Elementary Institute of Science

Hands-on Genetics Activity 4

Topic: Mendelian Genetics and Punnett Squares

Learning Objective: After completing the lesson, the group will be able to understand the process of Punnett squares and describe traits as genotypes and phenotypes. Students will understand the randomness in trait selection and how some traits are more favorable than others.

Alignment with NGSS Grades 3-5

Science and Engineering Practices

Developing and Using Models

- Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena.

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary)*

LS3.A: Inheritance of Traits

- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

LS3.B: Variation of Traits

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems.

Materials: Copies of Baby Lab (group in pairs, max 5 per class), Pencils (114, Shelf), Colored Pencils/Crayons (114, cab), Coins

Detailed Description:

After a lecture on dominant and recessive genes (etc.) and how to use Punnett squares, students will pair up to do the activity. By flipping a coin to show random chance, they will list the traits their baby will have. Then they will draw their child. The activity will allow the students to create background knowledge in trait selection and allow them to think about their own traits. They will learn many of the classic terms used in genetics.

How will you conclude the lesson to enforce the learning objective?

Pairs at the end of the activity will have a chance to present their child and talk about how they got certain traits.

What science process skills will this lesson exercise?

Observing, Inferring, Classifying, Predicting, Acquiring Data, Analyzing Data, Formulating Models

Safety precautions: Paper Cuts

Baby Lab

Introduction

The traits on the following pages are believed to be inherited in the explained manner. Most of the traits, however, in this activity were created to illustrate how human heredity works in a simplified model and to reinforce basic genetic principles. In actuality, inherited characteristics of the face are much more complicated than this activity illustrates. Most of these facial characteristics of the face are determined by many genes working together in a way geneticists do not yet understand. We hope you will be successful in this very important role as parents.

What would your baby look like if both you and your classmate (who will simulate your spouse) have one dominant gene and one recessive gene for each of the facial features illustrated in the following pages? In other words, each of you will be heterozygous for each trait. To determine the facial appearance of your child, you and your spouse will each flip a coin to determine what gene you will contribute to your child.

Heads = Dominant (uppercase) **Tails = Recessive (lowercase)**

1. Record your names, as parents on the attached data sheet.

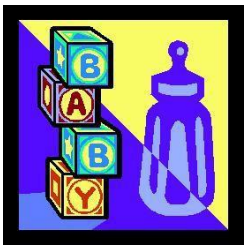
2. Determine the gender of the child. Heads will be a boy and tails will be a girl.

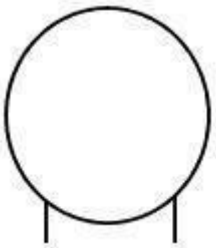
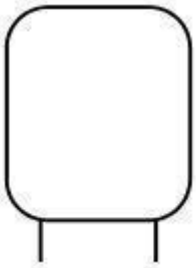
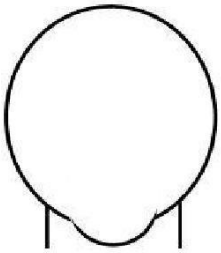
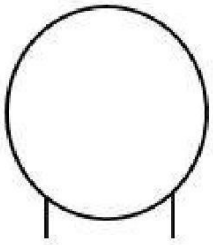
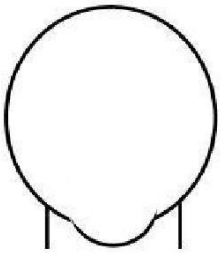
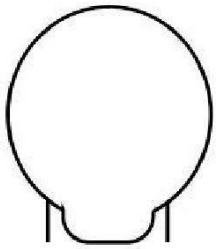
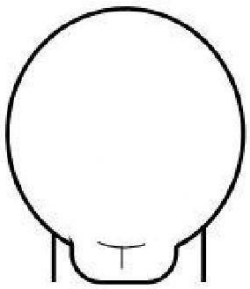
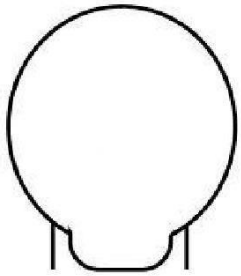
3. Give your child a name and record the name on your data sheet.

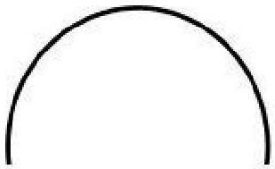
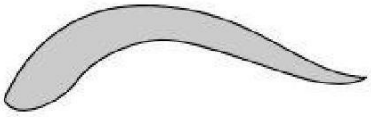
4. Flip the coins to determine which gene of each pair you contribute to the traits of your child. Each child will have two genes for each trait, one from each parent. You will supply one gene and your spouse will supply one gene.

