The learner will recognize and use geometric properties and relationships.

3

3.01 Use the coordinate system to describe the location and relative position of points and draw figures in the first quadrant.

A. Give each student a copy of Blackline Master III - 1
Direct the students to write their names using the coordinates.
Example (4,5) (2,2) (3,7) spells ABE.
Write simple messages/directions to students using the coordinates.
Students pair up and write a secret message to their partners using the coordinate grid. Have children decode the message from their partners.
Present the children with a message in which the path between points is described.

B. Given the following coordinates, plot the points in order on cm graph paper (See Blackline Master I - 25). Encourage students to create other designs.

(13,3) (15,5) (17,7) (19,9) (20,11) (21,13) (21,15) (20,17) (19,18) (17,18) (15,17) (13,15) (11, 17) (9,18) (7,18) (6,17) (5,15) (5,13) (6,11) (7,9) (9,7) (11,5) (13,3)

As a challenge, give students Blackline Master III - 5, “Using Coordinates”, which includes fractions in the ordered pairs and looks at doubling the numbers, etc.

Notes and textbook references

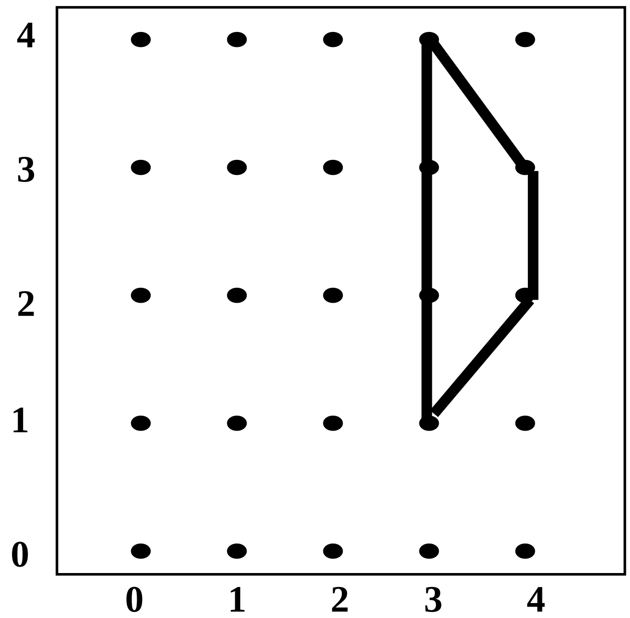
C. There are many engaging games that provide students opportunities to practice this skill. Here is an adaptation of the game **Coordinate Dice** from Math For Girls and Other Problem Solvers, an EQUALS publication. Each pair of students will label a 12 by 12 grid with numbers on both coordinates. They will also need two pairs of dice. These dice need to be in two colors, for example, 2 red and 2 green. The coordinates of the grid are then labeled to match the colors on the dice; for example the horizontal coordinate could be labeled red and the vertical coordinate green. Each student also needs some markers which are different from his/her partner's markers. To play this game, students take turns rolling the dice. If a student rolls a 2 and a 3 on the red dice and then a 1 and 5 on the green dice, this determines the point (5,6) on the grid. The student rolling (5,6) then places one of his/her markers on that point. Students proceed in this manner, taking turns until one of the players has 5 markers lined up in a row, horizontal, vertical, or diagonal. If a player rolls an ordered pair that is already covered, then he or she loses that turn. Obviously, there are points on the grid that will not be possible to cover because of using a pair of dice. These points include all of those with 0 and 1 as part of the ordered pair, such as (1,0) and (5,1). One of the rules might be that if a player rolls a coordinate point that is already covered, he or she may choose to place a marker on one of these "impossible-to-cover" points. Have students play this game before pointing this out, and then ask them whether they notice points being left out. Then suggest, or perhaps a student will suggest, this new role. Have students create new versions of this game. Is there a way to change the rules so that more strategy and less luck is involved? When a game is completed, have students record the ordered pairs of the 5 points creating the line, for example, (4,4), (5,3), (6,2), (7,1), (8,0). This will help make the connection between the actual position on the grid and its paper and pencil representation. See Blackline Masters III - 2 or III - 3 for grids.

D. **Geoboard Battleship** The teacher makes a trapezoid on a geoboard that the students can not see. Give students geoboards or geoboard recording sheets (Blackline Master III - 4). The teacher should call on a student to select a coordinate. The teacher says MISS if the point is not a vertex of the figure and records a tally mark under the miss column of the chart or T-table drawn on the board. If the student guesses correctly the teacher says HIT and records a tally in the hit column. The students will record the hits and misses on their recording sheets by circling the coordinates that have a HIT or by marking the MISSES with an X.
If geoboards are being used, students can record the HITS by marking the coordinates with the same color snap cube. Have the students use a different color snap cube to mark all of the MISSES.

