Genetics in Action

Teacher's Guide
Middle School

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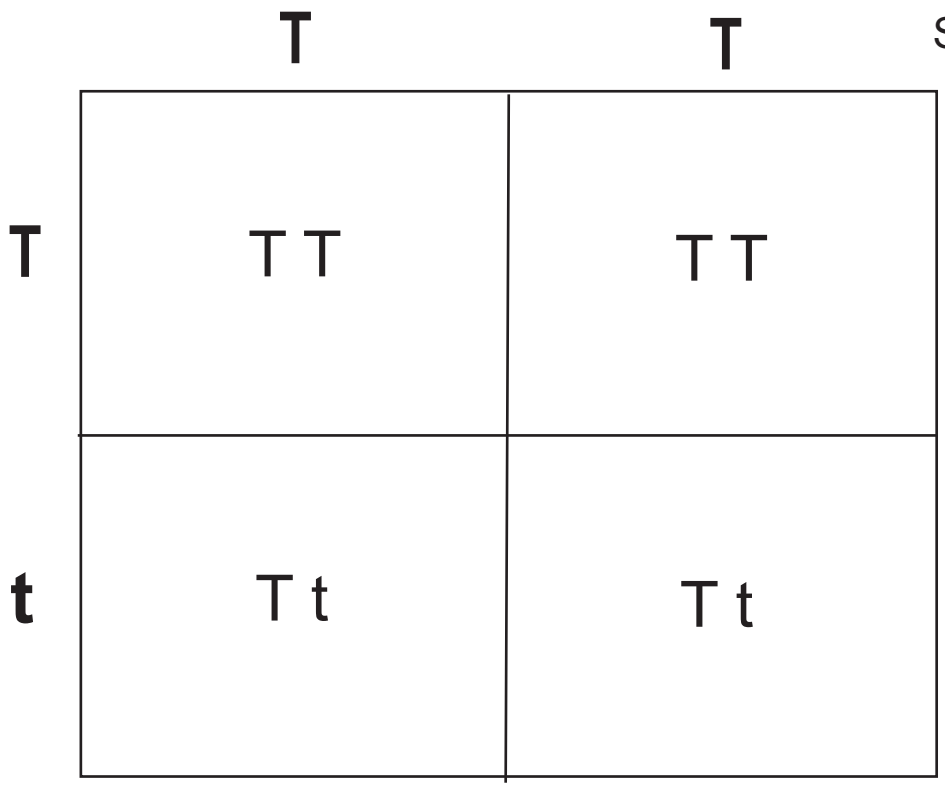

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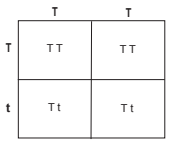

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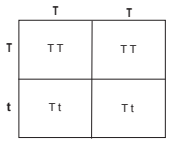

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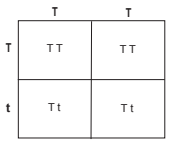

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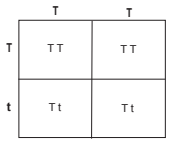


A Message from our Company. . .

Dear Educator:

Thank you for your interest in the educational videos produced by the Visual Learning Company. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

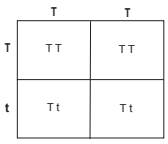
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and led Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



National Standards Correlations

National Science Education Standards
(Content standards: 5-8, National Academy of Sciences, c. 1996)

Life Science - Content Standard C:

- In many species, including humans, females produce eggs and males produce sperm. An egg and sperm unite to begin development of a new individual. The new individual receives genetic information from its mother (via the egg) and its father (via the sperm).

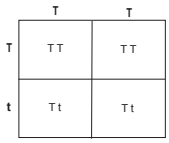
- Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

Benchmarks for Science Literacy
(Project 2061 – AAAS, c. 1993)

Heredity (5B)

By the end of the 8th grade, students should know that:

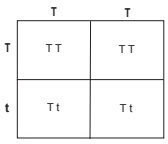
- In sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male. As the fertilized egg carrying genetic information from each parent, multiplies to form the complete organism with about a trillion cells, the same genetic information is copied in each cell.



Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

- Describe Mendel's law of segregation as the process by which a gene from each pair goes to each sex cell.
- Understand that in the process of fertilization, each sex cell carries a gene for a trait from each parent. And, the fertilized egg contains a gene from the mother and a gene from the father for a trait.
- Explain that Mendel's law of independent assortment proposes that different traits are inherited independently of one another. In other words, traits separate into sex cells randomly and independently from each other.
- Describe incomplete dominance as a process in which alleles pairs are neither recessive nor dominant.
- Provide an example of a cross in a plant or animal in which incomplete dominance occurs.
- Explain that in codominance each allele fully expresses itself.
- Describe how various blood types exemplify the principle of codominance.
- Understand that in polygenic inheritance a group of gene pairs act together to produce a trait.
- Cite an example of polygenic inheritance in a living thing.
- Explain that a mutation is a change in a gene or chromosome.
- Describe what is meant by a genetic disorder, and provide an example of one.



Assessment

Preliminary Assessment:

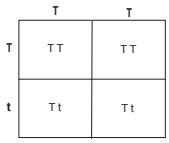
The Preliminary Assessment provided in the Student Masters section is an assessment tool designed to gain an understanding of students' pre-existing knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post Assessment:

The Post Assessment provided in the Student Masters section can be utilized as an assessment tool following completion of the video and student activities. The results of the Post Assessment can be compared against the results of the Preliminary Assessment to evaluate student progress.



Introducing the Video

The first portion of this program addresses Gregor Mendel's Law of Segregation and his Law of Independent Assortment. Write these two laws on the board. Next, tell students that both of these laws are fundamental in understanding how traits are passed on in sexually producing organisms, including humans.

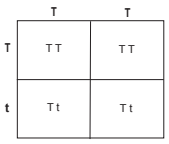
If students are not familiar with some of the basics you will need to cover this before showing the video. Introduce the terms fertilization, sperm, and egg. Creating diagrams of the process may be helpful. Next, tell students that both sperm and egg are sex cells which hold heredity information from each parent. This helps explain why each person has some outward physical traits that resemble outward physical traits from their parents. Tell students to pay close attention to the video to learn how the Law of Segregation and the Law of Independent Assortment relate to the passing on of heredity materials. Instruct students that at the conclusion of the program they will need to state the definitions of each of these laws.

Video Viewing Suggestions

The student Master "Video Review" is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

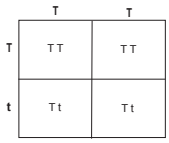
The program is approximately twenty minutes in length and includes a ten question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.



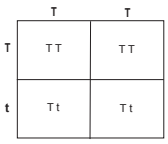
Video Script: Genetics in Action

1. Next time you get a chance, take a minute to look at the wide range of eye color among the students in your class.
2. Chances are you will find they range from brown,…
3. …to blue…
4. …to green…,
5. You may also notice different shades and intensities of all these colors. Why?
6. What causes these horses to have coats with such varied colors?
7. What causes different blood types in people?
8. And what factors are responsible for giving this cat its calico colored fur?
9. During the next few minutes we are going to try to answer these questions…
10. …and many others, as we explore genetics in action.
11. But, first let us review some of the work of Gregor Mendel, the father of genetics.
12. **Graphic Transition – Mendel's Work Reviewed**
13. As you may already know, Gregor Mendel, was an Austrian monk who experimented with pea plants in his garden in the 1860's. He made many discoveries, establishing the foundation for the study of genetics.
14. Genetics is the study of heredity – the passing on of traits from parents to offspring.
15. From his work with pea plants Mendel hypothesized that each trait has two factors. Today, we call these factors genes.
16. Genes are the basic unit of heredity, carrying information about traits from parents to offspring. Each organism has two copies of each gene. One copy from the female, and the other copy from the male parent.
17. The two copies may have different forms. We call different forms of a gene alleles. For example, in pea plants there is an allele that causes plants to grow tall and another allele that causes plants to grow short.
18. The allele for growing tall is commonly represented by the capital letter T, and the allele for growing short by the small letter t.
19. Mendel found that one allele often masks or dominates another.
20. In pea plants, tallness is dominant over shortness. The allele for shortness therefore is recessive.
21. While these concepts seem rather obvious today, at the time they were quite earth shaking, and did not reach their full impact until the turn of the twentieth century.
22. **Graphic Transition – Law of Segregation**
23. Another pea plant trait Mendel worked with was pea pod color.
24. He found that green pea pods, symbolized by capital P, were dominant over yellow pea pods symbolized by lower case p.



