General Information

Teacher Name: Jenny Ford and Renee Grogg, Chase Elementary
Subject: Math and Visual Arts, 3rd Grade

Topic: Geometry in art and architecture
Time Frame: Ten, 40-minute periods

Guiding Questions: If students realize that geometry is present in their everyday environments and learn to use it as an organizing principle in their art-making, will their ISAT scores increase?

Student guiding question: How can we use geometric concepts as building blocks to create art and architecture?

Goals, Standards and Vocabulary

Overview (How and where this art-integrated unit fits into the curriculum):
This unit should be presented in the month before the ISAT testing and aligns with the geometry unit of the Everyday Math Series, a University of Chicago textbook series for math in grades K-6 aligned with the state standards with a spiraling curriculum.

Goals (What students will realize by using the art form to activate content area):
Along with learning about basic geometric concepts from a textbook, students will realize the real life applications of geometry in art and architecture. They will make their own works of art and architecture from basic geometric shapes. Towards the end of this unit, students will go on a field trip to visit architectural landmarks around the city. As a part of the third grade curriculum focuses on Chicago history, this unit should precede the social studies unit.

Academic Standards and Descriptors: Illinois State Standards in the content area that this unit addresses.
Stage C
9A. Students who meet the standard can demonstrate and apply concepts involving points, lines, planes and space. (Properties of single figures, coordinate geometry and constructions)
   9A.3. Identify, draw, and build polygons
9B. Students who meet the standard can identify, describe, classify and compare relationships using points, lines, planes and solids. (Connections between and among multiple geometric figures)
   9B.5. Apply geometric ideas and relationships to problems that arise in the classroom or everyday life.
9C. Students who meet the standard can construct convincing arguments and proofs to solve problems. (Justifications of conjectures and conclusions)
   9C.1. Make and test conjectures about mathematical properties and relationships and justify the conclusions.

Fine Arts Standards and Descriptors: Illinois State Standards in the fine arts that this unit addresses.
Stage C
25A. Students who meet the standard can understand the sensory elements, organizational principles and expressive qualities of the arts
   25A.2. Describe line direction (e.g. horizontal, vertical, diagonal)
26A. The students who meet this goal understand the processes, traditional tools and modern technologies used in the arts
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Content and Art Making Activities
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26A.2. Compare the use of two-dimensional and three-dimensional tools and materials in creating art works.

27A. Students who meet the standard can analyze how the arts function in history, society and everyday life.

27A.2. React to performances/art works in a respectful, constructive and supportive manner.

Vocabulary Lists – Content and Art:
Content – polygons, regular and irregular, edge, vertices, triangle, hexagon, line, ray, three-dimensional, two-dimensional, solid, nets, models, rectangular prism, cube, cylinder, square, pyramid, triangular prism, cone, face, diagonal, parallel line, ellipse, trapezoid, rhombus, parallelogram, conjecture.

Art – stylized, Alexander Calder, score, pleat, fold, curl, slot, tab, critique, artistic elements, form, shape, materials, process, horizontal line, vanishing point, Frank Lloyd Wright, contrast, texture, architect, architectural model, landscape, landmark, silhouette.

Miscellaneous – ISAT, goals.

Day 1
Focus:
Assessing prior knowledge of geometric concepts, and introducing new geometric terms

Materials needed:
Pre-assessment tests (Appendix A and Appendix B), string, drafting tools or Everyday Math shape template

Warm-Up and Pre-Assessment Activities:
Give students a pre-assessment test (Appendix A and Appendix B) to gauge their understanding of geometric concepts. The test includes some ISAT-style questions and several pictures in which students have to circle examples of parallel and perpendicular lines or find specific shapes within the image.

After the students complete the pre-assessment test, gather in an open space to do some kinesthetic warm-ups. First, demonstrate to the students how we can use our bodies to create “line segments” and “rays” (feel free to use props, such as construction paper cut outs of arrows to show rays). Then ask the students to identify shapes in the “negative spaces” of our bodies (use arms to make triangles, outline rectangles of our torsos with our fingers, etc). Review the terms “regular polygons” and “irregular polygons” and provide some examples of each, identifying the number of sides and vertices within each.

