**Webquest Biotechnology—Preparation for Unit Test**

**Chapters 14.3 & 15.1—15.4, Miller & Levine (2010) Biology**

*For each of the following topics,* ***please watch the ENTIRE animation with volume low enough not to disturb others, THEN*** *complete the questions.*

**Copying a section of DNA quickly & cheaply using PCR**

<http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter14/animation_quiz_6.html>

<http://learn.genetics.utah.edu/content/labs/pcr/> Text book source: page 423

1. PCR is an abbreviation for technique **\_\_\_\_\_.**

a. gel electrophoresis

b. polymerase chain reaction

c. restriction fragment length polymorphism mapping

d. gene cloning

e. somatic cell nuclear transfer

2. These are the short pieces of DNA that are used to mark the section of a chromosome that need to be copied during PCR**. \_\_\_\_**

a. template or target DNA sequence

b. free nucleotides

c. Taq polymerase

d. primers

e. restriction enzymes

3. The enzyme needed during PCR is a form of DNA polymerase that does not become denatured at high temperatures, unlike eukaryotic DNA polymerase. This enzyme was cloned from bacteria that live in geysers in Yellowstone National Park. It is called **\_\_\_\_\_\_.**

a. template or target DNA sequence

b. free nucleotides

c. Taq polymerase

d. primers

e. restriction enzymes

4. What happens during the first step of PCR when the reaction tubes are heated to over 90°C, just under the boiling temperature of water. \_\_\_\_\_\_\_

a. primers form Hydrogen bonds to complementary base pairs in the target DNA sequence

b. the two strands of target DNA separate because Hydrogen bonds between them break

c. the primers form Hydrogen bonds with each other

d. nucleotides are added to primers, completing complementary copies of target DNA strands

e. the target DNA strands are cut at the restriction site recognized by Taq polymerase

5. When the DNA cools to around 70°C, what happens? \_\_\_\_\_

 a. primers form Hydrogen bonds to complementary base pairs in the target DNA sequence

b. the two strands of target DNA separate because Hydrogen bonds between them break

c. the primers form Hydrogen bonds with each other

d. nucleotides are added to primers, completing complementary copies of target DNA strands

e. the target DNA strands are cut at the restriction site recognized by Taq polymerase

6. When the DNA is cooled even further to about 50°C, what happens?\_\_\_\_

a. primers form Hydrogen bonds to complementary base pairs in the target DNA sequence

b. the two strands of target DNA separate because Hydrogen bonds between them break

c. the primers form Hydrogen bonds with each other

d. nucleotides are added to primers, completing complementary copies of target DNA strands

e. the target DNA strands are cut at the restriction site recognized by Taq polymerase

7. If you compare the contents of the reaction tubes before and after several PCR heating and cooling cycle, what will you observe about the target DNA sequence?\_\_\_\_\_

a. The target DNA sequence has been mutated

b. The target DNA sequence has been replicated millions or billions of times.

c. The target DNA has become longer due to insertion (addition) of the the primer sequence at each end.

d. The target DNA has been cut into smaller pieces at restriction sites.

DRAW and LABEL a sketch of the PCR process for 3 cycles, including: original target DNA, primers,labeled free nucleotides, Heat resistant DNA polymerase, and copied DNA sequences.

**Separating DNA by size**

[**http://learn.genetics.utah.edu/content/labs/gel/**](http://learn.genetics.utah.edu/content/labs/gel/) Textbook source: page 422

8. What is the name of the technique used to separate pieces of DNA by size? \_\_\_\_\_

a. gel electrophoresis

b. polymerase chain reaction

c. restriction fragment length polymorphism mapping

d. gene cloning

e. somatic cell nuclear transfer

9. In the gel below, which band is larger, A (top lane 2) or B (bottom lane 2)? \_\_\_\_\_\_\_\_

10. The size standards are on the left. Estimate the size of band A (top lane 2) \_\_\_\_\_\_

a. 4 kilobase pairs (that is 4000 nucleotides long)

b. 5 kb

c. 1.9 kb

d. you can’d determine this from the data shown



12**.** Which is an example of a biotechnical method that always requires the method shown above?\_\_\_

a. DNA fingerprinting b. polymerase chain reaction

c. genetic modification d. gene cloning e. cloning an organism

**Using the size of DNA for unique stretches of DNA to identify an organism**

[**http://highered.mcgraw-hill.com/sites/007337797x/student\_view0/chapter14/animation\_quiz\_-\_dna\_fingerprinting.html**](http://highered.mcgraw-hill.com/sites/007337797x/student_view0/chapter14/animation_quiz_-_dna_fingerprinting.html)