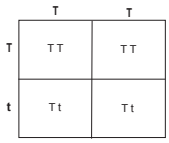
Script (cont.)

25. Mendel crossed a homozygous dominant green pea podded plant with…
26. …a homozygous recessive yellow pea podded plant. All the offspring were heterozygous and all had green pea pods. In other words, all the offspring had alleles in their gene pairs which were different from each other.
27. **You Predict**! What did the pea pods of these offspring look like?
28. About 25% of the offspring were homozygous dominant, having green pea pods.
29. About 50% were heterozygous with green pods.
30. And, about 25% of the offspring were homozygous recessive and had yellow pea pods.
31. In these crosses you can see that each parent contributes one gene for the trait to each offspring.
32. When a parent plant forms sex cells, sperm or egg cells, the genes of the parent separate. Another word for separate is segregate.
33. According to the law of segregation, a gene from each pair goes to each sex cell.
34. For example, in the case of a heterozygous father – capital P and lower case p separate to form sex cells. The same occurs in the mother.
35. In the process of sexual reproduction, the male sex cell carrying a trait unites with the female sex cell carrying another trait to form a fertilized egg which eventually grows into a new plant.
36. Each fertilized egg contains one gene from the mother and another gene from the father for a specific trait.
37. **Graphic Transition – Law of Independent Assortment**
38. Gregor Mendel also crossed pea plants that differed from one another by more than one trait.
39. For example, he made crosses in pea plants for the traits of both seed color and seed shape.
40. He knew that yellow seed color was dominant over green, and that round shape was dominant over wrinkled.
41. A special chart called a Punnett square can be used to predict the possible genotypes of offspring for a single trait. We can also use a Punnett square to keep track of possible genotypes in offspring where two different traits are involved. This chart is a little bigger, but it works the same way.
42. In the first cross, he chose a parent that was homozygous dominant for both traits. This plant was bred with a plant that was homozygous recessive for both traits.
43. The offspring of this cross outwardly displayed only the two dominant traits. In other words, the seeds were all yellow and smooth. These offspring were hybrids.



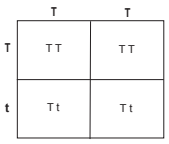
Script (cont.)

44. Next, these hybrid offspring were allowed to self pollinate.
45. This type of cross is called a dihybrid cross because it involves two different hybrid traits.
46. The offspring of the dihybrid cross revealed recessive traits for both characteristics.
47. From these results, Mendel concluded that different traits are inherited independently of one another. This principle is known as the law of independent assortment.
48. In other words, traits or gene pairs separate into sex cells randomly and independently of each other.
49. **Graphic Transition – Incomplete Dominance**
50. In 1900 an important discovery was made by the German botanist, Karl Correns.
51. He found that the traditional principle of dominance and recessiveness did not always hold true.
52. In his work with a type of flower called Four-o'clocks, he made a very interesting discovery.
53. He crossed a purebred red Four O'clock flower symbolized by RR and a purebred white Four O'clock flower symbolized by WW.
54. **You Predict!** What do you think the flowers looked like from this cross?
55. Amazingly, these flowers were not red or white but were pink.
56. Correns hypothesized that in some gene pairs the genes were neither recessive nor dominant.
57. These genes are said to show incomplete dominance.
58. Incomplete dominance may also occur in animals.
59. When a purebred chestnut brown horse symbolized by capital B capital B,…
60. …is bred with a purebred horse that is creamy white, symbolized by capital W capital W,…
61. …the offspring are a golden-brown color. This type of horse is called a palomino, and is the result of incomplete dominance.
62. **Graphic Transition – Codominance**
63. As you know, the human body contains blood, which you see when you cut yourself.
64. Red blood cells, responsible for carrying oxygen throughout the body, have two possible carbohydrates which coat their surface.
65. The letters A and B refer to these two different types of carbohydrates.
66. A person that has blood type A has the type A carbohydrate in their blood cells.
67. And a person that has blood type B has the type B carbohydrate in their blood cells.
68. A person with type AB blood has both carbohydrates, and a person with type O blood has neither of these carbohydrates.



