

7. In a translocation mutation, if a gene that is ordinarily transcribed at a very high rate is moved to a region close to the centromere, it can sometimes be partially engulfed by heterochromatin and not be expressed. The resulting unusual phenotype of the organism inheriting the mutation is said to be caused by
 - a. adjacent mutations
 - b. alternate segregation
 - c. position effect
 - d. hemizygoty
 - e. nullisomy
8. The existence of SYNTENY in related species is evidence that
 - a. chromosomes can undergo mutation without changing phenotype of the organism
 - b. most mutations are lethal
 - c. polyploid plants are more robust than their diploid parents
 - d. heterozygous individuals are more disease-resistant than homozygous individuals
 - e. multiple translocations and chromosomal rearrangements of originally similar chromosomes has been an important feature in evolutionary change
9. Which of the following is most likely to have direct evolutionary consequences?
 - a. triploidy in a single human liver cell
 - b. nullisomy in a rat gamete
 - c. inversion mutation in a butterfly spermatogonial cell
 - d. nondisjunction of chromosome 6 in a cell giving rise to part of a dog's iris
 - e. mutated meristem cell ultimately gives rise to a flower petal.
10. An enzyme which recognizes a specific DNA sequence and cleaves it only at that location is known as a(n)
 - a. recognition endonuclease
 - b. recognition exonuclease
 - c. restriction endonuclease
 - d. restriction site
 - e. RFLP
11. Which of the following is true of a bacterium carrying the F plasmid?
 - a. It is unable to form a pilus, but can transfect other bacteria with its plasmid
 - b. It is inhibited from making contact with bacteria that do not contain the F plasmid
 - c. Its F plasmid contains transposable elements which promote viral infection
 - d. It can convert F⁻ bacteria into F⁺ bacteria via conjugation
 - e. More than one of the above is true
12. When a virus carrying DNA from one bacterium infects a second bacterium and introduces the previous bacterium's DNA into the new host, _____ is said to have occurred.
 - a. transformation
 - b. conjugation
 - c. transduction
 - d. merozygoty
 - e. all of the above
13. A bacterial merozygote
 - a. contains an exogenote that is partially homologous to its own chromosome
 - b. is haploid
 - c. is completely diploid
 - d. is unable to survive and reproduce without enriched growth medium
 - e. contains a prophage
14. A chimeric DNA molecule
 - a. is composed of nucleotide sequences from two different species
 - b. can occur in natural populations, and is a type of mutation
 - c. results from a somatic mutation
 - d. will result in mosaic expression
 - e. is known only in Greek mythology
15. In genetics, an expression library
 - a. contains an organism's entire genome
 - b. is composed only of mRNA fragments
 - c. is initially derived by probing for proteins with labeled antibodies
 - d. is composed of artificial DNA
 - e. none of the above

Use the following information to answer #16 - 18.

You wish to determine the relative locations of several genes on the *E. coli* chromosome, and have decided to engage in a little bit of Hfr wildness. The genes and alleles of interest involve the bacteria's ability to resist being killed by antibiotics, to digest certain sugars, and to manufacture an amino acid:

pen - wild type (s) bacteria are sensitive to penicillin; mutants (r) are resistant to penicillin
mal - wild type (+) bacteria can digest the sugar maltose; mutants (-) are unable to digest maltose
dox - wild type (s) bacteria are sensitive to doxycycline; mutants (r) are resistant to doxycycline
leu - wild type (+) bacteria can manufacture leucine; mutants (-) cannot manufacture leucine
ser - wild type (+) bacteria can manufacture serine; mutants (-) cannot manufacture serine

You have two strains of *E. coli*, one Hfr and the other F⁻. The phenotypes of your two *E. coli* strains are as follows:

Hfr: sensitive to penicillin; resistant to doxycycline; able to digest maltose; able to make leucine; able to make serine

F⁻: resistant to penicillin; sensitive to doxycycline; unable to digest maltose; unable to make leucine; unable to make serine

You pour both strains into a blender and allow them to conjugate for brief periods before turning off the blender (this is an important step, if you wish to keep your lab nice and clean), and taking a sample at each interval to plate out and grow on appropriately supplied media.

