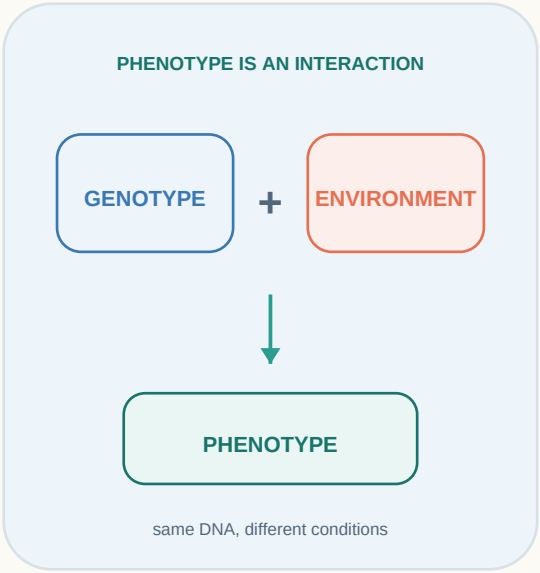
AP BIOLOGY | UNIT 5

TOPIC 5.5

Environmental Effects on Phenotype

Environmental conditions can alter gene expression and trait development without changing the underlying DNA sequence.



THE CORE CAUSAL CHAIN

GENOTYPE
inherited potential

→

ENVIRONMENT
external condition

→

GENE EXPRESSION
RNA and protein change

→

PHENOTYPE
observable trait

BY THE END, YOU SHOULD BE ABLE TO...

1. Distinguish genotype from phenotype.
2. Explain phenotypic plasticity.
3. Connect a specific condition to a specific trait.

CENTRAL IDEA

A phenotype reflects both genetic information and the environment in which development and physiology occur. One genotype can therefore produce multiple phenotypes.

1 Environment can change gene expression

Signals from the environment can alter regulatory pathways, RNA production, protein abundance, and trait development without changing DNA sequence.

FROM CONDITION TO TRAIT

ENVIRONMENT

light, diet, pH, temperature

SIGNAL PATHWAY

receptors and regulators respond

GENE EXPRESSION

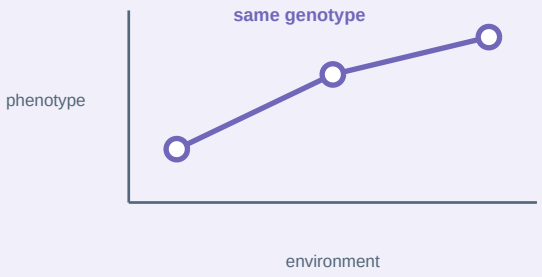
RNA or protein amount changes

PHENOTYPE

observable trait changes

PHENOTYPIC PLASTICITY

REACTION NORM



SAME GENOTYPE

The DNA sequence remains the same across conditions.

DIFFERENT PHENOTYPES

The trait value changes as the environment changes.

COMMON ERROR

An environmentally induced phenotype does not automatically mean the DNA sequence changed. The environment often changes how genes are expressed, not which alleles are present.

2 Specific conditions produce specific trait changes

A strong biological explanation names the environmental variable, connects it to a mechanism, and identifies the phenotype that changes.

THREE COMMON EXAMPLES

NUTRITION

FOOD

CONDITION

nutrient and energy availability

PROCESS

resources affect growth and tissue production

TRAIT height or weight

SOIL pH

pH

CONDITION

acidity around hydrangea roots

PROCESS

pH changes pigment-related chemistry and ion availability

TRAIT flower color

UV EXPOSURE

UV

CONDITION

ultraviolet radiation reaches skin

PROCESS

signaling increases melanin production

TRAIT skin pigmentation

BUILD THE EXPLANATION

1 **NAME THE CONDITION**

Identify the specific environmental variable that differs.

2 **CONNECT A MECHANISM**

Explain how signaling, expression, metabolism, or development responds.

3 **STATE THE TRAIT**

Name the observable phenotype and describe how it changes.

FINAL MAP

Genotype sets a range of possible responses. Environmental conditions influence which parts of that range are expressed. Phenotype is therefore the product of genotype, environment, and their interaction.