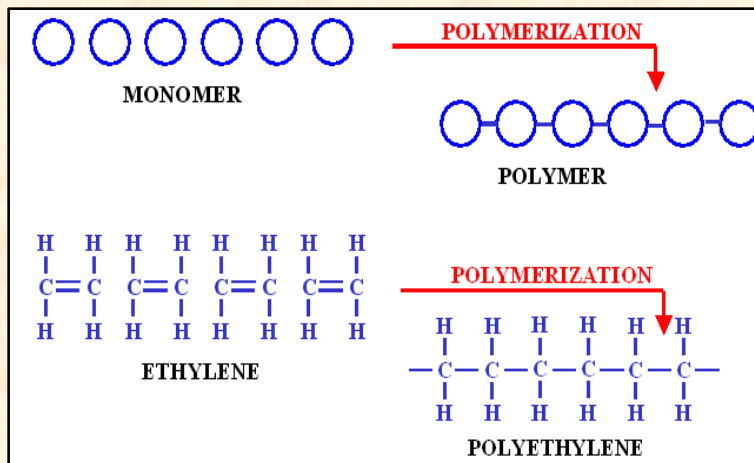


# Exploring Synthetic and Environmentally-Friendly Polymers, their Properties and Applications



Chuong Vu

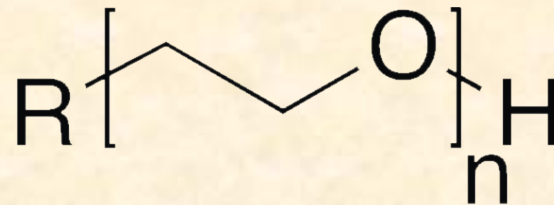
Material Research Laboratory  
UC, Santa Barbara

# RET I Research

## Polyethylene Glycol (PEG)

- Applications – cosmetic products, lubricant, laxatives, pharmaceutical
- Advantages – not toxic, reduce proteolytic degradation (opsonization), hydrophilic

