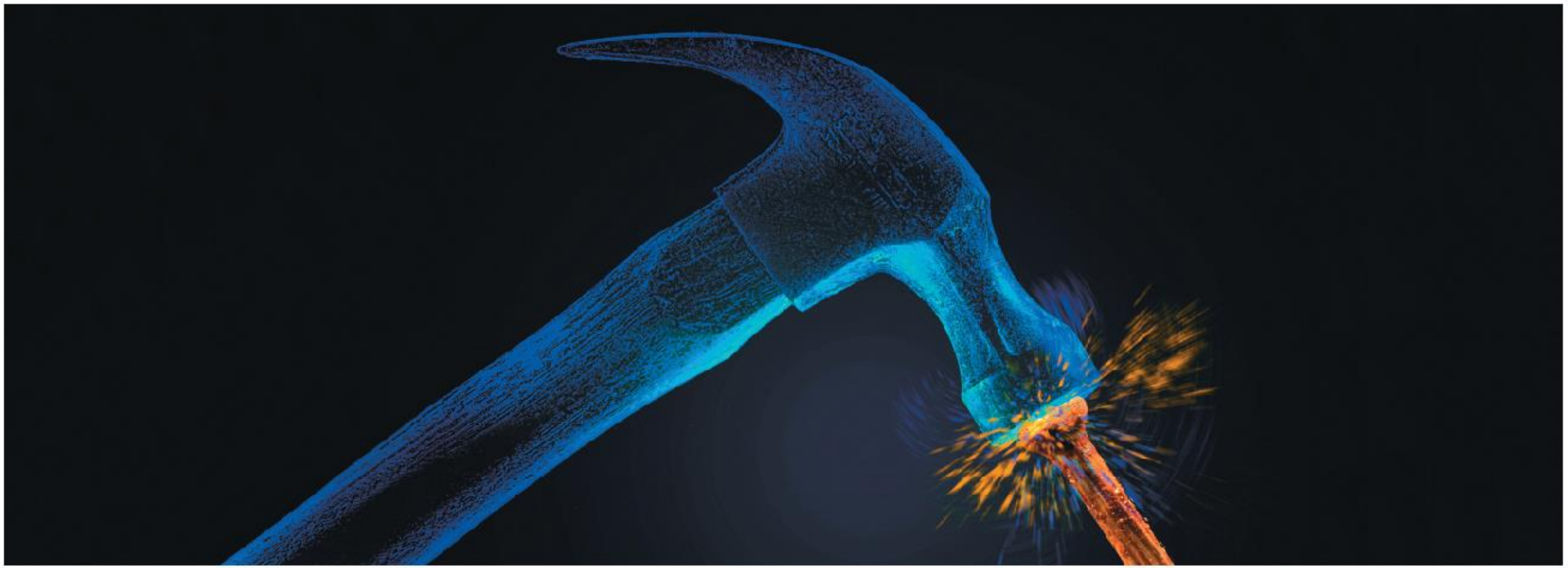
Chapter 7 – Newton's Third Law

- Newton's Third Law
- Objects/Systems/Environment
- Acceleration Constraints ~ ropes & pulleys



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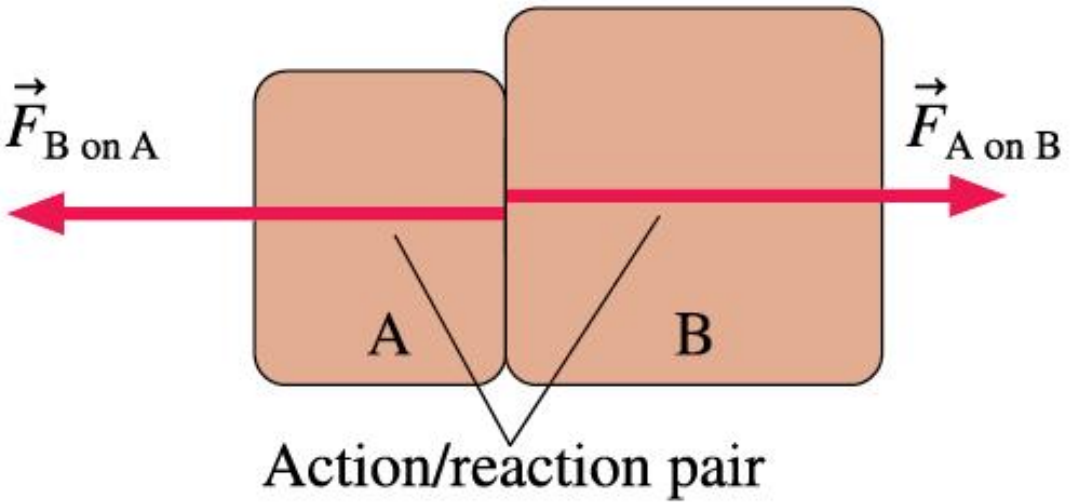
Newton's Third Law

