Explore 1D Screen

Explore vectors in 1D and discover how vectors add together.

SHOW/HIDE vector data

$|\vec{a}|$ 13.0 θ 180.0 a_x -13.0 a_y 0.0

SHOW the sum

☑ Sum
☐ Values
☑ ▦

SELECT a vector to inspect

$\vec{a}$

$\vec{b}$

$\vec{s}$

GRAB vector head to change magnitude or orientation

$\vec{a}$
$\vec{b}$
$\vec{c}$

DRAG vectors into the graph

EXPERIMENT with vertical or horizontal vectors

Vector Addition   Explore 1D   Explore 2D   Lab   Equations
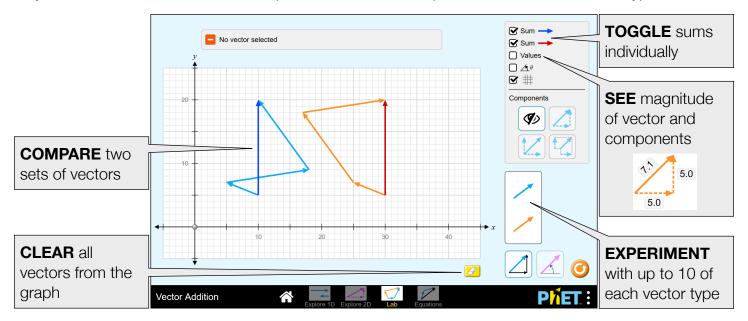
Explore 2D Screen

Experiment with vector addition in 2D. Specify vectors in Cartesian or polar coordinates, and see the magnitude, angle, and components of each vector.
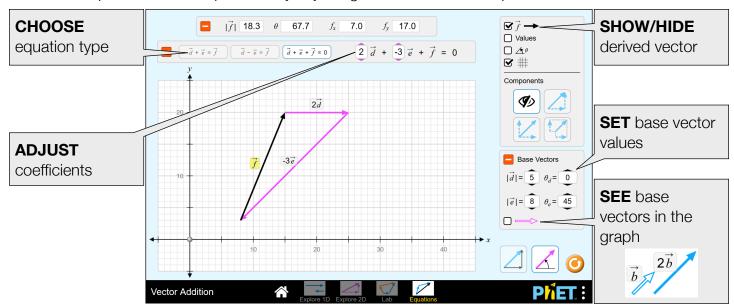
$|\vec{e}|$ 12.0 θ 120.0 e_x -6.0 e_y 10.4

☑ Sum
☐ Values
☐ ∡θ
☐ ▦

Components

VIEW angles

$\vec{d}$
40.0°

VIEW vector components

$\vec{s}$

$\vec{e}$

$\vec{d}$

SELECT component style: right triangle, parallelogram, or projection-like

$\vec{d}$
$\vec{e}$
$\vec{f}$

DRAG origin to shift quadrant

SNAP to integer coordinates $<x, y>$ (left) or $<r, \theta>$ (right)

Vector Addition   Explore 1D   Explore 2D   Lab   Equations

Lab Screen

Play with two sets of vectors and compare their sums. Add up to 10 vectors of the same type.

COMPARE two sets of vectors

CLEAR all vectors from the graph

No vector selected

Sum

Sum

Values

Components

Vector Addition

Explore 1D   Explore 2D   **Lab**   Equations

TOGGLE sums individually

SEE magnitude of vector and components

7.1   5.0

5.0

EXPERIMENT with up to 10 of each vector type

Equations Screen

Experiment with vector equations and compare vector sums and differences. Customize the base vectors or explore scalar multiplication by adjusting the coefficients in equation.

CHOOSE equation type

$|\vec{f}|$ 18.3 θ 67.7 f_x 7.0 f_y 17.0

$\vec{d} + \vec{e} = \vec{f}$ $\vec{d} - \vec{e} = \vec{f}$ $\vec{d} + \vec{e} + \vec{f} = 0$ 2 $\vec{d}$ + -3 $\vec{e}$ + $\vec{f}$ = 0

$\vec{f}$

Values

Components

Base Vectors

$|\vec{d}| =$ 5 $\theta_d =$ 0

$|\vec{e}| =$ 8 $\theta_e =$ 45

ADJUST coefficients

$2\vec{d}$

$-3\vec{e}$

$\vec{f}$

Vector Addition

Explore 1D   Explore 2D   Lab   **Equations**

SHOW/HIDE derived vector

SET base vector values

SEE base vectors in the graph

$\vec{b}$ $2\vec{b}$

Insights into Student Use

- The difference between the Cartesian and polar coordinate modes is subtle, and some students may not pick up on the difference on their own.
- If students are given opportunity to explore the sim without explicit directions, they will discover which vector representation makes the most sense for them. They may use different representations for different problems.

Rouinfar, November 2021

Complex Controls

- To translate a vector, grab its body. To stretch or rotate a vector, grab its tip.
- There are two snapping modes — Cartesian (left) and polar (right). In Cartesian mode, the vectors snap to integer $<x, y>$ values. In polar mode, the vectors snap to integer $<r, \theta>$ values with the angle adjusting in steps of 5°.

Model Simplifications

- The tail of the vector is restricted to the bounds of the graph. To prevent overly large vectors, the tip of the vector cannot be stretched beyond the bounds of the graph. However, the tip of the vector is allowed to escape the graph when translating the vector.
- The model allows 180° to have a positive or negative sign. In polar mode, the sign will depend on the direction of approach — positive if rotating counterclockwise, negative if rotating clockwise. To change the sign, click the vector head and move the cursor slightly up or down. In Cartesian mode, 180° will always be positive due to the way the y-coordinate snaps to zero.
- The vector labels are grabbable and can be used to translate the vectors within the graph. This may be particularly useful for touch devices with smaller screens.
- The goal of the projection-style component view is to collect the components along the axes. It is not meant to show true projection onto the axes.
- On the Equations screen, vectors **c** and **f** are always calculated from the values of the other vectors in the equation.

Suggestions for Use

Sample Challenge Prompts
- Describe a vector in your own words.
- Explain a method to add vectors.
- Compare and contrast the component styles.
- Decompose a vector into components.
- Describe what happens to a vector when it is multiplied by a scalar.
- Arrange vectors graphically to represent vector addition or subtraction.

See all published activities for Vector Addition here.
For more tips on using PhET sims with your students, see Tips for Using PhET.