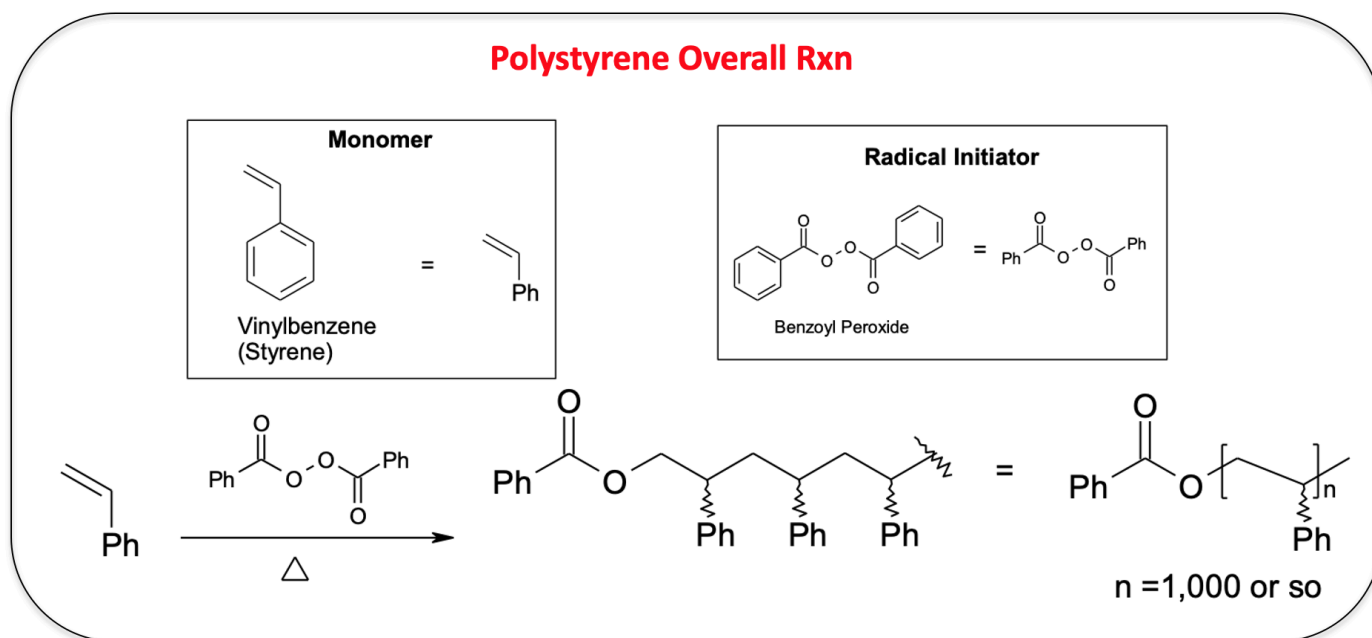


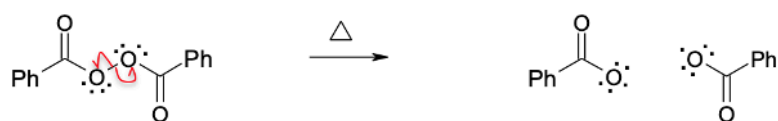
Introduction to Nylon Synthesis

A Polymer is a huge molecule made of small repeat unit molecules. The name comes from the Greek language, Poly = Many and Mer = parts. When we react the repeat units together to make the Polymer, it's called a Polymerization. The reaction can involve a radical mechanism, an acid catalyzed mechanism, a base catalyzed mechanism, Esterifications, epoxides, etc. Just about all the reactions we've learned this year are used to make different polymers. Polymer chemistry is all around us. Polymers include plastics, clothing, starch, DNA and our Proteins.

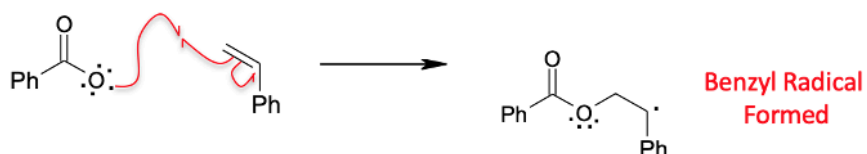
A Common Polymer you've probably heard of is Polystyrene. It's made into Styrofoam cups, Cooler's, etc. When not made into a foam, it's made into the white Starbucks cup lids and envelope windows on the bills, you get in the snail mail. It is made via a radical mechanism...



