

Beyond Mendel's Laws of Inheritance



Extending Mendelian genetics

- Mendel worked with a simple system
 - peas are genetically simple
 - most traits are controlled by a single gene
 - each gene has only 2 alleles, 1 of which is completely dominant to the other
- The relationship between genotype & phenotype is rarely that simple



AP Biology

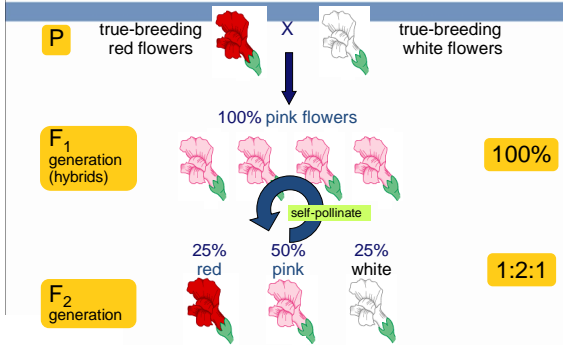
Incomplete dominance

- Heterozygote shows an intermediate, blended phenotype
 - example:
 - RR = red flowers → RR
 - rr = white flowers → WW
 - Rr = pink flowers → RW
 - make 50% less color



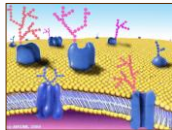
AP Biol

Incomplete dominance



Co-dominance

- 2 alleles affect the phenotype equally & separately
 - not blended phenotype
 - human ABO blood groups
- 3 alleles
 - I^A, I^B, i
 - I^A & I^B alleles are co-dominant
 - glycoprotein antigens on RBC
 - I^AI^B = both antigens are produced
 - i allele recessive to both



AP Biology

Genetics of Blood type

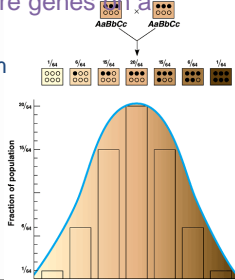
phenotype	genotype	antigen on RBC	antibodies in blood	donation status
A		antigens on surface of RBC	antibodies	—
B		antigens on surface of RBC	antibodies	—
AB		antigens on surface of RBC	antibodies	
O		on surface of RBC	antibodies	

AP Biology

Polygenic inheritance

- Some phenotypes determined by additive effects of 2 or more genes on a single character

- phenotypes on a continuum
- human traits
 - skin color
 - height
 - weight
 - intelligence
 - behaviors



