Title: Da Vinci Algebra I

Length of Course: Two Years/Units (4 semesters; 6 trimesters; 8 quarters)

Subject Area – Discipline: Mathematics ("c") – Algebra I

Subject Area – Discipline: Visual and Performing Arts ("f") – Visual Arts (Intro)

CTE Sector: Arts, Media and Entertainment

CTE Pathway: Design, Visual and Media Arts

Grade Level(s): 9

Course Overview:

Upon completion of Da Vinci Algebra 1, students experience and gain breadth and depth of understanding of fundamental algebraic concepts and standards integrated with a multimedia art perspective and approach. It recognizes the elemental connections between mathematics and art and allows students to consistently communicate their comprehension. Students demonstrate mastery in proportions, linear and quadratic relationships and systems, rational and irrational equations, problem solving, functions, and exponentials. The course integrates and relates artistic and media fundamentals such as design, composition, color, perspective, space, and anatomy. Students create an electronic and physical portfolio that allows them to communicate and record their understandings of the mathematics and art topics both individually and relationally. Through this method, students will be introduced to the appreciation and beauty of both disciplines.

Course Content:

Unit 1: Scaling Images and Murals - Ratios, Algebraic Expression

Students develop a working understanding of ratios, percents, and proportions by solving both computationally and conceptually challenging rational problems. Using the computed ratios, students scale a mural design using colored pencils and grid structures.

"a-g" Academic Topics	CTE Topics
· Factor and reduce fractions with polynomials in the numerator and denominator.	· Investigate mural design and composition.

· Solve and simplify ratios, percents, and proportions. · Solve computationally and conceptually challenging problems using appropriate operations. · Apply basic factoring techniques to second-degree polynomials.	· Survey art history from cave paintings to modern urban art. · Create an original mural design. · Identify and apply elements of Photoshop and scanning to manipulate and distort images. · Enlarge to painting size and explore the rudiments of painting.

Recurring assignments for course:

Daily Assignments
Throughout the course daily assignments will consist of warm-ups in both math and art, assignments from the math textbook, drawing and color projects, student entries into an electronic portfolio, maintaining a learning log (Cornell Notes) incorporating notes from class lectures, student self-evaluations, reflections, and study guides. Self and peer critiques will happen in either written or oral form on a weekly basis.

Cornell Note-taking Strategies
The Cornell method provides a systematic format for condensing and organizing rhetorical notes. Students learn the process of taking Cornell Notes and use this format throughout the course. The student divides the paper into two columns. Notes from a lecture or teaching are written in the right note-taking column. After the notes have been taken, the student writes a brief summary in the bottom five to seven lines of the page. This helps to increase understanding of the topic. When reviewing the material, the student can cover up the note-taking (right) column to answer the questions/keywords in the keyword or cue (left) column. The student is encouraged to reflect on the material and review the notes regularly.

Toolkits
This is a graphic organizer created by the student for the student to refine, summarize, and analyze what they have learned in a unit.

Unit One: Key Assignments

Algebra Worksheets
Students solve and simplify simple proportions and evaluate and describe direct variation. Students work with rational expressions, ratios, proportion, and percent through problem sets and worksheets to prepare them for the first key unit project.

Scaling Images Through Algebra
Students create and scale an original mural design using colored pencils and grid structures. Students paint their artwork on a larger format. Using their scaled mural designs, students create ratios, proportions, and percents by comparing points in their original and scaled drawings. Students evaluate their drawings by solving proportions to

validate the accuracy of their scaling. Students resize their image by using fractions with polynomials (rational expressions) and factoring techniques to investigate a variety of sizes their drawing might take.

<u>Applying Scaling Techniques in Photoshop</u>
In Photoshop, students take an existing image to scan and distort by keeping one of the dimensions a constant ratio and altering different parameters. Students use the techniques garnered in the Scaling Images Through Algebra Project to predict, describe, and interpret the outcomes of their scaled images. Students also apply different Photoshop techniques to alter and distort images and postulate the possible algebraic statements that might make the computer model possible. Students will add their creations and narratives to their electronic portfolio.

<u>Unit 2</u>: One-Point Perspective

Using the lines that occur naturally in one-point perspective, students will identify and model linear relationships both algebraically and graphically.

"a-g" Academic Topics	CTE Topics
· Simplify expressions before solving linear equations. · Solve multi-step problems using linear equations and linear inequalities. · Derive slope-intercept and standard form of linear equations by use of intercepts, slope, and coordinate points. · Direct variation, tangent, and constant rate of change will be used to model slope. · Model relationships between parallel and perpendicular lines through equations and graphs.	· Complete a one-point perspective drawing, for example the bookshelves in the library. · Demonstrate vanishing point, size/distance, angles, texture, and shading. · Identify and explain object relationships and perspective. · Create line drawings and scenery paintings. · Matt and frame artwork.

