

# Lesson 3 DNA and Genetics

**LA.7.2.2.3, SC.7.L.16.1, SC.7.L.16.2, SC.7.N.1.1, SC.7.N.3.2**

**Skim or scan** the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.

## Main Idea

### The Structure of DNA

I found this on page \_\_\_\_\_.



**NGSSS Check**  
What is DNA? **SC.7.L.16.1**

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## Details



**Define** DNA, and explain the relationship of DNA and genes.

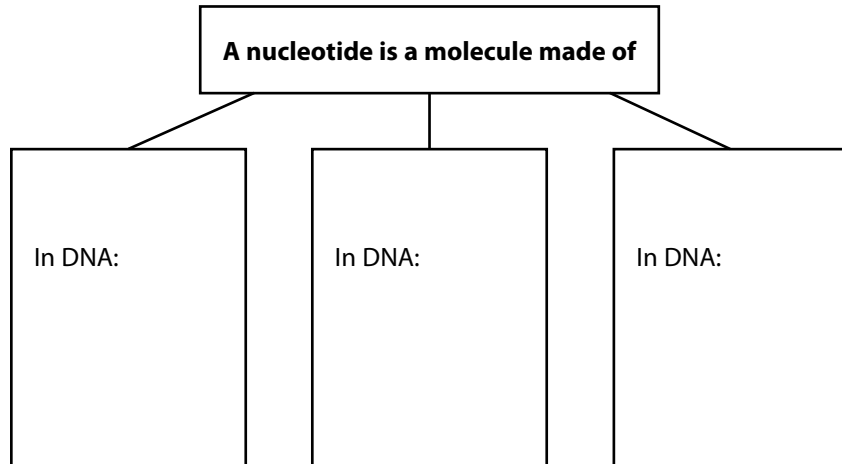
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**Describe** the shape of a DNA molecule.

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**Identify** the 3 components of a nucleotide, and tell where each component is found in a DNA molecule.



**Identify** the 4 nitrogen bases found in DNA, and finish the statement about the nitrogen bases.

1. \_\_\_\_\_ 3. \_\_\_\_\_

2. \_\_\_\_\_ 4. \_\_\_\_\_

\_\_\_\_\_ always bonds to T; \_\_\_\_\_ always bonds to G.

**Sequence** the DNA replication process.

1. DNA strand separates and _____.
2. Nucleotides form new _____.
3. Two _____ are produced.

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**Main Idea**

**Making Proteins**

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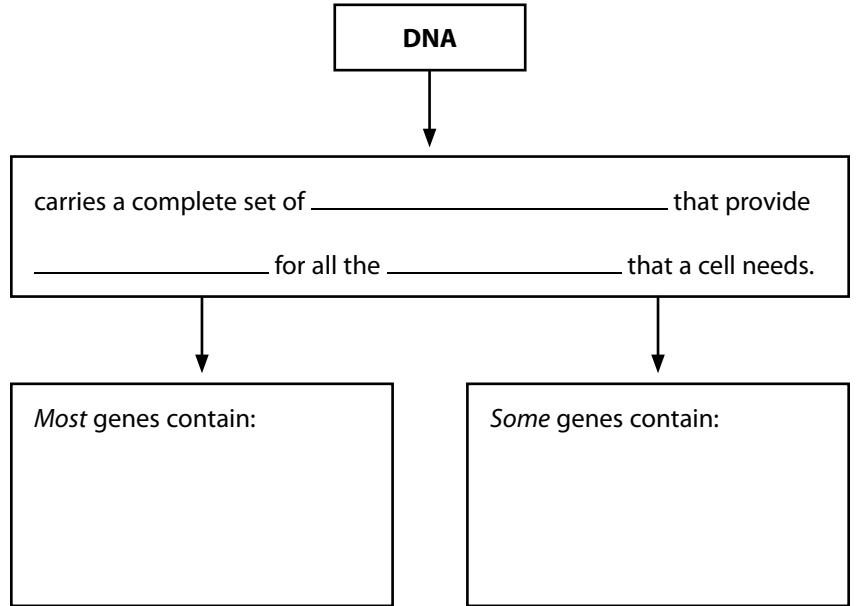
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**Details**

**Explain** the role DNA plays in making proteins.



**Explain** the term junk DNA and its function.

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**Define** RNA, and describe its 2 functions.