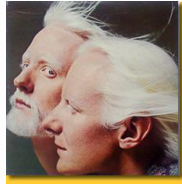
AP Biology

Skin color: Albinism

- Albinism is inherited as a single gene trait
 - aa = albino



albino Africans



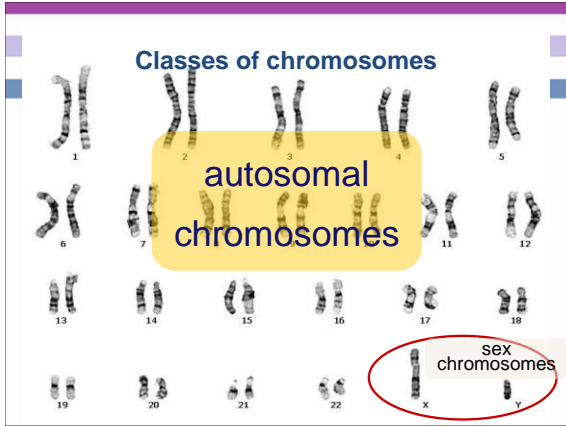
melanin = universal brown color

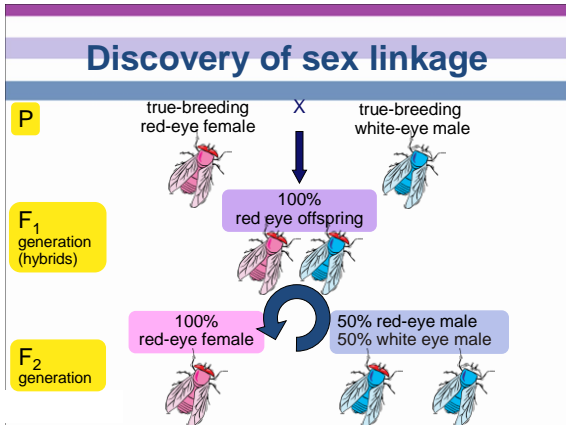


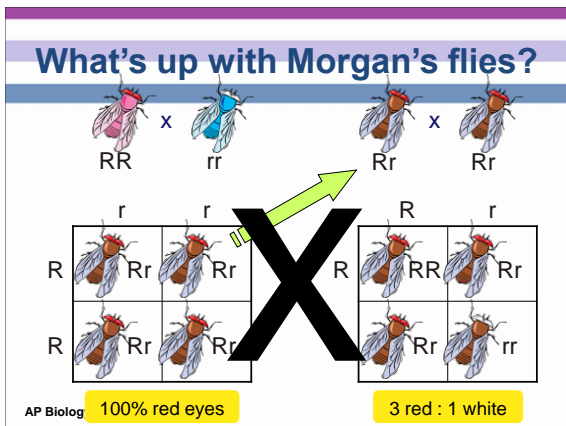
Sex linked traits 1910 | 1933

- Genes are on sex chromosomes
 - as opposed to autosomal chromosomes
 - first discovered by T.H. Morgan at Columbia U.
- Drosophila* breeding
 - good genetic subject
 - prolific
 - 2 week generations
 - 4 pairs of chromosomes
 - XX=female, XY=male









Genetics of Sex

- In humans & other mammals, there are 2 sex chromosomes: X & Y

- 2 X chromosomes



- develop as a female: **XX**
- gene redundancy, like autosomal chromosomes

- an X & Y chromosome



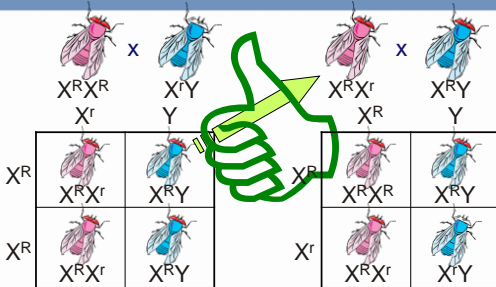
- develop as a male: **XY**
- no redundancy

	X	Y
X	XX	XY
X	XX	XY

AP Biology

50% female : 50% male

Let's reconsider Morgan's flies...



AP Biology

100% red eyes

100% red females
50% red males; 50% white males

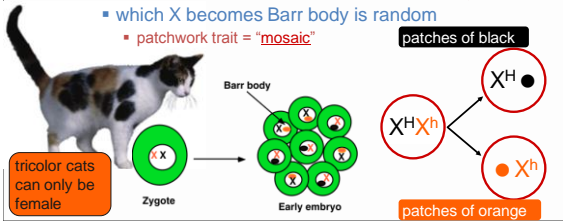
Genes on sex chromosomes

- Y chromosome
 - few genes other than **SRY**
 - sex-determining region
 - master regulator for maleness
 - turns on genes for production of male hormones
 - many effects = **pleiotropy!**
- X chromosome
 - other genes/traits beyond sex determination
 - mutations:
 - hemophilia
 - Duchenne muscular dystrophy
 - color-blindness

AP Biology

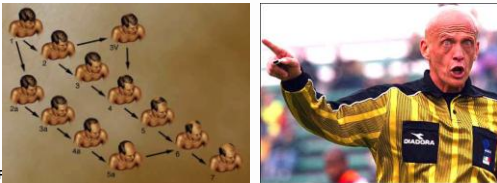
X-inactivation

- Female mammals inherit 2 X chromosomes
 - one X becomes inactivated during embryonic development
 - condenses into compact object = **Barr body**
 - which X becomes Barr body is random
 - patchwork trait = "mosaic"



Male pattern baldness

- Sex influenced trait
 - autosomal trait influenced by sex hormones
 - age effect as well = onset after 30 years old
 - dominant in males & recessive in females
 - $B_ =$ bald in males; $bb =$ bald in females



Environmental effects

- Phenotype is controlled by both environment & genes



Color of Hydrangea flowers is influenced by soil pH



Coat color in arctic fox influenced by heat sensitive alleles
