Particle Dynamics
(NEP Semester I - Chapter 3)

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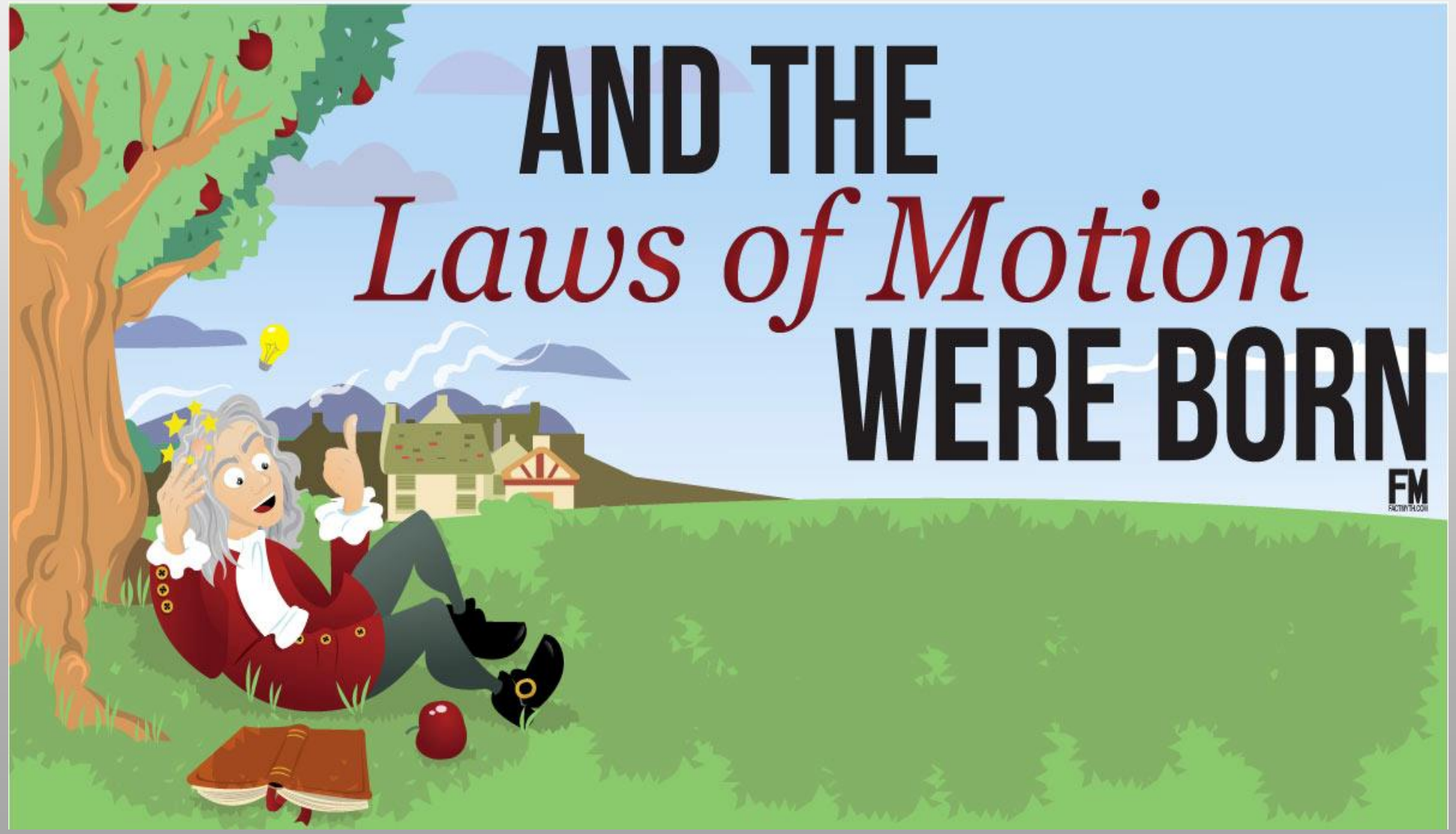
Learning Objectives

- I can state Newton's Laws of Motion.
- I can apply Newton's Laws of Motion to real life situations.
- I can describe momentum of different objects and how it affects motion.
- I can explain the relationship between inertia and mass.

Newton's Laws of Motion



Background

Sir Isaac Newton (1643-1727) an English scientist and mathematician famous for his discovery of the law of gravity also discovered the three *laws of motion*. He published them in his book Philosophiae Naturalis Principia Mathematica (mathematic principles of natural philosophy) in 1687.

Today these laws are known as *Newton's Laws of Motion* and describe the motion of all objects on the scale we experience in our everyday lives.

