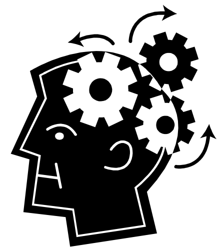
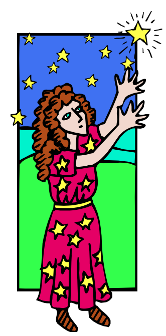
GOALS & OBJECTIVES

HUMAN VARIATIONS and MARSHIANS
incorporate teaching strategies that are designed to:



- involve students in inquiry and discovery activities
- require students to use analysis skills



- welcome curiosity
- encourage questioning
- reward creativity

- promote clear and effective oral and written communication

- integrate mathematics and science.

Sunshine State Standards

Florida Standards:

*<u>**SC.F.1.** (FL - SC.F. The Processes of Life)</u> The student describes patterns of structure and function in living things.

*<u>. .**SC.F.1.3.1** (FL - SC.F. The Processes of Life)</u> Understands that living things are composed of major systems that function in reproduction, growth, maintenance, and regulation.

*<u>**SC.F.2.** (FL - SC.F. The Processes of Life)</u> The student understands the process and importance of genetic diversity.

*<u>. .**SC.F.2.3.1** (FL - SC.F. The Processes of Life)</u> Knows the patterns and advantages of sexual and asexual reproduction in plants and animals.

*<u>. .**SC.F.2.3.2** (FL - SC.F. The Processes of Life)</u> Knows that the variation in each species is due to the exchange and interaction of genetic information as it is passed from parent to offspring.

*<u>. .**SC.F.1.4.1** (FL - SC.F. The Processes of Life)</u> Understands the mechanisms of asexual and sexual reproduction and knows the different genetic advantages and disadvantages of asexual and sexual reproduction.

*<u>**SC.H.1.** (FL - SC.H. The Nature of Science)</u> The student uses the scientific processes and habits of mind to solve problems.

*<u>. . **SC.H.1.3.4.** (FL - SC.H. The Nature of Science)</u> knows that accurate record keeping openness and replication are essential to maintaining an investigator's credibility with other scientists and society.

*<u>. . **SC.H.1.3.5.** (FL - SC.H. The Nature of Science)</u> knows that a change in one or more variables may alter the outcome of an investigation.

*<u>. . **SC.H.1.4.1.** (FL - SC.H. The Nature of Science)</u> knows that investigations are conducted to explore new phenomena to check on previous results to test how well a theory predicts and to compare different theories.

*<u>**SC.H.2.** (FL - SC.H. The Nature of Science)</u> The student understands that most natural events occur in comprehensible consistent patterns.

*<u>. . **SC.H.2.3.1.** (FL - SC.H. The Nature of Science)</u> recognizes that patterns exist within and across systems.

*<u>. . **SC.H.2.4.1.** (FL - SC.H. The Nature of Science)</u> knows that scientists assume that the universe is a vast system in which basic rules exist that may range from

very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful systemic study.

Background Information

“Did you hear the NEWS….Dolly Died?” What newspaper or network di not carry the news that the first cloned mammal had died! Students today have many serious and crucial dilemmas to face today, and foremost is among them is the appreciation of bioethics and the understanding of genetics. **HUMAN VARIATIONS** are two hands-on, inquiry-based activities designed to explain the science of genetics behind the process of inheritance.

** Genetics is the study of how characteristics of living things are passed from one generation to the next.

Until 150 years ago, people believed that parents' characteristics blended together in their children. In the 1830s, Gregor Mendel, a Moravian monk, conducted experiments crossbreeding peas. He determined that certain traits, such as color, shape, and size, were passing from the parents to their offspring in a predictable way. He called these characteristics "factors." We now call them genes.

Mendel observed that the traits of the parents did not blend in the offspring. A six-foot-tall pea plant crossed with a one-foot-tall pea plant did not produce a three-foot-tall pea plant. All the crosses with the six-foot plants produced six-foot plants. Mendel hypothesized that each organism has a pair of factors that determine each trait. Offspring receive one half of each pair from each parent. In the offspring, the two factors, or genes, work together. He discovered that one form of the trait was almost always stronger than the other (dominant). Further experiments revealed that the hidden (recessive) gene can reappear in future generations, if it is combined with a recessive gene like itself.

Although Mendel recorded his observations, published them, and sent them to many leading institutions, his work was ignored. Mendel's work was rediscovered around the turn of the century. However, it was still unclear what the precise agent of inheritance was and how it functioned. In 1907 Thomas Morgan demonstrated that the controlling mechanisms of inheritance are contained in chromosomes inside each cell. The work of Mendel, Morgan, and others showed that mechanisms for inheritance existed at the level of cells. The term gene was accepted as a description of the genetic mechanism located in the chromosome.