The bacteria allowed to conjugate for five minutes were resistant to penicillin and doxycycline

The bacteria allowed to conjugate for 10 minutes were able to manufacture to serine

The bacteria allowed to conjugate for 15 minutes were able to digest maltose

The bacteria allowed to conjugate for 20 minutes were able to manufacture leucine

16. From the information given, you can determine that the order of the loci is
- O pen dox mal leu ser*
 - O dox mal leu ser pen*
 - O dox ser mal leu pen*
 - O pen dox ser mal leu*
 - O dox ser mal leu* (*pen* locus cannot be determined from this information)
17. To selectively remove the Hfr bacteria in your sample after interrupting conjugation, you should
- add doxycycline to your sample
 - use electrophoresis to separate and remove the heavier Hfr bacteria
 - irradiate the cultures to kill the more sensitive Hfr individuals
 - add penicillin to your sample
 - heat the culture so that the already hot Hfr would burst into flames
18. The reason for interrupting conjugation at timed intervals is to
- facilitate cloning of Hfr DNA segments of interest
 - turn F⁻ bacteria into vectors to be used to insert genes into eukaryotic cells
 - allow mapping of the mutant and wild type alleles on the same chromosome
 - allow mapping of gene loci on the F plasmid in relation to the origin site
 - generate mutations which render F⁻ bacteria resistant to particular antibiotics
19. A radioactively labeled DNA sequence used to bind (and hence locate) a complementary DNA sequence of interest is known as a
- within a genome is known as a
- clone
 - vector
 - probe
 - phage
 - marker
20. A virus in which RNA is the primary genetic material is
- a vector
 - a prophage
 - lytic
 - a retrovirus
 - lysogenic

Use the following information to answer #21 - 23.

You have an enzyme named *Sa*RIII which specifically cleaves the phosphodiester bond between two adjacent cytosine nucleotides, but only when they occur in the exact sequence: **5'--CCTACGATGG--3'**.

21. *Sa*RIII is
- a. a protease
 - b. an exonuclease
 - c. a restriction endonuclease
 - d. a probe
 - e. a vector
22. From its name alone, you know that of the following choices, the enzyme *Sa*RIII was first discovered in and derived from
- a. *Escherichia coli*
 - b. *Pseudomonas aeruginosa*
 - c. *Bacteroides enteris*
 - d. *Staphylococcus aureus*
 - e. a mad cow
23. If you were to use *Sa*RIII to cleave the following double-stranded sequence:
- 5'--CCTACGATGG--3'**
3'--GGATGCTACC--5'
- one of the resulting single-stranded "sticky ends" should consist of the base sequence
- a. 5'--CCTACGATG--3'
 - b. 3'--GGATGCTACC--5'
 - c. 5'--CTACGATGG--3'
 - d. 3'--GATGCTAC--5'
 - e. more than one of the above
24. An *E. coli* cell has a mutant allele on its chromosome which renders it resistant to tetracycline by allowing it to manufacture an enzyme which inactivates tetracycline. This enzyme does not exist in wild type bacteria, which are killed by tetracycline. If a virus carrying the wild type allele inserts that allele into a tetracycline-resistant *E. coli* bacterium, creating a merozygote for the tetracycline gene, which of the following is likely to result? (A reasoning question!)
- a. The mere presence of the wild type allele will instantly override the host's tetracycline-resistance allele
 - b. A single crossover will cause the mutant allele to replace the wild type allele
 - c. The virus-delivered gene will insert at a locus other than the *tet* locus, and cause tetracycline sensitivity in the host cell.
 - d. The host cell's tetracycline resistance is not likely to be affected by the new DNA
 - e. The *E. coli* will now be only partially sensitive to tetracycline.

