Organization name	The Albin Polasek Museum & Sculpture Gardens
Lesson title	Art Meets Math -- Proportion and Measurement
Length of lesson	1-3 classes
Grade levels	6-8 and 9-12
Lesson type (pre/during/post)	Pre, during, and post

| Objectives |
|---|
| Students will analyze the anatomical advancements of the Greek and Renaissance periods in sculpture. They will apply these concepts during their historic home tour and examine the classical works of Albin Polasek. Our trained docent/educator will engage students in the artist's historic studio by exploring a selection of his sculpture tools, including proportion calipers. Students will measure and evaluate select Polasek works and check their proportion against measurement standards. Further measurement and scrutiny of the face will help them sketch a portrait using this applied mathematical concept. To prepare for your visit, we suggest you review the following vocabulary terms and pre/post activity to deepen knowledge retention in your students. |

Next Generation Sunshine State Standards (NGSSS)
MAFS.912.G-MG.1.1- Use geometric shapes, their measures, and their properties to describe objects MAFS.912.G-MG.1.3- Apply geometric methods to solve design problems MAFS.7.RP.1.2- Recognize and represent proportional relationships between quantities. VA.912.C.2.2-Assess the works of others, using established or derived criteria, to support conclusions and judgments about artistic progress. VA.912.C.2.4-Classify artworks, using accurate art vocabulary and knowledge of art history to identify and categorize movements, styles, techniques, and materials. VA.912.O.1.1-Use the structural elements of art and the organizational principles of design in works VA.912.O.1.2-Use and defend the choice of creative and technical skills to produce artworks. VA.912.H.1.4-Apply background knowledge and personal interpretation to discuss cross-cultural connections among various artworks and the individuals, groups, cultures, events, and/or traditions they reflect. Research and use the techniques and processes of various artists to create personal works. VA.912.H.1.7-Research and report technological developments to identify influences on society.

Common Core State Standards (CCSS)
NA

Key vocabulary and definitions
The Renaissance: A period in Europe, from the 1400s-1600, regarded as the cultural bridge between the Middle Ages and modern history. **Golden Mean/Ratio/Fibonacci Sequence:** A special number found by dividing a line into two parts so that the longer part divided by the smaller part is also equal to the whole length divided by the longer part. It is often symbolized using phi, after the 21st letter of the Greek alphabet. This ratio can be found repeated in patterns throughout the natural world and is related to our modern beauty standards. In an equation

form, it looks like this: $a/b = (a+b)/a = 1.6180339887498948420$. Or visually displayed as:
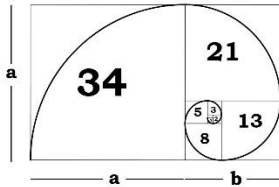
Classical Sculpture: Refers loosely to the forms of sculpture pioneered by Ancient Greeks and Romans from about 500 BC to around 200 AD. They studied human anatomy and proportion to create figures that appeared more natural in their form and poses than early archaic sculpture.

Sculpture Calipers: A caliper is a V-shaped tools with a moveable center joint, that allows artists to take precise and accurate measurements from life models that are otherwise difficult to obtain. Once measurements are taken the caliper can be enlarged or sized down to create larger or smaller versions of the figure in proportion.

Proportion: A principle of art that describes the size, location or amount of one element to another (or to the whole) in a work, such as the size of an arm in relation to the rest of the body. It is similar to scale and can be measured. It has a great deal to do with the overall harmony of the finished work.

Vitruvian Man: Leonardo da Vinci's 1487 drawing that portrayed the relationship between the human body and geometry. It stands today as a lesson on the close connection between science and art. The drawing captures "proportion" - how various dimensions of things relate to each other mathematically. Da Vinci's drawing helps us see how large the human head is in relation to the entire body, how long the arms and legs are in proportion to the trunk, and so on.