RNA, or ribonucleic acid, is a type of \_\_\_\_\_.

1. \_\_\_\_\_, and
2. \_\_\_\_\_.

**Compare** DNA and RNA.

	RNA	DNA
Made of		
Number of strands		
Nitrogen base		
Sugar		

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## Lesson 3 | DNA and Genetics (continued)

### Main Idea

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### Mutations

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### Details

 **Describe** transcription.

Transcription: \_\_\_\_\_

 **Sequence** the 2 steps involved in transcription.

1. \_\_\_\_\_

2. \_\_\_\_\_

**Identify** 3 types of RNA and their abbreviations.

1. \_\_\_\_\_


2. \_\_\_\_\_

3. \_\_\_\_\_

**Define** translation, and tell where this process occurs.

\_\_\_\_\_

\_\_\_\_\_

 **Sequence** the process of translation.

1. \_\_\_\_\_ carries amino acids to the \_\_\_\_\_.



2. \_\_\_\_\_ helps form chemical bonds that \_\_\_\_\_.



3. The first \_\_\_\_\_ separates from its amino acid and from the \_\_\_\_\_.

A third \_\_\_\_\_ brings in another \_\_\_\_\_.

**Explain** the part that codons play in making proteins.

\_\_\_\_\_

\_\_\_\_\_

**Define** mutation. Identify two factors that can trigger them.

Mutations: \_\_\_\_\_

\_\_\_\_\_

Triggered by: 1. \_\_\_\_\_ 2. \_\_\_\_\_

Lesson 3 | DNA and Genetics (continued)

Main Idea

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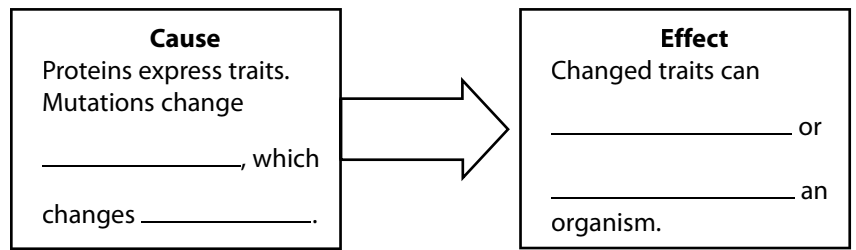
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Details

Analyze 3 types of mutations.

- 1. Deletion: \_\_\_\_\_  
\_\_\_\_\_
- 2. Insertion: \_\_\_\_\_  
\_\_\_\_\_
- 3. Substitution: \_\_\_\_\_  
\_\_\_\_\_

Identify the effects of a mutation.



Identify four genetic disorders caused by mutations.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

Connect It Are genetic disorders always inherited? Explain your answer.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





## Gummy Bear Genetics

Imagine you are on a team of geneticists that is doing “cross-breeding experiments” with gummy bears. Unfortunately, the computer containing your data has crashed. All you have left are six gummy-bear litters that resulted from six sets of parents. But no one can remember which parents produced which litter. You know that gummy-bear traits have either Mendelian inheritance or incomplete dominance. Can you determine which parents produced each set of offspring and how gummy bear traits are inherited?

### Ask a Question

What are the genotypes and phenotypes of the parents for each litter?

### Materials

gummy bears                  calculator                  paper bag

### Safety

### Make Observations

- Obtain a bag of gummy bears. Sort the bears by color (phenotype).  
 ⚠ *Do not eat the gummy bears.*
- Count the number (frequency) of bears for each phenotype. Then, calculate the ratio of phenotypes for each litter.
- Combine data from your litter with those of your classmates using the data table below.
- As a class, select a letter to represent the alleles for color. Record the possible genotypes for your bears in the class data table.

Gummy Bear Cross Data for Lab Group					
Cross #	Phenotype Frequencies	Ratio	Possible Genotypes	Mode of Inheritance	Predicted Parental Genotypes
EXAMPLE	15 green/5 pink	3:1	GG or Gg/gg	Mendelian	Gg × Gg
1.					
2.					
3.					
4.					
5.					

**Big Idea Lab continued**

**Form a Hypothesis**

5. Use the data to form a hypothesis about the probable genotypes and phenotypes of the parents of your litter and the probable type of inheritance.

