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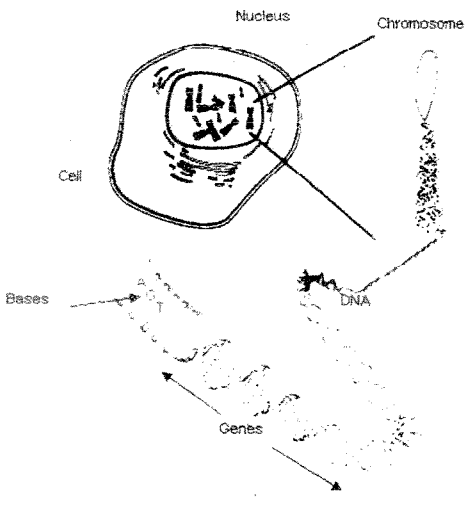
SBI3U Genetic Processes: MAKING A BABY LAB!

Introduction:

In this activity you will simulate two "parents" reproducing an offspring that will inherit traits carried by each parent. The purpose of this activity is to demonstrate the principles of Mendelian genetics, including the basic mechanism by which traits are inherited and the concepts of genotype and phenotype, and of complete and incomplete dominance. By the end of this lab you will understand that genes and traits are passed from one generation to the next through the formation of parental gametes which fertilize to produce a zygote that carries half of the genetic information from the female and the other half from the male.

Definitions:

Chromosome	A structure within a cell nucleus that contains all genetic material as a long strand of DNA. Humans have 46 chromosomes that occur in pairs (23 from mother and 23 from father).
DNA	A double-stranded nucleic acid that contains genetic information for cell growth, division and function. Known as the genetic 'blueprint'.
Gene	Short segment of DNA that determines the inheritable characteristics of an organism.
Allele	One member of a pair of genes that is located at a specific location on a specific chromosome that controls the same trait. Alleles are represented using letters; upper case denotes a dominant allele and lower case denotes a recessive allele.
Genotype	All of the genes in your DNA that determine your phenotype.
Phenotype	The physical appearance (e.g. skin colour, height, etc.) of an organism according to an individual's genotype and environment.
Diploid	A cell with two sets of chromosomes, one from each parent. For example, human somatic cells contain 46 chromosomes.
Haploid	A cell having half the number of chromosomes in somatic cells. For example, a human gamete cell is haploid because it has 23 chromosomes.
Gamete	A reproductive cell that contains the haploid set of chromosomes, e.g. sperm cell (male gamete) and egg cell (female gamete). The formation of a gamete involves the process of meiosis.
Zygote	A cell that results in the fertilization of a haploid male sex cell and haploid female sex cell. When the zygote begins to divide and multiply it is called an embryo.
Homozygous	Having two identical alleles for a given gene (e.g. AA or aa)
Heterozygous	Having two different alleles for a given gene (e.g. Aa)



Background Information:

For the purpose of this lab, human genetics has been simplified so that only one pair of alleles determines the expression of a single trait. However, in humans, this processes is much more complex - phenotypic traits are determined by interactions of *multiple* pairs of alleles. With this in mind, all human traits will be modeled using Mendel's basic laws of inheritance, where two interacting alleles for a specific trait will be expressed as complete dominance or incomplete dominance. In an interaction of complete dominance, three genotypes produce only two phenotypes (dominant and recessive). In an interaction of incomplete dominance, three genotypes produce three phenotypes (dominant, intermediate, recessive).

Name: _____ Date: _____

Procedure:

1.	**Determining phenotype and genotype**	Using the traits found in table 1 and 2, determine your personal genotype and phenotype. If you can be two genotypes, choose one. Circle your genotype and phenotype on the handout.
2.	**Find a mate!**	Find a "partner" among your classmates. One of you will be the "mother" and the other will be the "father." You will receive two packages that contain your set of chromosomes.
3.	**Creating chromosomes**	Each partner has 7 pairs of blank chromosomes (orange = female, yellow = male). Decide with your partner which 6 traits you would like to use to create your baby. The 7th pair will be your sex chromosomes. On table 3 record the genotype and phenotype of both mother and father for the traits you have selected. Next, write your genotypic information on your chromosome models – one allele per chromosome. Make sure your capitals and small case letters are clearly written and distinct.
4.	**Predicting the outcome**	With your partner, predict what your baby will look like based on the traits you have chosen. Write your prediction down in the space provided below and state why you came to that conclusion.
5.	**Gamete formation**	Place each chromosome FACE DOWN on your lab table so that no letters are visible. You will simulate the results of meiosis by separating each pair of chromosomes into gametes (you should have 14 gamete chromosomes). Randomly choose one chromosome of each length from each pair and put them in a pile. Place the unused chromosomes into a different pile. Repeat this for your partner.
6.	**Zygote formation**	You should now have 7 gamete chromosomes from mom and 7 from dad. Turn your baby's chromosomes over and match the pairs by length and trait. You should now have 7 pairs of chromosomes. Congratulations – your baby has just been conceived!
7.	**Determine your baby's genotype and phenotype**	Record your baby's genotype on table 3 and determine your baby's phenotype using table 1 and 2. Record this information in table 3.
8.	**Announcing Birth**	Draw a picture of your offspring's face based on the appropriate phenotypes you determined. Use arrows to clearly label the traits of your offspring. Use your creativity to announce the birth of your baby (i.e. song, birth certificate, radio broadcast, etc.)!

