

A bouquet of pink tulips is shown against a dark, textured background. The tulips are in various stages of bloom, with some fully open and others as buds. The text is overlaid on the image in a bright green, bold font.

Genetics

Why Do I Look Like
My Parents?

Gregor Mendel



Studied peas in a
monastery
garden

Came up with basic
genetics LAWS

Mendel's

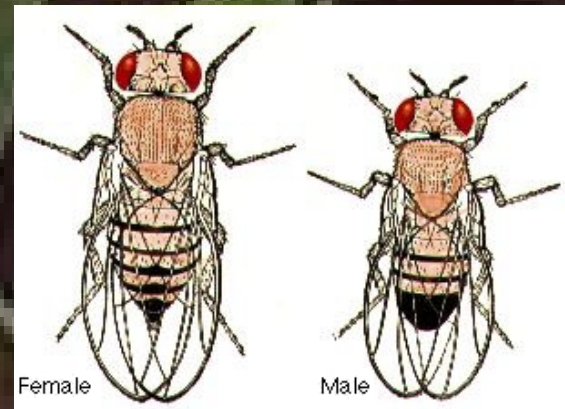


Peas

Thomas Hunt Morgan

Studied the fruit fly, *Drosophila melanogaster*

Developed rules of sex linkage














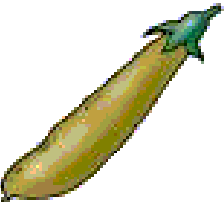
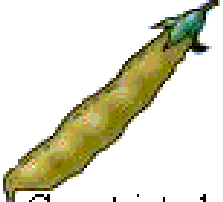
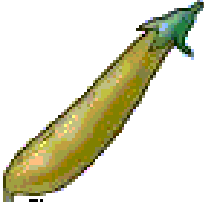

Some Terms

- Allele
- Gene
- Genotype
- Phenotype
- Mutation
- Homozygous
- Heterozygous
- Dominant
- Recessive
- Homozygous dominant
- Homozygous recessive
- Pure-bred
- Hybrid

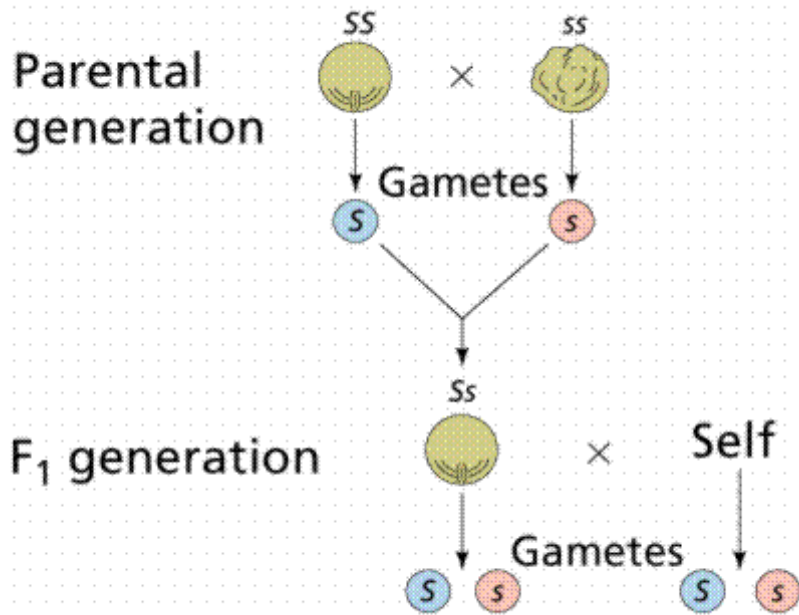
Probability

- Likelihood that a specific event will occur
 - Decimal ($20/100 = 0.20$)
 - Percentage ($20/100 = 20\%$)
 - Fraction or ratio ($20/100 = 1/5 = 1:5$)
- Flip a coin once: What is the probability of heads?
- Genetics Problems: Predict what the offspring of a crossing could look like.