Every force occurs as one member of an **action/reaction pair** of forces. The two members of an action/reaction pair:

- Act on two *different* objects.
- Are equal in magnitude but opposite in direction:

$$\vec{F}_{\text{A on B}} = -\vec{F}_{\text{B on A}}$$



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Important Concepts

Objects, Systems, and the Environment

Objects whose motion is of interest are the **system.**

Objects whose motion is not of interest form the **environment.**

The objects of interest interact with the environment, but those interactions can be considered external forces.

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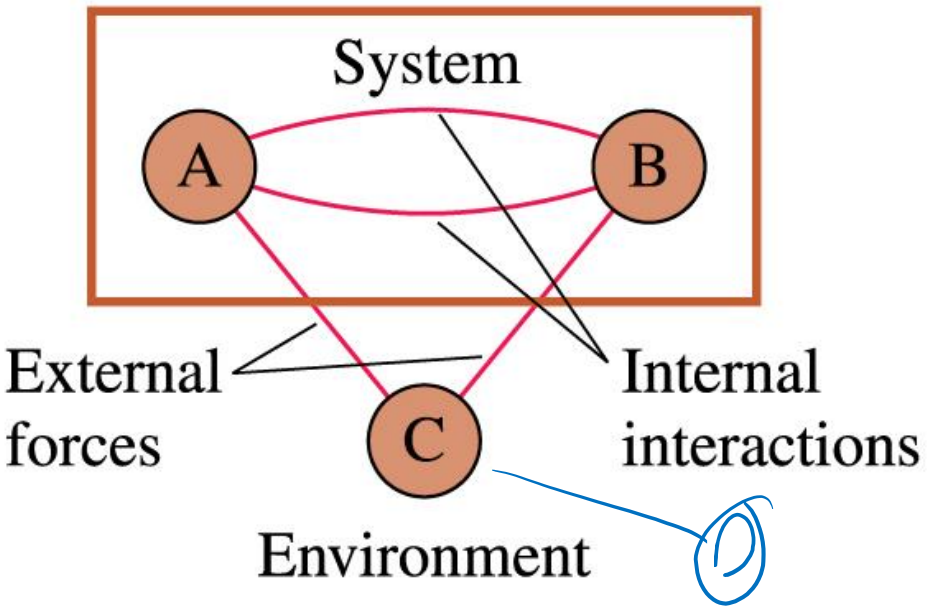
Interaction Diagram



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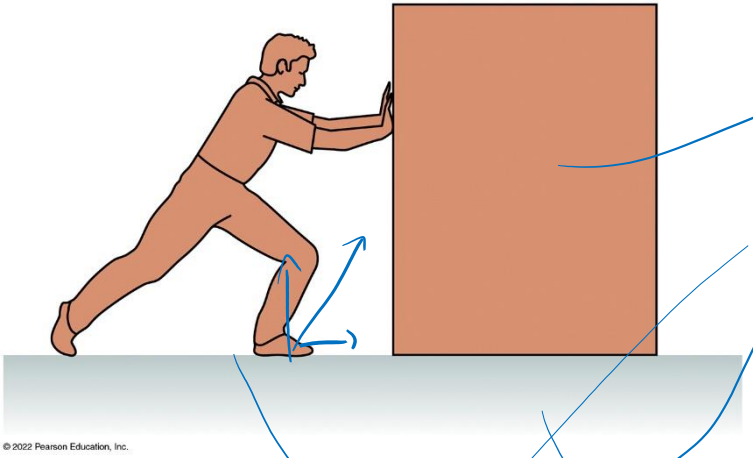

