Dihybrid Cross Worksheet

1. Set up a punnett square using the following information:
   - Dominate allele for tall plants = D
   - Recessive allele for dwarf plants = d
   - Dominate allele for purple flowers = W
   - Recessive allele for white flowers = w
   - Cross a homozygous dominate parent (DDWW) with a homozygous recessive parent (ddww)

	DW	DW	DW	DW
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw

2. Using the punnett square in question #1:
   a. What is the probability of producing tall plants with purple flowers? 100%

      Possible genotype(s)? DdWw

   b. What is the probability of producing dwarf plants with white flowers? 0%

      Possible genotype(s)? ddww

   c. What is the probability of producing tall plants with white flowers? 0%

      Possible genotype(s)? DDww Ddww

   d. What is the probability of producing dwarf plants with purple flowers? 0%

      Possible genotype(s)?

      ddWw ddWW

3. Set up a punnett square using the following information:
   - Dominate allele for black fur in guinea pigs = B
   - Recessive allele for white fur in guinea pigs =b
   - Dominate allele for rough fur in guinea pigs = R
   - Recessive allele for smooth fur in guinea pigs = r
   - Cross a heterozygous parent (BbRr) with a heterozygous parent (BbRr)

	BR	Br	bR	br
BR	BBRR	BBRr	BbRR	BbRr
Br	BBRr	BBrr	BbRr	Bbrr
bR	BbRR	BbRr	bbRR	bbRr
br	BbRr	Bbrr	bbRr	bbrr

BbRr X BbRr

gametes

BR Br bR br

4. Using the punnett square in question #3:
   a. What is the probability of producing guinea pigs with black, rough fur? 9/16 = .5625 = 56%

      Possible genotype(s)?

      BBRr BBRR BbRR BbRr

   b. What is the probability of producing guinea pigs with black, smooth fur? 3/16 = .1875 = 18.75%

      Possible genotype(s)?

      BBrr Bbrr

   c. What is the probability of producing guinea pigs with white, rough fur? 3/16 = 18.75%

      Possible genotype(s)?

      bbRr bbRR

   d. What is the probability of producing guinea pigs with white, smooth fur? 1/16 = .0625 = 6%

      Possible genotype(s)?

      bbrr

5. Set up a punnett square using the following information:

- Dominate allele for purple corn kernels = R
- Recessive allele for yellow corn kernels = r
- Dominate allele for starchy kernels = T
- Recessive allele for sweet kernals = t
- Cross a homozygous dominate parent with a homozygous recessive parent RRTT x rrtt

RRTT
(RT) (RT)
(RT) (RT)

rrtt
(rt) (rt)
(rt) (rt)

	RT	RT	RT	RT
rt	RrTt			
rt				
rt				
rt				

ALL IDENTICAL

100% purple, starchy

6. Using the punnett square in question #5:
   a. What is the probability of producing purple, starchy corn kernels? 100%

      Possible genotype(s)? RrTt

   b. What is the probability of producing yellow, starchy corn kernels? 0%

      Possible genotype(s)? rrTt rrTT

   c. What is the probability of producing purple, sweet corn kernels? 0%

      Possible genotype(s)? RRtt Rrtt

   d. What is the probability of producing yellow, sweet corn kernels? 0%

      Possible genotype(s)?

      rrtt

7. Set up a punnett square using the following information:

- Dominate allele for normal coat color in wolves = N
- Recessive allele for black coat color in wolves = n
- Dominant allele for brown eyes = B
- Recessive allele for blue eyes = b
- Cross a heterozygous parent with a heterozygous parent NnBb X NnBb

fully heterozygous

8. Using the punnett square in question #7:
   a. What is the probability of producing a wolf with a normal coat color with brown eyes?

      Possible genotype(s)?

   b. What is the probability of producing a wolf with a normal coat color with blue eyes?

      Possible genotype(s)?

   c. What is the probability of producing a wolf with a black coat with brown eyes?

      Possible genotype(s)?

   d. What is the probability of producing a wolf with a black coat with blue eyes?

      Possible genotype(s)?

9:3:3:1

NB Nb nB nb

normal, brown ↓ black, brown ↓

normal, blue black, blue

tall, terminal X short, axial = all Tall, axial
Dominant Dominant

9. A tall pea plant with **terminal** flowers (flowers on the ends of the stems) is crossed with a **short** plant that has axial flowers. All 72 offspring are tall with axial flowers. This is a dihybrid cross with the height and flower position traits showing independent assortment.