Main Activity:
Put students in groups of six to eight. Explain that as a group, they have to form a “regular polygon” with one piece of string and with each student holding an angle or point. Encourage students to explore all their options, (i.e. using a ruler or deciding not to use the entire length of string). After the challenge, gather students to share their struggles and ideas with the class.

Wrap-Up and Post Assessment Activities:
Near the end of this session, introduce students to drafting tools (rulers, polygon template, etc.). Have the students experiment with the tools by trying to make their own polygons on paper.
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Day 2
Focus:
Finding polygons in larger images

Materials Needed:
Images of Alexander Calder’s paintings and sculptures that employ geometric shapes to simplify the image (see below), entry task slips (Appendix C), chalk or oil pastel, scissors, construction paper, silhouettes of animals, envelopes

Alexander Calder (American, 1898-1976)
*Homage to the Sun*, 1973
Lithograph, 29 x 43 in.

Warm-Up and Pre-Assessment Activities:
Begin class with an entry task slip that will help assess what geometry vocabulary the students remember from the prior class. (A sample pre-assessment tool would be, “I am a polygon with ____ sides, I am called a __________ and I have ________vertices, draw me on the back side of this paper” (see Appendix C).

Have students use a ruler to draw a regular polygon on the back side of their entry task slip. After they have completed their entry task, show them pictures or a Power Point of works of art which display geometric concepts.

Alexander Calder found simple shapes in nature. What polygons did he see in these mountains?
Alexander Calder used simplifying skills to make his sculptures too. Show the students more examples of how shapes in nature can be broken down, or simplified, into geometric shapes.

Main Activity:
The challenge for the day is to break down a two-dimensional silhouette of an animal into polygons (Polygons Challenge- Appendix D). Hand out the Polygons Challenge worksheet to each student.

Have the students choose an animal from pre-cut animal silhouettes that they want to work with and instruct them to find different ways to divide the animal using polygons. Have the students use a ruler to draw the polygonal shapes onto the silhouette of the animal with chalk or oil pastels. They must fit the polygons as close together as possible so they create the whole figure.

Then, students should cut out the polygon pieces of the animal (hint: save the outer scrap of the image to help guide the student when they have to put the pieces back together). The students should reassemble the polygonal shapes into the animal (like putting a puzzle together) then glue the cut out shapes on paper.

Wrap-Up and Post Assessment Activities:
Gather together in a common area to share out challenges, thought processes and problem solving strategies.

Day 3 and Day 4
Focus:
Turning two-dimensional shapes into three-dimensional shapes

Materials Needed:
Card stock (different colors), glue (a glue gun works best), EAEC Transformation from 2-D to 3-D Step-by-Step Guide

Warm-Up and Pre-Assessment Activities:
Pre-assess the students by giving each an index card and asking them to make it three-dimensional using any strategy. As they come up with ideas of how to turn their two-dimensional cards into three-dimensional forms, identify the strategies they are using (i.e. crumpling, curling, folding—see EAEC Transformation from 2-D to 3-D Step-by-Step Guide). In a large group, show the students how to fold, score, pleat, slot and tab paper.

Main Activity:
Students will use these new techniques taught in the warm-up to turn their two-dimensional animal puzzles from the previous session into three-dimensional sculptures. The students may not use any glue to hold their animal together and they must use the folding techniques taught in the warm-up. When the animal sculptures are complete, help them glue the sculpture onto a base (white cardstock).
At the end of the second day of this lesson, students will have a critique of their sculptures. Discuss the importance of feeling safe as artists. Group the students in fours. Structure the critique session in a way in which the artist is in control.

