8th Grade Science Unit: Heredity: Traits, Genes, Alleles

Unit Snapshot

<table>
<thead>
<tr>
<th>Topic: Species and Reproduction</th>
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<tbody>
<tr>
<td>Grade Level: 8</td>
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</table>

**Summary**

Students will be learning about heredity and how traits are passed from parents to offspring. Students will discover the Law of Segregation, and the Law of Independent Assortment.

**CLEAR LEARNING TARGETS**

“I can” …*statements*

- ____ explain how traits are passed from one generation to the next
- ____ identify the difference between dominant and recessive traits
- ____ demonstrate the Mendelian Law of Segregation
- ____ demonstrate the Mendelian Law of Independent Assortment
- ____ analyze Family Histories to Identify Inherited Genetic Disorders

**Activity Highlights and Suggested Timeframe**

<table>
<thead>
<tr>
<th>Day</th>
<th><strong>Engagement:</strong></th>
<th><strong>Exploration:</strong></th>
<th><strong>Explanation:</strong></th>
<th><strong>Elaboration:</strong></th>
<th><strong>Evaluation:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students will make observations and interpret data about various traits found in their classmates through a Class Survey. This will lead into the discussion of dominant and recessive traits.</td>
<td>Students will explore how traits are passed down from parents to offspring through the How to Breed Your Dragon activity and Gizmo – Mouse Genetics (Activity A).</td>
<td>Students will be able to apply their knowledge of simple genetic traits. They will also define probability and describe how it helps explain the results of genetic crosses. Finally, students will be able to explain the meaning of genotype and phenotype through an Online Video – Mendelian Genetics, a Punnett square activity, Gizmo – Mouse Genetics (Activities B &amp; C), and Monster Genetics Lab.</td>
<td>Students will analyze a genetic trait found in pitbull dogs to make predictions about the possible outcomes of offspring. Students will be able to analyze a pedigree to determine which offspring could inherit a genetic disorder.</td>
<td>Formative and summative assessments are used to focus on and assess student knowledge and growth to gain evidence of student learning or progress throughout the unit, and to become aware of students misconceptions related to Mendelian Genetics. A teacher-created short cycle assessment can be administered at the end of the unit to assess all clear learning targets.</td>
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<td>10</td>
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| Day 12 | **Extension/Intervention:** | Based on the results of the short-cycle assessment, facilitate extension and/or intervention activities. |}

Columbus City Schools
Curriculum Leadership and Development
Science Department June 2013
NEW LEARNING STANDARDS:
8.PS.3 The characteristics of an organism are a result of inherited traits received from parent(s)
- Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene.
- During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring.

Note 1: The focus should be the link between DNA and traits without being explicit about the mechanisms involved.
Note 2: The ways in which bacteria reproduce is beyond the scope of this content statement.
Note 3: The molecular structure of DNA is not appropriate at this grade level.

SCIENTIFIC INQUIRY and APPLICATION PRACTICES:
During the years of grades K-12, all students must use the following scientific inquiry and application practices with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:
- Asking questions (for science) and defining problems (for engineering) that guide scientific investigations
- Developing descriptions, models, explanations and predictions.
- Planning and carrying out investigations
- Constructing explanations (for science) and designing solutions (for engineering) that conclude scientific investigations
- Using appropriate mathematics, tools, and techniques to gather data/information, and analyze and interpret data
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating scientific procedures and explanations

*These practices are a combination of ODE Science Inquiry and Application and Frame-work for K-12 Science Education Scientific and Engineering Practices

COMMON CORE STATE STANDARDS for LITERACY in SCIENCE:
CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
CCSS.ELA-Literacy.RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
CCSS.ELA-Literacy.W.8.2b Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
*For more information: http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf

STUDENT KNOWLEDGE:
Prior Concepts Related to Species and Reproduction
PreK-2: Offspring tend to look like their parents.
Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next.
Grades 6-7: Modern Cell Theory states cells come from pre-existing cells.

Future Application of Concepts
High School: The details and importance of gamete formation, the structure of DNA and modern genetics are studied.
## MATERIALS:

**Engage**
- Skills Lab Sheet – Class Survey
- Mirrors (optional)

**Explore**
- Computer Access (if done independently)
- Gizmo – Mouse Genetics Activity A
- How to Breed Your Dragon

**Explain**
- Mendelian Genetics - Video Questions
- Video - [http://www.bozemanscience.com/029-mendelian-genetics](http://www.bozemanscience.com/029-mendelian-genetics)
- Prentice Hall Life Science Textbook
- Guided Reading and Study
- Gizmo – Mouse Genetics Activities B & C
- Monster Genetics Lab

**Elaborate**
- Pitbull Dilemma
- Bikini Bottom Genetics

## VOCABULARY:
- Alleles
- Co-dominance
- Dominant Allele
- Fertilization
- Genes
- Genetics
- Genotype
- Heredity
- Heterozygous (hybrid)
- Homozygous (purebred)
- Hybrid
- Offspring
- Phenotype
- Probability
- Punnett Square
- Recessive Allele
- Trait

## SAFETY
- See CCS Lab Safety Contracts

## ADVANCED PREPARATION
- Make all required copies of handouts
- Create a Blackboard Discussion Board titled “Medical Journal”
- Familiarize yourself with Mouse Genetics Gizmo
- Investigate the genetic history of your own family, and complete a two-page reflection based on your discoveries.
- Reserve Computer lab or laptop cart for days in this lesson that computer access is required.

## Objective:
Students will make observations and interpret data about various traits found in their classmates. This will lead into the discussion of dominant and recessive traits.

### ENGAGE

**Day 1**
(What will draw students into the learning? How will you determine what your students already know about the topic? What can be done at this point to identify and address misconceptions? Where can connections be made to the real world?)

### Take a Class Survey (Day 1)
- Distribute to students Skills Lab Sheet for the Class Survey
- Review with students how to write a hypothesis.
- Instruct students to write a hypothesis about the problem questions, “Are traits controlled by dominant alleles more common than traits controlled by recessive alleles?”
- Show examples of Traits discussed. (Also found on page 116 in textbook.)

### SAFETY
- See CCS Lab Safety Contracts

### ADVANCED PREPARATION
- Make all required copies of handouts
- Create a Blackboard Discussion Board titled “Medical Journal”
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- Investigate the genetic history of your own family, and complete a two-page reflection based on your discoveries.
- Reserve Computer lab or laptop cart for days in this lesson that computer access is required.

