Vector Treasure Hunt

Teacher's Guide

1.0 Summary

Vector Treasure Hunt is the first activity to be done after the Pre-Test. This activity should take approximately 30 minutes.

2.0 Learning Goals

Driving Question: How is displacement described?

This activity illustrates how using an interactive geometrical symbol can develop an understanding of vectors and their properties. The students manipulate vector arrows to control the movement of an object in a game-like setting.

Step One: In **Constructing a Vector Path to a Treasure**, students develop an understanding that vector arrows have both size and direction by graphically adding them together in various ways to find a hidden treasure.

Step Two: In **Creating Your Own Vector Path to Reach the Treasure**, students become skilled in describing vectors by combinations of paired numbers to find a treasure.

Step Three: In **Guessing the Location of the Treasure**, students bury their own treasure and describe the path to locate it.

Learning Goals

- Students will understand that vectors have a magnitude and a direction.
- Students will understand the relationship between the Cartesian plane and vectors.
- Students will learn how to add vectors.
- Students will distinguish between distance traveled and displacement.

Additional Teacher Background

Specifying the position of an object is essential in describing motion. In one dimension, vector arrows with direction and magnitude are generally used. In two dimensions, either Cartesian or polar coordinates may be used, and the vector arrows are also common. In three dimensions, Cartesian or spherical polar coordinates are used, as well as other coordinate systems for specific geometries.

Scalars are quantities that are fully described by a magnitude alone. Vectors are quantities that are fully described by both a magnitude and a direction.

Distance and displacement are two quantities that appear to be identical to students, but they have distinctly different meanings. While an object is in motion, the amount of ground that you cover is the *distance*, a scalar quantity. Scalar quantities only depend on the size or magnitude of the movement. Displacement, on the other hand, is a vector quantity. This means that the motion is identified by how far an object is, and what direction, it is from its original position. It relies on both the magnitude of the motion as well as its position or

direction from its original position. For example, "I drove 50 miles" versus "I am 50 miles NW of my starting point."

3.0 Standards Alignment

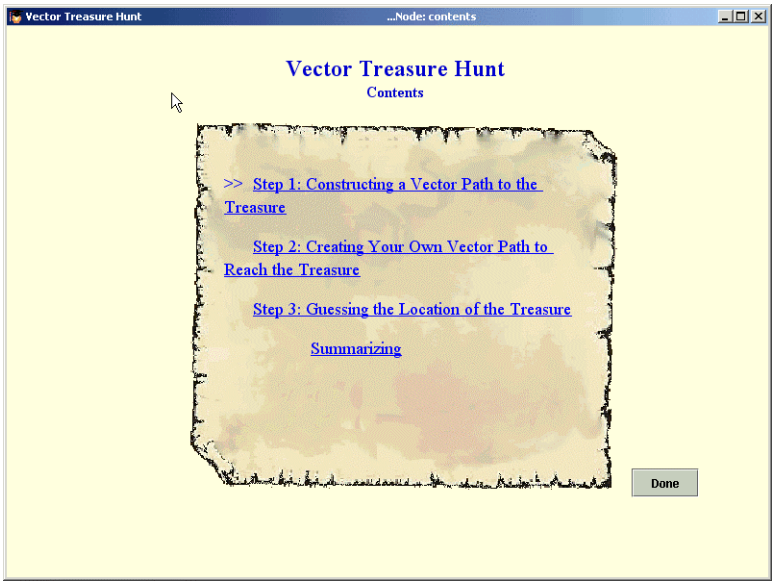
Alignment to National Math and Science Standards (NCTM or NSES)

Objective	Standards
Students will describe the properties of vectors.	• Students should understand vectors as systems that have some of the properties of the real-number system. • Students should understand meanings of operations and how they relate to one another. • Students should understand that vectors are composed of both magnitude and direction.
Students will manipulate a displacement vector to control movement.	• Students should use dynamic geometrical representation to develop an understanding of vectors. • Students should manipulate a displacement vector to control movement.
Students will use vector representations to explain phenomena.	• Students should use dynamic geometrical representation to develop an understanding of vectors. • Students should understand ways of representing numbers and relationships among numbers. • Students should use representations to model and interpret physical and mathematical phenomena. • Students should understand and represent translations and reflections of objects in the plane by using vectors. • Students should use mathematical models to represent and understand quantitative relationships. • Students should understand relations and functions and select, convert flexibly among, and use various representations for them. • Students should manipulate a displacement vector to control movement.
Students will add vectors.	• Students should recognize and apply mathematics in context outside of mathematics. • Students should identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships. • Students should generalize patterns using explicitly defined and recursively defined functions. • Students should understand meanings of operations and how they relate to one another. • Students should understand relations and functions and select, convert flexibly among, and use various representations for them. • Students should apply and adapt a variety of appropriate strategies to solve problems.

