Punnett Square
Practice Problems

Name Key

Hour _____

Monohybrid Crosses

1. In rabbits the allele for black coat color (B) is dominant over the allele for brown coat color (b). What would the genotypic ratio and phenotypic ratio be for a cross between a female homozygous for black coat color and a male homozygous for brown coat color?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description and ratio
B_ = black bb = brown	B	b	Bb 1
Parental Genotypes female BB male bb	**Punnett Square** b B | Bb		**Phenotypic description and ratio** Black 1

2. White (W) hair in sheep is caused by the dominant gene while black (w) hair is recessive. A heterozygous white male and a black female are parents of a black lamb. What is the probability that their next lamb will be white? What are the genotypic and phenotypic ratios?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description and ratio
W_ = white ww = black	w	W w	Ww : ww 1 : 1
Parental Genotypes female ww male Ww	**Punnett Square** W w w | Ww ww		**Phenotypic description and ratio** White : Black 1 : 1

3. Albinism is recessive in humans. An albino man marries a woman who is not albino, but had an albino father. What is the probability of this couple having a child that is not an albino? What are the genotypic and phenotypic ratios?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description an ratio
A_ = no albinism aa = albinism	A a	a	Aa : aa 1 : 1
Parental Genotypes female Aa male aa	**Punnett Square** A a a | Aa | aa		**Phenotypic description and ratio** Albinism : Not Alb 1 : 1

4. Todd and Melissa are college students who are planning to get married. They are currently taking a genetics course and decided to determine the eye color of any possible children they might have. Blue eyes are recessive to brown eyes. Todd has brown eyes, like his three brothers. His mother and grandmother have blue eyes, but his father and all other grandparents have brown eyes. Brown eyed Melissa has one blue eyed sister and one brown eyed sister and a mother with blue eyes. Her father and all of her grandparents have brown eyes. Construct an accurate punnett square to determine the possible eye colors of their yet to be born children. What are the genotypic and phenotypic ratios?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description and ratio
B_ = brown bb = blue	B b	B b	BB : Bb : bb 1 : 2 : 1
Parental Genotypes female Bb male Bb	**Punnett Square** B b B | BB | Bb b | Bb | bb		**Phenotypic description and ratio** Brown : Blue 3 : 1

4. In Teenage Mutant Ninja Turtles, green shells are dominant over brown shells. Leonardo, who is heterozygous for a green shell, marries the lovely Mona Lisa, who has a brown shell. What are the genotypic and phenotypic ratios?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description and ratio
G_ = Green gg = brown	(g)	(G) (g)	Gg : gg 1 : 1
Parental Genotypes female gg male Gg	**Punnett Square** (G) (g) (g) | Gg | gg		**Phenotypic description and ratio** Green : Brown 1 : 1

6. In humans, polydactyly (an extra finger on each hand or toe on each foot) is due to a dominant gene. If the mom is polydactylous, but heterozygous, and the dad is normal, what are the genotypic and phenotypic ratios of their children?

Key	Possible Egg Type(s)	Possible Sperm Type(s)	Genotypic description and ratio
D_ = polydactyl dd = normal hand	(D) (d)	(d)	Dd : dd 1 : 1
Parental Genotypes female Dd male dd	**Punnett Square** (D) (d) (d) | Dd | dd		**Phenotypic description and ratio** Polydactyl : Normal 1 : 1

Dihybrid Crosses

1. In human, aniridia, (a type of blindness resulting from absence of an iris) is due to a dominant gene. Migraine (a sickening headache) is due to a different dominant gene. A man with aniridia, whose mother was not blind, marries a woman who suffers from migraine. The woman's father did not suffer from migraine. In what proportion of their children would both aniridia and migraine be expected to occur?

Key

A_ = aniridia

aa = normal

M_ = migraine

mm = normal

Parental Genotypes

female aaMm

male Aamm

Possible Egg Type(s): aM, am

Possible Sperm Type(s): Am, am

Punnett Square

	aM	am
Am	AaMm	Aamm
am	aaMm	aamm

Proportion of children with both aniridia and migraine:

Children w/ aniridia and migraine : All of chil

1 : 3

2. In watermelons, solid green color (G) is dominant over striped pattern (g), and short shape (S) is dominant over long shape (s). What is the probability of each phenotype of possible offspring if a heterozygous solid, long watermelon cross pollinates with a heterozygous solid, heterozygous short watermelon?

