

## LAB #18: GENETICS PROBLEMS

F <sub>1</sub>	P	P	F <sub>2</sub>	P	P
f	Pp	Pp	P	PP	PP
f	Pp	Pp	P	Pp	PP

#02

F <sub>2</sub>	P	P	f	P	P
f	Pp	Pp	P	PP	PP
f	Pp	Pp	P	Pp	PP

PHENOTYPES: PURPLE

PHENOTYPES: WHITE

GENOTYPES: Pp

GENOTYPES: Pp

GENOTYPES: Pp

GENOTYPES: Pp

F <sub>2</sub>	P	P	f	P	P
f	Pp	Pp	P	PP	PP
f	Pp	Pp	P	Pp	PP

TEST CROSS

PHENOTYPES: PURPLE

PHENOTYPES: WHITE

GENOTYPES: Pp

GENOTYPES: Pp

GENOTYPES: Pp

GENOTYPES: Pp

#03 BECAUSE THE TWO SOLID COAT CATTLE ARE HETEROZYGOUS, THEY EACH HAVE THE DOMINANT AND RECESSIVE ALLELE. THEREFORE, A CROSS BETWEEN THE TWO WOULD PRODUCE A 3:1 RATIO OF SOLID COAT TO SPOTTED (OR 1:2:1).

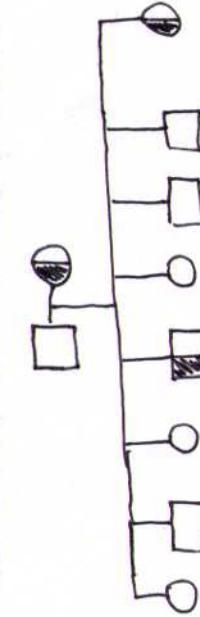
#04 FAMILY TREE FOR GALACTOSEMIA (TRIUMS)

RECESSIVE ALLELE



#05 GENE FOR LONG HAIR AND SHORT HAIR CATS

F <sub>1</sub>	L	L	L
L	LL	LL	LL
L	LL	LL	LL



GROUP B: 1:1 RATIO OF LONG HAIR TO SHORT, BUT (BUT) NO BREEDING 1:3. DEVIATION IS DUE TO THE 50/50 CHANCE OF ONE OR THE OTHER. A LARGER LETTER WOULD SHOW MORE CERTAIN THE 1:1 PATTERN.

(q1)

#06. AUBRIE (RECESSIVE) MALE WITH HETEROZYGOUS FEMALE

F <sub>1</sub>	F	F
P	Pp	Pp
P	PP	pp

offspring would be 1:1 for ALBITION AND NORMAL PIGMENTATION.

|  | YY |
|--|----|----|----|----|----|----|----|----|----|
|  | YY |
|  | YY |
|  | YY |
|  | YY |

#07. YELLOW MOUSE : GRAY MOUSE CROSS

F <sub>1</sub>	Y	y	Y	y	YY	Yy	YY	Yy	YY
	Y	Yy	Y	Yy	YY	Yy	YY	Yy	YY
	Y	Yy	Y	Yy	YY	Yy	YY	Yy	YY
	Y	Yy	Y	Yy	YY	Yy	YY	Yy	YY

PHENOTYPES: GRAY ( $\frac{1}{2}$ )  
YELLOW ( $\frac{1}{2}$ )

GENOTYPES:  
Yy ( $\frac{1}{2}$ )  
YY ( $\frac{1}{2}$ )

All offspring would survive  
(would produce the LARGEST LETTER)  
 $\approx 25\%$  of offspring would be  
YY homozygous and die as embryos.

#08. BLUE ANDALUSIAN CHICKEN : GENE ANDALUSIAN CHICKEN CROSS

F <sub>1</sub>	B	b	Bb	bb
B	BB	Bb	Bb	bb
b	Bb	bb	bb	bb

1:2:1 ratio of BLACK FEATHERED, BLUE FEATHERED, AND WHITE FEATHERED CHICKENS.

