Name _____ Period _____

Chapter 12: DNA Technology and Genomics

Guided Reading Activities

Big idea: Gene cloning

Answer the following questions as you read modules 12.1–12.5:

1. Match the following terms with their description: DNA technology, recombinant DNA, genetic engineering, plasmid, biotechnology, DNA ligase.

A molecule that facilitates the formation of covalent bonds between nucleotides: <u>DNA ligase</u>

A set of techniques for manipulating DNA: <u>DNA technology</u>

The use of organisms or their products for human purposes: biotechnology

A round bacterial chromosome: ____plasmid

DNA combined from two different sources: recombinant DNA

Purposefully altering genes for human purposes: genetic engineering

- True or false: Plasmids are crucial in gene cloning because they can carry almost any gene. If false, make it a correct statement. True
- Why is the DNA in steps 3 and 4 cut with the same enzyme? Refer to Figure 12.1B on page 233 of your textbook.
 This way the two sources of DNA can be mixed and spliced together because the ends of the cuts will match.
- 4. Restriction enzymes do not cut the DNA of bacteria because of <u>methyl</u> groups on the bacterial DNA.
- Bacteria can be infected by viruses just as human cells can. Propose an explanation for the normal role of restriction enzymes in a bacterial cell.
 A possible explanation is that bacteria can degrade invading viral DNA.

- 6. Which of the following explains why DNA from two different sources can be joined together as long as they were cut with the same restriction enzyme?
 - a. The restriction enzyme forms hydrogen bonds with the DNA.
 - b. The bases at the sticky ends will be complementary to each other.
 - c. DNA ligase recognizes that the two sources of DNA were cut with the same enzyme and joins the fragments.
 - d. The restriction fragments will be the exact same length, which allows the two fragments to join
- 7. An entire collection of cloned DNA pieces that consists of an organism's genome is known as a(n) genomic library.
- 8. A biologist makes cDNA from a normal pancreatic cell and then from a cancerous pancreatic cell. The biologist expects the cDNA to be different between the two cells. Briefly explain why you think she is doing this experiment. The biologist is trying to determine what, if any, differences there are in gene expression be-

tween the two conditions.9. True or false: A scientist can obtain cDNA from every gene from a particular cell. If false, make it a correct statement.

False, the scientist can obtain cDNA only from the genes that are actively being transcribed at that time.

10. A researcher wants to search a genomic library for a plasmid that contains the human gene for human growth hormone (HGH). He needs to design a nucleic acid probe that will recognize the gene contained within the library. The only other information he has is that a short sequence of the mRNA made from the HGH gene reads: AGGCUAUCGC. Would he be able to make a nucleic acid probe from this information? Briefly explain your answer either way. Yes, he would be able to because of the complementary nature of the bases.

Big idea: Genetically modified organisms

Answer the following questions as you read modules 12.6–12.10:

 List three reasons why bacteria are great organisms for the mass production of desirable protein products.
 Bacteria have a large number of plasmids and phages available for use as vectors, bacteria re-

produce quickly, and they can be designed to produce large amounts of a protein quickly.

- 2. Which of the following explains why mammalian cells are sometimes needed to produce protein products?
 - a. *E. coli* cannot make certain genes because the DNA language of certain human genes is different.
 - b. Certain mammalian proteins need sugar chains added to them and only mammalian cells can do this.
 - c. Many human genes require a special ribosome found only in mammalian cells.
 - d. Simple organisms, like bacteria, lack the ability to synthesize complex human genes.
- 3. Table 12.6 on page 237 of your textbook lists numerous protein products and the organisms that produce them. Tissue plasminogen activator (TPA) is not made by *E. coli* or *S. cerevisiae*. What are you able to infer about TPA? It is likely a protein that requires sugar chains to be attached.
- 4. Which of the following is a use of DNA technology?
 - a. Pinpoint viral infections
 - b. Develop vaccines
 - c. Produce products for therapy
 - d. All of the above
- 5. Briefly explain what is meant by the following statement: All transgenic organisms are GMOs, but not all GMOs are transgenic organisms. It means that all transgenic organisms are GMOs because they have had their DNA altered by the acquisition of one or more genes. An organism could be a GMO but not a transgenic organism, however, as long as the gene the organism acquires is not from a different species.
- 6. A corn plant that has a gene from a bacterium inserted into it would be considered a(n) transgenic organism.
- What percentage of beta-carotene is absorbed and converted to vitamin A from golden rice? Refer to Figure 12.9 on page 240 of your textbook. About 40%
- 8. List two concerns that GMO critics have of GMO products.
 - 1. It's possible that GMOs could pass their genes to related species in nearby areas.
 - 2. Genetic diversity of species can be reduced in GMOs, thus making them more susceptible if environmental conditions change within their environment.

- 9. The replacement of a person's disease-causing genes with functioning genes is known as <u>gene therapy</u>.
- Briefly explain why scientists may not want to eliminate disease-causing alleles from the human population.
 It is possible that it could backfire because under certain conditions, those disease alleles

It is possible that it could backfire because, under certain conditions, those disease alleles could have a beneficial effect.