T = tall A = axial
t = short a = terminal

a. Name the dominant and recessive alleles. (hint see textbook pg. 262)

b. Give the genotypes of the parents and offspring in this cross. All offspring the same which means parents are homozygous

TTff X ttFF = TtFf

c. Predict the F2 offspring when the tall-axial F1's are allowed to self pollinate. 9 : 3 : 3 : 1 TF Tf tF tf

100% heterozygous cross = 9:3:3:1 ratio

10. Suppose a white, straight haired guinea pig mates with a brown, curly-haired animal. All five babies in their first litter have brown fur, but three are curly and two have straight hair. The second litter consists of six more brown offspring, where two are curly and four are straight haired.

2 litters = All Brown and 5 curly / ~~6 curly~~ 6 straight = close to 50/50

a. Assuming curly is dominant to straight, what are the genotypes of the parents and the offspring?

BBSs X BBss (one parent could have a "b") offspring = BBSs or ~~BBSS~~ BBss

	S	s
s	Ss	ss
s	Ss	ss

b. What is the probability of getting two female guinea pigs with straight hair in a row?

female .5 X straight .5 X straight .5 = .125 or 12.5%

11. About 70% of Americans get a bitter taste from the substance called phenylthiocarbamide (PTC). It is tasteless to the rest. The "taster" allele is dominant to non-taster. Also, normal skin pigmentation is dominant to albino. A normally pigmented woman who is taste-blind for PTC has an albino-taster father. She marries an albino man who is a taster, though the man's mother is a non-taster. Show the expected offspring of this couple.

T = taster N = normal
t = non taster n = albino

woman = ttNn ⟹ father was Ttnn
man = Ttnn ⟹ mother was tt

12. In pigeons the checkered pattern is caused by a dominant allele. A plain (non-checkered) pattern is recessive. Red color is also caused by a dominant allele and brown color by a recessive allele.

checker = C
plain = c
red = R
brown = r

a. Show the expected offspring of a cross between a homozygous checkered red bird and a plain brown one. Carry out this cross through the F2 generation.

CCRR X ccrr
Will be 9:3:3:1
CcRr F1

b. Carry out to the F2 generation a cross between a homozygous plain red bird and its homozygous checkered brown mate.

ccRR X CCrr

c. A plain brown female pigeon laid five eggs. The young turned out to be: 2 plain red, 2 checkered red, and 1 checkered brown. Describe the father pigeon. Give the genotypes of all birds in this cross. Could any other types of offspring have been produced by this pair?

2 plain, red ⟹ ccR?
2 checkered, red ⟹ C?R?
1 checkered, brown ⟹ C?rr

C = checkered
c = plain
R = red
r = brown

female X male

ccrr CcRr
(all recessive)

notice "C" → cannot have come from female as she is "cc"
notice "cc" means one came from each parent
notice "rr" means one came from each parent
notice "R" → cannot have come from female

<u>Multiple Alleles:</u> A gene with more than two alleles

<u>Examples</u>

1) Fly eye colour is determined by multiple alleles. There are four different alleles that each code for a different eye colour (E^1 = Red with is dominant to E^2 = Apricot, which is dominant to E^3 = Honey which is dominant to E^4 = white).

a. Two flies mate and have 74 apricot colour eyed offspring and 30 honey colour eyed offspring. What are genotypes of both parent flies? – must have apricot, honey in offspring

74 of 100 – 75% apricot

30 of 100 – 25% honey → apricot

E^2E^3 X E^2E^3

or

E^2E^3 X E^4E^4

Red = $E^1E^?$ ~~E^1E^3 E^1E^4~~ E^1E^1 (can't be)

Apricot = ~~E^2E^2~~ E^2E^3 E^2E^4

Honey = E^3E^3 E^3E^4

White E^4E^4

b. You are in the process of performing genetic experiments on flies in the lab when all of your flies escape. You manage to trap a couple of flies but you no longer know what genotype they are. One of the flies has red eyes, and the other has white eyes. When you mate the two flies your results show approximately half the progeny with apricot eyes, and the other half with red eyes. What are the genotypes of the two flies you were able to capture?

