Here is data for nine states, taken from a take-home version of the PDM:

David R. started putting a table in here.

	F_L:	F_L :	F_L:
x_R:	F_R: x_L:	F_R: x_L:	F_R: x_L:
x_R:	F_R: x_L:	F_R: x_L:	F_R: x_L:
x_R:	F_R: x_L:	F_R: x_L:	F_R: x_L:

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1. What does each cell represent? Each row or column?
2. It takes TWO graphs to plot all this data. Why?

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3. Notice that the graphs are correlated. How?
4. Draw/label the processes State 1 to State 2 to State 3 to State 4 on each graph.
5. For the PDM, the analogue of the First Law and the thermodynamic identity are:

$$\begin{align} \Delta U &= W_L + W_R \tag{1} \\ dU &= \text{đ}W_L + \text{đ}W_R \tag{2} \\ & \tag{3} \\ dU &= F_L\,dx_L + F_R\,dx_R \tag{4} \\ & \tag{5} \\ \Delta U &= \int F_L\,dx_L + \int F_R\,dx_R \tag{6} \end{align}$$

   Find ΔU from state 1 to state 3 along (at least) two different paths. What can you say about the values of ΔU, W_L, and W_R along the different paths.

   You may wonder why the thermodynamic identity treats the four variables asymmetrically? Let's explore this asymmetry.

6. Pull on the right-hand side of your PDM. You are doing work. Where does the energy go?

   A Legendre transformation is a mathematical manipulation of the state variables. Define a new state variable B by:

$$B = U - F_L\,x_L$$

7. Find dB

8. If we do a Legendre transformation to the new state variable B, we have:

$$dB = -x_L\, dF_L + F_R\, dx_R \tag{7}$$

$$\tag{8}$$

$$\Delta B = \int -x_L\, dF_L + \int F_R\, dx_R \tag{9}$$

9. How do you calculate ΔB on your graphs?

10. Suppose your experimental set-up has no tape on the left-hand side. (Right-hand measuring tapes have not yet been developed.) For what process can you find ΔB but NOT ΔU?