We give four examples of trails in particular situations: A park playground, a city, a zoo, and a shopping mall. The playground and the shopping mall are each a single actual location, the city and the zoo trails are composites drawn from several locations. For each trail stop you will find one or more pictures, and then ideas and questions suggested by the pictures. The trail in the park playground is more specific than the others, in order for you to see examples of the development from what you see to questions and ideas to actual items for a trail guide.

RECREATIONAL MATHEMATICS IN THE PARK

Parks are popular places for many people, including family groups. In this chapter we will take a tour of a local park to blaze a math trail in the park playground. We'll discuss our thinking as we spot opportunities to highlight some math, identify questions to ask, and note choices to make in settling on a final guide design. We'll also include a draft of the trail guide for each stop.

THE FIRE ENGINE

Our park has an attractive red fire engine. Children of all ages have fun climbing aboard the fire engine, pretending to be the driver or one of the firefighters rushing to a fire across town. The fire engine certainly is large, but how large is it? Here's a chance for walkers to estimate some

Figure 1.

measurements using their hands and feet, although a tape measure would help move things along more quickly.

Think about the size of the tires, the length of the truck or various pieces, or the height of the seat from the ground. Walkers could record measurements on the trail guide in order to compare their results. They might also try estimating some of the lengths before measuring.

As an extension of this exploration, trail walkers can compare their numerical results when they divide the height of the tire into its circumference. While we would not expect everyone to get exactly the same quotient, we would expect the trailers to obtain similar results. This is a neat way to let everyone discover that π did not just "pop" out of the sky! It (π) really does have a true and valid meaning in life and mathematics. There will be other opportunities during our visit at the park to explore π.

GUIDE TO STOP 1—The Fire Truck

This truck is bigger than most cars on the road, but how big is it? Even the tires are large. Each of you estimate how long your hand is. Now use your hand to measure the height of a tire and then measure the distance around the outside of the tire. Compare your answers. Are they different? Talk about why.

Divide the height of the tire into its circumference. Is this number familiar? Compare your results.

Name:
Tire height:
Circumference:
Quotient:
Truck length:
Bumper length:
Seat height:

How long is the truck? How long is the front bumper? The driver's seat is high off the road, how high is it? Why is the seat so high? Try estimating the height first and then measuring. Is it easier to estimate longer or shorter lengths?

TILING BLOCKS

This gate has a grid of square tiles, light on one side and dark on the other. The tiles are mounted so that they rotate on a vertical wire. Rotating them generates a great variety of patterns and that affords a variety of counting problems. The most direct problem is to estimate or count the number of square tiles. A more complex problem is to count the number of different patterns. You might want to ask exactly what you mean by different.

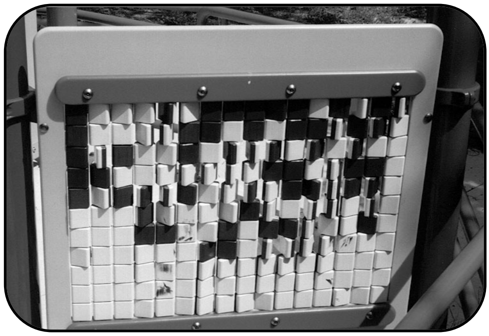

Figure 2.

GUIDE TO STOP 2—Tile Grid

See how each small square tile rotates independently so that you can turn either its light face or its dark face to the outside. Count the number of rows of tiles. Count the number of columns. How many individual tiles are there in the grid?

Rows	
Columns	
Tiles	

Each time you turn a tile, you change the pattern. One pattern has all the light faces showing. The opposite pattern has all the dark faces showing. There are many, many more patterns mixing light and dark tiles.

Look at the four tiles in the corner that make a 2 x 2 square. How many different patterns can you make with them?

How many patterns can you make with a 3 x 3 set of tiles?

2 x 2 patterns	
3 x 3 patterns	
4 x 4 patterns	
5 x 5 patterns	
Total patterns	

How many patterns can you make on the whole board? The number is very large! Think about 4 x 4 and 5 x 5 arrays first and see if you can spot a pattern.

