

(16 pts) Multiple True/False - CIRCLE ALL ANSWERS THAT ARE TRUE!!!!

1. A gene ...

- ... **is a sequence of deoxyribonucleotides.**
- ... **can be transcribed into RNA.**
- ... **typically codes for a protein.**
- ... **can have a slightly different sequence on different chromosomes.**

2. The genetic code...

- ... **is the same for all organisms.**

3. You've already isolated the Cry1a gene. Which of the following things will now be necessary to engineer Bt corn?

- restriction enzymes**
- Agrobacterium cells**

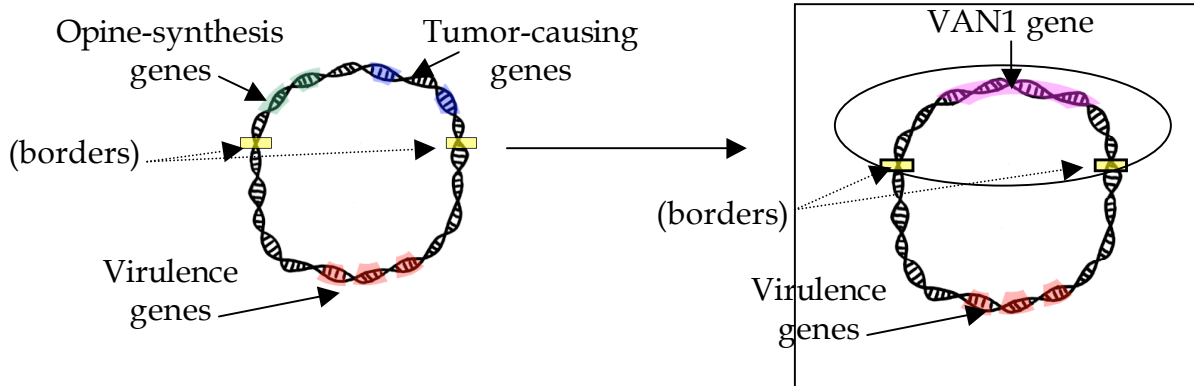
4. Which of the following genetic modifications have been made to plant species?

- addition of a toxin that kills insects**
- addition of genes that make carotene (vitamin A)**

5. (10 pts) During the famine in 2002, Zambia and two other countries/groups clashed, creating the global controversy over GM food aid. Name each country or group and give their main viewpoint +/- or concern.

<u>Country/Group</u>	<u>Main Concern/Viewpoint on GM foods</u>
i. United States	GM food is completely safe, should be accepted by Zambia to feed its people
ii. European Union	GM food is not safe, and not allowed to be grown in the E.U.
iii. <u>Zambia</u>	Government may have been pressured to not accept GM aid since it could harm future trade with the E.U. Also, people were afraid that GM food was dangerous to human health.

6. a. (6 pts) A Ti plasmid is diagrammed below. In the box to the right, draw a *modified* Ti plasmid that you will need to generate vanilla strawberries. Make sure to **label your plasmid**.



b. (2 pts) On your drawing, **circle the portion of the plasmid** that will be transferred into the plant cell.

c. (2 pts) What risk is there to the strawberry plant's genome? (answer in 1 sentence)

The T-DNA might be inserted into an important strawberry gene, making it non-functional.

d. i. What is the sequence indicated by the gel on the right?

5' AGTAGAATAGGG 3'

ii. What is different about this sequence compared to WT?

Three nucleotides are deleted (GAC)

iii. What is the new amino acid sequence from the Strange strawberry? **Ser - Arg - Ile - Gly**

iv. Would you consider this mutation a frameshift? Why or why not?

Although this mutation is a deletion, it isn't really a frameshift because it is THREE nucleotides that are deleted. In this case, an amino acid is lost, but the overall protein sequence will stay the same.

7. (8 pts) Fred and Sue want to have a **baby boy** who is free of the X-linked disease hemophilia, which Sue carries on *one* of her two X chromosomes. Which reproductive technology should they choose and why? (Answer in no more than 3 sentences).

Fred and Sue must use PGD to determine if a baby boy will be free of hemophilia. Since Sue carries the disease, sorting Fred's sperm will only help increase the chances of a boy, but will not tell us anything about the X chromosome in Sue's egg. Using PGD we can look to see if the embryo is male *and* if it has the hemophilia allele.