5. Record the genetic contributions of each parent on the data chart.

6. When you have determined the genotype of your baby, complete the data analysis.



Face Shape	Round (R) 	Square (r) 
Chin – Next 3 flips		
Prominence	Very Prominent (V) 	Less Prominent (v) 
Shape – only flip for this trait if the chin is very prominent. The genotype (vv) prevents the expression of this trait	Round (R) 	Square (r) 
Cleft	Present (P) 	Absent (p) 
Skin Color – to determine skin color, assume there are three gene pairs involved. Flip your coins first to determine the genotype of the A genes. Then flip the coins again to determine the B genes. Flip for the last time to determine the C genes. Each capitol letter represents an active allele for pigmentation		
	6 capitols = very, very dark brown	5 capitols = very dark brown
	4 capitols = dark brown	3 capitols = medium brown
	2 capitols = light brown	1 capitol = light tan
	0 capitols = white	

Hair Type – Next 2 flips		
Hair Texture		
Curly (homozygous dominant C) 	Wavy (heterozygous) 	Straight (homozygous recessive c) 
Widow's Peak	Present (W) 	Absent (w) 
Eyebrows – Next 3 flips		
Color		
Very dark (homozygous dominant H) 	Medium dark (heterozygous) 	Light (homozygous recessive h) 
Thickness	Bushy (B) 	Fine (b) 
Placement	Not connected (N) 	Connected (n) 

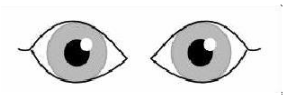
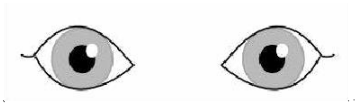
Eyes – Next 6 flips

Eye Color - Darker eyes are produced in the presence of more active alleles for pigment. In this situation, the large letters (A or B) represent alleles which are active in depositing dark pigment. Small letters represent alleles which deposit little pigment.

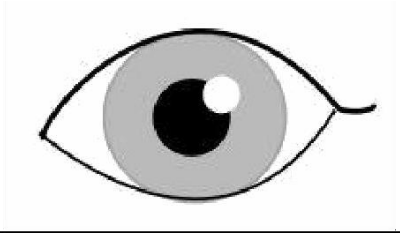
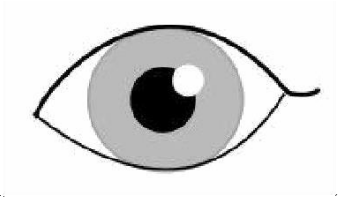
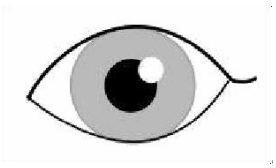
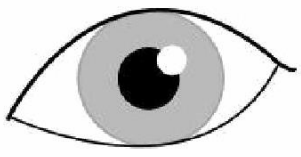
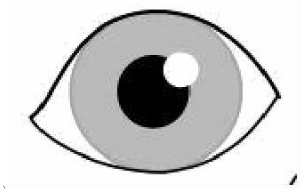
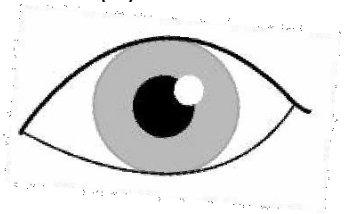
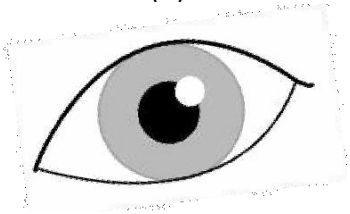
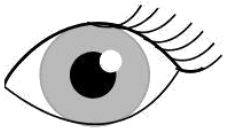
To determine the color of the eyes, assume there are two gene pairs involved, one which codes for depositing pigment in the front of the iris and one which codes for depositing pigment in the back of the iris. Determine the genotype of the A genes and then the B genes. In actuality, the determination of eye color is much more complicated.

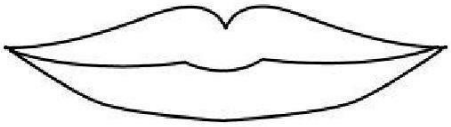
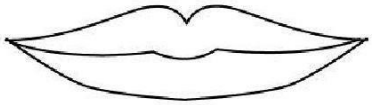
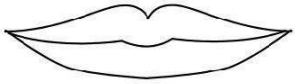
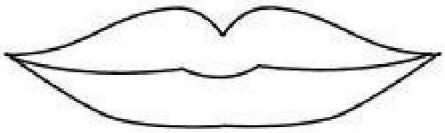
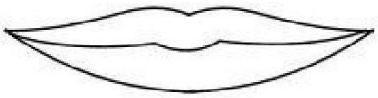
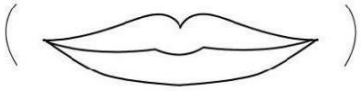
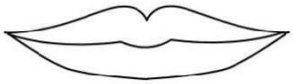
	AABB = Dark Brown	AABb = Brown
	AaBB = Brown	AaBb = Brown
	AAbb = Dark Blue	aaBB = Dark Blue
	Aabb = Light Blue	aaBb = Light Blue
	aabb = Pale Blue	

