VARIATIONS ON A HUMAN FACE

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TOPIC:

Genetics

INTRODUCTION:

The Austrian monk Gregor Mendel determined the basic laws of genetics, the rules governing how traits are handed down from parent to offspring. A trait is passed down through genes, the basic unit of genetic information, with at least two genes, one from each parent, controlling its inheritance. Some traits are dominant, that is they prevent other traits from appearing. Some are recessive, these do not appear when a dominant gene is present.

For example, let us say that "tallness" is a dominant trait and "shortness" recessive. The following diagram, called a Punnett square, shows what might happen when a plant with two tall genes (a pure tall) is crossed with a plant with two short genes (a pure short).

T = tall

s = short

	T (pure tall)	T
s (pure short)	Ts	Ts
s (pure short)	Ts	Ts

All the offspring would be hybrids, that is contain both a dominant and a recessive gene. Since we have determined that tallness is dominant, all offspring would look tall. But if we crossed these hybrids, we could get more varied results in the third generation as the following Punnett square shows.

T = tall

s = short

	T (hybrid)	s
T (hybrid)	TT	Ts
s (hybrid)	Ts	ss

It is important to note that the diagram holds true only when large numbers of offspring are represented. In this demonstration, we are going to discover what an offspring might look like if each parent is a hybrid for each characteristic and examine the possible variation that may result.

TIME NEEDED:

60-90 minutes

MATERIALS:

2 coins
drawing paper
pencil
colored pencils or crayons
~~scissors~~
~~glue~~

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3. Now flip for each of the facial characteristics that follow. Heads gives a capital letter, tails a small letter. See the illustrations section for the letters to use for each characteristic. For example, the first flip is for face shape. If your coin comes up heads, write *R* in the proper column next to face shape on the Data Table. If your partner's flip comes up tails, write *r* in his or her column on the Data Table. Then look at the illustrations. You will see that RR or Rr will produce a round face, while rr will produce a square face. Since your tosses resulted in Rr, this offspring will have a round face. Circle *round* in the Face shape section of the Checklist for Phenotypes. Continue in this way until you have flipped for all of the facial characteristics.

4. Now look at your completed Checklist for Phenotypes. Draw a picture of the offspring as he or she might look. ~~You may also cut out the various parts of the face from the illustrations and assemble your face on a sheet of paper~~.

ANALYSIS:

1. If your whole class did this experiment, compare your drawings. How much variation is there in the offspring? Are you surprised by the amount of variation? Why?

2. Research Mendelian and population genetics in your biology textbook or an encyclopedia. Explain in what ways your random coin tosses approximate the actual chances of a child being born with given facial characteristics. Explain in what ways the experiment does *not* accurately reflect the chances of receiving given characteristics and what factors it failed to take into account.

Checklist for Phenotypes—circle your coin flip results.

Sex
- Male
- Female

Face shape
- round
- square

Chin shape (1)
- very prominent
- less prominent

Chin shape (2)
- round
- square

Cleft chin
- absent
- present

Hair texture
- curly
- wavy
- straight

Widow's peak
- present
- absent

Hair color
- black
- brown
- red
- blonde
- dark blonde
- pale blonde

Eyebrows (1)
- bushy
- fine

Eyebrows (2)
- not connected
- connected

Color of eyebrows
- darker than hair
- same as hair
- lighter than hair

Eye distance
- close together
- average
- far apart

Eye size
- large
- medium
- small

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Eye shape
- round
- almond

Eye position
- horizontal
- upward slant

Eye color
- dark brown
- brown
- green
- brown/green flecks
- gray blue
- dark blue
- light blue

Eyelashes
- long
- short

Freckles
- present
- absent

Mouth
- long
- average
- small

Lips
- thick
- thin

Hapsburg lip
- present (very protruding)
- present (slightly protruding)
- absent