An example critique structure would be for one artist to go first by talking about his/her work. The artist explains the reasons for what they did, their goals and what they are most proud of in the piece. The other “critics” go around and say something they like about the piece, giving specific compliments, and constructive feedback, creating an art sandwich of a compliment, a constructive feedback and then a final compliment. See EAEC Assessment: Mapping Student Learning Chapter for more critique options.

Wrap-Up and Post Assessment Activities:
Students will display their work, then select another student’s work to identify the various geometric shapes, listing the forms they see on a worksheet that will be evaluated by the teacher.

Come together as a whole group and share how the process of critiquing one another felt. How did it go? How did you feel as the artist being critiqued? What did you like/dislike about the experience?

Day 5
Focus:
Using nets (two-dimensional outlines that can be folded to make three-dimensional shapes) to predict what geometric figures they fold into.

Materials Needed:
Sets of nets and pre-folded three-dimensional models for a cylinder, cube, triangular prism, square pyramid, cone and rectangular prism (one set for each group of 4 students), Nets Worksheets (See Appendix E)

Warm-Up and Pre-Assessment Activities:
Show the students what a net is and demonstrate how to fold one to make a three-dimensional shape.

Main Activity:
Divide students in groups of 4 and give each group one set of nets and models. The students are not allowed to fold the nets. The goal is for each group to match the two-dimensional net with its three-dimensional model. Label the nets with letters and the models with numbers. On the Nets Worksheet (see Appendix E), the students need to write the number of the model, the letter of the net and the correct geometric name of the shape. Students should discuss with their groups why they think each net will make that particular three-dimensional shape.

Wrap-Up and Post Assessment Activities:
Each group member can fold one of the nets to see if their chart is filled out correctly. Come together as a whole group and discuss findings. Which nets confused them? If students did not make the correlation between the base and the shape, point this out to them, and encourage students to help each other make the correct match.
Day 6

Focus:
Using nets to make three-dimensional objects

Materials needed:
Tag board, scissors and tape (to make the rest of the hexagonal prism in pre-assessment?)

Warm-Up and Pre-Assessment Activities:
Have students complete a hexagonal prism challenge. Give them the hexagon for the base of the prism. Challenge them to try to make a hexagonal prism without instruction. Have students examine the models of prisms first. Have them notice the different faces of the other prisms and notice what is similar in each.

Main Activity:
Have the students try to make their own nets from any shape that they choose and then fold it to make the three-dimensional shape. Let them explore this concept for a while. Students who cannot grasp the concept and are having difficulties may use the net templates from the previous lesson to trace and then fold.

Wrap-Up and Post Assessment Activities:
Have students share the three-dimensional shapes that they made with their groups.

Day 7

Focus:
Students are introduced to one-point perspective

Materials needed:
Paper, pencil, cubes (folded from nets), EAEC Perspective Drawing Step-by-Step Guide and/or Appendix F

Warm-Up and Pre-Assessment Activities:
The pre-assessment for perspective drawing is to have students draw cubes from the three-dimensional models. Make sure the face of the cube is pointing toward the students.

Students are taught to draw in one-point perspective, using the handout to follow the seven steps of one-point perspective using a horizon line, vanishing point, diagonal lines, finding the face of the cube, connecting the vertices to the vanishing point using the diagonal lines, and finding parallel lines to define the back edges of the rectangular prism.

Have student synthesize their understanding of one-point perspective by drawing their own rectangular prism in the eighth box of the handout.

Formative Assessment:
Using what they have learned about perspective, have the students draw a variety of geometric solids, including the cylinder, cone, cube, etc.

Main Activity:
Introduce how to hold a pencil when drawing different three-dimensional shapes freehand. Begin by having the students draw a circle, ellipse, square, rectangle, triangle, etc. Then, for instance, have the student draw a “table” by erasing the top of the triangle to create a trapezoid shape. Then have them add rectangles to the bottom corners of the trapezoid shape or “table-top” to represent legs of a table.
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Or, have them add vertical lines dropping down from the curves of the ellipse and have them add a curved parallel line at the base to create a cylinder. They could also introduce shading on a circle to create a sphere. See EAEC Visual Art Step-by-Step Guides for more instructions and ideas.

