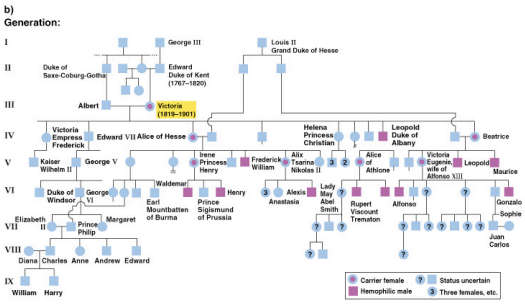
Lecture Outline 9/8/05

- Finish pedigrees for X-linked traits
  - Several more example problems
- Chromosomal basis of inheritance
  - Chromosome structure and packaging
  - Mitochondrial and Chloroplast genomes

Pedigree of Queen Victoria (III-2) and her descendants, showing the X-linked recessive inheritance of hemophilia

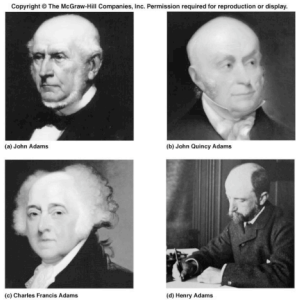


Question:

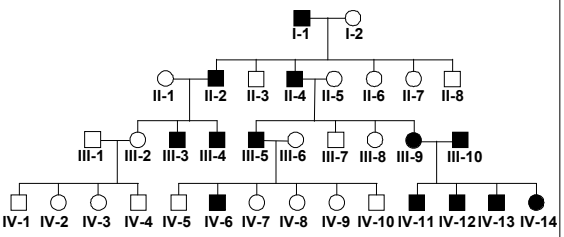
(We didn't do this one in class)

- In 1995, a sixty-three year old man named Eugene Romanov, a resident of the former Soviet Union, turned up.
- He shared both the disease and last name; claimed to be the grandson of Anastasia.
  - Said Anastasia was raised by a farmer, and later she married a nephew of her adopted parents and had a daughter, Eugene's mother.
- A) According to Eugene's argument, determine the hemophilia status of his mother, father, grandmother and grandfather.
- B) Is his story plausible?

Male-pattern baldness



Pedigree for Adams lineage showing incidence of male-pattern baldness



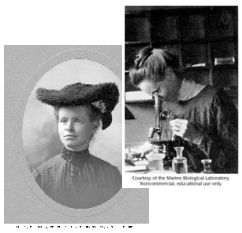
The trait is predominantly in males.

-> Is it X-linked? How can you tell?

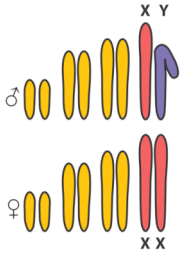
Another practice question

- White eyes (*w*) is a recessive gene on the X chromosome of *Drosophila melanogaster* and ebony body (*eb*) is a recessive gene on an autosome.
- A true breeding white-eyed female with normal body is crossed to a normal-eyed, ebony male (to make an F1).
  - How would you notate this cross?
    X^wX^w E/E x X/Y e/e
  - What is/are the phenotypes of the F1?
- Now the F1 are intercrossed to make an F2 generation. What are the expected phenotypes?
  Remember:determine what gametes can be produced
  Then combine gametes to make F2

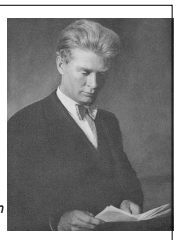
The chromosome theory of inheritance was worked out around 1900



Nettie Stevens first identified X and Y chromosomes

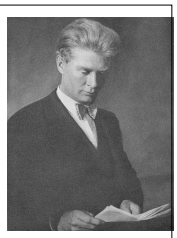


Non-disjunction of X



- Calvin Bridges discovery of rare non-disjunction events confirmed patterns of sex-linked inheritance.
  - *Can you work out the inheritance patterns in crosses with attached x chromosomes?*
- Attached X still a useful genetic tool in flies
  - (because Y0 and XXX flies die)
  - Example from current literature-- screening for x-linked mutations