In the 1930s, our understanding of genetics was aided by the discovery that the molecule deoxyribonucleic acid (DNA) is present in the nucleus of virtually every cell, but its function and shape were a mystery. In the 1950s, DNA was identified as the carrier of genetic information. Rosalind Franklin conducted x-ray diffraction studies of the DNA molecule in 1951, which suggested DNA had a helical structure. At the same time James Watson and Francis Crick were exploring how DNA functioned.

They realized that the form of a double helix would not only explain the shape of DNA, but also explain how the molecule passes on information. After physically building a model of their proposed structure, they realized they had solved the riddle of how genetic information is transmitted. In 1962, Watson, Crick and another researcher Maurice Wilkins, received the Nobel Prize for their discovery. Unfortunately, Rosalind Franklin's death in 1958 at age 38 prevented her from sharing in their recognition.

We now know that in the center of every cell are pairs of chromosomes. Each chromosome is a tightly wound thread of DNA. These very long threads contain repetitions and variations of four different chemicals, adenine (A), thymine (T), cytosine (C) and guanine (G). Segments of these strings of DNA are called genes. Genes have from a few hundred pairs to many thousands of pairs of As, Ts, Cs, and Gs joined together in a precise code that is unique to each gene. Human DNA contains 3 billion of these pairs. Genes are recipes for making proteins. These proteins determine how an organism grows and what it is like. Some proteins make cells; other proteins tell the cells how to function. Your cells are making new cells all of the time. Different genes are active in different cells at different times. There is a special kind of cell division that happens in sexual reproduction to form the cells that are passed on to the next generation. This division, meiosis, results in cells that have half the number of chromosomes as the original cell. Each parent produces cells that contain half of his or her genetic information. When these two special cells merge together, the two half sets of chromosomes combine to produce a fertilized egg or seed. In this way an organism inherits some traits from its mother and some from its father. The reason every organism is different is because each mixture of genes is slightly different.

A new person starts as just one tiny cell with 23 pairs of chromosomes containing a unique mixture of genes. As the person grows, the cells divide. The first cell becomes two cells; the two become four and so on. Before each cell divides, the DNA is copied and each new cell receives one of these copies.

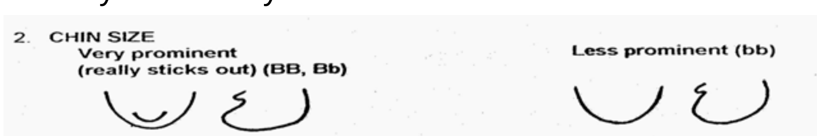
Mendel's theory about simple dominant factors was the start of our understanding of heredity. We now know that many pairs of genes working together influence most traits. Sometimes there is no dominant gene, and the offspring actually is a blend of both traits. Genes give instructions about what can be done, but genes also have to work with the environment in which the organism grows. Short parents can produce tall children. Tall parents can produce short children. Your height can also be influenced by your diet.

Today, geneticists around the world are working on mapping the entire sequence of the billions of chemicals that compose human DNA. They have already charted over 2,300 of the suspected 100,000 genes that make up the human genome.

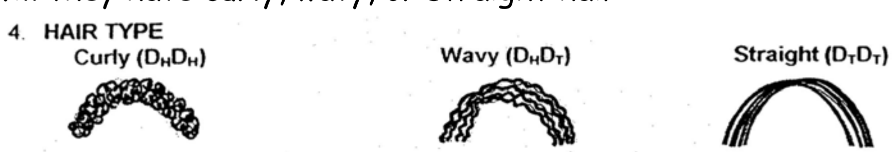
(*A Science Odyssey, A Resource for Science Teachers;***
http://www.pbs.org/wgbh/aso/resources/campcurr/genetics.html)

Middle school students use a simple method of flipping a coin to determine whether their offspring will inherit the dominant or recessive trait for a variety of head /facial features such as…

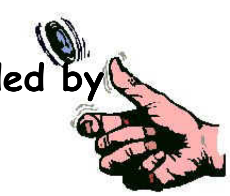
- will they have a Jay Leno chin or not …………………………



- will they have curly, wavy, or straight hair



A total of 21 different features are all decided by two students and the flipping of a coin.



Next the students complete a rendition of their 'child' by using paper plates, crayons, markers, curling ribbon (to make curly, wavy, or straight hair), and construction paper. A nursery is built to display all the "babies" and pictures with their proud parents are displayed.

Students are introduced to a variety of terms including: dominant, recessive, homozygous, heterozygous, ★Punnett square, and Mendel as they complete the assignment with the accompanying analysis questions.

A similar project is completed with high school students, but at a higher cognitive level where there is a formative understanding of the processes of Mitosis and Meiosis along with an elevated vocabulary. This activity is called 'Marshians', as the students construct 3-dimential creatures from marshmallows, pipe cleaners, curling ribbon, pushpins, colored dots, and toothpicks.

