



7. Whiplash sometimes results from an automobile accident when the victim's car is struck violently from the rear. Explain why the head of the victim seems to be thrown backwards in this situation. Is it really? **Depends. From the perspective (frame of reference) of the victim's torso, it and the car remain at rest while the head and everything outside the car windows move backwards. From the perspective of the ground, the car and the torso move backwards and the head stays at rest. Since no force acted on the head (until the neck pulled it forward), it remained at rest, as described by Newton's 1<sup>st</sup> (and 2<sup>nd</sup>) law.**

### Problems

8. Draw a free-body diagram (FBD) of the **bolded** object for each of the following situations. For each *action force* found on the FBD, identify the *reaction force*.
- a) An **apple** hangs from a tree

FBD	Action Force & Direction	Reaction Force & Direction
	stem pulls apple upwards	apple pulls stem downwards
	Earth pulls apple downwards	apple pulls Earth upwards

- b) A **box** is being pushed forward along some ice (no friction) by a child

FBD	Action Force & Direction	Reaction Force & Direction
	ice pushes box upwards	box pushes ice downwards
	Earth pulls box downwards	box pulls Earth upwards
	child pushes box forwards	box pushes child backwards

- c) A parent pushes a **box** forward along the ground. A child is on the box.

FBD	Action Force & Direction	Reaction Force & Direction
	ground pushes box upwards ( $F_N$ )	box pushes ground downwards
	Earth pulls box downwards ( $F_g$ )	box pulls Earth upwards
	parent pushes box forwards ( $F_{app}$ )	box pushes parent backwards
	ground pushes box backwards ( $F_f$ )	box pushes ground forwards
	child pushes box downwards ( $F_{child}$ )	box pushes child upwards