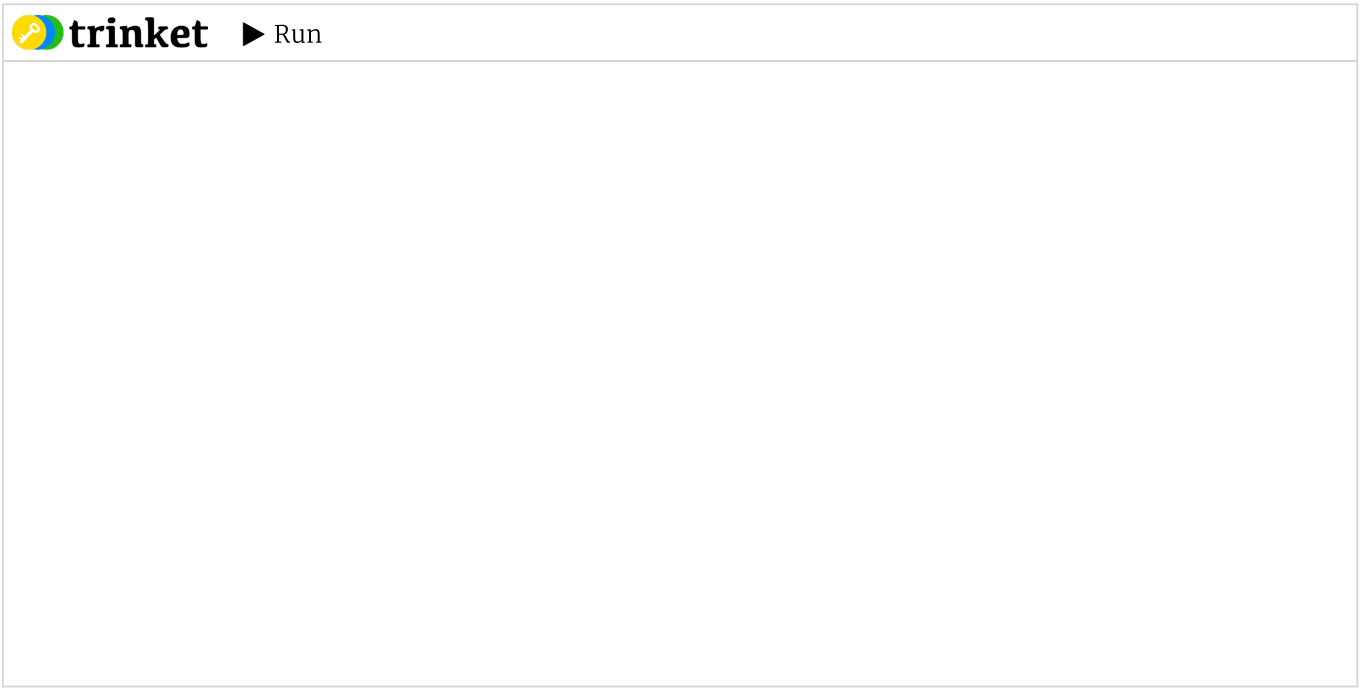
4.2: Exploring Vectors with PhET

The graph of two-dimensional motion in the previous section can be visualized using Visual Python. Run the program below. The velocity of the object is shown as magenta arrows at a few points along the trajectory. Notice how the x and y components of the velocity change over time.