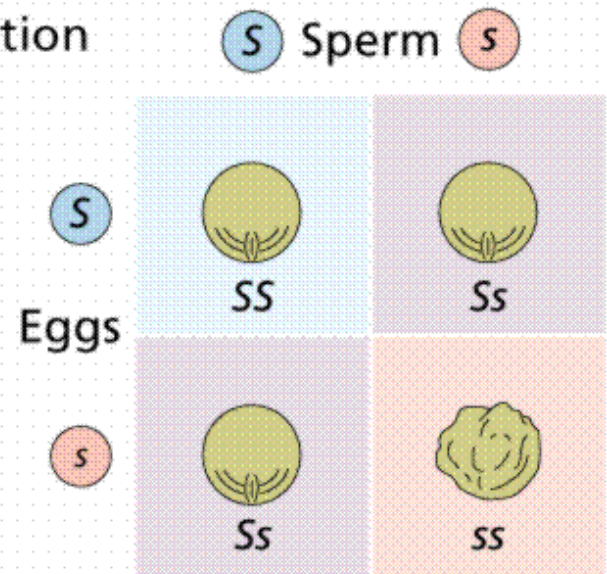
Mendel's Peas

Character	Dominant trait	Recessive trait	Character	Dominant trait	Recessive trait
Seed shape	 Spherical	 Wrinkled	Flower position	 Axial	 Terminal
Seed color	 Yellow	 Green		Stem height	 Tall
Flower color	 Purple	 White			
Pod shape	 Inflated	 Constricted			
Pod color	 Green	 Yellow			

Monohybrid Cross



F₂ generation

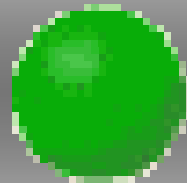


Let's Explain

**Monohybrid cross
of F1 plants**



X



Ss

Ss

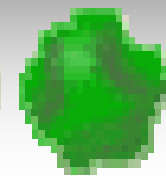
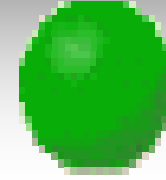
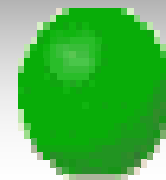
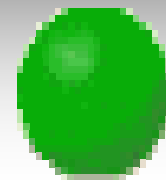
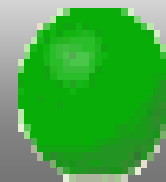
Spherical

