

1. The following processes are required to produce a transcription factor...

- ☐ A. transcription
- ☐ B. translation
- ☒ C. transcription and translation
- ☐ D. replication

2. How would Hammerling's observations on *Acetabularia* have been different if hereditary information were localized in the cytoplasm rather than in the nucleus?

- ☐ A. no difference
- ☐ B. regrowing head shape would be determined by the host cytoplasm
- ☐ C. regrowing head shape would be determined by the donor cytoplasm
- ☒ D. regrowing head shape would be determined by the relative amounts of host and donor cytoplasm.

3. In Griffith's transformation experiment, which would be a good **negative** control?

- ☐ A. injecting mice with dead R bacteria and living S bacteria
- ☒ B. injecting mice with living R bacteria and dead R bacteria
- ☐ C. check whether dead R and S bacteria kill mice
- ☐ D. injecting mice with living R and living S bacteria.

4. In Griffith's transformation experiment, a good **positive** control would be to check

- ☐ A. whether living R bacteria kill mice
- ☐ B. whether dead R bacteria kill mice
- ☒ C. whether living S bacteria kill mice
- ☐ D. whether the mice were healthy

5. Griffith's experiments **proved** that genetic information ...

- ☐ A. was stored in DNA
- ☐ B. was derived from the infected mouse
- ☒ C. was stored in a chemically stable form
- ☐ D. could arise spontaneously

6. The half-life of a molecule, whether a protein or an RNA, is a property of ...

- ☐ A. individual molecules
- ☒ B. population of molecules
- ☐ C. the location of molecules in the cell

7. More DNA in an organism's genome always means ...

- ☐ A. more genes, and so more complexity in gene expression
- ☐ B. a more complex phenotype (i.e. more complex structures and behaviors)
- ☒ C. more DNA, and so more energy needed to replicate the genome
- ☐ D. more types of RNA are produced

8. The trouble with storing information directly in a protein sequence is ...

- ☐ A. proteins are catalysts
- ☐ B. proteins are unstable
- ☐ B. proteins interact with one another
- ☒ C. not obvious how to copy a protein

9. In one of our tutorials we discussed non-sense suppressors, a mutation in a gene that encodes a tRNAs that suppress the effects of non-sense mutations. For an organism to be able to survive the mutation that creates a non-sense suppressor tRNA, which must be true?

- ☐ A. the gene with the original non-sense mutation must be relatively unimportant
- ☒ B. there must be multiple genes encoding specific tRNAs
- ☐ C. the original mutation must be in a non-coding region
- ☐ D. the mutation must alter the tRNA so that "wrong" amino acid is attached

10. During translation, binding of release factor leads to the disassembly of the ribosome/mRNA complex. Release factor does not normally cause the premature termination of translation because ...

- ☒ A. release factor binding sites are normally occupied by a tRNA
- ☐ B. the release factor only recognizes stop codons.
- ☐ C. release factor protein is normally unstable

11. Consider a typical water-soluble protein; there are often some hydrophobic R-groups on the surface of the native protein. Why is that?

- ☐ A. the protein is misfolded and will have a short half life
- ☒ B. it is not geometrically or energetically possible to hide them all in the interior
- ☐ C. whether they are hydrophobic or not depends on their environment

12. If you were trying to devise a simple system that could recognize unfolded proteins in the cytoplasm of a cell, you might look for ...

- ☐ A. hydrophilic R-groups in the interior of the molecule
- ☐ B. acidic R-groups within the interior of the molecule
- ☒ C. multiple hydrophobic R groups on the surface
- ☐ D. a negative net surface charge

13. In humans, lactose tolerance is most likely due to a mutation in ...

- ☒ A. a regulatory region
- ☐ B. a coding region
- ☐ C. a tRNA
- ☐ D. an enzyme

14. The appearance of lactose tolerance in certain human populations is a due to ....

- ☐ A. a conscious decision by humans to raise cows
- ☐ B. a conscious decision by adults to drink cow milk
- ☒ C. mutations that provided an advantage to milk-drinking humans
- ☐ D. directly caused by drinking milk

**15. The effects of post-translational modifications on proteins are similar to the effects of allosteric effectors in that they ...**

