Simi, D.M. Ontonagon Area Junior High/High School  
ESMIS-Artistic Expression Through Science and Mathematics  
Monday, June 24 through Friday June 29, 2002  
M. Hindelang- Instruction Coordinator

Brief summary of proposed idea-

**Overview**-
During my weeklong exploration of Artistic Expression through Science and Mathematics, I intend to focus my efforts on developing Unit Lesson Plans to facilitate learning in my Grade Eight Transition Mathematics course. Class population is dominated by academically challenged and historically non-motivated participants. During their second year of Transition Math (University of Chicago School Mathematics Project-Integrated Mathematics series) we will be exploring introductory Geometry concepts in the fall and preparing for spring of 2003 MEAP assessments.

With similar groups in the past two years, I have found that the terminology and concepts to be addressed at the onset of the year are often not fully absorbed and frequently lead to misconceptions inhibiting future learning. I recognize the need to supplement the normative curriculum with a hands-on learning approach that I will generate at the institute.

**Specific Goals:**
1.) Obtain resources and insight to explore geometric patterns and symmetry in nature; especially in the crystal structures of various ores and minerals from the area (arrange for Field Trip to Minerals Museum at MTU in fall 2002)
2.) Develop appropriate and applicable methodology and pedagogical strategies to institute the learning of the required topics and objectives within the Michigan Standards and Benchmarks Model (specifically, see below: MS.II.1.1 thru MS.II.1.4).
3.) Incorporate recently acquired Geometry SketchPad and Shape Maker software into the present curriculum and enhance artistic expression and ability of the student. Emphasis must be made to connect polygonal shapes and the image making process to “real-world” objects such as crystalline structures.
4.) Re-learn how to effectively share the joy and beauty of in-depth explorations of the macro- and micro-worlds which are all about us. I seem to have temporarily misplaced some of the zest which propelled me into the classroom each fall.

**Initial Concept:**
Using Jeweler's loupe or similar magnifying devices, examine several samples of local ores. Record observations in written Team Journals (accommodation: many students perform at very low levels in writing). Sketches by hand must be accompanied by computer generated images and labeling to match. Emphasis on categorizing geometric shapes encountered must be made (accommodation: posters in room for easy identification made by more advanced pre-Geometry students using Geometry SketchPad software).
Enhancement/enrichments: Examinations of western-U.P. ores will lead to connections to the mining industry shared by generations of families in the area. Opportunities to bring in guest speakers may result; possible visitation to White Pine Mine or Quincy Mine.

*Middle School Standard II: All students will develop spatial sense, use shape as an analytic and descriptive tool, identify characteristics and define shapes; identify properties and describe relationships among shapes (Shape and Shape Relationships).*

**MS.II.1.1.** Distinguish among shapes and differentiate between examples and non-examples of shapes based on their properties; generalize about shapes of graphs and data distributions

**MS.II.1.2.** Generalize the characteristics of shapes and apply their generalizations to classes of shapes.

Suggested practices:

- Exploring physical models of shapes to determine their symmetries and describing and demonstrating the symmetries of two- and three-dimensional shapes.
- Utilizing computer drawing programs to investigate shapes and shape relationships.
- Drawing or constructing and naming shapes that satisfy given criteria such as “a four-sided figure with one pair of parallel sides.”

**MS.II.1.3.** Derive generalizations about shapes and apply those generalizations to develop classifications of familiar shapes.

Suggested practices:

- Developing and verifying generalizations about geometric properties using informal means such as paper folding, reflecting with a mirror, or manipulating shapes with a dynamic computer drawing program.
- Developing hierarchies for families of shapes, such as drawing a Venn diagram to show the relationships among quadrilaterals, parallelograms, rectangles, squares, rhombi, trapezoids, etc.
- Investigating when a characteristic of a shape is sufficient to define a shape, such as determining whether congruent diagonals guarantees that a quadrilateral is a square.

**MS.II.1.4** Construct familiar shapes using coordinates or appropriate tools (including technology); sketch and draw two- and three-dimensional shapes.

