



Natural Beauty

6th Grade

Duration

2–4 classes (depending on length of class) and a Museum visit

Location

Gem & Mineral Hall

Supplies

- See individual lessons

Standards

CCS Math 6.G.1.2.4.5.

Visual Art 6.2.1.2.3.4

CCS Reading Standards for Literacy in Science and Technical Subjects Grades 6-8: 3, 4

Vocabulary

Gem

Mineral

Crystal

Measurement

Unit

Estimate

Surface Area

Volume

Quadrilateral

Polygon

Rectangle

Triangle

Prism

Two-point Perspective



Module Overview

Simple, yet aesthetically pleasing shapes exist throughout the natural world. What shapes can we find among rocks, minerals, and gemstones?

Module Purpose

In this interdisciplinary lesson set, students practice geometric reasoning and artistic expression while gaining appreciation for the natural beauty of rocks and minerals.

Module Outline

1. In 1-2 pre-visit sessions students practice estimation and geometric classification skills.
2. During a visit to the Museum students apply these skills to several gems and minerals and choose one mineral or gemstone of which to create 2D sketch labeled with their estimated measurements.
3. In 1-2 post-visit sessions, students use estimates and those of their classmates to calculate the approximate surface area and volumes of various minerals and gemstones. Then create an artistic representation of their chosen mineral or gemstone, using their sketch as a guide

Module Prerequisite Skills & Concepts

- Students know how to find the surface area and volume of rectangular and triangular prisms.
- Students know how to accurately measure objects in centimeters.
- Students know how to draw an object using two-point perspective.
- Students know how to use shading, tints, and intensities to add interest to an artistic representation.

Assessment Opportunities

Lesson/Phase	Before and During the Lesson		End of Lesson
	<i>Uncovers Student Ideas</i>	<i>Checks for New Understandings</i>	<i>Evaluates Learning</i>
Pre-Visit	Show What You Know! Do Now	Show What You Know! Estimating Measurements	
Museum		Gem and Mineral Hall Discoveries: Classifying Prism Shapes and Estimating Measurements; Gem Sketch	
Post-Visit		Gem and Mineral Hall Discoveries: Surface Area and Volume of Minerals; Analysis	Gem and Mineral Hall Discoveries: Surface Area and Volume of Minerals; Analysis; Artistic Representation

References & Resources

"Making Rock Candy" (Video) Teachers' Domain. 22 Aug. 2008. Web. 16 May. 2012.
<http://www.teachersdomain.org/resource/vtl07.math.geometry.sol.rockcandy/>



Estimating

Pre-Visit

Duration
30-60 minutes

Location
Classroom

Supplies

- Worksheet
- A variety of objects, preferably rocks and minerals with regular geometric shapes
- Computer
- Projector
- "Making Rock Candy" video (see References and Resources Section)
- Rulers
- Pencils

Purpose

This activity sets the stage for the Museum visit by introducing students to the idea that geometric shapes exist in crystal structures, assessing students' current skill level at length estimation, and allowing them to practice these skills with more teacher guidance before they visit the museum.

Objectives

- Students will activate, demonstrate, and critically examine their prior knowledge of geometric shapes, surface area, volume, and estimation.
- Students will practice estimating using their hands and thumbs in preparation for their visit to the Museum.

Outline

1. Give student 3-5 minutes to complete the worksheet and have them "Pair-Share" their answers.
2. After you have called on a few students to share their responses, explain that the class is going to watch a short video ("Making Rock Candy") and that you want students to watch for more shapes as they watch the video and to record them into their chart.
3. Call on students to share their shapes (1/student) and formulas. Make sure all students have written down the formulas/method for the following:

Area of: triangle, rectangle, circle

Surface area of: pyramid, cube, rectangular prism,
triangular prism

Volume of: rectangular and triangular prisms, cubes

4. Explain that while students are at the museum, one of their tasks will be to identify different rocks and minerals that have regular geometric shapes and to calculate their surface areas and volumes. However, because most of the minerals are behind glass enclosures and students won't be able to touch them (and the museum doesn't

want fingerprints all over the glass!), students won't be able to measure the minerals; instead, they will have to estimate the measurements. So today, they will practice estimating measurements.