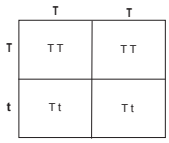
Script (cont.)

69. Blood type is a codominant trait meaning that each allele fully expresses itself.
70. In other words, neither allele dominates the other, and each allele is equally emphasized.
71. **Graphic Transition – Polygenic Inheritance**
72. In most cases, a combination of many genes is responsible for a trait. As in the case for the trait of eye color.
73. This is called polygenic inheritance. In polygenic inheritance a group of genes act together to produce a trait. Most traits are the result of polygenic inheritance.
74. In eye color, for example, different gene combinations produce an array of phenotypes. For this reason there are a wide range of different shades of eye color.
75. Height is another trait controlled by polygenic inheritance,…
76. …as is skin color.
77. It is estimated that three to six gene pairs control skin color.
78. And it is estimated that even more gene pairs control hair color.
79. Polygenic inheritance also plays a role in the traits of plants such as in wheat.
80. And in the traits of many animals.
81. For example, egg production in chickens is a polygenic trait.
82. **Graphic Transition – Mutations**
83. About thirty years after Gregor Mendel conducted experiments in his garden, a Dutch botanist by the name of Hugo DeVries made additional observations on another type of plant called evening primroses.
84. DeVries bred plants and got results similar to those of Mendel.
85. But, much to his amazement – every once in a while a new variety of primrose would appear.
86. At the time, these unusual appearances could not be accounted for by the current laws of genetics.
87. DeVries called the sudden changes he observed mutations.
88. A mutation is a change in a gene.
89. Mutations are rare events that produce new alleles in a population.
90. When mutations do occur they usually have no effect on an organism, or they may have a negative effect.
91. **Graphic Transition – Genetic Disorders**
92. As we just discussed, mutations can occur in plants and animals.
93. They can also occur in people. Most of the time mutations do not cause problems in the human body – but sometimes they can.
94. Genetic disorder is the term which refers to problems in the body as a result of genetic factors.



Script (cont.)

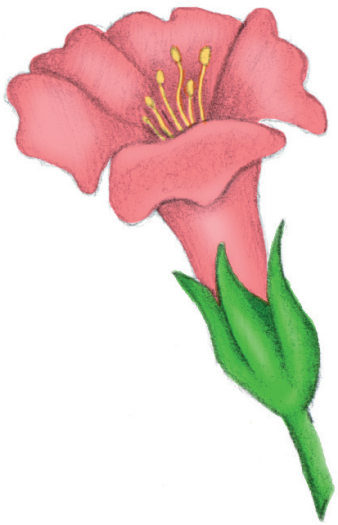
95. For example, sickle cell anemia is a serious blood disease caused by a genetic disorder.
96. Normal red blood cells have a round shape. However, a person with sickle cell anemia has red blood cells that are misshapen.
97. **You Observe!** What is the shape of this cell?
98. This cell is in the shape of a semicircle or half circle. These cells have a difficult time obtaining oxygen, making the person affected with the disorder weak.
99. This disorder is the result of an individual inheriting two copies of the recessive allele for that trait.
100. Sickle cell anemia exists mainly in people who can trace their ancestry to Africa.
101. We now know that certain factors in the environment can also cause genetic disorders such as harmful chemicals.
102. And in some cases, ultraviolet radiation in sunlight may cause mutations in skin leading to skin cancer.
103. This is just a brief look at the very complex nature of some genetic disorders.
104. **Graphic Transition – Summing Up**
105. During the past few minutes we have explored some of the fascinating aspects of genetics.
106. We reviewed some of the discoveries of Mendel, including the idea of dominant and recessive alleles.
107. Each organism has two copies of each gene. One copy from the female and the other copy from the male parent.
108. This is summarized in the Law of Segregation.
109. Another law discussed, the Law of Independent Assortment, states that different traits are inherited independently of one another.
110. Later, we saw that the principle of dominance and recessiveness does not always hold true, as in the case with incomplete dominance.
111. …In codominance, we saw that neither allele dominates the other and each allele is equally emphasized.
112. We explored how combinations of genes can be responsible for a trait in polygenic inheritance.
113. Eye color, height, and skin color are examples of polygenic traits.
114. Finally, we discussed mutations,…
115. … as well as a couple of genetic disorders found in humans.
116. So, the next time you look in the mirror,…
117. …observe a person's hair color…
118. …or notice the height of different people,
119. …think about some of the fundamentals of genetics we have just discussed, you might just look at your world a little differently.