- ☐ A. are reversible
- ☐ B. are irreversible
- ☐ C. add a charge
- ☒ D. change structure and activity

**16. Where are hydrophobic effects important in DNA?**

- ☒ A. base stacking
- ☐ B. base pairing
- ☐ C. the interactions between sugar-phosphate groups

**17. Gene X encodes an enzyme (EnzX) that catalyzes reaction A efficiently and reaction B inefficiently. You identify a mutant organism in which EnzX now catalyzes reaction A inefficiently and reaction B efficiently. The mutation is most likely in ...**

- ☐ A. the regulatory region of gene X
- ☐ B. a gene encoding a transcription factor
- ☒ C. the coding region of gene X
- ☐ D. the stop codon of gene X

**18. The genetic code is an example of ....**

- ☐ A. a rapidly evolving trait
- ☐ B. an analogous trait
- ☐ B. a trait associated with reproductive isolation
- ☒ C. a homologous trait

**19. Assume that a bacteriophage evolved that could infect only one type of bacteria; what would happen to the phage if there were no mutations leading to resistant bacteria?**

- ☒ A. the phage would become extinct
- ☐ B. the phage would infect other types of bacteria
- ☐ C. bacteria infected by the phage would become immune

**20. One might argue that there are two genetic codes, the first, how tRNAs recognize codons, and the second how**

- ☒ A. the enzymes that add amino acids to tRNAs recognize tRNAs
- ☐ B. the ribosome recognizes an mRNA and begins translation
- ☐ C. how release factors recognize stop codons and end translation

**21. A metabolic pathway produces a final product (Tett); the level of this product is always within a narrow concentration range, even if we block the synthesis of new enzymes. One way to do this would be to have ...**

- ☐ A. Tett acts as a positive allosteric effector of enzymes in the pathway
- ☒ B. Tett acts as a negative allosteric effector of enzymes in the pathway
- ☐ C. Tett acts as a regulator of the synthesis of enzymes in the pathway.

22. A diploid organism has both a maternal and a paternal set of chromosomes. During meiosis many different sets of chromosomes can be generated. Which is not normally involved in the generation of variation during meiosis?

- ☐ A. chromosome segregation
- ☐ B. crossing over between homologous chromosomes
- ☒ C. the generation of deletions and duplications

23. We can deduce that cell size and shape are normally under genetic control because ...

- ☐ A. they never vary
- ☒ B. mutations can alter cell size and shape
- ☐ C. changes in the environment can alter cell size and shape

24. As part of a meiosis-specific process, new alleles can be generated. This process involves

- ☐ A. mutation
- ☒ B. crossing-over
- ☐ C. fertilization
- ☐ D. DNA replication

25. You discover a mutation in a strain of bacteria that reduces the efficiency of the onset of DNA replication; once DNA replication begins everything else is normal. You predict that this leads to

- ☒ A. an increase in cell size
- ☐ B. a decrease in cell size
- ☐ C. cell death

26. Imagine that you could remove the nucleus from a skin cell and, after some manipulation, implant it into an egg (after removing the egg's nucleus); the manipulated egg produces a viable organism. This experiment proves that ....

- ☒ A. no genetic information was lost during the formation of the skin cell
- ☐ B. genetic information in the egg cytoplasm moves into the transplanted nucleus
- ☐ C. all genetic information is located in the egg's cytoplasm

27. You inherited a set of chromosomes from your mother and a set from your father. Why is it extremely unlikely that any of your children (even if you had a very large number), would inherit a complete set of your mother's chromosomes?

- ☐ A. developmental changes in chromosomes during mitosis and cell division
- ☐ B. specific chromosomes are lost and others are duplicated during meiosis
- ☒ C. random assortment of chromosomes during the first meiotic division

28. During development, i.e. going from a fertilized egg to an adult, which processes are the root cause of differentiation?

