1. 29:9 is ~ 3:1 ∴ parents are Bb + Bb

Both exhibit the black phenotype and...

Bb x Bb

	B	b
B	BB	Bb
b	Bb	bb

... this produces a 3 black : 1 white phenotypic ratio in the offspring.

2. Bb x bb

	B	b
b	Bb	bb
b	Bb	bb

F_1 is 50% Bb + 50% bb (genotypic)(1:1)
50% black + 50% white (phenotypic)(1:1)

a) backcross of black progeny to black parent

Bb x Bb

	B	b
B	BB	Bb
b	Bb	bb

genotypic ratio: 1 BB : 2 Bb : 1 bb
phenotypic ratio: 3 black : 1 white

b) backcross of black progeny to white parent

Bb x bb

	B	b
b	Bb	bb
b	Bb	bb

genotypic ratio: 1 Bb : 1 bb
phenotypic ratio: 1 black : 1 white

③ P_1 rr x RR

	r	r
R	Rr	Rr
R	Rr	Rr

F_1

Rr x Rr

	R	r
R	RR	Rr
r	Rr	rr

F_2

Backcrosses:

Ⓐ RR♂ x rr♀

Ⓑ [Rr♂ x rr♀] x2

Ⓒ rr♂ x rr♀

	R	R
r	Rr	Rr
r	Rr	Rr

[

	R	r
r	Rr	rr
r	Rr	rr

] x2

	r	r
r	rr	rr
r	rr	rr

Total genotypic ratio: 8 Rr : 8 rr (or 1:1)

Total phenotypic ratio: 8 red : 8 sepia (or 1:1)

(4) If both parents have the normal phenotype but can have an albino child, they both have the Aa genotype.

Aa x Aa

	A	a
A	AA	Aa
a	Aa	aa

phenotypic ratio: 3 normal : 1 albino

a) ∴ next child, 25% (1/4) probability for albino

b) $1/4 \cdot 1/4 = 1/16$ chance the next two will be albino.

c) $1/4 \cdot 3/4 = 3/16$ (albino first, normal second)

$3/4 \cdot 1/4 = 3/16$ (normal first, albino second)

so... $3/16 + 3/16 = 6/16 = 3/8$ chance they will have one albino + one normal child.

c) another interpretation: if you assume (from the problem) that the couple already has the one albino child, 3/4 chance the next is normal.

(5) a) BB x Bb

	B	B
B	BB	BB
b	Bb	Bb

geno: 2BB : 2Bb (or 1:1)
pheno: 4 red : 0 ~~white~~ silver-black

b) Bb x bb

	B	b
b	Bb	bb
b	Bb	bb

geno: 2Bb : 2bb (1:1)
pheno: 2 red : 2 silver-black (1:1)

c) BB x bb

	B	B
b	Bb	Bb
b	Bb	Bb

geno: 4 Bb : 0 anything else
pheno: 4 Red : 0 silver-black

(6) WWDD x wwdd

↓

F_1 is all WwDd

WwDd x WwDd

↓

	WD	Wd	wD	wd
WD	WWDD	WWDd	WwDD	WwDd
Wd	WWDd	WWdd	WwDd	Wwdd
wD	WwDD	WwDd	wwDD	wwDd
wd	WwDd	Wwdd	wwDd	wwdd

F_2 White, disc : 9/16

White, sphere : 3/16

yellow, disc : 3/16

yellow, sphere : 1/16

9 : 3 : 3 : 1

(7) GgNn x GgNn (same pattern as)

↓

Gray, normal : $\frac{9}{16} \cdot \frac{256}{1} = 144$

Gray, vestigial : $\frac{3}{16} \cdot \frac{256}{1} = 48$

Ebony, normal : $\frac{3}{16} \cdot \frac{256}{1} = 48$

Ebony, vestigial : $\frac{1}{16} \cdot \frac{256}{1} = 16$

(8) a) SsBb x SSbb

	SB	Sb	sB	sb
Sb	SSBb	SSbb	SsBb	Ssbb

geno: 1 SSBb : 1 SSbb : 1 SsBb : 1 Ssbb

pheno: 2 short, black : 2 short, brown

(or 1:1)

b) SsBb x Ssbb

	SB	Sb	sB	sb
Sb	SSBb	SSbb	SsBb	Ssbb
sb	SsBb	Ssbb	ssBb	ssbb

geno: 1 SSBb : 1 SSbb : 2 SsBb : 2 Ssbb : 1 ssBb : 1ss

pheno: short, black : ||| (3)

short, brown : ||| (3)

long, black : | (1)

long, brown : | (1)

9 a) The sow's genotype is probably WWMM because when mated to the boar (ww mm), all the progeny will have the white, mule phenotype.

WWMM x ww mm

	WM	WM
wm	Ww Mm	Ww Mm
wm	Ww Mm	Ww Mm

b) Now it is most probable that the sow is WWMm.