### Objective:
Students will make observations and interpret data about various traits found in their classmates. This will lead into the discussion of dominant and recessive traits.

### Take a Class Survey (Day 1)
1. Construct a hypothesis about the problem questions.
**Columbus City Schools**  
**Curriculum Leadership and Development**  
**Science Department June 2013**

<table>
<thead>
<tr>
<th><strong>Objective:</strong></th>
<th>Students will explore how traits are passed down from parents to offspring.</th>
</tr>
</thead>
</table>
| **What is the teacher doing?** | **(Day 2)**  
**How to Breed Your Dragon**  
**SEE TEACHER DIRECTIONS**  
- Set the scene for the students  
- Facilitate Think-Pair-Share Discussions  
- Help students draw conclusions and come up with a hypothesis |
| **What are the students doing?** | **(Day 2)**  
**How to Breed Your Dragon**  
1. Listen to scene set by teacher  
2. Analyze Family Portraits of Dragons provided  
3. Think-Pair-Share with a partner about your findings |

**EXPLORE**  
**Day 2 - 3**  
(How will the concept be developed? How is this relevant to students’ lives? What can be done at this point to identify and address misconceptions?)

<table>
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<th><strong>Objective:</strong></th>
<th>Students will be able to apply their knowledge of simple genetic traits. They will also define probability and describe how it helps explain the results of genetic crosses. Finally, students will be able to explain the meaning of genotype and phenotype.</th>
</tr>
</thead>
</table>
| **What is the teacher doing?** | **(Day 4)**  
**Video – Mendelian Genetics**  
- Distribute Mendelian Genetics – Video Questions to each student.  
- Show video from [http://www.bozemanscience.com/029-mendelian-genetics](http://www.bozemanscience.com/029-mendelian-genetics) |
| **What are the students doing?** | **(Day 4)**  
**Video – Mendelian Genetics**  
1. Watch an online video.  
2. Answer questions that go along with video. |
As students are watching the video there are some sample questions. Pause the video with each question and allow the students time to work out the problem before seeing the answer. **Some questions are more advanced than what the students need and have been adapted on the worksheet.**

It would be beneficial to pause the video periodically and add explanation or examples to reinforce concepts.

(Day 5)
**Probability and Heredity**
- Facilitate completion of **Guided Reading and Study**
  - Chapter 4 – Section 2 in textbook (pp. 118 – 123)
  - All-In-One Teaching Resources (pp. 255-257)

(Days 6 – 7)
**Gizmo – Mouse Genetics**
  **(Activities B & C)**
- Distribute **Gizmo Mouse Genetics Activities B & C Worksheet**
- Remind students of Activity A completed earlier in the unit.
- Instruct students to work through Activities B & C at their own pace.
- Facilitate discussions and questioning of students.

(Day 8 – 9)
**Monster Genetics Lab**
- Distribute **Monster Genetics Activity Sheet** to students
- Each group will need a coin to help determine genotypes of their monster.
- Facilitate discussions with groups about the genotype and phenotype of the monsters they created.

(Day 5)
**Probability and Heredity**
1. Students will read Chapter 4 – Section 2 in textbook (pp. 118 – 123)
2. Complete Guided Reading and Study

(Days 6 – 7)
**Gizmo – Mouse Genetics**
  **(Activities B & C)**
1. Students work through Gizmo – Mouse Genetic Activities B & C
2. Answer questions on Worksheet

(Days 8 – 9)
**Monster Genetics Lab**
1. Flip a coin for each trait to determine the genotype for the female monster.
2. Identify genotype/phenotype for male monster.
3. Create punnett squares for the probability of the baby monsters having each trait.
4. Answer follow up questions about the results of the punnett squares.
**ELABORATE**

*Day 10*

(How will the new knowledge be reinforced, transferred to new and unique situations, or integrated with related concepts?)

<table>
<thead>
<tr>
<th>Objective: Students will be able to use a real world scenario to make predictions about the possible outcomes of offspring. Students will be able to analyze a pedigree to determine which offspring could inherit a genetic disorder.</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the teacher doing? (Day 10) <strong>Pitbull Dilemma</strong></td>
</tr>
<tr>
<td>- Distribute <em>Pitbull Dilemma</em> to students.</td>
</tr>
<tr>
<td>- Facilitate discussion about punnett squares and genetic disorders.</td>
</tr>
<tr>
<td>- Homework or Reinforcement – <em>Bikini Bottom Genetics</em></td>
</tr>
<tr>
<td>What are the students doing? (Day 10) <strong>Pitbull Dilemma</strong></td>
</tr>
<tr>
<td>1. Read the scenario about Hip Dysplasia in Pitbulls.</td>
</tr>
<tr>
<td>2. Create 2 punnett squares to answer the scenario.</td>
</tr>
<tr>
<td>3. Analyze a pedigree to identify which offspring will have a genetic disorder.</td>
</tr>
<tr>
<td>4. <em>Bikini Bottom Genetics</em> practice</td>
</tr>
</tbody>
</table>

**EVALUATE**

(On-going)

(What opportunities will students have to express their thinking? When will students reflect on what they have learned? How will you measure learning as it occurs? What evidence of student learning will you be looking for and/or collecting?)

<table>
<thead>
<tr>
<th>Objective: To determine comprehension of Mendelian Genetics.</th>
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<tbody>
<tr>
<td><strong>EVALUATE</strong> (On-going)</td>
</tr>
<tr>
<td>Formative How will you measure learning as it occurs?</td>
</tr>
<tr>
<td>- Consider developing a teacher-created formative assessment.</td>
</tr>
<tr>
<td>- The following activities can be used to assess students' progression of knowledge towards mastery of learning targets.</td>
</tr>
<tr>
<td>1. Class Survey Lab Sheet</td>
</tr>
<tr>
<td>2. How to Breed Your Dragon</td>
</tr>
<tr>
<td>3. Gizmo Activity Sheets</td>
</tr>
<tr>
<td>4. Video Questions</td>
</tr>
<tr>
<td>5. Guided Reading and Study</td>
</tr>
<tr>
<td>Summative What evidence of learning will demonstrate to you that a student has met the learning objectives?</td>
</tr>
<tr>
<td>1. Monster Genetics Lab can be used to assess student knowledge related to inheritance of traits, dominant vs recessive traits, and Mendelian Laws.</td>
</tr>
<tr>
<td>2. Pitbull Dilemma can be used to assess student ability to use a pedigree to assess genetic inheritance patterns.</td>
</tr>
<tr>
<td>3. Teacher-created short cycle assessment will assess all students learning targets.</td>
</tr>
</tbody>
</table>

