Fundamentals of Genetics

Teacher's Guide
Middle School

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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) - Reproduction and Heredity

- Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.
- Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of genes.

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

Heredity 5B

By the end of the 5th grade, students should know that:

- For offspring to resemble their parents, there must be a reliable way to transfer information from one generation to the next.

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

- In some kinds of organisms, all the genes come from a single parent, whereas in organisms that have sexes, typically half of the genes come from each parent.

Student Learning Objectives

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

- State that heredity is the process of passing traits from parents to offspring.
- Describe how each trait is made up of two factors called genes.
- Differentiate between a dominant trait and a recessive trait.
- Symbolize dominant traits with a capital letter and recessive traits with a lower case letter.
- Define the meaning of the term phenotype and provide an example of a phenotypic feature of a living thing.
- Explain that genotype is the actual genetic makeup of a living thing.
- Differentiate between the terms heterozygous and homozygous.
- Describe the purpose and general use of a Punnett Square chart.
- Complete a cross between two organisms by illustrating potential offspring using a Punnett square chart.
- Identify a hybrid organism as one that is heterozygous for a particular trait.
- Perform a hybrid cross using a Punnett square, and describe the genotypes and phenotypes of potential offspring.
- Explain how probability can be used to actually predict the possible results of a genetic cross.
- Describe the outcomes of a genetic cross using probability, expressed in terms of fractions or percentages.

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

Before showing the video, ask students to feel their earlobes. Tell them to see if their earlobes are free or are attached directly to side of their head. Have them look at the person next to them to see what their earlobes are like: attached or unattached. Next, tell students to pull back their hair so the person next to them can clearly see their hairline. Ask them if their hairline comes to a distinct point or if it goes straight across. The last trait they will examine has to do with the ability to curl their tongue while extended. People either do or do not have the ability to roll their tongue into a U-shape when extended.

Ask students why some people in the class have these traits and others do not. Write their answers on the board. Tell students that these traits are dependent on the presence or absence of certain dominant and recessive genes. For example, unattached earlobes are due to the presence of a dominant gene. Widow's peak hairline is due to a dominant gene. And, the ability to roll your tongue is due to a dominant gene.

Tell students to pay close attention to the video to learn more about dominant and recessive traits. Also, tell them to listen closely to the program to see how the presence of some traits exhibited in offspring can actually be predicted.

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: Fundamentals of Genetics

1. When you look at this photograph you can see the resemblance between these children and their parents.
2. And you can tell by looking at this calf that it was born from this cow.
3. That is because these offspring exhibit certain characteristics, or traits, which are similar to the traits of their parents.
4. Offspring inherit traits from their parents through genetics and culture. Heredity is the passing on of traits from parents to offspring.
5. The study of heredity, called genetics, is one of the most fascinating and complex sciences.
6. During the next few minutes we are going to travel back in time to look at some of the early beginnings of genetics.
7. We will also look at some modern day examples of heredity.
8. And, we will explore how it is possible to actually predict the appearance of some traits in humans…
9. …in animals,…
10. …and in plants,….
11. ...as we investigate some of the fundamentals of genetics.
12. **Graphic Transition – Heredity**
13. Have you ever wondered why your eyes are the same color as your mother's?
14. Have you ever been puzzled by the fact that you have certain features that do not resemble those of either of your parents, …
15. …but, are similar to those of your grandparents?
16. These are fascinating and complex questions.
17. As we mentioned, heredity is the process of passing traits from parents to offspring
18. Until relatively recently we knew little about heredity.
19. Let us go back in time nearly 150 years ago to look at some of the early work done on heredity.
20. **Graphic Transition – Gregor Mendel's Discoveries**
21. Austrian monk, Gregor Mendel, did not know it at the time, but his experiments conducted in the 1860's would have a profound impact on the course of science.
22. Gregor Mendel's discoveries were so important that today he is often referred to as the "Father of Modern Genetics".
23. Mendel is most famous for his experiments with pea plants which he cultivated in his garden.
24. By working with specific traits in thousands of pea plants over seven years he unraveled patterns in the way certain traits are passed down from one generation to the next.

Script (cont.)

