PEEBEDU Environmental Effects on Phenotype Lab

Unit 5: Heredity

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **Environmental Effects on Phenotype Lab**. Read the introduction popup, which explains how environmental conditions influence gene expression and can lead to **phenotypic plasticity**. Then click **Begin Experiments** to enter the lab.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Environmental Effects on Phenotype Lab as a scientific model.

M — Mode

What type of model is the Environmental Effects on Phenotype Lab? Describe how this computational simulation represents the relationship between environmental conditions and phenotypic expression. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how genotype and environment interact to produce phenotype.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about how environmental factors influence phenotype. For each, name the specific simulation feature and explain what biological concept it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about the relationship between environment and gene expression. Consider what molecular-level processes are not visible in the simulation that would be important for a complete understanding of phenotypic plasticity.

P — Purpose

What is the learning goal of this simulation? Explain how the Environmental Effects on Phenotype Lab is designed to help you understand that the same genotype can produce different phenotypes under different environmental conditions. In your answer, connect at least one specific simulation feature to a biological concept related to how organisms respond to their environment.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries about gene-environment interactions might change or improve a simulation like this one. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for environmental effects on phenotype?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect observable phenotypic changes to underlying gene expression?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Hydrangea Flower Color and Soil pH

> *Simulation Task: In Experiment 1, tap each planter to plant a genetically identical hydrangea seed, then click **Grow All Plants**. Observe how flower color changes across the pH gradient from 4.0 (Very Acidic) to 8.5 (Very Alkaline). Record the flower colors at pH 4.0, pH 6.5, and pH 8.5.*

(A) (1 pt) **Describe** how environmental conditions can influence gene expression and lead to phenotypic plasticity, using the hydrangea flower color experiment as a specific example.

(B) (1 pt) **Explain** why genetically identical hydrangea plants produce blue flowers in acidic soil and pink flowers in alkaline soil, in terms of how the environmental factor (soil pH) affects the expression of the anthocyanin pigment genes.

(C) (1 pt) **Predict** what flower color would result if a hydrangea cutting from a plant currently growing in pH 4.0 soil (producing blue flowers) were transplanted into soil with a pH of 8.5.

(D) (1 pt) **Justify** your prediction using the concept of phenotypic plasticity and the relationship between genotype, environment, and phenotype.

EK 5.5.A.1

Analyze Model / Visual Representation

Question 2 — Temperature-Dependent Sex Determination

> *Simulation Task: In Experiment 2, set the genotype to ZZ and run trials at three different incubation temperatures: 26°C, 30°C, and 34°C. Record the sex ratio of offspring at each temperature.*

(A) (1 pt) **Describe** how environmental conditions can lead to phenotypic plasticity in organisms that exhibit temperature-dependent sex determination.

(B) (1 pt) **Explain** the relationship between incubation temperature, gene expression, and the resulting sex phenotype in reptiles with temperature-dependent sex determination.

(C) (1 pt) **Represent** how a single genotype (ZZ) can produce different phenotypic outcomes (male or female) depending on the environmental temperature during development.

Draw your diagram here.

(D) (1 pt) **Explain** how phenotypic plasticity, such as temperature-dependent sex determination, connects to the concept that natural selection acts on phenotypic variation in populations (Unit 7).

EK 5.5.A.1