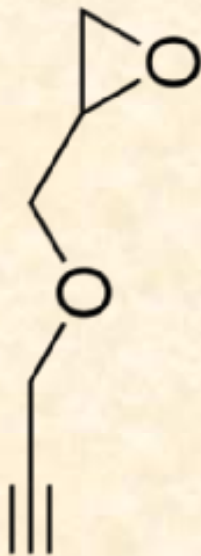
### PEG Structure



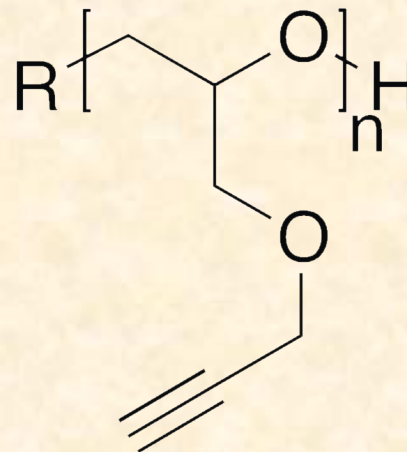
# RET I Objectives

1. Synthesize propargyl glycidyl ether (PGE)
2. Polymerize PGE to create Poly-PGE (backbone) with functional polyether

**Propargyl Glycidyl Ether  
(PGE)**

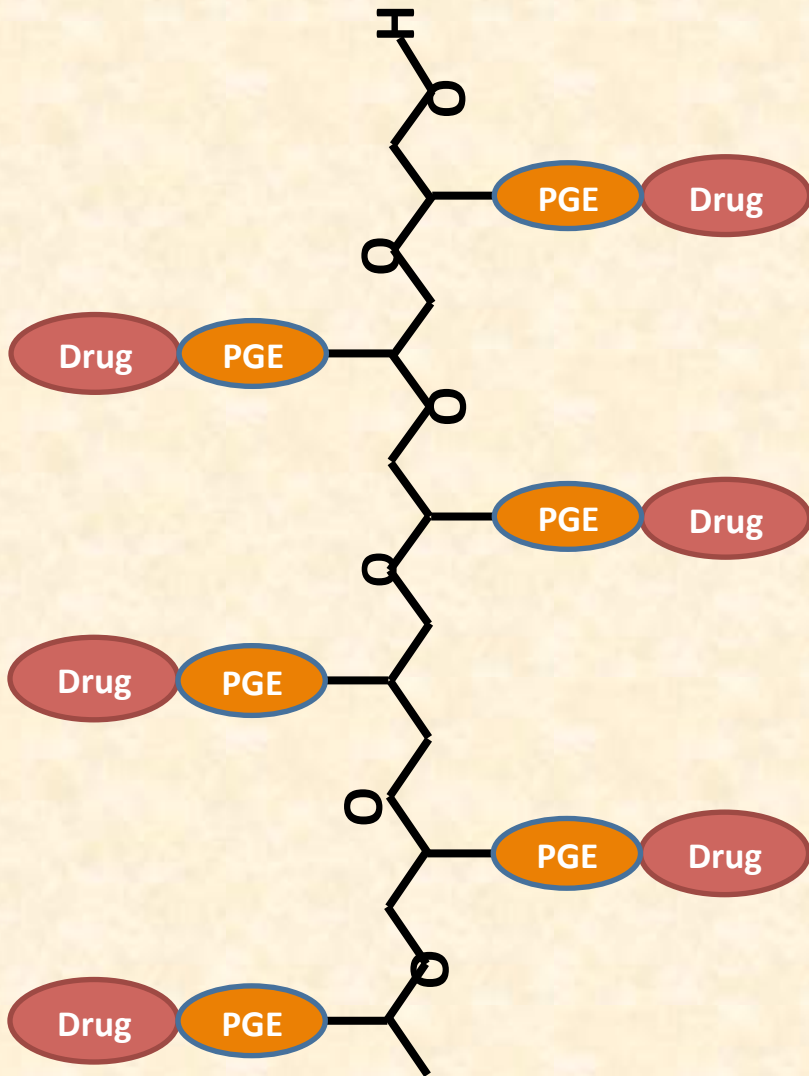


**Poly-PGE**



# RET I Objectives

## Project PEGylation



## Current PEGylation



# RET I Research to RET II Curriculum

- Polymers are versatile and crucial in society
- Extensive application from adhesives, coatings, packaging materials, textile, electronic, to biomedical devices
- Generate interest in material science and polymer science

# RET II Curriculum

## **Introduction to polymer**

- Lab 1: From Monomers to Polymer
- Lab 2: Making Slime through Cross-linking

## **Application of polymeric materials**

- Lab 3: Part 1 – Oogoo's Property
- Lab 3: Part 2 – Designing Gadgets Using Oogoo

