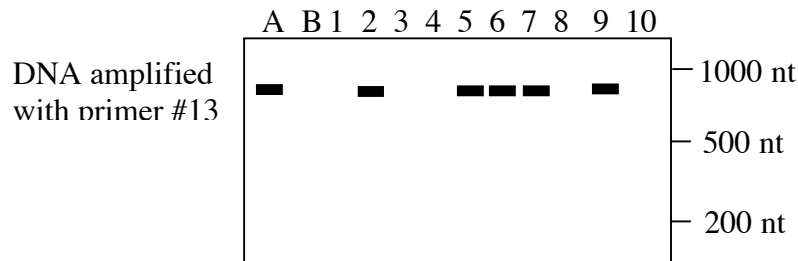


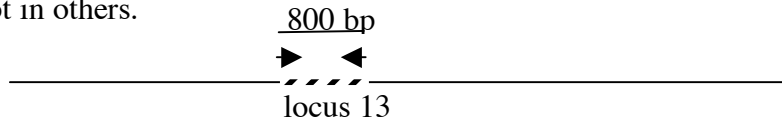
The highly esteemed molecular biologist Dee Ablo is trying to make a dense genetic map of the Tasmanian Devil chromosome number 1. As a starting point she knows of one locus (the *EYE* locus, encoding eye color) that is on this chromosome. Tasmanian Devils with the *EYE* allele at this locus have fiery red eyes, while devils with the *eye* (recessive) allele have white eyes. Jane has in her possession some DNA primers that amplify regions of the TD genome and she hopes to be able to use them as RAPD markers to make her genetic map.

She started with parents from two inbred lines, A and B, which are homozygous at all loci. A mating of a female devil from line A with a male from line B resulted in a child named devil C. Devil C was crossed with a devil from line B to produce 10 children (devils 1 through 10). Jane isolated genomic DNA from these animals. Each DNA sample was then used in PCR reactions with different primers. The PCR products were separated on an agarose gel and stained to make the bands of DNA show up.

Here are the results that she got with her first primer:



1a. Draw a diagram(s) of the relevant locus in the TD genome. Explain why a band occurs in some lanes and not in others.



In some individuals, primer #13 binds to two nearby locations at the “primer 13 locus” such that an 800 bp PCR product is formed. In other individuals, the sequence in the genome at one (or both) of the primer binding sequences is different, and the PCR product is not formed.

1b. Within the population that is being tested (devils 1 – 10), does an identifiable “polymorphism” exist at this locus? Would primer #13 be useful as a RAPD marker in this population of Tasmanian Devils?

Yes. Yes.

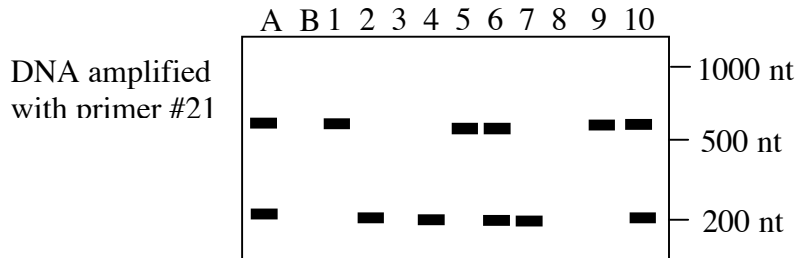
Some members of the population contain the allele that results in the formation of the 800 bp PCR product (we could call this the “13+” allele). Other members of the population contain the allele that DOES NOT give the 800 bp PCR product (we could call this the “13-” allele).

1c. What genotype is present at the “primer 13 locus” in devil A? In devil B? In devil #3? ? In devil #5?

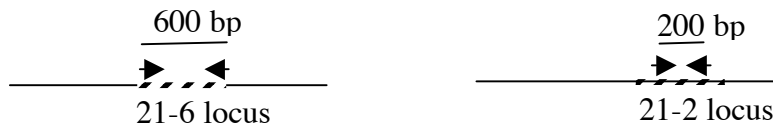
A 13+/13+

B 13-/13-

#5 13+/13- Here are the results that she got with her second primer:



2a. Draw a diagram(s) of the relevant loci in the TD genome. Explain the banding pattern observed.



At one locus in the genome (we could call this the 21-6 locus), primer 21 can give a 600 bp PCR product. At a second locus in the genome (we could call this the 21-2 locus), primer 21 can give a 200 bp PCR product.

2b. Within the population that is being tested (devils 1 – 10), does an identifiable “polymorphism” exist at one or both of these loci? Would primer #21 be useful as a RAPD marker in this population of Tasmanian Devils?

Yes. Yes.