### #09 STUMPY CAT : STUMPY CAT CROSS

F.	L	L	V	Lv
L	LL	LL	lv	lv
l	ll	lL	lv	lv

THE EXPECTED RATIO IS 1:2:1 AND THE RESULT OF THE CROSS SHOWS THAT A 3:5:1 WAS PRODUCED. GIVING THE SITE OF THE LETTER, THIS IS A FAIR REPRESENTATION OF THE EXPECTED OUTCOME. TAIL LENGTH IS DIFFERENTIATED BY INCOMPLETE DOMINANCE IN A 1:2:1.

F.	X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup>
X <sup>b</sup>	X <sup>b</sup> Y	X <sup>b</sup> Y	X <sup>b</sup> Y	Y
Y	X <sup>b</sup> Y	X <sup>b</sup> Y	X <sup>b</sup> Y	Y

#10 TO PRODUCE FEMALE CATS 1/2 BLACK COLOR AND 1/2 TORTOISE SHELL COLOR, AND MALE CATS 1/2 YELLOW COLOR AND 1/2 BLACK COLOR, A HOMOZYGOUS FEMALE NEEDS TO BE MATED WITH A MALE WITH AN ALLELE CODING FOR BLACK HAIR COLOR. THE RESULTS OF THIS CROSS WOULD BE:

F.	X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup>
X <sup>b</sup>	X <sup>b</sup> Y	X <sup>b</sup> Y	X <sup>b</sup> Y	Y
Y	X <sup>b</sup> Y	X <sup>b</sup> Y	X <sup>b</sup> Y	Y

#11 BLACK MALE : BARRED FEMALE CROSS

F.	X <sup>b</sup>	O	O
X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O
O	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O

PARENT MALE : BLACK FEMALE CROSS

F.	X <sup>b</sup>	O	O
X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O
O	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O

PHENOTYPES: MALE BARRED (1/2)  
FEMALE BLACK (1/2)

GENOTYPES: X<sup>b</sup> Y (1/2)  
X<sup>b</sup> O (1/2)

OR

DELTA

(100) (100)

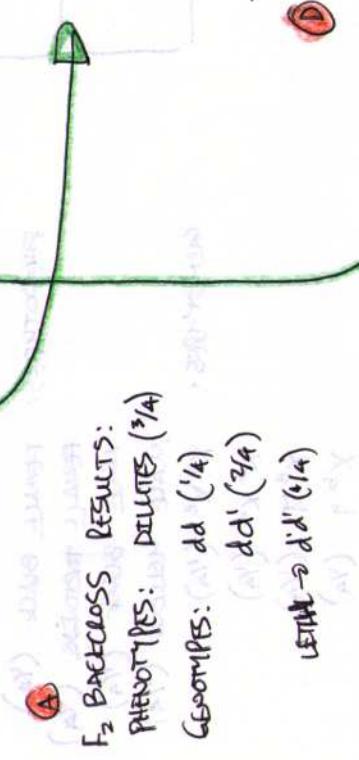
F.	X <sup>b</sup>	O	O
X <sup>b</sup>	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O
O	X <sup>b</sup> X <sup>b</sup>	X <sup>b</sup> O	X <sup>b</sup> O

#12 Full colored with  $d'$  ventral mouse  $\times$  dilute colored with  $d'$  ventral mouse cross