<u>Unit 2</u>: Key Assignments

<u>Library Project</u>
Students complete a one-point perspective pencil drawing based on the bookshelves in the library, and then finalize their drawing in ink, using watercolors for texture and shading. These drawing demonstrate vanishing point, size/distance, angles, texture, and shading. As students identify and explain object relationships and perspective, students also examine, identify, and represent linear models and develop a working knowledge of slope and intercepts. One-point perspective will be redefined by a system of linear equations. Students represent slope as variation, a constant rate of change, and as a tangent ratio in their drawings. Students will complete this assignment by learning to matt and frame one of their perspective drawings.

Unit 3: The Human Body and Quadratic Equations

Students identify, represent, and manipulate rational and quadratic models by using specific parts of the human body from drawings by Da Vinci.

"a-g" Academic Topics	CTE Topics
· Solve a quadratic equation by factoring or completing the square. · Demonstrate knowledge of the quadratic formula by completing the square and solving quadratic equations. · Graph quadratic functions and demonstrate that their roots are the zeros or x-intercepts. · Choose the quadratic formula or factoring technique to determine whether the graph of a quadratic function will intersect the x-axis in zero, one, or two points. · Describe quadratic function shifts by examining changes in the corresponding equations.	· Practice contour, gesture, and short and long term settings. · Study anatomy of the human body, using proportions for perspective angles, foreshortening and muscle and skeletal structures. · Use Maya 3D to transform facial and body representations. · Investigate the Golden Ratio. · Evaluate and choose appropriate media for artistic works. · Investigate how human figures are represented throughout history and differing cultures.

Unit 3: Key Assignments

Da Vinci's Vitruvian Man
Students are introduced to the works of Leonardo Da Vinci through a brief historical overview of his time and importance. The Vitruvian Man is discussed as a representation of ideal human proportions described by the Roman architect Vitruvius. As the students identify and explain characteristics of the human body through Da Vinci's drawings, students also examine, identify, and represent parabolas through their ability to model rational and quadratic functions. Students develop the skills to manipulate different forms of quadratic equations. They learn the benefit of each form to explain features of the face and body.In this process students learn the algebraic and concepts needed to communiate quadratics algebraically and graphically such as completing the square, factoring methods, quadratic formula, and extracting square roots. Using technology such as graphing calculators, online graphing tools, and animation/modeling software, students demonstrate algebraically and graphically aesthetically pleasing proportions (i.e.-Golden Ratio) and quadratic solutions to these proportions. Students complete problem-sets, model parabolas, analyze systems of inequalities, quadratics in vertex forms, shifts of quadratics equations shifts, and reinforce rational equations using measurements and calculations derived from the Vitruvian Man.

Contemporary Man or Woman
Students produce a digital photograph of themselves. Students measure the proportions of their own body and compare these to the measurements of the Vitruvian Man. Using graphing calculators and online graphing tools, students make algebraic transformations (graph shifts) by manipulations of these equations. Students develop an understanding of how the manipulation of equations changes the graphic representation and consequently the human characteristics and proportions. Students create models of themselves using 3D modeling software and manipulate the various characteristics to emphasize a chosen feature. The algebraic description of their shifts is attached and the work is added to their electronic portfolio.

Unit 4: Photography and Graphic Design

Students will apply linear and absolute value functions to the mechanics of pinhole cameras and the manual use of digital cameras.

"a-g" Academic Topics	CTE Topics
· Solve and justify multi-step problems involving linear equations and linear inequalities in one variable. · Piecewise functions will be used to model absolute value equations. · Determine the domain of independent variables and the range of dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression. · Identifying conics (parabolas and hyperbolas) as quadratic and rational equations.	· Survey history of photography and technological innovations. · Construct and use pinhole cameras. · Experience studio, art, and photojournalism genres. · Use and analyze varying F-stops, shutter speeds, and depth of field to create meaning in photography. · Examine the design of digital cameras and compare/contrast to film/wet media · Apply Photoshop elements and applications to create web pages and other works of art intended for public viewing. · Investigate the differences between raster and vector images and the quadratics used to create calculated curves for images and fonts

Unit 4: Key Assignments

Pinhole Camera
Students represent angle of incidence by linear and absolute value functions. They will use piecewise functions and ratios formed by similar triangles and solve rational equations. Students then build, use, and develop their own pinhole cameras. Using one photograph produced with their pinhole camera, students will identify angles, proportions, parabolas, and hyperbolas.