5. Model for students how they can use their hand/thumb to estimate measurements. Students will measure the length of their hand from the bottom of their palm to the tip of their middle finger, as well as the width of their thumb and record these measurements to use in their estimates. You can show students how to use ratios to convert their "measurements" now, or after the museum visit.
6. Pass out rulers for students to measure their hands and thumbs.
7. Pass out the rocks and minerals (or other objects) for students to practice estimating. They should verify their estimates with the rulers.
8. Go over your behavioral and academic expectations for your trip to the Museum and explain the activities students will be completing while there.



Natural Beauty: Estimation

Shaping Up

There are all kinds of shapes in the environment around us, both natural and man-made. Some shapes are 2-D, or flat, while others are 3-D, or multi-dimensional.

Can you name some shapes you notice in the classroom? What do they look like? Which are 2-D? Which are 3-D? Do you remember how to find the *surface area* and *volume* of these shapes? Fill out the table below with as many shapes as you can find, and then try to fill in the formulas for how to calculate their surface area and volume.

Sketch	Shape	Surface Area	Volume



Observation

Museum Visit

Duration

30-45 minutes

Location

Gem & Mineral Hall

Supplies

- Worksheet
- Clipboards with LED or similar lights (optional: it is quite dark in the Mineral Hall)
- Pencils

Purpose

While at the Museum, students practice using their previously learned geometry and art skills on real-world objects, thereby increasing motivation and encouraging transfer of learning.

Objectives

- Students will estimate the length, width, and height of 3-5 different prisms (at least 1 triangular prism and 1 rectangular prism).
- Students will create an accurate two-dimensional drawing of one prism, labeling it with estimated measurements.

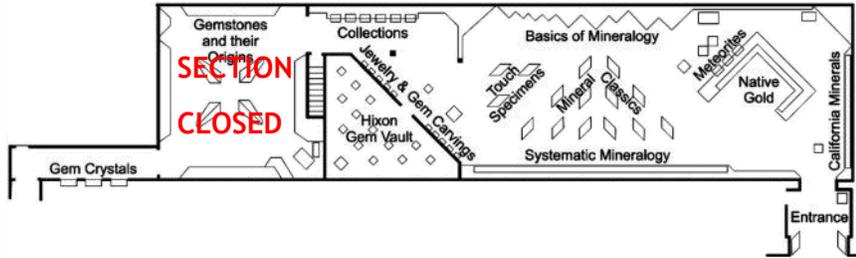
Outline

1. Verbally call on students before entering the hall and ask: What are the expectations for our visit?
2. Assign students to groups of 2-3 before arriving at the museum.
3. **Whole Group:** Gather students in front of the hall, pointing out the general layout of the hall. Start each group in a different part of the hall to avoid clumping. Make sure each group knows where they are starting and when and where they will meet up again. Emphasize that students need to manage their time well so that they have time to complete both their measurements and their sketch (5-10 min)
4. **Small Group:** Students work in groups to complete the assignment, observing the exhibits as they go. (30 min)
5. **Whole Group:** Once it is time for your class to move on, gather the class back at the entrance to the exhibit.
6. **Small Group:** Either on the bus or back in class, allow students time to share their results with another group or two.



Natural Beauty: Observation

Gem & Mineral Hall Discoveries



Classifying Prism Shapes and Estimating Measurements

Working with your group to carefully observe the gems and minerals in the exhibit. Look for gems and minerals that have recognizable shapes, such as regular quadrilaterals and triangles. Do you see any prisms? Are they rectangular or triangular prisms? Any cubes? Choose four of your favorite gems/minerals, identify the geometric shapes present and estimate the length, width, and height of their crystals.

Gem or Mineral	Geometric Shape	Length	Width	Height
1.				
2.				
3.				
4.				



Natural Beauty: Observation

Gem or Mineral Sketch

1. Choose your favorite mineral, what is it?
2. Sketch the mineral below, using two-point perspective.
3. Label the sketch with the estimate measurements of the length, height, and width of one crystal of the mineral.