$F_1$	D	$d'$	$d' d'$	$d d'$	$d d$	$F_2$ backcross	$d'$	$d$	$D$	$Dd$	$Dd'$	$Dd$	$Dd'$	$D'$	$D'd'$	$D'd$	$D'd'$	$d'd'$	$d'd$	$d'd'$	$d'd$
A	$d'$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d' D$	$d' Dd$	$d' Dd'$	$d' D'$	$d' D'd'$	$d' D'd$	$d' D'd'$	$d' d'd'$	$d' d'd$	$d' d'd'$	$d' d'd$	
B	$d'$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d' D$	$d' Dd$	$d' Dd'$	$d' D'$	$d' D'd'$	$d' D'd$	$d' D'd'$	$d' d'd'$	$d' d'd$	$d' d'd'$	$d' d'd$	
C	$d'$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d' D$	$d' Dd$	$d' Dd'$	$d' D'$	$d' D'd'$	$d' D'd$	$d' D'd'$	$d' d'd'$	$d' d'd$	$d' d'd'$	$d' d'd$	
D	$d'$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d' D$	$d' Dd$	$d' Dd'$	$d' D'$	$d' D'd'$	$d' D'd$	$d' D'd'$	$d' d'd'$	$d' d'd$	$d' d'd'$	$d' d'd$	

$F_1$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$F_2$ backcross	$D$	$Dd$	$Dd'$	$D'$	$D'd'$
A	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
B	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
C	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
D	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$

$F_1$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$F_2$ backcross	$d'$	$d$	$D$	$Dd$	$Dd'$	$D'$	$D'd'$
A	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
B	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
C	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
D	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$



$F_1$	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$F_2$ backcross	$d'$	$d$	$D$	$Dd$	$Dd'$	$D'$	$D'd'$
A	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
B	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
C	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$
D	$d'$	$d' d'$	$d' d'$	$d' d'$	$d' d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$	$d'$

D  $F_2$  backcross cannot be performed (dead mice)

D  $F_2$  backcross results:

Phenotypes: Full color ( $\frac{3}{4}$ )	Dilutes ( $\frac{1}{4}$ )
Genotypes: $Dd$ ( $\frac{1}{4}$ )	$Dd'$ ( $\frac{1}{4}$ )
	$D'$ ( $\frac{1}{4}$ )
	$D'd$ ( $\frac{1}{4}$ )
	$D'd'$ ( $\frac{1}{4}$ )

C  $F_2$  backcross results:

Phenotypes: Full color ( $\frac{2}{4}$ )

Dilutes ( $\frac{1}{4}$ )

Genotypes:  $Dd$  ( $\frac{1}{4}$ )

$Dd'$  ( $\frac{1}{4}$ )

$D'$  ( $\frac{1}{4}$ )

$D'd$  ( $\frac{1}{4}$ )

$D'd'$  ( $\frac{1}{4}$ )

Allele:  $D$

Full color: 50%

Dilute color (excluding dead mice): 66.7%

Dilute color (including dead mice): 50%

#13 NO, IT CANNOT BE USED, IN ORDER FOR INHERITANCE IT HAS TO HAVE ONE PARENT HETEROZYGOUS Ai AND Bi. SINCE i IS RECESSIVE AND A AND B ALLELES ARE DOMINANT OVER i (AND CO-DOMINANT WHEN TOGETHER), THE ONLY WAY PARENTS COULD PRODUCE OFFSPRING WITH THESE TWO BLOOD TYPES IS IF BOTH PARENTS HAVE i ALLELES AND ONE HAS A DOMINANT WHILE THE OTHER HAS B DOMINANT. THE PUNNET SQUARE BELOW SHOWS THAT ALL FOUR BLOOD TYPES ARE POSSIBLE, SHOWING THAT THE MAN'S CLAIMS CANNOT BE SUPPORTED BY THIS DATA.

$F_1$	A	i
B	A B	Bi
i	AI	ii

All four blood types  
ARE POSSIBLE

#### Possible Genotypes:

ALEXANDRA: NN, Nn, nn

NORMAL: nn, nn'

PROBLEMS: nn'

$F_1$	N	n
N	NN	Nn
n	Nn	nn

For a 1:2:1 ratio of normal to Alexandra to problems queen, the genotypes of the parents would need to be Nn AND nn. THIS WOULD PRODUCE THE FOLLOWING OFFSPRING:

PHENOTYPES: Alexandra ( $\frac{1}{4}$ )  
Normal ( $\frac{1}{4}$ )  
Problems Queen ( $\frac{1}{4}$ )