Materials needed

Sculpture caliper (V-shaped measuring tool), or fabric measuring tape (flexible ruler), or string with traditional rulers
Drawing pencils/charcoal
Clipboard or portable drawing surface
Sketch pad or drawing paper

School must provide

Art materials are available upon request, and may be included into group tour pricing. Please inquire about art activity fees.

Background information

The study of anatomy and proportion in sculpture has been utilized since the Classical Period 500 BC to around 200 AD when Greek and Roman sculptors began to portray the human body in a more accurate and natural manner. The poses were more relaxed and lifelike, *VS* the stiff archaic early works. The ancient Greek sculptors began to study the human body in a scientific manner, and used knowledge of the

human body, muscle groups, bones, and proportions to achieve realistic and dynamic poses for the first time. Later, Renaissance artists from the 1400s to 1600 developed this concept further with the creation of the Golden Mean. Math and art were shown to be directly related with this mathematical number ratio. Artist and inventor Leonardo da Vinci (1452–1519) made a drawing in about 1487, called "Vitruvian Man," showing an idealized male figure inscribed within a circle and a square. In accompanying notes, he proposed perfect ratios for parts of the body relative to each other and to the whole. Together, with his pioneering anatomical studies, the drawing reflects Leonardo's belief that the symmetry of the human body was a microcosm of the symmetry of the universe.

However, the theories shown in the "Vitruvian Man" were based on anatomy concepts from the ancient Roman architect Vitruvius. In his treatise *De Architectura,* Vitruvius wrote, "For if a man be placed flat on his back, with his hands and feet extended, and a pair of compasses centered at his navel, the fingers and toes of his two hands and feet will touch the circumference of a circle described therefrom. And just as the human body yields a circular outline, so too a square figure may be found from it."

In addition to geometry found in circles and the Golden Mean, proportion in sculpture can refer to size comparison between specific parts, such as an ear in relation to the face, or it can also refer to known ratios between the overall size of a figure and its parts. For example, the average man is seven and one half heads in height. Also, common drawing errors like squashing the top of the skull can be eliminated by knowing that the eyes are in the middle of head. Thoroughly understanding proportions enables sculptors, like Albin Polasek, to create accurate "classical" compositions and avoid time-consuming mistakes.

Lesson process

Pre Activity—*The Vitruvian Man*
Read the background information aloud with your students and display a picture of the "Vitruvian Man." Discuss the geometric shapes and their possible significance with the class. Da Vinci wrote the following notes along with the sketch of the man. Have students read each note aloud and choose a volunteer student to measure their proportions alongside each note, to act as a living example. Write a list of your student's proportions as a group to see how this "idealized man" DaVinci created rates against the student's. Discuss the importance of anatomy and proportion in "Classical Sculpture," like the collection they will be seeing on their upcoming visit to the Polasek Museum.
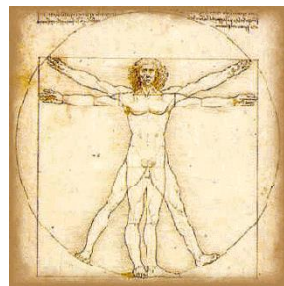
These proportions are seen in Leonardo's notes in the drawings accompanying text, written in mirror writing. It was made as a study of the proportions of the (male) human body as described in Vitruvius:

- a palm is the width of four fingers

- a foot is the width of four palms (i.e., 12 inches)
- a cubit is the width of six palms
- a pace is four cubits
- a man's height is four cubits (and thus 24 palms)
- the length of a man's outspread arms (arm span) is equal to his height
- the distance from the hairline to the bottom of the chin is one-tenth of a man's height
- the distance from the top of the head to the bottom of the chin is one-eighth of a man's height
- the distance from the bottom of the neck to the hairline is one-sixth of a man's height
- the maximum width of the shoulders is a quarter of a man's height
- the distance from the middle of the chest to the top of the head is a quarter of a man's height
- the distance from the elbow to the tip of the hand is a quarter of a man's height
- the distance from the elbow to the armpit is one-eighth of a man's height
- the length of the hand is one-tenth of a man's height
- the distance from the bottom of the chin to the nose is one-third of the length of the head
- the distance from the hairline to the eyebrows is one-third of the length of the face
- the length of the ear is one-third of the length of the face
- the length of a man's foot is one-sixth of his height