Notes and textbook references

Object of the game:
To guess all four vertices of the trapezoid within 20 guesses. Make play more difficult by reducing the number of guesses to 15 or 10.

MISS HIT



Extension: Use this activity with other mystery polygons. Make a different polygon and have students find the vertices to discover what polygon is graphed.

Notes and textbook references

3.02 Describe the relative position of lines using concepts of parallelism and perpendicularity.

A. Use dot paper, rulers and colored pencils. Draw line designs. Then label the line segments. Tell which line segments are parallel and which are perpendicular.

B. With a straight edge on plain paper, have each student draw a series of random straight lines covering much of the page. The paper should contain at least one set of each of: parallel, perpendicular, and intersecting lines. When complete, have students pair up, find, and color code the parallel lines, perpendicular lines, and intersecting lines on each other's paper.

C. Make parallel lines on geoboards that are horizontal, vertical and diagonal. Discover the polygons that can be formed with parallel lines.

D. Explore how many sets of perpendicular fold lines can be formed by continuing to fold a piece of paper into halves over and over. Is there a pattern?

E. Using Logo or a computer disk that creates graphics, students create a design that contains line segments, midpoints, intersecting lines, parallel lines, and perpendicular lines.

F. Divide class into pairs. Each pair is given a bundle of 12 toothpicks. Player A releases the bundle onto a flat surface. Then player A identifies any parallel lines, perpendicular lines, line segments, or intersecting lines. One point is awarded for each item identified. Then player B collects the toothpicks and proceeds in the same manner as player A. Player with the most points after five rounds wins.

G. Make full-page copies of the North Carolina flag. Have students color the flag. Then glue straws over all line segments. Identify any parallel, intersecting, or perpendicular lines. (Makes a good bulletin board display.)

Notes and textbook references

H. Students use tagboard or construction paper and cut out hexagons, triangles, trapezoids, squares, and parallelograms. They create a "Shape Man" by gluing the pieces together. Construct mobiles or hallway display. (Students identify types of lines displayed.)

I. **UP, UP, AND AWAY!!** Create a paper airplane. One pattern is found on page 105 in Complete Writing Lessons for Middle Grades by Marjorie Frank. As the student progresses through each step, he/she must identify any parallel, intersecting, or perpendicular lines.

J. Have students create books around a single concept. For example, after modeling a line segment and its midpoint, ask each student to create a small book of "Line Segments and Their Midpoints". Coffee stir sticks are good materials to use for line segments. Folding end to end will identify the midpoint. Each student creates a "Burrito Book." (Blackline Master III - 6). They glue a stir stick line segment onto each page and then draw details to illustrate where this line segment exists. Encourage them also to write text on each page to explain this line segment even further. For example, a line segment might be a high wire artist's balancing pole that she holds at the midpoint while crossing the wire. The text might say, "This line segment belongs to Willa Wirewalker while she wends her way warily!" Have each student create a book for each concept listed in this objective: midpoints, intersecting lines, parallel lines, and perpendicular lines.

K. Use two straws to demonstrate parallel, perpendicular and intersecting lines. Ask students to find similar models in the classroom architecture, e.g. opposite borders on the bulletin board are parallel, adjacent borders are perpendicular. Bend the straw to illustrate the midpoint.

L. Students look for lines in the classroom, identifying pairs of lines that are parallel, that intersect, or that are perpendicular.

M. Students look for a "Shape of the Day" throughout the school day, recording the number of times that the shape is seen.

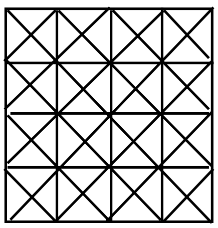
Notes and textbook references

3.03 Identify, predict, and describe the results of transformations of plane figures.

a.) Reflections
b.) Translations
c.) Rotations

A. Begin collecting rich problems and investigations that require the use of geometric concepts. Here are a few beginning ideas:

Square puzzle grid



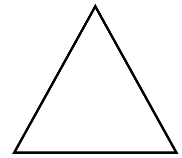
Square Puzzles - How many ways can a square be cut into two equivalent pieces? Two pieces will be considered equivalent if by rotating, reflecting or translating one of the pieces, it can be shown to be congruent to the other. This investigation can be enhanced by having students create a grid of lines on the squares. This grid results when drawing diagonals until 64 right triangles have been drawn, see sample. By drawing along the lines of this grid, students create two equivalent pieces in as many different ways as possible.