**EXTENSION**

*Day 11 and as needed*

1. The Test Cross – All-In-One Teaching Resources, p 249. |
2. Genetic Crosses with Two Traits - All-In-One Teaching Resources, p 259. |
3. All in the Family - All-In-One Teaching Resources, pp. 236 – 242. |
4. Teach Others About a Trait - All-In-One Teaching Resources, pp. 300 – 306. |

**INTERVENTION**

1. Make the Right Call, Skills Lab - All-In-One Teaching Resources, pp. 260 – 262. |
2. Mendel’s Work - All-In-One Teaching Resources, pp. 244 & 248. |
3. Probability and Heredity - All-In-One Teaching Resources, pp. 254 & 258. |
4. Tour of the Basics “what is a trait” on-line module and “what is heredity” online module. [http://learn.genetics.utah.edu/content/begin/tour/](http://learn.genetics.utah.edu/content/begin/tour/) |
| COMMON MISCONCEPTIONS | • One set of alleles is responsible for determining each trait, and there are only 2 different alleles (dominant and recessive) for each gene  
• Your genes determine all of your characteristics, and cloned organisms are exact copies of the original  
• All mutations are harmful  
• A dominant trait is the most likely to be found in the population  
• Genetics terms are often confused  
Strategies to address misconceptions: Misconceptions can be addressed through the use of Discovery Ed video clips, models, diagrams, and on-line simulations. |
| --- | --- |
| DIFFERENTIATION | Lower-Level: Provide text resources that are more appropriate for students reading levels, group students in various groups and various ability levels. Many video resources are available on united streaming to help reiterate concepts.  
Higher-Level: See Extension Activities. Have students research a genetic disorder. They can interview a family member to identify disorders that run in the family, or choose one they are interested in.  
Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at the following sites:  
| ADDITIONAL RESOURCES | Textbook:  
• Prentice Hall Life Science: Chapter 4, pp. 108 – 123  
• Prentice Hall Life Science: Chapter 5, pp. 142 – 155  
• Prentice Hall Life Science – All-In-One Teaching Resources, pp. 236-298  
• Prentice Hall Life Science – All-In-One Teaching Resources, pp. 299-354  
Websites:  
• [http://www.bozemannscience.com](http://www.bozemannscience.com)  
• Tour of the Basics – Interactive Modules: [http://learn.genetics.utah.edu/content/begin/traits/](http://learn.genetics.utah.edu/content/begin/traits/)  
• [http://learn.genetics.utah.edu/content/begin/tour/](http://learn.genetics.utah.edu/content/begin/tour/)  
<table>
<thead>
<tr>
<th>Discovery Ed: <a href="http://www.unitedstreaming.com">www.unitedstreaming.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>- <a href="#">Genes, Genetics, and DNA</a> [24:13]</td>
</tr>
<tr>
<td>- <a href="#">Greatest Discoveries with Bill Nye: Genetics</a> [44:39]</td>
</tr>
<tr>
<td>- <a href="#">Understanding Genetics</a> [37:13]</td>
</tr>
<tr>
<td>- <a href="#">Patterns of Inheritance</a> [2:31]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Literature:</th>
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Genetics: The Science of Heredity · Skills Lab

Take a Class Survey

Problem
Are traits controlled by dominant alleles more common than traits controlled by recessive alleles?

Skill Focus
developing hypotheses, interpreting data

Materials
mirror (optional)

Procedure

PART 1 Dominant and Recessive Alleles
1. Write a hypothesis reflecting your ideas about the problem question.

2. For each of the traits listed in the data table on the next page, work with a partner to determine which trait you have. Circle that trait in your data table.

3. Count the number of students in your class who have each trait. Record that number in your data table. Also record the total number of students.

PART 2 Are Your Traits Unique?
4. Look at the circle of traits in your text. All the traits in your data table appear in the circle. Place the eraser end of your pencil on the trait in the small central circle that applies to you—either free ear lobes or attached ear lobes.

5. Look at the two traits touching the space your eraser is on. Move your eraser onto the next description that applies to you. Continue using your eraser to trace your traits until you reach a number on the outside rim of the circle. Share that number with your classmates.
Data Table

<table>
<thead>
<tr>
<th>Total Number or Students</th>
<th>Trait 1</th>
<th>Number</th>
<th>Trait 2</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Free ear lobes</td>
<td>Attached ear lobes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Hair on fingers</td>
<td>No hair on fingers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Widow's peak</td>
<td>No widow's peak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Curly hair</td>
<td>Straight hair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Cleft chin</td>
<td>Smooth chin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Smile dimples</td>
<td>No smile dimples</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analyze and Conclude

Write your answers in the spaces provided.

1. **Observing** The traits listed under Trait 1 in the data table are controlled by dominant alleles. The traits listed under Trait 2 are controlled by recessive alleles. Which traits controlled by dominant alleles were shown by a majority of students? Which traits controlled by recessive alleles were shown by a majority of students?

2. **Interpreting Data** How many students ended up on the same number on the circle of traits? How many students were the only ones to have their number? What do the results suggest about each person’s combination of traits?