Dimples
- present
- absent

Nose
- big
- medium
- small

Nose shape
- rounded
- pointed

Nostril shape
- rounded
- flared

Ear and nose size
- large ear, wide nose
- small ear, narrow nose

Earlobes
- free
- attached

Darwin's ear point
- present
- absent

Hairy ears (males only)
- present
- absent

Face Shape:

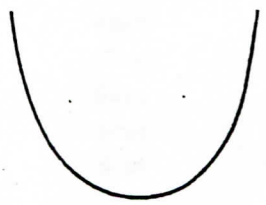
Round (RR, Rr)

Square (rr)

Chin Shape (1):

Very Prominent (VV, Vv)

Less Prominent (vv)



Chin Shape (2): NOTE: Flip coins for this trait only if chin shape (1) was VV or Vv.

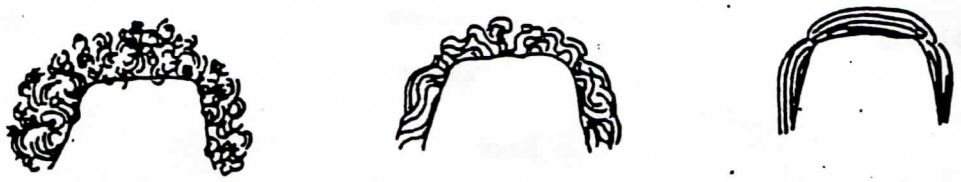
Round (RR, Rr) Square (rr)

Cleft Chin:

Absent (AA, Aa) Present (aa)

Hair Body:

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



Widow's Peak: The hair-line comes to a point in the center of the forehead.

Present (WW, Ww) Absent (ww)

Hair Color: Dark hair is dominant over light. To determine the color of the offspring's hair, assume there are two gene pairs involved. There are probably more. Flip your coin first to determine the genotype of the first pair of genes: (AA, Aa, aa). Now flip your coins again to determine the genotype of the second pair of alleles (BB, Bb, bb). Then match the genotype with the corresponding hair color by looking at the following chart:

If the genotype is:	Then the hair color is:
AABB	black
AABb	black
AAbb	red
AaBB	brown
Aabb	regular blonde
AaBb	brown
aaBB	dark blonde
aaBb	regular blonde
aabb	pale yellow blonde

Eyebrows (1) Bushy (BB, Bb) Fine (bb)

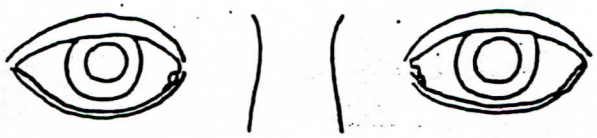
Eyebrows (2) Not connected (NN, Nn) Connected (nn)

Color of Eyebrows: Darker than hair (HH) Same as hair (Hh) Lighter than hair (hh)

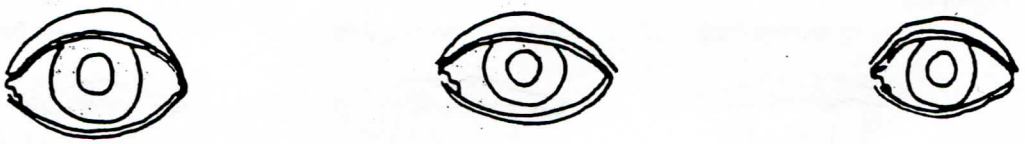
Eyes

Distance apart: Close together (EE) Average (Ee)

Far apart (ee)

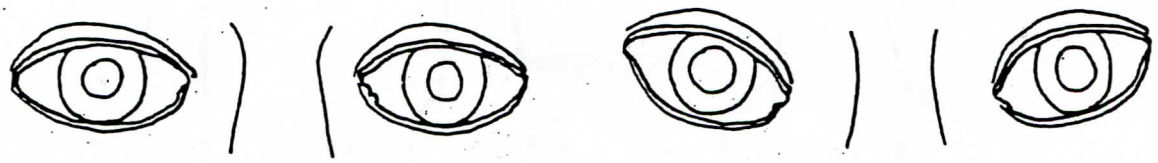


Size: Large (LL) Medium (Ll) Small (ll)