- ☐ A. mutations
- ☐ B. gene expression due to loss of DNA
- ☐ C. asymmetries
- ☒ D. cellular asymmetries and changes in gene expression

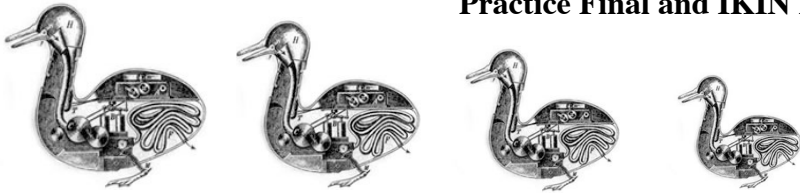
**29. It is difficult for a differentiated cell, like a muscle, a nerve cell, or a skin cell, to change back into a less specialized cell because it would require ....**

- ☒ **A. turning on, and turning off specific genes in an "unnatural" sequence**
- ☐ B. the occurrence of specific mutations with specific effects on cell behavior
- ☐ C. the expression of genes lost during the differentiation process

**30. Consider a population of single celled organisms that divides only after it reaches a certain genetically determined size. Why might a mutation that causes the cells to divide when they are smaller have a reproductive advantage.**

- ☒ **A. faster division cycle**
- ☐ B. more difficult for viruses to infect
- ☐ C. it would have less DNA

## Practice Final and IKIN Exams



On the "I know it now!" (IKIN!) exams, there is no "no idea" option.

**If you are taking one or more IKIN exams, you must check here, or we will not grade it!**

I am taking a I KNOW IT NOW! exam

Midterm 1

☐

Midterm 2

☐

Midterm 3

☐

**1. In most bacteria, there is a single origin of DNA replication. You introduce a mutation that removes this sequence - the most likely effect of such a mutation is that DNA replication ...**

- ☐ A. begins at another site, and the cell divides more or less normally.
- ☐ B. begins at multiple sites, and is aberrant.
- ☒ C. does not begin.

\_\_\_ is wrong because

**2. With regards to question 2; there are mutations in other genes that could mimic the loss of the origin of replication; one such mutation would be in a gene that encodes ...**

- ☐ A. a protein that binds to DNA.
- ☒ B. a protein that binds specifically to the origin sequence.
- ☐ C. a tRNA.

\_\_\_ is wrong because

**3. During mitotic cell division in eukaryotes, a cell produces two daughters that have the same chromosome number as itself. In meiosis, the number of chromosomes in the cells produced is ....**

- ☐ A. unchanged
- ☐ B. increased by 2-fold
- ☒ C. decreased by 2-fold

\_\_\_ is wrong because

**4. Organisms of the same species differ genetically because ....**

- ☐ A. they contain different genes
- ☒ B. they contain different alleles
- ☐ C. their genes are organized differently on their chromosomes

\_\_\_ is wrong because

**6. Consider two different mutation, one (mutation A) disrupts the production of a transcription factor, while the other (mutation B) disrupts a transcription factor binding site in the regulatory region of a gene. Which is likely to produce the more severe phenotype?**

- ☒ A. mutation A
- ☐ B. mutation B
- ☐ C. no reason to pick one over the other

\_\_\_ is wrong because

7. In a classic experiment, performed by David Prescott of MCDB, part of amoebas' cytoplasm was repeatedly removed; the effect was to block cell division. The positive control for this experiment was to ...

- ☐ A. to examine the behavior of unmanipulated cells.
  - ☒ B. determine whether the manipulated cell would divide if left alone.
  - ☐ C. cut the cell, but put the pieces back together again.
- \_\_\_ is wrong because

8. Consider the cellular slime mold *Dictyostelium*; how is it possible that natural selection could lead to the organism's "communal behavior" in which individual cells aggregate, but only a small number go on to produce offspring?

- ☐ A. In the real world, the cells involved are related and willing to sacrifice themselves
  - ☒ B. This behavior would increase the chance that a cell, or its close relatives, will survive; "selfish" cells would be more likely to perish
  - ☐ C. This is an example of trait that appeared due to a process like a founder effect or genetic drift.
- \_\_\_ is wrong because

What type of mutation would lead to cellular behavior that would "cheat" the rest of the cells in the population?

9. In an asexual organism, a mutation occurs and leads to a harmful, but not lethal phenotype. Ten generations after the original mutation occurred, you find that organisms with this original mutation are present, but at a very low frequency. You take a (much deserved) vacation and when you return, ~ 200 generations later, you find that organisms with the original mutation account for more than 98% of the population. Which is most likely to explain this observation.