13. Which is an enzyme used to remove a piece of DNA at a specific nucleotide sequence? \_\_\_\_

a. Restriction enzyme

b. Taq polymerase enzyme

c. ligase enzyme

14. What is the name of a technique that uses restriction fragment sizes to identify people? \_\_\_\_\_\_

a. DNA fingerprinting

b. polymerase chain reaction

c. generation of genetically modified organisms (GMO)

d. gene cloning

e. somatic cell nuclear transfer (SCNTR)

13. Since the gene sequences of humans are more than 99.8% identical, then why is it possible to identify someone by his/her DNA fingerprint? \_\_\_\_

a. different people have different types of genes

b. different people have different numbers of genes

c. repeated VNTR and STR sequences lying BETWEEN genes are variable in number, but the same in sequence, in different people

d. people have different alleles for their genes

14. True or False. \_\_\_\_\_ When a child’s DNA is tested by DNA fingerprinting, half of the child’s DNA bands will be the same size as bands found in his mother’s DNA fingerprint, and the other half will be the same size as bands found in his father’s DNA fingerprint.

15. True or False. \_\_\_\_ DNA fingerprints can be tested using DNA probes that examine sizes of repeated sequence restriction fragments on 13 different chromosomes. If even a single band is different out of all these tests, a suspect can be excluded as the donor of a DNA sample.

16. True or False. \_\_\_\_\_ The higher the number repeated sequence probes tested (13 are available to a forensic scientist), the lower the certainty that a suspect is actually the person whose DNA is seen in a matching DNA fingerprint.

17. When the DNA sample is very small, instead of restriction enzymes being used to generate the uniquely sized pieces of DNA, the technique called \_\_\_\_\_\_\_\_\_\_\_ is used to generate them. This technique works because sequences before and after the repeated sequences are the SAME in different people; primers can be made to match these identical sequences. \_\_\_\_\_

a. gel electrophoresis

b. polymerase chain reaction

c. restriction fragment length polymorphism mapping

d. gene cloning

e. somatic cell nuclear transfer

18. True or False. \_\_\_\_\_ Because of the technique described in #17, it is possible to identify the donor of DNA even if only a few cells, like those in the root of one lost hair, are collected.

Think: Why are DNA probes that bind to repeated DNA sequences necessary in a DNA fingerprint generated using restriction enzymes to cut DNA, but NOT in DNA fingerprints made with PCR fragments to mark ends of repeated DNA sections?

**How to clone (make many identical copies) a gene into a plasmid**

<http://www.hhmi.org/biointeractive/genetic-engineering> Textbook source: pages 423—425

<http://highered.mheducation.com/sites/0072556781/student_view0/chapter14/animation_quiz_1.html>

19. What is the name of the small circle of DNA into which a new piece of DNA can be added during gene cloning? These circles are examples of vectors, DNA that can be replicated and expressed (transcribed & translated) in more than one type of organism. \_\_\_\_\_

a. a restriction enzyme

b. ligase enzyme

c. a plasmid

d. a sticky end

20. The name of the type of enzyme used to cut target genes out of their original location so that they can be cloned into a vector, like a plasmid, is:\_\_\_

a. a restriction enzyme

b. ligase enzyme

c. a plasmid

d. a sticky end

21. After the plasmid and target gene DNA has been cut by a restriction enzyme, single stranded pieces of DNA extend off of the ends of piece of DNA. What is the term for these single stranded ends? Note that these will match to allow insertion of the target gene into the plasmid ONLY if the two pieces of DNA have been cut with the SAME restriction enzyme.\_\_\_\_

a. sticky ends

b. PCR products

c. Probes

d. polymerases

22. To clone a gene, after the plasmid has had the target gene inserted into it, the recombinant plasmid is placed/transformed into bacterial cells. Why? \_\_\_\_

a. to ensure that the plasmids are not mutant

b. to allow the bacteria to copy recombinant plasmids every time they divide by binary fission

c. to permanently seal the target gene into the plasmid

23. The bacteria are grown on culture media that contains antibiotics. Why?\_\_\_

a. to kill any bacteria that do not contain recombinant plasmids

b. to prevent scientists from getting infected with the bacteria

c. to increase the rate of division of the bacteria

d. to prevent the bacteria from becoming infected with viruses

NOTE: Plasmid gene cloning can be used to:

1. Create bacteria that can express target genes to make proteins for sale (e..g, insulin)
2. Create bacteria that can express target genes for research
3. Create copies of vectors to be used to genetically modify other organisms, like plants or animals, forming transgenic organisms **(G**ENETICALLY **M**ODIFIED **O**RGANISMS)

**How to clone an entire organism**

[**http://learn.genetics.utah.edu/content/cloning/clickandclone/**](http://learn.genetics.utah.edu/content/cloning/clickandclone/)

[**http://learn.genetics.utah.edu/content/cloning/cloningornot/**](http://learn.genetics.utah.edu/content/cloning/cloningornot/)

[**http://learn.genetics.utah.edu/content/cloning/whyclone/**](http://learn.genetics.utah.edu/content/cloning/whyclone/) Textbook source: page 427

24. A cloned organism is made by putting the nucleus of a donor’s cells into a(n):\_\_\_\_

a. bacterial cell

b. somatic cell with its nucleus removed

c. egg cell with its nucleus removed

d. sperm cell with its nucleus removed

25. A cloned organism shares the same genes and looks like: \_\_

a. the egg donor

b. the sperm donor

c. the somatic cell nucleus donor

d. the surrogate mother

26. Mimi the mouse was : \_\_\_\_

 a. the egg donor

b. the sperm donor

c. the somatic cell nucleus donor

d. the surrogate mother

27. List two possible ethical dilemmas regarding whether humans ought to be cloned. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Draw and label a sketch of the reproductive cloning process:

**How to make a genetically modified organism**

[**http://learn.genetics.utah.edu/content/science/pharming/**](http://learn.genetics.utah.edu/content/science/pharming/) Textbook source: pages 426

28. The abbreviation for genetically modified organism is \_\_\_\_\_\_\_\_\_\_.

29. Another name for a genetically modified organism is a \_\_\_\_\_ organism.

a. surrogate

b. transgenic

c. donated

d. cloned

30. Which of the following is a reason why a scientist might develop a genetically modified organism? Circle all that are valid reasons.

a. to produce human medications more inexpensively

b. to make plants that produce more food or more nutritious food

c. to make plants that farmers can grow without adding chemical fertilizers or pesticides

d. to produce desired products more cheaply—like silk made from goat’s milk

e. to add a new trait to an organism (e.g., like making cotton that is colored even without being dyed)

f. to cure diseases in people (e.g., to cure a baby with SCID, boy in the bubble suit disease, or Cystic fibrosis) by adding corrected genes to make up for their own mutated and nonfunctional genes

31. List two reason that making genetically modified plants and animals for food is controversial.

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32. List one reason that genetically modifying people is risky.

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CRISPR

[http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=video&cd=4&ved=0ahUKEwiU65TN467LAhUJNj4KHbjoAN4QtwIIJTAD&url=http%3A%2F%2Fwww.businessinsider.com%2Fhow-the-crispr-dna-editing-tool-works-2015-10&usg=AFQjCNFZoUXF0fey-TEb\_Ve0rOVXVHImuQ&bvm=bv.116274245,d.dmo](http://www.businessinsider.com/how-the-crispr-dna-editing-tool-works-2015-10)

<https://www.youtube.com/watch?v=1aJxXWkE3Ek>

33. What is the actual name of the technique abbreviated CRISPR? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

34. Why has CRISPR become so important in genetic biotechnology?

1. It increases the speed of copying DNA over even PCR
2. It allows deliberate and accurate targeting and elimination or changing of a single gene within the genome
3. It cuts DNA less specifically and more frequently than a restriction enzyme
4. It allows more accurate separation of DNA by size
5. It is a more rapid way of developing gene specific labeled probes

35. What is the purpose of the long piece of RNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Of the CAS-9 enzyme? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_’

**Making and using stem cells**

 (to review this topic, use text section 10.4 and your previously completed stem cell webquest)

**Review your text book, the learning goals, and these websites in preparation for your quiz on biotechnology tomorrow!**

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