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Genetic Questions 3

October 2021

1) Distance between genes: A genetic map

In guinea pigs, *white* coat (c^w) is recessive to *black* coat (C^B) and *wavy* hair (h^w) is recessive to *straight* hair (H^S). A breeder crosses a guinea pig that is homozygous for *white* coat and *wavy* hair with a guinea pig that is homozygous for *black* coat and *straight* hair. The F1 are then crossed with guinea pigs having white coats and wavy hair in a series of testcrosses.

if genes were not linked:

a) Assuming independent assortment, what outcome would you expect?

b) Knowing that the genes are linked, calculate the distance between the two genes:

progeny:	total	83
	black, straight	30
	black, wavy	10
	white, straight	12
	white, wavy	31

22 recombined chromosomes

Distance = $\frac{22}{83}$ = 26.5% ≈ 26.5 cent Morgen.

2) Robin had problems with his genetics homework. At school they were working with fruit flies. They were looking at the following genes:
st = the gene for *scarlet* eyes (wild type: red eyes)
e = the gene for *ebony* body color (wild type: grey body)
ss = the gene for *spineless* bristles (wild type: long bristles)
For all genes: the wild type is dominant over the mutant allele.

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On their first lab day they set up a cross with Drosophila males being homozygous for st, e and ss and wild type females. Two weeks later they crossed the resulting F1 females with their fathers.
Another two weeks later, they got progenies showing the following characteristics:

		0	e-ss	st-st	
	wild type	0	/	/	283
st e ss	scarlet, ebony and spineless	0	/	/	278
e ss	ebony, spineless	1	/	50	50
st	scarlet	1	/	52	52
ss	spineless .	2	5	5	5
e	ebony	1	43	/	43
st ss	scarlet, spineless	1	41	/	41
e st	scarlet, ebony	2	3	3	3
total			92	110	755

∴ scarlet >> spineless
ebony >> spineless.
∴ ss is in the middle
oder: e ss st (or reverse)

The teacher asked the students to determine the proper order of the genes and to calculate the distance between the genes. Can you do it for Robin?

distance e-ss?

92/755 = 12.2%
≈ 12.2 cM

distance st-ss:

= 110/755
= 14.6%
≈ 14.6 cM

3) Dog breeder John likes yellow and brown Labrador retrievers. In an attempt to produce yellow and brown puppies, he mated a yellow Labrador male and a brown Labrador female. Unfortunately, all the puppies produced in this cross were black.

a) Explain the result

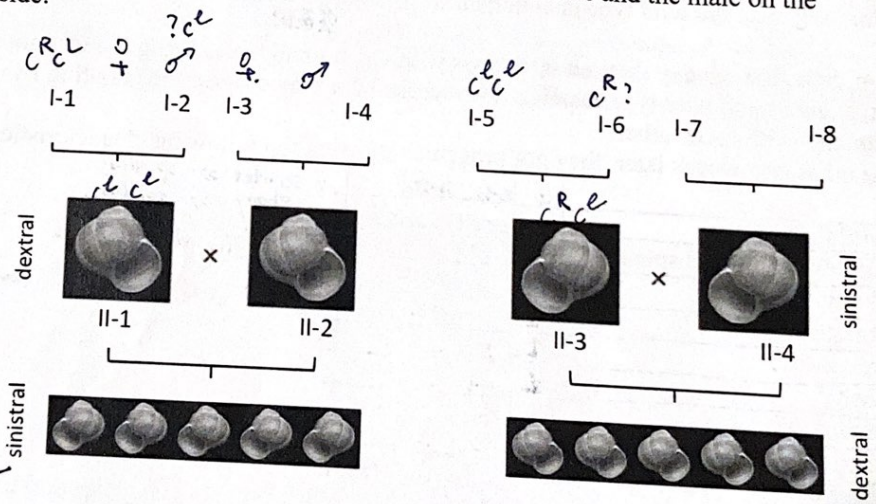
b) How might John go about producing yellow and brown Labradors?

4) You're a passionate gardener and love your job. One day, you get a phone call from the city to plant some white flowering *Illegitimati noncarborundum* in front of the Governments main building. You have two white flowering pure-breeding lines. Unfortunately, both are a little bit sickly. So, you decide to breed them, in the hope to get rid of the factor that causes lethality. Your F1 plants are all white flowering as expected. You allow the plants to self-fertilize and spread the seeds abundantly in front of the Governments building. A few weeks later you get a phone call of the janitor asking you why you weren't seeding the flowers as ordered. You're puzzled and inspect the site.

