

## Molecular and Mendelian Genetics

Rachel Smith-Bolton, PhD [rsbolton@illinois.edu](mailto:rsbolton@illinois.edu)

Amanda Brock, PhD [arbrock@illinois.edu](mailto:arbrock@illinois.edu)

### Next Generation Science Standards

<http://www.nextgenscience.org/>

MS-LS3-1.	<b>Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.</b> [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]
MS-LS3-2.	<b>Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.</b> [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]
MS-LS4-5.	<b>Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.</b> [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]
HS-LS3-1.	<b>Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</b> [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]
HS-LS3-2.	<b>Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</b> [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]
HS-LS3-3.	<b>Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</b> [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]

### Mendel's Peas:

<http://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593>

#### Punnett Square exercise for junior high:

Divide students into groups of 4.

Give them 4 green and 4 yellow squares of construction paper.

Give multiple problems:

- 1) Y- yellow peas, dominant  
y- green peas, recessive

Cross yy x Yy. What do the progeny look like ? What proportions? Have them "show" the answer with construction paper Answer:(2 yellow, 2 green).

- 2) T- tall pea plants, dominant  
t- short pea plants, recessive

Cross Tt x tt.

What do the progeny look like? What proportions? Have them “act” out the answer.  
(two tall, two short)

3)R- round peas, Dominant  
r- wrinkled peas, recessive

Cross Rr x Rr. What are the progeny? What are the proportions?

Have them act it out. Note: this gets silly.

### **Additional Resources:**

**University of Utah Genetic Science Learning Center**

<http://teach.genetics.utah.edu/content/heredity/>

**Bay Area Biotechnology Education Consortium**

<http://www.babec.org/node/27>

**Carolina Biological Supplies**

<http://www.carolina.com/>

**Smith-Bolton Lab**

<http://smithboltonlab.wordpress.com/>

**Next Generation Science Standards**

<http://www.nextgenscience.org/>

**Current Illinois State Science Standards**

<http://www.isbe.state.il.us/ils/science/standards.htm>