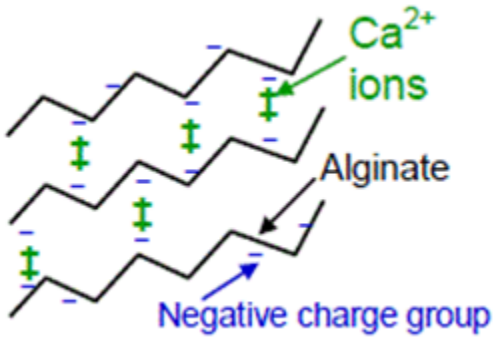
# What Bead is Best?

In this investigation you will begin working with Sodium Alginate.

Sodium alginate dissolves in water to form a viscous, clear solution. When reacted with calcium chloride a double replacement reaction occurs where the calcium ions replace the sodium ions on the alginate, producing calcium alginate. The second product formed is sodium chloride which remains in solution.

Calcium alginate has unique physical properties. It is extremely hydrophilic because of the negative charges on the alginate. Calcium alginate is not soluble in water, rather it forms beads with the +2 calcium ions sandwiched between layers of the negatively charged alginate.Many of these sandwiched layers will form and will create a material that is more of a net. (Similar to chicken wire, but on the molecular scale)




Your task is to investigate the behaviors of Sodium Alginate in a Calcium Chloride solution. Then, you are to study the properties of the resulting materials. Finally, you will be creating an Alginate hydrogel that has the highest retention rate.

## Part 1

**Materials:**

Dropper
Sodium Alginate solution 1% by weight (prepared)
Calcium Chloride solution 1% by weight (prepared)
Lithium Chloride solution 1% by weight (prepared)
Potassium Chloride solution 1% by weight (prepared)
Magnesium Chloride solution 1% by weight (prepared)
Plastic spoon
Petri dish
Goggles
Gloves
Electronic balance

**Procedures:**

**Day 1:**

1) Place ten drops of the Sodium Alginate into the beaker of Calcium Chloride.
2) Observe the drops and record observations
3) Mass your petri dish. Record the mass on your data chart.
4) Put five beads from your solution into the petri dish and find the total mass. Subtract to calculate the mass of just the beads.
5) Set the beads aside until tomorrow.

**Day 2:**

6. Mass your samples. Record the information collected into your data table.
7. Describe the changes in your materials both qualitatively and quantitatively.
8. Predict what you would expect to happen if you left the bead out for another day.
9. Calculate the amount of water lost (Initial mass - Final mass)/Initial mass X 100 = % lost

**Observations**

**(Quantitative)**

| | **Date/Time** | **Elapsed time (hours)** | **Mass of Petri Dish (g) (A)** | **Mass of petri dish + beads (g) (B)** | **Mass of beads (g) (B-A)** |
|---|---|---|---|---|---|
| Start | | Initial (time=0) | | | |
| | | | | | |
| Predicted | | | | | |

**Qualitative**

| | Date/Time | Elapsed time (hours) | Qualitative observations |
|---|---|---|---|
| Start | | **Initial Time =0** | |
| | | | |
| Predicted | | | |

## Part 2

For this portion of the experiment, you will carry out a similar set of trials but you will vary the solutions that you add the Sodium Alginate into.

Gather your data following the procedures from part 1 and record them into the appropriate data chart.

**Lithium Chloride**

| | Date/Time | Elapsed time (hours) | Mass of Petri Dish (g) (A) | Mass of petri dish + beads (g) (B) | Mass of beads (g) (B-A) |
|---|---|---|---|---|---|
| Start | | Initial (time=0) | | | |
| | | | | | |
| Predicted | | | | | |

Calculate % of mass lost

Initial mass – final mass / Initial mass X100 = %

**Magnesium Chloride**

| | Date/Time | Elapsed time (hours) | Mass of Petri Dish (g) (A) | Mass of petri dish + beads (g) (B) | Mass of beads (g) (B-A) |
|---|---|---|---|---|---|
| Start | | Initial (time=0) | | | |
| | | | | | |
| Predicted | | | | | |

Calculate % of mass lost

Initial mass – final mass / Initial mass X100 = %

**Potassium Chloride**

| | Date/Time | Elapsed time (hours) | Mass of Petri Dish (g) (A) | Mass of petri dish + beads (g) (B) | Mass of beads (g) (B-A) |
|---|---|---|---|---|---|
| Start | | Initial (time=0) | | | |
| | | | | | |
| Predicted | | | | | |

Calculate % of mass lost

Initial mass – final mass / Initial mass X100 = %

## Part 3

In part 3, your group is to select 1 of the 4 materials that you tested to make beads that have the greatest water retention capabilities. Then you will use that material in 3 different concentrations to see if you can maximize the swell and retention of the hydrogel even more.

1) Discuss with your group the material that you are going to use when making your hydrogels. Make sure that you can justify your choice.

| |
|---|
| We selected_____ because |

2) Discuss your decision with your teacher before you continue.
3) You have tested your material at a 1% concentration. You will need to test your material at 3 other concentrations. Select the %concentration your group is going to test and record them on the data table.

| | ___% concentration | ___% concentration | ___% concentration |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

4) Using the dilution formula $(C_1)(V_1) = (C_2)(V_2)$ make your samples for all 3 concentrations. (Do the math first so that you do not waste materials.
5) Test each concentration using your experience in parts 1 and 2. Record all needed data in the empty data chart above. (If you need to modify that data chart, feel free to create a new one in your lab journal.)

6) Remember that as you collect your data, you are going to be responsible for presenting your final formulation to the “Best Bead”. Any information that you may need (descriptions, pictures, observations) must be collected now. Also be sure to make note of anything that may result in or explain variations in data. (Error analysis is an important part of your investigation.)

7) Gather all needed data, repeat any parts of the experiment if needed and begin creating your presentation. Refer to the presentation guidelines for this.