10. To find the initial speed, use the slingshot to shoot the rock directly horizontally (no initial vertical speed) from a height of 1 meter. The vertical displacement of the rock can be related to the time of flight by Eq. 2-11b. Take downward to be positive.

$$y = y_0 + v_{y0}t + \tfrac{1}{2}at^2 \rightarrow 1\text{ m} = \tfrac{1}{2}gt^2 \rightarrow t = \sqrt{2(1\text{ m})/(9.8\text{ m/s}^2)} = 0.45\text{ s}.$$

Measure the horizontal range R of the rock with the meter stick. Then, if we measure the horizontal range R, we know that $R = v_x t = v_x(0.45\text{ s})$, and so $v_x = R/0.45\text{ s}$. The only measurements are the height of fall and the range, both of which can be measured by a meter stick.

11. Assume that the bullet was fired from behind and below the airplane. As the bullet rose in the air, its vertical speed would be slowed by both gravity and air resistance, and its horizontal speed would be slowed by air resistance. If the altitude of the airplane was slightly below the maximum height of the bullet, then at the altitude of the airplane, the bullet would be moving quite slowly in the vertical direction. If the bullet's horizontal speed had also slowed enough to approximately match the speed of the airplane, then the bullet's velocity relative to the airplane would be small. With the bullet moving slowly, it could safely be caught by hand.

12. The moving walkway will be moving at the same speed as the "car". Thus, if you are on the walkway, you are moving the same speed as the car. Your velocity relative to the car is 0, and it is easy to get into the car. But it is very difficult to keep your balance while trying to sit down into a moving car from a stationary platform. It is easier to keep your balance by stepping on to the moving platform while walking, and then getting into the car with a velocity of0 relative to the car.

13. Your reference frame is that of the train you are riding. If you are traveling with a relatively constant velocity (not over a hill or around a curve or drastically changing speed), then you will interpret your reference frame as being at rest. Since you are moving forward faster than the other train, the other train is moving backwards relative to you. Seeing the other train go past your window from front to rear makes it look like the other train is going backwards. This is similar to passing a semi truck on the interstate – out of a passenger window, it looks like the truck is going backwards.

14. When you stand still under the umbrella in a vertical rain, you are in a cylinder-shaped volume in which there is no rain. The rain has no horizontal component of velocity, and so the rain cannot move from outside that cylinder into it. You stay dry. But as you run, you have a forward horizontal velocity relative to the rain, and so the rain has a backwards horizontal velocityrelative to you. It is the same as if you were standing still under the umbrella but the rain had some horizontal component of velocity towards you. The perfectly vertical umbrella would not completely shield you.

15. (*a*) The ball lands at the same point from which it was thrown inside the train car – back in the thrower's hand.
    (*b*) If the car accelerates, the ball will land behind the point from which it was thrown.
    (*c*) If the car decelerates, the ball will land in front of the point from which it wasthrown.
    (*d*) If the car rounds a curve (assume it curves to the right), then the ball will land to the left of the point from which it was thrown.
    (*e*) The ball will be slowed by air resistance, and so will land behind the point from which it was thrown.

16. Both rowers need to cover the same "cross river" distance. The rower with the greatest speed in the "cross river" direction will be the one that reaches the other side first. The current has no bearing on the problem because the current doesn't help either of the boats move across the river. Thus the rower heading straight across will reach the other side first. All of his rowing effort has gone into