## **Polymers for the environment**

- Lab 4: Testing Factors that Affect Biodegradable Plastic

# Lab 1: From Monomers to Polymer by Polymerization

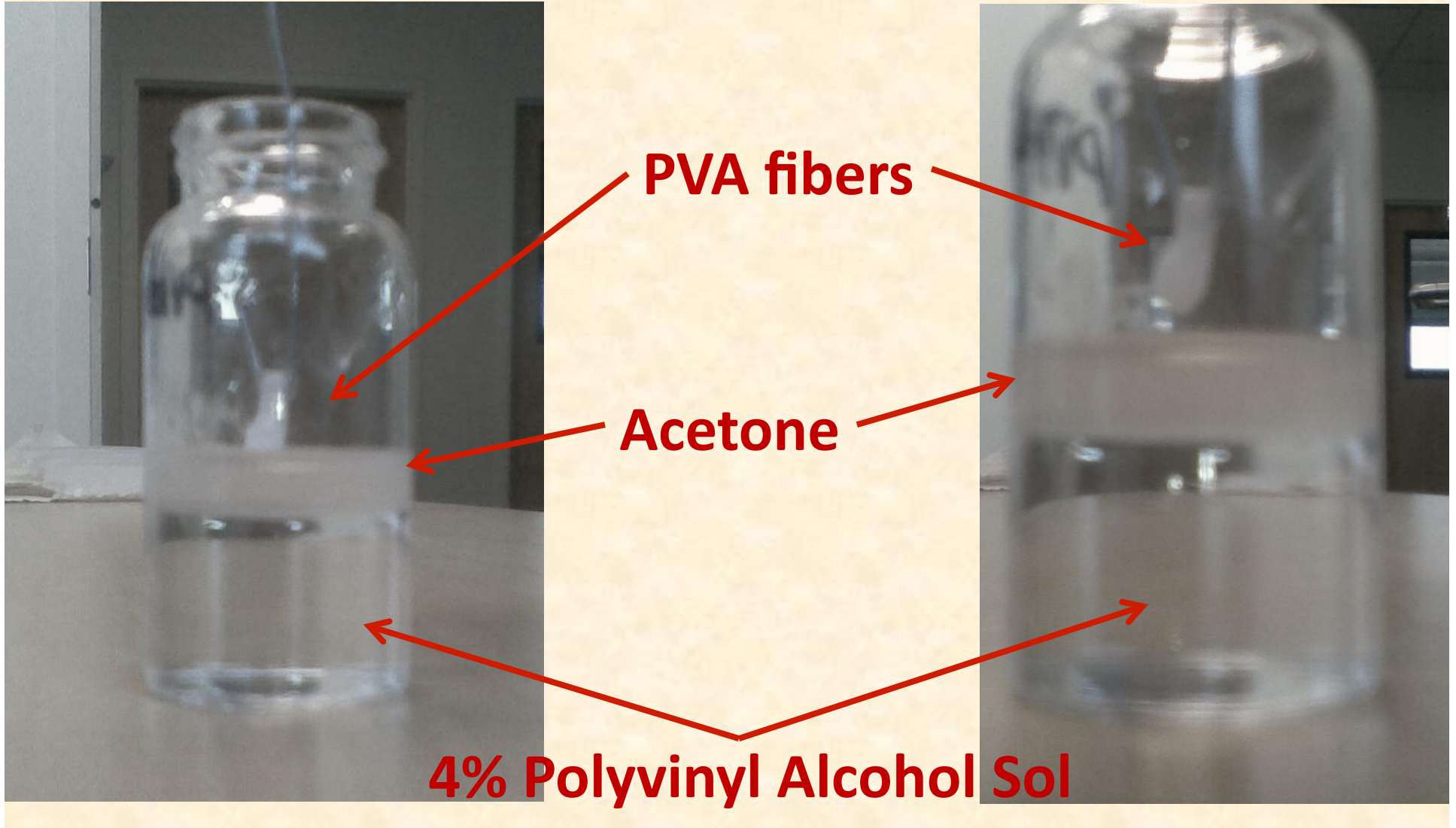
- Objective: Introduce the concepts and vocabulary of polymers with simple models



**Hand moldable plastic (polycaprolactone)**

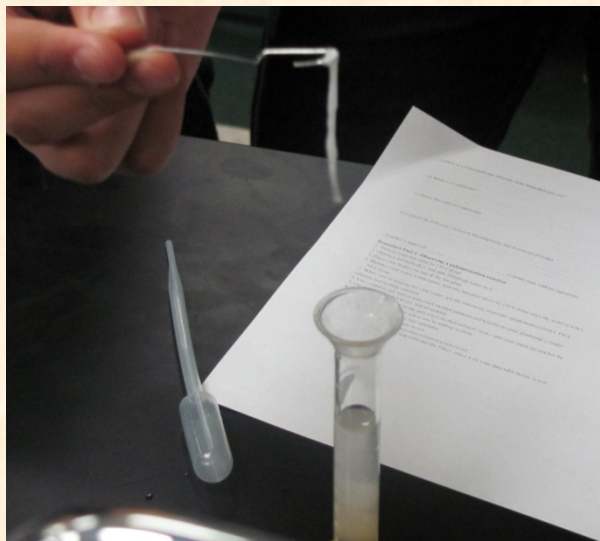
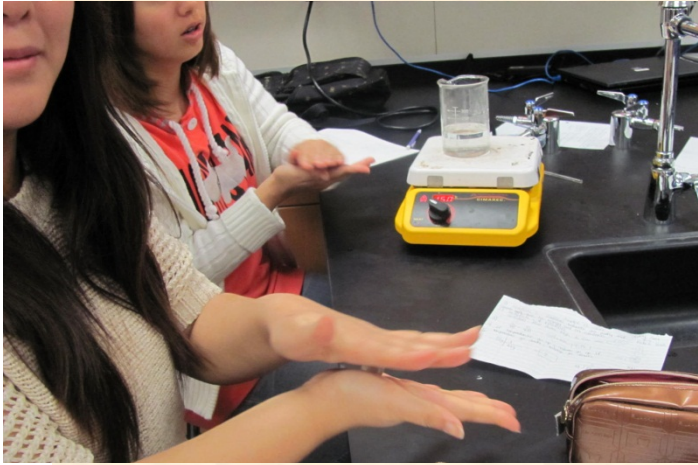


