REVISITING VECTORS

- We've defined vectors as **quantities that have a magnitude and a direction**
  - Displacement, velocity, and acceleration
- Represent by an arrow whose **length represents magnitude** and **head represents direction**

- If we arbitrarily say this vector is 20 m/s to the right

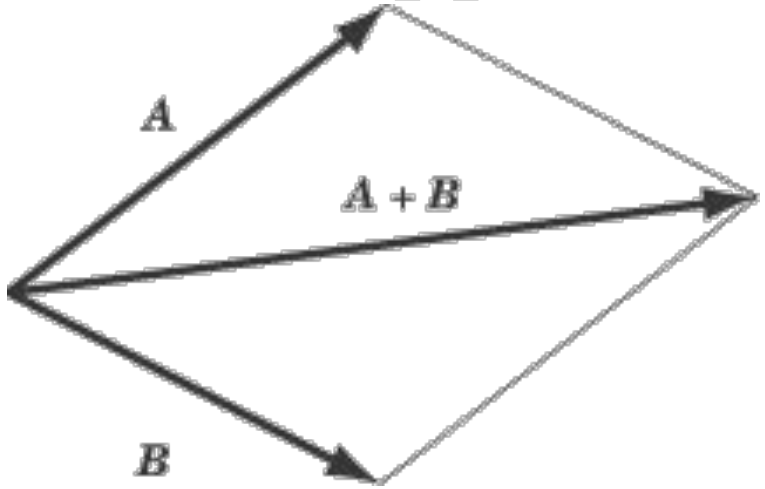
- This vector is 60 m/s to the right

ADDING VECTORS

- **Resultant** is the vector sum of two or more component vectors
- There are 2 ways to add vectors to get the resultant

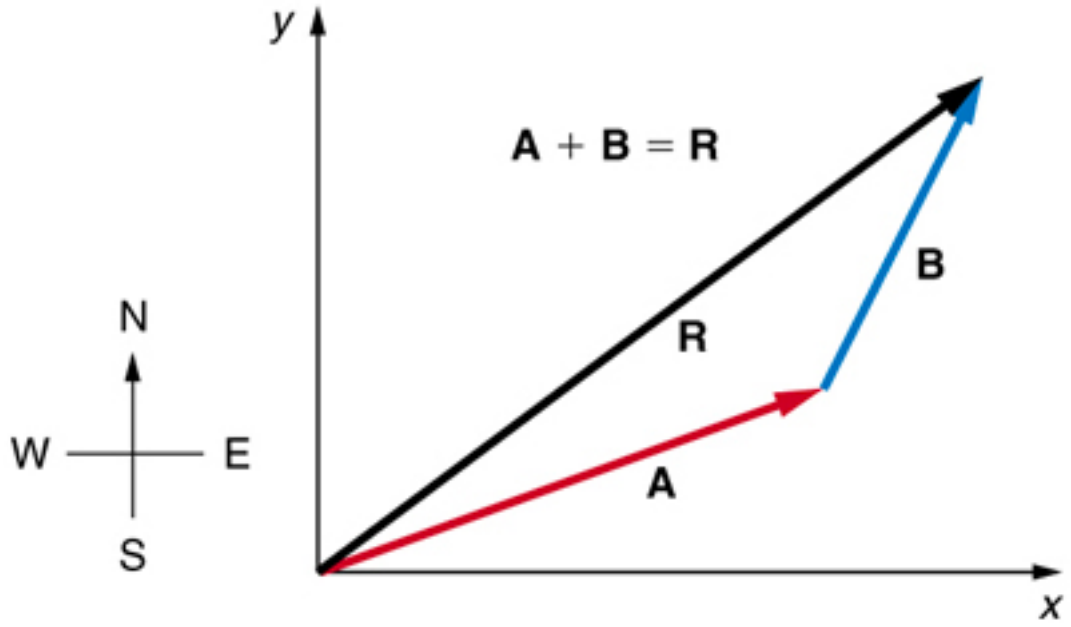
PARALLELOGRAM METHOD

- 1) Draw vectors with tails touching
- 2) Draw a parallelogram projection of the vector with dashed lines to form a rectangle
- 3) Resultant is the diagonal from the point where the two tails touch to the opposite corner



