2016 FFA Biotechnology CDE
   50 Questions

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?
    ○ Polymerase Chain Reaction (PCR)
    ○ Lateral flow strip test
    ○ Gene gun
    ○ Gel electrophoresis

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?
    ○ 1
    ○ 2
    ○ 3
    ○ 4

3. 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?
    ○ BbRr
    ○ BBRR
    ○ bbrr
    ○ All of the above

4. Protein(s):
    ○ are a chain of amino acids
    ○ is a rare molecule in an organism

5. 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?
    ○ 1/4
    ○ 3/4
    ○ 3/4 + 3/4
    ○ 3/4 X 3/4

6. Which choice is the correct ranking of the following items in order of smallest to largest?
    1. chromosomes 2. proteins 3. genes 4. Cell

    ○ 3 4 2 1
    ○ 3 2 4 1
    ○ 2 3 1 4
    ○ 4 2 3 1

7. Which is the item below that is true about animal breeding?

   ○ Although slightly more difficult, breeding between 2 different species (ex. cat and dogs) can be done just as breeding within the same species.

   ○ 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.

8. 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.

   ○ meiosis happens throughout an organisms life but mitosis only happens in young organisms.

   ○ meiosis replicates chromosomes and mitosis replicates proteins.

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

   ○ of similar species

   ○ the same age

   ○ the same color

   ○ the same size

10. Mitosis is used

    ○ in plant tissue culturing

    ○ to grow and develop tissues

    ○ both the above

    ○ none of the above

11. A transgenic organism is one that

    ○ has genes inserted into it from another organism

    ○ has genes created through mitosis

    ○ normally occurs in nature

    ○ none of the above

12. Clones are

    ○ genetically identical organisms

    ○ genes that cause the production of twins

    ○ organisms which produce a clone protein

    ○ organisms from which genes are removed

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

    ○ mitosis

    ○ meiosis

    ○ both of the above

    ○ none of the above

14. Biotechnology can be used in all of the following EXCEPT
   ○ making proteins for human medicine
   ○ protecting plants from pests
   ○ increasing animal reproduction rate
   ○ creating a living thing entirely from non living molecules

15. The most commonly-used bacterium for gene transfer in plants is
   ○ Bacillus thuringiensis
   ○ Escherichia coli
   ○ Agrobacterium
   ○ None of the above

16. A fertilized egg is known as a
   ○ zygote
   ○ anaphase
   ○ gamete
   ○ clone

17. Why are marker genes often inserted into a cell's DNA along with genes of interest?
   ○ to protect the legal rights of a company to sell the transgenic product
   ○ to add market appeal to the final transgenic organism
   ○ to visually identify transgenic cells or organisms
   ○ to make the cells grow faster in culture

18. A masked gene is known as a
   ○ genotype
   ○ recessive
   ○ gamete
   ○ dominant

19. Proteins are:
   ○ rare molecules in an organism
   ○ able to mutate into a different protein
   ○ biomolecules with a structure that is determined by a gene (DNA)

20. Select the statement that is true about animal breeding
   ○ breeders all have the same traits they want to improve, no matter what the animal species or breed.
   ○ animal breeders are only interested in traits for which selection is obvious and the genetic control or inheritance is easy to predict
   ○ animal breeders have a goal of improving a trait or traits in their breed or species of animal

21. Which are reasons why mice can be good model organisms for gene discovery?
   ○ Mice were the first domesticated animals to provide milk, food, and fur.
   ○ 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.
   ○ Mice are easy to manipulate so they grow as large as a cow or live as long as a person.

22. The reason DNA based detection works to detect a transgenic organism in more situations than Protein based detection is….

   ○ protein detection cannot be for a specific protein.

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

23. Nucleotides are:

   ○ molecules of sugar

   ○ building blocks of genes

   ○ building blocks of proteins

   ○ the same as genes

24. 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?