<u>Weekly History of Photography Worksheets</u>
Students study the history of photography and the impact of technological changes through time. Each week students examine the different purposes and uses of photography (i.e. sociopolitical, advertising, propaganda, art) by completing worksheets that build their observational skills and understanding of history. A written, oral, or graphic reflection of the impact of photography will be added to their electronic portfolio.

<u>Digital Photography</u>
Function terminology and representations such as domain (dependent variable) and range (independent variable) will be applied to the mechanics of pinhole cameras and the manual use of digital cameras. After studying various genres (such as commercial photography, fine art photography, photojournalism, and studio photography), students create photographs using digital cameras on manual settings and emphasizing the 13 basics areas (self portrait, series, scenery, etc) of photography developing the skills to express their ideas artistically. Photoshop will be used to manipulate and enhance students' images. Students also compare the workings of a digital camera to a pinhole/film cameras. Students matt their chosen photographs and add all photographs to their digital portfolios.

<u>Raster vs. Vector</u>
Students investigate how quadratics are used to create vector images/drawings. Students create an example of the triangles used to describe a truetype font and demonstrate how the curves are applied to fabricate a seamless font curve and add their project/observations to their electronic portfolio.

<u>Unit 5</u>: Elements of Design and Algebra

Students will refine and deepen their understanding of key concepts in both algebra and art. Students will identify their own areas of strength and areas that need reinforcement.

"a-g" Academic Topics	CTE Topics
· Review, refine, and reinforce concepts covered in units 1-4. · Using data from diagnostic testing, identify individual areas of mastery and refinement.	· Review elements of design and composition. · Refine creative works by using line, shape, positive and negative spaces, texture, movement and direction, shading, size, and color to create aesthetically pleasing compositions. · Apply elements of balance, repetition, contrast, scale, harmony and dominance to create abstractions.

Unit 5: Key Assignments

Refining and reinforcing concepts is spiraling the content by continuing to curve or return back to a topic. A spiral curriculum, by moving in a circular pattern from topic to topic, seeks to catch students when they first become ready to learn something and pick up other students the next time the topic occurs. The first four units introduce the main content. The refining comes in this unit and this half of the course. These spiraling activities develop depth of understanding and breadth of overall interconnectedness of the algebra content. Unit 5 is intended to allow students some time for "pure" algebra and "pure" art work to both reinforce and introduce concepts appropriate to each discipline.

Algebra Review
Using benchmark tests, students are assessed for areas of algebraic strength and weakness. Results are analyzed by individual students and by class. Students have access to this data and are reflect in writing and orally on their specific areas of need. Using specific skill packets, students can fill in the gaps in their algebraic knowledge. Class-wide areas of need are addressed by classroom re-teaching.

Abstract Composition
Students identify and refine the basic elements of art to create an abstract artwork emphasizing line, shape, positive and negative spaces, texture, movement and direction, shading, size, and color to create aesthetically pleasing compositions. No representational images will be permitted in this piece. Students will add this work to their portfolio.

Unit 6: Marketing

Students will analyze cost, baseline operating costs, and profit margin in the art industry using systems of equations and exponential growth and decay. Students will learn about the impact of artistic message, marketing, and the media.

"a-g" Academic Topics	CTE Topics
· Solve a system of two linear equations in two variables algebraically and interpret the answer graphically. · Solve a system of linear inequalities. Examine the properties of exponents in relationship to length, area, and volume. · Model proportions in length and area using exponents. · Analyze and apply concepts of rational and irrational exponents. · Model exponential growth and decay.	· Determine product cost, value, and expensing. · Investigate various art venues, potential markets, and marketing strategies for art and web design. · Communicate emotions, concepts, and themes through art and design. · Art show preparation and exhibition.

Unit 6: Key Assignments

Art Show Budgeting
Given a sample budget, students analyze cost, baseline operating costs, and profit margin using systems of linear equations and exponential growth and decay. Students will model their operating costs by linear and exponential representation. Students will learn about the impact of artistic message and the media. Students will research costs of and profit margin of artworks in different regions. They will create a sample budget for a student art show using information from their research.

Careers in Art Paper
*S*tudents self-assess the style of their own artwork and explore possible career options, educational pathways, and different markets. Students research various art venues (such as internet, galleries, studios, museums) and examine potential markets for merchandising their artwork (self-owned business, subcontracting, contests). Students write a two-page paper based on their research.

Matting and Mounting
By utilizing algebraic methods and measurement, students prepare and mount one of their art pieces for display and show.