1. Chromosomes with corresponding alleles are cut out and placed into a brown paper bag, representing fertilization.
2. The alleles for each trait are read and recorded. Gametes are formed.
3. Students combine the gametes of the parents. After combining, list the information for genotype and phenotype of the F1 generation, i.e. **Your Kid.**
4. Place the alleles of **Your Kid** into a paper bag. Mix the genes up. It's now time to form gametes.. Either eggs or sperm depending if **Your Kid** is a male or female.
5. Take turns with your partner and withdraw one chromosome at a time. You should only have 1 of each from each trait-- a-j. In other words if you picked up a gene for hair-color and then three picks later draw another gene for hair color, put it back and pick again. Continue until you have 1 allele for each trait.
6. Again, record this data in the table on the activity sheet, under gametes for F_1 **Your Kid**.
7. Find a 'mate' for your child and fill in their F_1 information in the bottom (**Their Kid/Your Kid's mate**) F_1 section of the data table.
8. The two F1 generation offspring are now going to have offspring of their own. It's time to mate again. Cross the gametes from these F1 generations (mating **Your Kid gametes with Their Kid/Your Kid's mate**

gametes) to determine the genotype and phenotype for the F2 generation--**YOUR GRANDCHILDREN!!**

9. Using the materials provided, **Build a model showing the phenotype of 'your' grandchild.**
10. Place **Your Grandchild** into the 'nursery'.

A birth announcement is also completed as well as a picture of their child. Analysis questions probe student understanding.

Students present their finished project to the class. Self and peer evaluation of the total concept is collected at the conclusion of the oral presentation.

In order to be a literate individual within our society, students must be able to comprehend the mechanics of inheritance. By simulating the process of gamete formation, and fertilization students gain the knowledge of how the science of genetics works. By creating 3-dimentional representations of their fictitious offspring, students are motivated to complete the assignment. Students also enjoy sharing-out their creations.

*The Punnett Square Method

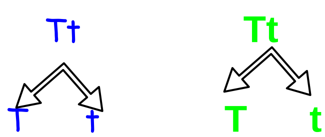
Step 1 - Choose letters, which will represent the genes/traits.

- **T** = tall **t** = short
- A capital letter signifies the dominant trait in the pair; use the same letter lower case, for the recessive form of the trait.
- Choose a letter that is easy to remember, usually chosen for the dominant trait

Step 2 - Write down the genotypes of each parent. It is helpful if you write the phenotype in parenthesis under the genotypes.

- **Tt** X **Tt---------genotype**
  (tall) (tall**)-------phenotype**
- Always write the dominant letter first, i.e Tt not tT

Step 3 - List the genes that each parent can contribute.

- 

- Remember that the parent can only contribute only one gene (allele) from each pair.

Step 4 - Write the possible gene(s) of one parent across the top and the gene(s) of the other parent along the sides of the Punnett Square.

- One side signifies the egg, the other side the sperm, i.e. genes from Mom, genes from Dad

	T	t
T		
t		

Step 5 – Fill in each box by combining the terms.

- Remember to write the capital letter first as you fill in each box.

	T	t
T	T T	T t
t	T t	tt

Step 6 – Read the phenotype and genotype of each box.

genotype	**T T**	**T t**	**T t**	**tt**
phenotype	tall	tall	tall	short

Glossary

GLOSSARY
http://www.ksu.edu/biology/pob/genetics/gene

alleles

All the different forms of the same gene.

dominant

An allele which, if present, masks the effect of any recessive allele paired with it. Indicated by a capital letter.

F_1

first-generation offspring (children).

F_2

second-generation offspring (grand children).

gametes

The haploid cells produced by meiosis which later fuse to form the diploid zygote. In humans, these are the eggs and sperm.

gene

Units of information about specific traits, passed from parents to offspring. Each gene has a specific location (locus) on a chromosome and may come in several forms (alleles).

genotype

The actual genes for a trait present in an individual.

haploid (1n)

Cells which have only one allele from the originally homologous pair. In humans, gametes are the only haploid cells.

heterozygous

The two alleles of a pair are not identical (for example: one dominant and one recessive allele for the color trait in roses).

homologous chromosomes

A pair of chromosomes in the same individual that carry the same type of information (eye color) but not necessarily the same alleles (blue or brown). One of these "homologs" comes from the individual's mother and one from the father.

homozygous

Both alleles of a gene in a homologous pair are identical.

meiosis

A type of cell division that produces haploid gametes. Reduction division. Each gamete has half the number of chromosomes as each body (somatic) cell. i.e. human skin cell = 46 chromosomes, egg/sperm = 23 chromosomes

mitosis

A type of cell division that produces identical daughter cells from each original Mother cell. I.e. human skin cell = 46 chromosomes→mitosis→2 skin cells, 46 chromosomes each

P

parental generation

phenotype

An individual's observable traits (how the organism looks, behaves, etc.).

recessive

An allele which must be homozygous for it's effect to be observed. Indicated by a lowercase letter.

