

Nebraska State FFA Biotechnology CDE

Comprehensive Knowledge Test

1. What is the name of the technique that allows geneticists to observe DNA fragments from a DNA sample and compare them based on the lengths of the fragments?
 - a. Gel electrophoresis
 - b. Gene gun
 - c. Lateral flow strip test
 - d. Polymerase Chain Reaction (PCR)
2. A plant breeder makes a cross between two plants that are both the genotype Aa (Aa X Aa). How many different genotypes with respect to the A,a genes will be produced in their offspring?
 - a. 1
 - b. 2
 - c. 3
 - d. 4
3. Below are listed five steps that would need to be completed by scientists to make a new corn hybrid that has a genetically engineered resistance to Roundup herbicide.
 - a. Cross the transgenic corn plant with other corn plants that can make good hybrids.
 - b. Extract all the genes from a strain of bacteria that is resistant to Roundup herbicide
 - c. Insert the transgene into corn cells growing in tissue culture and generate a cloned plant from those transformed cells.
 - d. Modify the Roundup resistance gene so that the gene information can be read by the corn plant to make the Roundup resistance protein in all cells of the plant.
 - e. Isolate and clone the Roundup Resistance gene from the resistant strain of bacteria.

Which choice lists these steps in their proper order?

- a. b c d e a
 - b. e b d a c
 - c. a e d c a
 - d. a c e d a
4. A corn plant has the genotype BbRr where BB and Bb plants are resistant to corn borers while bb plants are not AND RR and Rr plants are resistant to Roundup Herbicide while rr plants are not. Which of the follow is a genotype that could be made by selfing this BbRr plant?
 - a. BbRr
 - b. BBRR
 - c. bbrr
 - d. all of the above
 5. Proteins:
 - a. are a chain of amino acids
 - b. is a rare molecule in an organism

6. Below are listed five steps that would need to be completed by scientists to make a new corn hybrid that has a genetically engineered resistance to Roundup herbicide. Which step could be THE SAME if the genetic engineer wanted to make a new variety of Cotton that is resistant to the Roundup herbicide?
- Cross the transgenic corn plant with other corn plants that can make good hybrids.
 - Extract all the genes from a strain of bacteria that is resistant to Roundup herbicide
 - Insert the transgene into corn cells growing in tissue culture and generate a cloned plant from those transformed cells.
 - Modify the Roundup resistance gene so that the gene information can be read by the corn plant to make the Roundup resistance protein in all cells of the plant.
 - Isolate and clone the Roundup Resistance gene from the resistant strain of bacteria.
 - Step c
 - Step e
 - Step a
 - NONE of the steps would be the same to make Roundup Resistant Corn compared with Roundup Resistant Cotton.
7. A corn plant has the genotype BbRr where BB and Bb plants are resistant to corn borers while bb plants are not AND RR and Rr plants are resistant to Roundup Herbicide while rr plants are not. A corn breeder selfs the BbRr plant and produces hundreds of offspring. They grow hundreds of plants from these seeds. What fraction of all of these offspring from selfing BbRr will be BOTH corn borer resistant AND Roundup resistant?
- $\frac{1}{4}$
 - $\frac{3}{4}$
 - $\frac{3}{4} + \frac{3}{4} = \frac{6}{4}$
 - $\frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$
8. Which choice is the correct ranking of the following items in order of smallest to largest?
- i. 1. chromosomes 2. proteins 3. genes 4. Cell
- 2 3 1 4
 - 4 2 3 1
 - 3 4 2 1
 - 3 2 4 1
9. Which is the item below that is true about animal breeding?
- Animal breeders need to select the parents carefully
 - Animal breeders are only interested in traits for which selection is obvious and the genetic control or inheritance is easy to predict
 - Animal breeding would be much easier if there was no variation within a species in the genes that control their traits.
 - Although slightly more difficult, breeding between 2 different species (ex. cat and dogs) can be done just as breeding within the same species.
10. All the information needed to make an entire organism is in a molecule called
- DNA
 - a cell
 - a protein
 - a gene
11. What is a difference between mitosis and meiosis?
- meiosis happens faster than mitosis
 - meiosis is used to make gametes that can genetically vary and mitosis makes identical cells.

- c. meiosis happens throughout an organisms life but mitosis only happens in young organisms.
- d. meiosis replicates chromosomes and mitosis replicates proteins.

