Topic-Level learning goals for *Special Relativity*

UBC PHYS 250, *Introduction to Modern Physics*, Summer 2009

(updated July 30, 2009)

1. **Puzzles from Electromagnetism**
   - Give simple examples from electricity and magnetism that show that either the principle of relativity or some basic notions of distance, time, and velocity must be abandoned

2. **Einstein's Resolution**
   - Argue how the experimental evidence implies that the velocity of light is always independent of the of the motion of the source or of the observer
   - State Einstein's postulates of special relativity
   - Explain how an given observer can set up a coordinate system for making measurements of time and position
   - Show how Einstein's postulates imply that observers at large relative velocities will not agree on distances, time intervals or whether two events are simultaneous
   - Describe qualitatively the meaning of length contraction and time dilation
   - Calculate the lengths and times differences that an observer will measure, accounting for length contraction and time dilation.
   - Relate the measurements of observers moving at arbitrary relative velocities using the Lorentz transformation formulae
   - Calculate the observed velocity of an object in a new reference frame given the velocity in the old frame and the relative velocity of the two frames

3. **Relativistic Energy and Momentum**
   - Argue why classical formulae for momentum and energy must be modified to make sense physically at high velocities
   - Write down the relativistic formulae for energy and momentum and use them to solve simple mechanics problems
   - Give evidence for the equivalence between energy and mass and explain the implications
   - Analyze simple high-energy particle decay processes and scattering processes using energy and momentum conservation (did several examples of this in HW and Tutorial)