

DNA Determines Your Appearance!

Summary

DNA contains all the information needed to build your body. Did you know that your DNA determines things such as your eye color, hair color, height, and even the size of your nose? The DNA in your cells is responsible for these physical attribute as well as many others that you will soon see.



It turns out that the DNA in your body came almost directly from your mother and father. If your DNA came from your parents and DNA determines your appearance, why do you not look exactly like your mother or father?

The reason is that your DNA is a mixture of your mother and father's DNA. This is why some of your physical features may resemble your mother's while some may resemble your father's. Half of the DNA used to create your body came from your mother while the other half came from your father. Some of your features may look nothing like your mother's or father's, we will see why this occurs in the activity.

Human DNA comes in 23 pairs of packages called **chromosomes**. These chromosomes are large bundles of tightly packed DNA. Your mother and father each donate 23 chromosomes, which pair up to give you your full set of 23 chromosomes.

Within these 23 pairs of chromosomes, there are certain sections that determine different physical features. These sections of DNA that contain information that determine your physical features are called **genes**. Since you have two pairs of chromosomes, you also have two pairs of genes, one from your father and one from your mother. These pairs of genes then determine certain physical features or **traits**.

The genes that you have in your body right now make up your **genotype**. This genotype then determines your physical appearance, which is called your **phenotype**.

In this activity, you will be given two sets of chromosomes. One set is labeled male chromosomes while one is labeled female chromosomes. You will drop these chromosomes from above your head and they will randomly mix in different ways giving you a genotype. From this genotype, you will then have the detailed instructions to make a sketch of a human face.

Before you begin, you should know a few more things about how genes determine your appearance. Genes can come in two different forms or **alleles**. A gene can be either dominant or recessive. In this activity, dominant forms of a gene appear in capital letters while recessive forms of a gene appear in lower case letters.

Since you get one gene from your mother and one from your father for each trait, you may have a combination of dominant and recessive genes for each trait. When both

forms of a gene are the same (either both dominant or both recessive) you are said to be *homozygous* for that trait. If you have one dominant gene and one recessive gene, you are said to be *heterozygous* for that trait.

One final thing before you begin the activity. As you will see in the activity, when you receive the dominant form of a gene whether homozygous or heterozygous, you will express the dominant form of the gene. You will only express the recessive form of the gene if you receive the recessive form from both of your parents, thus being homozygous for the recessive form.

Finally, this information should provide you with the basics of how appearance is determined by DNA. If you are a bit confused, follow the steps of the activity and many concepts above will be seen. By performing the activity, you will be able to see exactly what is meant by some of the terms mentioned above. Good Luck creating your offspring!

In this activity we will:

- Create a genotype for an individual by pairing the chromosomes from a male and a female
- Make a sketch of a facial profile (phenotype) from the genotype that you created
- Learn some terms and concepts associated with genetic inheritance

Materials

- Set of 23 male chromosomes (provided at end of this activity)
- Set of 23 female chromosomes (provided at the end of this activity)
- Genotype conversion chart (provided at the end of this activity)
- Scissors
- Tape
- Blank sheet of paper
- Pencil
- Eraser
- Colored pencils, markers, or crayons

Safety

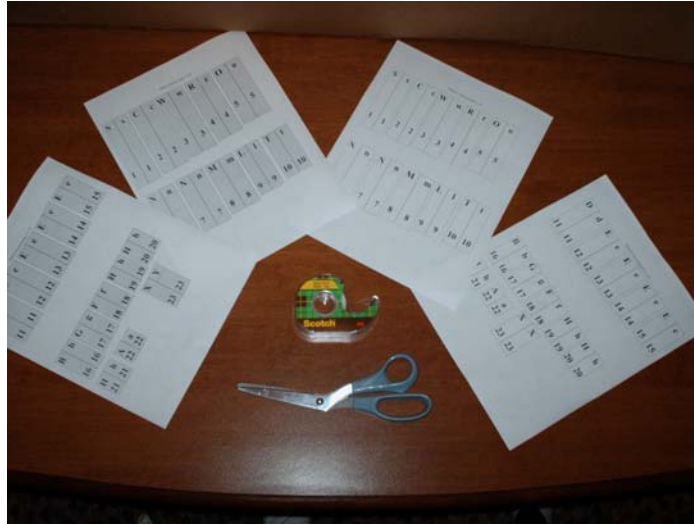
This activity requires the use of sharp scissors to cut out the chromosomes. Use caution when using scissors. Ask an adult to help you if necessary.