- ☐ A. the original mutation mutated back to wild type
  - ☐ B. the original mutant strain went extinct; the organisms you found on your return were derived from a new mutation
  - ☒ C. new mutations occurred that enhanced the ability of the organisms to compete.
- \_\_\_ is wrong because

10. You began as fertilized egg (before that, you were not you). Since that point, you developed as a clone (no offense intended, but it is true). Which process was not involved in the development of your body...

- ☐ A. DNA replication
  - ☐ B. mitosis
  - ☒ C. meiosis
- \_\_\_ is wrong because

11. Different version of a gene (alleles) can differ in a number of ways. What is the likely effect of a change in the regulatory region of a gene?

- ☒ A. changes in where, when and how much of a gene product is produced
  - ☐ B. changes in the structure of the gene product
  - ☐ C. changes in the stability of the gene product
- \_\_\_ is wrong because

12. Recently, it has become possible to take the nucleus of a differentiated cell, like a cell lining the gut, and use it to generate a new organism. This type of experiment indicates that ....

- ☒ A. no genetic information was lost during the process that produced the gut cell
  - ☐ B. genetic information in the egg cytoplasm is added to that present in gut cell nucleus
  - ☐ C. the genetic information required to form an embryo is located in the egg's cytoplasm
- \_\_\_ is wrong because

13. There is a suggestion, based on the "collar" structure found in choanoflagellates (unicellular eukaryotes) and some of cells found in sponges (multicellular eukaryotes) that choanoflagellates are the group of unicellular eukaryotes most closely related to sponges in particular, and multicellular animals in general. This is an argument that assumes that the collar structure in both choanoflagellates and sponge cells are ...

- ☐ A. analogous
  - ☒ B. homologous
  - ☐ C. different structures with different functions
- \_\_\_ is wrong because

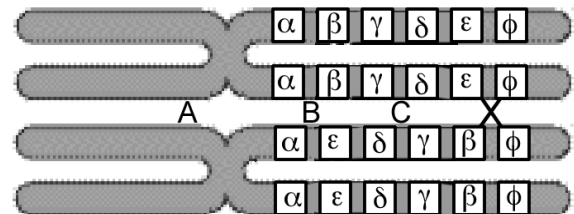


14. Following the division of a stem cell, one cell becomes different from the other. This is must be due to ...

- ☐ A. random chance
  - ☒ B. intracellular or extracellular asymmetries
  - ☐ C. differences in which genes each cell inherited
- \_\_\_ is wrong because

15. Consider a sexual organism in which the maternal copy of chromosome 4 (shown) has an inversion compared to the paternal homolog. During meiosis, there was a crossing-over event, marked by the "X". Where would a second crossing-over event lead to the loss of genetic information in one of the gametes?

- ☐ A.
  - ☐ B.
  - ☒ C.
- \_\_\_ is wrong because





The "I KNOW IT NOW!" EXAM #1

**NOTE: Some questions may have more than one correct answer; pick "and/or" and explain.**

**1. The importance of natural selection in understanding biological systems is that it ...**

☐ A. provides a mechanism that circumvents the laws of thermodynamics.

☒ B. provides an explanation for homologies between organisms.

☐ C. explains why human beings exist

\_\_\_ is wrong because

**2. Pick and justify the scientifically correct statement:**

☐ A. Evolution always produces organisms of increasing complexity

☒ B. A primitive looking organism can be descended from more complex predecessors.

☐ C. Random process cannot lead to the high levels of information observed in living organisms.

\_\_\_ is wrong because

**3. The importance of the Miller-Urey experiment was that it ....**

☐ A. proved that the conditions used were the same as those that existed on the early earth.

☒ B. demonstrated that many organic molecule could be synthesized under simple conditions.

☐ C. suggested that key organic molecules require cells to form.

\_\_\_ is wrong because

**4. Assuming that aliens visited the earth once (and only once) at some random time during the last 4 billion years. What are the odds that they would find humans?**

☐ A. More than 85%

☐ B. Less than 50%

☒ C. Less than 1%

\_\_\_ is wrong because

**5. The appearance of lactose tolerance is due to mutations; some populations of human show high levels of lactose tolerance, other do not. This is evidence that ...**

☐ A. humans are still evolving

☐ B. lactose tolerance is the ancestral state of mammals

☒ C. human technologies can shape human evolution

\_\_\_ is wrong because

Even more credit (2 pts): How would you tell whether the lactose tolerance in two human subpopulations was homologous or analogous?