Wrap-Up and Post Assessment Activities:
Have the students draw objects around the room using the new skills.

Day 8-9
Focus:
Looking at Frank Lloyd Wright's work and his use of geometrical form in his architecture.

Materials needed:
Poster or high quality photo reproductions of Fallingwater by Frank Lloyd Wright (included in the Picturing America poster collection, www.picturingamerica.neh.gov)

Frank Lloyd Wright (American, 1867-1959)
Fallingwater (Kaufmann House), Mill Runn, Pennsylvania, 1935-1939
Photograph of Fallingwater courtesy of the Western Pennsylvania Conservancy, © 2006 Frank Lloyd Wright Foundation, Scottsdale, Ariz./Artists Rights Society (ARS), New York.

Additional images of Fallingwater:
http://www.wright-house.com/frank-lloyd-wright/fallingwater-pictures/F1SW-fallingwater-in-fall.html

Warm-Up and Pre-Assessment Activities:
Conduct a Close Read with the students of Fallingwater (see EAEC Teaching Strategies). Have students discuss what they observe first, not what they infer. Ask about the elements of art, such as shapes, forms, colors, texture, and line—remind them to think about the geometric forms they have been learning about. Ask students about the kinds of lines (horizontal and vertical) they observe in the house. Also, ask them to describe the natural setting around the house. You may want to have students keep track of their observations on paper or make a list for the whole class on the board.

Next, ask the students if they see any similarities in the lines, shapes, or textures of the house and those they see in the natural setting. Are there any geometric forms in the house that they can also find in the setting? Ask them to infer why Frank Lloyd Wright might have created this house with such similarities?

Additional questions to guide the observation phase of the Close Read:
- Can you find a horizontal line segment on the exterior of this building?
- Could you point it out?
- Can you find what appears to be a negative space in the design of the building?
- Where do you see it?
- What patterns do you see?
- Where do you see them?
- Do you see the same shapes and patterns on the interior and exterior of the house?
Teacher can then introduce more specific guided questions that will connect with later activities in the lesson plan.

- Have you seen these patterns before? Where?
- Can you see these patterns in nature?

Next, provide some brief background information about the artist and the artwork.

**The Artist:**
- Frank Lloyd Wright wanted to make the house seem as if it were part of nature.
- He wanted the geometry of his architecture to reflect the geometry he saw in the natural world. (Remind them that they have already found geometric forms nature when they did the animal silhouette exercise.)
- Throughout his career, Wright advocated the use of modern technology to create new spaces that enhance a natural way of life; in essence, re-connecting people with the natural world by using modern materials and methods.

For further information about *Fallingwater* and Frank Lloyd Wright:
- The *Fallingwater* website with lesson plans, curriculum ideas, and background information: [http://www.fallingwater.org/44/curriculum-guide-lesson-plans](http://www.fallingwater.org/44/curriculum-guide-lesson-plans)
- The Frank Lloyd Wright Preservation Trust website has a biography of Frank Lloyd Wright and links to other major research centers: [http://www.gowright.org/index.html](http://www.gowright.org/index.html)

**Main Activity:**
Explain how Wright used Foebel Blocks (wooden geometric forms) as a child. Architects today still use these geometric solids to plan their buildings. Have the students use the solids they have created to plan their dream homes. Have them consider where they will be constructing their home. Like Wright, the students want to consider the location in which they will be constructing. After developing their plans with their solids, the students can draw up their plans with their new drawing skills.

**Day 10**

**Focus:**
Critiquing as artists

**Materials needed:**
Buildings from previous lesson

**Warm-Up and Pre-Assessment Activities:**
Students will have a critique of their house sculptures. Have students display their work on their desks to create a ‘museum’ in the classroom. Students will walk around the ‘museum’ and look at each other’s pieces.

