Lesson Plan

Performance Objective
Upon completion of this lesson, each student will be able to calculate assorted resolutions, parameters, percentages, sizing, and resizing.

Specific Objectives
- Students will explain the concepts of resolution for both print and web.
- Students will calculate resolution, print size and web sizes.
- Students will define the different types of ideal resolution values.
- Students will solve various vectoring math problems.
- Students will explain how resizing percentage is calculated.

This lesson should take 10-12 class days to complete,

Preparation

TEKS Correlations
This lesson, as published, correlates to the following TEKS. Any changes/alterations to the activities may result in the elimination of any or all of the TEKS listed.

130.90. Practicum in Graphic Design and Illustration
130.90. (c) (2) (B) apply mathematics knowledge and skills by identifying and demonstrating skills such as: use of whole numbers, decimals and fractions applied to measurement and scale; demonstrating a knowledge of arithmetic operations; using conversion methods such as fractions to decimals and inches to points; and applying measurement to solve a problem.

130.90. (c) (4) The student implements advanced problem solving methods. The student is expected to employ critical thinking and interpersonal skills, including data gathering and interpretation independently and in teams to solve problems and make decisions.

Interdisciplinary Correlations
English
110.42(b) Knowledge and skills
(6) Reading/word identification/vocabulary development. The student uses a variety of strategies to read unfamiliar words and to build vocabulary. The student is expected to:
(A) expand vocabulary through wide reading, listening, and discussing; and
(B) rely on context to determine meanings of words and phrases such as figurative language, idioms, multiple meaning words, and technical vocabulary.
(7) Reading/comprehension. The student comprehends selections using a variety of strategies. The student is expected to:
(F) identify main ideas and their supporting details;
(G) summarize texts; and
(J) read silently with comprehension for a sustained period of time.

Speech
110.56 (b) Knowledge and skills
(1)(A) Explain the importance of communication in daily interaction.
(2)(E) Participate appropriately in conversations for a variety of purposes.
(3)(A) Use appropriate communication in group settings.
(E) Use appropriate verbal, non-verbal, and listening strategies to communicate effectively in groups.
(5)(B) Use language clearly and appropriately,

Tasks
• Students will secure signatures on all forms, as specified by the teacher.
• Students will return all paperwork in a timely manner.

Accommodations for Learning Differences
It is important that lessons accommodate the needs of every learner. These lessons may be modified to accommodate your students with learning differences by referring to the files found on the Special Populations page of this website (cte.unt.edu).

Preparation
• Copy the handouts.
• Have multimedia presentations ready to show.

Instructional Aids
• Student Notes sheet
• Student worksheets
Materials Needed
- Copies
- Pencils

Equipment Needed
- Teacher computer
- Projector (for digital presentation)
- Calculators

Introduction

Learner Preparation
- How is math used in digital art?
- How do you know what is best for resolution?
- List what is included in determining sizes for different uses.
- Explain the difference in resolution dependent and resolution independent.

Lesson Introduction
- Ask the class what resolution their phone cameras are.
- Ask them if they know the size of a piece of letter-sized or legal paper.
- Explain the difference between pixels and inches when it comes to size.
- Explain how vector art is based on mathematical formulas and raster art is based on pixels – each having specific numeric values.
Multiple Intelligences Guide

MI

Outline

<table>
<thead>
<tr>
<th>OUTLINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. What’s MATH got to do with it??</td>
</tr>
<tr>
<td>II. Isn’t graphic design just art?</td>
</tr>
<tr>
<td>III. Where does Math come in?</td>
</tr>
<tr>
<td>IV. MATH used in raster design</td>
</tr>
<tr>
<td>V. MATH used in vector design</td>
</tr>
<tr>
<td>VI. Let’s look at some calculations</td>
</tr>
<tr>
<td>VII. Calculating Pixels</td>
</tr>
<tr>
<td>VIII. Calculating Resolution</td>
</tr>
<tr>
<td>IX. Calculating Increased Size</td>
</tr>
<tr>
<td>X. Calculations to Reduce Size</td>
</tr>
<tr>
<td>XI. Math in Good Principles of Design</td>
</tr>
<tr>
<td>XII. Check out the Math!</td>
</tr>
<tr>
<td>XIII. HAVE FUN WITH MATH IN ART!</td>
</tr>
</tbody>
</table>

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<tr>
<th>NOTES TO TEACHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher will use the multimedia presentation to explain the various types and uses for math in digital art. Students will take notes using the Student Notes Outline. The students will then complete the worksheets.</td>
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<tr>
<td>These concepts may be somewhat difficult for the students to grasp. It may be necessary for the teacher to make up additional problems. One suggestion is to put students into groups or pairs and have them craft five or 10 problems (and work the answer keys). These could be compiled and shared with the entire class.</td>
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Application

The teacher will use the multimedia presentations to teach the material. The teacher will monitor students’ independent practice.

