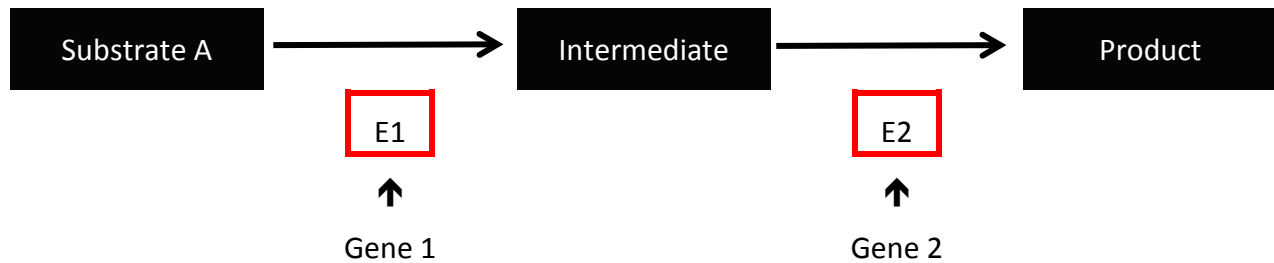


Demonstrate understanding of gene expression (AS 91159)

Metabolic Pathways

A metabolic pathway is a series of enzyme controlled reactions where the product of one chemical reaction is the reactant for the next.

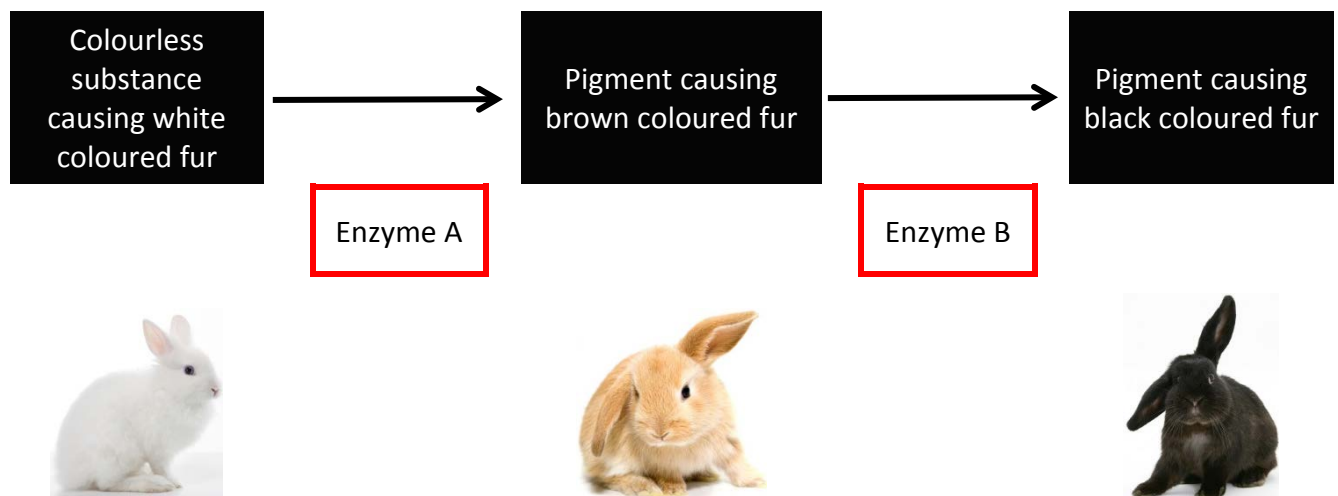
Remember each step in a chemical reaction is controlled by an enzyme, that enzymes are made during protein synthesis and the instructions to make a specific enzyme are on the DNA.



- Gene 1 carries the instructions to make enzyme 1 (E1) which converts Substrate A into intermediate.
- Gene 2 carries the instructions to make enzyme 2 (E2) which converts intermediate into the product.
- If Gene 1 has a mutation and enzyme 1 can't work, then substrate A cannot be converted into the intermediate therefore the product will not be produced. Substrate A will accumulate.
- If Gene 2 has a mutation and enzyme 2 can't work, the intermediate cannot be converted into the product. The intermediate will accumulate.

Question:

In some rabbits coat colour is controlled by a simple metabolic pathway. Two enzymes A and B determine what colour a rabbit's coat is.



Explain how two black rabbits could produce white, brown and black rabbits.

Your answer should include:

- A definition of a metabolic pathway
- The genotypes of the two black rabbits and how you worked this out
- An explanation of how this metabolic pathway works
- Use punnet squares to back up your answer

Answer:

A metabolic pathway is a series of enzyme controlled reactions where the product of one reaction is the reactant of the next reaction.

The genotypes of the two black rabbits have to be AaBb because for a rabbit to be black it must have a functioning A gene to make enzyme A and a functioning B gene to make enzyme B.

Therefore the black rabbits could have AABB, AaBB, AaBb or AABb as their genotypes, as they all have a functioning enzyme A which converts colourless substance to brown fur and a functioning enzyme B which converts the brown fur to the final product / black fur.

But because these two black rabbits produce offspring which are brown and white they must each have the non-functioning a and b form of the gene (allele) so that the phenotype of their offspring can include brown or white. The parents must be AaBb. See punnet square below.

AaBb	x	AaBb	Black parent rabbits
AB Ab aB ab		AB Ab aB ab	Gametes

	AB	Ab	aB	ab
AB	AABB Black	AABb Black	AaBB Black	AaBb Black
Ab	AABb Black	AAbb Brown	AaBb Black	Aabb Brown
aB	AaBB Black	AaBb Black	aaBB White	aaBb White
ab	AaBb Black	Aabb Brown	aaBb White	aabb White

AAbb and Aabb genotypes both result in rabbits with brown fur as enzyme A converts colourless substance to brown fur but bb cannot convert it into black fur so the rabbits fur stays brown.

The aaBB , aaBb and aabb genotypes each result in rabbits with white fur as enzyme A cannot convert the colourless substance into brown fur. The presence of a functioning enzyme B has no effect as the intermediate product (pigment causing brown fur) is absent.

