Length-Contraction

1. Begin by drawing the two observers in the train car (frame S’) each holding a clock, and the observer on the train platform (frame S) holding a clock.

2. Write the d=vt calculation for the length of the train car L measured by the observer in frame S, and write the d=vt calculation for the length of the train car L’ measured by the two observers in frame S’. Write the equation L/L’= in terms of v, Δt, and Δt’. Simplify the equation.

3. Explain which of the time intervals is the proper time interval, and rewrite the equation L/L’= using the proper time interval Δt0. One more step is necessary to write the equation L/L’= in terms of Δt0 and Δt. Explain that step and then write the equation L/L’= in terms of Δt0 and Δt.

4. Next use time dilation to put γ into the equation. This is now the length-contraction equation, written in terms of L, L’, and γ.

5. Write the definition of a proper length and explain which length is the proper length L0. Rewrite the length-contraction equation in terms of the proper length L0, L, and γ.

6. Show that the proper length is longer than the length measured in any other frame.