# Arts & Math Connections

**Title/Description of Lesson**

Proportional enlargement of drawings in art - Using fractions, ratios and proportions to enlarge or scale a drawing... Students will apply knowledge of fractions, proportion, ratio and scale in mathematics to create a scaled enlargement of a portion of Vincent Van Gogh’s ‘The Starry Night’.

**Grade Level:** 5th grade

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## Lesson Links

- **Objectives/Outcomes**
- **Materials and Resources**
- **Vocabulary**
- **Procedures**
- **Criteria for Assessing Student Learning**
- **California Standards in Visual & Performing Arts**
- **California Standards in Math**
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  - Video Resource
  - Vincent Van Gogh
  - ‘The Starry Night’ – Background Information/Knowledge
  - A little Van Gogh humor...
  - Starry_Night_Grid_Drawing
  - Blank_Enlargement_Grid
  - Retch_9_6_Equiv_Fractions_Simplest_Form
  - Enrichment_18_5_Proportional_Enlargement
Objectives/Outcomes  (Return to Links)

- How can an image be enlarged in proportional scale?
- Students will learn that doubling all of an object’s dimensions repeats the proportions and enlarges the size or scale of the object.
- Students will understand that size/scale relationships can be expressed as a fraction or ratio.
- Students will understand that each piece of the original grid, the original drawing, each student’s part of the original drawing, each piece of the enlarged grid, their enlarged piece and the final enlarged drawing are all proportional in a ratio of 3 to 4, 3:4 or 3/4.

Materials and Resources  (Return to Links)

- Art poster or digital image of Vincent Van Gogh’s ‘The Starry Night’(image included in this document).
- Pencil
- Ruler
- Pink Pearl or gum eraser
- Protractor or right angle triangle
- Plain white paper or grid paper
- 1 copy per student of ½ scaled drawing
- 1 copy per student of grid enlargement on white Bristol paper(9”x12” cut to 8 ½”x11” for use in copier)(The teacher will need to cut the paper down to copier size and make copies of the attached full scale grid onto the Bristol paper.)
- Crayons or oil pastels(2 shades of green, 2 shades of blue, 2 shades of brown, orange and golden yellow).. enough for class.
- Scissors
- Depending upon choice of final assemblage of enlarged pieces…
  o 9”x12” black paper and glue stick to glue mural pieces down on or
  o Masking tape to tape across the back of the enlarged pieces.

Vocabulary  (Return to Links)

- Measure – the process of assigning a number to a physical property.
- Doubling – to make twice as great
- Ratio – comparative value of 2 amounts
- Fractions – a ratio of numbers representing part of a whole
- Scale – to enlarge or reduce, the equation that represents the enlargement or reduction.
- Proportion – a part to whole comparison…the equality of two ratios, written as an equation.
- Similar figures – having the same shape but not necessarily the same size.
- Enlarge/blow up – to make bigger
- Shape – A two dimensional/flat space bordered by a real or implied line with a regular or irregular geometric shape.
- Shade – to make darker
Procedures  (Return to Links)

1. Teacher may choose to utilize either or both (Reteach 9.6 or Enrichment 18.5) as a starter activity. Teacher should review equivalent fractions, similar figures, proportion and scale for success in this activity.

2. Teacher hands out ruler, rt. triangle or protractor, plain white or grid paper and pencil. Students are asked to draw a rectangle that is 2 inches in height and 1 ½ inches wide. They are told that this is a ½ scale drawing and that below it they should now draw the full scale rectangle by multiplying each dimension by 2. The full scale rectangle will be 4 inches in height and 3 inches wide. Teacher informs students that in measurement, the use of height and width is not always necessary. That when dimensions are listed with no guidance, it is assumed that the height is always listed first.

3. Discuss the fractional, ratio and scale relationship between 1½:2 and 3:4. What would be the next proportional step both down and up.

4. Following this warm up, the class is divided into groups of 4 students.

5. Teacher projects Van Gogh’s ‘The Starry Night’. Teacher discusses Vincent Van Gogh and utilizes biography/background information to conduct a discussion of the painting.

