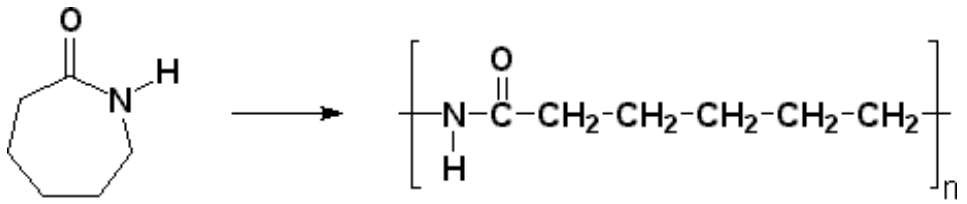
# The One That Got Away
# Student Activity

### Introduction and Historical Context

Before Carothers had given the world nylon 6-6, his scientists tried to make another kind of nylon. They tried to carry out a *ring-opening polymerization* on caprolactam:



caprolactam nylon 6

A ring-opening **polymerization** is a chemical reaction in which small ring-shaped molecules are opened, and then joined together to make a long **macromolecule**.

Carothers and his team never succeeded in making this other nylon, nylon 6. In fact he wrote that it could not be done! But German chemist Paul Schlak did what Carothers and his team could not, making caprolactam into nylon 6. He was working for the giant chemical company IG Farben at the time, which meant that IG Farben had a product to compete with DuPont's nylon.

Today you are going to do what Wallace Carothers never could. You are going to make nylon 6 for yourself.

### Purpose

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### Safety

Do not point the open end of the heated test tube toward anyone. The contents may splatter and cause burns!

### Materials and Apparatus

- Caprolactam
- Polyoxyethylene
- *N*-acetylcaprolactam
- Sodium hydride (NaH)
- 18 × 20 test tube

- 2 spatulas
- Disposable pipette
- Tongs
- Bunsen burner
- Safety goggles

**Procedure**

1. Weigh 8ö10 g caprolactam and place into the test tube.
2. Weigh out 0.5 g polyoxyethylene and place in the test tube with the caprolactam.
3. Using a disposable pasteur pipette, add 2ö5 drops of *N*-acetylcaprolactam to the mixture in the test tube.
4. Light your Bunsen burner. Holding your test tube with a pair of tongs, heat it gently in the flame. Move the tube about for even heating. ***WARNING!*** Do not point the open end of the tube toward anyone. The contents may splatter and cause burns!
5. When the mixture in the tube has melted, have your teacher add a very small amount (0.05 g or about a 5 × 5 mm square pinch at the end of your spatula) of sodium hydride to the solution in the tube. Make sure all the sodium hydride touches the solutions, and none stays stuck to the inside of the tube.
6. Heat the tube in the flame again for 2ö4 minutes. Heat it just enough for the solution to come to a very gentle boil. The solution should become very thick (viscous).
7. Remove the tube from the flame. Allow it to cool slightly.
8. Insert a glass or wooden rod into the viscous liquid and draw it out again. This will draw out a thin filament of the material. One student should hold the tube, and another should hold the rod. Try to stretch the fiber out as far as you can.

**Post-Lab Questions**

1. Describe your reaction mixture before heating.
2. Describe the reaction mixture after heating. How is it different? How is it the same?
3. If you notice any differences, how can you explain them?
4. Nylon 6 is made of long chain-like molecules. When you made the nylon 6, those chains were all tangled up in any old manner. What do you think happened to the tangled chains when you drew out a fiber?

**Extension Questions**

To makes things interesting, your teacher may choose to add a different amount of sodium hydride to each student's test tube. How does this affect the nylon 6 that is produced?

Compare your nylon 6 with that of other students. Are the fibers made from the nylon 6 better when more or less sodium hydride is used?