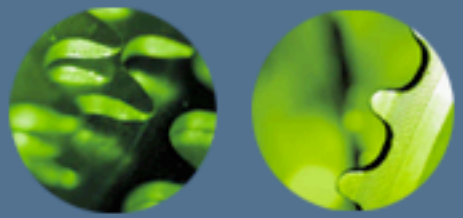
What is Projectile Motion?

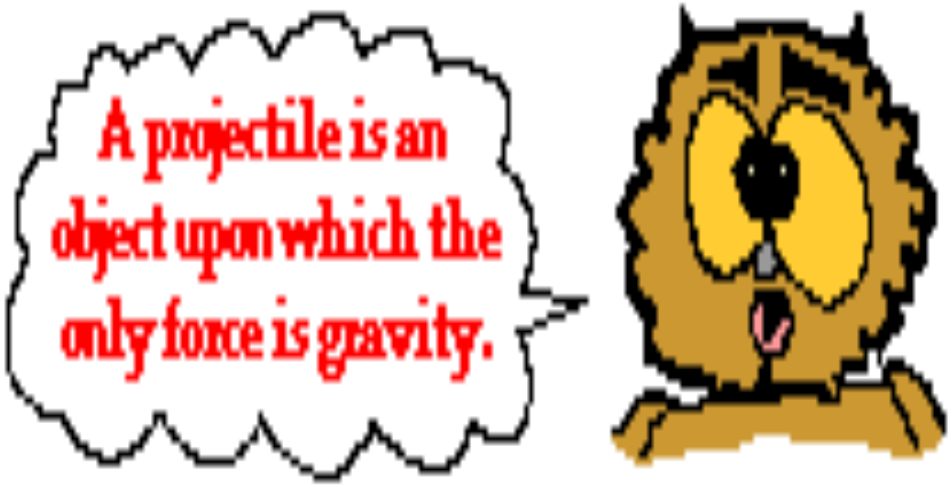


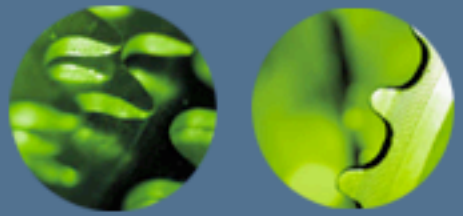
Instructional Objectives:

- Students will be able to:
  - Define Projectile Motion
  - Distinguish between the different types of projectile motion
  - Apply the concept to a toy car and measure its velocity

Projectile Motion

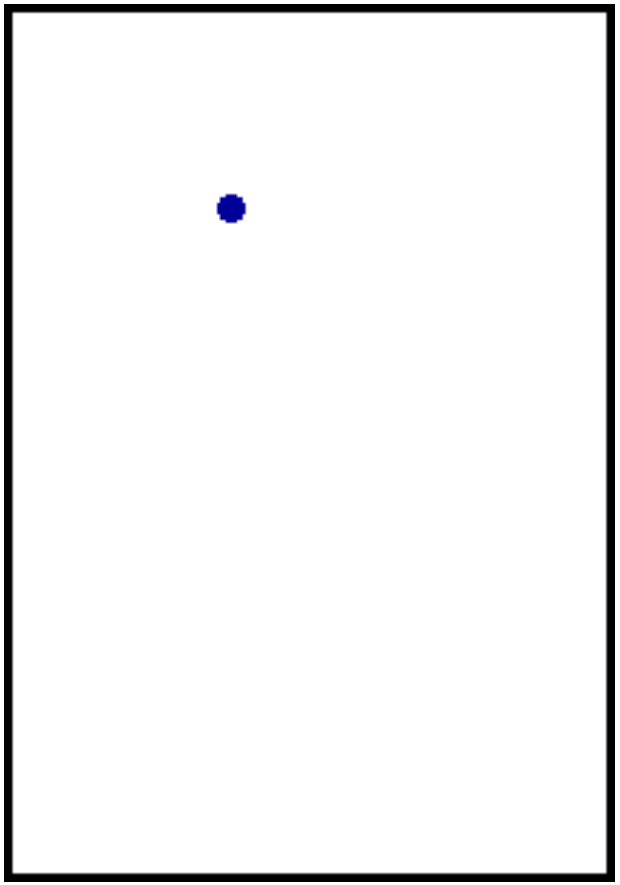
- Two-dimensional motion of an object
  - Vertical
  - Horizontal