6. Students can be asked about the scene. (i.e. what’s happening in the picture, colors they see, emotions they feel, identify different types of lines and shapes etc…..note: students often think that the cypress tree on the left hand side is a fire/flames.)

7. Students are put into groups of four.

8. Each student is given
   a. 1 copy per student of ½ scaled drawing
   b. 1 copy per student of the copied grid enlargement on white Bristol paper
   c. Crayons or oil pastels(2 shades of green, 2 shades of blue, 2 shades of brown, orange and golden yellow).enough for each group.
   d. Scissors

9. Within each group, the students must work collaboratively to assign 1 quadrant of the ½ scaled drawing to each student. (they are labeled 1A, 2A, 7B, 8B….there is a darker line down the middle vertically and horizontally to indicate the quadrant boundaries.)

10. Discuss and compare the scale change from the ½ scaled drawing to the full scale grid. They are proportionally the same as in their warm up, step 2 above.

11. Students should use their ruler and pencil to enlarge their chosen/assigned ½ scale drawing on the full scaled grid.

12. Students should be told that they can accurately position where the lines, that they need to draw, will touch the edges of their enlargement by measuring the position on the ½ scaled drawing and then multiplying that measurement by 2 for placement on the enlarged full scale grid.

13. Groups should be encouraged to help each other and to compare results to ensure the edges will match up as best as possible upon completion.
14. After the drawings are complete, students should use the crayons or oil pastels to add color. Teacher should project the image of the sample drawing (SampleDrawing) so that students will be able to select and pattern their colors. Groups will need to work cooperatively in order to match up which shade to use in order for them to match up upon completion.

15. When each quadrant is complete, students will then construct the final enlarged drawing. They will need to cut out their piece and then assemble the pieces together.

16. This is accomplished by flipping the pieces over and using masking tape. If poster paper is available, they could glue them to the paper with a 3 inch border all around.

**Criteria for Assessing Student Learning**  
(Return to Links)

**General statement:** Students duplicate the original shapes proportionally into larger scaled shapes to enlarge a drawing.

**Target Learning:** Students demonstrate an understanding of proportion and ratio with geometric shapes

**Assessment Criteria:** Student completes a scale drawing that repeats the dimensions of the original shapes in a larger scale.

**Target Learning:** Changes scale in a work of art

**Assessment Criteria:** Enlarges the size of an object or shape form a work of art but repeats the original proportions

**Target Learning:** Collaborates with classmates

**Assessment Criteria:** Works collaboratively with group to ensure that grid sections will match up upon completion and that colors used and color saturation used match.

**California Standards in Visual & Performing Arts**  
(Return to Links)

(There are sub-standards by grade level. These are the high level standards that guide instruction at all grade levels.)

**1.0 ARTISTIC PERCEPTION (Learn & Talk)**
Processing, Analyzing, and Responding to Sensory Information through the Language and Skills Unique to the Visual Arts.

Students perceive and respond to works of art, objects in nature, events, and the environment. They also use the vocabulary of the visual arts to express their observations.

**2.0 CREATIVE EXPRESSION (Make)**
Creating, Performing, and Participating in the Visual Arts.

Students apply artistic processes and skills, using a variety of media to communicate meaning and intent in original works of art.

**3.0 HISTORICAL AND CULTURAL CONTEXT (Learn, Look & Talk)**
Understanding the Historical Contributions and Cultural Dimensions of the Visual Arts.
Students analyze the role and development of the visual arts in past and present cultures throughout the world, noting human diversity as it relates to the visual arts and artists.

4.0 AESTHETIC VALUING (Talk)
Students analyze, assess, and derive meaning from works of art, including their own, according to the elements of art, the principles of design, and aesthetic qualities.

5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS (Connect)
Connecting and Applying What Is Learned in the Visual Arts to Other Art Forms and Subject Areas and to Careers.

California Standards in Math (Return to Links)

Number Sense
2.0 Students perform calculations and solve problems involving addition, subtraction, and simple multiplication and division of fractions and decimals:
   2.4 Understand the concept of multiplication and division of fractions.