WWMm X ww mm

	WM	Wm
wm	Ww Mm	Ww mm
wm	Ww Mm	Ww mm

Until the last litter, all the offspring were Ww Mm even though there was a 1/2 probability of being Ww mm. This occurance (26 ~~#~~ Ww Mm in a row) is possible, but statistically improbable. (one chance in 67,108,864)

(10) $X^H X^h \cdot X^H Y$

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y	$X^H Y$	$X^h Y$

pheno: 2 normal ♀, 1 normal ♂, 1 hemo. ♂)

geno: 1 $X^H X^H$, 1 $X^H X^h$, 1 $X^H Y$, 1 $X^h Y$

11 a) $X^yY \cdot X^yX^y$

	X^y	Y
X^y	X^yX^y	X^yY
X^y	X^yX^y	X^yY

pheno: 1 yellow ♀ : 1 yellow ♂

b) $X^yX^y \cdot X^YY$

	X^y	X^y
X^Y	X^YX^y	X^YX^y
Y	X^yY	X^yY

pheno: 1 ~~yellow~~ wild type ♀ : 1 yellow ♂

c) $X^YX^Y \cdot X^yY$

	X^Y	X^Y
X^y	X^YX^y	X^YX^y
Y	X^YY	X^YY

pheno: 1 w-t ♀ : 1 w-t ♂

d) $X^YX^y \cdot X^YY$

	X^Y	X^y
X^Y	X^YX^Y	X^YX^y
Y	X^YY	X^yY

pheno: 2 w-t ♀ : 1 w-t ♂ : 1 yellow ♂

e) $X^YX^y \cdot X^yY$

	X^Y	X^y
X^y	X^YX^y	X^yX^y
Y	X^YY	X^yY

pheno: 1 w-t ♀ : 1 yellow ♀ : 1 w-t ♂ : 1 yellow ♂

(12) If the woman's father was colorblind (X^cY), he had to give the colorblind allele. She exhibits the normal phenotype, so her genotype must be X^CX^c.

$$X^CX^c \cdot X^cY$$

	X^C	X^c
X^c	X^CX^c	X^cX^c
Y	X^CY	X^cY

a) 1/4 chance

b) 50% colorblind girls

c) 50% normal

(13) $C^YC^W : C^YC^W$

	C^Y	C^W
C^Y	C^YC^Y	C^YC^W
C^W	C^YC^W	C^WC^W

pheno: 1 yellow : 2 cream : 1 white

geno: 1 C^YC^Y : 2 C^YC^W : 1 C^WC^W

14) W = white allele
W' = black allele

a) $WW \cdot W'W'$

	W	W
W'	WW'	WW'
W'	WW'	WW'

all checkered

b) $WW' \cdot WW'$

	W	W'
W	WW	WW'
W'	WW'	W'W'

pheno: 1 white : 2 checkered : 1 black
genot: 1 WW : 2 WW' : 1 W'W'

15) a) Incomplete dominance is shown because the two alleles "blend" in the phenotype. If it were codominance, the progeny of splashed + black would have splashed regions + black regions.

b) S = splashed allele
S' = black allele

$SS \cdot S'S'$

	S	S
S'	SS'	SS'
S'	SS'	SS'

F_1 all "blue"

$SS' \cdot SS'$

	S	S'
S	SS	SS'
S'	SS'	S'S'

F_2 pheno: 1 splashed
2 A. blue
1 black

16

a) $M^R M \cdot M^R m$

	M^R	m
M^R	$M^R M^R$	$M^R m$
M	$M^R M$	Mm

genot. $1\, M^R M^R : 1\, M^R M : 1\, M^R m : 1\, M$

phenot. 3 restricted : 1 mallard

b) $M^R m \cdot Mm$

	M	m
M^R	$M^R M$	$M^R m$
m	Mm	mm

genot: $1\, M^R M : 1\, M^R m : 1\, Mm : 1\, mm$

phenot: 2 restricted : 1 mallard : 1 dusky

c) $Mm \cdot mm$

	m	~~m~~ not necessary
M	Mm	
m	mm	

genot: $1\, Mm : 1\, mm$

phenot: 1 mallard : 1 dusky

(17) a) Yes, it could if $I^Bi \times I^Ai$.

	I^B	i
I^A	I^AI^B	I^Ai
i	I^Bi	ii — this could be the child.

b) I^BI^B would make it impossible.

c) No. As in b above, I^AI^B has no i allele to give to the child.