3. **Developing Hypotheses** Do your data support the hypothesis you proposed in Step 1? Write an answer with examples.
Design an Experiment
Do people who are related to each other show more genetic similarity than unrelated people? Write a hypothesis. Then design an experiment to test your hypothesis. Obtain your teacher’s permission before carrying out your investigation.
How to Breed Your Dragon – Teacher Page

http://www.mooarcade.com/games/play-7152-Create_a_Dragon.html

<table>
<thead>
<tr>
<th>Trait</th>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horns</td>
<td>Dominant has horns</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Recessive no horns</td>
<td>h</td>
</tr>
<tr>
<td>Toes</td>
<td>Dominant white</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td>Recessive black</td>
<td>t</td>
</tr>
<tr>
<td>Wings</td>
<td>Dominant has wings</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>Recessive no wings</td>
<td>w</td>
</tr>
<tr>
<td>Spikes</td>
<td>Dominant thin, spaced</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Recessive thick, touching</td>
<td>s</td>
</tr>
</tbody>
</table>

Possible Genotypes

- HH or Hh
- TT or Tt
- WW or Ww
- SS or Ss

Family A: HH + HH
Family B: Hh + Hh
Family C: HH + hh
Family D: Hh + hh
Family E: hh + hh

Figure 1: All dominant traits appear

Figure 2: All recessive traits appear

For this initial exploration, all traits are the same genotype. Once punnett squares have been explained, students can play with breeding varied genotypes to get the desired dragon.
Teacher directions:

1. Teacher says, “Since the popularity of the movie How to Train Your Dragon, people have been flooding your pet store wanting a pet dragon. They are very rare, but you think it might be a sound business decision to invest in a breeding a pair of dragons. You fly halfway around the world. Then you climb halfway up a Tibetan mountain to meet with some very reclusive monks. After gaining their trust, you are told to go deep into a mysterious cave, where you will find a dragon lair, where you can take two, and only two, infant dragons. The monks caution you not to wake the sleeping dragons or you will end up a human s’more. You find the cave and manage to smuggle a small male and female out of the cave, down the mountainside and back home to Columbus, Ohio. You dutifully take care of the dragons until they reach breeding age and mate them. Here is the family portrait of your first litter.”

2. Distribute Family Portrait A. Have students identify some of the traits (characteristics) of this specie of dragon. (Some traits might include 4 legs, pointy horns, wings, tail, spiky spine, 4 toes, etc. Accept all reasonable observations.)

3. Teacher says, “After mating the original pair again, you watch the birth of the second litter. Here is the family portrait.”

4. Distribute Family Portrait B. Have students observe and compare this family to Family A. What do they see? (One of the babies is different.) What traits are different? (No horns, no wings, black toes, thicker spikes on the spine) Ask students to think about the differences and then turn to a partner (pair) and discuss how this could have occurred. [hypothesize]

5. Have students share their hypotheses. Teacher listens for students’ depths of vocabulary. Possible terms which might come out: mutation, genes, traits, recessive, dominant

6. Teacher says, “No one will want a bald, wingless dragon! You exclaim to your assistant. Just then, an adorable little girl comes into your pet store and instantly runs to the new litter.” “Look, mama,” she cries “no wings. This one won’t fly away! No horns. This one won’t pop my balloons.” The girl’s mother offers you double the going price for your baby dragon. You begin to think that your gold mine just became richer and want to breed more of the different dragons. You tell the mother that this one is not for sale, because it is for breeding. When it reaches breeding age, you mate the bald dragon to one of the regular dragons.

7. Ask the students to predict the makeup of the third litter, then distribute Family portrait C. (Think-Pair-Share)

8. Teacher says, “Over the next two years you continue to breed your dragons resulting in a total of 5 litters.”

9. Distribute Family Portraits D and E.

10. Tell students to develop a new hypothesis on How to Breed Your Dragon.
C
Student Exploration: Mouse Genetics (One Trait)
www.explorelearning.com

Vocabulary: allele, DNA, dominant allele, gene, genotype, heredity, heterozygous, homozygous, hybrid, inheritance, phenotype, Punnett square, recessive allele, trait

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. The image shows a single litter of kittens. How are they similar to one another?
   ____________________________________________________________
   ____________________________________________________________

2. How do they differ from one another? __________________________________________________________

3. What do you think their parents looked like? ______________________________________________________
   ____________________________________________________________________________

Gizmo Warm-up

Heredity is the passage of genetic information from parents to offspring. The rules of inheritance were discovered in the 19th century by Gregor Mendel. With the Mouse Genetics (One Trait) Gizmo™, you will study how one trait, or feature, is inherited.

1. Drag two black mice into the Parent 1 and Parent 2 boxes. Click Breed several times. What do the offspring look like?
   ____________________________________________________________

   The appearance of each mouse is also called its phenotype.

2. Click Clear, and drag two white mice into the parent boxes. Click Breed several times. What is the phenotype of the offspring now? ____________________________________________________________

3. Do you think mouse offspring will always look like their parents? ______________________________
**Activity A:** Patterns of inheritance

Get the Gizmo ready:
- Click **Clear**.
- Drag a black mouse and a white mouse into the parent boxes, but don’t click **Breed** yet.

**Question:** What patterns are shown by offspring traits?

1. **Predict:** What do you think the offspring of a black mouse and a white mouse will look like?

   __________________________________________________________________________

2. **Observe:** Click **Breed** several times. What do you see? ________________________________

3. **Observe:** Drag two offspring into the **Holding Cages**. These mice are called **hybrids** because their parents had different traits. Click **Clear**, and then breed the two hybrids.

   What do you see now? ________________________________

4. **Experiment:** Turn on **Show statistics**. Click **Breed** until there are 100 offspring.

   How many offspring were black? ________ How many were white? ________

5. **Explore:** Using your Gizmo, determine which combination of mice would yield the following scenarios.

   A. Which parent combination(s) yield only white offspring? ________________________________

      __________________________________________________________________________

   B. Which parent combination(s) yield only black offspring? ________________________________

      __________________________________________________________________________

   C. Which parent combination(s) yield a mixture of black and white offspring? ________

      __________________________________________________________________________
Introduction: Inherited traits are encoded on a molecule called DNA (deoxyribonucleic acid). Genes are segments of DNA that control a particular trait. Most genes have several different versions, or alleles. The genotype is the allele combination an organism has.

Question: How do alleles determine fur color?

1. Observe: Turn on Show genotype. Move your cursor over a mouse to see its genotype.
   
   A. What is the genotype of the black parent? _______ White parent? _______
   
   These mice are homozygous for fur color, meaning both alleles are the same.

   B. Click Breed. What is the genotype of the offspring mice? _______
   
   These mice are heterozygous for fur color, meaning the alleles are different.

2. Analyze: Dominant alleles are always expressed when present. Recessive alleles are not expressed when the dominant allele is also present. Look at the two alleles for fur color.

   Using the Gizmo, determine the dominant and recessive alleles present in the black and white mice.