Independent Practice

- Math Exercises
  Students work out math problems.
- Math in Art
  Students select a naturally occurring mathematical phenomenon in nature that makes art look beautiful.

Summary

Review

- Why do designers need to be concerned with resolution?
- What is an advantage of vector artwork that is resolution independent?

Evaluation

- Informal Evaluation:
  - Teacher will check for understanding
  - Very small group work option (students help each other)

- Formal Evaluation:
  - Worksheets and tests over the material
Outline Worksheet

What’s MATH got to do with it???
Isn’t graphic design just _____?

Graphic design is just used to create beautiful artwork, logos, signs or posters, right?

It is concerned with things like:
• __________
• Artistic
• Colors
• __________
• Special effects

Where does MATH come in?

The truth is that graphic design is saturated with MATH!
• Raster design is __________ ________, which means on the number of points of colors or pixels per square inch.
• Vectors, while ___________ of resolution or pixels, are based solely on __________. functions or formulas to define shapes, curves, objects, etc.
• Both use math for placement, ________, exact movement, alignment and file size – just to name a few!

MATH used in ________ design

Pixels are constantly working behind the scenes to prevent “________” or poor picture quality in rasters.

A few examples of math in raster design are:
• __________ per inch (PPI) Dots per inch (DPI)
• Resolution
• Page size inches or pixels
• Scaling up or ________
• File size

MATH used in vector design.

Vector design is totally ________ on MATH. It does ____ use pixels.

Examples in vector design are:
• ________ points
• Bezier curves
• Area

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Let’s look at some calculations

_____ traditionally uses _____ dots/pixels per inch for best results.

To find the needed pixel size for web banner 10 by 3 inches:

– 72dpi x the width (72 x 10 = 720)
– 72dpi x height (72 x 3 = 216)

So the needed size would be width 720 and height 216 in pixels.

_____ traditionally uses _____ dpi for best results.

To find the needed pixel size for header 10 by 3 inches:

– 300 dpi x the width (300 x 10 = 3000)
– 300 dpi x height (300 x 3 = 900)

So the needed size would be width 3000 and height 900 in pixels.

Let’s look at some calculations

You found a picture you want to use for web and don’t want to get the “jaggies.” How do you know what the numbers mean?

Take the given measurements of the photo and divide by 72.

This photo is 216 x 180. So do the math!

• 216 pixels width / 72dpi (216 / 72 = 3 in wide.)
• 180 height 180/ 72 = 2.5 in high.
• So the best use of this photo would be at

3 x 2.5 ________ or less like shown here.

Calculating Pixels

Using this same photo for print makes a big __________ due to the preferred resolution. Now you would divide by 300!

So taking the same photo measurements – 216 x 180 and calculating for print this is what we get:

• 216 width (216 / 300 = .72 in wide.)
• 180 height (180 / 300 = .6 in high.)
• That comes out to roughly ¾ “ x ½ “ like the picture here!
• Unless you want the picture to really be less than an ______ high and wide, find a higher resolution picture!
Calculating Resolution

The resolution for the web peaks at_____.
   • So if you want a banner that is 9” wide by 2” high then it would be as follows:
      • 9 x 72 = 648
      • 2 x 72 = 144
   So your resolution would be 720 x 216

Calculating Increased Size

Calculations to Reduce Size

   • If you have a 3” _______ and you want to reduce it by 25% then you subtract that _________ from 100% and multiply. It looks like this: 100%-25%= 75%
      • 3 x .75= 2.25
      • So your reduced square would be 2.25”

Math in Good _________ of Design

   Also saturated with MATH are the very principles of design we use to make our projects and artwork beautiful!

   Some examples that use math are:
      • Rule of _______
      • Symmetry/Asymmetry
      • ___________
      • Golden _______
      • Proximity/Hierarchy
      • Rhythm
      •

Check out the Math!