Non-disjunction of X



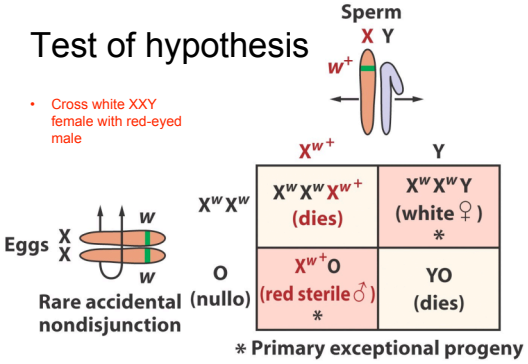
- Cross white-eyed female by red-eyed male fruit fly

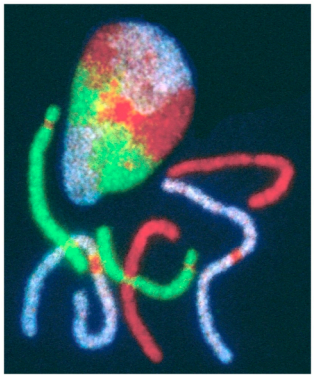
  X^w/X^w x X/Y

- What do you expect?
  - Very rarely, he found white-eyed females and red-eyd males. Why?

Test of hypothesis

- Cross white XXY female with red-eyed male





Structure of Chromosomes

- DNA plus associated proteins = chromatin
  - Euchromatin vs heterochromatin
- Bacterial chromosomes tend to be circular, eukaryotic chromosomes linear
- Two important heterochromatic regions are
  - Centromeres
    - Essential for mitosis and meiosis
    - Range from 120bp to many thousands
    - No obvious sequence similarity across taxa
  - Telomeres
    - Protective "caps" at ends of chromosomes
    - Usually consist of short sequences repeated back to back (tandem repeats)

Table 3-2 Numbers of Pairs of Chromosomes in Different Species of Plants and Animals

Common name	Scientific name	Number of chromosome pairs	Common name	Scientific name	Number of chromosome pairs
Mosquito	*Culex pipiens*	3	Wheat	*Triticum aestivum*	21
Housefly	*Musca domestica*	6	Human	*Homo sapiens*	23
Garden onion	*Allium cepa*	8	Potato	*Solanum tuberosum*	24
Toad	*Bufo americanus*	11	Cattle	*Bos taurus*	30
Rice	*Oryza sativa*	12	Donkey	*Equus asinus*	31
Frog	*Rana pipiens*	13	Horse	*Equus caballus*	32
Alligator	*Alligator mississipiensis*	16	Dog	*Canis familiaris*	39
Cat	*Felis domesticus*	19	Chicken	*Gallus domesticus*	39
House mouse	*Mus musculus*	20	Carp	*Cyprinus carpio*	52
Rhesus monkey	*Macaca mulatta*	21			