   Dominant allele: ______________________

   Recessive Allele: _____________________

3. Using either homozygous or heterozygous mouse combinations, breed two mice that produce 80% white offspring. Explain your process below.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
Mendelian Genetics

_________________ __________________ made huge advances in modern genetics.

Most of Gregor Mendel’s discoveries were done with pea plants. In the second cross of pea plants, Mendel found that purple flowers appeared with a ratio of ______ : ______.

Punnett Squares help find the probability of the outcomes of the offspring. Complete the Punnett Square.

\[
\begin{array}{ccc}
& P & p \\
P & & \\
p & & \\
p & & \\
\end{array}
\]

What is the probability of having a white flower?

Mendel’s Laws

Law of Segregation
The Law of Segregation is the __________________________ of two ________________.

Law of Independent Assortment
The Law of Independent Assortment states that two _____________ don’t affect each other, or they sort _______________________.

### Sample Questions

**Round (R) is dominant to wrinkled (r). Yellow (Y) is dominant to green (y).**

1. A coin is flipped four times and comes up heads each time. What is the probability that the next coin flip will come up heads?

2. Classify the following as heterozygous or homozygous: RR, Rr, yy

3. What is the phenotype of the following: Yy, Rr, yy

4. What is the probability of Rr x Rr producing wrinkled seeds?

5. What is the probability of Yy x yy producing green seeds?

---

**Phenotype:** Physical appearance of a trait (Purple Flower or White Flower)

**Genotype:** The allele combination of a trait (PP, Pp, pp)

**Heterozygous (Hybrid):** Having two different alleles for a trait.

**Homozygous (Purebred):** Having two of the same alleles for a trait.
**Huntington’s Disease**
What are some of the symptoms of Huntington’s Disease?

A **Pedigree** shows how a disease can be ___________ __________ through ________________.

**Ethics of Genetic Testing**
If you could take a test to see if you had Huntington’s Disease, would you want to know? Explain why.
Mendelian Genetics - Video Questions - ANSWER KEY

Mendelian Genetics

__GREGOR__  __MENDEL__ made huge advances in modern genetics.

Most of Gregor Mendel’s discoveries were done with pea plants. In the second cross of pea plants, Mendel found that purple flowers appeared with a ratio of ___3___ : ___1___.

Punnett Squares help find the probability of the outcomes of the offspring. Complete the Punnett Square.

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>PP</td>
<td>Pp</td>
</tr>
<tr>
<td>p</td>
<td>Pp</td>
<td>pp</td>
</tr>
</tbody>
</table>

What is the probability of having a white flower? 25% or 1/4

Mendel’s Laws

Law of Segregation

The Law of Segregation is the _____SEPARATION_____ of two _____ALLELES_____.

Law of Independent Assortment

The Law of Independent Assortment states that two ____TRAITS____ don’t affect each other, or they sort ____INDEPENDENTLY_____.

Sample Questions

Round (R) is dominant to wrinkled (r). Yellow (Y) is dominant to green (y).

1. A coin is flipped four times and comes up heads each time. What is the probability that the next coin flip will come up heads?
   (7:41 in video)
   Everything that happened in the past can’t influence anything that will happen in the future. So the probability is 50% or ½.

2. Classify the following as heterozygous or homozygous: RR, Rr, yy
   (8:03 in video)
   RR – Homozygous (Dominant)
   Rr – Heterozygous
   yy – Homozygous (Recessive)

3. What is the phenotype of the following: Yy, Rr, yy
   (9:00 in video)
   Yy – Yellow
   Rr – Round
   Yy – Green

4. What is the probability of Rr x Rr producing wrinkled seeds?
   (9:37 in video)
   Probability of Wrinkled Seeds = 25% or ¼

5. What is the probability of Yy x yy producing green seeds?
   (10:22 in video)
   Probability of Green Seeds = 50% or 2/4 ( ½ )

**SKIP QUESTION 6! (10:57 in video) This concept will be discussed in High School.

Phenotype: Physical appearance of a trait (Purple Flower or White Flower)
Genotype: The allele combination of a trait (PP, Pp, pp)
Heterozygous (Hybrid): Having two different alleles for a trait.
Homozygous (Purebred): Having two of the same alleles for a trait.
**Huntington’s Disease**
What are some of the symptoms of Huntington’s Disease?
- Uncontrollable Shakes
- Unable to Walk
- Eventually you die

A Pedigree shows how a disease can be **PASSED** _ DOWN_ through ____ORGANISMS____.

**Ethics of Genetic Testing**
If you could take a test to see if you had Huntington's Disease, would you want to know? Explain why.

**ANSWERS MAY VARY**
Probability and Heredity

This section explains what probability is and how the laws of probability can be used in the study of genetics.

Use Target Reading Skills

After you read the section, reread the paragraphs that contain definitions of Key Terms. Use all the information you have learned to write a definition of each Key Term in your own words.

Principles of Probability

1. A number that describes how likely it is that an event will occur is called _____________.

2. Circle the letter of each answer that equals the probability that a tossed coin will land heads up.

   a. 1 in 2
   b. 1/2
   c. 50 percent
   d. 20 percent

3. Is the following sentence true or false? When you toss a coin 20 times, you will always get 10 heads and 10 tails. ______________

4. If you toss a coin five times and it lands heads up each time, can you expect the coin to land heads up on the sixth toss? Explain.

   ____________________________________________
Genetics: The Science of Heredity  •  Guided Reading and Study

Probability and Heredity (continued)

Probability and Genetics

5. When Mendel crossed two hybrid plants for stem height (Tt), what results did he always get?

6. Mendel realized that the principles of probability could be used to _________________ the results of genetic crosses.

7. A chart that shows all the possible combinations of alleles that can result from a genetic cross is called a(n) _________________.

8. Write in the alleles of the parents and the possible allele combinations of the offspring in the Punnett square below. (Note that both parents are tall. Three of the offspring are tall and one is short.)

