HOW TO SOLVE GENETICS PROBLEMS

1. Read the problem.

2. Determine what traits are dominant and which are recessive. Often you must marshal background knowledge to do this – which may not be explicitly mentioned in the problem.

3. Are any letters assigned to the genes? If not, make some up. We usually take the **dominant characteristic** and use the first letter of that word. For example, if **polydactyly** (extra fingers) is dominant over the normal five–fingered condition , we would pick **P** for the dominant gene, and small **p** for the recessive normal allele.

4. Determine, if possible, the genotypes of the parents. In 9 out of 10 problems this information is given, or at least implied. Sometimes you have to deduce it from other information given. Write it down so that you can remember what it is, e.g. **Pp**.

5. Determine all the possible kinds of gametes that can be made by each parent. Be careful, remember that a gamete can ordinarily receive only one gene of a pair of alleles. This is the part that most people have trouble with! e.g. **P p**.

6. Make a Punnett square, using each of the gametes for one parent across the top of each column, those of the other parent go vertically. If you have done step 5 properly you shouldn't have any trouble with this step.

7. Work the cross carefully.

8. Now read the problem again. Find out exactly what it is asking for. Don't assume too much. This is another place where many people get lost.

9. In most problems, these steps should get you through adequately. Some are slightly altered – for example, if the genotype of one of the parents is unknown, and that is what the problem wants you to discover. You may assign that parent something like A_ or __ genotype and see if that helps. Put the offspring genotypes in the square and work backward. Remember this won't get **all** the problems – there is still nothing like real understanding – but it can help organize your attack on a genetic problem. and of curse, unless you understand the terms, such as homozygous, heterozygous, dominant, recessive, allele, and so on, you cannot begin to think of working problems.

10. Finally, the actual genetic information you need to solve these problems often appears concealed rather than revealed by the wording of the problem. learn to translate such a sentence, "Mary is normally pigmented but had an albino father", into its logical consequence: "Mary is heterozygous for albinism" and then into "Mary is Cc". Notice that, in this kind of a problem you may need to solve several subsidiary problems before you can proceed with the final solution.

PROBLEMS AND SOLUTIONS

1. In human families it is often observed that certain characteristics may "skip" a generation, then reappear. How would you explain this in the light of the facts expounded by Mendel?

   If a parent who is homozygous dominant for a trait marries a homozygous recessive person, then al of their children will express the dominant allele's phenotype. These children would be carriers and when marrying another carrier or a homozygous recessive person, the recessive phenotype could reappear. e.g. Aa x Aa produce AA, Aa and aa.

2. In certain Norwegian families there is an inherited condition known as "woolly hair". Individuals showing this characteristics have hair which resembles sheep's wool. A study of family pedigrees shows that a person never has woolly hair unless at least one parent also has woolly hair. How would this character most likely be inherited? **Explain.**

   Dominant traits do not skip generations. Only one dominant allele is required for expression in the phenotype. Since woolly hair only occurs when one parent has it too, it is due to a dominant allele not a recessive one.

3. In Holstein cattle the spotting of the coat is due to a recessive gene while a solid–coloured coat is dominant. What types of offspring might be produced by a cross between two spotted animals? Show how you reach your conclusion. The gene **P** is responsible for coat pattern.

   *Let **P** be the dominant allele for a solid coloured coat.*
   *Let **p** be the recessive allele for a spotted coat.*

   *Parents: **pp** x **pp** (no **P** present)*

   Punnett Table

		sperm	*sperm*
		p	*P*
egg	*p*	*pp*	*pp*
egg	*p*	*pp*	*pp*

   ∴ all of the offspring of two spotted animals are also spotted

4. In cats the gene for short hair is dominant over the gene for long hair (angora). A short–haired tom is mated with an Angora female. She bears eight kittens, six short–haired and two with long hair. How do these numbers compare with the expected ratio? If you mated these same cats four more times and obtained a total of forty offspring, would you expect the results to be a closed approximation of the expected ratios? Explain.

