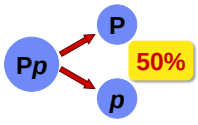
Genetics & Probability

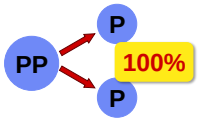
- Mendel's laws:
  - segregation
  - independent assortment

reflect same laws of probability that apply to tossing coins or rolling dice

Genetics & Probability

- Calculating probability of making a specific gamete is just like calculating the probability in flipping a coin
  - probability of getting a **P** gamete?
  - probability making a **P** gamete?

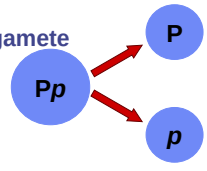




Genetics & Probability

- Outcome of 1 toss has no impact on the outcome of the next toss
  - probability of tossing heads each time? **50%**

  - probability making a **P** gamete each time? **50%**



Rule of Multiplication

- Chance that 2 or more independent events will occur together
  - probability that 2 coins tossed at the same time (or 1 coin on two consecutive flips) will land heads up

1/2 x 1/2 = 1/4

  - probability of Pp x Pp → pp

1/2 x 1/2 = 1/4

Calculating Dihybrid Probability

- Rule of multiplication also applies to dihybrid crosses (as long as you don't have linked genes on the same chromosome)
  - heterozygous parents — YyRr
  - probability of producing yyrr?
    - probability of producing y gamete = 1/2
    - probability of producing r gamete = 1/2
    - probability of producing yr gamete = 1/2 x 1/2 = 1/4
    - probability of producing a yyrr offspring = 1/4 x 1/4 = 1/16

Rule of Addition

- Chance that an event can occur 2 or more different ways
  - sum of the separate probabilities
    - think of all the ways you can roll a 7!
  - probability of Pp x Pp → Pp

sperm		egg		offspring
P		p		Pp
1/2	x	1/2	=	1/4
p		P		Pp
1/2	x	1/2	=	1/4

1/4
+ 1/4
1/2

Calculating Probability

Pp x Pp

male / sperm: P, p

female / eggs: P, p

	P	p
P	PP	Pp
p	Pp	pp

sperm	egg	offspring
P 1/2	x P 1/2	= PP 1/4
P 1/2	x p 1/2	= Pp 1/4
p 1/2	x P 1/2	= Pp 1/4
p 1/2	x p 1/2	= pp 1/4

1/2

Chi-square Test (Analysis)

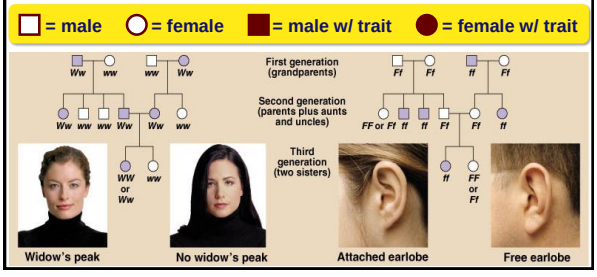
- Test to see if your data supports your hypothesis
- Compare "expected" vs. "observed" data

H_0
- Do the data occur in the predicted ratio of **A : B** ? Is there no stat. sig. difference between expected and observed numbers? Is the variance from expected due to "random chance"? (not stat. sig.)

H_A
- Is there a stat. sig. difference between expected and observed numbers? Is the variance from expected due to possibly a ***different inheritance pattern***? (stat. sig.)

Pedigree Analysis

- Pedigree analysis reveals Mendelian patterns in human inheritance
  - data mapped on a family tree



Genetic Counseling

- Pedigree can help us understand the past & predict the future
- Thousands of genetic disorders are inherited as simple recessive traits
  (can be benign conditions to deadly diseases)
  - albinism
  - cystic fibrosis
  - Tay sachs
  - sickle cell anemia
  - PKU

Recessive Diseases

- The diseases are recessive because the allele codes for either a malfunctioning protein or no protein at all
  - Heterozygotes (Aa)
    - carriers
    - have a normal phenotype because one "normal" allele produces enough of the required protein

How a hidden disease reveals itself…

AA x Aa

Aa x Aa

	A	A
A	AA	AA
a	Aa	Aa

	A	a
A	AA	Aa
a	Aa	aa