   • Look up some of the mathematical formulas associated with the _________ of Design. They are fascinating and make a great research project!

HAVE FUN WITH MATH IN _____!
Outline Worksheet

What’s MATH got to do with it???
Isn’t graphic design just art?

Graphic design is just used to create beautiful artwork, logos, signs or posters, right?

It is concerned with things like:
- Creativity
- Artistic
- Colors
- Typography
- Special effects

Where does MATH come in?

The truth is that graphic design is saturated with MATH!
- Raster design is resolution dependent, which means on the number of points of colors or pixels per square inch.
- Vectors, while independent of resolution or pixels, are based solely on mathematical functions or formulas to define shapes, curves, objects, etc.
- Both use math for placement, scalability, exact movement, alignment and file size – just to name a few!

MATH used in Raster design

Pixels are constantly working behind the scenes to prevent “jaggies” or poor picture quality in rasters.

A few examples of math in raster design are:
- Pixels per inch (PPI) Dots per inch (DPI)
- Resolution
- Page size inches or pixels
- Scaling up or reducing
- File size

MATH used in vector design.

Vector design is totally dependent on MATH. It does not use pixels.

Examples in vector design are:
- Anchor points
- Bezier curves
- Area
• Gradient fades
• File size

Let’s look at some calculations

**Web** traditionally uses 72 dots/pixels per inch for best results.

To find the needed pixel size for web banner 10 by 3 inches:

- 72dpi x the width (72 x 10 = 720)
- 72dpi x height (72 x 3 = 216)

So the needed size would be width 720 and height 216 in pixels.

**Print** traditionally uses 300 dpi for best results.

To find the needed pixel size for header 10 by 3 inches:

- 300 dpi x the width (300 x 10 = 3000)
- 300 dpi x height (300 x 3 = 900)

So the needed size would be width 3000 and height 900 in pixels.

Let’s look at some calculations

You found a picture you want to use for web and don’t want to get the “jaggies.” How do you know what the numbers mean?

Take the given measurements of the photo and divide by 72.

This photo is 216 x 180. So do the math!

- 216 pixels width / 72dpi (216 / 72 = 3 in wide.)
- 180 height 180 / 72 = 2.5 in high.)
- So the best use of this photo would be at

3 x 2.5 inches or less like shown here.

Calculating Pixels

Using this same photo for print makes a big difference due to the preferred resolution. Now you would divide by 300!

So taking the same photo measurements – 216 x 180 and calculating for print this is what we get:

- 216 width (216 / 300 = .72 in wide.)
- 180 height (180 / 300 = .6 in high.)
- That comes out to roughly ¾ “ x ½ “ like the picture here!
- Unless you want the picture to really be less than an inch high and wide, find a higher resolution picture!
Calculating Resolution

The resolution for the web peaks at 72dpi.
- So if you want a banner that is 9” wide by 2” high then it would be as follows:
  - 9 x 72 = 648
  - 2 x 72 = 144

So your resolution would be 720 x 216

Calculating Increased Size

Calculations to Reduce Size

- If you have a 3” square and you want to reduce it by 25% then you subtract that percentage from 100% and multiply. It looks like this: 100% - 25% = 75%
  - 3 x .75 = 2.25
  So your reduced square would be 2.25”

Math in Good Principles of Design

Also saturated with MATH are the very principles of design we use to make our projects and artwork beautiful!

Some examples that use math are:
- Rule of Thirds
- Symmetry/Asymmetry
- Fibonacci
- Golden Ratio
- Proximity/Hierarchy
- Rhythm

Check out the Math!

- Look up some of the mathematical formulas associated with the Principles of Design. They are fascinating and make a great research project!

HAVE FUN WITH MATH IN ART!
Math Exercise for Graphic Design

1. You want to create a web banner that is 10” x 3”. What is the calculation?

2. You want to place a 4 x 6 picture in a print layout. What resolution will be perfect?

3. You want to increase the size of a print project that is 8 x 10 by 25%. What calculations would you use?

4. What ideal pixels would you use for a 12 x 16 print project?
Math Exercise for Graphic Design

(Answer Key)

1. You want to create a web banner that is 10” x 3”. What is the calculation? Note: For web you need 72 ppi

   10 x 72 = 720
   3 x 72 = 216
   Banner calculation is 720 x 216 pixels

2. You want to place a 4 x 6 picture in a print layout. What resolution will be perfect? Note: For print you need 300 dpi