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**Test Your Hypothesis**

6. Design and complete a Punnett square using the predicted parental genotypes in your hypothesis.

7. Compare your litter's phenotype ratio with the ratio predicted by the Punnett square. Do your data support your hypothesis? If not, revise your hypothesis and repeat steps 5–7.

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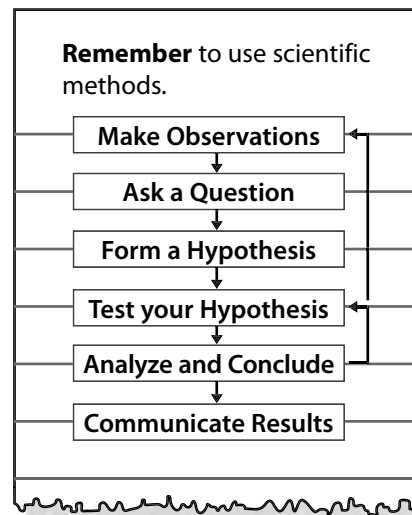


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**Reminder**

**Using Ratios**

- A ratio is a comparison of two numbers.
- A ratio of 15:5 can be reduced to 3:1.



## Big Idea Lab continued


### Analyze and Conclude

8. **Infer** What were the genotypes of the parents? The phenotypes? How do you know?

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9.  **The Big Idea** Determine the probable modes of inheritance for each phenotype. Explain your reasoning.

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10. **Graph** Using the data you collected, draw a bar graph that compares the phenotype frequency for each gummy bear phenotype.

### Communicate Your Results

Create a video presentation of the results of your lab. Describe the question you investigated, the steps you took to answer the question, and the data that support your conclusions. Share your video with your classmates.

### **Extension**

Think of a question you have about genetics. For example, can you design a pedigree to trace a Mendelian trait in your family? To investigate your question, design a controlled experiment or an observational study.



