GEOMETRY

Teachable Units

Learning Consortium

Northen Michigan Learning Consortium

Revised Fall 2007

Reflects MDE Expectation and Code Changes for Algebra I Content Expectations

GEOMETRY
Mathematical Reasoning

Suggested Percentage of Instructional Time - __10__ %

Recommended Instructional Sequence	Suggested Instructional Strategies/Intervention
***G.1.1.6** **L3.1.3** **L3.2.1 & L3.2.4** **L3.3.1 & L3.3.2** **L3.3.3** **L3.1.1** **L3.1.2, L3.2.2, & L3.2.3**	Instructional Strategies – Mathematical Reasoning L4.2.4, L4.1.3 and L4.2.1 Converses, Negation, Counterexamples, Inverse, Contrapositive, Logic Tables Materials: Construction Paper Goal: Use if – then statements to reorganize logic Use construction paper. 1. "If" on one piece. "Then" on another piece. "You are in Los Angeles" on a third piece. "You are in California" on a fourth piece. Or 2. "A figure is a quadrilateral" on third piece and "a figure is a square" on the fourth piece. Or 3. "$x \geq 7$" on a third piece and "$x \geq 10$" on a fourth piece. Students hold different phrases. Then they switch places to obtain converse. If false, we talk about counter-examples. You can also add the word "not" to discuss inverses. From here, students can use logic notation for other examples and start to use a logic table.
	L4.1.1 – Inductive & Deductive; L4.3.1 – In-Then structure & truth of statement. Mathematical Reasoning *Logical Arguments & Reasoning Great warm-ups and/or end of the hour activities can be found in logic puzzles & games. Use logic puzzles to discuss inductive & deductive reasoning. Have students turn some of the clues given in a puzzle into If – then statements & analyze how the statements aid in forming conclusions. Also use Sudoku, the colored squares puzzle, card or number tricks… anything where students have to supply reasoning for their arguments. Type "logic puzzles" into a Google search for many printable, usable ideas.
	Intro to the Value of Proofs – Answering the "Why?" Geometric Proofs: *Training the mind to approach problems in logical manner. Computer Program: *A computer w/o software is actually dumber than a "box of rocks." Software Engineers design the "function" of the software/game with "Lines of Code" (commands). Typical games are thousands of codes in order for the software to operate correctly. One missed code causes the computer to freeze. Which game would finish first? One with 150,000 lines of code or 75,000 lines of code? Which would take less space on a hard drive? Which would be able to be installed on a smaller hard drive? Would it be worth it for a software company to be as efficient as w/o missing any steps? THIS QUESTION BECOMES "How does the Public school system train the human brain to think in a logical manner?" Geometric Proofs are the mental training ground for the human brain where logic is the rule of law. Lawyer: During Courtroom proceedings, a lawyer must support his or her objections by laws or other precedents set by case law. This mirrors providing justifications for conclusions.

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GEOMETRY
Lines, Angles & Construction

Suggested Percentage of Instructional Time - 8 %

Recommended Instructional Sequence	Suggested Instructional Strategies/Intervention
***G1.1.6** **G1.1.5** **G1.1.3** **G1.1.4** **G1.1.1** **G1.1.2** **L1.2.3**	Vectors L1.2.3 Vector Map Activity: Using a map, plan a 3-leg trip. Draw a vector from starting point to the 1st destination. Measure the heading & magnitude. Draw a vector from 1st destination to second destination. Measure the heading & magnitude. Use vector addition to determine the heading and magnitude of the resultant vector. or Use navigation techniques for airplanes. If an airplane is traveling at 600 mph at a heading of 30˚ and the wind is blowing at a heading of 120˚ at 30 mph, what heading and magnitude would the plane actually fly? Can also adapt this to how you would adjust your heading and speed to go a certain route.
	Corresponding Angles (CA), AIA, AEA G1.1.2 Road Intersections: Talk about how certain roads are parallel. How other roads cross those. When constructing those roads, how did they know they were parallel? Construction: Show photos on overhead of homes under construction or stained glass, etc. Talk about the relationships between the beams/studs, angles the beams/studs form etc. Could also use satellite photos of roads.
	Constructions G1.1.3, G1.1.4 Make a construction book. Have students draw certain objects that contain midpoints, bisected angles, parallel and perpendicular lines. Keep these in a book for quick reference/review. Could also do drafting/technical drawings that would include the use of parallel and perpendicular lines.

