**Genetics of Parenthood**

**Biology**

**Unit 11 Genetics**

**Goal**: Students will gain an understanding of dominant and recessive traits, forms of inheritance, and the laws of segregation and independent assortment.

**Background:**

State Standards:

B4.1c Differentiate between dominant, recessive, co-dominant,

polygenic, and sex-linked traits.

B4.1d Explain the genetic basis for Mendel’s laws of segregation and

independent assortment.

This is a simulation that easily captures student interest and can be varied to meet different ability levels. Making the assumption that the P (parental) generation is heterozygous at all loci and that independent assortment occurs (no linkages), students flip coins to determine which allele they will pass on to the F1 generation, and draw the resulting child's face. Emphasize the variation which occurs, reminding the students that these children are genetic siblings since all parents have identical genotypes.

Several inheritance patterns are represented in this simulation, and it is important to review these with the students beforehand. *Inheritance of the traits used in this simulation have been simplified to serve as a mode*l; actual inheritance is far more complex and students may need to be reminded about this in case they get overly concerned about their own traits.

Time Required: one to two class periods

**Vocabulary:**

allele

chromosome

chromosome pair

co-dominant traits

dominant trait

gene expression

genetic diversity

genetic variation

genotype

heterozygous

homologous chromosome

human genetics

independent assortment

law of Segregation

meiosis

Mendelian genetics

new gene combinations

phenotype

polygenic traits

protein

punnet square

recessive traits

recombination of genetic material

**Materials:**

 -2 coins

 -wipeboards or drawing paper

 -markers or colored pencils

**Organization**: Preferably male/female pairs, but other configurations like same sex pairs, trios and single parents have also been used, depending on the students; use your discretion

**Procedure:**

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Record all your work on each parent’s data sheet.

• First, determine your baby’s gender. Remember, this is determined entirely by the father. The mother always

contributes an X chromosome to the child.

**Heads** = X chromosome, so the child is a GIRL

**Tails** = Y chromosome, so the child is a BOY

Fill in the results on your data sheet.

• Name the child.

• Determine the child's facial characteristics by having **each** parent flip a coin.

**Heads** = child will inherit the first allele (ie. B or N1) in a pair

**Tails** = child will inherit the second allele (ie. b or N2) in a pair

On the data sheet, circle the allele that the parent will pass on to the child and write the child's genotype.

• Using the information in this guide, look up and record the child's phenotype and draw that section of the face where

indicated on the data sheet.

• Some traits follow special conditions, which are explained below.

• When the data sheet is completed, draw your child's portrait as he/she would look as a teenager. You must include

the traits as determined by the coin tossing. Write your child's full name on the portrait.

**Conclusions:**

Assess student’s worksheet and final face diagram

## Activity ideas after completing the data sheets

1. Each student draws the child's face; compare "mother's" and "father's" perception of characteristics.

1. One student draws the child's face; partner writes a biography of the child at age 30 - what is the child like, what have they accomplished, what are their dreams...this can also bring about interesting discussions on how the students feel about their parents and their perceptions of parenthood.
2. Do the lab twice, comparing the genotypes and phenotypes of the resulting siblings.
3. "Marry" the children off, to produce an F2 generation (grandchildren).
4. Instead of drawing the face, decorate an egg or a five pound package based on the child's traits. It can then be used in the activity "Problem Solving in Genetic Disorders" by Nikki Chen, or "One + One = One" by Dorothy Josephine Cox.

Source: <http://www.accessexcellence.org/AE/AEPC/WWC/1994/parenthood.php>

(STUDENT SHEETS begin on next page!!!)

# The Genetics of Parenthood—FACE LAB Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_HR\_\_\_\_

Several inheritance patterns are represented in this simulation, and it is important to review these with the students

beforehand. Inheritance of the traits used in this simulation has been simplified to serve as a model . Actual inheritance is far

more complex; students may need to be reminded about this in case they get overly concerned about their own traits.

**• Dominant**: allele which masks the expression of another; represented by capital letters (R, V)

**• Recessive**: allele which is expressed only if both parents contribute it; represented by small letters (r, v)

**• Incomplete dominance**: phenotype of the heterozygote is an intermediate form; represented by capital letters and

subscripts (C1, C2); an example is red color tints in the hair

**• Polygenic**: several genes contribute to the overall phenotype; an example is skin color

**• Sex-linked**: commonly applied to genes on the X chromosome, the more current term is X-linked; genes on the Y

chromosome are **holandric** genes; no examples in this activity

**• Epistasis**: one gene masking the effects of another; an example is hair color to red color tints

After students have completed their individual data sheets, they need to collect class data for at least traits # 2 and trait # 8

in order to answer the analysis questions. This is a good time for class discussion of the probability of individuals sharing

multiple traits.

