



TeachEngineering

The Amazing Hydrogel



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Outline

- Introduction and Motivation, Pre-Assessment: 15min
- Hydrogel preparation: 20 min
- Wrap up discussion and Post-Assessment: 15 min

Learning Objectives

- Create a hydrogel using the crosslinking process (chelation)
- Understand and explain the chelation of a polymer using the ionic crosslinking process by exchanging a monovalent metal cation (Na^{+1}) with a divalent metal cation (Ca^{+2})
- Explain what a hydrogel is and its different uses and applications

Polymers and Hydrogels in everyday life

Have you used hydrogels before? Chances are you have. If you are wearing a contact lens, you are using a hydrogel; how about a hydrogel hand sanitizer? A hydrogel is likely keeping a baby's bottom dry.

You are probably a frequent user of hydrogels, but do you know the science behind them?

Polymers and hydrogels in everyday life

Hydrogels are [hydrophilic](#), or water-loving, polymers that are capable of absorbing and retaining a lot of water while also making a substrate for other materials, such as other polymers, minerals (nanoparticles), or other compounds.

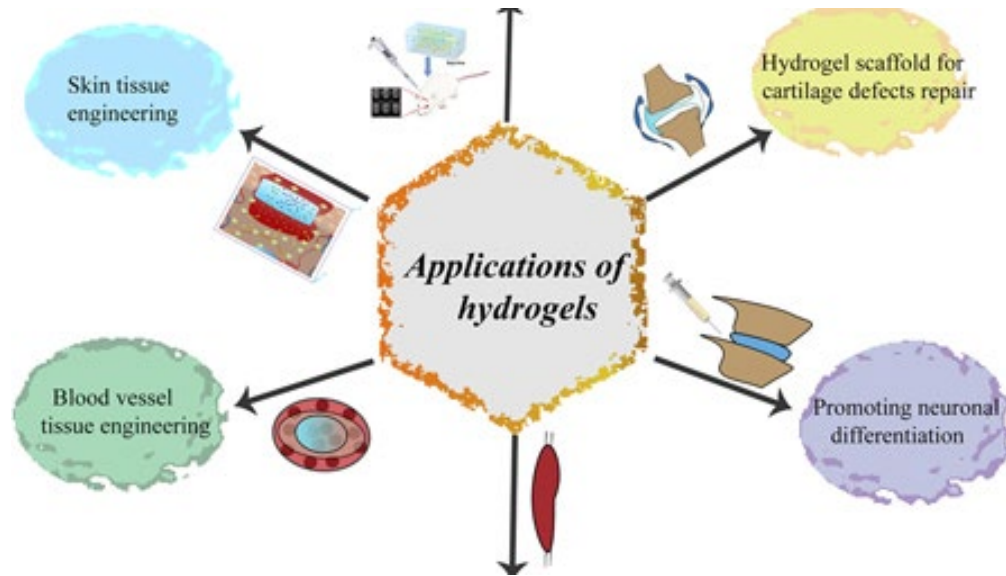
There are even 3D printable hydrogels that show promise in [knee surgery](#)!