   2.5 Compute and perform simple multiplication and division of fractions and apply these procedures to solving problems.

Measurement and Geometry
2.0 Students identify, describe, and classify the properties of, and the relationships between, plane and solid geometric figures:
   2.1 Measure, identify, and draw angles, perpendicular and parallel lines, rectangles, and triangles by using appropriate tools (e.g., straightedge, ruler, compass, protractor, drawing software).

Mathematical Reasoning
1.0 Students make decisions about how to approach problems:
   1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

3.0 Students move beyond a particular problem by generalizing to other situations:
   3.1 Evaluate the reasonableness of the solution in the context of the original situation.
   3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
   3.3 Develop generalizations of the results obtained and apply them in other circumstances.
**Other Resources**  *(Return to Links)*
(The information below can be used as is or as resource materials to put together your own PowerPoint or Flipchart presentation.)

**Sample of finished project**…*(Return to Links)*

![Sample of finished project](image)

**Video Resource**  *(Return to Links)*
Link to YouTube video of other drawings and paintings by Van Gogh with soundtrack by Don Mclean (Starry, Starry Night).

[http://www.youtube.com/watch?v=nkvLq0...](http://www.youtube.com/watch?v=nkvLq0...)
**Vincent Van Gogh**  *(Return to Links)*

(March 30, 1853-July 29, 1890) was a Dutch Impressionist painter whose work had a far-reaching influence on 20th century art for its vivid colors and emotional impact. He suffered from anxiety and increasingly frequent bouts of mental illness throughout his life, and died largely unknown, at the age of 37, from a self-inflicted gunshot wound.

**‘The Starry Night’ – Background Information/Knowledge**  *(Return to Links)*

Starry Night is one of Vincent Van Gogh's most famous works. The painting depicts the view outside his sanatorium room window at night, although it was painted from memory during the day.

![The Starry Night painting by Vincent Van Gogh](https://via.placeholder.com/150)

**Dimension**

The Starry Night, painted in 1889, is oil on canvas, measuring 29 inches by 36 1/4 inches. Van Gogh painted ‘The Starry Night’ while in an Asylum at Saint-Remy in 1889.

**Setting**

The painting focuses on the sky above a small town with a large tree in the foreground. The town is based loosely on Saint-Remy while the sky is concocted from Van Gogh's imagination.
**Color Scheme**  
The painting consists mostly of blues, greens and yellows, combined in swirls and various hues. The painting highly contrasts light and dark hues in both the foreground and background.

**11 Stars**  
Vincent Van Gogh was a religious man for most of his life and drew a church steeple into the painting. Many believe the 11 stars in the painting signify a quote in Genesis alluding to 11 stars. This is so far unproved.

**Reproduction**  
Starry Night has been replicated numerous times; it is one of the most well-known images in modern culture. It can be found in prints, calendars, bamboo hangings, magnets, screen savers and many other mediums. One of the most famous uses of the painting is Don McLean's song "Starry, Starry Night," which is based on the painting.

**Description of content of the painting:**

- 1. There is the night sky filled with swirling clouds, stars ablaze with their own luminescence, and a bright crescent moon. Although the features are exaggerated, this is a scene we can all relate to, and also one that most individuals feel comfortable and at ease with. This sky keeps the viewer's eyes moving about the painting, following the curves and creating a visual dot to dot with the stars. This movement keeps the onlooker involved in the painting while the other factors take hold.

- 2. Below the rolling hills of the horizon lies a small town. There is a peaceful essence flowing from the structures. Perhaps the cool dark colors and the fiery windows spark memories of our own warm childhood years filled with imagination of what exists in the night and dark starry skies. The center point of the town is the tall steeple of the church, reigning largely over the smaller buildings. This steeple casts down a sense of stability onto the town, and also creates a sense of size and seclusion.

- 3. To the left of the painting there is a massive dark structure that develops an even greater sense of size and isolation. This structure is magnificent when compared to the scale of other objects in the painting. The curving lines mirror that of the sky and create the sensation of depth in the painting. This structure also allows the viewer to interpret what it is. From a mountain to a leafy bush, the analysis of this formation is wide and full of variety.