Spherical

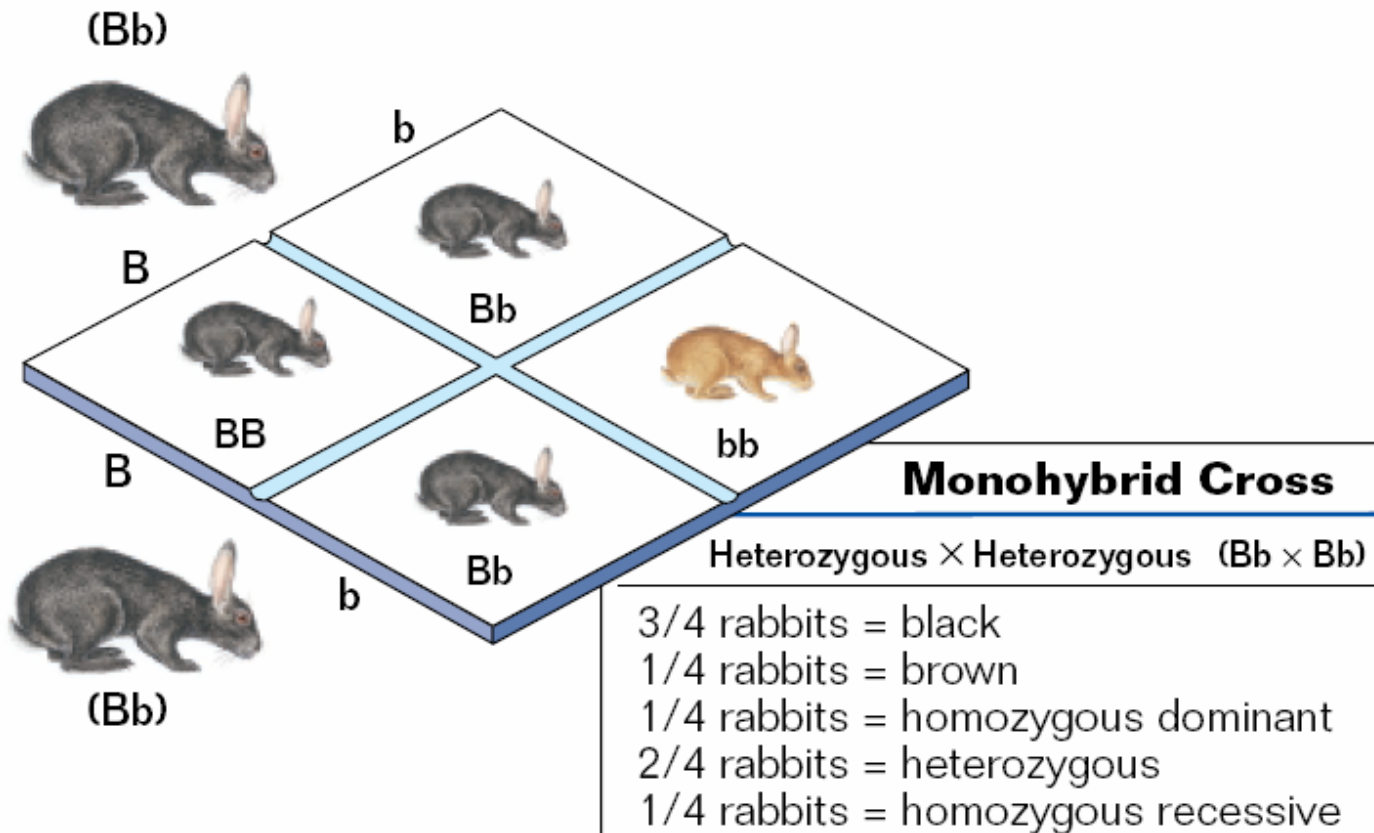
Phenotypic ratio of 3:1



X























Here's another monohybrid cross



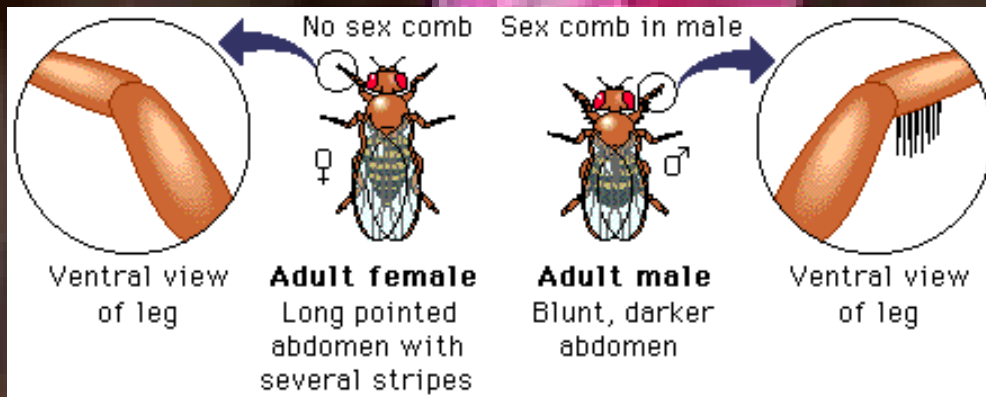
Dihybrid Cross:

Round Yellow
by
Round Yellow
(RrYy x RrYy)