Human Variations

Overview:

Have you ever wondered why everybody looks different from everyone else? Even brothers and sisters many times don't resemble one another. It is because of the large variety of traits that exist in the human population. Perhaps this still doesn't explain why brothers and sisters might look very different, or very much alike. This lab exercise will help you understand the many possible combinations available to offspring as they are being produced. You and a partner will become parents and produce a baby. What your baby will look like will depend on the laws of genetics. In this activity students will determine the appearance of their child's face; by flipping coins to determine the pairing of the alleles for each of the major characteristics

Time Frame: 90-120 minutes

Materials:

2 coins

2 students

Construction paper for face features

Paper plates

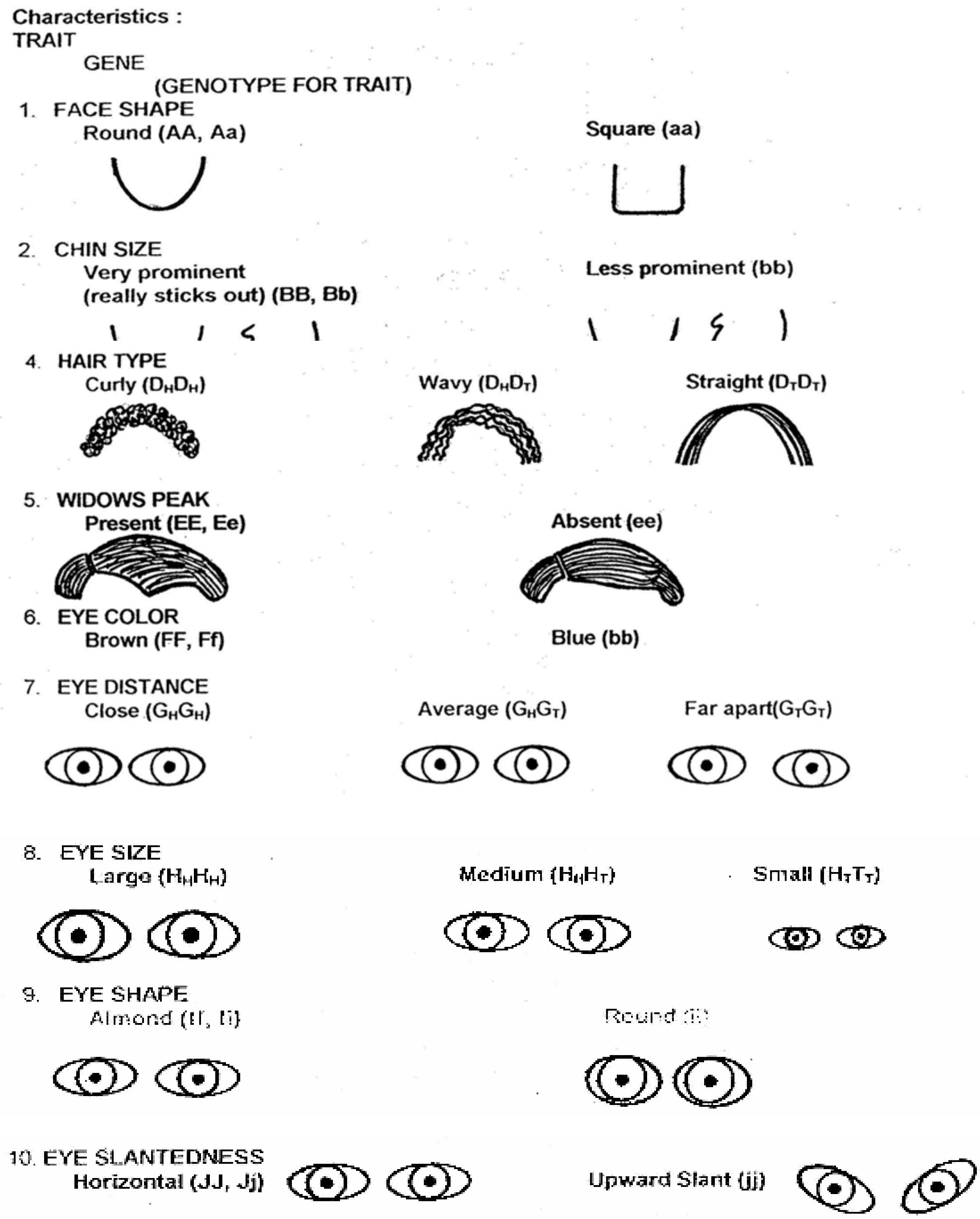
Colored pencils or markers

Yarn for hair

Procedure:

1. Choose a partner for this experiment.
2. Each person will take out a coin and designate the heads side as dominant and the tails side recessive.
3. Determine which of the group will be the father and the mother.
4. The father will flip the coin to determine the sex of the child. Heads indicates the child will be a boy, tails a girl.

