To Geometry Students and Families:

Attached is the Geometry summer project for the 2014-2015 school year. This project was created to help introduce you to some of the fundamental ideas necessary for success in Geometry. This project will allow you to demonstrate your creativity and apply what you know about mathematics. If you feel that you need further assistance, you can explore the videos on “Geometric Constructions” available at https://www.khanacademy.org.

All Geometry summer projects are due on the first day of school and opening day activities will be based on this project. Additional copies are available at http://www.piscatawayschools.org under “Curriculum & Instruction” or at the Piscataway Township Central office located at 1515 Stelton Road.

This project will be 5% of the first marking period for all Geometry students. Scoring will be based on completeness, accuracy, organization, and explanation. The rubric for the elements of grading is attached.

Have fun completing the packet and enjoy your summer! If you have any questions about the project, please call (732) 981-0700 x2241 and leave a detailed message. I will check my messages periodically and return your call when I have the chance.

Sincerely,
Daniel J. Ross, Esq.
Mathematics Department Chair
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Fax: (732) 981-1685
dross@pway.org
Project Description

For this project you will construct various figures to practice your skills with the basic tools of Geometry (compass, protractor, and straight edge/ruler) and then incorporate these constructions into an original artwork using the specifications below. Make sure that you follow the rubric provided to ensure you complete the project fully and receive the maximum number of points per section. And please remember to be original and creative – you can create anything you like!

Objective:
- To create an art piece utilizing geometric constructions with straightedge and compass.

Procedure:
1. Use the Construction Reference with Web Video Resources to familiarize yourself with basic constructions.
2. Complete the Construction Practice using your compass and straight edge (ruler) leaving all marks and confirming with protractor as directed.
3. Create a work of art that uses at least four distinct geometric constructions following the requirements outlined below.
4. On a separate page, write a summary that contains the following information:
   a. Identify the constructions you used and locate each one in your picture.
   b. Define the two types of symmetry used and locate them in your picture. How does each symmetry affect the angles and segments involved?
   c. Describe your artwork. What is it? What do you like about your subject? (Note: this must still be done if your art work is abstract.)
   d. Describe how having to use constructions and symmetry affected the planning of your artwork.
   e. What did you learn during this project?
5. Complete the Notations Reference Sheet.
7. Review the grading rubric to ensure your project has all required components and is complete.

Artwork Requirements:
- Dimensions of your artwork should be on unlined paper at least 8” x 11” and no larger than 11” x 16” (equivalent to 1-2 sheets of notebook paper).
- Your picture must include at least four distinct geometric constructions (e.g., bisecting an angle, constructing a parallel line). You may include a construction more than once (e.g., bisecting another angle), but this will not count towards your goal of four.
- Your construction work must be shown. Keep all “arc marks” left by your compass in your final product. (You may color these or otherwise incorporate them into your drawing, but they should be clearly visible.)
- You must incorporate both rotational and reflection symmetry into your artwork.

What You Need to Hand in:
- Construction Practice Problems
- Completed Artwork
- Notation Reference Sheet
- Parent/Guardian Sign-Off
- Geometry Summer Project Rubric
Constructions Reference

**Construct the perpendicular bisector of a line segment.**  
Or, construct the midpoint of a line segment.

1. Begin with line segment $XY$.

2. Place the compass at point $X$. Adjust the compass radius so that it is more than $(\frac{1}{2})XY$. Draw two arcs as shown here.

3. Without changing the compass radius, place the compass on point $Y$. Draw two arcs intersecting the previously drawn arcs. Label the intersection points $A$ and $B$.

4. Using the straightedge, draw line $AB$. Label the intersection point $M$. Point $M$ is the midpoint of line segment $XY$, and line $AB$ is perpendicular to line segment $XY$.