Name: _____ Date: _____

STUDENT HANDOUT – DATA RECORDING SHEETS

For each of the traits found below discuss with your partner to determine your personal phenotype and genotype. If you can be two genotypes, choose one. Circle your genotype on this sheet. [K/U = 7/2 marks]

Table 1. Examples of traits showing complete dominance:

Trait	Dominant	Recessive
Face Shape	Round (AA, Aa)	Square (aa)
Chin Shape	Very Noticeable (BB, Bb)	Less noticeable (bb)
Dimple in Chin	Absent (CC, Cc)	Present (cc)
Freckles	Present (DD, Dd)	Absent (dd)
Dimple in Cheek	Present (EE, Ee)	Absent (ee)
Eye Brows	Bushy (FF, Ff)	Fine (ff)
Eye Brow Shape	Two brows (GG, Gg)	Uni-brow (gg)
Eye Shape	Wide/Almond (HH, Hh)	Round (hh)
Eyelash length	Long (II, Ii)	Short (ii)
Ear Lobes	Free (JJ, Jj)	Attached (jj)
Ear Shape	Long (KK, Kk)	Round (kk)
Widow's Peak (hairline)	Present (LL, Ll)	Absent (ll)
Tongue Roll	Roll (MM, Mm)	No Roll (mm)
Tongue Fold	Inability to fold (NN, Nn)	Ability to Fold (nn)

Table 2. Examples of traits showing incomplete dominance:

Trait	Homozygote 1	Heterozygote	Homozygote 2
Hair Texture	Curly (OO)	Wavy (Oo)	Straight (oo)
Hair Colour	Black (PP)	Brown/Red (Pp)	Blonde (pp)
Eye Spacing	Wide (QQ)	Average (Qq)	Narrow (qq)
Eye Size	Large (RR)	Medium (Rr)	Small (rr)
Eye Colour	Brownish (SS)	Greenish (Ss)	Bluish (ss)
Lip Thickness	Thick (TT)	Medium (Tt)	Thin (tt)
Mouth Size	Long (UU)	Medium (Uu)	Small (uu)
Nose Size	Big (VV)	Medium (Vv)	Small (vv)

Name: _____ Date: _____

Make a PREDICTION:

What do you think your baby will look like based on the traits you have chosen with your partner? Explain your prediction. [T/I = 1.5/2 marks]

I think that my baby will have the traits that my partner and I both share. These traits are black hair, fine eyebrows, and brownish eye colour. I think this because since my partner and I both have these traits they will be passed on to our baby. The rest of the baby's traits we are unsure of because there's a 50% chance because those are the traits my partner and I do not share.

or complete dominance ones were you both homozygous?

COLLECT DATA:

Table 3. Genotype and Phenotype [K/U = 3/3 marks]

	Trait	Female		Male		Offspring	
		Phenotype	Genotype	Phenotype	Genotype	Phenotype	Genotype
1	Face shape	Round	AA	Round	Aa	Round	AA
2	Chin shape	Less Noticable	bb	Very Noticable	Bb	Very noticable	Bb
3	Eye brows	fine	ff	Fine	ff	Fine	ff
4	Eye shape	almond/ wide	Hh	wide/ Almond	HH	wide/ Almond	Hh
5	Hair Colour	black	PP	Black	PP	Black	PP
6	Eye colour	brownish	Ss	Brownish	SS	Brownish	SS
7	Sex	female	XX	male	XY	Boy	XY

Name: _____ Date: _____

DISCUSSION QUESTIONS:

1) a) Is it possible to create a face identical to yours in this simulation? [T/I = 2 /2 marks]

Yes, it is possible to create a face identical to mine in this stimulation. This is because many traits were shared between my partner and I. Also, for most of the traits that were not common between my partner and I, I carried the dominant allele.

b) Would you expect this to happen when conceiving a baby? Explain. [T/I = 2 /2 marks]

No, I would not expect this to happen when conceiving a baby. This is because in real life, there are more than just 6 traits to be compared between myself and a partner, so it is not likely that my baby will look exactly as I do.

2) Is it possible for you to show a trait when neither of your parents show it? Why? [T/I = 2 /2 marks]

Yes, it is possible to show a trait when neither of your parents show it. This is possible if both parents alleles are heterozygous. If this is the case, it is possible that the offspring's phenotype will display the recessive trait. For example, if B is the dominant allele for black hair and b is the recessive allele for brown hair and 2 people with heterozygous alleles mate:

	B	b
B	Bb	Bb
b	Bb	bb

It is possible for the offspring to have the phenotype for brown hair even though none of the parents have it because the parents are both carriers of the recessive b.

3) Compare the results of your baby's phenotype to what you had originally predicted. Are the results similar or different? Explain. [T/I = 2 /2 marks]

Yes, the results of our baby's phenotype were similar to what we predicted. This is because many common traits were shared between my partner and I, such as black hair, fine eyebrows, a round face, wide / almond shaped eyes, and brownish eye colour.

Name: _____ Date: _____

Lab Assessment Scheme:
Your final assignment should have the following components and will be marked according to the criteria listed in the rubric below.

Category	Item	Value
Knowledge & Understanding	• Complete table 1 and 2: all genotypes are circled (2) 2 • Complete and accurate data recorded in table 3 (3) 3	5 /5 marks
Thinking & Inquiry	• Prediction with clear rationale (2) 1.5 • Discussion Questions (8) 8	9.5/10 marks
Communication	A) Drawing of your child: • All 6 traits are present and accurate (6) 6 • Neatness and accuracy: labeling is clear, and free of spelling mistakes (2) 2 • Artistic style: use of colour, and creativity (2) 2	10 /10 marks
	B) Birth Announcement: • Creativity in story telling (2) 2 • Includes appropriate information; baby's name, date of birth, description of characteristics etc. (3) 3	5 /5 marks
	Total	**/30 marks**

Amazing Work!