TOPIC: DETERMINING INHERITANCE PATTERNS
Drosophila

1. Wild-type *Drosophila melanogaster* have dark red eyes and smooth, tapered bristles (these are the "hairs" that they have on their back). A geneticist performed a series of crosses using *D. melanogaster* with the mutant eye colour phenotype *scarlet* (bright red) and the mutant bristle phenotype *singed* (*singed* bristles look like they have been burned). The results were as follows:

Cross 1: pure-breeding female, dark red eyes, *singed* bristles **X** pure-breeding male, *scarlet* eyes and tapered bristles

Progeny (F1): 82 females, dark red eye colour and tapered bristles (one is used for cross 2)
79 males, dark red eye colour and *singed* bristles (one is used for cross 2)

Cross 2: F1 female from cross 1 **X** F1 male from cross 1

Progeny (F2):

	Dark red eyes, tapered bristles	Dark red eyes, *singed* bristles	*scarlet* eyes, tapered bristles	*scarlet* eyes, *singed* bristles
Females	29	31	10	8
Males	27	30	9	11

Highly recommend that you look at each trait separately because they may not have the same mode of inheritance. Also, if provided with an F2 generation, look at both the F1 and F2 generation.

(a) Based on these data, what is the mode of inheritance of the phenotypes *scarlet* eyes and *singed* bristles, respectively? Show your work/steps.

Eye colour:

Step 1: Look for a pattern in the F1 eye colour data

Parents: Pure-breeding flies with red eyes x Pure-breeding flies with scarlet eyes F1 all dark red; no sex bias with respect to eye colour

F2 no sex bias (females: 60 red:18 scarlet, males: 57 red, 20 scarlet)

= 3:1 for both sexes

Step 2: Hunch/Hypothesis:

Mode of Inheritance – Autosomal with red eye colour dominant to scarlet eye colour

Why: no sex bias in either F1 or F2 generation

- F1s – all have the same color (dark red), scarlet phenotype has disappeared.
- F2s – 3:1* phenotypic ratio of dark red:scarlet eyes.

*Mendel saw a similar pattern (3:1) in his crosses of pure-breeding parents

Step 3: Define the genes, alleles, and genotypes

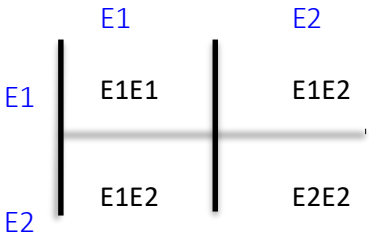
- define gene: E = eye colour
- define alleles: E1 = dark red, E2 = scarlet
- define genotypes: E1E1 and E1E2 = dark red eyes, E2E2=scarlet eyes

Step 4: Prediction: What genotype and phenotype ratios should you EXPECT to see in F1 & F2 generations if your hypothesis is correct?

- Parents true breeding so E1E1 x E2E2:
- F1 predicted genotype ratios: All F1s should be heterozygous (E1/E2)
- F1 predicted phenotype ratios: All F1s (both males and females) should have dark eyes

Predictions for F2 generation: - E1E2 x E1E2

F1 x F1



Predicted genotype ratios for F2: 1:2:1 E1E1 E1E2 E2E2

Predicted phenotype ratios for F2: 3:1 dark red eyes to scarlet eyes

Step 5: Compare the OBSERVED data with the EXPECTED (predicted) pattern. Are they consistent?

F1 observed: All 82 F1 flies have dark red eyes, as predicted

F2 observed:

Number of flies with dark red eyes: 29 + 31 + 27 + 0 = 117

Number of flies with scarlet eyes: 10 + 8 + 9 + 11 = 38

- 3:1 phenotypic ratio, as predicted.

No phenotypic differences between males and females

Females - 60 dark red eyes: 18 scarlet eyes (=3:1 phenotypic ratio)

Males – 57 dark red eyes: 20 scarlet eyes (=3:1 phenotypic ratio)

Step 6: Final step of reasoning – do the result support your hypothesis?

