Biotechnology Active Learning Teachable Tidbit

Learning Goal:

Students will be able to identify the most significant biomolecules exploited by technology including where they come from and explain the significance of their role in nature and role in humans.

Specific Learning Outcomes:

- Develop a logical process for a real life application of biotechnology using knowledge of biomolecules.
- Relate evolution of biomolecules to potential bio technology application
- Recognize that you can use bacterial enzymes in humans because of the universality of the genetic code

Prior Knowledge Required:

Identify the major biomolecules utilized in Biotechnology

Describe the function of the biomolecules in nature

How is Diversity Addressed?

This activity focuses on the use of biotechnology in the treatment of a common disease around the world, that being diabetes. This disease is one that is familiar to a majority of students, and for those unfamiliar with it, this activity will provide an opportunity to learn about this important disease. Additionally, this activity utilizes a variety of instructional techniques, including group discussion, think/pair/share, model building (or model completion), and questioning. The variety of activities is included as part of the activity design in order to resonate with the diversity of learning styles and preferences that are likely to be observed in any group of students.

Activity Narrative:

Introduction:

The activity, as presented, requires that in a previous class session, an additional activity be conducted in which students are tasked with identifying the role of a variety of biologically significant items (see PowerPoint slide 5). These items also happen to play significant roles in biotechnology. Students complete the table in groups, on their own, or in tandem with instruction, and will utilize the resulting chart in completion of the present activity.

Warm Up Exercise:

Student groups work to list some familiar biotech applications. These are shared following a brief brainstorming period and can be listed on a slide or with a real-time-writing technology. The

presentation then provides a sequence of slides depicting some important biotech applications, many of which may have already been identified during the brainstorming session. These slides are only included to highlight some of the most critical steps and concepts associated with biotech methods and procedures.

Biotech Applications Activity:

Students should now retrieve a copy of the table of biomolecules they generated previously, and are presented with a "problem" to solve. This problem is associated with the prevalence of diabetes and the associated need for insulin as a treatment option. The question posed to students is, "How is human insulin mass produced for these [diabetic] patients using biotechnology?"

Think/Pair/Share:

Students complete a short TPS activity on how we can utilize E.coli to produce proteins in biotech applications, for proteins which E. coli doesn't naturally carry the genes to construct. The intention of this question is to get students to the realization that the gene (information) to produce the desired protein must be inserted/introduced to the E. coli genome.

Main Activity Handout:

Students are now presented with the main activity handout, which is an image-based outline of the process required for insulin biosynthesis. The handout will be completed in reverse, starting at the final step. Students must identify what is being depicted/indicated at each step of the process presented. As written, the activity is completed in a type of "gradual release" in which the instructor demonstrates what is expected by filling in and describing what is happening in the final step (translation/expression and purification of insulin = step 9) and completes this step for the students. The instructor then facilitates completion of steps 8, 7, and 6. Finally, student groups are tasked with independently completing steps 5, 4, 3, 2, and 1 (again using the biomolecules table from the previous session).

Thinking Further:

As a final component of the activity (can be completed in class or at home) students are asked to consider why bacterial restriction enzymes are used to cut human DNA (*answer: because these enzymes are found only in bacteria*), and how prokaryotic enzymes can be active in both prokaryotic and eukaryotic cells (from an evolutionary perspective…*answer: establish link between the universality of the genetic code and the structure of proteins in both groups*).