Note: It doesn't matter which watermelon is male or female.

Key

G_ = solid green

gg = striped

S_ = short

ss = long

Parental Genotypes

Female

Gg ss

male

GgSs

Possible Egg Type(s): Gs, gs

Possible Sperm Type(s): GS, gS, Gs, gs

Punnett Square

	Gs	gs
GS	GGSs ✓	GgSs ✓
Gs	GGss *	Ggss *
gS	GgSs ✓	ggSs
gs	Ggss *	ggss

List Description and Probability of each Phenotype

$\frac{3}{8}$ Solid Green, Short

$\frac{3}{8}$ Solid Green, Long

$\frac{1}{8}$ Striped, Short

$\frac{1}{8}$ Striped, long

3. Having two eyebrows is dominant (E) over having one large eyebrow (e). Also having six fingers (F) is dominant over having five fingers (f). What is the probability of each phenotype if a man that has one eyebrow and twelve fingers total (heterozygous), has children with a woman that is heterozygous for both traits?

Key

E_ = two eyebrows

ee = one eyebrow

F_ = 6 fingers

ff = 5 fingers

Parental Genotypes

Female: Ee Ff

male: ee Ff

Possible Egg Type(s)

EF, Ef, eF, ef

Possible Sperm Type(s)

eF, ef

Punnett Square

	EF	Ef	eF	ef
eF	EeFF *	EeFf *	ceFF	ceFf
ef	EeFf *	Eeff	eeFf	eeff

List Description and Probability of each Phenotype

$\frac{3}{8}$ = 2 eyebrows, 6 f

$\frac{3}{8}$ = 1 eyebrow, 6

$\frac{1}{8}$ = 2 eyebrows, 5

$\frac{1}{8}$ = 2 eyebrows, 5 fi

Incomplete Dominance

1. Yellow coat color in guinea pigs is produced by the homozygous genotype, YY, and cream color by the heterozygous genotype, Yy. White is produced by the homozygous genotype, yy. What genotypic ratios are produced by matings between cream colored guinea pigs? Describe the phenotypic ratio.

Key

YY = yellow

Yγ = cream

γγ = white

Parental Genotypes

female: Yγ

male: Yγ

Possible Egg Type(s)

Y, γ

Possible Sperm Type(s)

Y, γ

Punnett Square

	Y	γ
Y	YY	Yγ
γ	Yγ	γγ

Genotypic description and ratio

YY : Yγ : γγ

1 : 2 : 1

Phenotypic description and ratio

Yellow : Cream : White

1 : 2 : 1

2. In humans hair texture is controlled by incomplete dominance. A curly haired individual and a straight haired individual have all wavy haired children. If two wavy haired people have children, what will the phenotypic ratio be?

Key

HH = Curly

Hh = Wavy

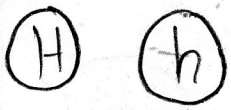
hh = Straight

Parental Genotypes

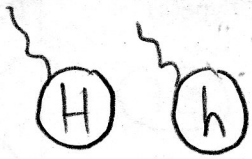
Female Hh

male Hh

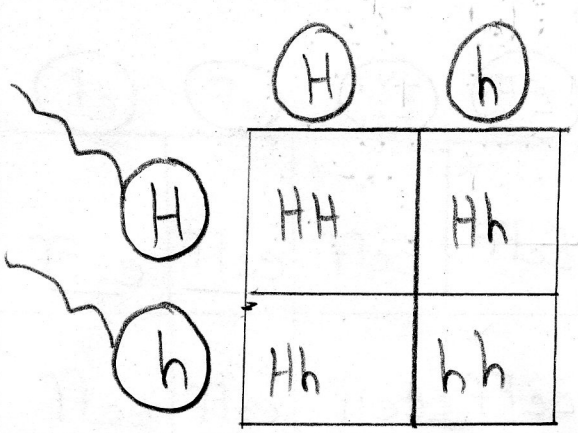
Possible Egg Type(s)



Possible Sperm Type(s)



Punnett Square



Phenotypic description and ratio

Curly hair : Wavy Hair : Straight Hair

1 : 2 : 1

3. In Japanese four o'clock flowers, color is inherited by genes that show incomplete dominance. In such flowers, a cross between a homozygous red flower and a homozygous white flower will always result in pink flowers.

   a. A cross is made between two pink flowers. What is the probability for each phenotype?