Preparation

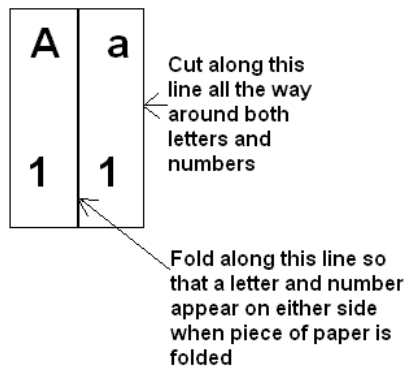
- Print out all 23 male chromosomes
- Print out all 23 female chromosomes

- Gather all other materials

Activity

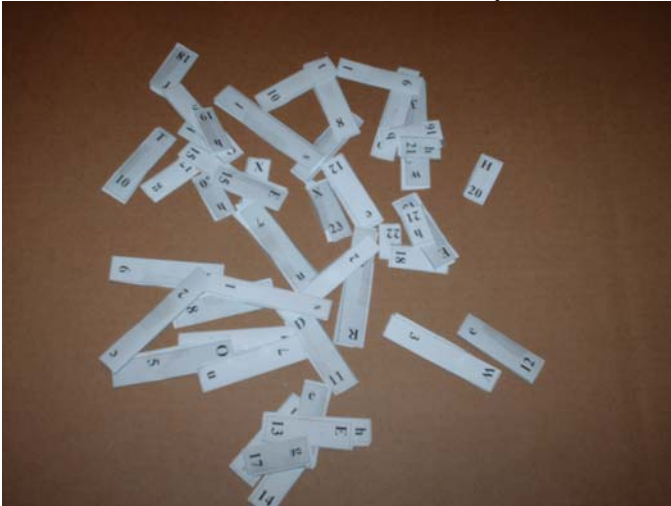


- Cut out all male and female chromosomes that you printed out. Each chromosome that you cut out should have two of the same letters (one capital and one lower case) on the top and the two same numbers on the bottom. **Do not cut along the line in between two similar numbers!** Be careful not to cut yourself when using the scissors.
- Fold along the line separating each of the letters and numbers so that one letter and one number are visible on either side when the piece of paper is folded.