## Study Guide

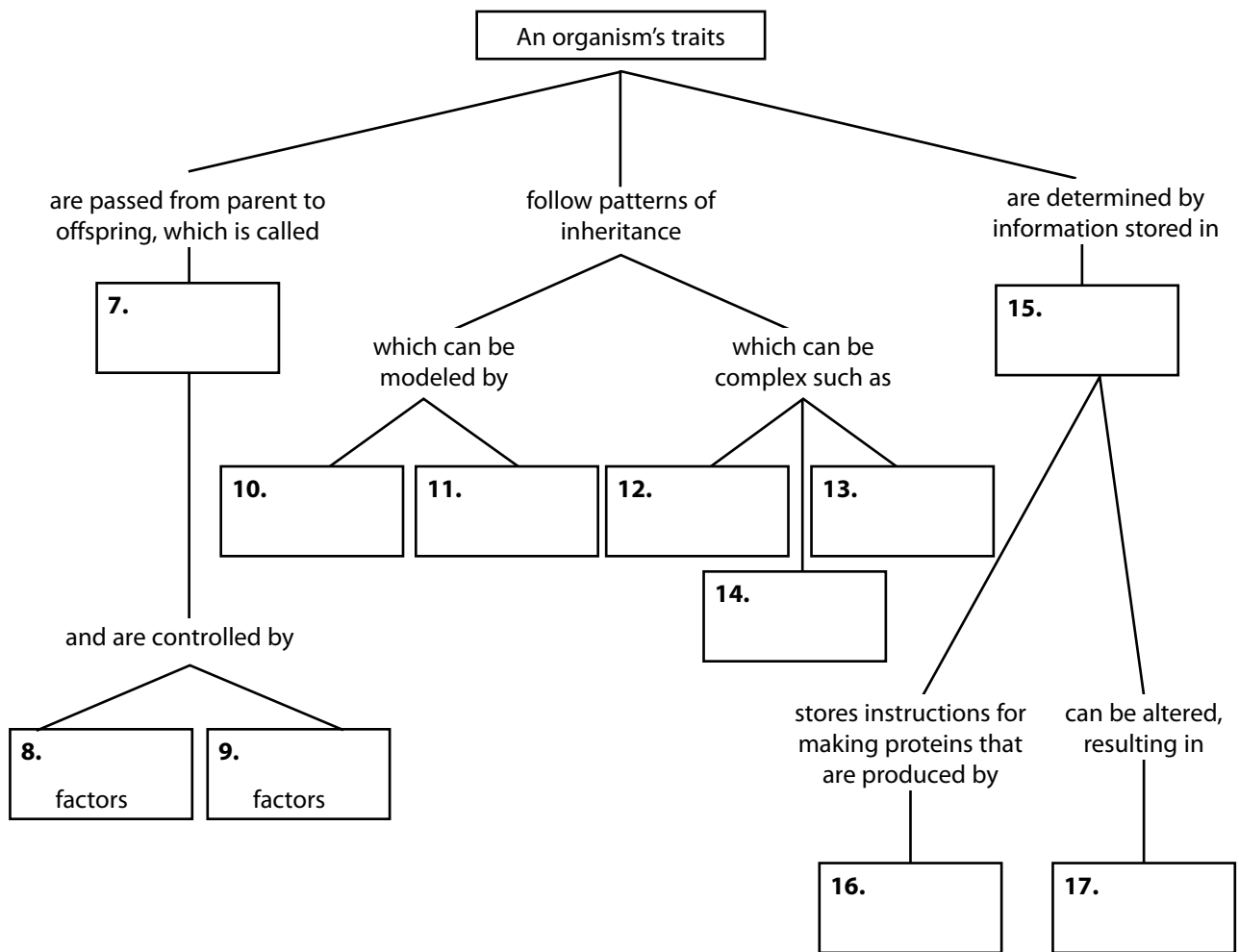
### Use Vocabulary

Use vocabulary terms from the chapter to complete the sentences below.

1. The study of how traits are passed from parents to offspring is called \_\_\_\_\_.
2. The passing of traits from parents to offspring is \_\_\_\_\_.
3. Human height, weight, and skin color are examples of characteristics determined by \_\_\_\_\_.
4. A helpful device for predicting the ratios of possible genotypes is a(n) \_\_\_\_\_.
5. The code for a protein is called a(n) \_\_\_\_\_.
6. An error made during the copying of DNA is called a(n) \_\_\_\_\_.

### Link Vocabulary and Key Concepts

Use vocabulary terms from the chapter to complete the concept map below.



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## Chapter 12 Review

### Understand Key Concepts

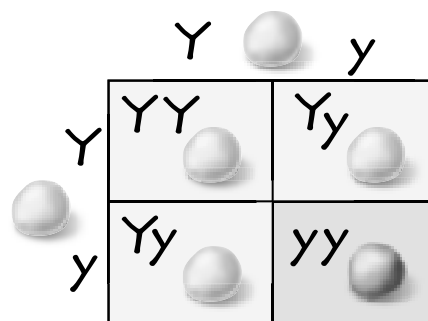
Circle the correct answer below.

1. The process shown below was used by Mendel during his experiments. What is the process called? **SC.7.N.2.1**



- A. cross-pollination  
 B. segregation  
 C. asexual reproduction  
 D. blending inheritance
2. Which statement best describes Mendel's experiments? **SC.7.N.2.1**
- A. He began with hybrid plants.  
 B. He controlled pollination.  
 C. He observed only one generation.  
 D. He used plants that reproduce slowly.
3. Before Mendel's discoveries, which statement describes how people believed traits were inherited? **SC.7.N.2.1**
- A. Parental traits blend like colors of paint to produce offspring.  
 B. Parental traits have no effect on their offspring.  
 C. Traits from only the female parent are inherited by offspring.  
 D. Traits from only the male parent are inherited by offspring.
4. Which term describes the offspring of a first-generation cross between parents with different forms of a trait? **SC.7.L.16.1**
- A. genotype  
 B. hybrid  
 C. phenotype  
 D. true-breeding

5. Which process makes a copy of a DNA molecule? **SC.7.L.16.1**
- A. mutation  
 B. replication  
 C. transcription  
 D. translation
6. Which process uses the code on an RNA molecule to make a protein? **SC.7.L.16.1**
- A. mutation  
 B. replication  
 C. transcription  
 D. translation
7. The Punnett square below shows a cross between a pea plant with yellow seeds and a pea plant with green seeds. If mating produces 100 offspring, about how many will have yellow seeds? **SC.7.L.16.2**



Phenotypes—3 yellow, 1 green  
 Genotypes—1 YY, 2 Yy, 1 yy

- A. 25  
 B. 50  
 C. 75  
 D. 100
8. Which term describes multiple genes affecting the phenotype of one trait? **SC.7.L.16.1**
- A. codominance  
 B. blending inheritance  
 C. incomplete dominance  
 D. polygenic inheritance

## Chapter 12 Review continued

### Critical Thinking

Use the lines below to respond to the following questions.

