The Color Code

Model how inherited DNA instructions can shape a trait

BIO.3C.1 "Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where the passage places a gene in DNA and chromosomes, circle the alleles a parent can pass on, and number the steps from inherited alleles to wing-cover color.

Why Some Beetles Are Pale

1. Imagine a species of beetle with either dark or pale wing covers. To explain one possible cause, suppose scientists build a simplified model of a single gene that affects pigment. DNA is a long molecule that stores instructions in its sequence of chemical units. A chromosome is a packaged DNA molecule, and a gene is a stretch of that DNA with instructions for making a product, often a protein. In this model, the pigment gene gives cells instructions for an enzyme, a protein that helps produce dark pigment. The beetle's wing-cover color depends on whether its cells make enough of that enzyme.

2. Beetles carry two copies of this chromosome, one inherited from each parent. The pigment gene occupies the same location on both chromosomes, but its DNA sequence can differ. These versions are called alleles. In our model, allele D gives instructions for a working enzyme; allele d does not produce a working enzyme. One D allele makes enough enzyme for dark wing covers, so DD and Dd beetles are dark. A dd beetle makes no working enzyme from this gene and has pale wing covers. This model focuses on one gene; real traits can involve many genes and environmental conditions.

3. Consider two dark beetle parents, each with genotype Dd. When they make eggs or sperm, each passes on just one of the two chromosomes in this pair. An egg could carry D or d, and a sperm could carry D or d. Their offspring receives one chromosome from each parent, restoring a pair. Combining those chromosomes can give the offspring DD, Dd, or dd. The parents' dark appearance does not guarantee a dark offspring, because an egg carrying d and a sperm carrying d can produce a pale dd beetle. This chromosome-to-gene-to-protein model links inheritance to a visible trait.

2 ANSWER WITH EVIDENCE

Use the passage

1. In this model, where is the pigment gene located, and why does an offspring have two copies of it?

2. DD and Dd beetles have different pairs of alleles. Use the model to explain why both have dark wing covers.

3. How can two dark Dd parents produce a pale offspring? Name the allele carried by each chromosome the offspring inherits.

4. A dd beetle has the pigment gene on both chromosomes. Explain why it still has pale wing covers.

3 YOUR TURN

Your own words

Invent a single-gene trait in an imaginary animal that is different from beetle wing-cover color. In the box, draw and label a model showing one DNA-containing chromosome from each parent, a version of the gene on each chromosome, the offspring's chromosome pair, a protein, and the resulting trait; add two sentences explaining your model.

The Color Code

PART 1 · READ AND MARK

Underline where the passage places a gene in DNA and chromosomes, circle the alleles a parent can pass on, and number the steps from inherited alleles to wing-cover color. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In this model, where is the pigment gene located, and why does an offspring have two copies of it?	**The gene is a stretch of DNA on a chromosome. The offspring inherits one copy of that chromosome from each parent.**
2	DD and Dd beetles have different pairs of alleles. Use the model to explain why both have dark wing covers.	**Both have at least one D allele, which gives instructions for enough working enzyme to produce dark pigment.**
3	How can two dark Dd parents produce a pale offspring? Name the allele carried by each chromosome the offspring inherits.	**Each parent can pass on a chromosome carrying d. An offspring that inherits d from both parents is dd and has pale wing covers.**
4	A dd beetle has the pigment gene on both chromosomes. Explain why it still has pale wing covers.	**Both copies are the d allele, which does not produce a working enzyme. Without that enzyme, the beetle does not make enough dark pigment.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Mother's chromosome: DNA with S version of spot gene → egg carries S; father's chromosome: DNA with s version of spot gene → sperm carries s; imaginary moth offspring: paired chromosomes with S and s → working spot-pattern protein → spotted wings. The S version of the gene gives instructions for a working protein, while the s version does not. The offspring inherits one chromosome from each parent, and its S copy makes enough protein for spots.

Accept other invented traits if the model correctly places gene versions on DNA-containing chromosomes inherited from two parents and connects the offspring's alleles to a protein and a trait. Students may choose their own allele symbols and inheritance rule if their explanation is consistent.