General Physics: Mechanics

PHYS-101(en)

Lecture 6b: Momentum, impulse, and center of mass

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EPFL
Swiss Plasma Center

Conceptual question

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You drop a ball that bounces off the ground in a perfectly elastic manner. Is the ball's momentum conserved?

A. Yes

B. No

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If you drop an egg on the floor, it will break, but if you drop it (from the same height) on a mattress, it won't. Why?

A. The change in momentum decreases…
B. The average force decreases…
C. The maximum force decreases…
D. The impulse decreases…
E. None of the above.

when using the mattress.

Conceptual question

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When Javier Sotomayor broke the high jump world record (going over a 2.45 m high bar), did his center of mass also go over this height?

A. Yes, necessarily.

B. Not necessarily.

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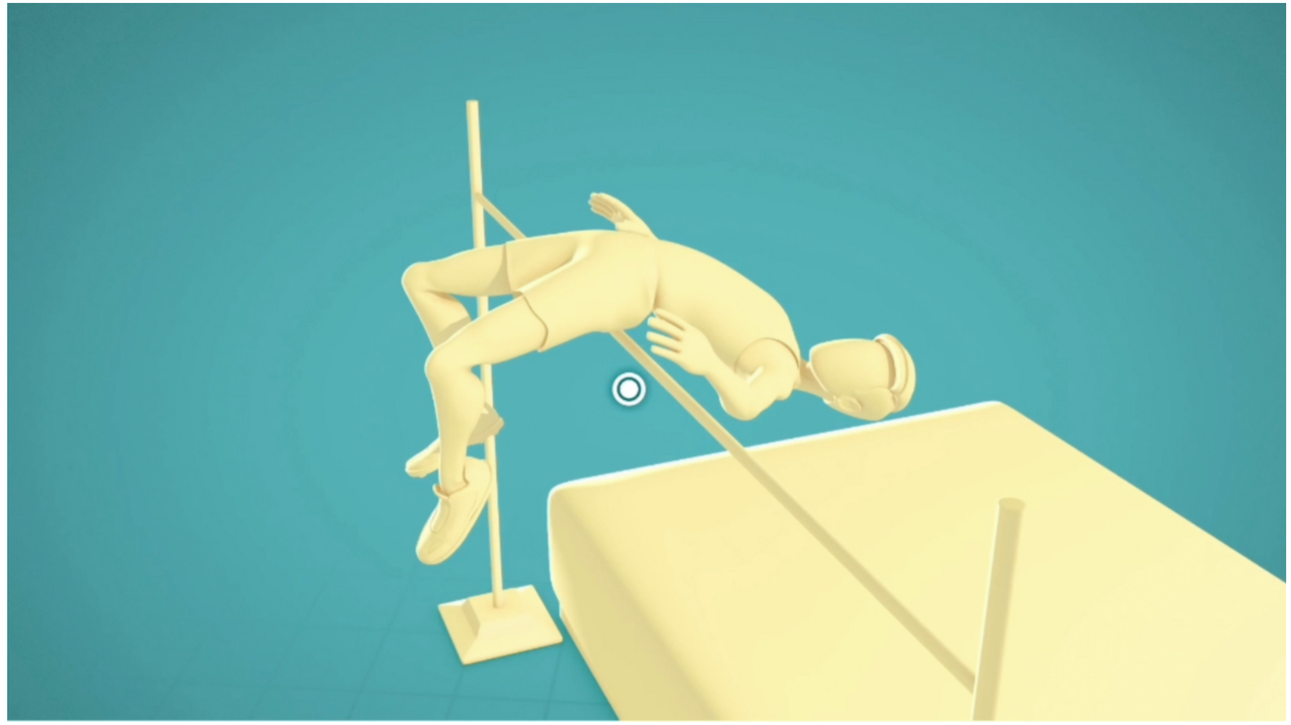
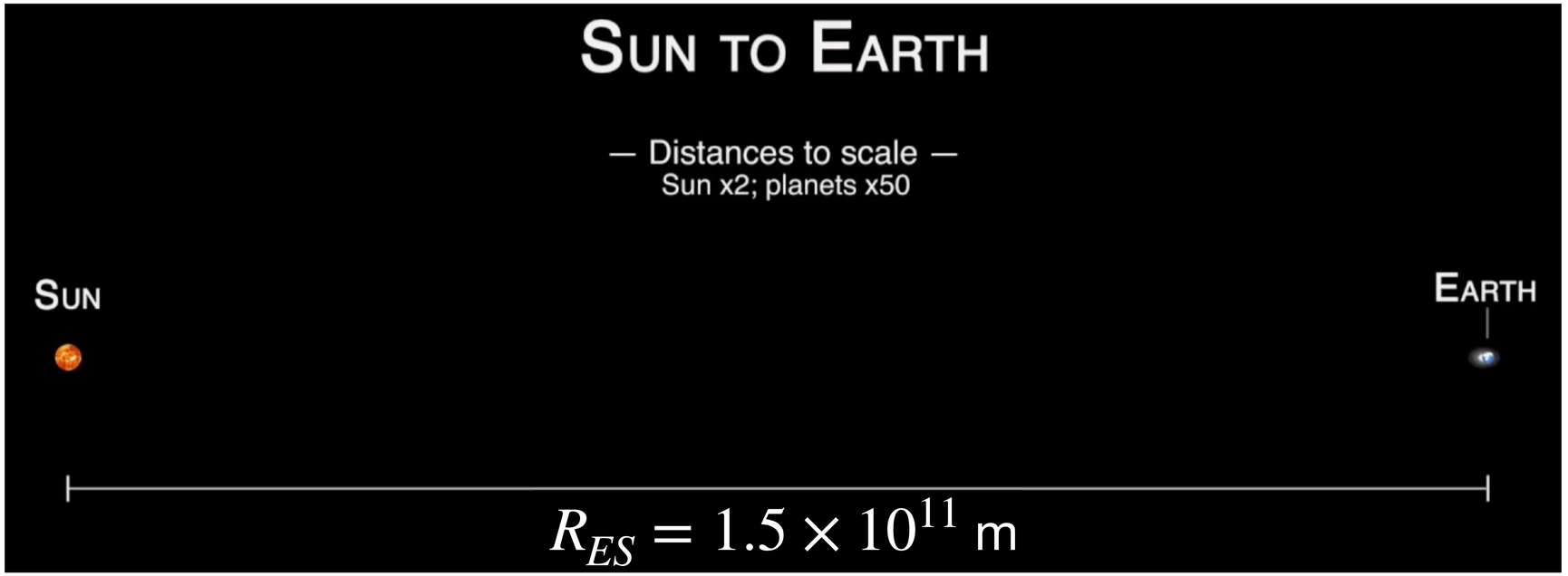


Example: Center of mass Sun-Earth

The mean distance from the Earth to the Sun is $R_{ES} = 1.5 \times 10^{11}$ m. The mass of the Earth is $m_E = 6.0 \times 10^{24}$ kg and the mass of the Sun is $m_S = 2.0 \times 10^{30}$ kg. The mean radius of the Earth is $r_E = 6.4 \times 10^{6}$ m. The mean radius of the Sun is $r_S = 6.4 \times 10^{8}$ m. Where is the location of the center of mass of the Earth-Sun system?



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Example: Exploding projectile

An instrument-carrying projectile of mass m_1 accidentally explodes at the top of its trajectory. The horizontal distance between launch point and the explosion is x_0. The projectile breaks into two pieces that fly apart horizontally. The larger piece, m_3, has three times the mass of the smaller piece, m_2. To the surprise of the scientist in charge, the smaller piece returns to earth at the launching station. Neglect air resistance and effects due to the earth's curvature.

How far away, x_3^f, from the original launching position does the larger piece land?

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