Famous Artists and Styles Presentation
Students investigate an artist whose artwork they admire and the market that supported the artist. Students produce a narrated 2-3 minute video showcasing a minimum of 13 pieces of the chosen artist's work, and a biography of the artist's life, including a piece of artwork the student likes most and explaining why.

Unit 7: Electronic Portfolio

This unit is designed for students to self-assess their algebraic mastery and artistic understanding through demonstration of their portfolio and digital media presentation.

"a-g" Academic Topics	CTE Topics
· Demonstrate understanding of the concepts of a relation and a function. · Define and use simple aspects of a logical argument. · Model and differentiate between inductive and deductive reasoning, providing examples of each. · Use properties of the number system to judge the validity of results, to justify each step of a procedure, and to prove or disprove statements.	· Create podcasts, slideshows, video, web pages, web designs, etc. that correlate art projects with math concepts. · Design a database for the electronic portfolio and use associated applications such as Access and FileMaker. · Use queries, metadata, and media containers.

<u>Unit 7</u>: Key Assignments

<u>Final Student Portfolio (Algebra and Art)</u>
The culminating portfolio consists of the student's previous key artwork assignments, which demonstrate the student's overall algebraic mastery.

Examples of work included:
- Toolkits (graphic organizer) of interrelated math topics
- Key unit projects
- Learning logs (Cornell notes)
- Homework
- Class activities
- Self and peer critiques
- Assessments including oral, partner quizzes, unit exams, midterms, and finals.

<u>Final Presentation Integrating Algebra and Art</u>
Students focus on one of the previous projects completed in the course to create a 3-5 minute digital media presentation (using one of the following methods: FinalCut, Dreamweaver, Podcast, MovieMaker, live@edu, Google Docs) that teaches a lesson on how algebra and art relate.

<u>Final Examination</u>
This unit includes the final examination for the course.

<u>Unit 8</u>: Two-Point Perspective

Through a final culminating project, students apply and demonstrate theoretic algebraic concepts acquired throughout the course. Students revisit perspective drawing, producing an artistic work which uses two-point perspective. Students discuss both the mathematical and artistic elements of these works bridging from algebra into initial geometric concepts.

"a-g" Academic Topics	CTE Topics
· Review, refine, and reinforce concepts covered in the course. · Introduce key geometric concepts such as polygons (triangles and quadrilaterals), similarities, properties of parallel lines, congruence, and area and volume.	· History of perspective in different cultures. · Elements of two-point perspective. · Use of scale, angle, shading, texture, and details.

<u>Unit 8</u>: Key Assignments

<u>Final Two-Point Perspective Drawing</u>

Students survey the use of perspective across cultures and history. Students then identify and apply the elements of two-point perspective by creating an artwork (styles varying from a realistic rendering of a building to an urban art piece) that demonstrates proper use of scale, angle, shading, texture, and details. Students present the drawing as the final project in their individual portfolios.

Bridging Algebra to Geometry
Students identify in their Two-Point Perspective Drawings key algebraic concepts they have learned in the course. Students are introduced to key geometric concepts such as polygons (triangles and quadrilaterals), similarities, properties of parallel lines, and area and volume, and identify these concepts on their drawing.

Textbooks:

Title: **Algebra 1**
Edition: **1st**
Publication Date: **2001**, Publisher: **McDougal Littell Inc.**
Author(s): **Larson, Ron et. al.**
Usage: **Primary Text**

Supplemental Instructional Materials:

Algebra with Pizzazz Marcy, Steve and Janice *Creative Publications*, 1st Ed. (2002)

Key to Algebra Student Workbook King, Julie and Rasmussen, Peter *Key Curriculum Press* (1990)

Algebra 1 CPM Sallee, Kysh, Kasimatis, Hoey *CPM,* 6th Ed. (2000)

Mathematics: A Practical Odyssey Johnson, David B. and Mowry, Thomas A. *Thomson, Brooks/Cole,* 6th Ed. (2007)

Integrated Mathematics Rubenstein, Rheta N. Craine, Timothy V. and Butts, Thomas R. *Houghton Mifflin* (1995)

Intermediate Algebra: Graphs and Functions Larson, Ron, Hostetler, Robert and Neptune, Carolyn *Houghton Mifflin,* 3rd Ed. (2003)

Principles and Standards for School Mathematics National Council of Teachers of Mathematics, Inc *NCTM Publishers,* 4th Ed. (2005)

Historical Topics for the Mathematics Classroom National Council of Teachers of Mathematics, Inc *NCTM Publishers,* 3rd Ed. (1998)

Mathematicians are People, Too Reimer, Luetta and Wilbert *Dale Seymour Publications* (1990)

Geogebra graphing program: http://www.geogebra.org/cms