Purpose: The following activities allow students to demonstrate their understanding of the coordinate system as well as learn various geometry projects.

Goals: This project addresses the following goals in the NC Standard Course of Study for Grade 6 Math.

3.03 - Locate, give the coordinates of, and graph plane figures which are the results of translations or reflections in all quadrants of the coordinate plane.
3.01 - Describe, extend, analyze, and create a wide variety of patterns to investigate relationships and solve problems.

Procedure: The student will complete all activities. Graph all activities on ¼” graph paper and answer all questions connected with each activity on the sheet provided. DO NOT ANSWER QUESTIONS ON THE GRAPHS!!! Each graph must be drawn using a ruler or straight edge and must be colored.

Grade: This packet will be graded according to the grade sheet included in this packet. This project will count as 2 test grades.

Date Due: This project is due on Friday, May 9, 2008. Please remember to return the grade sheet with your project.
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**COLUMN TOTALS:**

Questions total: (30 pts) __________
Accuracy total: (30 pts) __________
Color/Neatness total: (20 pts) __________
Turning project in on time: (10 pts) __________
Overall Presentation: (10 pts) __________

**Project Grade:** __________
Activity 1: Maps

1. Use the graph paper vertically (the usual position). Put the origin in the center.

2. Locate these points and label them:

   | A = (1, 2)  | G = (1, -8) | M = (-6, -2) |
   | B = (4, 2)  | H = (-1, -7) | N = (-8, 0) |
   | C = (5, 1)  | I = (-2, -3) | O = (-5, 0) |
   | D = (5, -4) | J = (-3, -3) | P = (-5, 5) |
   | E = (2, -5) | K = (-4, -4) | Q = (-2, 5) |
   | F = (1, -6) | L = (-5, -4) | R = (-2, 3) |

3. Connect A to B to C to D and so on. Be sure to connect R to A. **What do you see?**

4. Multiply the coordinates of each point by 2 to get new points A’, B’, C’, and so on. Fill in the coordinates below.

   | A’ = (2, 4)   | G’ = ( , )   | M’ = ( , )   |
   | B’ = ( , )   | H’ = ( , )   | N’ = ( , )   |
   | C’ = ( , )   | I’ = ( , )   | O’ = ( , )   |
   | D’ = ( , )   | J’ = ( , )   | P’ = ( , )   |
   | E’ = ( , )   | K’ = ( , )   | Q’ = ( , )   |
   | F’ = ( , )   | L’ = ( , )   | R’ = ( , )   |

5. Locate A’, B’, C’, and so on, and connect them in the same way as A, B, C, and so on.

6. **What do you see?**
Activity 2: King Tut

1. Use the graph paper vertically. Put the origin in the center.

2. Locate and label these points:

   A = (1,5)      B = (7,-2)      C = (4,-3)
   D = (-4,-3)    E = (-1,-2)

3. Make solid lines AB, AC, BC, CD, AD.

4. Make dashed lines AE, DE, EB.


   A’ = ( , )      B’ = ( , )      C’ = ( , )
   D’ = ( , )      E’ = ( , )


8. **How do the two graphs compare?**
Activity 3: The Incredible Shrinking Cube

1. Use the graph paper horizontally. Put the origin in the lower left-hand corner.

2. Locate and label these points:
   A = (12,12)  B = (12,20)  C = (20,20)  D = (20,12)
   E = (16,24)  F = (24,24)  G = (24,16)  H = (16,16)

   Make solid lines AB, AD, AH, BE, EF, EH, DG, FG, GH. Make dashed lines BC, CF, CD. Do you see a cube?

   A’ = (  ,  )  B’ = (  ,  )  C’ = (  ,  )  D’ = (  ,  )
   E’ = (  ,  )  F’ = (  ,  )  G’ = (  ,  )  H’ = (  ,  )


   A’’ = (  ,  )  B’’ = (  ,  )  C’’ = (  ,  )  D’’ = (  ,  )
   E’’ = (  ,  )  F’’ = (  ,  )  G’’ = (  ,  )  H’’ = (  ,  )

6. Locate the points in part 5 on the same graph. Make the same dotted and dashed lines that you made in part 2.

8. Turn your paper half-way around. **What do you see?**

9. Draw another cube that lines up with the three you have and is smaller than the others. Label these new points.

\[ a = ( , ) \quad b = ( , ) \quad c = ( , ) \quad d = ( , ) \]
\[ e = ( , ) \quad f = ( , ) \quad g = ( , ) \quad h = ( , ) \]
Activity 4: Diamonds are Forever

1. Use the graph paper vertically. Put the origin in the center.

2. Locate and label these points:

   A = (0,12)   B = (-2,8)   C = (2,8)   D = (0,4)
   E = (4,4)   F = (2,0)   G = (-4,4)   H = (-2,0)
   I = (-4,-4)   J = (-6,0)   K = (-2,-8)   L = (0,-4)
   M = (2,-8)   N = (4,-4)   O = (6,0)

   Connect ABDCA, BGHD, DFEC, GJIH, HLF, FNOE, IKL, LMN.