5. Each person in the group will flip the coin, at the same time, for each of the traits found on the chart. Two heads indicates a homozygous dominant trait; Heads and a tails, heterozygous dominant; and two tails a recessive trait.
6. Record all the results on the table provided.
7. Once the chart is completed, draw a picture of the offspring using the collected traits.



11. EYELASHES

Long (KK, Kk) | Short (kk)

12. EYEBROW COLOR

Darker than hair Color (L_HL_H) | Same as hair color (L_HL_T) | Lighter than hair color (L_TL_T)

13. EYEBROW THICKNES

Bushy (MM, Mm) | Fine (mm)

14. EYEBROW LENGTH

Not connected (NN, Nn) | Connected (nn)

15. MOUTH SIZE

Long (O_HO_H) | **Medium (O_HO_T)** | **Short (O_TO_T)**

16. LIP THICKNESS

Thick (PP, Pp) | **Thin (pp)**

17. DIMPLES

Present (QQ, Qd) | **Absent (qq)**

18. NOSE SIZE

Large (R_HR_H) | Medium (R_HR_T) | Small (R_TR_T)

19. NOSE SHAPE

Rounded (SS, Ss) | Pointed (ss)

20. EARLOBE ATTACHMENT

Free (TT, Tt)

Attached (tt)

21. FRECKLES ON CHEEKS

Present (UU, Uu) | Absent (uu)

		Child #1				Child #2			
Trait	Possible Genotypes	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype
Sex									
face shape	AA,Aa,aa								
chin size	BB,Bb.bb								
hair color	C_HC_H $C_H C_T$ $C_T C_T$								
hair type	D_HD_H $D_H D_T$ $D_T D_T$								
widow's peak	EE,Ee,ee								
eye color	FF,Ff,ff								
eye distance	G_HG_H $G_H G_T$ $G_T G_T$								

Trait	Possible Genotypes	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype
eye size	$H_H H_H$ $H_H H_T$ $H_T H_T$								
eye shape	II,Ii,ii								
eye slantedness	JJ,Jj,jj								
eyelashes	KK,Kk,kk								
eyebrow color	$L_H L_H$ $L_H L_T$ $L_T L_T$								
eyebrow thickness	MM,Mm,mm								
eyebrow length	NN,Nn,nn								
mouth size	$O_H O_H$ $O_H O_T$ $O_T O_T$								

Trait	Gene	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype	Father's Genes	Mother's Genes	Child's Genotype	Child's Phenotype
lip thickness	PP,Pp,pp								
Dimples	QQ,Qq.qq								
nose size	R_HR_H $R_H R_T$ $R_T R_T$								
nose shape	SS,Ss,ss								
earlobe attachment	TT,Tt,tt								
freckles	UU,Uu,uu								

Questions for further Discussion

1. How did you determine which piece of information would contribute to the genotype of the child?

2. Using your experience in the lab today, give a good reason why this is a true statement: " ***Every child is a product of their parents"***.

3. Do your children look alike in any way? ________________. Explain.

4. Look around at all the other children; do any of your classmate's children look alike? ______________. Justify your answer.

5. After examining all the children created, describe how sexual reproduction contributes to variation within a species.

6. Do you think that everyone has a "twin", someone who looks exactly like them, somewhere in the world? Explain your reasoning.

Use the characteristic sheet to answer the following questions. Show all your work including Punnett Squares.

7. What is the probability of a mother with genotype (HH) and a father with genotype (HH) having a child with free earlobes?

8. What is the probability of a mother with genotype (FF) and a father with genotype (ff) having a child with a pointed nose?

9. What is the probability of a mother heterozygous for freckles and a father homozygous for no freckles, having a child with freckles?

Assessment:

- Completed data table
- Answers to questions for discussion

Home learning:

1. Have students chart the number of traits found in two generations of their family members

2. Using the genotype for child one and child two, construct a pictorial representation of each child. Household items such as paper plates, string, markers and any other materials may be used to complete this assignment.

Note: Be sure to tell the students to cut the paper plate into the actual shape of the face and chin.

Extensions:

1. Research genetic diseases such as Tay Sachs, Sickle-cell anemia, or Cystic Fibrosis.
2. Have students create a pedigree chart for their family of one characteristic such as attached/unattached ear lobes, tongue roller/tongue nonroller, hair/no hair on knuckles.