4.0 Activity Sections

4.1 Table of Contents

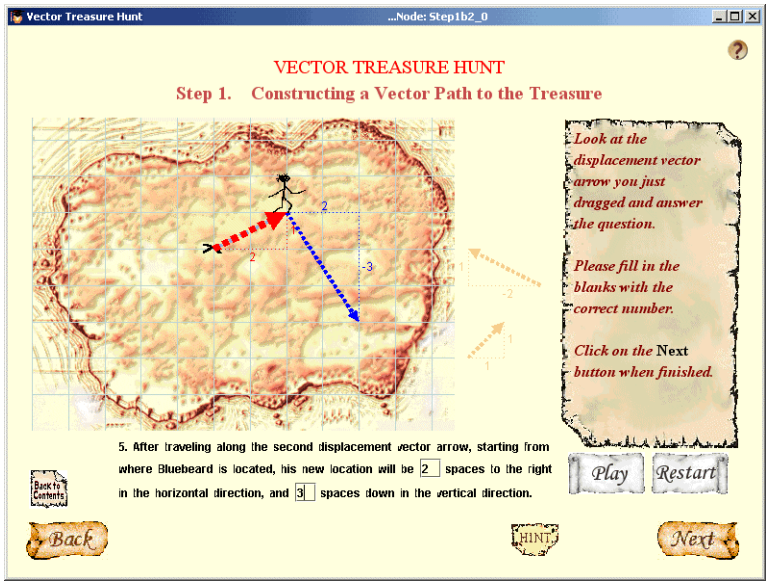
This activity has 4 sections, three steps and one summary. The steps should be done in order.



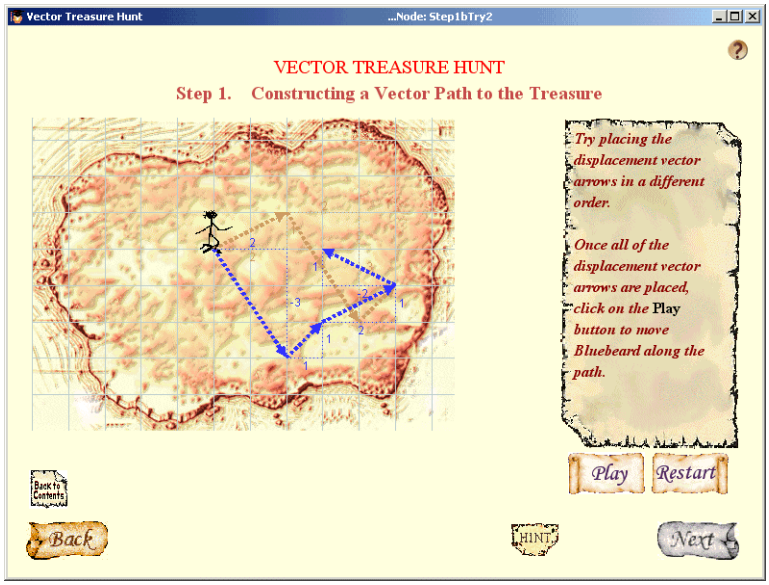
4.2 Step 1: Creating a Vector Path to the Treasure

The first step introduces the topic of vectors by using a treasure map theme, which is carried through the remainder of the activity. Students place blue vectors on the map to lead the pirate to the treasure. Students are asked to place the same vectors in a different order. Students should discover that whatever order they place the vectors the resultant displacement will be the same.