Key

RR = red

Rr = pink

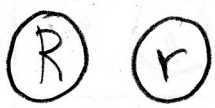
rr = white

Parental Genotypes

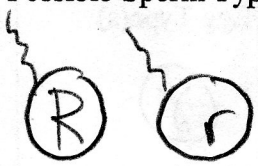
Female Rr

Male Rr

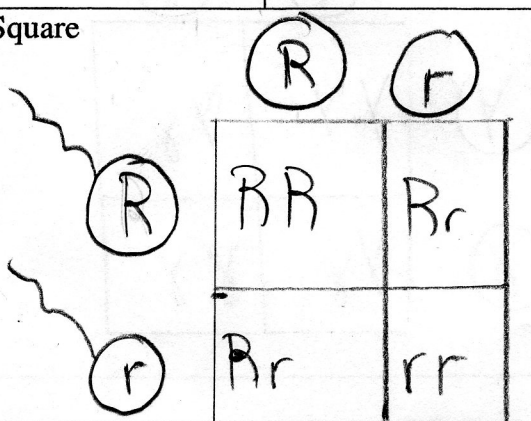
Possible Egg Type(s)



Possible Sperm Type(s)



Punnett Square



Phenotypic description and ratio

Red : Pink : White

1 : 2 : 1

b. What is the genotypic and phenotypic ratio for a cross between a plant with red flower and a plant with pink flowers?

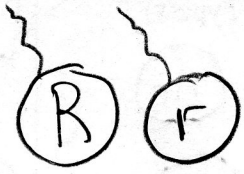
Key

RR = red

Rr = pink

Possible Egg Type(s)

Possible Sperm Type(s)



Phenotypic description ratio

Red : Pink

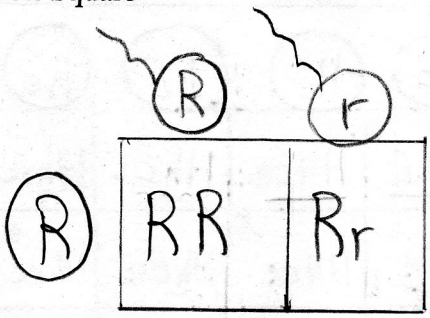
1 : 1

Parental Genotypes

Female RR

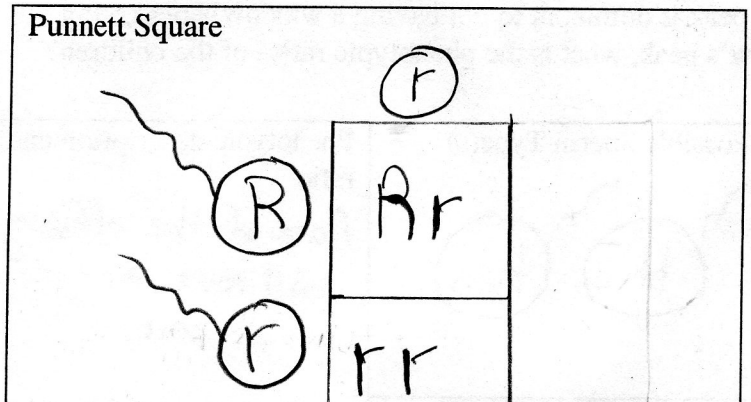
Male Rr

Punnett Square



c. A plant breeder wants to produce only pink Japanese four o'clock flowers. Can he do so by crossing pink Japanese four o'clock flowers with white Japanese four o'clock plants? Use a punnett square to support your answer.

Punnett Square



A pink Japanese four o'clock flower produces gametes with "R" and "r" alleles. A white Japanese four o'clock flower pro gametes with only "r" alleles. As seen in the Punnett Square, 1/2 of all zygotes produced will be white flowers.