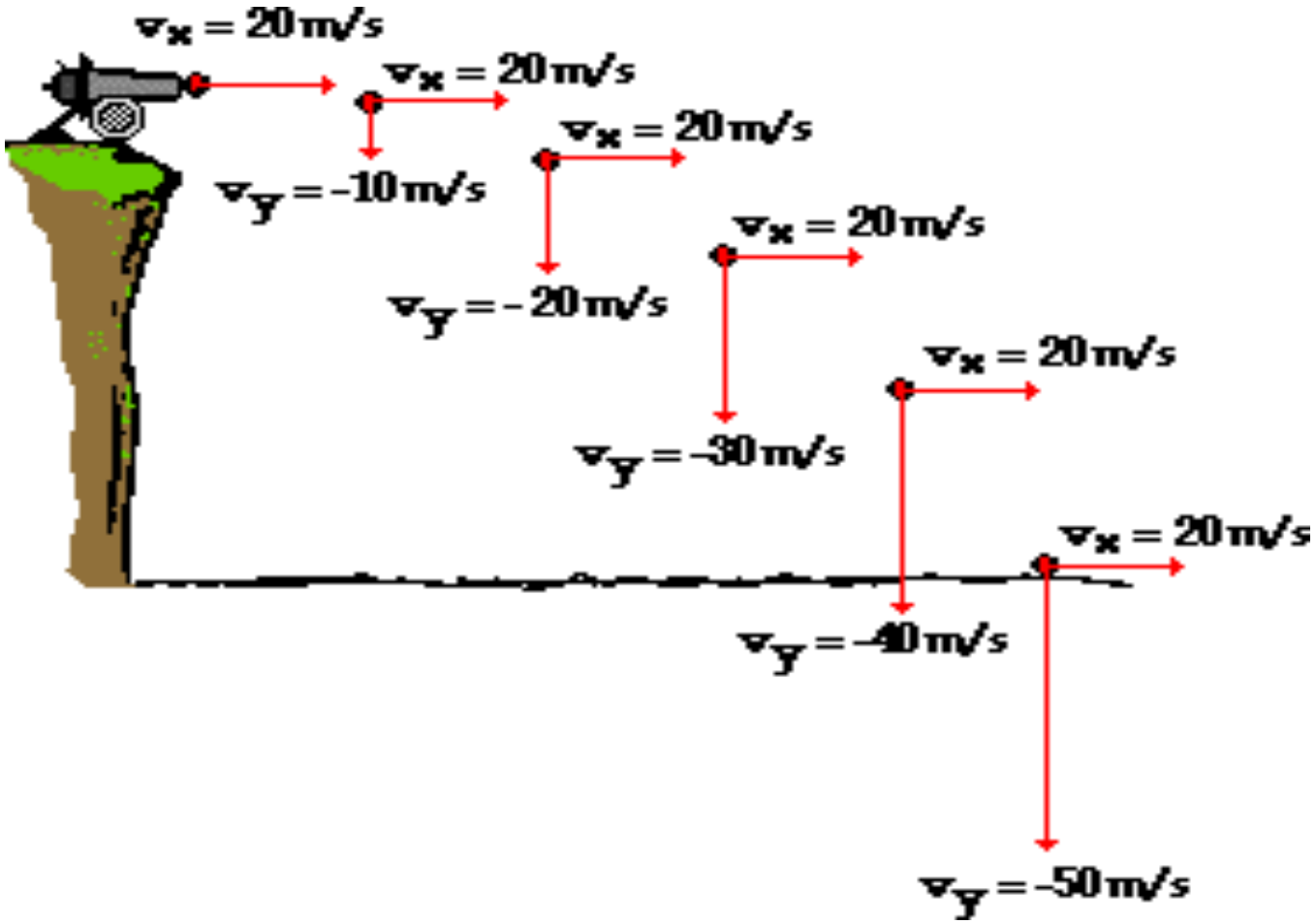
Types of Projectile Motion

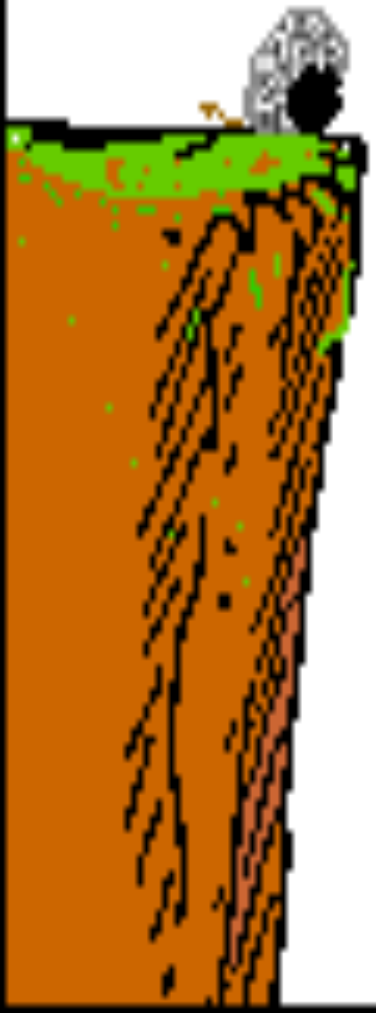
- Horizontal
  - Motion of a ball rolling freely along a level surface
  - Horizontal velocity is ALWAYS constant
- Vertical
  - Motion of a freely falling object
  - Force due to gravity
  - Vertical component of velocity changes with time
- Parabolic
  - Path traced by an object accelerating only in the vertical direction while moving at constant horizontal velocity



