

Directions: You must take the final. There are a total of 25 two-part questions. Each question is worth a maximum of 6 points, for 150 points total on the final.

YOU HAVE THE OPTION OF TAKING one, two, or all three "I know it now" (IKIN™) tests. Each is worth 25 points and consists of 5 questions, each worth 5 points each.

If you want to take these tests **you must check here or we will not grade it!**

I am taking:

- ☐ IKIN exam 1 (for midterm 1)
- ☐ IKIN exam 2 (for midterm 2)
- ☐ IKIN exam 3 (for midterm 3)

FINAL COURSE GRADES:

midterm 1 exam _____	+ IKIN1 _____	= _____	(max 100)
midterm 2 exam _____	+ IKIN2 _____	= _____	(max 100)
midterm 3 exam _____	+ IKIN3 _____	= _____	(max 100)
midterm 4 + final exam		_____	(max 150)
extra credit		_____	(5 points)
NB _____ + beSocratic _____		_____	(max 50 points)

500 total possible points _____ total

_____ percent _____ letter grade

GOOD LUCK!



1. You have isolated and characterized a new organism, a type of fern; its genome is 20 times the size of the human genome. This means that each of its somatic cells

- ☐ A. has 20 times as many genes as a human somatic cell
- ☐ B. has 20 times as many different proteins as a human somatic cell
- ☒ C. has 20 times as much DNA as a human somatic cell ☐ no idea
- ☐ D. the answer would depend on how the genome is organized

Explain why genome size is not a good measure of an organism's genetic complexity.

2. You compare two related species whose common ancestor lived approximately 50 million years ago; one is an obligate parasite of a single kangaroo species while the other is free living and is found in a wide range of environments. You would be justified in concluding that ...

- ☒ A. the obligate parasite had a smaller genome and few genes
- ☐ B. both organisms have similar numbers of genes ☐ no idea
- ☐ C. the free living species would have a smaller genome and fewer genes

Explain the logic of your answer.

3. PICK THE WRONG ANSWER: Consider the movement of a transposon from one place in the genome to another. Its movement could lead to a mutation in a host gene by...

- ☐ A. disrupting the coding region of the gene in which it inserts ☐ no idea
- ☐ B. disrupting the regulatory region of the gene in which it inserts
- ☒ C. inactivating the enzymes required for transposon movement

Explain why the wrong choice is wrong

4. Scientists estimate that, in humans, less than less that 10% of genomic DNA encodes genes (both regulatory and transcribed regions). To be completely certain that a particular region of DNA is not part of a gene, you would need to ...

- ☐ A. examine whether it contains an open-reading frame ☐ no idea
- ☐ B. determine whether there are variations of the sequence within the human population
- ☒ C. determine the effects of mutations in that region on the phenotype of the organisms

Explain the logic of your choice.

5. A region of the genome that contains four genes is duplicated and moves into a new position within the genome. These genes are now ...

- ☐ A. orthologs of the original genes
- ☒ B. paralogs of the original genes
- ☐ C. alleles of the original ☐ no idea

Explain why the two wrong answers are wrong or irrelevant.

6. After a gene has been duplicated ...

- ☐ A. one gene will inevitably be inactivated by mutation
- ☐ B. the two genes are subject to the same selective pressures ☐ no idea
- ☒ C. one gene can evolve independently and assume distinct functions

Explain the logic of your choice.

7. The ability to import DNA into a cell and use it as genetic material, as opposed to food, is the basis of ...

☐ A. mutation

☐ B. vertical inheritance

☒ C. horizontal gene transfer

☐ no idea

Explain how this would look in an evolutionary context. Feel free to use a phylogeny to help explain your answer.

8. PICK THE WRONG ANSWER: Consider the process by a bacterial virus imports DNA into its head. Given what you know this is likely ...

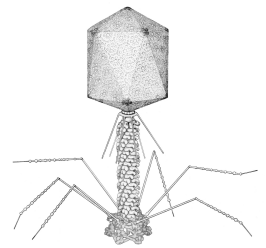
☒ A. to be a spontaneous, thermodynamically favorable process

☐ B. to be a thermodynamically unfavorable process requiring coupling to an process such as ATP hydrolysis

☐ C. to involve specific proteins, encoded by the virus

☐ no idea

Explain why the wrong answer is wrong.



9. A bacterial virus (a bacteriophage) can move DNA from one cell to another. The amount of DNA such a virus can move is limited by the space within its capsid (head). We might predict that if a particular virus has lots of non-viral DNA in its head it would ...

☒ A. not be able to replicate when it infects another cell

☐ B. be able to replicate perfectly well when it infects another cell

☐ C. produce fewer viruses when it infects another cell

☐ no idea

Explain the logic of your answer ...

10. One response to viral (phage) infection by a bacterium is that it will kill itself before the virus has a chance to reproduce. This also “kills” the virus. This type of behavior is an example of ...

☐ A. natural selection

☒ B. social selection

☐ C. sexual selection

☐ no idea

Explain the evolutionary benefit of this type of behavior

11. In Griffith’s studies, bacteria with the rough (R) non-virulent phenotype were transformed into bacteria with the smooth (S) virulent phenotype. What is going on?

☒ A. horizontal gene transfer of a wild type gene

☐ B. evolution of a new wild type gene

☐ C. a change in gene expression with the R type cells

☐ no idea

Explain the logic of your answer.

12. In contrast to mitosis, during meiosis new alleles can be generated when ...

☐ A. DNA is replicated

☐ B. a cross-over event over occurs between genes

☒ C. a cross-over event occurs within a gene

☐ no idea

Explain why the wrong answers fail to generate a new allele.