4. Hair texture in humans is incompletely dominant. Curly hair plus straight hair gives you wavy hair. Also, having 2 eyebrows is dominant over one eyebrow. If two individuals are heterozygous for both traits, what is the probability of each phenotype in their future offspring?

Key

HH = curly
Hh = wavy
hh = straight
E_ = 2 eyebrows
ee = 1 eyebrow

Parental Genotypes

Female
HhEe

male
HhEe

Possible Egg Type(s)

HE, He, hE, he

Possible Sperm Type(s)

HE, He, hE, he

Punnett Square

	HE	He	hE	he
HE	HHEE	HHEe	HhEE	HhEe
He	HHEe	HHee	HhEe	Hhee *
hE	HhEE	HhEe	hhEE	hhEe
he	HhEe	Hhee *	hhEe	hhee

List Description and Probability of each Phenotype

$\frac{6}{16}$ = Wavy Hair, 2 eyebrows
$\frac{2}{16}$ = Wavy Hair, 1 eyebrow
$\frac{3}{16}$ = Curly Hair, 2 eyebrows
$\frac{1}{16}$ = Curly Hair, 1 eyebrow
$\frac{3}{16}$ = Straight Hair, 2 eyebrows
$\frac{1}{16}$ = Straight Hair, 1 eyebrow

5. Remember that hair texture is incompletely dominant. (With a curly hair person that mates with a strait hair person resulting in wavy hair children). Widow's peak is dominant to not having a window's peak. If a couple has wavy hair and both do not have a widow's peak, what is the phenotypic ratios of the children?

Key

HH = Curly hair
Hh = Wavy hair
hh = straight hair
W_ = Widow's peak
ww = normal

Parental Genotypes

Female
HhWw

male
HhWw

Possible Egg Type(s)

Hw, hw

Possible Sperm Type(s)

Hw, hw

Punnett Square

	Hw	hw
Hw	HHWw	HhWw
hw	HhWw	hhWw

Phenotypic description and ratio

None of the offspring will have a widow's peak.

Curly : Wavy : Straight
1 : 2 : 1

Codominance

1. In shorthorn cattle, the hybrid between red and white is roan, having red and white hairs intermingled. If a roan male is bred with a white female, what will the phenotypic ratio be?

Key

$H^R H^R$ = red

$H^W H^W$ = white

$H^R H^W$ = roan

Parental Genotypes

Female

$H^W H^W$

male

$H^R H^W$

Possible Egg Type(s)

H^W

Possible Sperm Type(s)

H^W H^R

Punnett Square

	H^W	H^R
H^W	$H^W H^W$	$H^R H^W$

Phenotypic description and ratio

White : Roan

1 : 1

Multiple Alleles

1. Suppose a man with homozygous A blood marries a woman with AB blood. What blood types would you expect to find among their children?

Key

I^A _ = Type A

$I^A I^B$ = Type AB

Parental Genotypes

Female

$I^A I^B$

Male

$I^A I^A$

Possible Egg Type(s)

I^A I^B

Possible Sperm Type(s)

I^A

Punnett Square

	I^A	I^B
I^A	$I^A I^A$	$I^A I^B$

Possible Blood types of children

Type A

Type AB

2. A man of type AB blood is married to a woman of type O and he questions the legitimacy of her child, wh has type O blood. What should the legal judgment be?

Key

$I^A\_$ = Type A

$I^B\_$ = Type B

I^AI^B = Type AB

ii = Type O

Possible Egg Type(s)

(i)

Possible Sperm Type(s)

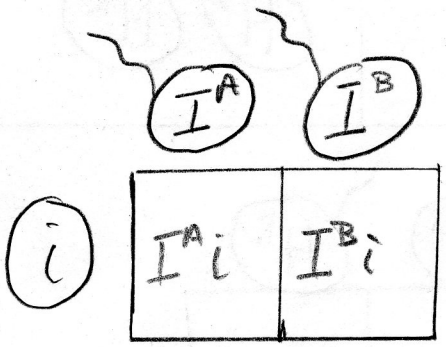
(I^A) (I^B)

Possible Blood types of children

Type A

Type B

Punnett Square



Parental Genotypes

Female

ii

Male

I^AI^B

Legal judgement

The man with type AB blood can not be the father.

