Engineering Nanoparticles for the Body

Engineering Design Worksheet

20 points possible

1. Problem and Objective (1 pts)

Since this question will be discussed with the entire class it is only worth 1 point.

Problem: The nanoparticle sticks to the inside of the blood vessel.

Objective: Engineer a design to allow the nanoparticle to travel through the blood vessel without blocking active sites of the nanoparticle

1. Constraints and Criteria (1 pts)

Since this question will be discussed with the entire class it is only worth 1 point.

Constraints:

1. Nanoparticle needs to travel through the blood vessel without getting stuck
2. A large portion of the nanoparticle’s active sites need to be accessible

Criteria:

1. Nanoparticle passes through the blood vessel without getting stuck three consecutive times
2. More than 50% of the active sites can be touched by the instructor
3. Brainstorming (drawings and lists of supplies) (6 pts)

Look for three unique ideas, not just small alterations of one concept.

1. Testing Results (what happened and why) (6 pts)

Look for information regarding the distance that the Bunchem traveled before getting stuck or if the Bunchem cleared the tube. Also look for how many times they ran the trial and if they had the same results all three times. If they had different results on different runs they should explain why they think that happened. If their Bunchem got stuck they should look at what part of the design was attaching to the tube and causing the Bunchem to get stuck and then explain why they think that happened. If their Bunchem cleared the tube they need to explain how their design improved the ability of the Bunchem to not get stuck.

1. Ideas for Improvement (what to try next time) (6 pts)

The students should have a list of multiple ways that they can avoid the issue discussed in question 4. The ideas do not necessarily have to succeed in allowing the Bunchem to travel through the tube, this is like a directed brainstorming session in which they look at the problem and make alterations to correct it.

If instructors want to add additional assessment components they can add the following questions:

For question 3 – ask the students to explain why they chose the design that they chose, what do they think they will accomplish?

Have the students measure the distance that their nanoparticle travels before getting stuck in the vessel and plot their progress with each additional attempt. Make sure that the students test their design three times and find an average distance traveled for their plot.

Have the students mathematically determine the ‘bioavailability’ of their nanoparticle. They could count the number of projections on the Bunchem and then count the number that are available for interactions and find the percent bioavailability (number of projections that can interact / total number of projections = percent bioavailability).