© Pearson Education, Inc., publishing as Pearson Prentice Hall. All rights reserved.
**Phenotypes and Genotypes**

Match the term with its definition.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. phenotype</td>
<td>a. Describes an organism with two identical alleles for a trait</td>
</tr>
<tr>
<td>10. genotype</td>
<td>b. An organism’s physical appearance, or visible traits</td>
</tr>
<tr>
<td>11. homozygous</td>
<td>c. An organism’s genetic makeup, or allele combinations</td>
</tr>
<tr>
<td>12. heterozygous</td>
<td>d. Describes an organism that has two different alleles for a trait</td>
</tr>
</tbody>
</table>

13. Mendel used the term _____________________ to describe heterozygous pea plants.

**Codominance**

14. Is the following sentence true or false? In codominance, the alleles are neither dominant nor recessive. ___________________

15. In cattle, red hair and white hair are codominant. Cattle with both white hair and red hair are ____________________.
Activity B: Genetics basics
Get the Gizmo ready:
- Click Clear.
- Drag a black mouse and a white mouse into the parent boxes.

Introduction: Inherited traits are encoded on a molecule called DNA (deoxyribonucleic acid). Genes are segments of DNA that control a particular trait. Most genes have several different versions, or alleles. The genotype is the allele combination an organism has.

Question: How do alleles determine fur color?

1. **Observe**: Turn on Show genotype. Move your cursor over a mouse to see its genotype.
   - A. What is the genotype of the black parent? ________ White parent? ________
      These mice are **homozygous** for fur color, meaning both alleles are the same.
   - B. Click Breed. What is the genotype of the offspring mice? ________
      These mice are **heterozygous** for fur color, meaning the alleles are different.

2. **Analyze**: **Dominant alleles** are always expressed when present. **Recessive alleles** are not expressed when the dominant allele is also present. Look at the two alleles for fur color.
   - A. Which allele is dominant, and which fur color does it produce? ________________
   - B. Which allele is recessive, and which fur color does it produce? ________________

3. **Predict**: Place two of the F1 offspring into the Holding Cages. Click Clear, and then place them into the parent boxes.
   - A. Which allele(s) could the offspring inherit from parent 1? ________________
   - B. Which allele(s) could the offspring inherit from parent 2? ________________
   - C. What are the possible genotypes of the offspring? ________________

4. **Experiment**: Click Breed several times, and look at the genotypes of the offspring. Did you find all the predicted genotypes? Explain.

_________________________________________
_________________________________________
_________________________________________
Activity C:  
Modeling inheritance

Get the Gizmo ready:
- Click Clear.
- Drag a black mouse and a white mouse into the parent boxes.

<table>
<thead>
<tr>
<th>F</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>Ff</td>
</tr>
<tr>
<td>f</td>
<td></td>
</tr>
</tbody>
</table>

Question: How do scientists predict the genotypes of offspring?

1. **Model:** Scientists use a [Punnett square](#) to model the different possible offspring genotypes from a parent pair. The parent genotypes are written across the top and side of the square, as shown. The four possible offspring genotypes are then filled in.

   The first square is filled in for you. Fill in the remaining squares.

   A. What are the genotypes of the offspring? __________________________

   B. What percentage of the offspring will have black fur? ______________________

   C. What percentage of the offspring will have white fur? ______________________

2. **Experiment:** Click **Breed** several times. Were your predictions correct? ______________

3. **Model:** Use the Punnett squares below to model each parent combination. After filling in each Punnett square, predict the percentages of black and white offspring.

   Parent 1: Heterozygous black \((Ff)\)  
   Parent 2: Heterozygous black \((Ff)\)

   Parent 1: Heterozygous black \((Ff)\)  
   Parent 2: Homozygous white \((ff)\)

   Predicted % black offspring: _____  
   Predicted % white offspring: _____  
   Predicted % black offspring: _____  
   Predicted % white offspring: _____

(Activity C continued on next page)
Activity C (continued from previous page)

4. **Experiment:** Turn on **Show statistics** and **Show as approximate percentage**. For each combination, breed approximately 500 offspring. Record the results in the table below.

(Hint: To obtain an \( Ff \) mouse, breed an \( FF \) mouse to an \( ff \) mouse. Place two \( Ff \) offspring into the holding cages, click **Clear**, and then drag the \( Ff \) mice into the parent boxes.)

<table>
<thead>
<tr>
<th>Parent 1 Genotype</th>
<th>Parent 2 Genotype</th>
<th>% Black offspring</th>
<th>% White offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Ff )</td>
<td>( Ff )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Ff )</td>
<td>( ff )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Draw conclusions:** How well did the Punnett squares predict the offspring percentages for each parent pair? ____________________________

6. **Summarize:** In your own words, describe what heredity is and how it works in mice.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

7. **Think and discuss:** Do you think most traits are inherited the way mouse fur color is? _____

Why do you think this is? ________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
You have learned about many different patterns of inheritance. Some are simple dominant or recessive, as in Mendelian traits. Some are more complex, such as incomplete dominant or codominant traits. In this lab you will investigate how simple dominant and recessive traits work together to create an organism.

**Part I**

1. Flip a coin twice to determine the genotype for each trait and record it in the data table. Heads = allele 1  Tails = allele 2 (Example: If you flipped heads twice, your monster will have two copies of allele 1 for its genotype.)
2. Determine the phenotype resulting from the allele pair for each trait.
3. Repeat steps 1-2 for each trait and complete the female monster’s Table 1.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Allele 1</th>
<th>Allele 2</th>
<th>Genotype</th>
<th>Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>Two small eyes (E)</td>
<td>One large eye (e)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tail Shape</td>
<td>Curly (C)</td>
<td>Straight (c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tail Color</td>
<td>Purple (P)</td>
<td>Orange (p)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tail</td>
<td>Have tail (T)</td>
<td>No tail (t)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teeth</td>
<td>Sharp (S)</td>
<td>Round (s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horn Color</td>
<td>Purple (W)</td>
<td>White (w)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ear shape</td>
<td>Pointy (Y)</td>
<td>Round (y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ears</td>
<td>No ears (N)</td>
<td>Two ears (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Claws</td>
<td>Long (L)</td>
<td>Short (l)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Part 2**
The female monster (described in Table 1) is married to a male monster (see Table 2 below) and they plan to have baby monsters. They are interested in finding out the probabilities of which traits their offspring will have.