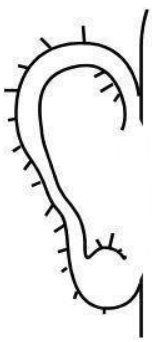
Distance Apart

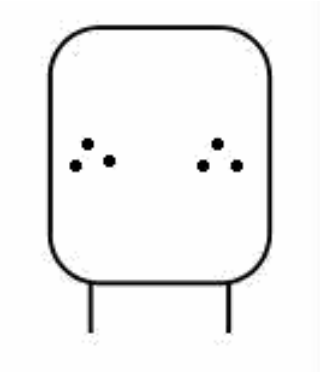
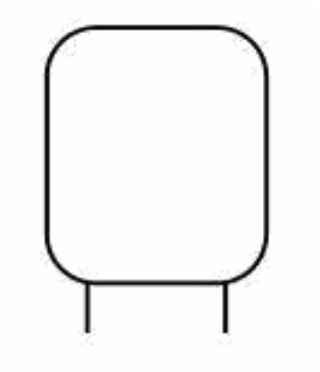
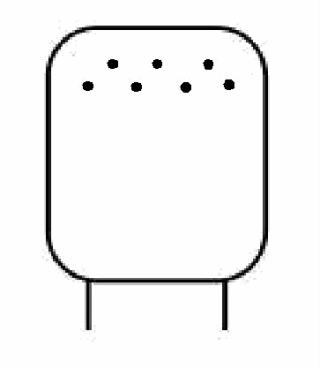
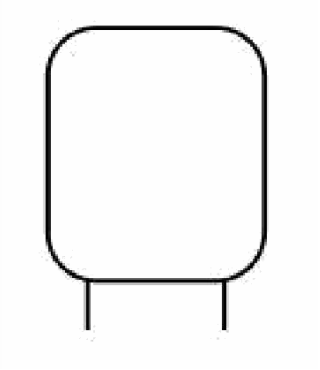
Close together (homozygous dominant E) 	Average distance (heterozygous) 	Far apart (homozygous recessive e) 

Size

Large (homozygous dominant E) 	Medium (heterozygous) 	Small (homozygous recessive e) 
Shape	Almond (A) 	Round (a) 
Slantedness	Horizontal (H) 	Upward slant (h) 
Lashes	Long (L) 	Short (l 

Mouth and Lips – Next 3 flips		
Mouth size		
Long (homozygous dominant M) 	Average (heterozygous) 	Short (homozygous recessive m) 
Lip Thickness	Thick (L) 	Thin (l) 
Dimples	Present (D) 	Absent (d) 
Nose – Next 3 flips		
Size		
Big (homozygous dominant N) 	Medium (heterozygous) 	Small (homozygous recessive n) 
Shape	Rounded (R) 	Pointed (r) 
Nostril Shape	Rounded (R) 	Pointed (r) 

Ears – Next 4 flips		
Attachment	Free earlobe (F) 	Attached earlobe (f) 
Darwin's Earpoints	Present (D) 	Absent (d) 
Ear Pits	Present (P) 	Absent (p) 
Hairy Ears – sex limited to males	Absent (H) 	Present (h) 

Freckles – Next 2 flips		
On Cheeks	Present (F) 	Absent (f) 
On Forehead	Present (F) 	Absent (f) 

Name _____

Baby Lab – Data Table

Parent 1 Name _____ Parent 2 Name _____

Child's Name _____ Gender _____

Trait	Parent 1 gene	Parent 2 gene	Genotype	Phenotype
Face Shape				
Chin Prominence				
Chin Shape				
Cleft Chin				
Skin Color				
Hair Texture				
Widow's Peak				
Eyebrow Color				
Eyebrow Thickness				
Eyebrow Placement				
Eye Color				
Eye Distance Apart				
Eye Size				
Eye Shape				
Eye Slantedness				
Eyelashes				
Mouth size				
Lip Thickness				
Dimples				
Nose Size				
Nose Shape				
Nostril Shape				
Earlobe Attachment				
Darwin's Earpoints				
Ear Pits				
Hairy Ears				
Cheek Freckles				
Forehead Freckles				

Baby Lab – Data Analysis

1. Draw and color a picture of your child.