mobile inquiry technology
TEACHER NOTES
Walking Off Distances Introduction

In this activity, students will explore changes over time on a line graph. By using a sonar ranger attached to the computer, the students will be able to make and compare different types of motion.

Students will develop a number of key concepts related to line graphs that change over time:

- making and interpreting different graphical shapes;
- comparing line graphs that show different amounts of change;
- realizing that the motion of an object can be described by its position, direction of motion, and speed;
- identifying variables that can affect the outcome of an experiment;
- gaining skills and confidence in using a scientific measurement tool, the sonar ranger, as well as the spreadsheet and graphing capacity of a computer to represent and analyze data.

CLOSE

mobile inquiry technology
Walking Off Distances TEACHER NOTES
Discussion Guide

Read the following paragraph to the class:

> Mary had been waiting by the window all morning for the mail to be delivered. She was expecting a present to arrive that day. When she finally spotted the mail truck drive away, she dashed out of the front door toward the mailbox at the end of the driveway. Excitedly, she pulled the small box and a few letters out of the mailbox and slowly made her way back to the house. Part of the way back to the house she dropped one of the letters and stopped to pick it up. Then she walked quickly to the front door.

Ask the class to discuss what facts they could gather from hearing the story.

Now, on an overhead show a graph that would represent the same motion. Ask the class to discuss what new facts they could find out from the graph? Ask how the information in the story with words is different from the story told by the graph?

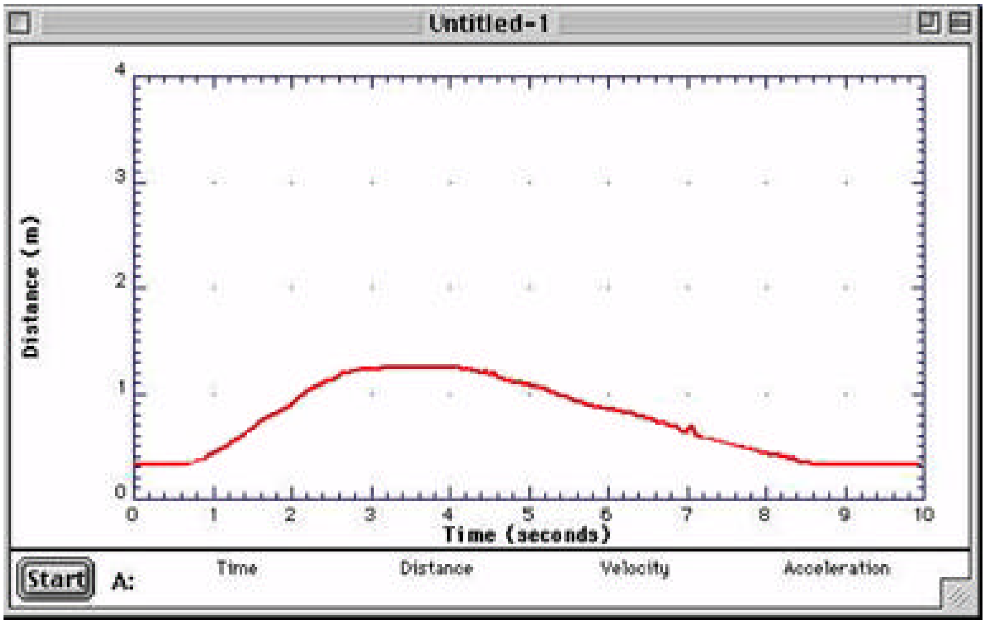
The discussion should bring out the additional mathematical information that can be determined from the graph, including time of changes in direction, distance from the starting point at any moment, changes in speed, and the timing of different events in the story.

Ask the class what a graph that represents a person walking across the room would look like. What would each axes of the graph indicate? (The y-axis represents distance and the x-axis represents time.) How could we tell if the person was moving forward or backward? (A distance-time graph represents movement in relation to a reference point. The students may not understand this immediately. Confusion about this concept at this point is OK. It will become clearer to them as they engage in the investigation.)

