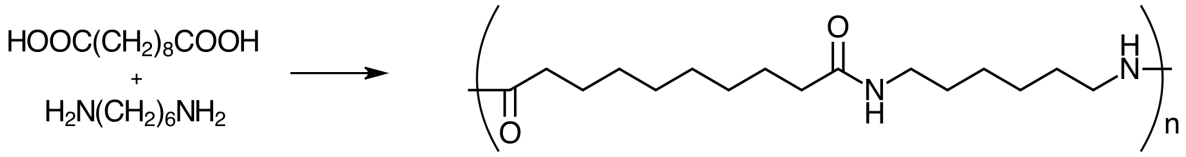
Polymerization

Summary:

Polymerizations are commonly taught within organic chemistry laboratory courses, with one of the most common being the polymerization of nylon. Procedures typically involve the use of chlorinated solvents and hazardous reagents. In this procedure, sebacic acid and 1,6-hexanediamine are used to create a nylon polymer in a condensation polymerization.



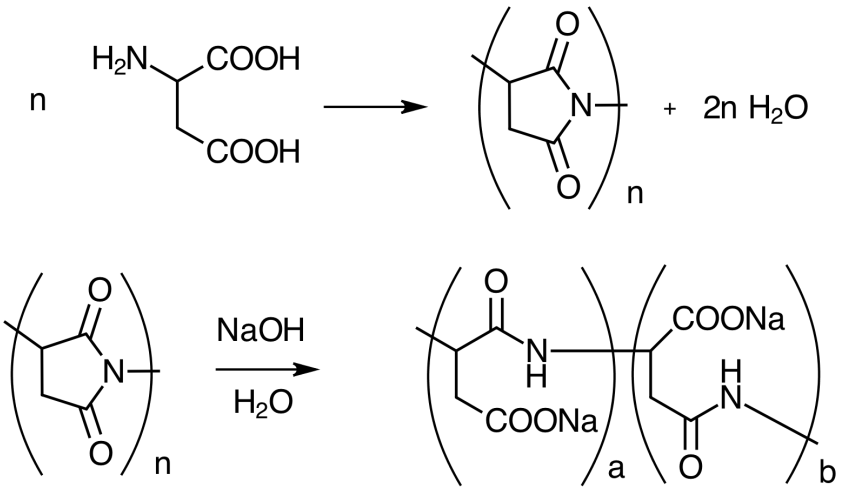
Traditional alcohol dehydration: Synthesis of nylon by interfacial polymerization, Macroscale and Microscale Organic Experiments, 6e; Brooks/Cole, 2011; pp. 763-765.

Chemical Name Aldrich Catalog #	Amount per 100 students (g or mL)	EH&S	Purchasing cost per 100 students ($)
Sebacic acid 283258	100 g		$11.16
Thionyl chloride 320536	100 mL		$13.00
Dimethylformamide 227056	5 mL	*	$0.48
Dichloromethane 676853	2500 mL		$110.94
1,6-Hexanediamine H11696	100 g		$22.60
Sodium hydroxide 221465	50 g	*C	$5.76
Water n/a	3750 mL		n/a

Polymerization: A Greener Approach

Summary:

This greener reaction involves the polymerization of aspartic acid to create poly(aspartate), which has similar applications to poly(acrylate) polymers.



"Greener" polymerization: A Green Polymerization of Aspartic Acid for the Undergraduate Organic Laboratory, *J. Chem. Educ.*, **2005**, *82*, 1380–1381

Chemical Name Aldrich Catalog #	Amount per 100 students (g or mL)	EH&S	Purchasing cost per 100 students ($)
L-Aspartic acid A9256	67 g		$17.16
Sodium bicarbonate, sat. sol'n S6014	750 mL		$4.90
Hydrochloric acid, 1% 320331	250 mL		$0.10
Water N/A	250 mL		n/a
Sodium hydroxide, 0.1M 221465	5000 mL		$0.23

Comparison: Polymerization

Comparison of greener and traditional lab:

- Greener method avoids the use of hazardous solvents such as dichloromethane and dimethylformamide
- Greener method avoids the use of thionyl chloride

	Purchasing costs	Waste reduction (per 100 students)	"Greener" benefits
Greener method	$22.39	6.6L liquid waste (6L aqueous waste)	
Traditional method	$163.94	6.6L liquid waste (3.7L aqueous waste)	

Other greener lab options to explore:

- Sustainable Polymers in the Organic Chemistry Laboratory: Synthesis and Characterization of a Renewable Polymer from δ-Decalactone and l-Lactide, J. Chem. Educ. 2014, 91, p. 131-135 (renewable triblock copolymers)
- The Cyclohexanol Cycle and Synthesis of Nylon 6,6: Green Chemistry in the Undergraduate Organic Laboratory, J. Chem. Educ., 2012, 89 (2), pp 262–264
- Ring-Opening Polymerization of Lactide To Form a Biodegradable Polymer, J. Chem. Educ. 2008, 85, 258–260 (polylactic acid)

EHS Key: