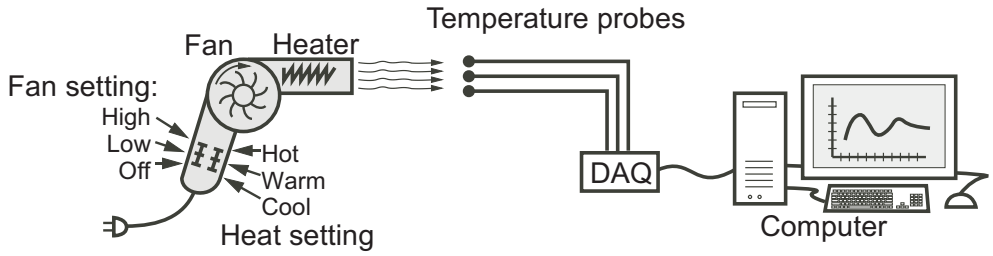

Figure 1: Apparatus for the hair dryer experiment.

Apparatus

Figure 1 shows the equipment for this demonstration. The key components are

1. A hair dryer with independent heater (cool, warm, hot) and fan (off, low, high) settings.
2. One thermocouple upstream of the hair dryer inlet and three thermocouples downstream of the outlet.
3. A data acquisition device (DAQ) for digitizing the thermocouple output.
4. A computer to record the output of the DAQ.

In-Class Demonstration

With the data acquisition system collecting and displaying temperature readings, the hair dryer is turned on at medium heater power and low fan speed.

1. When the fan is adjusted from low speed to high speed, the thermocouples downstream of the hair dryer will indicate (*circle one answer*)

   a. increase in temperature b. decrease in temperature c. not change in temperature

2. What physical principle explains why the temperature changes (or does not change) with fan speed in the way that you predicted?

3. Write an equation that demonstrates why the temperature changes (or does not change) with fan speed in the way that you predicted?

4. The three thermocouples downstream of the fan are separated vertically by approximately 1.5 cm. If the middle thermocouple is aligned with the centerline of the hair dryer exit, the three thermocouples will show

   (a) approximately the same temperature.
   (b) a noticeable gradient from high temperature at the top to low temperature at the bottom.
   (c) a noticeable gradient from low temperature at the top to high temperature at the bottom.
   (d) a random variation of temperature with height.

5. What physical principle explains the spatial temperature gradient (or lack of gradient) that you predicted?