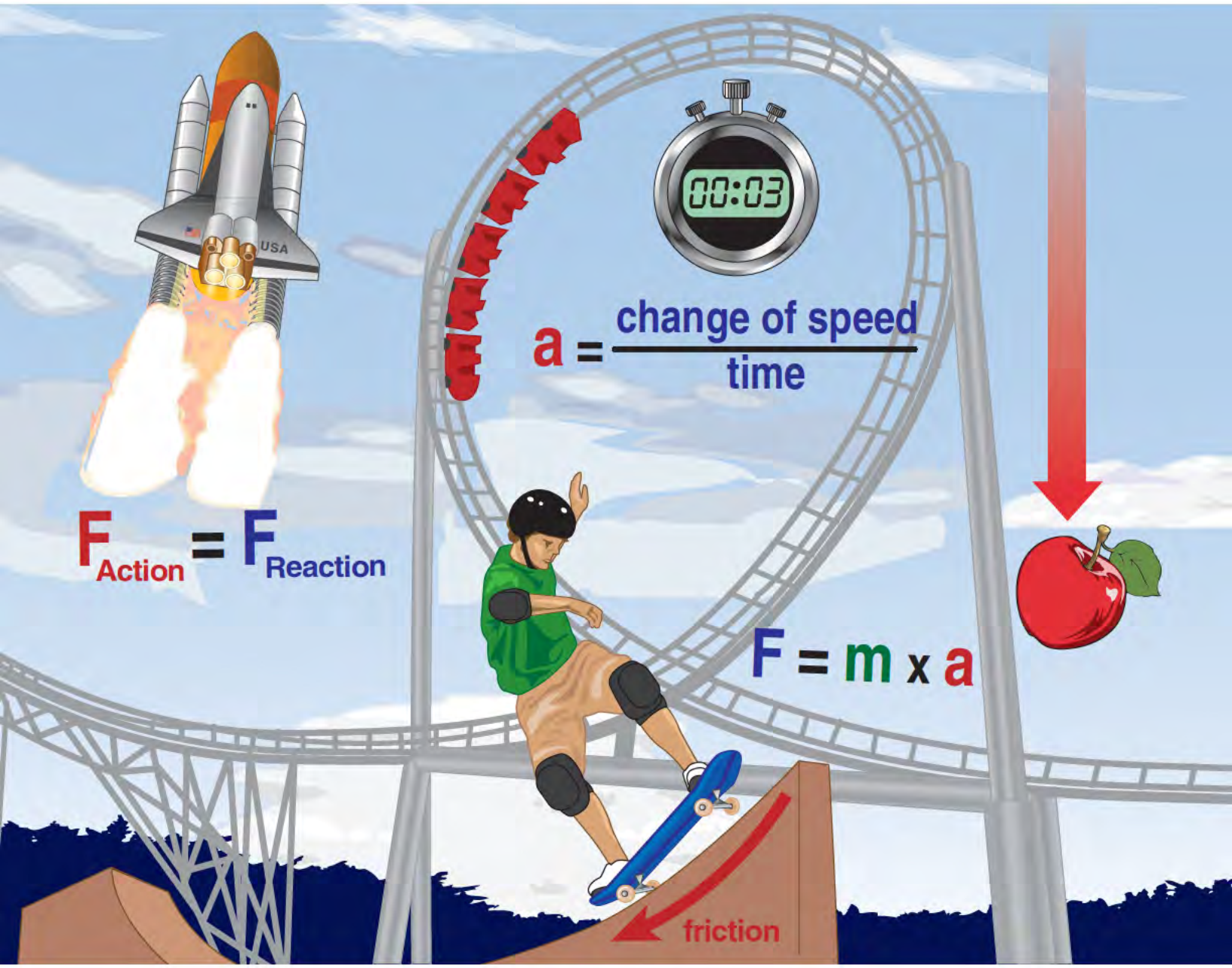
Forces & Motion
Learning Guide



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LESSON 1

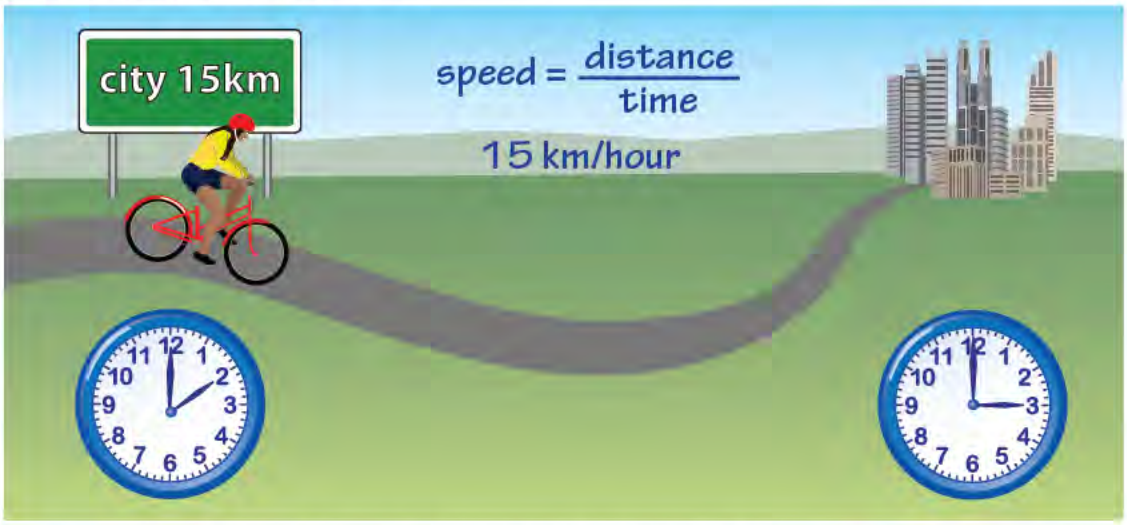
MOTION

What Is Motion?

An object is in **motion** if it changes its position relative to another object. You can describe the characteristics of **motion** in many ways including **distance**, **speed**, **velocity**, **acceleration** and **momentum**.

Speed

Speed describes the **distance an object travels during a certain amount of time**. **Speed** is a **measurement** of a **rate**. If a cyclist traveled a distance of 15 kilometers in an hour's time, the bicycle was moving at a speed of 15 kilometers per hour. **Speed** equals the **distance traveled divided by the time it took to travel**.



Many objects in motion do not travel at a constant speed. A car traveling between two cities moves at different speeds along the way. To calculate the **average speed** of an object, use the **total distance traveled divided by the total time**.

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

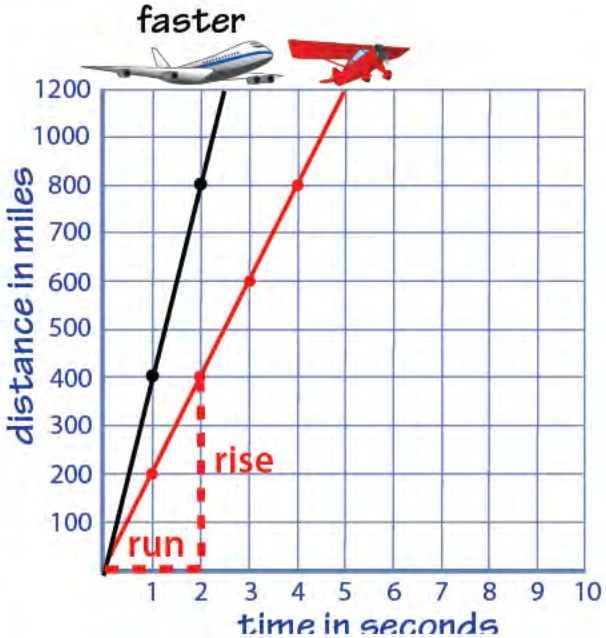
$$\text{average speed} = \frac{50\text{ km} + 80\text{ km} + 70\text{ km}}{1\text{ hr} + 2\text{ hr} + 2\text{ hr}} = \frac{200\text{ km}}{5\text{ hr}} = \frac{40\text{ km}}{\text{hr}}$$

Graphing the Speed of an Object

The **motion** of an object can be shown on a graph with the **x axis** as **time** and the **y axis** as **distance**. To graph the motion, plot the data points that indicate the distance traveled at a particular time, and then draw a line through the points. The **slope** of this line represents the **speed of the object**. A **steeper slope** indicates a **faster speed**.

$$\text{slope} = \frac{\text{rise}}{\text{run}} \qquad \text{speed} = \frac{\text{m}}{\text{sec}}$$

$$\text{slope} = \frac{400}{2} \qquad \text{speed} = 200 \text{ m/sec}$$



Velocity

To completely describe an object in motion, you need to know both the **speed** and **direction** it is traveling. **Velocity** is defined as the **speed of an object in a given direction**. **Velocity** can provide important information. For example, although knowing the **speed** of a hurricane is informative, actually knowing the **velocity** of the storm is critical for people to determine if they are in the predicted path of destruction.