

A White-eyed Female Fruit Fly XWXW Is Crossed With A Red-eyed Male XWTY. Select All Of The Viable Offspring

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When studying genetics, especially in model organisms like fruit flies (*Drosophila melanogaster*), understanding inheritance patterns of traits such as eye color provides valuable insights into Mendelian genetics. In this article, we examine a specific cross: a white-eyed female fruit fly with the genotype XWXW is crossed with a red-eyed male with the genotype XWTY. We will analyze the possible offspring, focusing on which are viable, and explore the genetic principles underlying their inheritance.

Understanding the Parent Genotypes and Phenotypes

The Female Parent: White-eyed Fruit Fly (XWXW)

- Genotype: XWXW
- Phenotype: White eyes
- Inheritance Pattern: Since the female is homozygous recessive (XW), she exhibits the white-eye trait.
- Sex Chromosomes: XX

The Male Parent: Red-eyed Fruit Fly (XWTY)

- Genotype: XWTY
- Phenotype: Red eyes
- Inheritance Pattern: Male is hemizygous for the X chromosome, carrying the dominant allele (XW) for red eyes.
- Sex Chromosomes: XY

Note: The alleles for eye color are located on the X chromosome, with white (XW) being recessive and red (XW) being dominant.

Predicting Offspring Genotypes and Phenotypes

To determine the viable offspring, we analyze the possible combinations of alleles from each parent during gamete formation.

Gamete Formation in Parents

- Female (XWYW):
- Gametes: all carry the XW allele

- Male (XWYY):
- Gametes: 50% carry XW, 50% carry Y

Fertilization and Offspring Genotypes

Using a Punnett square, the combinations are:

	XW (female)		XW (female)	
	-----		-----	
	XW (male)		XWYW XWYW	
	Y (male)		XWY XWY	

Resulting Genotypes and Phenotypes:

- XWYW: Female, white-eyed (since homozygous recessive)
- XWY: Male, red-eyed (since Y chromosome does not influence eye color)

Summary of Viable Offspring:

	Offspring Type		Count		Phenotype		Notes	
	-----		-----		-----		-----	
	Female		2		White-eyed		Homozygous recessive for eye color	
	Male		2		Red-eyed		Hemizygous for the dominant allele	

All these offspring are viable, as they do not possess any lethal genotypes.

Genetic Principles Behind the Cross

Inheritance of Eye Color in Drosophila

- Eye color is X-linked, with white (XW) being recessive and red (XW) being dominant.
- Males have only one X chromosome; thus, a single white allele results in white eyes.
- Females require two copies of the white allele to exhibit white eyes.

Implications of the Cross

- Crossing a homozygous white-eyed female with a heterozygous or dominant red-eyed male

demonstrates classic Mendelian inheritance patterns.

- The progeny show a predictable ratio of phenotypes: 1 white-eyed female, 1 red-eyed male, and their respective genotypes.

Summary of All Viable Offspring in the Cross

Based on the genetic analysis, the viable offspring from the cross between a white-eyed female (XWXW) and a red-eyed male (XWTY) are:

- Female Offspring:
- Genotype: XWXW
- Phenotype: White eyes
- Number: 2 (from the Punnett square)

- Male Offspring:
- Genotype: XWY
- Phenotype: Red eyes
- Number: 2

In total, the cross produces four viable offspring: two females with white eyes and two males with red eyes.

Conclusion

This classic cross highlights Mendel's laws of inheritance, demonstrating how sex-linked traits such as eye color in *Drosophila* are inherited. All four offspring are viable, with the phenotypic ratios aligning with expectations based on dominant and recessive alleles on the X chromosome. Understanding these inheritance patterns is fundamental to genetics and provides a basis for more complex genetic analyses.

Keywords: fruit fly genetics, *Drosophila* eye color inheritance, X-linked traits, white-eyed fruit fly, red-eyed fruit fly, Mendelian genetics, viable offspring, sex-linked inheritance

Frequently Asked Questions

What are the genotypes of the parent fruit flies in the cross?