**Main Activity:**
Students will revisit the critique process learned earlier with the animal sculpture. Remember to discuss the importance of feeling safe as artists during a critique. Have the students split into groups of four. One artist goes first by talking about his/her work. The artist explains the reasons for what they did, their goals and what they are most proud of in the piece. The other ‘critics’ go around and share something they like about the piece, giving specific compliments. See EAEC Student Critique Protocol.
Wrap-Up and Post Assessment Activities:
Come together as a whole group and share how the process of critiquing one another went. How did it go? How did you feel as the artist being critiqued? What did you like/dislike about the experience?
If you feel that your students can handle it, model some constructive criticism comments. The idea is to slowly steer students to ask questions and criticize constructively while not “bashing” the artist.

Unit Assessment – Formative and Summative:
The ISAT test will serve as the post-assessment piece for this unit. Other assessments include pre-assessment quizzes entry task slips, problem-solving activities, art-making activities critiques, worksheets and the Close Read. Please see Assessment: Mapping Student Learning for a closer examination of assessments used in this unit.

Unit Support and Resources:
Texts, websites, primary and secondary sources, supplies, materials, outside resources, etc.
EAEC Assessment Chapter
Everyday math series/ website/ math manipulative polygon template
Picturing America Series Images / website/ teacher manual
Nets/ tag board/ tape/rulers

Alexander Calder (American, 1898-1976)
*Homage to the Sun,* 1973
Lithograph, 29 x 43 in.

Alexander Calder (American, 1898-1976)
*The Flamingo,* 1974
53’ high x 29’ wide x 60’ length
Location: Chicago Federal Plaza
Installed: 1974

Frank Lloyd Wright (American, 1867-1959)
*Fallingwater* (Kaufmann House), Mill Runn, Pennsylvania, 1935-1939
Photograph of Fallingwater courtesy of the Western Pennsylvania Conservancy. © 2006 Frank Lloyd Wright Foundation, Scottsdale, Ariz./Artists Rights Society (ARS), New York.

www.picturingamerica.neh.gov
http://www.wright-house.com/frank-lloyd-wright/fallingwater-pictures/F1SW-fallingwater-in-fall.html
Google search: animal silhouettes

Field Trip: Field trip associated with this unit.
Take students on a tour of Chicago to see some of the buildings that students observed and made models of in class.

Documentation (photos, student work, student interviews, etc.):
Photographs, student work, and assessments
1. Find a **CONE** in this castle and color it RED.

2. Find a **CUBE** in this castle and color it GREEN

3. Find a **SQUARE PYRAMID** and color it YELLOW.

4. Find a **RECTANGULAR PRISM** and color it PURPLE.
Appendix B (page 1)

LESSON PLAN
American Art - Calder

Pre-Assessment B

Name:

1. This shape is called a(n) __________.
   A) pentagon
   B) hexagon
   C) octagon
   D) triangle

2. A polygon that has 6 sides and 6 vertices is a(n) __________.
   A) pentagon
   B) hexagon
   C) octagon
   D) trapezoid

3. How many sides does a quadrilateral have?
   A) 3
   B) 4
   C) 5
   D) 6

4. How is a square different from a rectangle?
   A) a square has four equal sides
   B) a square has two equal sides
   C) a square has right angles
   D) a square has parallel sides

5. A shape with 5 sides is known as what?
   A) a rectangle
   B) a hexagon
   C) a pentagon
   D) an octagon

6. This shape is called a __________.
   A) circle
   B) sphere
   C) pentagon
   D) pyramid

7. Which polygon has more sides than a hexagon?
   A) pentagon
   B) triangle
   C) octagon
   D) square

8. A cereal box is shaped like a __________.
   A) pyramid
   B) sphere
   C) rectangular prism
   D) cone

9. An alphabet block is usually shaped like a __________.
   A) pyramid
   B) cone
   C) cylinder
   D) cube

10. A can of soup is shaped like a __________.
    A) pyramid
    B) sphere
    C) cylinder
    D) trapezoid

11. Reflection
    A) reflection
    B) rotation

12. Reflection
    A) reflection
    B) rotation

13. Reflection
    A) reflection
    B) rotation
Appendix B (page 2)

Pre-Assessment B.