   Let gene H control the length of the cat's hair

   *Let **H** be the dominant allele for short hair.*
   *Let **h** be the recessive allele for long hair.*

   *Short–haired tom: **H**_ (we don't know the second allele for sure)*
   *Angora female: **hh***

*Two of their offspring are long–haired with a genotype of **hh**. Therefore, each parent contributed an h allele and therefore the tom cat father has the genotype **Hh**.*

Punnett Table

		eggs (all the same)	
		h	*h*
Sperm	*H*	*Hh*	*Hh*
Sperm	*h*	*hh*	*Hh*

Expected ratio is 1 Hh : 1 hh

Actual ratio is 3 Hh : 1 hh

Over a long range of matings, the actual ratio should approach the expected ratio.

5. The hornless condition in cattle is dominant over horned. A cattleman has a herd of hornless cattle only, but some horned cattle occasionally appear. These are removed from the range before they can reproduce. Assuming that this man has good fences which can keep out stray bulls, how could this be explained?

   One of this farmer's original cattle was a hornless carrier animal for the gene for horns. When the original cattle reproduce, most of their offspring will be hornless carriers of the recessive allele for horns. Occasionally, during mating, two recessive alleles will meet to produce a horned animal. These homozygous animals are quickly removed by the farmer so that they won't reproduce with other cattle. It is unlikely that the recessive allele will quickly be removed especially if the Hardy Weinberg conditions apply.

6. In summer squash, white coloured fruit is dominant over yellow. If you place pollen from a yellow–fruited plant on the pistil of a hybrid white–fruited (heterozygous) plant, what type of seeds would you expect from the seed which come from this cross?

   Let the gene C control fruit colour in summer squash.

   *Let **C** be the dominant allele for a white–coloured fruit.*
   *Let **c** be the recessive allele for a yellow–coloured fruit.*

Punnet Table

		eggs	*eggs*
		C	c
Pollen	c	Cc	cc

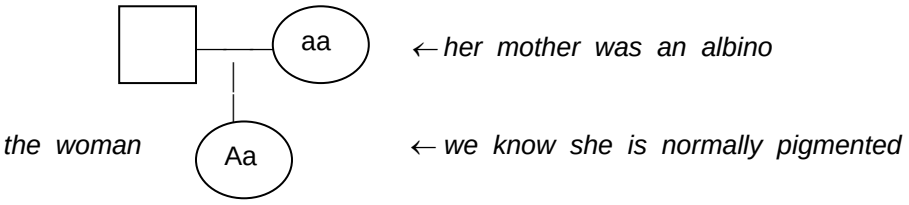
Cc : hybrid white–fruited plant

Cc : yellow–fruited plant

You can expect hybrid white–fruited plants and yellow–fruited plants in a 1 : 1 ratio

7. An albino man marries a normally–pigmented woman who had an albino mother. Show the types of children that this couple may have and the proportions of each. (Albino is recessive; normal is dominant).

*Let gene **A** control human pigmentation : **A** for normal; **a** for albino*



*She must have inherited **a** from her mother; but we know she has normal pigmentation, therefore, she must have inherited **A** from her father. Therefore, her genotype is **Aa**. Since she marries an albino – whose genotype is **aa** – their offspring could be:*

Punnett Table

		eggs *A*	*eggs* *a*
Sperms	*a*	*Aa*	*Aa*
sperms	*a*	*Aa*	*Aa*

Their children would either be normally pigmented carriers for albinism or they would be albinos.

Proportions: 1 normal carrier : 1 albino

8. In Drosophila, vestigial wings and ebony colour are due to two separate recessive genes. The dominant alleles are normal (long) wings and normal (gray) body colour. What type of offspring would you expect from a cross between a bomozygous vestigial ebony female and a normal double homozygous (long–winged, gray–bodied) male? If the F_1 are allowed to breed among themselves what types of offspring would you expect in the F_2? Show complete genotype and phenotype of both generations.