Suggested practices:

- Constructing shapes using simple materials such as straws, toothpicks, pattern blocks, geostrips, or geoboards.
- Constructing shapes using various tools including Euclidean tools (compass and straight edge), mirrors or other reflection devices, computer drawing tools, coordinate graphs, paper folding, and tangram pieces.
- Constructing shapes that conform to given specifications (e.g., make a trapezoid with two right angles), and determining when it is impossible to create a certain shape (e.g., make a parallelogram with only two right angles).

Textbook resource: Sec: 5-9 “Polygons” (pp. 283-287); Sec: 6-3 “Draw a picture” (pp. 311-314); Sec: 7-6 “Angles and Lines” (pp. 375-380); Sec: 7-7 “Angles and Parallel Lines” (pp. 381-386); Sec: 7-8 “Special Quadrilaterals” (pp. 387-392)
Submitted by: Dennis M. Simi; Ontonagon Area Junior High School

Subject and Grade Level: Jr. High Math; Eighth Grade

Title: Crystal Constructions

Purpose: To facilitate learner in making visual and mental connections between Introductory level Geometric terms and concepts, elementary geometric constructions and diagrams and real-world examples and their physical models.

Overview of content: Review of 2-dimensional polygonal shapes and their descriptions based on definitions and characteristics will be enhanced by in-depth drawing and geometric constructions. 3-dimensional polyhedral shapes and their descriptions based on definitions and characteristics will be introduced with emphasis on the drawing of their representations using paper and pencil (2-D media).

Estimated time commitment: One-week

Learner Expectations:
1.) All students will be able to represent specific geometric patterns and relationships using diagrams and/or pictures.
2.) All students will be able to use presented patterns and their generalizations to make and justify inferences and predictions.
3.) All students will be able to distinguish among specific shapes and differentiate between examples and non-examples of these shapes based on their properties.
4.) All students will be able to construct familiar shapes using coordinates, appropriate tools (including technology), and sketching and two- and three-dimensional shapes.
5.) All students will be able to use shape, shape properties and shape relationships to describe some components of the physical world.

Activities and Procedures:
Day One: Expectations for the week presented per handouts with comments on group work and assigned poster illustrating various crystals and their attributes. PowerPoint review of geometric shapes presented in previous course. Using the “I do, we do, you do” scenario, students will draw and classify/identify the most evident 2-dimensional shapes found in crystal structures (triangles, squares, rectangles, parallelograms, trapezoids and hexagons).

Day Two: Handouts on components of crystal formations and classification of types of minerals and crystalline metals. Ten minutes of reading and highlighting will be followed by a brief lecture emphasizing
visually observed patterns and a question/answer period. Remaining classtime devoted to CLG poster of crystals.

**Day Three:** Film presentations of "Upper Peninsula Mineral Deposits" (3 minutes) and "Donald in Mathemagicianland" (26 minutes: min.) to be paused each time a student calls out a viewed geometric shape. Sketch must be entered into Math Journal with notation (eg: Square-roots). Note: this will be the fourth time this film will have been shown to class.

**Day Four:** Field Trip to MTU’s Seaman Mineral Museum and the Quincy Mine. Notes, sketches must be entered into student’s Math Journal. At least three of each of the six elemental shapes must be noted during bus ride (one on trip to Houghton, two on return or vice versus).

**Day Five:** Computer drawing software will be used to perfect raw sketches entered into student journals. A minimum of four 3-dimensional shapes must be presented. Note: students have already been introduced to “point-to-point” segment construction using software. However, object/shape rotations, translations (slides) must be demonstrated. Take home quiz will be handed in on Monday with poster.

During the learning process they will incorporate: 2-D and 3-D geometric shape classification/identification, mathematical modeling, artistic expression within mathematics, teamwork, journal entries, note keeping and data collection, computer aided drawing (Geometer SketchPad).