**9. Compare** heterozygous genotype and homozygous genotype. **LA.7.2.2.3**

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**10. Distinguish** between multiple alleles and polygenic inheritance. **LA.7.2.2.3**

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**11. Give an example** of how the environment can affect an organism's phenotype. **SC.7.L.16.1**

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## Chapter 12 Review continued

### Critical Thinking

Use the lines below to respond to the following questions.

- 12. Predict** In pea plants, the allele for smooth pods is dominant to the allele for bumpy pods. Predict the genotype of a plant with bumpy pods. Can you predict the genotype of a plant with smooth pods? Explain. **SC.7.L.16.1**

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- 13. Interpret Graphics** In tomato plants, red fruit (R) is dominant to yellow fruit (r). Interpret the Punnett square below, which shows a cross between a heterozygous red plant and a yellow plant. Include the possible genotypes and corresponding phenotypes. **SC.7.L.16.2**

	R	r
r	Rr	rr
r	Rr	rr

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- 14. Compare and contrast** characteristics of replication, transcription, translation, and mutation. Which of these processes takes place only in the nucleus of a cell? Which can take place in both the nucleus and the cytoplasm? How do you know? **LA.7.2.2.3**

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**Chapter 12 Review continued**



**Review the Big Idea**

**16.** How are traits passed from generation to generation? Explain how dominant and recessive alleles interact to determine the expression of traits. **SC.7.L.16.1**

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**17.** The photo on page 451 in your textbook shows an albino offspring from a non-albino mother. If albinism is a recessive trait, what are the possible genotypes of the mother, the father, and the offspring? **SC.7.L.16.2**

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**Math Skills**

**MA.6.A.3.6**

**18.** A cross between two heterozygous pea plants with yellow seeds produced 1,719 yellow seeds and 573 green seeds. What is the ratio of yellow to green seeds?

**19.** A cross between two heterozygous pea plants with smooth green pea pods produced 87 bumpy yellow pea pods, 261 smooth yellow pea pods, 261 bumpy green pea pods, and 783 smooth green pea pods. What is the ratio of bumpy yellow to smooth yellow to bumpy green to smooth green pea pods?

**20.** A jar contains three red, five green, two blue, and six yellow marbles. What is the ratio of red to green to blue to yellow marbles?

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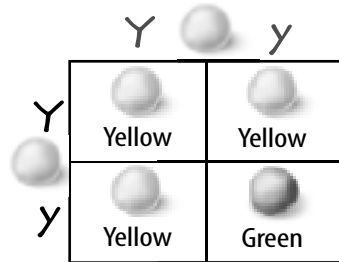


# Science Benchmark Practice

Mark your answer in the answer bubbles below each question.

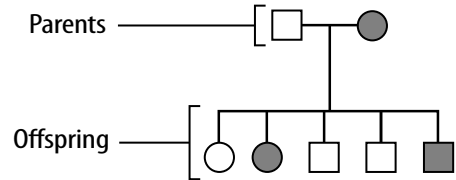
## Multiple Choice

Use the diagram below to answer questions 1 and 2.



- Which genotype belongs in the lower right square? **SC.7.L.16.2**
  - (A) YY
  - (B) Yy
  - (C) yY
  - (D) yy
- What percentage of plants from this cross will produce yellow seeds? **SC.7.L.16.2**
  - (F) 25 percent
  - (G) 50 percent
  - (H) 75 percent
  - (I) 100 percent
- What is heredity? **SC.7.L.16.1**
  - (A) the study of how traits are passed from parents to offspring
  - (B) the study of how DNA replicates
  - (C) the process of chromosomes mutating
  - (D) the passing of traits from parents to offspring
- Which can be determined by using a Punnett Square or pedigree? **SC.7.L.16.2**
  - (F) phenotypes of polygenic traits
  - (G) phenotypes of dominant and recessive traits
  - (H) phenotypes of codominant traits
  - (I) genotype mutations

Use the chart below to answer questions 5 and 6.