SHAPES AND NUMBERS BOARD

This panel on the carousel is not only decorative, but also an instructive opportunity for very small children to recognize numbers and simple shapes. This can be a prompt for the youngest of the trail walkers to look for numbers and shapes along the trail.

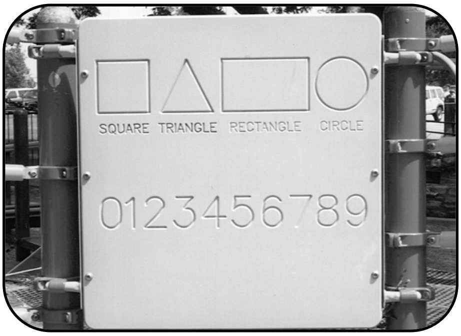

Figure 3.

GUIDE TO STOP 3—Shapes and Numbers

Look at all of the shapes and numbers on the board. Name them and trace them with your finger. As you walk through the playground today, see if you can find all of these shapes and numbers. Keep a tally for each of the shapes and numbers. At the end of your walk, check the tallies to see which shape you found most often and which number you found most often.

	How many?
0	
1	
2	
3	
4	
5	
6	

	How many?
7	
8	
9	
Square	
Triangle	
Rectangle	
Circle	

CHIMES

Chimes have always fascinated children and adults alike. Windchimes catch the breeze and play beautiful musical notes. Other chimes, such as the brightly colored panel containing eight chimes pictured here, need to be struck with something like a stick in order for us to hear musical notes.

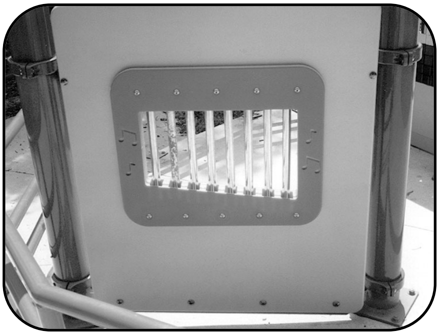

Figure 4.

GUIDE TO STOP 4—Chimes

What a terrific place to stop and have some fun with musical chimes! Are all the eight chimes the same length?

Hit each of the chimes starting from the shortest to the longest, left-to-right. Do all of the chimes make the same sound? Which chime has the lowest sound? Which has the highest sound? How do you think the length of the chime and the pitch of the tone are related?

GAME BOARD

Game boards can be found throughout many playgrounds, recreational picnic areas, and zoos. This game board in our playground is made up of Xs and Os. Each of the nine faces can come up either as an X or an O or a blank. The game board is in an arrangement of a 3 x 3 grid.

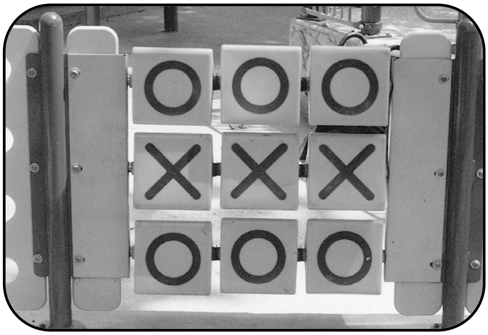

Figure 5.

SLIDES

Slides are loads of fun for everyone! We never seem to outgrow the thrill of coming down a slide—the steeper and faster, the more fun! One of the things you learn in mathematics has to do with the slopes of lines. We can combine the fun and thrill of a slide with the concept of the slope of the slide. Once the walkers are comfortable finding the slope of the first slide, it is a good idea to have them find other slides or ramps in the playground and compare their slopes.

GUIDE TO STOP 5—The Game Board

See how each square face of the game board rotates independently so that you can turn an X or an O or a blank to the outside.

Work with a partner to see how many different ways you can arrange the Xs and Os on the game board grid with no blanks. How is this like Stop 2?

How many different ways can you arrange the Xs and Os if the nine squares were lined up in a row instead of in a grid?

