Mapping to Common Core State Standards for Mathematics

GRADE 2

Common Core State Standards - MATH

BlocksCAD activities aligning with grade 2 standards

- **Intro Series:**
  - **Shapes and Translation:** Snowman, Caterpillar, Cube Corners, Robot, Top
  - **Sides:** use Sides transform block on circles and cylinders to create shapes with different numbers of sides.
  - **Set Operations:** Difference and Hull activities
- **Teacher-created lessons based on criteria below**

While we recommend BlocksCAD for Grades 3 and up, teachers may choose to introduce concepts of shapes and computing in earlier grades. It is easier starting with models prepared in advance by the teacher, rather than expecting students to construct their own (especially at the start).

Grade 2 CCSS Math standards that are in alignment with BlocksCAD activities include the recognition and drawing of geometric shapes based on their attributes, such as sides, angles, and component shapes. Moving beyond the Grade K and 1 standards, students may begin to use BlocksCAD to explicitly compose shapes based on criteria given by a word problem or by the teacher.

Critical areas of instruction in grade 2 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Extending understanding of base-ten notation;
2) Building fluency with addition and subtraction;
3) Using standard units of measure; and
4) **Describing and analyzing shapes.**

"Students describe and analyze shapes by examining their sides and angles. Students investigate, describe, and reason about decomposing and combining shapes to make other shapes. Through building, drawing, and analyzing two- and three-dimensional shapes, students develop a foundation for understanding area, volume, congruence, similarity, and symmetry in later grades."

- from CCSS Math grade 2 introduction

CCSS Math Grade 2 Alignment with BlocksCAD

DOMAIN: GEOMETRY

Standard A: Reason with shapes and their attributes.

Cluster	In BlocksCAD
2.G.A.1 -- Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexa gons, and cubes. (Sizes are compared directly or visually, not compared by measuring.)	Identifying and describing 2D and 3D shapes is fundamental to the BlocksCAD experience. Students can use various blocks including **rotate, translate, hull, and sides** to create a wide variety of shapes based on inputting angles and attributes about those shapes.

Math Series lessons aligned with specific **Common Core and CSTA Standards** are highlighted. Each lesson targets specific math/CS standards and BlocksCAD tools. All encourage standards-aligned creative design, organized program development, spatial reasoning, number sense, and problem solving.

GRADE 3

Common Core State Standards - MATH

BlocksCAD lessons aligning with grade 3 standards

- **Intro Series:**
  - **Shapes and translation**: Snowman, Caterpillar, Cube Corners, Robot, Top
  - **Sides:** Cheese. Use Sides transform block on circles and cylinders to create shapes with different numbers of sides
- **Math Series:**
  - Bar Graphs: Build and manipulate bar graphs with variables
  - Telling Time: Read and adjust an animated analog clock model
  - Shape Sorter: Creating and analyzing properties of four-sided figures
  - Box of Chocolates: Visualizing multiplication
  - My Neighborhood: Using fractions in measuring distance
  - Chemistry Assistant: Measurement and volume
- **Teacher-created lessons based on criteria below**

Numerous grade 3 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, In grade 3 students begin to more deeply engage with multiplication and arrays as a means of problem solving, which can be related to making arrays of shapes and measuring area and volume.

Critical areas of instruction in grade 3 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Developing understanding of multiplication and division and strategies for multiplication and division within 100;
2) Developing understanding of fractions, especially unit fractions (fractions with numerator 1);
3) **Developing understanding of the structure of rectangular arrays and of area; and**
4) **Describing and analyzing two-dimensional shapes.**

"Students recognize area as an attribute of two-dimensional regions. They measure the area of a shape by finding the total number of same-size units of area required to cover the shape without gaps or overlaps, a square with sides of unit length being the standard unit for measuring area. Students understand that rectangular arrays can be decomposed into identical rows or into identical columns. By decomposing rectangles into rectangular arrays of squares, students connect area to multiplication, and justify using multiplication to determine the area of a rectangle."

- from CCSS Math grade 3 introduction

"Students describe, analyze, and compare properties of two-dimensional shapes. They compare and classify shapes by their sides and angles, and connect these with definitions of shapes. Students also relate their fraction work to geometry by expressing the area of part of a shape as a unit fraction of the whole."

- from CCSS Math grade 3 introduction

CCSS Math Grade 3 Alignment with BlocksCAD

DOMAIN: OPERATIONS & ALGEBRAIC THINKING

Standard A: Represent and solve problems involving multiplication and division

Cluster	In BlocksCAD
3.OA.A.1 -- Interpret products of whole numbers, e.g., interprete 5 x 7 as the total number of objects in 5 groups of 7 objects each. For example, describe a context in which a total number of objects can be expressed as 5 x 7.	Box of Chocolates: Students adjust variables for length and width to create and analyze different-sized arrays of chocolates.
3.OA.A.3 -- Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.	Students can use multiplication, division, and remainder blocks to calculate when constructing projects. Students can estimate the number of shapes in an array by using multiplication - such as a 10 x 10 array of cubes (10 x 10 = 100 total cubes).