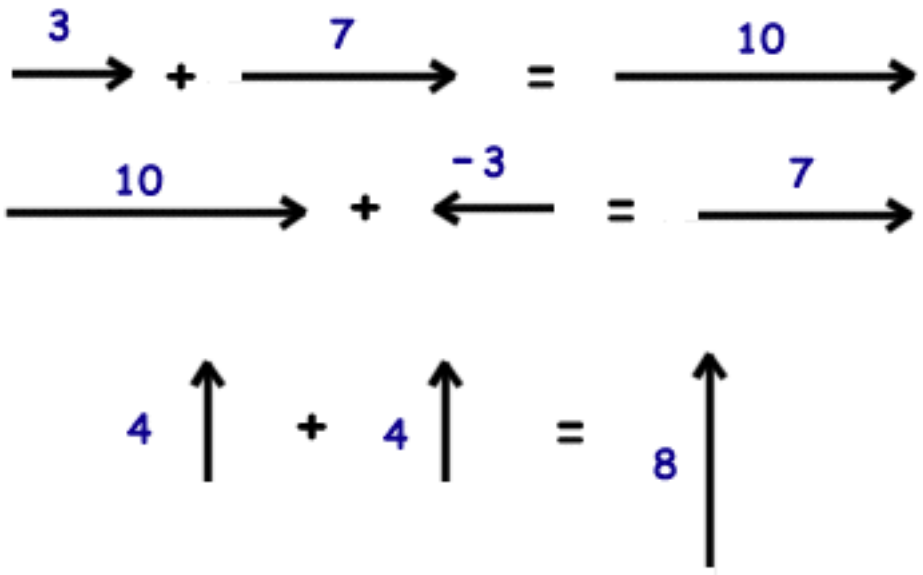
HEAD-TO-TAIL METHOD

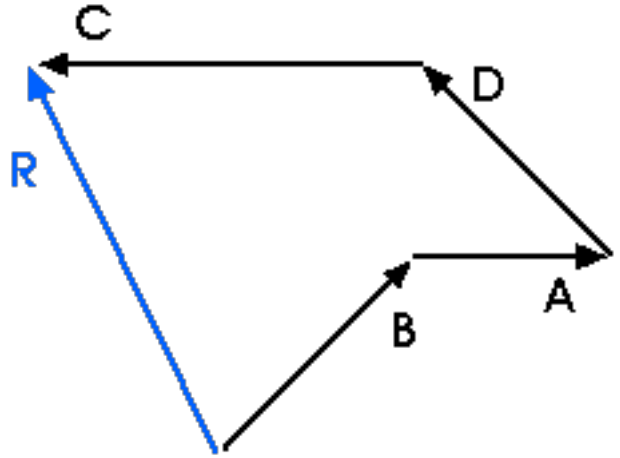
- 1) Draw the first vector
- 2) Connect the tail of the second to the head of the first
- 3) **Resultant is from the tail of the first to the head of the second**