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GEOMETRY
Triangles

Suggested Percentage of Instructional Time - 18 %

Recommended Instructional Sequence	Suggested Instructional Strategies/Intervention
G1.2.1 **G1.2.5** **G1.2.2** ***G.2.3.5** **G2.3.1 & G2.3.2** **G2.3.3 & G2.3.4** **G1.2.3**	G1.2.1 1. Draw and cut out several different triangles. Tear off each corner and place them adjacent to each other. (Shows an interior angle sum of 180˚) 2. Draw and cut out several different triangles. Place each triangle on a piece of paper and extend one side to form an exterior angle. Tear off the two angles that are not adjacent to the exterior angle. Use those two angles to fill in the exterior angle.
	G1.2.5 Get out a State map. Select 3 cities on the map that "your company" would distribute to. Draw a triangle with each city as a vertex. Construct the perpendicular bisector of each side. The point of concurrency of the perpendicular bisectors is the circumcenter and equidistant to each city. This is where your company would build its distribution center. (This also works well with a city map and the location of three clients you would make deliveries to.)
	G1.2.5, G2.3.3 and G2.3.2 Origami books provide a variety of designs that apply mid-segments, similarity, and congruence.
	G1.2.5 Cut a nice big triangle out of poster board, construction paper, or wood (something sturdy). Draw each median from a vertex to the midpoint of the opposite side. The point of concurrency is the centroid. Balance the triangle on the tip of a pencil or hang from a string. (Can be used jointly with other shapes and their diagonals).
	G2.3.3 Place a mirror on the floor/ground between a student and an object. Have the student walk backwards (while looking at the mirror) until he/she sees the top of the object in the mirror. Measure the height of the student's eyes, distance from the student to the mirror, distance from the mirror to the object. Set up a similar triangle proportion and solve. Can also use shadows!

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GEOMETRY
Trigonometry

Suggested Percentage of Instructional Time - 18 %

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L2.3.1 **G1.2.4** **L1.1.6** **G1.3.1** **G1.3.3** **G1.3.2**	SOHCAHTOA G1.3.1 Make or use actual clinometers. Measure a person's shadow & angle of elevation. Use info to find their height. or Make or use clinometers to measure angle of elevation to certain objects at school (height of building, height of flag pole, etc.) using trig.
	Exact values of Sine, Cosine, Tangent G1.3.3 Use flashcards. Students must answer the flashcard correctly to gain entrance into room, exit room, etc. Can be used just to study or review, too. Students can also make their own & test each other with them.
	Law of Sines & Cosines G1.3.2 Have students make triangles out of linkage strips (or just use construction paper/cardboard) with 2 different length sides. Have students measure angle C. Use Law of Cosines to find length AB. Adjust the side length. Measure angle C again. Solve for AB again, etc.

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GEOMETRY
Quadrilaterals & Other Polygons

Suggested Percentage of Instructional Time - __18__%

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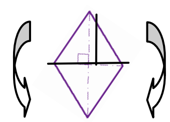
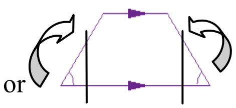
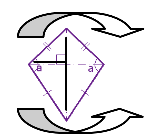
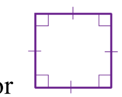
L2.3.1 G1.4.4 G1.4.3 G1.4.2 G2.1.1 G2.1.2 G1.4.1 G1.5.2 G1.5.1 *G2.3.5	G1.5.2 *Interior angle sums: Each student should draw his/her choice of convex polygon. By drawing in diagonals only, try to find the least possible # of triangles created. Start a table on the board showing student results & develop "n sides results in n-2 triangles." From here, have students work together to find angle sums of different n-gons based on triangle sums & develop formula (n-2) ·180. *Exterior angle sums: Pairs of students should accurately draw any convex n-gon & extend segments in one direction to form "n" exterior angles. Cut out every exterior angle drawn (discard interior) & try to arrange angles side to side. Record results on the board to find that no matter what shape was drawn, exterior angles sum to 360˚. If access to Geometer's Sketchpad is available, download activities for both of these investigations through www.mathbits.com
	G2.1.2 Whichever <u>Quad</u> you are dealing with have each student construct and cut out their own shape (Quad). Have each student duplicate this shape 2 times for a total of 3 □ Quads. (Note: One for practice, 2nd for dimensions, 3rd for original dimensions.) W/1st shape: Have students cut their shape into pieces which could be rearranged into a rectangle in the <u>EASIEST</u> way possible. Have a student share their method  or  or  or  (done) or rectangle (done). Examples: Rhombus: A = ½ $d_1 d_2$; =(½ d_1) d_2 [Note: ½ d_1 = h for rectangle]; =h(d_2) [Note: d_1= b for rectangle]; =h•b; =b•h Kite: Follow kite but note diagonals are <u>NOT</u> interchangeable. Trapezoid: A = ½ h (b_1+ b_2); = ½ (b_1+ b_2) h; =[½ (b_1+ b_2)] h; =[midsegment length] • h; =b•h (of rectangle created by cutting trapezoid) W/2nd shape: Have all students reproduce shared method on 2nd shape. With a rectangle = L·W have them identify L and W on their rectangle w/2 different colored highlighters. W/3rd shape: Have students transpose their highlighted dimensions <u>back</u> to starting 3rd shape for dimensions from ORIGINAL SHAPE. Substitute in values (i.e. appropriate variables) to derive area formula for specific Quadrilateral
	G1.4.3 - Understanding the quadrilateral hierarchy: Step 1: Use an Ellison Machine to make die cuts of each type of quadrilateral. Use different color for each shape. Step 2: Put 8 shapes in a Ziploc, one being just a basic quadrilateral. Hand out bags to pairs of students and have them rank these from least properties to most properties. Each pair shares their answer. Then ask them to list the property of each shape. Then ask each pair to try to create a "family tree" for these shapes based on the properties. Finally, analyze statements. Every trapezoid is a square. A rhombus is a square. A rectangle is a trapezoid.

