# **Concept Building Questions**

- 1. Answers are as follows:
  - a. Codon wobble, because it introduces uncertainty in the third position of the codon, can potentially decrease your ability to "match" sequences. If you are comparing sequences from two organisms for the purposes of determining relationships based on DNA, you have to ask yourself whether any differences you see between the two DNAs are due to wobble or to actual differences between the species. On long sequences, this usually becomes less of a problem because the degree of similarity will be more evident.
  - b. There probably is enough DNA in the sequence, but scientists usually like to look at much more than a tri-peptide to confirm relatedness. The probability that any one small stretch of DNA is similar to another is too high to base a judgment from something so short. It is less likely, over long sequences, that similarity is due to random chance. Thus your ability to relate organisms becomes greater the longer the sequence you have to compare.
  - c. GC pairs share three bonds between them whereas AT pairs only share two bonds. Therefore, sequences rich in G + C are held together more tightly than sequences rich in A + T. The sequences presented are really too short to get a full sense of the actual sequence, but of the sequences given, those with 5 GCs (corresponding to rows 4, 6, and 8) will be a bit stronger than those with fewer. The sequences with lower stability would therefore be those with only 3 GCs (corresponding to rows 1 and 5).

# CHAPTER 9 Controlling Microbial Growth in the Environment

### **Multiple Choice**

1.	В	4.	А	7.	В	10.	D	13.	D
2.	D	5.	С	8.	С	11.	С	14.	С
3.	А	6.	В	9.	В	12.	С	15.	А

## Fill in the Blanks

- 1. disinfectant
- 2. bacteriocidal, bacteriostatic
- 3. increases
- 4. thermal death point
- 5. moist, dry
- 6. thermoduric, thermophilic
- 7. particulate, electromagnetic
- 8. phenolic disinfectant
- 9. tincture, iodophor
- 10. antibiotics

## Short-Answer Questions for Thought and Review

- 1. From least effective to most effective, the techniques are: degerming, disinfection, sanitization, pasteurization, and sterilization.
- 2. The two modes of action are: 1) disrupt the integrity of the cell (physical structure), or 2) disrupt the functions of metabolism or reproduction. For

### Short-Answer Questions for Thought and Review

- 1. The three major goals of recombinant DNA technology are to get rid of undesirable traits in various organisms, engineer beneficial traits into other organisms, and create new organisms. The ethical controversy centers around the question of whether we *should* do any of this, whether we have the *right* to do this, and what will *happen* if we do.
- 2. The central medical focus of recombinant DNA technology is to fix what is genetically wrong in humans (cure diseases) or to improve the life of those who are ill (i.e., produce new therapeutic drugs). In agriculture, the focus is on making hardier plants that survive better, resist disease and pests, and are more nutritious. Both venues seek to improve the organism in question, but for somewhat different purposes (health vs. productivity).
- 3. Three benefits of recombinant DNA technology are: 1) gene therapy to cure diseases, 2) better drugs, and 3) better research tools. Three potential hazards are: 1) unexpected environmental consequences from the release of genetically engineered microbes, 2) unwanted deaths from gene therapy, and 3) unexpected health hazards due to changes in the nutritional quality of foods.

### **Critical Thinking**

1. The possible sequences are listed below. The left hand column shows the mRNA, and the right hand column shows the cDNA.

mRNA Sequence	cDNA Sequence
5' - AUG GCU UUU - 3'	5' - AAA AGC CAT - 3'
5' - AUG GCU UUC - 3'	5' - GAA AGC CAT - 3'
5' - AUG GCC UUU - 3'	5' - AAA GGC CAT - 3'
5' - AUG GCC UUC - 3'	5' - GAA GGC CAT - 3
5' - AUG GCA UUU - 3'	5' — AAA TGC CAT — 3'
5' - AUG GCA UUC - 3'	5' - GAA TGC CAT - 3'
5' — AUG GCG UUU — 3'	5' — AAA CGC CAT — 3'
5' - AUG GCG UUC - 3'	5' — GAA CGC CAT — 3'

2. The following is a very general experimental scenario (there are variations to this so it's ok if you come up with a different answer): 1) Since all the genes in the clones are in plasmids, first isolate the plasmids away from all other DNA and cellular material. 2) Run the plasmids on an agarose gel in separate lanes. 3) Create a probe to clone 6 (since you want it you can assume you know enough about it to make a probe). 4) Transfer the DNA to nitrocellulose via Southern blot. 5) Probe the membrane. When you identify which lane is positive for gene 6, then you can go back to your cultures and select the appropriate one.

the first point, damage is done to the cell wall and/or cell membrane so that physical integrity is lost; this leads to a loss of stability, osmotic imbalance, and eventually lysis. For the second point, damage is done to proteins or nucleic acids (thus damage is done to structural elements), but it isn't the structural damage but rather the corresponding loss of functional capacity that is the problem. If the cell can't metabolize, it can't survive, cannot reproduce, and ultimately dies.

