SI Biology - Full Discipline Demo

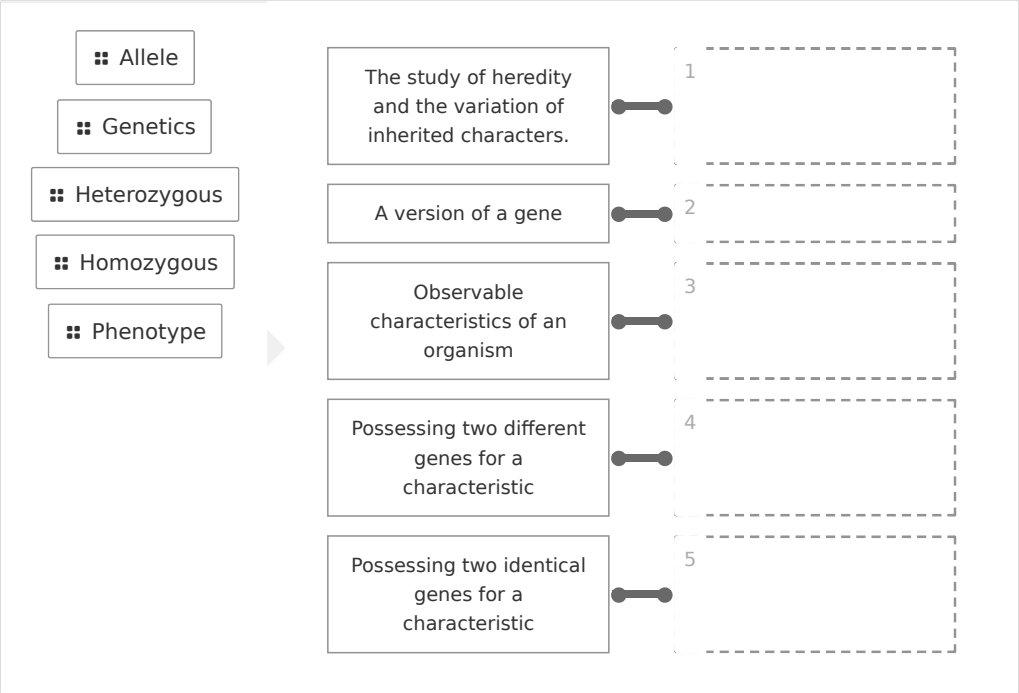
Mendelian Genetics - Digital

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

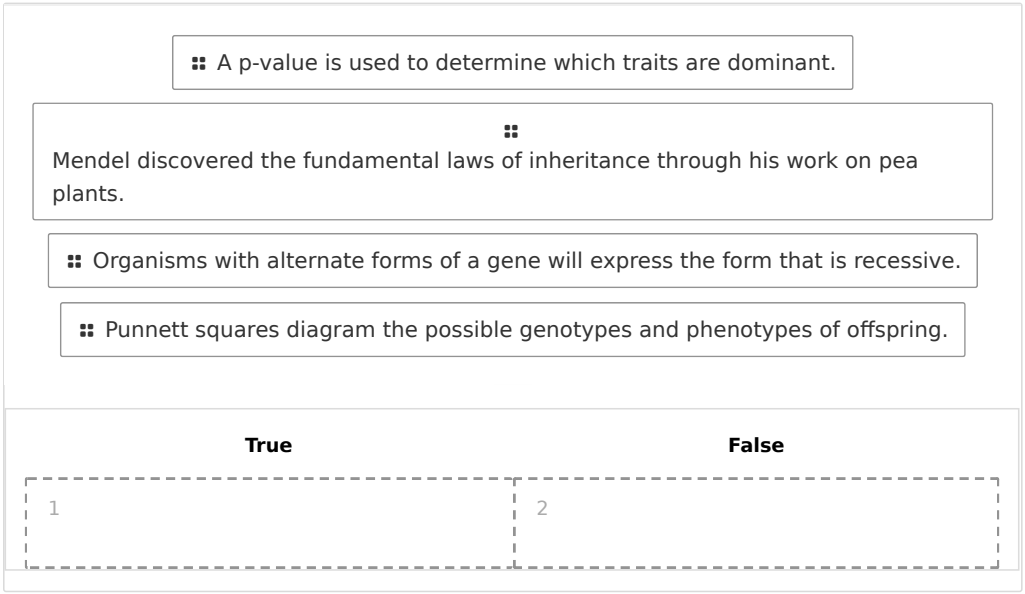


Correct answers:

1 Genetics 2 Allele 3 Phenotype 4 Heterozygous

5 Homozygous

Identify each statement as true or false.