   ○ UADDAG

   ○ TACCAG

   ○ ATGGTC

   ○ AUGGUC

25. In mitotic division....

   ○ new cells have 3/4 the original number of chromosomes

   ○ new cells have 1/2 the original number of chromosomes

   ○ new cells have three of each chromosome

   ○ new cells are exactly like the original cell

26. Most organisms are _____ meaning that they have two sets of chromosomes, one from each parent.

   ○ haploid

   ○ diploid

   ○ polyploidy

   ○ triploid

27. Most humans have _____ pairs of chromosomes

   ○ 20

   ○ 21

   ○ 23

   ○ 25

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

   ○ eye color

   ○ inherited diseases

   ○ skin color

   ○ nutrition

29. This is the molecule that actually does work in the cell such as catalyze a chemical reaction.
   - ○ Gene
   - ○ Trait
   - ○ Protein

30. _____ is a small part of the larger molecule that makes up a chromosome.
   - ○ Protein
   - ○ Gene
   - ○ Trait

31. A plant breeder wants to cross a red flowered penstemon and a strong stemmed penstemon. The plants have perfect flowers. If the breeder wants the strong stemmed penstemon to be the male parent, he should?
   - ○ Remove the pistil from the flower of the strong stemmed penstemon and then carefully place it in the flower of the other parent.
   - ○ Remove the stamen from the flowers of the strong stemmed penstemon and collect the pollen the plants are shedding, without worrying about damaging the pistil.
   - ○ Do nothing, the flower is already a male and female.
   - ○ Remove the stamen from the flowers of the strong stemmed penstemon, but be careful not to damage the pistil.

32. A peanut breeder would like to develop a variety that produces sweet flavored nuts for the peanut butter industry. She searches the world collection of peanut lines and cannot find any that produce sweet flavor. What should she do next?
   - ○ She will need to cross peanuts with sugar beets or sugar cane to get sweet peanuts.
   - ○ Grow peanuts in a high sugar environment so they acquire the sweet flavor trait.
   - ○ 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.
   - ○ Give up, there is nothing she can do to incorporate this trait into peanuts.

33. 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...
   - ○ c, e, a, b, d
   - ○ d, b, e, a, c
   - ○ c, e, a, d, b
   - ○ d, b, c, e, a

34. Why do tree breeders need to be more patient than corn breeders?
   - ○ Trick question, trees do not have flowers so there are not tree breeders.
   - ○ Trees produce very few seeds.
   - ○ All trees have the same traits, so there is no motive for doing plant breeding with trees.
   - ○ Trees have a longer generation time, so it takes longer for the breeder to select individuals that have the right traits

35. 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.

    ○ BOTH of the above are true.

    ○ Trick question, the entire chromosome IS copied into mRNA and travels into the cytoplasm.

36. Bacteria are different from plants and animals in that they

    ○ replicate slower than plants and animals

    ○ have more genes than plants and animals

    ○ are all genetically identical because they never change

    ○ have fewer genes than plants and animals

37. Which is the most accurate description of plant transformation?

    ○ genes inserted into pollen, seeds made from the pollen produce transgenic plants.

    ○ genes are shot at the plant leaves and the leaves develop into flowers, then seeds.

    ○ 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.

    ○ genes inserted into thousands of cells in a seed and if enough cells incorporate the genes, the plant is considered genetically engineered.

38. 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…

    ○ genetic engineering can remove all biological restrictions so there will be no limit to the number of pigs in a litter.

    ○ pig breeders cannot increase litter size using classical methods

    ○ the genetic engineering approach to increasing litter size might be faster than the classical breeding approach.

39. What is the definition of a chromosome?

    ○ Amino acid chains that have a specific shape and function

    ○ Segment of DNA that encodes a protein or an RNA molecule

    ○ Organism's characteristics

    ○ Macromolecules that are long DNA chains wound around proteins and contain genes.

40. What is the definition of a phenotype?

    ○ Macromolecules that are long DNA chains wound around proteins and contain genes.