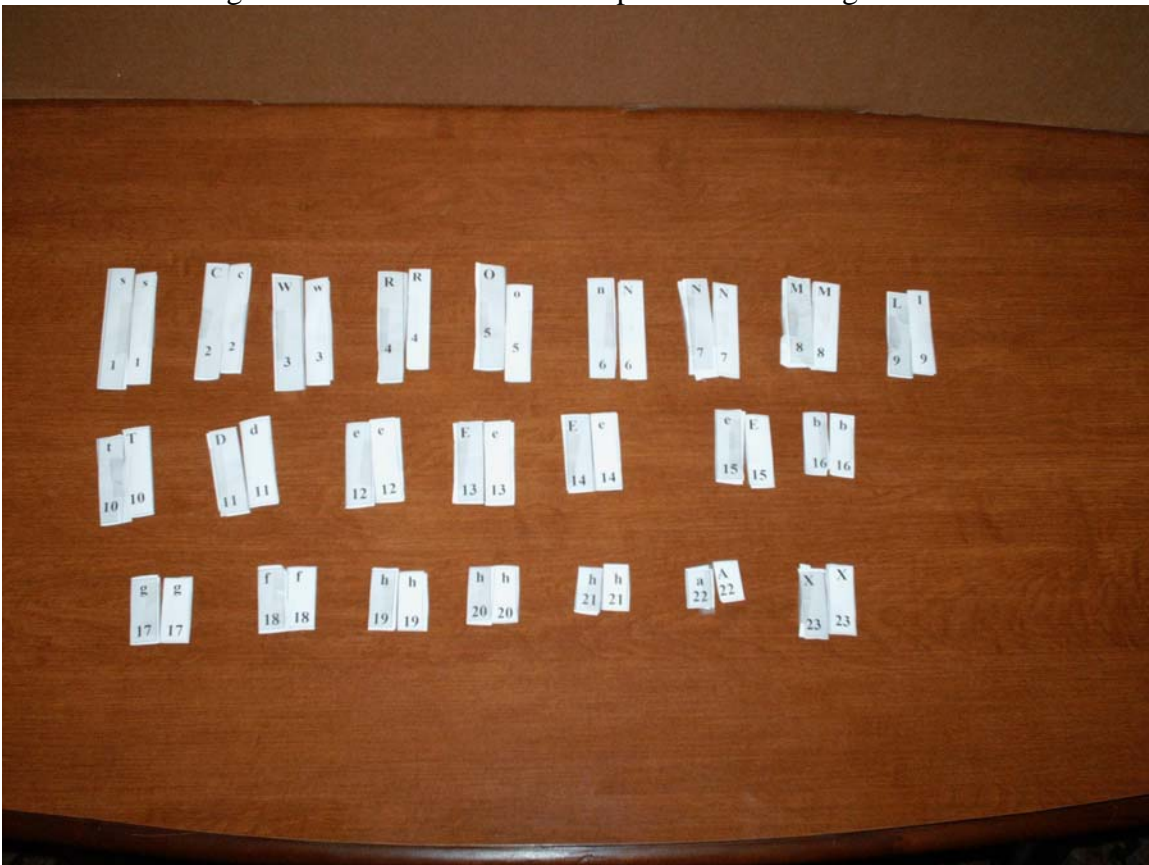


- Place a piece of tape in between the letters and numbers so that the piece of paper remains folded in half.
- Take all 23 male chromosomes and all 23 female chromosomes and place them into a box or large bowl.

- Shake the chromosomes so that they mix well.
- Raise the chromosomes above your head and spill them out onto the floor.



- Without flipping any of the chromosomes over, line up chromosomes of the same number beside one another. You will have one male and one female chromosome for each number from one to twenty-three, thus giving you 23 pairs of chromosomes. The letters on each of the chromosomes will be your genotype. These letters each represent a gene. Remember that capital letters represent dominant genes and lower case letters represent recessive genes.



- Before finding any physical features, look at the pair of chromosomes with a number 23. Chromosome # 23 determines the gender of your individual. Using the genotype conversion chart, find out if your individual is male or female. According to the chart, if the two letters facing up are **X** and **X**, your individual will be female. If the two letters facing up are **X** and **Y**, your individual will be male.
- Now look at chromosome #1, and refer to the genotype conversion table.
- As the chart indicates, chromosome #1 determines head shape. The two letters on chromosome #1 represent the genotype. If the letters facing up are **S** and **S** or **S** and **s**, the head shape will be oval. If the letters facing up are **s** and **s**, the head shape will be round.
- Using a pencil, sketch the head shape that your genotype indicates.
- Move on to chromosome #2. Using the genotype conversion chart, determine what the chin shape will be.
- Follow this same procedure for all 23 pairs of chromosomes.
- When you get to chromosome 12, you will see that eye color is determined by more than one chromosome. You will need to look at the letters from chromosomes 12, 13, 14, and 15 to determine the eye color. Count up the total number of Capital **E**'s and lower case **e**'s and compare them to the genotype conversion chart. For example, if you have 8 capital **E**'s from chromosomes 12-15, your individual will have black eyes.
- You will see that hair color is also determined by genes on more than one chromosome.
- Complete a sketch of your individual using the genotype conversion chart. You have just created features of an individual by using DNA just as the human body does!
- Did you notice anything about this activity that does not seem correct? Hint: look at the genotypes of the parents.

Extension Activity

- You can create more offspring by mixing the chromosomes and spilling them to the floor again.
- You will see how different combinations of genes (genotypes) will yield a different appearance (phenotype).
- Look up the terms polygenic, intermediate expression, codominance, and pleiotropy. See if you can tie these terms into what was seen in this activity.

Wrap-Up

After this activity, you should be able to understand how DNA determines your appearance. Remember DNA is condensed into **chromosomes**. You have 23 pairs of chromosomes, 23 from your mother and 23 from your father. Within these chromosomes, there are sections called **genes** that control specific characteristics or **traits**. These genes have both a dominant and recessive form. If you have two dominant

or two recessive genes for a given trait, you are said to be **homozygous** for that trait. If you have one dominant and one recessive form of a gene, you are said to be **heterozygous** for that trait. The dominant form of a gene will always be expressed while the recessive form of a gene will be expressed only if you have two recessive forms. These are the general rules of how traits are inherited from your parents. However, there are many exceptions to this rule, which are still being explored by scientists today!

A note about this activity that you should know is that chromosomes carry many more than one gene. There are thousands of genes carried within the 23 pairs of human chromosomes. There was only one gene per chromosome in this activity to make it simpler. The question posed at the end of the activity does have a simple answer. The genotypes for both parents were all heterozygous. In real life, parents will be heterozygous and homozygous for some traits just as your offspring was. Finally, the term polygenic means that more than one gene effects outcome (Seen in hair and eye color in this activity). Intermediate expression means that there is a blending of features in the heterozygous state (Seen in the prevalence of freckles in this activity). Codominance means that both dominant and recessive genes are expressed separately. This is not seen in this activity but is seen in human blood type. Pleiotropy means that a single gene is responsible for many traits.

