Genetics: Mendelian Genetics (2)

Patterns of Inheritance

Outline

6. Extending Mendelian Genetics
   a. Incomplete Dominance
   b. Codominance
   c. Polygenic Inheritance
   d. Environmental Impact
7. Mendilian Inheritance in Humans
8. Key Terms
9. Conclusions

Incomplete dominance

Incomplete dominance – heterozygous phenotype is intermediate between two parents

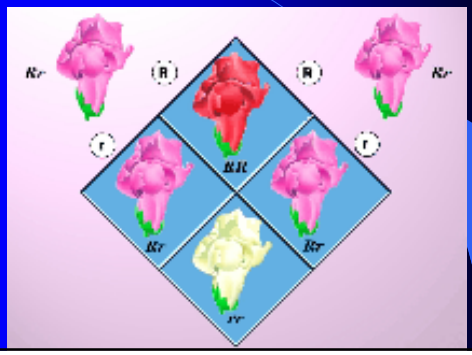
for example, snapdragons:

P: Red x White (RR x R'R')

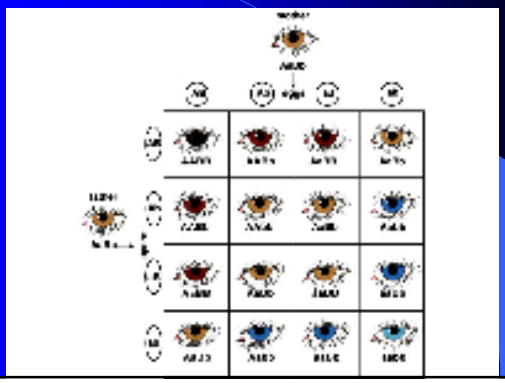
F1:Pink (RR')

F2: ¼ Red(RR), 2/4 Pink(RR'), ¼ White(R'R')

Incomplete dominance



Incomplete dominance



Codominance

Phenotype (blood group)	Genotypes	Antibodies present in blood serum	Reacts (clumps) when red blood cells from groups below are added to serum from groups at left?			
			O	A	B	AB
O	ii	Anti-A Anti-B	No	Yes	Yes	Yes
A	$I^A I^A$ or $I^A i$	Anti-B	No	No	Yes	Yes
B	$I^B I^B$ or $I^B i$	Anti-A	No	Yes	No	Yes
AB	$I^A I^B$	—	No	No	No	No

Blood Typing

Human Blood types

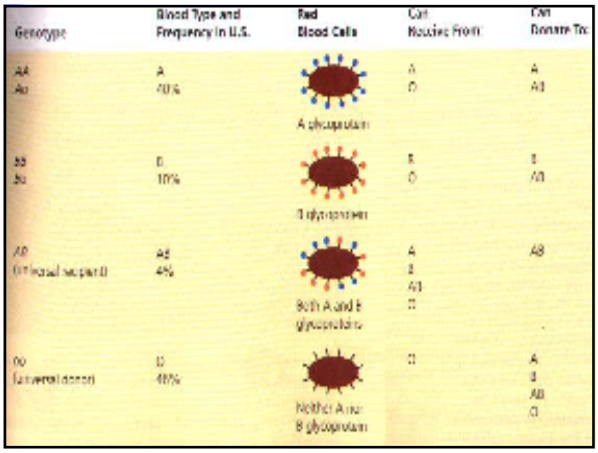
The gene located on chromosome 9

Three alleles I^A, I^B, i (4 types: A, B, AB, O)

Based on markers on red blood cells

[Blood Type]

1. **A ($I^A I^A$, I^A i)** — **anti B antibodies**
2. **B ($I^B I^B$, I^B i)** — **anti A antibodies**
3. **AB ($I^A I^B$)** — **none**
4. **O (ii)** — **anti A and anti B antibodies**



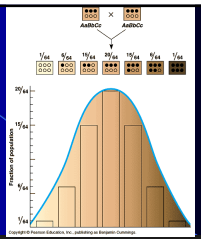
Polygenic inheritance

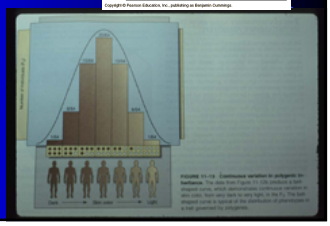
Polygenic inheritance – when alleles at more than one locus contribute to the same trait

for example:

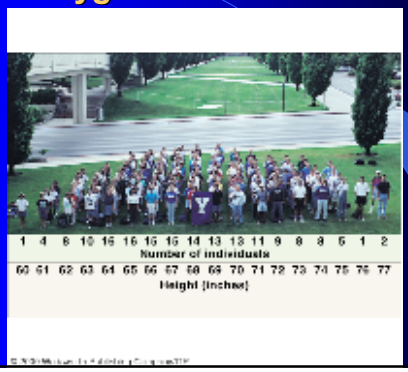
(1) **skin color**

(2) **human height**





Polygenic inheritance

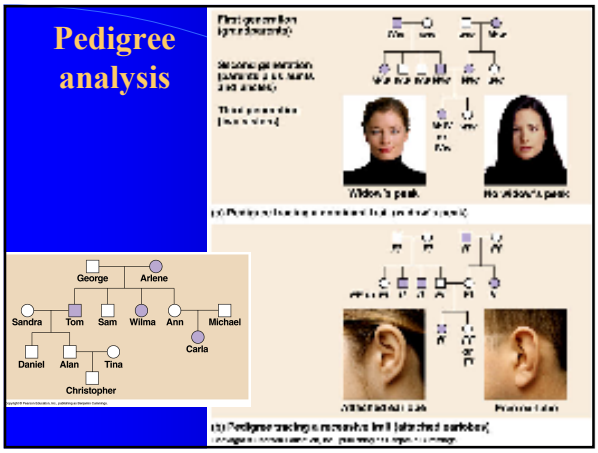


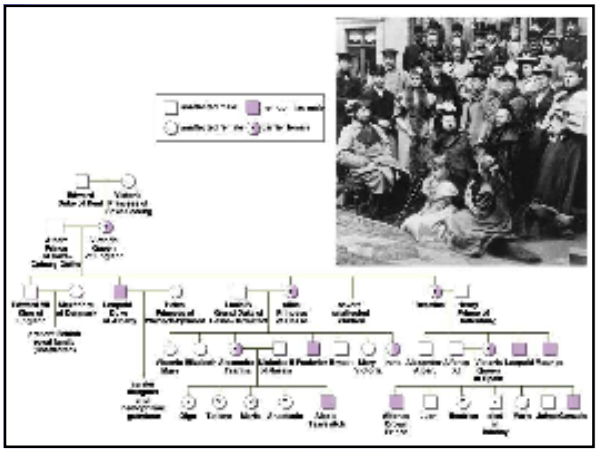
Environmental Impact

Mendilian Inheritance in Humans

1. Pedigree analysis
2. Recessive inherited diseases
3. Dominant inherited diseases

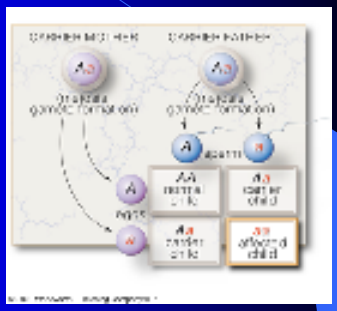
Pedigree analysis





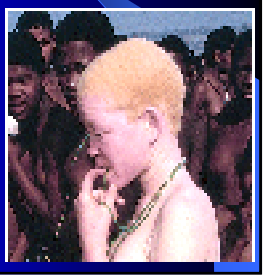
Patterns of Autosomal Recessive Inheritance

Both Parents are carriers

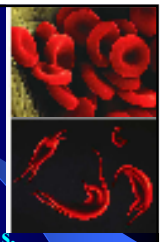


Albinism

- Caused by autosomal recessive allele (aa)
- Absence of pigment
- Tyrosine (**not a pigment**)
  --->Melanin (**pigment**)
  ↑
  Tyrosinase



Sickle cell anemia



Sickle cell anemia

a recessive disease; one amino acid changes in hemoglobin molecule; Sickle-cell hemoglobin molecules tend to cluster together and block the capillary vessels.

normal SS, disease ss, carriers Ss.

In Africa, 45% of certain population have the genotype Ss. Because the heterozygotes (Ss) are resistant to the disease Malaria (a deadly disease).

Cystic Fibrosis

4% whites are carriers – the most common lethal genetic diseases in the US. Most children with cystic fibrosis die before five years old. Now may live to over 30s.
The gene can hide in the population for long time.
0.1% X 0.1% → it is still there
Recessive disease
Parents: Normal heterozygous for cystic fibrosis

P: Cc x Cc

[Punnett Square] ♂\♀ C c

C CC Cc

c Cc cc

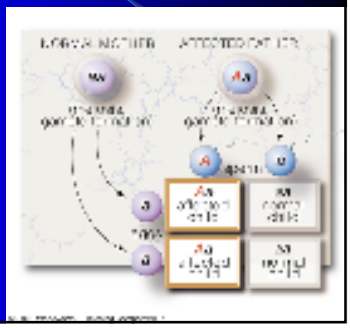
25% normal, 50% carriers, 25% with the disease

Patterns of Autosomal Dominant Inheritance

1. **Achondroplasia 1/10,000**

2. **Huntington disorder no symptoms until the carrier is about 35 to 45 years old**

disease gene located on chromosome # 4



Patterns of Autosomal Dominant Inheritance

One type of dwarfism in humans is caused by a single dominant gene; the condition is called Achondroplastic dwarfism. Dwarf individuals are heterozygous, while persons who are homozygous recessive are of normal stature. The homozygous dominant individuals all die before birth. (20% family history, and 80% new mutations)
If two achondroplastic dwarfs marry and have a family, what fraction of their living offspring will also be achondroplastic dwarfs?

Dwarf Aa Normal aa AA die P: Aa X Aa

F1 genotypes: AA(die)Aa Aa aa 2/3 to be dwarf

Key Terms

Character
Trait
True-breeding
Hybridization
Monohybrid cross
Dihybrid cross
Alleles
Dominant allele
Recessive allele
Homozygous
Heterozygous
Phenotype
Genotype

Law of segregation
Law of independent assortment
Incomplete dominance
Codominance
Multiple alleles
Polygenic inheritance
Carrier
Cystic fibrosis
Sickle-cell disease
Achondroplasia
Huntington disorder

In Conclusion

1. *A gene is a unit of information about a heritable trait*
2. *Mendel provided evidence of dominant and recessive genes*
3. *Monohybrid crosses are crosses between two individuals that are homozygous for different versions of a trait*
4. *Crosses from F_1 result in F_2 offspring with phenotypes having a 3:1 ratio*
5. *Dihybrid crosses result in 9:3:3:1 phenotypic ratio*

In Conclusion

6. *Theory of Independent Assortment states that gene pairs independently sort out into different gametes regardless of other gene pairs of other chromosomes*
7. *Gene dominance can be in different level from complete dominance to incomplete dominance to co-dominance*