# Name \_\_\_\_

**Use a Punnett Square to answer each question.**

1. Yellow guinea pigs crossed with white ones always produce cream colored offspring. What type of inheritance pattern is this and what are the genotype and phenotype ratios of the offspring?

2. In radishes, the shape may be long, round or oval. Crosses between long and oval yielded 159 long and 156 oval offspring. Crosses between round and oval yielded 199 round and 203 oval. Crosses between oval and oval yielded 121 long, 243 oval and 119 round. What type of inheritance pattern is this and what are the genotype and phenotype ratios of the offspring?

3. Roan is a rust color due to the intermediate effect of the expression of a gene for white and a gene for red in short-horned cattle. If a breeder has white cows and a bull that is roan, what proportion of the calves would be expected to be white, red or roan? What type of inheritance is this?

4. In Drosophila, vestigial wings and ebony body color are due to two separate recessive genes. The dominant alleles are normal (*long*) wings and normal (*gray*) body color. What type of offspring would you expect from a cross between a homozygous vestigial ebony female and a homozygous normal male (*long-winged, gray-bodied*)? If the F1 are allowed to breed among themselves, what type of offspring would you expect in the F2? Show genotypes and phenotypes of both generations. What type of inheritance is this?

5. How sex is inherited in Drosophila and in man?

6. In a certain family there are six girls. What are the chances of the next child being a boy?

7. A cross between two fruit flies 224 offspring were counted. How many females would probably be noted?

8. Red-green color blindness is inherited as a sex-linked recessive trait. If a color-blind woman marries a man who has normal vision, what would be the expected phenotypes of their children with reference to this character.

9. A man and his wife both have normal color vision, but a daughter has red-green color blindness, a sex-linked recessive trait. The man sues his wife for divorce on ground of infidelity. Can genetics provide evidence supporting the man’s case?

10. Suppose a father of blood type A and a mother of blood type B have a child of group O. What groups are possible in their other children?

11. If a father of blood type B and a mother of blood type O have a child of blood type O, what are their chances of having the next child with blood type O? B? A? AB?

12. A father and a mother claim that they have been given the wrong baby at the hospital. Both parents are blood type A. The baby they have been given is blood type O. Prove the case true or false.

13. John Doe has blood type O. A woman has blood type A and HER child has blood type B. In a court case to determine who the child’s father was, John Doe was found guilty – he’s the father. Do you agree with the court’s decision? Show why or why not with a Punnett Square.

14. Queen Victoria and husband, Albert, had a great-grand child with hemophilia. Both had normal blood phenotypes. None of the daughters married hemophiliacs. How is this possible?

# Answers

**Use a Punnett Square to answer each question.**

1. Yellow guinea pigs crossed with white ones always produce cream colored offspring. What type of inheritance pattern is this and what are the genotype and phenotype ratios of the offspring?

Genotype of parents: Yy x Yy

Incomplete / Co-Dominance F1 generation

Genotype & Phenotype

YY yellow Yy cream yy white

1:2:1

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | *Y* | *y* |
| *Y* | YY | Yy |
| *y* | Yy | yy |

2. In radishes, the shape may be long, round or oval. Crosses between long and oval yielded 159 long and 156 oval offspring. Crosses between round and oval yielded 199 round and 203 oval. Crosses between oval and oval yielded 121 long, 243 oval and 119 round. What type of inheritance pattern is this and what are the genotype and phenotype ratios of the offspring?

Genotype of parents: LL long x RL oval

Punnett Square (genotype F1 generation)

Incomplete / Co-Dominance F1 generation

Genotype & Phenotype

50% LL long 50% RL oval

|  |  |  |
| --- | --- | --- |
| gametes | L | L |
| R | RL | RL |
| L | LL | LL |

Genotype of parents: RR round x RL oval

Punnett Square (genotype F1 generation)

F1 generation

Genotype & Phenotype

50% RR round 50% RL oval

|  |  |  |
| --- | --- | --- |
| gametes | *R* | R |
| R | RR | RR |
| L | RL | RL |

Genotype of parents: RL oval x RL oval

F1 generation

Genotype & Phenotype

RR round RL oval LL long

1:2:1

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | *R* | L |
| R | RR | RL |
| L | RL | LL |

3. Roan is a rust color due to the intermediate effect of the expression of a gene for white and a gene for red in short-horned cattle. If a breeder has white cows and a bull that is roan, what proportion of the calves would be expected to be white, red or roan? What type of inheritance is this?

Genotype of parents: WW white x RW roan

Punnett Square (genotype F1 generation)

Incomplete / Co-Dominance F1 generation

Genotype & Phenotype

50% RW roan 50% WW white

|  |  |  |
| --- | --- | --- |
| gametes | R | W |
| W | RW | WW |
| W | RW | WW |

 Or

Genotype of parents: rr white x Rr roan

Punnett Square (genotype F1 generation)

F1 generation

Genotype & Phenotype

50% Rr roan 50% rr white

|  |  |  |
| --- | --- | --- |
| gametes | R | r |
| r | Rr | rr |
| r | Rr | rr |

4. In Drosophila, vestigial wings and ebony body color are due to two separate recessive genes. The dominant alleles are normal (*long*) wings and normal (*gray*) body color. What type of offspring would you expect from a cross between a homozygous vestigial ebony female and a homozygous normal male (*long-winged, gray-bodied*)? If the F1 are allowed to breed among themselves, what type of offspring would you expect in the F2? Show genotypes and phenotypes of both generations. What type of inheritance is this?

