

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **IVF Simulator**. Read the introduction popup, which describes sexual reproduction, the IVF process, and preimplantation genetic testing (PGT) for three monogenic disorders: sickle cell disease (HBB gene), Tay-Sachs disease (HEXA gene), and cystic fibrosis (CFTR gene). Click **Begin Laboratory Session** to enter the virtual IVF laboratory.

Free Response Questions

Question 1 – Conceptual Analysis

Simulation Task: *Activate the micropipette and collect one oocyte and one spermatozoon. Deposit both onto the microscope workspace to perform ICSI. Once the zygote forms, hover over the embryo to view its complete karyotype and genotype for all three genes (HBB, HEXA, CFTR). Record the allele combinations. Repeat the fertilization with a second pair of gametes and compare the two embryos' genotypes.*

(A) (1 pt) **Describe** the relationship between the chromosome number in each gamete and the chromosome number in the zygote that forms when two gametes fuse during fertilization.

(B) (1 pt) **Explain** why two embryos produced from gametes of the same two parents have different allele combinations for the HBB, HEXA, and CFTR genes.

(C) (1 pt) **Predict** how the frequency of the sickle cell allele (HBB^a) would change over many generations in a population where heterozygous individuals (Aa) survive at higher rates than both homozygous genotypes.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

Simulation Task: Perform at least four separate fertilizations by collecting different oocyte-sperm pairs. For each resulting embryo, hover to view the karyotype and record the genotype for all three genes and the sex chromosomes. Identify which embryos are healthy (no homozygous recessive genotypes and no chromosomal abnormalities) and which are affected or carriers.

(A) (1 pt) **Describe** the possible genotypes for a single autosomal gene when an offspring inherits one allele from each parent.

(B) (1 pt) **Explain** why an embryo that is heterozygous for HBB is not necessarily heterozygous for HEXA or CFTR.

(C) (1 pt) **Represent** how the two alleles of the HBB gene in each heterozygous parent (Aa) are distributed into gametes during meiosis and then combined during fertilization by drawing a diagram that shows chromosome segregation and the resulting offspring genotypes.

Draw your diagram here.

(D) (1 pt) **Explain** why a population of sexually reproducing organisms is more likely to persist through a sudden environmental change than a genetically identical clonal population of the same size.

5.1.A.1, 5.3.A.2