Correct answers:

1

Mendel discovered the fundamental laws of inheritance through his work on pea plants.

Punnett squares diagram the possible genotypes and phenotypes of offspring.

2 A p-value is used to determine which traits are dominant.

Organisms with alternate forms of a gene will express the form that is recessive.

Exploration

Alleles are different versions of a gene that are passed from parent to offspring.

- True ✔
- False

When Mendel crossed true-breeding purple flowering peas to true-breeding white flowering peas, the offspring produced _____ colored flowers.

- pink
- purple ✔
- white
- white and purple

The Law of _____ states that offspring inherit one allele from each parent.

- Dominance
- Independent Assortment
- Segregation ✔
- Recessivity

A Punnett square describing a monohybrid cross contains _____ cells.

- two
- four ✔
- six
- eight

The phenotypic ratio for the offspring of a dihybrid cross between two parents with heterozygous genotypes is 4:2:2:2:2:1:1:1:1.

- True
- False ✔

A chi-square test can be used to compare the predictions of a Punnett square to what is observed in a population.

- True ✔
- False

Exercise 1

Explain the difference between the terms genotype and phenotype.

Genotype refers to the genetic makeup of an organism, whereas phenotype refers to the observable characteristics of an organism. The genotype determines the phenotype of an individual.

The seeds in this exercise were produced by a heterozygous parent and homozygous recessive parent as described in step 4. List all possible crosses that could have produced the homozygous recessive parent (cc).

The homozygous recessive parent could have been produced by the following crosses: cc x cc, Cc x cc, and Cc x Cc.

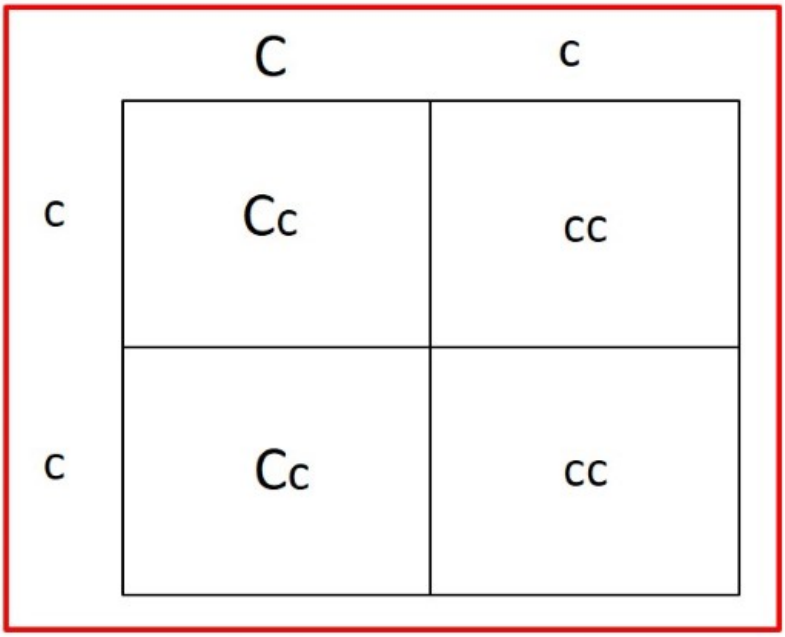
Was the Punnett square created in this exercise a good predictor of offspring phenotypes resulting from a cross between a homozygous recessive wrinkled-seed-producing millet plant and a heterozygous smooth-seed-producing millet plant? Reference Photo 1 and the results recorded in Data Table 4 in your explanation.

