Investigations in Number, Data, and Space®

The *LogoPaths* Software (3-5)

LogoPaths is designed to extend and deepen the mathematical ideas emphasized in the 2-D geometry and measurement units—length, perimeter, angle, and the characteristics of a variety of polygons. In the *LogoPaths* environment, students determine the angle measurements and lengths to move a turtle through a maze or across an empty plane. In some cases, the software allows students to work with geometric figures and angles in ways that they are not able to in the off-computer activities.

When using the *LogoPaths* software, students use commands to move the turtle in different directions. Such commands include:

fd #/bk #	Tells the turtle how many steps to move and in which direction, **forward** or **back**.
rt #/lt #	Tells the turtle how many degrees to rotate and in which direction, **right** or **left**.
pu/pd	**Pen up** raises the pen so that the turtle will not draw a line; **pen down** lowers the pen so that it will.
ht/st	**Hide turtle** removes the turtle from view; **show turtle** returns the turtle to view.
home	Moves the turtle in a straight line back to its starting position.
repeat	Performs a set of commands a specified number times. For example, **repeat** 4 [fd 75 rt 90] makes the turtle act out the commands in the brackets, 4 times, resulting in a square.

Students can also teach the turtle to complete a certain series of steps by naming a procedure, and teaching it to the turtle. For example, after asking the turtle to repeat 4 [fd 75 rt 90], a student could name that procedure *square*. Then, any time that student wants to draw a square, s/he can simply type "to square". Students can also customize their experience by changing the size or color of the turtle and using a different icon, instead of a turtle.

Grade 3 Overview

LogoPaths activities are embedded in the 2-D Geometry and Measurement unit *Perimeter, Angles, and Area*, the fourth unit in the Grade 3 sequence. *Investigations* recommends that students have access to the software during units 2 and 3, to do the activity *Get the Toys* which focuses on the basic commands (moving forward and back, making right and left turns), and to spend time with the *Free Explore* option. Giving students access to the software outside of math

time will help them become comfortable working on the computer, and with the software, in preparation for its use in Unit 4. The Grade 3 software activities include:

- *Get the Toys.* Students guide the turtle from an "elevator" in the middle of a maze, to a toy and back again. Only steps in multiples of 10 and turns of 90º may be taken.

- *Free Explore.* Students use the commands to move the turtle in any direction on an empty plane. Students can draw polygons by telling the turtle how much to move and turn.

- *Missing Measures.* Students use *Free Explore* to draw and then complete unfinished rectangles that include some labeled dimensions. They then determine the perimeter of each completed rectangle.

- *200 (400, 500) Steps.* Students use *Free Explore* to draw rectangles with perimeters of 200 (400, 500) turtle steps. They may enter forward and back commands of any amount.

- *Feed the Turtle.* Students guide the turtle through a maze, trying to retrieve each piece of food before its energy runs out. Only steps in multiples of 10 and turns in multiples of 30º may be taken.

Grade 4 Overview

LogoPaths activities are embedded in the 2-D Geometry and Measurement unit, *Size, Shape, and Symmetry*, the fourth unit in the Grade 4 sequence. *Investigations* recommends that students have access to the software during units 2 and 3, to do the activity *Feed the Turtle* which focuses on the basic commands (moving forward and back, making right and left turns), and to spend time with the *Free Explore* option. Giving students access to the software outside of math time will help them become comfortable working on the computer, and with the software, in preparation for its use in Unit 4. The Grade 4 software activities include:

- *Feed the Turtle.* Students guide the turtle through a maze, trying to retrieve each piece of food before its energy runs out. Only steps in multiples of 10 and turns in multiples of 30º may be taken. This activity was introduced in Grade 3.

- *Free Explore.* Students use the commands to move the turtle in any direction on an empty plane. Students can draw polygons by telling the turtle how much to move and turn. This activity was introduced in Grade 3.