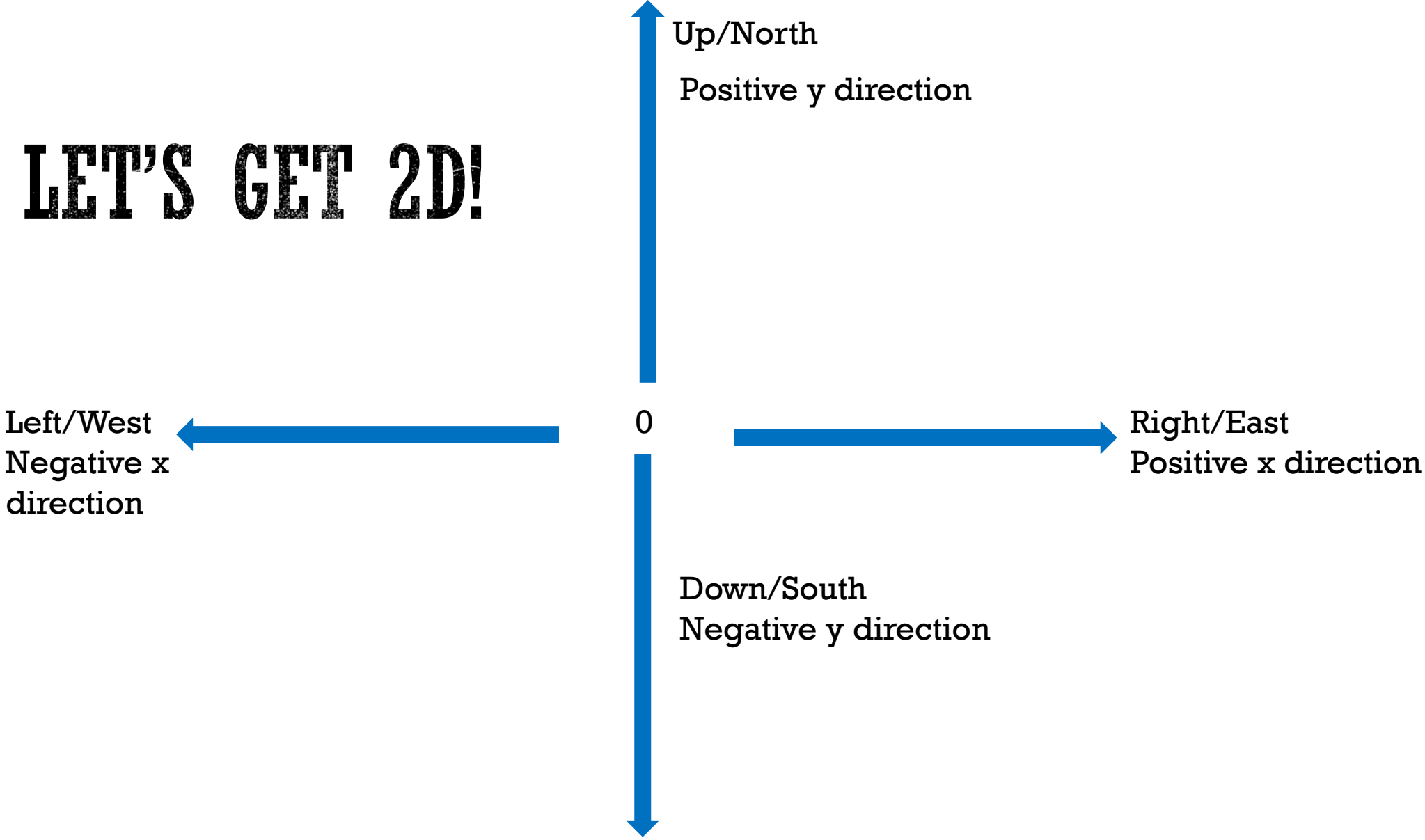
ORDER OF ADDITION DOESN'T MATTER!