No, the Punnett square in Photo 1 predicted that 50% of the offspring would be smooth and 50% of the offspring would be wrinkled. The sample contained 61 smooth seeds and 39 wrinkled seed. The difference was statistically significant producing a p-value between 0.05-0.025 as recorded in Data Table 4.

Data Table 1: Millet Seed Genotypes and Phenotypes
(SAMPLE ANSWER BELOW)

	Genotype	Phenotype
Homozygous dominant	CC	smooth coat
Heterozygous	Cc	smooth coat
Homozygous recessive	cc	wrinkled coat

Photo 1 : Cross Producing Seeds in Kit (Cc x cc)
(SAMPLE ANSWER BELOW)



Data Table 2: Expected Ratios
(SAMPLE ANSWER BELOW)

Phenotypic ratio	1:1
Genotypic ratio	1:1
Offspring expected to be smooth (%)	50
Offspring expected to be wrinkled (%)	50

Data Table 3: Millet Seed Data
(SAMPLE ANSWER BELOW)

	Round Seeds	Wrinkled Seeds	Total
Observed number of individuals	61	39	100
Expected number of individuals	50	50	

Panel 1: Chi-square Calculation for Millet Seeds
(SAMPLE ANSWER BELOW)

$$x^2 = \frac{(61-50)^2}{50} + \frac{(39-50)^2}{50} = 4$$

Data Table 4: Millet Seed Chi-square Test
(SAMPLE ANSWER BELOW)

Degrees of Freedom	1
p-Value Range	0.05-0.025
Conclusion	Difference between expected and observed is statistically significant

Exercise 2

Was the Punnett square created in this exercise a good predictor of offspring phenotypes resulting from a dihybrid cross of heterozygous parents? Reference Photo 2 and Data Table 11 in your explanation.

Yes, the Punnett square in Photo 2 predicted a phenotypic ratio of 50%, 19%, 19%, and 6% for purple-smooth, purple-wrinkled, yellow-smooth, and yellow-wrinkled, respectively. The numbers of each phenotype in the sample were 297, 86, 85, and 25. The difference between the expected numbers and observed numbers of the phenotypes was not statistically significant producing a p-value range 0.500-0.050 as recorded in Data Table 11.

Would a cross between a homozygous purple-smooth parent (PPSS) and a parent that is heterozygous for both traits (PpSs) result in offspring that produced either yellow or wrinkled seeds? Explain your answer by listing the genotypes and phenotypes produced by the cross.

No, all offspring would produce purple, smooth seeds. The genotypes of the offspring would be: PPSS, PpSS, PPSs, and PpSs. An offspring would need to be homozygous recessive for either of the traits to produce yellow or wrinkled seeds.

Data Table 5: Kernel Alleles
(SAMPLE ANSWER BELOW)

Allele	Trait Description	Dominant/Recessive
P	Purple color	Dominant
p	Yellow color	Recessive
S	Smooth texture	Dominant
s	Wrinkled texture	Recessive

Data Table 6: Kernel Phenotypes and Genotypes
(SAMPLE ANSWER BELOW)

Phenotype	Possible Genotype (s)	Number of possible Genotypes
Purple-smooth	PPSS, PPSs, PpSS, PpSs	4
Yellow-smooth	ppSS, ppSs	2
Purple-wrinkled	PPss, Ppss	2
Yellow-wrinkled	ppss	1

Data Table 7: Genotypes of True-Breeding Corn
(SAMPLE ANSWER BELOW)

True-Breeding Phenotypes	Genotype	Number of possible Genotypes
Corn that produces only purple-smooth kernels	PPSS	1
Corn that produces only yellow-smooth kernels	ppSS	1
Corn that produces only purple-wrinkled kernels	PPss	1
Corn that produces only yellow-wrinkled kernels	ppss	1

Data Table 8: Allelic Combinations for Axes
(SAMPLE ANSWER BELOW)

Genotype	Allele Combinations for the Axis of a Punnett Square
Parent: PpSs	Combination 1: PS

Combination 2: Ps
Combination 3: pS
Combination 4: ps

Photo 2: Cross of Heterozygous Corn (PpSs x PpSs)
(SAMPLE ANSWER BELOW)

