The Genetics of Parenthood- Face Lab (SB2c)

Purpose: To simulate the various patterns of inheritance using Mendall's laws.

The Genetics of Parenthood Guidebook Introduction

Why do people, even closely related people, look slightly different from each other? The reason for these differences in physical characteristics (called **phenotype**) is the different combination of **genes** possessed by each individual. To illustrate the tremendous variety possible when you begin to combine genes, you and a classmate will establish the genotypes for a potential offspring. Your baby will receive a random combination of genes that each of you, as genetic parents, will contribute. Each normal human being has 46 chromosomes (23 pairs; **diploid**) in each body cell. In forming the gametes (egg or sperm), one of each chromosome pair will be given, so these cells have only 23 single chromosomes (**haploid**). In this way, you contribute half of the genetic information (**genotype**) for the child; your partner will contribute the other half. Because we don't know your real genotype, we'll assume that you and your partner are **heterozygous** for every facial trait. Which one of the two available alleles you contribute to your baby is random, like flipping a coin. In this lab, there are 36 gene pairs and 30 traits, but in reality there are thousands of different gene pairs, and so there are millions of possible gene combinations!

You and your partner are to determine the characteristics of your "child" by using the information shown below and by flipping coins.

1. You will need one data sheet and one plain white sheet of paper (with both your names).

2. The first step is to determine whether your child is a boy or girl by flipping one coin: heads is the Y chromosome, tails is the X chromosome.

3. Next, you are to use two coins to determine the shape of your child's face as shown below in #1

4. You are to sketch in the details of your child's face as you flip coins to determine heads and tails

5. NOTE: some of the traits require that you flip the coins more than once so read before you proceed.

6. When finished, give your child a name.

REMEMBER: Heads = Dominant Allele
Tails = Recessive Allele

1. **FACE SHAPE**:

Round (AA, Aa)
heads/heads or heads/tails

Square (aa)
tails/ tails

2. **CHIN SIZE**: The results may affect the next two traits.

Very prominent (BB, Bb)
heads / heads or heads/tails

Less prominent (bb)
tails / tails

3. **CHIN SHAPE**: ONLY FLIP COINS FOR THIS TRAIT IF CHIN SIZE IS <u>VERY PROMINENT</u>!! The genotype bb prevents the expression of this trait.

Round (CC, Cc)
heads/heads or heads/tails

Square (cc)
tails/ tails

4. **CLEFT CHIN**: ONLY FLIP COINS FOR THIS TRAIT IF CHIN SIZE IS <u>VERY PROMINENT</u>!! The genotype bb prevents the expression of this trait.

Cleft (DD, Dd)
heads/heads or heads / tails

No Cleft (dd)
tails / tails

5. **SKIN COLOR**: To determine the color of skin or any other trait controlled by more than 1 gene, you will need to flip the coin for each gene pair. Dominant alleles represent color; recessive alleles represent little or no color. For example, if there are 3 gene pairs...
   a. First coin toss determines whether the child inherits E or e (heads = E, tails = e)
   b. Second coin toss decides F or f inheritance. (heads=F, tails = f)
   c. Third coin toss determines inheritance of G or g. (heads = G, tails = g)

6 dominant alleles - black
[all heads]

5 dominant alleles - very dark brown
[5 heads, one tails]

4 dominant alleles - dark brown
[4 heads, two tails]

3 dominant alleles - medium brown
[3 heads, 3 tails]

2 dominant - light brown
[two heads. four tails]

1 dominant - tan
[one head, five tails]

0 dominant - white
[no heads – all tails]

6. **HAIR COLOR**: Determined by 4 gene pairs. (toss the two coins four times, dominant means heads)

8 dominant - black	3 dominant - brown mixed w/blonde
7 dominant - very dark brown	2 dominant - blond
6 dominant - dark brown	1 dominant - very light blond
5 dominant - brown	0 dominant - silvery white
4 dominant - light brown	

7. **RED COLOR TINTS IN THE HAIR**: This trait is only visible if the hair color is light brown or lighter (4 or less dominant alleles for hair color).

Dark red tint (LL) Light red tint (L l) No red tint (l l)

8. **HAIR TYPE**:

Curly (MM) [heads/heads]

Wavy (Mm) [heads/tails]

Straight (mm) [tails/tails]

9. **WIDOW'S PEAK**:

Present (OO, Oo) [heads/heads or heads/tails]

Absent (oo) [tails/tails]

10. **EYE COLOR**: [two sets of coins, NOTE: the order is important!]
P or Q = heads, p or q = tails.

PPQQ - black	PpQQ - brown with green tints	pPqQ - gray blue
PPQq - dark brown	ppQQ - green	ppQq - dark blue
PPqq – brown	PpQq - violet	ppqq - light blue

11. **EYE DISTANCE**:

Close (RR)

Average (Rr)

Far apart (rr)

12. **EYE SIZE**:

Large (SS)

Medium (Ss)

Small (ss)

13. **EYE SHAPE**: [T = heads, t = tails]

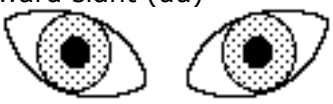
Almond (TT, Tt)

Round (tt)

14. **EYE SLANTEDNESS**: [U = heads, u = tails]

Horizontal (UU, Uu)

Upward slant (uu)



15. **EYELASHES**: [V = heads, v = tails]

Long (VV, Vv)

Short (vv)

16. **EYEBROW COLOR**:

Darker than hair	Same as hair	Lighter than hair
color (WW)	color (Ww)	color (ww)