white must be E^4E^4

red must be $E^1E^?$

	E^1	$E^?$ ← must be E^2
E^4	E^1E^4	$E^?E^4$
E^4	E^1E^4	$E^?E^4$

? must be apricot

E^1E^2 and E^4E^4

2) The gene that controls chinchilla coat colour in rabbits has 4 alleles: Agouti C > chincilla c^{ch} > Himalayan c^h > albino c. Agouti coat colour must have at least one C.

a) What are the possible genotypes for agouti colouration? Cc^{ch} Cc^h CC Cc

b) What are the possible genotypes for chinchilla colouration? $c^{ch}c^{ch}$ $c^{ch}c^h$ $c^{ch}c$

c) What are the possible genotypes for Himilayan colouration? c^hc^h c^hc

d) A chinchilla rabbit with the genotype $c^{ch}c^h$ is crossed with a himilayan rabbit with genotype c^hc. What is the expected ratio of phenotypes among the offspring of this cross?

	c^{ch}	c^h
c^h	c^hc^{ch}	c^hc^h
c	cc^{ch}	cc^h

2 chinchilla
1 albino
1 himalayan

e) Some of the offspring of a chinchilla rabbit and a Himilayan rabbit are albino. What must be the genotypes of the parent rabbits?

→ each must have at least 1 "c" in its genotype so 2 recessives come together

$c^{ch}c$ X c^hc

Incomplete and Co-Dominance

<u>Incomplete Dominance:</u> Describes a condition where there is *partial* expression of both alleles: neither of two alleles for the same gene can completely conceal the presence of the other.

<u>Examples</u>

1. The Four O'clock plant has only two alleles for flower color, but has three different phenotypes: red flowered plants, white flowered plants, and pink flowered plants.

a. Show the expected offspring of a cross between two pink-flowered plants. Include genotypes, phenotypes and ratios.

F^R = Red
F^W = white
F^RF^W = pink.

	F^R	F^W
F^R	F^RF^R	F^RF^W
F^W	F^RF^W	F^WF^W

– genotypes: F^RF^R / F^RF^W / F^WF^W

– pheno – 1 : 2 : 1
red : pink : white

b. Show the expected offspring of a cross between a red-flowered Four O'clock plant and a pink-flowered plant.

	F^R	F^R
F^R	F^RF^R	F^RF^R
F^W	F^RF^W	F^RF^W

50% Red

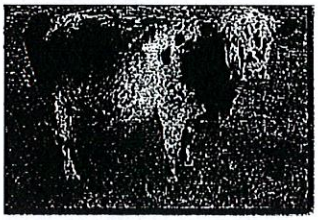
50% pink.

c. Show the expected offspring of a cross between a pink-flowered Four O'clock plant and a white flowered plant.

50% white

50% pink

Co-Dominance: Describes a condition in which *both* alleles are fully expressed.



Examples

1. In shorthorn cattle the C^R allele, when homozygous, produces animals with red hair and the C^W allele, when homozygous, produces cattle with white hair. An animal with a heterozygous genotype is **roan** in color, meaning its coat contains *both* red hairs and white hairs.

a. Describe the expected offspring when a breeder mates cows and bulls of the following phenotypes:

red x red - all Red

white x white - all white

red x roan -50% red 50% roan

white x roan 50% white 50% roan

red x white = all Roan

roan x roan 1 red 1 white 2 - roan

	C^R	C^R
C^R	C^RC^R	C^RC^R
C^W	C^RC^W	C^RC^W

	C^W	C^W
C^R	C^RC^W	C^RC^W
C^W	C^WC^W	C^WC^W

	C^R	C^R
C^W	C^RC^W	C^RC^W
C^W	C^RC^W	C^RC^W

	C^R	C^W
C^R	C^RC^R	C^RC^W
C^W	C^RC^W	C^WC^W

b. What is the probability of a pair of roan cattle producing (1) a red calf? (2) a roan calf? (3) a white calf?

red calf = 25% (1 of 4)

roan - 50% (2 of 4)

white 25% (1 of 4)

2. A blue roan horse is a heterozygote in which one allele is expressed in the white hairs and the other allele is expressed in the black hairs. When both these colours are expressed, the horses coat color sometimes looks blue. If two blue roan horses are bred together, what is the chance that the colt will be white?

C^W = white

C^B = black

	C^W	C^B
C^W	C^WC^W	C^WC^B
C^B	C^WC^B	C^BC^B

C^WC^W = white

25% chance

1 of 4