F_2 Generation		Parent 1			
		_PS_	_Ps_	_pS_	_ps_
Parent 2	_PS_	PPSS Purple-smooth	PPSs Purple-smooth	PpSS Purple-smooth	PpSs Purple-smooth
	_Ps_	PPSs Purple-smooth	PPss Purple-wrinkled	PpSs Purple-smooth	Ppss Purple-wrinkled
	_pS_	PpSS Purple-smooth	PpSs Purple-smooth	ppSS Yellow-smooth	ppSs Yellow-smooth
	_ps_	PpSs Purple-smooth	Ppss Purple-wrinkled	ppSs Yellow-smooth	ppss Yellow-wrinkled

Student Name
Date

Data Table 9: Description of Corn Offspring
(SAMPLE ANSWER BELOW)

Phenotypic ratio	9:3:3:1
Genotypic ratio	4:2:2:2:2:1:1:1:1
Offspring expected to be purple-smooth (%)	56.25%
Offspring expected to be purple-wrinkled (%)	18.75%
Offspring expected to be yellow-smooth (%)	18.75%
Offspring expected to be yellow-wrinkled (%)	6.25%

Data Table 10: Corn Offspring Data
(SAMPLE ANSWER BELOW)

	Purple-smooth	Purple-wrinkled	Yellow-smooth	Yell
Expected Number of Offspring	278	92	92	31
Section A (Observed)	53	27	17	3
Section B (Observed)	93	21	25	12
Section C (Observed)	89	17	32	8
Section D (Observed)	62	21	11	2
Observed Number of Offspring (A + B + C + D)	297	86	85	25

Panel 2: Chi-square Calculation for Corn Offspring
(SAMPLE ANSWER BELOW)

$$x^2 = \frac{(297-278)^2}{278} + \frac{(86-92)^2}{92} + \frac{(85-92)^2}{92} + \frac{(25-31)^2}{31} = 3.38$$

Data Table 11: Corn Chi-square Test
(SAMPLE ANSWER BELOW)

Degrees of Freedom	3
p-Value Range	0.500-0.050
Conclusion	p=0.500 – 0.050, therefore p > 0.05. There is not a statistically significant difference between the expected and observed values.

Competency Review

____ refers to the observable characteristics of an organism.

- Genotype
- Genetics
- Phenotype ✔
- Recessive

The Law of ____ states that the inheritance of one trait is not dependent of the inheritance of another.

- Dominance
- Independent Assortment ✔
- Segregation
- Homozygous

Punnett squares are used to predict the genotypic and phenotypic ratios in offspring.

- True ✔
- False

A Punnett square illustrating a dihybrid cross has ____ cells.

- 4
- 8
- 16 ✔
- 32

A significant X^2 value implies that the difference found between the expected and observed data is probably not due to chance alone.

- True ✔
- False

The highlighted area of the corn ear depicts _____ phenotypes.

- 2
- 4 ✔
- 9
- 123

The axis of a Punnett square illustrating the expected offspring of a parent with the genotype AaBB would be labeled as _____.

- Aa BB Aa BB
- AB AB ab ab
- AB AB aB aB ✔
- aa bb AA BB

A X^2 analysis of an offspring sample from a monohybrid cross between heterozygous parents generated a p value of .50 when analyzed against the expected results. The observed sample is _____ the expected results.

- identical to
- not significantly different from ✔
- significantly different from
- unrelated to

Extension Questions

A plant collector locates a wild population of lilies composed of 75% spotted flowers and 25% solid colored flowers. The collector selects seeds from several of the spotted individuals and plants the seeds in their garden. The collector is surprised that 25% of the resulting lilies produced solid colored

flowers. **Apply your knowledge of Mendelian genetics to explain why the collector did not produce only spotted flowering plants in their garden.**

(SAMPLE ANSWER BELOW)

The sampled population exhibited a 3:1 phenotypic ratio of spotted flower plants to solid colored flower plants suggesting that the genotypic ratio of the population was 1:2:1 for the flower color allele, with the solid color being recessive. By selected seeds from only a few plants, the collector was likely selecting seeds from the heterozygous plants. When planted in the collector's garden, these seeds would result in plants with a 3:1 phenotypic ratio of spotted flowers to solid flowers.