17. **EYEBROW THICKNESS**:

Bushy (ZZ, Zz)

Fine (zz)

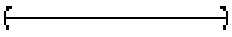
18. **EYEBROW LENGTH**:

Not connected (AA, Aa)

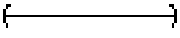
Connected (aa)

19. **MOUTH SIZE**:

Long (BB)



Medium (Bb)

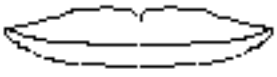


Short (bb)

20. **LIP THICKNESS**:

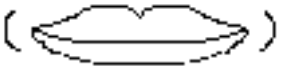
Thick (CC, Cc)

Thin (cc)

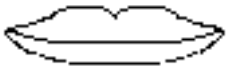


21. **DIMPLES**:

Present (DD, Dd)



Absent (dd)



22. **NOSE SIZE**:

Large (EE)

Medium (Ee)

Small (ee

23. **NOSE SHAPE**:

Rounded (FF, Ff)

Pointed (ff)

24. **NOSTRIL SHAPE**:

Rounded (GG, Gg)

Pointed (gg)

25. **EARLOBE ATTACHMENT**:

Free (HH, Hh)

Attached (hh)

26. **DARWIN'S EARPOINT**:

Present (II, Ii)

Absent (ii)

27. **EAR PITS**:

Present (JJ, Jj)

Absent (jj)

28. **HAIRY EARS**:

Present (KK, Kk)

Absent (kk)

29. **FRECKLES ON CHEEKS**:

Present (LL, Ll)

Absent (ll)

30. **FRECKLES ON FOREHEAD**:

Present (MM, Mm)

Absent (mm)

Post Lab Questions (answer on separate sheet of paper)

1. What percentage does each parent contribute to a child's genotype?

2. Explain how/what part of this lab is unrealistic. Design an alternative procedure that is more realistic.

3. Using examples from this activity, explain your understanding of the following inheritance patterns:
   a. dominant
   b. recessive
   c. incomplete dominance
   d. polygenic
   e. epistasis

4. Compare the predicted phenotype ratio (Punnett squares) to the actual ratio (class data) for the following traits:
   a. trait # 2 (chin size)
   b. trait #8 (hair type)

5. All the children had two heterozygous parents. Use the law of independent assortment to explain why there were no identical twins produced.

Data Sheet

Parents _____ and _____

Child's gender _____Child's name_____

Fill in the data table as you determine each trait described in the Reference Sheets. Do not simply flip the coin for all traits before reading the guide, because some of the traits have special instructions. In the last column, combine the information and draw what that section of the child's face would look like.

#	TRAIT	ALLELE FROM MOM	ALLELE FROM DAD	CHILD'S GENOTYPE	CHILD'S PHENOTYPE (written)	CHILD'S PHENOTYPE (drawn)
1	Face Shape	A a	A a		round/ square	face & chin
2	Chin Size	B b	B b		very prominent, less prominent	
3	Chin Shape	C c	C c		Round / square	
4	Cleft Chin	D d	D d		Cleft / no cleft	
5	Skin Color	E e F f G g	E e F f G g		Black/ very dark brown/ dark brown/ medium brown/light brown/ tan/ white	Skin color **NOTE: SKIN COLOR REQUIRES 3 COIN TOSSES**
6	Hair Color	H h I i J j K k	H h I i J j K k		Black/V.D. Brown /Dark Brown /Brown/L. Brown /Brownw/Blond /Blond/ V.L. Blond/ Silvery white	hair **HAIR COLOR REQUIRES 4 TOSSES**
7	Red Tints	L l	L l		D.R. Tint/ L.R.Tint No Tint	
8	Hair Type	M m	M m		curly/ wavy / straight	
9	Widow's Peak	O o	O o		present / absent	
10	Eye Color	P p Q q	P p Q q		black/dark brown/ brown w/ green tints/ green/ violet/ grey blue light blue/ Dark blue	eye & eyelashes **NOTE: EYE COLOR REQUIRES 2 COIN TOSSES**
11	Eye Distance	R r	R r		close / average/ far apart	
12	Eye Size	S s	S s		Large/ Medium/ Small	

13	Eye Shape	T t	T t		almond/ round	
14	Eye Slant-edness	U u	U u		horizontal/ Upward slant	
15	Eyelashes	V v	V v		long / short	

#	TRAIT	ALLELE FROM MOM	ALLELE FROM DAD	CHILD'S GENOTYPE	CHILD'S PHENOTYPE (written)	CHILD'S PHENOTYPE (drawn)	
16	Eyebrow Color	W w	W w		Darker / Same / Lighter	eyebrow	
17	Eyebrow Thickness	Z z	Z z		bushy/ fine		
18	Eyebrow Length	A a	A a		not connected/ connected		
19	Mouth Size	B b	B b		long / medium/ short	mouth	
20	Lip Thickness	C c	C c		thick/ thin		
21	Dimples	D d	D d		present/ absent		
22	Nose Size	E e	E e		large/ medium small	nose	
23	Nose Shape	F f	F f		rounded/ pointed		
24	Nostril Shape	G g	G g		rounded/ pointed		
25	Earlobe Attach-ment	H h	H h		free / attached	ear	
26	Darwin's Earpoint	I i	I i		present/ absent		
27	Ear Pits	J j	J j		present/ absent		
28	Hairy Ears	K k	K k		present/ absent		
29	Cheek Freckles	L l	L l		present/ absent		
30	Forehead Freckles	M m	M m		present/ absent		