1. Fill in the missing genetic information in the table for the male.

   **Table 2: Genotypes & Phenotypes for Male Monster**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Genotype</th>
<th>Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td>ee</td>
<td></td>
</tr>
<tr>
<td>Tail Shape</td>
<td>Straight</td>
<td></td>
</tr>
<tr>
<td>Tail Color</td>
<td>Pp</td>
<td></td>
</tr>
<tr>
<td>Tail</td>
<td>No tail</td>
<td></td>
</tr>
<tr>
<td>Teeth</td>
<td>Round</td>
<td></td>
</tr>
<tr>
<td>Horn Color</td>
<td>ww</td>
<td></td>
</tr>
<tr>
<td>Ear shape</td>
<td>yy</td>
<td></td>
</tr>
<tr>
<td>Ears</td>
<td>Have 2 ears</td>
<td></td>
</tr>
<tr>
<td>Claws</td>
<td>Short</td>
<td></td>
</tr>
</tbody>
</table>

Create Punnett Squares (on the following sheet) to predict what traits would result from a cross between the two monsters and answer the following questions. Draw a family portrait of Mom, Dad and new baby.

1. What percent of offspring will have only one eye?

2. What percent of offspring will have a tail?

3. What percent of offspring will have purple horns?

4. What percent of offspring will have long claws?
Eyes

Tail Shape

Tail Color

Tail

Teeth

Horn Color

Ear Shape

Ears

Claws
Pit bull Dilemma

Margie is an American Pit bull Breeder in Columbus, Ohio. She has specialized in pit bull breeding for over 10 years, and has had a great deal of success with one male pit bull. The male is a 120-pound American Pit bull with Brindle coloring, brown eyes, white markings on his chest, and hip dysplasia. Hip Dysplasia is a disease that causes large breed dog’s joints to deteriorate causing extreme pain. Margie wants to breed her male once more with a female that does not have the hip dysplasia. The female is a 90-pound American Pit bull with Gray coloring, brown eyes, and white markings on her chest.

How many of these dogs offspring will display the recessive genotype for hip dysplasia?

*Use a highlighter to indicate the important information that is located in the reading above.

- The last sentence in the reading tells us that hip dysplasia is a recessive gene. This means that the Male pit bull would have the genotype hh since he has hip dysplasia.

- Since the female does not have hip dysplasia she must have one of two genotypes Hh, which means she carries the gene but does not show the phenotype, or she has HH, which means she only has the dominant genotypes that do not have the disease.

- Create a punnett square that shows the genotypes of these two dog’s offspring. Remember since you do not know the genotype of the female you must complete two squares for each possible female genotype.
Hip Dysplasia Pedigree

Pedigree – A pedigree is a chart or “family tree” that tracks which members of a family have a particular trait.

PEDIGREE SYMBOLS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Female</td>
</tr>
<tr>
<td>□</td>
<td>Male</td>
</tr>
<tr>
<td>■</td>
<td>Homozygous</td>
</tr>
<tr>
<td>○</td>
<td>Heterozygous</td>
</tr>
<tr>
<td>○</td>
<td>Homozygous</td>
</tr>
<tr>
<td>○</td>
<td>Dominant</td>
</tr>
</tbody>
</table>

Parents

First Generation Offspring (F1)

1 2 3 4
hh hh Hh Hh

Second Generation Offspring (F2)

Hh Hh

1. Analyze the Pedigree above for hip dysplasia. Describe the pedigree using the terms: parent, offspring, heterozygous, homozygous, recessive, dominant, genotype, phenotype. Be sure to discuss the parents, first generation of offspring, and second generation of offspring. Include which pit bulls will have hip dysplasia and which will not.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

2. In this pedigree, how many of the pit bulls have hip dysplasia? ________________
3. What is the genotype and phenotype of the first daughter in the first generation?

Genotype = ___________________ Phenotype = ___________________

4. If the original parents had another offspring, what are the chances the offspring would have hip dysplasia? __________________________

5. Offspring #4 in the first generation mates with a homozygous dominant female. Create a punnett square to determine the probability of their offspring having hip dysplasia.

   ______% of offspring with hip dysplasia

6. Explain how the pedigree is supported in your results from the punnett square.

   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________

7. Construct a pedigree in which offspring 1 in the first generation mates with another pit bull. Provide a punnett square as evidence to support your pedigree.
Margie is an American Pit bull Breeder in Columbus, Ohio. She has specialized in pit bull breeding for over 10 years, and has had a great deal of success with on male pit bull. The male is a 120-pound American Pit bull with Brindle coloring, brown eyes, white markings on his chest, and hip dysplasia. Hip Dysplasia is a disease that causes large breed dog’s joints to deteriorate causing extreme pain. Margie wants to breed her male once more with a female that does not have the hip dysplasia. The female is a 90-pound American Pit bull with Gray coloring, brown eyes, and white markings on her chest. How many of these dogs offspring will display the recessive genotype for hip dysplasia?

Use a highlighter to indicate the important information that is located in the reading above.

The last sentence in the reading tells us that hip dysplasia is a recessive gene. This means that the Male pit bull would have the genotype hh since he has hip dysplasia. Since the female does not has hip dysplasia she must have one of two genotypes Hh, which means she carries the gene but does not show the phenotype, or she has HH, which means she only has the dominant genotypes that do not have the disease. Create a punnett square that shows the genotypes of these two dog’s offspring. Remember since you do not know the genotype of the female you must complete two squares for each possible female genotype.

\[
\begin{array}{c|c}
\text{H} & \text{h} \\
\text{H} & \text{h} \\
\text{h} & \text{h} \\
\text{h} & \text{h} \\
\end{array}
\]

\[
\begin{array}{c|c}
\text{H} & \text{h} \\
\text{H} & \text{h} \\
\text{h} & \text{h} \\
\text{h} & \text{h} \\
\end{array}
\]
**Hip Dysplasia Pedigree**

Pedigree – A pedigree is a chart or “family tree” that tracks which members of a family have a particular trait.

**PEDIGREE SYMBOLS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>Female</td>
</tr>
<tr>
<td>□</td>
<td>Male</td>
</tr>
<tr>
<td>■</td>
<td>Homozygous recessive</td>
</tr>
<tr>
<td>○</td>
<td>Homozygous dominant</td>
</tr>
<tr>
<td>□</td>
<td>Heterozygous</td>
</tr>
</tbody>
</table>

1. Analyze the Pedigree above for hip dysplasia. Describe the pedigree using the terms: parent, offspring, heterozygous, homozygous, recessive, dominant, genotype, phenotype. Be sure to discuss the parents, first generation of offspring, and second generation of offspring. Include which pit bulls will have hip dysplasia and which will not.