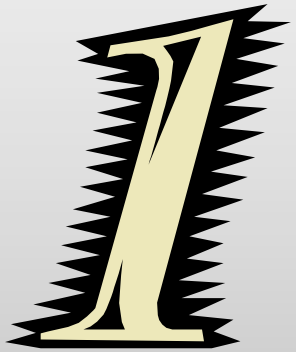
Newton's 3 Laws of Motion

1. An object in motion tends to stay in motion and an object at rest tends to stay at rest unless acted upon by an unbalanced force.

2. Force equals mass times acceleration (F = ma).

3. For every action there is an equal and opposite reaction.

Newton's First Law
(law of inertia)



An object at rest tends to stay at rest and an object in motion tends to stay in motion unless acted upon by an unbalanced force.

Newton's First Law of Motion:

- **Also know as: Law of Inertia!**
  - Inertia is an objects resistance to a change in its motion (even if it isn't moving at all!)
  - Inertia is caused because objects have mass
  - The more mass an object has, the more inertia!
  - "An object at rest will stay at rest unless it is acted upon by an outside force." (and the opposite is also true! An object in motion will stay in…blah blah blah)

Newton's Second Law
(F = ma)

Force equals mass times acceleration.

$F = ma$

Acceleration: a measurement of how quickly an object is changing speed.

Newton's Second Law of Motion says:

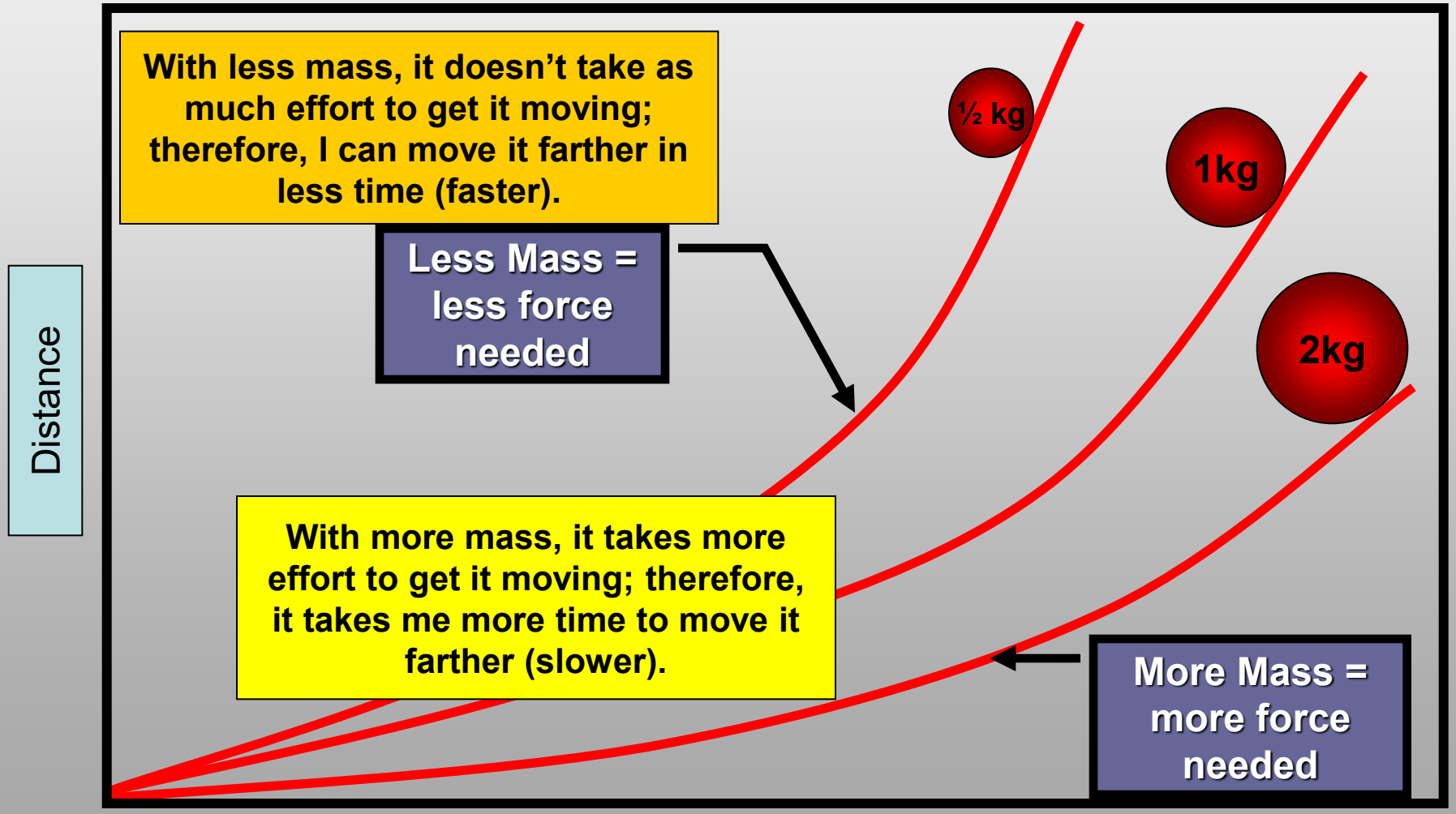
I am so smart

"To move a mass, you need a force!"
Also known as F=ma

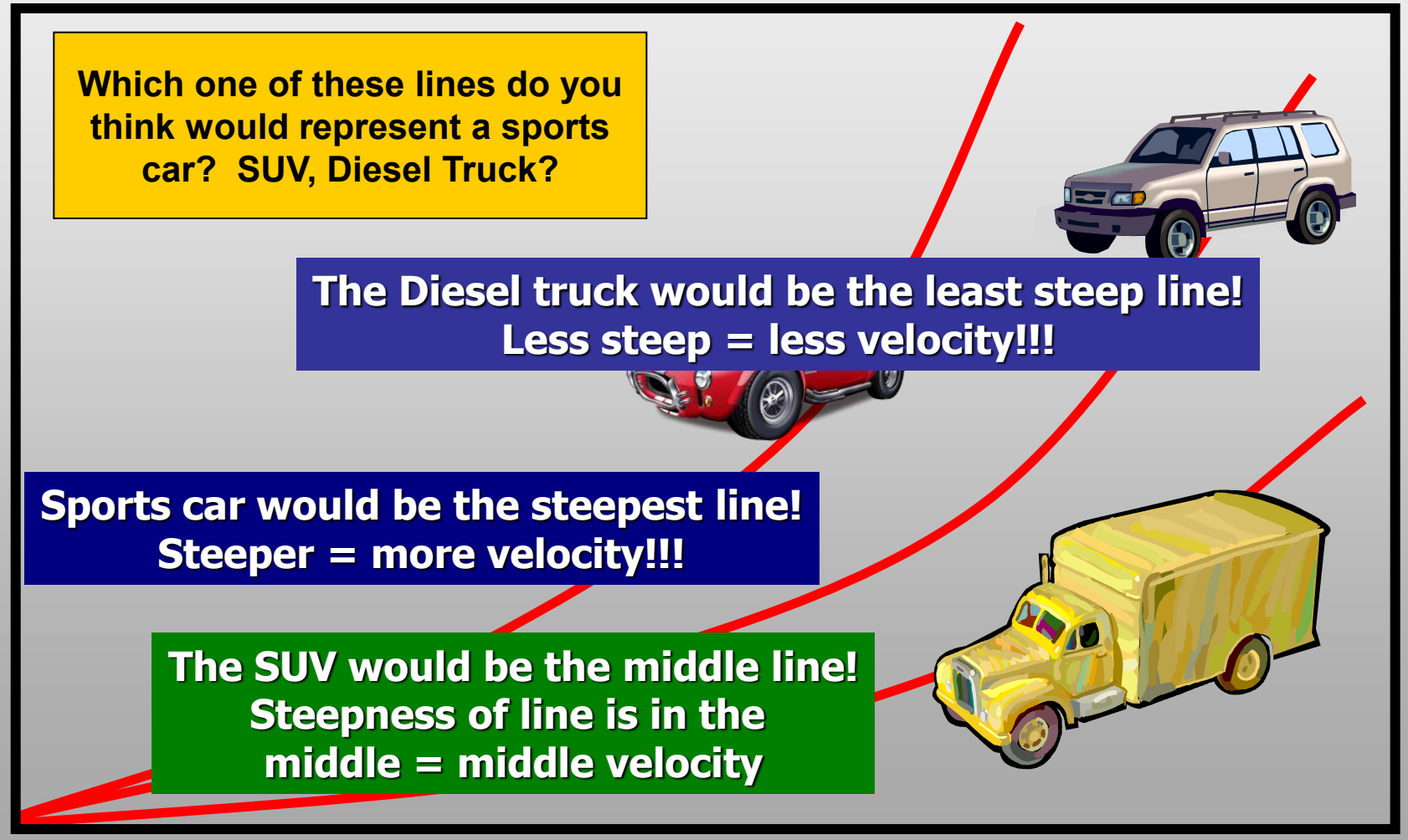
- More Force = more Acceleration
- More Mass = more Force needed!

The greater the mass = greater inertia = more force needed!

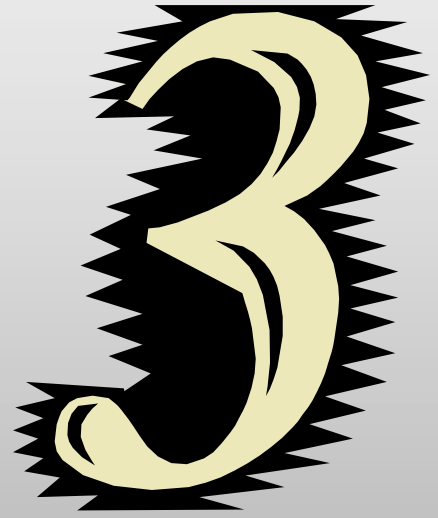
What do you think happens to our acceleration w/ different masses?