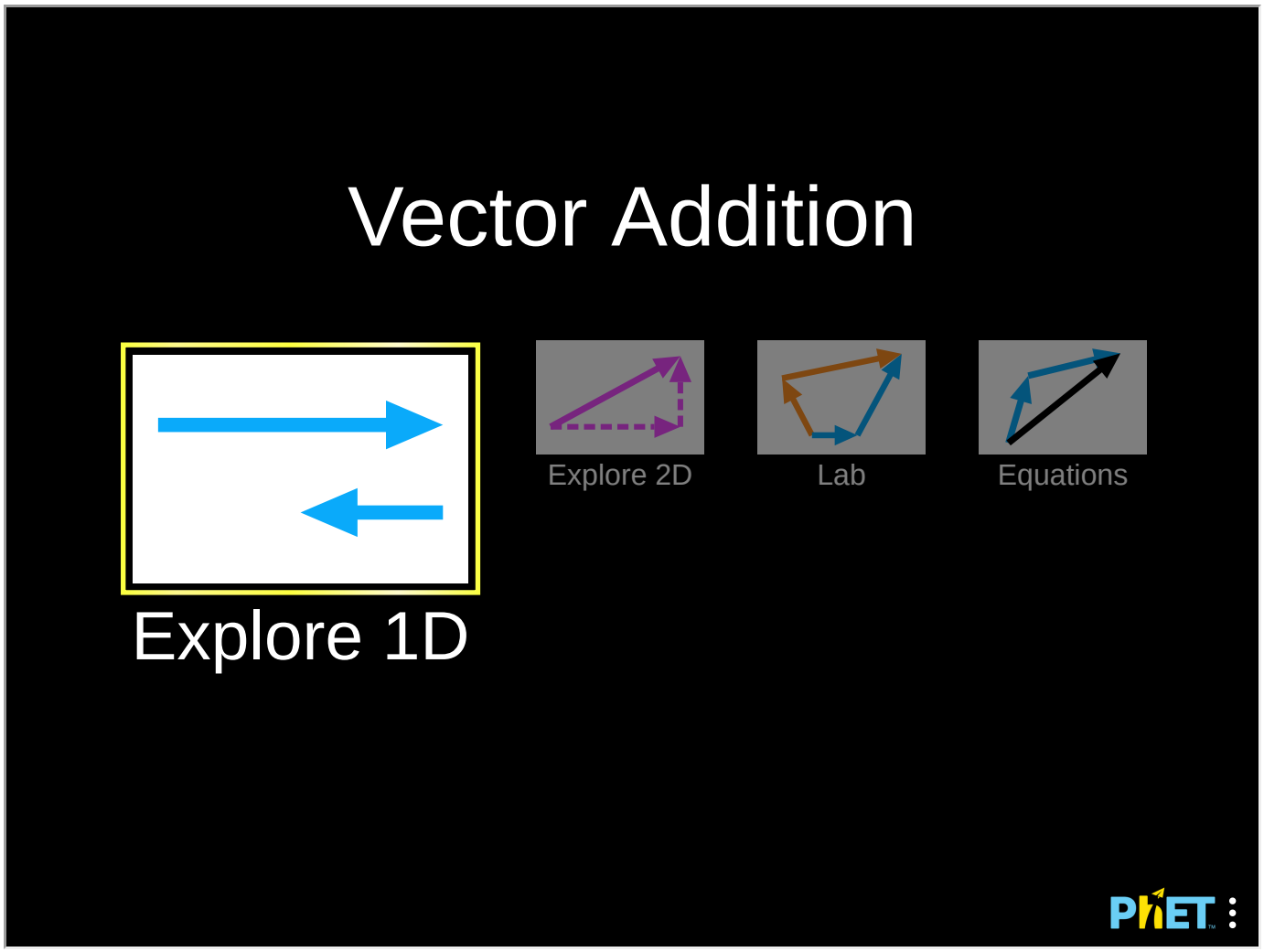


Using the kinematic equations, we can calculate the positions and velocities at each second. These calculations are left to the reader, and the results are shown in Table.

Results of calculating the position and velocity of an object starting at the origin and with initial velocity $(10, 15)\mathrm{m/s}$.

$t(\mathrm{s})$	$x(\mathrm{m})$	$y(\mathrm{m})$	$v_x(\mathrm{m/s})$	$v_y(\mathrm{m/s})$
0.0	0.0	0.0	10.0	15.0
1.0	10.0	10.2	10.0	5.2
2.0	20.0	10.4	10.0	-4.6
3.0	30.0	0.9	10.0	-14.4
4.0	40.0	-18.4	10.0	-24.2
5.0	50.0	-47.5	10.0	-34.0

Open the "Lab" section of the PhET simulation below. Using the coordinates in the table, draw the vectors for the position at each second. You may need to round the numbers since the PhET simulation does not allow all values. Each vector will have its tail at the origin. Reset the simulation and draw the velocity vectors for each second listed above. Each vector will have its tail at the position of the object at the corresponding time. How do your velocity vectors compare to the simulation above?



In the PhET simulation, you can see the vector lengths and angles in addition to the x and y components. Are you able to determine these values by calculation? You will read more about this in the upcoming sections.