MARSHIANS

Background: "You have your mother's eyes and your father's nose!" People often comment on the similarities between children and their parents. From the earliest of time, people probably realized that certain traits were being passed from generation to generation. A **trait** is any characteristic that can be passed from parents to offspring. We are all a product of our heredity. We inherit 1 set of **alleles** for each trait from each of our parents. One is in the egg from the Mom and one is in the sperm from the Dad. During fertilization the two are rejoined to make the new offspring. In other words each **gene** is composed of two alleles (one from each parent) and that gene codes for a certain trait. For example: The trait is height in pea plants; the alleles are either tall or short. In pea plants, tall symbolized with a capital **T** is **dominant** to short symbolized with a lower case **t**. The dominant trait is expressed over the recessive trait. When we write out the alleles this is called expressing the **genotype,** the organisms genetic make-up. When we read or interpret the genotype this is called the **phenotype**, the organisms physical appearance. Any combination of the two alleles can be inherited: TT, Tt, tT, or tt… notice that Tt and tT are really the same. The genotype of TT gives a phenotype of tall; the genotype of tt gives a phenotype of short; **what is the phenotype of Tt?** ________________________

MATERIALS

2 pennies

Supplies to build your grandchild

body segments= Marshmallows	Hair = Curling ribbon	Toothpicks to hold it together
Tail = Pipe cleaners	Eyes = Push pins	Scissors
Nose = Paper dots or color in	Legs = Pipe cleaner	
Mouth shape = Drawn on	Antennae = Pipe cleaner(bushy and not bushy)	

PROCEDURE

1. Take one chromosome sheet. Males will label these chromosomes Females will label these chromosomes.
2. Flip a penny to determine whether you are passing on the dominant or recessive allele; **head = recessive allele; tail = dominant allele**. **NOTE**: You will flip a coin for each trait a-j! Record the letter on the appropriate chromosome. **NOTE**: Your Teacher will tell you to record either an X or Y for the sex-chromosome… Remember girls are XX and boys are XY, both sexes can produce X-gametes, (sex-cells), but only guys can produce Y-gametes.

Determine the genotype and phenotypes by following your teacher's instructions and this list:

Letter of Gene	Trait / Allele Flip a penny, **head = recessive allele tails = dominant allele**	Genotype/Phenotype	Genotype/Phenotype	Genotype/Phenotype
A	SEX	XX= female	XY = male	
B	Hair Color (B or b)	BB=blue	Bb=blue	bb=red
C	Number of Legs(N or n)	NN=10	Nn=10	nn=6
D	Nose Color (D or d)	DD=orange	Dd=orange	dd=green
E	Eye Color (E or e)	EE=green	Ee=green	ee=yellow
F	Antennae (F or f)	FF=bushy	Ff=bushy	ff=smooth
G	Mouth Shape (M or m)	MM=smile	Mm=smile	mm=frown
H	Hair Texture (H or h)	HH=straight	Hh=straight	hh=curly
I	Tail (T or t)	TT=curly	Tt=curly	tt=straight
J	Number of Body Segments (S or s)	SS=5	Ss=5	ss=3

3. You should only have one letter on each chromosome as this is your Parental **gamete (sperm or egg)** genotype
4. Record this information in the Data Table **Labeled P_1 gamete**, in only the appropriate table, i.e. males in males, females in females.
5. Cut out each paper chromosome.
6. Find a mate, for the purposes of this exercise, just find someone in the classroom to mix with your alleles. (**Make sure that two 'Y's don't mate**!!!)
7. Record your mate's gamete genotype in the appropriate P_1 Table. If you filled in the female, now this person is the male.
8. Mate to combine the gametes of the parents. After combining, list the information for genotype and phenotype of the F_1 generation, i.e. **Your Kid.**
9. Place the alleles of **Your Kid** into a paper bag. Mix the genes up. It's now time to form gametes... either eggs or sperm depending if **Your Kid** is a male or female.
10. Take turns with your partner and withdraw one chromosome at a time. ***You should collect only 1 of each from each trait***--- a-j. In other words if you picked up a gene for hair-color and then three picks later draw another gene for hair color, put it back and pick again. *Continue until you have 1 allele for each trait. Each person now has a set of chromosomes from 'Your Kid'.*
11. Again, record this data in the table on the activity sheet, under gametes for F_1 **Your Kid**.
12. Find a 'mate' for your child and fill in their F_1 information in the bottom (**Their Kid/Your Kid's mate**) F_1 section of the data table.
13. The two F1 generation offspring are now going to have offspring of their own. It's time to mate again. Cross the gametes from these F1 generations (mating **Your Kid gametes with Their Kid/Your Kid's mate gametes)** to determine the genotype and phenotype for the F2 generation--**YOUR GRANDCHILDREN!!**
14. Using the materials provided, **build a model showing the phenotype of 'your' grandchild.**
15. Place **Your Grandchild** into the 'nursery'
16. Draw a picture of the lil' grandbaby with the appropriate characteristics and then make out your birth announcement and share with all your friends and loved ones...
17. Examine all the grandchildren in the nursery.