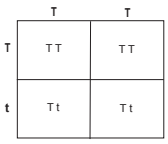


Script (cont.)

Fill in the correct word to complete the sentence. Good luck and let us get started.

1. Genetics is the study of _____.
2. _____ are the basic units of heredity.
3. A _____ trait often masks a recessive trait.
4. An offspring, according to the Law of Segregation, generally receives a gene for a trait from each _____.
5. Different traits are inherited _____ of one another.
6. The cross of these four-o'clock flowers illustrates _____ dominance.
7. Blood type is an example of _____.
8. In _____ inheritance a group of genes together produces a trait.
9. A _____ is a change in a gene or chromosome.
10. Sickle cell anemia is the result of a _____ disorder.





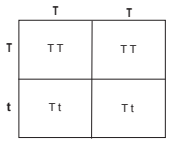
Student Assessments and Activities

Assessment Masters:

- Preliminary Assessment
- Video Review
- Post Assessment

Student Activity Masters:

- Dihybrid Cross
- The Amazing Morgan
- Vocabulary of *Genetics in Action*



Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)

1. pea
2. allele
3. separate
4. segregation
5. fertilized
6. dihybrid
7. independent
8. codominant
9. polygenic
10. mutation
11. true
12. true
13. false
14. true
15. false
16. true
17. false
18. false
19. false
20. true

Video Review (pg. 22)

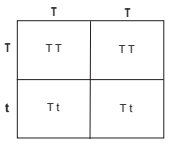
1. About 25% of the offspring were homozygous dominant, giving them green pods. About 50% were heterozygous with green pods. About 25% were homozygous recessive with yellow pods.
2. The flowers from this cross were pink.
3. This cell is in the shape of a semicircle or half circle.

Video Quiz (p. 22)

1. heredity
2. genes
3. dominant
4. parent
5. independently
6. incomplete
7. codominance
8. polygenic
9. mutation
10. genetic

Post Assessment (pgs. 23-24)

1. codominant
2. segregation
3. allele
4. mutation
5. dihybrid
6. polygenic
7. separate
8. pea
9. independent
10. fertilized
11. false
12. false
13. true
14. false
15. true
16. false
17. false
18. true
19. true
20. true



Answers to Student Activities

Dihybrid Cross (pgs. 25-27)

	R Y	R y	r Y	r y
R Y	RRYY	RRYy	RrYY	RrYy
R y	RRYy	RRyy	RrYy	Rryy
r Y	RrYY	RrYy	rrYY	rrYy
r y	RrYy	Rryy	rrYy	rryy

	B T	B t	b T	b t
B T	BBTT	BBTt	BbTT	BbTt
B t	BBTt	BBtt	BbTt	Bbtt
b T	BbTT	BbTt	bbTT	bbTt
b t	BbTt	Bbtt	bbTt	bbtt

Questions:

1. A monohybrid involves crossing of two parents for a single trait.
2. A dihybrid cross involves crossing of parents while considering two different traits.

Descriptions:

RRYY, RRYy, RrYY, RrYy are round and yellow. RRyy and Rryy are round and green. rrYY and rrYy are wrinkled and yellow. rryy is wrinkled and green.

BBTT, BBTt, BbTT, BbTt are black with trotting gait. BBtt and Bbtt are black with pacer gait. bbTT and bbTt are white with trotting gait. bbtt is white with pacer gait.

Incomplete Dominance (pg. 28)

Incomplete dominance in Four-O'clock flowers:

	R	R
W	R W	R W
W	R W	R W

The offspring are all pink.

Incomplete dominance in horses:

	B	B
W	B W	B W
W	B W	B W

The offspring are a golden brown color and are called palominos.