Examples of Projectile Motion

- Launching a Cannon ball





t= -- s

v_x= -- m/s v_y= -- m/s

Equations

- X- Component

$$x_f = x_i + v_{xi}t$$

- Y- Component

$$y_f = y_i + v_{yi}t - \frac{1}{2}gt^2$$

$$v_{yf}^{\ 2} = v_{yi}^{\ 2} - 2g\Delta y$$

$$v_{yf} = v_{yi} - gt$$

Note: g= 9.8 m/s^2

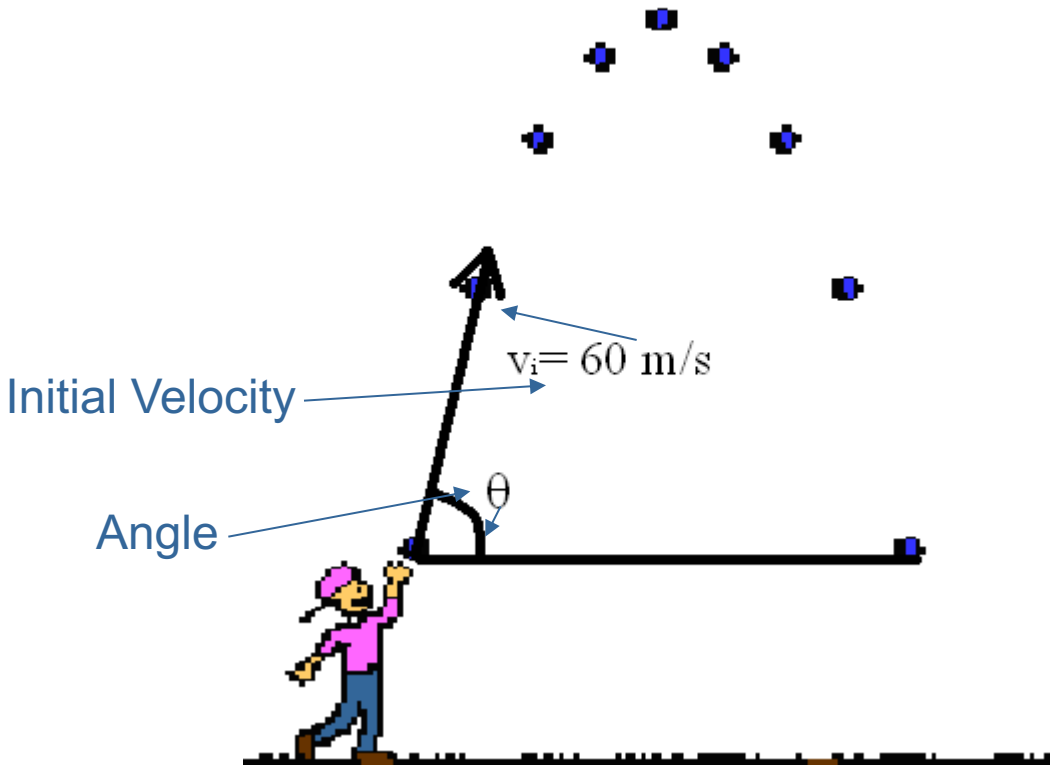
- Vectors

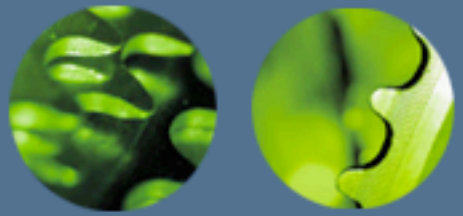
$$v_{xi} = v_i \cos(\theta)$$

$$v_{yi} = v_i \sin(\theta)$$

Factors Affecting Projectile Motion

- What two factors would affect projectile motion?
  - Angle
  - Initial velocity

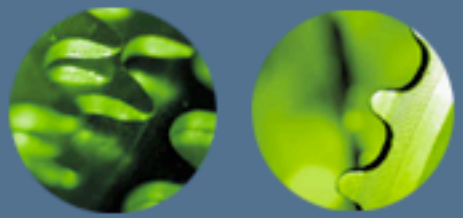




Class Exercise

An object is fired from the ground at 100 meters per second at an angle of 30 degrees with the horizontal

- ✓Calculate the horizontal and vertical components of the initial velocity
