

# Algebra and Art

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# Life Learning Academy Project-Based Curriculum

**Project Title:** Colors & Algebra

**Design Team and/or Instructor(s):** Joanne C. da Luz and Justin Warren

**Subject Area(s):** Algebra and Art

## Project Overview:

This project demonstrates how we have used Henri Picciotto's Lab Gear manipulatives to motivate students at Life Learning Academy to become successful, "hands on," learners in an algebra class. The project also describes the involvement of a collaborative interdisciplinary project based on the Lab Gear manipulatives.

*The Colors & Algebra Project* provides students with an opportunity to create a unique representation of their own understanding of algebra through the use of color mixing and painting on canvas. Objectives and goals include the following: Students will be able to a) accurately multiply algebraic expressions, factor quadratics, and combine like terms b) describe their understanding of multiplication and factoring by referring to geometric concepts of dimension and area and c) describe their understanding of a variable by referring to their experiences with color, shapes, and materials. Extensive assessment tools and journal prompts will be provided to support implementation.

## Educational Standards Addressed:

Visual and Performing Arts Content Standards for California Public Schools,  
Prekindergarten through Grade Twelve

Visual Arts – proficient grades 9-12, p.152-154

Edited by Ed O'Malley, for CDE, 2001

### 1.0 ARTISTIC PERCEPTION

*Processing, Analyzing, and Responding to Sensory Information Through the Language and Skills Unique to the Visual Arts*

### 2.0 CREATIVE EXPRESSION

*Creating, Performing, and Participating in the Visual Arts*

2.1 Solve a visual arts problem that involves the effective use of the elements of art and the principles of design.

Communication and Expression Through Original Works of Art

2.5 Create an expressive composition, focusing on dominance and subordination.

### 4.0 AESTHETIC VALUING

*Responding to, Analyzing, and Making Judgments About Works in the Visual Arts*

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.

*Make Informed Judgments*

4.3 Formulate and support a position regarding the aesthetic value of a specific work of art and change or defend that position after considering the views of others.

4.4 Articulate the process and rationale for refining and reworking one of their own works of art.

4.5 Employ the conventions of art criticism in writing and speaking about works of art.

**5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS**

*Connecting and Applying What Is Learned in the Visual Arts to Other Art Forms and Subject Areas and to Careers*

Students apply what they learned in the visual arts across subject areas. They develop competencies and creative skills in problem solving, communication, and management of time and resources that contribute to lifelong learning and career skills.

**Algebra I**

4.0 Students simplify expressions before solving linear equations and inequalities in one variable, such as  $3(2x - 5) + 4(x - 2) = 12$

10.0 Students add, subtract, multiply, and divide monomials and polynomials. Students solve multi-step problems, including word problems, by using these techniques.

14.0 Students solve a quadratic equation by factoring or completing a square.

**Expected Student Learning:**

<b>Objectives</b>	<b>Outcomes</b>
Students will know...	Students will be able to...
1. multiplication of algebraic expressions such as $(x + 2)$ and $(y + 3)$ means that you are given the dimensions of an area and you are looking for the area representation	1. accurately multiply algebraic expressions and combine like terms.
2. to factor a quadratic such as $x^2 + 2y + 3x + 6$ means that you are given an area of a rectangle and you are looking for its dimensions	2. accurately factor a quadratic with the use of Lab Gear and/or a Generic Rectangle
3. the properties of squares and rectangles	3. use a T-square to draw parallel and perpendicular lines
4. the properties of primary and secondary colors.	4. create secondary colors by choosing appropriate paint to mix
5. the difference between when variables are multiplied together to create squares and when they create rectangles.	5. present their understanding of multiplication and factoring of algebraic expressions by referring to geometric concepts of dimension and area.
6. the sense of a variable and its relation to the size of their variable shapes.	6. Choose a size and make scale drawings to represent their variables.
7. the definition of commutative property.	7. Accurately provide examples of commutative property by referring to colors, variables, and constants.

**Lesson Outline/Detailed Description:**

Day 1: Groups agree on their own names for Lab Gear blocks based on the 1 block and use of dimensions. Teacher leads class to agreed upon names 1,5,25,  $x$ ,  $5x$ ,  $y$ ,  $5y$ ,  $x^2$ ,  $y^2$ ,  $xy$ .

Days 2-5: Students use Lab Gear and worksheets to practice and develop multiplication of variables and factoring.

Days 5-10: Painting project begins and ends and daily painting activities are guided by journal questions.

## Assessment Methods and Tools:

### Colors & Algebra Facilitator's Checklist

My name is \_\_\_\_\_ and my partner's name  
is \_\_\_\_\_.

We will check off the boxes below as we prepare our final product.

#### Final painting on canvas (15 pts.)

- painting is complete and clearly demonstrates correct use of tools and techniques
- algebraic expression for the area is correct for the given dimensions
- the rule for secondary colors is accurately demonstrated
- blocks are scaled accurately

#### Essay ( 45 pts.)

- (5 pts) There are five days of journal entries written in paragraph form.
- (30 pts) Each entry:
  1. Sets the stage with what you we're given
  2. Clearly describes goal setting and/or experimentation
  3. Refers to you and your partner
  4. Describes any surprises and/or verifications
  5. Responds to the day's questions
  6. Refers to your day's painting and its colors
- (5 pts) There are no spelling or grammar errors.
- (5 pts) The essay is double spaced and legible (no fancy fonts please!)

#### Presentation (25 pts)

We will write notes below to remind us how we will show...