The Amazing Morgan (p. 29)

1. "Figure" was unique because he had strength for pulling stumps and logs to clear land, speed that won him numerous races, and the ability to work tirelessly.
2. "Figure" was a "sport" because he did not resemble his parents in obvious ways and was able to pass his unique traits onto his offspring.
3. Some of the contributions made by the Morgan breed are that they served as powerful, dependable, hardy workhorses, served in teams pulling freight and passengers, in the American West were workhorses on ranches, and they served as calvary horses in the Civil War.

Vocabulary of *Genetics in Action* (p. 30)

1. f - law of segregation
2. i - dihybrid cross
3. d - law of independent assortment
4. a - incomplete dominance
5. c - codominance
6. j - dominant trait
7. b - polygenic inheritance
8. g - mutation
9. h - cancer
10. e - genetic disorder

Assessment and Student Activity Masters

	T	T
T	T T	T T
t	T t	T t

Name _____

Preliminary Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. Gregor Mendel conducted most of his work on _____ plants.

2. An _____ is a form of a gene.

3. When a living thing forms sex cells, the genes of the parent _____.

4. According to the law of _____, an allele from each pair goes to each sex cell.

5. A _____ egg contains an allele from each parent for a trait.

6. A _____ cross involves two different hybrid traits.

7. The law of _____ assortment proposes that traits, or gene pairs, separate into sex cells randomly and separately from each other.

8. Blood type is a _____ trait meaning each allele fully expresses itself.

9. _____ inheritance involves a group of gene pairs acting together to produce a trait.

10. A _____ is a change in a gene or chromosome.

mutation	allele
fertilized	segregation
pea	dihybrid
codominant	independent
separate	polygenic

Preliminary Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. Gregor Mendel hypothesized that each parent contributes a factor for each trait. T F

12. When a parent forms sex cells, the genes of the parent separate. T F

13. A fertilized egg contains just genes from the mother. T F

14. Mendel concluded that different traits are inherited independently of one another. T F

15. A dihybrid cross involves just one trait. T F

16. Crossing a red Four O'clock flower with a white Four O'clock flower to get a pink flower is an example of incomplete dominance. T F

17. Blood type is an example of a dominant trait. T F

18. Polygenic inheritance involves a single gene being responsible for a trait. T F

19. Mutations are always harmful to a living thing. T F

20. Sickle cell anemia is an example of a genetic disorder. T F

Video Review

Directions: During the course of the program, answer the questions as they are presented in the video. At the end of the video, answer the Video Quiz questions.

You Predict!

1. What did the pea pods of these offspring look like?

You Predict!

2. What do you think the flowers looked like from this cross?

You Observe!

3. What is the shape of this cell?

Video Quiz:

1. Genetics is the study of _____.
2. _____ are the basic units of heredity.
3. A _____ trait often masks a recessive trait.
4. An offspring, according to the Law of Segregation, generally receives a gene for a trait from each _____.
5. Different traits are inherited _____ of one another.
6. The cross of these four-o'clock flowers illustrates _____ dominance.
7. Blood type is an example of _____.
8. In _____ inheritance a group of genes together produces a trait.
9. A _____ is a change in a gene or chromosome.
10. Sickle cell anemia is the result of a _____ disorder.

Post Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. Blood type is a _____ trait meaning each allele fully expresses itself.

2. According to the law of _____, an allele from each pair goes to each sex cell.

3. An _____ is a form of a gene.

4. A _____ is a change in a gene or chromosome.

5. A _____ cross involves two different hybrid traits.

6. _____ inheritance involves a group of gene pairs acting together to produce a trait.

7. When a living thing forms sex cells, the genes of the parent _____.

8. Gregor Mendel conducted most of his work on _____ plants.

9. The law of _____ assortment proposes that traits, or gene pairs, separate into sex cells randomly and separately from each other.

