

Competition 8: evolution puzzles

- Disease X is genetically passed on
- it is recessive (AA)
 - the disease stops you from having kids

Part 1:

	A	B	25% chance of inheriting disease
A	AA	AB	
B	AB	BB	50% chance of carrying

Part 2:

prevalance of the gene is 20%.

$$\rightarrow \frac{6}{7} AB, \frac{1}{7} AA$$

$$\frac{20}{100} \times \frac{6}{7} = \frac{6}{35}$$

$\frac{6}{35}$ chance of mating with someone in the population with AB

$\frac{1}{4}$ chance of offspring inheriting disease

$$\frac{6}{35} \times \frac{1}{4} = \frac{3}{70}$$

	B	B	
A	AB	AB	50% chance of carrying
B	BB	BB	0% chance of inheriting

$\frac{3}{70}$ chance of your child inheriting the disease.

Part 3:

P(AB*AB) in the population is $\frac{6}{35} \times \frac{6}{35} = \frac{36}{1225}$

probability of inheriting disease: $\frac{36}{1225} \times \frac{1}{4} = \frac{9}{1225}$

0.7% chance of two random people having a child with the disease.

Part 4:

80% chance of mating with someone of BB

↳ 50% chance of offspring being a carrier

$$\frac{8}{10} \times \frac{1}{2} = \frac{2}{5} \text{ or } 40\%$$

$\frac{6}{35}$ chance of mating with someone of AB with a

50% chance of offspring being a carrier

$$\frac{6}{35} \times \frac{1}{2} = \frac{3}{35}$$

$$\frac{2}{5} + \frac{3}{35} = \frac{17}{35} \text{ or } 48.57\% = 49\%$$

Part 5:

P(AB*AB)

$$\frac{17}{35} \times \frac{6}{35} = \frac{102}{1225}$$

$$\frac{102}{1225} \times \frac{1}{2} = \frac{51}{1225}$$

P(AB*BB)

$$\frac{17}{35} \times \frac{8}{10} = \frac{68}{175}$$

$$\frac{68}{175} \times \frac{1}{2} = \frac{34}{175}$$

P(BB*AB)

$$\frac{31}{70} \times \frac{6}{35} = \frac{93}{1225}$$

$$\frac{93}{1225} \times \frac{1}{2} = \frac{93}{2450}$$

probability of your child having BB:

$$\frac{6}{35} \times \frac{1}{4} = \frac{3}{70}$$

$$\frac{3}{70} + \frac{2}{5} = \frac{31}{70}$$

overall probability of grandchild being a carrier:

$$\frac{51}{1225} + \frac{34}{175} + \frac{93}{2450} = \frac{671}{2450} \text{ or } 27.38775\% \approx 27\%$$