ALSO WORKS IF YOU HAVE VECTORS POINTING IN THE SAME OR OPPOSITE DIRECTIONS, OR MORE THAN 2 VECTORS





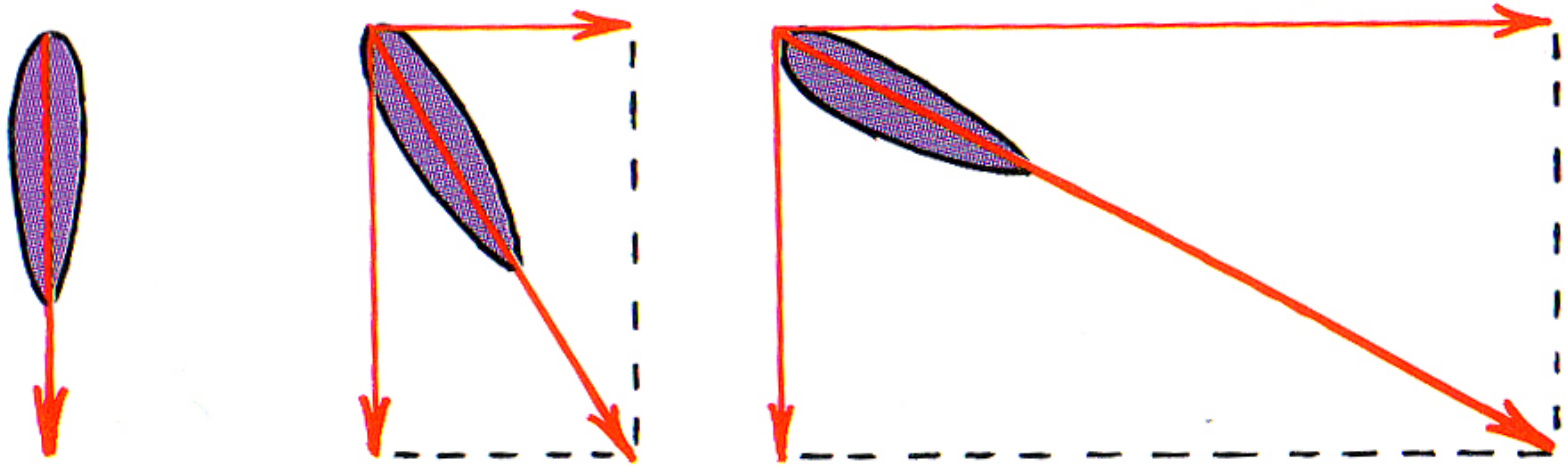
LET'S GET 2D!


Up/North
Positive y direction
Left/West
Negative x direction
0
Right/East
Positive x direction
Down/South
Negative y direction

- **A plane flying at 3600 m up is traveling at 150. m/s. Vin Diesel puts a car in reverse so it leaves the back of the plane traveling at a horizontal -10 m/s. How far would the car travel horizontally before it hits the ground in the absence of air resistance?**

RESOLUTION

- **Any vector** drawn can be resolved into **vertical and horizontal components**

