

# Genetic Problems (I)

## SINGLE GENE INHERITANCE

1. What are the expected phenotypic and genotypic ratios in the F1 generation?

Where black guinea pigs are dominant and white are recessive.

- a. P= Pure bred black mated with white
- b. P= Hybrid black mated with white
- c. P= Heterozygous black mated with homozygous black

2. What are the expected parental phenotypes and genotypes? (how confident are you?)

Where two guinea pigs produce...

- a. 3 black offspring, 1 white offspring
- b. 3 black offspring
- c. 19 white offspring

3. If black guinea pigs are dominant and white are recessive.

3. How can one determine the genotype of a black guinea pig?

- a. What result would be definitive in nature?
- b. What is this procedure called?

4. If a black guinea pig is crossed with a white guinea pig what is its genotype?

Where black guinea pigs are dominant and white are recessive.

- a. If 23 pigs are black
- b. If 12 pigs are black and 1 is white

5. If you cross two hybrid guinea pigs, what is the probability of producing the following:

Where black guinea pigs are dominant and white are recessive.

- a. 3 black pigs
- b. 2 black pigs, 2 white pigs in that order
- c. 3 black male pigs
- d. 1 black female pig, 1 white male pig

6. If you cross two hybrid guinea pigs, what is the probability of producing the following:  
Where black guinea pigs are dominant and white are recessive.

- a. 3 black pigs, 1 white pig, in any order
- b. 2 black pigs, 2 white pigs, in any order
- c. 3 male pigs, 1 female pig, in any order

7. If a cross between two plants one with red flowers and the other with white flowers produces a 1:2:1 phenotypic ratio in the offspring, what type(s) of gene interaction(s) are at work?

- b. If this same cross produces red, white and pink offspring, what type(s) of gene interaction(s) are at work?
- c. If this same cross produces red, white and red/white offspring, what type(s) of gene interaction(s) are at work?

8. What are the expected genotypic and phenotypic ratios?

Where coat color in shorthorn breed of cattle is determined by two dominant genes, (red =  $C^R C^R$ ) (white =  $C^W C^W$ ) and (roan =  $C^R C^W$ ).

- a. Pure bred red mated with white
- b. Hybrid red mated with white
- c. Heterozygous red mated with homozygous red

9. What are the expected parental phenotypes and genotypes? (how confident are you?)

Where coat color in shorthorn breed of cattle is determined by two dominant genes, (red =  $C^R C^R$ ) (white =  $C^W C^W$ ) and (roan =  $C^R C^W$ ).

When a bull and a cow produce...

- a. 2 roan offspring, 6 red offspring, 1 white offspring
- b. 2 red offspring
- c. 17 white offspring

10. Would a test cross ever be used in situations of codominance or incomplete dominance?  
Explain

11. What is the probability that a roan bull and a roan cow produce...

Where coat color in shorthorn breed of cattle is determined by two dominant genes, (red =  $C^R C^R$ ) (white =  $C^W C^W$ ) and (roan =  $C^R C^W$ ).

- 3 calves, one of each color, red, white and roan, in any order
- 3 calves, one of each color, red, white and roan, in that order

12. What are the expected phenotypic and genotypic ratios?

Where the absence of legs (amputated) has been attributed to a recessive lethal allele in cattle (it is lethal early in embryological development).

- Normal bull "carrier" mates with normal "carrier" cow
- Normal bull "carrier" mates with normal cow

13. What is the probability that a normal bull "carrier" mates with normal "carrier" cow and produces...

Where the absence of legs (amputated) has been attributed to a recessive lethal allele in cattle (it is lethal early in embryological development).

- 1 non-carrier female calf and 1 carrier male calf, in that order
- 2 carrier calves, 1 non-carrier calf

14. What are the expected phenotypic and genotypic ratios?

Where the blood group A =  $I^A I^A$  or  $I^A i$ , blood group B =  $I^B I^B$  or  $I^B i$ , blood group AB =  $I^A I^B$  and blood group O =  $ii$ .

- A woman with blood type O mates with man with blood type AB
- A woman with blood type AB mates with man with blood type AB

15. List the possible and impossible blood types in the offspring of the following matings...

Where the blood group A =  $I^A I^A$  or  $I^A i$ , blood group B =  $I^B I^B$  or  $I^B i$ , blood group AB =  $I^A I^B$  and blood group O =  $ii$ .

- A woman with blood type O mates with man with blood type A
- A woman with blood type A mates with man with blood type B
- A woman with blood type B mates with man with blood type AB

16. What is the blood type and genotype (if you can tell) of the mom when her kids and husband are the following...

Where the blood group A =  $I^A I^A$  or  $I^A i$ , blood group B =  $I^B I^B$  or  $I^B i$ , blood group AB =  $I^A I^B$  and blood group O =  $ii$ .

- a. daughter is blood type A and her husband is type O
- b. son is blood type A and her husband is type AB
- c. daughter is blood type B, son is blood type A and her husband is type O

17. What is the probability that a woman with type A blood and her husband with type B blood have...

Where the blood group A =  $I^A I^A$  or  $I^A i$ , blood group B =  $I^B I^B$  or  $I^B i$ , blood group AB =  $I^A I^B$  and blood group O =  $ii$ .

- a. daughter with blood type O
- b. two kids with blood type A
- c. son with blood type A and a daughter with type A, in that order
- d. son with blood type A and a daughter with type A, in any order

18. What are the expected phenotypic and genotypic ratios?

Where coat colors in mice are governed by multiple allelic series in which  $A^y$  when homozygous, is lethal early in embryological development but produces yellow color in heterozygous conditions with other alleles. Agouti (yellow tips) is governed by the A allele, and black by the recessive a. The dominance hierarchy is as follows:  $A^y > A > a$ .

- a. cross between two yellow mice one carrying A allele and the other carrying the a allele
- b. cross between two agouti mice
- c. cross between an agouti mouse and a black mouse

19. Calculate probabilities for the following crosses.

Where coat colors in mice are governed by multiple allelic series in which  $A^Y$  when homozygous, is lethal early in embryological development but produces yellow color in heterozygous conditions with other alleles. Agouti (yellow tips) is governed by the  $A$  allele, and black by the recessive  $a$ . The dominance hierarchy is as follows:  $A^Y > A > a$ .

- chance that an agouti female and yellow male lose an offspring to the lethal condition
- chance that a yellow female carrying a dominant  $A$  and a black male make an agouti mouse
- chance that a yellow female and a black male make an agouti mouse

20. Given the following the genotypes and phenotypes of rabbits place the alleles in order of dominant hierarchy.

Where:  $C\_ =$  full color  
 $cc^{ch} =$  gray  
 $c^{ch}c^{ch} =$  chinchilla

21. How could a person determine the genotype of a full colored female rabbit? Explain

Where:  $C\_ =$  full color  
 $cc^{ch} =$  gray  
 $c^{ch}c^{ch} =$  chinchilla

**\* Many of these problems could be extended by giving you the parental generation and asking for the F2 generation. This means that you would carry the first cross, taking then these results and crossing them again with the provided information.**

**\* I asked only the F1 results in these problems, but if you get the F1 progeny correct then doing another cross should not prove difficult.**