BIOL121 Section 121
Sept 27, 2021

BIOL 121 – Evaluating Hypotheses for Inheritance

1) You have identified a new phenotype in a population of fruit flies (Drosophila melanogaster). The flies have small wings and can't fly. You have named the phenotype "vestigial wings". You perform a cross between a male with vestigial wings and a female with normal wings. All of the offspring (both male and female) have normal wings. Based on this result, you hypothesize that inheritance of vestigial wings is autosomal and recessive. In order to evaluate this hypothesis you plan to cross males and females of your F_1 flies to generate an F_2 generation. Prior to making your cross, your supervisor asks you to diagram predictions for alternative hypotheses of inheritance for this trait.

a) Under the hypothesis that the vestigial allele is <u>autosomal recessive</u>, define your alleles for the wing gene. (0.5 marks)

W = wing gene

W^v = vestigial allele (recessive under the hypothesis being evaluated)

W^N = normal wings (dominant under the hypothesis being evaluated)

b) Under the hypothesis that the vestigial allele is <u>autosomal recessive</u>, define **all** genotypes and their associated phenotypes (0.5 marks).

Under the hypothesis that wing gene is autosomal and recessive we can define genotypes
$W^v W^v$ = vestigial wings (males and females would both have this genotype)
$W^N W^v$ and $W^N W^N$ = normal wings (males and females would both have this genotype)

c) Under the hypothesis that the vestigial allele is <u>autosomal recessive</u>, draw a Punnet Square for the F_1 cross and resulting F_2 progeny. Indicate the phenotype frequency for all offspring (recall that sex is also a phenotype).

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		Female parent (P1) Normal wings	
		W^N	W^N
Male Parent Vestigial Wings	W^v	W^N W^v	W^N W^v
	W^v	W^N W^v	W^N W^v

100% of F1 individuals have normal wings – both male and female

		Female parent (F1) Normal wings	
		W^N	W^v
Male Parent (F1) Normal wings	W^N	W^N W^N (normal)	W^N W^v normal
	W^v	W^N W^v (normal)	W^v W^v (vestigial)

3:1 ratio of normal to vestigial in the F2 for both male and female

d) An alternative hypothesis is that the vestigial allele is X-linked recessive. Under the hypothesis that the vestigial allele is X-linked recessive define your alleles for the wing gene. (0.5 marks)

X = refers to the X chromosome with the wing gene

Y = refers to the Y chromosome without the wing gene but that confers the trait of maleness

X^v = X chromosome with the vestigial allele

X^N = X chromosome with the normal allele

e) Under the hypothesis that the vestigial allele is X-linked recessive, define **all** genotypes and their associated phenotypes (0.5 marks).

Female Genotypes and Phenotypes

$X^v X^v$ = vestigial wing female

$X^N X^v$ or $X^N X^N$ = normal wing female

Male Genotypes and Phenotypes

X^vY = vestigial wing male

X^NY = normal wing male

f) Under the hypothesis that the vestigial allele is X-linked recessive, draw a Punnet Square for the F_1 cross and resulting F_2 progeny. Indicate the phenotype frequency for all offspring (recall that sex is also a phenotype).

P1 male (normal) X^NY x female $X^N X^N$ (note that since all offspring have the same phenotype, the female parent must be homozygous under this model of inheritance; you can check by setting up a cross between a heterozygous female and a vestigial winged male).

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		Female parent (P1) Normal wings	
		X^N	X^N
Male Parent Vestigial Wings	X^v	$X^N X^v$ (normal female)	$X^N X^v$ (normal female)
	Y	W^N Y (Normal male)	W^N Y (Normal male)

		Female parent (F1) Normal wings	
		X^N	X^v
Male Parent (F1) Normal wings	X^N	$X^N X^N$ (normal female)	$X^N X^v$ (Normal female)
	Y	W^N Y (normal male)	W^v Y (vestigial male)

All females have normal wings

½ males have normal wings ½ males have vestigial wings

Note: if you only look at the phenotypes of normal and vestigial wings but not the phenotype of sex this looks like a 3:1 ratio of normal to vestigial expected for autosomal inheritance.

g) Imagine that you performed the cross you diagrammed in "f" and generated 372 offspring. Indicate the ~ number of offspring that would be associated with each phenotype.

Frequency of normal females = ¼ + ¼ = ½

Number of normal females = 372 * ½ = 186

Frequency of normal males = ¼

Number of normal males = 372 * ¼ = 93

Frequency of vestigial males = ¼

Number of vestigial males = 372 * ¼ = 93

Total number of individuals (checking work) = 186+93+93= 372