DOMAIN: MEASUREMENT & DATA

Standard A: Solve problems involving measurement and estimation

Cluster	In BlocksCAD
3.MD.A.1 --Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.	Telling Time: Use an animated BlocksCAD clock to set and read an analog clock. Perform time difference calculations by reading different states of this clock.
3.MD.A.1 --Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).1 Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.	Chemistry Assistant: Use a pre-built module and cylinders to fill beakers with chemicals. Solve problems about their combined volumes.

Standard B: Represent and interpret data

Cluster	In BlocksCAD
3.MD.B.3 -- Draw a scaled picture graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs.	Bar Graphs: Interpret data presented in BlocksCAD bar graphs. Adjust variables to change the height of the bars to represent new data.
3.MD.B.4 -- Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked	My Neighborhood: Students work with measurement data in wholes, half, and quarter miles while reading and manipulating a map of their neighborhood.

off in appropriate units -- whole numbers, halves, or quarters.	

Standard C: Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

Cluster	In BlocksCAD
3.MD.C.5 -- Recognize area as an attribute of plane figures and understand concepts of area measurement. -- a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area. -- b. A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units.	Measure the area of rectangles using the BlocksCAD coordinate grid, or by constructing unit-squares which are **translated** over a shape to estimate area. Unit squares as well as non-standard units (such as "unit right-triangles") can be used to calculate surface area in terms of different units.
3.MD.C.6 -- Geometric measurement: understand concepts of area and relate area to multiplication and to addition. Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).	Measure the area of rectangles using the BlocksCAD coordinate grid. Use multiplication and unit square to find the area of several flat shapes, and then add those areas together to calculate their total surface area. Examples could include the floorplan of a student's house or the classroom.
3.MD.C.7 -- Geometric measurement: understand concepts of area and relate area to multiplication and to addition. Relate area to the operations of multiplication and addition. -- a. Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. -- c. Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a × b and a × c. Use area models to represent the distributive property in mathematical reasoning.	Demonstrate that an array of unit squares can be used to measure the area of a rectangle. Unit squares can be in square mm (BlocksCAD's grid size), or custom dimensions. For part C, visual representations of two side-by-side rectangles with height *a* (but differing lengths *b* and *c*) can be used to prove the distributive properties of area.

DOMAIN: GEOMETRY

Standard A: Reason with shapes and their attributes.

Cluster	In BlocksCAD
3.G.A.1 -- Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.	Identifying and describing 2D and 3D shapes is fundamental to the BlocksCAD experience. Constructing equilateral quadrilaterals from scratch can be achieved by using the **sides** block on circles and cylinders. For irregular polygons, shapes can be constructed from scratch by creating thin rectangles (which serve as lines), and then arranging them in the build space through **rotation** and **translation.** The final shapes can then be **hulled** together to make solid shapes for printing and 3D modeling. Shape Sorter: Students will adjust variables to create four-sided figures. They will compare their properties and sort them based on similarities and differences.

GRADE 4

Common Core State Standards - MATH

<u>BlocksCAD lessons aligning with grade 4 standards</u>

- **Intro Series:**
  - **Shapes and Translation** (Snowman, Caterpillar, Cube Corners, Robot, Top)
  - **Rotation** (Spiky Ball, Spiky Hair, Table, Torus Cage, Figure, Flower)
  - **Hull** (Round Corners, Scraper [difficult]): students can use hull operation to join together "lines" in BlocksCAD to make solid shapes (more detail below)
  - **Sides** (cheese)**:** Use Sides transform block on circles and cylinders to create shapes with different numbers of sides
- **Math Series:**
  - Birdhouses: Calculate areas and perimeters and scale shapes with variables
  - Compass Construction: Use angles to create a compass model
  - Fair Share: Identify and draw lines of symmetry
  - Cake Cutter: Use a module to create and add fractional cake slices
  - Pattern Puzzles: Analyze and create shape and number patterns
  - Mountain Views: Rotate objects and measure angles
  - Class Table (AR): Area/perimeter calculations about tables renderable in AR
  - Halloween Hats (AR): Area calculations about hats renderable in AR
  - Protractor (AR): Design a protractor and render in AR to measure angles
- **Teacher-created lessons based on criteria below**

Numerous grade 4 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, In grade 4 students build their understanding of angles and degrees, which is a fundamental concept in BlocksCAD and opens up a huge realm of possible activities. In order to scaffold student understanding, teachers should advise students to begin rotating only in the Z axis (which will rotate shapes on the X-Y plane), before moving on to rotation around other axes. Students all are expected to begin constructing shapes from lines and angles, which can be mimicked in BlocksCAD by using long skinny cylinders and rectangles as "lines", and then using the Hull set operation to join them together into solid shapes.

