Zora Test Cross: Hands and Legs

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

In zoras, the **hands** gene and the **legs** gene are both on **chromosome 2**. For both genes, **clawed** is dominant and **webbed** is recessive. In this activity you will test cross a zora that is heterozygous for both genes, use a Punnett square to predict its babies, and use test cross data to calculate how far apart the two genes are on chromosome 2.

The two parents

	Chromosome 2, Copy A	Chromosome 2, Copy B	Phenotype
Parent 1	clawed hands, clawed legs	webbed hands, webbed legs	
Parent 2 (the tester)	webbed hands, webbed legs	webbed hands, webbed legs	

Write a chromosome 2 as its hands allele, then its legs allele. For example, *clawed, webbed* is a chromosome 2 that carries clawed hands and webbed legs.

Part 1: The Test Cross

(A) (1 pt) **Identify** the phenotype of each parent and write it in the last column of the table above.

(B) (1 pt) **Explain** why a test cross uses a parent that is homozygous recessive for both genes.

(C) (1 pt) **Describe** the gametes Parent 2 can make for chromosome 2.

Part 2: Mendel's Prediction

> **Assume the genes assort independently.** Mendel's law of independent assortment predicts that Parent 1 makes four kinds of gametes, each equally likely.

(A) (2 pt) **Complete** the Punnett square. In the first column, list the four kinds of chromosome 2 that Parent 1 can pass on and the probability of each. Parent 2 makes only one kind of gamete, which is filled in for you. In the last column, write the baby's two chromosome 2s.

Parent 1 gamete (hands, legs) and its probability	**Parent 2 gamete** (hands, legs)	**Baby's genotype** its two chromosome 2s
	webbed, webbed	
	webbed, webbed	
	webbed, webbed	
	webbed, webbed	

(B) (2 pt) **Calculate** the probability of each genotype and phenotype among the babies, and the number expected out of 400 babies.

Baby genotype hands alleles; legs alleles	**Baby phenotype**	**Probability**	**Expected out of 400**

5.3.A.1, 5.3.A.2.i, 5.3.A.2.v

Part 3: Calculate Recombinant Frequency and Map Distance

> A researcher used the same two parents and recorded 400 babies with 12 chromosomes.

Baby phenotype	**Number of babies**	**Parental or recombinant?**
Clawed hands, clawed feet	182	
Webbed hands, webbed feet	178	
Clawed hands, webbed feet	21	
Webbed hands, clawed feet	19	
Total	**400**	

(A) (1 pt) **Identify** which phenotypes come from parental (unchanged) chromosome 2s and which come from recombinant chromosome 2s. Fill in the last column of the table.

(B) (1 pt) **Explain** how you decided which phenotypes are recombinant.

(C) (1 pt) **Calculate** the recombinant frequency. Show your work.

Recombinant frequency = (number of recombinant babies ÷ total babies) × 100

(D) (1 pt) **Calculate** the map distance between the hands gene and the legs gene.

1% recombinant frequency = 1 map unit

5.2.A.2, 5.4.A.1.i

Part 4: A Better Prediction

> Use the recombinant frequency from Part 3(C). The two parental gametes share the parental fraction equally, and the two recombinant gametes share the recombinant fraction equally.

(A) (2 pt) **Calculate** the probability of each kind of gamete from Parent 1, then the probability and expected number of each baby phenotype out of 400.

Parent 1 gamete (hands, legs)	**Parental or recombinant?**	**Probability**	**Baby phenotype**	**Expected out of 400**
clawed, clawed				
webbed, webbed				
clawed, webbed				
webbed, clawed				

(B) (1 pt) **Explain** why the genes on chromosome 2 do not follow Mendel's law of independent assortment.

5.3.A.1, 5.4.A.1

Part 5: Apply the Map

(A) (1 pt) Another zora has **clawed hands, webbed legs** on Copy A and **webbed hands, clawed legs** on Copy B. **Predict** which two phenotypes would be most common in a test cross with Parent 2, and justify your prediction.

(B) (1 pt) The color gene and the counter shading gene on chromosome 1 are 20 map units apart. **Compare** them with the hands and legs genes: which pair is closer together, and which pair gives more recombinant babies in a test cross?

5.4.A.1.i

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