This is a dihybrid crosss.
*Gene **L** controls wing length and gene **G** controls body colour.*

*Let **L** be the dominant allele for normal long wings.*
*Let **l** be the recessive allele for vestigial wings.*
*Let **G** be the dominant allele for normal gray body colour.*
*Let **g** be the recessive allele for ebony body colour.*

*Homozygous vestigial ebony female : **llgg***
*Normal (long–winged, gray–bodied) male : **LLGG***

Parents : llgg x LLGG

Punnett Table

		eggs *lg*
sperms	*LG*	*LlGg*

offspring from this mating are long–winged, gray–bodied Drosophila.

We raise an F_2 by mating the F_1 among themselves: LlGg x LlGg

F_1 gametes

	LG	Lg	LG	lg
LG	LLGG	LLGg	LlGG	LlGg
Lg	LLGg	LLgg	LlGg	Llgg
lG	LlGG	LlGg	llGG	LlGg
lg	LlGg	Llgg	llGg	llgg

Independent assortment of chromosomes

F_1 gametes

F_2 Genotypes

Types of offspring in the F_2 generation of a dihybrid cross:

GENOTYPE	PROPORTIONS	PHENOTYPE
LLGG	1 / 16	normal (long, gray)
LLGg	2 / 16	Normal
LlGG	2 / 16	Normal
LlGg	4 / 16	Normal
LLgg	1 / 16	Long winged, gray body
Llgg	2 / 16	Long winged, ebony body
llGG	1 / 16	Vestigial wings, gray body
llGg	2 / 16	Vestigial wings, gray body
llgg	1 / 16	Vestigial wings, ebony body

9. If you made a test cross of the F_1 males of the preceding problem what results would you expect to obtain? (A test cross is a backcross .)

F_1 male is LlGg x llgg female (homozygous recessive)

F_1 sperms

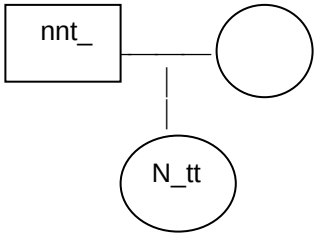
		LG	*Lg*	*lG*	*lg*
eggs	*lg*	*LlGg*	*Llgg*	*llGg*	*llgg*

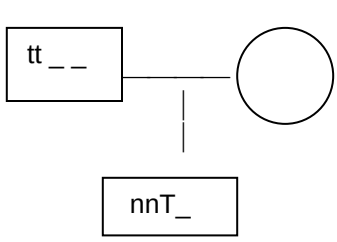
Phenotypes are: *1 long, gray* *1 vestigial, gray*
1 long, ebony *1 vestigial, ebony*

10. About 70% of Americans get a bitter taste from a chemical called phenyl thiocarbamide (PTC); the others do not. The ability to taste this chemical results from a dominant gene while taste–blindness is recessive. A normally pigmented woman who is non–taster has a father who is an albino–taster. She marries an albino man who is a taster, but who has a mother who is non–taster. Show the types of children which this couple may have.

Gene **T** controls taste ability; gene **N** controls pigmentation.

*Let **T** be the dominant allele for being able to taste PTC.*
*Let **t** be the recessive allele for taste–blindness of PTC.*
*Let **N** be the dominant allele for normal pigmentation.*
*Let **n** be the recessive allele for albinism.*





information given

.: the woman's genotype is Nntt
and the man's genotype is nnTt

	Nt	Nt
nT	NnTt	nnTt
nt	Nntt	nntt

The children can be:

GENOTYPE	***PHENOTYPE***
NNtT	Normal pigmented tasters
Nntt	Normal pigmented non–1 taster
NnTt	Albino tasters
Nntt	Albino non–tasters

11. In tomatoes, yellow fruit and dwarfed vine are due to recessive alleles of genes which produce the more common red fruit and tall vine. If pollen from the pure–line dwarf plant bearing red fruit is placed on the pistil of a pure–line tall plant bearing yellow fruit, what type of plant and fruit would be expected in the F_1? If these are crossed among themselves, what results would be expected in the F_2?