25. In one experiment, Mendel started with plants he called true breeders. These were plants that always produced offspring with desired traits, and the traits resembled the traits of their parents.
26. For example, when a true breeding tall pea plant was bred with another true breeding tall pea plant, they produced offspring that were all tall.
27. Mendel was interested to see what would happen when he bred a true breeding tall pea plant with a true breeding short pea plant.
28. He found that the offspring in the first generation were all tall.
29. Mendel then allowed these tall offspring to self-pollinate among themselves.
30. **You Predict!** What do you think the second generation of offspring looked like?
31. An amazing thing revealed itself in these offspring. About 3/4 of the plants were tall and about 1/4 were short. Why?
32. **Graphic Transition – Dominant and Recessive Traits**
33. Why did the trait for shortness, which seemingly disappeared in the first generation reappear in the second generation?
34. Mendel hypothesized that each trait has two factors, which today we call genes.
35. Each parent contributes a gene to an offspring for each trait.
36. In other words, the male parent contributes a gene and the female parent contributes a gene.
37. In some cases, as with pea plant height, one gene masks or dominates the other gene.
38. The “stronger” trait, which masks the weaker trait, is called the dominant trait, and is symbolized by a capital letter.
39. And the weaker trait, which seemingly disappeared is called the recessive trait.
40. Recessive traits are symbolized by a lower case letter.
41. When a true breeding tall pea plant, symbolized by TT, was crossed with a true breeding short pea plant, symbolized by tt,…
42. …all the pea plants were tall. These offspring are symbolized by Tt.
43. Here the dominant gene for tallness masks the recessive gene for shortness.
44. And, when these plants self-pollinated, they produced offspring that were 3/4 tall and 1/4 short.
45. **You Decide!** What gene did the short plant have?
46. The short pea plant had two recessive genes, tt.
47. **Graphic Transition – Genotype and Phenotype**
48. The color of your eyes,…
49. …and, the shape of your ears are all observable traits.
50. A living thing’s phenotype describes characteristics that can be observed.
51. Pea pod color, as well as,...

Script (cont.)

52. …pea plant height are all observable traits that are part of a plant's phenotype.
53. The phenotype of a living thing is the result of something else called its genotype.
54. Genotype is the genetic make up of an organism. Two genes together makeup an individual's genotype for a trait.
55. Having earlobes unattached is a dominant trait that is represented by L.
56. This person's phenotype is described as unattached earlobe.
57. **You Decide!** What is this person's genotype?
58. Attached earlobes are recessive and are represented by the genotype ll.
59. Whereas, the two possible genotypes for people with unattached earlobes include LL and Ll.
60. **Graphic Transition – Heterozygous and Homozygous**
61. Scientists use different terms to describe genotypes.
62. The genes for color in horses has two different forms. Different forms of a gene are called alleles.
63. In horses, black coat color is dominant over white coat color.
64. White horses are represented by b and b. Because these two genes are the same, they are said to be homozygous.
65. The black horse can also be homozygous, represented by B and B.
66. When two genes for a particular trait are different, we describe them as being heterozygous.
67. The black horse can also be heterozygous represented by capital B and lower case b.
68. **Graphic Transition – Punnett Squares**
69. As you know, a given trait has two genes.
70. Each gene comes from a parent. In other words, one gene comes from the female parent…
71. …and the other gene comes from the male parent.
72. A special chart called a Punnett Square can be used to illustrate possible combinations of genes in a cross between two organisms. A Punnett Square helps illustrate how the parents' genes might combine in offspring.
73. The Punnett Square chart was developed by Reginald Punnett, an English geneticist.
74. It consists of four square boxes positioned like this.
75. At the top of the chart the genes for one parent, let us say the female parent, are written for a trait.
76. And, to the left of the chart we can write the two genes for the male parent for a particular trait.

Script (cont.)

77. In this particular cross, the trait illustrated is pea plant height. The female parent is homozygous dominant and is tall.
78. The male is homozygous recessive and is short.
79. To see what the possible genotypes of offspring from these parents might be we just need to fill in the four boxes.
80. To do this we take one gene from each parent in the row and column.
81. In the first box we take a capital T from the female parent and a small t from the male parent.
82. In the second box we do the same.
83. In the next row, we take one gene from each parent.
84. And, we do the same for the fourth box.
85. So, looking at these offspring we can conclude they are all heterozygous, and all have the phenotype of being tall.
86. Let us see what would happen if we crossed two of these offspring.
87. **Graphic Transition – Hybrid Cross**
88. As we just mentioned, the genotype of the offspring from a cross between a homozygous tall pea plant and a homozygous short pea plant are all heterozygous pea plants.
89. These types of plants are called hybrids. A hybrid is an organism that is heterozygous for a particular trait.
90. Let us see the possible results of crossing two hybrids by plugging them into a Punnett Square.
91. When we take a gene from each parent, the four offspring have the following genotypes.
92. The first one has the genotype of T and T. Its' phenotype is tall.
93. Two of the offspring have a genotype of T and t.
94. **You Decide!** What is their phenotype?
95. That is right, these plants are tall because the trait for tallness is dominant over the short trait.
96. The last offspring has the genotype of t and t. This is the only offspring that has the phenotype of being short.
97. When two hybrids are bred this is known as a hybrid cross.
98. A hybrid cross results in offspring with similar genotypes for a given trait.
99. **Graphic Transition – Probability**
100. If you were to toss this coin, the chance or probability, it would come up heads is one out of two or 50%.
101. In genetics, probability can be used to actually predict the possible results of genetic crosses.