	Team 1	Team 2
Game 1		
Game 2		
Game 3		
Game 4		

What if you decided that the Xs and Os must alternate? How many different ways can this be done?

Choose teams and play some games of tic-tac-toe.

GUIDE TO STOP 6—Straight Slides

Measure and record the height of the slide at its tallest point and at its lowest point. Subtract the lowest from the highest and record your results in the numerator of the fraction below.

$$\frac{\text{height of tallest point} - \text{height of lowest point}}{\text{distance from tallest point to end of slide}} = \underline{\hspace{4cm}} =$$

Now measure and record how far it is along the ground from the tallest point of the slide to the end of the slide. Record this answer in the denominator of the fraction above.

This fraction is called the average slope of the slide.

Divide the first result by the second result.

Some slides are not perfectly straight, but rather have a slight bend toward the end of the slide. This bend acts as a brake for children, slowing them down before they come to the end of the slide. Once trail walkers are comfortable finding the slope of a straight slide, have them tackle finding the slope of a slide with a bend in it.

Figure 6.

GUIDE TO STOP 6—Slides With Bends

Discuss ways of defining the slope of this slide. There might be more than one suggestion for defining the slope. How close are the different slopes? Why are there different answers? If you see other slides or ramps, find their slopes and compare them.

GUIDE TO STOP 6—Slides

How long does it take to get down each of the different slides you find on the playground? Suppose your friend weighs more than you. Would she/he get down the slide faster than you? Record your findings in the following table.

Time to get down each slide	Walker 1	Walker 2	Walker 3
Slide 1			
Slide 2			
Slide 3			
Slide 4			

GUIDE TO STOP 6—Slides

If you roll a ball down the slide, how far does it land from the end of the slide?

What do you think affects this distance?

Distance from the end of the slide
Slide 1
Slide 2
Slide 3
Slide 4

SWINGS

Have you ever noticed how children run over eagerly to a swing set once they spot it? Many times they will also screech with delight as they run toward the swings. Adults also enjoy swinging! There just seems to be something relaxing and carefree about swinging.

Figure 7.

GUIDE TO STOP 7—Swings

Now walk over and watch the children as they swing. Do some of the children need to be pushed by someone else in order to go higher? Why? Take turns swinging with your friends. How would you describe the motion of the swings? How do you make yourself swing higher? Why does the swing eventually stop?

Some trail walkers could work the with the following situation using the motion of the swing or "damping."

GUIDE TO STOP 7—Swings

At this stop along the math trail you are to decide if the motion of the swing or "damping" is constant. You will need two friends to help you out with this activity. Have one of your friends sit in the swing. Stand behind your friend and mark the position in the sand from where you will let the swing go. Another friend should stand to the side of the swing to mark the distance the swing will travel. Now bring the swing back to your marked position in the sand and let go. The friend on the side should place marks in the sand to indicate the distance that the swing travels on each successive swinging motion. After the swing comes to a stop (or near-stop), repeat the swinging and distance measuring activity again using the same person in the swing and letting the swing go from the same position. Repeat once more and see if you can make a conjecture about your observations.

GUIDE TO STOP 7—Swings

Now explore another activity at the swings. You will need a stopwatch or a watch with a second hand, and two friends for this exploration. Do you remember what a period is? It is the time it takes for one back-and-forth motion of the swing. Have a friend sit in one of the swings. Stand behind your friend and bring the swing back and start your friend going in the swing. Have another friend time 10 back-and-forth swings and divide that time by 10. Do this several times giving your friend a different amount of push on each trial. Does this affect the period?

Repeat the whole process using different distances from which to start the swing. Does this affect the period?

	$\frac{\text{Time for 10 back-and-forth swings}}{10}$
Trial 1	
Trial 2	
Trial 3	
Trial 4	

GUIDE TO STOP 7—Swings

Find some other swings in the playground with different length chains. Try the same experiment using these swings and see if the length of the chain affects the period of the swing.

	$\frac{\text{Time for 10 back-and-forth swings}}{10}$
Swing 1	
Swing 2	
Swing 3	
Swing 4	