Critical areas of instruction in grade 4 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Developing understanding and fluency with multi-digit multiplication, and developing

understanding of dividing to find quotients involving multi-digit dividends;

2) Developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers;
3) **Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry.**

"Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry."

- from CCSS Math grade 4 introduction

CCSS Math Grade 4 Alignment with BlocksCAD

DOMAIN: OPERATIONS & ALGEBRAIC THINKING

Standard C: Generate and analyze patterns.

Cluster	In BlocksCAD
4.OA.C.5 -- Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.	Pattern Puzzles: Students use 3D shapes and Transforms to fill in the missing pieces of shape and number patterns.

Standard A: Solve problems involving measurement and conversion of measurements.

Cluster	In BlocksCAD
4.MD.A.1 -- Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. **4.MD.A.3** -- Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.	Birdhouses: Students will convert measurements from inches to feet as they calculate the area and perimeters of rectangles. Class Table (AR): Students calculate areas and perimeters of tables and then design and render a table in augmented reality. Halloween Hats (AR): Students calculate areas and perimeters of festive hats and then design and render their own hats in augmented reality.

Standard C: Geometric measurement: understand concepts of angle and measure angles.

Cluster	In BlocksCAD
4.MD.C.5 -- Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: -- a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a	Students can use **rotate** blocks to rotate shapes by any angle. Students can use **angle** input blocks to use angles in calculations. BlocksCAD Activities using Rotation can be found in the *assignments* section of the My Classes tab on Blockscad3d.com. Compass Construction: Students will create a model of a compass by rotating cardinal and intercardinal directions around the origin.

"one-degree angle," and can be used to measure angles. -- b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees.	
4.MD.C.6 -- Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.	Students can use rotation blocks to rotate shapes by any angle. Students can use angle blocks to use angles in calculations. Students can craft their own protractors in BlocksCAD using the **rotate** and **translate** blocks. Protractor (AR): Students use rotations to build a model of a protractor and then render it in AR to measure angles.
4.MD.C.7 -- Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.	Students can use **rotate** blocks to rotate shapes by any angle. Students can use angle input blocks to use angles in calculations. Students can input added and subtracted values into angles. Mountain Views: Students create a model of the view from a mountain by rotating cities on a horizon. They use angle measures to describe the different views.

DOMAIN: NUMBER & OPERATIONS

Standard B: Build fractions from unit fractions.

Cluster	**In BlocksCAD**
4.NF.B.3-- Understand a fraction a/b with a > 1 as a sum of fractions 1/b. --Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. --Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. --Add and subtract mixed numbers with like denominators --Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.	Cake Cutter Students use a module to create fractional slices of cakes. They fulfill orders by creating multiple slices and adding their sizes up to get bigger fractions.

Standard A: Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Cluster	**In BlocksCAD**
4.G.A.1 -- Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.	BlocksCAD cannot render pure "lines", but skinny cubes can be used to simulate lines in the 3D environment. For example, a cube with dimensions of x=0.1, y=0.1, and z=10 would make a tall, skinny, line-like shape. These shapes can then be arranged in angles and parallel to each other using a combination of **rotate** and **translate** blocks. Lines can also be connected into fully 3-D shapes by using the **hull set operation**.
4.G.A.2 -- Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size.	Using the techniques spelled out above, students can construct a limitless variety of 2D and 3D shapes based on certain properties. Students can also be shown these models in BlocksCAD, and from

Recognize right triangles as a category, and identify right triangles.	their can identify the shapes based on measured properties inferred from the code.
4.G.A.3 -- Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.	The **mirror** block can be used to create objects with bilateral symmetry. Students can also use a thin cube to identify lines of symmetry, by using a combination of **rotate** and **translate** to place the thin cube along the line of symmetry, "cutting" the shape. The shape can also literally be cut by using the **difference** set operation to remove a thin segment along the plane of symmetry, allowing the printing of two separate halves. Fair Share: Students will examine shapes for symmetry and rotate a lie so that it becomes a line of symmetry. They will consider how the mirror block can create symmetry.

