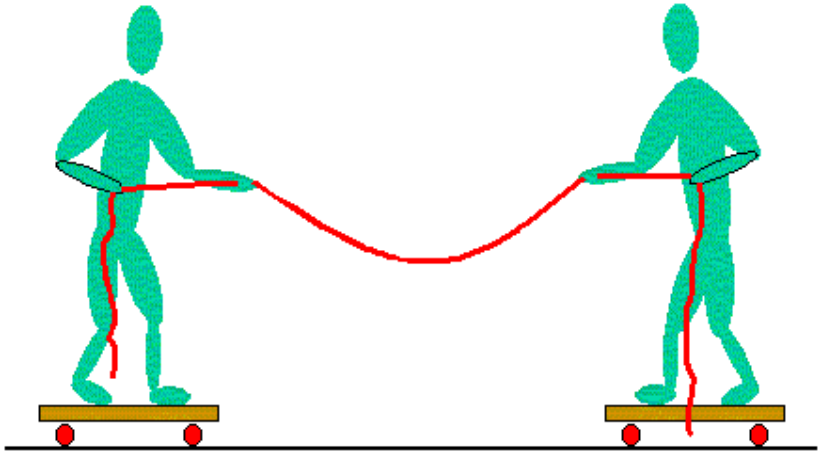
Pulling a slackened rope

Title: Pulling a slackened rope.

Aim: To show that only a short impulse is needed to make a student move.

Subjects: 1N20 (Conservation of Linear Momentum)

Diagram:



Equipment:

- Two light carts, easily rolling.
- Rope; l=10m.
- Two students.

Presentation: The two students stand each on a cart. Between them is a slackened rope. Slowly they increase the tension in the rope and at a certain moment both carts start moving towards each other. The rope slackens again, but both carts keep on moving. (Eventually friction will stop their movement.)
When there is a clear massdifference between the two students, the difference in their respective speeds will be clearly observable.

Explanation: The tension in the rope implies an impulse $F\Delta t$ to the cart + student. This impulse changes the momentum $p=m_1\Delta v_1$ of the cart + student. Applying Newton's second law we can say: $F\Delta t=m_1\Delta v_1$. When the initial velocity is zero, then m_1 will move with v_1 after the short impulse is over.
Applying 'conservation of linear momentum' to the whole system it is clear that the change of momentum of m_2 is $-\Delta p=m_2\Delta v_2$. v_2 will be opposite to v_1 and when $m_2>m_1$, v_2 will be lower than v_1.

Sources:

- Mansfield, M and O'Sullivan, C., Understanding physics, pag. 122-123