    ○ Amino acid chains that have a specific shape and function

    ○ Organism's characteristics

    ○ Segment of DNA that encodes a protein or an RNA molecule

41. What is the definition of a gene?
    ○ Organism's characteristics
    ○ Amino acid chains that have a specific shape and function
    ○ Segment of DNA that encodes a protein or an RNA molecule
    ○ Macromolecules that are long DNA chains wound around proteins and contain genes.

42. What is the definition of a protein?
    ○ Macromolecules that are long DNA chains wound around proteins and contain genes.
    ○ Amino acid chains that have a specific shape and function
    ○ Segment of DNA that encodes a protein or an RNA molecule
    ○ Organism's characteristics

43. Quantitative traits are
    ○ traits that are often controlled by many genes and are measured in amounts, such as inches, pounds, percent, quantity.
    ○ traits that are not controlled by genes
    ○ 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.

44. Which type of genetic engineer must clone (copy) a gene as part of their work?
    ○ Microbial genetic engineer
    ○ Plant genetic engineer
    ○ Animal genetic engineer
    ○ All the above

45. Two genes that the genetic engineer could work with are gene A and gene B. Gene A from algae, is turned on in salt water and encodes an enzyme that breaks down oil. Gene B is from soil bacteria, is turned on in soil and encodes an enzyme that breaks down plant material. Which transgene could be used to create a genetically engineered soil bacteria that can clean up oil spills?
    ○ Use the promoter from gene A and coding region from gene B
    ○ Use the promoter from gene B and the coding region from gene A
    ○ Use gene B
    ○ Use gene A

46. Identify advantages mice would have over cattle or even pigs as a model to discover animal function genes?
    ○ Mice are cheaper to raise
    ○ Mice do not make messes where they live or bleed when you cut them.
    ○ Cattle and pigs who have a very unique genetic code from other animals, mice would use a more common DNA code.

47. 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?

   ○ 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.

   ○ 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.

   ○ Yes, potato varieties that meet farmer and consumer needs today will always fit those needs decades later.

48. Plants are easier to transform than animals because…

   ○ the cells that are targeted to be transformed are so big you do not need a microscope to see them.

   ○ they have fewer genes than animals

   ○ they have a cell wall

   ○ they have cells that can be cultured more easily to produce new plants in a test tube or on a petri dish

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

   ○ Genetic engineers add new genes and plant breeders combine these new genes with the best combinations of genes between different plants.

   ○ They do not work together. A company uses either plant breeder or genetic engineering to make new varieties, but not both.

   ○ Plant breeders add new genes and genetic engineers combine these new genes with the best combinations of genes between different plants.

   ○ Genetic engineers always finish the genetic improvement process that plant breeders start so they are responsible for making the seeds sold to farmers.

50. The things that are true about animal breeding are…

   ○ although slightly more difficult, breeding between 2 different species (ex. cat and dogs) can be done just as breeding within the same species.

   ○ animal breeding would be much easier if there was no variation within a species in the genes that control their traits.

   ○ breeding can only be done between 2 animals of the same species.

   ○ animal breeding is only done on domestic animals not wild animals

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2016 FFA Competition
50 Questions for the 2016 FFA Competition at UNL

1. Gel electrophoresis
2. 3
3. All of the above
4. are a chain of amino acids
5. 3/4 X 3/4
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50. breeding can only be done between 2 animals of the same species.

Biotechnology CDE Practicum 2016

Practicum Rules (75 points/individual; 300 points/team)

1. This practicum is designed to evaluate participants' ability to evaluate a problem set using information provided. The practicum may include a combination of the following:

   • Utilizing biological information
   • Research (onsite) a situation relevant to the biotechnology industry
   • Determining supporting facts in solving the situation
   • Justify the credibility of their resources.

   For the practicum portion of the contest, team members will be asked to find and distill information, utilizing resources provided, rather than memorize information.

