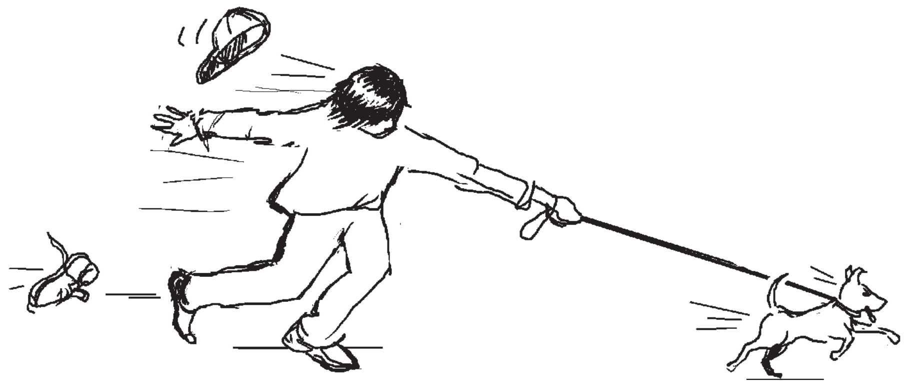
Introduction to Vectors: Walking Rex

For GSP5

You know that $2 + 2 = 4$. But if you walk 2 miles north and then 2 miles south, how far did you go? In one sense you went 4 miles—that's what your feet would tell you. But in another sense you haven't gone anywhere. We could say: $2N + 2S = 0$.

Values with both magnitude (size or length) and direction are called *vectors*. Vectors are useful in studying the flight paths of airplanes in wind currents and the push and pull of gravitational or electric forces. In this activity you'll explore the algebra and geometry of vectors in the context of a walk with your faithful dog, Rex.



WALK THE DOG

1. Open **Introduction to Vectors.gsp.** Rex's leash is tied to a tree at the origin of an *xy*-coordinate system. Rex is pulling the leash tight as he excitedly waits for you to take him on a walk.

Vectors often have a physical meaning. This particular vector represents Rex's position relative to the tree.

Rex's taut leash is represented by a vector, a segment with an arrowhead. The end with the arrow (Rex) is called the *head*, and the plain end is called the *tail*. We've labeled this particular vector **a**.

Q1 One way to define a vector is by its magnitude and direction. Which of these two quantities stays the same as you drag point *Rex*?

Another way to define a vector is by the coordinates of its head when its tail is at the origin. These coordinates are called the *components* of the vector.

You will not be able to make the components match the given values exactly. Just make them as close to those values as you can.

Q2 For each problem, drag *Rex* so the vector has the given components, and find the magnitude and direction of the vector.

a. components are $(5, 0)$

b. components are $(-4, 3)$

c. components are $(0, -5)$

d. components are $(-3, -4)$

Q3 For each problem, drag the vector as close as you can to the given magnitude and direction, and find the vector's components.

a. magnitude = 5; direction = 30°

b. magnitude = 5; direction = 135°

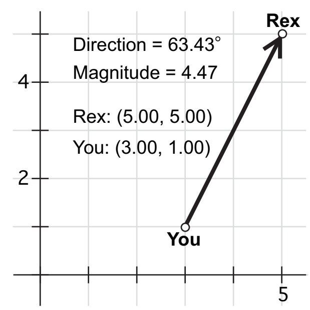
c. magnitude = 5; direction = 240°

d. magnitude = 5; direction = 307°

Q4 Rex is terrified of ladybugs. Suppose a ladybug is sitting at (5, 0). Where should Rex move to face in the opposite direction and be as far from it as possible? Describe Rex's position both ways, using components and using magnitude and direction.

Q5 What if the ladybug moves to a position 5 units away from the tree at 140°? Where should Rex go now?

Now it's time to untie the leash from the tree and take Rex for a walk.



2. Go to page 2. Rex is very determined! As you walk him, he pulls the leash taut and always tries to pull you in the same direction. Rex is still at the head of vector **a**, and now you're at the tail.

Q6 What are the components of vector **a**? How can you determine the components without moving point *You* to the origin?

Q7 Drag vector **a** around the screen. Explain why, no matter where you drag it, vector **a** is always the same vector. Support your argument using both of the two methods for describing vectors.

Q8 Suppose you walk to the point (80, 80). Where will Rex be? Explain how you found your answer. (Don't scroll—all the information you need is on the screen.)

3. Go to pages 3 and 4. Rex is heading in different directions on these pages. The information presented on screen is also a little different for each page.

Q9 On each of these two pages, determine where Rex will be standing when you're at (80, 80). Explain your reasoning in each case.

Q10 What if your leash is twice as long, and Rex is still pulling in the same direction? Now where will Rex be when you're at (80, 80)? Answer for both page 3 and page 4.