Name:______________________________ Date:______________ Class:________________

Student Worksheet

Gelatin Microfluidics

Safety

Use caution while handling hot thing gelatin and soldering iron to prevent burns.

Introduction

A lab-on–a-chip is a micro/nano sized device that can run several biochemical analyses (tests) at one time using very small samples. They contain channels through which liquids flow. Your team has been hired to design a channel that will mix a certain tag (yellow fluid) with proteins (blue fluid). Your team leader (your teacher) will show you a video of some of the problems we've been having getting the fluids to mix. We need you to design a small channel that will mix two fluids. The path the fluid will take is completely up to your design. We also need to know how fast or slow the fluid flows through your designed channel. Good Luck!

Materials

- 4 large paper clips
- wire cutters
- pliers
- a square mold
- a transparency square
- gelatin
- masking tape
- 2 glass slides
- 6–8 pipette tips, depending on design; (3–4 to *create* inlet/outlet points; 3–4 new, *unclogged* ones for directing flow of dye)
- 2 pipettes, one for each color dye
- small cup with yellow water
- small cup with blue water
- microscope

Question: How can you design a small thin channel so that a yellow fluid and blue fluid will mix to be a green fluid?

Design Challenge:

Design a shape that will mix the two dyes. Draw your design in the box. Label the inlet of blue and yellow dye and the outlet(s).

Designs will vary and may include H, T, or Y shapes. Zigzagging shapes are typically used in research and industry to combine substances by creating turbulence.

Why do you think this design will mix the two colors?

I think the bends in the paper clip will create bends in the channel that will add turbulence to the fluid flow and mix the colors.

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Procedure

1. Twist a paper clip into the shape of your design. If you need to stick 2 or more pieces together, ask your teacher to show you how to solder them together.
2. Cut the ends of the paper clip so it will fit inside the square mold without touching the sides. Make sure that your design is flat. Hammer it to flatten.
3. Write your name or group number on a piece of masking tape and put it on the bottom of the square mold (on the outside).
4. Place a piece of transparency into the bottom of the square mold.
5. Place your design into the square mold, but on top of the transparency.
6. Your teacher will pour gelatin into your square mold.
7. Wait 30 minutes or place it in the refrigerator for at least 15 minutes.
8. Carefully remove the gelatin from the square mold.
9. Peel off the transparency film.
10. Remove the paper clip. **Keep the channel intact as much as possible**.
11. Place your gelatin on a glass slide with the channel-side down. Gently press to bond the gelatin to the glass and remove any air bubbles.
12. Wait 3 minutes for it to bond to the glass.
13. Insert a pipette tip at the inlet and the outlet points of your design. (**Do not push the tips all the way to the glass, as this may break the seal**.) Remove these tips (they are now clogged with gelatin) and discard.
14. Insert a fresh pipette tip into each hole you just made (at the inlet and outlet points).
15. Place slide on a microscope stage and observe the physical appearance of the channel. Record your observations below.
16. Use the pipettes to drop yellow dye into one inlet hole and blue dye into the other inlet hole at the **same time**. Look into the microscope. Do the fluids mix? Record your observations.

Record Your Observations

1. Describe the physical appearance of the channel before adding the dye:

2. What did you observe as the dye filled the channel?

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Analyze the Results

Did your design mix the two colors? How do you know?

Draw Conclusions

1. Why did we inject a dye into the channel?
2. If the dyes did not mix, explain why.
3. If your dyes did mix, explain why.
4. If your dyes did not mix, look at other groups who had designs that did mix. What could you do with your design to make it work better?
5. Explain how this mixing technique could be useful for bionanotechnology lab-on-a-chip applications.

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