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BICH/GENE 431, EXAM 1, Wednesday, February 17, 2010, 100 points total

You **MUST** sign the following academic integrity statement:

On my honor, I have neither given nor received unauthorized aid on this academic work.

Signed: _____

1. Write your name on the cover page **ONLY**.
2. Write your student UID# on **ALL** pages. If you do not remember your UID#, make up a random 8 digit number. **DO NOT** use your social security number.
3. Write concise answers to demonstrate effectively your mastery of the subject. In order to obtain maximum credit, you need to show your work.

1) (15 pts) Given the following sequence of a double-stranded segment of DNA:

5'-CCGAATGTCGGAAGCTATAGCCTAGCTGGGGTTACACATCG-3'
3'-GGCTTACAGCCTTGATATCGGATCGACCCCAATGTGTAGC-5'

Using an oligodeoxynucleotide primer of sequence: 5'-GTAACCCAGCTAGGC-3' for a dideoxy sequencing reaction with DNA polymerase, write the complete set of DNA fragments that are synthesized for each reaction to which the designated nucleotides are added. You do not have to write the entire primer sequence for each DNA fragment; just write "5'-primer" followed by the rest of DNA in that fragment.

- A) dATP, dGTP, dTTP, dCTP, plus a lower concentration of ddCTP
- B) dATP, dTTP, dCTP, ddGTP
- C) dATP, dTTP, dGTP, plus a lower concentration of ddTTP
- D) dATP, dGTP, dTTP, dCTP

2) (10 pts) You are performing an electrophoretic mobility shift assay with DNA and proteins having the following properties:

DNA X: radiolabeled with ^{32}P

Protein A: 30,000 molecular wt., binds DNA X as a monomer

Protein B: 50,000 molecular wt., does not bind DNA X, does not bind protein A

Protein C: 50,000 molecular wt., binds DNA X as a monomer at same sequence as protein A with same binding affinity as protein A

Protein D: 50,000 molecular wt., binds protein A at the same site of protein A used to bind DNA X; protein D does not bind DNA by itself

Protein E: 50,000 molecular wt., binds protein A at a location that does not affect protein A binding to DNA; protein E does not bind DNA by itself

Sketch the expected results for lanes 3-7 on the EMSA gel after the following experiments:

