



Genetics

- science of heredity
- factors affecting the transmission of characteristics from one generation to another
- it attempts to describe similarities and differences (variation) among organisms.
- it also explains the characteristics that are transmitted from one generation to the next generation offspring



Heredity

- passing of traits from parents to offspring

Inherited

- traits that are passed from parents to their offspring

Traits

- characteristics of an organism



2 Kinds of Characteristics

1. Species Characteristics

- similar to those of other humans

2. Individual Characteristics

- characteristics that make an individual member of a species different from another



Factors that *Affect Individuality*

1. Biological Inheritance/ Heredity

- key difference between species
- makes us similar to, and also different from, your siblings or other people
- transmission of genetic material or characteristics from parents to offspring

2. Environment

- may contribute much to an organism's nature and behavior
- may affect an individual's growth



Theory of Inheritance

- Theory of Blending Inheritance

- idea that maternal and paternal characteristics blend or mix to produce the characteristics found in the offspring

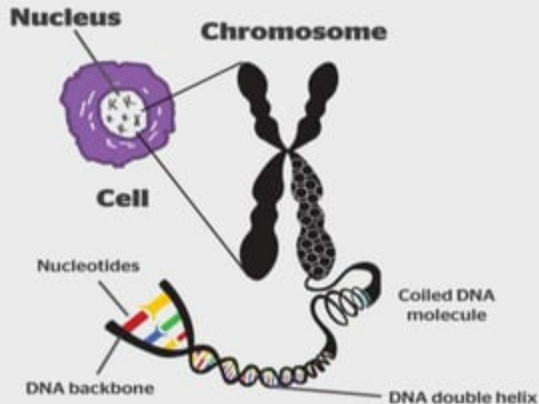
- Particulate Model of Heredity

- Mendel's idea that heredity could be governed by "particles" that retain their identity from generation to generation



Chromosomes

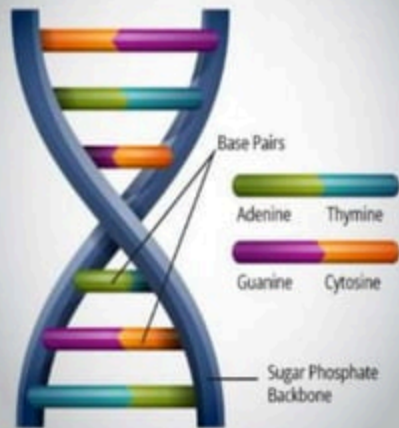
“Threads of Life”
- thread-like structures
in the nucleus of a cell that
control heredity





Composition of Chromosomes

DNA Structure



Deoxyribonucleic acid (DNA)

- is the chemical that makes up chromosomes
- double-helix shape / twisted ladder
- made up of sugar and phosphates
- four kinds of nitrogen bases
 - A - Adenine
 - T - Thymine
 - G - Guanine
 - C - Cytosine