3. Highly effective chemical control agents (oxidizing agents, aldehydes, and gaseous agents) are smaller molecules that will be able to work their way into the interior of cells and cause damage. Because they can penetrate, they will be effective against more cell types. They are also more destructive to proteins than other chemicals and can damage enough protein content to kill or inhibit a high proportion of microbial cells.

#### **Critical Thinking**

- 1. The in-use test would probably be the most suitable. It allows for testing of disinfectants within the environmental setting that they would be used to identify the ones that are most effective. In this test, swabs are taken from actual objects before and after application of a disinfectant. The swabs are then incubated and examined for microbial growth. This test allows for a more accurate determination of the disinfectants and their strengths that are appropriate for a given situation.
- 2. The methods that inhibit growth of microbes by removing water are: 1) desiccation, which removes water from cells by drying (sunlight, hot air); 2) lyophilization, which involves freezing cells and then using a vacuum to remove frozen water by sublimation; and 3) osmotic pressure, which uses sugar and salts in hypertonic solutions to draw water out of cells thereby drying them. In all cases the loss of water prevents metabolism from occurring.
- 3. In this case the CDC is erring on the side of caution. There is no proof that triclosan increases resistance, but there is also no firm proof that it does not. Since degerming with normal, non-triclosan soaps is just as effective if done properly, there is no detriment to restricting the use of antimicrobial soaps and thus no reason not to be cautious. In the event that triclosan does prove to increase resistance, having already begun to restrict use will also cut down on the work that will have to be done to get triclosan out of the environment.

### **Concept Building Questions**

1. The fundamental structural differences between the most susceptible microbes to antimicrobial agents and the most resistant comes down to the external coverings of the cells. Endospores, cysts, and encapsulated organisms are most resistant because they have very thick, impermeable protective layers between them and the environment. Nothing can travel through these layers very well and thus chemical agents won't be able to do much damage. For the most susceptible, no such outer coverings exist (the Gram-positive cell wall is thick, but not nearly as impermeable or protective as spore walls) and therefore antimicrobial agents can penetrate better. To be an effective germicide and kill the resistant organisms, the germicide must have penetrating power—by some mechanism it must bypass the protective outer layers or must physically destroy these outer layers to expose the organism underneath.

- 2. The form of resistance a microbe will evidence will differ depending on the organism and the chemical agent in question. Only a few of many possibilities are therefore presented.
  - a. If an agent inhibits growth by bonding to a protein and inhibiting some function, then natural mutations in the protein that prevent bonding will prevent agent activity. If an agent targets formation of a structure, then changes to the structural elements such that they can't interact with the agent will prevent activity.
  - b. If an agent targets function, such as metabolism, then alternate pathways that bypass the inhibited spot can circumvent agent activity. Alternatively, induction of a transporter that can pump the agent back out of the cell can result in not enough of the agent remaining inside to cause damage.
  - c. If the agent binds DNA to prevent transcription (or otherwise modifies DNA so that transcription cannot occur) then changes to the DNA such that the agent can't alter it will result in loss of function for the agent.

# CHAPTER 10 Controlling Microbial Growth in the Body: Antimicrobial Drugs

## Multiple Choice

1.	А	4.	D	7.	D	10.	D
2.	D	5.	В	8.	С	11.	А
3.	С	6.	D	9.	С	12.	А

## Fill in the Blanks

- 1. Streptomyces
- 2. growing
- 3. amphotericin B, fungal cells
- 4. sulfanilamide
- 5. narrow-spectrum, broad-spectrum
- 6. can
- 7. hospitals, nursing homes
- 8. cross resistance

## Short-Answer Questions for Thought and Review

- 1. There are so few antiviral agents because viruses are obligate parasites that live inside of host cells and use host cell materials to complete their life cycle. There is very little, therefore, about them that is truly distinct enough to target without killing the host cell outright. Bacteria have many differences from human cells, and therefore present more targets for drugs.
- 2. Drugs that target general processes such as DNA synthesis are usually not prescribed because they will affect host cells too much (i.e., they will be toxic to the host and the microbe). Drugs that are more specific are a better choice.
- 3. Clinicians must consider the following when administering drugs to treat infectious diseases: the effectiveness of the drug, the dose needed, the route of administration, the safety of the drug, and the side effects of the drug. Of these, safety and side effects probably weigh most heavily because some patients will be able to tolerate some drugs but not others.