What do you think happens to our acceleration w/ different masses if we pushed with the same amount of force?



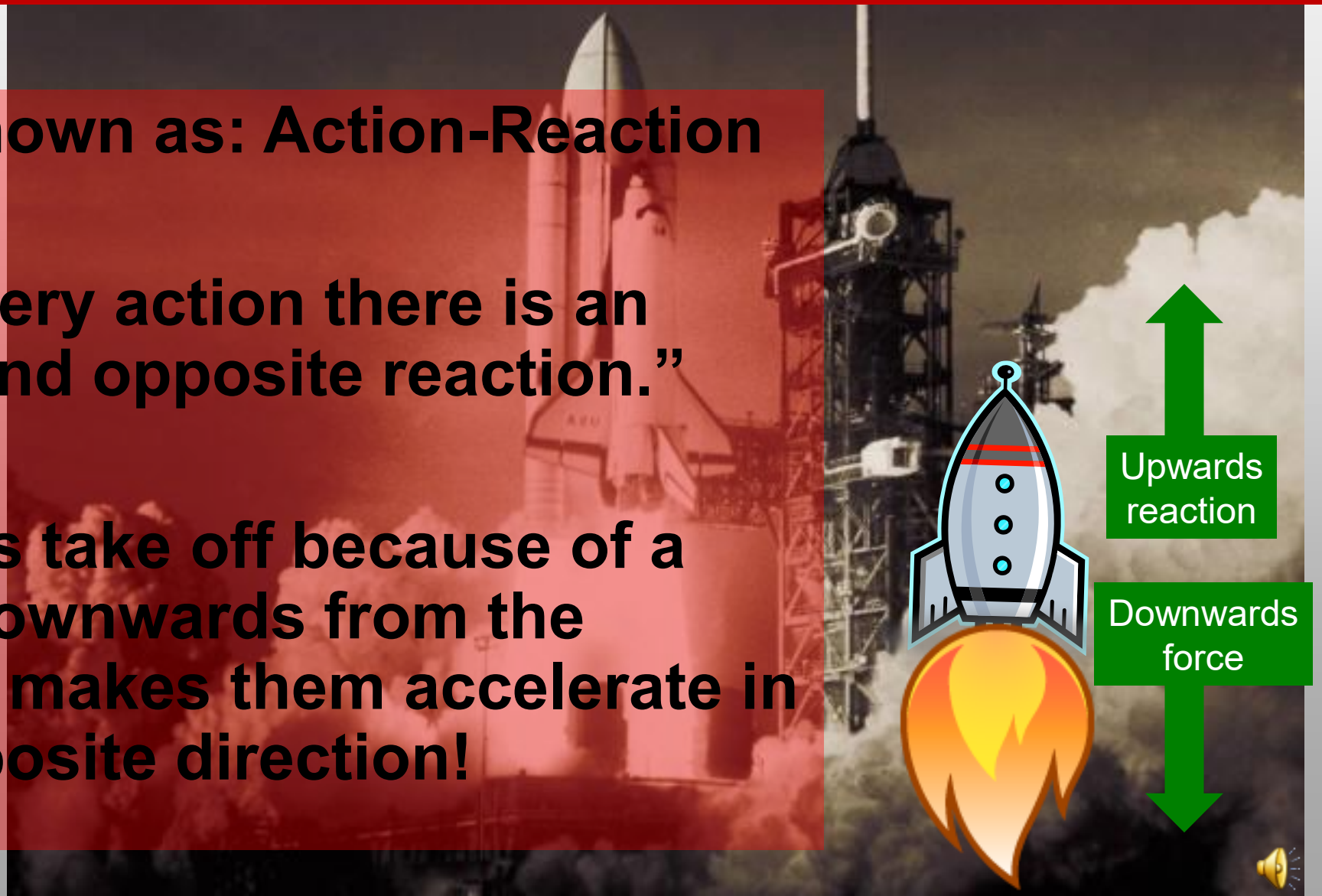
Newton's Third Law (Action-Reaction)



For every action there is an equal and opposite reaction.

Newton's Third Law of Motion

- Also known as: Action-Reaction
- "For every action there is an equal and opposite reaction."
- Rockets take off because of a force downwards from the bottom makes them accelerate in the opposite direction!



Vocabulary

Inertia: the tendency of an object to resist changes in its state of motion

Acceleration:

- a change in velocity
- a measurement of how quickly an object is changing speed, direction or both

Velocity: The rate of change of a position along a straight line with respect to time

Force: Push or pull (strength or energy