

# Thermodynamics of Rubber Bands

*Recommended for Chapter(s): 10*

## Demo #032

### Procedure

1. (Prep) Pass out rubber bands to the class. I have the students pick up a rubber band as they come into the room.
2. Have the students touch the rubber bands to their lips. Then have the students stretch the rubber band quickly and then immediately touch it to their lips again. Lastly have the students let the rubber band go loose and touch it to their lips.
3. Have the students determine the signs of  $\Delta G$ ,  $\Delta H$ , and  $\Delta S$ .

### Clean Up

1. Allow students to keep their used rubber bands.
2. Return any unused rubber bands to the demonstration box.
3. Return the materials to the cart in the demonstration library room.

### Stockroom Notes

4. If there are less than 400 rubber bands e-mail Darby (feldwinn@chem.ucsb.edu).
5. Return items to the demonstration tub.
6. Return tub to the demonstration library.

### Discussion

As the students stretch the rubber bands they will feel the rubber bands get warm. As the rubber bands contract they cool down. Therefore,  $\Delta H$  is negative for stretching the rubber band and positive when the rubber band contracts. In order to feel the heat from the rubber band the student needs to physically stretch the rubber band; therefore, the reaction is non-spontaneous and the sign of  $\Delta G$  is positive. In order for the rubber band to contract, all one needs to do is let go of the rubber band; therefore, the reaction is spontaneous and the sign of  $\Delta G$  is negative. The sign of  $\Delta S$  can be determined from  $\Delta G = \Delta H - T\Delta S$ . When the rubber band is stretched,  $\Delta G$  is positive and  $\Delta H$  is negative; therefore,  $\Delta S$  must be negative. When the rubber band is contracted,  $\Delta G$  is negative and  $\Delta H$  is positive; therefore,  $\Delta S$  must be positive. The sign of  $\Delta S$  results from the polymers in the rubber band being more ordered when the rubber band is expanded than when the runner band is compressed.

*Materials for demo 032*

1. At least 400 rubber bands