) from parents to offspring. And you need to microscopically examine cells to understand the pattern of transmission of chromosomes. The correlation between the pattern of transmission of chromosomes during meiosis, and Mendel's laws of segregation and independent assortment, is what led to the chromosome theory of inheritance.
- E12. These rare female flies would be XXY. Both X chromosomes would carry the white allele and the miniature allele. These female flies would have miniature wings because they would have inherited both X chromosomes from their mother.
- E13. Originally, individuals who had abnormalities in their composition of sex chromosomes provided important information. In mammals, X0 individuals are females, while in flies, X0 individuals are males. In mammals, XXY individuals are males, while in flies, XXY individuals are females. These results indicate that the presence of the Y chromosome causes maleness in mammals, but it does not in flies. A further analysis of flies with abnormalities in the number of sets of autosomes revealed that it is the ratio between the number of X chromosomes and the number of sets of autosomes that determines sex.
- E14. In X-linked recessive inheritance, it is much more common for males to be affected. In autosomal recessive inheritance, there is an equal chance of males and females being affected (unless there is a sex influence as described in Chapter 4). For X-linked dominant inheritance, affected males would produce 100% affected daughters and not transmit the trait to their sons. This would not be true for autosomal dominant traits, where there is an equal chance of males and females being affected.