During Your Visit:
Now locate the dark brown *Self Portrait* (Bust) of Albin Polasek located in the Main Salon Room during your historic home tour. Notify the Polasek Group Tour Coordinator ahead of time that you selected this particular lesson, and your docent will allow students to measure the *Self Portrait* Bust and will additionally, showcase Polasek's sculpture tools to your group, including examples of his various sculpture calipers. Have your students take Polasek's measurements and have them sit down in front of the portrait and make a quick sketch.

Self Portrait (Bust*)*, Albin Polasek, Bronze 1933

Post Activity—Portraits using the 5 Proportions of the Face:
Proportion #1: The eyes are halfway down the head.
Proportion #2: The edges of the nostrils line up with the tear ducts of the eyes.
Proportion #3: The space between the eyes is approximately the width of an eye.
Proportion #4: The head is about five eyes wide.
Proportion #5: The corners of the mouth line up with the pupils of the eyes.

Back in your classroom, have your students finish their sketch of the *Self Portrait* of Albin Polasek. Then have them create an additional drawing utilizing the proportion principles they learned on their visit. Students may choose a partner and take the measurement of his or her facial features to create a life-size portrait using those numbers. Or they can use a mirror and use themselves as their life-study model. They will use the 5 drawing proportion principals as a guide and encourage them to create a drawing grid to scale (on a piece of transfer paper) to assist with accuracy (see grid example). Each drawing should come with a paragraph description, which lists the numerical measurements between facial features. Final assessment should be made based on how closely students are able to match the original measurements of their life model to their realized portrait drawing.

Stress that although the proportions of a head will vary from person to person and change slightly with age, that these general principles will allow them to improve their drawing skills. Measurements and grid system can be used these to check the general size, shape and position of features in your drawings.
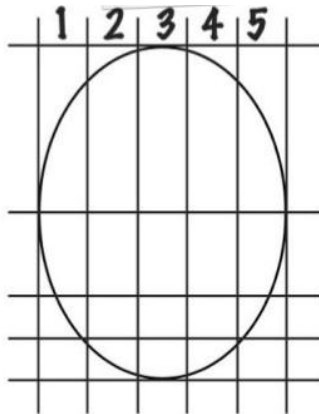
21st Century Skills to Increase Rigor
Internet research proficiency
Writing skills
Analyzing visual interpretations
Practical geometry
Measurement/scale ability

Assessment
The tangible product will be a portrait sketch with proportion measurements of Albin Polasek's *Self Portrait* from their onsite tour; and also a portrait of a life model (using a classmate's or their own

measurements to serve as their subject.) The main features should be clearly labeled and measured and/or shown on the grid. A written description summarizing their facial findings may accompany the drawing, and discuss what ratio features were surprising and how their measurements compared to "the standard." Was their face ratio what they expected it to be? How do their measurements compare to the Self Portrait of Albin Polasek?

Reflection/follow-up activities

- Opt to watch online videos with your students or assign as take-home enrichment:
"Leonardo's Universe" a National Geographic production which can be viewed on YouTube.
https://www.youtube.com/watch?v=DSsGRfCqN2s

- And/or the short film "Mathematical Beauty": https://www.youtube.com/watch?v=46f6ozRTVsU

- Have your students do additional exploratory internet research and explore the Gold Mean/Fibonacci Sequence with regard to modern notions of "beauty." What does beauty mean and how does that relate to classic proportions? Have them write a paper on their findings noting resources used.

Additional resources (online, print, etc.)

- Read, "Exploring the Math and Art Connection: Teaching and Learning Between the Lines," by Daniel Jarvis and Irene Naested.
- Read "Geometry of Design: Studies in Proportion and Composition," by Kimberly Elam