Web Resource: [http://www.youtube.com/watch?v=5bvjnlMeMn5A](http://www.youtube.com/watch?v=5bvjnlMeMn5A)
**Given point P on line k, construct a line through P, perpendicular to k.**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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</thead>
</table>
| 1.   | Begin with line k, containing point P.  
      | ![Diagram 1](image1.png) |
| 2.   | Place the compass on point P. Using an arbitrary radius, draw arcs intersecting line k at two points. Label the intersection points X and Y.  
      | ![Diagram 2](image2.png) |
| 3.   | Place the compass at point X. Adjust the compass radius so that it is more than $(\frac{1}{2})XY$. Draw an arc as shown here.  
      | ![Diagram 3](image3.png) |
| 4.   | Without changing the compass radius, place the compass on point Y. Draw an arc intersecting the previously drawn arc. Label the intersection point A.  
      | ![Diagram 4](image4.png) |
| 5.   | Use the straightedge to draw line AP. Line AP is perpendicular to line k.  
      | ![Diagram 5](image5.png) |

Web Resource: [http://www.youtube.com/watch?v=1krqS8hSip0](http://www.youtube.com/watch?v=1krqS8hSip0)
**Given point R, not on line k, construct a line through R, perpendicular to k.**

1. Begin with point line \( k \) and point \( R \), not on the line.

2. Place the compass on point \( R \). Using an arbitrary radius, draw arcs intersecting line \( k \) at two points. Label the intersection points \( X \) and \( Y \).

3. Place the compass at point \( X \). Adjust the compass radius so that it is more than \((\frac{1}{2})XY\). Draw an arc as shown here.

4. Without changing the compass radius, place the compass on point \( Y \). Draw an arc intersecting the previously drawn arc. Label the intersection point \( B \).

5. Use the straightedge to draw line \( RB \). Line \( RB \) is perpendicular to line \( k \).

Web Resource: [http://www.youtube.com/watch?v=35iBLh-ItG8](http://www.youtube.com/watch?v=35iBLh-ItG8)
Construct the bisector of an angle.

1. Let point $P$ be the vertex of the angle. Place the compass on point $P$ and draw an arc across both sides of the angle. Label the intersection points $Q$ and $R$.

2. Place the compass on point $Q$ and draw an arc across the interior of the angle.

3. Without changing the radius of the compass, place it on point $R$ and draw an arc intersecting the one drawn in the previous step. Label the intersection point $W$.

4. Using the straightedge, draw ray $PW$. This is the bisector of $\angle QPR$.

Web Resource: http://www.youtube.com/watch?v=llwvSzfUkOY
**Construct an angle congruent to a given angle.**

1. To draw an angle congruent to $\angle A$, begin by drawing a ray with endpoint $D$.

   ![Diagram](image1.png)

2. Place the compass on point $A$ and draw an arc across both sides of the angle. Without changing the compass radius, place the compass on point $D$ and draw a long arc crossing the ray. Label the three intersection points as shown.

   ![Diagram](image2.png)

3. Set the compass so that its radius is $BC$. Place the compass on point $E$ and draw an arc intersecting the one drawn in the previous step. Label the intersection point $F$.

   ![Diagram](image3.png)

4. Use the straightedge to draw ray $DF$.

   $\angle EDF \cong \angle BAC$

   ![Diagram](image4.png)

Web Resource: [http://www.youtube.com/watch?v=AkvNo6PQsRs](http://www.youtube.com/watch?v=AkvNo6PQsRs)
Given a line and a point, construct a line through the point, parallel to the given line.

1. Begin with point $P$ and line $k$.

2. Draw an arbitrary line through point $P$, intersecting line $k$. Call the intersection point $Q$. Now the task is to construct an angle with vertex $P$, congruent to the angle of intersection.

3. Center the compass at point $Q$ and draw an arc intersecting both lines. Without changing the radius of the compass, center it at point $P$ and draw another arc.

4. Set the compass radius to the distance between the two intersection points of the first arc. Now center the compass at the point where the second arc intersects line $PQ$. Mark the arc intersection point $R$.

5. Line $PR$ is parallel to line $k$.

Web Resource: [http://www.youtube.com/watch?v=d5YxbX_9hto](http://www.youtube.com/watch?v=d5YxbX_9hto)
Given a line segment as one side, construct an equilateral triangle. This method may also be used to construct a 60° angle.