GRADE 5

Common Core State Standards - MATH

BlocksCAD lessons aligning with grade 5 standards

- **Intro Series:**
  - **Shapes and Translation** (Snowman, Caterpillar, Cube Corners, Robot, Top)
  - **Difference** (Cube Cage, Cup)
  - **Hull** (Round Corners, Scraper [difficult]): students can use hull operation to join together "lines" in BlocksCAD to make solid shapes (more detail below). Hull can be used to make right-triangles as well (see scraper), which relates to several standards.
  - **Sides** (Cheese)**:** Use Sides transform block on circles and cylinders to create shapes with different numbers of sides, including right-triangles
- **Math Series:**
  - Shape Up: Sort shapes with translations based on their attributes
  - Dinner Robot: Identify and move objects to specific coordinate points
  - Pie Pieces: Visualize and add fractions
  - Ruler Construction: Unit conversion and fractions
  - Inside the Box: Estimate volume using rectangular prisms
  - Battleship: Identify points on the plane using coordinates
  - Class Table (AR): Volume calculations about tables renderable in AR
  - Halloween Hats (AR): Volume calculations about hats renderable in AR
- **Teacher-created lessons based on criteria below**

Numerous grade 5 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, In grade 5 students begin to engage deeply with calculating volume according to various formulae. This provides opportunities for students to combine their mathematical understanding of volume with shapes designed in BlocksCAD according to certain criteria. Students may also use 3D printed version of their shapes to measure their volume in a variety of ways, including formulas, unit cubes, and liquid displacement. Students also begin to build understanding in the x-y

coordinate grid. For students familiar with BlocksCAD, these standards should come naturally as BlocksCAD fundamentally engages in the x-y-z coordinate grid for design.

Critical areas of instruction in grade 5 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Developing fluency with addition and subtraction of fractions, and developing understanding of the multiplication of fractions and of division of fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions);
2) Extending division to 2-digit divisors, integrating decimal fractions into the place value system and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operations; and
3) **Developing understanding of volume.**

"Students recognize volume as an attribute of three-dimensional space. They understand that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps. They understand that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. They select appropriate units, strategies, and tools for solving problems that involve estimating and measuring volume. They decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes. They measure necessary attributes of shapes in order to determine volumes to solve real world and mathematical problems."

- from CCSS Math grade 5 introduction

CCSS Math Grade 5 Alignment with BlocksCAD

DOMAIN: NUMBER AND OPERATIONS - FRACTIONS

Standard A: Use equivalent fractions as a strategy to add and subtract fractions.

Cluster	In BlocksCAD
5.NF.A.1 -- Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. **5.NF.A.2** -- Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.	Pie Pieces: Students will use a module to create fractional pie pieces. They will perform calculations using these fractions to calculate the price of different pie orders.

DOMAIN: MEASUREMENT & DATA

Standard A: Convert like measurement units within a given measurement system

Cluster	In BlocksCAD
5.MD.A.1 -- Convert among different -sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world	Ruler Construction: Students convert BlocksCAD mm units to inches and feet to design a ruler. They use the difference block to inscribe notches and labels.

problems.
Represent and interpret data.

Cluster	In BlocksCAD
5.MD.C.3 -- Recognize volume as an attribute of solid figures and understand concepts of volume measurement. -- a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. -- b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units.	Measure the volume of rectangular shapes using BlocksCAD's coordinate space. Students may also construct unit cubes and manipulate them with **translate** in order to graphically count the volume of various shapes.
5.MD.C.4 -- Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.	Measure the volume of rectangular shapes using BlocksCAD's coordinate space. Similar to standard 5.MD.B.3 above. refer to that for activity suggestions.
5.MD.C.5 -- Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.	Demonstrate that an array of unit cubes can be used to measure the volume of a 3D rectangular shape. Inside the Box: Students create a module to create rectangular prisms with any dimensions and use these to estimate volumes of irregular 3D shapes. Class Table (AR): Students calculate volumes of table pieces to calculate costs and then design and render a table in augmented reality. Halloween Hats (AR): Students calculate volumes of festive hats and then design and render their own hats in augmented reality.
5.MD.C.5a -- Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent three-fold whole-number products as volumes, e.g., to represent the associative property of multiplication.	Demonstrate that an array of unit cubes can be used to measure the volume of a 3D rectangular shape.
5.MD.C.5b -- Apply the formulas V =(l)(w)(h) and V = (b)(h) for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.	Create 3D rectangular shapes with different dimensions to explore volume formulae. Students can use mathematical formulae to precisely calculate volume, and can then use methods such as liquid displacement to measure the volume of their 3D printed design in the real world.
5.MD.C.5c -- Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.	Create a complex shape out of rectangular prisms, then sum the volume of those prisms to find the shape's volume.

DOMAIN: GEOMETRY

Standard A: Graph points on the coordinate plane to solve real-world and mathematical problems.