The observed phenotypic ratios for both the F1 and F2 generation are consistent with the predicted results if eye colour in *Drosophila* is an autosomal trait, with dark red eyes dominant to scarlet eyes.

If you observed a different pattern, you would need to take another look at the data and state a new hypothesis.

Bristle Pattern:

Step 1: Pattern

Parents: Pure-breeding flies (female) singed bristles x Pure-breeding males tapered bristles

F1: Females: tapered bristles
Males: singed bristles
(a sex bias!)

Step 2: Hunch/Hypothesis:

X-linked, and tapered bristles is dominant to singed bristles

Why?

Strong sex bias (if autosomal, dominant/recessive relationship - would expect males and females to have the same phenotype)

F1 Females heterozygotes (i.e., carrying an allele for both tapered and singed bristles), but all F1 females have tapered bristles (see below); suggesting that tapered > singed

Step 3: Define alleles & genotypes:

X^B: Tapered Bristles, X^b: singed bristles

X^BX^B=tapered bristles
X^BX^b=tapered bristles
X^BY=tapered bristles
X^bY = singed bristles

Step 4: Prediction/Expectation (F1 & F2) if hypothesis is true:

P: X^bX^b (female) x X^BY (male)

Predicted Progeny (F1):

	X^B	Y
X^b	X^BX^b	X^bY

Predicted genotypes: Females all heterozygotes (X^B/X^b); males all X^bY

Predicted phenotypes: Females all have signed bristles, males all have tapered bristles
Expected pattern in F2 if hypothesis correct

F1 x F1 = X^BX^b x X^bY:

	X^b	Y
X^B	X^BX^b	X^BY
X^b	X^bX^b	X^bY

Expected/Predicted Genotype ratios in F2 generation if X^B is dominant over X^b:

Females: ½ X^BXb ½ X^bX^b

Males: ½ X^BY ½ X^bY

Expected/Predicted Phenotype ratios in F2 generation if X^B is dominant over X^b

Females: ½ singed bristles, ½ tapered bristles,

Males: ½ singed bristles, ½ tapered bristles

OR 1:1:1:1 phenotypic ratio.

Steps 5 & 6: Compare OBSERVED data with the EXPECTED (predicted) pattern. Do, they support your hypothesis?

F1 generation: As expected, all 82 female flies had singed bristles and all 79 males had tapered bristles.

F2: As expected half of F2 female (n=40) and male (n=41) had singed bristles, and half of the F2 female (39) and male (36) had tapered bristles; so, as predicted, there was close to the expected 1:1:1:1 phenotypic ratio.

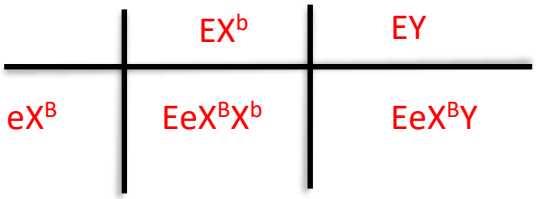
Therefore, the observed data for bristle type is consistent with the expected phenotypic ratio if the mode of inheritance is X-linked with tapered bristles dominant to singed bristles.

(b) Predict the outcome of a cross between a pure breeding female with *scarlet* eyes and smooth bristles, a pure breeding male with dark red eyes and *singed* bristles.

Show the genotype of the parents, a Punnett square representing this particular cross, and the predicted phenotypes of the progeny (including their respective ratios).

Dark red eyes = E
Scarlet eyes = e
Tapered Bristles = X^B
Singed Bristles = X^b

Parent:e/e; X^BX^B (female) x E/E; X^bY (male)



Therefore, predicted phenotypes of the F1 offspring:

50% of offspring are females with dark red eyes, tapered bristles (EeX^BX^b)

50% of offspring are males with dark red eyes, tapered bristles (EeX^BY)