HW12 Solution
Fall 2017

1. (10 pts) The word “CRISPR” stands for “Clustered Regularly Interspaced Short Palindromic Repeats.” CRISPR is an essential part in a bacterial defense system against viruses and in a CRISPR/Cas9 technology which can target and edit DNA specifically. Genes can be knocked in and out using this technique.

2. (10 pts) CRISPR is different from other techniques already out there because it is very specific, easy to assemble its molecular constituents and can edit genes without leaving foreign DNAs behind.

3. (10 pts) In basic science, DNA can be edited very easily with this technology. In applied science, too, this ease of editing provides new possibilities in many areas, such as therapeutics and crop science.

4. (10 pts) It can be used for many applications, such as transplanting animal organs into human, developing better crops, etc.

5. (20 pts)
A. (10 pts) Gene drives are genetic systems that can circumvent conventional Mendelian genetics, increasing the chances that the drive will be passed on to the next generation more than 50%. With this increased probability of inheritance, it can eventually spread to almost all members of a population.
B. (10 pts) It can be used only in organisms which reproduce sexually, such as insects, animals and most plants. It is not applicable to bacteria, which reproduce asexually.

6. (10 pts) If an allele has a molecular mechanism, which gives it a transmission chance greater than 50%, it can act as a gene drive, spreading itself through a population even though it does not increase the fitness of its carrier. At molecular level, the gene drive works by cutting the chromosomes that don’t have the drive and by copying itself and inserting it into these chromosomes, exploiting natural DNA repair mechanism for damaged chromosomes (homology-directed recombination).

7. (10 pts) There are ethical problems concerning CRISPR and gene drive technique, such as editing human embryo and altering human germline.

8. (10 pts) Off-target mutagenesis, efficient delivery of molecular machinery (namely, Cas9) into tissues or cells and control of repairing pathways (increasing the rate of homology-directed recombination repair process, which is essential to CRISPR system, while decreasing the rate of non-homologous end-joining repair process) can be technical difficulties.

9. (10 pts)