You find 126 white-flowering and 33 purple-flowering F2 plants.

What was the phenotype of the parents? Explain the result.

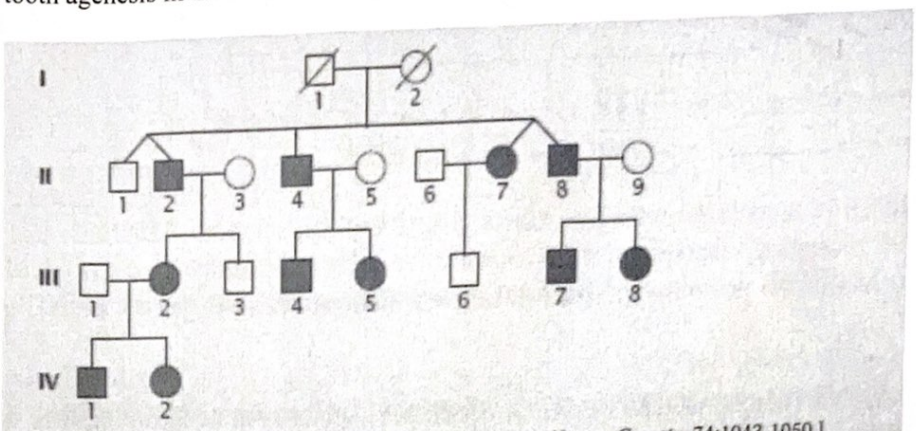
5) Shell coiling in snails is maternally inherited but otherwise follows the Mendelian rules. Right coiling (dexter) is dominant over left coiling (sinistral). In the following snail-crossings the female is always indicated on the left side and the male on the right side.



a) What can you say about the genotype of the animals II-1 and II-3?

b) What about their parents? I-1, I-2, I-5 and I-6?

6) The complete absence of one or more teeth (tooth agenesis) is a common trait in humans - indeed, more than 20% of humans lack one or more of their third molars. However, more severe absence of teeth, defined as missing six or more teeth, is less common and frequently an inherited condition. L. Lammi and colleagues examined tooth agenesis in the Finnish family shown in the pedigree below.



[Pedigree adapted from L. Lammi. 2004. *American Journal of Human Genetics* 74:1043-1050.]

a) What is the most likely mode of inheritance for tooth agenesis in this family? Explain your reasoning. Autosomal Dominant. because individuals of both genders are affected, and affected individuals usually produce affected children.

b) Are the two sets of twins in this family monozygotic (identical) or dizygotic twins) What is the basis of your answer?

Both sets are dizygotic. Because for Ⅱ-1 and Ⅱ-2, Ⅰ-1 is affected and Ⅱ-2 is no they don't have the same genotype. and for Ⅱ-7 and Ⅱ-8 they have different genders.

c) If IV-2 had a child with a man who has a full set of teeth, what is the probability that their child would have tooth agenesis?

Ⅳ-2 is heterozygous. she has 50% chance produce a gamete of affected gene.

So. probability is 50%

d) If III-2 and III-7 had a child, what is the probability that their child would have tooth agenesis?

Ⅲ-2 & Ⅲ-7 are both heterozygous. since Ⅰ-3, Ⅰ-4 is healthy.

so. their child would have a 3/4 chance having tooth agenesis.

7) A female fruit fly with singed bristles was mated with a male from a true-breeding wild type stock with long bristles. All of the F1 females had wild-type bristles and all of the F1 males had singed bristles. If the F1 flies are intercrossed, the expected ratio of long to singled bristles in the F2 flies is:

a. 1:0 in both sexes (i.e. males and females will all have long bristles)
b. 3:1 in both sexes
c. 3:1 in females, while all the males will have singed bristles
d. 1:1 in females, while all the males will have singed bristles
e. 1:1 in both sexes

♀ singed bristles X^sX^s × ♂ long bristles X^LY

F1: ♀ long bristle X^LX^s ♂ singed bristle X^sY

F2: X^sX^s; X^LY; X^sX^s; X^sY

What is the mode of inheritance?

recessive sex-linked inheritance

8) The lady marked with the dark circle suffers from a mitochondrial disease. Fill in all individuals in generation II and III that will suffer from the same disease.