Cluster	In BlocksCAD

5.G.A.1 -- Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate). **5.G.A.2** -- Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.	BlocksCAD uses a coordinate space to place all of the shapes constructed. Any student using BlocksCAD can develop understanding of the coordinate plane. Dinner Robot: Students move cylindrical plates around a table using a module that brings the plates to specific coordinate points. Battleship: Students create a module for placing white and red dots on their Battleship board at specific coordinates.

Standard B: Classify two-dimensional figures into categories based on their properties

Cluster	In BlocksCAD
5.G.B.3 -- Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles. **5.G.B.4** -- Classify two-dimensional figures in a hierarchy based on properties.	Use shapes in BlocksCAD to discuss categorization of shapes. Shape Up: Students use translations to move different shapes into a series of categories about their attributes.

GRADE 6

Common Core State Standards - MATH

BlocksCAD lessons aligning with grade 6 standards

- **Intro Series:**
  - **Shapes and Translation** (Snowman, Caterpillar, Cube Corners, Robot, Top)
  - **Difference** (Cube Cage, Cube Cage Toy, Cup, Name Tag)
  - **Hull** (Round Corners, Scraper [difficult]): students can use hull operation to join together "lines" in BlocksCAD to make solid shapes (more detail below). Hull can be used to make right-triangles as well (see scraper), which relates to several standards.
  - **Sides** (Cheese)**:** Use Sides transform block on circles and cylinders to create shapes with different numbers of sides, including right-triangles and right-angle prisms
  - **Variables** (any-size box)
- **Math Series:**
  - Tangram Level 1: Use translations to play the popular shapes game
  - Sugar Cube: Work with the volume formula for rectangular prisms
  - Starry Night: Use coordinates and the hull block to create polygons

    - Cardboard Recycling: Calculate surface area and draw 2D nets
    - Dice Nets: Work with 2D nets and probabilities
    - Saving Up: Use loops to graph and analyze linear functions
    - Professional Printer: Use a module and hull block to create shapes
    - Opposite Day: Consider the effect of reflections on coordinates
    - New Glasses (AR): Decompose polygons into triangles to calculate area
- **Teacher-created lessons based on criteria below**

Numerous grade 6 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, grade 6 builds on the understanding of volume and volume formulas that students began in grade 5, including fundamental shapes as well as right triangles and right prisms (new in grade 6). In order to build these shapes, students should engage in activities using the sides block, as well as hull and linear extrude (on 2D shapes). Grade 6 also features the introduction of variables and writing expressions and equations. Students can use BlocksCAD's features relating to variables and math blocks to construct models which utilize variables and expressions as part of their construction.

Critical areas of instruction in grade 6 Math include the following (**bolded** items are particularly suited to BlocksCAD)

1) Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems;
2) Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers;
3) **Writing, interpreting, and using expressions and equations; and**
4) **Developing understanding of statistical thinking.**

"Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as 3x = y) to describe relationships between quantities."

- from CCSS Math grade 6 introduction

"Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane."

- from CCSS Math grade 6 introduction

CCSS Math Grade 6 Alignment with BlocksCAD

DOMAIN: EXPRESSIONS & EQUATIONS

Standard A: Apply and extend previous understandings of arithmetic to algebraic expressions.

Cluster	In BlocksCAD
6.EE.A.1 -- Write and evaluate numerical expressions involving whole-number exponents.	Students can use exponent blocks to calculate when constructing projects. Students can use exponents to define the dimensions of their shapes, which visually demonstrates how each power a dimension is raised by will result in exponential growth in the size of their shapes. Shapes can be 3D printed to have their volume calculated, or measured through liquid displacement.
6.EE.A.2 -- Apply and extend previous understandings of arithmetic to algebraic expressions. Write, read, and evaluate expressions in which letters stand for numbers.	Students can use variable blocks to calculate when constructing projects. Variables can act as placeholders for dimensions on certain shapes, which can be changed at any point. Numerous shapes can be defined by a single variable, which can be changed in one location and affect all shapes simultaneously.
6.EE.A.2a -- Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y.	Students can use variable blocks to calculate when constructing projects.

Standard C: Represent and analyze quantitative relationships between dependent and independent variables.

6.EE.C.9 -- Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.	Saving Up: Calculate areas and consider similarity of Tangram pieces and then use translations to move them around the plane into specific designs.

Standard B: Reason about and solve one-variable equations and inequalities.

Cluster	In BlocksCAD
6.EE.B.6 -- Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	Students can use variable blocks to calculate when constructing projects.
6.EE.B.8 -- Write an inequality of the form x > c or x < c to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form x > c or x < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams.	Students can use inequality blocks to calculate when constructing projects.

DOMAIN: GEOMETRY

Standard A: Solve real-world and mathematical problems involving area, surface area, and volume.

