Genetic Recombination: One Mechanism of Evolution
(or "Baby Mak'in")

Why do people look so different from one another? How significant are these differences? Even close relatives often show little resemblance. This happens because a very large number of traits exist in the human population and new combinations are created as humans reproduce. Remember: during meiosis, there is crossing-over of genes, along with random assortment and distribution of homologous pairs. These factors create variation within a population. This is why sexual reproduction is good for species that inherit it from a common ancestor.

In this activity, you will examine why brothers and sisters have different **genotypes** (genetic messages on their DNA) and therefore different **phenotypes** (physical appearances), even though they share the same parents.

So…CONGRATULATIONS! You are a parent! You and your lab partner represent a couple. Each of you is **heterozygous** (having one **dominant** and one **recessive** gene) for each facial feature illustrated in this lab.

Procedure:

1. With your partner, obtain a penny, and colored pencils. Decide who will contribute the genes of the mother and who will contribute the genes of the father.

2. Determine the gender of your child:
   - Remember: Mom's genotype is XX and Dad's is XY, so only Dad flips the coin.
   - Heads represents Y sperm, which means the child will be a boy.
   - Tails represents X sperm, which means the child will be a girl.

3. Give your bouncing baby a name!

4. Discover the facial features your child will have by flipping the coin as directed on the following pages. For the rest of the activity:
   - Heads will represent the **dominant** trait (shown with a *CAPITAL* letter).
   - Tails will represent the **recessive** trait (shown with a *lowercase* letter).

5. On the ***Face Lab Data Sheet,*** record the genetic contributions (heads or tails) in the columns labeled ***Gene(s) from Mother*** and ***Gene(s) from Father***. Record the actual genetic message in the genotype column and record the appearance in the phenotype column.

6. Draw your child's teenage picture! When you have determined all the features of your child's face, draw and color the way your baby will look when he/she has reached their senior year of high school.

7. Complete the analysis & conclusions section of the lab.

Facial Features

1. Face Shape: Round (RR, Rr) Square (rr)

2. Chin Shape: Prominent (PP, Pp) Weak (pp)

3. Chin Shape II: ONLY if your child's chin is Prominent (PP, Pp)!

Round Chin (RR, Rr) Square Chin (rr)

4. Cleft Chin: Present (CC, Cc) Absent (cc)

5. Skin Color: Skin color involves 3 gene pairs. Each parent needs to flip the coin 3 times and record the A/a, B/b, and C/c alleles. Each CAPITAL letter represents an active gene for melanin production (melanin determines skin coloration).

6 capitals	very dark skin
5 capitals	dark skin
4 capitals	medium dark skin
3 capitals	medium skin
2 capitals	medium light skin
1 capital	light skin
0 capitals	very light skin

6. Hair Color: Like skin color, hair color is produced by several genes (i.e., it's a polygenic characteristic). For the purpose of this activity, we will assume that 4 pairs are involved (though, actually, more are responsible). So, each parent will flip the coins 4 times for the A, B, C and D alleles. As before, the CAPITAL letters represent color while the lowercase represent little or no color.

8 capitals	black hair
7 capitals	very dark brown hair
6 capitals	dark brown hair
5 capitals	brown hair
4 capitals	light brown hair
3 capitals	honey blonde hair
2 capitals	blonde hair
1 capital	very light blonde hair
0 capitals	white hair

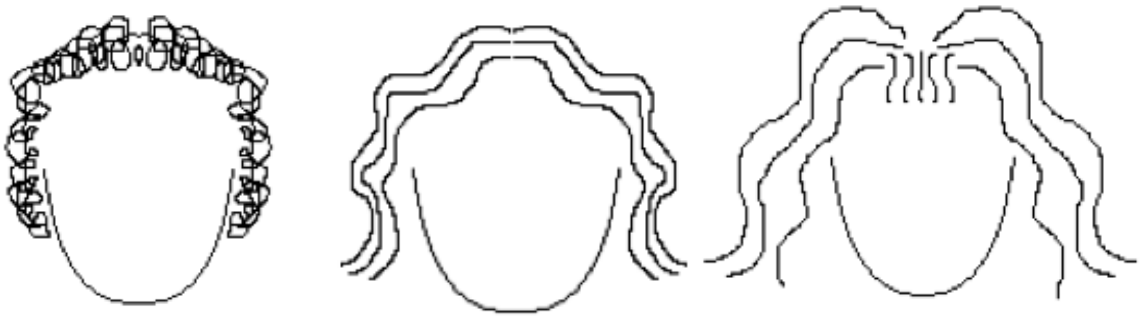
7. Red Hair: Red hair is further complicated by the fact that brown hair will mask or hide red hair color. The lighter the hair color, the more the red coloration can show through. If your child has 3 or fewer CAPITALS for hair color (#6, above) and RR is tossed, your child will have flaming red hair. If Rr is tossed, add in a reddish hue.