This is a dihybrid cross.
*Gene **R** controls fruit color; gene **T** controls height.*

*Let **R** be the dominant allele for red fruit.*
*Let **r** be the recessive allele for yellow fruit.*
*Let **T** be the dominant allele for tall vine.*
*Let **t** be the recessive allele for dwarf vine.*

*Pureline (homozygous) dwarf plant bearing red fruit: **ttRR***
*Pureline (homozygous) tall plant bearing yellow fruit: **TTrr***

Punntt Table

	Tr
tR	*TtRr*

F_1 offspring are all red, tall–vined plants

TtRr x TtRr

	TR	*Tr*	*tR*	*tr*
TR	*TTRR*	*TTRr*	*TtRR*	*TtRr*
Tr	*TTRr*	*TTrr*	*TtRr*	*Ttrr*
tR	*TtRR*	*TtRr*	*ttRR*	*ttRr*
tr	*TtRr*	*Ttrr*	*ttRr*	*ttrr*

12. Some dogs bark while trailing, others are silent. The barking trait is due to a dominant gene. Erect ears are dominant to drooping ears. What kind of pups would be expected from a double heterozygous erect–eared, barker mated to a drooped–eared, silent trailer?

Gene **B** controls the barking ability; gene **E** controls ear shape.

*Let **B** be the dominant allele for the barking trait.*
*Let **b** be the recessive allele for the silent trait.*
*Let **E** be the dominant for erect ears.*
*Let **e** be the recessive allele for drooping ears.*

*Heterozygous erect–eared barker: **BbEe***
*Drooped–eared, silent trailer: **bbee***

Punnett Table

	BE	*Be*	*bE*	*be*
be	*BbEe*	*Bbee*	*bbEe*	*bbee*

Expected pups:

Erect – eared (heterozygous) barker: ***BbEe***
Drooping – eared (homozygous) barker (heterozygous): ***Bbee***
Erect – eared (heterozygous) silent (homozygous) trailer: ***bbEe***
Drooping – eared silent trailer: ***bbee***

13. A woman has a rare abnormality of the eyelids called ptosis, which makes it impossible for her to open her eyes completely. The condition has been found to depend on a single dominant gene **P**. the woman's father had ptosis, but her mother had normal eyelids. Her father's mother had normal eyelids.
    a. What are the probable genotypes of the woman, her father and mother?
    b. What proportion of her children will be expected to have ptosis if she marries a man with normal eyelids?

Since the woman's father's mother had normal eyelids, ***pp****, then the woman's father can have at most* ***one P*** *allele; the one he would get from his father. Since we know that the woman's father had ptosis, we conclude that the father's genotype was* ***Pp****. Since the woman has ptosis, but her mother does not, we conclude that the woman's* ***P*** *allele comes from her father; therefore she gets a* ***p*** *allele from her mother. The woman's genotype is* ***Pp****. The woman's mother had normal eyelids, therefore her genotype is* ***pp****. If the woman marries a man with normal eyelids:* ***Pp x pp****,*

Punnett Table

sperm \ egg	*P*	*p*
p	*Pp*	*pp* ← *Normal eyelids*

ptosis

50% of her children will be expected to have ptosis.

14. In pigeons, the checkered pattern is dependent on a dominant gene **C** and plain on the recessive allele **c**. red colour is controlled by a dominant gene **B** and brown by the recessive allele **b**. diagram completely a cross between homozygous checkered, red and plain, brown birds. Summarize the expected F_2 results.

Let ***C*** *be the dominant allele for checkered feathers and* ***c*** *for the recessive plain.*
Let ***B*** *be the dominant allele for red feathers and* ***b*** *for the recessive allele for brown.*

Genotype of homozygous checkered red birds: ***CCBB***
Genotype of plain, brown birds: ***ccbb***

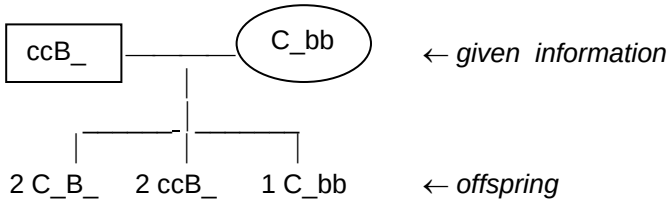
Punnett Table

	cb
CB	*CcBc*

F_1 offspring are heterozygous checkered, red birds

F_2 offspring:
9 checkered red birds (express both dominant traits).
3 checkered brown birds (express one dominant trait).
3 plain brown bird (express both recessive traits).
1 plain brown bird (express both recessive traits).