Cluster	In BlocksCAD
6.G.A.1 -- Find area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.	Demonstrate that an array of unit squares can be used to measure the area of a 2D shape. Tangram: Calculate areas and consider similarity of Tangram pieces and then use translations to move them around the plane into specific designs. New Glasses (AR): Students calculate the cost of glasses by decomposing the lens shapes into triangles and calculating the areas. They then render try on the glasses using AR.
6.G.A.2 -- Solve real-world and mathematical problems involving area, surface area, and volume. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	Demonstrate that an array of unit cubes can be used to measure the volume of a 3D shape. Create 3D rectangular shapes with different dimensions to explore volume formulae. Sugar Cubes: Use a module that creates a rectangular prism of sugar cubes of any size. Use the volume formula to solve for side lengths.
6.G.A.3 -- Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.	Drawing polygons using the coordinate plane is a fundamental functionality of BlocksCAD. Starry Night: Hull stars at specific coordinate points together to create polygon constellations. Professional Printer: Create a module to place points at polygon vertices for hulling. Compose concave shapes from simpler polygons.
6.G.A.4 -- Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	Demonstrate that an array of unit squares can be used to measure the area of a 2D shape. Cardboard Recycling: Draw 2D nets of 3D figures and vice-versa. Calculate surface areas using these nets. Dice Nets: Translate die faces into a 2D net that could be folded into a 3D die. Calculate probabilities of different scenarios.

GRADE 7

Common Core State Standards - MATH

<u>BlocksCAD Lessons aligning with grade 7 standards</u>

- **Intro Series:**
  - **Difference** (Cube Cage, Cube Cage Toy, Cup, Name Tag)
  - **Hull** (Round Corners, Scraper)
  - **Sides and Scale** (Cheese)**:** Use Sides transform block on circles and cylinders to create shapes with different numbers of sides, including right-triangles and right-angle prisms. Use scale block to model and discuss proportionality, and prepare for grade 8 concepts in congruence.
  - **Intersection set operation (**Boat, two letters)**:** Intersection can be used to create slices from 3d shapes, in accordance with standard 7.G.A.3
  - **Variables** (any-size box)
- **Math Series:**
  - Scale City: Scale factors and similarity
  - Sous Chef: Use intersection block to see 2D intersections
  - Pizza Printer: Create module to make and top a pizza
  - Angle Deduction: Apply angle properties to solve multi-step problems
  - Model Home: Calculate areas and volumes of 3D shapes
  - Tangram Level 2: Use translations and rotations to move shapes
  - What are the Chances?: Create a coin-flipping simulator
  - Halloween Hats (AR): Volume calculations about hats renderable in AR
  - Protractor (AR): Design a protractor and render in AR to measure angles
- **Teacher-created lessons based on criteria below**

Numerous grade 7 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, grade 7 builds on the understanding of variables and writing expressions from grade 6, and so students can continue to build increasingly sophisticated models using variable inputs. Grade 7 also features explorations of circles, circumference, and area, which can be modeled and printed in BlocksCAD. Students can use their knowledge of fomulae and BlocksCAD's arithmetic blocks to build their own "calculators" which take certain inputs and calculate results (volume, area, etc) from known formulae. Students are expected to draw (using technology) various shapes according to criteria from the teacher, offering problem-solving opportunities in blocksCAD. In particular, students are expected to draw 2D "slices" that are taken from cross sections of 3D shapes, which can be done by using the **intersection** set operation (by intersecting a mostly 2D plane with a 3D shape).

Critical areas of instruction in grade 7 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Developing understanding of and applying proportional relationships;
2) **Developing understanding of operations with rational numbers and working with expressions and linear equations;**

3) **Solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and**
4) Drawing inferences about populations based on samples.

"Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems."

- from CCSS Math grade 7 introduction

"Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms."

- from CCSS Math grade 7 introduction

CCSS Math Grade 7 Alignment with BlocksCAD

DOMAIN: EXPRESSIONS & EQUATIONS

Standard B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Cluster	In BlocksCAD
7.EE.B.4 -- Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.	Students can use arithmetic, inequality, and variable blocks to calculate when constructing projects.

DOMAIN: GEOMETRY

Standard A: Draw, construct, and describe geometrical figures and describe the relationships between them.

Cluster	In BlocksCAD
7.G.A.1 -- Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	Students can create similar shapes at different scales and use them to solve scale-related problems. Students can use the scale block to quickly scale shapes. Scale City: Students will create models of famous buildings by finding scale factors between specific parts. They will use these scale factors to help calculate volumes and areas.