Script (cont.)

102. Probabilities are usually written as fractions or as percentages.
103. Punnett square charts help predict the probability of traits appearing in offspring from a cross between two organisms.
104. Let us consider a hybrid cross for the trait of pea pod color in which green is dominant and yellow pea pod color is recessive.
105. You Predict! When two heterozygous parents are crossed, represented by P and p, what is the probability that one of the offspring will have the phenotype of yellow pea pod?
106. The offspring have the genotypes as shown.
107. One offspring has a homozygous genotype that is dominant. Two offspring have a heterozygous genotype. And one offspring is homozygous recessive.
108. Three of the four offspring have the phenotype that exhibits green pea pods.
109. And, one of the four offspring has yellow pea pods. This offspring has a genotype of lower case p, lower case p.
110. Expressed as a percentage, it is probable that 25% of the plants will have yellow pea pods,…
111. … and 75% of the pea plants will have green pea pods.
112. It is important to realize that probability and the use of Punnett squares do not guarantee the outcome of a genetic cross. Instead, they indicate the probability of different possible outcomes.
113. Graphic Transition – Summing Up
114. During the past few minutes, we have explored many of the fundamentals of genetics.
115. We reviewed the early principles established by Gregor Mendel, the father of genetics.
116. We discussed how his work with pea plants led to the notion of dominant and recessive traits, in which one gene masks or dominates another gene for a given trait.
117. The observable characteristics known as phenotypes were discussed, as well as the genotype, or genetic makeup of a living thing.
118. We also differentiated between homozygous genes and heterozygous genes.
119. The use of the Punnett square was introduced, illustrating its usefulness in showing the results of a cross between two organisms for a given trait.
120. We discussed a specific type of cross called the hybrid cross and the possible types of offspring produced from such a cross.
121. Finally, the concept of predicting the results of genetic crosses as related to probability was discussed.
122. We saw how probabilities can be written as fractions or percentages.

Script (cont.)

123. And, we saw how probabilities can be obtained from Punnett square crosses.
124. So, the next time you observe a trait in a plant,…
125. …or an animal,…
126. …or look at some of your own traits in a mirror, think about some of the fundamentals of genetics we discussed during the past few minutes.
127. You just might look at your world a little differently.

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

1. _____ is the passing on of traits from parents to offspring.
2. A _____ trait often masks a recessive trait.
3. Dominant traits are usually symbolized by a _____ letter.
4. Each parent contributes _____ gene for a trait to each offspring.
5. The _____ is the visible characteristics of an organism.
6. _____ is the term used to describe two unlike genes.
7. A _____ square illustrates possible combinations of genes in offspring.
8. A _____ is an organism that is heterozygous for a trait.
9. A _____ consists of the actual genes for a trait.
10. In this hybrid cross, where T is dominant and lower case t is recessive, the probability of producing short pea plants is ___%

Answers can be found on page 17

Student Assessments and Activities

Assessment Masters:

- Preliminary Assessment
- Video Review
- Post Assessment

Student Activity Masters:

- Mendelian Genetics
- The Punnett Predictor
- Predicting with Probability
- Vocabulary of *Fundamentals of Genetics*

Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)

1. heredity
2. trait
3. dominant
4. phenotype
5. genotype
6. homozygous
7. hybrid
8. cross
9. probability
10. percentages
11. false
12. true
13. true
14. false
15. true
16. false
17. true
18. false
19. false
20. true

Video Review (pg. 22)

1. About ¾ of the offspring were tall and about ¼ were short.
2. The short pea plant had two recessive genes, tt.
3. Attached earlobes are recessive and are represented by the genotype ll.
4. The phenotype of these plants are tall.
5. One offspring has a homozygous genotype that is dominant. Two offspring have a heterozygous genotype. And one offspring is homozygous recessive. Three of the four offspring have the phenotype that exhibits green pea pods. And, one of the four offspring has yellow pea pods. This offspring has a genotype of lower case p, lower case p.