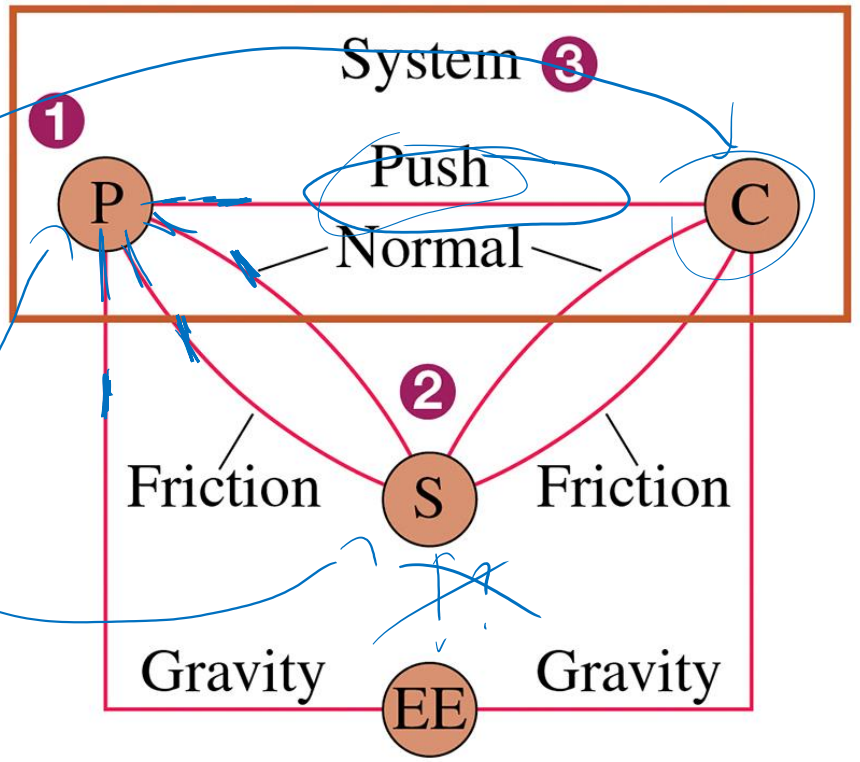

P = Person
C = Crate
S = Surface
EE = Entire earth

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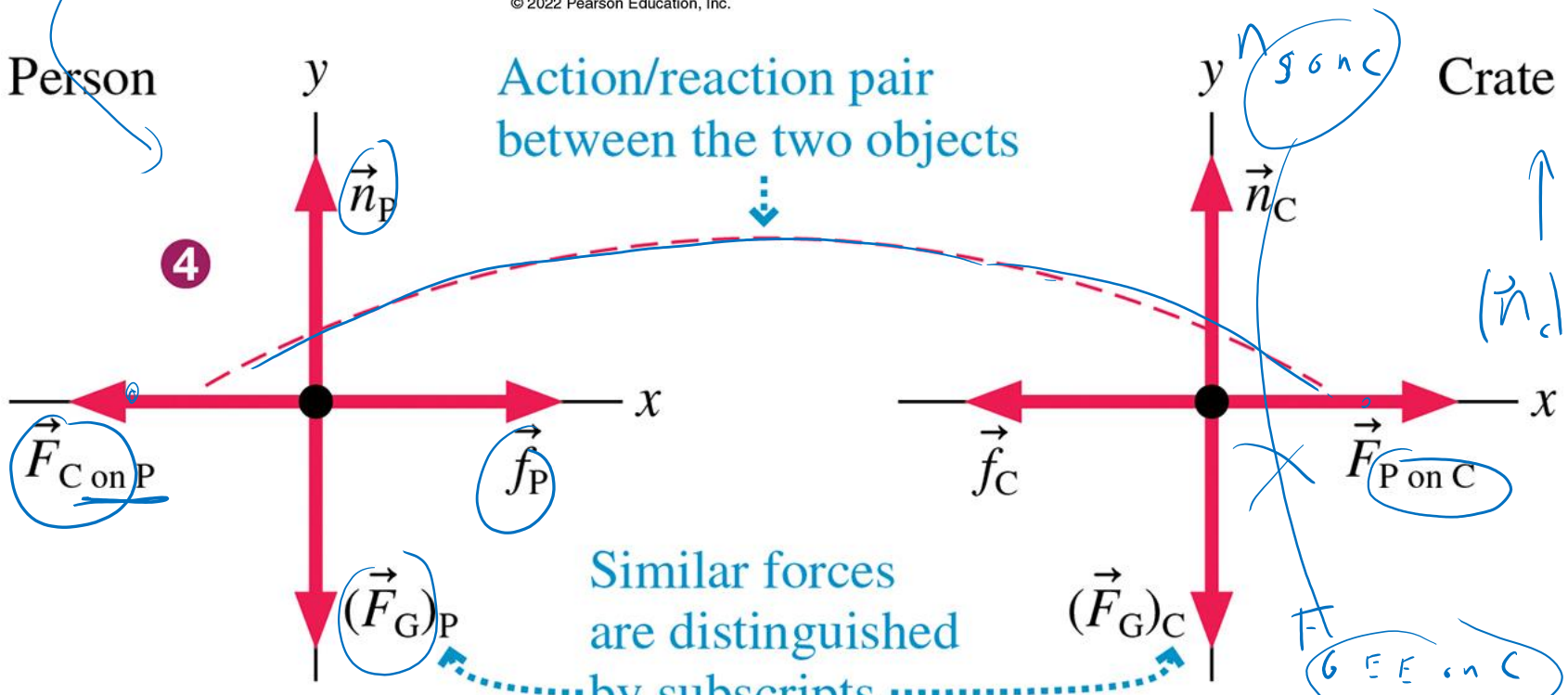