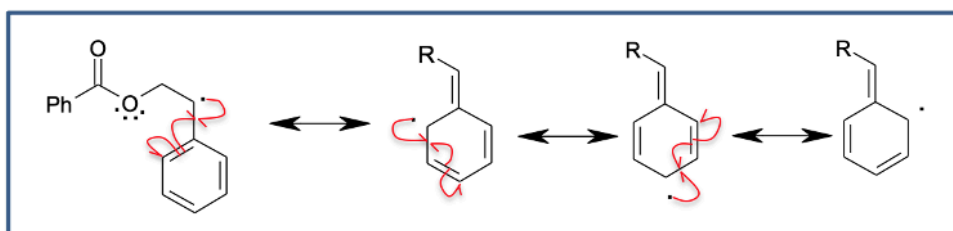
Polystyrene Radical Mechanism



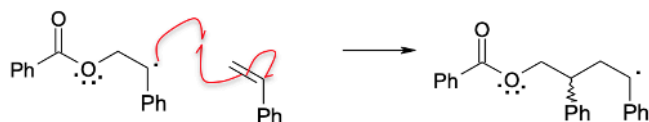
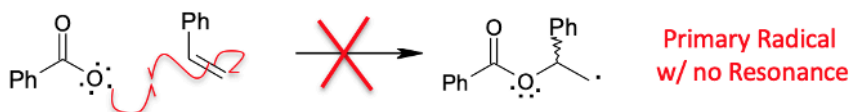
Initiation