2. Research resources and blank paper will be provided.

3. Students will have 60 minutes to complete this section. Contestants will be allowed to work at their own pace.

4. Students will work, as a team, on the practicum and put together a five minute presentation. The presentation will be presented in front of a CDE assistant and videotaped for scoring following the CDE.

Alternative for other states: The team will create a scaled poster and a bulleted outline which would serve as a visual aid and talking point outline for a presentation.

Practical Problem with a Genetic Engineering Solution

**Fig. 1:** An ethanol plant in Nebraska
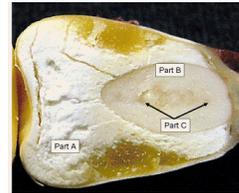
Fig. 2: Dent corn

Corn farmers in the USA are providing the raw material for a biofuel industry. Dent corn grown for feed for animals or food for humans could also provide the carbon needed to make ethanol biofuel (see Figures 1 and 2). Ethanol (see Figure 3b) is produced when yeast perform fermentation using the carbon in corn seeds.


starch is synthesized from sugar during grain fill (late summer)

starch synthase enzyme
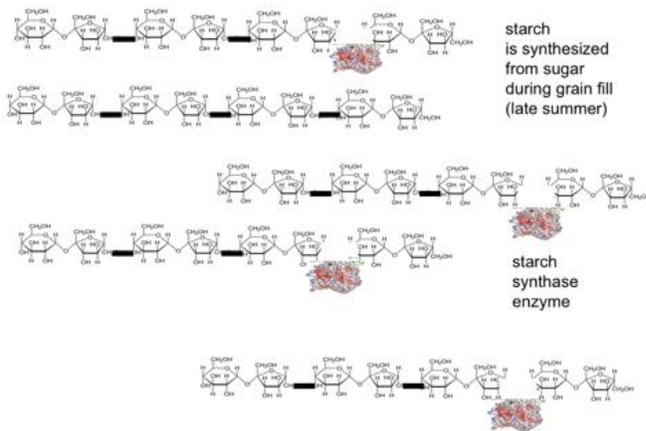
Fig. 3a: Starch is made from many sucrose sugars connected together.
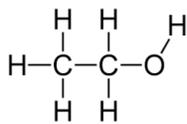
Fig. 3b: Chemical structure for ethanol. Ethanol is the biofuel made by yeast when they eat or ferment sugars

Almost all of the carbon stored in dent corn seeds is in the form of starch. Starch is a long chain of sugars (see Figure 3a) and high yielding dent corn hybrids are outstanding at starch production and storage in the developing seeds.

Fig. 4: Yeast cells as seen under a microscope.

Yeast (Figure 4) that live in the fermentation chambers in an ethanol plant need to consume and ferment sugar in order to produce ethanol. So the corn seeds are ground-up to release the starch, heated and expensive enzymes called amylases are added to breakdown the starch into sugars (see Figure 5).


starch breaks down to sugars during germination or in the ethanol plant.

alpha amylase enzyme

alpha amylase enzyme
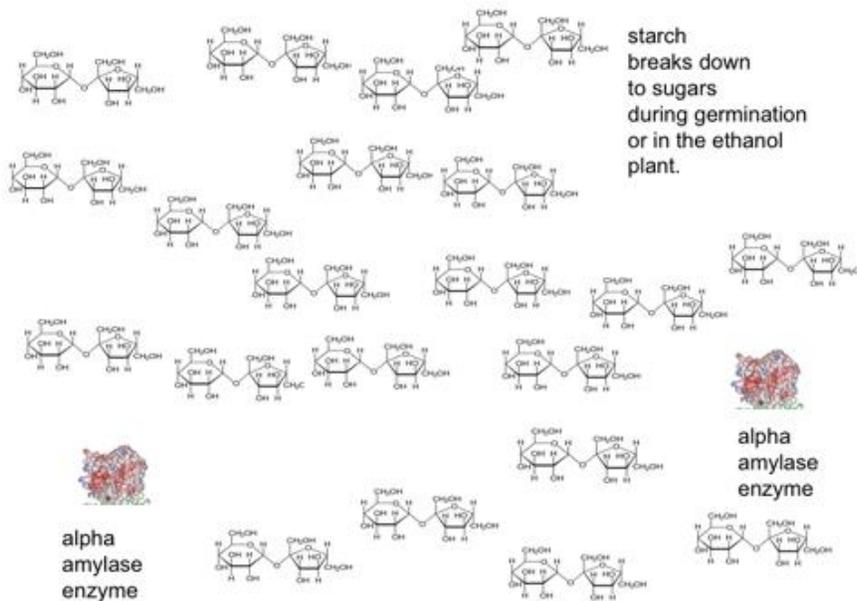
Fig. 5: Starch can be broken down to sugars by alpha amylase enzyme.