Watson and Crick

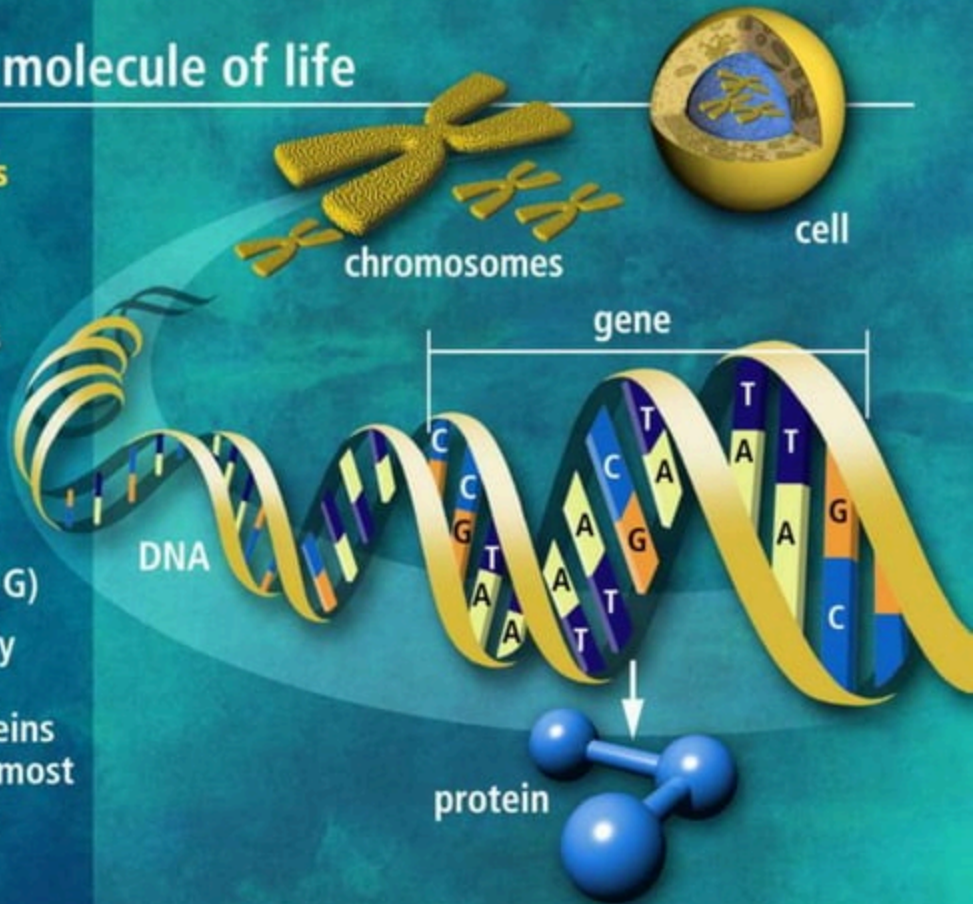


DNA the molecule of life

Trillions of cells

Each cell:

- 46 human chromosomes
- 2 meters of DNA
- 3 billion DNA subunits (the bases: A, T, C, G)
- Approximately 30,000 genes code for proteins that perform most life functions



DNA Genetic Code Dictates Amino Acid Identity and Order



*DNA
Sequence*

Is

*the
Genetic
Code.*

GCA AGA GAT AAT TGT...



*Growing
Protein
Chain*



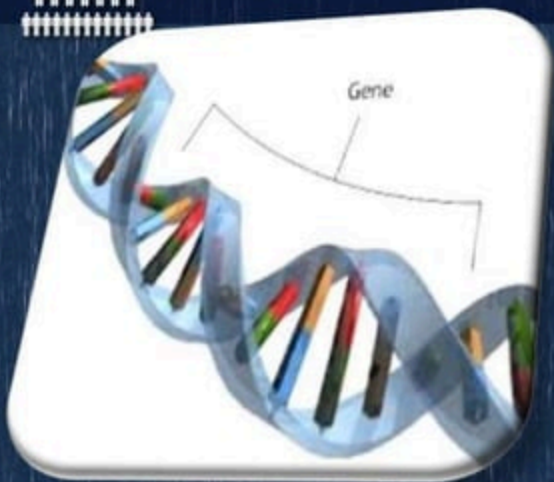
Genetic Code



- determines the kind of gene that forms
- controls the inherited traits



Genes



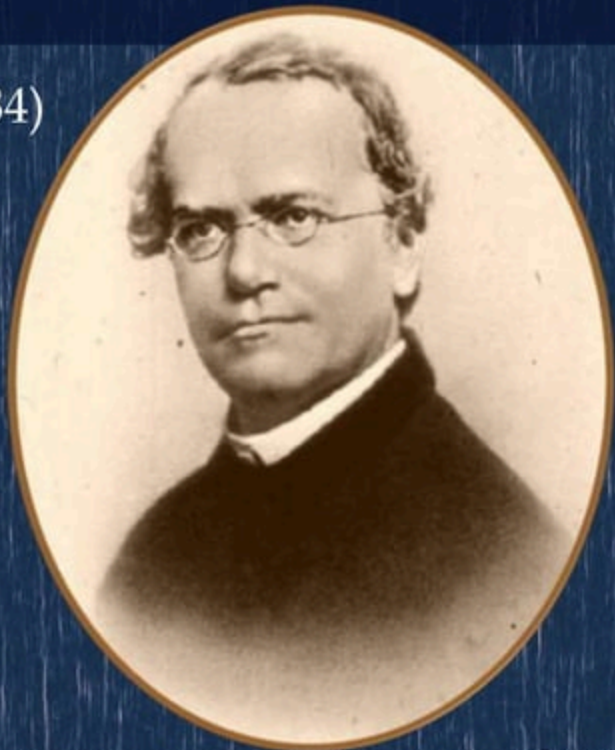
- is a part of the chromosome that controls inherited traits
- can determine the height, eye color, hair color, and many other characteristics
- also controls the life processes of the cells