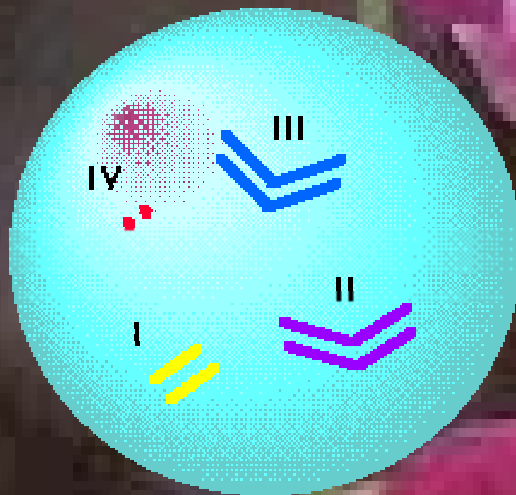
		♂ gametes			
		RY $\frac{1}{4}$	Ry $\frac{1}{4}$	ry $\frac{1}{4}$	rY $\frac{1}{4}$
♀ gametes	RY $\frac{1}{4}$	RRYY $\frac{1}{16}$ 	RRYy $\frac{1}{16}$ 	RrYy $\frac{1}{16}$ 	RrYY $\frac{1}{16}$ 
	Ry $\frac{1}{4}$	RRYy $\frac{1}{16}$ 	RRyy $\frac{1}{16}$ 	Rryy $\frac{1}{16}$ 	RrYy $\frac{1}{16}$ 
	ry $\frac{1}{4}$	RrYy $\frac{1}{16}$ 	Rryy $\frac{1}{16}$ 	rryy $\frac{1}{16}$ 	rrYy $\frac{1}{16}$ 
	rY $\frac{1}{4}$	RrYY $\frac{1}{16}$ 	RrYy $\frac{1}{16}$ 	rrYy $\frac{1}{16}$ 	rrYY $\frac{1}{16}$ 

9  : 3  : 3  : 1 

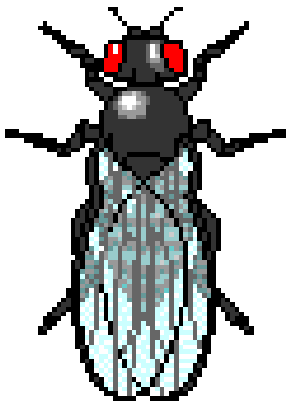
Drosophila melanogaster



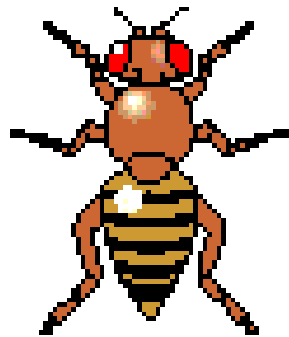
- Easy to study
- Simple to determine sex
- Only 4 pairs of chromosomes



Some Basic Mutations



Ebony body



Wingless



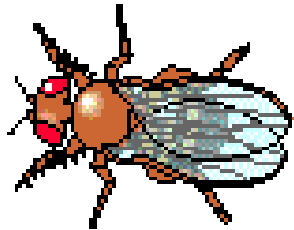
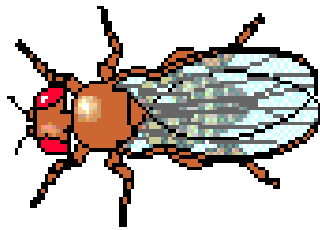
White eyes



