1. If a child has type O (ii) blood and the father has type B (I^B I^B or I^B i), the mother
   a. can be any blood type except O.
   b. can be any blood type except AB.
   c. must be type O.
   d. can be either type A or AB.
   e. must have fooled around to have this child.
   Since the mother donated an i allele, she could have been A (I^A i), B (I^B i), or O (ii).

2. In radishes, red and white are the pure-breeding colors and long and round are the pure-breeding shapes, while the hybrids are purple and oval. The cross of a purple long with a purple oval will produce all but which of the following phenotypes?
   a. red and oval
   b. purple and oval
   c. purple and oval
   d. red and long
   e. white and oval
   This is a case of incomplete dominance. If we use R for color and L for shape:
   RR = Red; Rr = purple; rr = white
   LL = Long; Ll = oval; ll = round
   The cross is RrLL x RrLl. All combinations are possible except ll = round. Therefore b. is the correct answer.

3. If a child belonged to blood type AB (I^A I^B), he or she could NOT have been produced by which set of parents?
   a. Type A (could donate I^A) mother and type B (could donate I^B) father
   b. Type B (could donate I^B) mother and type A (could donate I^A) father
   c. Type AB mother and type O (cannot donate either I^A or I^B) father
   d. Type AB (could donate either I^A or I^B) mother and type AB (could donate either I^A or I^B) father
   e. a and c could not, but both b and d could produce a type AB child

4. In cocker spaniels, black coat color (B) is dominant over red (b), and solid color (S) is dominant over spotted (s). If a red spotted male (bbss) were crossed with a red solid female (bbSs), the most common phenotype would be

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Half of the offspring are expected to be red and solid and half are expected to be red and spotted.
5. In cocker spaniels, black coat color ($B$) is dominant over red ($b$), and solid color ($S$) is dominant over spotted ($s$). If a black solid male is crossed with a red solid female to produce a red spotted puppy, the genotypes of the parents (with male genotype first) would be

The best way to approach this is to list what we do know. The father’s genotype is $B_S_-$ and the mother’s is $bbS_$. The puppy is $bbss$. One $b$ allele came from mom so the other must have come from dad. He must be $Bb$. One $s$ allele came from dad so he must be $Ss$. The other $s$ allele came from mom so she must be $Ss$. Therefore, father’s genotype is $BbSs$ and mother’s genotype is $bbSs$.

6. Determine the possible genotypes of the parents shown below by analyzing the phenotypes of their children. In this case, we will assume that brown eyes ($B$) is dominant to blue ($b$) and that right-handedness ($R$) is dominant to left-handedness ($r$).

a. Parents: brown eyes, right-handed X brown eyes, right-handed
   Offspring: 3/4 brown eyes, right-handed
               1/4 blue eyes, right-handed
   Since all the offspring are right-handed, the parents are both $RR$. Since there is a 3 brown: 1 blue ratio, both parents are $Bb$. Therefore both parents are $BbRR$ or one parent could be $BbRr$.

b. Parents: brown eyes, right-handed X blue eyes, right-handed
   Offspring: 6/16 blue eyes, right-handed
               2/16 blue eyes, left-handed
               6/16 brown eyes, right-handed
               2/16 brown eyes, left-handed
   Since there is an 8 brown: 8 blue ratio, the brown-eyed parent is $Bb$. Since there is a 12 right-handed: 4 left-handed ratio, both parents are $Rr$. Therefore the cross is $BbRr$ X $bbRr$.

c. Parents: brown eyes, right-handed X blue eyes, left-handed
   Offspring: 1/4 brown eyes, right-handed
               1/4 brown eyes, left-handed
               1/4 blue eyes, right-handed
               1/4 blue eyes, left-handed
   Since there is a 2 brown: 2 blue ratio, the brown-eyed parent is $Bb$. Since there is a 2 right-handed: 2 left-handed ratio, the right-handed parent is $Rr$. Therefore the cross is $BbRr$ X $bbrr$. 
In cats with the Manx trait, the $M$ allele causes a short or absent tail, whereas the $m$ allele confers a normal, long tail. Cats of genotype $MM$ die as embryos (homozygous lethal allele). If two Manx cats mate, what is the probability that they will have a living kitten with a long tail?

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Since $MM$ leads to death of the embryo and not a live birth, the Manx cats must both be $Mm$. $Mm$ will be Manx cats; $mm$ will have a long tail. Of the live births, $1/3$ will have a long tail.

George is colorblind. His one brother and five sisters are not. The boy has three maternal uncles and four maternal aunts. None of his uncles’ children or grandchildren are colorblind. One of the maternal aunts married a colorblind man, and half of their children, both male and female, are colorblind. The other aunts married men who have normal color vision. All their daughters have normal vision, but half of their sons are colorblind.

a. Which of the George’s four grandparents transmitted the gene for colorblindness?
   Since the only incidences of colorblindness are on George’s maternal side, George must have inherited the defective $X$ chromosome from his mother. Since there is no mention of either grandfather being colorblind, we can assume that the defective allele resides with George’s maternal grandmother.

b. Are any of the George’s aunts or uncles colorblind?
   Since none of his uncles’ children or grandchildren are colorblind, we can assume that his uncles are not colorblind.

c. Are either of George’s parents colorblind?
   Since we have identified George’s mother as having a defective $X$ chromosome, we can assume that she is a carrier. George’s father is not colorblind.

d. If George married a woman who was a carrier for the colorblindness gene, what would be the chances of them having a colorblind child? a carrier child? a normal, non-carrier child?
   They would have a 50% chance of having a colorblind child ($X^cX^c$, $X^cY$), a 25% chance of having a carrier child ($XX^c$), and a 25% chance of having a normal, non-carrier child ($XY$).
8. A woman with type A \((I^A I^A \text{ or } I^A i)\) blood claims that a man with type AB \((I^A I^B)\) blood is the father of her child. They decide to test the child for blood type. Who is right if the child is type A? type B? type AB? type O?

With this combination, they can have a child that is type A \((I^A I^A \text{ or } I^A i)\), type B \((I^B i)\), type AB \((I^A I^B)\), but not type O \((ii)\) because the man does not have an i allele to give.

9. Domesticated hens with white feathers and large, single combs mate with roosters that have dark feathers and small, multiple combs. The offspring all resemble their mothers for these two traits.

a. Which alleles of each trait are dominant, and which are recessive?
   Since the F1 all resemble their mothers, white feathers and large, single head combs are dominant over dark feathers and small combs.

b. If one of the F1 males is crossed with one of the parental hens, what percentage of the offspring would be expected to have white feathers and small, multiple combs?

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All of the offspring would have white feathers and large, single combs like their mother. None would have white feathers and small, multiple combs.

Fun genetics activities at  \url{http://www.quia.com/custom/3413main.html}