**Resources and materials:**
1.) Procedural handouts
2.) Powerpoint presentation
3.) Film Clip (“Upper Peninsula Mineral Deposits”) downloaded from website:www.geo.mtu.edu/museum
4.) VCR film from REMC or Seaborg Center for Math/Science Education: “Donald in Mathemagicianland”
5.) Computer aided drawing software: Geometer SketchPad.
6.) Poster board, Sharpie pens, pastel crayons, watercolor pencils
7.) Digital photos of crystals from “The F. John Barlow Mineral Collection”
8.) Seaman Mineral Museum and Quincy Mine Tours

**Closure:** Students will view posters of “real” mineral crystals that exhibit polyhedral attributes which have been generated by peers. Teacher will share comments collected from quiz concerning opinions about weeklong experience including tours. Group discussion about positives and negatives of event will be accompanied by directed discourse including means to improve for next year’s group experience.

**Performance Assessment:**
1.) Has the student appropriately represented the necessary polygons and polyhedrons? Evaluation of drawings/sketches
and notes in individual Math Journals. Evaluation of group generated posters.

2.) Has the student retained information presented in various formats and made appropriate connections? Evaluation of performance on quiz on topics from films, lectures and tours.

3.) Can the student manually draw assigned shapes and regenerate same using technology? Evaluation of Geometer SketchPad illustrations

**Standards/Benchmarks Addressed:**

**MS.II.1.1** Students develop spatial sense; use shape as an analytic and descriptive tool, identify characteristics and define shapes; identify properties and describe relationships among shapes. Distinguish among shapes and differentiate between examples and non-examples of shapes based on their properties; generalize about shapes of graphs and data distributions.
- exploring diagrams and two- and three-dimensional objects in order to:
  - describe the shapes of the objects.
  - name common shapes found in the objects.
  - identify special characteristics and properties of shapes.
  - classify objects according to their shapes.
  - differentiate between examples and non-examples of particular shapes.
- going on a geometry walk in the neighborhood and identifying and recording shapes that are observed.

**MS.II.1.2** Students develop spatial sense; use shape as an analytic and descriptive tool, identify characteristics and define shapes; identify properties and describe relationships among shapes. Generalize the characteristics of shapes and apply their generalizations to classes of shapes.
- using paper folding, geoboards, and other models to generate and test hypotheses about families of shapes and their properties (e.g., the opposite sides of the rectangles are always equal).
- exploring physical models of shapes to determine their symmetries, and describing and demonstrating the symmetries of two- and three-dimensional shapes.
- utilizing computer drawing programs to investigate shapes and shape relationships.
- drawing or constructing and naming shapes that satisfy given criteria such as “a four-sided figure with one pair of parallel sides.”

**MS.II.1.3** Students develop spatial sense; use shape as an analytic and descriptive tool, identify characteristics and define shapes; identify properties and describe relationships among shapes. Derive generalizations about shapes and apply those generalizations to develop classifications of familiar shapes.
- developing and verifying generalizations about geometric properties using informal means such as paper folding, reflecting with a mirror, or manipulating shapes with a dynamic computer drawing program.
- developing hierarchies for families of shapes, such as drawing a Venn diagram to show the relationships among quadrilaterals, parallelograms, rectangles, squares, rhombi, trapezoids, etc.
- investigating when a characteristic of a shape is sufficient to define a shape, such as determining whether congruent diagonals guarantee that a quadrilateral is a square.

**MS.II.1.4** Students develop spatial sense; use shape as an analytic and descriptive tool, identify characteristics and define shapes; identify properties and describe relationships among shapes. Construct familiar shapes using coordinates or appropriate tools (including technology); sketch and draw two- and three-dimensional shapes.
- constructing shapes using simple materials such as straws, toothpicks, pattern blocks, geostrips, or geoboards.
- constructing shapes using various tools including Euclidean tools (compass and straight edge), mirrors or other reflection devices, computer-drawing tools, coordinate graphs, paper folding, and tangram pieces.
• constructing shapes that conform to given specifications (e.g., make a trapezoid with two right angles), and determining when it is impossible to create a certain shape (e.g., make a parallelogram with only two right angles).

Follow-up Activities: Posters of other crystalline or architectural structures which exhibit polyhedral attributes, research on Mining and Engineering and related careers, bring in other films “cued” to points showing crystals and components (both geometric and structural), enrichment with guest speaker/mineralogist/mining engineer from community

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