### Phenotypes

- Female, dominant
- Female, recessive
- Male, dominant
- Male, recessive

- Based on the pedigree above, how many offspring from this cross had the recessive phenotype? **SC.7.L.16.2**
  - (A) 1
  - (B) 2
  - (C) 3
  - (D) 5
- Based on the pedigree above, how many offspring from this cross are homozygous dominant? **SC.7.L.16.2**
  - (F) 0
  - (G) 1
  - (H) 3
  - (I) 5
- Which is a section on a chromosome that has genetic information for one trait? **SC.7.L.16.1**
  - (A) allele
  - (B) genotype
  - (C) phenotype
  - (D) gene
- Which is a model used to predict possible genotypes and phenotypes of offspring? **SC.7.L.16.2**
  - (F) polygenic inheritance
  - (G) ratio
  - (H) Punnett Square
  - (I) incomplete dominance

**NGSSS for Science Benchmark Practice continued**

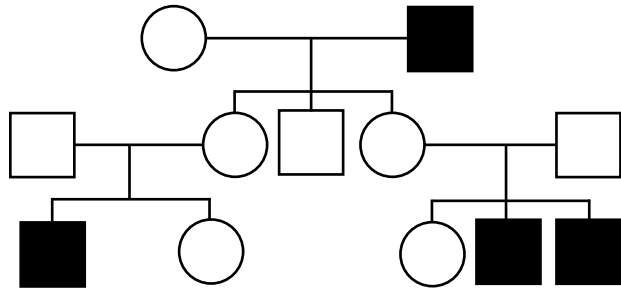
Use the diagrams below to answer questions 9 and 10.

	R	r
r	Rr	rr
r	Rr	rr

Genotype	Phenotype
RR	Red
Rr	Pink
rr	White

- 9** According to the information in the diagrams above, what is the ratio of the offspring? **SC.7.L.16.2**
- (A) 0 red: 4 pink: 0 white
  - (B) 1 red: 2 pink: 1 white
  - (C) 3 red: 0 pink: 1 white
  - (D) 4 red: 0 pink: 0 white
- 10** According to the information in the diagrams above, what is the phenotype of homozygous dominant offspring? **SC.7.L.16.2**
- (F) red
  - (G) pink
  - (H) white
  - (I) yellow
- 11** Mendel crossed a true-breeding plant with round seeds and a true-breeding plant with wrinkled seeds. Which was true of every offspring of this cross? **SC.7.L.16.2**
- (A) They had the recessive phenotype.
  - (B) They showed a blend of traits.
  - (C) They were homozygous.
  - (D) They were hybrid plants.

Use the diagram below to answer question 12.



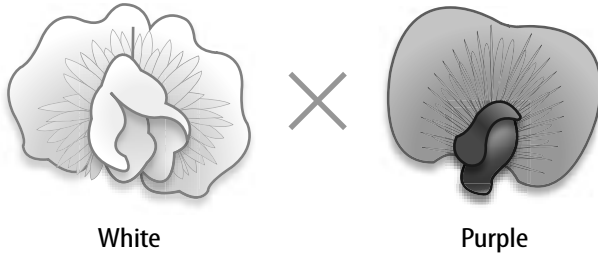
**Phenotypes**

- female, dominant
- Female, recessive
- male, dominant
- male, recessive

- 12** Using the diagram above, what can be determined about the genotypes of the first generation of offspring? **SC.7.L.16.2**
- (F) They are all homozygous recessive.
  - (G) They are all homozygous dominant.
  - (H) They are all heterozygous.
  - (I) Two are heterozygous, and one is homozygous recessive.
- 13** If a pea plant with a homozygous dominant genotype for a trait is crossed with a pea plant with a heterozygous genotype for the same trait, what is the ratio of offspring? **SC.7.L.16.2**
- (A) 1 homozygous dominant: 2 heterozygous: 1 homozygous recessive
  - (B) 2 homozygous dominant: 2 heterozygous: 0 homozygous recessive
  - (C) 0 homozygous dominant: 2 heterozygous: 2 homozygous recessive
  - (D) 1 homozygous dominant: 0 heterozygous: 3 homozygous recessive



**Multiple Choice** *Bubble the correct answer.*



- Look at the image above. What color flowers did Mendel discover were produced in the first generation? **SC.7.L.16.1**
  - The flowers were all blue.
  - The flowers were all pink.
  - The flowers were all purple.
  - The flowers were all white.
- Which is NOT a reason that Mendel used pea plants for his experiments? **SC.7.L.16.1**
  - Pea plants do not self-pollinate.
  - Pea plants reproduce quickly.
  - Pea plants have many easily observed traits.
  - Pea plant reproduction could be controlled by Mendel.