12. For natural sexual reproduction to take place, parents have to be

- a. the same size
- b. of similar species
- c. the same color
- d. the same age

13. Mitosis is used

- a. in plant tissue culturing
- b. all of the above
- c. to grow and develop tissues
- d. none of the above

14. The "BT" in BT corn stands for

- a. biologically tampered
- b. Bacillus thuringiensis
- c. bacteria tolerant
- d. bird tolerant

15. A transgenic organism is one that

- a. has genes inserted into it from another organism
- b. has genes created through mitosis
- c. normally occurs in nature
- d. none of the above

16. Clones are

- a. organisms from which genes are removed
- b. genes that cause the production of twins
- c. genetically identical organisms
- d. organisms which produce a clone protein

17. Cell division that creates two genetically identical cells is called

- a. mitosis
- b. both a and b
- c. meiosis
- d. neither a or b

18. Biotechnology can be used in all of the following EXCEPT

- a. protecting plants from pests
- b. increasing animal reproduction rate
- c. making proteins for human medicine
- d. creating a living thing entirely from non living molecules

19. The most commonly-used bacterium for gene transfer in plants is

- a. Bacillus thuringiensis
- b. Agrobacterium
- c. Escherichia coli
- d. none of the above

20. Of the following, which is most likely to increase a plant's productivity?

- a. increasing its rate of photosynthesis
- b. decreasing its rate of photosynthesis
- c. maintaining its rate of photosynthesis
- d. eliminating its ability to flower

21. A fertilized egg is known as a
- a. zygote
 - b. clone
 - c. gamete
 - d. anaphase
22. Why are marker genes often inserted into a cell's DNA along with genes of interest?
- a. to visually identify transgenic cells or organisms
 - b. make the cells grow faster in culture
 - c. add market appeal to the final transgenic organism
 - d. protect the legal rights of a company to sell the transgenic product
23. A masked gene is known as
- a. genotype
 - b. recessive
 - c. dominant
 - d. gamete
24. Proteins are:
- a. is a rare molecule in an organism
 - b. can mutate into a different protein
 - c. a protein's structure is determined by a gene (DNA)
25. Mark the sentence is that is true.
- a. microbes have little benefit to people, they are pathogens or critters that just take advantage of people, animals or plants.
 - b. people have taken advantage of microbes to help them make foods that do not spoil (fermented foods)
 - c. in contrast to plants and animals, microbes as a group of living things have very little variation in traits. All microbes do essentially the same thing to "make a living".
 - d. an ethanol plant uses the exact same yeast strains you probably buy at the grocery store to make bread.
 - e. no new money will be invested in better understanding the biology and developing biotechnology from microbes. We have pretty much gotten all we can from these critters.
26. Select the statement that is true about animal breeding are.
- a. animal breeders are only interested in traits for which selection is obvious and the genetic control or inheritance is easy to predict
 - b. inheritance is easy to predict
 - c. animal breeders have a goal of improving a trait or traits in their breed or species of animal
 - d. they all have the same traits they want to improve, no matter what the animal species or breed.
27. Which are reasons why mice can be good model organisms for gene discovery?
- a. Mice were the first domesticated animals to provide milk, food and fur.
 - b. Mice use a universal genetic code so the DNA sequence of a mouse gene will be similar to the sequence of the gene that works in a similar way in other animals.
 - c. Mice are easy to manipulate so they grow as large a cow or live as long as a person.
28. The reason DNA based detection works to detect a transgenic organism in more situations than Protein based detection is....
- a. protein detection cannot be for a specific protein.

b. DNA detection works in all tissues of an organism that is transgenic but protein detection may not.

29. Nucleotides are:

- a. building blocks of genes
- b. molecules of sugar
- c. building blocks of proteins
- d. the same as genes

30. The four bases found in RNA are:

- a. cytosine, thymine, adenine, guanine
- b. cytosine, uracil, adenine, guanine
- c. cytosine, thymine, uracil, guanine
- d. cytosine, uracil, adenine, guanine

31. If the sequence of bases in a strand of DNA is represented by TACCAG, what would be the sequence of bases in the complementary DNA strand?