GENOTYPES: Nn ( $\frac{1}{4}$ )

nn ( $\frac{1}{4}$ )

nn' ( $\frac{1}{4}$ )

nn' ( $\frac{1}{4}$ )

#15 Full colored parent Heterozygous for hemophilia with a colorless parent cross

$F_1$	C	c
C	Cc	cc
c	Cc	cc

Phenotypes: Full color ( $\frac{1}{4}$ )  
Colored white ( $\frac{1}{4}$ )

Genotypes: Cc ( $\frac{1}{4}$ )  
Cc ( $\frac{1}{4}$ )

## #16 aaBb WITH AaBb DOMINANT CROSS

	a B	a b	A B	A b	a B	a b
A B	$\frac{a}{2}$ $\frac{B}{2}$					
A b	$\frac{a}{2}$ $\frac{B}{2}$					
a B	$\frac{a}{2}$ $\frac{B}{2}$					
a b	$\frac{a}{2}$ $\frac{B}{2}$					

↳ BROWNNESS OCCURS IN OCCURRENCE OF THE "B" DOMINANT ALLELE (MARKED IN BLUE).

↳ RATIO OF BLACK TO NORMAL OFFSPRING IS 1:1, BECAUSE OF EPISTASIS. (DEPENDENT ON THE SECOND GENE TO BE RECESSIONAL).

#17 Because black female has no history of recessives in ancestry, it must be  $Bc + \frac{C}{B}$ . The albino male must be  $\frac{b}{b} + \frac{c}{c}$ .

F <sub>1</sub>	B c	B C	b c	B C	B c	B C
b c	$\frac{B}{2}$ $\frac{c}{2}$					
b c	$\frac{B}{2}$ $\frac{c}{2}$					
b c	$\frac{B}{2}$ $\frac{c}{2}$					
b c	$\frac{B}{2}$ $\frac{c}{2}$					

PHENOTYPES: BLACK ( $\frac{16}{16}$ )

GENOTYPES: BbCc ( $\frac{16}{16}$ )

PHENOTYPES: BLACK ( $\frac{16}{16}$ )  
BROWN ( $\frac{3}{16}$ )  
ALBINO ( $\frac{4}{16}$ )

F <sub>2</sub>	B c	B c	b c	b c	$\frac{b}{2}$ $\frac{C}{2}$	
B C	$\frac{B}{2}$ $\frac{c}{2}$					
B C	$\frac{B}{2}$ $\frac{c}{2}$					
B C	$\frac{B}{2}$ $\frac{c}{2}$					
B C	$\frac{B}{2}$ $\frac{c}{2}$					

PHENOTYPES: SEE PUNNET SQUARE  
RATIO IS 9:3:4 FOR BLACK TO BROWN TO ALBINO MIX.

#18 Male C<sub>1</sub>C<sub>1</sub> children with female C<sub>1</sub>C<sub>1</sub>

F <sub>1</sub>	C 0	C 0	C 0	C 0	C 0	C 0
c 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
c 0	c 0	c 0	c 0	c 0	c 0	c 0

PHEnotypes: colored ( $\frac{15}{16}$ )  
genotypes:  $\frac{C}{c} + \frac{0}{0}$  ( $\frac{15}{16}$ )

F <sub>2</sub>	C 0	C 0	C 0	C 0	C 0	C 0
c 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
c 0	c 0	c 0	c 0	c 0	c 0	c 0

PHEnotypes: colored ( $\frac{9}{16}$ )  
genotypes: white ( $\frac{7}{16}$ )

genotypes: see Punnett square

F <sub>2</sub>	C 0	C 0	C 0	C 0	C 0	C 0
c 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0	C 1 0
c 0	c 0	c 0	c 0	c 0	c 0	c 0

PHEnotypes: colored ( $\frac{4}{16}$ )  
genotypes: white ( $\frac{12}{16}$ )

genotypes: see Punnett square

EXPECTED PHEnotypes would be 25% colored and 75% white CHILDREN.