**Dihybrid Trait (Independent Assortment).**

**Genotype of parents: llgg female x LLGG male 🡪 all offspring LlGg**

**Genotype of F1 generation: LlGg female x LlGg male 🡪 9:3:3:1 phenotype ratio**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gametes | LG | Lg | lG | lg |
| LG | LLGG | LLGg | LlGG | LlGg |
| Lg | LLGg | LLgg | LlGg | Llgg |
| lG | LlGG | LlGg | llGG | llGg |
| lg | LlGg | Llgg | llGg | llgg |

* + - **9/16 long wings, gray body**
		- **3/16 long wings, ebony body**
		- **3/16 vestigial wings, gray body**
		- **1/16 vestigial wings, ebony body**

5. How sex is inherited in Drosophila and in man?

Genotype of parents: Xy male x XX female

Punnett Square (genotype F1 generation)

During meiosis the gametes become X, y

50% XX female 50% Xy male

|  |  |  |
| --- | --- | --- |
| gametes | X | X |
| X | XX | XX |
| y | Xy | Xy |

6. In a certain family there are six girls. What are the chances of the next child being a boy?

Genotype of parents: Xy male x XX female

Punnett Square (genotype F1 generation)

During meiosis the gametes become X, y

50% XX female **50% Xy male**

|  |  |  |
| --- | --- | --- |
| gametes | X | X |
| X | XX | XX |
| y | **Xy** | **Xy** |

7. A cross between two fruit flies 224 offspring were counted. How many females would probably be noted?

Genotype of parents: Xy male x XX female

Punnett Square (genotype F1 generation)

During meiosis the gametes become X, y

**50% XX female** **(112)** 50% Xy male

|  |  |  |
| --- | --- | --- |
| gametes | X | X |
| X | **XX** | **XX** |
| y | Xy | Xy |

8. Red-green color blindness is inherited as a sex-linked recessive trait. If a color-blind woman marries a man who has normal vision, what would be the expected phenotypes of their children with reference to this character.

Genotype of parents: XrXr female x XRy male

F1 generation

**100% XRXr female – normal vision**

**100% Xry male – color blind**

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | XR | y |
| Xr | XRXr | Xr**y** |
| Xr | XRXr | Xry |

9. A man and his wife both have normal color vision, but a daughter has red-green color blindness, a sex-linked recessive trait. The man sues his wife for divorce on ground of infidelity. Can genetics provide evidence supporting the man’s case?

Genotype of parents: XRXr female x XRy male

F1 generation

**XRXR & XRXr female – normal vision**

**50% XRy male – normal vision**

**50% Xry male – color blind**

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | XR | y |
| XR | XRXR | XR**y** |
| Xr | XRXr | Xry |

 **The man has a case. This mother could NOT have a color-blind daughter.**

10. Suppose a father of blood type A and a mother of blood type B have a child of group O. What groups are possible in their other children?

Genotype of parents: AO male x BO female

F1 generation

**25% AB 25% A 25% B 25% O**

**The parents had to be heterozygous to have an O blood type child.**

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | B | O |
| A | AB | AO |
| O | BO | OO |

11. If a father of blood type B and a mother of blood type O have a child of blood type O, what are their chances of having the next child with blood type O? B? A? AB?

Genotype of parents: BO male x BO female

Punnett Square (genotype F1 generation)

F1 generation

**50% B 50% O 0% A 0% AB**

|  |  |  |
| --- | --- | --- |
| gametes | O | O |
| B | BO | BO |
| O | OO | OO |

12. A father and a mother claim that they have been given the wrong baby at the hospital. Both parents are blood type A. The baby they have been given is blood type O. Prove the case true or false.

Genotype of parents: BO male x BO female

F1 generation

**75% A 25% O FALSE**

**The parents had to be heterozygous to have an O blood type child.**

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | A | O |
| A | AA | AO |
| O | AO | OO |

13. John Doe has blood type O. A woman has blood type A and HER child has blood type B. In a court case to determine who the child’s father was, John Doe was found guilty – he’s the father. Do you agree with the court’s decision? Show why or why not with a Punnett Square.

Genotype of parents: OO male x AO female

F1 generation

**50% A 50% O FALSE**

**The mother would need at least one B allele for the child to have B blood type.**

Punnett Square (genotype F1 generation)

|  |  |  |
| --- | --- | --- |
| gametes | A | O |
| O | AO | OO |
| O | AO | OO |

14. Queen Victoria and husband, Albert, had a great-grand child with hemophilia. Both had normal blood phenotypes. None of the daughters married hemophiliacs. How is this possible?

**Hemophilia is a sex-linked trait. Queen Victoria was a carrier (XHXh) while Albert (XHy) did not have the allele for hemophilia. Daughters and grand-daughters were also carriers. A male could then have the hemophiliac allele (Xhy), making him a hemophiliac.**