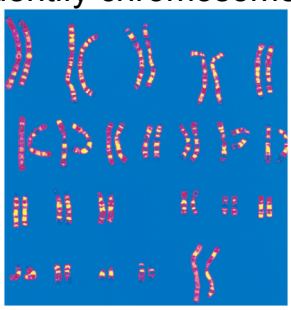
Table 3-3 Human Chromosomes

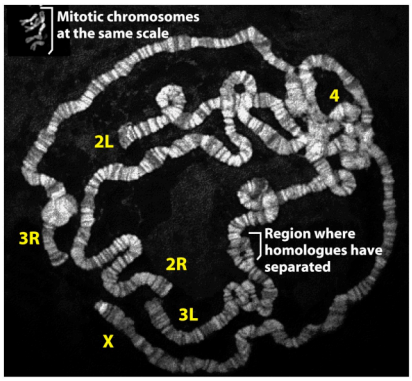
Group	Number	Diagrammatic representation	Relative length*	Centromeric index†
		Large chromosomes		
A	1		8.4	48 (M)
	2		8.0	39
	3		6.8	47 (M)
B	4		6.3	29
	5		6.1	29
		Medium chromosomes		
C	6		5.9	39
	7		5.4	39
	8		4.9	34
	9		4.8	35
	10		4.6	34
	11		4.6	40
	12		4.7	30
D	13		3.7	17 (A)
	14		3.6	19 (A)
	15		3.5	20 (A)
		Small chromosomes		
E	16		3.4	41
	17		3.3	34
	18		2.9	31
F	19		2.7	47 (M)
	20		2.6	45 (M)
G	21		1.9	31
	22		2.0	30
		Sex chromosomes		
	X		5.1 (group C)	40
	Y		2.2 (group G)	27 (A)

* Percentage of the total combined length of a haploid set of 22 autosomes.

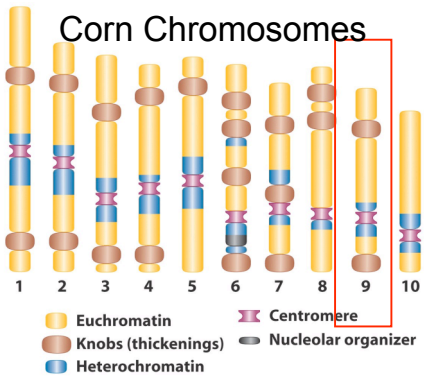
† Percentage of a chromosome's length spanned by its short arm. The four most metacentric chromosomes are indicated by an (M); the four most acrocentric by an (A).

Banding patterns are used to identify chromosomes





Corn Chromosomes



Creighton and McClintock

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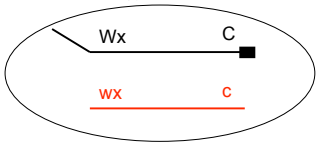
Genes are linked on chromosomes

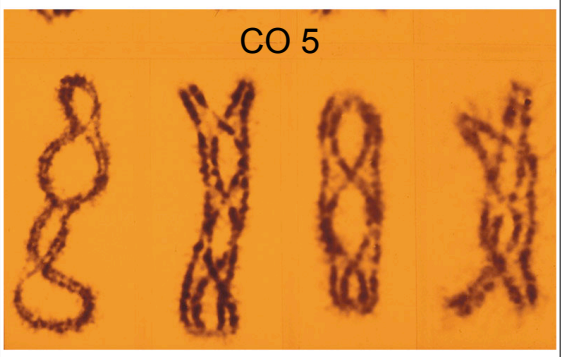
- A variant of Chromsome 9 had genes for for waxy and colored kernels of corn, and distinctive morphology



They crossed this heterozygote with recessive wx/wx c/c

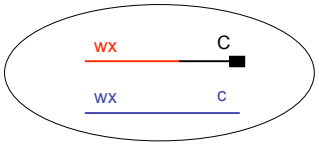
What are the expected offspring?

Harriet Creighton and Barbara McClintock



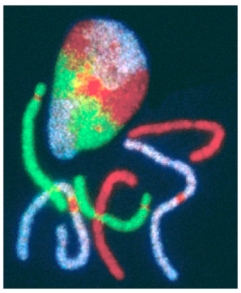
Genes are linked on chromosomes

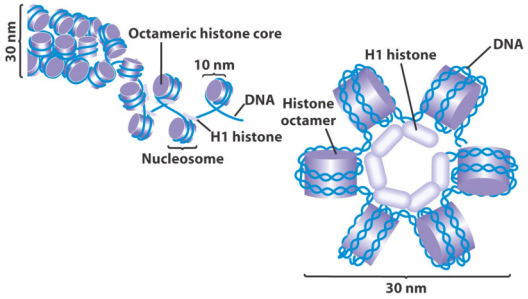
- Some offspring had Colored, but not waxy kernels (C/c, wx/wx).
  - How could that be?