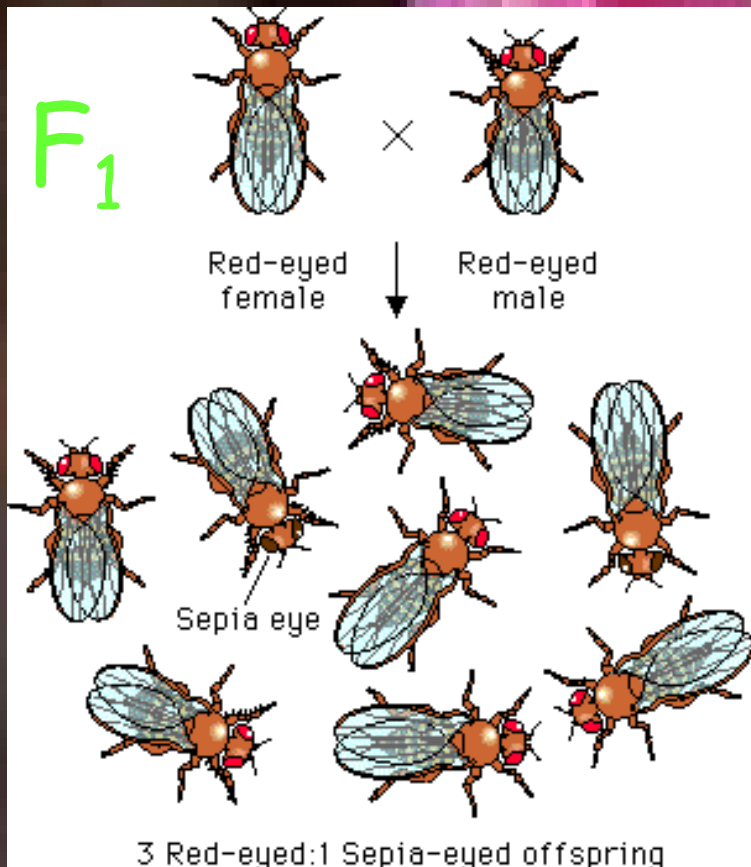
Sepia eyes

Monohybrid Cross: Red-eyed male x red-eyed female





F₁

F ₁ RESULTS	OBSERVED PHENOTYPES AND NUMBERS	
	Red eyes	
♂ MALES	12	
♀ FEMALES	8	

Crossing the offspring:

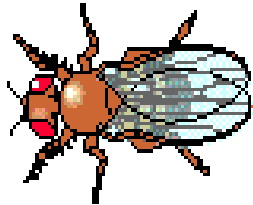
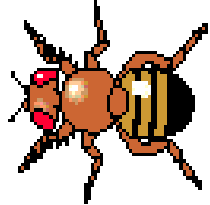
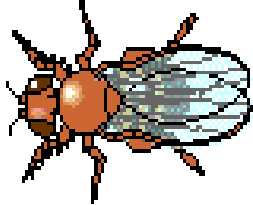
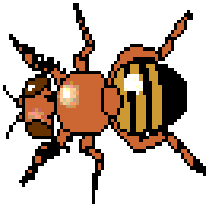
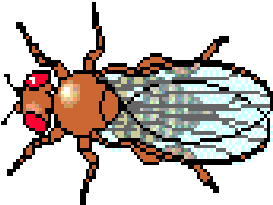
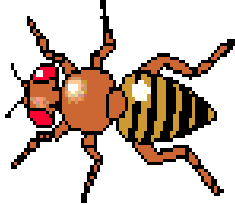
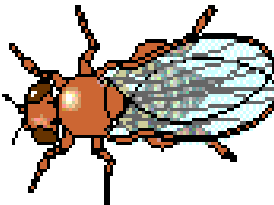
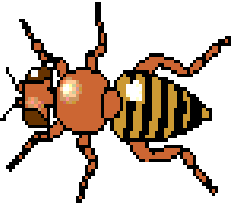


F₂

	OBSERVED PHENOTYPES AND NUMBERS	
F ₂ RESULTS	Red eyes	Sepia eyes
♂ MALES	19 	4 
♀ FEMALES	12 	9 

DiHybrid Cross

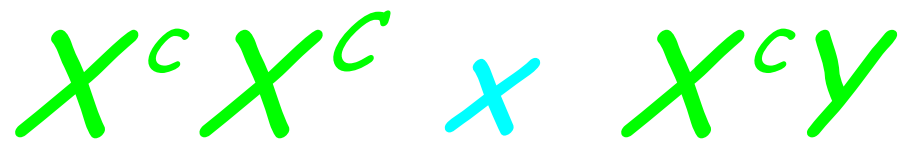
Red-eye normal wings x Red-eye normal wings
(RrWw x RrWw)

	OBSERVED PHENOTYPES AND NUMBERS			
F ₂ RESULTS	Red eyes normal wings	Red eyes no wings	Sepia eyes normal wings	Sepia eyes no wings
♂ MALES	48 	13 	16 	4 
♀ FEMALES	50 	9 	10 	10 