# Lab 1: From Monomers to Polymer by Polymerization



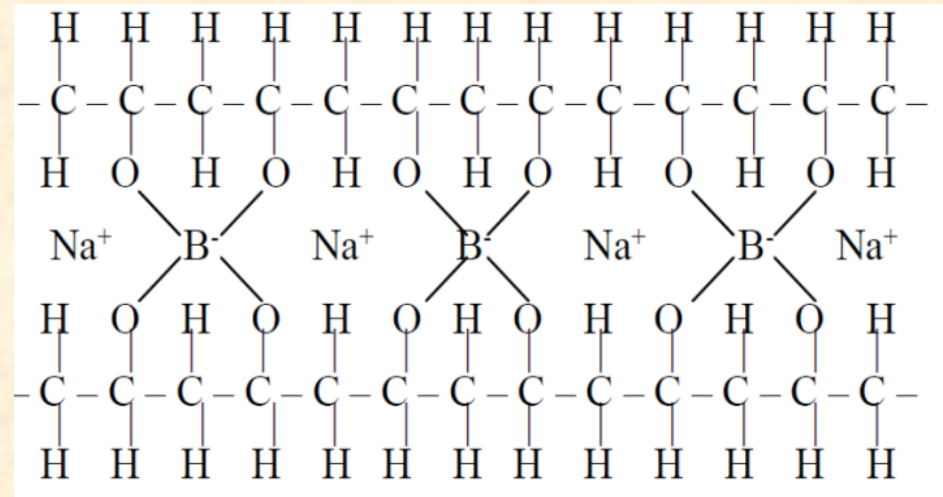


# Lab 1: From Monomers to Polymer by Polymerization



# Lab 2: Making Slime through Cross-linking Process

- Objective: Understand cross-linking and its effect in polymers



Cross-linked PVA and borax

# Lab 3: Part 1 - Oogoo's Physical Property



Hobbyists & do-it-yourself enthusiasts



- Marketed as a product to improve or repair gadgets
- Customize grips, handles, form unique shapes
- 40 grams = \$18



# Lab 3: Part 1 - Oogoo's Physical Property

- Objective: Study characteristics of oogoo polymer using quantitative tests



+



Corn starch

=



Oogoo

# Lab 3: Part 1 - Oogoo's Physical Property



Use molds for a uniform cylinder diameter to test compression, insulation, and tensile strength

# Lab 3: Part 2 - Designing Gadgets Using Oogoo

- After quantitative testing, students will be challenged to find applications for oogoo
- Use oogoo to create potential objects that have high consumer demand
- Create advertisement posters or videos to sell their creations