- *Missing Measures.* Students use *Free Explore* to draw and then complete unfinished polygons that include some labeled dimensions. They then determine the perimeter of each completed polygon. This activity requires students to use forward and back steps of varying amounts and right and left turns in multiples of 30º. A variation of this activity was introduced in Grade 3.

- *600 (800) Steps.* Students use *Free Explore* to draw rectangles and other polygons with perimeters of 600 (800) turtle steps. They may enter forward and back commands of any amount. Students are challenged to draw an equilateral triangle with a perimeter of 600

steps and a nonrectangular quadrilateral with a perimeter of 800 steps. A variation of this activity was introduced in Grade 3.

- *Mazes.* Students guide the turtle to retrieve prizes scattered throughout a maze. Students may enter forward and back and turn commands of any amount, though solutions generally involve moves in multiples of 10 turtle steps and turns in multiples of 10º. Each turtle move depletes the turtle's energy reserve, so students need to make maximally efficient moves in order to retrieve the prizes before the energy runs out.

Grade 5 Overview

LogoPaths activities are embedded in the 2-D Geometry and Measurement unit, *Measuring Polygons*, the fifth unit in the Grade 5 sequence. *Investigations* recommends that students have access to the software during units 2 through 4, to do the activity *Mazes,* and to spend time with the *Free Explore* option. Giving students access to the software outside of math time will help them become comfortable working on the computer, and with the software, in preparation for its use in Unit 5. The Grade 5 software activities include:

- *Mazes.* Students guide the turtle to retrieve prizes scattered throughout a maze. Students may enter forward and back and turn commands of any amount, though solutions generally involve moves in multiples of 10 turtle steps and turns in multiples of 10º. Each turtle move depletes the turtle's energy reserve, so students need to make maximally efficient moves in order to retrieve the prizes before the energy runs out. Introduced in Grade 4.

- *Free Explore.* Students use the commands to move the turtle in any direction on an empty plane. Students can draw polygons by telling the turtle how much to move and turn. This activity was introduced in Grade 3.

- *Angle and Turn Game.* At the beginning of the game, the turtle turns and moves to a new location on the screen, drawing a line as it does so. One player (secretly) enters a turn angle. The second player attempts to enter the angle that will get the turtle pointing back towards the point of origin. Students begin with a version focusing on supplementary angles. As an extension, students can use other combinations of two turns to return the turtle to its point of origin.

- *Triangles, Rhombuses, and Parallelograms.* Students use *Free Explore* to draw examples of these polygons that fit given criteria.

- *Polygon Pairs.* Students determine whether pairs of polygons are similar to one another and explain the reasoning behind their responses.

Using *LogoPaths* All Year

Investigations suggests introducing students to *LogoPaths* early in the year so that they are prepared for the software activities that are embedded in the 2-D Geometry and Measurement

units at grades 3-5. The following table shows the *LogoPaths* activities at each grade, as well as the unit in which they are introduced.

Grade 3	**Grade 4**	**Grade 5**
Get the Toys (Unit 2)	Feed the Turtle (Unit 2)	Mazes (Unit 2)
Free Explore (Unit 2)	Free Explore (Unit 2)	Free Explore (Unit 2)
Missing Measures (Unit 4)	Missing Measures (Unit 4)	Angle & Turn Game (Unit 5)
200 (400, 500) Steps (Unit 4)	600 (800) Steps (Unit 4)	Triangles, Rhombuses and Parallelograms (Unit 5)
Feed the Turtle (Unit 4)	Mazes (Unit 4)	Polygon Pairs (Unit 5)

Subsequent units include suggestions and reminders for ongoing use of the software, throughout the school year. *LogoPaths* activities can be incorporated into Math Workshop, and in other times outside of math class, such as computer time, before and after school, choice time, and/or during recess. Continued experience with *LogoPaths* allows students to become increasingly fluent in the mechanics of the software itself and able to better focus on the mathematical ideas of the game and activities.