7.G.A.2 -- Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.	Students can use BlocksCAD to create geometric shapes to meet specified conditions from the teacher. Protractor (AR): Students use rotations to build a model of a protractor and then render it in AR to measure angles.
7.G.A.3 -- Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.	Students can use BlocksCAD coordinate space, and its difference and intersection blocks, to explore the cross-sections of 3D figures. Sous Chef: Students will use the intersection block and rotations to visualize the different possible cross sections of regular 3D geometric shapes.

Standard B: Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Cluster	In BlocksCAD
7.G.B.4 -- Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.	Create circles with different radii to explore area and circumference formulae. Pizza Printer: Students will create a module to build a pizza of any size and will perform calculations about these circular pizzas. They will write loops to add toppings.
7.G.B.5 -- Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.	Angle Deduction: Students will use facts about 3D angle diagrams to solve for unknown angles. They will practice organizing their reasoning in the form of a proof.
7.G.B.6 -- Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	Create complex 2D and 3D shapes out of simpler shapes, then sum the simple shapes' areas and volumes to find the complex shapes' properties. Tangram Level 2: Students will decompose the Tangram shapes into triangles and rectangles so that they can calculate areas. Model Home: Students will write conditional statements that let them customize a model home. They will calculate volumes and areas of the features of the house like the walls and the pool. Halloween Hats (AR): Students calculate volumes of festive hats and then design and render their own hats in augmented reality.

DOMAIN: STATISTICS & PROBABILITY

Standard C: Investigate chance processes and develop, use, and evaluate probability models

Cluster	In BlocksCAD
7.SP.C.5 -- Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	
7.SP.C.6 -- Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.	What are the chances?: Students use a conditional statement and loops to create a coin-flipping simulator. They record data on their simulations and investigate the Law of Large Numbers.
7.SP.C.7 -- Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.	

GRADE 8

Common Core State Standards - MATH

BlocksCAD lessons aligning with grade 8 standards

- **Intro Series:**
  - **Shapes and Translation** (Snowman, Caterpillar, Cube Corners, Robot, Top): creating cones can be achieved with the cylinder block when the top and bottom radius are “unlocked” from each other.
  - **Rotation** (Spiky Ball, Spiky Hair, Table, Torus Cage, Figure, Flower)
  - **Difference** (Cube Cage, Cube Cage Toy, Cup, Name Tag)
  - **Hull** (Round Corners, Scraper)
  - **Sides and Scale** (Cheese)**:** Use Sides transform block on circles and cylinders to create shapes with different numbers of sides, including right-triangles and right-angle prisms. Use scale block to model and discuss proportionality, and prepare for grade 8 concepts in congruence.
  - **Variables** (any-size box)

- **Math Series:**
    - Triangle Target Practice: Transformations in three dimensions
    - Bikini Bottom City Planning: Effect of transformations on coordinates
    - Witch's Cauldron: Application of the cylindrical volume formula
    - Ice Cream Machine: Application of the volume of spheres
    - Tessellations: Visual investigation of interior angle sum theorem
    - Chessboard Triangles: Pythagorean Theorem application
    - Pythagoras on TV: Pythagorean Theorem application
    - Class Table (AR): Volume calculations about tables renderable in AR
- **Teacher-created lessons based on criteria below**

Numerous grade 8 CCSS Math standards are in alignment with activities that can be prepared in BlocksCAD. In particular, grade 8 builds on the geometric understanding of scale and ratios by having students directly engage with translation, rotation, and mirroring of shapes. Student's familiar with BlocksCAD should have no problem applying these concepts, since they have been practicing them as a fundamental aspect of using BlocksCAD to make 3D models. The mirror transformation may be unfamiliar to some students and should be used to complete these transformations. Students can manipulate models in using transformations to test them for congruence and similarity. Students are also expected to work with fomulae for cones, cylinders, and other shapes (which can be modeled in BlocksCAD), as well as the Pythagorean Theorem. Calculations relating to volume and the Pythagorean Theorem can also be expressed through BlocksCAD's arithmetic blocks and functions.

Critical areas of instruction in grade 8 Math include the following (**bolded** items are particularly suited to BlocksCAD):

1) Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations;
2) Grasping the concept of a function and using functions to describe quantitative relationships;
3) **Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.**

"Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres."

- from CCSS Math grade 8 introduction

CCSS Math Grade 8 Alignment with BlocksCAD

DOMAIN: GEOMETRY

Standard A: Understand congruence and similarity using physical models, transparencies, or geometry software.