Video Quiz (p. 22)

1. heredity
2. dominant
3. capital
4. one
5. phenotype
6. heterozygous
7. Punnett
8. hybrid
9. genotype
10. 25

Post Assessment (pgs. 23-24)

1. homozygous
2. dominant
3. percentages
4. heredity
5. cross
6. probability
7. genotype
8. trait
9. phenotype
10. hybrid
11. false
12. true
13. true
14. false
15. true
16. false
17. true
18. true
19. false
20. false

Answers to Student Activities

Mendelian Genetics (pgs. 25-27)

1.  round  wrinkled

 short  tall

 constricted  regular

2. Answers will vary, depending on the class.

3.  T T
T t
 t t

4. The dominant trait is tall, symbolized by T. The recessive trait is short, symbolized by lower case t.

5. TT and Tt.
6. Round seed: RR
Round seed: Rr
Wrinkled seed: rr
7. TT - homozygous
Tt - heterozygous
tt - homozygous
Rr - heterozygous
RR - homozygous
rr - homozygous
8. homozygous tall - TT
heterozygous round - Rr
heterozygous dominant tall - Tt
homozygous wrinkled - ww
homozygous dominant round - RR

The Punnett Predictor (pg. 28)

1.

	T	T
T	T T	T T
T	T T	T T

2.

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

3.

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

4.

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

Predicting with Probability (pg. 29)

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

a. 50% tall, 50% short
b. 100% heterozygous dominant tall

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

a. 75% tall, 25% short
b. 25% homozygous tall
50% heterozygous dominant tall
25% homozygous short

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

phenotypes: 50% tall pea plants
50% short pea plants.
genotypes: 50% heterozygous dominant tall, 50% homozygous short

Vocabulary of *Fundamentals of Genetics* (p. 30)

1. f - heredity
2. d - alleles
3. h - dominant trait
4. a - recessive trait
5. j - phenotype
6. b - genotype
7. i - heterozygous
8. c - homozygous
9. e - Punnett square chart
10. g - probability

Assessment and Student Activity Masters

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. _____ is the passing of traits from parents to offspring.

2. Eye color is an example of a _____.

3. A _____ gene tends to mask a recessive gene for a trait.

4. A living thing's _____ describes characteristics that can be observed.

5. _____ refers to the genetic makeup of an organism.

6. When two genes are the same for a trait they are said to be _____.

7. A _____ is an organism that is heterozygous for a trait.

8. A hybrid _____ involves the breeding of two hybrids.

9. In genetics, _____ can be used to predict the possible results of a cross.

10. Probabilities are usually written as fractions or as _____.

cross	percentage
heredity	phenotype
genotype	homozygous
probability	trait
dominant	hybrid

Preliminary Assessment

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

11. Heredity is rarely responsible for the traits we possess. T F

12. Generally speaking, each parent contributes one gene to an offspring for a given trait. T F

13. The “stronger” trait which masks the “weaker” trait is called the dominant trait. T F

14. A person with blue eyes has a phenotype described as bb. T F

15. Genotype is the genetic makeup for a particular trait. T F

16. A genotype of Tt is described as being homozygous. T F

17. When two genes for a trait are different they are heterozygous. T F

18. Punnett square charts are used to show just phenotypes of offspring. T F

19. Hybrid organisms are described as being homozygous dominant. T F

20. In genetic probability, the results of one event do not effect the results of the next event. 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 do you think the second generation of offspring looked like?

You Decide!

2. What genes did the short plant have?

You Decide!

3. What is this person's genotype?

You Decide!

4. What is their phenotype?

You Predict!

5. When two heterozygous parents are crossed, represented by P and p, what is the probability that one of the offspring will have the phenotype of yellow pea pod?

Video Quiz:

1. _____ is the passing on of traits from parents to offspring.
2. A _____ trait often masks a recessive trait.
3. Dominant traits are usually symbolized by a _____ letter.
4. Each parent contributes _____ gene for a trait to each offspring.
5. The _____ is the visible characteristics of an organism.
6. _____ is the term used to describe two unlike genes.
7. A _____ square illustrates possible combinations of genes in offspring.
8. A _____ is an organism that is heterozygous for a trait.
9. A _____ consists of the actual genes for a trait.
10. In this hybrid cross, where T is dominant and lower case t is recessive, the probability of producing short pea plants is _____%.