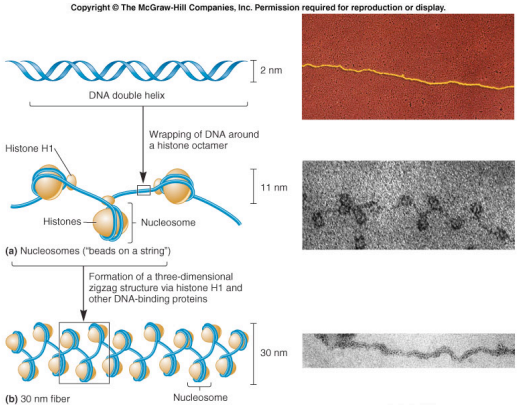


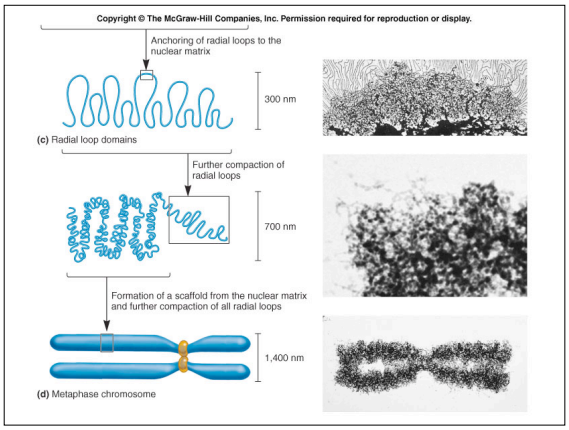
Harriet Creighton and Barbara McClintock

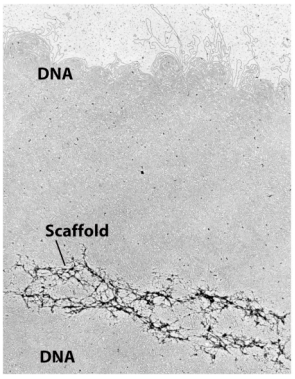
How are chromosome packed into cells?



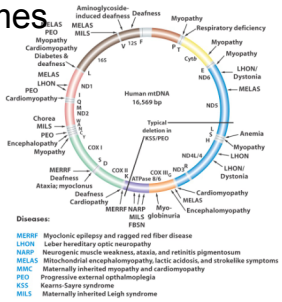


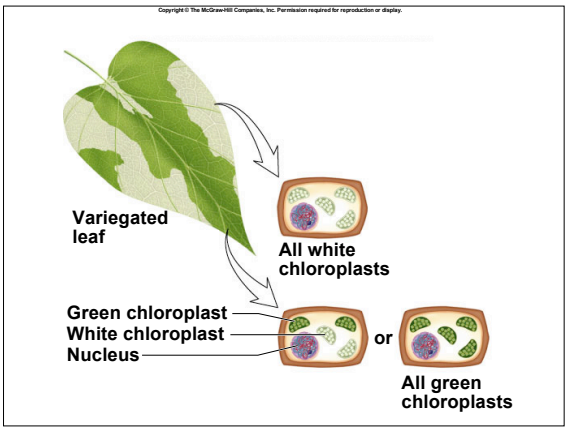




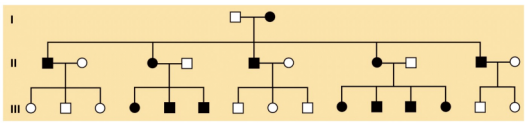


Mitochonrdia and Chloroplasts have their own chromosomes





Pedigree for Mitochondrial trait



Strictly maternal inheritance

For next time:

- Read Chapter 4
- Finish first two homework assignments for recitation next week