- ✓After 2.0 seconds, how far has the object traveled in the horizontal direction?
- ✓How high is the object at this point?



Solution

- Part a

$$v_{ix} = v_i \cos\theta = \left(100\,{}^{m}\!/_{s}\right)\left(\cos 30^0\right) = 87\,{}^{m}\!/_{s}$$

$$v_{iy} = v_i \sin\theta = \left(100\,{}^{m}\!/_{s}\right)\left(\sin 30^0\right) = 50\,{}^{m}\!/_{s}$$

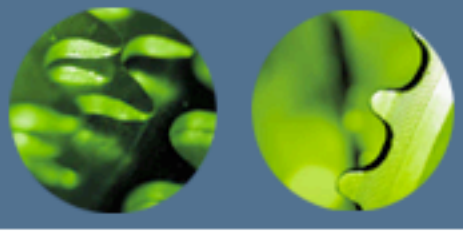
- Part b

$$v_{ix} = \frac{\Delta x}{\Delta t}$$

$$\Delta x = v_x t = \left(87\,{}^{m}\!/_{s}\right)\left(2.0s\right) = 174m$$

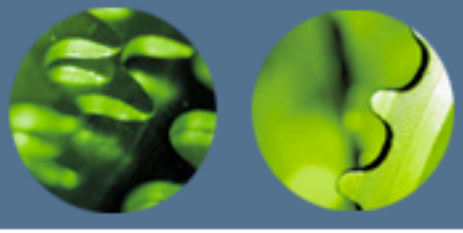
- Part c

$$\Delta y = v_{iy}\Delta t + \frac{1}{2}g\left(\Delta t^2\right) = \left(50\,{}^{m}\!/_{s}\right)\left(2.0s\right) + \frac{1}{2}\left(9.8\,{}^{m}\!/_{s^2}\right)\left(2.0s\right)^2$$



Applications

Any Ideas?



LAB TIME!!!