3. **How many small diamonds do you see?**

4. Draw some more of the pattern so you have at least fifteen small diamonds.

5. **What are some easy ways you found to continue the pattern? Explain them.**
Activity 5: Kites or Stingrays?

1. Use the graph paper vertically. Put the origin in the center.

2. Locate and label these points:

   \(A = (0,4)\)  \(B = (-2,2)\)  \(C = (0,0)\)  \(D = (4,2)\)
   \(E = (6,0)\)  \(F = (4,-2)\)  \(G = (0,-4)\)  \(H = (-2,-2)\)
   \(I = (-6,0)\)  \(J = (-8,-2)\)  \(K = (-6,-4)\)  \(L = (-2,-6)\)
   \(M = (0,-8)\)  \(N = (4,-6)\)  \(O = (6,-4)\)  \(P = (-2,-10)\)
   \(Q = (-6,-8)\)  \(R = (-8,-6)\)

Connect \(ABCDA, BIHC, CFED, IJKH, HGF, KRQLK, LG, GNOF, LMN, QPM\).

3. **What kind of small shape do you see?**

4. Draw more of a pattern. Add at least six more of the shapes.

5. Look back in part 2 at the coordinates for points \(A, C, G,\) and \(M\). **What do they have in common?**

6. **Do you see any patterns? Describe them.**

7. Look at the coordinates for points \(I, C,\) and \(E\). **What do they have in common?**

8. Look at the coordinates for points \(B, H, L,\) and \(P\). **What patterns do you see?**
Activity 6: Slides

1. Use the graph paper horizontally. Put the origin in the center.

2. Locate and label these points:

   A = (-4,-2)   B = (-2,2)   C = (1,2)   D = (5,-2)
   Connect ABCDA. The figure you have is called a \textit{trapezoid}.

3. Add 10 to each \(x\)-coordinate and 5 to each \(y\)-coordinate to get A1, B1, C1, D1.
   List the coordinates below:

   \[
   A1 = (6,3) \quad B1 = (\ ,\ ) \quad C1 = (\ ,\ ) \quad D1 = (\ ,\ )
   \]

4. Locate A1, B1, C1, D1 and connect them to make a trapezoid.

5. Draw a straight arrow from A to A1. \textbf{How far over and how far up is it from A to A1?}

6. Add 10 to each \(x\)-coordinate in part 1, and subtract 5 from each \(y\)-coordinate in part 1.
   Call these points A2, B2, C2, and D2. List the coordinates below:

   \[
   A2 = (\ ,\ ) \quad B2 = (\ ,\ ) \quad C2 = (\ ,\ ) \quad D2 = (\ ,\ )
   \]
   Locate these points and connect them to make a trapezoid.
7. Draw an arrow from A to A2. How far over and how far down is it from A to A2?
8. What kind of motion will move the trapezoid from ABCD onto A2 B2 C2 D2?

9. What would you do to the coordinates of A, B, C, and D to slide the trapezoid ABCD ten squares to the left and five up?
Try your guess and locate these points:
A3 = ( , )   B3 = ( , )   C3 = ( , )   D3 = ( , )

10. What would you do to the coordinates of A, B, D, and D to slide the trapezoid ABCD ten squares to the left and five squares down?
Try your guess and locate these points:

11. Remember that the vertices of the original trapezoid had these coordinates:
A = (-4,-2)   B = (-2,2)   C = (1,2)   D = (5,-2)
Suppose the trapezoid was slid eight squares to the right and twelve up. Without drawing it, give the coordinates of the vertices:
A5 = ( , )   B5 = ( , )   C5 = ( , )   D5 = ( , )

12. Suppose ABCD were slid seven squares to the left and nine down. Without drawing it, give the coordinates of the vertices:
A6 = ( , )   B6 = ( , )   C6 = ( , )   D6 = ( , )
Activity 7: Flips

1. Use the graph paper vertically. Put the origin in the center. Locate these points:
   A = (3,3)   B = (5,7)   C = (8,7)   D = (12,3)
   Connect ABCDA to make a trapezoid.

2. Multiply each first coordinate by -1 to get A1, B1, C1, D1.
   A1 = (   ,   )   B1 = (   ,   )   C1 = (   ,   )   D1 = (   ,   )
   Locate these points and connect them to make a trapezoid. **How is this trapezoid related to the one you made in part 1?**

3. Now multiply each second coordinate in A, B, C, D by -1 to get new points:
   A2 = (   ,   )   B2 = (   ,   )   C2 = (   ,   )   D2 = (   ,   )
   Locate these points and connect them to make a trapezoid. **How is this trapezoid related to the one you made in part 1?**

4. Now take the points in part 2 and multiply each second coordinate by -1 to get new points:
   A3 = (   ,   )   B3 = (   ,   )   C3 = (   ,   )   D3 = (   ,   )
   Locate these points and connect them to make a trapezoid. **How is this trapezoid related to the one you made in part 2?**

5. Take the points from part 3 and multiply each first coordinate by -1 to get new points:
   Locate and connect them to make a trapezoid. **Is it the same as the trapezoid in part 4?**
6. Start a new picture on another vertical piece of graph paper. Put the origin in the center of the page.