- a. TACCAG
- b. ATGGTC
- c. UADDAG
- d. AUGGUC

32. In developing countries, "Golden Rice" may help prevent

- a. pollution
- b. food spoilage
- c. blindness
- d. all of the above

33. In mitotic division....

- a. New cells are exactly like the original cell
- b. new cells have 3/4 the original number of chromosomes
- c. new cells have three of each chromosome
- d. new cells have 1/2 the original number of chromosomes

34. Most organisms are _____ meaning that they have two chromosomes that control each trait.

- a. haploid
- b. triploid
- c. diploid
- d. polyploidy

35. Most humans have _____ pairs of chromosomes

- a. 20
- b. 21
- c. 23
- d. 25

36. You are the parent of a child with a severe wheat allergy, and must take great precautions to make sure he does not consume any food with even a trace amount of wheat. Which of the following diagnostic tests might you be able to use regularly to test his food before he eats it to insure that it is safe for him to eat?

- a. PCR
- b. gel electrophoresis
- c. lateral flow strip test
- d. all of the above

37. In humans, genes control all of the following EXCEPT

- a. nutrition
- b. skin color
- c. eye color
- d. inherited diseases

38. Quantitative traits:

- a. are traits that are often controlled by many genes and are measured in amounts, such as inches, pounds, percent, and quantity.

- b. traits are traits that are often controlled by one (or just a few) genes and their expression is either present or absent, such as no hair vs. hair, black fur color vs. brown fur color.

39. This is the molecule that actually does work in the cell such as catalyze a chemical reaction.

- a. Gene b. Protein c. Trait

40. Genetics call this the organisms phenotype

- a. Gene b. Protein c. Trait

41. _____ is a small part of the larger molecule that makes up a chromosome.

- a. Gene b. Protein c. Trait

42. In a rose breeding program, the goal rose is large with red petals. Which two roses shown below, based on observable characteristics, should I choose from?

- a. Medium size pink and white rose d. Large sized white rose
b. Medium size pink rose e. Small sized white rose
c. Small size red rose f. Small sized white and red rose

43. A plant breeder wants to cross a red flowered penstemon and a strong stemmed penstemon. The plants are perfect flowers. If the breeder wants the strong stemmed penstemon to be the mail parent, he should?

- a. Remove the stamen from the flowers but be careful not to damage the pistil.
b. Remove the stamen from the flowers and collect the pollen the plants are shedding, without worrying about damaging the pistil.
c. Remove the pistil and then carefully place it in the flower of the other parent.
d. Do nothing, the flower is already a male and female.

44. In your garden, you find seeds from a flower. The parent that produced these seeds was the....

- a. Female
b. Male
c. Could be male and the female if a self-pollination was made. The female if a cross pollination was made.
d. Genes

45. A peanut breeder would like to develop a variety that produces sweet flavored nuts for the peanut butter industry. They search the world collection of peanut lines and they cannot find any that produce sweet flavor. What should they do next?

- a. They will need to cross peanuts with sugar beets or sugar cane to get sweet peanuts.
b. Grow peanuts in a high sugar environment so they acquire the sweet flavor trait.
c. Treat a peanut plant or peanut seeds with a mutagen in the hopes that a random mutation will make a new allele that can make peanuts produce sweet nuts.
d. Give up, there is nothing they can do to incorporate this trait into peanuts.

46. a: select parents; b: select offspring; c: identify a problem; d: cross parents
e: determine what combination of traits would help a plant overcome a problem.

The steps above are done by a plant breeder. The order they would do those steps is...

- a. *c, e, a, d, b*

- b. *c, e, a, b, d*
- c. *d, b, c, e, a*
- d. *d, b, e, a, c*

47. Why do tree breeders need to be more patient than corn breeders?
- a. Trick question, trees do not have flowers so there are not tree breeders.
 - b. Trees produce very few seeds.
 - c. Trees have a longer generation time so it takes longer for the breeder to select individuals that have the right traits
 - d. All trees have the same traits so there is no motive for doing plant breeding with trees.
48. During transcription, the DNA code of a single gene is read and a copy is made called mRNA. Why is it not necessary for the entire DNA molecule (every one of hundreds of genes on the chromosome) to be copied during transcription? (check all that apply)
- a. an mRNA strand the size of a chromosome would be too large to travel outside of the nucleus to the cytoplasm.
 - b. not every gene is active in the cell at the same time...meaning not every protein is being produced all the time in every cell of an organism.
 - c. Trick question, the entire chromosome IS copied into mRNA and travels into the cytoplasm.
49. Bacteria are different from plants and animals in that they
- a. are all genetically identical because they never change
 - b. have more genes than plants and animals
 - c. have fewer genes than plants and animals
 - d. replicate slower than plants and animals
50. Which is the most accurate description of plant transformation?
- a. genes inserted into thousands of cells in a seed and if enough cells incorporate the genes, the plant is considered genetically engineered.
 - b. genes inserted into pollen , seeds made from the pollen produce transgenic plants.
 - c. the immature embryo might get removed from a plant, but these embryos are induced to develop masses of cells on a petri dish and it is these cells that are targeted for gene delivery before they develop into plants.
 - d. genes are shot at the plant leaves and the leaves develop into flowers, then seeds.
51. Pig producers would like female pigs that have more piglets per litter. If a pig geneticist knew what gene or genes were responsible for litter size they could genetically engineer their best meat production breeds to have more offspring. The motivation for doing this would be...
- a. pig breeders cannot increase litter size using classical methods
 - b. the genetic engineering approach to increasing litter size might be faster than the classical breeding approach.
52. What is the shape of a bacteria's chromosome?
- a. linear
 - b. circular
 - c. 'X' shaped