(18) $SS \times ss$

$\downarrow$

$Ss \times s^hs^c$

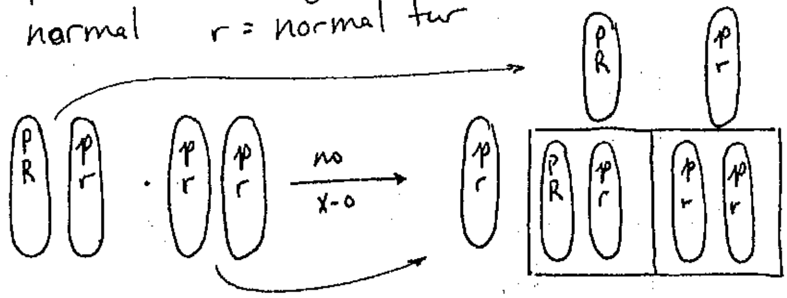
	S	s
s^h	Ss^h	s^hs
s^c	Ss^c	s^cs

geno: $1\ Ss^h : 1\ Ss^c : 1\ s^hs : 1\ s^cs$

pheno: 2 Dutch : 1 Hereford : 1 Solid

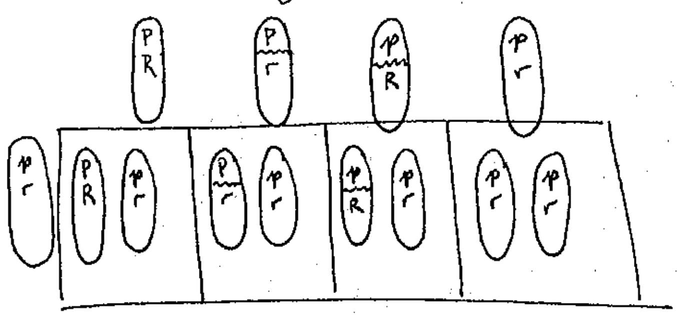
(19) P = pollex R = rough fur
p = normal r = normal fur

a)



1 pollex + rough : 1 normal + normal

b) <u>with</u> crossing over



95 rough, pollex 35 pollex, norm. 29 rough, norm 103 normal, normal

$\underbrace{\text{35 pollex, norm.}}_{\text{X-o}}$ $\underbrace{\text{29 rough, norm}}_{\text{X-o}}$

$$\text{frequency of X-o} = \frac{\#\ \text{X-o}}{\#\ \text{population}} = \frac{64}{262} = .244 = 24.4\%$$

c) 24.4% X-o = 24.4 map units apart

(20) B = wild-type body V = wild-type wings
b = black body v = vestigial wings

a) All of the F1 generation will be heterozygous for both traits.

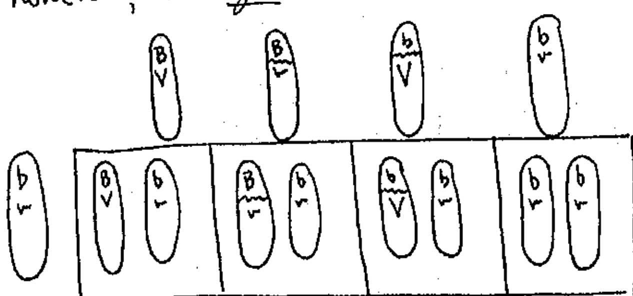
b) Yes, they are linked. If they weren't linked, we'd expect:

BbVv · bbvv

	BV	Bv	bV	bv
bv	BbVv	Bbvv	bbVv	bbvv

1 wild, wild : 1 wild, vestigial : 1 black, wild : 1 black, vestigial

however, we got



1930 normal (wild, wild) | 370 wild vestigial | 412 black wild | 1880 black vestigial

$\underbrace{370 \text{ wild vestigial} \quad 412 \text{ black wild}}_{\text{X-o}}$

c) $\text{Freq. X-o} = \dfrac{\# \text{ X-o}}{\# \text{ population}} = \dfrac{370+412}{1930+370+412+1880} = \dfrac{782}{4592} = .170$

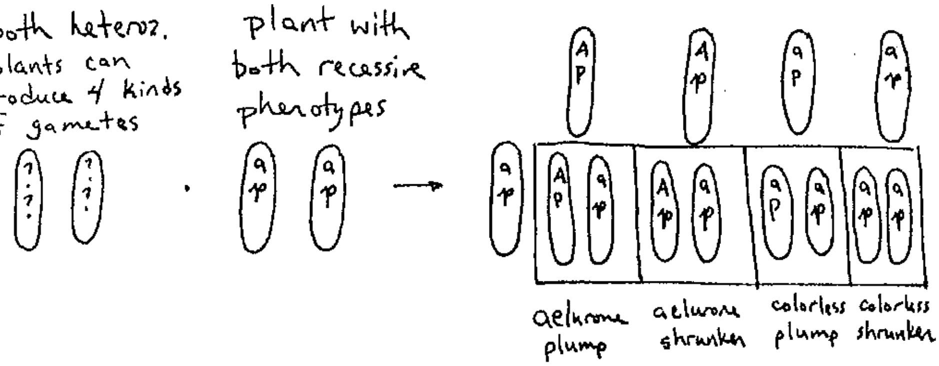
The genes are 17.0 map units apart.

(21) A = aleurone　　P = plump
a = colorless　　p = shrunken

Linked gene rules of thumb:

1) Phenotypes with higher than expected frequency show the allele combination of the unaltered chromosomes.
2) Phenotypes with lower than expected frequency are the result of crossing over.

both heteroz. plants can produce 4 kinds of gametes　　plant with both recessive phenotypes



plant A　　610　　380　　392　　618
crossing over (380, 392)

plant B　　382　　612　　616　　390
X-o (382)　　X-o (390)

	original	crossed over
Plant A's chromosomes	A P　a p	A p　a P
Plant B's chromosomes	A p　a P	A P　a p