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A one-generation assay for induced genetic damage.

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Usually it is difficult to demonstrate the induction of genetic damage in a higher organism in a teaching environment. There are several reasons for this. Chemical mutagens are potentially hazardous, especially when used by students with little laboratory experience. Furthermore, many assays for germ-cell mutations are multi-generation crosses (for example, screens for recessive sex-linked lethals in *Drosophila melanogaster*), and one-generation assays like those for visible mutations on the X chromosome are inappropriate because the inexperience of students in identifying new visible phenotypic changes can yield many misclassifications. Finally, germ-cell mutation rates are low, so extensive data are needed to evaluate them. This creates a large work load in media preparation and physical processing of crosses. Hence, we have tested a new DNA repair-defective assay in *D. melanogaster* (Negishi *et al.*, 1991) using UV and X-ray treatments. This one generation assay is shown to be a safe and efficient method to demonstrate induced genetic damage. Description of the mutations is given in Lindsley and Zimm (1992).

In this assay, the eggs and first instar larvae of the following cross are treated.

C(1)DX, *y w f* / Y females (repair efficient) × *sc*^{1} *z*^{1} *w*$^{+(TE)}$ *mei-9*^{a} *mei-41*^{D5} / Y males (defective in DNA excision repair and postreplication repair)

↓

Score for the number of F1 matroclinous females (yellow body color, white eyes, and forked bristles) and F1 patroclinous males (yellow eyes). A treatment with a mutagenic agent will reduce the male to female ratio as compared to this ratio in untreated F1 eggs and larvae.

Table 1. X-ray treatment.

		C(1)DX, *y w f* Females	Sc^{1} z^{1} $w^{+9(TE)}$ mei-9^{a} mei-41^{DS} Males
Control			
Vial	1	21	179
	2	89	179
	3	136	130
	4	110	166
Total		256	654
		% male = 654/910 = 71.87%[a]	
500R			
Vial	1	99	170
	2	106	191
	3	16	92
	4	117	109
Total		338	562
		% male = 562/900 = 62.44%[a]	

P< 0.0001

In the X-ray experiment, F1 eggs and larvae up to four days old were given 500R of irradiation or were untreated (control). In the UV experiment, F1 eggs and first-instar larvae up to three days old were exposed for 10 minutes to a UV transilluminator. The *Drosophila* food carrying the eggs and larvae in open vials was held directly against the UV transilluminator.

Table 2. U-V treatment.

		C(1)DX, *y w f* Females	Sc^1 z^1 $w^{+9(TE)}$ mei-9^a mei-41^{DS} Males
Control			
Vial	A	32	32
	B	20	33
	C	31	56
	D	19	39
	E	34	51
	F	30	50
	G	20	50
	H	15	31
	I	37	49
	J	34	33
	K	24	42
	L	28	52
Total		324	518
		% male = 518/842=61.52[b]	
UV-10 MIN			
Vial	A	31	15
	B	29	36
	C	39	18
	D	13	25
	E	12	15
	F	16	13
	G	19	31
	H	12	8
	I	8	9
	J	13	6
	K	7	4
	L	7	7
Total		206	187
		% male = 187/393=47.58%[b]	

P< 0.01

The results are shown in Tables 1 and 2. They show that X-rays and UV cause a significant increase in somatic cell genetic damage that leads to the death of flies that are defective in DNA repair. This quite logical result, in turn, supports the use of this assay as a way to demonstrate induced genetic damage in a classroom exercise. The common availability of a UV source makes this a treatment of choice when considering safety concerns in working with students who have limited laboratory experience.

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References: Lindsley, D.L., and G.G. Zimm 1992, *The Genome of* Drosophila melanogaster. Academic Press, NY; Negishi, T., T. Shiotani, K. Fujikawa, and H. Hayatsu 1991, Mut. Res. 252: 119-128.