Lane 1: DNA X only

Lane 2: DNA X incubated with 10 pmole protein A

Lane 3: DNA X incubated with 10 pmole protein A + 10 pmole protein B

Lane 4: DNA X incubated with 10 pmole protein C

Lane 5: DNA X incubated with 10 pmole protein A + 10 pmole protein C

Lane 6: DNA X incubated with 10 pmole protein A + 1000 pmole protein D

Lane 7: DNA X incubated with 10 pmole protein A + 100 pmole protein E



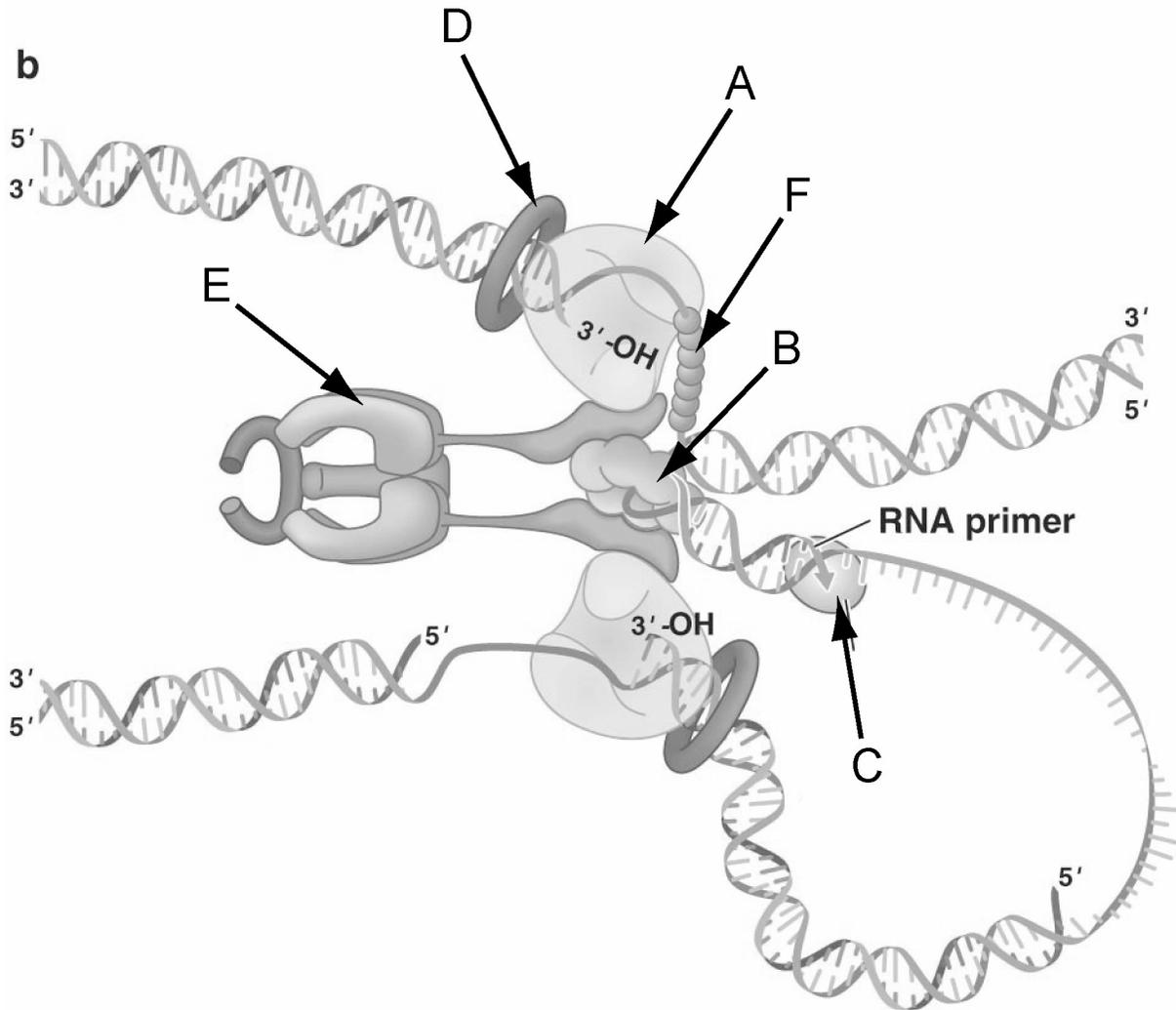
3) (10 pts) Match the scientific discovery or method with the model organism where it was discovered or it is used.

- | | |
|---|---|
| _____ eukaryotic cell cycle | A. <i>E. coli</i> |
| _____ RNA interference | B. budding yeast (<i>S. cerevisiae</i>) |
| _____ restriction enzymes | C. nematode worm (<i>C. elegans</i>) |
| _____ P element transformation | D. fruit fly (<i>Drosophila melanogaster</i>) |
| _____ transparent embryo to study development | E. zebrafish |
| | F. <i>Arabidopsis thaliana</i> |
| | G. mouse |

4) (8 pts) Explain the difference between a selection and a screen. Give a specific example for each.

5) (5 pts) Explain why telomerase inhibitors might be a good anticancer drug.

6) (12 pts) The diagram below from your textbook depicts the *E. coli* replisome. Certain proteins are marked with the letters A-F. Give a name for each protein.



- A _____
- B _____
- C _____
- D _____
- E _____
- F _____

7) (10 pts) For each protein below, tell whether it is correlated with activation of gene expression (write “activation”), repression of gene expression (write “repression”), either activation or repression (write “both”), or not involved in gene expression (write “neither”).

- A. histone H3K9 acetylation _____
- B. histone H3K9 methylation _____
- C. histone methyltransferase _____
- D. histone deacetylase (HDAC) _____
- E. histone H3K4 methylation _____

8)(12 pts)

A) (4 pts) What proteins constitute the pre-RC (pre-replicative complex) in eukaryotes?

B) (8 pts) Explain how pre-RC activation/formation is regulated during each phase of the cell cycle.

9)(18 pts) Short answers

A) (2 pts) What is one example of a nucleosome remodeling complex?

B) (4 pts) Give two examples of histone chaperones and, for each, what histones they "carry."

C) (3 pts) What are three key chemical features that characterize histone-DNA interactions for nucleosome core particles?

D) (4 pts) Name two of the three scientists who received the 2009 Nobel Prize for work on telomeres and the discovery of telomerase.

E) (3 pts) Draw the structure of an acetylated lysine side chain.

F) (2 pts) What simple experiment, prior to detailed structural characterization, suggested that the amino-terminal tails of core histones protruded from the nucleosome core particle?