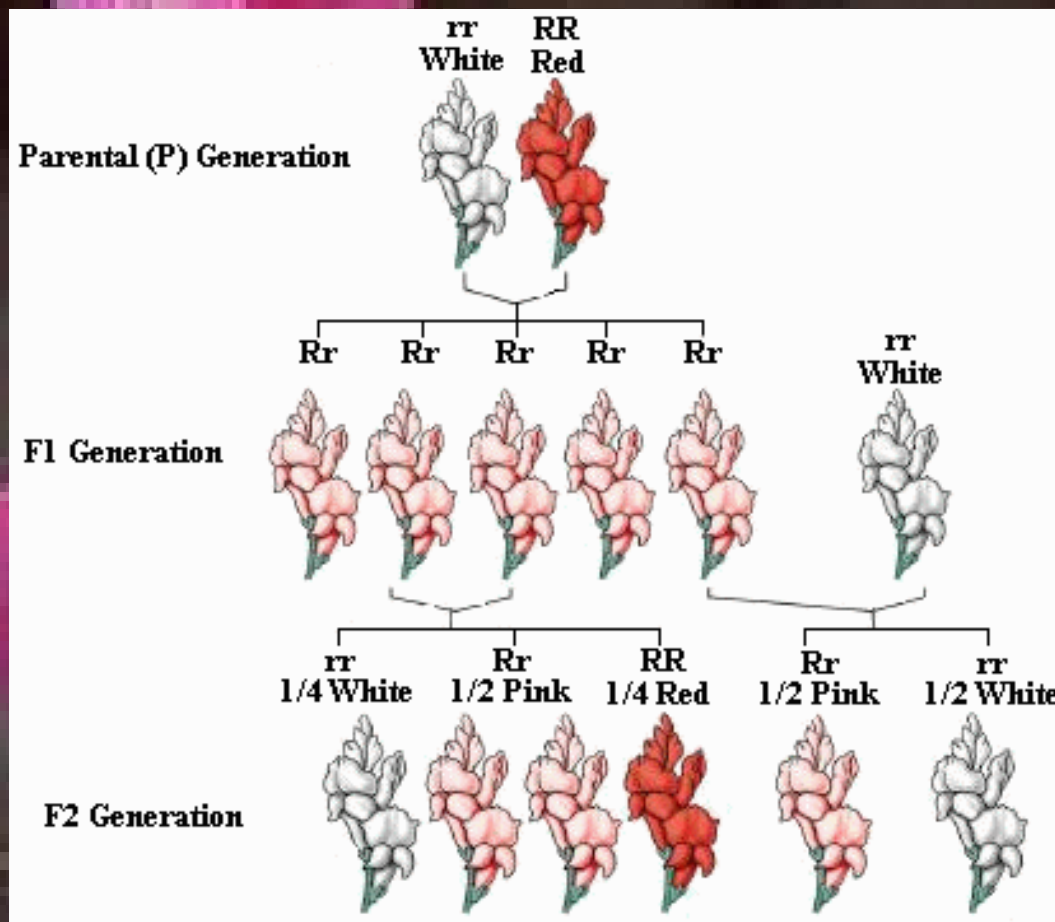
Sex-linked genes

- Online color-blind test

- Try these crosses



Incomplete Dominance



Codominance

- two alleles are dominant
- both forms of the trait are expressed at the same time.
- Blood type in humans

Possible alleles

	I^A	I^B	i
I^A	$I^A I^A$	$I^A I^B$	$I^A i$
I^B	$I^A I^B$	$I^B I^B$	$I^B i$
i	$I^A i$	$I^B i$	ii

Possible alleles

Blood types

A	AB	B	O
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Polygenic Inheritance

- 2 or more genes interact with each other to produce a phenotype
- Skin color, hair color, eye color
- Example: Eye color
 - aaBbcc - blue
 - AABbcc - dark brown



What color eyes do you have?



What color eyes do your parents have?