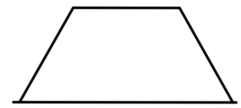
B. Students, working together, use the hexagons (yellow), trapezoids (red), blue parallelograms and triangles of the pattern blocks to find all the different ways to cover "Pattern Block Triangles." Students cover the triangles with the blocks. As a triangle is covered, the students color to record that solution. Students cut out the colored solution. This makes it easier to compare with another triangle solution since they will probably find solutions that are flips or turns or slides of triangles they have already done.

C. It is 3:05 on an analog clock. If the hands are flipped to the left what time will it be? Suppose they are flipped down, what time is it now? Try this with different times during the day.

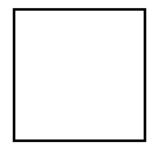
Notes and textbook references

D. Place a trapezoid on the overhead for all to see. Have students take turns at the overhead, rolling a number cube. Turn off the overhead to block the view. If the number cube lands on a 1 or 2, the student will rotate (turn)the trapezoid. If the number cube lands on a 3 or 4, the student will reflect (flip) the trapezoid. If the number cube lands on a 5 or 6, the student will translate (slide) the trapezoid. Turn the overhead back on. If a person from the opposite team can describe the activity, one point is awarded for the correct answer. (Can be played as teams or individuals.)

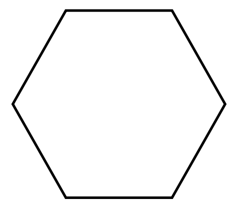




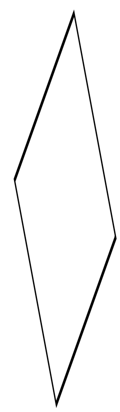
E. Explore which of the six pattern block pieces can be used to demonstrate clearly a flip, a turn, and a slide. If a figure looks the same after the transformation, we would not consider it a good model. Record findings on a chart:

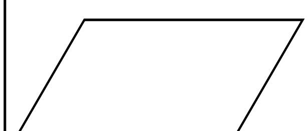


	REFLECTION	ROTATION	TRANSLATION
HEXAGON			
TRAPEZOID			
SQUARE			
TRIANGLE			
BLUE PARALLELOGRAM			
TAN PARALLELOGRAM			



In their journals, have students summarize which pattern block pieces can be used to demonstrate all three transformations . . . only two . . . only one . . . none at all.





Notes and textbook references

By creating a floor plan to scale, students can create a complete picture of the school building. There are several different things going on here:
• using a scaled approach by having one inch represent a larger measure, such as one foot or one yard

• computing actual areas in square feet/ square yards and then converting this to square inches/square feet . . . hopefully, not to be confused with the scale used for the drawings.

F. Using the orange squares from the pattern blocks, one-inch ceramic tiles or one-inch paper squares, students work in groups to discover what are polyominoes and their possible arrangements. Starting with two squares, how many ways can those two be arranged so that they follow the rule that squares must share at least one side with another square? There is only one way and it is called a domino. If a shape can be turned or flipped or slid so that the two look alike they are considered the same. Students take three squares and see how many arrangements are possible following the rule that squares share at least one side with another square. (There are five possible triminoes.) There are five possible solutions to a four-square puzzle. They are called tetrominoes. Continue on with five squares and all the possible solutions. These are pentominoes. (There are five possible pentominoes.) Continue on with six squares. These are called hexominoes. (There are thirty-five possible hexominoes.) See Blackline Master II - 5.

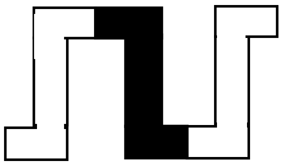
G. Return to using geoboards in groups of four. Provide each group with 4 “job cards” stating “original shape”, “rotation”, “reflection”, and “translation”. Each student draws a card. The one drawing “original shape” creates a polygon on his/her geoboard with one rubber band. The student drawing “rotation” creates the rotation of the same shape on his/her geoboard. The student with the “translation” card creates a translation of this same shape and the “reflection” student creates a reflection of the original shape. The group must then find a way to verify that they have successfully created a rotation, reflection, and translation of the original shape. When they have indeed verified this, they switch “job cards” and repeat the process. Students who are ready for a greater challenge could create combinations of “jobs”. For example, a “ro-flection” might be a rotation and reflection of a given shape while a trans-tation could be a translation followed by a rotation.