**6. You are doing an experiment on acupuncture. A good negative control would be ...**

☐ A. not using needles

☒ B. placing the needles where they should not have an effect, but not telling the person that.

☐ C. using needles, an anesthetic, and not allowing the person to see whether the needle had been inserted or not

\_\_\_ is wrong because

THIS IS THE "I KNOW IT NOW!" EXAM #2

1. Which is not a common feature of both photosynthesis and respiration?

- ☐ A. an electron transport chain
- ☐ B. a  $H^+$ -dependent, ATP synthase
- ☒ C. the extraction of electrons from  $H_2O$

\_\_\_ is wrong because

2. You are studying a cell with bacteriorhodopsin in its membrane. In the light, glucose starts to enter the cell. It would not be unreasonable to assume that the cell's membrane contains ...

- ☒ A. a  $H^+$ /glucose symporter.
- ☐ B. a  $H^+$ /glucose antiporter.
- ☐ C. the enzymes required to extract electrons from water.

\_\_\_ is wrong because

3. Oils are insoluble in water, while lipids form complex structures, such as micelles and bilayers. Why?

- ☒ A. Lipids have both hydrophilic and hydrophobic domains
- ☐ B. Lipids are shaped so that their van der Waals interactions favor micelle/bilayer formation
- ☐ C. Lipids have smaller hydrophobic domains than do oils

\_\_\_ is wrong because

4. Consider bacterial cells growing in a dilute salt solution. You add an antibiotic that inhibits the assembly of new cell walls. What happens?

- ☐ A. Cell growth stops.
- ☐ B. Cells will continue to grow, but without a cell wall.
- ☒ C. Growing cells will swell and burst.

\_\_\_ is wrong because

5. Consider the reactions:



(relax, read slowly, and take your time)



All three reactions are catalyzed by enzymes, and so the system reaches equilibrium. What happens to the concentration of A if M is removed from the system?

- ☐ A. it increases
- ☐ B. it decreases
- ☒ C. nothing

\_\_\_ is wrong because

6. Increasing the temperature increases the reaction rates because

- ☐ A. The energy of the "activation" state is reduced.
- ☒ B. A larger proportion of the molecules have enough energy to reach the "activation" state.
- ☐ C. The nature of the activation state of the reaction is altered.

\_\_\_ is wrong because

## THIS IS THE "I KNOW IT NOW!" EXAM #3

NOTE: Some questions may have more than one correct answer; pick "and/or" and explain.

1. How does the hydrophobic effect most directly influence DNA structure?

- ☒ A. It favors base stacking.
- ☐ B. It determines the specificity of base pairing.
- ☐ C. It mediates interactions with proteins.

\_\_\_ is wrong because

2. What would happen if mRNA transcription began randomly along DNA?

- ☐ A. translation might begin at the wrong place
- ☐ B. polypeptides would be longer
- ☒ C. many abnormal polypeptides would be produced

\_\_\_ is wrong because

3. How do different tRNA differ from one another?

- ☒ A. they have different anti-codons
- ☒ B. they interact differently with the enzymes that attach amino acids
- ☐ C. they interact differently with release factor

\_\_\_ is wrong because

4. Why is the R-group of the amino acid leucine [  $-\text{CH}_2-\text{CH}-\text{CH}_3$  ] considered to be hydrophobic?



- ☐ A. it is symmetrical
- ☒ B. C-H bonds are nonpolar
- ☐ C. C-H bonds are polar

\_\_\_ is wrong because

5. A protein has a short half-life, that means....

- ☐ A. it is rarely synthesized.
- ☐ B. it is rarely degraded.
- ☒ C. it is rapidly degraded.

\_\_\_ is wrong because

6. Two transcription factors bind to overlapping DNA sequences present in the Nan-E gene; one acts positively, the other negatively. In response to a signal from outside the cell, the negatively acting transcription factor is inactivated. What do you expect to happen to the level of Nan-E RNA?

- ☒ A. increase
- ☐ B. decrease
- ☐ C. it will not change

\_\_\_ is wrong because