13. In contrast to mutations that occur in somatic cells, mutations that occur in the cells of the germ line ...

- ☒ A. can be passed to the next generation of organisms
- ☐ B. are efficiently repaired
- ☐ C. do not influence the phenotype of the organism
- ☐ no idea

Explain the logic of your answer.

14. Particularly in small populations, the processes of meiosis and gamete fusion can influence the frequency of alleles in the next generation because ...

- ☐ A. all alleles are passed from one generation to the next
- ☒ B. which alleles are passed on is random, beneficial alleles can be lost
- ☐ C. these processes do not influence allele frequencies, only natural selection does that
- ☐ no idea

Explain the logic of your answer.

15. Based on genomic sequence data, you discover a gene present in barnacles and gorillas that is over 90% identical in encoded polypeptide sequence. These two genes are likely to ...

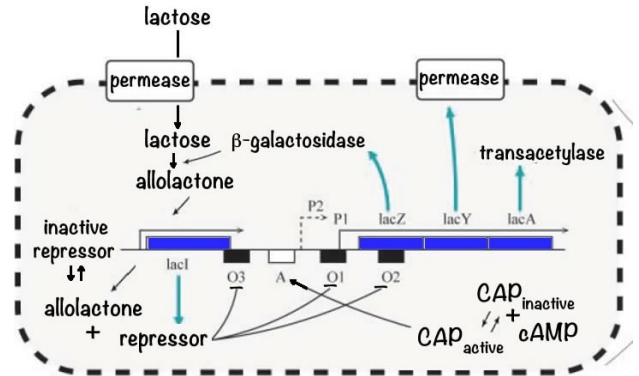
- ☐ A. be the result of random genetic drift
- ☒ B. reflect common ancestry and evolutionary conservation
- ☐ C. unrelated, with similarities due to analogous functions
- ☐ D. the same set of mutations occurred independently in the ancestors of the two species
- ☐ no idea

Explain the logic of your answer.

16. Consider the lac operon, its expression is regulated both positively and negatively. Its positive regulation (by CAP) insures that... ☐ no idea

- ☒ A. the operon is off when energy is abundant
- ☐ B. the operon turns on when lactose is present
- ☐ C. the operon is off if lactose is absent

Explain the logic of your answer.



17. Negative regulation of the operon by the lactose repressor insures that ...

- ☐ A. the operon is off when energy is abundant
- ☐ B. the operon turns on when lactose is present
- ☒ C. the operon is off if lactose is absent

☐ no idea

Explain the logic of your answer.

18. The regulation of the activity of both the lac repressor and the CAP proteins is an example of ...

- ☐ A. post-translational modification
- ☐ B. proteolytic processing
- ☐ C. regulation of protein half-life
- ☒ D. allosteric regulation

☐ no idea

Explain the logic of your answer.

19. A mutation occurs that disrupts the ability of lac repressor to regulate the activity of the lac operon, the mutant cells would ...

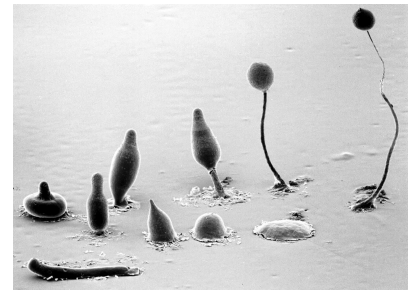
- ☐ A. always express the lac operon
- ☐ B. never express the lac operon
- ☒ C. express the lac operon whenever there were low energy levels in the cell
- ☐ D. lead to the death of the cell when lactose was present
- ☐ no idea

Explain the logic of your answer.

20. When starving, cells of the cellular slime mold *Dictyostelium* aggregate to form a multicellular slug that can differentiate into stalk cells that die and spore cells that can reproduce. How might a mutation that creates a social cheater influence cellular behavior?

- ☒ A. Cheater cells would not form the stalk.
- ☐ B. Cheater cells would divide more frequently.
- ☐ C. Cheater cells would not form spores.
- ☐ no idea

Explain the logic of your choice.



21. PICK THE WRONG ANSWER: If individuals with “cheater” mutations can avoid self-sacrifice and insure their survival and enhance their reproductive success, how is it possible that social processes can be maintained evolutionarily?

- ☒ A. Good behavior is its own reward.
- ☐ B. A certain level of social interactions may be essential to reproductive success.
- ☐ C. Populations may be competing with one another and social interactions influence the outcome (that who wins) of this competition.
- ☒ D. Enhanced social interaction is a common outcome of random mutation and natural selection

Explain why the wrong choice is wrong.

22. Here is the binding motif for the positively acting ABF1 transcription factor protein. A version of this motif is found in the regulatory region of the Xex gene, but it has Gs at positions 3, 5, and 10. A mutation occurs in a cell that leads to a dramatic increase in the expression of the Xex gene, it is most likely to be at which position?



☒ 3

☐ 5

☐ 10

☐ can't be predicted, mutations are random

☐ no idea

Which mutation would produce the largest effect on Xex expression and explain why.

23. **PICK THE WRONG ANSWER:** Human female cells have two X-chromosomes while male cells have only one. Assume that in a particular population there are many different alleles for genes located on the X chromosome. The process of X-inactivation means that ...

☐ different cells in a female that express a gene on the X chromosome will all express the same allele of a particular gene

☐ all cells in a male that express a gene on the X chromosome will express the same allele of that gene

☒ different cells in a female that express a gene on the X chromosome can express different alleles of that gene

☐ no idea

Explain why the wrong choice is wrong.

24. As a general rule you would predict the greater the concentration of a specific transcription factor is present in a cell, the ...

☐ the more noisy the target genes it regulates would be

☐ no idea

☒ the less noisy the target genes it regulates would be

☐ the noisiness of gene expression is not influenced by the concentration of regulatory factors

Explain the logic of your answer.