Analysis, Art and Science

Post-Visit

Duration

1–2 classes

Location

Classroom (and possible homework)

Supplies

- Worksheets & Rubric
- Pencils
- Calculators
- Art paper
- Art pencils, pastels, paint, etc...

Purpose

Students will use estimates from the museum to calculate the surface areas and volumes of authentic objects and practice critical thinking skills to decide and what formulas to use. They will create surface area nets for to develop spatial reasoning and produce an artistic representation of a mineral, giving them the opportunity to engage in creative expression.

Objectives

- Students will present possible answers to others and listen critically to another students' explanations.
- Students will calculate surface area and volume for rectangular and triangular prisms.
- Students will create a surface area net.
- Students will create an artistic representation of their chosen mineral or gemstone, using two-point perspective and varying tints, shades, and intensities.

Outline

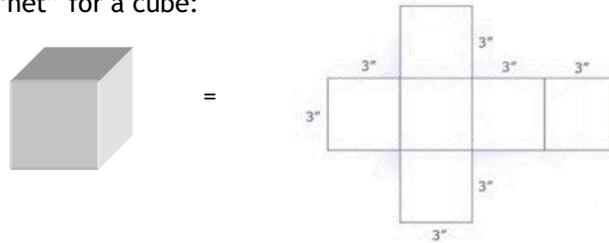
1. Together, identify the formulas for finding the surface area and volume of these shapes (last one is a bonus!).



2. Review answers with students in preparation for completing the remainder of the assignments. (5-10 min)
3. Have students work in Museum groups to complete the calculations of the surface area and volumes of their prisms, check for accuracy as students work and correct errors when you see them.
4. Introduce students to the drawing rubric and give them a reasonable completion date and time for the assignment.

1. How did you decide which formula to use to calculate the surface area and volumes of the minerals?

2. The “net” of a cubic shape is what it would look like if the surfaces of the object were laid flat. For example, here is the “net” for a cube:



Draw the “net” of the crystal you drew using two-point perspective, and include the converted measurements:

3. What patterns do you notice in the surface area and volumes of the different kinds of shapes?

4. If you could go back to the museum and do the activity again, what would you do differently? Why?



Gem & Mineral Drawing Rubric

Choose a specimen to carefully draw using two-point perspective. Take the time to note details about your specimen, and present it in an interesting way. You will be assessed using the rubric below:

	4	3	2	1	Score
Form	Student has skillfully used two-point perspective to represent a three-dimensional mineral in two dimensions. Student used a horizon line and vanishing points. Student consistently drew straight using a ruler. The shapes, patterns and textures accurately represent the source mineral.	Student has used two-point perspective. Student used a horizon line, vanishing points and a ruler, but lines don't always meet up with v.p. Student has used some basic shapes, patterns and textures to represent the source mineral.	Student has attempted to use two-point perspective. Use of a horizon line and vanishing point doesn't appear evident and/or lines are not straight. Very little use of shapes, patterns, and textures to represent the mineral.	Student did not attempt to use two-point perspective OR it is unclear what the drawing is intended to be.	
Detail	Representation is expressive and detailed. Student used varying tints, shades, and intensities to add interest to the drawing. Student has great control and is able to experiment a little, making the mineral "come to life".	Representation is expressive and somewhat detailed. Little use has been made of tints, shades, or intensities. Student has basics, but has not "branched" out.	Representation has few details. It is primarily representational with very little use of tints, shades, or intensities. Student needs to improve control.	The representation lacks almost all detail OR it is very messy. Student needs to work on control.	
Creativity	Student has taken the technique being studied and applied it in a way that is totally his/her own. The student's personality/voice comes through.	Student has taken the technique being studied and has used source material as a starting place. The student's personality comes through in parts of the representation.	Student has copied some representation from the source material. There is little evidence of creativity, but the student has done the assignment.	Student has not made much attempt to meet the requirements of the assignment.	
Time/Effort	Student used class time wisely. Much time and effort went into the planning and design of the representation. It is clear the student worked at home as well as at school.	Student used class time wisely. Student could have put in more time and effort at home.	Student did not always use class time wisely, but student did do some additional work at home.	Student did not always use class time wisely and the student put in no additional effort.	