Ethanol plants could save time and money if the developing corn seed was already making a fast acting, heat stable enzyme that breaks down starch (alpha amylase). No corn plant in the world has a naturally occurring gene that encodes a heat stable alpha amylase. But other organisms that typically live in high temperature environments do make heat stable alpha amylase enzymes.

Your assignment is to: 1. Create a genetic engineering plan to develop a type of corn that makes heat stable alpha amylase in the seed and 2. Develop a plant breeding plan to combine this seed trait with other traits farmers would want in hybrids they grow in their fields.

Your team has 60 minutes to complete the following:

1. Create a name for your biotechnology company.

2. Research via the Internet "amylase corn" to learn specific details about the gene that was introduced.

3. Use "Journey of a Gene" or other resources to determine a plant transformation method.

4. Outline the steps the scientists performed to develop the genetically engineered corn plant.

5. Outline a plan to use plant breeding to develop the two parent lines that will pass on the heat stable amylase gene to all offspring in a hybrid seed production field. Use Punnett squares to predict the inheritance of genes in the breeder's plants.

6. Indicate in the outline diagram how DNA testing can be used in your plan to help in the selection of the desired offspring and at which step(s) in the process this testing will occur.

7. Anticipate potential scientific and non scientific challenges to your projects success and list how your research team or your biotechnology company will address these challenges.

NOTE: Assume these are the three main genetic differences among the corn inbred lines you could choose to use in the breeding part of your plan.

The homozygous alpha amylase from the genetic engineer: **AAhhii**
A parent line homozygous for a herbicide resistance trait: **aaHHii**
A parent line homozygous for an insect resistance trait: **aahhII**

'A' is the transgene introduced by the genetic engineers to encode a heat stable alpha amylase. Plants that are '**aa**' do not have this transgene in their chromosome.

HH and **Hh** corn plants are resistant to a herbicide a farmer could use for weed control. Plants that are **hh** are sensitive to the herbicide (can be damaged or die)

II and Ii corn plants are insect resistant to a common insect pest while **ii** plants are not resistant to this insect.

Use Punnett squares to predict the inheritance of all genes.

Check list and Work sheet: Turn this in with your teams outlines and lists

Team points (300 possible)

1. 10 points: Biotechnology company name
2. 20 points: Promote the benefit of this new trait for people.
3. 100 points: Genetic Engineering steps (50 content + 50 presentation)
4. 100 points: Breeding steps that will make parent lines for hybrid seed production. Include Punnett squares. (50 content + 50 presentation)
5. 30 points: DNA testing plan
6. 20 points Scientific and non scientific challenges you will address
7. 20 points Clarity, organization and appeal of your outlines

Team work checklist

___ Company name

___Research important facts

___Organize and draw your steps for GE outline

___Organize and draw your plant breeding process to get your final desired outcome for offspring in a hybrid seed corn field. Use appropriate Punnett squares.

___Indicate how DNA testing will be done & at which step(s) in the process.

___Benefits of your successful project.

___ Issues and concerns and how you will address them.