

# PUNNETT SQUARE CHEAT SHEET

**Below is a sampling of Punnett Square problems that you will be expected to solve. In order to do this, you will also have to understand the meaning of the terms below.**

- **Genotype:** The letters that make up the individual. E.g. ***TT* or *Tt***
- **Phenotype:** The physical characteristics of the particular trait. E.g. ***Tall* or *short***
- **Dominant trait:** Signified by capital letter-E.g. ***T***. If the traits you are using are dominant or recessive, this trait will "overpower" the recessive trait and will be expressed. E.g. ***Tt***
- **Recessive trait:** Signified by small case letter-e.g. ***t***. An organism with a recessive allele for a particular form of a trait will have that form only when the dominant allele for the trait is not present
- **Homozygous:** Has same letters. E.g. ***TT* or *tt*** (same alleles for trait)
- **Heterozygous:** Has different letters. E.g. ***Tt*** (different alleles for trait)
- **Purebred trait:** Also known as true breeding. Individuals genotype is homozygous and will only make one type of gamete. E.g. ***TT*** will always produces ***T***, and ***T***. ***tt*** will always produce ***t***, and ***t***.
- **Gamete:** sex cells. Represented by letter N (meaning they are haploid-contain half the chromosomes)
- **P generation:** The parental generation (Usually the first one in a genetic cross)
- **F<sub>1</sub> generation:** The ***first*** generation of offspring from P generation (means first filial: Latin for "son")
- **F<sub>2</sub> generation:** The ***second*** generation of offspring from P generation (means first filial: Latin for "son")
- **Monohybrid Cross:** Also known as a Single-Factor Cross. Only one trait is used in the genetic cross. E.g. ***T*=Tall, *t*=short**. Example: ***Tt* x *Tt***
- **Dihybrid Cross:** Also known as a Two-factor Cross. Two trait are used in the genetic cross. E.g. ***T*=Tall, *t*=short & *B*=Black fur, *b*=white fur**. Example ***TtBb* x *TtBb***
- **Incomplete Dominance:** One allele is not completely dominant over the other. There is a blending with the heterozygous offspring. E.g. ***RR*=Red, *Rr*=Pink, and *rr*=white**
- **Co-dominance:** Both alleles contribute to the phenotype. Offspring will have combination of two alleles. E.g. ***RR*=Red hair, *Rr*=Roan (mix of red and white hairs-almost looks pink), and *rr*=white**
- **Sex-linked trait:** Genes located on the sex-chromosomes called ***sex-linked genes***. Usually found on the ***X chromosome***. X-linked alleles are always expressed in males because males have only one X chromosome.
- **Multiple Alleles:** There are more than two-choices for the allele. Example is human blood group genes. There are three possible alleles for this gene. ***I<sup>A</sup>*, *I<sup>B</sup>*, and *i***. ***I<sup>A</sup>* and *I<sup>B</sup>* are co-dominant**. There are four possible phenotypes: ***A, B, AB, and O***.
- **Genotypic ratios:** The ratio of different genotype in the offspring from a genetic cross. E.g. 1:2:1
- **Phenotypic ratios:** The ratio of different phenotypes in the offspring from a genetic cross. E.g. 3:1

## Dominant and Recessive

(***T*** = Tall & ***t*** = short)

Cross: ***Tt* x *Tt***

	<b><i>T</i></b>	<b><i>t</i></b>
<b><i>T</i></b>	<b><i>TT</i></b>	<b><i>Tt</i></b>
<b><i>t</i></b>	<b><i>Tt</i></b>	<b><i>tt</i></b>

Genotypic ratio: 1 : 2 : 1 (TT=25% Tt=50% tt=25%)

Phenotypic ratio: 3 : 1 (Tall=75% Short=25%)

## Incomplete Dominance

(***TT*** = Tall & ***Tt*** = Medium & ***tt*** = short)

Cross: ***Tt* x *Tt***

	<b><i>T</i></b>	<b><i>t</i></b>
<b><i>T</i></b>	<b><i>TT</i></b>	<b><i>Tt</i></b>
<b><i>t</i></b>	<b><i>Tt</i></b>	<b><i>tt</i></b>

Genotypic ratio: 1 : 2 : 1 (TT=25% Tt=50% tt=25%)

Phenotypic ratio: 1 : 2 : 1 (Tall=25% Medium=50% Short=25%)

co dominance  
(BB = Black & BW = tan & WW = white  
Cross: BW x BW

	B	W
B	BB	BW
W	BW	WW

Genotypic ratio: 1 : 2 : 1 (BB=25% BW=50% WW=25%)

Phenotypic ratio: 1 : 2 : 1 (White=25% Tan=50% Black=25%)

Multiple Alleles  
Cross: AB x AO

	A	B
A	AA	AB
O	AO	BO

Genotypic ratio: 1:1:1:1  
(AA =25% AB=25% AO=25% BO=25%)

Phenotypic ratio: 1:1:1:1  
(Type A =50% Type AB =25% Type B =25%)

Blood Type	
Phenotype	Genotype
Type A	AA and AO
Type B	BB and BO
Type AB	AB
Type O	OO

Sex-linked

H = normal & h = hemophilia

Cross:  $X^h X^h$  x  $X^h Y$

	X	$X^h$
$X^h$	$X^h X$	$X^h X^h$
Y	XY	$X^h Y$

Genotypic ratio: 1:1:1:1  
( $X^h X$  =25%  $X^h X^h$ =25% XY=25%  $X^h Y$ =25%)

Phenotypic ratio: 1:1:1:1  
Female carrier =25% Female hemophilia =25%  
Male normal =25% Male hemophilia =25%

Dihybrid Cross  
Dominant and Recessive

T= Tall, t=short

B=Black, b=white

Cross: TtBb x TtBb

	TB	Tb	tB	tb
TB	TTBB	TTBb	TtBB	TtBb
Tb	TTBb	TTbb	TtBb	Ttbb
tB	TtBB	TtBb	ttBB	ttBb
tb	TtBb	Ttbb	ttBb	ttbb

Genotypic ratio: 1:2:2:1:4:1:2:2:1

Phenotypic ratio: 9:3:3:1

Dihybrid Cross

Dom.-Rec. / Sex-linked

T=Tall, t=short

H=Normal, h=hemophilia

Cross: homozygous Tall female carrier w/ short male

Cross:  $X^h XTT$  x  $XYtt$

	$X^h T$	$X^h T$	XT	XT
Xt	$X^h XTt$	$X^h XTt$	XXTt	XXTt
Xt	$X^h XTt$	$X^h XTt$	XXTt	XXTt
Yt	$X^h YTt$	$X^h YTt$	XYTt	XYTt
Yt	$X^h YTt$	$X^h YTt$	XYTt	XYTt

Genotypic ratio: 4:4:4:4 or 1:1:1:1

Phenotypic ratio: 4:4:4:4 or 1:1:1:1