7. Locate these points:
   E = (0,0)   F = (2,7)   G = (2,4)   H = 6,8)
   I = (6,4)   J = (8,4)   K = (9,0)
   Connect EFGHIJK

8. Multiply each first coordinate by -1 to get new points:
   E1 = (  ,  )   F1 = (  ,  )   G1 = (  ,  )   H1 = (  ,  )
   I1 = (  ,  )   J1 = (  ,  )   K1 = (  ,  )
   Locate and connect the points. **What do you see?**

   Is your picture symmetrical? How?

9. Now multiply all the second coordinates in part 7 by -1 to get new points.
   E2 = (  ,  )   F2 = (  ,  )   G2 = (  ,  )   H2 = (  ,  )
   I2 = (  ,  )   J2 = (  ,  )   K2 = (  ,  )
   Locate these points and connect them. **What do you see?**

10. Finally, multiply all the first coordinates in part 9 by -1 to get new points:
    E3 = (  ,  )   F3 = (  ,  )   G3 = (  ,  )   H3 = (  ,  )
    I3 = (  ,  )   J3 = (  ,  )   K3 = (  ,  )
    Locate and connect these points. **What do you see?**

11. **Is your picture symmetrical? How? Is the left side a mirror of the right? Is the top a mirror of the bottom?**
Activity 8: Turns

1. Use the graph paper vertically. Put the origin in the center of the paper.

2. Locate and label these points:

   A = (0,0)  B = (5,10)  C = (5,4)  D = (4,6)  E = (1,0)
   Connect ABCDEA to make an arrow.

3. Multiply each coordinate in part 2 by -1 to get new coordinates:

   A1 = (0,0)  B1 = (-5,-10)  C1 = ( , )  D1 = ( , )  E1 = ( , )
   Locate and connect these points.

   How is the new arrow related to the first one?

4. Start a new picture on another piece of graph paper. Use it vertically. Put the origin in the center.

5. Choose your own points on the graph paper.

   Use twelve or fewer. Record the coordinates here and name them.

   = ( , )  = ( , )  = ( , )  = ( , )
   = ( , )  = ( , )  = ( , )  = ( , )
   = ( , )  = ( , )  = ( , )  = ( , )
   Locate and connect your points on the graph paper.
6. Multiply each coordinate in part 5 by -1 to get new points: (Remember to name your new points.)

\[= (, ) \quad = (, ) \quad = (, ) \quad = (, )\]

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7. Look carefully at your picture. Do you see that your original design has been turned? How has it been turned?
Activity 9: ZigZag

1. Use the graph paper horizontally. Put the origin in the center.

2. Locate and label these points:
   A = (-10, 0)  B = (-5,0)  C = (0,0)  D = (5,0)
   E = (10,0)   F = (15,0)  G = (17,3)  H = (12,3)
   I = (7,3)    J = (2,3)   K = (-3,3)  L = (-8,3)
   M = (-10,6)  N = (-5,6)  O = (0,6)   P = (5,6)
   Q = (10,6)   R = (15,6)  S = (17,9)  T = (12,9)
   U = (7,9)    V = (2,9)   W = (-3,9)  X = (-8,9)

Connect ABKLA, BCJK, CDIJ, DEHI, EFGH, KNML, JON, IPO, HQP, GRO, RSTQ, TUP, UVO, VWN, WX.
The figure ABKL is called a parallelogram. **How many parallelograms do you see?**

3. Make another row of the pattern. Be sure it zigzag!

4. Look back in part 2 at the coordinates for A, B, C, D, E, F. **Do you see any patterns in the first coordinates (-10, -5, 0, 5, 10, 15)?**

**What do you notice about the second coordinates?**

5. Look back in part 2 at the coordinates for G, H, I, J, K, L. **Do you see any patterns?**

6. List the new points that you added to the pattern in part 3. **Do you see any patterns? Describe them.**
Activity 10: Create Your Own

1. Set up an x-axis and a y-axis on your graph paper.

2. Draw a design on your graph paper. You will need a minimum of 25 ordered pairs. (Keep in mind that sometimes simple is better.)

3. Make a list of the ordered pairs necessary to create your design. Be sure to include directions that indicate where it is necessary to lift the pencil and where it is necessary to connect each point to the next one in the order that you have them listed.

4. Color your graph.