Shape: Almond (wide) (AA, Aa) Round (narrow) (aa)

Slantedness (position): Horizontal (HH, Hh) Upward slant (hh)



Eye Color: Dark eyes are dominant over light. To determine the color of the offspring's eyes, assume there are two gene pairs involved, one which codes for depositing pigment in the front of the iris and one which codes for depositing pigment in the back of the iris. Determine the genotype of the first pair (AA, Aa, aa). Then flip again to determine the second pair of genes (BB, Bb, bb).

If the genotype is:	Then the eye color is:
AABB	dark brown
AABb	dark brown
AAbb	brown
AaBB	brown/green fleck
AaBb	brown
Aabb	gray-blue
aaBB	green
aaBb	dark blue
aabb	light blue (hazel)

Eye Lashes: Long (LL, Ll) Short (ll)

Mouth: Long (MM) Average (Mm) Small (mm)

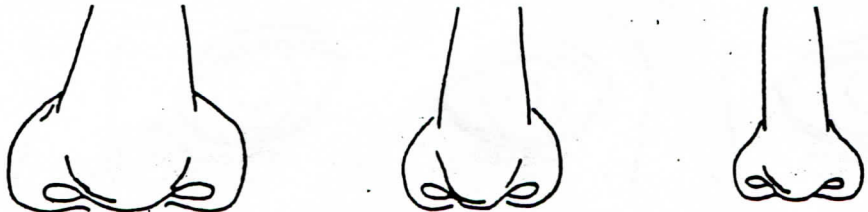
Lips: Thick (TT, Tt) Thin (tt)

Hapsburg Lip:

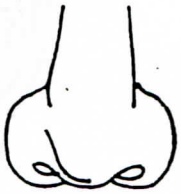
Very Protruding (HH) Slightly Protruding (Hh) Absent (hh)

Dimples: Present (DD, Dd) Absent (dd)

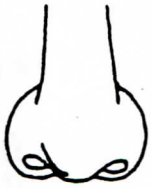
Nose size: Big (NN) Medium (Nn) Small (nn)

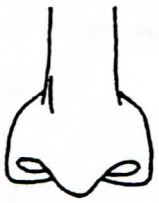


Nose Shape: Rounded (RR, Rr) Pointed (rr)



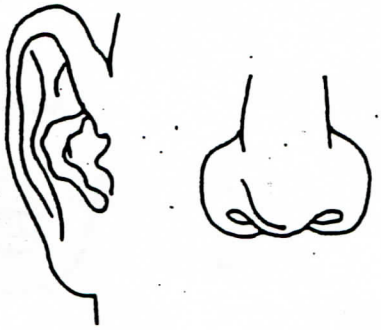
Nostril Shape: Rounded (RR, Rr) Flared (rr)

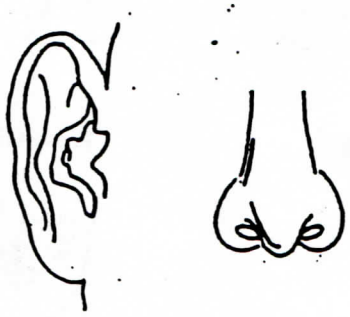




Note: Nose tip thickness and size of ears are almost always inherited together. In other words, thick nose tip and large ears are usually inherited together, but not always.

Flip coins first : (XX, Xx) large ears, thick nose (xx) small ears, narrow nose





To see if the traits have stayed together, flip again. If both tails come up and the results of the first flip called for big ears, make the ears small. If the results called for small ears, make them big.

Ear Lobes: Free (FF, Ff) Attached (ff)

Darwin's Ear Point:

Present (DD, Dd)

Absent (dd)

Hairy Ears:

Note: occurs only in males (sex limited)

Absent (EE, Ee)

Present (ee)

Freckles:

Present (FF, Ff)

Absent (ff)

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