8. (10 pts) Imagine you are a farmer who wants to make a clone that generates good milk. You have the following three cows:



Cow 1:
- good milk
- no eggs



Cow 2:
- bad milk
- otherwise normal



Cow 3:
- good milk
- can't carry pregnancies

- a. (2 pts) Which cow(s) would make a suitable surrogate for cloning? **Cows 1 and 2 (or just the one with good milk - to nurse the calf)**
- b. (2 pts) Which cow(s) would make a suitable egg donor for cloning? **Cows 2 and 3**
- c. (2 pts) Which cow(s) would make a suitable genetic donor for cloning? **Cows 1 and 3**
- d. (4 pts) List two complications of mammalian cloning that might convince you to simply breed your animals:
- i. **It is very inefficient**
 - ii. **the overall health of the clones is a concern**
 - iii. **it is expensive**

9. (10 pts) Matching: For each of the definitions on the left, match with a choice from the list on the right. There is at least one answer for each definition, and there may be more than one. The choices may be used once, more than once, or not at all.

2 pts each - if a letter is in parentheses, we did not require it as an answer, but did accept it.

- a. **G** a lipid
- b. **B, F (I)** molecule that can contain genes
- c. **H, I, L (B,F)** molecule necessary for transcription
- d. **D, I, J, K (B,F)** molecule necessary for DNA sequencing
- e. **C, E (F)** things involved in sperm sorting

Choices:

- A. ribosome
 B. a plasmid
 C. fluorescent dye
 D. DNA polymerase
 E. UV light
 F. chromosome
 G. canola oil
 H. RNA polymerase
 I. DNA template
 J. individual dideoxyribonucleotides
 K. individual deoxyribonucleotides
 L. individual ribonucleotides

10. (14 pts) True/False - circle the correct answer: **2 pts each**

- a. **T** The FOXP2 gene can be found in chimps, humans, and mice.
- b. **F** The FOXP2 gene codes for the RNA polymerase protein.
- c. **F** The protein made from the FOXP2 gene in humans is 50 amino acids different than the chimp FOXP2 protein.
- d. **T** The FOXP2 protein is involved in brain/neural development.
- e. **F** FOXP2 is the only gene thought to be different between chimps and humans.
- f. The following four sequences show the amino acid sequence of the same portion of the FOXP2 gene for the four species listed:

Human: Glu - Ser - Ala - Thr - Glu
 Chimp: Glu - Ser - Ala - Thr - Glu
 Orangutan: Glu - Ser - Val - Thr - Glu
 Mouse: Glu - Ser - Ala - Thr - Glu

- i. In which species did a mutation occur in the DNA corresponding to this region? **orangutan**
- ii. What was the nucleotide change in the **DNA**? From **C** to **T** (or **G** to **A**)

11. (12 pts) Answer **TWO** of the following three questions. A 2-4 sentence answer is sufficient.

For each, I've given two full-point (6) answers from student papers. These don't necessarily encompass all the "correct", full-point answers.

a. The highly effective anti-malarial drug artemisinin is naturally synthesized by a tree. How is GM technology involved in the production of this drug, and what potential problems might there be with the widespread use of artemisinin?

A gene from the tree is inserted into the yeast cell which grows and multiplies much faster than the tree. The yeast cells will produce artemisinin much quicker and much more than the actual plant. The widespread use of artemisinin can increase the chance that the parasite that causes the disease will build up [resistance] faster.

Since artemisinin is very expensive to produce when it comes naturally from the tree, scientists have inserted the gene that codes for this into yeast. The yeast then produces the drug in greater quantities and at less cost. With widespread use of this drug, the malaria parasite might evolve resistance to it like previous malaria drugs.

b. What is "horizontal transfer" of genes? Why is this of concern in relation to GM crops?

The 'horizontal transfer' of genes is a plausible concern that the seeds of the GM crops would cross-pollinate with the weeds and then result in weeds that would have the Bt toxin that would kill insects or have the herbicide resistance gene. This is of concern in relation to GM crops because then there are resistant weeds that can fight off insects or when spraying round-up ready, the weeds will have the herbicide resistance gene and not die like it is intended to.

Horizontal transfer of genes is when genes go from one species to another through cross-pollination or if, for example, a plant dies and decomposes, its DNA gets into the soil, and fungus or bacteria pick it up. One reason this is a concern is because GM technology is patented, and the owners don't want people to reap the benefits that they didn't pay for. Another concern is that if GM foods take over, it would lead to the evolution of superbugs that would be resistant to that GM strain.

c. GM foods have been suggested to be dangerous for humans to eat. What concerns are valid and which are not? Explain each using as much biology as possible.

It is a valid concern that people may be allergic to the proteins used to create the Bt corn, but that is about it. Any concerns regarding diseases like AIDS or other adverse mutations are unfounded.

So far GM food have been safe to eat, w/o much current human-health risks. In Bt corn for example, the toxin binds to proteins on an insect's cell and causes pores so the contents spill out, thus killing the cell and insects but humans don't have those proteins so the toxin can't bind. The main concern is with human allergies we don't know the effect the Bt toxin has if someone is allergic to the toxin.