Environmental Effects

- Hydrangea-
 - acidic soil= blue
 - Basic/neutral= pink
- Fur Color- arctic foxes and hares
 - Cold weather- white
 - Warmer weather- brown
- Human traits
 - Height, skin color

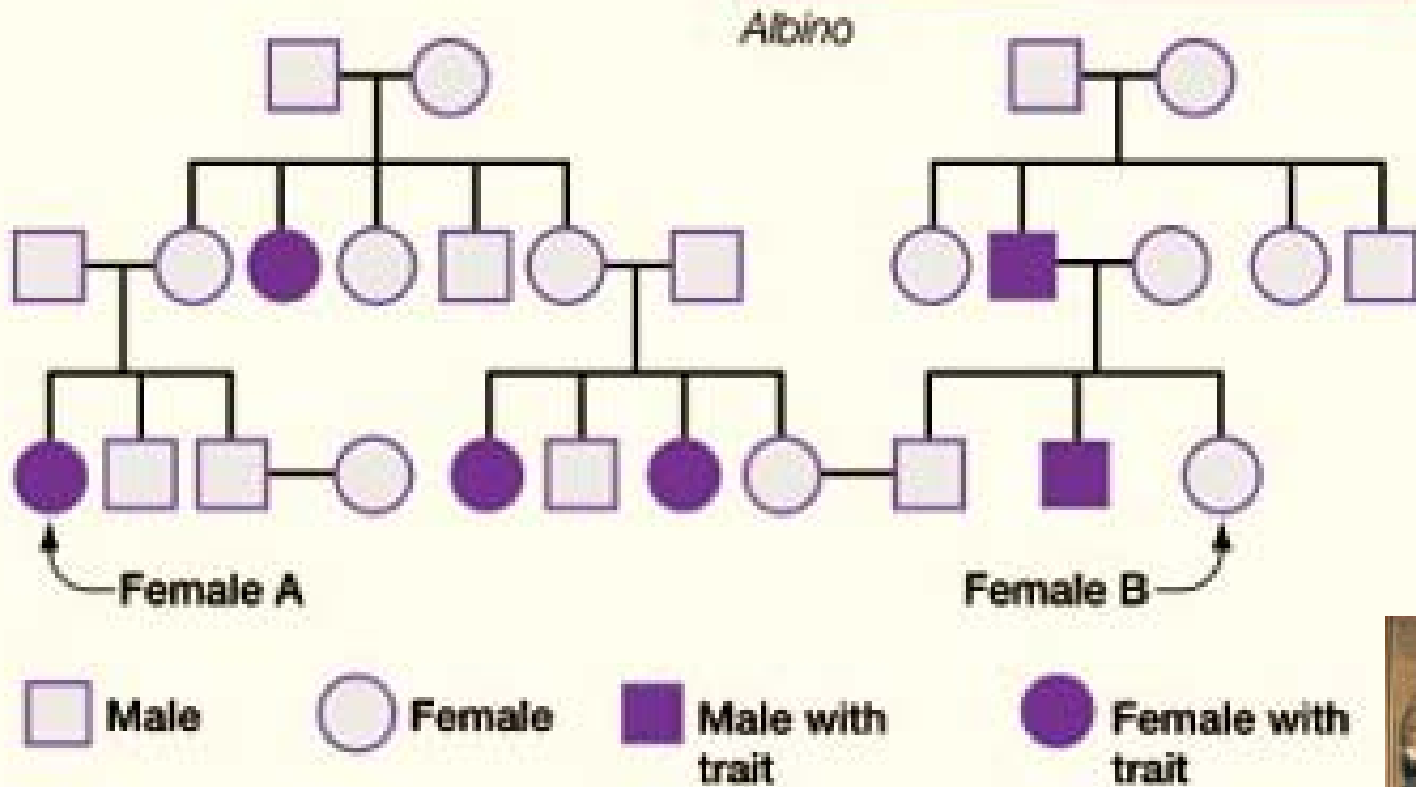




Pedigree




- A way to show the occurrence of a of a genetic trait (phenotype) from generation to generation of a family
- Square = male
- Circle = female
- shaded = homozygous recessive

Pedigree for Albinism



Genetic Disorders

- **Sickle Cell Anemia**
 - recessive genetic disorder that causes an abnormal form of hemoglobin protein.
- **Cystic Fibrosis**
 - fatal recessive trait that causes a defective chloride-ion transport protein.
- **Hemophilia**
 - recessive genetic disorder that leads to a defective blood-clotting factor.
- **Huntington's Disease**
 - dominant genetic disorder that leads to the production of an inhibitor of brain-cell metabolism.