Use the following information to answer #25 - 28

You have four reaction flasks in which you have provided all the raw materials (DNA template strands, DNA nucleotides, labeled primers, DNA polymerases, etc.) and physical conditions for DNA synthesis from a cloned template DNA strand you wish to sequence. To each of your flasks, you add radioactively labeled dideoxy nucleotide triphosphates (ddNTP's), as follows:

- Flask #1: dideoxy-adenine triphosphate (ddATP)
 - Flask #2: dideoxy-cytidine triphosphate (ddCTP)
 - Flask #3: dideoxy-guanine triphosphate (ddGTP)
 - Flask #4: dideoxy-thymidine triphosphate (ddTTP)
25. The function of the ddNTP's is to
- a. facilitate DNA synthesis by activating DNA polymerases
 - b. create a new DNA strand in which every nucleotide is radioactively labeled
 - c. increase the reaction rate of DNA synthesis
 - d. help generate a series of DNA fragments that differ in length by only one base pair
 - e. More than one of the above
26. The purpose of the "dideoxy method" you have set up as described above is to
- a. clone large quantities of DNA very rapidly
 - b. facilitate sequencing of the DNA template strand
 - c. create cloning vectors
 - d. radioactively label DNA of which the base sequence is already known

27. After you allowed your reaction flasks to run for an appropriate amount of time, you treat your samples to remove any residual single-stranded DNA, and then place a sample from each of the four flasks into a well on an acrylamide gel for electrophoresis. Once this is complete, you can visualize the location of the various bands of DNA samples by exposing the radioactive samples on the gel on x-ray film. This visualization technique is known as
- x-ray crystallography
 - autoradiography
 - electroradiography
 - Giemsa staining
 - dideoxy fragmentation
28. The diagram below represents the bands you were able to visualize with the technique you used above. The wells containing containing samples made with ddATP, ddGTP, ddCTP and ddTTP are at the left, and the samples have traveled to the right during electrophoresis.



From reading the gel above, you can determine that the sequence of the original template strand of DNA in your reaction flasks was

- 5'--ACCCGTTAAGGCTCCAAAGGCAGT--3'
 - 3'--ACCCGTTAAGGCTCCAAAGGCAGT--5'
 - 5'--TGGGCAATTCCGAGGTTTCCGTCA--3'
 - 3'--TGGGCAATTCCGAGGTTTCCGTCA --5'
 - need more information to determine this
29. A DNA sequence of unknown function and flanked on either end by a start codon and stop codons is
- known as an open reading frame (ORF)
 - a stem loop
 - a putative gene
 - a non-functional gene
 - two of the above
30. Luciferase is an enzyme responsible for mediating bioluminescence (glowing!) in certain organisms. When the luciferase gene is inserted alongside another foreign gene the investigator wishes to insert into a host cell, its expression in the host's phenotype indicates successful insertion of the gene of interest. The luciferase gene is thus used as a
- molecular marker
 - cytoplasmic marker
 - reporter gene
 - replicon
 - physiological activator
31. In the process known as *in vitro* mutagenesis
- an oligonucleotide containing a mutation is inserted into a bacterial cell.
 - only base pair substitution mutations can be generated
 - 100% of the resulting replicated bacterial chromosomes will carry the mutation
 - the investigator uses a vector to sequence a short segment of bacterial DNA
 - none of the above
32. A sequence of genes adjacent to one another on the DNA and under the collective control of a promoter and an operator is known as this.
- allosteric protein
 - operator
 - operon
 - repressor
 - cistron
33. The sequence of DNA, usually just upstream of the promoter, to which a repressor molecule attaches and either inhibits or enhances transcription of the operon is known as a(n)
- allosteric site
 - operator
 - silencer
 - inducer
 - repressor site