The female has the genotype XWXW (white-eyed) and the male has the genotype XWTY (red-eyed).

What is the inheritance pattern for eye color in this fruit fly

cross?

Eye color is sex-linked, with the white-eye allele (W) being recessive and located on the X chromosome, while the red-eye allele (T) is dominant.

Which offspring are viable in this cross?

All female offspring with genotypes XWXW or XWTXW and all male offspring with genotypes XWTY are viable, as they do not carry two recessive alleles for white eyes.

What are the expected genotypes of female offspring?

Female offspring could be XWXW (white-eyed) or XWTXW (red-eyed).

What are the expected genotypes of male offspring?

Male offspring could be XWTY (red-eyed) or, if they inherit the white-eyed allele from the female, XWY, which is typically inviable due to the lack of a second X chromosome.

Are all the offspring from this cross viable?

Yes, all female offspring with genotypes XWXW or XWTXW and male offspring with XWTY are viable; males with XWY are typically inviable.

What is the expected phenotypic ratio of the viable offspring?

The viable offspring phenotypic ratio is approximately 1:1 for females (white-eyed to red-eyed) and 1:1 for males (red-eyed to inviable white-eyed males), with most viable male offspring being red-eyed.

Why are some male offspring inviable in this cross?

Male offspring inheriting the white-eye allele (W) on the X chromosome are inviable because they lack a second X chromosome to compensate, leading to lethality.

What is the significance of this cross in understanding sex-linked traits?

This cross illustrates how sex-linked recessive traits like white-eye are inherited and how they affect male and female offspring differently.

How can this cross be used to determine the inheritance pattern of eye color in fruit flies?

By analyzing the phenotypes and viability of offspring, researchers can confirm that eye color is sex-linked and recessive, as white-eyed females are crossed with red-eyed males, revealing inheritance patterns.

Additional Resources

Genetics of Drosophila Eye Color Crosses: An In-Depth Analysis of A White-eyed Female XW^XW Crossed With A Red-eyed Male XW^TY

Understanding the inheritance patterns of traits in *Drosophila melanogaster* (fruit flies) provides foundational insights into classical genetics. The specific cross of a white-eyed female (XW^XW) with a red-eyed male (XW^TY) offers an excellent case study to explore sex-linked inheritance, dominance, and the resulting phenotypic and genotypic ratios among offspring. This review delves into the genetic principles underpinning this cross, the expected outcomes, and the identification of viable offspring, providing a comprehensive understanding suitable for students, educators, and genetic enthusiasts.

Background on Drosophila Eye Color Genetics

Drosophila eye color is a classic genetic trait widely studied since the early days of genetics. The gene responsible for eye color in *Drosophila* is located on the sex chromosome (X chromosome). The two main alleles are:

- Red eye (dominant): X^W (or X^{WT} in some notations)
- White eye (recessive): X^w (or X^wW)

In this discussion, we use the notation:

- X^W for the dominant red-eye allele
- X^w for the recessive white-eye allele

Note: The white-eye mutation is recessive and sex-linked, meaning males and females inherit and express traits differently.

Genotypes and Phenotypes of Parent Flies

The parental genotypes are:

- Female: White-eyed, homozygous recessive — X^wX^w
- Male: Red-eyed, heterozygous or homozygous dominant

However, in this specific cross, the male is described as XW^TY—which indicates a red-eyed male with a potentially dominant allele on his X chromosome. Since the notation suggests he carries a "W" (wild-type, red-eyed) allele, and "Y" chromosome, his genotype is:

- Male: XW^TY

The female is:

- Female: XW~~X~~W

The key points here:

- The female is homozygous recessive for white eyes (XwXw).
- The male is hemizygous for the red-eye allele (XW) and Y.

Inheritance Patterns in This Cross

Because the eye color gene is sex-linked, typically on the X chromosome:

- Females have two X chromosomes, so their phenotype depends on the combination of X alleles.
- Males have only one X chromosome, so their phenotype directly reflects the allele on their single X.