Allele – is an alternative/
different forms of a gene
(one member of a pair)



Gregor Mendel

- Austrian monk (1822 – 1884)
- plant breeder
- Father of Genetics
- First person to study genetics methodically
- done research on heredity with garden peas from 1856-1868 and published in 1866
- 1900 he's research was rediscovered





Mendel's Experiment

- Experimented with Garden peas:
 1. grows quickly
 2. reproduce by self-pollination
 3. possess characteristics that can easily be recognized – height, color of flowers, seed shape
 4. pollination can be controlled in this group of plants w/ minimum work
 5. can produce enough offspring for study purposes



Mendel's Experiment

- Cross-pollination procedure with pure tall x pure small plants
 - deliberately cross two plants to transfer pollen from one self-fertilizing flower to another

Parent generation (P_1)

- the individuals that give rise to the first generation

First-filial generation (F_1)

- the first generation in the line of descent



Dominant and Recessive

Dominant

- traits that appeared
- gene that always shows itself

Recessive

- form of trait that was masked
- hidden gene



Mendel's Principle

1. Concept of Unit Character
2. Principle of Dominance and Recessiveness
3. Law of Segregation



Concept of Unit Character

- Each organism has a pair of heredity factors – called as *genes*
- All characteristics of organisms are inherited as independent units
- Genes of one characteristic are not influenced by the genes for any other characteristics



Principle of Dominance and Recessiveness

- Law of dominance

- one factor in a pair may mask the expression of the other factor

- One trait was stronger than the other – dominant trait
 - The mask factor is known as recessive trait



Principle of Dominance and Recessiveness

- An organism with at least one dominant allele for a particular form of a trait will exhibit that form of the trait
- An organism with a recessive allele for a particular form of a trait will exhibit that form only when the dominant allele for the trait is not present.



Law of Segregation

- able to postulate that the traits may be traced back to the sperm and egg cells from the parent – contributes one heredity factor
- States that a pair of genes is segregated or separated during the formation of sex cells.



Law of Segregation

During gamete formation, the alleles for each gene segregate from each other, so that each gamete carries only one allele for each gene.



Fundamentals of Genetics

- **Alleles** – different copies or forms of genes controlling a certain trait

Homozygous – alleles on a certain trait in an organism are the same (pure)

ex. homozygous for tallness – (TT)

both dominant or (tt) both recessive

Heterozygous – alleles for the same trait are different (hybrid)

ex. heterozygous for tallness – (Tt)

1 gene for tallness and 1 for shortness



Genotype & Phenotype

Capital letter is used for the allele indicating a dominant trait; lowercase letter for the contrasting recessive allele

- **Genotype**
 - organism's genetic make-up
 - combination of genes of an organism
- **Phenotype**
 - physical trait of an organism



Genotype & Phenotype

Traits	Symbol for Trait	Alleles	Phenotype	Genotype
Plant Height	TT	T, T	tall	homozygous tall
	Tt	T, t	tall	heterozygous tall
Seed Shape	Tt	T, t	short	heterozygous short
	RR	R, R	round	homozygous round
	Rr	R, r	round	heterozygous round
	rr	r, r	wrinkled	wrinkled
Pod Shape	Ii	I, I	inflated	homozygous inflated
	Ii	I, i	inflated	heterozygous inflated
	ii	i, i	constricted	constricted



For each genotype, indicate whether it is heterozygous or homozygous

AA

Bb

Cc

Dd

Ee

ff

GG

HH

Ii

jj

Kk

Ll

MM

nn

Oo

Pp



For each genotype, determine what phenotypes would be possible

Purple flowers are dominant to white

PP _____

Pp _____

pp _____

Brown eyes are dominant to blue

BB _____

bb _____

Bb _____



For each genotype, determine what phenotypes would be possible

Round seeds are dominant to wrinkled

Rr _____

RR _____

rr _____

Bobtails are recessive to long tails

Tt _____

tt _____

TT _____



For each phenotype, list the genotypes

Straight hair is dominant to curly

_____straight

_____straight

_____curly

Tail spikes are dominant to plain tails

_____spikes

_____spikes

_____plain



Monohybrid Cross

(One-factor Cross)

- Using Punnett Square

- use mathematical probability to help predict the genotype and phenotype combinations in genetic crosses.