34. Under ordinary conditions, *E. coli* constantly produces the series of enzymes necessary for it to manufacture the amino acid proline from its various chemical precursors. Sometimes, the bacterium encounters environmental conditions in which amino acids are scarce, necessitating a "slowdown" in amino acid production. If conditions are severe enough, the genes encoding the proline-manufacturing enzymes can be completely shut off, stopping proline production. When proline is needed again, the genes are re-activated. This type of system is said to be
- inducible
 - translatable
 - repressible
 - attenuatable
 - prolificous
35. When the *trp* operon system of *E. coli*, is working under attenuator control
- a high concentration of tryptophan will cause the *trp* operon to cease being transcribed
 - a high concentration of tryptophan will cause the *trp* operon to cease being translated
 - a low concentration of tryptophan will cause the *trp* operon to cease being transcribed
 - a low concentration of tryptophan will cause the *trp* operon to cease being translated
 - more than one of the above
36. Which of the following is true of *E. coli*'s stringent response?
- it occurs when the cell has an excess of amino acids
 - it is triggered by attachment of the wrong tRNA to an mRNA codon
 - an unusual guanosine nucleoside phosphate is produced by a special enzyme
 - the bacterium goes into environmentally-induced protein super-production
 - the bacterium ceases all life functions and encapsulates for 1000 years
37. Which of the following is utilized by prokaryotes to effect control gene expression at the level of translation?
- rapid degradation of mRNA
 - RNA/RNA hybridization
 - differential ribosome binding efficiency
 - codon preference
 - all of the above
38. The actual, physical location of a transposable genetic element can often be pinpointed by
- greater transcription of an area of DNA than usual
 - suppression of a gene in which the element has been inserted
 - viral DNA in a host cell's cytoplasm
 - the presence of inverted repeats on either side of the suspected location
 - none of the above
39. The Southern Blot procedure is used to isolate _____ of interest.
- protein sequences
 - RNA fragments
 - DNA fragments
 - vectors
 - probes
40. The general term used to describe the plasmid or phage chromosome which carries a DNA segment to a target site on a host chromosome is
- probe
 - artificial chromosome
 - vector
 - transformant
 - cDNA
41. An organism which has a segment of DNA from another species inserted into its own genome is said to be
- transfected
 - transgenic
 - cloned
 - merozygotic
 - homeotic
42. A "knockout" mouse
- is made via transfection of a mouse oocyte with a wild type allele of a particular gene
 - is a naturally-occurring organism that is useful for studying mutant alleles
 - is genetically engineered mouse that is homozygous for a non-functional mutant allele
 - is expected 75% of the time from a mating of two heterozygote mice
 - is irresistible to other mice, and can always get a date on Friday night

43. The nucleotide sequences of the telomeres do not code for protein, yet they are vital to the specific DNA replication via the activity of telomerase and associated enzymes which allow telomere replication without significant reduction in telomere length. The DNA sequences of the telomeres are thus said to be
- pseudogenes
 - tandem gene families
 - non-functional, coding sequences
 - non-coding, functional sequences
 - redundant
44. A particular type of protein that exists in many different forms may be encoded by the genes comprising a
- dispersed gene family
 - pseudogene family
 - tandem gene family
 - multi-functional gene family
 - chamaeleonic gene family
45. Which of the following is TRUE of DNA fragmented with restriction endonucleases?
- the fragments can be used as transposable genetic elements
 - the resulting fragment sizes are unique and constant within a species
 - RFLPs can be mapped and used to determine evolutionary relationships between species
 - they are the only type of DNA that can be sequenced with Sanger's dideoxy method
 - the fragments can serve as DNA "fingerprints" in forensics
46. When a transposable genetic element moves from its site on the DNA to a completely different site and is not copied, which of the following types of transposition has taken place?
- imprecise
 - semiconservative
 - replicative
 - conservative
 - precise
47. The transposable genetic elements (found in *Drosophila*) known as "P elements"
- are maternally inherited and located in the cytoplasm
 - are genes that prevent transposition of deleterious alleles
 - can be prevented from transposing by cytoplasmic repressors encoded by the P elements
 - always cause hybrid dysgenesis when inherited in the nuclear genome
 - are lethal in natural populations of *Drosophila*
48. When a _____ transposon inserts into a chromosome without its associated partner, it becomes _____.
- autonomous; stable
 - autonomous; unstable
 - non-autonomous; stable
 - non-autonomous; unstable
 - more than one of the above
49. The type of DNA that is used in forensics as "DNA fingerprints" and is highly variable among individuals, even in the same species are known as
- Restriction Fragment Polymorphisms
 - Variable Number Tandem Repeats
 - Pseudogenes
 - Repetitive DNA
 - Telomeric DNA
50. The enzyme which prevents chromosomes from becoming shorter and shorter with every mitotic division is known as
- preservatase
 - telomerase
 - transposase
 - DNA polymerase
 - reverse replicase

If you're in a war, instead of throwing a hand grenade at some guys, throw one of those little baby-type pumpkins. Maybe it'll make everyone think of how crazy war is, and while they're thinking, you can throw a real grenade.

--Deep Thoughts by Jack Handey