Cluster	In BlocksCAD
8.G.A.1 -- Verify experimentally the properties of rotations, reflections, and translations: -- a. Lines are taken to lines, and line segments to line segments of the same length. -- b. Angles are taken to angles of the same measure. -- c. Parallel lines are taken to parallel lines.	Have students use rotation and mirror blocks, plus shape positioning, to explore the effect on lines and angles in shapes relative to the x-y grid.
8.G.A.2 -- Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	Students can use mirror and rotation blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it. Triangle Target Practice: Students use multiple translations to "hit" successive target triangles with a starting triangle block.
8.G.A.3 -- Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates.	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it. Bikini Bottom City Planning: Students document changes to the "addresses" (coordinates) of different Bikni bottom houses after changes to the city (transformations).
8.G.A.4 -- Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it.
8.G.A.5 -- Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.	Tessellations: Students rotate triangles and squares to visualize the interior angle sum theorem. They create tessellations of other shapes using loops.

Standard B: Understand and apply the Pythagorean Theorem

Cluster	In BlocksCAD
8.G.B.6 -- Understand and apply the Pythagorean Theorem. Explain a proof of the Pythagorean Theorem and its converse.	Use squares in BlocksCAD to explain the visual proof of the Pythagorean Theorem. Use arithmetic blocks and student-crafted functions to accept inputs and calculate output values relating to the pythagorean theorem.
8.G.B.7 -- Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **8.G.B.8** -- Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	Use squares in BlocksCAD to explain the visual proof of the Pythagorean Theorem. Use arithmetic blocks and student-crafted functions to accept inputs and calculate output values relating to the pythagorean theorem. Chessboard Triangles: Students will calculate distances traveled on a chessboard using coordinates.

	Pythagoras on TV: Students write a function using the Pythagorean Theorem that calculates the size of a TV for them.

Standard C: Solve real-world and mathematical problems involving volumes of cylinders, cones, and spheres.

Cluster	In BlocksCAD
8.G.C.9 -- Know the formulas for the volume of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	Design projects in BlocksCAD using cones, cylinders, and spheres to solve problems. Use arithmetic blocks to render formuae for shapes, using the correct inputs to calculate final values. Witch's Cauldron: Students use the cylindrical volume formula to judge which cauldrons hold the same volume after a spell goes awry. Ice Cream Machine: Students program a function that uses the spherical volume formula to calculate the price of different ice cream orders. Class Table (AR): Students calculate volumes of table pieces to calculate costs and then design and render a table in augmented reality.

HIGH SCHOOL GEOMETRY

Common Core State Standards - MATH

CCSS Math High School Geometry Alignment with BlocksCAD

- **Math Series:**
  - Transformations Challenge: Construct specific geometric shapes in the plane
  - Analog Clock: Build a model clock that can show any specified time
  - Triangular Prism: Create special right triangles of any size using variables
  - Helical Gear: Build a model of a gear using difference and loop blocks
- **Teacher-created lessons based on criteria below**

DOMAIN: GEOMETRY - CONGRUENCE

Standard A: Experiment with transformations in the plane.

Cluster	In BlocksCAD

HSG.CO.A.2 -- Experiment with transformations in the plane. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it. Transformations: Students use transformations and trigonometry to create 2D shapes like parallelograms or triangles with specific angles.
HSG.CO.A.3 -- Experiment with transformations in the plane. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it.
HSG.CO.A.4 -- Experiment with transformations in the plane. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it.
HSG.CO.A.5 -- Experiment with transformations in the plane. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	Students can use mirror, rotation, and scale blocks to manipulate shapes in 3D space. Students can redefine a shape's position to translate it.

DOMAIN: GEOMETRY - SIMILARITY, RIGHT TRIANGLES, & TRIGONOMETRY

Standard A: Define trigonometric ratios and solve problems involving right triangles

HSG.SRT.C.8 -- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.	Triangular Prism: Students will use translations and the hull block to make prisms with bases that are specific types of special triangle.

DOMAIN: GEOMETRY - GEOMETRIC MEASUREMENT & DIMENSION

Standard A: Explain volume formulas and use them to solve problems.

Cluster	In BlocksCAD
HSG.GMD.A.3 -- Explain volume formulas and use them to solve problems. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	Design projects in BlocksCAD using cones, cylinders, pyramids and spheres to solve problems.
HSG.GMD.A.4 -- Visualize relationships between two-dimensional and three-dimensional objects. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	Students can use BlocksCAD coordinate space, and its difference and intersection blocks, to explore the cross-sections of 3D figures.

DOMAIN: GEOMETRY - MODELING WITH GEOMETRY

Standard A: Apply geometric concepts in modeling situations.

Cluster	In BlocksCAD
HSG.MG.A.1 -- Apply geometric concepts in modeling situations. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).	Modeling objects as 3D shapes is fundamental to the BlocksCAD experience. Analog Clock: Students use translations, rotations, loops, and variables to create a model clock that can display any specified time. Helical Gear: Students use translations, the difference block, and loops to create a helical gear for a machine.
HSG.MG.A.3 -- Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).	Design projects in BlocksCAD using 3D shapes to solve problems and meet constraints.