Resources

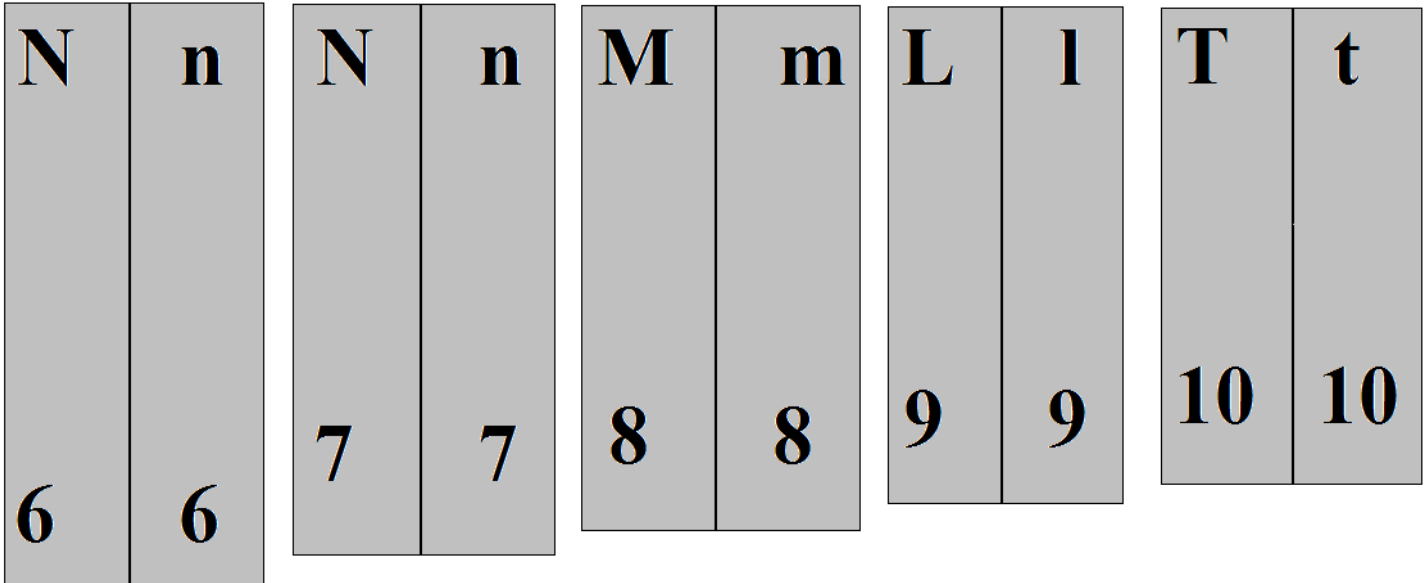
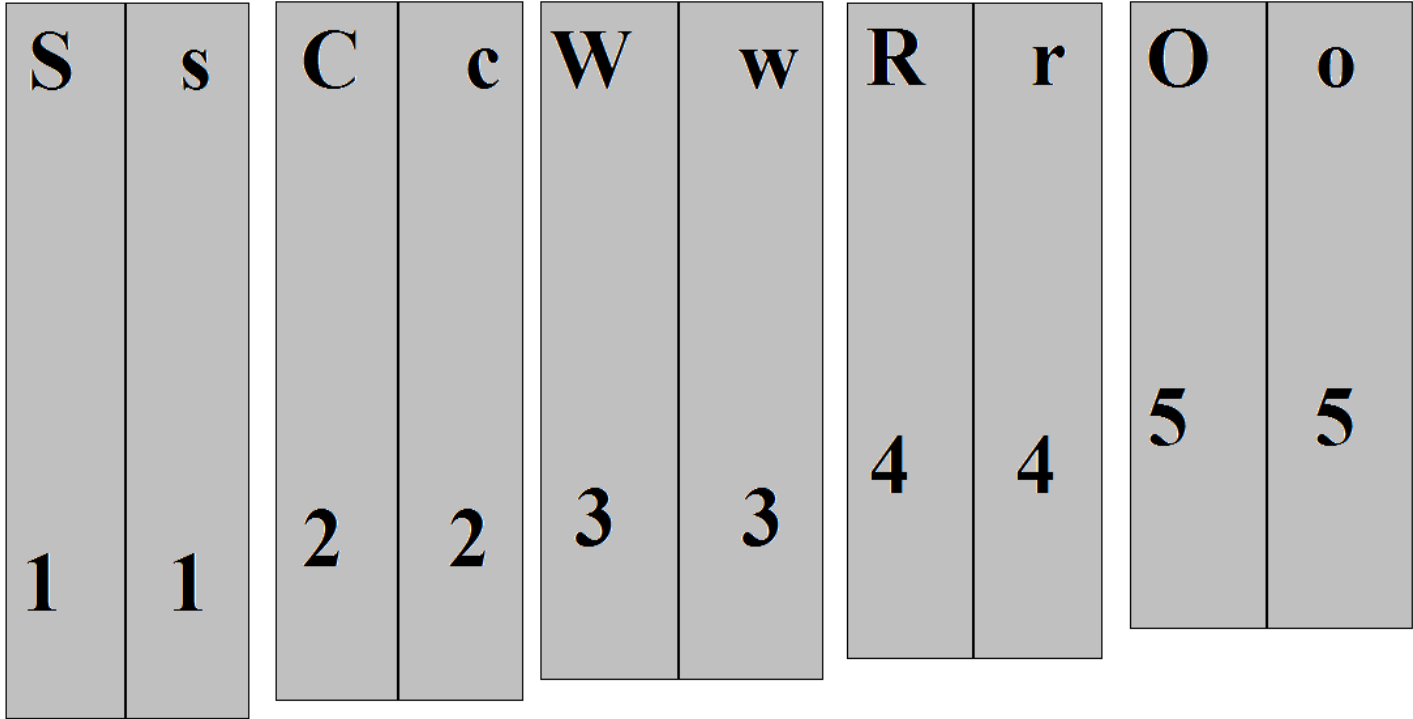
(Idea taken from) <http://www.woodrow.org/teachers/bi/1997/makeface/>(Background on Inheritance) <http://www.dnaftb.org/dnaftb/5/concept/index.html>