2c. What genotype is present at the loci relevant to primer #21 in devil A? In devil B? In devil #1? In devil #2? In devil #3 In devil #6?

A 21-6+/21-6+.21-2+/21-2+

B 21-6-/21-6-.21-2-/21-2-

#1 21-6+/21-6-.21-2-/21-2-

#2 21-6-/21-6-.21-2+/21-2-

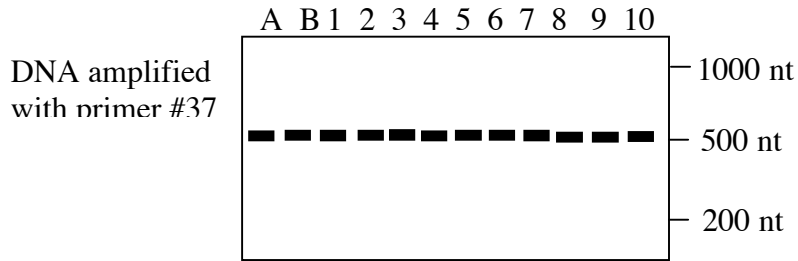
#3 21-6-/21-6-.21-2-/21-2-

#6 21-6+/21-6-.21-2+/21-2-

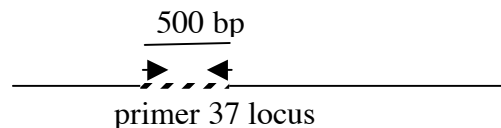
2d. Is there any evidence that the loci involved here are linked to each other?

NO

Here are the results that she got with her third primer:



3a. Draw a diagram of the relevant locus in the TD genome. Explain the banding pattern observed.



3b. Within the population that is being tested (devils 1 – 10), does an identifiable “polymorphism” exist at the “primer 37 locus”? Would primer #37 be useful as a RAPD marker in this population of Tasmanian Devils?

No. No.

The locus could not be mapped because we do not have two different alleles that give distinguishable phenotypes.

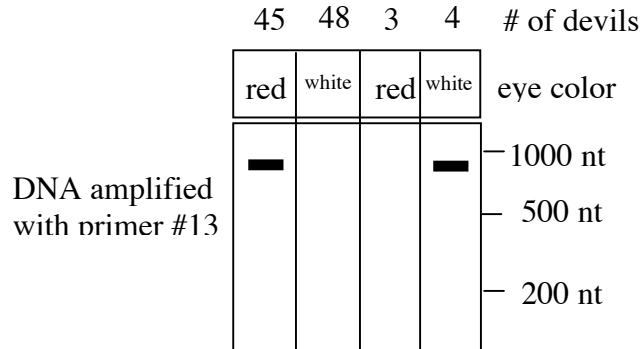
3c. What genotype is present at the loci relevant to primer #37 in devil A? In devil B? In devil #1? In devil #2? In devil #3 In devil #6?

A 37+/37+
B 37+/37+
#1 37+/37+
#2 37+/37+
#3 37+/37+
#6 37+/37+

In order to map the location of the “primer 13 locus”, Jane made the following cross:

Devil C (*EYE/eye*) X Devil B (*eye/eye*)

100 little devils were obtained from this cross, and these had the following distribution of phenotypes:



4. What information can be obtained from this cross about the map location of the “primer 13 locus”?

Most of the little devils obtained from the cross have parental allele combinations. Only 7% of them have recombinant allele combinations. This means that the two loci being studied are linked. The “primer 13 locus” is thus on chromosome 1, and it is 7 cM from the *EYE* locus.

5. The JOX protein functions as a homo-hexamer. This hexameric enzyme is required for correct leaf development of Arabidopsis, and the hexamers only function if all 6 subunits are functional. The JOX polypeptide contains two domains: domain A, which is required for enzymatic activity and domain B which is required for multimerization. The leaf of an Arabidopsis plant will develop properly if there are at least 20% of the “normal” amount of JOX multimers present. A homozygous *jox* mutant plant (with no JOX protein) has square leaves.

The famed molecular biologist Margarita Ramos has plants carrying several different alleles of the *JOX* gene:

The wild type allele (*JOX*) encodes a completely functional JOX polypeptide

One mutant allele (*jox-1*) has a mutated promoter and cannot be transcribed

The *jox-2* allele is mutated so that domain A is nonfunctional but domain B is unaffected

The *jox-3* allele is mutated so that domain B is nonfunctional but domain A is unaffected

a. Would you expect the *jox-1* allele to be dominant or **recessive** to the WT allele?

b. Would you expect the *jox-2* allele to be **dominant** or recessive to the WT allele?

a. Would you expect the *jox-3* allele to be dominant or **recessive** to the WT allele?