**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!

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**TRAITS:**

1. **FACE SHAPE**:

Round (AA, Aa) Square (aa)

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

Very prominent (BB, Bb) Less prominent (bb)

3. **CHIN SHAPE**: Only flip coins for this trait if chin size is

very prominent. The genotype bb prevents the expression

of this trait.

Round (CC, Cc) Square (cc)



4. **CLEFT CHIN**: Only flip coins for this trait if chin size is

very prominent. The genotype bb prevents the expression

of this trait.

Present (DD, Dd) Absent (dd)

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.

b. Second coin toss decides F or f inheritance.

c. Third coin toss determines inheritance of G or g.

6 dominant alleles - black 2 dominant - light brown

5 dominant alleles - very dark brown 1 dominant - light tan

4 dominant alleles - dark brown 0 dominant - white

3 dominant alleles - medium brown

6. **HAIR COLOR**: Determined by 4 gene pairs.

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 (L1L1) Light red tint (L1L2) No red tint (L2L2



8. **HAIR TYPE**:

Curly (M1M1) Wavy (M1M2) Straight (M2M2)

9. **WIDOW'S PEAK**:

Present (OO, Oo) Absent (oo)

10. **EYE COLOR**:

PPQQ - black PpQq - brown ppQQ - green

PPQq - dark brown PPqq- violet ppQq - dark blue

PpQQ - brown with green tints Ppqq - gray blue ppqq – light blue

11. **EYE DISTANCE**:

Close (R1R1) Average (R1R2) Far apart (R2R2)

12. **EYE SIZE**:

Large (S1S1) Medium (S1S2) Small (S2S2)

13. **EYE SHAPE**:

Almond (TT, Tt) Round (tt)

14. **EYE SLANTEDNESS**:

Horizontal (UU, Uu) Upward slant (uu)

15. **EYELASHES**:

Long (VV, Vv) Short (vv)

16. **EYEBROW COLOR**:

Darker than hair Same as hair Lighter than hair

color (W1W1) color (W1W2) color (W2W2)



17. **EYEBROW THICKNESS**:

Bushy (ZZ, Zz) Fine (zz)

18. **EYEBROW LENGTH**:

Not connected (AA, Aa) Connected (aa)

19. **MOUTH SIZE**:

Long (B1B1) Medium (B1B2) Short (B2B2)



20. **LIP THICKNESS**:

Thick (CC, Cc) Thin (cc)

21. **DIMPLES**:

Present (DD, Dd) Absent (dd)



22. **NOSE SIZE**:

Large (E1E1) Medium (E1E2) Small (E2E2)



## STUDENT WORKSHEET Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hr\_\_\_

**The Genetics of Parenthood Data Sheet**

Parents \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Child's gender \_\_\_\_\_ Child's name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Fill in the data table as you determine each trait described in the Guidebook.

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.

 Can also use the space on the right to make sketches as you progress…









CLASS DATA: Total # Offspring: \_\_\_\_\_\_\_\_

Trait #2 Chin Size BB/Bb \_\_\_\_\_\_\_\_ bb\_\_\_\_\_\_\_\_\_

Trait #8 Hair Type Curly \_\_\_\_\_\_\_\_ Wavy\_\_\_\_\_\_\_\_ Straight\_\_\_\_\_\_\_\_

**Questions for Analysis:**

1. What percentage does each parent contribute to a child’s genotype? \_\_\_\_\_\_\_\_\_\_\_\_

2. Explain how/what part of your procedures represents the process of meiosis:

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 phenotypic ratio (punnet squares) to the actual ratio (class data) for the following traits:

Cross Heterozygous with Heterozygous for

Chin Type:

Hair Type:

How do the expected ratios compare with what actually happened in class?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Given that all the “offspring” in class were siblings, why weren’t there any identical twins?

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**The Genetics of Parenthood: FACE LAB** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hr\_\_\_\_\_

FINAL FACE: Combine all of your phenotypes into a final rendering of your ‘child’s’ face!!!