Problem-ability Set

1. In the plants with which Mendel conducted experiments, alleles at two independent genetic loci encode the yellow (Y) or green (y) and round (R) or wrinkled (r) phenotypes. Please determine the gametes that could be produced by heterozygous individuals and predict the proportion for each gamete type.

2. Suppose that warthogs possessing the genotype Gg Oo Dd mated with other warthogs possessing the same genotype. Assuming that alleles for the three genes reside at independent genetic loci (and that uppercase and lowercase letters indicate dominant and recessive alleles), please predict the proportion among offspring that would possess the genotype GG oo Dd.

3. Imagine conducting the pentahybrid cross (Uu Vv Ww Yy Zz) x (uu Vv ww Yy zz). Assuming that alleles for the 5 genes reside at independent loci (and that uppercase and lowercase letters indicate dominant and recessive alleles), please predict the proportion among offspring that would resemble (phenotypically):
the first parent;
the second parent;
either parent; and
neither parent.

4. Consider two-child families in which the parents have been identified as carriers for a condition that is encoded by a recessive allele because at least one child exhibits the phenotype for that condition. First, please state what you can conclude about the parents' genotypes from this information. Second, please predict the proportion among the children in these families that would exhibit the phenotype.

(brazen hint: consider all possible pairs for the children in any family – *e.g.*, the first child exhibits the phenotype and second fails to; then, for each possible pair, calculate the probability for the two phenotypes – *e.g.*, P(condition, normal) = x; then, multiply these probabilities by the proportion with which the phenotype is exhibited – *i.e.*, 1 for the case wherein both exhibit the phenotype and 1 / 2 for cases wherein one child does; *e.g.*, x (1 / 2); then sum these products – *i.e.*, x (1 / 2) + …; finally, divide this sum by 1 - P(normal, normal) = y – *i.e.*, (x (1 / 2) + …) / y).

5. Currently, I house two female sea urchins in an aquarium in the laboratory. Ursula produces 800 eggs per day with 1% among them being defective. Udora produces 200 eggs per day with 2% among them being defective. Every day, I choose one egg from the aquarium. Let D = the egg is defective, M = the egg was produced by Ursula, and N = the egg was produced by Udora. The conditional probability that the egg that I choose is defective given that it was produced by Ursula is P(D | M) = 0.01. Please describe very briefly (using words) what the conditional probability P(M | D) represents; provide a name for the formula that would be used to calculate P(M | D); then calculate it.