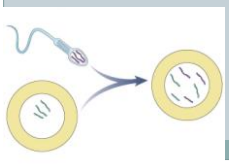
AICE Biology

Probability & Genetics



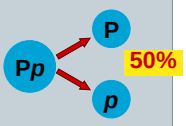
Genetics & Probability

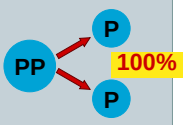
- Mendel's laws:
  - segregation
  - independent assortment

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

Probability & genetics

- Calculating probability of making a specific gamete is just like calculating the probability in flipping a coin
  - probability of tossing heads? 50%
  - probability making a P gamete...



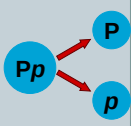


Probability & genetics

- Outcome of 1 toss has no impact on the outcome of the next toss
  - probability of tossing heads each time?
  - probability making a P gamete each time?

50%

50%



Calculating probability

Pp x Pp

male / sperm

female / eggs

	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 =	1/4
		1/2
p 1/2	x p 1/2 =	pp 1/4

Rule of multiplication

- Chance that 2 or more independent events will occur together
  - probability that 2 coins tossed at the same time will land heads up

1/2 x 1/2 = 1/4

  - probability of Pp x Pp → pp

1/2 x 1/2 = 1/4

AICE Biology

Calculating dihybrid probability

- Rule of multiplication also applies to dihybrid crosses
  - 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
  - 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

Chi-square test

- Test to see if your data supports your hypothesis
- Compare "observed" vs. "expected" data
  - is variance from expected due to "random chance"?
- Other important aspects:
  - Null Hypothesis: that there is no significant difference in proportions between groups

Chi-square test

- Equation:

$$\chi^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

Chi-square test

- Determine degrees of freedom (df):
  - df= Total possible outcomes – 1
  - (row numbers)(column numbers) -1
- Compare answer to a chi-squared significance chart:
  - P value = chance alone caused this result, i.e., if P=0.05, less than a 5% chance this was random

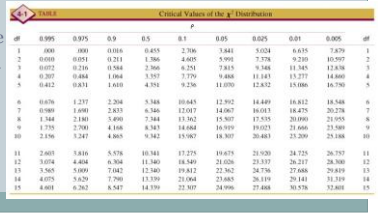


TABLE Critical Values of the χ^2 Distribution

df	0.995	0.975	0.9	0.5	0.1	0.05	0.025	0.01	0.005	df
1	.000	.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879	1
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597	2
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838	3
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860	4
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750	5
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548	6
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278	7
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955	8
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589	9
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188	10
11	2.603	3.816	5.578	10.341	17.275	19.675	21.920	24.725	26.757	11
12	3.074	4.404	6.304	11.340	18.549	21.026	23.337	26.217	28.300	12
13	3.565	5.009	7.042	12.340	19.812	22.362	24.736	27.688	29.819	13
14	4.075	5.629	7.790	13.339	21.064	23.685	26.119	29.141	31.319	14
15	4.601	6.262	8.547	14.339	22.307	24.996	27.488	30.578	32.801	15