d. bacteria don't have chromosomes

53. Proteins :

- a. are a chain of amino acids
- b. a rare molecule in an organism
- c. can mutate into a different protein

54. What is the definition of a chromosome?

- a. Macromolecules that are long DNA chains wound around proteins and contain genes.
- b. Amino acid chains that have a specific shape and function
- c. Segment of DNA that encodes a protein or an RNA molecule
- d. Organism's characteristics

55. What is the definition of a phenotype?

- a. Macromolecules that are long DNA chains wound around proteins and contain genes.
- b. Amino acid chains that have a specific shape and function
- c. Segment of DNA that encodes a protein or an RNA molecule
- d. Organism's characteristics

56. What is the definition of a gene

- a. Macromolecules that are long DNA chains wound around proteins and contain genes.
- b. Amino acid chains that have a specific shape and function
- c. Segment of DNA that encodes a protein or an RNA molecule
- d. Organism's characteristics

57. What is the definition of a protein

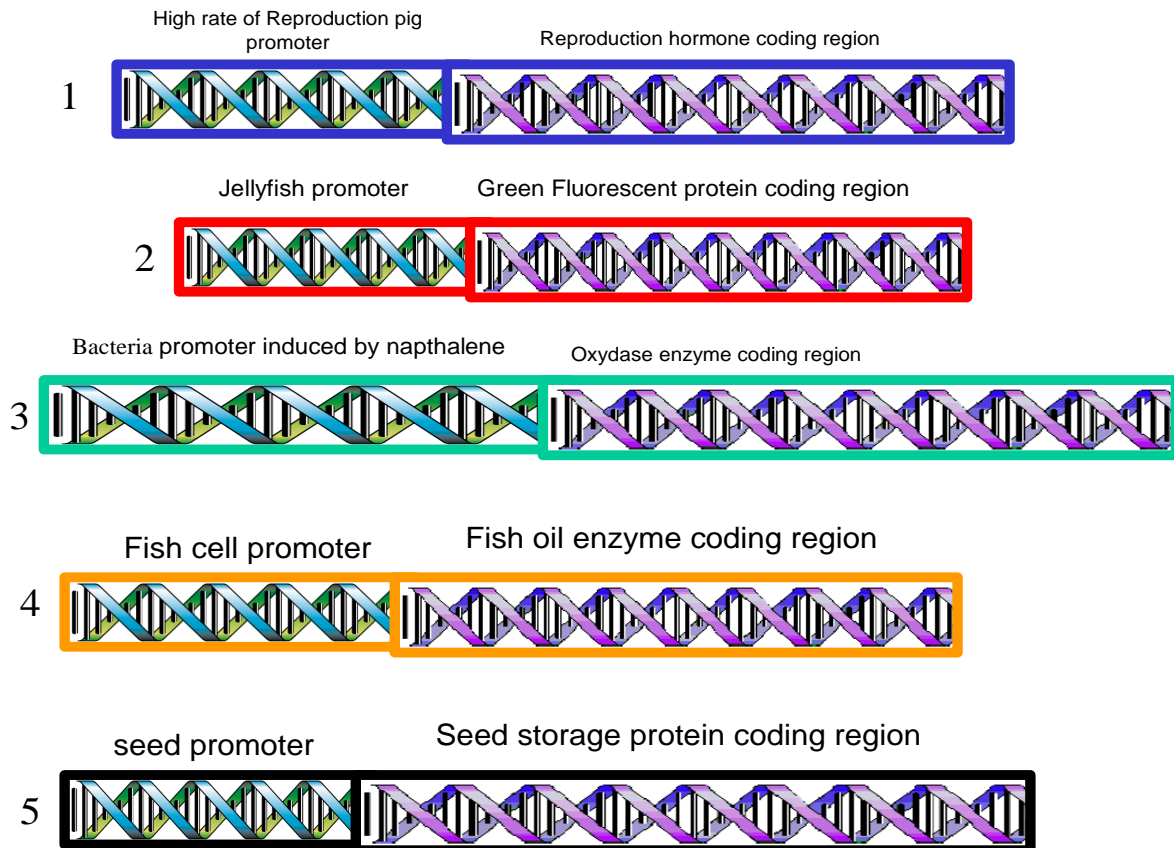
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58. Quantitative traits are