H. Use a trapezoid from the tangram set to illustrate flips, slides and turns on the overhead. Try another shape from the same set. (See Blackline Master II - 6.)

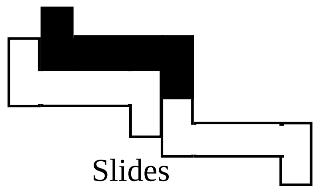
I. Juxtapose two congruent shapes on the overhead. Call one shape “Aaron” and the other “Billy.” What moves (rotations, translations and reflections) will it take to move “Aaron” onto “Billy” ? Is there more than one way to do it?

Notes and textbook references

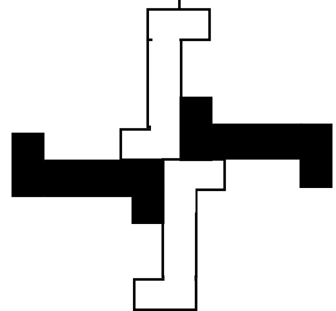
J. Students create borders from a single simple design element which is repeated using rotations, reflections, and translations.



Flips



Slides



Turns

One of the most common applications of area is land measure.

Old deeds in the United States included land measures in sections, rods, chains, acres, and townships. The English system commonly uses the acre as a land measure. There are 4,840 square yards in one acre. Large land measures are usually reported in square miles. One square mile is equal to 640 acres.

In the metric system, small land areas are measured in “are” (pronounced “air”) and denoted by “a”. An are is 10 meters by 10 meters or 100 square meters. Larger land areas are measured in “hectares.” A hectare is 100 are. Thus, 1 ha (the denotation for hectare) is a piece of land 100 meters by 100 meters, or 10,000 square meters. For very large land measures, the square kilometer is used.

Notes and textbook references

K. Trace the basic shape of your county from a North Carolina map. Predict how that figure will look after you flip, slide, or turn it different amounts. Experiment, trace, and label the transformation.

L. Use a non-regular geometric shape to create a picture incorporating turns, flips, and slides.

M. Give each student a set of tangram pieces and several tangram puzzle sheets for practice in turning, flipping and sliding the seven pieces to fit inside the form.

N. Let students cut out a cardboard pattern of an interesting figure. Make a design by tracing around the design and then do a flip, slide or turn. Trace again. Repeat until a design is made.

O. Using the geoboard, Player A constructs a geometric figure. Player B will choose a card from a deck of index cards (labeled with either the word flip, turn, or slide). Whatever the card has written on it, Player B must reconstruct Player A's shape to match the direction on the card chosen. Player B scores if the new figure is correct. The player with the most points after six rounds wins.

P. Have your students place three pattern blocks side by side. Use a triangle, a parallelogram, and a trapezoid. Small pieces of tape help hold the designs together as students move them around. Trace around the blocks. Have the students reflect (flip) the figure in several directions. Trace the reflections. Use the same activity to rotate (turn) and translate (slide) the figure. Tell students they may use color to identify the pattern blocks as they are transformed.

Notes and textbook references

Q. Have the students make a design using pattern blocks or Cuisenaire Rods. Trace the design on centimeter graph paper. Have each student write down two transformations of their design. In groups of two, exchange designs and directions and follow the transformation directions. The students should check each other to determine whether the directions were followed correctly.

R. In groups of 2 to 5, have the students examine several letters of the alphabet. Ask the students to determine which letters look exactly the same after a transformation as they did before the transformation. Classify the letters according to the transformation(s) that yield(s) exactly the same figure. For instance, the letter "H" translates, rotates, and reflects itself so it would be placed in each category. Use a Venn diagram or make a chart to show how the letters can be categorized.

S. When shapes fit together like tiles (example: bathroom tiles, kitchen floor tiles), they tessellate (cover an area leaving no gaps or overlaps). Shapes tessellate depending on their angles and how you place them. Experiment with tiling by using pattern blocks, tangrams, or pentominoes.

There are many resources related to tessellations. See the Dale Seymour Company catalog for a large collection of tiles.

T. Have students draw stick figures on an index card. Use these figures to model different transformations. Be sure to relate the informal language of flips, slides, and turns to the mathematical vocabulary of reflections, translations, and rotations.

The word tessellation comes from the Latin tessella, which was the small, square stone or tile that the ancient Romans used in their mosaics.

U. See the tessellation activity sheet entitled "Tessellation Originals" (Blackline Master III - 7). Students can create posters, cards, bulletin board designs, and book covers.

Notes and textbook references