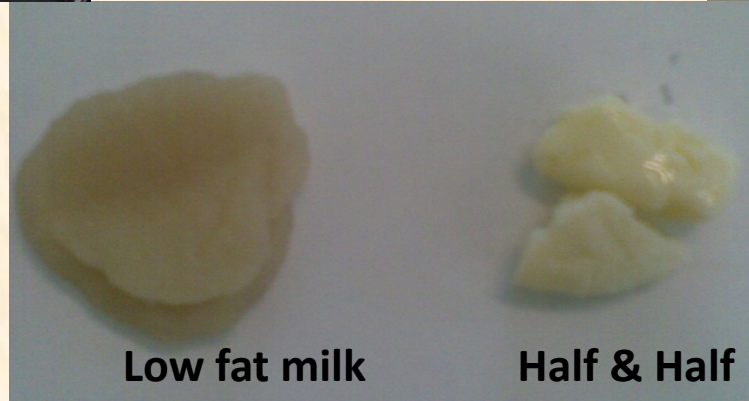
# Lab 4: Testing Factors that Affect Biodegradable Plastic

- Petroleum based plastics do not readily break apart and small percent are recycled
- Introduce bioplastics and biodegrade concepts to students
- How fast will bioplastics degrade?



# Lab 4: Testing Factors that Affect Biodegradable Plastic

- Objective: Making bioplastics (casein) and see how they degrade under different conditions