Vectors leading to the treasure



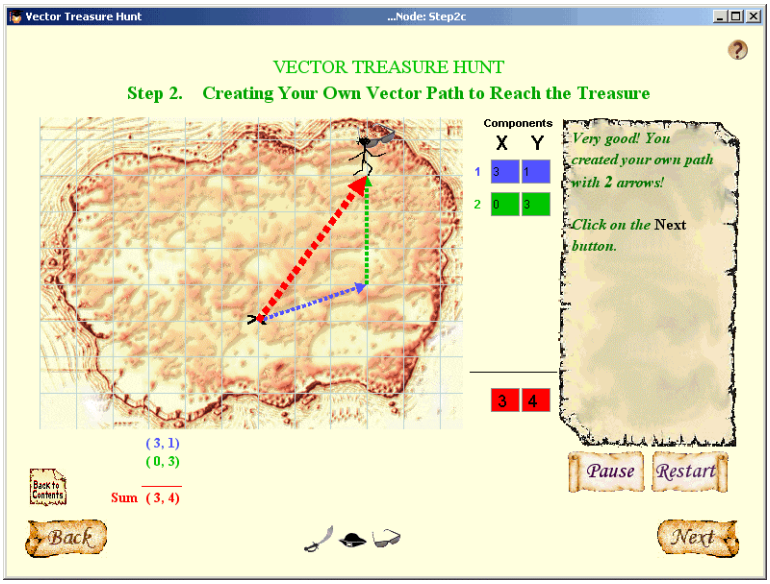
Assessment question for vector magnitude



Sum of the vectors

4.3 Step 2: Creating Your Own Vector Path to Reach the Treasure

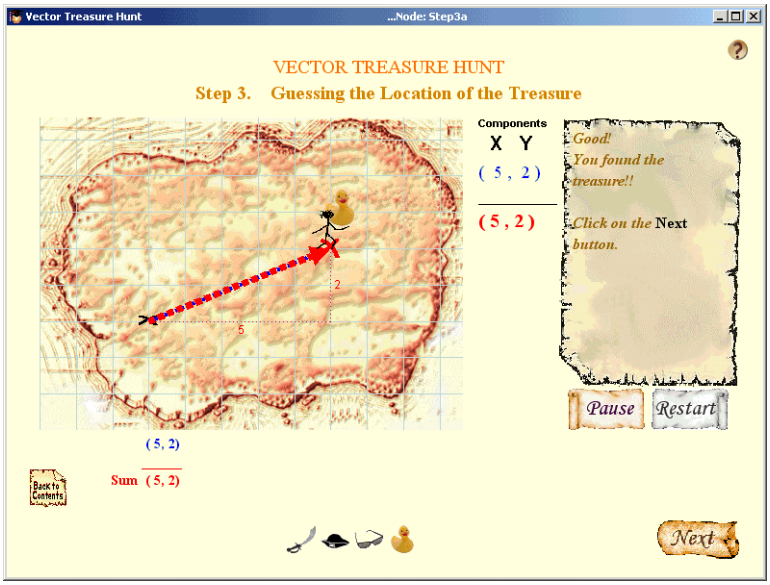
In this activity, students create their own displacement vectors. In addition, the activity teaches the student to read the direction and magnitude of vectors as well as add vectors.