- a. traits are traits that are often controlled by many genes and are measured in amounts, such as inches, pounds, percent, quantity.
- b. traits are traits that are often controlled by one (or just a few) genes and their expression is either present or absent, such as no hair vs. hair, black fur color vs. brown fur color.
- c. traits that are not controlled by genes

59. Which type of genetic engineer must clone (copy) a gene as part of their work?

- a. Microbial genetic engineer
- b. Plant genetic engineer
- c. Animal genetic engineer.
- d. All of the above



60. Which transgene is designed to transform a bacteria that will allow someone to grow them and detect very specific chemicals (e.g. naphthalene) in the environment? (What promoter and coding region from above would you use?)
- Promoter 4 and coding region 2
 - Promoter 2 and coding region 3
 - Promoter 3 and coding region 2
 - Promoter 3 and coding region 5
61. During transcription, the DNA code of a single gene is read and a copy is made called mRNA. Why is it not necessary for the entire DNA molecule (every one of hundreds of genes on the chromosome) to be copied during transcription?
- an mRNA strand the size of a chromosome would be too large to travel outside of the nucleus to the cytoplasm.
 - not every gene is active in the cell at the same time...meaning not every protein is being produced all the time in every cell of an organism.
 - Trick question, the entire chromosome IS copied into mRNA and travels into the cytoplasm.
62. Identify advantages mice would have over cattle or even pigs as a model to discover animal function genes? (Check all that apply)
- Mice are cheaper to raise
 - Cattle and pigs who have a very unique genetic code from other animals, mice would use a more common DNA code.
 - Mice do not make messes where they live or bleed when you cut them.
63. Why is it the least difficult to transform bacteria compared with animals or plants?

- a. Bacteria are single celled so the transgene must enter one cell, then as that cell is replicated, the gene is passed to every new cell. Plants and animals are transformed by inserting the gene into thousands of cells.
- b. Bacteria can be transformed dead and then brought back to life.
- c. Transforming bacteria does not require the DNA to enter the cell.
- d. Bacteria can be transformed by adding just a few genes with a new plasmid of DNA and the new gene does not need to insert into a chromosome or get into a cell nucleus.

64. A potato breeder develops a variety of potatoes that makes excellent French fries, has good yield and gives potato farmers very little management problems. Can the plant breeder retire?

- a. Yes, potato varieties that meet farmer and consumer needs today will always fit those needs decades later.
- b. No, the growing environment can change and so a variety that grows well now, may not grow as well years from now. The breeder needs to always be working for future change.
- c. No, the breeder cannot retire because the improved plants they create and select for farmers cannot be propagated by the farmer, only by the plant breeder.

65. Plants are easier to transform than animals because....

- a. they have a cell wall
- b. they have fewer genes than animals
- c. they have cells that can be cultured more easily to produce new plants in a test tube or on a petri dish.
- d. the cells that are targeted to be transformed are so big you do not need a microscope to see them.

66. How do genetic engineers and plant breeders work together?

- a. Genetic engineers add new genes and plant breeders combine these new genes with the best combinations of genes between different plants.
- b. Plant breeders add new genes and genetic engineers combine these new genes with the best combinations of genes between different plants.
- c. Genetic engineers always finish the genetic improvement process that plant breeders start so they are responsible for making the seeds sold to farmers.
- d. They do not work together. A company uses either plant breeder or genetic engineering to make new varieties, but not both.

67. The things that are true about animal breeding are...

- a. breeding can only be done between 2 animals of the same species.
- b. animal breeding is only done on domestic animals not wild animals
- c. animal breeding would be much easier if there was no variation within a species in the genes that control their traits.
- d. although slightly more difficult, breeding between 2 different species (ex. cat and dogs) can be done just as breeding within the same species.