Disorder	Dominant or Recessive	Symptom	Defect	Frequency Among Human Births
Sickle Cell Anemia	Recessive 	Poor blood circulation	Abnormal hemoglobin molecules	1:500 (African Americans)
Hypercholesterolemia	Dominant	Excessive cholesterol levels in blood, leading to heart disease	Abnormal form of cell surface receptor for cholesterol	1:500
Tay-Sachs Disease	Recessive in early childhood	Deterioration of central nervous system; death in early childhood	Defective form of a brain enzyme	1:3,500 (Ashkenazi Jews)
Cystic Fibrosis	Recessive 	Mucus clogs organs including the lungs, liver, and pancreas; affected individuals usually do not survive to adulthood	Defective chloride-ion transport protein	1:2,500 (Caucasians)
Hemophilia A (Classical)	Sex-linked recessive	Failure of blood to clot	Defective form of a blood-clotting factor	1:10,000 (males)
Huntington's Disease	Dominant 	Gradual deterioration of brain tissue in middle age; shortened life expectancy	Inhibitor of brain-cell metabolism is made	1:10,000

Treating Genetic Diseases

A bouquet of purple tulips is the central focus of the slide, set against a dark, textured background. The tulips are in various stages of bloom, with some fully open and others as buds. The lighting highlights the delicate petals and the green leaves.

- **Genetic Counseling**

- Genetic counseling can help patients concerned about a genetic disorder.

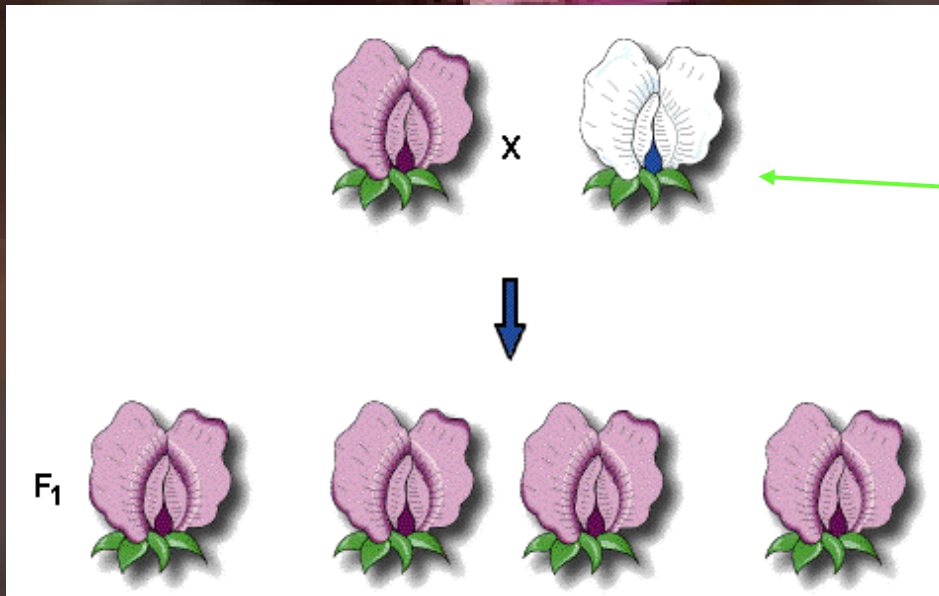
- **Gene Therapy**

- replace defective genes with copies of healthy genes.

Autosomal and Sex-Linked Traits

- Autosomal trait appear in both sexes equally
- Sex-link- a trait with allele on the X chromosome
- Females -XX, Males- XY
- In humans and other creatures, the y chromosome is very small.
- Trait is only carried on the X,
- No matching allele on the Y

Some Problems



What are the genotypes of the

P

F₁

Sources

- <http://esg-www.mit.edu:8001/esgbio/mg/mgdir.html>
- <http://vcourseware5.calstatela.edu/VirtualFlyLab/Design.html>
- <http://gened.emc.maricopa.edu/bio/bio181/BIOBK/BioBookgenintro.html>
- <http://wsrv.clas.virginia.edu/~rjh9u/slidlis.html>