2. A child has blood type AB, and the mother has blood type A.

What is the Child's genotype? I^AI^B

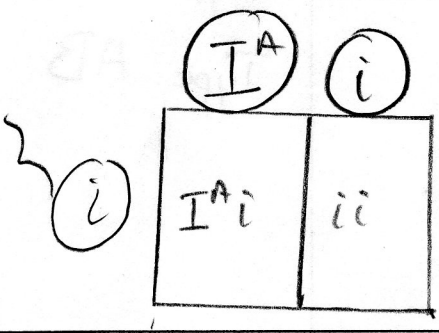
What are the mother's possible genotypes? I^Ai or I^AI^A

a. What are the possible genotypes of the child's father given the information you know?

I^Bi or I^BI^B

b. Could the father be type O? Explain (use a CER) using a Punnett square for evidence.

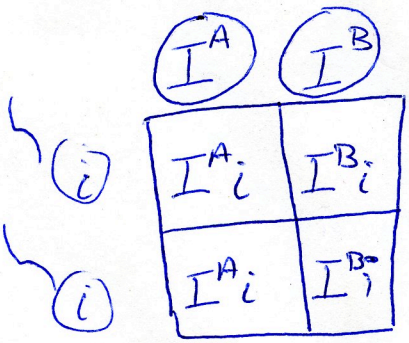
Punnett Square



CER: The father can not be type O. Since the mother has blood type A, we know that her blood type genotype must be eithe I^Ai or I^AI^A. We also know that ii is the genotype for type O. Since neither genotype of Mom or Dad contain I^B, which is necessary for type AB blood type to be present, it can be seen that the father can't have type O blood.

4. Mrs. Doe and Mrs. Jones had babies at the same hospital at the same time. Mrs. Doe took home a girl and named her Nancy. Mrs. Jones received a boy and named him Richard. However, Mrs. Jones was sure she had had a girl and brought a law suit against the hospital. Blood tests showed the Mr. Jones was type O. Mrs. Jones was type AB. Mr. and Mrs. Does were both type A. Nancy was type B and Richard was type O. Had an exchange occurred? Explain with a CER. (Hint: you may need to make more than one Punnett square to use for evidence)

Punnett Square(s)

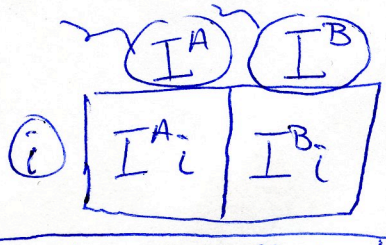


CER: Richard can not belong to Mr. and Mrs. Jones. Richard's blood type O while Mrs Jones has blood type AB. As seen in the Punnett Square, Mrs. Jones' eggs will either carry I^A or I^B. Since both possibilities for eggs are dominant alleles and "i" is a recessive allele, all offspring will have either type A or type B blood.

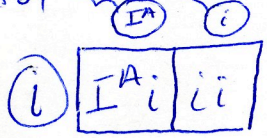
5. Mike and Carol Brady are expecting their first child together. Mike, however, has noticed that Sam the Butcher has been hanging around the house at weird times and often when Alice is not around. When baby Brady is born, Mike notices that its blood type is B+. Mike is concerned because he has AB- blood and Carol has O+ (heterozygous positive). Sam the butcher has A+ (heterozygous positive) blood. Is Mike just being silly and as normal will they have this situation settled in 30 minutes, or will the show be continued for paternity suits? ? Explain with a CER.

Punnett Square(s)

Blood Types of offspring between Mike and Carol



Blood Types of offspring between Sam and Carol



CER: Sam can not be the father of Br. If Sam and Carol were to have offspring, their offspring's blood type would either be type A ($I^A i$) or type O (ii). Baby Brady however has blood type B. This blood type is feasible because Mike and Carol's punnett square shows a type B possibility for offspring (I^B). Thus Mike is the legitimate father of Br.