10. A _____ egg contains an allele from each parent for a trait.

independent
mutation
allele
codominant
polygenic

dihybrid
fertilized
segregation
pea
separate

Name _____

Post Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. A dihybrid cross involves just one trait. T F

12. Mutations are always harmful to a living thing. T F

13. Gregor Mendel hypothesized that each parent contributes a factor for each trait. T F

14. Polygenic inheritance involves a single gene being responsible for a trait. T F

15. Sickle cell anemia is an example of a genetic disorder. T F

16. A fertilized egg contains just genes from the mother. T F

17. Blood type is an example of a dominant trait. T F

18. Crossing a red Four O'clock flower with a white Four O'clock flower to get a pink flower is an example of incomplete dominance. T F

19. Mendel concluded that different traits are inherited independently of one another. T F

20. When a parent forms sex cells, the genes of the parent separate. T F

Dihybrid Cross

Background: You already know how to perform a monohybrid cross using a Punnett square chart. A monohybrid cross involves just one trait. In this activity we are going to perform a dihybrid cross. A dihybrid cross involves looking at two traits at the same time. We can also use a Punnett square chart to predict the outcomes of a dihybrid cross.

Predicting the outcomes of dihybrid cross is kind of like tossing two coins at the same time. The outcome of one coin does not influence the outcome of the other coin being tossed.

Mendel's Law of Independent Assortment states that genes will sort into all possible combinations. Therefore, in a dihybrid individual there are four possible combinations of genes in the offspring of parents when two traits are considered. Let us learn how this works, and how to perform a dihybrid cross.

Directions:

1. In this first example we will consider two different traits for peas. The first trait is pea shape, where round peas (R) are dominant over wrinkled peas (r). The second trait has to do with pea color. Here, yellow peas (Y) are dominant over green peas (y). A hybrid for these traits has the genotype RrYy. The first step involves separating these into all four combinations of genes, and inserting these combinations in the boxes at the top of the Punnett square. The four possible combinations are RY, Ry, rY, and ry. Do the same for the second trait and place the combinations in the boxes on the left.

2. The next step involves combing the genes inside the empty boxes in the grid. These letters stand for the possible genotypes of the offspring. Fill in the chart.

3. The third step involves determining the phenotypes of the offspring. You can do this by describing the appearance of each pea or by creating a color drawing of each pea. Why don't you try both?

4. Now, try another dihybrid cross. This dihybrid cross considers the traits for coat color and gait in a horse. Black coat (B) is dominant over white coat (b) and trotting gait (T) is dominant over pacer gait (t). Complete the three steps we covered in the previous dihybrid cross.

Questions:

1. What is a monohybrid cross?

2. What is a dihybrid cross?

Name _____

Dihybrid Cross (cont.)

Dihybrid cross for pea shape and pea color. For pea shape, round peas (R) are dominant over wrinkled peas (r). For pea color, yellow peas (Y) are dominant over green peas (y).

	R Y	R y	r Y	ry
____				
____				
____				
____				

Write your descriptions and drawings below:

Name _____

Dihybrid Cross (cont.)

Dihybrid cross for coat color and gait in horses. Black coat color (B) is dominant over white coat color (b). Trotting gait (T) is dominant over pacer gait (t).

Write your descriptions and drawings below:

Name _____

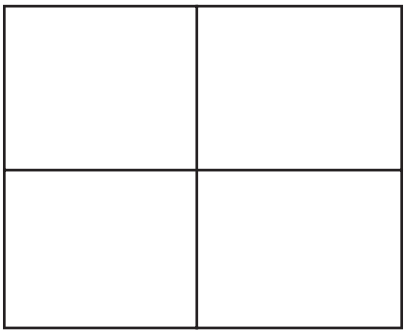
Incomplete Dominance

In 1900 an important discovery was made by the German botanist, Karl Correns. He worked with a specific type of flower called Four-o'clock flowers. Through his work with these flowers he found that the traditional principles of dominance and recessiveness proposed by Mendel did not always hold true.

Correns crossed a purebred red Four-O'clock flower with a purebred white Four-O'clock flower. Amazingly, the offspring of these flowers were neither red or white, but were pink. To explain this Correns hypothesized that in some gene pairs the genes are neither recessive nor dominant. This phenomenon is described as incomplete dominance.

Incomplete dominance in Four-O'clock flowers:

Use a Punnett square for the cross between a purebred red Four-O'clock flower symbolized by RR, and a purebred white Four-O'clock flower symbolized by WW. Describe the phenotype of the offspring.

