Activity Review

- **Elastic Collisions**
  - **Momentum Conserved?** YES
  - **What happened to the objects after the collision?** BOUNCED OFF / BOTH MOVED
- **Inelastic Collisions**
  - **Momentum Conserved?** YES
  - **What happened to the objects after the collision?** STUCK TOGETHER
  - **If one cart collides with another with the same mass, how will the velocity after compare to the velocity before?** 1/2 VELOCITY AFTER

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Activity Review

- **Explosions**
  - **Momentum Conserved?** YES
  - **If the objects involved in an explosion are different masses, how will the velocities of the objects compare?** THE OBJECT WITH MORE MASS WILL HAVE LESS VELOCITY

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Law of Conservation of Momentum

- **The total momentum of the objects in a system does not change**
- **The momentum of any one object can change but the momentum lost by one object must be gained by the other objects**
- **Momentum is <u>always</u> conserved in an closed system.**

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Types of collisions

- Elastic
  - An elastic collision is one in which momentum is conserved and the objects bounce off one another.
- Inelastic
  - An inelastic collision is one in which momentum is conserved and the objects combine after the collision.

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Law of Conservation of Momentum

- In both cases, momentum is conserved.
- So the following is true:
- total momentum before collision = total momentum after collision
- $p_{initial} = p_{final}$
- $(p_1 + p_2)_{initial} = (p_1 + p_2)_{final}$
- $(mv_1 + mv_2)_i = (mv_1 + mv_2)_f$

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Example

- A 2100 kg car is traveling with a velocity of 15 m/s. A 3450 kg truck is traveling toward the car with a velocity of 13 m/s. After they collide, the truck continues to move in the same direction at 2 m/s. What is the velocity of the car after the collision?

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Example (cont.)

Initial		Final	
m_1:	2100	m_1:	2100
v_1:	15	v_1:	?
m_2:	3450	m_2:	3450
v_2:	-13	v_2:	-2

$(m_1v_1 + m_2v_2)_i = (m_1v_1 + m_2v_2)_f$

$(2100)(15) + (3450)(-13) = (2100)v_1 + (3450)(-2)$

$31500 + (-44850) = (2100)v_1 + (-6900)$

$-13350 = 2100v_1 + (-6900)$

$-6450 = 2100v_1$

$-3.07\text{ m/s} = v_1$

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Inelastic Collisions

- When using the conservation of momentum with an inelastic collision, the two masses before the collision are combined after the collision and they both move together with the same velocity.
- $m_1v_1 + m_2v_2 = (m_1 + m_2)\, v_f$

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Example 2

- **A 30 g bullet is shot into a stationary 6 kg wood block. The bullet embeds itself into the block and they both travel with a velocity of 0.80 m/s. What is the original velocity of the bullet?**
- **What type of collision?**
  - **Inelastic**

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Example (cont.)

Initial

m_1: 30g => .03 kg
v_1: ?
m_2: 6kg
v_2: 0m/s

Final

m_1: .03kg
m_2: 6 kg
v_f: .8m/s

$$(m_1v_1 + m_2v_2)_i = (m_1 + m_2)v_f$$
$$.03v_1 + (6)(0) = (6 + .03)(.8)$$
$$.03v_1 = (6.03)(.8)$$
$$.03v_1 = 4.824$$
$$v_1 = 160.8 \text{ m/s}$$

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