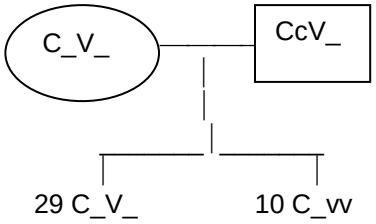
15. A checkered–brown female mated with a plain–red male produced 2 checkered–red, 2 plain–red, and 1 checkered–brown offspring. Give the probable genotypes of the parents.



*The two plain–red offspring, ccB_, got one **c** allele from their father and the other **c** allele from their mother. Since we know the mother has a **C** allele, the other one must be **c**. Therefore, the mother's genotype is **Ccbb**. The checkered brown pigeon got one **b** allele from his father and the other **b** allele from his mother. Since we know his father has one **B** allele, the other one must be **b**. Therefore, the father's genotype is **ccBb**.*

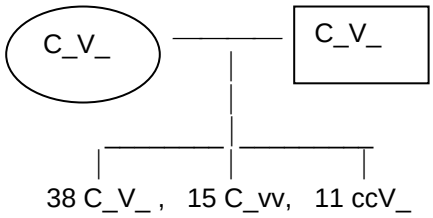
16. In mice, the gene **C** for coloured fur is dominant over its allele **c** for white. The gene **V** for normal behaviour is dominant over **v** that for waltzing. Give the probable genotypes of the parent mice (each was mated repeatedly) that produced the following offspring:
    a. coloured–normal mated with white–normal, produced 29 coloured–normal and 10 coloured–waltzers;
    b. coloured–normal mated with coloured–normal, produced 38 coloured–normal, 15 coloured–waltzers, 11 white–normal and 4 white–waltzers;
    c. coloured–normal mated with white–waltzer , produced 8 coloured–normal, 7 coloured–waltzers, 9 white–normal and 6 white–waltzers.

a.



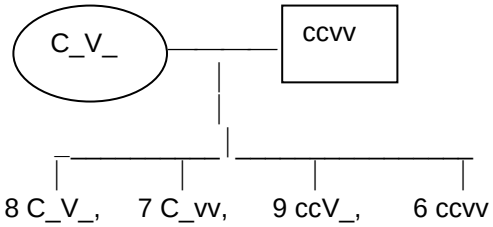
∴ *father's genotype is CCVv; mother's genotype is ccVv.*

c.



∴father's genotype is CcVv; mother's genotype is CcVv.

c.



∴ father's genotype is CcVv; mother's genotype is ccvv.

17. In rabbits, black fur depends on a dominant allele **B** and brown on the recessive allele **b**. Normal length fur is determined by a dominant allele **R** and short (rex) by the recessive allele **r**.
    a. Diagram and summarize the results of a cross between a double homozygous black rabbit with normal length fur, and a brown–rex rabbit.
    b. What proportion of the normal–black F_2 rabbits from the above cross may be expected to be homozygous for both gene pairs?
    c. Diagram and summarize a backcross between the F_1 and the fully recessive brown–rex parent.

    Gene B controls fur colour; gene R controls fur length.

    *Let **B** be the dominant allele for black fur; **b** the recessive allele for brown.*
    *Let **R** be the dominant allele for normal fur length; **r** the recessive allele for rex (short).*

    *a. Homozygous black rabbit with normal–length fur: **BBRR***
    *Brown, rex rabbit: **bbrr***

    Punnett Table

	BR
Br	BbRr

    F_1 offspring are heterozygous black rabbits with normal length fur.

    c. There are nine different kinds of rabbits that have both dominant traits, black with normal length fur. Of those nine, only one is homozygous for both dominants.

    b. BbRr x bbrr

	br	
BR	*BbRr*	← *heterozygous black rabbits with normal length fur*
Br	*Bbrr*	← *black rabbits with short fur*
BR	*BbRr*	← *brown rabbits with normal length fur*
Br	*Bbrr*	← *brown rabbits with short fur*

18. In snapdragons, flower colour shows intermediate inheritance rather than dominance. Homozygous plants, **RR**, are red, heterozygous **RR'** are pink, and homozygous **R'R'** are white. Diagram a cross between a red–flowered and a white–flowered plant and summarize the F results under the headings of phenotypes, genotypes, genotypic frequency, and phenotypic ratio.