	B	b
B		
b		



Monohybrid Cross

(One-factor Cross)

1. **Start with the Parents:** Write the genotypes of the two organisms that will serve as parents in a cross.
2. **Figure out the Gametes:** Determine what alleles would be found in all of the possible gametes that each parent could produce.
3. **Line them up:** Draw a table with enough squares for each pair of gametes from each parent.
4. **Write out the New Genotypes:** Fill in the table by combining the gametes' genotypes
5. **Figure out the Results:** Determine the genotype and phenotype of each offspring. Calculate the percentage of each



Monohybrid Cross

(One-factor Cross)

- How are Dimples Inherited?

1. Write the last four digits of your cellular phone number. These four random digits represents the alleles of a gene that determines whether a person will have a dimples. Odd digits represents the allele for the dominant trait of dimples. Even digits represents the allele for the recessive trait of no dimples.
2. Use the first two digits to represent a father's genotype. Use the symbols D and d to write his genotype.



Monohybrid Cross

(One-factor Cross)

- How are Dimples Inherited?

3. Use the last two digits the same way to find the mother's genotype. Write her genotype.
4. Using the Punnett square, determine the probability that their child will have dimples.
5. Determine the class average of the percent of children with dimples.



Monohybrid Cross

(One-factor Cross)

1. What would the resulting offspring of a cross between a long tailed cat (HH) with short tailed cat (hh) be?
2. Cross two individuals: *Brown* dominant to *black* – one that is homozygous recessive and the other has a dominant phenotype, but had a mother with recessive phenotype



Monohybrid Cross

(One-factor Cross)

3. $Rr \times rr$

Determine the genotype, phenotypes and give the ratio of its genotype.

What percentage of the offspring will be round?



Monohybrid Cross

(One-factor Cross)

4. $RR \times Rr$

Determine the genotype, phenotypes and give the ratio of its phenotype.

What percentage of the offspring will be round?



Monohybrid Cross

(One-factor Cross)

5. $Bb \times Bb$

Determine the genotype, phenotypes and give the ratio of its genotype.

What percentage of the offspring will be round?



Monohybrid Cross

(One-factor Cross)

- Two parents are having a child. The father has a hybrid freckles. The mother does not have freckles. Find the possibility of the child having freckles.
- In humans, the alleles for six fingers (F) is dominant to the allele for five fingers (f). If both parents are heterozygous for six fingers, what is the probability that their first child will be "normal"



Dihybrid Cross

(Two-factor Cross)

- is a genetic cross that involves two sets of traits.

	RY	Ry	rY	ry
RY				
Ry				
rY				
ry				



Dihybrid Cross

(Two-factor Cross)

Principle of Independent Assortment

- states that genes for different traits can segregate independently during the formation of gametes and do not influence each other's inheritance.



Dihybrid Cross

(Two-factor Cross)

1. Select the letters to represent the genes.
2. Write the genotypes of P_1 .
3. Determine the possible gametes from P
4. Make a punnett square. Enter the gametes
5. Complete the punnett square by combining the gametes forming alleles in the appropriate boxes.
6. **Figure out the Results:** Determine the genotype and phenotype of each offspring. Calculate the percentage of each



Dihybrid Cross

(Two-factor Cross)

	R \dot{Y}	R \dot{y}	r \dot{Y}	r \dot{y}
R \dot{Y}	RRYY	RRYy	RrYY	RrYy
R \dot{y}	RRYy	RRyy	RrYy	Rryy
r \dot{Y}	RrYY	RrYy	rrYY	rrYy
r \dot{y}	RrYy	Rryy	rrYy	rryy



Dihybrid Cross

(Two-factor Cross)

2. In summer squash, white fruit color (W) is dominant over yellow fruit color (w) and disk-shaped fruit (D) is dominant over sphere-shaped fruit (d).. If a squash plant true-breeding for white, disk-shaped fruit is crossed with a plant true-breeding for yellow, sphere-shaped fruit, what will the phenotypic and genotypic ratios be for:

- a. the F_1 generation? b. the F_2 generation?



Dihybrid Cross

(Two-factor Cross)



3. $RrGg \times rrgg$

Genotype:

Phenotype:

Genotypic Ratio:



Dihybrid Cross

(Two-factor Cross)

4. Two long and purple flowered pea plants.



Determine the genotype, phenotypes and give the ratio of its phenotype.