**Kelmscott Senior High School**

**Scientific Inquiry 2017**

**Biotechnological techniques: Homework Questions**

Human Biological sciences

Complete the virtual labs on Utah genetics on each topic and complete the following questions. These questions will be used to help you answer the assessed portion of this investigation. Please answer specifically and succinctly.

Virtual labs are found at <http://learn.genetics.utah.edu/>

Virtual Lab 1: **DNA extraction**

1. Why is DNA extracted from organisms?
2. What protein is associated with the DNA that needs to be removed?
3. How can cells be extracted from the person being tested?
4. What materials will you need to purify the DNA? What is each material used for?
5. Write a method describing the steps you need to take to isolate DNA from cheek cells?

Virtual lab 2: **PCR**

1. What does PCR stand for?
2. What are some sources of DNA you could use to conduct PCR?
3. What are primers? What are they used for in PCR?
4. What are nucleotides? What are they used for in PCR?
5. What is DNA polymerase? What is it used for in PCR?
6. What is a thermalcycler? How is it used in PCR?
7. What happens when the thermalcycler reaches 95˚C?
8. What happens when the thermalcycler reaches 50˚C?
9. At what temperature does DNA polymerase attach to the primers? What happens after the DNA attaches?
10. How many segments of the desired DNA fragments do you have after 30 PCR cycles?

Once we have the segment of DNA we are interested in looking at Restriction Enzymes are added. Restriction enzymes cut the DNA sequence when certain nucleotide sequences occur (eg ACCTGG, or ACGACT). Each person’s DNA will be ‘çut’ differently when treated with restriction enzymes. The purified DNA sequence may be treated with restriction enzymes and then put through Gel Electrophoresis to identify suspects in criminal cases, to identify bodies and to determine paternity. The pattern formed during gel electrophoresis will be the same every time for the same segment of an individual’s DNA when the same restriction enzymes are added

Gel Electrophoresis

1. How does the Gel in Gel Electrophoresis separate DNA strands according to their length?
2. Where do we place different DNA samples?
3. What do we add to the Gel to make the DNA move?
4. What length of DNA strands move farthest away from the starting point? Shortest or longest?
5. What do we do to the DNA to enable the DNA strands to be seen?
6. What do we use to make a Gel?
7. What steps are involved in making a Gel?
8. Why do we add buffer to the electrophoresis box?
9. Why do we add loading buffer to the DNA sample?
10. Why do we add DNA size standard to the Gel?
11. What charge does DNA have? Negative or positive?

1. What do you look out for to prove that electricity is flowing in the electrophoresis box?
2. What chemical do we use in the staining gel?
3. How long does it take to stain the Gel?
4. What do we place the Gel on after it has been stained?
5. What is the estimated length of the bands in your DNA sample based on the DNA size standard?

Go to <https://www.bioteach.ubc.ca/TeachingResources/Applications/GMOpkgJKloseGLampard2.swf> Watch the animation and summarise the process of creating recombinant DNA.

**Scientific Inquiry 3: Unit 4 Human Biology 2017**

**Biotechnological techniques**

Please answer the following questions. You may use the Investigation 3 homework sheets you prepared to help you with your answers. You may continue your answers on the back of the sheet if you run out of room but this must be clearly indicated!

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Questions | Marks possible | Marks Achieved |
| 4 | 35 |  |

1.

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| --- | --- | --- | --- | --- |
|  | The table below shows details of the Sanger technique of gene sequencing. **(9 marks)** | | |  |
|  |  |  | |  |  |  | | --- | --- | --- | | **1.** | Label 4 test tubes labelled A, T, C and G. Into each test tube add: a sample of the DNA to be sequenced (containing millions of individual molecules), the 4 DNA nucleotides and the enzyme DNA polymerase. | http://www.mrothery.co.uk/images/Image257.gif | | **2.** | In each test tube add a small amount of a special modified nucleotide \* that cannot form a bond and so stops further synthesis of DNA. Tube A = A\*, tube T = T\*, tube C = C\* and tube G = G\*. The \* nucleotides are present at about 1% of the concentration of the normal nucleotides. | http://www.mrothery.co.uk/images/Image258.gif | | **3.** | Let the DNA polymerase synthesise many copies of the DNA sample. From time to time at random a \* nucleotide will be added to the growing chain and synthesis of that chain will then stop. A range of DNA molecules will be synthesised ranging from full length to very short. The important point is that in tube A, all the fragments will stop at an A nucleotide. In tube T, all the fragments will stop at a T nucleotide , and so on. | http://www.mrothery.co.uk/images/Image259a.gif | | **4.** | The contents of the four tubes are now run side by side on an electrophoresis gel. | http://www.mrothery.co.uk/images/Image260.gif | |  |
|  | **(i)** | Give the sequence of the bases in the DNA used in this example by interpreting the developed gel shown in stage 4. **(1 mark)** | |  |
|  |  | Top of Form  Bottom of Form | |  |
|  | **ii)** | Give the corresponding mRNA sequence (1 mark) | |  |
|  |  | Top of Form  Bottom of Form | |  |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  b. Describe and explain how electrophoresis is used to separate the different fragments of DNA produced by the Sanger technique. **(5 marks)**                    c. Describe two ways Scientists have been able to use information from the Human Genome sequence being completed **(2 marks)**              2. In 1990 a gene mutation in the BRCA1 gene located on chromosome 17 was discovered. All individuals possess the BRCA1 gene which is involved in gene stability by repairing damaged DNA in the breast tissue. If BRCA1 itself is damaged by a BRCA mutation, damaged DNA is not repaired properly, and this increases the risk for breast cancer by 60 – 85% **(6 marks)**  http://biology.arizona.edu/sciconn/lessons2/Alongi/graphics/gel.jpgWomen with known family history of breast cancer were tested to see if they contained the mutated BRCA gene represented by Band 8.   1. Which women had the gene for breast cancer   **(1 mark)**     1. Some of the women tested were from the same family. Which women are related? **(1 mark)**      1. Explain how you can tell? **(2 marks)**            1. Explain 2 ways in which DNA profiling of genetically inherited disease, such as the BRCA mutation, can be beneficial to an individual.   **(2 marks)**        3. Techniques in biotechnology use DNA material to analyse sequences which can be used to modify life. Scientists use repeating patterns to identify traits for particular proteins, genetic disorders and show evolutionary relatedness of different species.  **(14 marks)**   1. Describe a gene **(1 mark)**   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   1. The process of DNA electrophoresis a particular enzyme is used. Name the enzyme and state its function (2 marks) 2. Enzyme: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   Function: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   1. Summarise the difference between DNA sequencing and DNA profiling   **(2 marks)** | | |  |

1. Draw a labelled diagram to show the difference between a sticky end and blunt end strand of recombinant DNA

**(3 marks)**

1. Describe the technique of Recombinant Technology in producing Transgenic Organisms.

**(6 marks)**

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4. The graph below indicates the temperatures at which different parts of the polymerase chain reaction (PCR) cycle occur. (5 marks)



a) Which section of the graph BEST represents the temperature at which annealing occurs? **(1 mark)**

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b) Why is the temperature required to be so high at section B of the graph? **(1 mark)**

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c) Describe the role of Taq polymerase in section D of the graph **(2 marks)**

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d) Explain why Taq polymerase is an appropriate enzyme to use in PCR. **(1 mark)**

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