Polymers and hydrogels

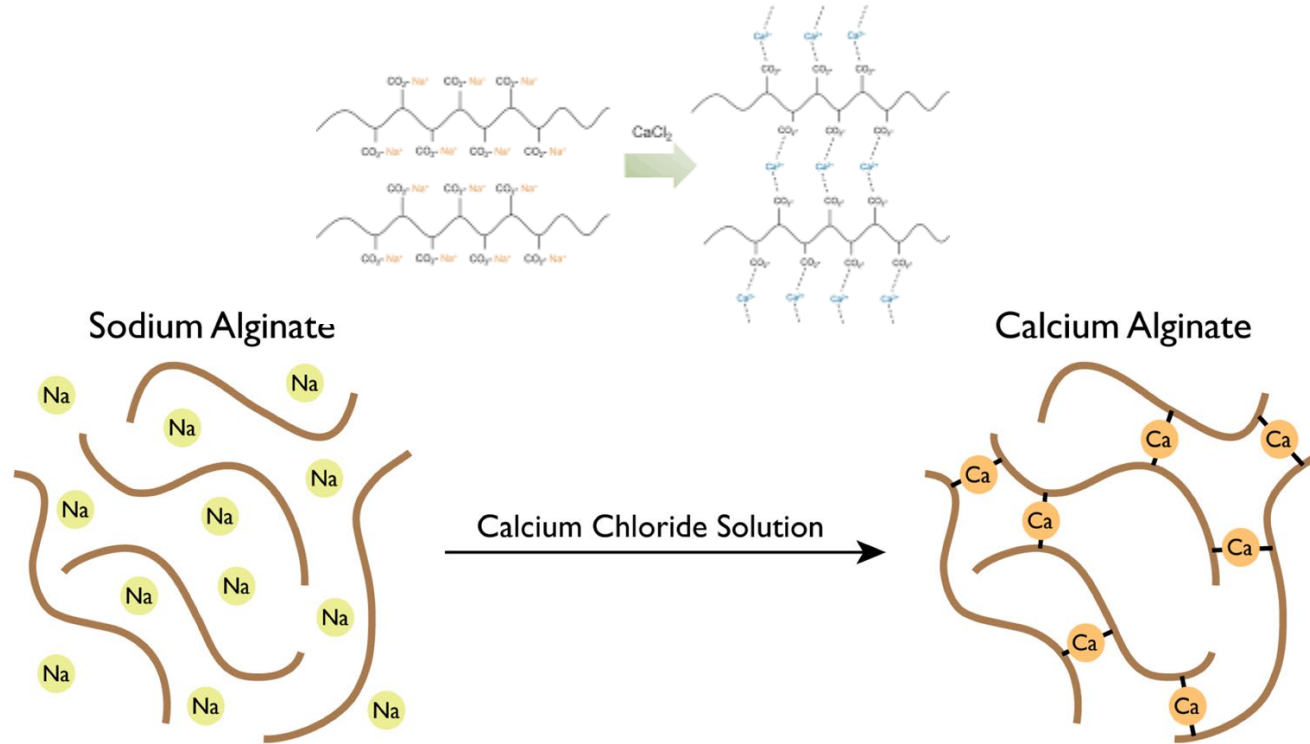
Polymers are a class of natural or synthetic substances composed of very large molecules, called macromolecules, which are multiples of simpler chemical units called monomers. Polymers make up many of the materials in living organisms and are the basis of many minerals and man-made materials.

Hydrogels are hydrated, polymeric networks that exhibit higher elasticity and strength and can be blended with other materials for endless applications

Hydrogel applications in medicine



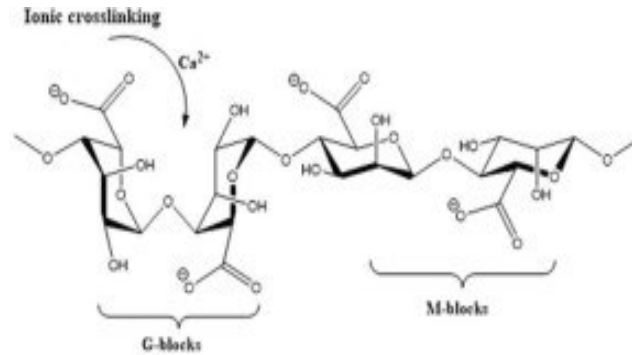
We are going to create [alginate-based hydrogels](#) by ionic crosslinking



Engineering Connection

Hydrogels are hydrated, polymeric networks that exhibit high elasticity and strength. Sodium alginate (SA) is a natural hydrophilic biopolymer typically obtained from marine brown macroalgae, suitable for making hydrogels due to its cross-linking ability, biocompatibility, chelating ability, water solubility, bio absorbency and low cost.

Alginate-based hydrogels



Alginate remains an potential material for biomedical applications



Hydrophilicity

Biocompatible

Biodegradable

Mucoadhesive

pH-responsive

Pre-Assessment Worksheet

Hydrogel Activity

Hydrogel preparation: 20 minutes

Solutions:

- Sodium alginate (SA) solution in distilled water a 1% w/v concentration
- Calcium chloride 0.1M, 0.05M and 0.02M

Activity (20 minutes)

Follow the Activity Worksheet for crosslinking the alginate solution with calcium chloride solutions and then answer the questions.



Wrap Up (15 minutes)

- Post-Assessment Worksheet
- Recap and discussion led by teacher
- Reflection

Recap and discussion

- What is a hydrogel?
- What happens during ionic crosslinking?
- What do you think about uses of hydrogels?

Reflection

1. What did you learn today?
2. What was difficult?
3. What could you have done differently?