Red hair seems to be caused by a single gene with two alleles:

Dark red (RR) Light red (Rr) No red (rr)

8. Hair Type: Hair type is caused by incomplete dominance:

Curly (CC) Wavy (Cc) Straight (cc)



9. Widow's Peak: The hair comes to a point:

Present (WW, Ww) Absent (ww)

10. Eyebrow Color: Eyebrow color is caused by incomplete dominance.

Dark (DD) Medium (Dd) Light (dd)

11. Eyebrow Thickness: Bushy (BB, Bb) Fine (bb)

12. Eyebrow Placement: Not Connected (NN, Nn) Connected (nn)

13. Eye Color: Assume that there are two gene pairs involved. The CAPITAL letters represent more color and the lowercase less color. Dark eyes are dominant over light. Assume that there are two layers of color on the iris of the eye. The first alleles (A or a) code for the front of the iris and the second alleles (B or b) code for the back of the iris. Determine the first layer, A, then the second layer, B. In reality, eye color is much more complex than this.

AABB	dark brown eyes
AABb	dark brown eyes
AaBB	brown eyes with green flakes
AaBb	hazel eyes
Aabb	dark blue eyes
aaBB	green eyes
aaBb	gray blue eyes
aabb	light blue eyes

14. Eye Distance: Close Together (EE) Average (Ee) Far Apart (ee)

15. Eye Size: Large (LL) Average (Ll) Small (ll)

16. Eye Shape: Almond (AA, Aa) Round (aa)

17. Eye Tilt: Horizontal (HH, Hh) Upward Slant (hh)

18. Eyelashes: Long (LL, Ll) Short (ll)

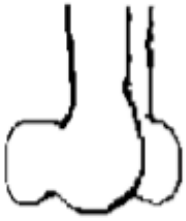
19. Mouth Size: Long (LL) Average (Ll) Short (ll)

20. Lip Thickness: Thick (TT, Tt) Thin (tt)

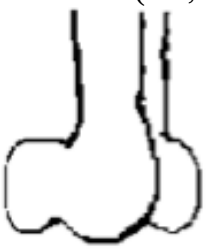
21. Lip Protrusion: Very Protruding (PP) Slightly Protruding (Pp) Absent (pp)

22. Dimples: Present (PP, Pp) Absent (pp)

23. Nose Size: Big (BB) Average (Bb) Small (bb)



24. Nose Shape: Rounded (RR, Rr) Pointed (rr)



25. Nostril Shape: Rounded (RR, Rr) Pointed (rr)

26. Earlobe Attachment: Free (FF, Ff) Attached (ff)

27. Darwin's Ear Point: Present (PP, Pp) Absent (pp)

28. Ear Pits: Present (PP, Pp) Absent (pp)

29. Hairy Pinna: This trait is sex-linked and only occurs in males, so if your baby is a girl, skip this. If your baby is a boy, only mom flips. (The external part of your ear is called the pinna or auricle!)

Present (P)

Absent (p)

30. Freckles on Cheeks: Present (PP, Pp)

Absent (pp)

31. Freckles on Forehead: Present (PP, Pp)

Absent (pp)

Your Name+Partner Name: _____ Baby Name: _____ Period: ___

Facial Trait	Allele From Mom	Allele From Dad	Genotype	Phenotype
1. Face Shape				
2. Chin Shape				
3. Chin Shape II				
4. Cleft Chin				
5. Skin Color				
6. Hair Color				
7. Red Hair				
8. Hair Type				
9. Widow's Peak				
10. Eyebrow Color				
11. Eyebrow Thickness				
12. Eyebrow Placement				
13. Eye Color				
14. Eye Distance				
15. Eye Size				
16. Eye Shape				
17. Eye Tilt				
18. Eyelashes				
19. Mouth Size				
20. Lip Thickness				
21. Lip Protrusion				
22. Dimples				
23. Nose Size				
24. Nose Shape				
25. Nostril Shape				
26. Earlobe Attachment				
27. Darwin's Ear Point				
28. Ear Pits				
29. Hairy Ears				
30. Freckles on Cheeks				
31. Freckles on Forehead				

Analysis & Conclusions

In this activity, you created a simplified model of how human genes recombine through sexual reproduction. In real life, the heritance of facial features is more complex and is determined by the way several sets of genes work together.

1. Of the *mono-allelic* traits (simple dominance), how many of each of the following did your child possess?

    A. Homozygous Dominant: _____

    B. Heterozygous: _____

    C. Homozygous Recessive: _____

2. Why did only the father flip the coin to determine the sex of your child? Draw a Punnett Square in the blank space below and reference it in your answer. Write only 2-3 sentences.

3. What is the probability that a child could be completely recessive for every trait? Show all of your work, and then explain your reasoning in 1-2 sentences.

4. All parents simulated in this lab had identical genotypes. Explain why each child produced during this modeling is unique. Which Mendelian law gave rise to these differences and why is it significant to evolution?