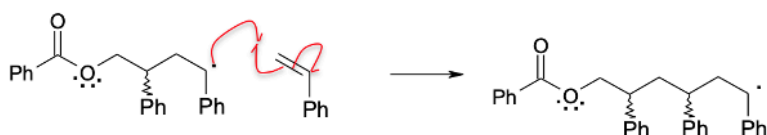
Propagation



Benzyl Radical has Resonance



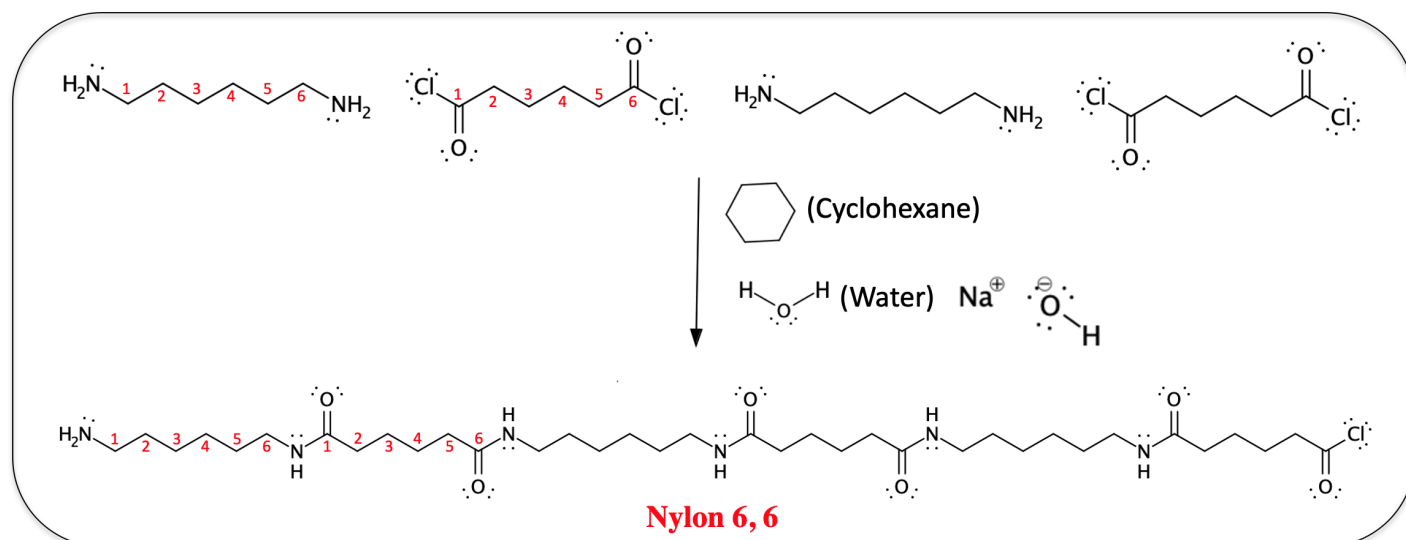
Propagation



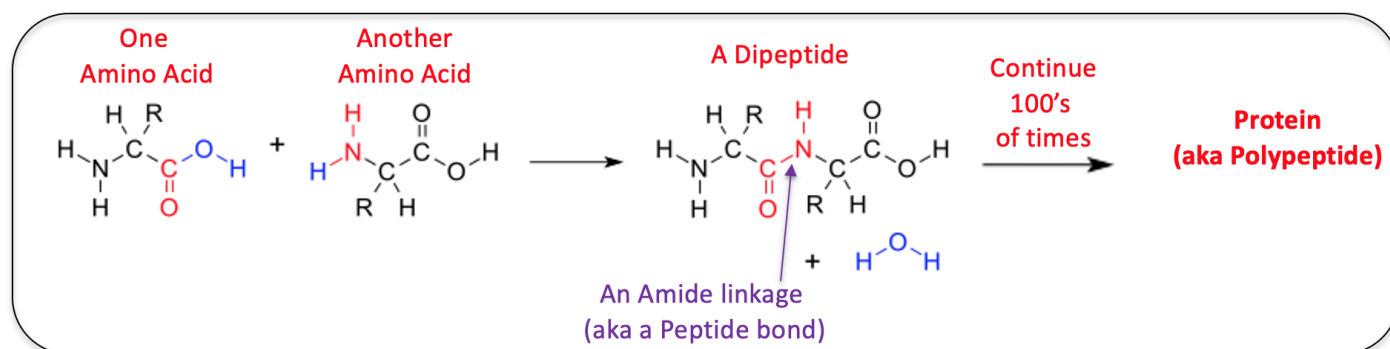
Propagation

If you'd like draw out the rest of the curved arrow mechanism...
Just repeat the propagation about 1,000 to 3,000 thousand times.
Then have two radicals come together to terminate the reaction.

You will be making the Polymer Nylon. You'll make it with an Addition / Elimination mechanism between an Acid Chloride and an Amine...



This is just a very small portion of the Polymer you'll make. It's called Nylon 6,6 because it is made from a 6 Carbon Diamine monomer and a 6 Carbon Diacid Chloride monomer. Nylon has an Amide linkage between the two monomers, similar to our proteins that are Amino Acids bound together by Amide.



Notice the Amide made in the proteins does not involve an Acid Chloride like our reaction. Remember the Acid Chloride is a very strong electrophile, that would be terrible to have inside of our bodies. Interestingly, most Nylon made is made from a Carboxylic Acid, not an Acid Chloride like our reaction. We are using the Acid Chloride because we want the reaction to be very fast.

Nylon was first introduced by DuPont around 1939 in the USA. It is used for many things, including Stockings, which were very popular. During World War Two, the War Production Board in the USA, stopped the production of Nylon Stockings, so that the Nylon could be used to make material for the war effort, such as Parachutes. Some who were missing the Nylon Stockings would use makeup to paint fake seam lines down their legs, to give the illusion of Nylon Stockings. https://en.wikipedia.org/wiki/Nylon_riots



Women standing in line for nylon stockings outside [Miller's Department Store](#) in [Oak Ridge](#) in January 1946.



https://en.wikipedia.org/wiki/Nylon_riots

<https://www.pinterest.com/pin/768426755141541642/>

Back in the early 2000's Nicki "Nylon" had the All-time, Sierra College, "Clean" record of about 32 feet! Then we went through a performance enhanced era, the 32 feet record was broken but the students were using more Aq and Organic Layers to start the reaction. Try to do yours "Clean" and set a natural record for this unnatural fiber.

Ripstop Nylon is a woven fabric made out of Nylon polymer that is strong and as the name suggests, is resistant to ripping. Here are some examples of Ripstop uses...



Ripstop nylon is the primary material used in [hot air balloons](#)



Ripstop used in high-quality camping hammock

https://en.wikipedia.org/wiki/Ripstop#Ripstop_nylon

You too will get to make Nylon and characterize it. Since it is a huge molecule that is not soluble in our NMR solvents we can't take NMR of it. Solid State NMR does exist to take NMR of undissolved solids but they are not all that common. Often chemists just rely on IR spectroscopy to characterize polymers and that is what you'll do. Since we have an ATR adapter on our IR Spectrometer, the IR is simple to take, you just crush it down onto the Zinc Selenide crystal with the anvil, like other solids you've worked with.

You'll also take the IR of a common plastic, just about any plastic will do (plastic bag, water bottle, etc.).

You'll try to confirm that you made the Nylon 6,6 with our Giant Book of IR's in the Lab. It's actually easier to look up IR's of polymers in our book than online. You'll also use this book to try and identify what polymer is used to make the common plastic you got an IR of.

Now you can go skim the "3. Procedure for Nylon Synthesis" file or skip ahead to the Video of the experiment that has the Procedure embedded in it.

[3. Procedure for Nylon Synthesis](#)

Nylon Synthesis Video link...

<https://www.youtube.com/watch?v=LXGrqJqr3W4&feature=youtu.be>