    *Let **R** be the allele for the red snapdragons and **R'** be the allele for white.*
    There is no dominance.

    RR x R'R'

	R'	
R	*RR'*	← *F_1 plants are pink*

RR' x RR'

	R	R'
R	RR	RR'
R'	RR'	R'R'

F_2 offspring

Phenotype	*Genotype*	*Genotypic Freqency*	*Phenotypic Retio*
Red	*RR*	*1/4*	*1*
Pink	*RR'*	*1/2*	*2*
White	*R'R'*	*1/4*	*1*

19. In shorthorn cattle, the gene **R** for red coat colour is not dominant over white **R'**. The heterozygous combination **RR'** produces roan. A breeder has white, red and roan cows and bulls. What phenotypes might be expected from the following matings and in what proportions:
    a. red x red
    b. red x roan
    c. red x white
    d. roan x roan
    e. roan x white
    f. white x white
    g. would it be easier to establish a true–breeding herd of red or a true–breeding herd of roan shorthorns? Explain.

    *Let **R** be the allele for red coat in cattle and **R'** be the allele for white.*
    There is no dominance.

    a. red
    b. 1 red : 1 roan
    c. roan
    d. 1 red : 2 roan : 1 white
    e. 1 white : 1 roan
    f. white
    g. It would be easier to establish a true–breeding herd of red shorthorns because two red parents would have red F_1 offspring which would inbreed and have red F_2 offspring and so on. Roan are never homozygous and therefore would produce red, roan and white offspring.

20. A colour blind man marries a woman with normal vision. Her mother was colour blind. What kind of children would you expect from this marriage?

    Colourblindness is due to a sex–linked recessive allele. It on the X–chromosome.

    *The colour vision gene **C** has two alleles. It is shown on the X–chromosome.*

    *X^C = X–chromosome with the dominant **C** allele for normal vision.*
    *X^c = X–chromosome with the recessive **c** allele for colourblindness.*

Parents are : colourblind man $\rightarrow \therefore X^cY$
normal woman who had a colourblind mother $\rightarrow \therefore X^CX^c$

Parents: $X^CX^c \times X^cY$

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

The kind of offspring from such a marriage are:

Half the daughters will be normal but carriers.
Half the daughters will be colourblind.
Half the sons will be normal.
Half the sons will be colourblind.

21. Suppose a young lady comes to you for advice in your capacity as a marriage counselor. She tells you her brother has hemophilia, but both of her parents are normal. She wishes to marry a man who has no history of hemophilia in his family. She would like to know the probability of having hemophilic offspring. Explain.

The lady has a brother with hemophilia but her parents are normal.

Hemophilia is due to a sex–linked recessive allele. It is therefore on the X chromosome.

Let X^H *represent the X chromosome with the dominant allele for normal blood clotting.*

Let X^h *represent the X chromosome with the recessive allele for hemophilia.*

The parents of the lady must be: X^HX^h *and* X^HY.

The brother of the lady must be X^hY.

The lady is either X^HX^h *or* X^HX^h.

If she marries a normal man then she either has 0% chance or a 50% chance of having hemophilic son depending on her own genetype.

22. A woman with normal vision marries a man with normal vision and they have a colour blind son. Her husband dies and she marries a colour blind man. Show the type of children that might be expected from the second marriage and the proportions of each.

Keep in mine: X^C *= X chromosome with dominant allele for normal vision.*
X^c *= X chromosome with recessive allele for colourblindness.*

First marriage: $X^CX^?$ *and* X^CY

They have a colourblind son. Therefore she must be a carrier for Colourblindness. Her genotype is now known to be X^CX^c

Second marriage: X^CX^c *and* X^cY

Since he is colourblind and she is a carrier the possibilities are as follows:

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

23. A man has hypertrichosis of the ears, a condition which is due to a gene on the non–homologous portion of the Y chromosome (hollandria). He marries a normal woman. Show the types of children they may expect.

Hypertrichosis is on the Y chromosome.

Parents: normal woman x hairy–eared man

$XX \quad x \quad XY^h$

	X	Y^h
X	*XX* *normal female*	XY^h *Hairy–eared male*

All their sons will have hypertrichosis (hairy ears).

24. Two drosophila are crossed and yield 82 females and 38 males. Such a great deviation from the expected 1:1 ratio could hardly be due to chance. Suggest an alternate explanation. Think on this one.

We expect 1:1 ratio of male to female but we only hatch out half as many males as we anticipate. Something is affecting the survival of males. Possibility: A recessive lethal gene on the X. if a recessive lethal is on the X then we expect males who receive the lethal do die and not hatch.

$\boldsymbol{X^L}$ = *normal*
$\boldsymbol{X^l}$ = *recessive lethal*

If we mate a carrier female X^LX^l *to a normal male* X^LY *, we get:*

	X^L	Y
X^L	X^LX^L *normal female*	X^LY *normal male*
X^l	X^LX^l *carrier female*	X^lY *dies*
∴ Result is 2 females : 1 male PROBLEM SOLVED!		

25. A woman bears a child with erythroblastosis at her second delivery. She has never had a blood transfusion. On the basis of this data, classify the woman, her husband and both children as to Rh type.

Rhesus antigen production is under the control of the Rh gene which has two alleles:

Rh = dominant allele for Rhesus antigen production and results in Rh^+ blood;
rh = recessive allele for no rhesus antigen and results in Rh^- blood.

In order to have erythroblastosis the baby must be Rh^+ and the mother has to be Rh^-.

In the first pregnancy the Rh^- mother (rhrh) carries an Rh^+ fetus (Rh_). She had leakage of blood between herself and her fetus resulting in her becoming sensitized to the Rh antigen.

At her second Rh^+ pregnancy and following additional leakage from mother to fetus, the baby's blood cells are attacked and destroyed by the anti–Rh antibodies produced by the mother.

25. A man has blood type A and his wife has type B. A physician types the blood of their four children and is amazed to find one of each of the four blood types among them. He is not familiar with genetics and calls upon you for an explanation. Provide one.

The ABO system is due to a gene which is multiple allelic.

I^A represents the allele that produces antigen A.
I^B represents the allele that produces antigen B.
(There is no dominance between I^A and I^B.
i represents the recessive allele for no antigen production.

In order for a couple of blood types A and B to have A, B, AB, and O children, each parent must be heterozygous.

Parent genotypes: I^Ai and I^BI

	I^B	i
I^A	I^AI^B	I^Ai
i	I^Bi	ii

Four phenotypes result: AB, B, A, O

26. A woman is Rh positive and both of her parents are Rh positive. She marries an Rh negative man. Is there any chance that they may have any Rh negative children? Explain.

Rh gene has two alleles:

Rh = Rh antigen produced ∴ Rh^+
rh = no Rh antigen produced ∴ Rh^-

Woman is Rh^+ ∴ Rh _

Her parents are Rh^+ but may be carriers for rh, so the woman could be a carrier too. We can't tell for sure yet. She would have to have children that are Rh^- in order for us to know for sure that she is RhRh or Rhrh.

Husband is Rh^- ∴ rhrh.

The only way this couple could have Rh^- kids is if the woman is a carrier Rhrh.

27. Can a child having blood type A be born to parents having types AB and B respectively? Explain.

I gene has three alleles:

I^A = antigen A
I^B = antigen B
i = no antigen

Parents: AB and B; Genotypes: I^AI^B and I^B _

If the B parent is a carrier I^Bi then it is possible for an A child to be born. This would get I^A from one parent and i from the other.