Silicon Polymers: Preparation of Bouncing Putty  
*(as modified by S. Jurisson and S. W. Keller)*

This laboratory experiment is modified from that given in the original procedure. The reaction is scaled up so that the silicon polymer is formed in sufficient quantity for evaluation. The wash step and the chromatography step have been deleted.

**New, modified procedure:**

**Carry out this reaction in the hood.** Attach a water condenser to a 100-mL round-bottom flask containing a magnetic stirring bar. Attach the hoses (input at the low end, output at the high end). Arrange the assembly on a magnetic stir plate and clamp the assembly to the rack. Turn on the water (slowly) to the condenser.

Using a 10-mL graduated cylinder (twice), pour 20 mL of diethyl ether through the top of the condenser into the flask. Using the same cylinder, add 10 mL of dichlorodimethylsilane through the top of the condenser to the ether solvent already in the flask.

Turn on the magnetic stirrer, and with rapid stirring, carefully add 20 mL of water, **dropwise** for at least the first 5-10 mL, through the top of the condenser. A cloud of HCl vapor will be visible with the first drops, and as the HCl output diminishes, the water can be added more rapidly. Allow the resulting mixture to stir for a few minutes at room temperature after addition of the water is complete.

Remove the reaction flask from the condenser and transfer the contents to a separatory funnel (*make sure the stopcock is closed on the funnel!*). Remove the lower aqueous layer by carefully opening the stopcock. Do not let any of the ether layer pass through the stopcock with the water layer. Put the aqueous layer in a container for unwanted materials. Open the stopcock and let the ether layer pass into a 50-mL round-bottom flask. Reattach the reflux condenser.

Add 20 mL of 10% sodium bicarbonate solution slowly through the top of the condenser with stirring. After bubbling of the solution has stopped, transfer the contents of the flask to the separatory funnel as before (*make sure the stopcock is closed on the funnel!*)) and drain out the aqueous layer. Put the aqueous layer in a container for unwanted materials. Place the ether layer into a 50-mL beaker with a stir bar and place the beaker on a hot plate.
Boil off the ether with the hot plate set on a relatively low setting (check with TA). When all the ether is gone, take the 50-mL beaker off the hot plate with your forceps and set it on the counter. Allow it to cool until it is not too hot to touch. Do not turn the hot plate off; instead, turn it to a relatively high setting (check with TA) to get it ready for the next step.

Pour the silicone fluid from the 50-mL beaker into a tared 10-mL beaker and determine the mass of the fluid. Add boric acid to the 10-mL beaker in an amount of 5% of the mass of the fluid (for example, if the silicone fluid has a mass of 10 g, 0.5 g of boric acid should be added), and stir the mixture with a microspatula for five minutes.

Place the 10-mL beaker on the hot plate, and suspend a 260°C thermometer from the rack so that the bulb will be in the liquid without touching the beaker. Heat the mixture until it reaches 160°C, and then remove the beaker from the hot plate (with forceps, not your fingers). Allow the product to cool to room temperature.

Manipulate the product in the beaker with your microspatula until it forms a more or less uniform mass. Remove the product from the beaker and continue kneading it with your fingers.

There is a sample of commercial-grade silicon polymer (SillyPutty®) in the lab. Compare your sample with the commercial product by performing the following tests on your product:

1. It should give a lively bounce on a hard surface. Shape into a ball and note how high it bounces (drop from 1 meter height and determine how high it bounces back).
2. Pulling sharply causes cleavage of the polymer.
3. Pulling slowly results in stretching similar to chewing gum.
4. Placed on a hard surface, the ball will flow into a flat plate.
5. If test (4) is done on a newspaper, careful removal of the flat gum will reveal the mirror image of the print.