

## Evolution Puzzles

### Part 1:

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

**A:**

1. Two parents with the genes AB and AB give rise to the four permutations: AA, BB, AB or BA.
2. AA means having the disease.
3. AA is  $\frac{1}{4}$  of the options AA, BB, AB or BA.

### Part 2:

**Q:** 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?

**A:**

1. Parent 1 = AB (me), Parent 2 = 20 % chance of AB or BA (passing on the gene).
2. If parent 2 has AB or BA then there is a  $\frac{1}{4}$  chance of our child having the disease. (see part 1)
3. So the probability of our child having AA is  $\frac{1}{4}$  of 20% or 5% chance.

### Part 3:

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

**A:**

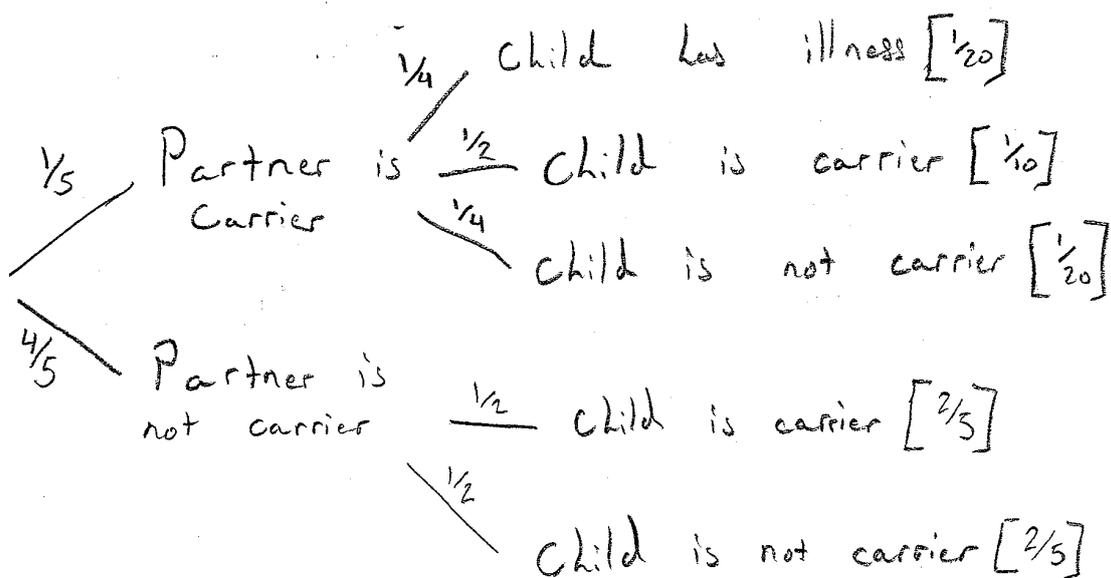
1. 20% chance that person 1 has the gene and 20% chance that person 2 has the gene.
2. And 25% chance that the child develops the disease.
3.  $20\% \times 20\% = 4\%$
4.  $4\% \times 25\% = \underline{1\%}$  chance the child will develop the disease.

Part 4:

**Q:** 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)?

**A:**

1. My offspring can either inherit AA or BB or AB or BA variants of the gene.
2. Of those AB and BA are carriers.
3. My partner cannot be AA since we are having a child.
4. If my partner is AB there is a 50% chance our child will be a carrier.
5. If my partner is BA there is a 50% chance our child will be a carrier.
6. If my partner is BB there is a 50% chance our child will be a carrier.
7. Thus there is a 50% that our child will be a carrier.



Part 5:

**Q:** 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.

**A:**

1. I stated in part 4 that there is a 50% chance my child is a carrier.
2. However, since they can't be AA because they are having a child then there is a 10/19 chance that my child is a carrier. And a 9/19 chance that my child is not a carrier
3. My child's partner has a 20% chance of being a carrier, as stated in the question.
4. The probability of my grandchild being a carrier is 59/190.