Guinea Pig Fur Color		
Generation	White fur (number of offspring)	Black fur (number of offspring)
First	0	9
Second	6	19



- Based on the table above, which statement is true? **SC.7.L.16.1**
  - Guinea pigs are not true-breeding for fur color.
  - The ratio of a hybrid cross in guinea pigs is about 2:1.
  - In the first generation, the trait for black fur is masked by the trait for white fur.
  - In guinea pigs, the trait for black fur is dominant, and the trait for white fur is recessive.
- How did Mendel control pollination during his cross-pollination experiments involving the study of flower color in pea plants? **SC.7.L.16.1**
  - He allowed pollinators such as bees to pollinate the plant.
  - He removed the pistils from the plant being pollinated.
  - He removed the stamens from the plant being pollinated.
  - He transferred pollen from flower to flower on the same plant.

**Extend Your Learning** Turn the page to Learn Out Loud





**Multiple Choice** *Bubble the correct answer.*

1. Which Punnett square shows a cross between two heterozygous parents?

SC.7.L.16.2

(A)

	M	m
M	MM	Mm
m	Mm	mm

(B)

	Y	Y
y	Yy	Yy
y	Yy	Yy

(C)

	G	G
G	GG	GG
g	Gg	Gg

(D)

	R	r
R	RR	Rr
R	RR	Rr

2. A cross between a plant with red flowers and a plant with white flowers produces offspring with pink flowers. What is this an example of? SC.7.L.16.2

- (F) codominance
- (G) dominance
- (H) incomplete dominance
- (I) polygenic inheritance

3. In one generation, two true-breeding plants produce offspring that look like one of the parents. In the second hybrid generation, the offspring have a ratio of 3:1 for the traits. Which statement is true of the parents of the first generation? SC.7.L.16.2

- (A) Both were heterozygous for the dominant trait.
- (B) Both were homozygous for the recessive trait.
- (C) One was homozygous for the dominant trait and the other was homozygous for the recessive trait.
- (D) One was homozygous for the dominant trait and the other was heterozygous for the dominant trait.

4. Which of these is a trait in humans that is determined by multiple alleles? SC.7.L.16.1

- (F) height
- (G) weight
- (H) blood type
- (I) skin color

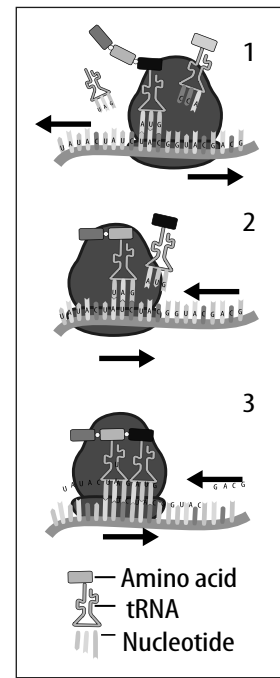




**Multiple Choice** Bubble the correct answer.



1. In the image above, what are *A*, *C*, *T*, and *G*? **SC.7.L.16.1**
  - (A) codons
  - (B) nucleotides
  - (C) amino acids
  - (D) nitrogen bases
  
2. How do mutations potentially cause harm? **SC.7.L.16.1**
  - (F) Mutations break down chromosomes.
  - (G) Mutations damage ribosomes.
  - (H) Mutations can cause a gene to code for a different protein than normal.
  - (I) Mutations prevent the formation of RNA, so translation does not take place.



3. In the image above, what is the correct order of the steps shown? **SC.7.L.16.1**
  - (A) 1, 2, 3
  - (B) 1, 3, 2
  - (C) 2, 3, 1
  - (D) 3, 2, 1
  
4. RNA carries the code for making **SC.7.L.16.1**
  - (F) acids.
  - (G) bases.
  - (H) DNA.
  - (I) proteins.



