SUPER BOWL PHYSICS

Use the yard markers on the field, converted to meters of course, to provide the horizontal distances.

Even though this may seem like a fun activity, be sure to show all your work that explains the PHYSICS of the game.

1. During the coin toss before the game, find the amount of time the coin was in the air. From this information, **calculate** the maximum height the coin reaches above the ground, disregard air resistance. This obviously can only be done if the coin toss is televised.

2. During the kickoff, determine the horizontal distance and time the ball travels. Assuming the ball leaves a tee on the ground and lands on the ground, **calculate** the angle the ball left the ground. Disregarding frictional and rotational forces, calculate the velocity of the ball at this angle. **Calculate** the height the football reaches. What would be the effect if the receiver's height is considered (be sure you have **calculated** this)?

3. When the quarterback throws a pass, three distinct stages of the motion occur. One, the quarterback brings the football to rest behind his head and readies the ball. Two, he accelerates the football by applying force with the arm in the direction of the pass. In the third stage he releases the ball. Coaches call the amount of time to complete all three stages of a pass the release time.

Observe several passes by the same quarterback and **find** the mean release time. **Calculate** the initial velocity of the ball the instant it becomes airborne. **Calculate** the amount of force the quarterback applies to the ball using ***impulse-momentum equations***.

Estimate the average distance the quarterback throws the ball and **calculate** the acceleration on the ball during the throwing motion. Using ***Newton's laws***, **calculate** the force on the ball. **Why** is this value not equal to the other one? How much work was done on the ball?

Jacklyn Bonneau Massachusetts Academy of Mathematics and Science