**Directions:** Match each three-dimensional shape with a corresponding two-dimensional shape. Some shapes will have more than one answer.

<table>
<thead>
<tr>
<th>Shape 14</th>
<th>Shape 15</th>
<th>Shape 16</th>
<th>Shape 17</th>
<th>Shape 18</th>
<th>Shape 19</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Shape 14" /></td>
<td><img src="image" alt="Shape 15" /></td>
<td><img src="image" alt="Shape 16" /></td>
<td><img src="image" alt="Shape 17" /></td>
<td><img src="image" alt="Shape 18" /></td>
<td><img src="image" alt="Shape 19" /></td>
</tr>
</tbody>
</table>

**20.** Which lines appear to be parallel?

- m and x
- x and y
- m and n
- n and y

**21.** Which shapes below appear to be congruent?

- 1 and 4
- 2 and 4
- 2 and 3
- 1 and 3

**22.** If you were to draw a polygon with 4 equal sides and 4 square corners, what would it look like?

- ![Shape F](image)
- ![Shape G](image)
- ![Shape H](image)
- ![Shape J](image)
Appendix C
Entry Task Slips

Name ______________________

I am a polygon, I have ______________________ sides and ______________________ vertices.

What is my name? ______________________

Draw me on the back

Name ______________________

I am a solid, I have ______________________ sides and ______________________ vertices.

What is my name? ______________________

Draw my net on the back
Appendix D

Polygons Challenge

• CHOOSE ONLY ONE ANIMAL
• FIND THE POLYGONS IN YOUR ANIMALS SHAPE.
• CUT POLYGONS OUT OF CARD STOCK PAPER AND LAY THEM ON YOUR ANIMAL.
• SAVE ALL PIECES IN YOUR ENVELOPE.
### Nets Worksheet

<table>
<thead>
<tr>
<th>NAME</th>
<th>ROOM #</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCABULARY</td>
<td>NET</td>
</tr>
<tr>
<td></td>
<td><img src="image1.png" alt="Net" /></td>
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<tr>
<td></td>
<td><img src="image4.png" alt="Net" /></td>
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<td><img src="image7.png" alt="Net" /></td>
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<td></td>
<td><img src="image10.png" alt="Net" /></td>
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**Appendix E**

American Art - Calder
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<tr>
<th>NAME</th>
<th>ROOM#</th>
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<tbody>
<tr>
<td>#1</td>
<td>#5 CONNECT VERTICES TO THE VANISHING POINT WITH DIAGONAL LINES</td>
</tr>
<tr>
<td>DRAWA HORIZON LINE</td>
<td></td>
</tr>
<tr>
<td>HORIZONTAL</td>
<td></td>
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<tr>
<td></td>
<td>#6 DRAW HORIZONTAL AND VERTICAL PARALLEL LINES TO FACE OF CUBE</td>
</tr>
<tr>
<td></td>
<td>#7 ERASE THE DIAGONAL LINES CONNECTING THE RECTANGULAR PRISM TO THE VANISHING POINT</td>
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<td></td>
<td>#8 TRY IT YOURSELF</td>
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<tr>
<td>#2</td>
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<tr>
<td>DRAW VANISHING POINT</td>
<td></td>
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<tr>
<td>POINT</td>
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<tr>
<td>#3</td>
<td></td>
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<tr>
<td>DRAW THE FACE OF THE CUBE</td>
<td></td>
</tr>
<tr>
<td>FACE</td>
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<td></td>
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<tr>
<td>#4</td>
<td></td>
</tr>
<tr>
<td>MARK THE VERTICES WITH POINTS</td>
<td></td>
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<tr>
<td>VERTICES</td>
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<td>#8</td>
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**Appendix F**

**Perspective Drawing Worksheet**