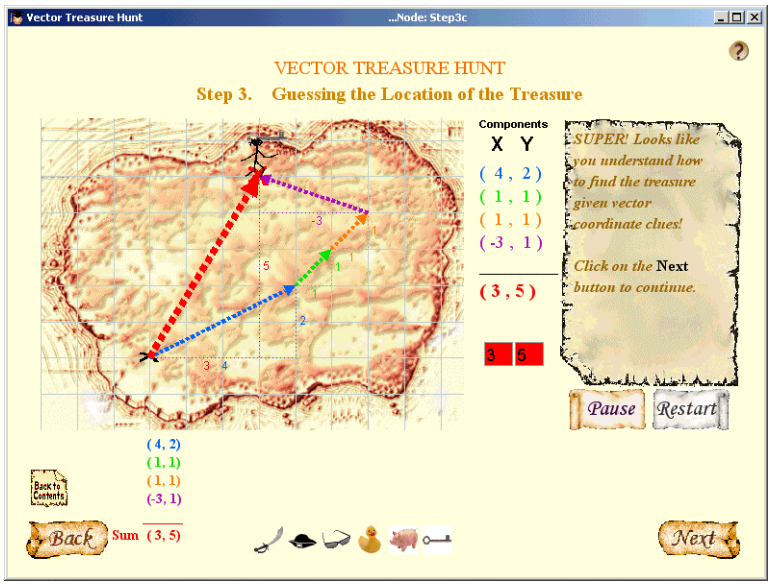
Creating vectors and adding them

4.4 Step 3: Guessing the Location of the Treasure

Step 3 requires students to anticipate where the treasure is located based on the magnitude and direction of a single vector. Then, the student is given the opportunity to add a set of vectors to find the resultant. If the student is incorrect, a new set of vectors will be given for the student to try.



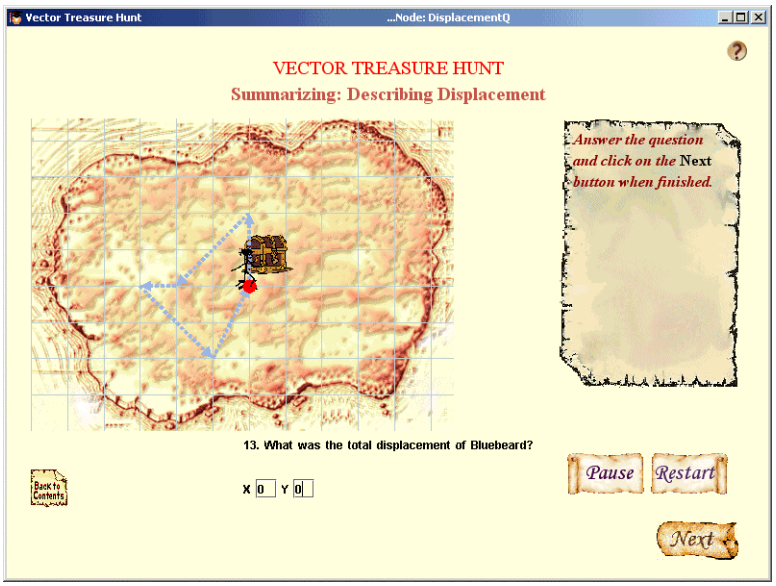
Student must translate vectors to map coordinates



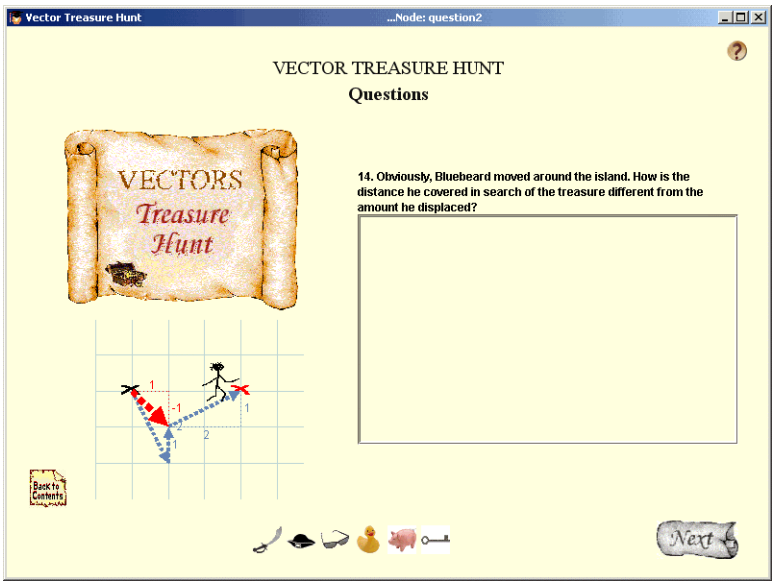
Student adds vector x and y components

4.5 Summarizing: Describing Displacement

The summary sections tests to see if students understand the relationship between displacement and distance traveled. For example, the student is given a set of vectors that sum such that the displacement is 0.



Displacement vs. distance traveled



Free response question to assess understanding

5.0 Student Reports

Your students' work with the Vector Treasure Hunt activity is logged and viewable on the MAC Project Web Portal at http://mac.concord.org. For each student, you can view a report containing questions and answers.

The next activity that students should use is Vector Motion.