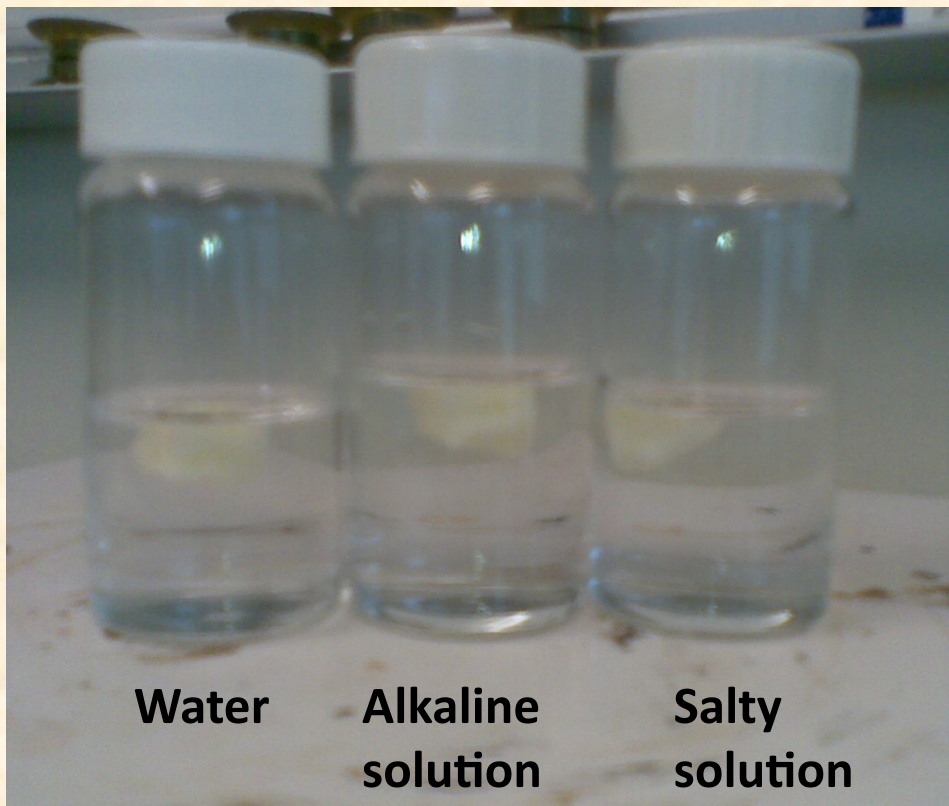


Low fat milk

Half & Half

# Lab 4: Testing Factors that Affect Biodegradable Plastic

Conditions for Biodegradability Test



at room temperature  
and under heat

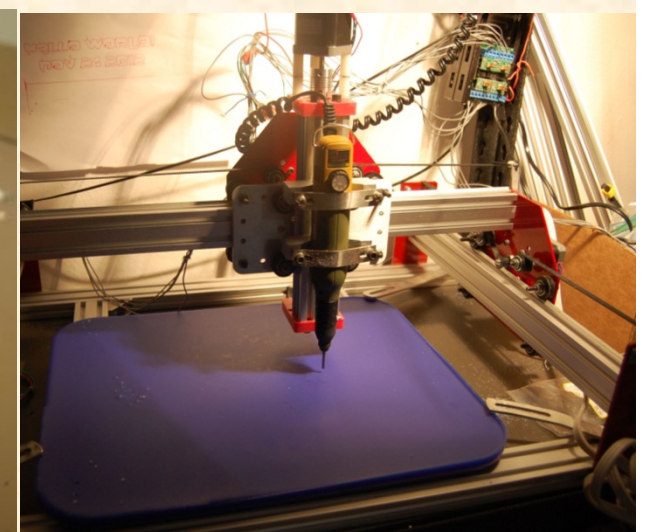
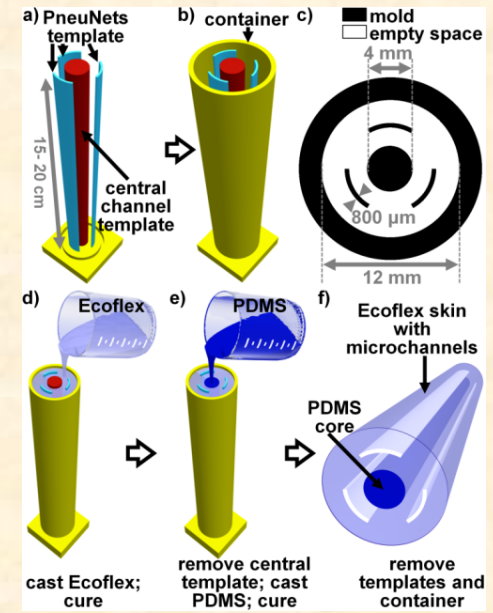
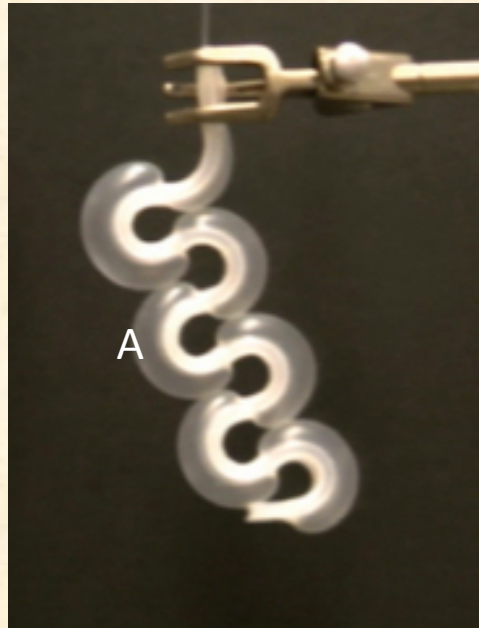
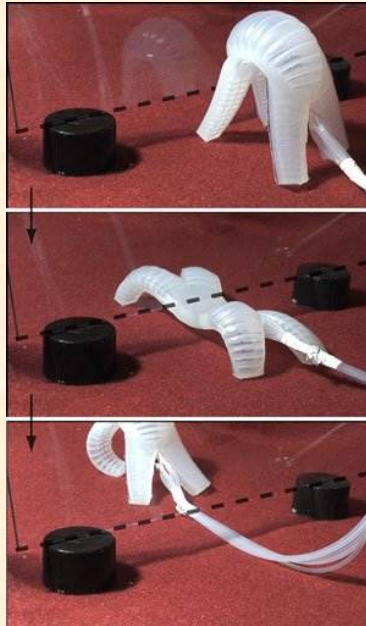


# Lab 4: Testing Factors that Affect Biodegradable Plastic

- Testing PVA film in addition to casein to show students decompose



# Soft Robotics



# Standards

## High School Chemistry

- 2.a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
- 10.a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
- 10.b. Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.

## Eight Grade Physical Science

- 3.c. Students know atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.
- 5.a. Students know reactant atoms and molecules interact to form products with different chemical properties.



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