1. Begin with line segment $TU$.

2. Center the compass at point $T$, and set the compass radius to $TU$. Draw an arc as shown.

3. Keeping the same radius, center the compass at point $U$ and draw another arc intersecting the first one. Let point $V$ be the point of intersection.

4. Draw line segments $TV$ and $UV$. Triangle $TUV$ is an equilateral triangle, and each of its interior angles has a measure of 60°.

Web Resource: [http://www.youtube.com/watch?v=t-ZtoNhEYWQ](http://www.youtube.com/watch?v=t-ZtoNhEYWQ)
Constructions Practice

Complete each of the constructions using a pencil, compass, and straight edge. Leave all compass marks.

1. Construct a perpendicular bisector of \( \overline{XY} \), label the midpoint M and the perpendicular bisector \( \overline{AB} \). Confirm with a protractor that the lines are perpendicular.

2. Given point P on line k, construct a line m through P, perpendicular to line k. Confirm with a protractor that the lines are perpendicular.
3. Given point R, not on line k, construct a line j through R, perpendicular to line k. Confirm with a protractor that the lines are perpendicular.

![Diagram of line k with point R and line j](image)

4. Construct the bisector of $\angle ABC$. Confirm with a protractor the measurements of these angles.

![Diagram of triangle ABC with bisector](image)

5. Construct an angle congruent to a given angle using the ray provided. Confirm with a protractor the measurements of these angles.

![Diagram of angles with congruent angle](image)
6. Given line \( k \) and point \( A \), construct a line \( n \) through the point \( A \), parallel to line \( k \).

7. Construct an equilateral triangle \( ABC \) given side \( \overline{AB} \).
# Geometry Summer Project Grading Rubric

## Creativity:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
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| 12-16 | Original design is very clever; creatively designed  
Original design is either completely original or combines non-original designs in an original way.  
Coloring, etc. on all designs is creative and shows care and creativity.  
Original design has a line of symmetry and rotational symmetry. |
| 8-11  | Original design displays creative thinking  
Some portion of the original design is copied from another source, but most is original.  
Coloring, etc. on most designs is creative and shows care and creativity.  
Original design has either a line of symmetry or rotational symmetry. |
| 4-7   | Original design shows some creative thinking  
Most of the original design is copied from another source, but some portions are original in nature.  
Coloring, etc. on designs is somewhat creative and shows some care and creativity.  
Original design attempts to include line of symmetry or rotational symmetry. |
| 0-3   | Original design lacks creativity  
“Original” design is fully copied from another source.  
Designs are not colored and little care is shown.  
Original design does not include line of symmetry or rotational symmetry. |

## Effort:

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| 16-20 | The project clearly shows that much effort was put into producing an excellent design.  
The project looks complete – nothing was left undone.  
Risks were taken in terms of design (design is complex, materials used are unique, etc.)  
Written summary answers all questions fully. |
| 10-15 | The project shows that good effort was put into producing the design.  
The project looks mostly complete – some touch up is still required.  
Some risks were taken in terms of design (design is relatively complex, materials used are mostly unique, etc.)  
Written summary answers most questions fully |
| 5-9   | The project looks like parts of it were thrown together at the last minute.  
The project does not look complete – a lot of work is still required.  
Few risks were taken in terms of design (design is relatively simple, materials used are predictable, etc.)  
Written summary answers questions partially. |
| 0-4   | The project looks as if it were put together in a hurry.  
The project is not complete.  
No risks were taken in terms of design (design is very simple)  
No written summary is included. |

## Construction Practice: You will receive one point per completed construction for a total of 7 points.

## Notation Reference Sheet: You will receive one point per completed word on the notation reference sheet for a total of 8 points.

## Parent/Guardian Sign-Off: This section will be worth 5 points
## Notation Reference Sheet

<table>
<thead>
<tr>
<th>Vocabulary Word</th>
<th>Definition/Picture</th>
<th>Notation</th>
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<tbody>
<tr>
<td>Point</td>
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Parent/Guardian Sign-Off

My student, ____________________________, has completed this project and has a compass, protractor, and ruler for his /her Geometry class this school year.

_________________________________  _______________________________________
Parent/Guardian Signature                        Date