Lab Activity: Biomaterial Polymers

As we have discussed in class, scientist often use different polymers to provide an environment for cells to then assess how changes to their environment alter cell behavior. Here we are going to work with a particular biomaterial that is often used, alginate. In Particular, we will look at methods to cross-link this polymer which is derived from seaweed. Please read through the lab entirely prior to starting and remember to answer the questions and record your observations/results in your lab notebooks as you work through each step.

Prior to starting the lab, answer the following questions:

1) Alginate is a copolymer consisting of (1-4)-linked D-mannuronic acid (M) and L-guluronic acid (G)

Draw a representation of the bond between the G units of the copolymer.

2) Alginate is a linear, blocked copolymer. With this knowledge, if you were to draw a representation of alginate in solution, how might it appear?
   a. Use /\ /\ /\ to represent the G components and \_\_\_\_\_\_\_ to represent M components.
   b. The carboxylic groups on the G components of this copolymer can be ionically crosslinked. Using a colored marker/pen to represent the ion, how would the pictorial representation drawn in part (a) change with cross-linking?

3) Given what you now know about alginate, which of the aqueous solutions that will be used in this lab (see back side) do you think will cause alginate to crosslink? (HINT: if two carboxylic groups on the G components are bound via an ionic bond after losing H-ions, what charge would the ion need to have?) How do you think you will know the material is cross-linked? In order to test this, set up a table in your lab notebook to record your methods & observations. Prior to proceeding to the experimentation steps discuss your hypothesis with your instructor.
Materials for experimentation:

- CaCl₂
- NaCl
- Ba(NO₃)₂
- KCl
- 4% w/v solution of alginate
- Petri dishes
- Transfer pipettes
- Markers

Safety: No corrosive or poisonous materials are employed in this experiment. You may wear goggles if you wish. Wash your hands before leaving the lab area.

First: Prepare 100 mL of 0.1 M CaCl₂, 0.1 M NaCl, 0.1 M BaSO₄, and 0.1 M KCl. The class can work in 4 groups to prepare these solutions and then the solutions can be shared for further experimentation.

1) What changed about the alginate solution when it cross-linked? Why would this occur?

2) Which solution(s) caused the alginate to cross-link? Why did this/those solution(s) cause alginate cross-linking? What type of interaction is causing this crosslinking?

3) Given that you have now worked with alginate, why do you think that this material might be commonly used in cell culture? There are many reasons, so try to think of a few different reasons that this material might be good for this application.