   4 x 300 = 1200
   6 x 300 = 1800
   Perfect resolution would be 1200 x 1800

3. You want to increase the size of a print project that is 8 x 10 by 25%. What calculations would you use? Note: First add the percentages 100% + 25% = 125%

   8 x 1.25 = 10
   10 x 1.25 = 12.5
   New size is 10” x 12.5”

4. What ideal pixels would you use for a 12 x 16 print project? Note: For print you need 300 ppi

   12 x 300 = 3600
   16 x 300 = 4800
   Ideal pixels would be 3600 x 4800
Exercise Drills for Resolution

Calculate the resolution using the information given.

1. 3 x 10 inches at 72 dpi for web = ___________________.
2. 3 x 10 inches at 300 dpi for print = ___________________.
3. 3 x 10 inches at 600 dpi or fine print = ______________.
4. 9 x 14 inches at 72 dpi for web = ______________.
5. 9 x 14 inches at 300 dpi for print = ______________.
6. 9 x 14 inches at 600 dpi for fine print = ______________.
7. 7 x 16 inches at 72 dpi for web = ______________.
8. 7 x 16 inches at 300 dpi for print = ______________.
9. 7 x 16 inches at 600 dpi for fine print = ______________.
10. 3 x 10 inches at 72 dpi for web = ______________.
11. 3 x 10 inches at 300 dpi for print = ______________.
12. 3 x 10 inches at 600 dpi for fine print = ______________.
Exercise Drills for Resolution

Calculate the resolution using the information given.

1. 3 x 10 inches at 72 dpi for web = 216 x 720 dpi.
2. 3 x 10 inches at 300 dpi for print = 900 x 3000 dpi.
3. 3 x 10 inches at 600 dpi for fine print = 1800 x 6000 dpi.
4. 9 x 14 inches at 72 dpi for web = 648 x 1018 dpi.
5. 9 x 14 inches at 300 dpi for print = 2700 x 4200 dpi.
6. 9 x 14 inches at 600 dpi for fine print = 5400 x 8400 dpi.
7. 7 x 16 inches at 72 dpi for web = 504 x 1152 dpi.
8. 7 x 16 inches at 300 dpi for print = 2100 x 4800 dpi.
9. 7 x 16 inches at 600 dpi for fine print = 4200 x 9600 dpi.
10. 8 x 5 inches at 72 dpi for web = 576 x 360 dpi.
11. 8 x 5 inches at 300 dpi for print = 2400 x 1500 dpi.
12. 8 x 5 inches at 600 dpi for fine print = 4800 x 3000 dpi.
Math in Art

Nature provides several naturally occurring mathematical phenomena, which create beautiful art. Select one of the following to research and create an informative one page report that describes the mathematical concepts and also includes a sample created by the student.

- Golden Ratio
- Fibonacci Sequence
- Tessellations
- Fractals
- Other – discuss with instructor

Report should include:

- Title
- Description of the mathematical phenomenon
- Formula for the math
- Explain how the phenomenon makes beauty in art
- A student-created example
# Math in Art Report Rubric

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>3 15 Points</th>
<th>2 10 Points</th>
<th>1 5 Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of difficulty in presenting the math behind the art.</td>
<td>Project demonstrates a high degree of difficulty in techniques/skills.</td>
<td>Project demonstrates some degree of difficulty in techniques/skills.</td>
<td>Project demonstrates little degree of difficulty in techniques/skills.</td>
</tr>
<tr>
<td>Attractiveness in the layout of the report.</td>
<td>Makes excellent use of font, color, graphics, effects, etc. to enhance the presentation.</td>
<td>Makes good use of font, color, graphics, effects, etc. to enhance the presentation.</td>
<td>Makes use of font, color, graphics, effects, etc. but occasionally these detract from the presentation content.</td>
</tr>
<tr>
<td>Clear and understandable.</td>
<td>Information is clear to understand and informative.</td>
<td>Information is mostly clear to understand and informative.</td>
<td>Information is not very clear nor informative.</td>
</tr>
<tr>
<td>Mechanics: Spelling and grammar correct on report.</td>
<td>No misspellings or grammatical errors.</td>
<td>Three or fewer misspellings and/or mechanical errors.</td>
<td>Four misspellings and/or grammatical errors.</td>
</tr>
</tbody>
</table>

**Teacher comments:**