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

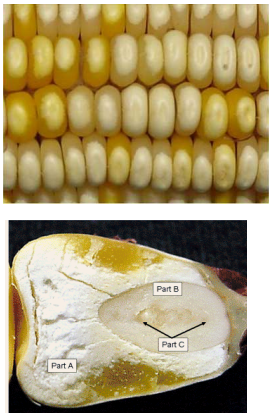

Fig. 2: Dent corn

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.

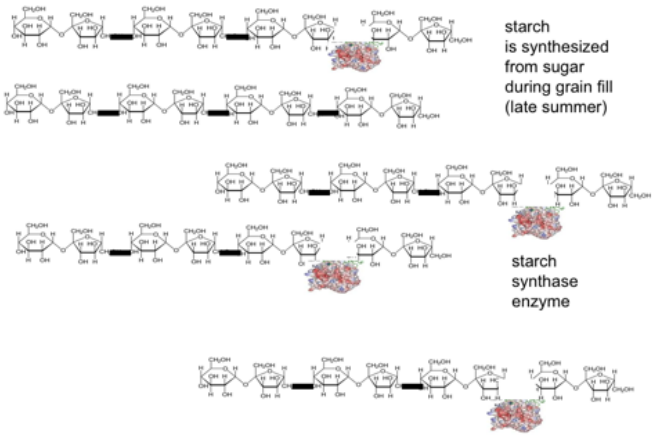

Fig. 3a: Starch is made from many sucrose sugars connected together.

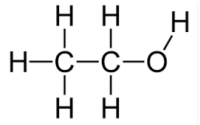

Fig. 3b: Chemical structure for ethanol. Ethanol is the biofuel made by yeast when they eat or ferment sugars

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).

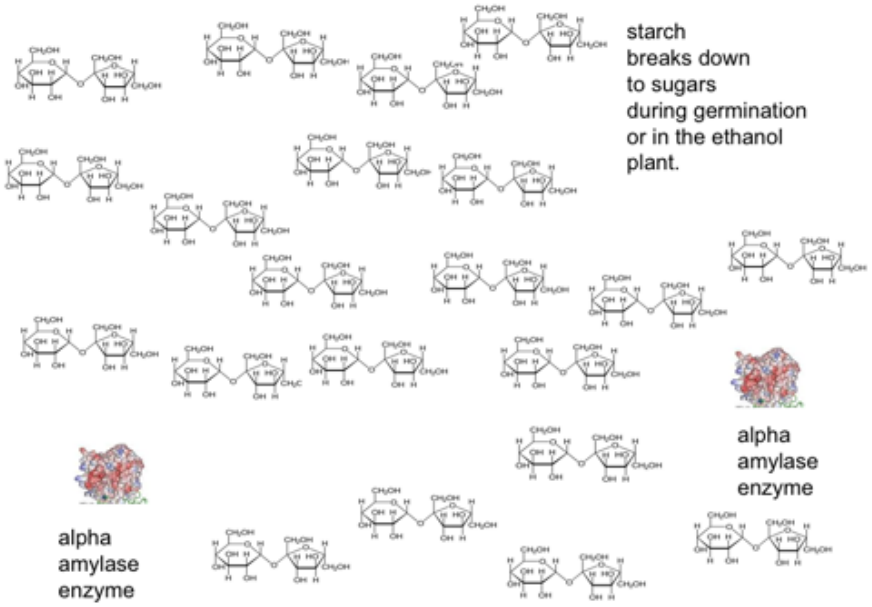

Fig. 5: Starch can be broken down to sugars by alpha amylase enzyme.

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.