Genotype Conversion Chart

Chromosome #	Genotype	Phenotype	Chromosome #	Genotype	Phenotype
1	SS or Ss	Oval Shaped Head	16	BB or Bb	Thick Eye brows
	ss	Round Shaped Head		bb	Thin Eye brows
2	CC or Cc	Square Chin	17	GG or Gg	No Glasses
	cc	Round Chin		gg	Wears Glasses
3	WW or Ww	Wide Neck	18	FF	No Freckles
	ww	Skinny Neck		Ff	Few Freckles
4	RR or Rr	Small Ears	19, 20, 21	ff	Many Freckles
	rr	Large Ears		HHHHHH	Black Hair
5	OO or Oo	Has Ear Lobe		HHHHHh	Brown Hair
	oo	No Ear Lobe		HHHHhh	Light Brown Hair
6	NN or Nn	Long Nose		HHHhhh	Reddish-Brown Hair
	nn	Short Nose		HHhhhh	Red Hair
7	NN or Nn	Skinny Nose		Hhhhhh	Dirty Blond Hair
	nn	Wide Nose		hhhhhh	Blond Hair
8	MM or Mm	Large Mouth	22	AA or Aa	Straight Hair
	mm	Small Mouth		aa	Curly Hair
9	LL or Ll	Wide Lips	23	XX	Female
	ll	Thin Lips		XY	Male
10	TT or Tt	Straight Teeth			

	tt	Crooked Teeth
11	DD or Dd	Eyes Close Together
	dd	Eyes Far Apart
12, 13, 14, 15	EEEEEEEE	Black Eyes
	EEEEEEEe	Brown Eyes
	EEEEEEee	Hazel Eyes
	EEEEEEEE	Grey
	EEEEEEEE	Amber
	EEEEEEEE	Blue-Green
	EEEEEEEE	Green
	Eeeeeeee	Blue
	eeeeeeee	Light Blue

Male Chromosomes 1-10



Male Chromosomes 11-23

D	d	E	e	E	e	E	e	E	e
11	11	12	12	13	13	14	14	15	15

B	b	G	g	F	f	H	h	H	h
16	16	17	17	18	18	19	19	20	20

H	h	A	a
21	21	22	22

X	Y
23	23

Female Chromosomes 1-10

S	s	C	c	W	w	R	r	O	o
1	1	2	2	3	3	4	4	5	5

N	n	N	n	M	m	L	l	T	t
6	6	7	7	8	8	9	9	10	10

Female Chromosomes 11-23

D	d	E	e	E	e	E	e	E	e
11	11	12	12	13	13	14	14	15	15

B	b	G	g	F	f	H	h	H	h
16	16	17	17	18	18	19	19	20	20

H	h	A	a
21	21	22	22

X	X
23	23