**ANSWERS WILL VARY**

2. In this pedigree how many of the pit bulls have hip dysplasia? _____3_____

---

Columbus City Schools
Curriculum Leadership and Development
Science Department June 2013
3. What is the genotype and phenotype of the first daughter in the first generation?

Genotype = _______ hh _______ Phenotype = ___ has hip dysplasia ___

4. If the original parents had another offspring, what are the chances the offspring would have hip dysplasia? _______ 50% ________

5. Offspring #4 in the first generation mates with a homozygous dominant female. Create a punnett square to determine the probability of their offspring having hip dysplasia.

6. Explain how the pedigree is supported in your results from the punnett square.

   ____ There is a zero percent chance that the offspring in the second generation will have Hip Dysplasia, because the mother is Homozygous Dominant and the father is Heterozygous. Half of the offspring will carry the trait, but it will not be present.

7. Construct a pedigree in which offspring 1 in the first generation mates with another pit bull. Provide a punnett square as evidence to support your pedigree.

   **Possible Solution**

   ![Pedigree and Punnett Square](image-url)
Bikini Bottom Genetics

Scientists at Bikini Bottoms have been investigating the genetic makeup of the organisms in this community. Use the information provided and your knowledge of genetics to answer each question.

1. For each genotype below, indicate whether it is a heterozygous (H) OR homozygous (Ho).
   TT _____  Bb _____  DD _____  Ff _____  tt _____  dd _____
   Dd _____  ff _____  Tt _____  bb _____  BB _____  FF _____
   Which of the genotypes in #1 would be considered purebred? ________________________
   Which of the genotypes in #1 would be hybrids? ________________________

2. Determine the phenotype for each genotype using the information provided about SpongeBob.
   Yellow body color is dominant to blue.
   YY ____________  Yy ____________  yy ____________
   Square shape is dominant to round.
   SS ____________  Ss ____________  ss ____________

3. For each phenotype, give the genotypes that are possible for Patrick.
   A tall head (T) is dominant to short (t).
   Tall = ____________  Short = ____________
   Pink body color (P) is dominant to yellow (p).
   Pink body = ____________  Yellow body = ____________

4. SpongeBob SquarePants recently met SpongeSusie Roundpants at a dance. SpongeBob is heterozygous for his square shape, but SpongeSusie is round. Create a Punnett square to show the possibilities that would result if SpongeBob and SpongeSusie had children. HINT: Read question #2!

A. List the possible genotypes and phenotypes for their children.

B. What are the chances of a child with a square shape? _____ out of ____ or ____%

C. What are the chances of a child with a round shape? _____ out of ____ or ____%

5. Patrick met Patti at the dance. Both of them are heterozygous for their pink body color, which is dominant over a yellow body color. Create a Punnett square to show the possibilities that would result if Patrick and Patti had children. HINT: Read question #3!

A. List the possible genotypes and phenotypes for their children.

B. What are the chances of a child with a pink body? _____ out of ____ or ____%

C. What are the chances of a child with a yellow body? _____ out of ____ or ____%

T. Trimpe 2003  http://sciencespot.net/
6. Everyone in Squidward’s family has light blue skin, which is the dominant trait for body color in his hometown of Squid Valley. His family brags that they are a “purebred” line. He recently married a nice girl who has light green skin, which is a recessive trait. Create a Punnett square to show the possibilities that would result if Squidward and his new bride had children. Use B to represent the dominant gene and b to represent the recessive gene.

   A. List the possible genotypes and phenotypes for their children.

   B. What are the chances of a child with light blue skin? ____%

   C. What are the chances of a child with light green skin? ____%

   D. Would Squidward’s children still be considered purebreds? Explain!

7. Assume that one of Squidward’s sons, who is heterozygous for the light blue body color, married a girl that was also heterozygous. Create a Punnett square to show the possibilities that would result if they had children.

   A. List the possible genotypes and phenotypes for their children.

   B. What are the chances of a child with light blue skin? ____%

   C. What are the chances of a child with light green skin? ____%

8. Mr. Krabbs and his wife recently had a Lil’ Krabby, but it has not been a happy occasion for them. Mrs. Krabbs has been upset since she first saw her new baby who had short eyeballs. She claims that the hospital goofed and mixed up her baby with someone else’s baby. Mr. Krabbs is homozygous for his tall eyeballs, while his wife is heterozygous for her tall eyeballs. Some members of her family have short eyes, which is the recessive trait. Create a Punnett square using T for the dominant gene and t for the recessive one.

   A. List the possible genotypes and phenotypes for their children.

   B. Did the hospital make a mistake? Explain your answer.

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Bikini Bottom Genetics

Answer Key

1. **Homozygous**  He  He  He  He  Ho  Ho
   **Heterozygous** He  Ho  He  Ho  He  Ho
   Purebreds - TT, DD, BB, FF, ff, dd, bb, tt
   Hybrids - Dd, Bb, Ff, Tt

2.  **Square shape**  Yellow body  Square shape  Blue body

3.  Tall - TT or Tt  Short - tt
   Pink - PP or Pp  Yellow - pp

4.  A. SS - square shape, Ss - square shape, and ss - round shape
    B. 2 out of 4 or 50%
    C. 2 out of 4 or 50%

   NOTE: Some of your students may feel that the roundpants gene should be the dominant trait as SpongeBob’s TV parents are both roundpants. However, these are only his parents on the TV show and his real parents are both heterozygous for squarepants.

5.  A. PP - pink body, Pp - pink body, and pp - yellow body
    B. 3 out of 4 or 75%
    C. 1 out of 4 or 25%

6.  A. Bb - light blue skin
    B. 100%
    C. 0%
    D. Squidward’s children would not be considered purebred, since each would have a gene pair made up of a dominant gene and a recessive gene.

7.  A. TT - tall eyeballs or Tt - tall eyeballs
    B. The hospital must have made a mistake, since the genotype “tt” would not be possible based on the genotypes of Mr. and Mrs. Krabbs.

   NOTE: Students may come up with other possible scenarios, such as Mr. Krabbs not really a homozygous tall-eyed crab or a mutation. A few of my students suggested that Mr. Krabbs might not be the father!

   NOTE: Some of your students may comment that Mr. Krabbs was married to a whale. However, this was only for the TV show and he is happily married to a beautiful crab in real life. (Ok, so it’s not “real” life!)

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