Big idea: DNA profiling

Answer the following questions as you read modules 12.11–12.16:

- True or false: DNA profiling involves the analysis of two separate DNA samples to determine whether or not they came from the same person. If false, make it a correct statement. True
- 2. Rather than comparing the genomes of two samples, researchers can compare <u>genetic markers</u>, which are sequences within the human genome that vary from person to person.
- 3. A crime scene technician obtains a single hair from the scene of a bank robbery. What will the technician do in order to get enough DNA from the hair to analyze? The technician will perform the polymerase chain reaction method in order to amplify the amount of DNA.
- 4. What role does temperature have in PCR? DNA requires high temperatures to separate the DNA strands and cooler temperatures to allow hydrogen bonds to form between the bases of the target strand and the primer.
- Refer to Figure 12.12 on page 242 of your textbook. How many DNA sequences are there after five cycles? How long did that take if each cycle took 30 minutes? There would be 32 DNA sequences after five cycles. It would take 150 minutes (2.5 hours).
- 6. A sieve is a device used to separate solids from liquids. On page 243 of your textbook, module 12.13, the authors state, "Because agarose contains a tangle of cable-like threads, it can act as a molecular sieve." Briefly explain this analogy. The analogy works because the agarose is acting like a sieve in that it separates out the DNA based on the sizes of the DNA molecules. Larger DNA molecules have more difficulty passing through the agarose and travel a shorter distance down the agarose gel.
- 7. A graduate student working in a molecular biology laboratory sets up an agarose gel so that the wells that contain the DNA are at the positive end of the power source. Did she load the gel correctly? Briefly explain what will happen.

No, if the gel is loaded in this manner, the DNA will run out the back of the gel.

- 8. A short sequence of DNA nucleotides that repeats one after the next is known as which of the following?
 - a. STR
 - b. PCR
 - c. CODIS
 - d. DNA
- 9. STR analysis used for DNA profiling in the pursuit of a criminal or legal matter requires that ______ STR sites be compared.
- 10. A crime has been committed in your home. The police take DNA samples for DNA profiling using STR analysis. Days later, you are arrested for the crime based solely on STR analysis of the DNA. Briefly explain why this would be silly of the police. This could be silly if the DNA samples are all of the evidence the police have. Specifically, it is your home, and your DNA is bound to be almost everywhere. By itself, this evidence really means nothing because it is your home.
- DNA profiling has proven to be a huge asset to solving many forensic investigations. List four high-profile instances in which DNA profiling was used in a forensic investigation.
 It was used in the O.J. Simpson trial.
 - 2. It was used to overturn Earl Washington's murder conviction.
 - 3. It was used to identify victims of the 9/11 attacks.
 - 4. It was used to determine that Thomas Jefferson fathered a child with Sally Hemmings.
- True or false: An SNP can occur in either a gene or noncoding sequence of the human genome. If false, make it a correct statement. True
- 13. A segment of DNA is known to have three restriction sites for a particular restriction enzyme. An SNP has occurred in the middle restriction site that causes it to no longer be recognized by the restriction enzyme. When the DNA is separated by gel electrophoresis, there will be ________ bands of DNA visible.

Big idea: Genomics

Answer the following questions as you read modules 12.17–12.21:

1. The study of entire sets of genes and their interactions is referred to as <u>genomics</u>.

2. People usually assume that the human genome is the largest in terms of size and number of genes. Is this true? Cite specific examples in your answer. Refer to Table 12.17 on page 247 of your textbook.

No, this is false. Chimpanzees have more base pairs, and rice and mustard plants have more genes.

- 3. Briefly state what the purposes of the Human Genome Project (HGP) were. The goals were to determine the nucleotide sequence of the entire genome and to determine the location and sequence of every gene.
- What percentage of the human genome consists of repetitive sequences of DNA? Refer to Figure 12.18 on page 248 of your textbook. Roughly 59%
- The human genome consists of about 21,000 genes spread across 24 different chromosomes. Do men and women have the same number of different genes? Briefly explain your answer. No, men have more due to the genes on the Y chromosome.
- 6. What method of genome sequencing is described as a method where all the chromosomes are cut with restriction enzymes and all the fragments are sequenced by computers using special software?

Whole-genome shotgun method

- A research biologist assembles a list of all the proteins produced by a certain spider found in the Amazon. He uses this list to study the interactions of certain proteins of interest. This scientist is using an approach called ______.
 Proteomics
- What would you expect to be true about the genomes of two species that evolved away from each other a million years ago?
 You would expect them to have many regions of DNA that are still similar.

CONNECTING THE BIG IDEAS

Use your knowledge of the information contained within this chapter's "Big Ideas" to answer this question.

Researchers identify a gene in cockroaches that is responsible for nerve regeneration in cockroaches. How might this gene be used in treating human paralysis?