Credit:  [http://www.vangoghgallery.com/painting/starryindex.html](http://www.vangoghgallery.com/painting/starryindex.html)
**A little Van Gogh humor…** *(Return to Links)*

**Van Gogh’s Family Tree**

His dizzy aunt - Verti Gogh  
The brother who ate prunes - Gotta Gogh  
The brother who worked at a convenience store - Stop an Gogh  
The grandfather from Yugoslavia - U Gogh  
The cousin from Illinois - Chica Gogh  
His magician uncle - Where-diddy Gogh  
His Mexican cousin - A mee Gogh  
The Mexican cousin’s American half-brother - Ring Gogh  
The nephew who drove a stage coach - Wells-far Gogh  
The constipated uncle - Cant Gogh  
The ballroom dancing aunt - Tang Gogh  
The bird lover uncle - Flaming Gogh  
His nephew psychoanalyst - E Gogh  
The fruit loving cousin - Man Gogh  
An aunt who taught positive thinking - Way-to Gogh  
The little bouncy nephew - Poe Gogh  
A sister who loved disco - Go Gogh  
And his niece who traveled the country in a van - Winnie Bay Gogh

Full scale grid
**Equivalent Fractions and Simplest Form**

You can multiply or divide numerators and denominators of a fraction by the same counting number. When you do this, you don’t change the value of the fraction. You are finding equivalent fractions.

Find equivalent fractions.

<table>
<thead>
<tr>
<th>Way 1: Multiply.</th>
</tr>
</thead>
</table>
| \[
\frac{1}{2} \times \frac{2}{3} = \frac{2}{4} \times \frac{3}{6}
\] |

<table>
<thead>
<tr>
<th>Way 2: Divide.</th>
</tr>
</thead>
</table>
| \[
\frac{1}{2} \div \frac{3}{4} = \frac{2}{4} \div \frac{3}{6}
\] |

Find the simplest form of the equivalent fraction.

<table>
<thead>
<tr>
<th>Way 1: Divide by the GCF of the numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 = 2 \times 5</td>
</tr>
<tr>
<td>20 - 2 \times 5 \times 2 = \frac{10}{20} = \frac{1}{2}</td>
</tr>
<tr>
<td>The GCF of 10 and 20 is 2 \times 5, or 10.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Way 2: Cancel common prime factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 \div 2 = \frac{1}{2}</td>
</tr>
<tr>
<td>20 \div 2 = \frac{1}{2}</td>
</tr>
</tbody>
</table>

Complete.

| 1. \[ \frac{2}{7} = \frac{6}{31} \] | 2. \[ \frac{14}{35} = \frac{2}{5} \] | 3. \[ \frac{3}{7} = \frac{18}{29} \] |
| 4. \[ \frac{4}{9} = \frac{27}{27} \] | 5. \[ \frac{24}{28} = \frac{7}{7} \] | 6. \[ \frac{48}{60} = \frac{8}{10} \] |
| 7. \[ \frac{1}{2} = \frac{22}{22} \] | 8. \[ \frac{54}{81} = \frac{6}{9} \] | 9. \[ \frac{6}{12} = \frac{4}{4} \] |
| 10. \[ \frac{49}{14} = \frac{2}{2} \] | 11. \[ \frac{4}{7} = \frac{24}{24} \] | 12. \[ \frac{2}{9} = \frac{90}{90} \] |


Enlargement

You want to make two copies of the picture below. One copy will be for your grandparents, and it will hang in a space that measures 3 feet by 4 feet. The other copy will be 12 inches by 16 inches and will hang on a wall in your house.

1. Measure the picture on this page with a customary ruler. What are its measurements?

2. If this picture represents the picture on your grandparents’ wall, what is the scale?

3. If this picture represents the picture on your wall, what is the scale?

4. Suppose you find a map of your backyard that has a scale of \( \frac{1}{2} \) inch representing 50 feet. If your backyard is 4 inches on the map, how long is your backyard?

5. Draw and measure a geometric shape. Create a scale. Give it to a classmate to find the actual dimensions.

Use with text pages 496–499.