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GEOMETRY
Circles

Suggested Percentage of Instructional Time - __18__%

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L1.1.6 & **G1.6.1** **G1.6.2** **G1.6.3 & G1.4.5** **L2.3.1** & **G1.6.4**	Deriving π G1.6.1 Use a string to measure the circumference and diameter of several circles/circular objects. Divide the circumference by the diameter for each object.
	Pizza Pricing G1.6.4 Gather data for S, M, L and XL pizzas (price for whole and cost per slice, diameter, number of slices). Find the area of each whole and each sector slice. Divide the cost for each respectively by the area. Which is the best deal for you? Which is the best way to accumulate a profit?
	Finding the area of a Boomerang G1.6.4 Students create boomerangs out of construction paper. They separate the boomerang into different regions. The regions are two semicircles (at the ends), two are rectangles, and a portion of a ring. Students are to find the area of each region and add the areas together. (The curved portion of the ring is the difference of two 90˚ sectors)

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GEOMETRY
3-Dimensional Figures

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G2.2.1 **G1.8.2** **G2.2.2** **G2.1.3** **G1.8.1** **L2.3.1**	G2.2.1 – Views <u>Assignment</u>: Students must draw the front, right, back elevations of their house. Also, they must draw <u>one</u> floor plan. (4 drawings all together.) <u>Rubric to Grade</u>: Put on plain white copy paper. Use a straight edge. Do <u>not</u> need decks or landscape. Does <u>not</u> need to be to exact scale, but it should be proportional.
	G1.8.1 – Figures Wrappers: Bring in simple solids from real world that may need "wrapping" – boxes, cylinders, cones, pyramids. What would we need to know about each figure to determine the exact amount of paper needed to wrap the figure with? (surface area) Each group gets an item to "wrap." Groups must calculate surface area of item using careful measurements & show calculations on poster. Groups must then design a net with which to perfectly wrap their figure, cut that net out of wrapping paper & attach to poster with calculations.
	G2.2.1 – Volumes & Nets Have students create two nets for a solid with a predetermined volume. Fold and assemble one and leave the second flat. Students should provide a mathematical proof for their shape. The teacher should provide a sliding scale; 3 pair of parallel faces = C, 2 pair of parallel faces with multiple curved faces = B, and no parallel faces with at least 7 faces = A.

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Transformations

Suggested Percentage of Instructional Time - __5__%

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G3.1.1 **G3.1.3** **G3.1.2** **G3.2.1 & G3.2.2** **G3.2.3** **L1.2.3**	G3.2.1, G3.2.2 - Dilations Students draw a picture on graph paper labeling the points. They choose a piece of paper from a hat with a scale factor written on it. They then have to dilate their picture by the scale factor they chose. (Some scale factors greater than 1, some less than 1). Plot them both on same axis system. Draw a dashed line from the center of the dilation to each pre-image point. Then from the pre-image point to the image to show the progression of the dilation.
	G3.1.1, G3.1.3 – Tessellations Have students look at examples of M.C. Escher. Have them create their own pattern that incorporates reflections, rotations, translations/or glide reflections.
	G3.1.1, G3.1.3 – Using the World Around Us Look for patterns in nature, at home, at work etc., that would incorporate any of the transformations you've studied. Bring in the object or a picture of the object.

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