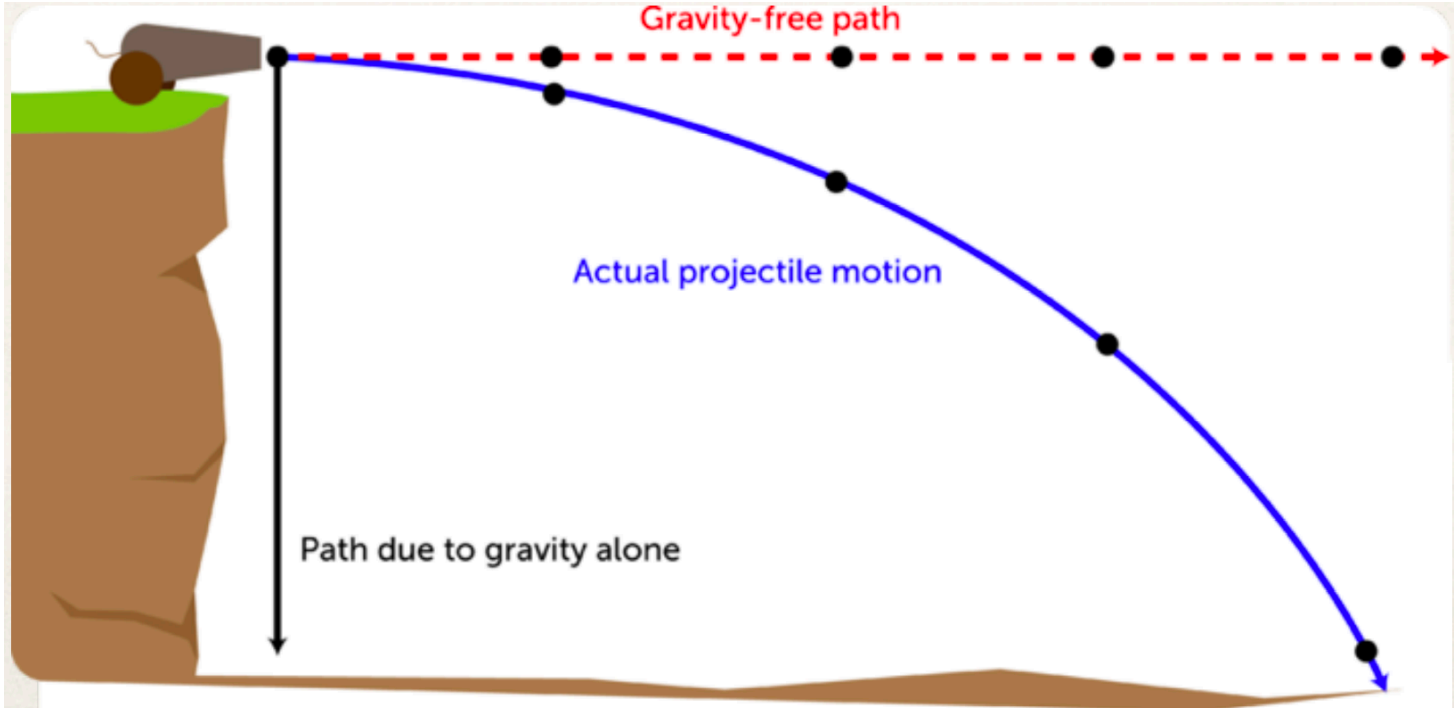


RULES FOR RESOLVING VECTORS

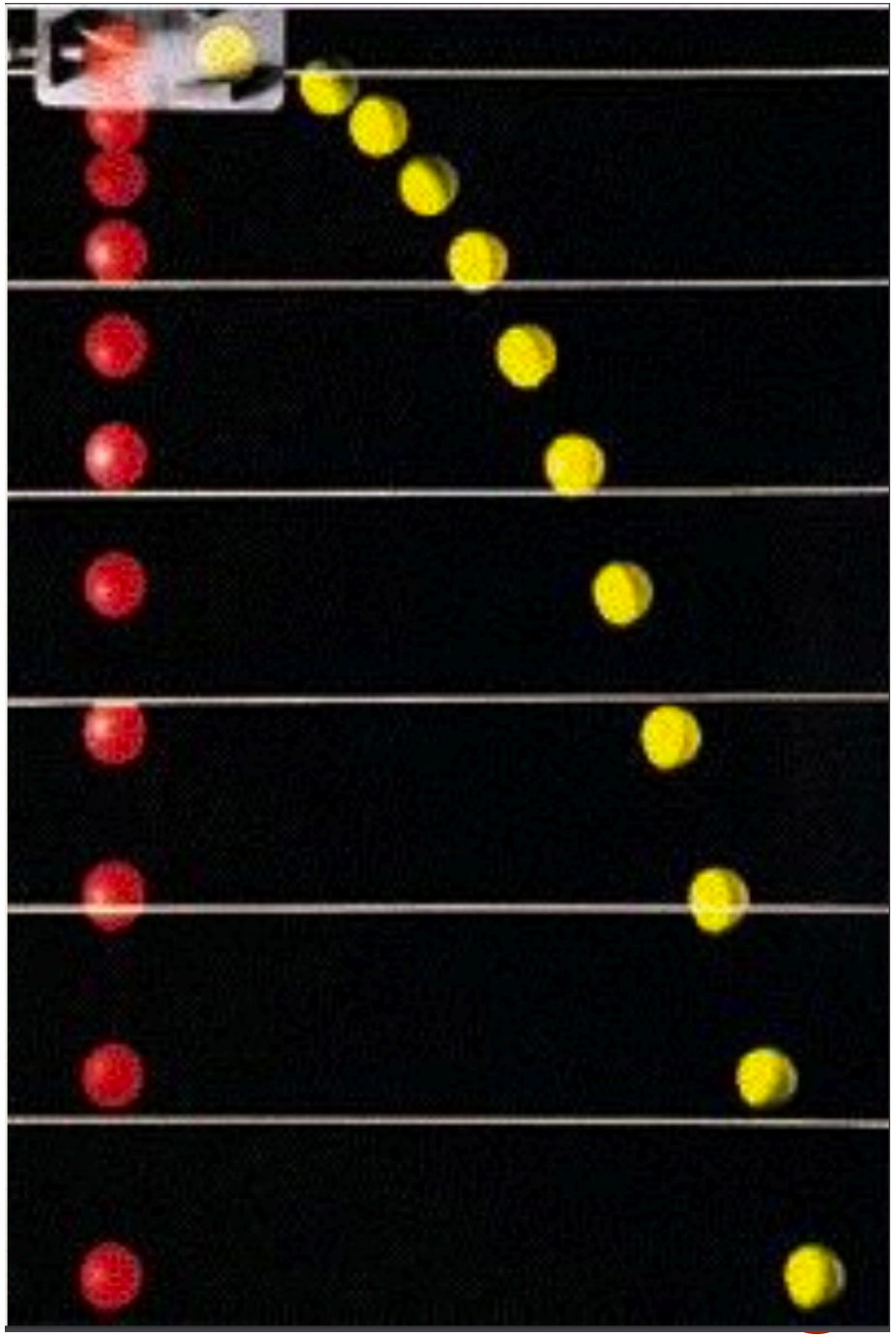
- Decompose all vectors into ***x* and *y* components**
- **Add the x components together** to get x component of resultant
  - **Same for y**
- To get **magnitude** and **direction** of resultant vector:
- $V = \sqrt{V_x^2 + V_y^2}$ $\theta = \tan^{-1}\left(\frac{V_y}{V_x}\right)$

- Scrat is looking for his acorn. He walks 70.0 ft North, then 20.0 ft west. Lastly, he walks 50.0 ft at 30.0 degrees N of E. What is his overall displacement?

- The horizontal and vertical components of a projectile are **completely independent of each other**
- Gravity does not affect the horizontal component of the velocity, so the horizontal velocity (v_x) remains constant



- An object projected horizontally will reach the ground at the **same time** as an object dropped vertically



ON TARGET LAB

- Secure your track down with tape and keep one end tilted with books, binders, etc.
- Roll the ball from the top of the track and use your phones to time how long the ball is rolling **on the horizontal part**. Do **not** let the ball roll onto the floor! Average 12 times
- Measure the horizontal distance of your track and calculate the horizontal velocity
- Measure the vertical height of your table
- Calculate how long it will take for the ball to hit the ground, then calculate the horizontal distance based on the horizontal velocity you measured.
- Moment of truth! Place the cup at the horizontal distance you predicted, roll the ball, and see if you make it in the cup!
- If you make it, congratulations! If not, go back and check your calculations and try again.

- Introduction
  - Define a problem (that is not a "yes/no" question)
  - Write a hypothesis, and be able to take a stand and give a rationale
- Materials and Methods
  - All materials given and procedure well organized
  - Repeated trials
- Results
  - Raw data given in a neatly drawn chart
  - Draw position, velocity, and acceleration vs. time graphs **while the ball is airborne**, draw a curve for x and y on the same graph
  - Sample calculations
- Conclusion
  - "CER" - "Claim, Evidence, Reasoning"- claim for the results of the experiment, evidence to justify the experiment, tie back to a basic physical concept
  - Explain uncertainty/error