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. When two genes are the same for a trait they are said to be _____.

2. A _____ gene tends to mask a recessive gene for a trait.

3. Probabilities are usually written as fractions or as _____.

4. _____ is the passing of traits from parents to offspring.

5. A hybrid _____ involves the breeding of two hybrids.

6. In genetics, _____ can be used to predict the possible results of a cross.

7. _____ refers to the genetic makeup of an organism.

8. Eye color is an example of a _____.

9. A living thing's _____ describes characteristics that can be observed.

10. A _____ is an organism that is heterozygous for a trait.

probability
hybrid
trait
homozygous
percentage
heredity
genotype
cross
phenotype
dominant

Post Assessment

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

11. A genotype of Tt is described as being homozygous. T F

12. The “stronger” trait which masks the “weaker” trait is called the dominant trait. T F

13. In genetic probability, the results of one event do not effect the results of the next event. T F

14. Heredity is rarely responsible for the traits we possess. T F

15. When two genes for a trait are different they are heterozygous. T F

16. Hybrid organisms are described as being homozygous dominant. T F

17. Genotype is the genetic makeup for a particular trait. T F

18. Generally speaking, each parent contributes one gene to an offspring for a given trait. T F

19. A person with blue eyes has a phenotype described as bb. T F

20. Punnett square charts are used to show just phenotypes of offspring. T F

Mendelian Genetics

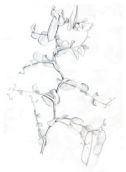
Background: In the 1850's and 1860's, an Austrian monk by the name of Gregor Mendel was quietly conducting experiments in his vegetable garden. Little did he know that these experiments would later change the course of biological science. Often called the father of modern genetics, in 1866 Gregor Mendel published the results of his study of inheritance in garden peas. While his discoveries were not well received for over thirty years, Mendel's work later proved to be fundamental in our understanding of the process of heredity.

Mendel conducted hundreds of experiments on thousands of different pea plants in his garden. From this work he formulated several laws of inheritance which he found held true in his experiments crossing pea plants. In this activity we will explore one of these laws: the Law of Dominance. We will also discuss some of the ways traits can be symbolized, and cover some of the basic terminology associated with Mendelian genetics.

Directions:

1. Mendel studied the appearance of certain traits in pea plants, and was interested in how these traits were passed from one generation to the next. He studied a total of seven different traits including: seed color, seed shape, pod color, pod shape, plant height, flower position, and flower color. Below are drawings of some of these traits studied by Mendel. Describe the two different phenotypes for each trait.

Seed shape:  _____  _____

Plant height:  _____  _____

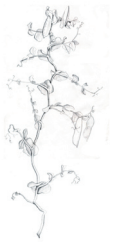
Pod shape:  _____  _____

Mendelian Genetics Cont.

2. Today, we use the term phenotype to describe the appearance of traits. For example, pea shape can be described as round or wrinkled. Plant height described as short or tall. Look around your classroom and describe phenotypes for the following traits:

Traits	**Possible Phenotypes**		
Eye Color	_____	_____	_____
Hair Color	_____	_____	_____
Hair curliness	_____	_____	_____

3. Mendel theorized that for every trait in pea plants there are two factors. He also hypothesized that each parent contributes one factor for a trait to the offspring. In other words, the male parent contributes one factor and the female parent contributes a factor. In many cases, as with pea plant height, one factor masks or dominates the other factor. The stronger trait, symbolized by a capital letter masks the weaker trait, symbolized by a lower case letter. If the letter t is used to symbolize plant height, write the correct notation under each plant.



_____

_____

_____

4. In pea plant height, which trait is dominant, and which trait is recessive? What symbol do we use for each?

5. Remember, that each trait is made up of two factors even though we describe the outward appearance by a simple description. For example, we say a plant is either tall or short. In the case of pea plant height, a short plant is symbolized by tt. Write the two possibilities for representing a tall pea plant.

_____ _____

You have just written out the two possible genotypes of a tall pea plant. Genotype is the actual genetic makeup of a trait.

Mendelian Genetics Cont.

