INTRO TO GENETICS, MENDELIAN ANALYSIS

1/5/94, rvsd 1/26/94, 1/4/95, 1/3/96, 1/9/96, 1/6/97, 1/5/98, 1/5/00, 3 Jan 01, 7 Jan 02, 7 Jan 04, 9 Jan 08, 7Jan09, 6Jan10 4Jan11, 6Jan12
GMSLG, P 22-32, 7th: 28-37, Griffiths, Wessler, Lewontin and Carroll, 9th Ed: 31-42

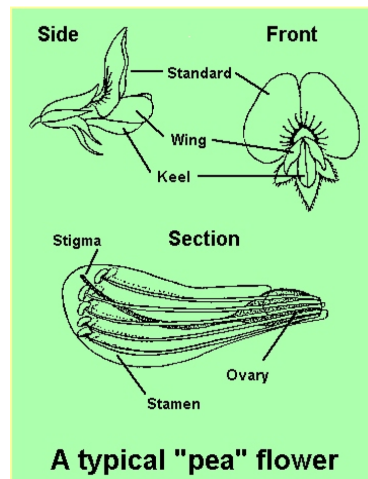
Gregor Mendel (1822-1884) Czech from Brno, trained to be teacher, twice failed teacher's test, retreated to monastery. Took science and math courses there. See my web page on my "pilgrimage" to Brno:
http://biology.clc.uc.edu/Fankhauser/Travel/Berlin/for_web/Mendel_in_Brno.html
Smithsonian article quoting DBF on visit to Brno:
http://www.smithsonianmag.com/travel/evotourism/Evotourism-World-Tour-Mendels-Garden-Czech-Republic.html
He convinced abbot to place him in charge of the Abby garden. (Keenly interested in data collection: weather, bees, etc)
Took to breeding *Pisum sativum*, keeping 1) careful records, 2) applied math analysis to data
Peas *(Pisum sativum)* were an excellent choice for several reasons:

1) **Naturally self pollinating** They therefore tended to breed true [we now know they were therefore mostly **homozygous**]
2) **Many varieties** were readily available commercially (p 38)
3) **Multiple crosses in a single season** (esp in green house), **got many progeny/cross** (i.e., many seeds)

How to perform cross (see p. 38):
1) **emasculate** immature flower by removing anthers
2) **pollinate** brushing stigma of emasculated plant with pollen from different parent
3) **save seeds, plant** record numbers of progeny with particular **phenotype**

MONOHYBRID CROSS (**phenotype** is the observed physical trait, **genotype** is the genetic makeup)

P = **parental generation** crossed to produce F_1 (Parental usually from pure lines)
ex: P phenotypes: *true-breeding white* times *true-breeding purple* flowered plants (also did reciprocal cross, purple x white)
(Note: alternate forms of same trait = **allele** ("other form")
F_1= **first filial generation** self pollinates (selfed) to produce F_2
ex: F_1 phenotype: *all* purple F_1 (purple is therefore the **DOMINANT** allele, white the **RECESSIVE**)
F_2 = **second filial generation**: progeny of F_1 x F_1
ex: F_2 phenotypes 929 seeds, planted: 705 purple
224 white (close to 3:1 ratio)



A typical "pea" flower
(Woolcock; "Australian Plants", (12) 95

He selected seven pure-lined pairs of traits to cross: same 3:1 ratio (table on p. 40):

			F_2 numbers of phenotypes:	
PHENOTYPE	**Dominant**	**Recessive**	**Dom**	**Recessive**
seed shape	round	wrinkled	5474	1850
seed color	yellow	green	6022	2001
flower color	purple	white	651	207
pod shape	inflated	pinched	882	299
pod color	green	yellow	428	152
flower position	axial	terminal	705	224
stem length	long	dwarf	787	277

"Blending" is disproved: 1) F_1 showing only dominant phenotype
2) reappearance of recessive phenotype in F_2

He proposed that the dominant phenotype in F_2 is composed of two distinct genotypes:
519 F_2 selfed, progeny scored: 166 only yellow, 353 yellow and green in 3:1 ratio

TEST CROSS: Def: cross dominant phenotype of unknown genotype times recessive phenotype: as Mendel did (p 41 far right)
predicted: 1:1 yellow to green when F_1 yellow is back crossed to green
result: 58 yellow and 52 green peas

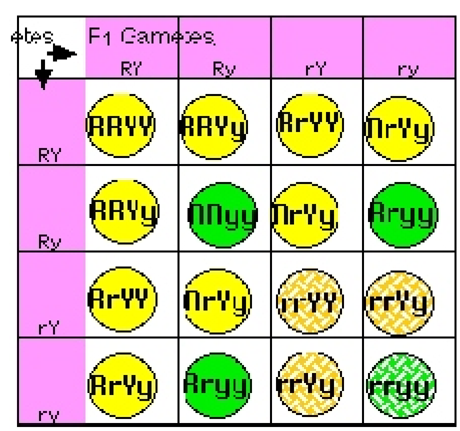
These were monohybrid crosses, for single set of alleles.

Mendel's laws, proposed in 1866. Ignored for 34 years, [Rediscovered in 1900, 34 yr later)]

I. MENDEL'S FIRST LAW OF *EQUAL SEGREGATION*: Each parent carries two copies of each hereditary determinant (gene) for each trait (**diploid**). When gametes are formed, pairs of alleles segregate in a 50:50 ratio.
If two copies are identical, **HOMOZYGOUS**
If two copies are different, **HETEROZYGOUS**

Fank restates Mendel's First law: a: a trait is due to pair of hereditary factors (genes)
b: gametogenesis: the pair segregates with = probability

II. MENDEL'S SECOND LAW OF *INDEPENDENT ASSORTMENT*
During gamete formation, alleles of one gene **assort independently** of those of another gene.
I.e., Multiple pairs assort independent of each other
ex: **DIHYBRID CROSS:** Round green X wrinkled yellow (RRyy X rrYY)
Got 100% RY F_1, but 9:3:3:1 RY, Ry, rY, ry pattern in F_2 (p 93)
NOTE: *only* true when genes are on separate chromosomes..



PROBABILITY laws to predict probability of progeny (See next set of lecture notes.)