

Competition 8 - Evolution puzzles

Probability of passing on diseases by genes.

Part 1: If your parents both have only one copy of the gene – so they both have AB – what is the probability that you inherit the disease?

- **AA** = two copies of the gene (passed on genetically)
- **Parent 1** = AB
- **Parent 2** = AB

(1 copy of the gene each)

Possible outcomes for inheritance:

A + A	= $\frac{1}{4}$ (25%)
A + B	
B + A	
B + B	

Part 2: If the prevalence of the gene in the general population is 20%, and you have one copy – so you have AB – what is the probability that your child develops the disease?

- **Gene in general population = 20%**
- $20\% = \frac{1}{5}$
- $\frac{1}{5} \times \frac{1}{4} = \frac{1}{20}$

Part 3: If you select two people at random from the general population, what is the chance that their child will develop the disease?

- **Gene in general population = 20%**
- $\frac{1}{5} \times \frac{1}{5} \times \frac{1}{4} = \frac{1}{100}$ (1%)

Part 4: If you are a carrier of the gene (you have only one copy of it, i.e., you are AB), what is the chance that it is passed onto your offspring and continues in the population (i.e. your children are also carriers)?

Combinations for offspring

		Partner	
		A	B
You	A	AA	BA
	B	AB	BB

You

50% from the chart

$$= \frac{1}{1} \times \frac{1}{5} \times \frac{1}{2} = \frac{1}{10}$$

20% from the population

Part 5: Finally, if you are a carrier of the gene, what is the probability that your grandchildren are also carriers? Assume that the prevalence of the gene in the general population stays at 20% in your children's generation.

$$\frac{1}{10} \times \frac{1}{5} \times \frac{1}{2} = \frac{1}{100} \text{ (grandchildren as a carrier)}$$

Child carrier of gene

Population carrier of gene (20%)

From chart (2parents) of grandchild