Important considerations:

- White-eyed females (XwXw): Always express white eye because they are homozygous recessive.
- Red-eyed males (XWY): Express red eyes because they carry the dominant allele on their single X.

Crossing the Genotypes: Female (XwXw) × Male (XWY)

Let's analyze the possible gametes:

- Female (XwXw): Produces Xw eggs only.
- Male (XWY): Produces XW sperm and Y sperm.

Punnett Square for the Cross:

	XW (male sperm)	Y (male sperm)
Xw (female egg)	XwXW	XwY

Offspring Genotypes and Phenotypes

Based on the Punnett square, the potential offspring are:

Genotype	Description	Phenotype	Number of offspring	Percentage
XwXW	Female, heterozygous	Red eyes (dominant)	1	25%
XwY	Male, hemizygous white-eyed	White eyes	1	25%

Summary of viable offspring:

- All females are XwXW (heterozygous), with red eyes.
- All males are XwY, with white eyes.

What Are the Viable Offspring?

Given the above, the viable offspring are:

- Red-eyed females (XwXW)
- White-eyed males (XwY)

Note: In *Drosophila*, both male and female offspring are viable, but the phenotypic expression depends on sex and genotype.

Implications for Phenotypic Ratios

The cross yields:

- 50% red-eyed females (XwXW)
- 50% white-eyed males (XwY)

Expressed as a ratio:

1 female (red-eyed) : 1 male (white-eyed)

This is consistent with classical sex-linked inheritance ratios in such crosses.

Analyzing All Viable Offspring and Their Characteristics

Since the question specifies "Select All Of The Viable Offspring," the focus is on the phenotypic and genotypic combinations that can survive and reproduce.

1. Red-eyed female offspring (X^wX^W):

- Genotype: X^wX^W
- Phenotype: Red eyes
- Viability: Fully viable
- Reproductive potential: Capable of reproducing, passing X^W or X^w alleles to offspring

2. White-eyed male offspring (X^wY):

- Genotype: X^wY
- Phenotype: White eyes
- Viability: Fully viable
- Reproductive potential: Capable of reproducing, passing X^w allele

Additional Considerations: Potential for Other Offspring or Mutations

In this specific cross, assuming standard Mendelian inheritance without mutations or additional genetic factors:

- No other offspring types are expected, as white-eyed females (X^wX^w) cannot produce red-eyed females unless crossed with a male that carries a dominant W allele.
- The Y chromosome does not carry the eye color gene, so no Y -linked influence on eye color exists beyond sex determination.

However, if a different parental genotype was involved, or if mutations occurred, other combinations might be possible, but within the scope of this cross, these are the only viable offspring.

Summary and Key Takeaways

- Inheritance Pattern: The eye color trait in *Drosophila* is sex-linked, with the white-eye allele being recessive.
- Parental Genotypes:
 - Female: X^wX^w (white-eyed)
 - Male: X^WY (red-eyed)
- Offspring Genotypes and Phenotypes:
 - Females: X^wX^W , red-eyed
 - Males: X^wY , white-eyed
- Ratios: 1 female (red-eyed) : 1 male (white-eyed)
- Viable Offspring: All offspring are viable; no lethality is associated with these genotypes.

Concluding Remarks

This cross exemplifies classic sex-linked inheritance, illustrating how a recessive trait (white eye) manifests predominantly in males due to their hemizygous state, while heterozygous females display the dominant phenotype (red eye). The predictable ratios and phenotypes reinforce fundamental principles of genetics.

Understanding these inheritance patterns in *Drosophila* not only sheds light on sex-linked traits but also provides a model for studying inheritance of sex chromosomes, allelic interactions, and genetic ratios. Such foundational knowledge extends beyond fruit flies, informing broader biological and medical genetics.

In summary, the viable offspring from a cross between a white-eyed female (X^wX^w) and a red-eyed male (X^WY) are:

- Red-eyed females (X^wX^W)
- White-eyed males (X^wY)

Both groups are viable and follow expected Mendelian ratios, making this a textbook example of sex-linked inheritance in action.

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