- Teamwork:
- Organization:
- Content:
- Visuals:
- Delivery:

## Colors & Algebra Presentation Grade Sheet

My name is \_\_\_\_\_ and I am grading \_\_\_\_\_

On the presentation of \_\_\_\_\_

**Organization:** Introductions are made and it is clear that the presenter is ready, prepared, and the project is complete

5      4      3      2      1

**Content:** the presenter clearly explains how his texture and color choices support his understanding of factoring, multiplying, commutative property and combining like terms

5      4      3      2      1

**Visuals:** dimension tool and blocks are clearly delineated and block sizes are appropriately scaled and colors are appropriately placed

5      4      3      2      1

**Delivery:** use of volume, pace, projection, eye contact, appear(s) comfortable in stance and facial expression

5      4      3      2      1

## Colors & Algebra Grade Sheet

My name is \_\_\_\_\_ and I am grading the final painting for

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### Final painting on canvas ( 15 pts.)

### Comments

painting is complete and clearly demonstrates  
correct use of tools and techniques

5      4      3      2      1

algebraic expression for the area is correct  
for the given dimensions

5      4      3      2      1

the rule for secondary colors is accurately  
demonstrated

5      4      3      2      1

dimension tool and blocks are clearly delineated  
and block sizes are appropriately scaled

5      4      3      2      1

## Colors & Algebra Essay Grade Sheet

My name is \_\_\_\_\_ and I am grading the final essay for

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### **Journal Days**

There are four days of journal entries written in paragraph form

5    4    3    2    1

### **Setting the Stage**

Each entry sets the stage with what you were given, clearly describes goal setting and/or experimentation, refers to you and your partner, describes any surprises and/or verifications, responds to the day's questions, refers to your day's painting and its colors

5    4    3    2    1

### **Formal**

There are no spelling or grammar errors

5    4    3    2    1

### **Format**

The essay is double spaced and legible w/12pt font

5    4    3    2    1

## Colors & Algebra Journal Questions

- What are primary colors? What are secondary colors?
- What is the rule that describes how to get secondary colors?
- What is domain and range and how are they connected to primary and secondary colors?
- If the art teacher walked in, saw your painting, and said "Hey! You didn't use the rule!" What must he have seen on your painting?
- Sketch and paint the following equation:  $(x + 2)(x + 5) = x^2 + 7x + 10$ .
  - What are the dimensions of your blocks? Why? Explain how and why you decided on their sizes.
- How does your painting on paper demonstrate a) combining like terms?  
b) commutative property?                      c) (length) x (width) = area?
- Explain your use of primary colors... secondary colors.... Where? How? Why?
- How did you achieve these colors?
- Today you are given that the expression  $xy + 2x$  is made of purple and orange. What are the dimensions and what are their colors? How do you know?
- You and your partner can make up your own equation. What are all the possible ways you could have arranged the area and the dimensions? Include sketches.
- What are all the different ways you could have chosen your colors? Use colored pencils in your sketches.
- Which ones do you and your partner prefer? Why? How do the combinations of colors and shapes affect your decisions?
- How do the combinations of colors and shapes affect and/or represent commutative property, multiplication, combining like terms?

What is the algebraic equation for your final painting on canvas and why did you choose it?

Explain two artistic techniques you learned in this project and how it is exemplified in your final painting.

How did you use art to express/communicate algebra concepts? Refer to your toolkits, color rules, and specific parts of your final painting when describing them.

**Colors & Algebra**  
**Day 5:  $(L)(W) = \text{Area}$**

The story (essay) part of your project will be...

- Written in journal format with paragraphs titled Day 1, Day 2,..... etc.
- Each paragraph
  - sets the stage with what you we're given
  - clearly describes achievements made through goal setting and/or experimentation
  - refers to yourself and/or others who inspired you
  - describes any surprises and/or verifications
  - responds to the day's questions
  - refers to your painting and its colors

What is the algebraic equation for your final painting on canvas and why did you choose it?

Explain two artistic techniques your learned in this project and how it is exemplified in your final painting.

How did you use art to express/communicate algebra concepts? Refer to your toolkits, color rules, and specific parts of your final painting when describing them.

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**Text and Supplemental Materials:**

The Algebra Lab: Lab Gear Activities for Algebra 1 by Henri Picciotto

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Lab Gear manipulatives

**Project Development History:**

I have used Lab Gear during every year of LLA's existence. Most of our students arrive to the Life Learning Academy without a successful career in mathematics. The Lab Gear provides students with a fresh start and an opportunity to become "hands-on" learners. For example, students handle actual squares that represent  $x^2$  and  $y^2$ . The geometric perspective of abstract concepts provides students with a new way into the math.

I had asked the photography teacher to cover my class one-day when he noticed the student produced posters hanging on the walls. They represent factored quadratic equations of the form (Length) (Width) = Area where blue and yellow colors represent the  $x$  variables and the constants respectively. Days later, as the instructor was sitting across from me in our office, he showed me some notes he had taken that were inspired by the posters. He had carefully sketched another  $(L)(W) = \text{Area}$  representation but added his own idea of color mixing to further explicate the multiplication of variables. Those notes evolved into the Colors Project and art instructor collaborated with us to enhance the artistic methods and standards that could be addressed during the project.

The history of the project continues to evolve. During the second year of the project I utilized more scaffolding techniques to support students' understanding of multiplication of variables. The photography instructor planned an extra credit art project that addressed the sense of a variable in another medium. The art instructor has researched and provided some insight into the art standards and the connection to P. Mondrian's work.