Ask the class: How could we collect and record the data that would represent the movement of a person over time? Suggestions would most likely include some fairly laborious simultaneous distance and time measurements.

Propose to the class that there is a tool that can be used to do this task easily. Show the class the Sonar Ranger. (It is strongly suggested that the students have used the sonar ranger in "Making Waves" prior to doing this activity.) Ask the class to recall what they did with the sonar ranger in the "Making Waves" activity.

The graph below is an example of a motion graph while a student is walking a straight track with their back to a sonar ranger. The graph slopes upward when the student walks away from the detector. When the student stands still, a flat line appears on the graph. When the student starts to move toward the detector again the slope of the graph is downwards. Notice that the slope of the line is less steep as you move toward the detector. This means that the speed of the student is slower.



Dividing the class into two teams (each with a sonar ranger) is helpful. Refer to Technical Hints to see how to set up the walking track. Allow the two teams time to experiment with the sonar probe. Once the teams have had time to "mess around", ask the students to review the first graph. Have the team discuss each movement needed to reproduce the graph. Students should use the draw program to reproduce the distance-time graphs and label the motion needed for each portion of the graphs.

Each team member should be active in the process. One student will need to start the sonar ranger by clicking the trigger and another student will need to walk the track with their back to the sonar. All of the other students should count time out loud to provide a good walking pace. At the end of the first try, compare the graphs of the two teams. Allow the students to repeat several times until they are sure that they know the exact motion needed to reproduce the given graph. Have each group print out their best trial.

After the first graph is successfully produced, switch roles within the group so other students have the chance to be the focus of the motion. Repeat the process for each of the graphs.

The sonar ranger doesn't really measure distance. Instead it measures the time needed for the sound waves to leave the sonar ranger and bounce off the target and return to the sonar ranger. The software determines and displays the distance the pulse covered based on the speed of sound.

To obtain reasonable graphs, the surface that the sound pulse bounces off should be flat. This means that the sonar ranger needs to be pointed at a relatively flat portion of the body. As the sound pulse travels further away from the sonar ranger, it spreads out about 10 degrees. Make sure that nothing else but the student is in the spreading path of the pulse.

Indicate to the student that in this activity they will be able to try out the sonar ranger to collect and record distance-time data about students moving on a walking track. Ask the students to read the first paragraph in "Thinking About the Question". After the students have had an opportunity to share their thoughts hold a brief discussion. Direct the students to complete the reading before moving to the prediction section of the "Investigation I".

After the students have completed the prediction section of the procedure and questions 1-4 in the "Analysis" hold a class discussion to present their predictions and share their responses to the analysis questions. Encourage the students to ask each other questions. After the discussion, direct the students to move on to "Testing your Predictions" and the "Analysis".

CLOSE

mobile inquiry technology
Walking Off Distances TEACHER NOTES

Additional Teacher Background

Displacement and distance are often used interchangeably. They are not really the same. Displacement is a vector quantity. Vectors describe magnitude and direction.

For example, if you leave the front door of your house and run **2** blocks **North**, **3** blocks **West**, **2** blocks **South**, and **3** blocks **East**, you will end up back at your front door. The displacement is zero, but the overall distance covered is 10 blocks.

Speed and velocity are also used interchangeably, but velocity is a vector. This means that it describes both direction and the magnitude of the speed. Distance and speed are considered scalar quantities, showing only magnitude.

CLOSE

mobile inquiry technology
Walking Off Distances Suggested Timeline

The amount of time you spend on introductory discussions, data collection, and analysis, will determine your overall timeline. The following represents a possible timeline.

- One class period - Introductory Discussion
- One class period - Investigation I: Messing around
- One class period - Investigation II: Predicting
- One class period - Investigation III: Testing your predictions
- One class period - Analysis

Additional days can be used for further investigations.

CLOSE