ANALYSIS

1. Given the following genotype; give the phenotype:
   a. XX b. Hh c. DD d. ss

2. Give the genotype(s) for each of the following:
   a. curly hair b. frown c. six legs d. female

3. Explain why in procedure # 9, you were told, make sure that two 'Y's don't mate?

4. How many pairs of homologous chromosomes did you have? What made them homologous?

5. What is the diploid number for your Marshian? The haploid number? Which did the gamete contain, the haploid or diploid number? Explain.

6. After examining the grandchildren
   a. How many of the grandchildren in the nursery were exactly alike?
   b. Did this fact surprise you? Explain your answer.
   c. What percentage of grandchildren in the entire class had 5 body segments?
   d. What percentage of grandchildren in the entire class had smooth tails?
   e. Which traits showed up more frequently in the grandchildren, the dominant traits or the recessive ones? Give a mathematical reason for your answer?

7. Complete the following genetic problems using Punnett squares. Show ALL WORK
   a. Mate an mm mouth shape male with an Mm female. What is the probability of them having a child with a frowning mouth shape?
   b. Mate an EE male with an ee female. What is the probability of them having a child with yellow eyes?
   c. Mate an Ff male with an Ff female. What is the probability of them having a child
      i. with smooth antennae?
      ii. with bushy antennae?

d. Mate a homozygous blue haired male with a heterozygous female. What is the probability of them having a red-haired offspring?

Challenge Questions:

1. Determine the possible genotype of the P_1 male and the P_1 female

2. What are the possible genotypes of the parents (P_1) if the child (F_1) has 10 legs?

3. Draw the Punnett square mating of NnHh x NNHh. What is the probability of them having a 10-legged, curly-haired child?

Birth Notice

Circle or Fill in the appropriate information for the grandchild

This is to announce the birth of__________________________a delightful little boy/girl. The proud parents are_________________and_____________________ . One of the first things the proud parents did was count to make sure that the baby had _________ legs. The baby has___________hair that is naturally curly / straight. Naturally, he/she rolls around a lot as he/she has ___________ segments. Because the baby's tail is _______________ it sometimes helps the baby to stay in one place. This ________________ eyed, baby with ____________antennae, and a mouth that ________________ will be a welcome addition to the family. You can't help but want to tweak that cute little ________________ nose, there is no doubt that this cute, dimpled little bundle o'joy is bound for fame and fortune. To be sure, he/she resembles __________________more than_________________.

DRAW A PICTURE OF THE LITLE ONE ABOVE

If you are the designated female, then your partner is the designated male…
Don't forget to fill in both boxes

FEMALE, P_1		
	Trait	GAMETE GENOTYPE
A	SEX	
B	Hair Color	
C	Number of Legs	
D	Nose Color	
E	Eye Color	
F	Antennae	
G	Mouth Shape	
H	Hair Texture	
I	Tail	
J	Number of Body Segments	

MALE, P_1		
	Trait	GAMETE GENOTYPE
A	SEX	
B	Hair Color	
C	Number of Legs	
D	Nose Color	
E	Eye Color	
F	Antennae	
G	Mouth Shape	
H	Hair Texture	
I	Tail	
J	Number of Body Segments	

F_1 YOUR KID / mating of female (P_1) + male (P_1)				
	Trait	GENOTYPE	PHENOTYPE	GAMETE GENOTYPE
A	SEX			
B	Hair Color			
C	Number of Legs			
D	Nose Color			
E	Eye Color			
F	Antennae			
G	Mouth Shape			
H	Hair Texture			
I	Tail			
J	Number of Body Segments			

F$_1$, THEIR KID/YOUR KID'S MATE (copy from your partner)				
	Trait	GENOTYPE	PHENOTYPE	GAMETE GENOTYPE
A	SEX			
B	Hair Color			
C	Number of Legs			
D	Nose Color			
E	Eye Color			
F	Antennae			
G	Mouth Shape			
H	Hair Texture			
I	Tail			
J	Number of Body Segments			

Combine YOUR KID'S gametes with THEIR KID'S gametes to make the GRANDKID!