19 HOMOZYGOTIC SHORT HAIRLESS BUNNY (L<sub>1</sub> L<sub>1</sub> B<sub>1</sub> B<sub>1</sub>) crossed with HETEROZYGOTIC LONG HAIR (L<sub>1</sub> L<sub>1</sub> B<sub>2</sub> B<sub>2</sub>)

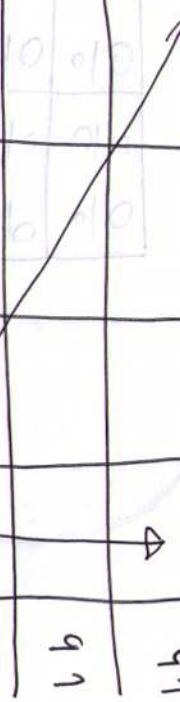
F <sub>1</sub>	L B	L B	L B	L B
L b	L B	L B	L B	L B
L b	L B	L B	L B	L B
L b	L B	L B	L B	L B
L b	L B	L B	L B	L B

MALE  $\frac{L}{L} + \frac{B}{B}$  WITH FEMALE  $\frac{L}{L} + \frac{B}{B}$

F <sub>2</sub>	L B	L b	L B	L b
L B	L B	L B	L B	L B
L b	L B	L B	L B	L B
L b	L B	L B	L B	L B
L B	L B	L B	L B	L B

PHENOTYPES: SHORT BLACK HAIR (L<sub>1</sub> L<sub>1</sub>)

GENOTYPES:  $\frac{L}{L} + \frac{B}{B}$  (L<sub>1</sub> L<sub>1</sub>)



PHENOTYPES: SHORT BLACK HAIR (L<sub>1</sub> L<sub>1</sub>)  
SHORT BROWN (L<sub>1</sub> B)  
LONG BLACK (B B)  
LONG BROWN (B B)

GENOTYPES: SEE PUNNET SQUARE

PHENOTYPES & 9:3:3:1 SHORT BLACK HAIR TO SHORT BROWN HAIR TO LONG BLACK HAIR TO LONG BROWN HAIR.

	short black	short brown	long black	long brown
short black	100%	0%	0%	0%
short brown	0%	100%	0%	0%
long black	0%	0%	100%	0%
long brown	0%	0%	0%	100%

(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z)

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#20 Heterozygous TALL RED POMATO MATE WITH Homozygous SHORT YELLOW TOMATO CROSS  
 $(\frac{Y}{y} + \frac{D}{d}) \text{ MATE } (\frac{y}{y} + \frac{d}{d})$

F <sub>1</sub>	Y D	Y d	y D	y d	Y D	Y d	y D	y d
y A	$\frac{Y}{y}$	$\frac{D}{d}$						
y d			$\frac{Y}{y}$	$\frac{D}{d}$				
y d					$\frac{Y}{y}$	$\frac{D}{d}$		
y d							$\frac{Y}{y}$	$\frac{D}{d}$

Phenotypes: TALL RED ( $\frac{9}{16}$ )

Genotypes:  $\frac{Y}{y} + \frac{D}{d}$  ( $\frac{16}{16}$ )

$$\frac{Y}{y} + \frac{D}{d} \text{ MATE } \frac{y}{y} + \frac{D}{d}$$

F <sub>2</sub>	Y D	Y d	y D	y d	Y D	Y d	y D	y d
y D	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$
y D	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$
y D	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$
y D	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$	$\frac{Y}{y}$	$\frac{D}{d}$

Phenotypes: TALL RED ( $\frac{9}{16}$ )

Genotypes: TALL RED ( $\frac{3}{16}$ )

Phenotypes: TALL YELLOW ( $\frac{3}{16}$ )

Genotypes: SHORT YELLOW ( $\frac{1}{16}$ )

TO SHORT RED TO TALL YELLOW.  
 TO SHORT YELLOW PLATED.