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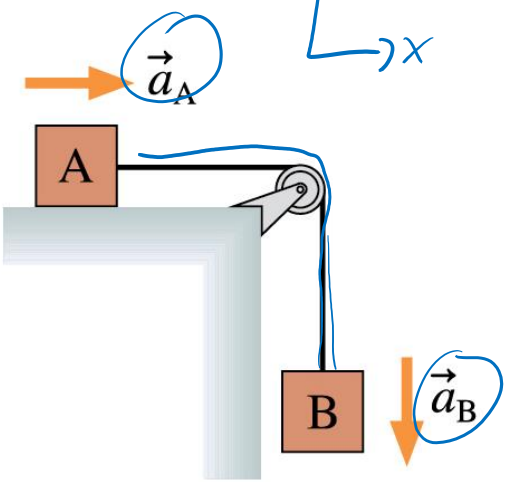
Acceleration Constraints

Objects that are constrained to move together must have accelerations of equal magnitude: $a_A = a_B$.

This must be expressed in terms of components, such as $a_{Ax} = -a_{By}$.



$\vec{a}_A \neq \vec{a}_B$

$|\vec{a}_A| = |\vec{a}_B|$

$a_A = 2a_B$

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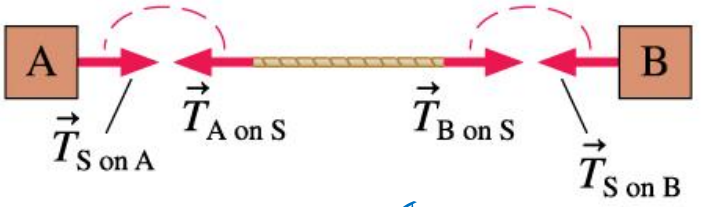
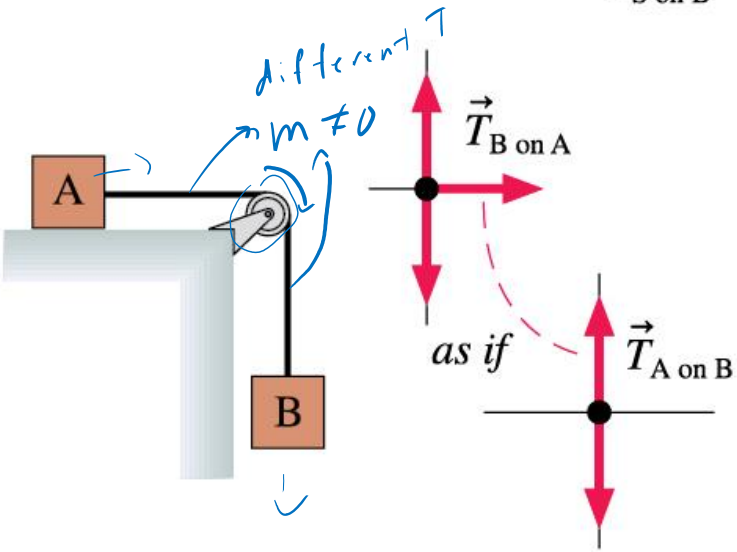
Strings and Pulleys

The tension in a string or rope pulls in both directions. The tension is constant in a string if the string is:

- Massless, or
- In equilibrium

Objects connected by massless strings passing over massless, frictionless pulleys act *as if* they interact via an action/reaction pair of forces.





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