S: What are the postulates of special relativity?
F: That the laws of physics don’t change depending on your inertial reference frame, and that the speed of light is constant in all inertial reference frames.
S: What’s the Lorentz transform?
F: It’s the chart transition function used in special relativity to transition between inertial reference frames.
S: How do you arrive at the definition of the Lorentz transform by starting with the two postulates?
F: The first postulate says if you’re inside a closed box, you have no experiment you can do that would tell you which inertial reference frame you’re in.
S: Why is that useful?
F: Essentially, this means that looking at any spacetime diagram which represents a chart of spacetime, the laws of physics will hold for every chart.
S: What is meant by the laws of physics?
F: Mechanics & electromagnetism.
S: So do these laws always hold in every inertial frame of reference?
F: Yes.
S: Does position stay invariant?
F: No, because position is not a law. Position is used in calculating the laws.
S: Does velocity stay invariant?
F: No.
S: Does Gauss' law on magnetism hold in both frames?
F: Yes.
S: Does the distance between two objects stay the same in both frames?
F: I don’t know…
S: What is a spacetime diagram?
F: It’s a diagram where you have c*time on the y-axis, and space on the x-axis.
S: Why do you have ct on the y-axis?
F: That way the geometry works out such that a diagonal 45 degree line is going at the speed of light.
S: So is velocity determined by the angle from the y-axis?
F: Yes, and direction is determined by if the angle is positive or negative.
S: What is distance in this graph?
F: I don’t know.
S: What does the y-axis mean on a spacetime diagram?
F: It means that the observer is always at position 0.
S: What happens if you shift to another straight line 30 degrees going right of the y-axis?
F: Then the line of the observer shifts to the right.
S: What if you repeat this process multiple times in a row by continuing to switch to observers that are 30 degrees off the right of the y-axis?
F: In theory you would arrive at the point where it appears that the original observer is going faster than the speed of light, which is to say leaning more than 40 degrees to the right. But in practice this doesn’t happen.
S: Why does it not happen?

F: Because we impose the condition that the lines drawn out by light stay in the same place (they can squeeze or stretch though).
S: Does such a transformation exist?
F: Yes, and it’s called the Lorentz transformation.
S: Why does the Lorentz transformation preserve the light paths?
F: Because those light paths are Eigenvectors.
S: Are they mathematically really eigenvectors?
F: If you represent the Lorentz transformation as a matrix and calculate the eigenvectors, you’re left with all the vectors on the 4 degree axis.