6. Let us try to write the genotypes of pea seeds where R represents a round seed, and r represents a wrinkled seed.

Round seed _____
Round seed _____
Wrinkled seed _____

7. Scientists use some specific terms to describe genotypes. The term homozygous describes a genotype in which both factors are the same. For example, in the case of a short pea plant, tt, the term homozygous can be used. Heterozygous refers to factors for a particular trait that are different. A tall pea plant, symbolized Tt, is said to be heterozygous. Decide whether the genotypes are homozygous or heterozygous.

TT _____
Tt _____
tt _____
Rr _____
RR _____
rr _____

8. Now, let us put some of these terms together. For example, we can say for pea plant height that a specific plant has a genotype of homozygous recessive, or tt. Fill in the blanks for the traits of pea plant height or seed shape.

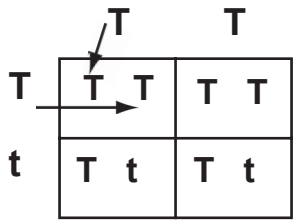
Homozygous tall _____
Heterozygous round _____
Heterozygous dominant tall _____
Homozygous wrinkled _____
Homozygous dominant round _____

Name _____

The Punnett Predictor

Background: As you know, when considering simple Mendelian traits, each trait has two genes. Each gene comes from a parent. In other words, one gene comes from the female parent, and the other gene comes from the male parent. How is it possible to predict the genotypes of offspring for a specific trait? Reginald Punnett, an English geneticist, developed a simple technique to answer this question.

The simple device, called a Punnett square chart, consists of four boxes. At the top of the chart are two genes for a trait of one parent, and on the left side are the two genes for another parent. To obtain the possible genotypes of offspring from parents, each of the four empty boxes are filled in by taking a corresponding gene from each parent. This diagram may help you understand how this is done.



A Punnett square helps predict the possible genotypes of offspring. In this activity you will perform several crosses using Punnett squares.

1.

	T	T
T		
T		

Describe the phenotypes of the four offspring.

2.

	T	t
T		
T		

Describe the phenotypes of the four offspring.

3.

	T	t
T		
t		

Describe the phenotypes of the four offspring.

4.

	t	t
T		
t		

Describe the phenotypes of the four offspring.

Predicting with Probability

Background: How would you answer if someone asked the question, "What are the chances of the sun setting tonight?" Of course, you would say that it is certain the sun will set tonight. In other words there is a 100% chance of this happening. But, what if someone asked you, "What are the chances it will rain tomorrow?" Depending on where you live this can be a difficult question. Meteorologists often answer this question in terms of probability. They might say there is a 30% chance of rain. Probabilities are usually written as fractions or as percentages.

In genetics, probability can be used to actually predict the possible results of a genetic cross. Punnett square charts can help predict the probability of traits appearing in offspring for a specific cross. For example, the Punnett square for a cross between a homozygous tall pea plant and a heterozygous tall pea plant looks like this:

	T	**T**
T	T T	T T
t	T t	T t

The probability that the offspring will all have the phenotype of tall is 100%. But, what is the probability that some offspring will be heterozygous? The probability that some of the offspring will be heterozygous is 50%. Let's try some more.

1.

	T	**T**
t		
t		

a. Describe the phenotype as a percentage.
b. Describe the genotype as a percentage.

2.

	T	**t**
T		
t		

a. Describe the phenotype as a percentage.
b. Describe the genotype as a percentage.

3.

Using a Punnett square, show a cross between a heterozygous tall plant, and a homozygous recessive plant. Describe the possible genotypes and phenotypes of the offspring.

Vocabulary of *Fundamentals of Genetics*

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

____ 1. ethriyed _____

____ 2. lealesl _____

____ 3. notadmni irtat _____ _____

____ 4. esrcsviee tirta _____ _____

____ 5. nppteohye _____

____ 6. nyetgepo _____

____ 7. zoserhtyugoe _____

____ 8. smzghyoouo _____

____ 9. nteuntp aqrseu tahrc _____ _____ _____

____ 10. iioyptbarlb _____

a. a trait which tends to be masked by a dominant trait.

b. the actual genetic makeup of a trait.

c. a trait represented by the same genes.

d. a form of a gene for a given trait.

e. a grid which illustrates how the genes of parents might combine in offspring.

f. the process of traits passed on from parents to offspring.

g. a prediction of the possible results of genetic crosses expressed as percentages or fractions.

h. a “stronger trait which masks a recessive trait.

i. a trait represented by different genes.

j. the outward appearance of a trait.