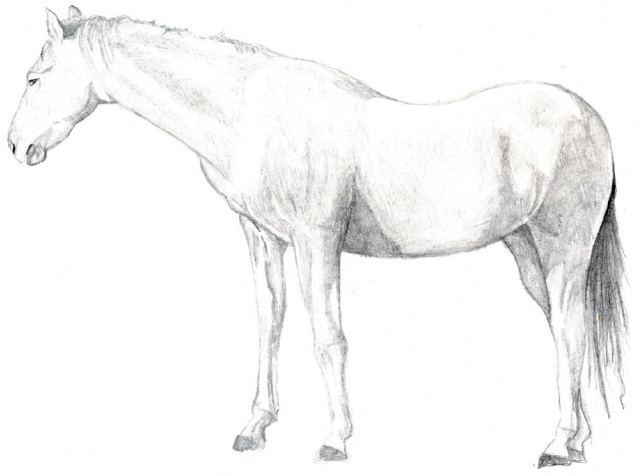


Incomplete dominance in horses:

Use a Punnett square for the cross between a purebred chestnut brown horse symbolized by BB, and a purebred creamy white horse symbolized by WW. Describe the phenotype of the offspring.

Name _____

The Amazing Morgan



In 1791 a Vermont school teacher by the name of Justin Morgan made the trip to Springfield, Massachusetts to receive payment for a debt. His payment was not money, but a small one-year old colt referred to by the name "Figure". Little did Justin Morgan realize while walking his new colt back to Vermont that this horse would be the foundation of one of the most well known horse breeds in North America. In the years to follow the horse was referred to as "Justin Morgan's horse", and later as simply the Morgan horse.

While Justin Morgan's horse was short, stout, full bodied, and strong looking for the times, he soon demonstrated amazing qualities. Figure became widely known for his strength in pulling stumps and logs to clear land. He won many pulling contests, and his speed won him numerous races. Tales soon spread throughout New England of his strength, beauty, endurance, and gentle disposition. His ability to work tirelessly and to outrun and outpull other horses became legendary.

But, perhaps Figure's greatest contribution was his ability to pass these same traits on to his offspring. Figure is considered a "sport", meaning that he did not resemble his parents in obvious ways, and was able to pass his unique traits on to his offspring. In a sense, Figure was the result of a genetic mutation. The genes associated with this mutation gave Figure these wonderful traits.

Figure sired many horses, the most famous ones are his three sons: Bulrush, Woodbury, and Sherman. Every Morgan horse today can be traced back to Figure through one of these three stallions. The Morgan breed consists of horses having characteristics which are distinguishably Morgan. The horses in the Morgan breed look, work, and behave in ways which make them truly unique.

The Morgan breed has played a prominent role in the history of the United States. The Morgan served as a powerful, dependable, hardy workhorse on New England farms throughout the 19th century. Morgans also served in teams pulling freight and passengers in large cities. In the American west, they were employed on ranches as workhorses. And, they served as cavalry horses in the Civil War. Today, Morgans are prized as superb pleasure horses for recreational uses. Their grace, eagerness to work, intelligence and hardiness make them one of America's most prized breeds.

Questions:

1. What was unique about "Figure"?

2. Why was "Figure" considered a "sport"?

3. What are some of the significant contributions of the Morgan breed?

Name _____

Vocabulary of Genetics in Action

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

____ 1. alw fo ggiosrteena _____ __ _____

____ 2. yddhriib srsoc _____ _____

____ 3. wal fo ddeeennnti ttsesramon _____ ___ _____

____ 4. milecnoetyp mednnioca _____ _____

____ 5. dnnoocciaem _____

____ 6. mdtnoin attir _____ _____

____ 7. gcpoinley iienthanrce _____ _____

____ 8. ntmiutoa _____

____ 9. rrccnea _____

____ 10. ecegtni oedirdsr _____ _____

a. occurs when a gene is neither dominant nor recessive

b. involves a group of gene pairs acting together to produce a trait

c. occurs when each allele is equally emphasized

d. states that different traits are inherited independently from one another

e. a problem in the body resulting from genetic factors

f. states that a gene from each parent goes to each sex cell

g. a change in a gene or chromosome

h. a group of genetic disorders responsible for abnormal growth of cells in the body

i. a cross involving two different traits

j. a “stronger” trait which masks a recessive trait