F$_2$, THE GRANDKID (mating of F$_1$ x F$_1$)			
	Trait	GENOTYPE	PHENOTYPE
A	SEX		
B	Hair Color		
C	Number of Legs		
D	Nose Color		
E	Eye Color		
F	Antennae		
G	Mouth Shape		
H	Hair Texture		
I	Tail		
J	Number of Body Segments		

This is the kid that is 'built'

A-Sex

B-Hair Color

C-# of Legs

D- Nose Color

E- Eye Color

F- Antennae

G- Mouth Shape

H- Hair Texture

I- Tail

J- # of Body Segments

E- Eye Color

J- # of Body Segments

D- Nose Color

I- Tail

C-# of Legs

H- Hair Texture

B-Hair Color

G- Mouth Shape

A-Sex

F- Antennae

Resources

1. This primer covers basic science, the Human Genome Project, what we know so far, ELSI, medicine, benefits, future scientific challenges, and more http://www.ornl.gov/TechResources/Human_Genome/publicat/primer/index.html

2. Just about every activity on our website has a teacher guide to go with it. In the Classroom Activities Index, you'll find these guides, as well as Print-and-Go™ activities and wet labs for the classroom. Genetic Science Learning Center at the Eccles Institute of Human Genetics University of Utah http://gslc.genetics.utah.edu/teachers/

3. Human Reproduction: Why are there so many colors of flowers? How come seedless watermelons cost more than watermelons with seeds? How can you grow a seedless watermelon if it doesn't have any seeds? Is it really possible to clone something? This section of Sci-ber Text invites you to discover the world of reproduction and heredity. Have FUN!

   http://www.usoe.k12.ut.us/curr/science/sciber00/7th/genetics/sciber/intro.htm

4. GenScope is a learning environment that uses the computer to provide an alternative to text-based science education. It provides teachers and learners with a new tool that enables students to investigate scientific and mathematical concepts through direct manipulation and experimentation. You may download the activities.
   http://genscope.concord.org/

5. Genetics Animation Library. Advanced site that illustrates such techniques as Southern Blot and PCR.
   http://www.dnalc.org/resources/BiologyAnimationLibrary.htm

An animated primer on the basics of DNA, genes, and heredity.

Funded by
The Josiah Macy, Jr.
Foundation

DNA from the Beginning
is organized around key concepts.
The science behind each concept is explained by:
animation, image gallery, video interviews,
problem, biographies, and links.

http://www.dnaftb.org/dnaftb/.

7. Before Watson and Crick A NOVA presentation
Brenda Maddox, author of *Rosalind Franklin: The Dark Lady of DNA,* describes the discoveries that lead scientists to focus on DNA as the secret behind life. The Secrets of Photo 51. The story behind the discovery of the structure of DNA, featuring Rosalind Franklin's story. A personal favorite.
http://www.pbs.org/wgbh/nova/photo51/

8. DNA: the Instruction Manual for All Life. A slide presentation on DNA.
http://www.thetech.org/exhibits_events/online/genome/index.html

9. Genetic Puzzle. In this lesson, students will come to understand that in sexually reproducing organisms, such as humans, typically half of the genes come from each parent.
http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=5&DocID=96

10. Making A Face—A Genetic Simulation. Converting Genotype into Phenotype by Simulating Gametogenesis, Fertilization and Embryogenesis. A more advanced version of MARSHIANS.
http://www.woodrow.org/teachers/biology/institutes/1997/makeface/

11. An extensive list of Forensic sites.
http://www.kumc.edu/gec/forensic.html

12. Baby Steps through the Punnett Square. An excellent primer on how to do Punnett Squares.
http://www.borg.com/~lubehawk/psquare.htm

13. Figuring out how genes combine. Another site on Punnett Squares.
http://www.athro.com/evo/gen/punnett.html

14. Probability of Inheritance. A primer on Punnett Squares.
http://anthro.palomar.edu/mendel/mendel_2.htm

15. Punnett Square, named after the famous Dr. Square. A cute site, but limited access.

Menu of Online Rubrics

Appetizers:

Science Rubrics To Save Us Time
http://www.usd305.com/staffdev/hs/sci/scirubrics.htm

Science Generic Rubrics
http://www.bconnex.net/~drussell/rubrics.htm

Soup and Salad:

Kathleen Schrock's Varied Choice of Rubric Weblinks
http://school.discovery.com/schrockguide/assess.html

The Main course

Rubric Generator
http://www.teach-nology.com/web_tools/rubrics/

Odyssey of Rubrics
http://www.odyssey.on.ca/~elaine.coxon/rubrics.htm

Holistic and Analytic Generic Rubrics
http://www.gsu.edu/~mstnrhx/457/rubric.htm

Portfolio, Performance, and Project Rubrics
http://www.milwaukee.k12.wi.us/audubon/Pages/ScienceRubrics.html

Assessing Your Rubric with a Rubric
http://www.idecorp.com/assessrubric.pdf

Dessert:

What is a rubric?

http://www.geocities.com/Athens/Delphi/1993/rubrics/teresa/rubrics.htm#6

Rubric for the Advanced Inquiry-Based Biology, Chemistry, or Physics Student to be given around the middle of the school year. [NOTE: Please print in "landscape" mode.]
http://www.exemplars.com/science_rubric_k-2.html